ARUBA VALIDATED DESIGN

aruba
a Hewlett Packard Enterprise company

ARUBA SD-BRANCH

Design & Deployment Guide

August 2020

Table of Contents

Document Conventions

Bold text indicates a command, navigational path, or a user interface element. Examples:

- the **show stacking** command
- Navigate to **Configuration** > **System** > **General**
- click **Save**

Italic text indicates the definition of important terminology. Example:

- *Spatial streaming* is a transmission technique in MIMO wireless communication

Blue text indicates a variable for which you should substitute a value appropriate for your environment. Example:

- `stacking member 2 priority 250`

Highlighting indicates emphasis. Example:

- `ip address 10.4.20.2/22`

Note Notes contain asides or tips.

Caution Cautions warn you about circumstances that could cause a failure.

Introduction

Software-defined branch (SD-Branch) is a technology shift towards solutions that are agile, open, and cloud-integrated. SD-Branch includes SD-WAN components that deliver a secure, service provider independent network with enterprise-level performance over disparate wide-area network (WAN) technologies. However, although SD-WAN solves a real IT problem, it only addresses part of the issue organizations face when dealing with distributed locations.

Organizations often roll out and operate distributed, heterogeneous networks with centralized teams. These distributed networks offer many services besides just WAN connectivity. Branch networks need wired and wireless LANs, security and policy enforcement, and of course, WAN interconnects. SD-Branch extends the concepts beyond SD-WAN to all elements in the branch, delivering a full-stack solution that includes SD-LAN and security that address all network connectivity needs.

When you are formulating the strategy for your SD-Branch rollout, Aruba recommends that you:

- Purchase as much WAN bandwidth as possible to alleviate potential bottlenecks during the busiest times of the day.
- Increase Internet bandwidth, instead of buying additional private bandwidth.
- Use cloud-based tools to simplify the configuration, operation, and management of the WAN.

PURPOSE OF THIS GUIDE

This guide covers the Aruba SD-Branch design, including reference architectures along with their associated hardware and software components. It contains an explanation of the requirements that shaped the design and the benefits it provides your organization. The guide describes a single unified infrastructure that integrates access points (APs), switches, gateways, and network management with access-control and traffic-control policies.

This guide assumes the reader has an equivalent knowledge of an Aruba Certified Mobility Associate or Aruba Certified Switching Associate.

Design Goals

The overall goal is to create a simple, scalable design that is easy to replicate across all sites in your network. The solution components are limited to a specific set of products to help with operations and maintenance. The key features addressed by Aruba SD-Branch include:

- **Simplicity with zero-touch provisioning**—SD-Branch devices can be factory-shipped directly to a remote site by automatically matching orders to an Aruba customer account, and a mobile Installer app is available for third-party systems integrators to quickly install equipment. Combined with configuration hierarchy, which assigns APs, switches, and gateways to site-specific configurations, networks are brought up very quickly.

- **Unified policy management**—For Aruba and third-party network infrastructure, Aruba ClearPass delivers a common policy framework for multivendor wired and wireless networks. This software-defined approach makes it easy for the network administrator to distribute changes quickly based on corporate risk and compliance requirements. ClearPass Device Insight (CPDI) adds AI-powered device profiling to help automate discovery of the latest mobile and IoT endpoints.

- **Predictive analytics and assurance**—Aruba Central's artificial intelligence (AI), machine learning (ML), and automation capabilities identify issues and notify IT of problems while recommending changes. When you shift to a cloud-hosted model, data is collected and crowdsourced from Aruba's large installed base while taking advantage of Aruba's data science expertise.

- **Secure WAN connectivity**—Enable SD-WAN technology to support the use of the Internet to replace or augment private WAN services. Elements of the solution include path quality monitoring (PQM) to track the available paths, stateful firewall with application fingerprinting to identify traffic flows, dynamic path selection (DPS) to use the optimal path, and centralized routing to offload the branch gateways (BGWs) from participating in the routing decisions. You can also use end-user identity information when selecting the available WAN paths.

- **LAN automation with dynamic segmentation**—Most branch networks are needlessly complex because designs are based on a proliferation of VLANs, complex IP addressing schemes, access control lists (ACLs), and architectures that are tailored to the needs of automation software. The SD-Branch architecture seeks to flatten the branch into fewer subnets or even a single subnet, eliminating the dependence on static IP addressing schemes and hardwired ACLs across multiple devices. This is achieved by consolidating all policy enforcement into a single device in the branch.

You can use this guide to design new networks or to optimize and upgrade existing networks. It is not intended as an exhaustive discussion of all options but rather to present commonly recommended designs, features, and hardware.

Audience

This guide is written for IT professionals who need to design an Aruba SD-Branch network. These IT professionals can fill a variety of roles:

- Systems engineers who need a standard set of procedures for implementing solutions
- Project managers who create statements of work for Aruba implementations
- Aruba partners who sell technology or create implementation documentation

CUSTOMER USE CASES

Branch networks are changing rapidly. The most pressing challenges include an increasing number of mobile and IoT devices, growing bandwidth requirements of the business, and modern users who expect connectivity for work and personal use from anywhere at any time. The teams that run these distributed networks are not getting any bigger and often, they are shrinking. Organizations expect new network rollouts to be complete in shorter timeframes, and IT organizations are asked to improve service levels, reduce costs, and shift spending from capital expense to operating expense.

This guide discusses the following use cases:

- Secure WAN communications using IPsec tunnels over an independent transport
- ZTP for all networking components in the branch
- Switch stacking for simplified management, high availability, and scalability
- Link aggregation for high bandwidth, redundancy, and resiliency between switches and gateways
- Wireless as the primary access method for branch employees
- Wireless and wired guest access for customers, partners, and vendors
- Consistent security for wired and wireless devices based on roles

SD-Branch Design

This guide addresses the most common uses cases of an SD-Branch solution. If you are planning a more complex project that is not covered in this guide, contact an Aruba or partner SE/CSE for design verification. The Aruba SD-Branch design consists of the following elements:

- **Aruba Central**—Flexible policy, configuration, and monitoring capabilities allow an organization to simplify network operations by providing zero-touch provisioning and customizable templates in order to quickly deploy BGWs, switches, and APs. Aruba Central provides centralized management for historical data reports, monitoring for PCI compliance, and troubleshooting for regional and global locations. It also gives you key insights into WAN health and optimization to help IT determine the best link to send traffic to corporate data centers or to the Internet based on per-user, per-device, or per-application policies.

- **Aruba ClearPass**—Allows network security policies to be automatically assigned based on user or device role from a central location. This capability ensures that policies are consistent, eliminating the chance of devices having old configurations and minimizing human-introduced errors. The network identifies, authenticates, and grants trust based on the user or device role.

- **Aruba headend gateways—**The Aruba 7200 Series, virtual gateways, and certain Aruba 7000 Series platforms can act as headend gateways, or *VPN concentrators* (VPNCs), for SD-Branch designs. BGWs establish VPN tunnels to one or more VPNCs over multiple providers networks. High availability options support multiple VPNCs deployed at a single site or deployed in pairs at multiple sites for the highest availability. The VPNC supports active/standby or active/active uplinks from the branch locations.

- **Aruba virtual gateways**—The virtual gateway simplifies branch network deployments for organizations that are migrating to Infrastructure as a Service (IaaS) providers such as Amazon Web Services and Microsoft Azure. They provide the ability to directly connect a branch to cloud instances, improving access to the resources hosted in a public cloud. The virtual gateway supports resilient connectivity by using multiple transport links and delivers centralized policy management across the branch, data center, and cloud endpoints.

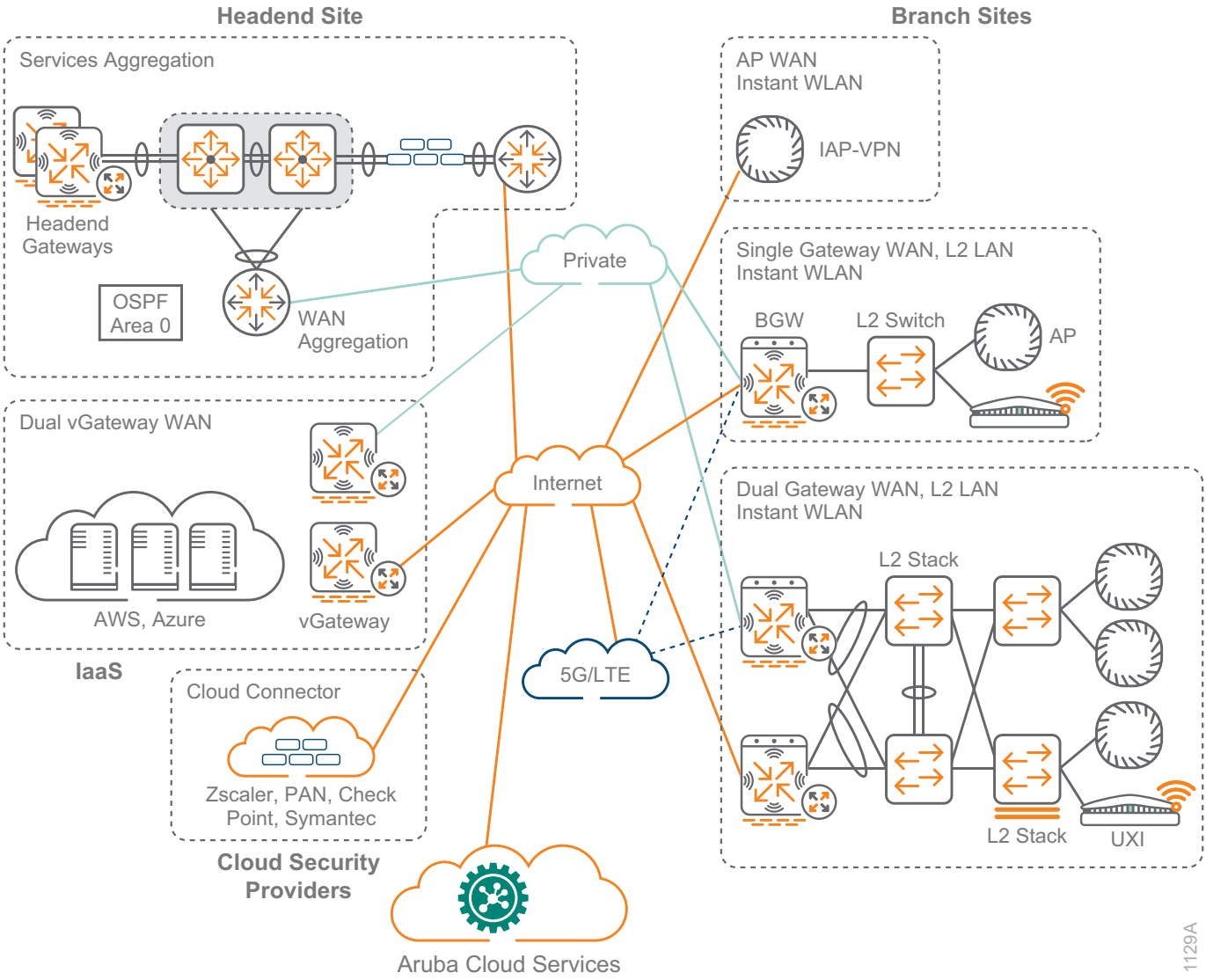
- **Aruba branch gateways—**The Aruba 9000 Series, 7200 Series, and 7000 Series can operate as BGWs to optimize and control WAN, LAN, and cloud security services. The BGW provides routing, firewall, security, URL filtering, and WAN optimization. With support for multiple WAN connection types, the BGW routes traffic over the most efficient link based on availability, application, user, and link health. This allows organizations to take advantage of high-speed, low-cost broadband links to supplement or replace traditional WAN links such as MPLS.

- **Aruba access switches**—The Aruba 2930F, 2930M, 3810M, and 5400R family of switches connect wired devices to the branch network, such as APs, workstations, medical devices, multi-function printers, point-of-sale devices, and other devices that don't support Wi-Fi or that do need higher performance than a wireless connection can provide. The access layer also provides PoE to devices such as APs, IP phones, and IP cameras. You can use the switches standalone or in a stacked configuration, depending on the number of ports needed at each location.
- **Aruba access points**—Aruba AP-5xx models are dual radio 802.11ax Wi-Fi 6 APs and the AP-3xx models are dual radio 802.11ac Wave 2 Wi-Fi 5 APs that support different throughput and client loads. With Aruba's controllerless model called *Instant*, there is no central controller, and the controller functions are distributed among the APs. Instant is typically used in branch sites and scales up to 128 APs per cluster. In this type of design, you normally see less than 50 APs per cluster at each remote site.
- **Aruba threat detection**—Aruba's role-based Intrusion Detection System and Intrusion Prevention System (IDPS) capabilities are available in the 9000 series gateways. Aruba IDPS allows an organization to set security policies on individual- or role-based access to branch endpoints. It analyzes data packets entering the network and acts quickly to prevent threats in real time. All identified threats are logged for correlation analysis.

You can find a complete list of Aruba Central-supported hardware in the components area at the end of this section.

The following figure shows an example SD-Branch design with a headend site, an IaaS data center, cloud security providers, and several remote locations, each depicting different branch deployment models.

Figure 1 SD-Branch design



The Aruba SD-Branch solution provides network access for employees, wireless Internet access for guests, and connectivity for IoT devices. Regardless of their location on the network, wired and wireless devices have the same experience when connecting to their services.

The Aruba SD-Branch includes the following key features and capabilities:

- **Stateful firewall**—Context-aware, role-based data adapted from Aruba WLAN to dynamically apply policy from RF to WAN Information on user, device, application, and location can enhance visibility and security.
- **Dynamic segmentation**—With centralized policy for WAN, wired, and wireless, IT can extend consistent policies across the entire distributed branch footprint. This provides a simple and secure way to configure network devices and onboard IoT endpoints without additional overhead.
- **Traffic analysis—**Gain rich application awareness into over 3,000 applications across 21 categories. Web Content Classification provides protection from malicious or unauthorized web URLs and includes geolocation filtering and IP reputation.
- **Deep packet inspection (DPI)**—Monitors application usage and performance while optimizing bandwidth, priority, and network paths in real time, including apps that are encrypted or appear as web traffic. DPI is vital to understanding usage patterns that might require changes to network design and capacity.
- **Installer app and zero-touch provisioning**—Simplify on-site deployment with ZTP through cloud-based Aruba Central and deploy new branches more efficiently with a task-oriented Install Manager dashboard, as well as the installer app for mobile devices.
- **Health check**—The BGW can actively and passively monitor established TCP connections for latency, jitter, packet loss, and throughput.
- **Policy-based routing (PBR)**—You can route traffic across private or public WAN uplinks based on application or user role (examples: guest or employee), in addition to traditional destination-based routing.
- **Dynamic path selection**—When multiple WAN links exist, DPS helps choose the best available path for an application based on characteristics like throughput, latency, jitter, packet loss, and uplink utilization.
- **SaaS optimization**—When accessing cloud-based applications from a branch location with multiple transports, software-as-a-service (SaaS) optimization dynamically chooses the best-performing path based on real-time information.
- **WAN optimization**—To improve overall bandwidth efficiency, the BGW can enable IP payload compression on the IPsec sessions between the branch and headend gateways. Compression efficiency varies depending on the traffic type, but real-world scenarios typically show 40-60% bandwidth savings.

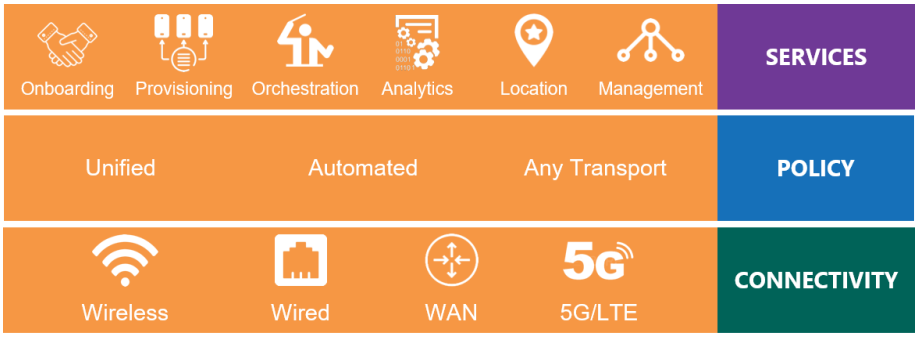
- **Private or Internet WAN**—The BGW can support multiple uplinks, such as Internet broadband, existing MPLS, metro Ethernet, and cellular connectivity, with multiple transport overlays across uplinks. You can route traffic destined for the Internet locally, and you can route traffic destined for the data center either over private WAN or any available Internet path.
- **Third-party integration**—To reduce local branch complexity, integration with cloud services provided by firewall vendors such as Zscaler, Palo Alto Networks, Check Point, and UCC applications such as Microsoft Skype for Business makes extending security easier and more reliable across the distributed enterprise.

SD-BRANCH ARCHITECTURE

WANs are the key component for branch office employees to communicate with their co-workers and customers. Applications have moved to centralized data centers and cloud-based providers. Businesses depend on their network to maintain a competitive edge and the WAN is one of the highest monthly costs of the network.

Aruba SD-Branch allows an organization to implement the most cost-effective option at each branch-site location by providing flexible alternatives to traditional private WAN offerings. Traffic can use any available bandwidth to and from each location while maintaining the service level agreements defined by the network administrator. The Aruba SD-Branch architecture is built in layers, as shown in the following figure.

Figure 2 SD-Branch architecture



Connectivity Layer

Starting from the bottom in the figure, the *connectivity layer* is the foundation for the SD-Branch architecture. It forms the underlay network between locations in an organization, and in a WAN setting, the transport links can be private or public depending on the type of service available at each location. Gateways provide flexible connectivity in a variety of form factors. At the branch location, they perform the LAN integration for the wired and wireless devices, and the WAN access for the public and private networks. At the headend location, they allow high speed connectivity to the campus and data center environments. Gateways use advanced routing to direct the traffic to and from each location.

The switches and access points form the campus network at each location and connect to the gateway for the WAN services. There are several different branch sizes, and each of them has a recommended wired and wireless design based on their requirements.

Policy Layer

The *policy layer* runs over the top of the connectivity layer and allows organizations to securely transport traffic between sites. VPN tunnels are established between branch and headend gateways to create an SD-WAN overlay network. *Headend sites* are typically corporate headquarters, private data centers, or IaaS data centers hosted in the cloud, and they include one or more headend gateways. *Branch sites* are remote locations that include one or more branch gateways. Larger deployments might include additional headend sites, providing path diversity and application redundancy in the event of a primary site failure.

A flexible transport design uses secure policy overlay tunnels to simplify the WAN deployment. The tunnels for public and private WAN connections reduce complexity for your routing and security, regardless of the underlying networks. The tunnels also provide flexibility by allowing an organization to choose different service provider options based on availability and cost for each location, while maintaining a common overlay network.

Services Layer

The *services layer* is where the operations team interacts with the network. It provides significant capabilities leveraging AI, ML, and location-based services for network visibility and insights into how the network is performing. By leveraging a common data lake in the cloud, Aruba Central can correlate cross-domain events and display multiple dimensions of information in context, unlocking powerful capabilities around automated root cause analysis while providing robust analytics.

Headend Site Design

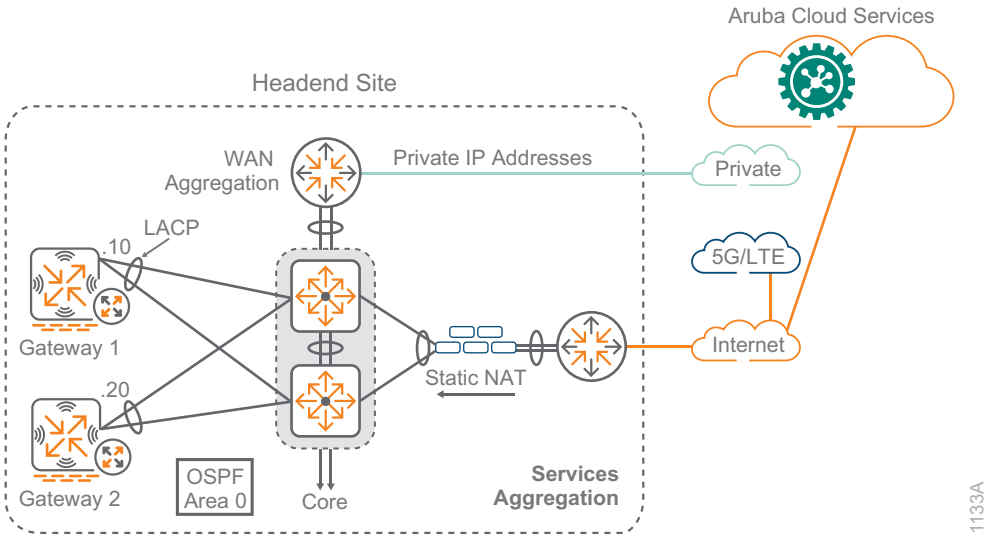
The recommended headend site design consists of a pair of redundant gateways to terminate the IPsec tunnels from the BGWs. Additional headend sites are supported, and you can deploy them by using the techniques described in this guide.

Physical Gateways

The physical gateways connect to the services aggregation layer, and we recommend LACP for uplink port redundancy or equal-cost multi-path routing for L3 redundancy. The gateways terminate the IPsec tunnels from the private WAN by using private IP addresses and from the Internet by using static NAT addresses on the firewall.

The following figure shows an example headend site with a pair of physical gateways using LACP.

Figure 3 Headend site



The gateways are configured with static IP addresses, which allows the BGWs to reliably connect to them using established addresses.

Virtual Gateways

The IaaS public cloud environment is for many companies a “foreign” element in their network. Services rely on cloud-provider tools that are not like those in the companies’ own data center. To alleviate the management and operational concerns, something more advanced than a simple virtual machine offered through the marketplace is desirable.

The Aruba SD-Branch solution automates the deployment and configuration of a virtual gateway (vGW) in public cloud environments like Amazon Web Services (AWS) and Microsoft Azure. Aruba Central handles the whole lifecycle of the vGW, from the initial startup and provisioning, through the regular management and the failover between them in high availability scenarios.

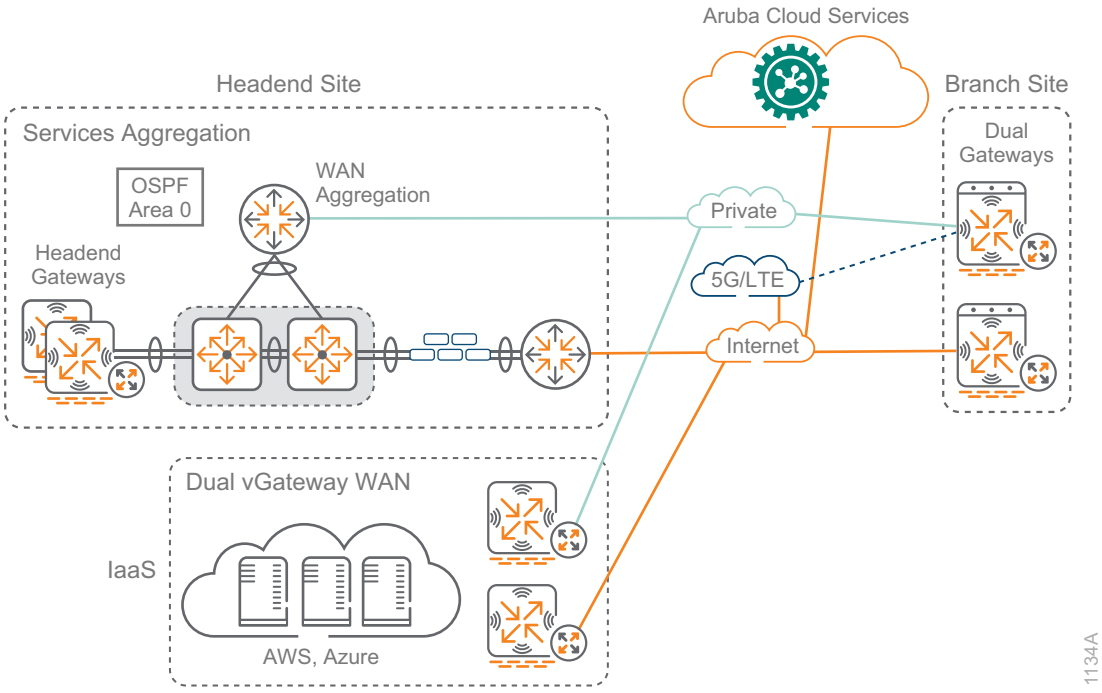
Aruba BGWs support standard IPsec tunnels and could therefore establish direct communication with the IaaS provider’s own VPN concentrators. However, cloud VPN termination points do not support the advanced SD-Branch capabilities equivalent to those of an Aruba vGW.

The most critical features are as follows:

- **Orchestrated tunnels**—Aruba Central automates the establishment of IPsec tunnels from all BGWs to all relevant VPNCs, including the vGW.
- **Orchestrated routing**—Aruba Central automates the exchange of routes across the SD-WAN, to and from the vGW location.
- **Reverse path pinning**—The vGW ensures the traffic always returns through the same WAN path, allowing BGWs to perform DPS, PBR, and uplink load-balancing as needed.
- **End-to-end visibility**—Allows you to manage all SD-Branch network devices under a single pane of glass in the cloud.

The following figure shows a pair of virtual gateways in an IaaS public cloud environment.

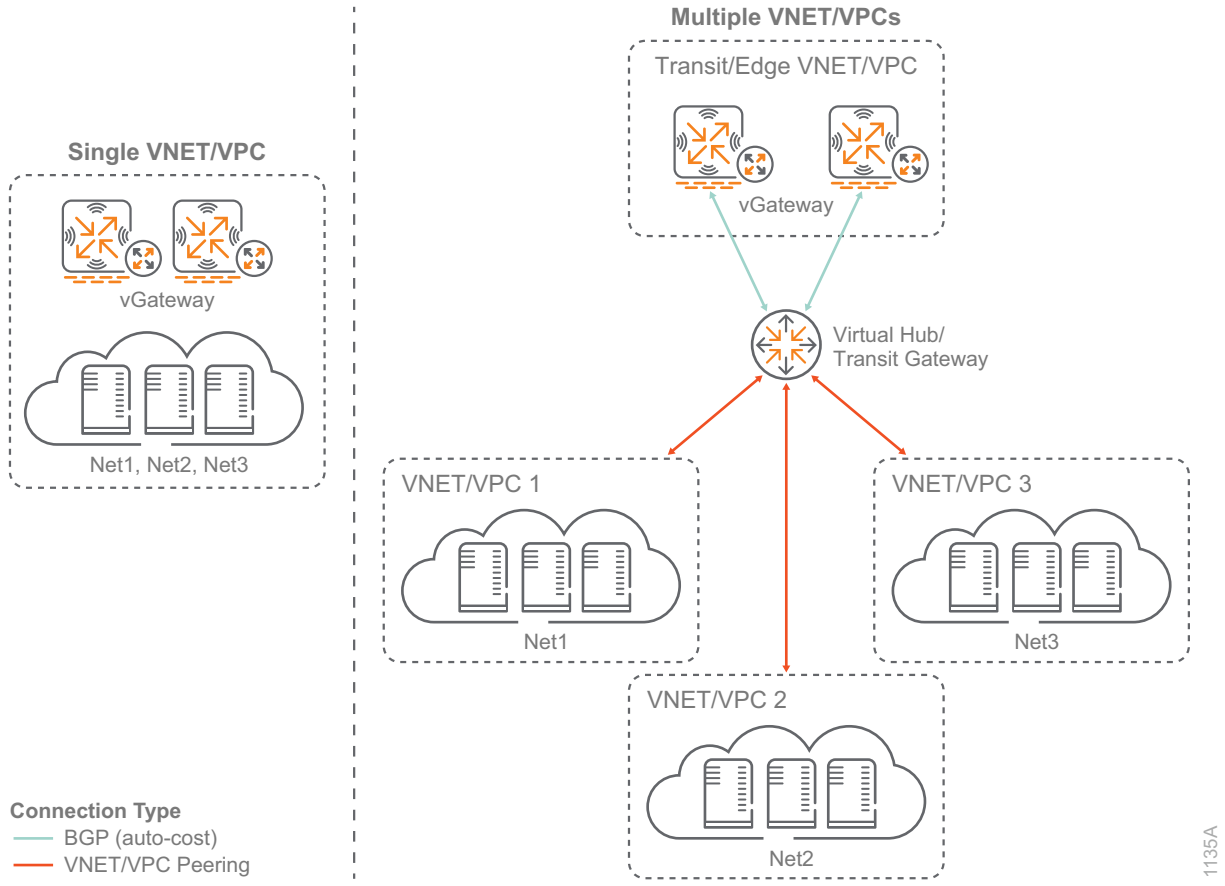
Figure 4 Virtual gateways in IaaS



From the perspective of the SD-WAN network in an IaaS environment, deployments are differentiated between those where each Virtual Network (VNET) or Virtual Private Cloud (VPC) is treated as a separate node of the SD-WAN and those where there are multiple VNET/VPCs accessible through a single SD-WAN node. When there are multiple VNET/VPCs, you place the vGW into the transit or edge VNET/VPC.

The vGW communicates with the VHUB/TGW, as shown in the right side of the following figure.

Figure 5 IaaS deployment types—single vs multiple VNET/VPCs



The use of the vGW to connect the SD-WAN environment to the IaaS environment is highly encouraged, as it truly brings the public-cloud data center into the SD-WAN network as if it were any other headend location.

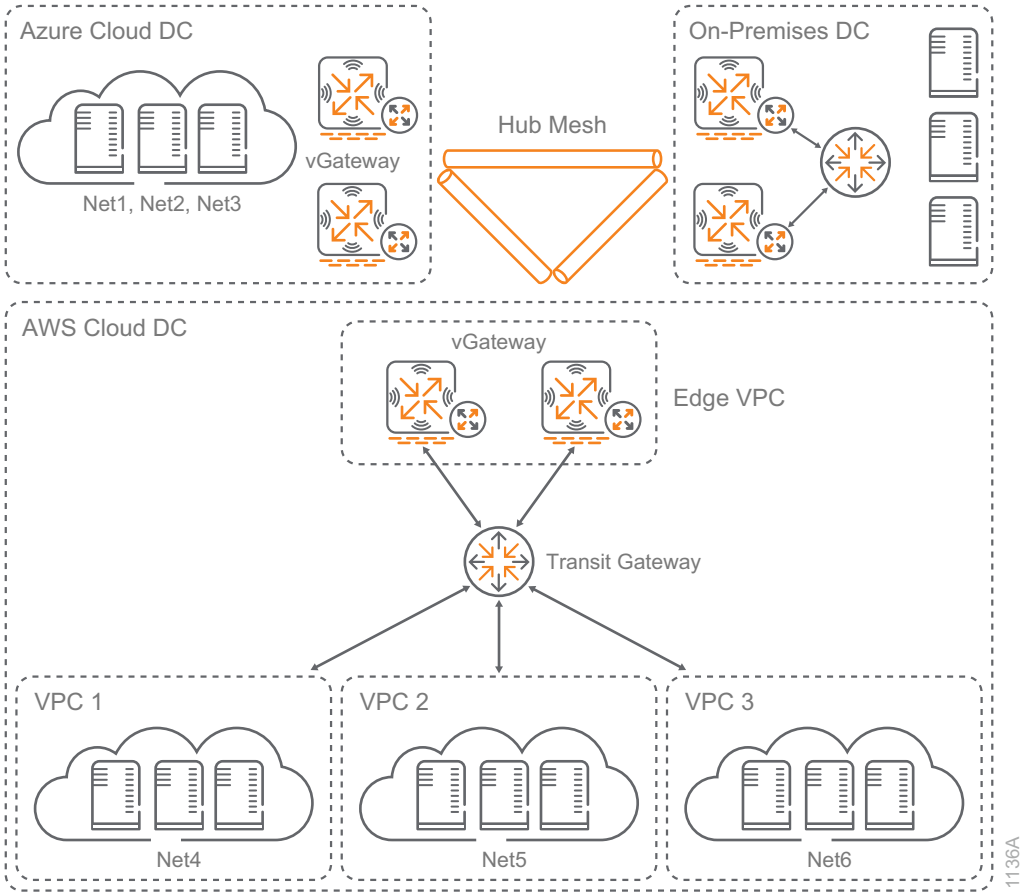
Hub Mesh

Aruba supports mesh topologies between on-premises hubs (physical gateways) and/or cloud hubs (virtual gateways). In a mesh topology, all or a portion of your hub sites are connected to each other through site-to-site IPsec tunnels. Using a mesh, you can connect any type of hub and create an overlay network between your data centers.

The mesh topology is highly redundant because it creates a mesh of tunnels over all available uplinks and uses BGP mechanisms to exchange routes between each peer. For easier identification of the hubs and a simplified configuration, it is recommended that you use a loopback address on each hub and source the site-to-site tunnels and the BGP peering from the loopback address. You can route-map match prefixes received or advertised by the peer, and you can modify them to control what is advertised between the hub locations.

You can configure up to eight hub sites in a mesh topology. Each hub site can be in only one mesh topology at a time.

Figure 6 Hub mesh



Branch Site Design

A branch site with two WAN interfaces is a common use case, but you can use the same techniques for other options. For example, you can deploy a single BGW or dual BGWs, depending on the business criticality of the location. You can add up to four active and one standby LTE uplink per branch location. The goal of all SD-WAN designs is to choose the best WAN path for each different class of traffic. After choosing the best path based on current WAN conditions, you create flexible rules to allow your traffic to efficiently pass over the available paths.

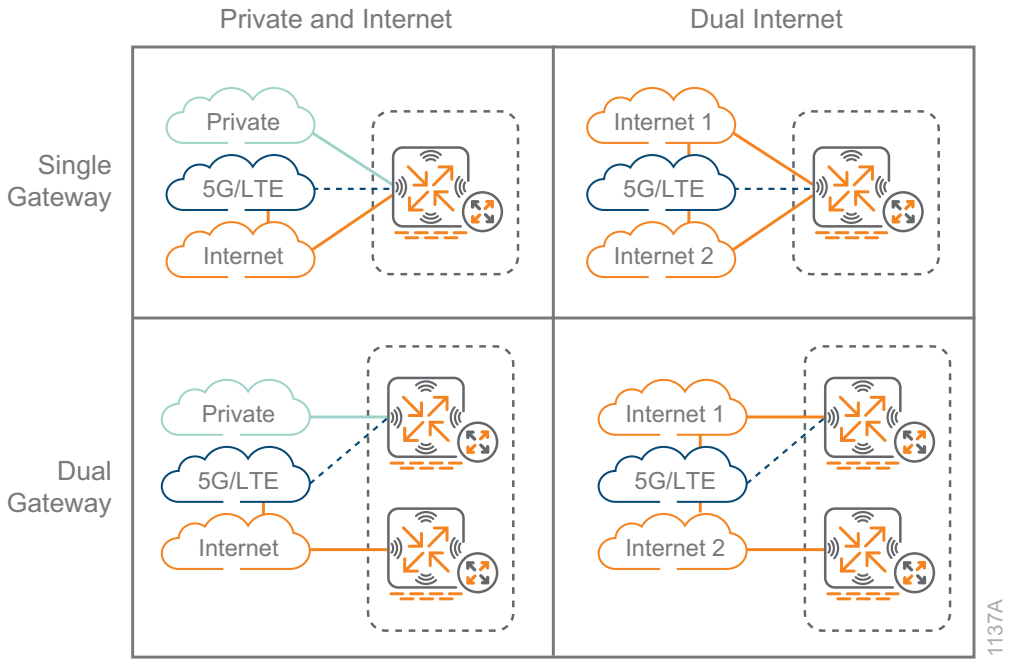
The first option is the SD-WAN Private and Internet, which uses private WAN paired with Internet. In this option, the private WAN handles the critical traffic because you have SLA guarantees from your service providers for certain applications. The secondary traffic classes use the public WAN available at each location.

The second option is the SD-WAN Dual Internet, which uses two Internet services. With this option, you select one of the Internet paths as the preferred path. You can select the provider that has more direct connections to each of your branch sites, or you can choose the one with the most bandwidth. The secondary traffic classes use the remaining Internet bandwidth available at each location.

Branch Gateway Options

This guide highlights several branch-site designs, and they provide different levels of service and redundancy using diverse WAN transports tied to the specific requirements for each site. Single gateway designs provide uplink resiliency and dual gateway designs provide uplink and gateway resiliency. Both can optionally add 5G/LTE uplinks for a path of last resort. The following figure shows common branch-site options.

Figure 7 Branch gateway options

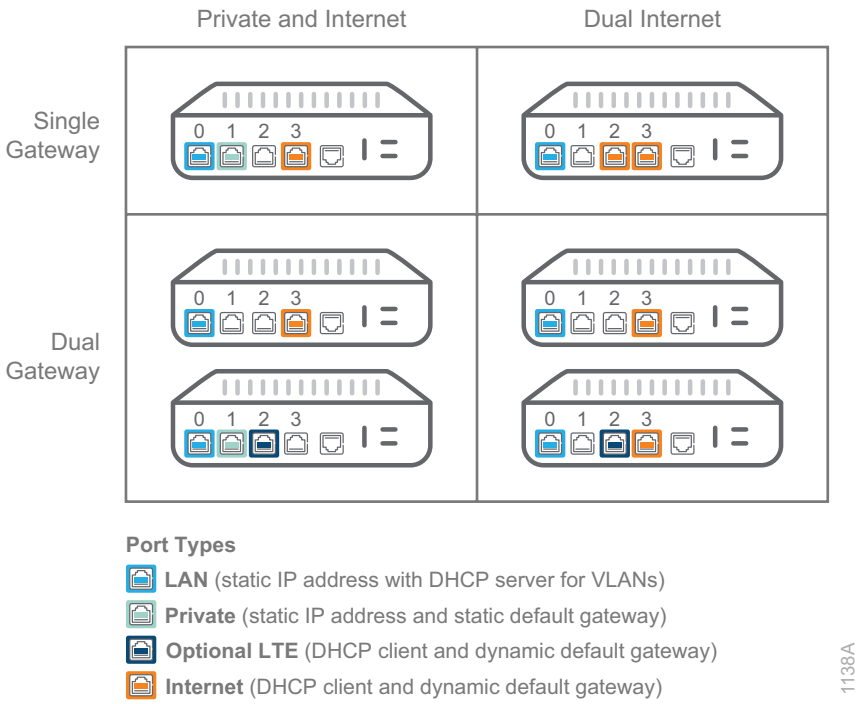


Branch Gateway Ports

You should use the physical ports on a BGW in a uniform manner across your network. This provides consistency between your branches and reduces the number of groups required. The examples shown in the following figure are focused on the Aruba 7005 BGWs because it has the fewest number of physical ports, but the same port arrangement principles are used for the rest of the BGWs in the portfolio. The idea is to pick a common set of ports that work for as many of your branch configurations as possible.

The following figure highlights port arrangements on the Aruba 7005 BGWs for the different branch site options mentioned previously.

Figure 8 Branch gateway ports



Note You can also purchase the 9004-LTE gateway, which has an integrated LTE module, or you can configure the optional LTE port with a USB interface.

It is very important the physical port types on gateways at dual-gateway sites share the same characteristics, because both gateways must be added to the same group for routing, DPS, and PBR configurations. All four examples in Figure 8 use the physical ports in a similar fashion as noted below:

- **Port 0/0/0**—LAN with static IP addresses and DHCP servers for VLANs
- **Port 0/0/1**—Private WAN with static IP address and default gateway
- **Port 0/0/2**—Public WAN (LTE or secondary INET) with DHCP client and dynamic default gateway
- **Port 0/0/3**—Public WAN (primary INET) with DHCP client and dynamic default gateway

Because the port arrangements for each of the groups are aligned configuration-wise, you can configure an initial group and then copy it to the new groups to save time during the group configuration procedures. The port types you choose do not have to align with the choices above, but they should match the common port arrangements for your environment.

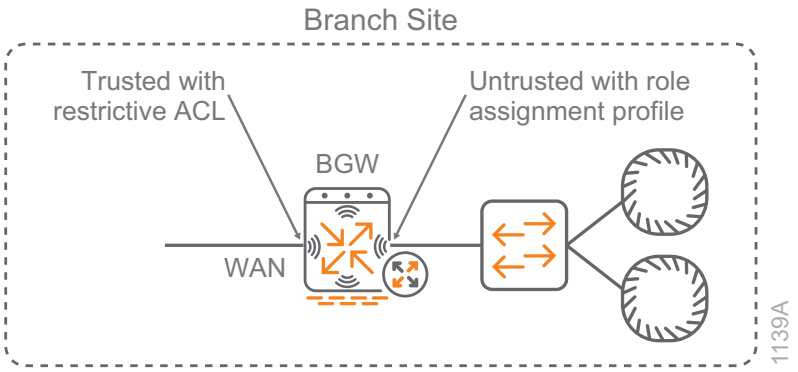
Trusted vs Untrusted

Unlike traditional perimeter firewalls, the trusted interface feature in an Aruba gateway's role-based firewall refers to whether there is a user-session for all traffic coming through an interface with the potential for role assignment policies. The two options are as follows:

- The gateway does not keep user-sessions for traffic coming through trusted interfaces.
- The gateway maintains user-sessions for all devices coming from untrusted interfaces. This means you must assign a role assignment (AAA) profile to all VLANs attached to untrusted interfaces, regardless of whether you plan to enable role assignments.

You achieve the best combination of security and visibility when LAN-facing interfaces are marked as untrusted with an associated role-assignment profile and WAN-facing interfaces are marked as trusted with a restrictive policy applied to them.

Figure 9 Trusted vs untrusted interfaces



Note When you use the Basic setup mode in Aruba Central, the interfaces are correctly configured for trust based on how their WAN or LAN designations.

The gateway determines if traffic is trusted by first selecting the trust status of the port and then the trust status of the VLANs attached to the port. In case of a discrepancy, the untrusted status always takes precedence.

Policy Layer

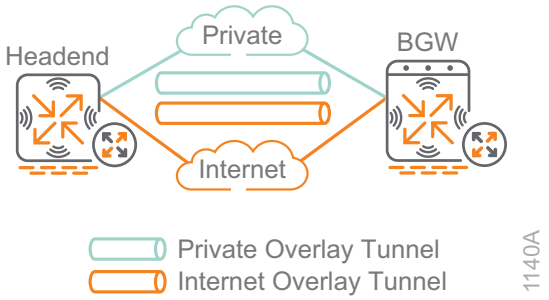
The Aruba SD-Branch solution implements standards-based VPN tunnels. To simplify the SD-WAN overlay tunnel establishment, the Aruba gateways leverage factory installed trusted platform module (TPM) certificates for mutual authentication. The TPM certificates are installed on each Aruba gateway at the factory; however, end-user certificates are also supported.

The SD-WAN overlay tunnel is initiated from the BGW and terminates on a gateway using network address translation-traversal for the Internet paths. The only firewall port that you need to open between a headend gateway and a BGW for a tunnel to establish is UDP destination port 4500. You can terminate the tunnels directly on the headend gateway or NAT them via an intermediate device, such as an edge firewall for the Internet WAN connection.

For private WANs, the tunnels are typically terminated on a headend gateway by using a VLAN interface assigned with a private IPv4 address. You can either terminate Internet-based WAN services on a gateway using a public IPv4 address or a private IPv4 address. This depends on your organization's data center architecture.

You establish the SD-WAN overlay tunnel through the connectivity underlay network to a gateway at the headend site. Each BGW establishes one tunnel to each headend for every WAN service in the deployment. The following figure shows an example of a single BGW at a branch site establishing one tunnel over the private WAN and one tunnel over the Internet WAN service.

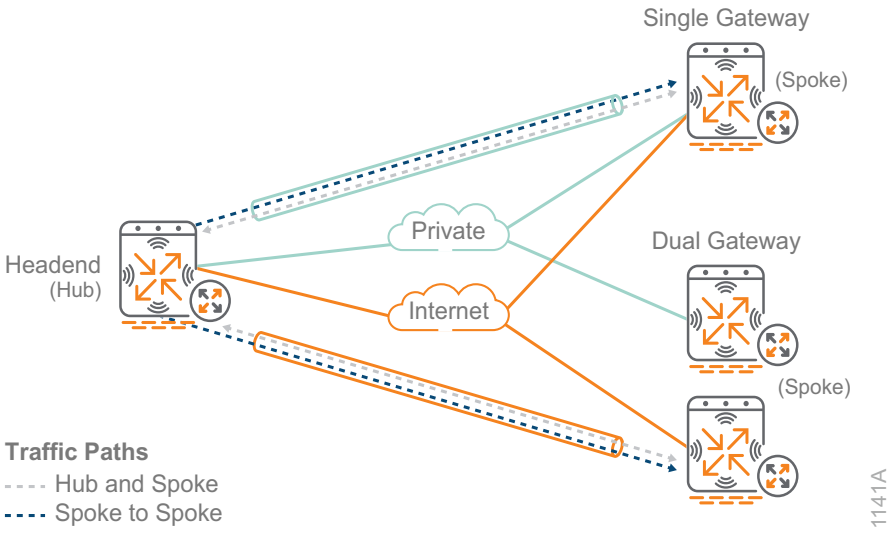
Figure 10 SD-WAN overlay tunnels



Hub-and-Spoke

The Aruba SD-Branch solution supports a hub-and-spoke topology where the SD-WAN overlay tunnels are established between headend gateways (hubs) and BGWs (spokes). With a hub-and-spoke design, the DPS policies, routing, and PBR rules you configure for each branch group determine the branch traffic that is selected and forwarded to the gateways via the overlay tunnels. The gateways at the headend sites provide routing and forwarding for hub-to-spoke and spoke-to-spoke traffic.

Figure 11 Hub-and-spoke



Most SD-Branch deployments include at least one headend site with one or more gateways installed that terminate VPN tunnels initiated from BGWs installed at the branch sites. The number of gateways that are deployed in each headend site is dependent on the deployment size and redundancy needs. The most basic SD-Branch deployment consists of one gateway installed at a headend site that services all the BGWs installed at branch sites. L2 or L3 redundancy are available by installing a backup gateway at the headend site, but L3 redundancy is recommended due to faster failover times.

Larger SD-Branch deployments can include additional headend sites, providing redundancy in the event of a primary hub failure. A typical large deployment consists of a primary and secondary headend with L3 redundant gateways at each site. More complex topologies using additional headend sites are also supported. For example, your deployment might include a cloud-based data center hosting a specific application or service using virtual gateways.

ARUBA SD-WAN

The Aruba SD-Branch solution provides a centralized control plane function (offered from Aruba Central) that is based on a cloud-native, multi-tenant architecture that automatically scales to a customer's network growth. In previous SD-Branch deployments, the network administrator had to configure IPsec tunnels between branch and headend gateways, interface types, public IP addresses of the VPNCs and the IKE parameters. When using a tunnel through a common Internet service provider, the uplink on BGW and the public IP address on the VPNC was manually configured.

The configuration workflows were cumbersome and prone to misconfigurations that often-delayed deployments and led to unnecessary calls to TAC. There was no support for dynamic protocols or orchestrated routes through the overlay tunnels. Static routes pointing to each data center were configured with different costs in order to provide redundancy in case of a failure. For large deployments, which might have hundreds of locations, static routes were not scalable or easy to administer.

SD-WAN Orchestrator

To simplify the configuration, Aruba introduced SD-WAN Orchestrator to automatically setup IPsec tunnels and configure dynamic routing between the BGWs and headend VPNC. Overlay Tunnel and Route Orchestrator processes run in Central to automate the existing workflows.

The Aruba SD-WAN Orchestrator provides the following features:

- The IPSec overlay is automatically created through tunnel orchestration.
- Reachability information is propagated through route orchestration, and route redistribution is done through a single group configuration.
- Routing policies are set with a simple hub preference at the group level and route redistribution at the headend ensures symmetry.
- Individual devices do not need to be configured with the overlay topology and routing policy because they are done at group level for all devices.
- When a new BGW is added to a group, it dynamically learns the overlay topology and orchestration creates the tunnels and route policy.
- Changing the path preference is done by changing hub preference setting and routing costs are translated into the data center routing process.
- Scalability is built into the orchestration, which helps an organization build a robust routing design.

Tunnel Orchestrator

In order to build an SD-WAN network, the first step is to bring up a policy overlay network that is independent of the underlying WAN circuits. In order to do this, the administrator identifies the uplink interfaces in all gateways with their corresponding service provider. After the information is entered, SD-WAN Orchestrator establishes the overlay tunnels according to the defined policy.

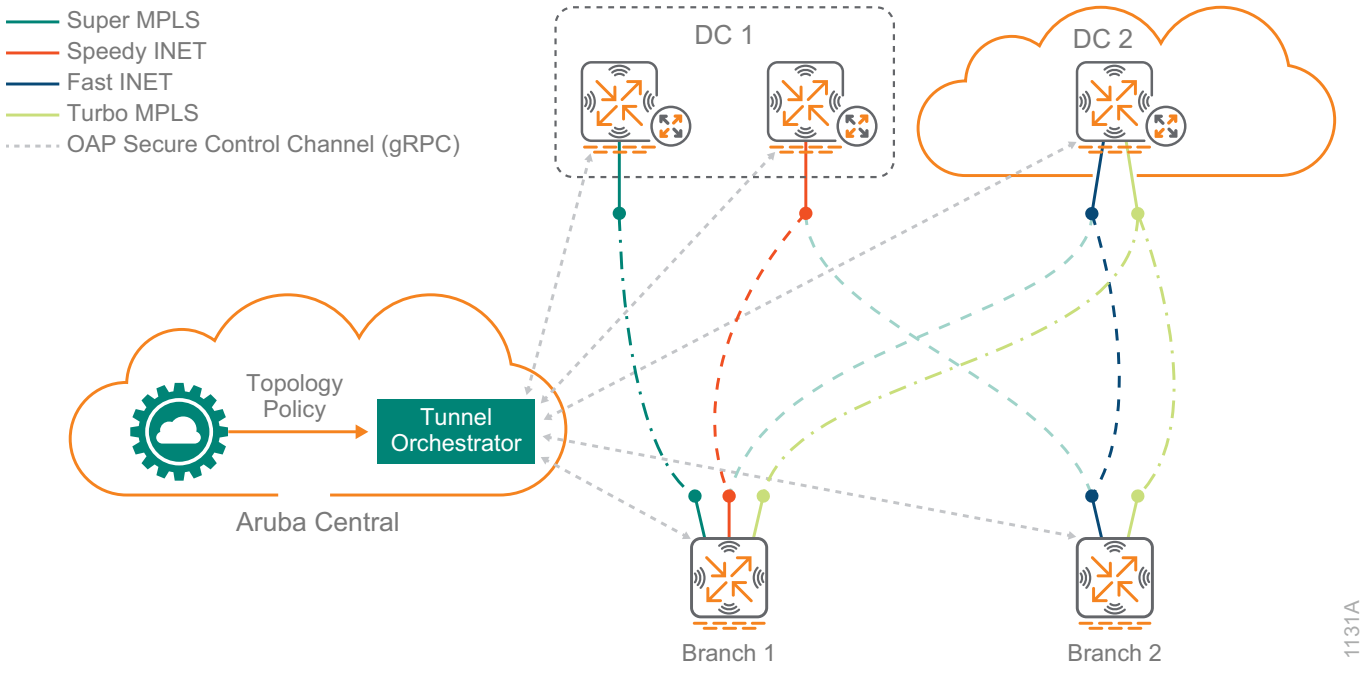
The main functions of Aruba Overlay Tunnel Orchestrator include:

- Discovering the public/private IP addresses and uplinks attributes
- Exchanging keys and sending keys to devices
- Building IPsec tunnels
- Refreshing keying material before old keys expire

Aruba Overlay Tunnel Orchestrator removes the complexity and scalability issues associated with configuring IPsec tunnels. It also eliminates the need to specify Internet Key Exchange (IKE)-related information. With SD-WAN Orchestrator, Aruba simplifies the configuration of one of the most complex tasks when bringing up an SD-WAN service.

SD-WAN Orchestrator sends the topology policy to Tunnel Orchestrator and, based on interface type and provider name, it automatically establishes the tunnels. If the interface type is MPLS, the names must match for the orchestrator to build the tunnels. If the interface type is INET, the orchestrator prefers names that match, but tunnels are also built for non-matching Internet providers names as shown in the following figure. In the figure, the tunnel orchestrator establishes an Overlay Agent Protocol (OAP) secure control channel using Google RPC to each BGW and VPNC.

Figure 12 Tunnel Orchestrator



Route Orchestrator

Aruba Route Orchestrator enables the distribution of routing information across all sites including branches and headend. It provides route distribution across sites in a dynamic way according to the topology and routing segmentation policy configurations.

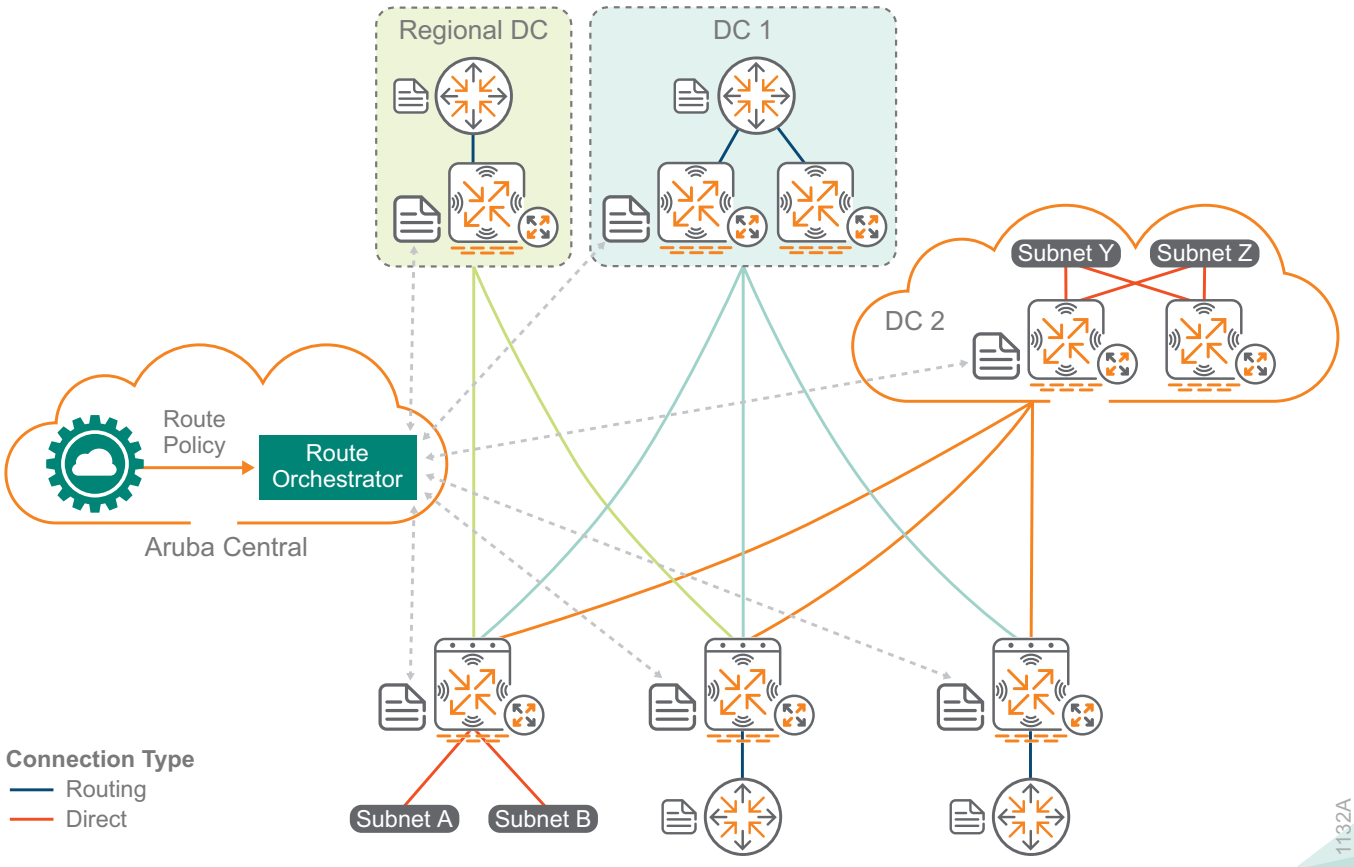
The main functions of Aruba Route Orchestrator include:

- Learning routes from headend and branch sites
- Advertising routes across the SD-WAN network with appropriate costs
- Redistributing routes into the LAN side with appropriate costs

SD-WAN Orchestrator's goal is to build the SD-WAN overlay and provide dynamic routing with minimal intervention from the user's side. The network behind the gateways can be a simple L2 with connected subnets or a more complex L3 environment running OSPF or BGP routing.

In the following figure, Route Orchestrator acts like a BGP route reflector to collect and redistribute the routing information from each gateway using the routing policy defined in Aruba Central.

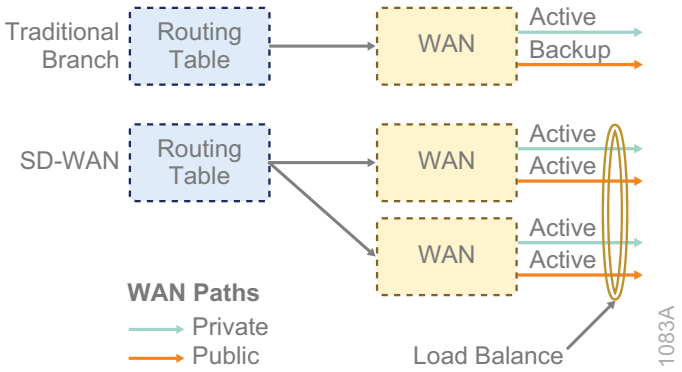
Figure 13 Route Orchestrator



Traditional Branch

With traditional branch solutions, traffic is routed using the information from the routing table over a single active WAN path, and other paths are backup links that are used only when the active link becomes unavailable. The Aruba SD-Branch solution sends traffic simultaneously over multiple active WAN paths. The paths can be different types with unequal bandwidths, and they can also span a second gateway device. The following figure compares traditional branch solutions with Aruba SD-Branch.

Figure 14 Traditional branch vs Aruba SD-Branch



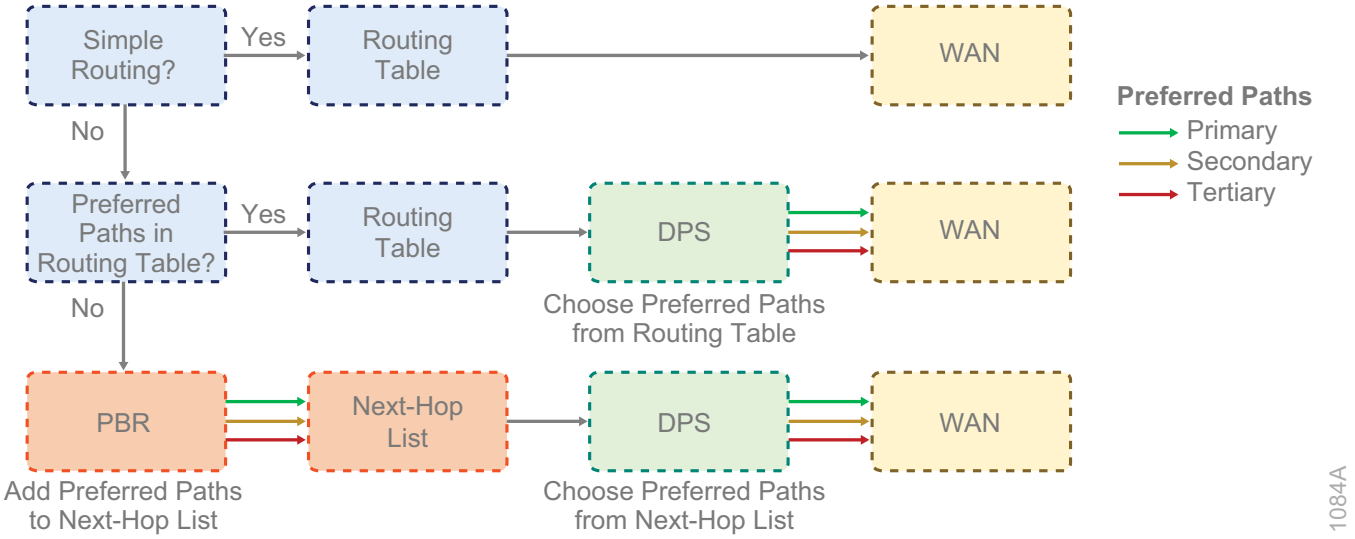
To further enhance the Aruba SD-Branch solution, routing is manipulated using SLAs to ensure compliance with defined thresholds and preferred WAN paths are chosen on a dynamic basis. The three areas where path selection decisions are made are as follows:

- **Routing table**—If special treatment is not required, traffic is forwarded from the routing table.
- **Dynamic path selection**—If SLAs are required and the preferred paths are in the routing table, DPS dynamically selects the best available WAN path.
- **Policy-based routing**—If the preferred WAN paths are not available in the routing table or you want to specify a path for traffic, PBR overrides the available WAN paths using next hop lists.

If the traffic has a simple path without specific requirements, it can follow the routing table. However, most SD-WAN customers want to use SLAs to provide a better user experience for their real-time traffic while pushing their background traffic to lower performing WAN paths. If SLAs are needed and the preferred WAN paths are available in the routing table, a DPS policy is required. If the preferred WAN paths are not in the routing table or you want to steer to a specific set of equal cost paths, a PBR policy with a next-hop list is required.

The administrator decision tree shown below helps you determine when DPS and PBR policies are needed in your environment. PBR policies take precedence over entries in the routing table, so you should only use them when required.

Figure 15 Routing, DPS, and PBR administrator decision tree

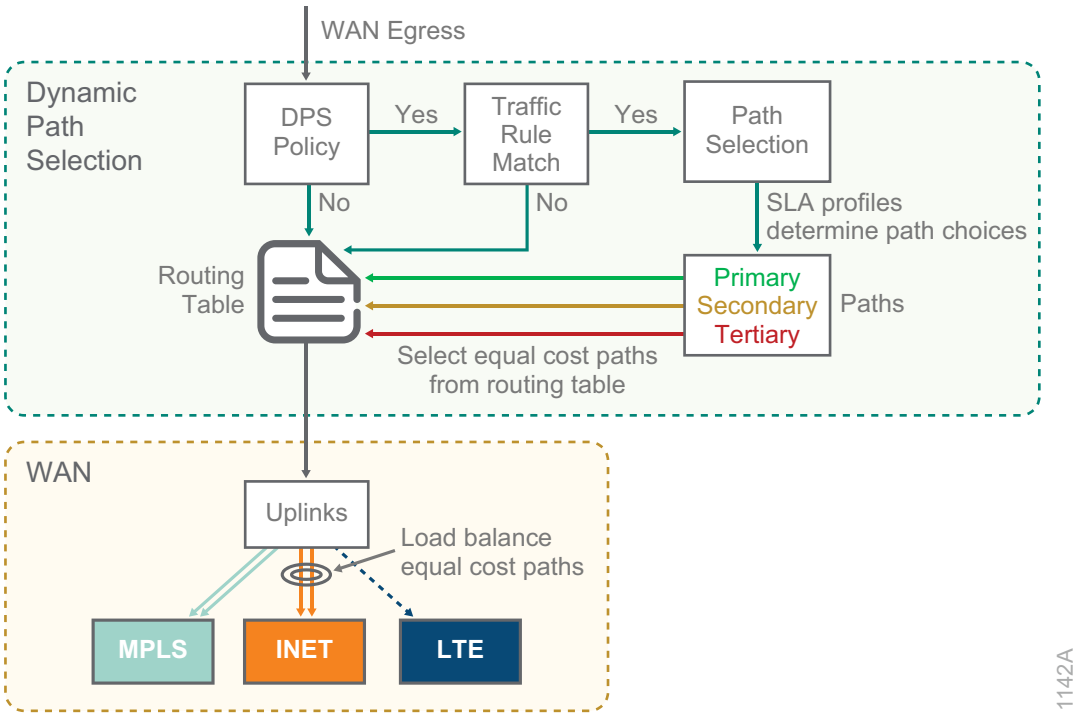


Dynamic Path Selection

Using health-monitoring information, DPS can intelligently route traffic based on policy, ensuring that applications are sent over the paths most appropriate to their needs. Based on user-defined criteria, DPS allows branch gateways to select the best path for an application to take across the WAN. The network administrator can define service-level agreements (SLAs) for an application based on values such as latency, jitter, packet loss, and uplink utilization, and the gateway makes a path selection based on which available link meets the SLA criteria.

The selected forwarding path can be a single WAN uplink, or traffic can be load-balanced across a group of WAN uplinks. The destination IP address of the traffic determines if the traffic is steered towards a VPN tunnel or forwarded directly to the Internet at the branch location. The DPS policy selects an uplink, and the gateway's routing table or PBR rules determines the next hop.

Figure 16 DPS on WAN egress



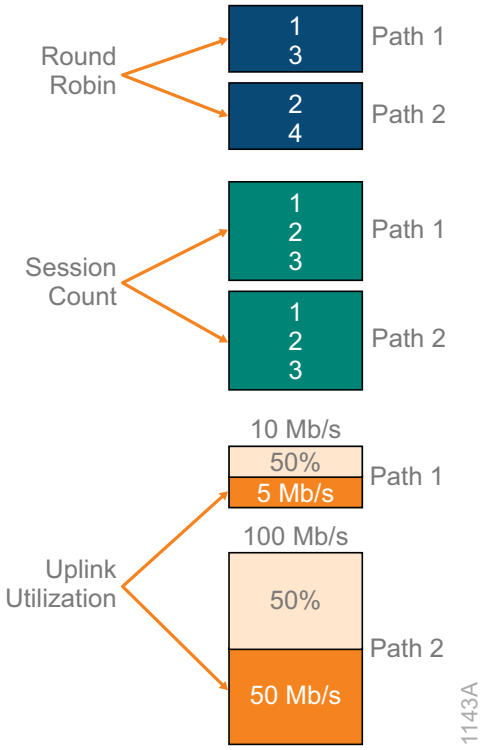
Load Balancing

When DPS selects a group of WAN uplinks, the gateway performs a load-balancing action. The load-balancing algorithm determines how sessions are distributed between the active WAN uplinks in the group.

Branch gateways support the following load-balancing algorithms:

- **Round robin**—Sequentially distributes outbound traffic between each active WAN uplink. This is the simplest algorithm to configure and implement but might result in uneven traffic distribution over time.
- **Session count**—Distributes outbound traffic between active WAN uplinks based on the number of sessions managed by each link. This algorithm attempts to ensure that the session count on each active WAN uplink is within 5% of the other active WAN uplinks.
- **Uplink utilization**—Distributes traffic between active WAN uplinks based on each uplink's utilization percentage. Uplink utilization considers the link speed to calculate the utilization for a given link and allows a maximum bandwidth percentage threshold to be defined. After the bandwidth threshold percentage has been exceeded, that WAN uplink is no longer considered available.

Figure 17 Load-balancing algorithms



Aruba recommends the uplink utilization algorithm because it accounts for the WAN service speed when making path selection.

Health Checks

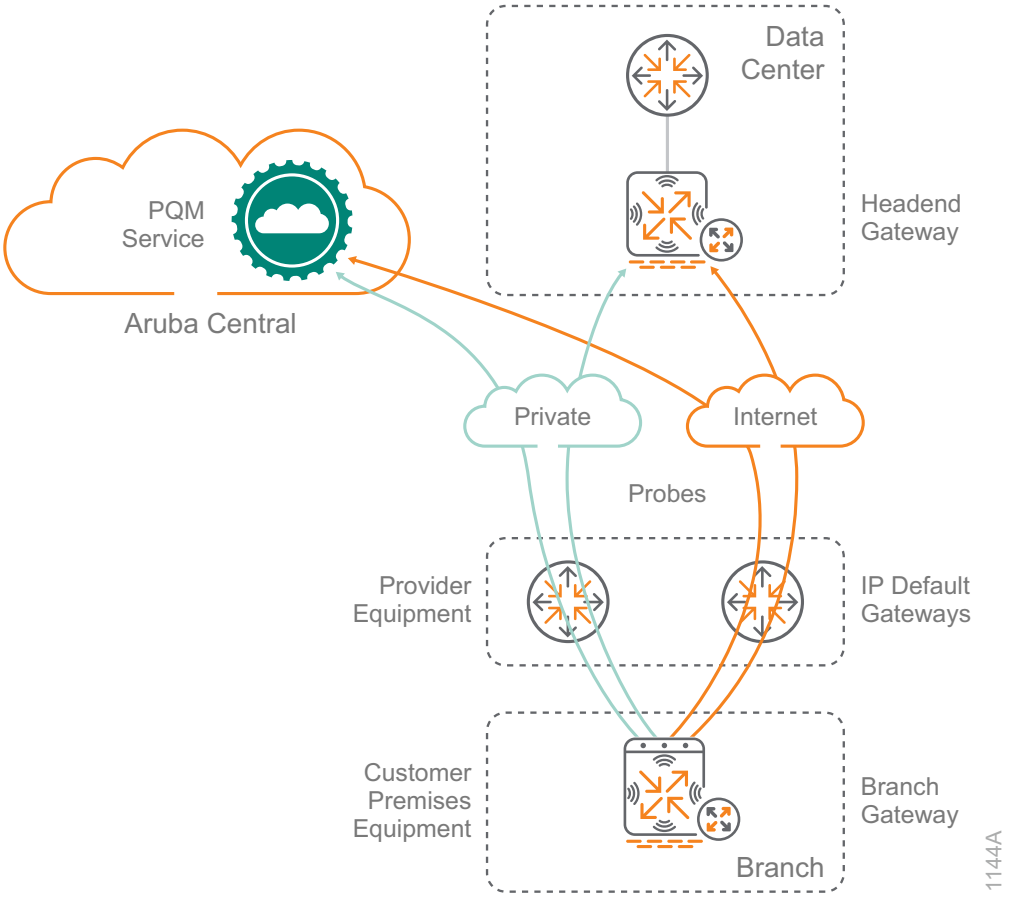
You must enable health checks in order to determine the path availability of each WAN uplink and policy overlay tunnel. When health checks are enabled, the gateway sends UDP or ICMP probes to an IP or FQDN of a host to determine if the connectivity underlay paths are available to accommodate traffic. The BGW also sends probes to all VPNCs to determine if the policy overlay paths are available for traffic. The primary use case for health checks is to verify the WAN underlay and overlay networks are operational which prevents branch traffic from being forwarded into a black hole.

When the defined health check host is not reachable over a WAN uplink, the default gateway associated with the WAN uplink is removed from the gateway's routing table. This prevents the WAN uplink from being used for branch traffic that is NAT'd to the Internet or management traffic that is destined for Central. Any established VPN tunnels continue to operate if the VPNC is reachable over the WAN uplink.

Aruba Gateways monitor the state of every WAN circuit by probing their default-gateway, the tunnel destination to each headend gateway as well as a service in the cloud to assess the health and status of every uplink. The following criteria are used:

- There must be a default-gateway defined for every WAN interface for it to be considered a valid uplink. A higher cost can be associated if the default-gateway shouldn't be used, but it must exist for the health check to work.
- BGWs send probes to headend gateway destinations through all uplinks in order to measure the health and state of the policy overlay tunnels.
- BGWs send probes to a health check service. In order to avoid black-holing Internet traffic, the gateway prevents connectivity underlay communication through uplinks marked as "unreachable" by the health check probes. Because they have their own probes, overlay traffic continues to work without impact

Figure 18 Headend gateway and PQM service probes



Aruba PQM Service

As part of the SD-Branch solution, Aruba provides a global Path Quality Monitoring (PQM) service that gateways can probe to measure the quality of the uplinks. This global service consists on a set of nodes that respond to ICMP/UDP probes from gateways managed by Aruba Central. All other traffic is throttled to avoid DoS attacks.

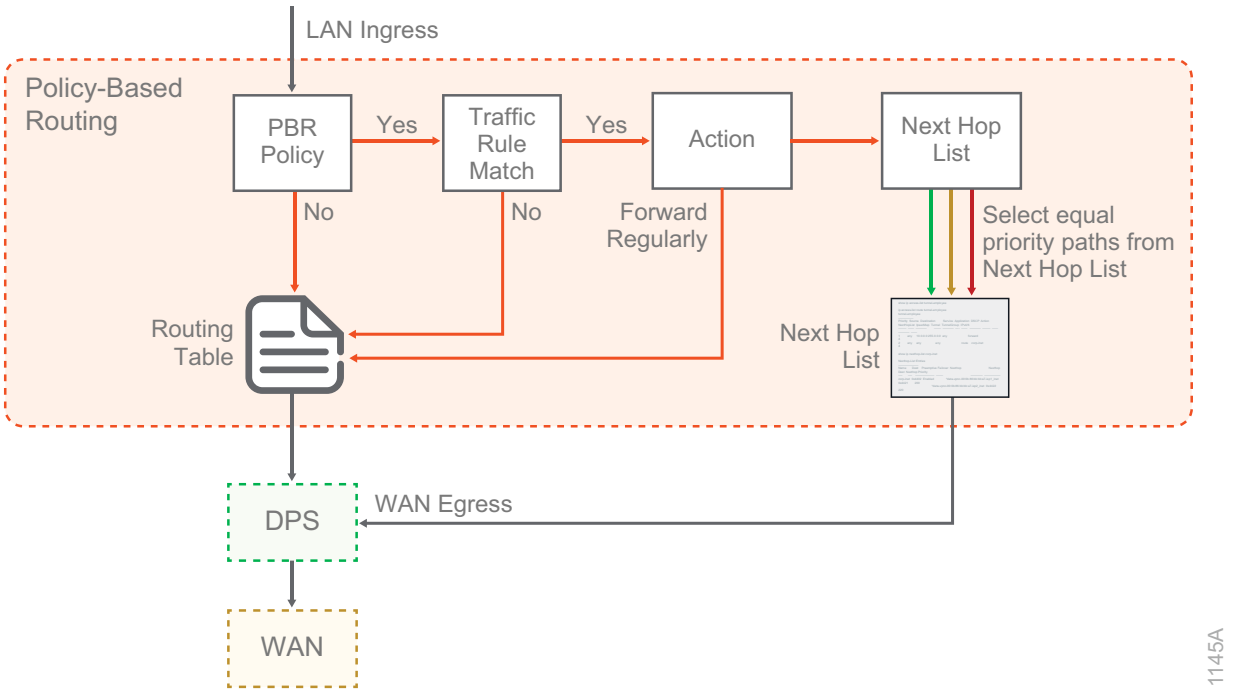
This service is maintained by the Aruba Cloud Operations team. On top of the regular monitoring of all the PQM nodes and the authoritative DNS, Aruba has distributed probes all over the world probing pqm.arubanetworks.com every five minutes. These probes are constantly reporting latency, packet loss, and which PQM node is responding to the Aruba Cloud Operations dashboard. This provides not just monitoring of the instances but a true 24x7 monitoring of the PQM service.

The Aruba SD-Branch solution relies on control-plane communication between BGWs and VPNCs, which allows the SD-WAN orchestrator to negotiate tunnels and establish routes. At least two paths of communication are recommended between the gateways and Aruba Central. This becomes even more important when dealing with Internet, LTE or VSAT circuits that are not be as reliable as an enterprise-grade MPLS network. You can achieve a second path to Aruba Central by configuring a static default route with a higher cost pointing to the private WAN overlay tunnel, which is routed over the headend site's DMZ out to the Internet.

Policy-Based Routing

Some advanced deployments might require PBR to override destination-based routes when traffic must be forwarded over a specific WAN path. If needed, PBR policies override the routing table for both underlay and overlay traffic. For example, if you want all traffic from your corporate users to go through the hub-site location, you apply a PBR rule pointing to the overlay tunnels. The gateway can use multiple paths by setting the same priority in a next-hop list and applying the PBR policy to the relevant user roles. If more than one active path is available, the gateway selects them using a combination of DPS and load-balancing.

Figure 19 PBR on LAN ingress



Common use cases where PBR policies are implemented include:

- All employee Internet traffic must be routed to the hub-site location to provide additional policy checks.
- Traffic from a specific subset of clients' needs to be forwarded out a specific WAN path.
- Integration with third-party SaaS or unified threat management providers—such as Check Point, Palo Alto Networks, or Zscaler—where certain traffic needs to be steered through a cloud-based security provider.

Reverse-Path Pinning

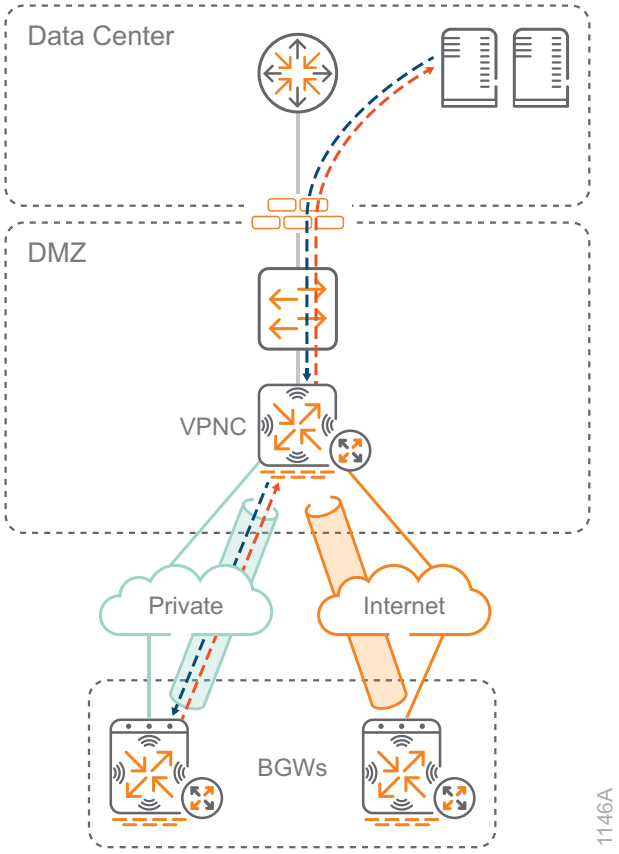
When a path selection is made for sessions destined for the corporate network through a VPN tunnel, the reverse traffic must take the same WAN path to prevent connectivity problems caused by asymmetric routing issues. Reverse-path pinning allows the hub gateway to choose the same WAN path for each active session to and from the branch. This is important because the branch gateway selects paths based on performance and SLAs. Reverse-path pinning is performed for corporate sessions originating from the branch destined to the data center, as well as sessions originating from the hub towards the branches.

A session destined for a branch from the hub site is handled as follows:

- The VPNC gateway selects an available WAN path using equal-cost multi-path routing.
- If the WAN path matches the preferred path defined in the DPS policy, then no additional steering is required.
- If the WAN path does not match the preferred path defined in the DPS policy, the branch gateway sends the return session over the preferred path. Upon receipt of the traffic from the new path, the VPNC steers the outbound session to the preferred path to maintain symmetry.

The following figure shows traffic from a branch location over the private WAN overlay tunnel and the reverse path pinning feature on the VPNC returns the traffic on the same path to enforce symmetry.

Figure 20 Reverse-path pinning



Cloud Security Providers

Security is an integral part of the Aruba SD-Branch solution. The solution is built from the ground up to be completely policy-driven using a role-based model. In most deployments, the BGW is directly connected to the Internet, requiring very robust hardening policies. The Aruba SD-Branch solution begins with the hardening of the operating system, adds signature-based device profiling with ClearPass and supports the integration with best-of-breed security partners by using on-premises appliances or cloud-based services.

The BGW has a hardened operating system that includes the following security features:

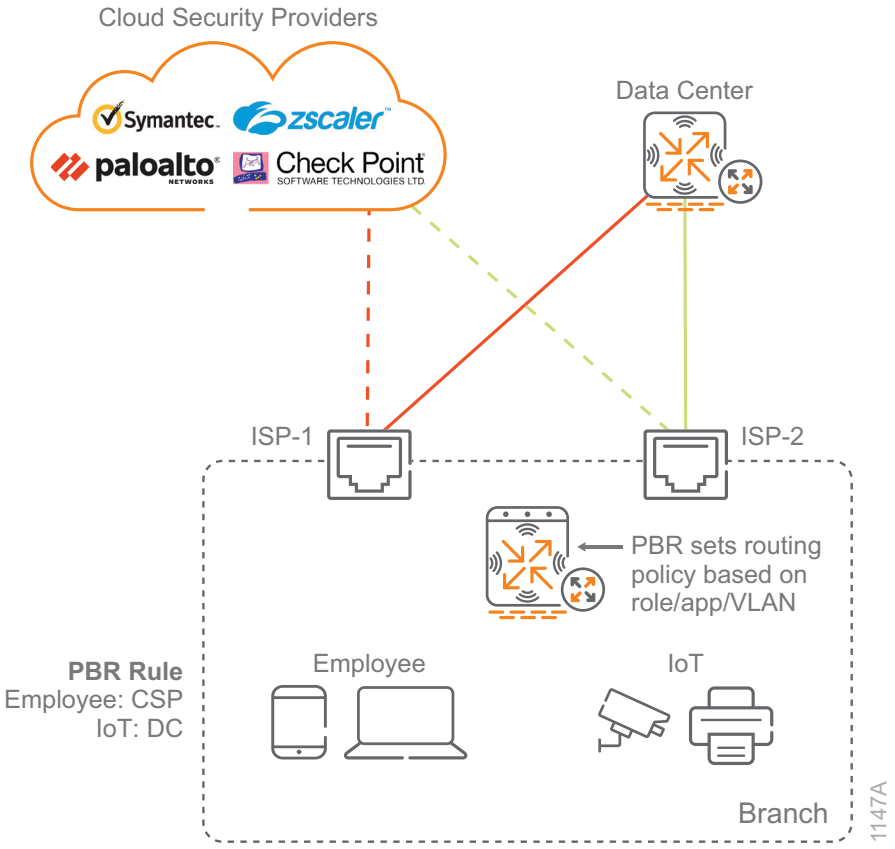
- **Secure boot**—TPM-signed software image that heavily restricts communications until the BGW receives its initial configuration from Aruba Central
- **Secure zero touch provisioning**—Leverages the TPM to securely communicate with Aruba Central
- **AES 256 encryption**—To secure the SD-WAN policy overlay tunnels
- **Role-based stateful firewall**—Support for scalable configuration using firewall aliases, ALGs, and role-based policies
- **Deep packet inspection**—Capacity to identify close to 3200 applications
- **Web content and reputation filtering**—WebRoot's ML technology to classify content, reputation, and geolocation for billions of URLs
- **Aruba threat detection**—IPS/IDS available in the 9000 series gateways

The Aruba SD-Branch solution integrates with ClearPass Policy Manager to form a true policy-driven branch. This model dynamically assigns policies based on users and devices, as opposed to the traditional way of assigning policies manually based on VLANs, IP addresses. and ports. You can enhance the policy-driven branch by leveraging integrations with partners in the ClearPass Exchange. You can push device identification further by integrating with Aruba Device Insight for advanced AI/ML-based profiling.

Aruba SD-Branch can also integrate with best-of-breed third-party security infrastructure partners to offer enterprise-grade advanced threat protection in a scalable manner. The integration with cloud-based security offerings from third party companies provides an extremely simple and scalable solution for advanced threat protection in branch networks.

To secure your Internet traffic, the BGW redirects selected traffic through a cloud-based security platform. This enables best-of-breed security, with services like advanced threat protection or data loss prevention, without the need to increase the footprint in branch locations. In the following figure, a PBR rule sends the employee Internet traffic to the cloud security provider for threat mitigation, and the IoT traffic goes straight to the data center.

Figure 21 Cloud security providers with PBR rules



SaaS Express

As more businesses deploy SD-WAN to take advantage of inexpensive broadband Internet services and also adopt software-as-a-service (SaaS) applications such as Office 365, Box, Slack, and Zendesk, operations teams must ensure the users at a branch site can seamlessly and securely connect to their applications in the cloud with the best possible performance. The Aruba SaaS Express feature enables the discovery of the SaaS application servers, monitors application performance, and steers traffic to the best available servers in order to provide an improved user experience.

The SaaS Express feature offers the following benefits:

- Real-time probe measurement to determine the optimal ISP for user traffic
- Ability to choose the best network path for SaaS applications in order to optimize the user experience
- Improved service reliability with multiple network paths and dynamic traffic-steering

SaaS Application Profile Parameter

The BGW supports a set of applications and application categories in the DPI library. The built-in application profiles include a set of SaaS applications; for example, Adobe, Dropbox, Amazon, Google, Salesforce, Slack, Webex, etc. If a SaaS application is not available in the list, the network administrator can configure their own.

Each SaaS application profile includes the following elements:

- **Name**—Name of the SaaS application
- **FQDN**—A list of domain URLs bound to the SaaS application
- **Exit profile**—Traffic steering policy for determining an optimal path exit
- **SLA**—Threshold profile for measuring path quality and performance
- **Health check probe URI**—URI to use for probes to determine the best available path

HTTP and DNS Probes

Aruba BGWs send HTTP requests to each SaaS application over every available path. They calculate the average packet loss and latency for each path in order to determine the one with the best performance. When a user requests access to a SaaS application, the BGW dynamically steers the application traffic to the best available path.

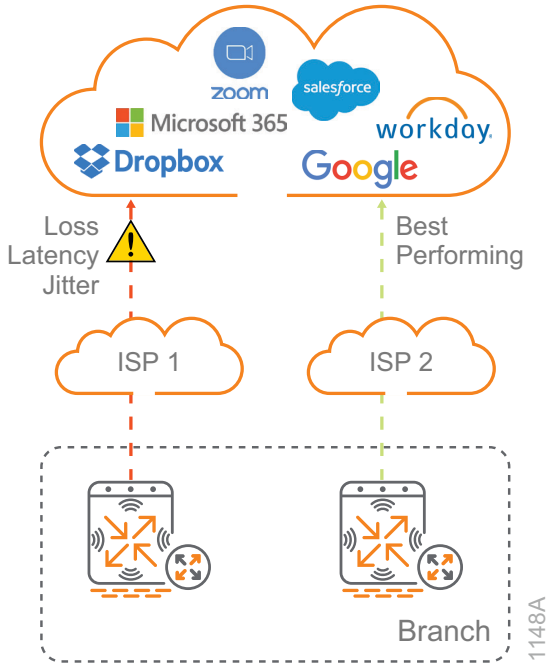
When a client requests SaaS application access, the BGW intercepts the DNS query acting as a proxy and forwards the query to the DNS server to resolve into IP addresses. Using the type of SaaS application and the location of DNS caching servers for a given ISP, the BGW determines the best available uplink. This means traffic is automatically steered to the best performing SaaS servers, rather than statically defining them based on a best-guess geographic location.

Traffic Steering and Path Selection

Network administrators can use a WAN policy with path steering based on key performance indicators, such as jitter, latency, and packet loss, to attach the policy to each SaaS application profile. By default, the BGW includes a Best for SaaS SLA profile, which is used for SaaS application profiles. Network administrators can also use a custom SaaS policy for steering their SaaS application traffic.

The following figure illustrates SaaS traffic steering and path selection from a branch site with dual Internet circuits.

Figure 22 SaaS Express traffic steering and path selection



ARUBA SD-LAN

The Aruba SD-Branch solution provides a centralized control plane function offered from Aruba Central that is based on a cloud-native, multi-tenant architecture that automatically scales to a customer's network growth. After the SD-WAN is deployed, the SD-LAN behind the branch gateway is next.

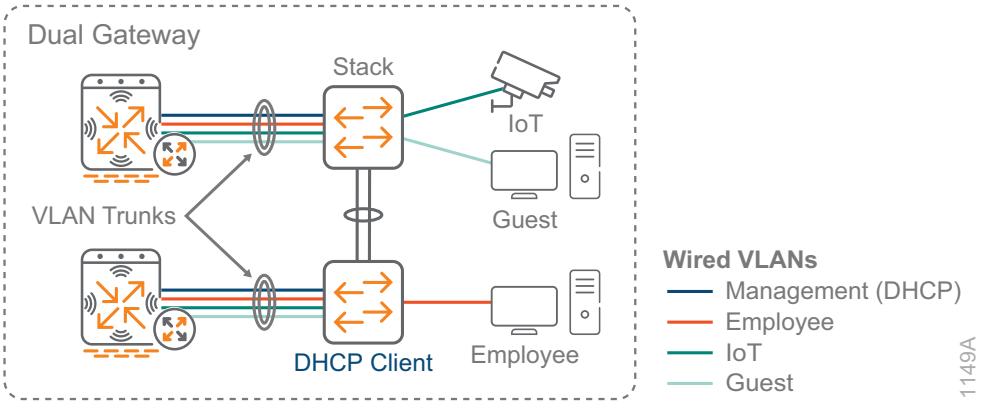
Non-Tunneled L2 Wired Access

To handle complex topologies with more IP subnets, branch sites use non-tunneled L2 switching for simple wired designs and L3 switching. If micro-segmentation is needed, traffic can be tunneled from the wired switches and APs to offer additional security.

In this design, the BGW provides L3 services for the site. The switches use VLANs for segmentation, which allows you to configure your access switches identically to further reduces the complexity of the design. Using the same switch hardware and feature configurations saves money due to lower operational costs and maintaining fewer sets of spares.

The access switch is trunked to the BGW to map the VLANs between them. The BGW acts as the IP default gateway for each of the IP subnets and provides DHCP services to the end devices. DHCP can also be centralized at the headend location. The switch obtains its IP address by using a DHCP client on the management VLAN.

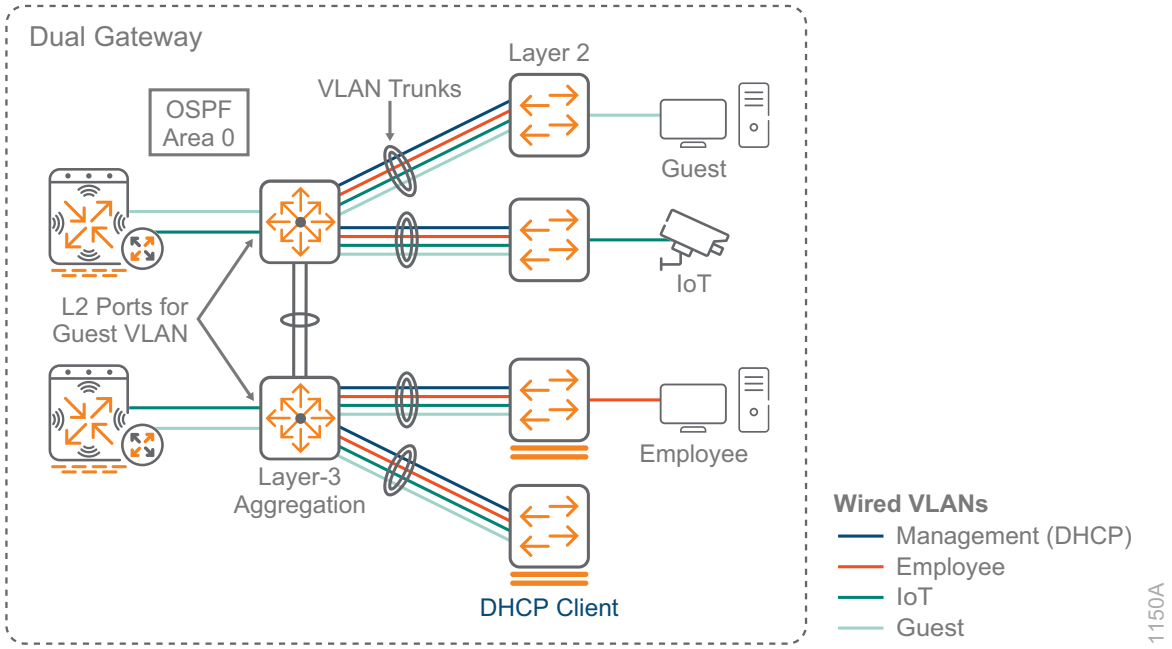
Figure 23 Non-tunneled L2 wired access



Non-Tunneled L3 Wired Access

In this design, the L3 aggregation switch provides layer-3 services for the site. The L2 access switches use multiple VLANs that are trunked to the aggregation switches to map the VLANs between them. The aggregation switches acts as the IP default gateway for each of the IP subnets and provides DHCP services to the end devices. DHCP can also be centralized at the headend location. The L2 access switch obtains its IP address using a DHCP client on the management VLAN. The aggregation switches are routed to the BGWs using L3 ports. The guest VLAN uses a second set of ports to provide L2 access to the BGWs for direct access to the Internet.

Figure 24 Non-tunneled L3 wired access

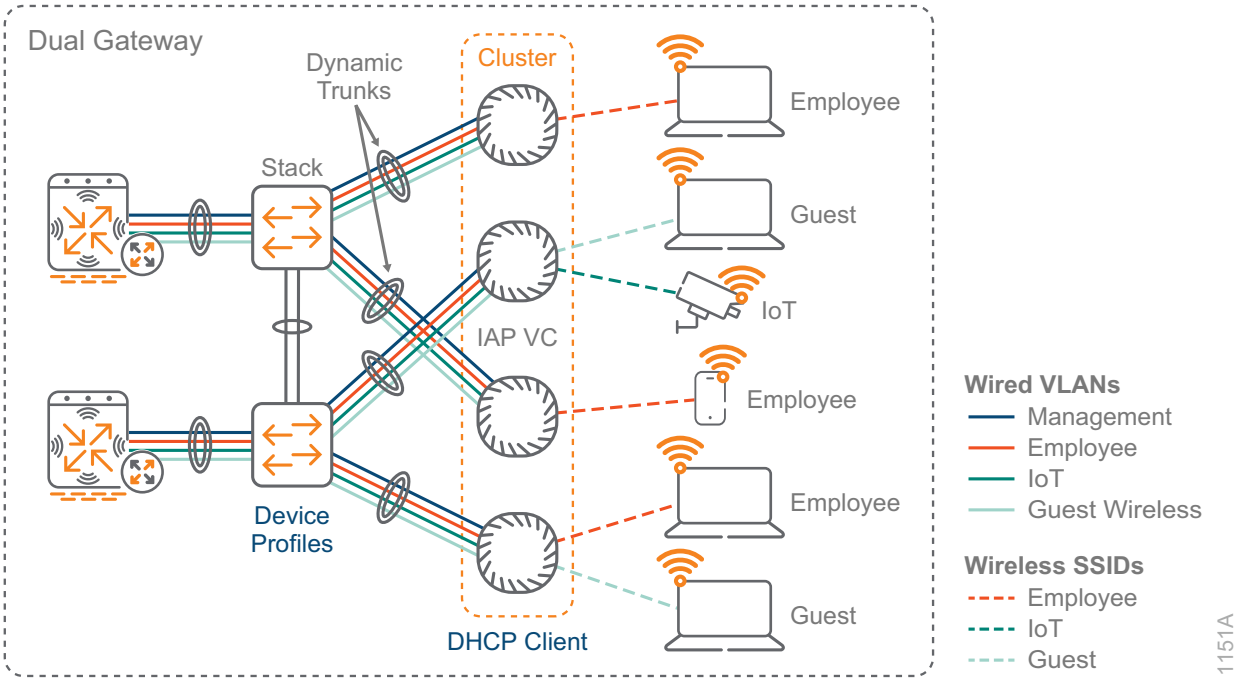


Non-Tunneled Wireless Access

Aruba Instant is a controllerless wireless architecture that is easy to set up and that supports robust security features. It includes automatic RF management to ensure the best Wi-Fi connection and granular visibility into applications, which helps prioritize business-critical data, limit or block non-business data, and keep malicious actors off your network. This design is well suited for deployments where tunneled traffic is not needed. Unlike solutions that require a separate management system, an Aruba Instant cluster distributes certain functions across the APs in the cluster and elects a single AP to act as a virtual controller for the remaining configuration functions, which are managed by Central.

APs are staggered into different switches within a stack in order to minimize disruption during software upgrades or unexpected switch outages. The switches use device profiles to automatically place the APs into the management VLAN and the APs use a DHCP client to obtain their IP addresses. Dynamic trunks are created between the APs and the L2 switches that map to the SSIDs and are passed through to the BGW for L3 termination.

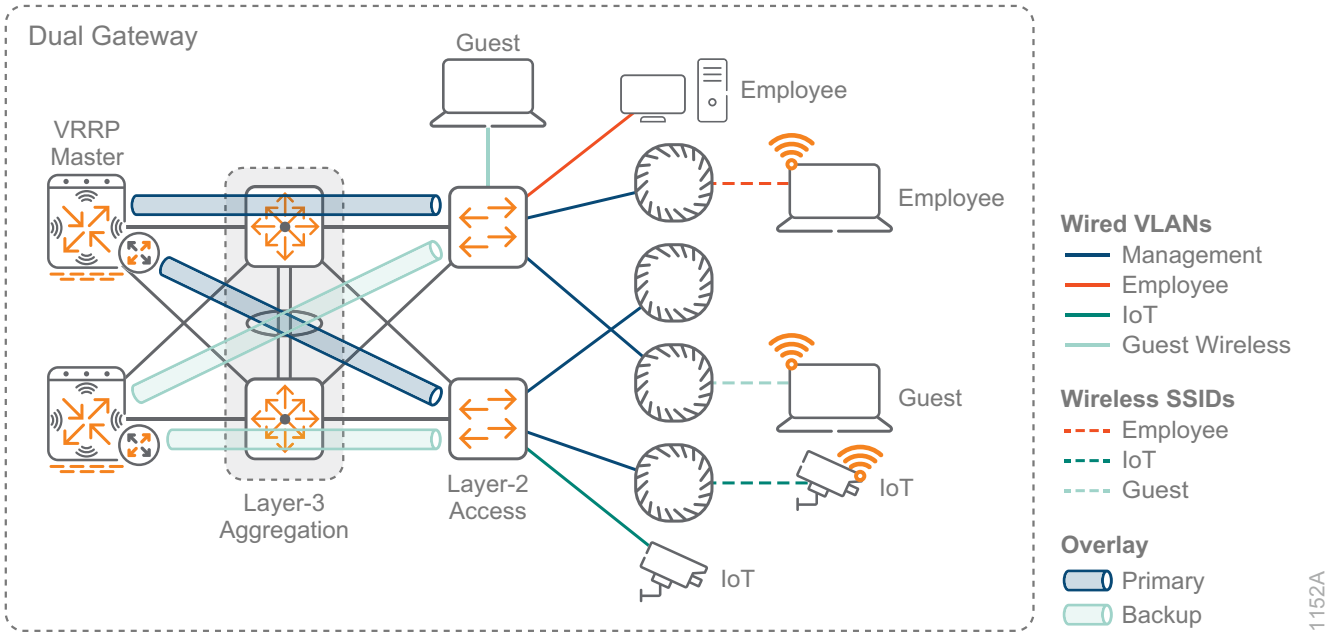
Figure 25 Non-tunneled L2 wireless access



Tunneled Access with Dynamic Segmentation

In this design, the user VLANs from the access switches, and APs are tunneled to the BGWs for L3 termination. Device profiles are used on the switches to automatically configure the AP ports for the management underlay VLAN and the SSID VLANs are dynamically trunked. Role-based access is configured for all ports on the switch and port-based mode is used for APs. Tunneled traffic is always untrusted, which means you must apply an AAA profile to the VLAN. Each VLAN can have a separate AAA profile with a different initial role in the BGW.

Figure 26 Tunneled access with Dynamic Segmentation



SD-BRANCH COMPONENTS

This section discusses the recommended components for an SD-Branch solution. Not every component is required for a valid SD-Branch deployment. The only hard requirements are a branch location with multiple WAN paths and Aruba Central for the management.

Gateway Components

The gateway offers organizations a reliable, high performance option with support for multiple WAN connections. From a routing standpoint, this provides IT with insight into the traffic flowing in and out of a site, regardless of the uplink. A headend gateway is needed for VPN tunnel termination in private data center and campus routing scenarios. A virtual gateway is needed for network deployments using cloud providers. A branch gateway provides direct access to the Internet at a remote site, as well as secure tunnel access to corporate resources at the headend location.

Headend Gateway

The headend gateway acts as a VPN concentrator terminating VPN tunnels, and it provides routing into the data center or campus environments using OSPF or BGP. The headend gateway participates in the SD-WAN fabric overlay topology by terminating the tunnels from the BGWs. The headend gateway is a software function that runs on the Aruba 7200 series appliances, the 9000 series appliances, and some of the Aruba 7000 series appliances. The following table details the headend gateway scaling.

Table 1 Headend gateway scaling

Platform	Max tunnels	Max IKE learned routes	Max routes in forwarding table	WAN compression	Crypto throughput	Firewall sessions
7280	8192	32,768	32,768	10 Gbps	50 Gbps	2M
7240XM	6144	32,768	32,768	10 Gbps	30 Gbps	2M
7220	4096	16,384	16,384	10 Gbps	21 Gbps	2M
7210	1024	8096	8192	10 Gbps	8 Gbps	2M
7030	512	3000	4096	2.5 Gbps	2.6 Gbps	128K
7010/7024	256	1500	4096	2.5 Gbps	2.6 Gbps	64K
9004/9012	512	3000	4096	2.5 Gbps	4 Gbps	64K

Virtual Gateway

The virtual gateway extends the SD-WAN overlay services to the public cloud infrastructure. Virtual gateways function as VPN concentrators and terminate tunnels from branch gateways, Instant APs and, VIA clients. Like the hardware VPN concentrators, virtual gateways support routing, security, and tunneling features. Virtual gateways are supported in Amazon Web Services and in Microsoft Azure. The following table details the virtual gateway scaling.

Table 2 Virtual gateway scaling

Platform	Max tunnels	Max IKE learned routes	Max routes in forwarding table	Crypto throughput	Firewall sessions
vGW-4G	8192	32,768	131,072	4 Gbps	6M
vGW-2G	4096	16,384	65,536	2 Gbps	256K
vGW-500M	1600	8096	2048	500 Mbps	64K

Branch Gateway

The branch gateway is the appliance at each remote site that connects to WAN uplinks and participates as an endpoint in the SD-WAN overlay fabric. The branch gateway provides the dynamic segmentation by acting as a policy-enforcement point for wired, wireless, security, and WAN policies including routing. The gateway functions include stateful firewall, web content classification, hybrid WAN connectivity, IPsec VPN, QoS, and WAN path monitoring and selection. The branch gateway is a software function that runs on the Aruba 7200, 9000 and 7000 series appliances.

The following table details the branch gateway scaling.

Table 3 Branch gateway scaling

Platform	Client devices	Firewall throughput	Crypto throughput	Active firewall sessions	Firewall sessions per second	Tunneled node ports
7240XM	32,768	40 Gbps	30 Gbps	2M	800K	Pending QA
7220	24,576	40 Gbps	20 Gbps	2M	500K	Pending QA
7210	16,384	20 Gbps	6 Gbps	2M	350K	Pending QA
7030	4096	8 Gbps	2.6 Gbps	128K	65K	2048
7010/7024	2048	4 Gbps	2.6 Gbps	64K	64K	1024
9004/9012	2048	7 Gbps	4 Gbps	64K	32K	2048
7005/7008	1024	2 Gbps	1.2 Gbps	64K	63K	512

For a complete list of Aruba Central–supported gateways, see Aruba Central Supported Gateways.

Microbranch

For very small and micro branch deployments, Aruba does not require a traditional branch gateway. You can deploy an Instant AP cluster at a small branch or home office location without a gateway. In this design, the Instant AP acting as a virtual controller establishes secure connections with the VPN concentrators at each headend or data center location. The Instant cluster provides Wi-Fi connectivity to the end devices and secure WAN access to corporate resources.

For a complete list of Aruba Central–supported Instant APs, see Aruba Central Supported Instant APs.

Wired Components

The wired LAN in the SD-Branch uses a layer-2 or layer-3 design. Although there are many hardware choices that work at the access layer in the network, this design focuses on products that are the most common and easily supported options in each layer of the network, with general guidance on which option to choose.

Access Switches

The access layer connects wired devices to the network, such as APs, workstations, multi-function printers, and other devices that don't support Wi-Fi or need higher performance than a wireless connection can provide. The access layer also provides PoE to devices such as APs, IP phones, and IP cameras.

The following features are common across the Aruba access switches:

- Support for security and network management with Aruba ClearPass and Aruba Central
- REST APIs for automation
- PoE for APs, IP phones, and IoT devices

The number of ports needed in an access closet and the performance required determine which access switch model is the best fit for your network.

Aruba 5400R—The Aruba 5400R chassis supports a variety of interface modules that provide copper and fiber interfaces in different speeds and densities. At the access layer, the switch supports up to 96 HP Smart Rate Multi-Gigabit or 288 1-GbE ports with PoE+. This switch is ideal for organizations that need large numbers of access ports in high-density areas of their network (majority of access closets with 96+ ports). Features:

- Layer-3 modular switch with VSF stacking, tunnel node, ACLs, robust QoS, low latency, and resiliency
- HPE Smart Rate for high-speed multi-gigabit bandwidth (IEEE 802.3bz) and PoE+
- Scalable line-rate 40 GbE for wireless traffic aggregation

Aruba 3810M—The Aruba 3810M is available with either 24 or 48 1-GbE access ports with PoE+ (30W) on each port and either 4 SPF+ ports or 2 40-GbE ports on an optional expansion module. The 3810M is also available in a model with 40 1-GbE ports and 8 HPE Smart Rate ports capable of 1, 2.5, 5, or 10 GbE. The 3810M supports backplane stacking with up to 10 switches in a single stack and advanced layer-3 services. It also supports meshed stacking. This switch is ideal for organizations that have larger access closets requiring larger switch stacks, are deploying or planning on deploying 802.11ac Wave 2 APs and want a switch with high performance and room for future growth. Features:

- Layer-3 switch with backplane stacking, tunnel node, ACLs, robust QoS, low latency, and resiliency
- HPE Smart Rate for high-speed multi-gigabit bandwidth (IEEE 802.3bz) and PoE+
- Modular line-rate 10-GbE and 40-GbE ports for wireless aggregation

Aruba 2930M—The Aruba 2930M is available with either 24 or 48 1-GbE access ports with PoE+ (30W) on each port and either 4 SPF+ ports or 2 40-GbE ports on an optional expansion module. The 2930M is also available in a model with 40 1-GbE ports and 8 HPE Smart Rate ports capable of 1, 2.5, 5, or 10 GbE. The 2930M supports backplane stacking with up to 10 switches in a single stack and dynamic layer-3 services. This switch is designed for organizations wanting to create a digital workplace optimized for mobile users with an integrated wired and wireless access network. Features:

- Layer-3 switch with backplane stacking, tunnel node, ACLs, and robust QoS
- HPE Smart Rate for high-speed multi-gigabit bandwidth (IEEE 802.3bz) and up to 1440 W PoE+
- Modular 10-GbE or 40-GbE uplinks
- Models with 24 ports of HPE Smart Rate with IEEE 802.3bz

Aruba 2930F—The Aruba 2930F is available with either 24 or 48 1-GbE access ports and 370W PoE+. The switch supports Virtual Switching Framework (VSF), allowing you to stack up to 8 switches using available front ports. Although the 2930F supports basic layer-3 features, it is typically deployed as a layer-2 switch. This switch is ideal for organizations that have smaller access closets requiring only one or two switches, are looking for good performance, and who can accept a limited feature set in return for lower cost. Features:

- Layer-3 switch with VSF stacking, tunnel node, ACLs, and robust QoS
- Convenient built-in 1GbE or 10GbE uplinks and up to 740 W PoE+

Aggregation Switches

The aggregation layer provides connectivity for all access layer switches and connects to the branch gateways. The aggregation layer is responsible for layer-3 routing in this design, and it handles all traffic between networks on the LAN and traffic leaving the LAN for the WAN or the Internet. For high availability, the aggregation layer consists of a pair of switches acting as a single switch. If a switch fails or needs to be taken out of service for maintenance, the other switch continues forwarding traffic without interruption to the LAN services.

The following features are common across the aggregation switches:

- HPE Smart Rate for high-speed multi-gigabit bandwidth (IEEE 802.3bz) and PoE+
- Support for security and network management with Aruba ClearPass and Aruba Central
- REST APIs for the software-defined network

Aruba 5400R—The Aruba 5400R chassis supports a variety of interface modules that provide copper and fiber interfaces in different speeds and densities. The switch supports up to 96 10-GbE ports (SFP+ and 10GBASE-T), 96 HP Smart Rate Multi-Gigabit, or 288 1-GbE ports with PoE+. This switch is ideal for organizations that need to aggregate many access switches and might need to connect servers, firewalls, or other network appliances directly to the aggregation layer. The 5400R chassis includes the following features:

- Layer-3 modular switch with VSF stacking, static routing, RIP, OSPF, ACLs, robust QoS, policy-based routing, low latency, and resiliency
- Scalable line-rate 40GbE for wireless traffic aggregation

Aruba 3810M—The Aruba 3810M is available in a 16 port SFP+ and a two-module slot model. The module slots allow for an additional 8 SFP+ or 2 40-GbE ports. This switch is ideal for organizations with a small LAN who to aggregate 1 or 10-GbE connected access switches. The 3810 includes the following features:

- Layer-3 switch with backplane stacking, static routing, RIP, OSPF, ACLs, robust QoS, policy-based routing, low latency, and resiliency
- Modular line-rate 10-GbE and 40-GbE ports for wireless aggregation

For a complete list of Aruba Central–supported switches, see Aruba Central Supported Switches.

Wireless Components

With Aruba's controllerless model called *Instant*, there is no central controller and the controller functions are distributed among the APs. Instant is typically used in smaller networks or branch sites and scales up to 128 APs per cluster. In this design, we recommend deploying Aruba Instant with up to 50 APs. If you are planning to install more than 50 Instant APs, please contact an Aruba or partner SE/CSE for verification of your design.

Access Points

There are currently two series of Aruba access points: the latest generation 5xx series 802.11ax APs and the 3xx series 802.11ac Wave 2 APs. Details about currently available models are listed below; they support different throughput and client loads to meet different deployment needs.

The last digit in the model number denotes the antenna type. If the number is 4, then the AP has connectors for external antennas. If the number is 5, then the AP has internal antennas. For example, IAP-334 has external antennas and IAP-335 has internal antennas. In most office deployments, internal antenna models are preferred.

The following features are common across the current Aruba 5xx and 3xx APs:

- Unified AP for either controller-based or controllerless deployment modes
- Hitless PoE failover between both Ethernet ports (dual Ethernet models only)
- Built-in Bluetooth Low-Energy radio
- Advanced Cellular Coexistence to minimize interference from cellular networks
- Support for security and network management with Aruba ClearPass and Aruba Central
- Application visibility for QoS and traffic control
- Enhanced security with WPA3 and Enhanced Open

Aruba 5xx Series Access Point Options

The Aruba 5xx Series of campus access points support 802.11ax to efficiently and simultaneously serve multiple clients and traffic types in dense environments. These APs offer increased data rates for both individual device and overall system while delivering high performance and throughput in environments where mobile and IoT density is a growing concern.

Aruba 5xx common capabilities:

- Dual uplink ports with LACP support for redundancy and increased capacity
- Bluetooth 5 and Zigbee radios for location and IoT use-cases
- Green AP mode for energy savings up to 70%

Aruba 550 Series Access Points—The Aruba 550 Series APs are ideal for extreme high-density environments, such as public venues, higher education, hotels, and enterprise offices. The 550 series supports maximum data rates of 4.8Gbps in the 5GHz band and 1,150Mbps in the 2.4GHz band (for an aggregate peak rate of 5.95Gbps). The Aruba 550 series requires ArubaOS and Aruba InstantOS 8.5 software, and its features include:

- Dual-radio (8x8 + 4x4 MIMO)
- Optional tri-radio mode* with two 5GHz and one 2.4GHz radio (all 4x4 MIMO)
- Dual 5G HPE Smart Rate ports
- AI-powered features for wireless RF and client connectivity optimization
- Up to 1024 associated client devices per radio (recommended active 200) *

**Some 5xx features are not supported in the initial release but will be enabled in future software releases.*

Aruba 530 Series Access Points—The Aruba 530 Series APs are ideal for very high-density environments, such as higher education, K12, retail branches, hotels, and digital workplaces. The 530 series supports maximum data rates of 2.4Gbps in the 5GHz band and 1,150Mbps in the 2.4GHz band (for an aggregate peak rate of 3.55Gbps). The Aruba 530 series requires ArubaOS and Aruba InstantOS 8.5 software, and its features include:

- Dual-radio (dual 4x4 MIMO)
- Dual 5G HPE Smart Rate ports
- AI-powered features for wireless RF and client connectivity optimization
- Up to 1024 associated client devices per radio (recommended active 200)*

**Some 5xx features are not supported in the initial release but will be enabled in future software releases.*

Aruba 510 Series Access Points—The Aruba 510 Series APs are ideal for high-density environments, such as schools, retail branches, hotels, and enterprise offices. The 510 series supports maximum data rates of 2.4Gbps in the 5GHz band and 575Mbps in the 2.4GHz band (for an aggregate peak data rate of 2.975Gbps). The Aruba 510 series requires ArubaOS and Aruba InstantOS 8.4 software, and its features include:

- Dual-radio (4x4 + 2x2 MIMO)
- Single 2.5G HPE Smart Rate and Gigabit Ethernet uplink ports
- Up to 256 associated client devices per radio

Aruba 3xx Series Access Point Options

Aruba 340 Series Access Points—The Aruba 340 Series is the highest performance AP and supports HPE Smart Rate uplink, so it can use the full performance of 3.5 Gbps on two 5-GHz bands or 1.7 Gbps in the 5-GHz band and 800Mbps in the 2.4-GHz band, for a combined bandwidth of 2.5 Gbps. This model is ideal for organizations that require very high density and next-generation performance for auditoriums, high-density office environments, or public venues. The Aruba 340 series requires ArubaOS and Aruba InstantOS 8.3 software.

- Dual radio 4x4 802.11ac AP with MU-MIMO
- Optional dual 5-GHz mode supported, where the 2.4-GHz radio is converted to a second 5-GHz radio
- Antenna polarization diversity for optimized RF performance
- HPE Smart Rate and Gigabit Ethernet uplink ports with Link Aggregation Control Protocol (LACP) support for increased capacity
- Hitless PoE failover between both Ethernet ports

Aruba 330 Series Access Points—The Aruba 330 Series is a high-performance AP and supports HPE Smart Rate uplink, so it can use the full performance of 1.7 Gbps in 5-GHz band and 600Mbps in 2.4-GHz band for a combined bandwidth of 2.3 Gbps. This model is ideal for organizations that require high density and next-generation performance for auditoriums, high-density office environments, or public venues.

- Antenna polarization diversity for optimized RF performance
- HPE Smart Rate and Gigabit Ethernet uplink ports with LACP support for increased capacity
- Hitless PoE failover between both Ethernet ports

Aruba 310 Series Access Points—The Aruba 310 Series is a medium-performance AP that supports 1.7 Gbps in the 5GHz band and 300 Mbps in the 2.4-GHz band with a single Gigabit Ethernet uplink. This model is ideal for organizations that need to support medium-density environments, such as schools, retail branches, hotels, and enterprise offices that don't require multi-gigabit performance.

Aruba 300 Series Access Points—The Aruba 300 Series is an entry-level AP that supports 1.3 Gbps in the 5-GHz band and 300 Mbps in the 2.4-GHz band with a single Gigabit Ethernet uplink. This model is ideal for organizations with medium-density environments, organizations that want the latest technology but don't need the higher level of performance.

For a complete list of Aruba Central–supported Instant APs, see Aruba Central Supported Instant APs.

Deploying the SD-Branch

The Aruba SD-Branch design provides SD-WAN, wired, and wireless connectivity for branch users. The SD-WAN interconnects the corporate site with the remote-site locations, making it a critical part of the network. Modern WAN networks require a flexible and scalable design to support mission-critical applications and real-time multimedia communications from any location on the corporate network. Access to cloud-based services from each branch location is also critical to the success of keeping the network running as efficiently as possible.

The SD-Branch design:

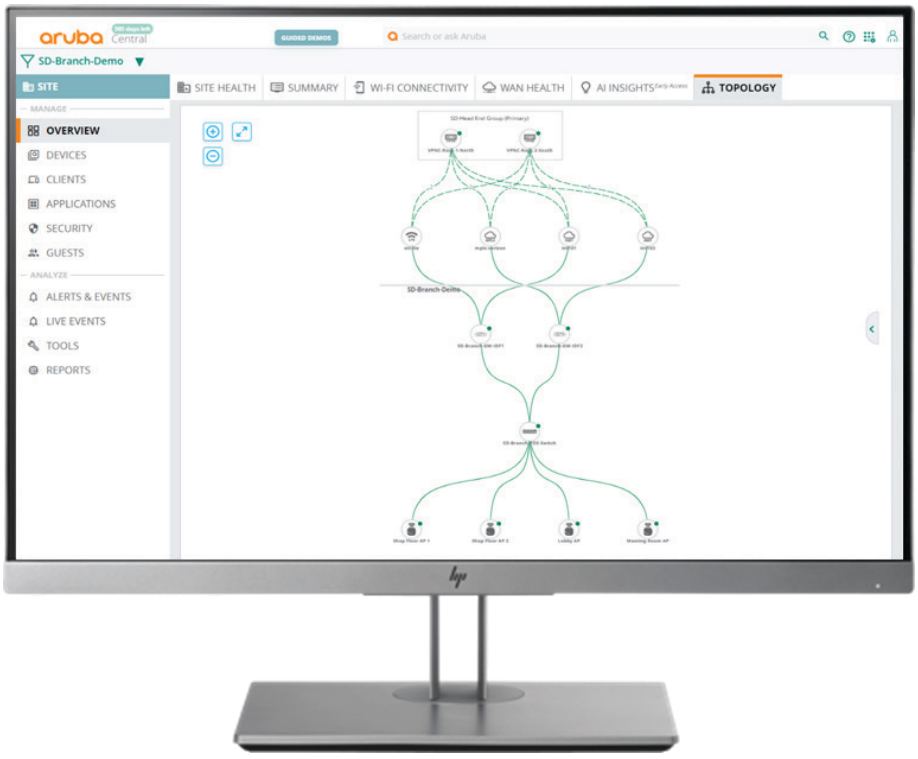
- Combines SD-WAN, wireless, and wired infrastructure with cloud-based orchestration
- Provides location-independent network access to improve employee and guest productivity
- Simplifies setup with zero-touch provisioning and plug-and-play branch deployment
- Provides wireless connectivity to hard-to-wire locations, eliminating the need for costly construction
- Simplifies configuring, managing, and operating, by using cloud-based controls

Simple, repeatable designs are easier to deploy, manage, and maintain. This design shows recommended deployment options and general guidance for which options to use.

ARUBA CENTRAL

Aruba Central is a cloud-based platform that enables you to configure, manage and monitor your Aruba SD-Branch network. Designed as a software-as-a-service subscription-based set of applications, Central provides a standard web-based interface that allows you to work on your network from anywhere. The hierarchical configurations provide operational efficiency; the monitoring and alerting streamlines day-2 operations, and the historical data reporting helps with auditing and troubleshooting.

Note The content in the Deploying the SD-Branch section of this guide is based on Aruba Central version 2.5.1.

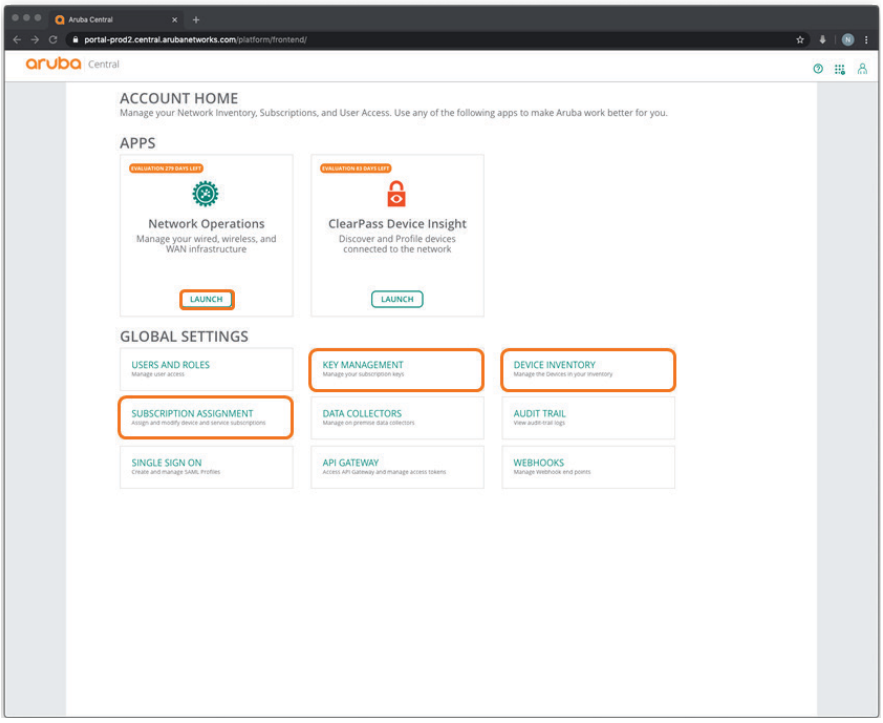


Aruba Central Account Home Page

The Aruba Central account home page provides access to the Network Operations application, which is a dashboard for configuration, monitoring, reporting, and troubleshooting.

The home page also provides access to global settings. In this guide, we use the following global setting areas:

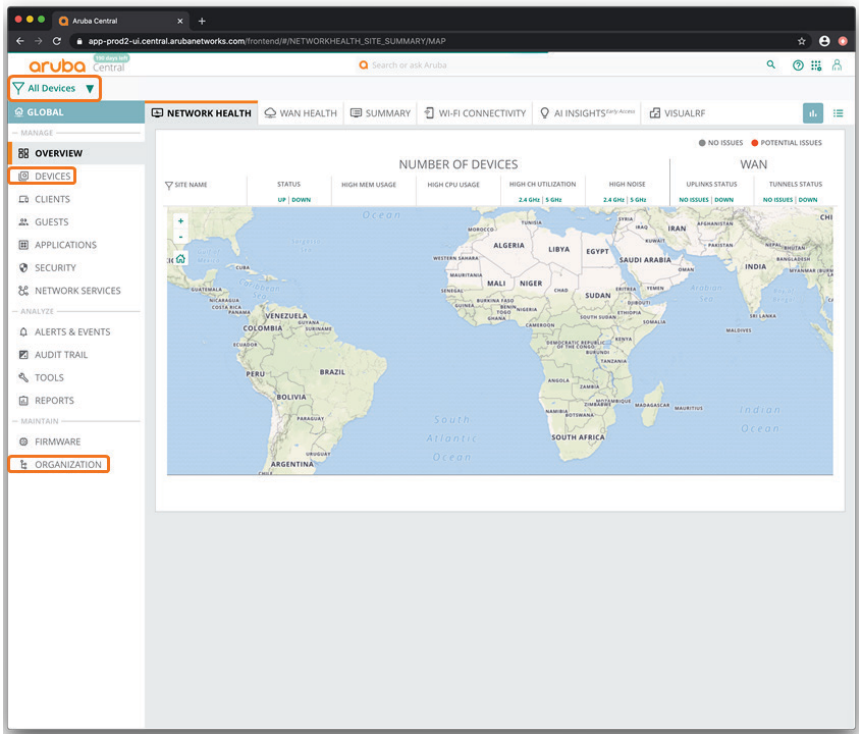
- Key Management
- Device Inventory
- Subscription Assignment



Aruba Central Network Operations App

The Aruba Central Network Operations app is the main application for configuring, monitoring, reporting, and troubleshooting your network. You use the navigation bar on the left to change the context of the main screen. In this guide, we focus on configuration and use the following areas:

- **Filter drop-down list**—Used to select the devices, groups, sites, or labels that you need to configure or monitor.
- **Devices**—Used to manage and configure access points, switches, and gateways.
- **Organization**—Used to manage groups, sites, and labels.



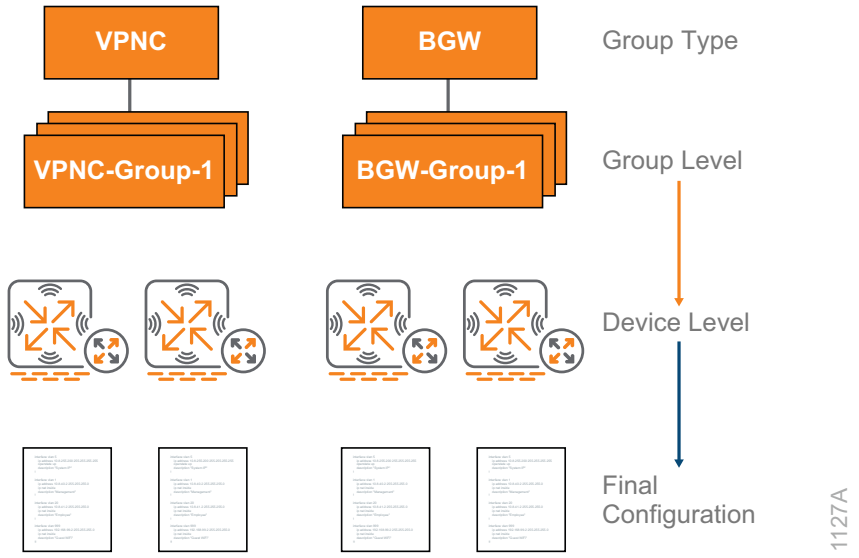
Groups are the parent level for a hierarchical network configuration. You use groups to apply common parameters to a group of devices.

Sites group all devices into a single location. You use sites to monitor devices, not to configure them.

Labels provide additional user-defined context for monitoring devices. You can assign a single device with up to five labels.

SD-BRANCH NETWORK CONFIGURATION OVERVIEW

Figure 27 SD-Branch network configuration



To configure the SD-Branch network, you need to:

1. Verify that all devices are listed in the inventory and have licenses assigned to them.

2. Plan how you want to organize the device groups. We recommend that you keep the number of groups to a minimum. While a single group can be used to combine gateway, switching, and wireless configurations, keeping them separated can provide more flexibility for the assignment of configurations to the devices.

3. Configure the sites, data center, and remote. Sites represent the physical locations where you have installed the equipment.

4. Configure the VPNC groups and devices. When you implement redundant data centers, use one group per data center.

5. Bring the VPNC devices online. You can perform one-touch provisioning by using a console or you can use the local GUI to download the device's final configuration from Central.

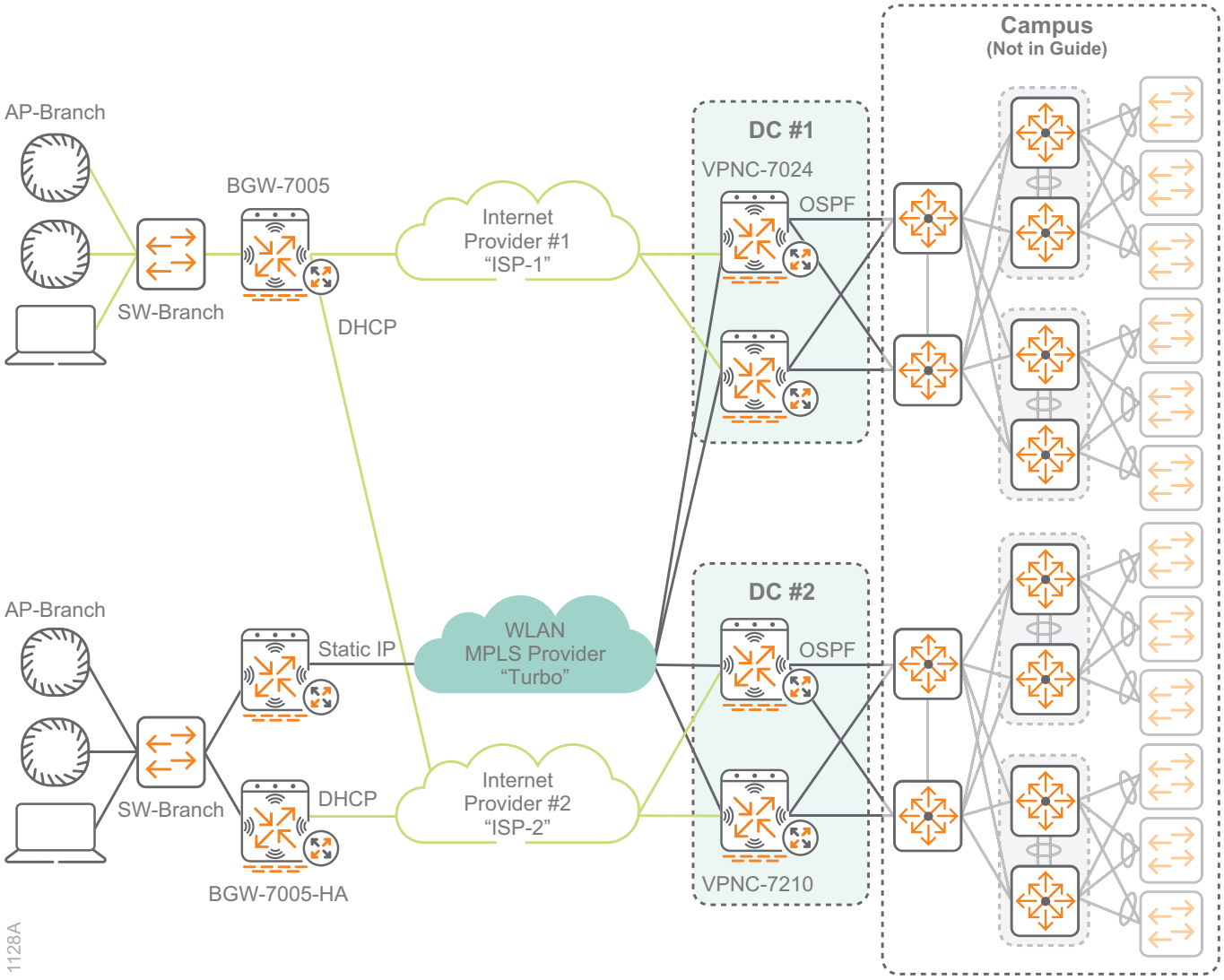
6. Configure the branch device groups. In this guide, we use separate groups for branch gateways, switches, and APs.

7. Assign devices to sites and groups. You can complete this step by using the Install Manager app at the installation site (not covered in this guide) or you can allow your Central admin to assign them before installing the equipment.

8. Configure the branch devices. All branch devices support zero-touch provisioning when you use DHCP-assigned IP addresses. If you use static IP addresses, you can implement one-touch provision by using the GUI or you can use CLI to get the device online and connected to Central.

> **Note** You must assign a group to a device prior to configuring the device.

Figure 28 SD-Branch network deployment examples



Procedures

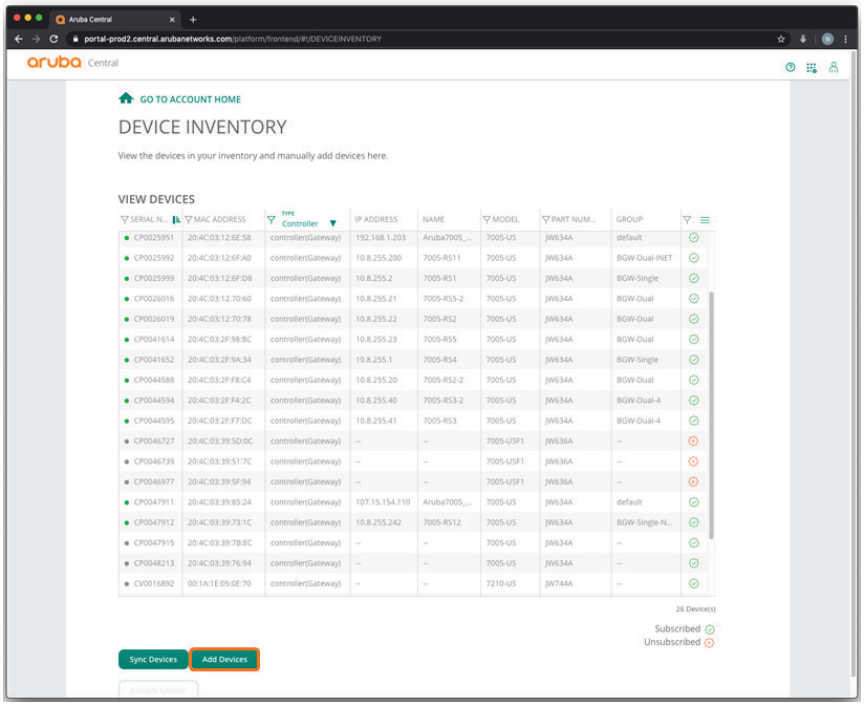
Preparing to Deploy the SD-Branch Network

We recommend that you complete the steps in this section prior to configuring the network devices.

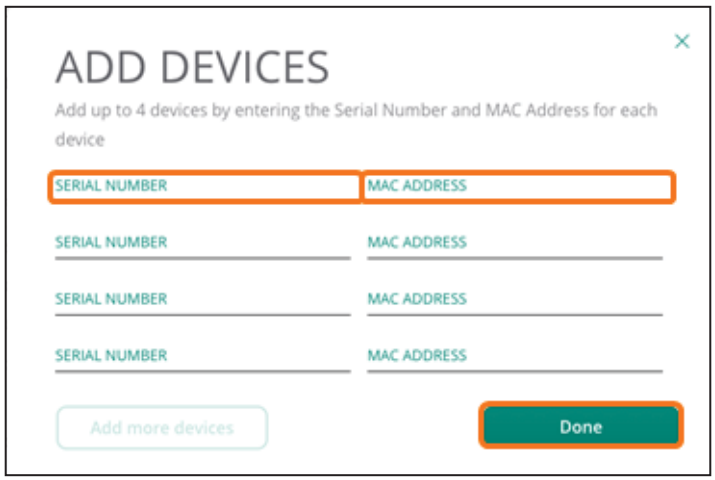
1.1 Add Your Devices to the Device Inventory Manually

Aruba Central automatically adds each device you purchase to the device inventory in your Central account. You also have the option of manually adding a device by using the MAC address and serial number of the device.

Step 1: On the Aruba Central Account Home page, select **Device Inventory**, and then click **Add Devices**.



Step 2: In the Add Devices dialog box, enter the serial number and MAC address for each device that you need to add to the device inventory list, and then click **Done**.



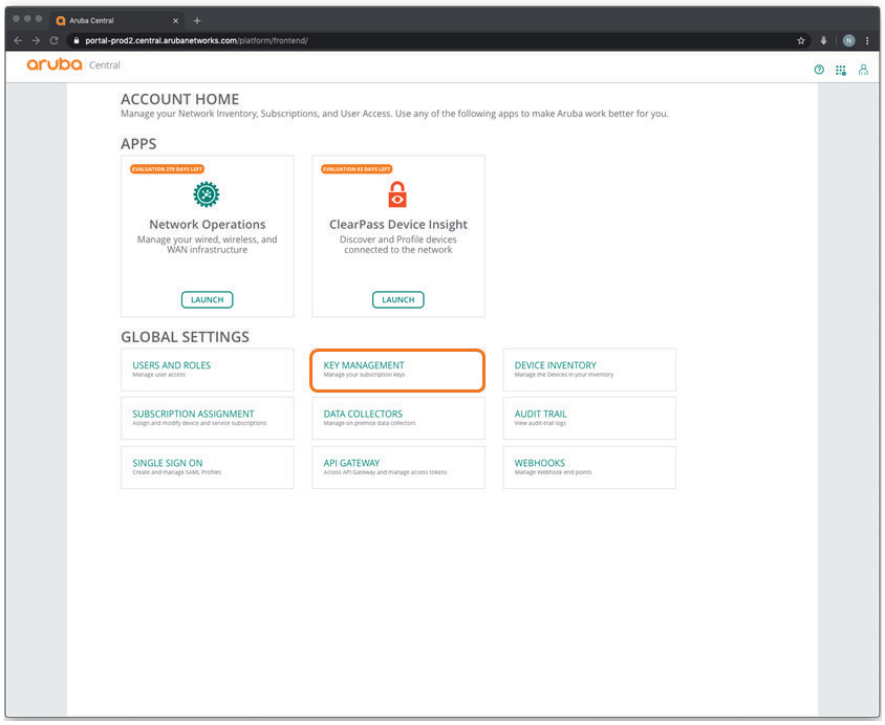
You can also use this page to assign new and offline devices to configuration groups.

1.2 Configure the Device Subscription Keys

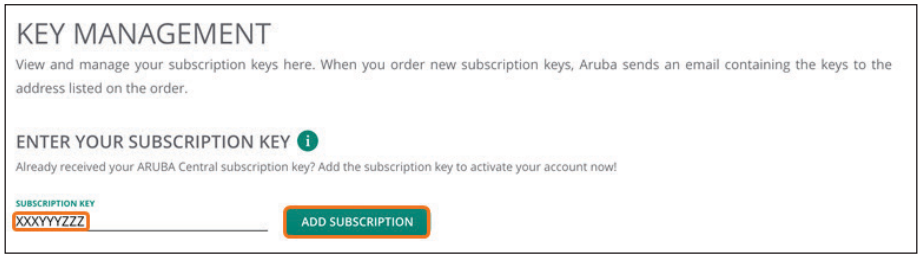
After you have added the devices to the inventory, you need to add subscription keys for the devices so you can configure and manage them in Aruba Central.

Aruba provides several subscription options. For more information, see the Aruba SD-WAN Ordering Guide.

Step 1: On the Aruba Central Account Home page, select **Key Management**.



Step 2: In the **Key Management** dialog box, enter your subscription key, and then click **Add Subscription**.



Note The Key Management page also displays the status and expiration dates for existing licenses.

1.3 Assign Subscriptions to the Devices Manually

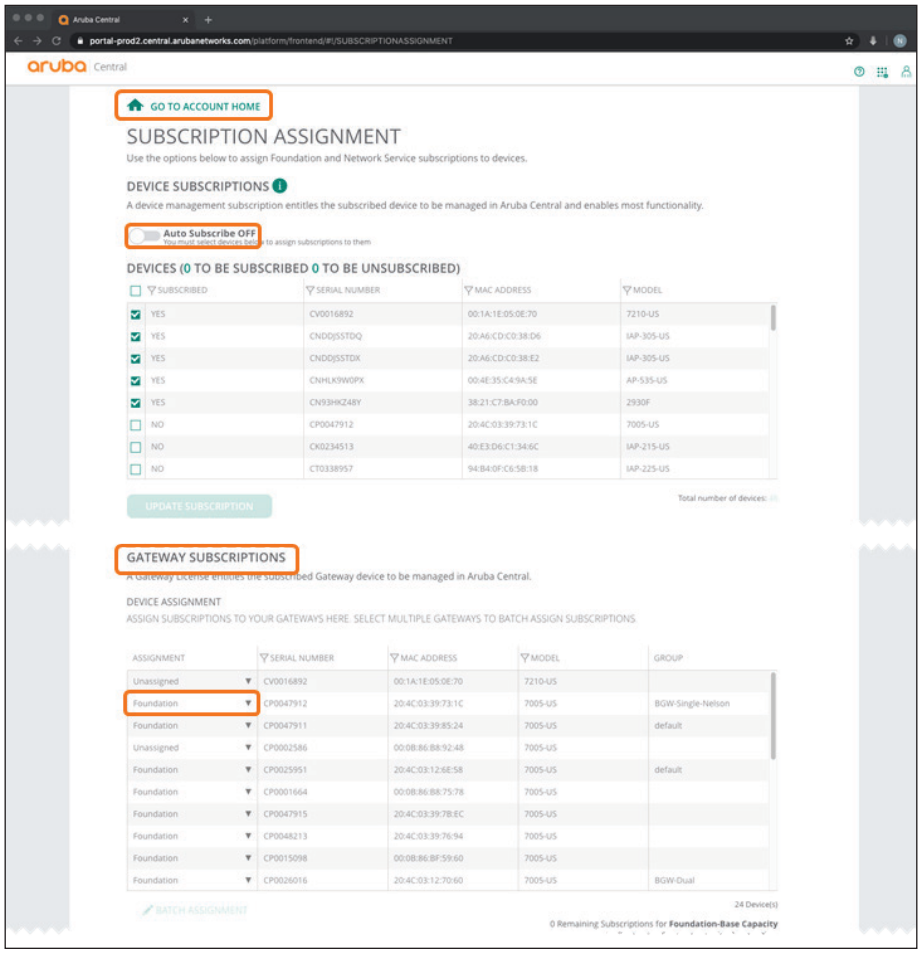
After adding your subscription keys, you must assign a subscription to each device for configuration and management. Central allows you to automatically assign device licenses by using the Auto Subscribe option.

Alternatively, you can manually assign subscription keys to gateways by using the following steps:

Step 1: On the Aruba Central Account Home page, select **Subscription Assignment**.

Step 2: In the Gateway Subscriptions section, select a gateway.

Step 3: In the Assignment column for the gateway, select a subscription from the drop-down list to assign it to the gateway.



Step 4: Click **Go To Account Home**.

1.4 Define the Device Sites

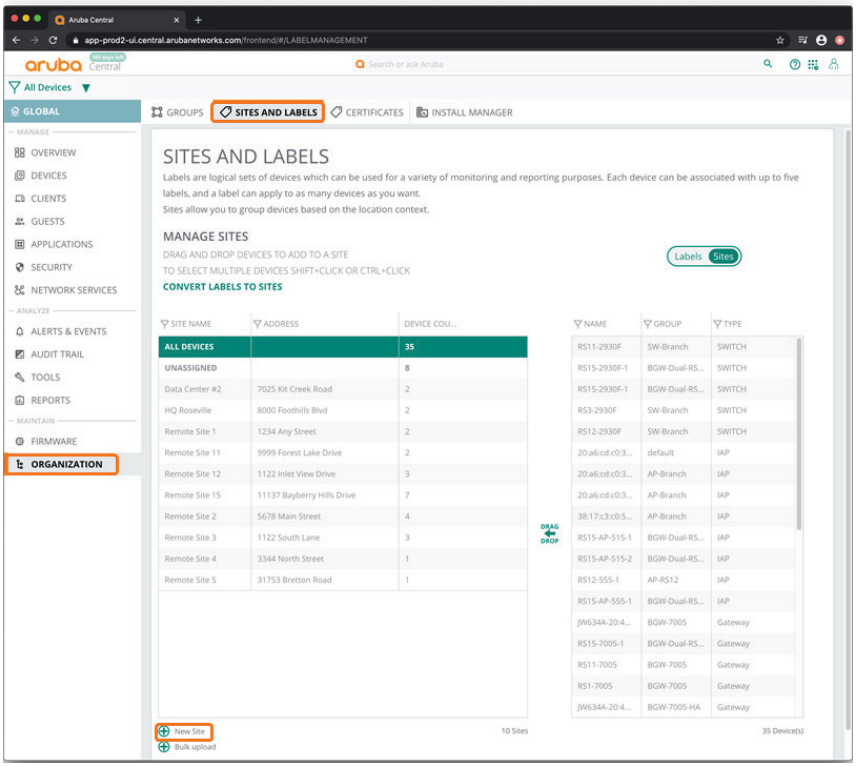
Aruba Central uses sites to organize devices by the geographical locations in which you install them.

Step 1: On the Aruba Central Account Home page, launch the **Network Operations** app.

Step 2: In the filter drop-down list, select **All Devices**.

Step 3: In the left navigation pane, in the Maintain section, select **Organization**.

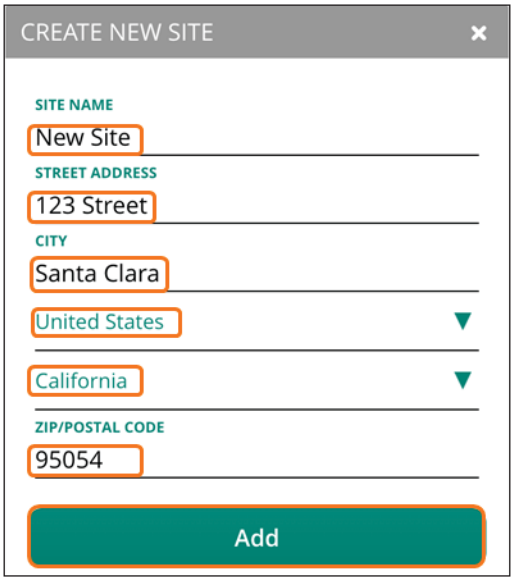
Step 4: On the Sites and Labels tab, click **New Site**.



Step 5: In the Create New Site dialog box, implement the following settings:

- Site Name—**New Site**
- Street Address—**123 Street**
- City—**Santa Clara**
- County—**United States**
- State or Province—**California**
- Zip/Postal Code—**95054**

Step 6: Click **Add**.



Procedures

Configuring the VPNC Group

Aruba Central uses a two-level hierarchy for configuration tasks. A device's final configuration is a combination of the group configuration along with the device-specific configuration. Aruba recommends that you create groups for devices that have similar deployment parameters and that you use groups for most device configuration. You configure device-specific configurations, like IP addresses and routing, at the VPNC device level. Aruba recommends that you fully configure the gateways at the group and device level before connecting to the network to prevent partial configurations from creating connectivity issues .

2.1 Create a New VPNC Group

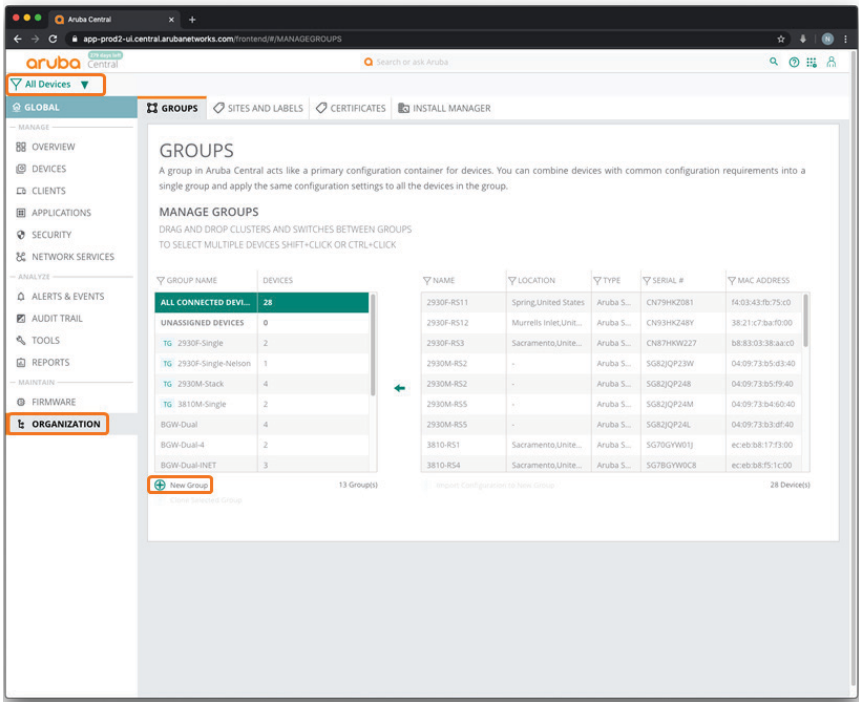
Use this procedure to create a group and assign it to the VPNC group type. Use one group per data center.

Step 1: On the Aruba Central Account Home page, launch the **Network Operations** app.

Step 2: In the filter drop-down list, select **All Devices**.

Step 3: In the left navigation pane, in the Maintain section, select **Organization**.

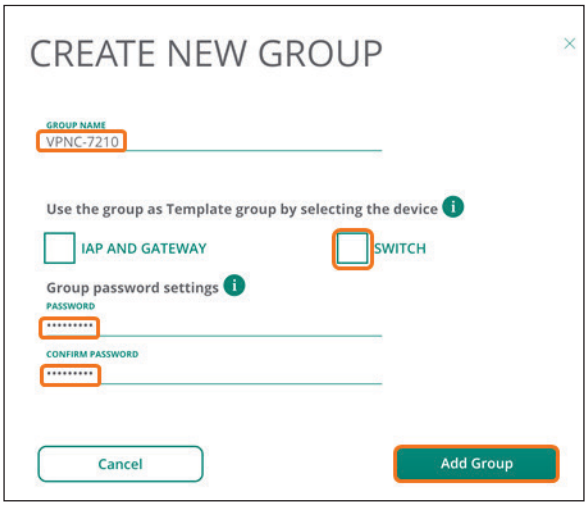
Step 4: On the Groups tab, click **New Group**.



Step 5: In the Create New Group dialog box, implement the following settings:

- **Group Name**—**VPNC-7210**
- **Switch**—Unselect
- **Password**—**password**
- **Confirm Password**—**password**

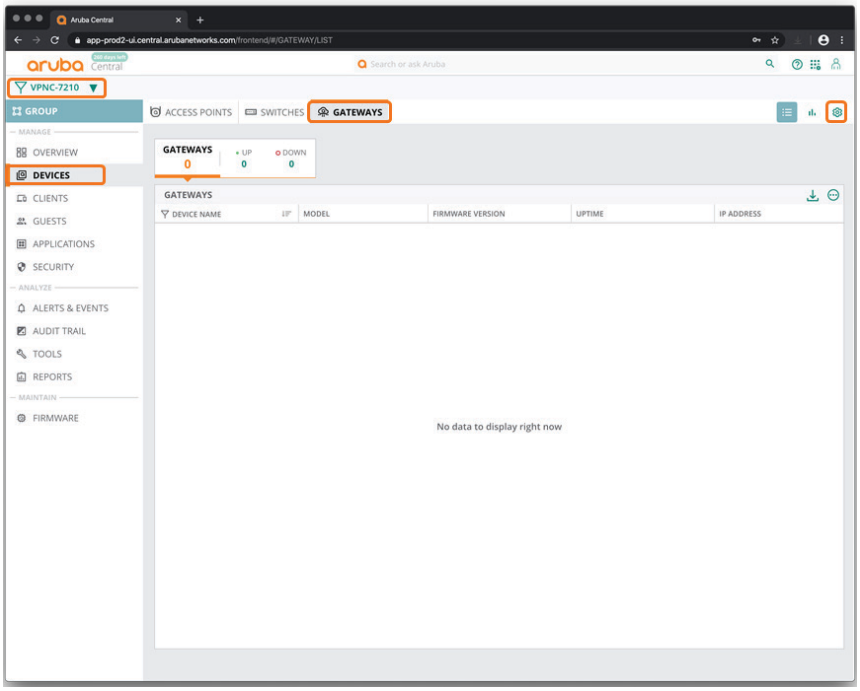
Step 6: Click **Add Group**.



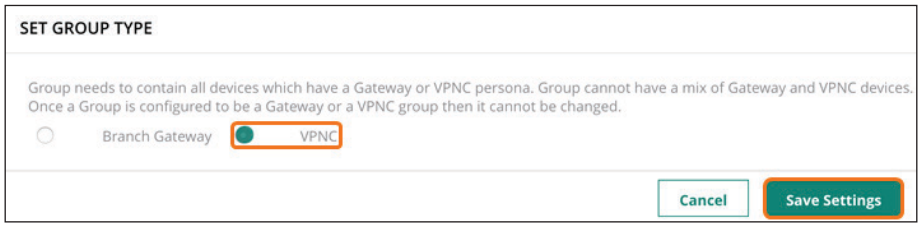
Step 7: In filter drop-down list, select the group you created in Step 5.

Step 8: In the left navigation pane, in the Manage section, select **Devices**.

Step 9: Select the **Gateways** tab, and then click the gear icon in the upper right corner.

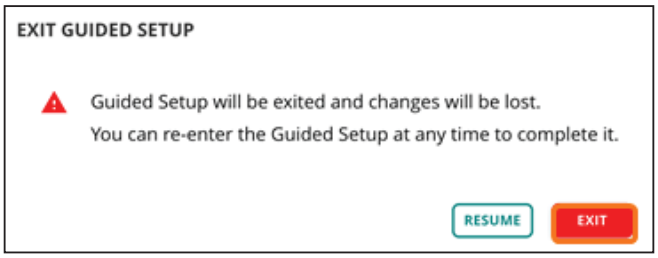


Step 10: In the Set Group Type dialog box, select **VPNC**, and then click **Save Settings**.



For educational purposes, the next step exits the guided setup.

Step 11: Click **Cancel**, and then click **Exit**.



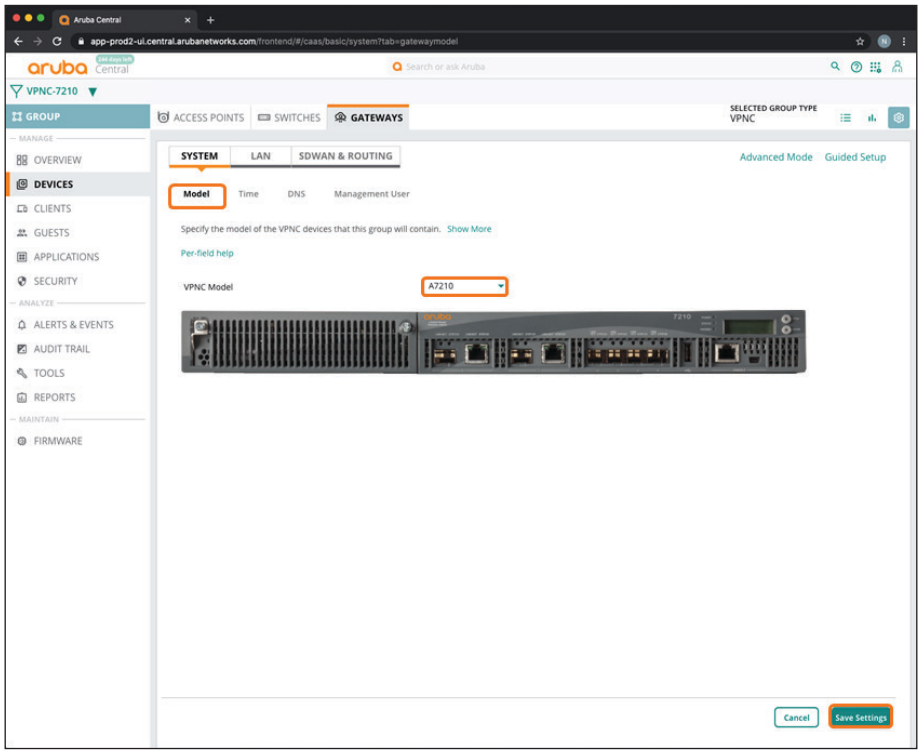
2.2 Select the Hardware Model of the VPNC Group

You can have only one VPNC gateway model per group.

Step 1: On the Gateways tab, in the System section, select **Model**.

Step 2: In the **VPNC Model** drop-down list, select the hardware model for the VPNC gateway group (example: **A7210**).

Step 3: Click **Save Settings**.

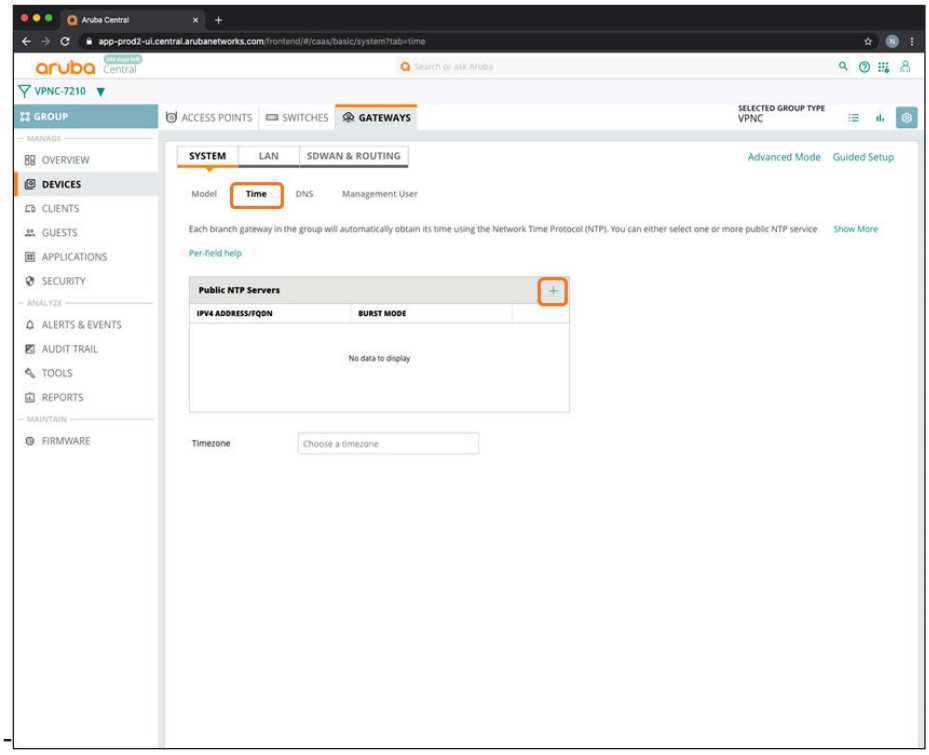


2.3 Set the VPNC Group System Time Parameters

Use this procedure to set the network time protocol (NTP) parameters and time zone to keep the VPNC clocks synchronized.

Step 1: On the Gateways tab, in the System section, select **Time**.

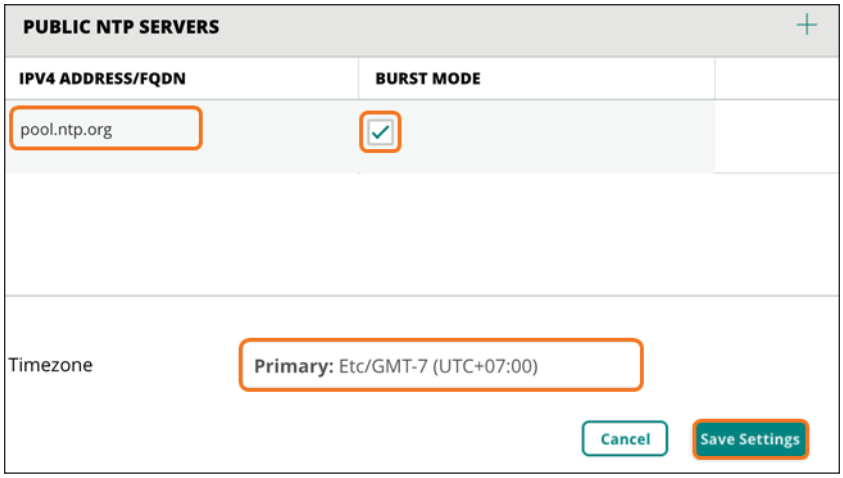
Step 2: In the **Public NTP Servers** table, click the plus (+) sign to add a public NTP server.



Step 3: In the **IPv4 Address/FQDN** column, enter pool.ntp.org or another NTP server address.

Step 4: Select **Burst Mode** if this feature is supported by the NTP server. Burst mode provides faster time synchronization.

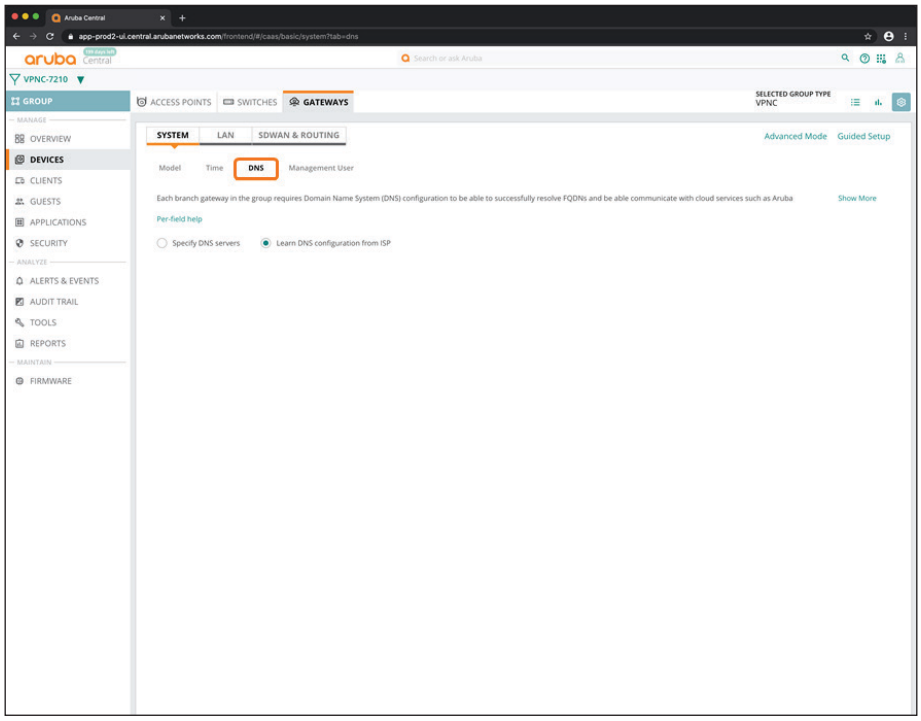
Step 5: In the **Timezone** drop-down list, choose your time zone, and then click **Save Settings**.



2.4 Select a DNS Server for the VPNC Gateway

You must specify the DNS server(s) that the VPNC gateway uses to communicate to Aruba Central.

Step 1: On the Gateways tab, in the System section, select **DNS**.



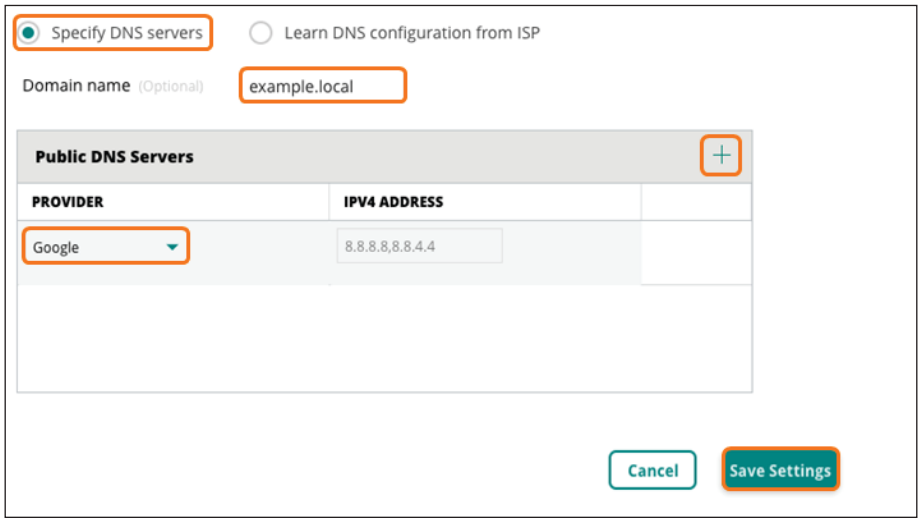
Step 2: Select **Specify DNS servers**.

Step 3: In the **Domain name** text box, enter a domain name (example: **example.local**).

Step 4: In the **Public DNS Servers** table, click the plus (+) sign to assign a public DNS server. For a virtual gateway VPNC, leave the default DNS provided by the cloud provider and go to Step 6.

Step 5: In the **Provider** drop-down list, pick one of the providers listed or select **Alternate DNS** if the desired server is not in the list.

Step 6: Click **Save Settings**.

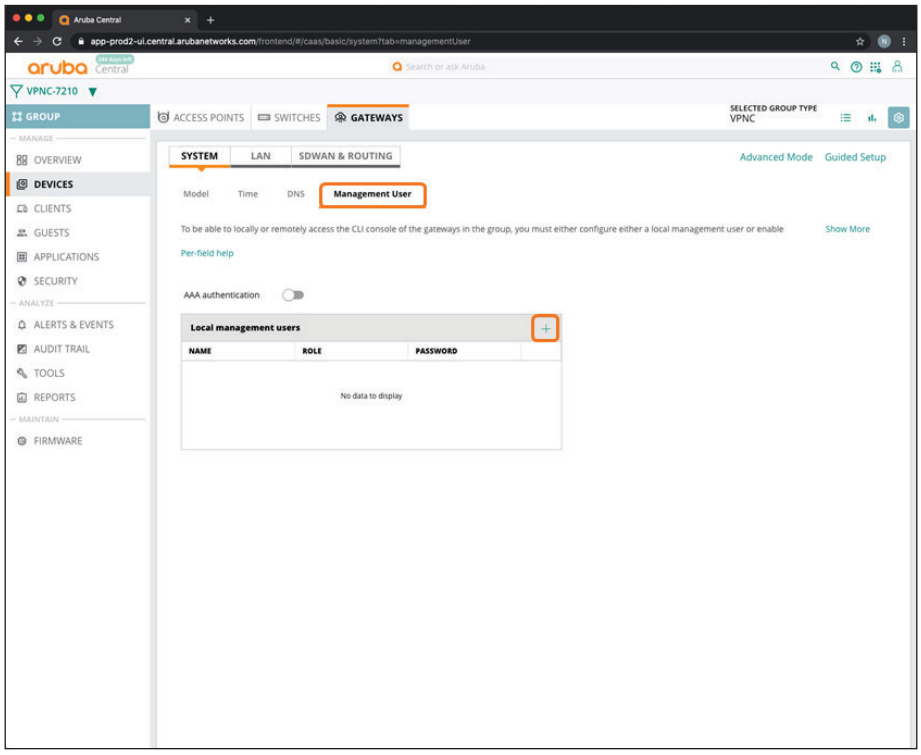


2.5 Create a Management User Account

You must have a management user account to use CLI to access the gateways.

Step 1: On the Gateways tab, in the System section, select **Management User**.

Step 2: In the **Local management users** table, click the plus (+) sign.



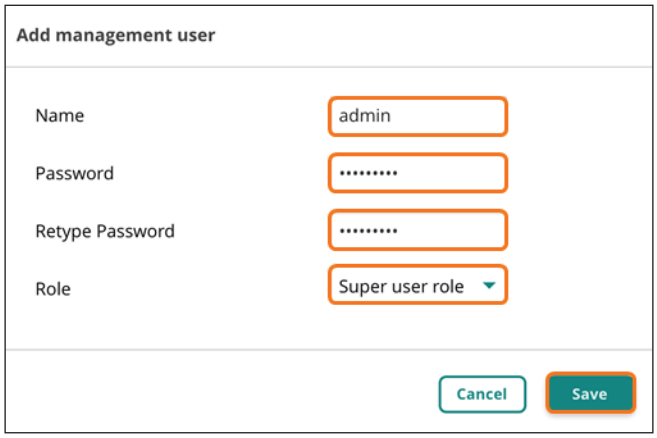
Step 3: In the Add Management User table, implement the following settings:

- Name—**admin**
- Password—**password**
- Retype Password—**password**

Step 4: **Role—Super user role**

Step 5: Click **Save**.

> **Note** You can add additional users with other roles as needed. These additional users are optional.

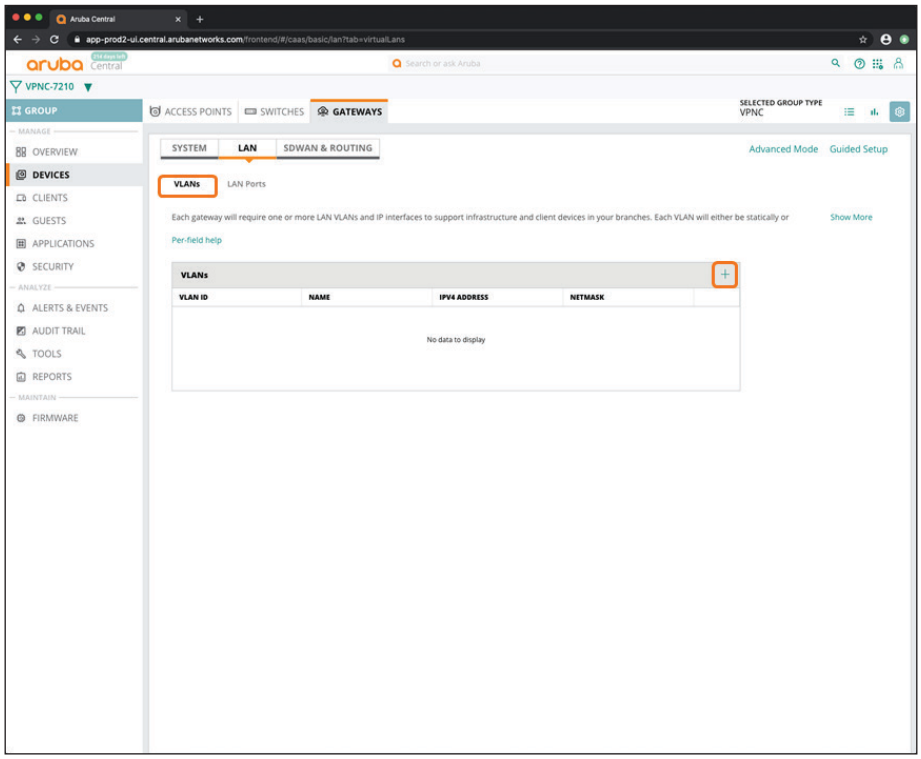


Step 6: Click **Save Settings**.

2.6 Create VLANs for Each Ethernet Port

Step 1: On the Gateways tab, in the LAN section, select **VLANs**.

Step 2: In the **VLANs** table, click the plus (+) sign.

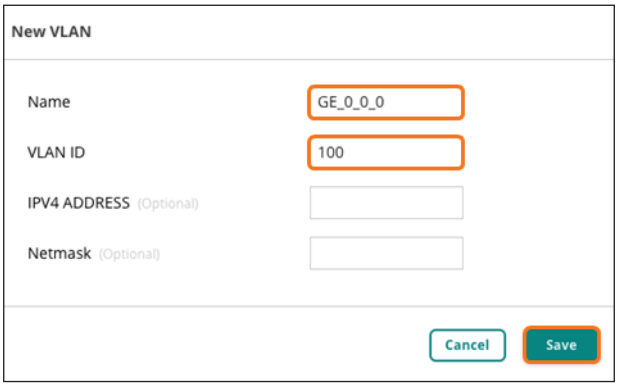


Step 3: In the New VLAN dialog box, implement the following settings:

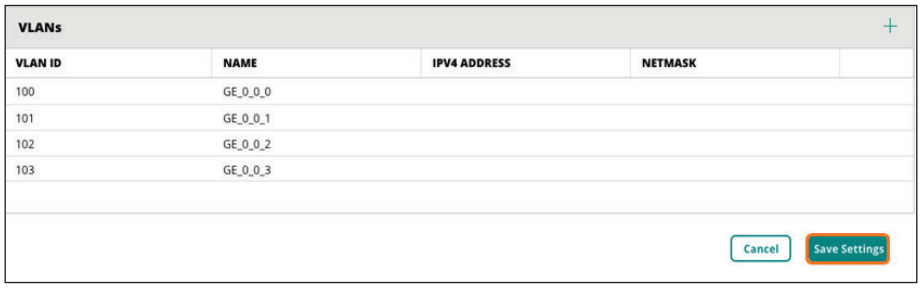
- Name—**GE_0_0_0**
- VLAN ID—**100**

Step 4: Click **Save**.

Step 5: Repeat Step 2 - Step 4 for each VPNC port you intend to use.



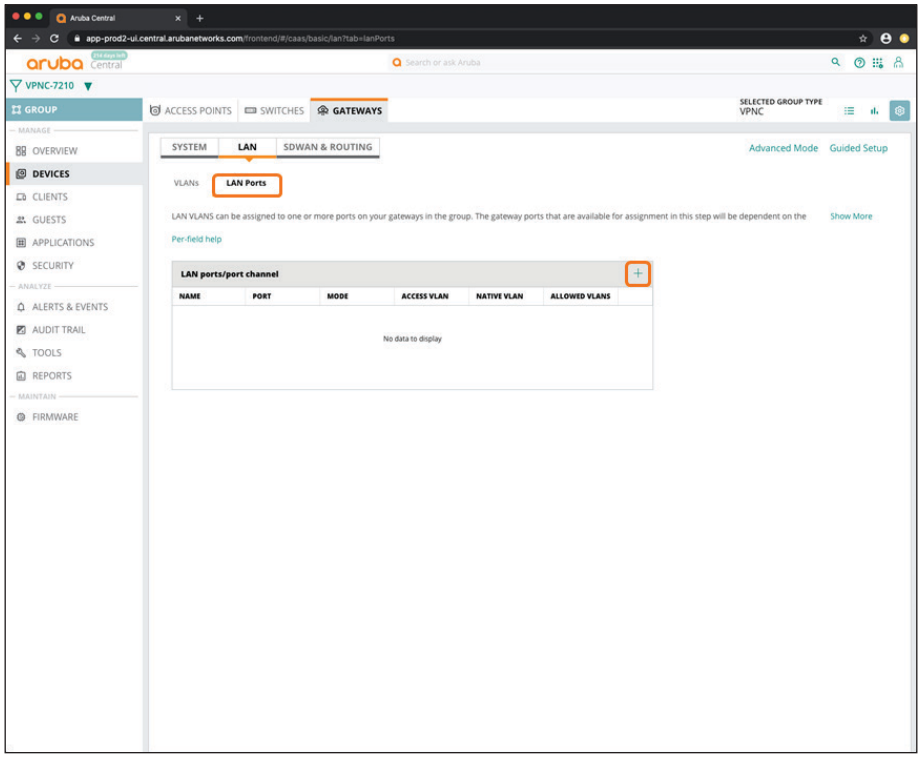
Step 6: Verify the VLAN information in the summary table, and then click **Save Settings**.



2.7 Assign the VLANs to the LAN Ports

Step 1: On the Gateways tab, in the LAN section, select **LAN Ports**.

Step 2: In the **LAN ports/port channel** table, click the plus (+) sign.

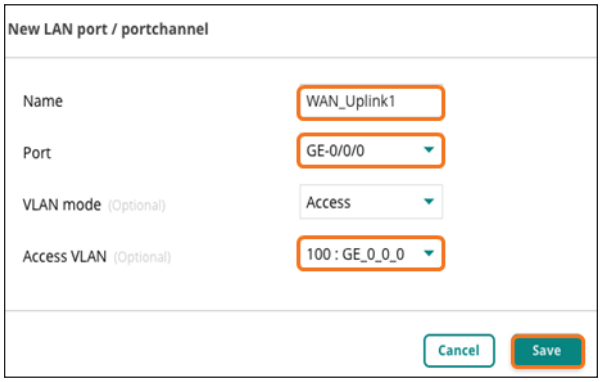


Step 3: In the New LAN port/port channel dialog box, implement the following settings:

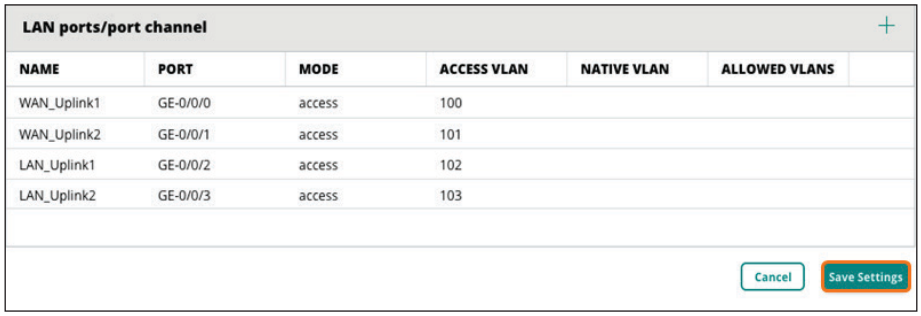
- Name—**WAN_Uplink1**
- Port—**GE-0/0/0**
- Access VLAN—**100:GE_0_0_0**

Step 4: Click **Save**.

Step 5: Repeat Step 2 - Step 4 for each VPNC port you intend to use.



Step 6: Verify the port information in the summary table, and then click **Save Settings**.

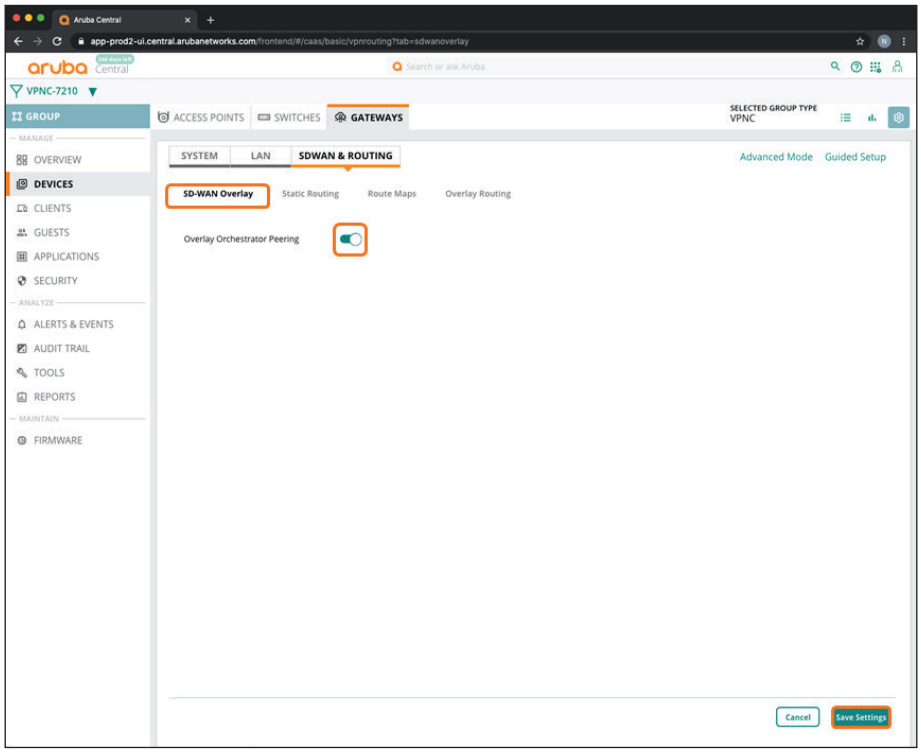


2.8 Enable Tunnel Orchestrator Peering

In this procedure, you enable SD-WAN overlay orchestrator peering to automate tunnel establishment.

Step 1: On the Gateways tab, in the SDWAN & Routing section, select **SD-WAN Overlay**.

Step 2: Click **Overlay Orchestrator Peering**, and then click **Save Settings**.



2.9 Create a New Route Map

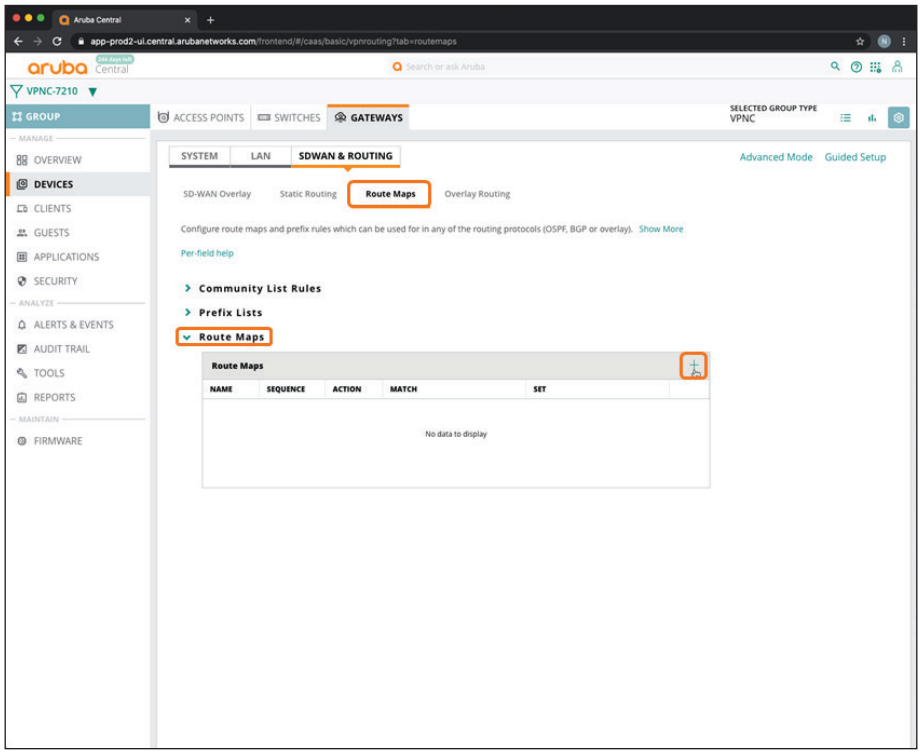
(Optional)

Use this procedure to create a route map. You can use this route map to control redistribution of specific overlay prefixes into OSPF.

Step 1: On the Gateways tab, in the SDWAN & Routing section, select **Route Maps**.

Step 2: On the Route Maps page, expand **Route Maps** to display the route maps table.

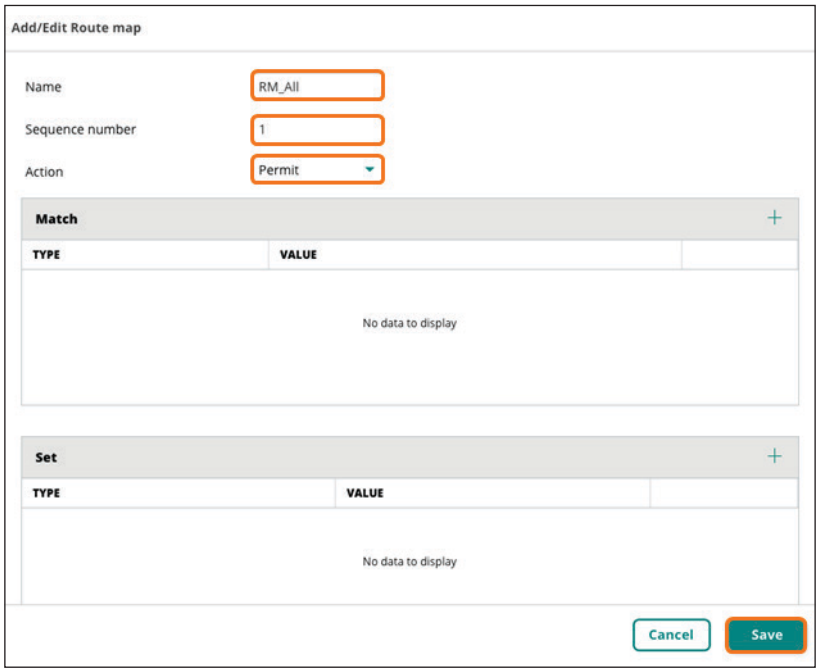
Step 3: In the **Route maps** table, click the plus (+) sign.



Step 4: In the Add/Edit Route map dialog box, implement the desired filters. This example permits all prefixes:

- Name—**RM_All**
- Sequence number—**1**
- Action—Permit

Step 5: Click **Save**.



2.10 Configure the Overlay Routing

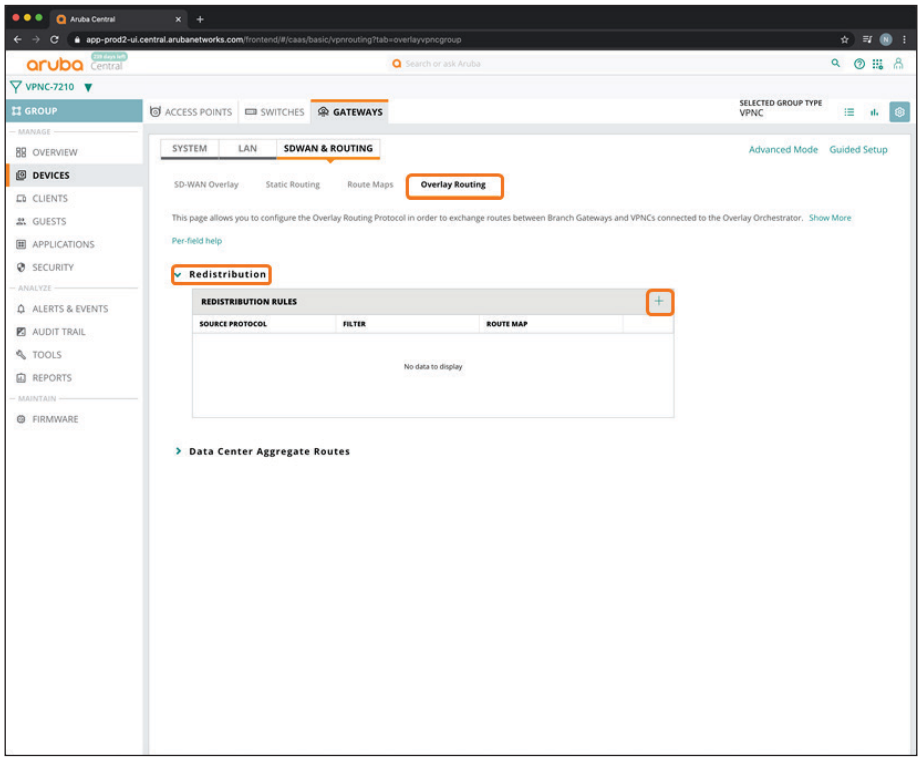
Use this procedure to redistribute OSPF routes into the overlay so that branches can reach corporate prefixes.

> **Note** Aruba SD-WAN automatically translates routing costs between the overlay and data center to ensure symmetry. For more information, see the Aruba SD-WAN Orchestrator tech note.

Step 1: On the Gateways tab, in the SDWAN & Routing section, select **Overlay Routing**.

Step 2: On the Overlay Routing page, expand **Redistribution** to display the redistribution table.

Step 3: In the **Redistribution** table, click the plus (+) sign to create a new redistribution rule.

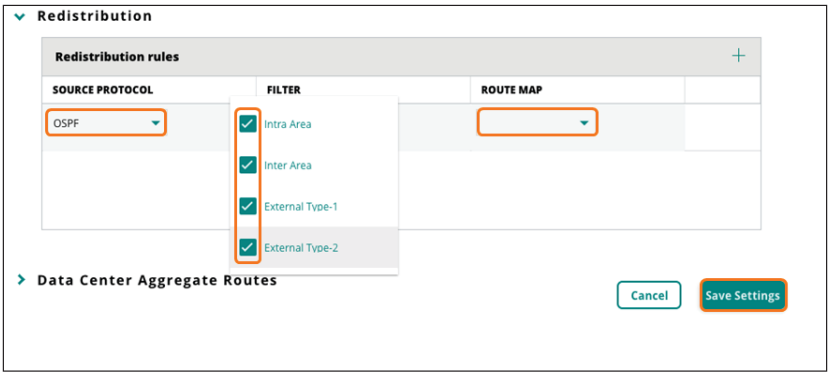


Step 4: In the Source Protocol drop-down list, select **OSPF**. Static, connected, and BGP routes are also supported but not shown in this example.

Step 5: In the Filter drop-down list, select **Intra Area**, **Inter Area**, **External Type-1**, and **External Type 2** if all types of OSPF routes need to be redistributed.

Step 6: In the Route Map drop-down list, select the new route-map you created in Procedure 2.9 (Example: **RM_All**).

Step 7: Click **Save Settings**.

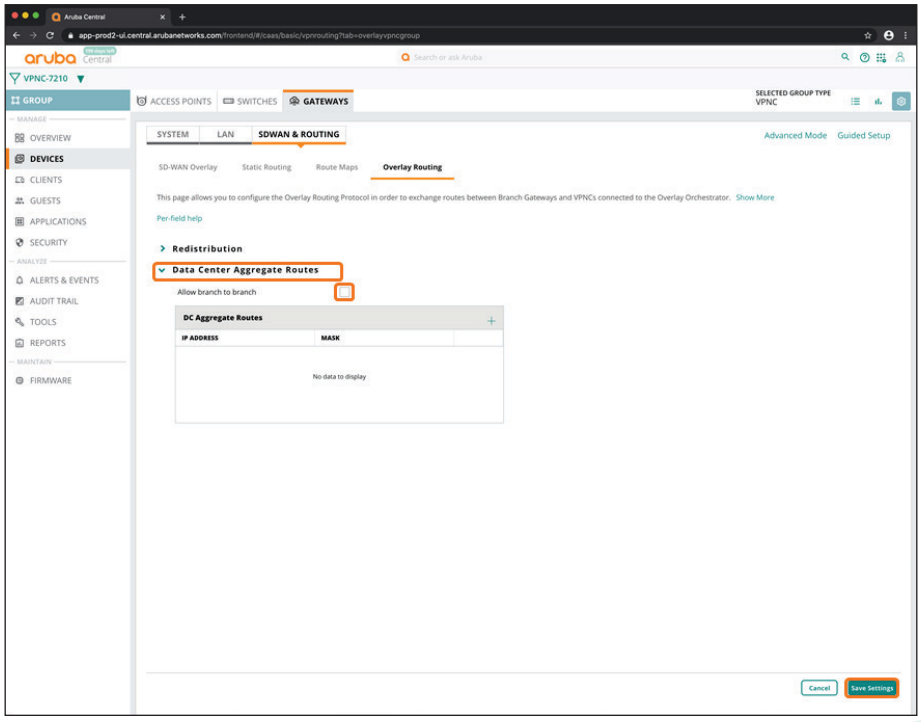


Step 8: On the Gateways tab, in the **SDWAN & Routing** section, select **Overlay Routing**.

Step 9: On the Overlay Routing page, expand **Data Center Aggregate Routes** to display the DC Aggregate Routes table.

Step 10: Unselect **Allow branch to branch**. Clear this option to send only the data center summary route and not send specific prefixes from other branches.

> **Note** If the DC aggregate includes branch prefixes, branch-to-branch will communicate over the VPNC hub.

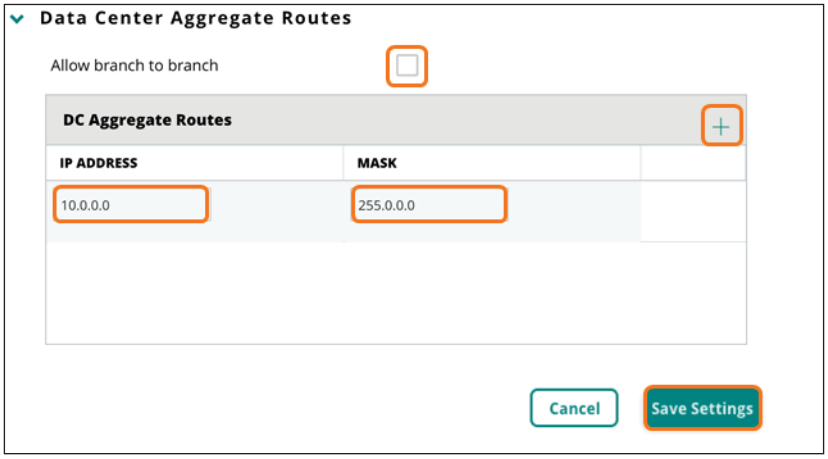


Step 11: In the **DC Aggregate Routes** table, click the plus (+) sign to create a new aggregate route. We use 10.0.0.0/8 in this example to represent corporate prefixes.

Step 12: In the **IP Address** column, enter **10.0.0.0**, and then in the **Mask** column, enter **255.0.0.0**.

Step 13: Click **Save Settings**.

The example in the screenshot below aggregates all OSPF routes into the overlay by using a single 10.0.0.0/8 prefix.



Procedures

Configuring the VPNC Devices

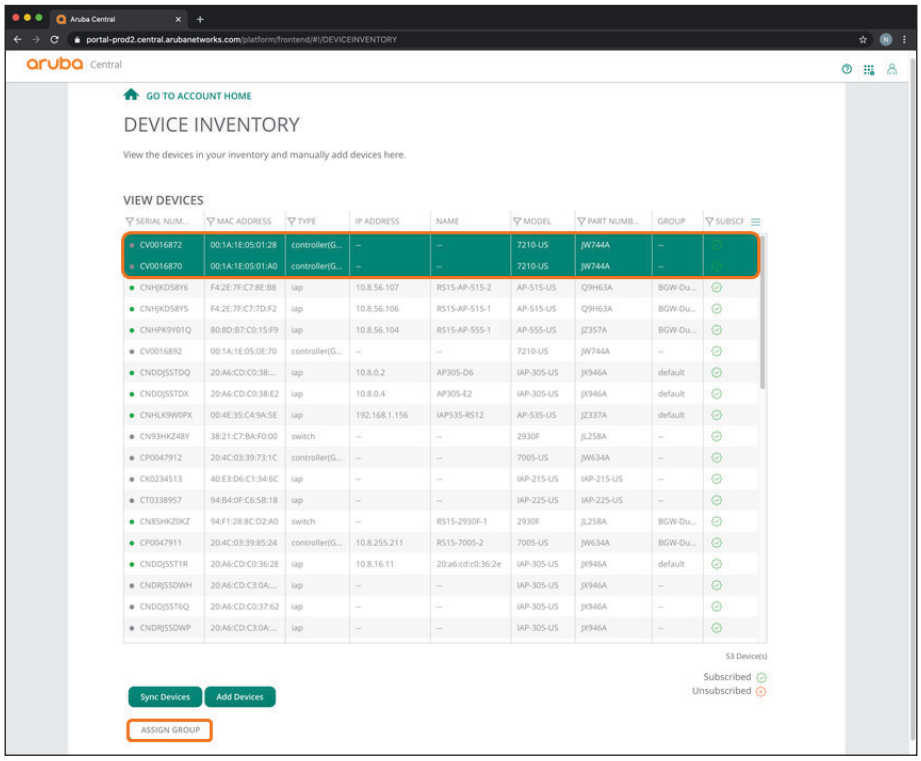
Repeat this set of procedures for each VPNC.

3.1 Assign a VPNC Device to a Group

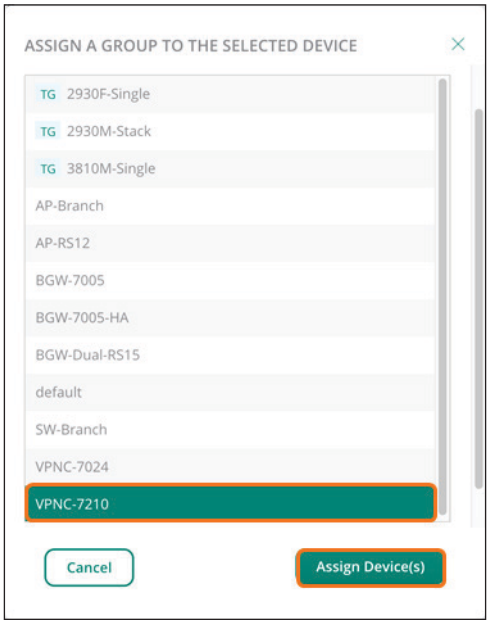
In this procedure, you assign the VPNC device(s) to a group. Use one VPNC group per data center.

Step 1: On Aruba Central Account Home page, select **Device Inventory**.

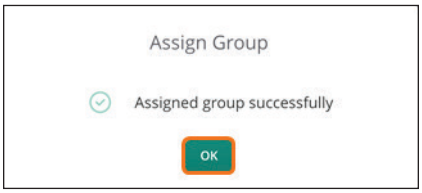
Step 2: In the View Devices table, select the VPNC gateways, and then click **Assign Group**.



Step 3: In the **Assign a Group to the Select Device** dialog box, select one of the VPNC groups you created in Procedure 2.1 (example: **VPNC-7210**).

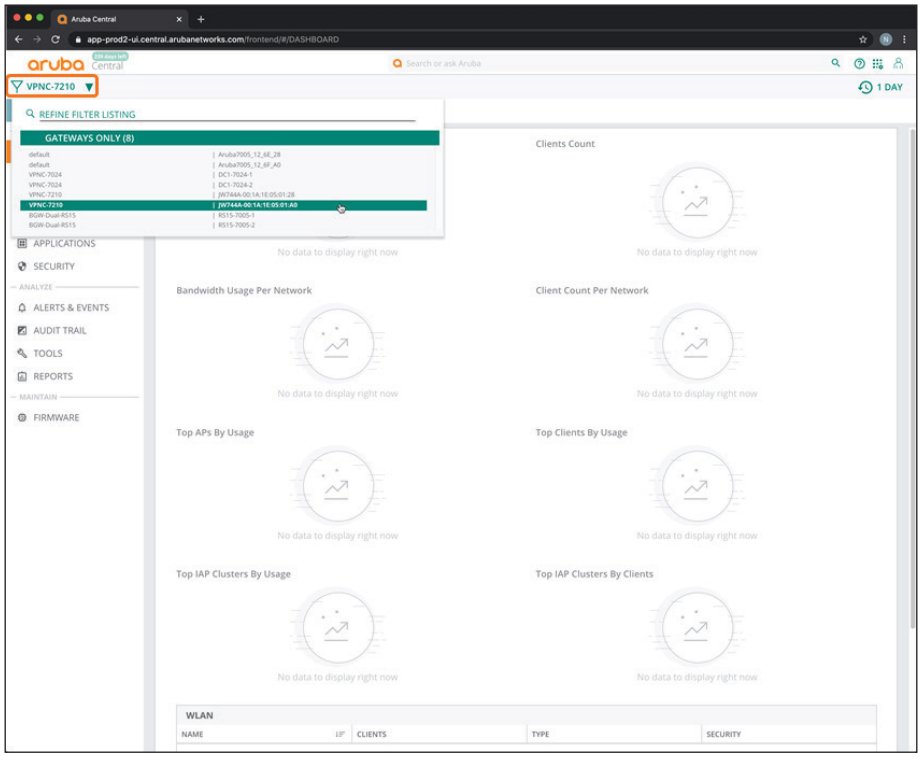


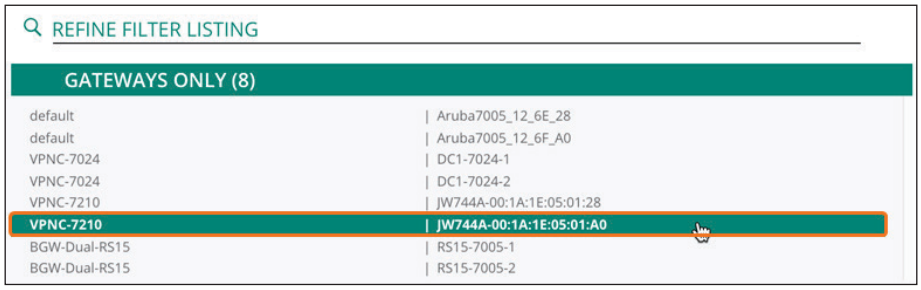
Step 4: Click **Assign device(s)**, and then click **OK**.



3.2 Initiate the VPNC Device Configuration

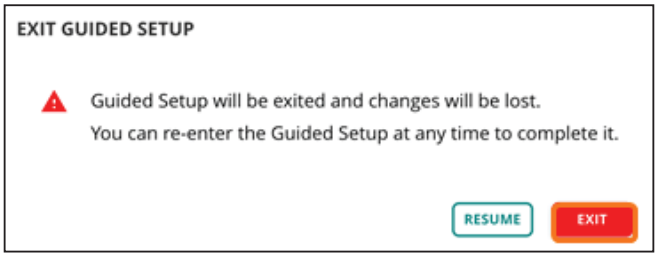
Step 1: In the filter drop-down list, select the gateway that you want to configure.





For educational purposes, the next step exits the guided setup.

Step 2: In the guided setup dialog box, click **Cancel**, and then click **EXIT**.



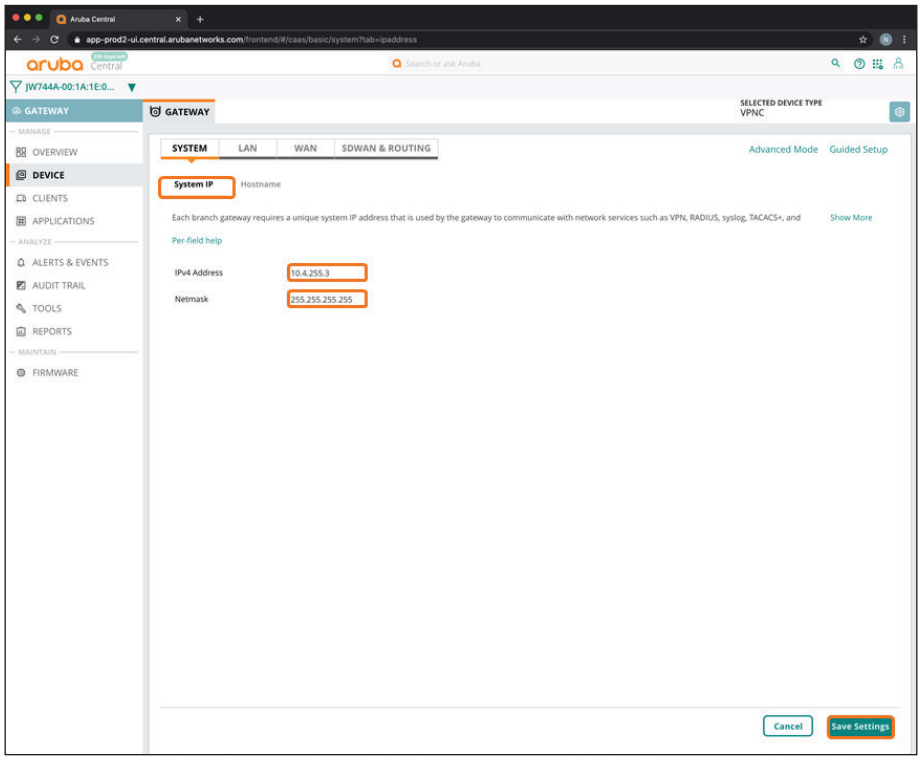
3.3 Configure the IP Address for the VPNC Device

Use this procedure to define the system IP address that the gateway will use for network services.

Step 1: On the Gateway Tab, in the SYSTEM section, select **System IP**.

Step 2: In the **IPV4 Address** box, enter the system IP address (example: **10.4.255.3**), and then in the **Netmask** box, enter **255.255.255.255**.

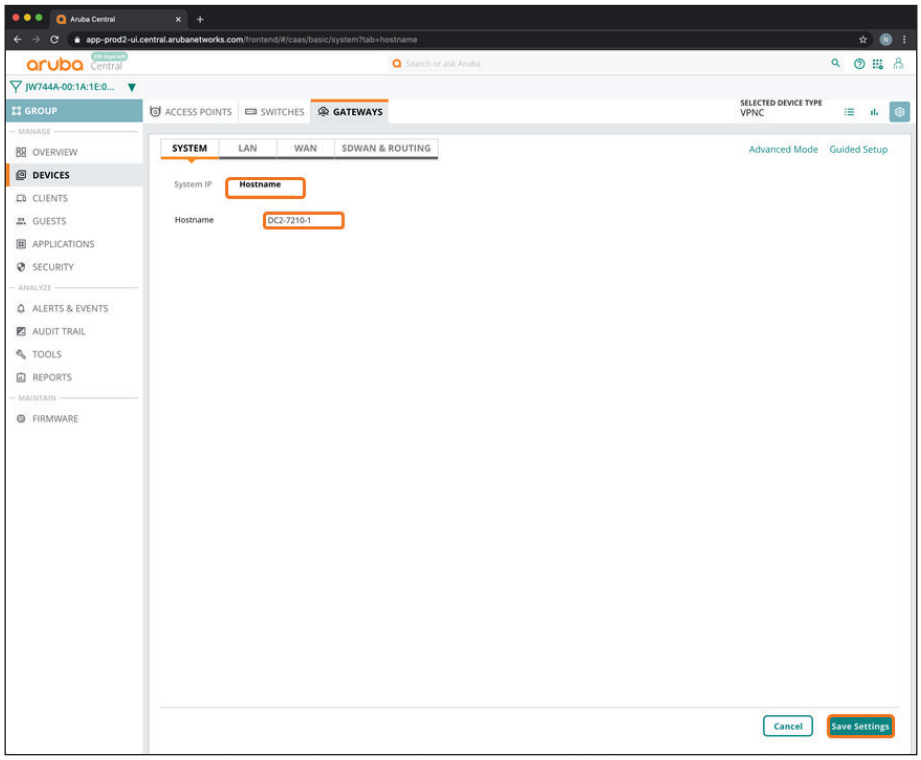
Step 3: Click **Save Settings**.



3.4 Assign a Hostname to the VPNC Device

Step 1: On the Gateways tab, in the **SYSTEM** section, select **Hostname**.

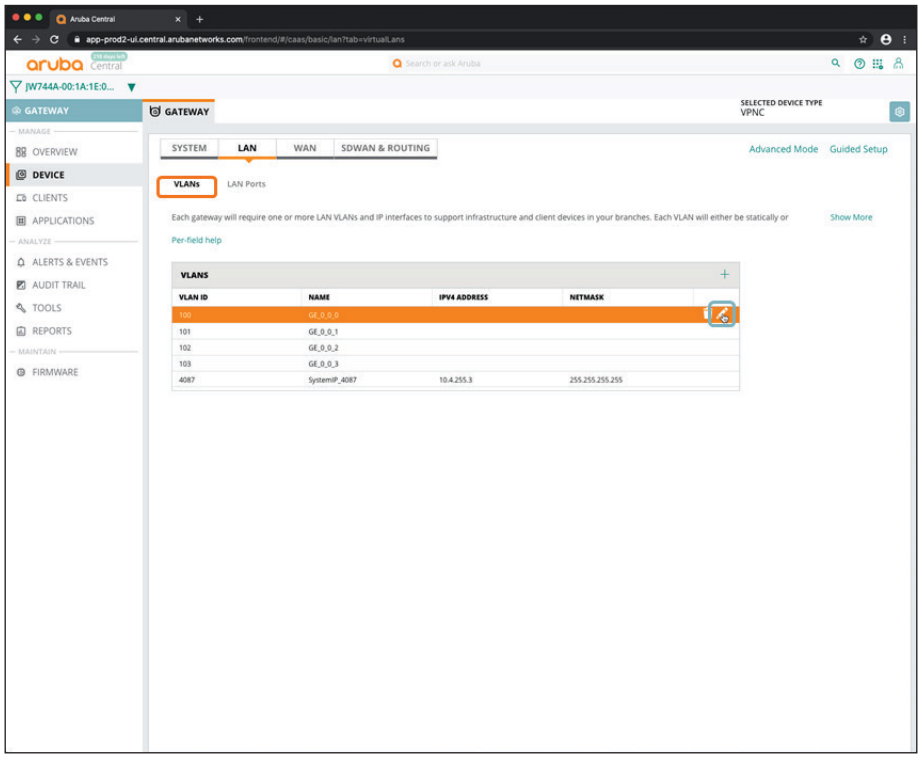
Step 2: In the **Hostname** box, enter a name (example: **DC2-7210-1**), and then click **Save Settings**.



3.5 Assign IP Addresses to the VLANs

Step 1: On the Gateway tab, in the LAN section, select **VLANs**.

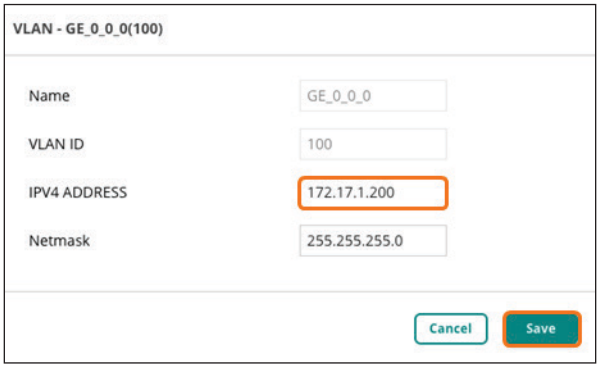
Step 2: In the **VLANs** table, select the VLAN you want to update, and then click the pencil icon.



Step 3: In the VLAN dialog box, implement the following settings:

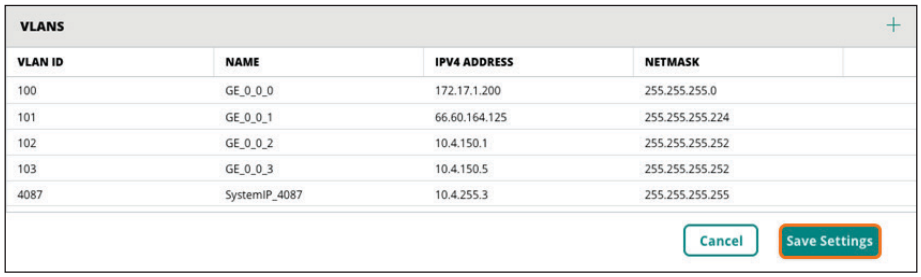
- **IPv4 Address—172.17.1.200**
- **Netmask—255.255.255.0**

Step 4: Click **Save**.



Step 5: Repeat Step 2 - Step 4 for each additional LAN uplink VLANs.

Step 6: In the VLANs table, verify your changes, and then click **Save Settings**.

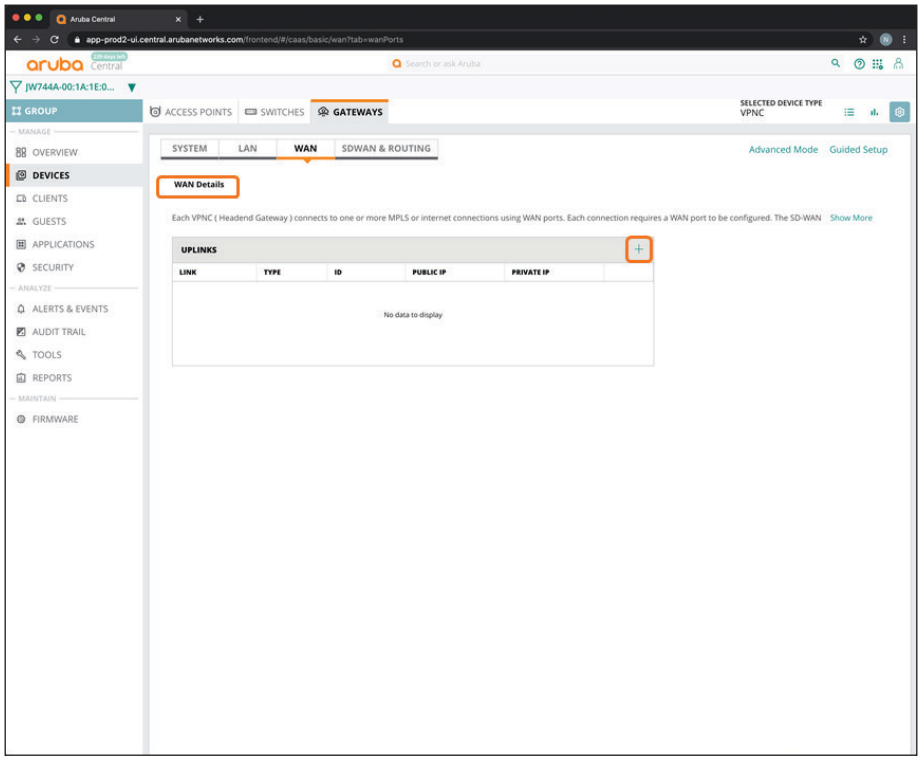


3.6 Configure the WAN Providers

In this procedure, you configure the WAN uplinks (providers) and map them to the VLANs.

Step 1: On the Gateways tab, in the **WAN** section, select **WAN Details**.

Step 2: In the **Uplinks** table, click the plus (+) sign.

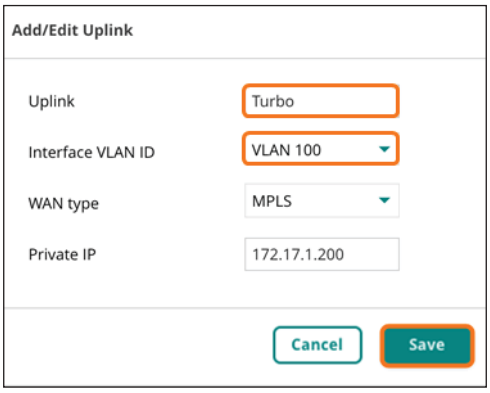


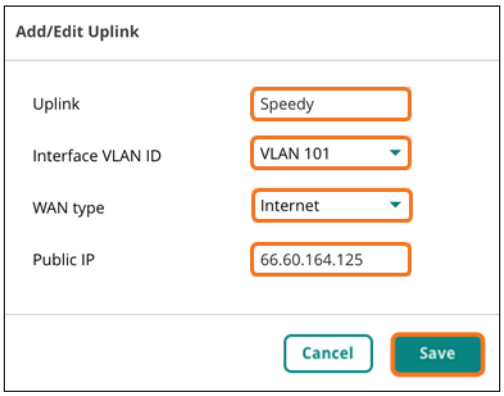
Step 3: In the Add/Edit Uplink dialog box, implement the following settings:

- Uplink Name—**Turbo**
- Interface VLAN ID—**VLAN 100**
- WAN type—**MPLS** or **Internet**

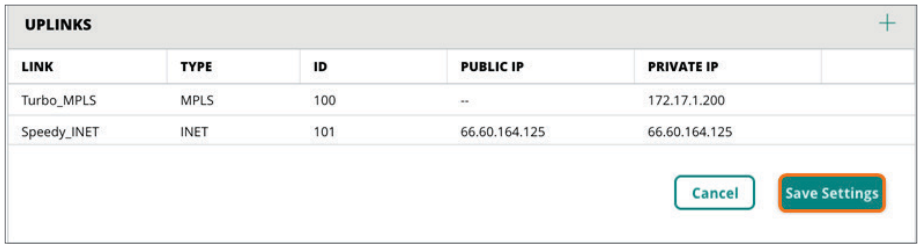
> **Note** If you set **WAN type** to **Internet**, you must enter a public IP address to enable 1:1 NAT translation at the internet firewall. If you set **WAN type** to **MPLS**, the uplink name must match the MPLS providers on the branch gateways to enable automated tunnel orchestration between gateways.

Step 4: Click **Save**.





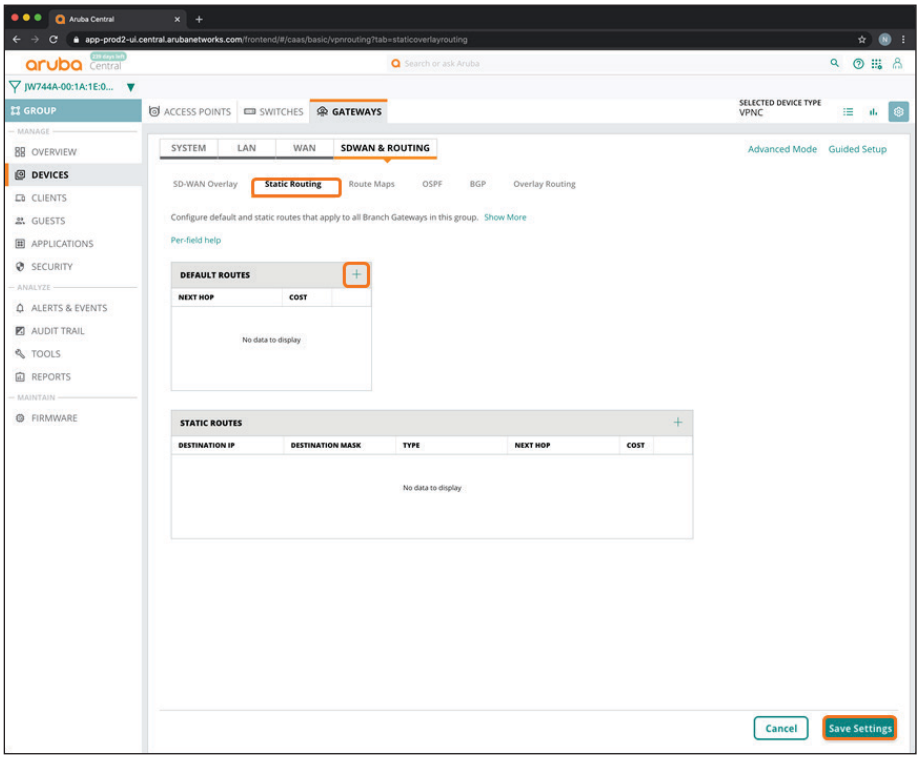
Step 5: In the Uplinks table, review your changes, and then click **Save Settings**.



3.7 Configure the Default Route to the Internet

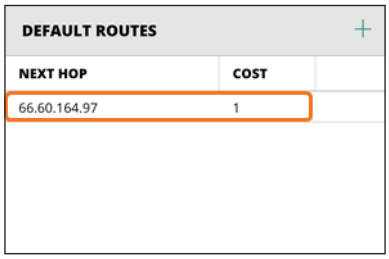
Step 1: On the Gateways tab, in the SDWAN & Routing section, select **Static Routing**.

Step 2: In the **Default Routes** table, click the plus (+) sign to add a default route toward the internet provider.



Step 3: In **Next Hop** column, enter the default gateway (example: **66.60.164.97**).

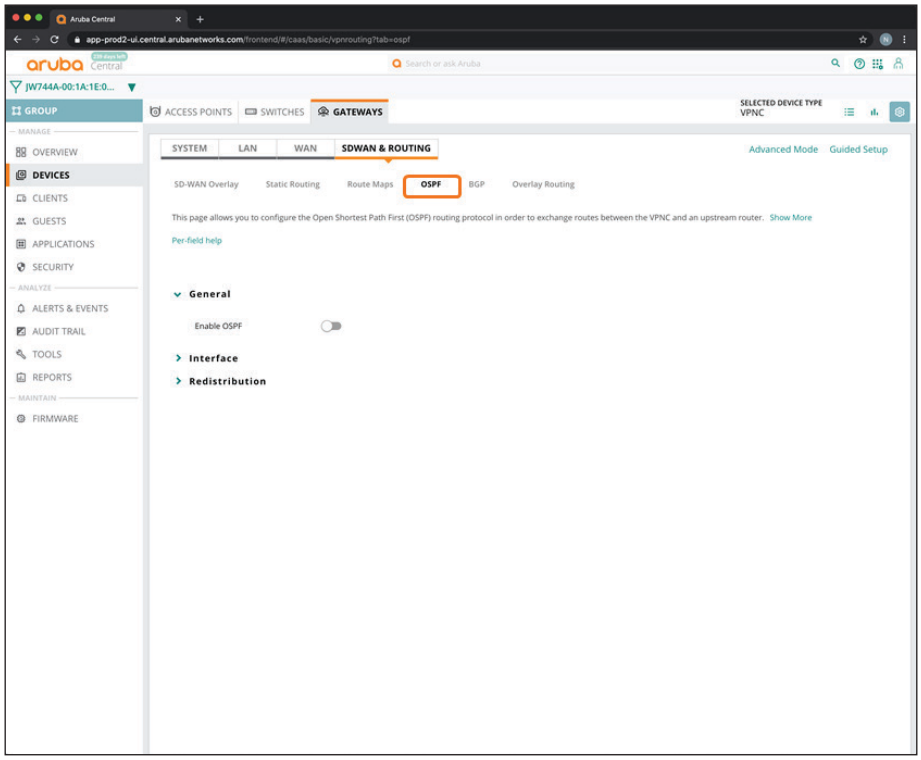
Step 4: In the **Cost** column, enter **1**.



Step 5: Click **Save Settings**.

3.8 Configure OSPF Routing to the LAN

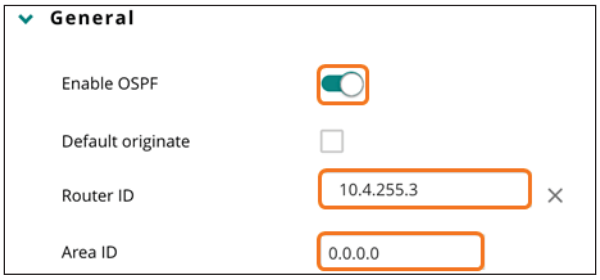
Step 1: On the Gateways tab, in the SDWAN & Routing section, select **OSPF**.



Step 2: Under General, click the **Enable OSPF** slider.

Step 3: In the **Router ID** box, select the System ID interface for OSPF Router ID (example: **10.4.255.3**).

Step 4: In the **Area ID** box, define the OSPF area (example: **0.0.0.0**).



Step 5: Click **Save Settings**.

Step 6: Repeat these steps, if necessary.

Step 7: On the OSPF page, expand **Interface**.

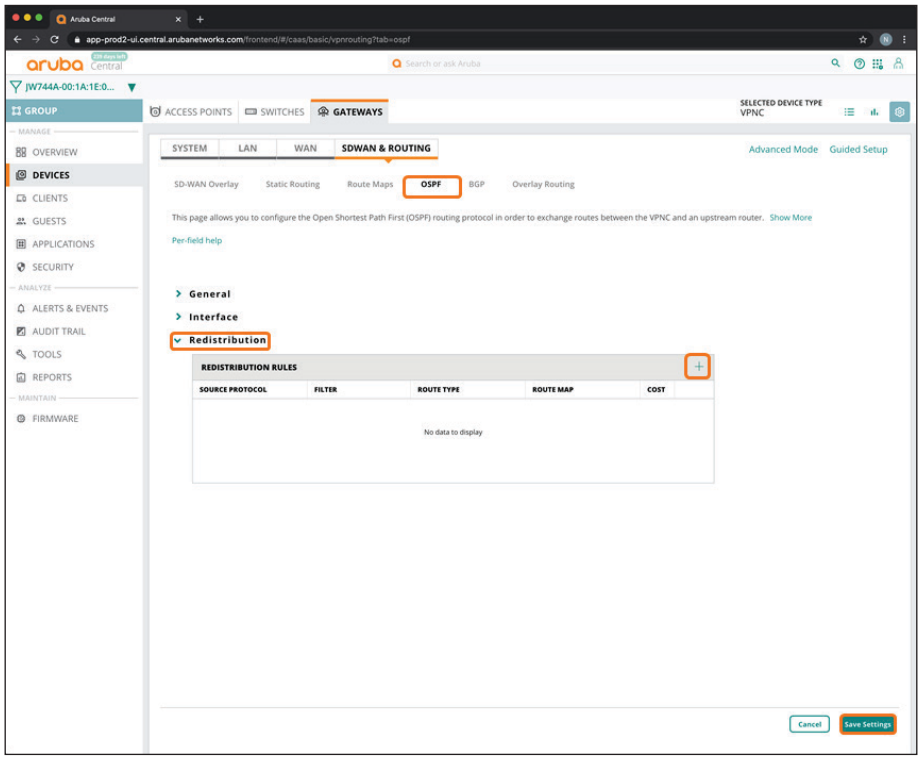
Step 8: In the **VLANs** table, click the plus (+) sign.

Step 9: Enable OSPF on each of the LAN uplinks and System IP interfaces, define area ID, and adjust the OSPF metrics, if desired, and then click **Save Settings**.

VLANS

VLAN	AREA ID	COST	HELLO INTERVAL
GE_0_0_2 102 (10.4.150.1)	0.0.0.0	1	10
GE_0_0_3 103 (10.4.150.5)	0.0.0.0	1	10
SystemIP_4087 4087 (10.4.25...	0.0.0.0	1	10

Step 10: Expand **Redistribution**.

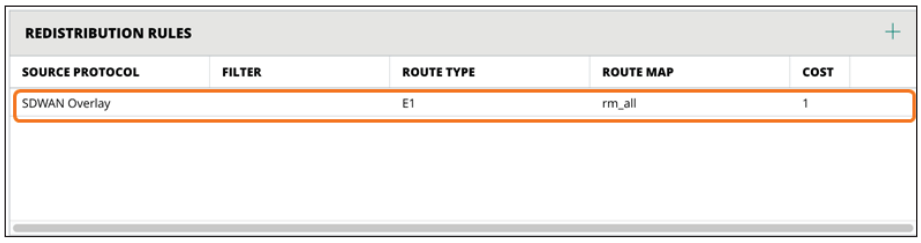


Step 11: In the **Redistribution Rules** table, click the plus (+) sign.

Step 12: In **Source Protocol** drop-down list, select **SDWAN Overlay**.

Step 13: For **Route Type**, select **E1** using the drop-down.

Step 14: In the **Route Map** drop-down list, select none or the route map you created at the group level in optional Procedure 2.9 (example: **rm_all**).



Step 15: Click **Save Settings**.

3.9 Enable One-Touch Provisioning on the VPNC Device

Use this procedure to connect the VPNC device to the network and execute an initial script to enable one-touch provisioning.

Step 1: Using the VPNC console port and the settings below for your terminal software, select the **static-activate** option from the menu to enable one-touch provisioning by using a static IP address.

- Baud rate—9600
- Data bits—8
- Parity—None
- Stop bits—1
- Flow control—None

```
Auto-provisioning is in progress. It requires DHCP and Activate servers
Choose one of the following options to override or debug auto-provisioning...
    'enable-debug'      : Enable auto-provisioning debug logs
    'disable-debug'     : Disable auto-provisioning debug logs
    'mini-setup'        : Start mini setup dialog. Provides minimal customization and requires DHCP
server
    'full-setup'        : Start full setup dialog. Provides full customization
    'static-activate'   : Provides customization for static or PPPOE ip assignment. Uses activate for
master information

Enter Option (partial string is acceptable): static-activate
Enter Controller VLAN ID [1]: 101
Enter Uplink port [GE 0/0/0]: GE 0/0/1
Enter Uplink port mode (access|trunk) [access]:
Enter Uplink Vlan IP assignment method (static|pppoe) [static]:
Enter Uplink Vlan Static IP address [192.168.1.1]: 66.60.164.125
Enter Uplink Vlan Static IP netmask [255.255.255.0]: 255.255.255.224
Enter IP default gateway [none]: 66.60.164.97
Enter DNS IP address [none]: 8.8.8.8
Do you wish to configure IPV6 address on vlan (yes|no) [yes]: no
Do you want to disable spanning tree (yes|no)? [no]:
Do you want to configure dynamic port-channel (yes|no) [no]:

Current choices are:

Controller VLAN id: 101
Uplink port: GE 0/0/1
Uplink port mode: access
Uplink Vlan IP assignment method: static
Uplink Vlan static IP Address: 66.60.164.125
Uplink Vlan static IP net-mask: 255.255.255.224
Uplink Vlan IP default gateway: 66.60.164.97
Domain Name Server to resolve FQDN: 8.8.8.8
Option to configure VLAN interface IPV6 address: no
Spanning-tree is disabled: no

Do you wish to accept the changes (yes|no) yes
```

Procedures

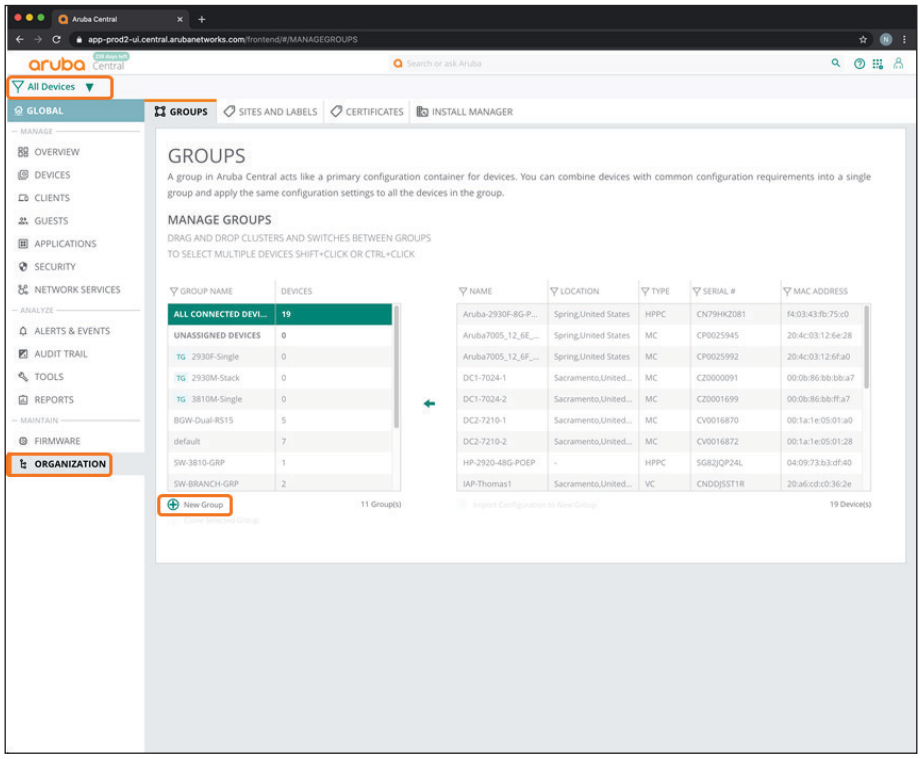
Configuring the Branch Gateway Group—One Branch Gateway per Branch

4.1 Create a New Branch Gateway Group

In this procedure, you create a branch gateway group and assign a branch gateway group type to the group.

Step 1: In filter drop-down list, select **All Devices**, and then in the left navigation bar, under maintain, select **ORGANIZATION**.

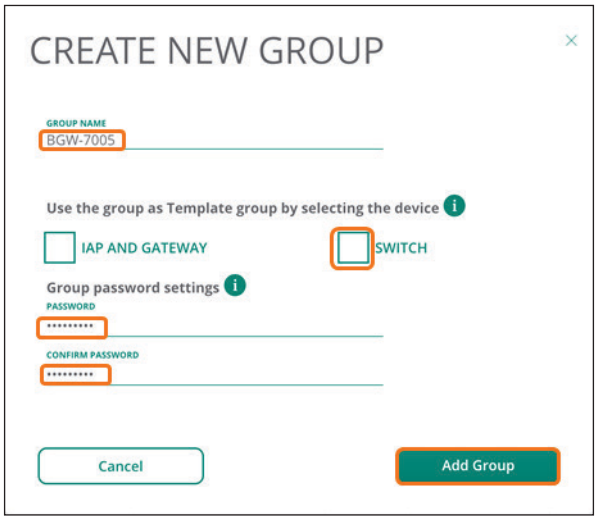
Step 2: Select the **Groups** tab, and then click **New Group**.



Step 3: In the Create New Group dialog box, implement the following settings:

- Group Name—**BGW-7005**
- Switch—Unselect
- Password—**password**
- Confirm Password—**password**

Step 4: Click **Add Group**.

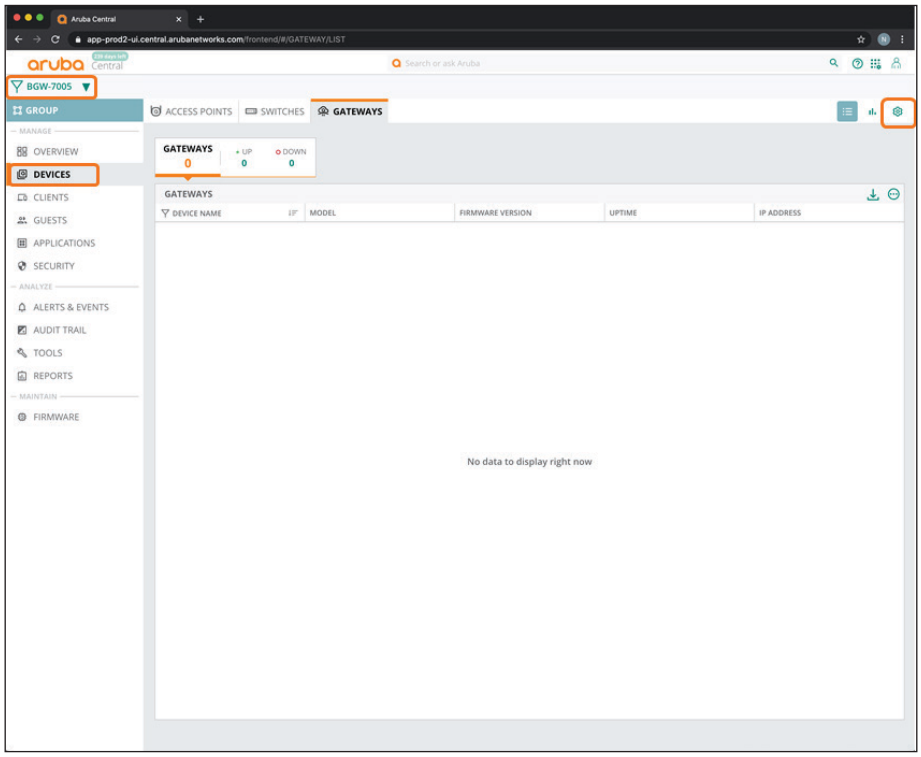


Note If you intend to use the Install Manager App, assign the group to the sites at this point.

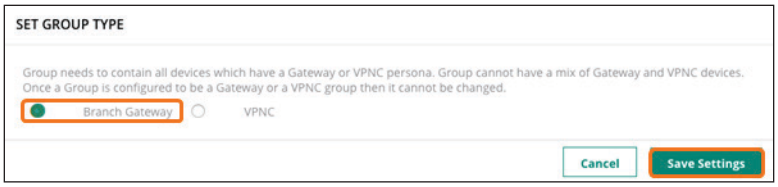
Step 5: In the filter drop-down list, select **BGW-7005**.

Step 6: In the left navigation pane, in the Manage section, click **Devices**.

Step 7: Select the **Gateways** tab, and then click the gear icon in top right.

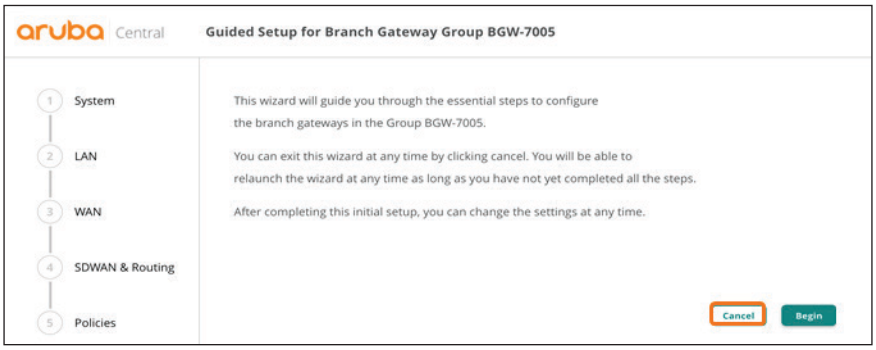


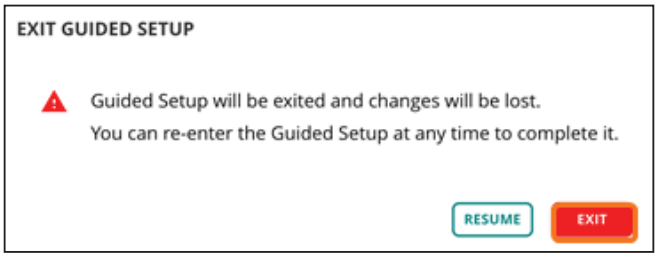
Step 8: In the Set Group Type dialog box, select **Branch Gateway**, and then click **Save Settings**.



For educational purposes, the next step exits the guided setup.

Step 9: In the Guided Setup dialog box, click **Cancel**, and then click **Exit**.

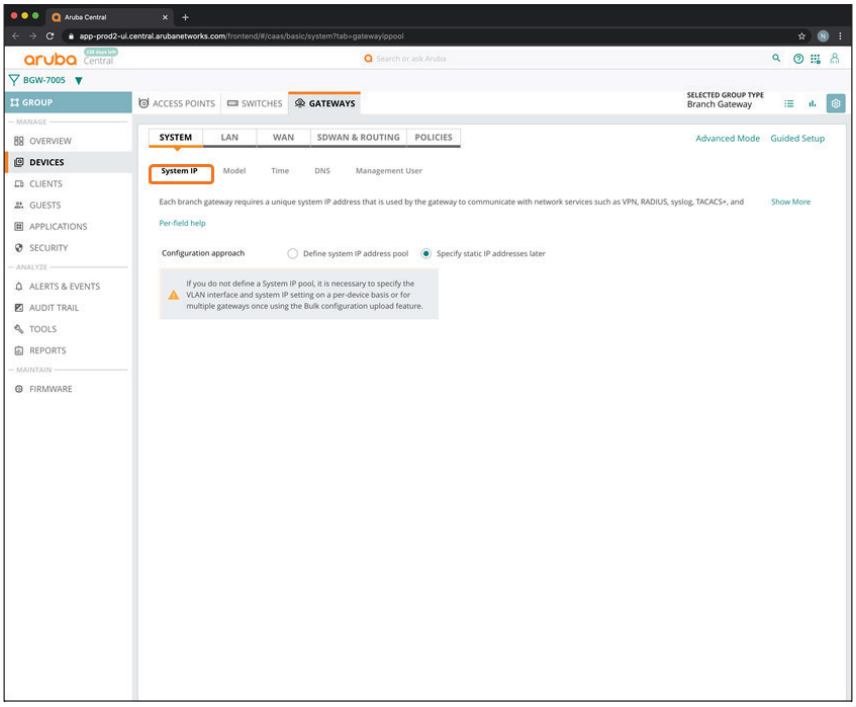




4.2 Create the System IP Address Pool for the Branch Gateway Group

Use this procedure to define the system IP address pool that the gateway will use for network services.

Step 1: On the Gateways tab, in the System section, select **System IP**.

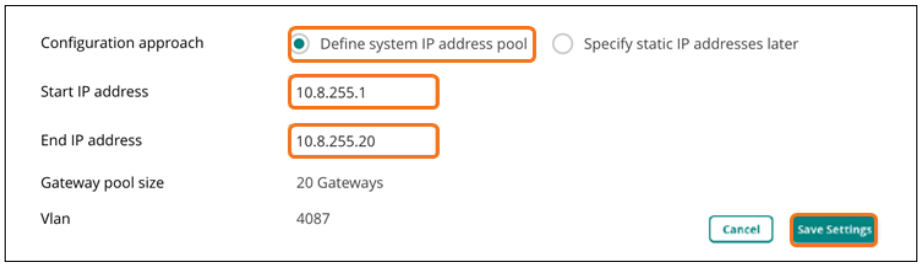


Step 2: Select **Define system IP address pool**.

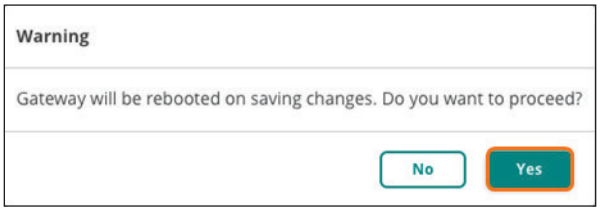
Step 3: In **Assign the Start IP address** box, enter **10.8.255.1**.

Step 4: In the **End IP address** box, enter **10.8.255.20**, and then click **Save Settings**.

> **Note** The system IP address is used for gateway management and needs to be in a routable space.



Step 5: In the Warning dialog box, click **Yes**. When you move the gateways to a group, the gateways need to reboot to complete the group configuration.



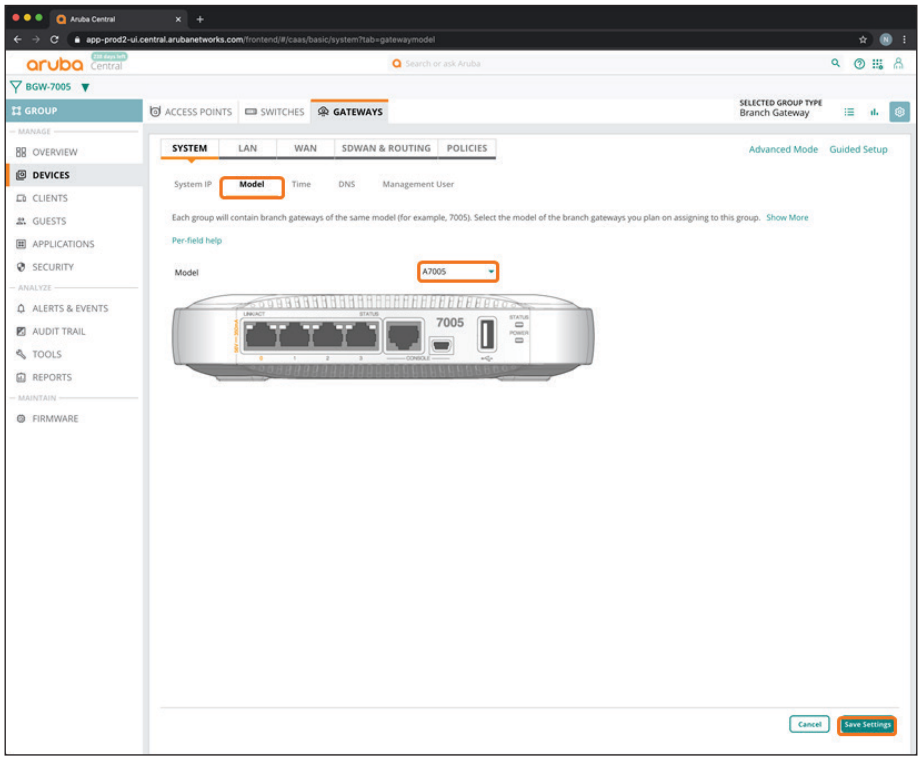
4.3 Select the Hardware Model of the Gateway Group

You can have only one gateway model per branch in the gateway group.

Step 1: On the Gateways tab, in the System section, select **Model**.

Step 2: In the **Model** drop-down list, select the hardware model for the branch gateway(s) in the group (example: **A7005**).

Step 3: Click **Save Settings**.

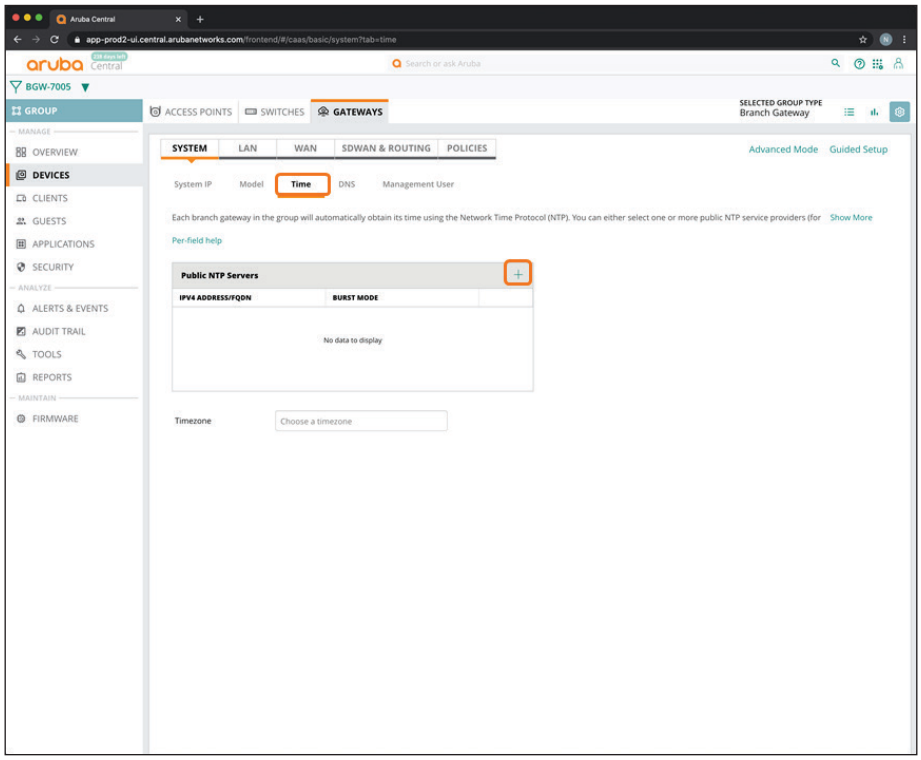


4.4 Select the Branch Gateway Group Time Zone

Use this procedure to set the NTP parameters and time zone to keep the branch gateway clocks synchronized.

Step 1: On the Gateways tab, in the System section, select **Time**.

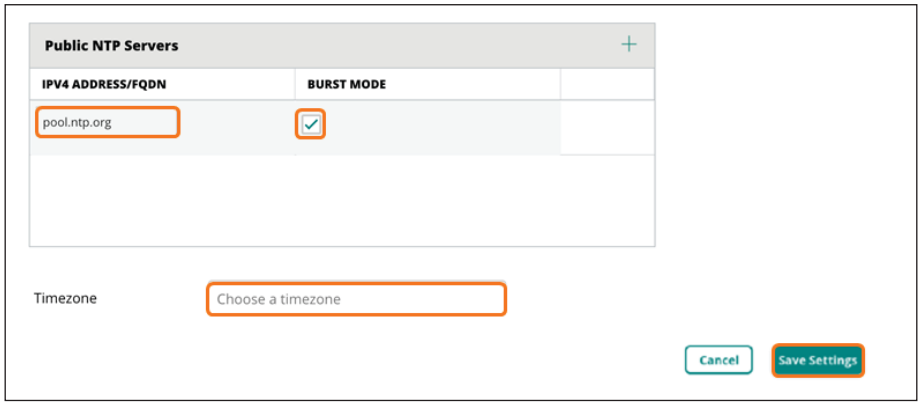
Step 2: In the **Public NTP Servers** table, click the plus (+) sign to add a public NTP server.



Step 3: In the **IPv4 Address/FQDN** column, enter pool.ntp.org or another NTP server address.

Step 4: Select **Burst Mode** if this feature is supported by the NTP server. Burst mode provides faster time synchronization.

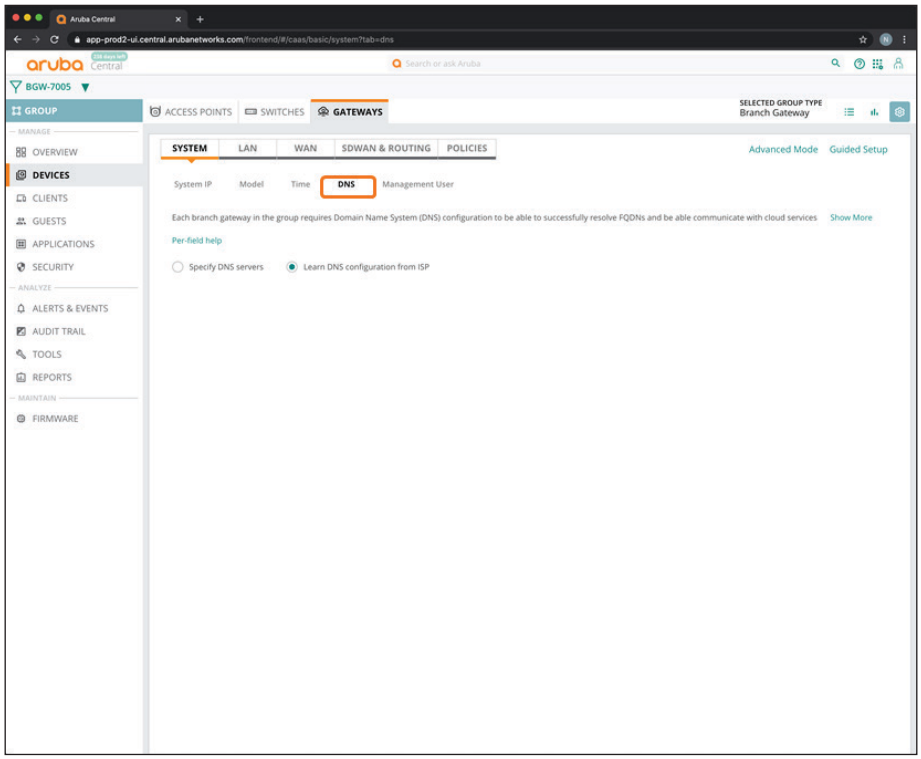
Step 5: In the **Timezone** drop-down list, choose your timezone, and then click **Save Settings**.



4.5 Configure the DNS Servers for the Branch Gateway Group

You must specify the DNS server(s) that the gateway uses to communicate to Aruba Central.

Step 1: On the Gateways tab, in the System section, select **DNS**.



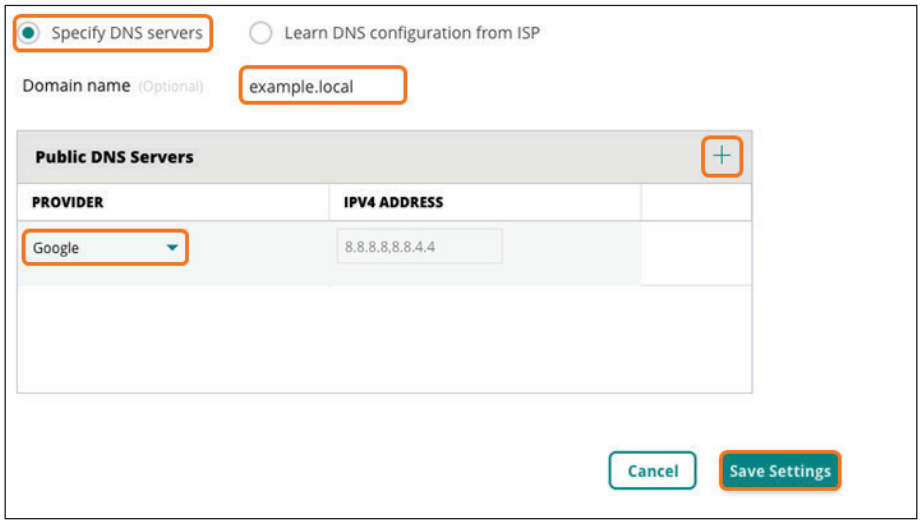
Step 2: Click **Specify DNS servers**.

Step 3: In the **Domain name** text box, enter a domain name (example: **example.local**).

Step 4: In the **Public DNS Servers** table, click the plus (+) sign.

Step 5: In the **Provider** drop-down list, select one of the providers listed or manually configure the desired DNS server(s). This server needs to be reachable when the device comes up for connectivity to Central.

Step 6: Click **Save Settings**.

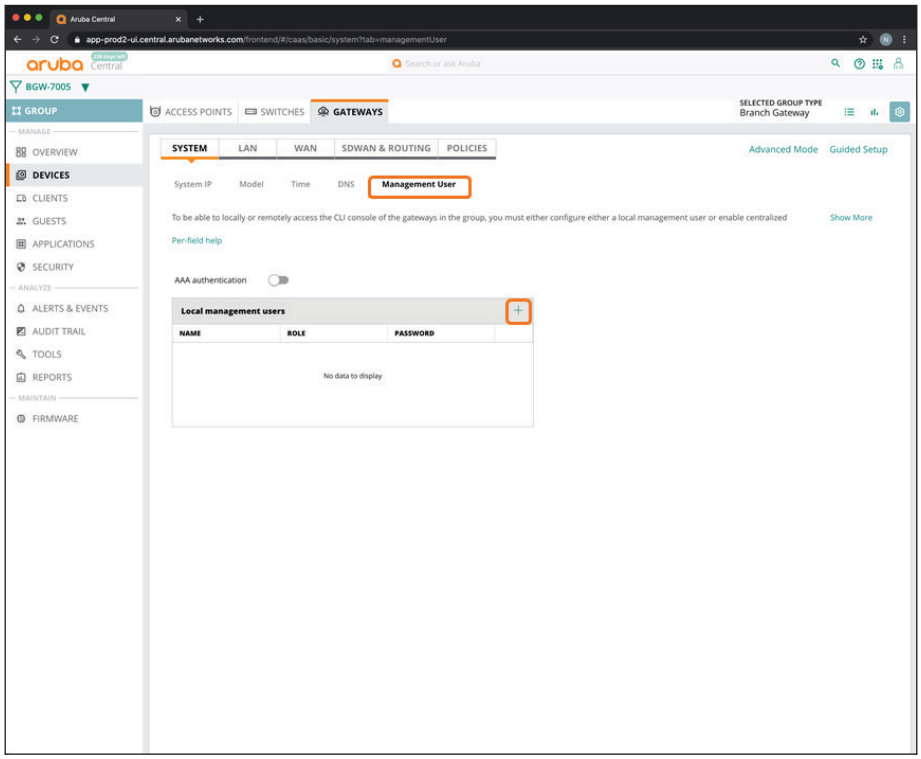


4.6 Create a Management User Account for the Branch Gateways

You must have a management user account to use CLI to access the gateways.

Step 1: On the Gateways tab, in the System section, select **Management User**.

Step 2: In the **Local Management Users** table, click the plus (+) sign.

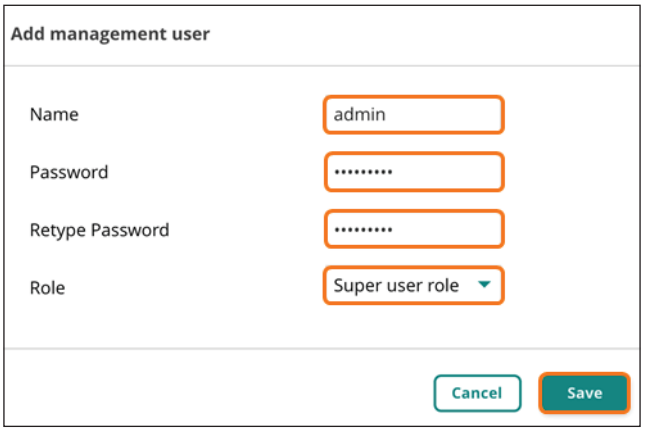


Step 3: In the Add Management User dialog box, implement the following settings:

- Name—**admin**
- Password—**password**
- Retype Password—**password**
- Role—Super user role

Step 4: Click **Save**.

> **Note** You can add additional users with other roles as needed. These additional users are optional.



Step 5: Click **Save Settings**.

4.7 Configure VLANs for the Branch Network Devices and Users

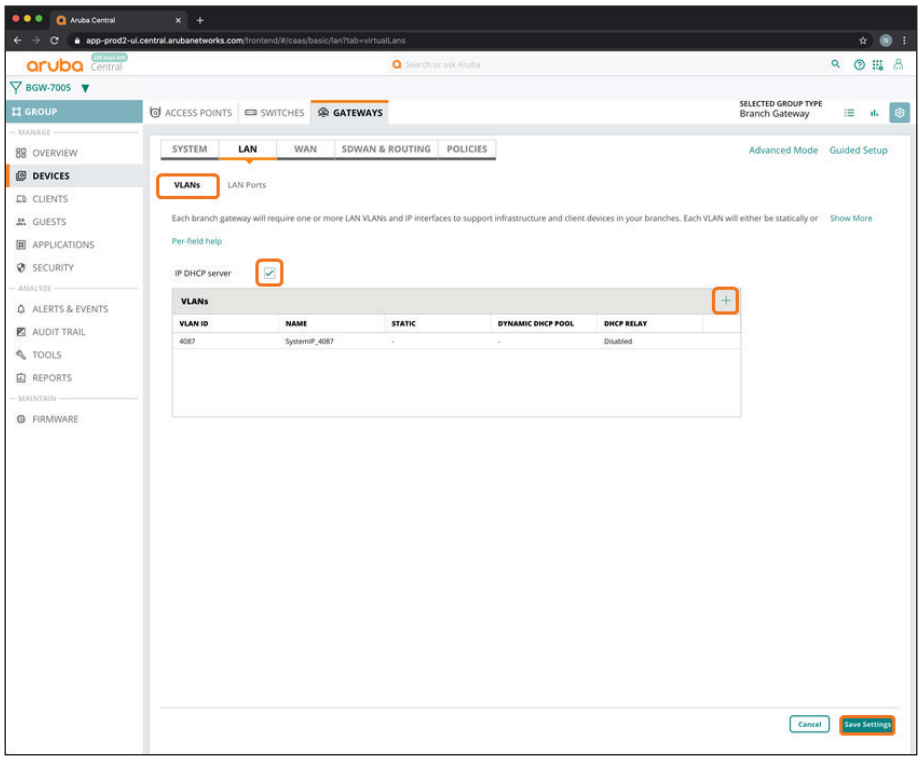
In this procedure, you define the VLANs for the branch network devices and users as well as assign subnets at the device level.

Step 1: On the Gateways tab, in the LAN section, select **VLANs**.

Step 2: Select **IP DHCP server**.

Step 3: In the **VLANs** table, click the plus (+) sign.

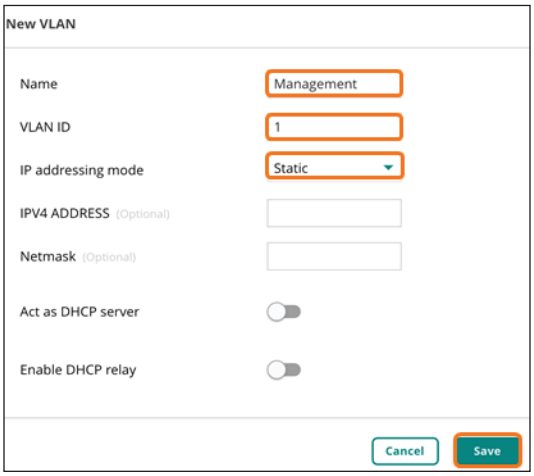
In this example, we create VLAN 1 for management. VLAN 1 is recommended for plug and play of the switches and APs in the branch.



Step 4: In the New VLAN dialog box, implement the following settings:

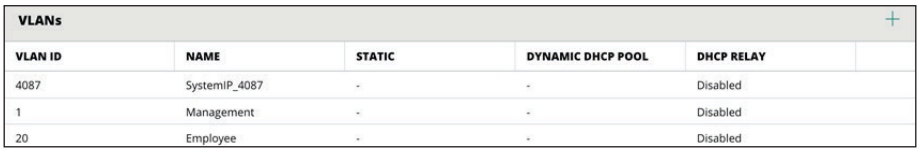
- Name—**Management**
- VLAN ID—**1**
- IP addressing mode—Static

Step 5: Click **Save**.



Step 6: Repeat Step 3 - Step 5 for each additional user VLAN. For example, an **Employee** VLAN.

Step 7: Click **Save Settings**.

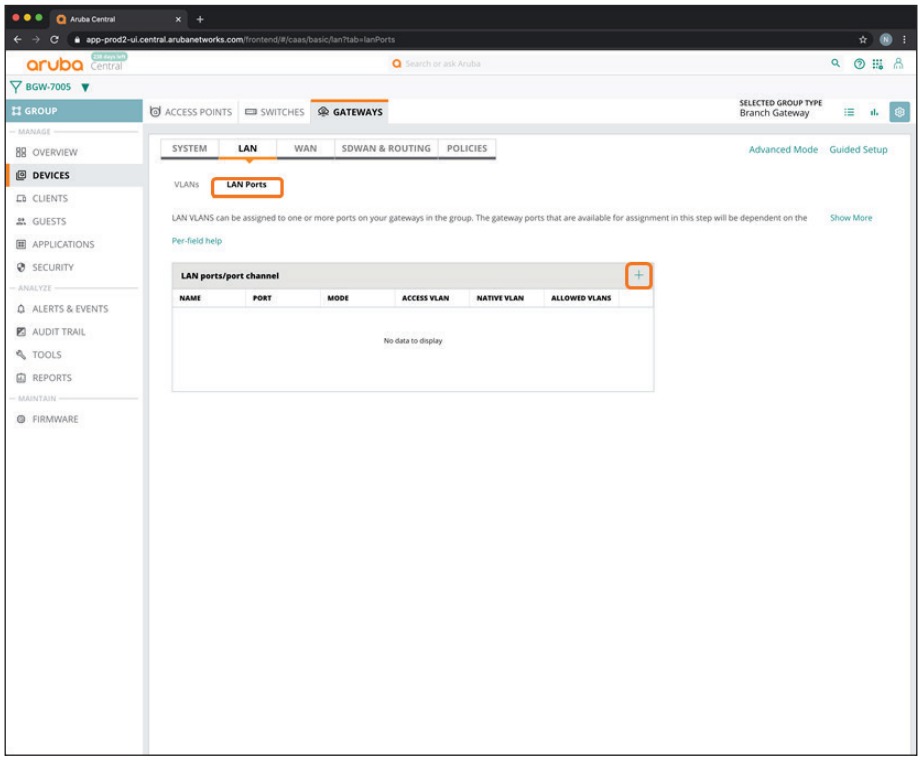


4.8 Configure the LAN Ports for the Branch Gateway

Assign the LAN ports that the downstream switches use and permit the user and management VLANs.

Step 1: On the Gateways tab, in the LAN section, select **LAN Ports**.

Step 2: In the **LAN ports/port channel** table, click the plus (+) sign.



Step 3: In the New LAN port/port channel dialog box, enter a name for the new port (example: **LAN**).

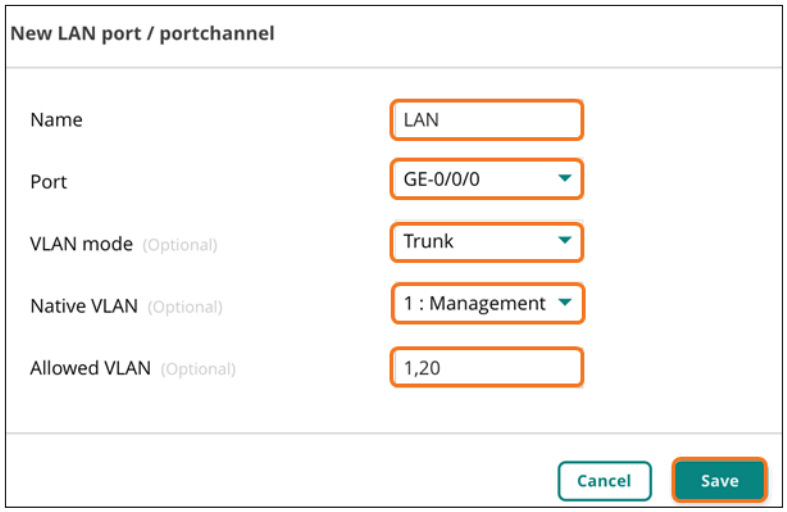
Step 4: In the **Port** drop-down list, select a physical port on the gateway (example: **GE-0/0/0**).

Step 5: In the VLAN mode drop-down list, select **Trunk**.

Step 6: In the **Native VLAN** drop-down list, select the management VLAN you created in Procedure 4.7 (example: **1 : Management**).

Step 7: In the **Allowed VLAN** box, enter the VLAN IDs for the VLANs allowed towards LAN, and then click **Save**.

Step 8: Repeat Step 2 - Step 7 for each additional LAN port that you need to configure.

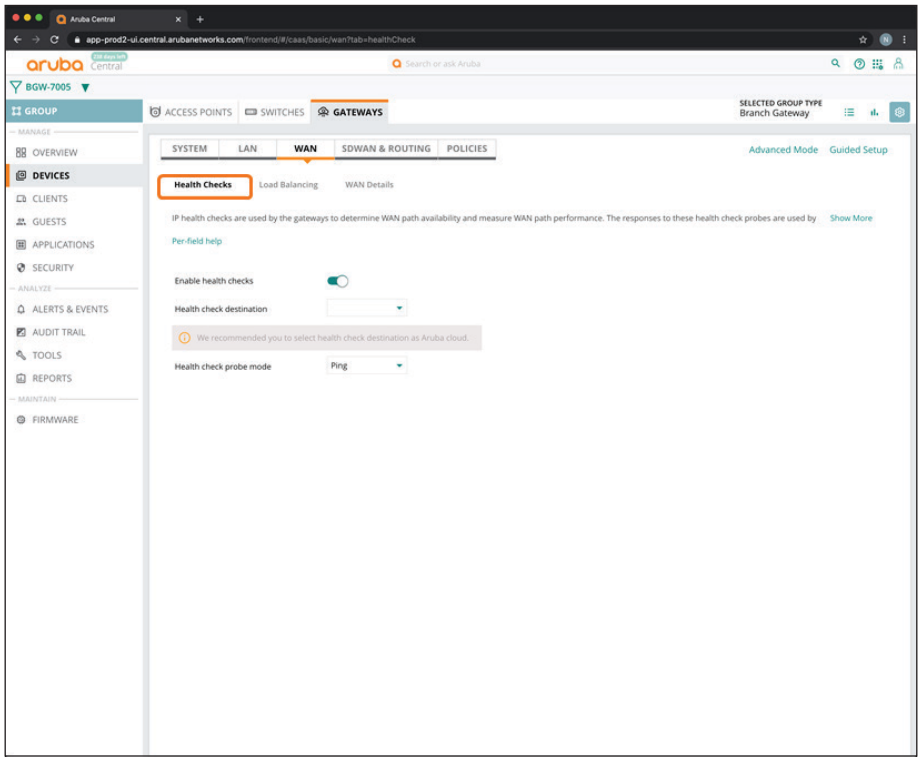


Step 9: Click **Save Settings**.

4.9 Configure WAN Health Checks

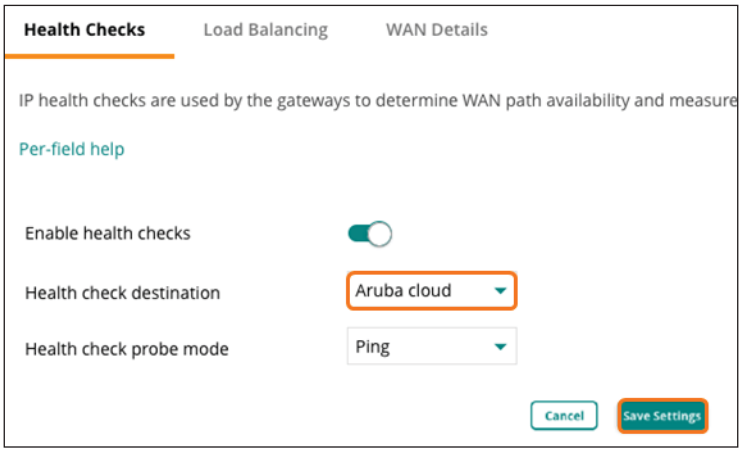
For more information, see Enabling WAN Health Check Probes.

Step 1: On the Gateways tab, in the WAN section, select **Health Checks**.



Step 2: In the Health check destination drop-down list, select **Aruba cloud**.

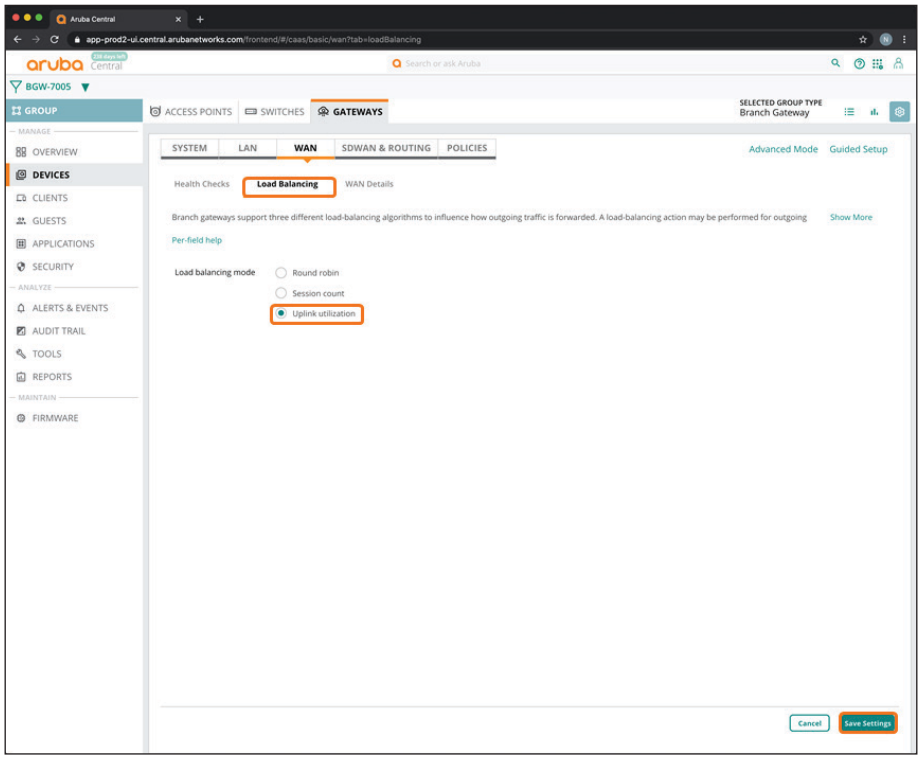
Step 3: Click **Save Settings**.



4.10 Configure the WAN Load Balancing Algorithm

Step 1: On the Gateways tab, in the WAN section, select **Load Balancing**.

Step 2: In Load balancing mode list, select **Uplink utilization**, and then click **Save Settings**.

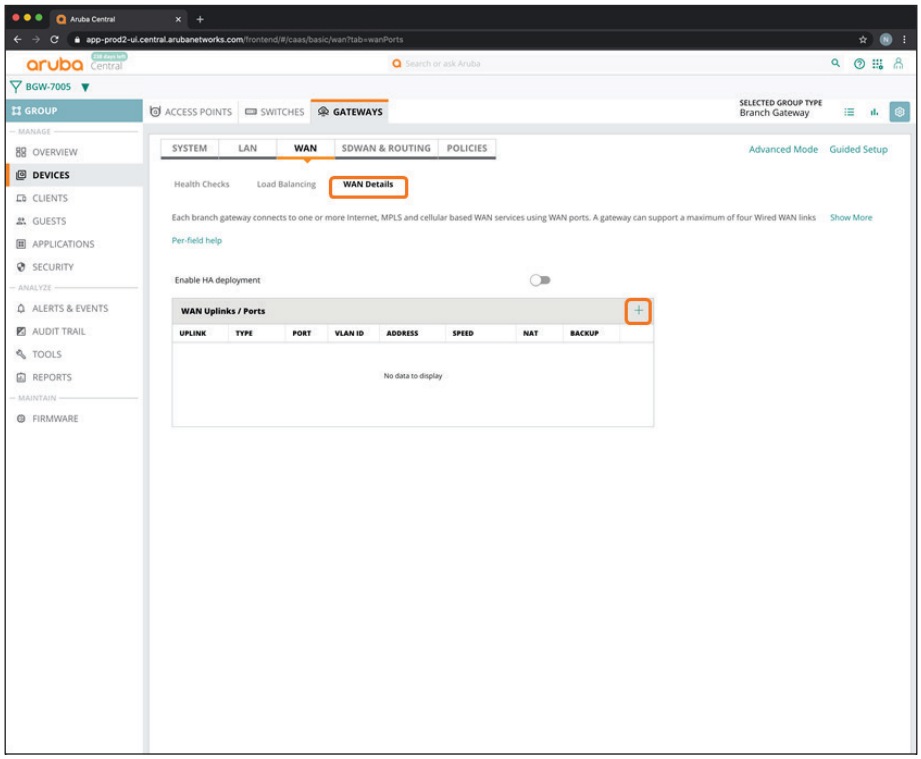


4.11 Define the WAN Service Providers

In this example, we use a single gateway with dual internet connections.

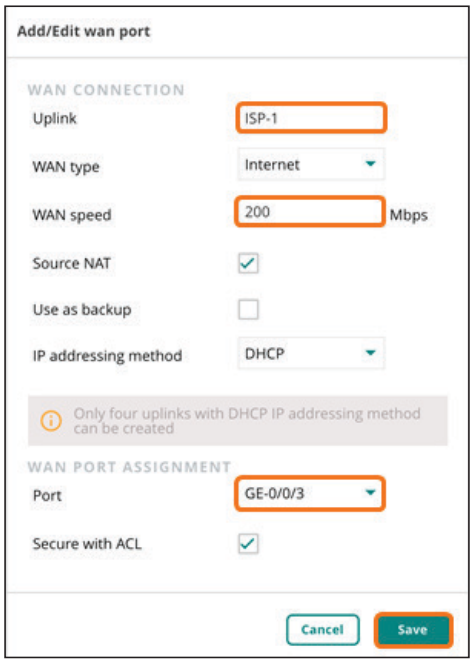
Step 1: On the Gateways tab, in the WAN section, select **WAN Details**.

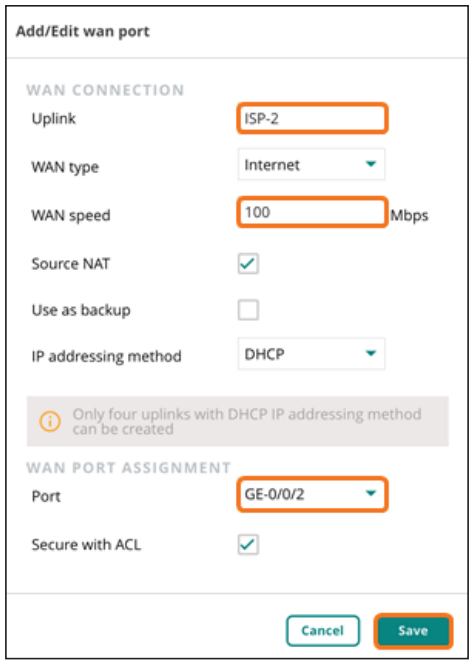
Step 2: In the **WAN Uplinks/Ports** table, click the plus (+) sign.



Step 3: In the Add/Edit wan port dialog box, implement the following settings:

- Uplink—**ISP-1**
- WAN—Internet
- WAN speed—**200**
- Port—**GE-0/0/3**





Step 4: Click **Save**.

Step 5: Repeat Step 2 - Step 4 for each dual uplink.

WAN Uplinks / Ports

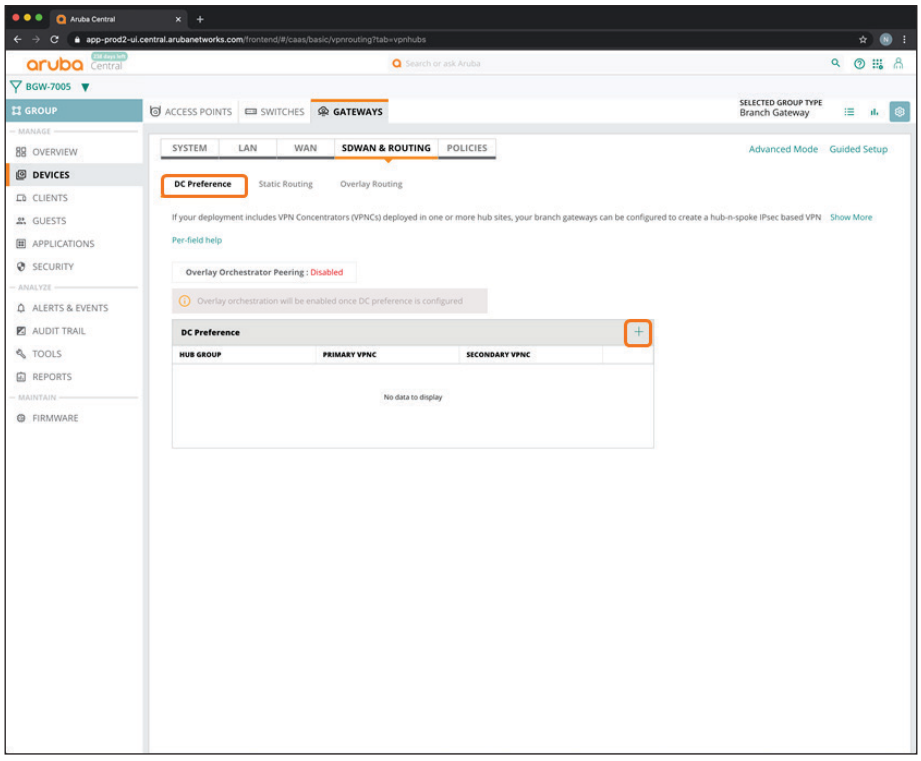
UPLINK	TYPE	PORT	VLAN ID	ADDRESS	SPEED	NAT	BACKUP
isp-2_inet	INET	GE-0/0/2	4085	DHCP	100 Mbps	Enabled	Disabled
isp-1_inet	INET	GE-0/0/3	4086	DHCP	200 Mbps	Enabled	Disabled

4.12 Specify the SD-WAN Data Center Preferences

Use this procedure to assign the data center preferences for route orchestration toward the VPN concentrators.

Step 1: On the Gateways tab, in the SDWAN & Routing section, select **DC Preferences**.

Step 2: In the **DC Preference** table, click the plus (+) sign to add a VPNC hub group.



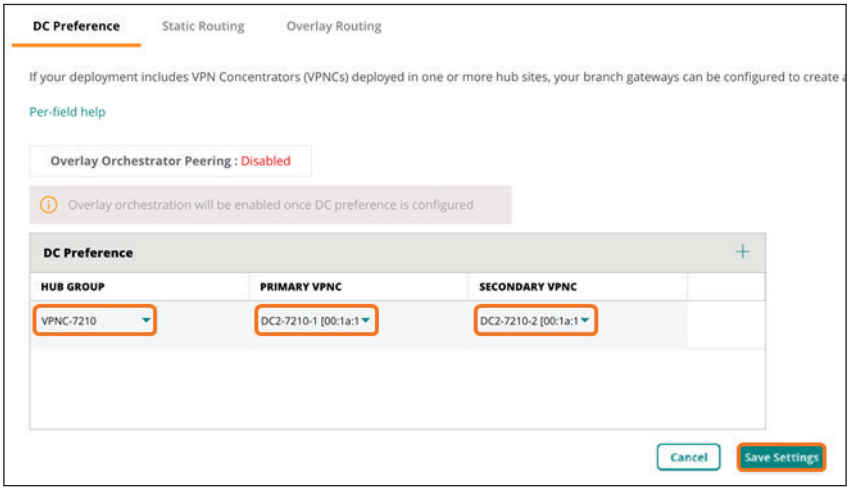
Step 3: In the **Hub Group** drop-down list, select a VPNC group for the preferred data center (example: **VPNC-7210**).

Step 4: In the **Primary VPNC** drop-down list, select the primary VPNC.

Step 5: In the **Secondary VPNC** drop-down list, select the secondary VPNC.

Step 6: Repeat Step 2 - Step 5 if a secondary data center is used.

Step 7: Click **Save Settings**.



Aruba Central automatically enables overlay orchestrator peering after you click Save Settings.

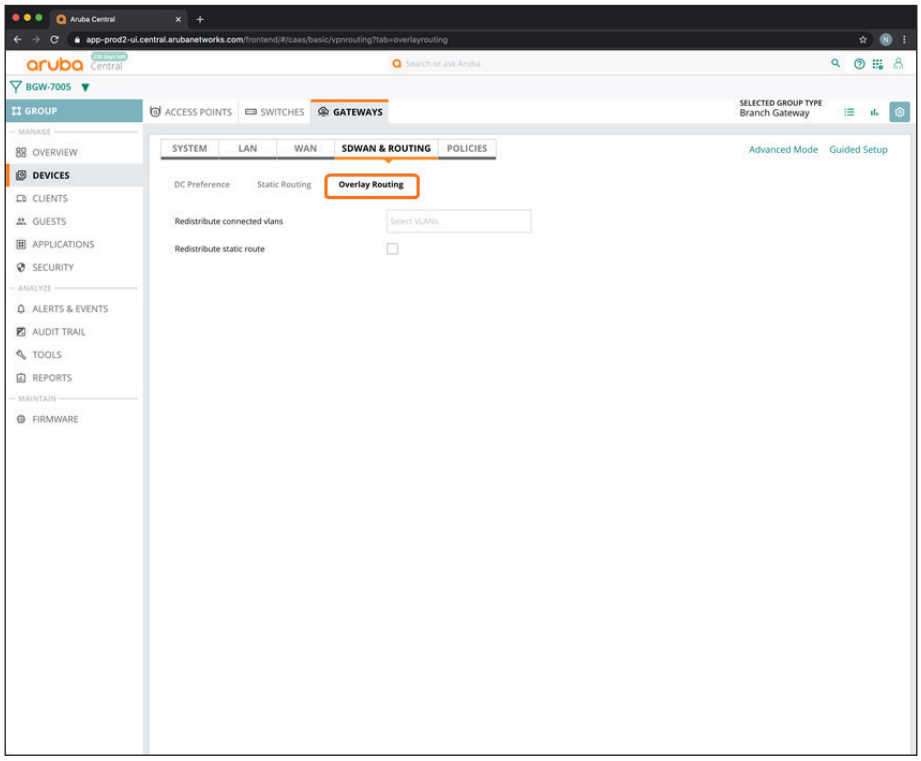
DC Preference

HUB GROUP	PRIMARY VPNC	SECONDARY VPNC
VPNC-7210	DC2-7210-1 [00:1a:1e:05:01:a0]	DC2-7210-2 [00:1a:1e:05:01:28]
VPNC-7024	DC1-7024-1 [00:0b:86:bb:bb:a7]	DC1-7024-2 [00:0b:86:bb:ff:a7]

4.13 Configure the SD-WAN Overlay Routing

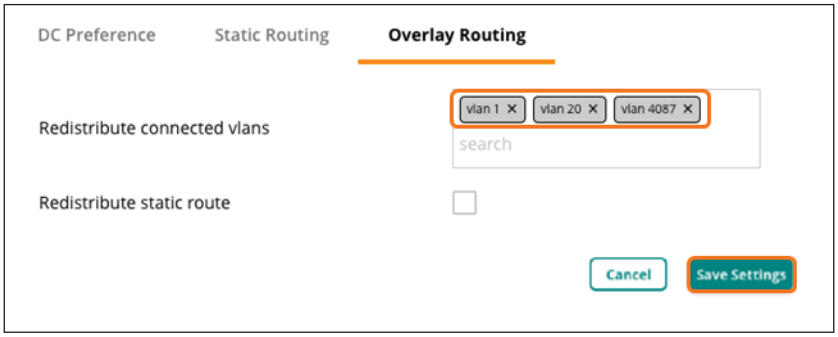
You should redistribute branch subnets in the VPN overlay to enable the dynamic routing functionality at the headend site.

Step 1: On the Gateways tab, in the SDWAN & Routing section, select **Overlay Routing**.



Step 2: In the **Redistribute connected vlans** box, select all of the user VLANs and system IP VLAN for overlay redistribution.

Step 3: Click **Save Settings**.

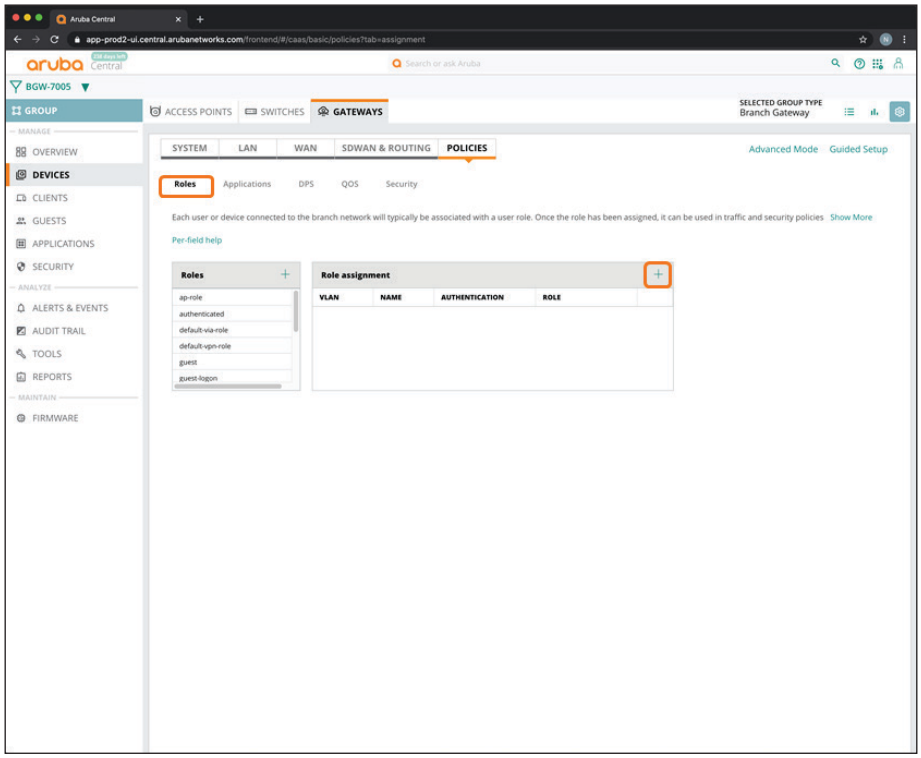


4.14 Configure Role-Based Policies for the Branch Gateways

Use this procedure to define the policies for user VLANs to allow network access.

Step 1: On the Gateways tab, in the Policies section, select **Roles**.

Step 2: In the **Role assignment** table, click the plus (+) sign.



Step 3: In the Role assignment dialog box, implement the following settings:

- VLAN ID—**Management (1)**
- **Initial Role—authenticated**
- **Authentication**—Disable this option

Step 4: Click **Save**.

Step 5: Repeat Step 2 - Step 4 for all of the user VLANs (example: **Employee**).

ROLE ASSIGNMENT			
VLAN	**NAME**	**AUTHENTICATION**	**ROLE**
1	Management	Disabled	authenticated
20	Employee	Disabled	authenticated

Procedures

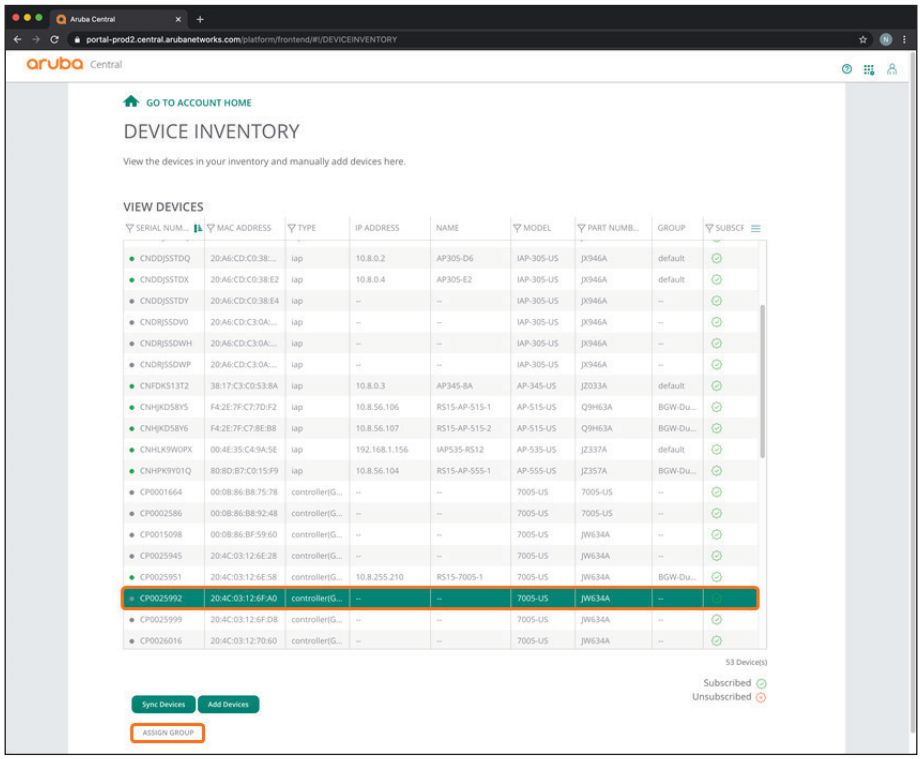
Configuring a Branch Gateway Device—One Branch Gateway per Branch

5.1 Assign a Device to a Branch Gateway Group

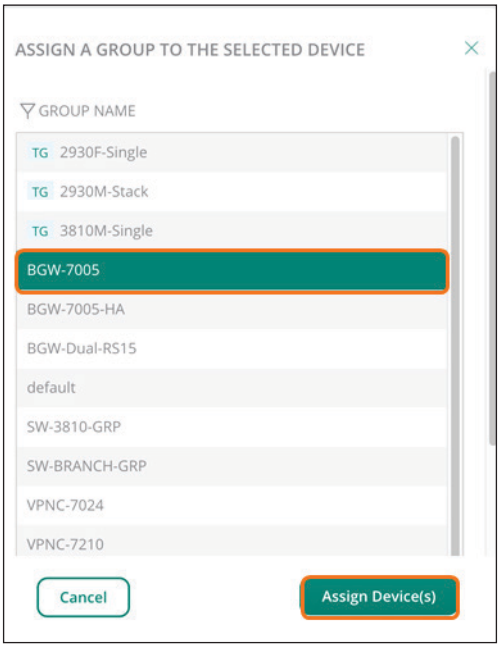
Use this procedure to assign a device to a branch gateway group to inherit global configurations.

Step 1: On the Aruba Central Account Home page, select **Device Inventory**.

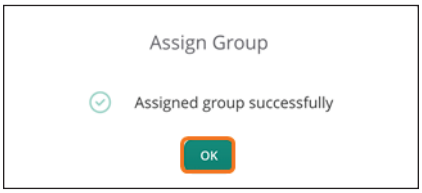
Step 2: In the View Devices table, select a branch gateway, and then click **Assign Group**.



Step 3: In the **Assign a Group to the Select Device** dialog box, select the Branch Gateway group you created in Procedure 4.1 (example: **BGW-7005**).



Step 4: Click **Assign device(s)**, and then click **OK**.



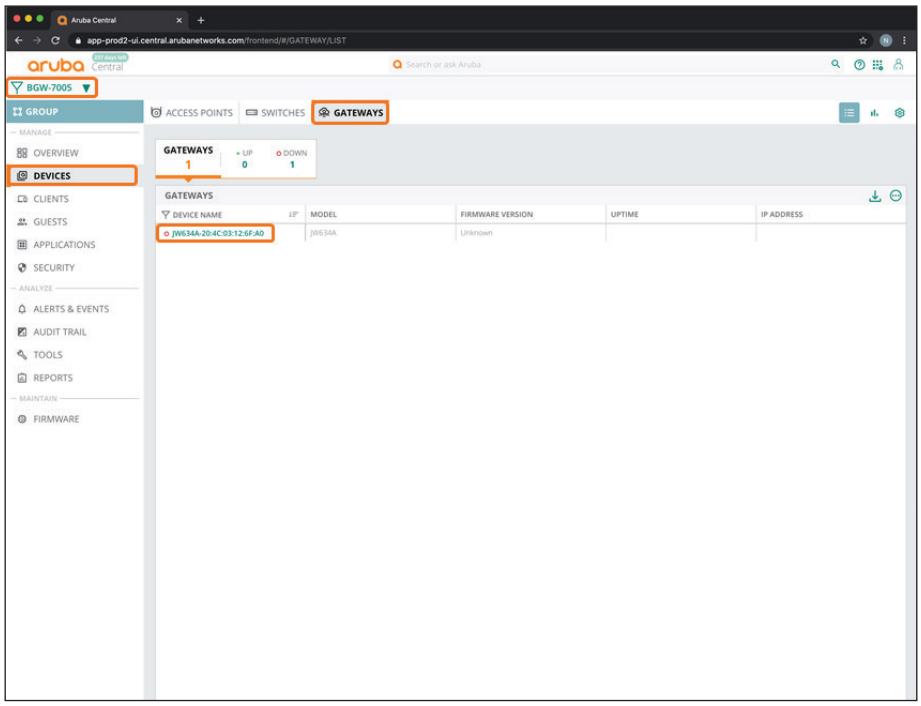
5.2 Initiate the Branch Gateway Device Configuration

Step 1: On the Aruba Central Account Home page, launch the **Network Operations** app.

Step 2: In the filter drop-down list, select the branch gateway group you created in Procedure 4.1 (example: **BGW-7005**).

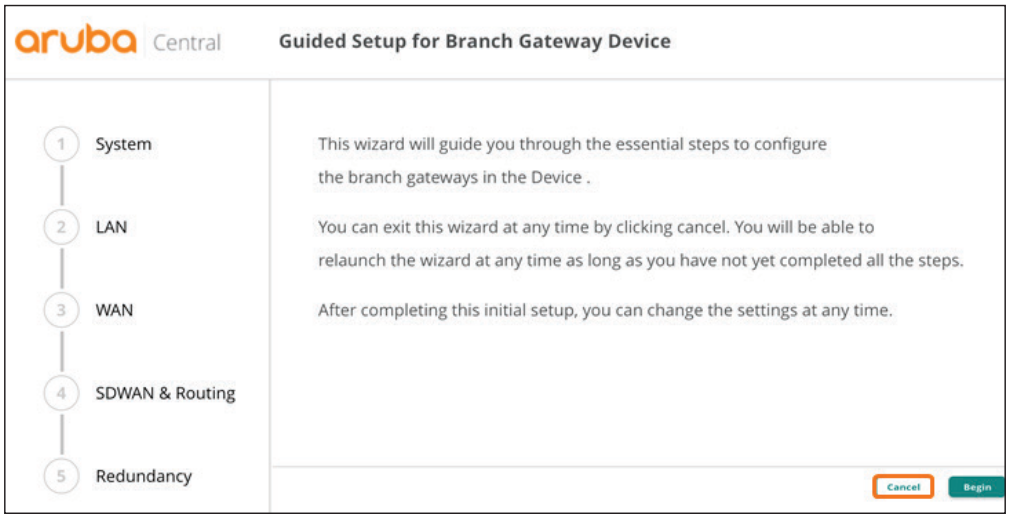
Step 3: In the left navigation pane, in the Manage section, select **Devices**, and then click the **Gateways** tab.

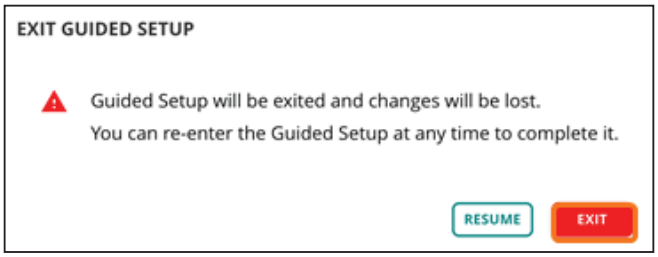
Step 4: In the **Gateways** table, select the device you intend to configure.



For educational purposes, the next step exits the guided setup.

Step 5: In the Guided Setup dialog box, click **Cancel**, and then click **Exit**.

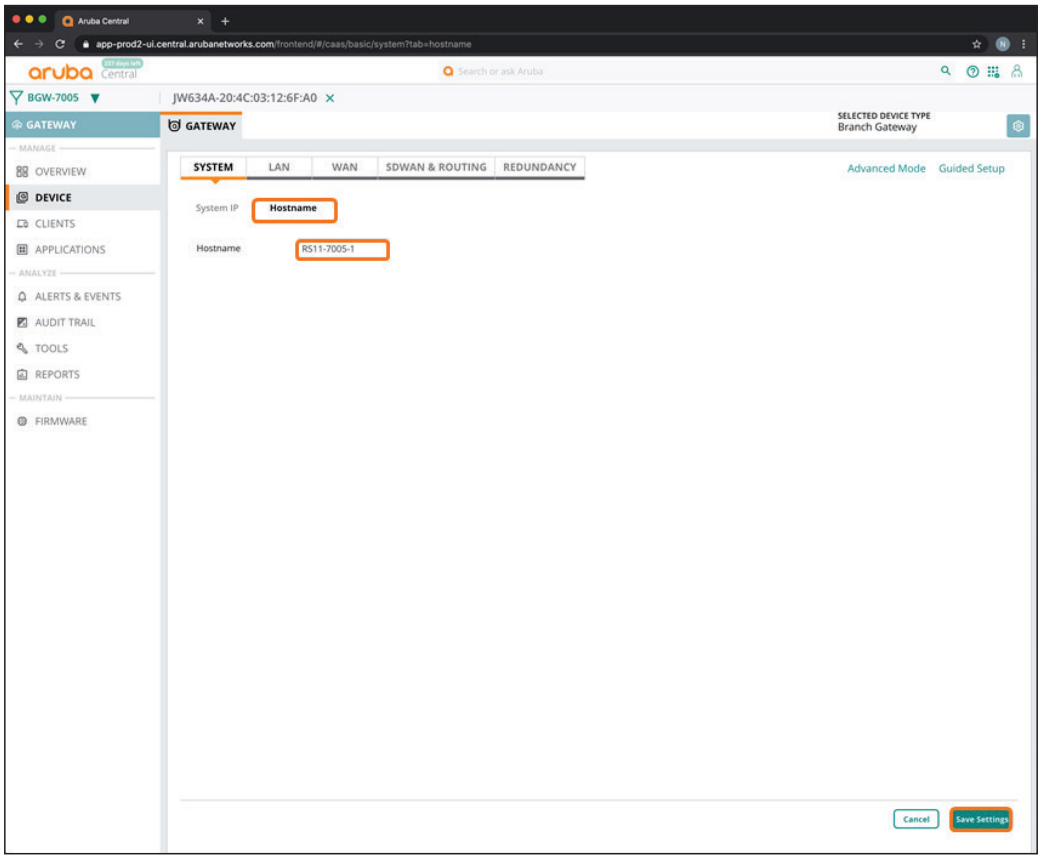




5.3 Assign a Hostname to the Branch Gateway Device

Step 1: On the Gateway tab, in the System section, select **Hostname**.

Step 2: In the **Hostname** box, enter a name (example: **RS11-7005-1**), and then click **Save Settings**.

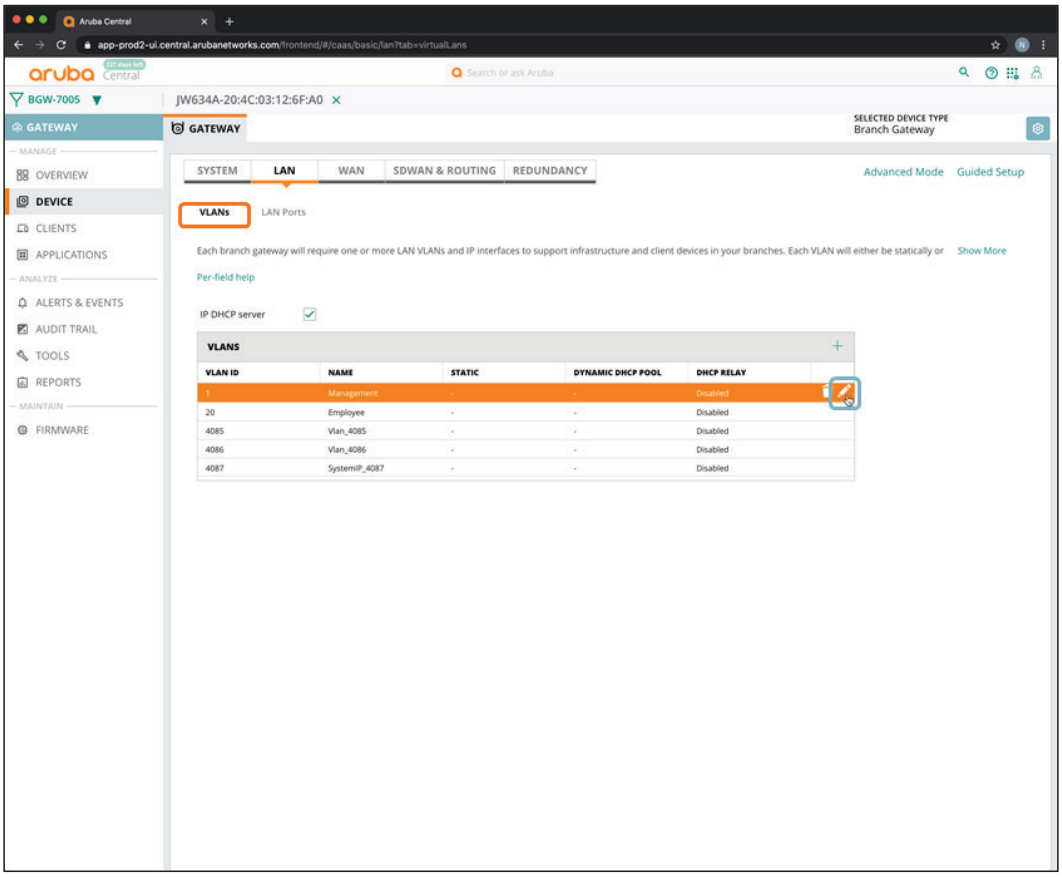


5.4 Assign IP Addresses to the VLANs

In this procedure, you assign IP addresses, and define the DHCP scope, for the management and user VLANs.

Step 1: On the Gateway tab, in the LAN section, select **VLANs**.

Step 2: In the VLANS table, select the **Management** VLAN, and then click the pencil icon.



Step 3: In the VLAN - Management dialog box, implement the following settings:

- IPV4 Address—**10.8.40.1**
- Netmask—**255.255.255.0**
- **Act as DHCP server**—Enable this option
- Default router—**10.8.40.1**
- Domain name—**example.local**
- DNS server type—Public DNS Server
- DNS Service Provider—Google

Step 4: Click **Save**.

Step 5: Repeat Step 2 - Step 4 for any additional VLANs (example: **Employee**).

VLANS

VLAN ID	NAME	STATIC	DYNAMIC DHCP POOL	DHCP RELAY
1	Management	10.8.40.1 / 24	-	Disabled
20	Employee	10.8.41.1 / 24	-	Disabled
4085	Vlan_4085	-	-	Disabled
4086	Vlan_4086	-	-	Disabled
4087	SystemIP_4087	-	-	Disabled

Procedures

Configuring the Branch Gateway Group for High Availability—Two Branch Gateways Per Branch

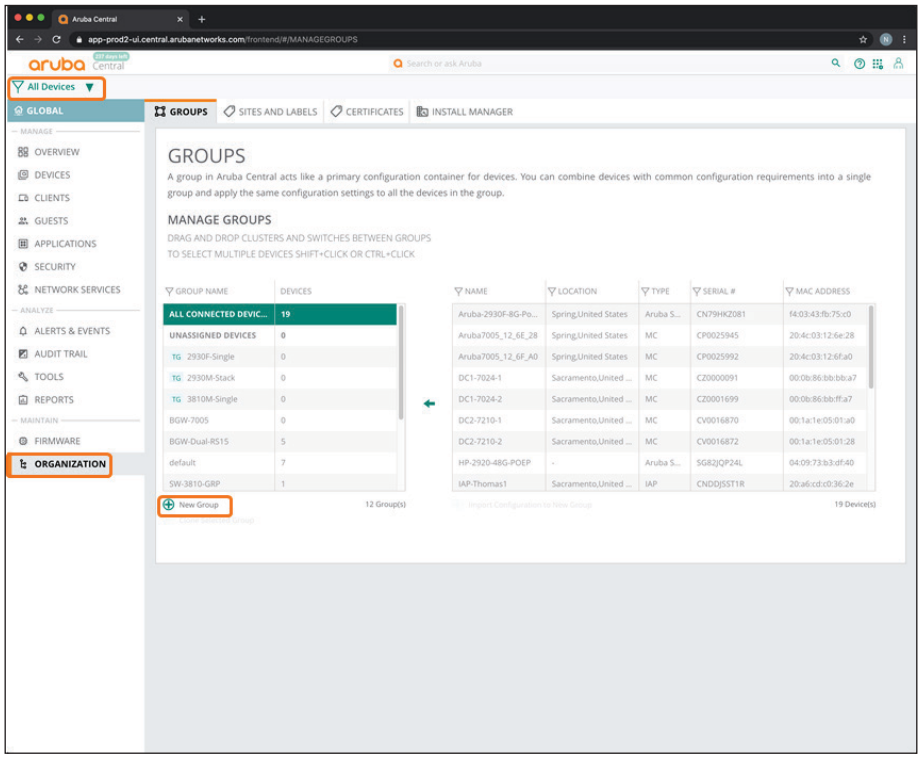
In this set of procedures, we configure a branch gateway group that can be used for sites that include two branch gateways for high availability.

6.1 Create a New Branch Gateway Group

In this procedure, you create a branch gateway group and assign a type to the branch gateway group.

Step 1: In filter drop-down list, select **All devices**, and then in the left navigation pane, select **Organization**.

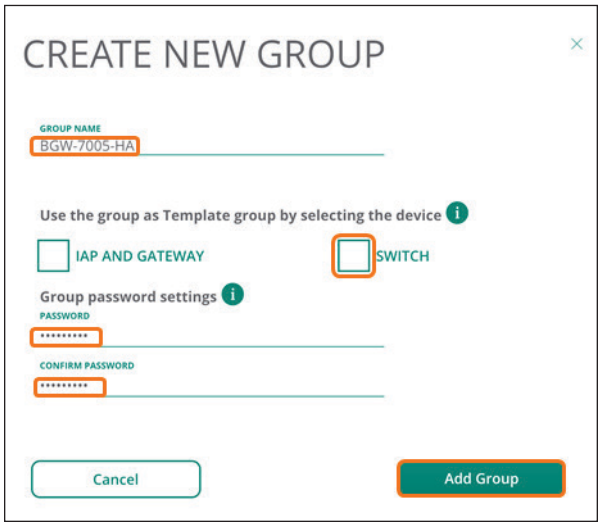
Step 2: On the Groups tab, click **New Group**.



Step 3: In the Create New group dialog box, implement the following settings:

- **Group Name—BGW-7005-HA**
- **Switch**—Unselect this option
- **Password—password**
- **Confirm Password—password**

Step 4: Click **Add Group**.

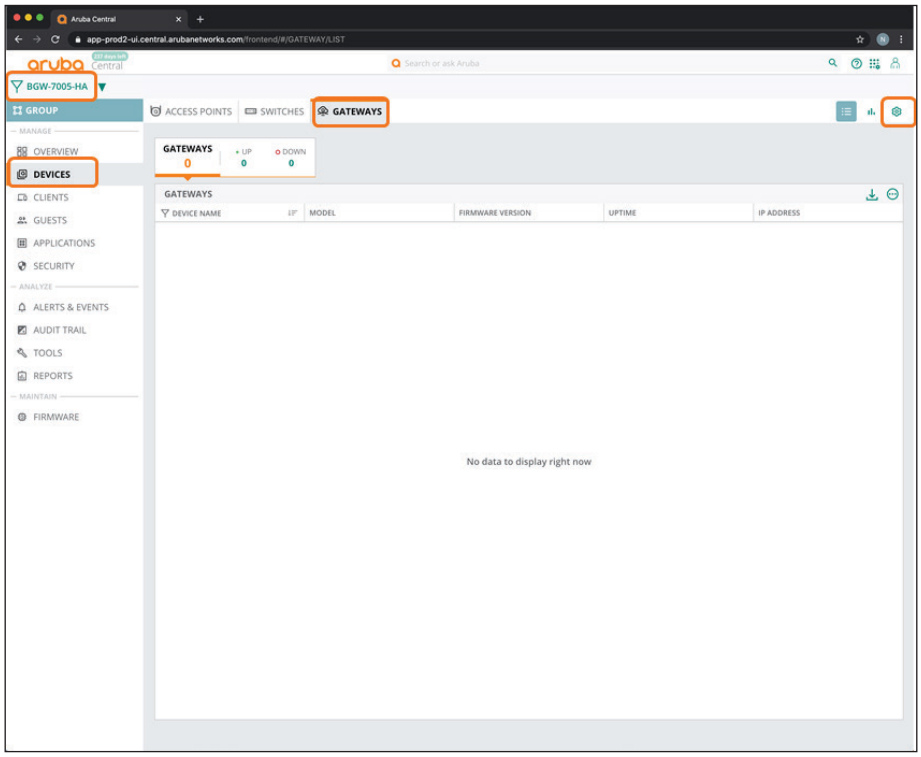


Note If you intend to use the Install Manager App, assign the group to the sites at this point.

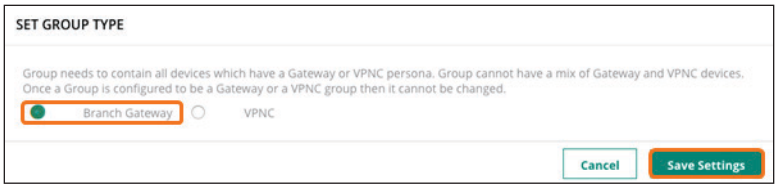
Step 5: In the filter drop-down list, select **BGW-7005-HA**.

Step 6: In the left navigation pane, in the Manage section, select **Devices**.

Step 7: Select the **Gateways** tab, and then click the gear icon in top right.

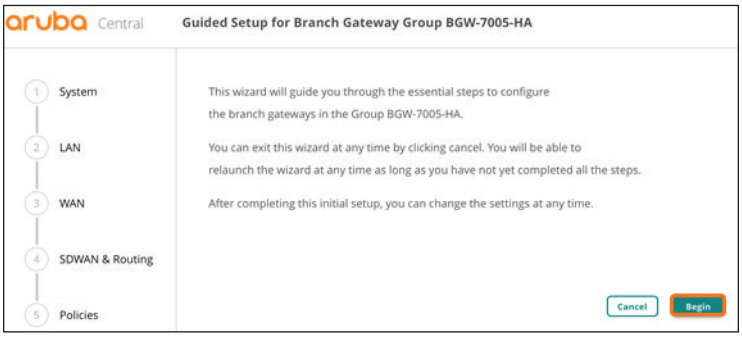


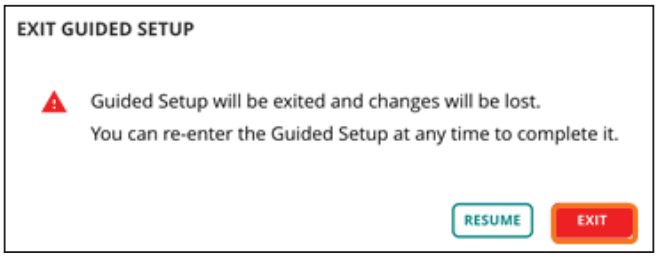
Step 8: In the Set Group Type dialog box, select **Branch Gateway**, and then click **Save Settings**.



For educational purposes, the next step exits the guided setup.

Step 9: In the Guided Setup dialog box, click **Cancel**, and then click **Exit**.



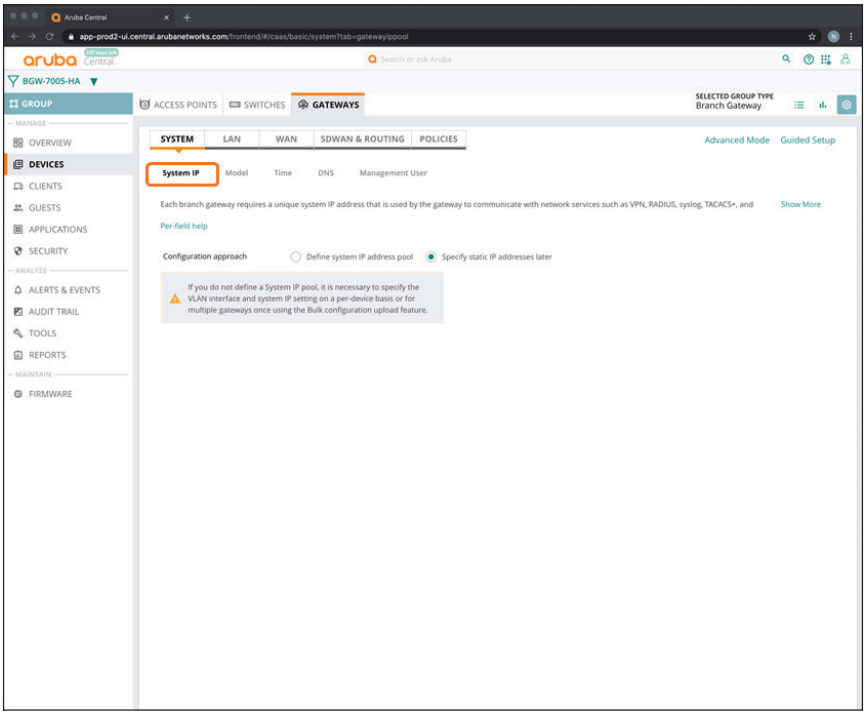


6.2 Create the System IP Address Pool for the Branch Gateway Group

Use this procedure to define the system IP address pool that the gateway will use for network services.

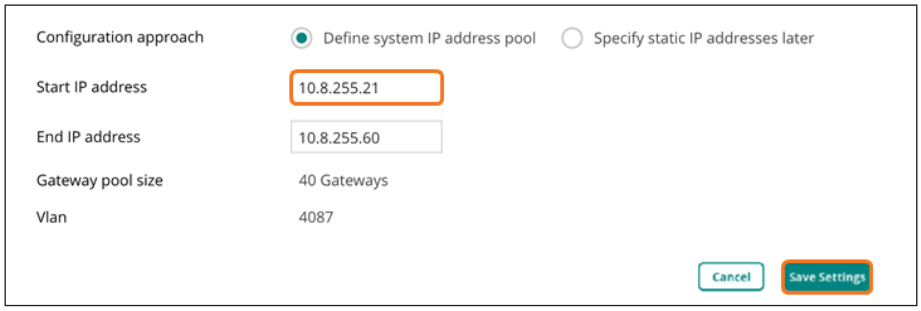
Step 1: On the Gateways tab, in the System section, select **System IP**.

Step 2: Select **Define system IP address pool**.

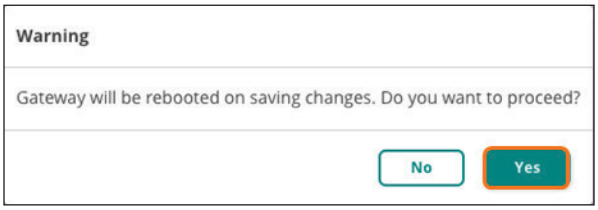


Step 3: In the **Start IP address** box, enter **10.8.255.21**.

Step 4: In the **End IP address** box, enter **10.8.255.60**, and then click **Save Settings**.



Step 5: In the Warning dialog box, click **Yes**. When you move gateways to a group, the gateways need to reboot to complete the group configuration.



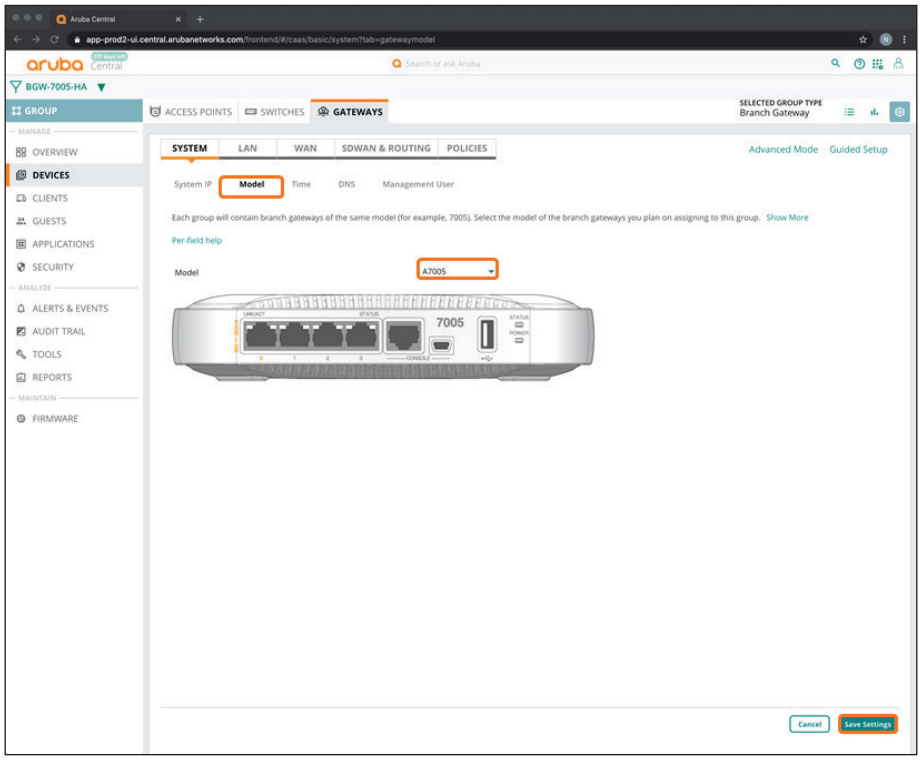
6.3 Select the Hardware Model of the Gateway Group

You can have only one gateway model per branch in the gateway group.

Step 1: On the Gateways tab, in the System section, select **Model**.

Step 2: In the Model drop-down list, select the hardware model for the branch gateway(s) in the group (example: **A7005**).

Step 3: Click **Save Settings**.

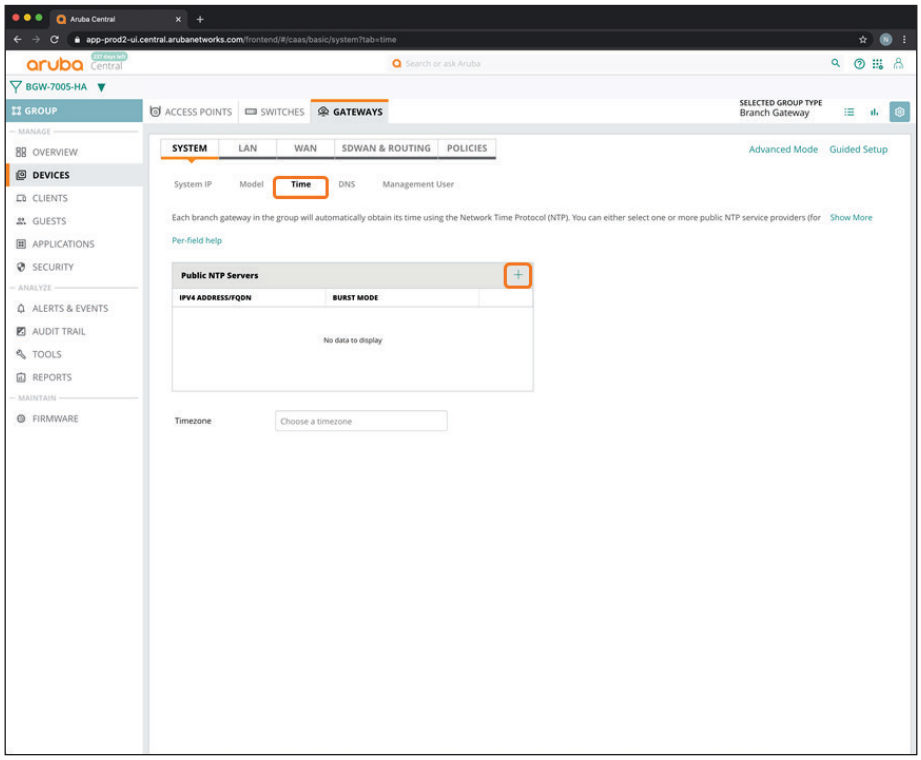


6.4 Select the Branch Gateway Group Time Zone

Use this procedure to set the NTP parameters and time zone to keep the branch gateway clocks synchronized.

Step 1: On the Gateways tab, in the System section, select **Time**.

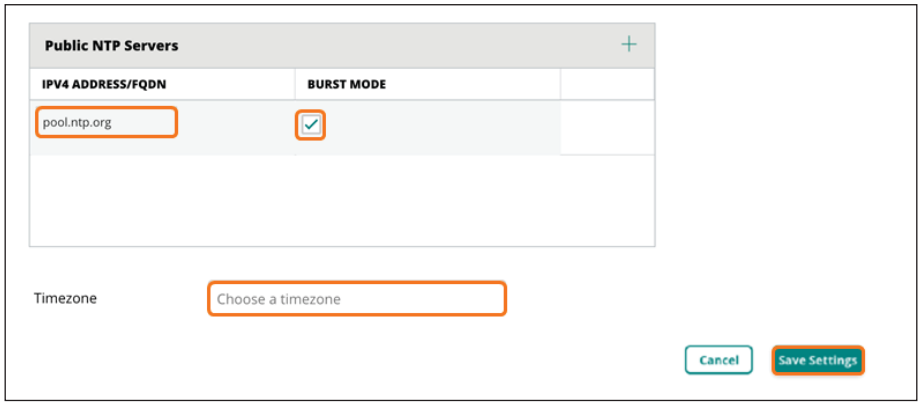
Step 2: In the **Public NTP Servers** table, click the plus (+) sign to add a public NTP server.



Step 3: In the **IPv4 Address/FQDN** column, enter pool.ntp.org or another NTP server address.

Step 4: Select **Burst Mode** if this feature is supported by the NTP server. Burst Mode provides faster time synchronization.

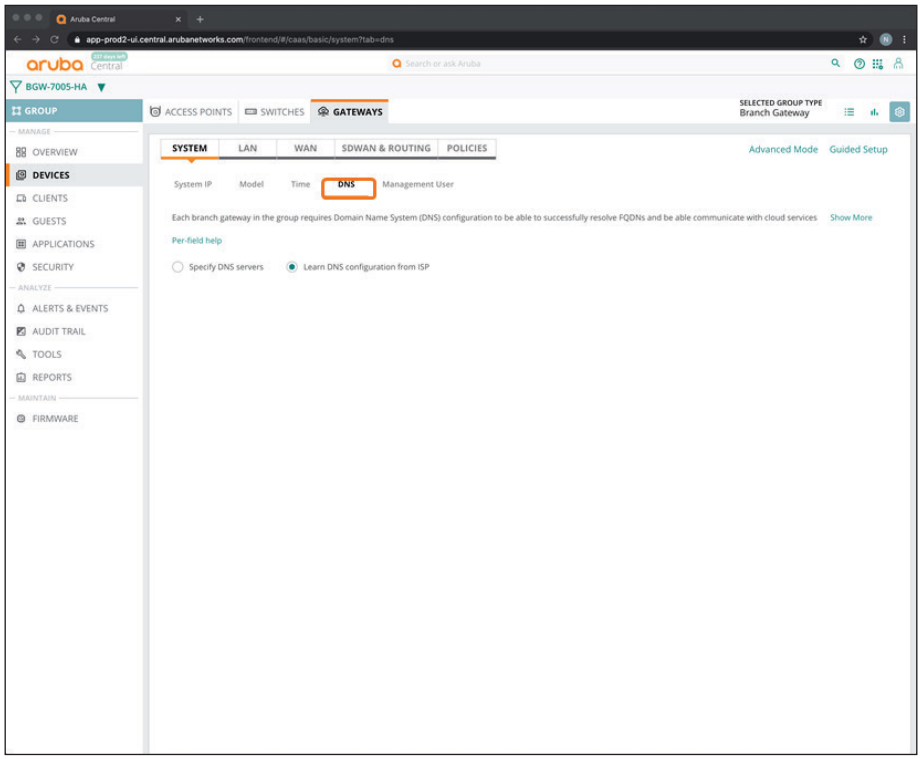
Step 5: In the **Timezone** drop-down list, choose your timezone, and then click **Save Settings**.



6.5 Configure the DNS Servers for the Branch Gateway Group

You must specify the DNS server(s) that the gateway uses to communicate to Aruba Central.

Step 1: On the Gateways tab, in the System section, select **DNS**.



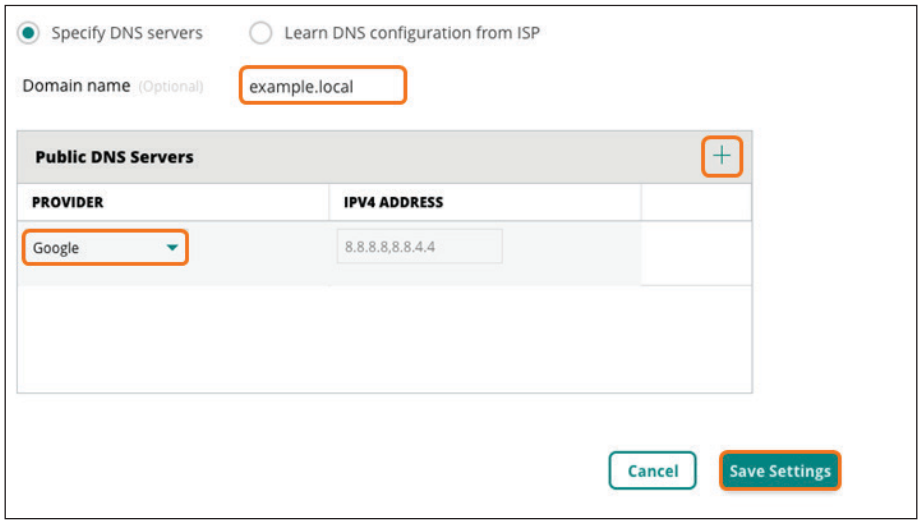
Step 2: Select **Specify DNS servers**.

Step 3: In the **Domain Name** text box, enter a domain name (example: **example.local**).

Step 4: In the **Public DNS Servers** table, click the plus (+) sign.

Step 5: In the **Provider** drop-down list, select one of the providers listed or manually configure the desired DNS server(s).

Step 6: Click **Save Settings**.

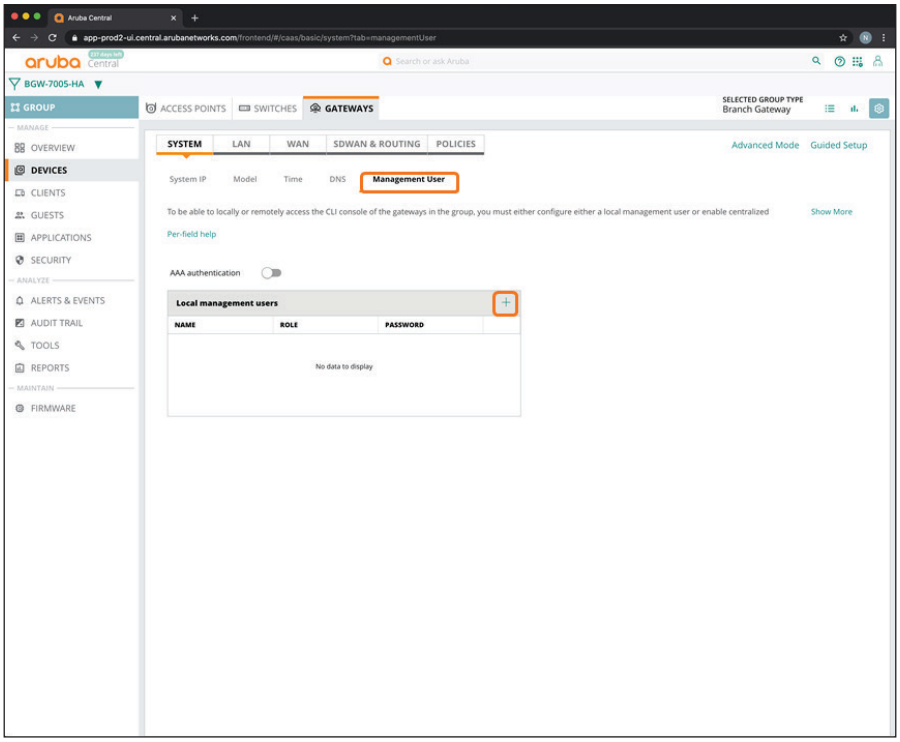


6.6 Create a Management User Account for the Branch Gateways

In this procedure, you create a local management user account so you can use CLI to access the gateway.

Step 1: On the Gateways tab, in the System section, select **Management User**.

Step 2: In the **Local Management User** table, click the plus (+) sign.



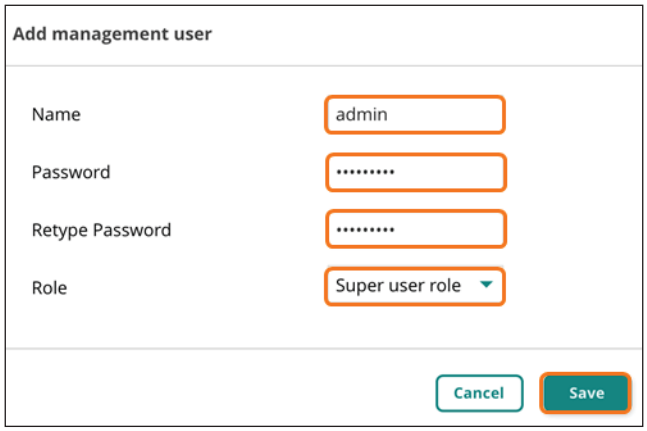
Step 3: In the Add Management User dialog box, implement the following settings:

- Name—**admin**
- Password—**password**
- Retype Password—**password**
- Role—Super user role

Step 4: Click **Save**.

> **Note** You can add additional users with other roles as needed. These additional users are optional.

Step 5: Click **Save Settings**.



6.7 Configure VLANs for the Branch Network Devices and Users

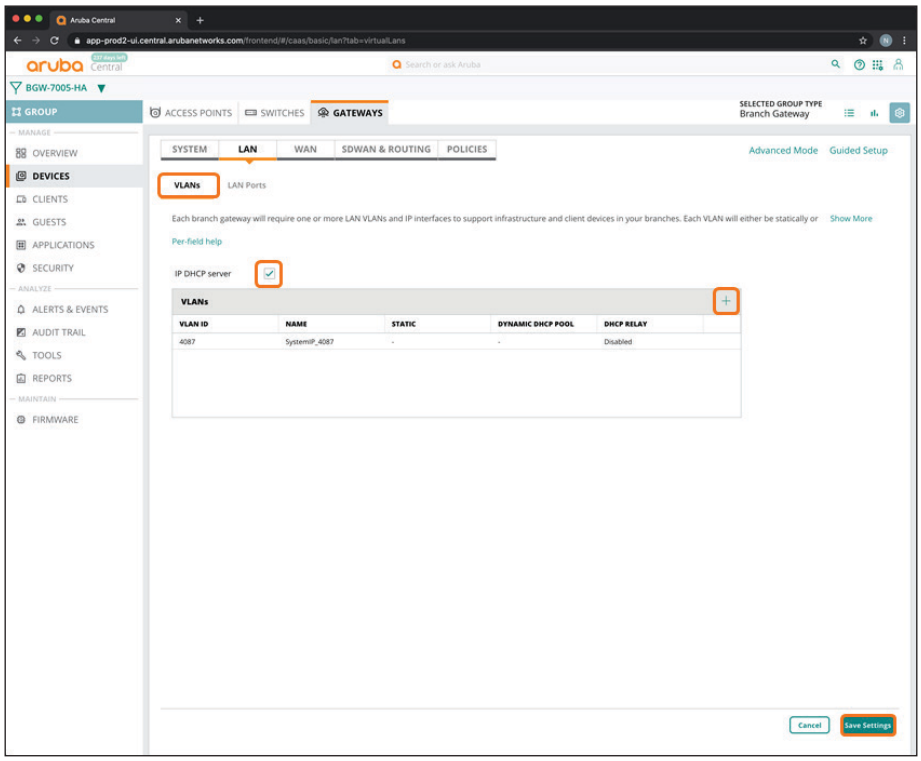
Use this procedure to define the VLANS for the branch network devices and users, as well as assign subnets at the device level.

Step 1: On the Gateways tab, in the LAN section, select **VLANs**.

Step 2: Select **IP DHCP server**.

Step 3: In the VLANs table, click the plus (+) sign.

In this example, we create a native VLAN 1 for management.

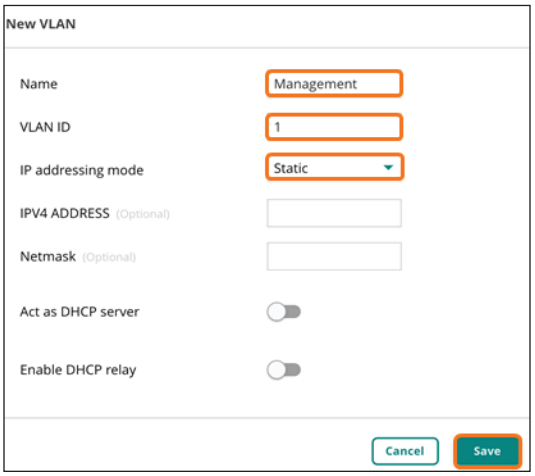


Step 4: In the New VLAN dialog box, implement the following settings:

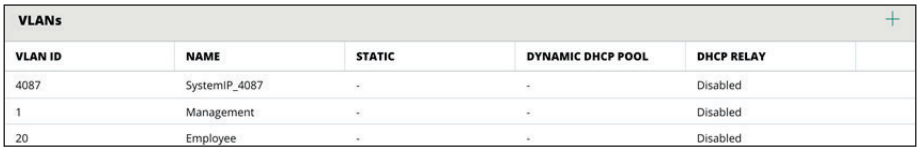
- Name—**Management**
- VLAN ID—**1**
- **IP addressing mode—Static**.

Step 5: Click **Save**.

Step 6: Repeat Step 3 - Step 5 for each additional user VLAN. For example, an **Employee** VLAN.



Step 7: Click **Save Settings**.

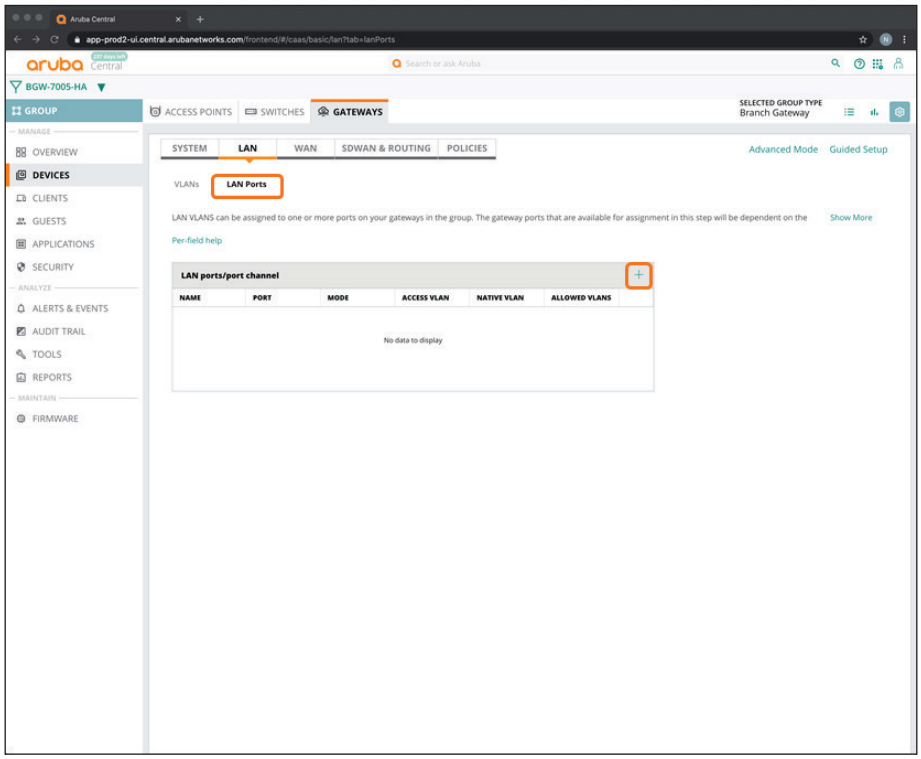


6.8 Configure the LAN Ports for the Branch Gateway

Assign the LAN ports that the downstream switches use and permit user and management VLANs.

Step 1: On the Gateways tab, in the LAN section, select **LAN Ports**.

Step 2: In the **LAN ports/port channel** table, click the plus (+) sign.



Step 3: In the New LAN port/port channel dialog box, in the Name box, enter a name for the new port (example: **LAN**).

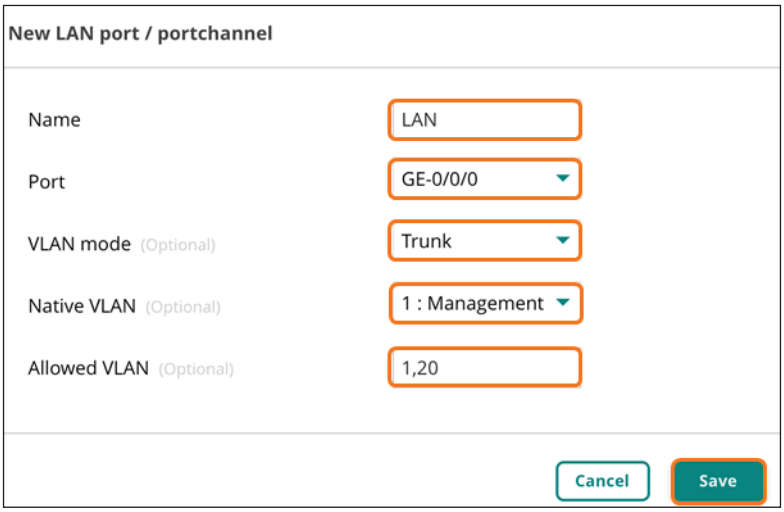
Step 4: In the **Port** drop-down list, select a physical port on the gateway (example: **GE-0/0/0**).

Step 5: In the VLAN mode drop-down list, select **Trunk**.

Step 6: In the **Native VLAN** drop-down box, select the management VLAN you created in Procedure 6.7 (example: **1 : Management**).

Step 7: In the **Allowed VLAN** box, enter the VLAN IDs for the VLANs allowed towards the LAN.

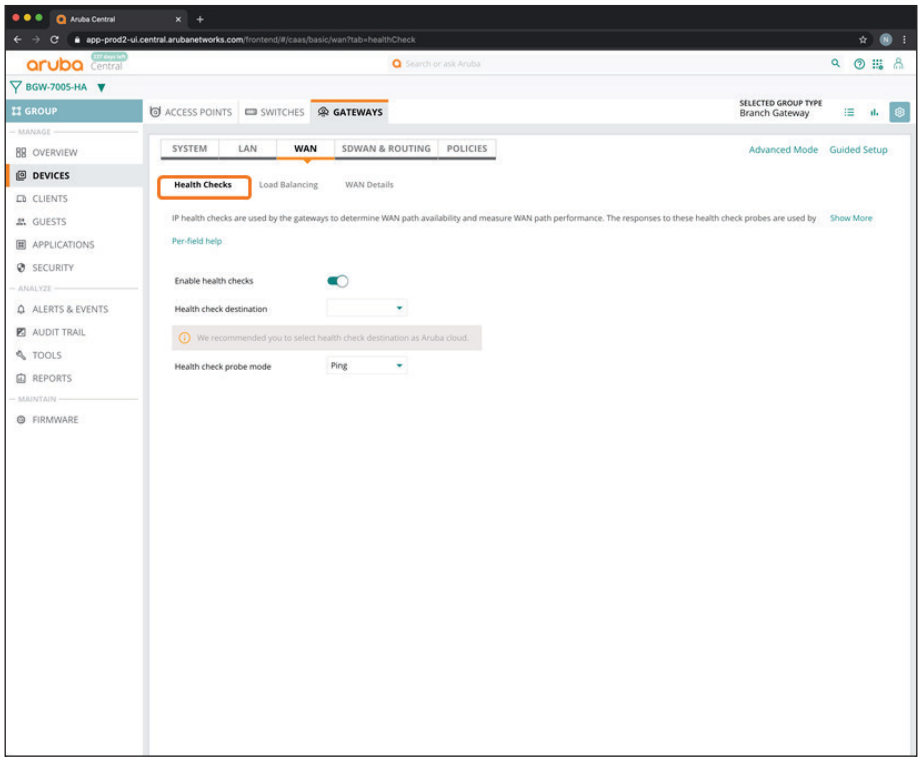
Step 8: Repeat Step 2 - Step 7 for each additional LAN port that you need to configure.



Step 9: Click **Save**, and then click **Save Settings**.

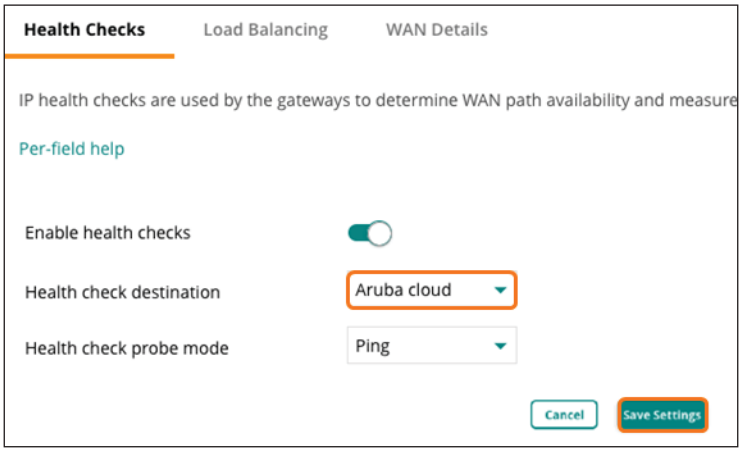
6.9 Configure WAN Health Checks

Step 1: On the Gateways tab, in the WAN section, select **Health Checks**.



Step 2: In the Health check destination drop-down list, select **Aruba cloud**.

Step 3: Click **Save Settings**.

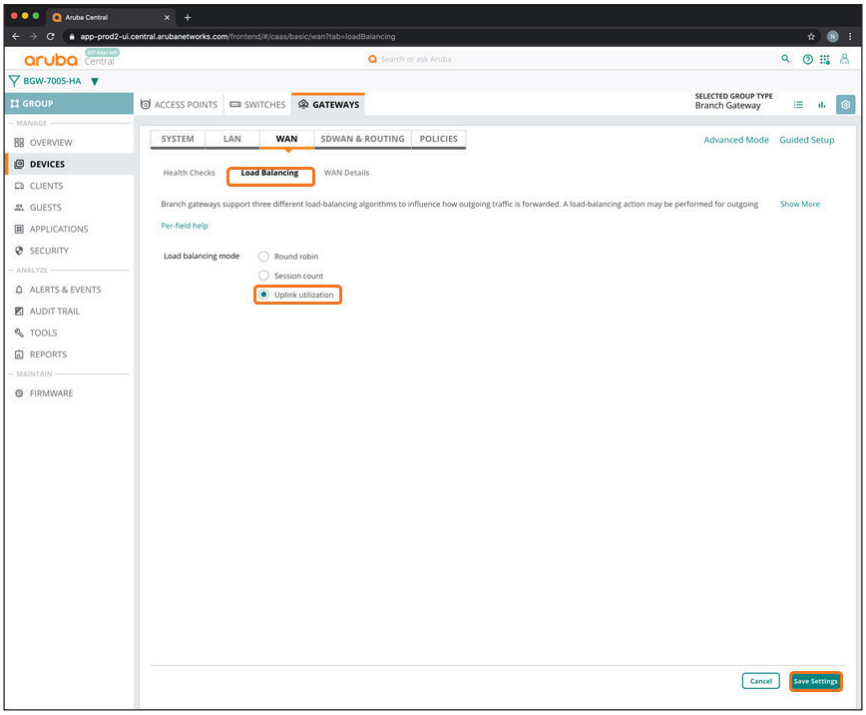


6.10 Configure the WAN Load Balancing Algorithm

Step 1: On the Gateways tab, in the WAN section, select **Load Balancing**.

Step 2: In the Load balancing mode list, select **Uplink utilization**.

Step 3: Click **Save Settings**.



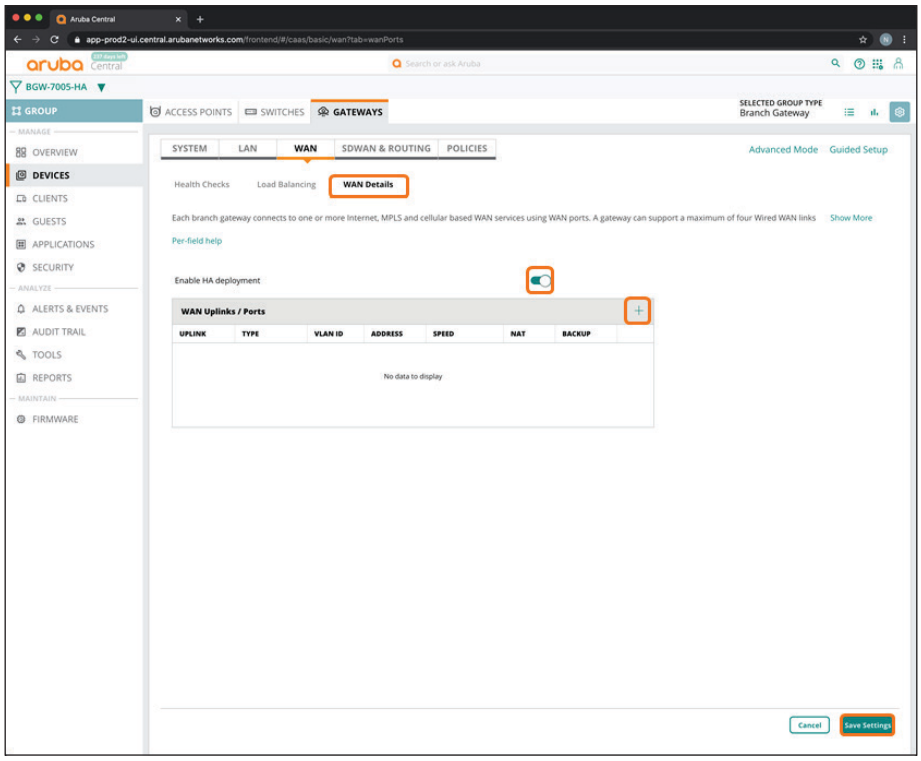
6.11 Configure the WAN Service Providers

In this procedure, you enable high availability (HA) and configure the WAN service providers. We use a dual gateway with internet and MPLS WAN for HA.

Step 1: On the Gateways tab, in the WAN section, select **WAN Details**.

Step 2: Click the **Enable HA Deployment** slider.

Step 3: In the **WAN Uplinks/Ports** table, click the plus (+) sign.



Step 4: In the Add/Edit WAN port dialog box, implement the following settings:

- **Uplink—Turbo**

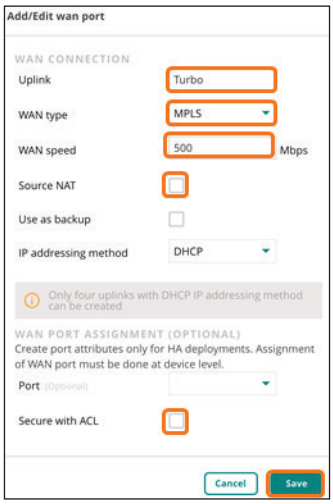
> **Note** If you choose an MPLS WAN, the uplink name must match the name used at the VPNCs to enable automated tunnel orchestration between gateways.

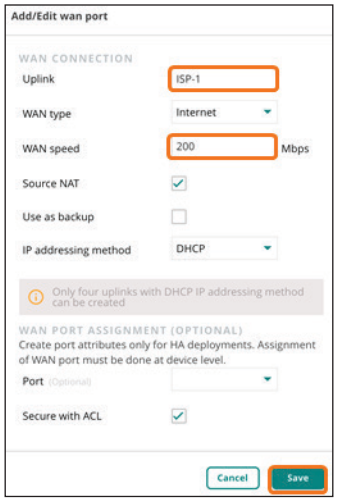
- **WAN type—MPLS**
- **WAN speed—500**
- **Source NAT**—Unselect this option
- **Secure with ACL**—Unselect this option

Step 5: Click **Save**.

Step 6: Repeat Step 3 - Step 5 for each WAN provider.

These screenshots illustrate a dual gateway with an internet and an MPLS WAN provider.



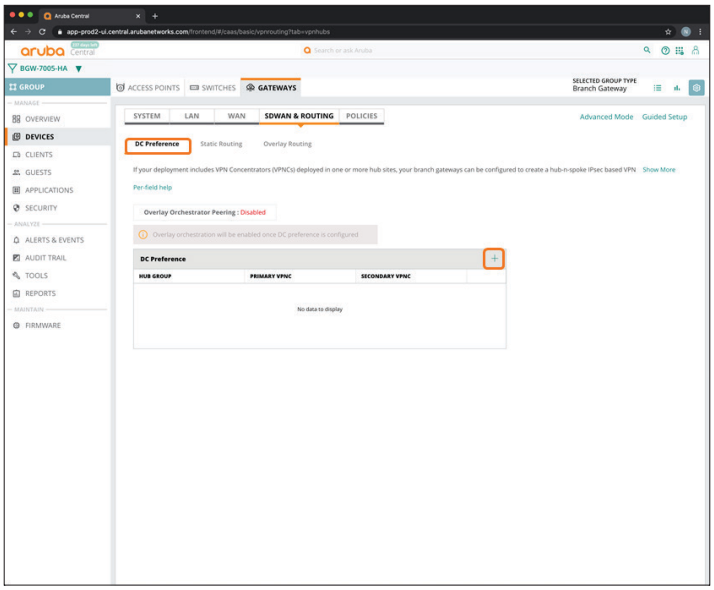


6.12 Specify the SD-WAN Data Center Preferences

Use this procedure to assign data center preferences for tunnel orchestration toward the VPN concentrators.

Step 1: On the Gateways tab, in the SDWAN & Routing section, select **DC Preferences**.

Step 2: In the **DC Preference** table, click the plus (+) sign to add a VPNC hub group.



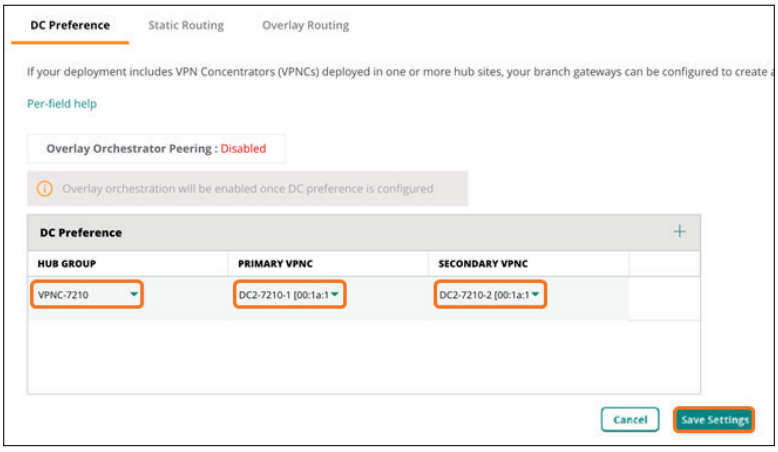
Step 3: In the **Hub Group** drop-down list, select a VPNC group to assign the preferred data center (example: **VPNC-7210**).

Step 4: In the **Primary VPNC** drop-down list, select the primary VPNC.

Step 5: In the **Secondary VPNC** drop-down list, select the secondary VPNC.

Step 6: Repeat Step 2 - Step 5 if a secondary data center is used.

Step 7: Click **Save Settings**.



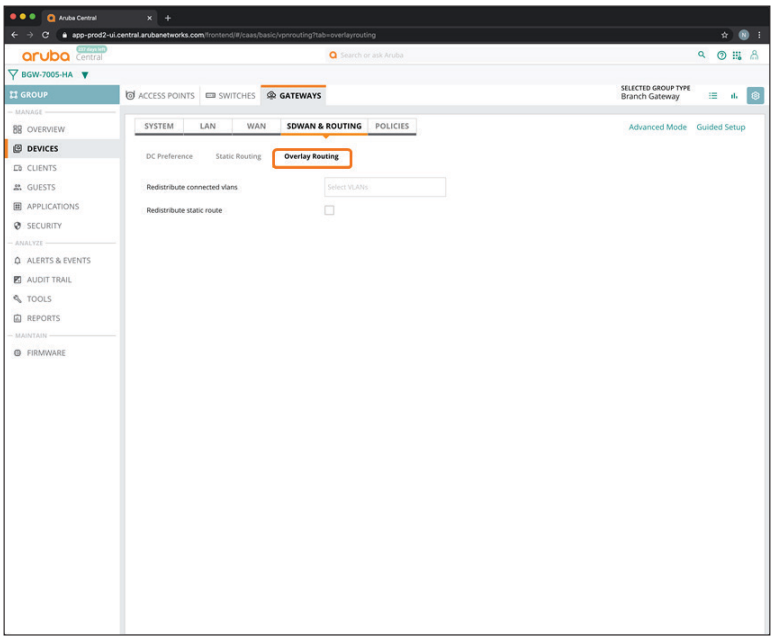
Aruba Central automatically enables overlay orchestrator peering after you click Save Settings.

DC Preference		
HUB GROUP	**PRIMARY VPNC**	**SECONDARY VPNC**
VPNC-7210	DC2-7210-1 [00:1a:1e:05:01:a0]	DC2-7210-2 [00:1a:1e:05:01:28]
VPNC-7024	DC1-7024-1 [00:0b:86:bb:bb:a7]	DC1-7024-2 [00:0b:86:bb:ff:a7]

6.13 Configure the SD-WAN Overlay Routing

In this procedure, you redistribute the branch subnets in the VPN overlay to enable the dynamic routing functionality at the headend site.

Step 1: On the Gateways tab, in the SDWAN & Routing section, select **Overlay Routing**.



Step 2: In the **Redistribute connected vlans** box, select all of the user VLANs and system IP VLAN for overlay redistribution.

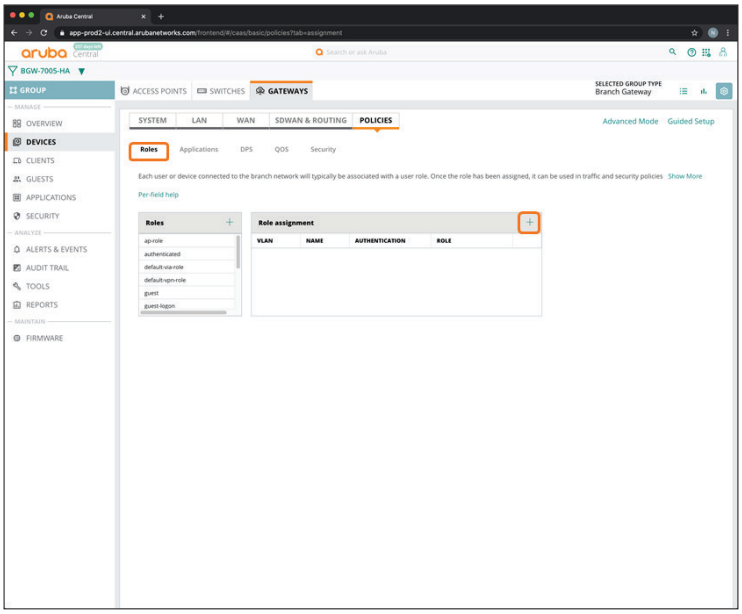
Step 3: Click **Save Settings**.

6.14 Configure Role-Based Policies for the Branch Gateways

Use this procedure to define the policies for the user VLANs to allow network access.

Step 1: On the Gateways tab, in the Policies section, select **Roles**.

Step 2: In the **Role assignment** table, click the plus (+) sign.



Step 3: In the Role assignment dialog box, implement the following settings:

- VLAN ID—**Management (1)**
- **Initial Role—authenticated**
- **Authentication**—Disable this option

Step 4: Click **Save**.

Step 5: Repeat Step 2 - Step 4 for all of the user VLANs.

ROLE ASSIGNMENT

VLAN	NAME	AUTHENTICATION	ROLE
1	Management	Disabled	authenticated
20	Employee	Disabled	authenticated

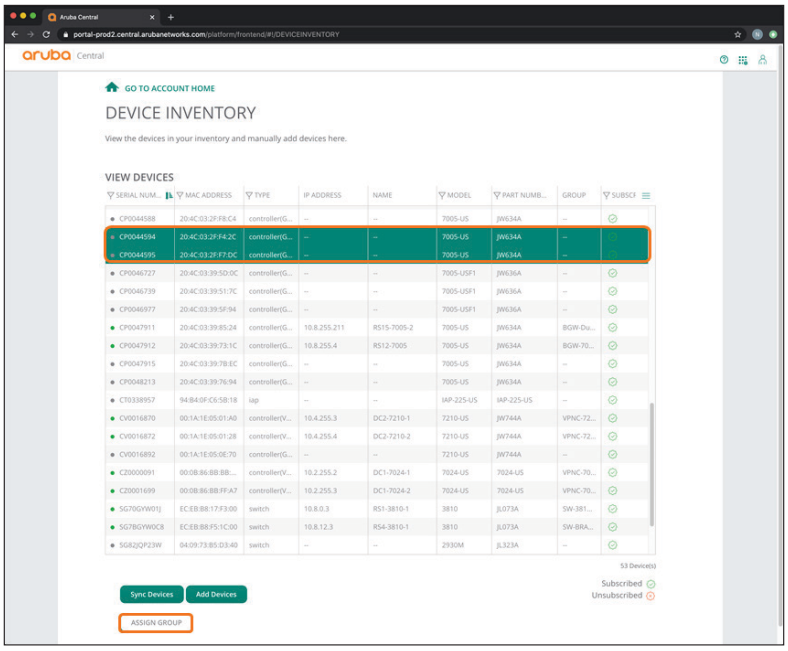
Procedures

Configuring a Branch Gateway Device—Two Branch Gateways per Branch

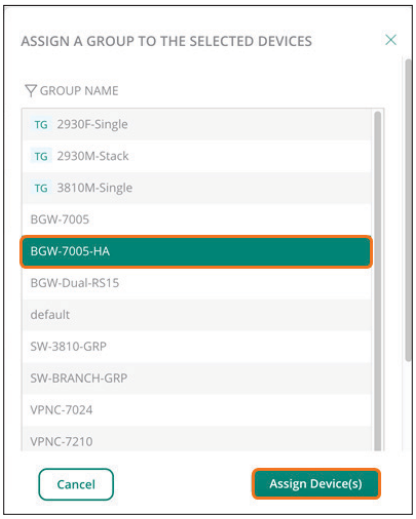
7.1 Assign the Branch Gateway Devices to a Group

Step 1: On the Aruba Central Account Home page, select **Device Inventory**.

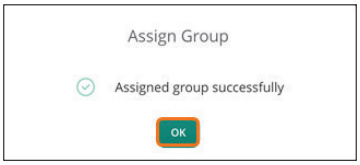
Step 2: In the View Devices table, select two branch gateways, and then click **Assign Group**.



Step 3: In the Assign a Group to the Selected Devices dialog box, select the Branch Gateway group you created in Procedure 6.1 (example: **BGW-7005-HA**).



Step 4: Click **Assign device(s)**, and then click **OK**.



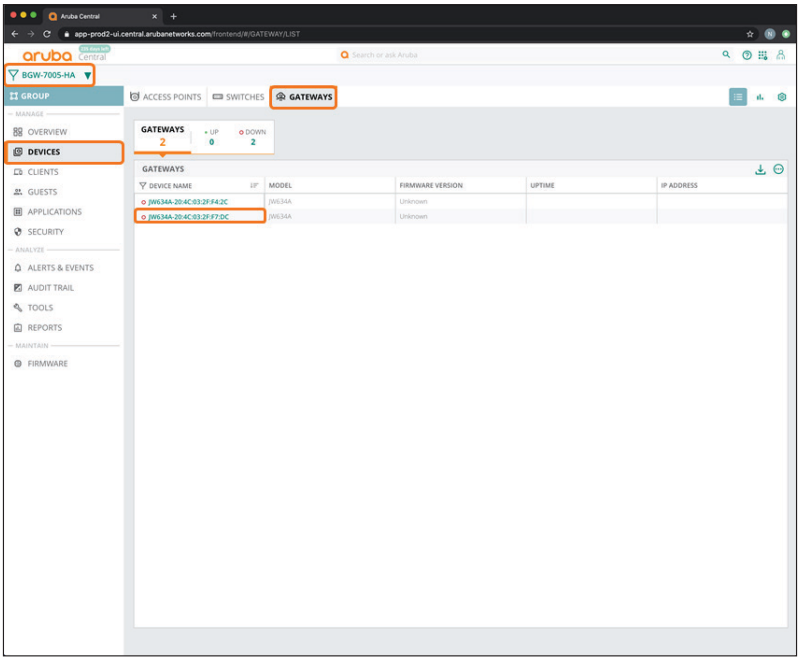
7.2 Initiate the Primary Branch Gateway Configuration

Step 1: On the Aruba Central Account Home page, launch the **Network Operations app**.

Step 2: In the filter drop-down list, select the branch gateway group you assigned the devices to in Procedure 7.1 (example: **BGW-7005-HA**).

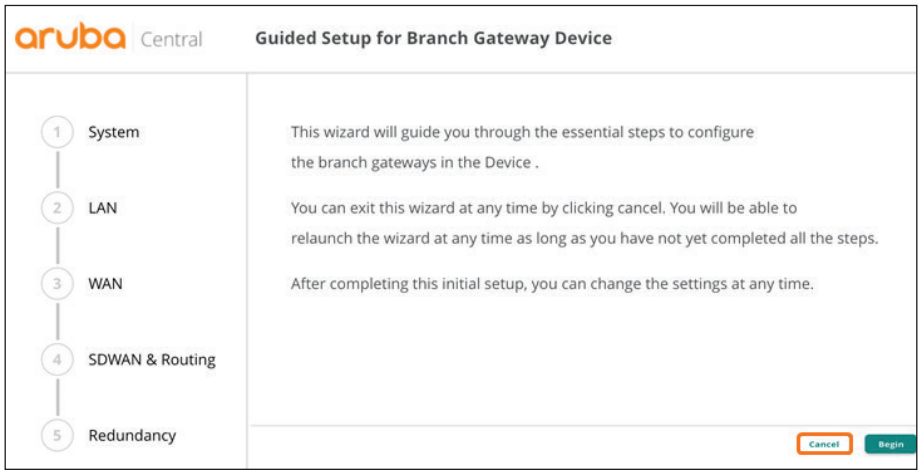
Step 3: In the left navigation pane, in the Manage section, select **Devices**, and then select the **Gateways** tab.

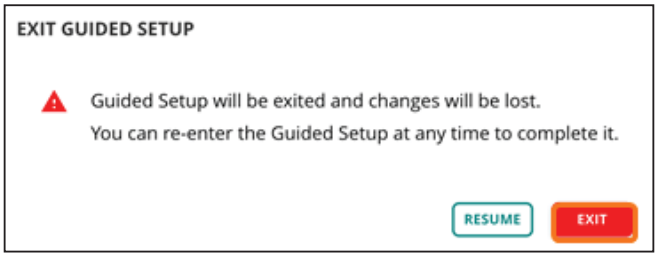
Step 4: In the **Gateways** table, select the device you intend to configure as the primary branch gateway.



For educational purposes, the next step exits the guided setup.

Step 5: In the Guided Setup dialog box, click **Cancel**, and then click **Exit**.

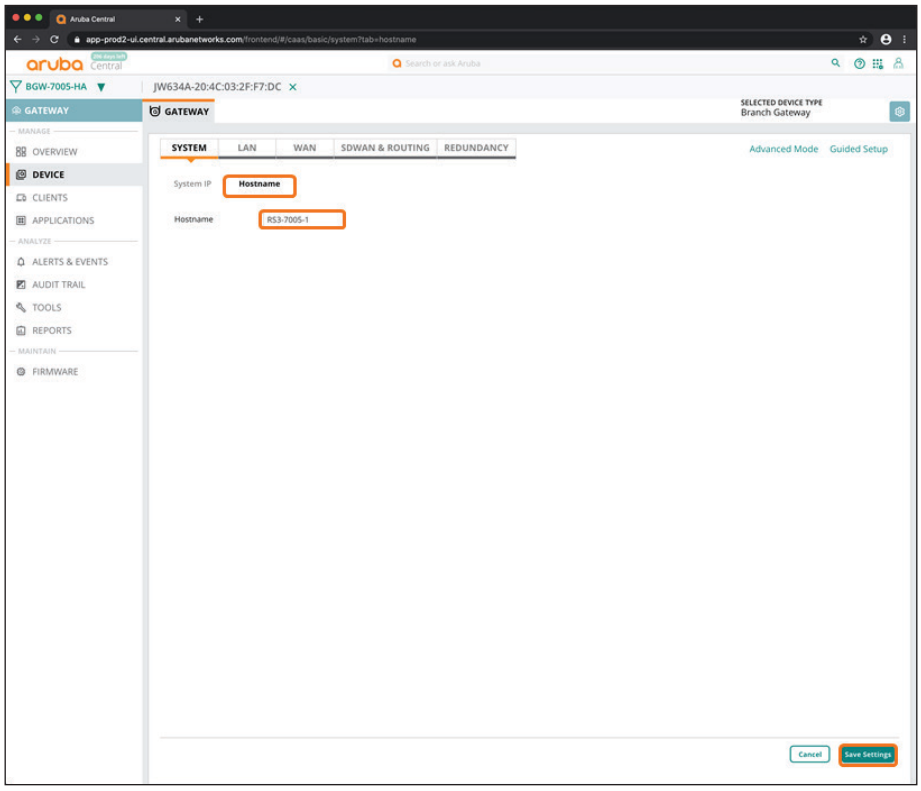




7.3 Assign a Hostname to the Primary Branch Gateway Device

Step 1: On the Gateway tab, in the System section, select **Hostname**.

Step 2: In the **Hostname** box, enter a name (example: **RS3-7005-1**), and then click **Save Settings**.

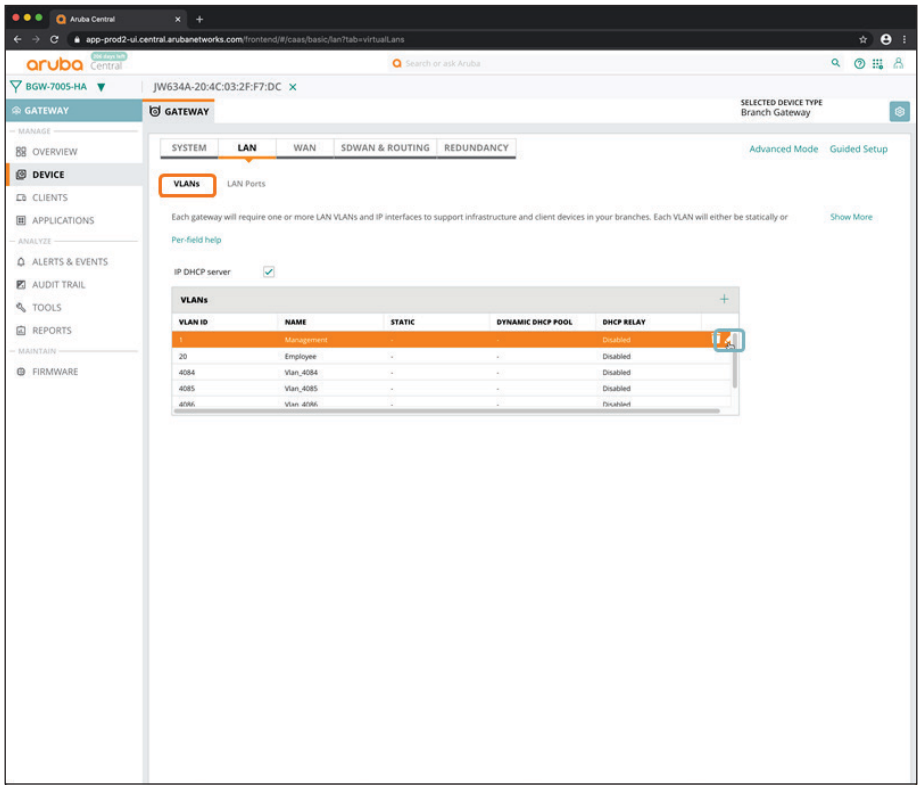


7.4 Assign IP Addresses to the VLAN

Use this procedure to assign LAN VLAN IP addresses and set the DHCP scope for the management and user LANs.

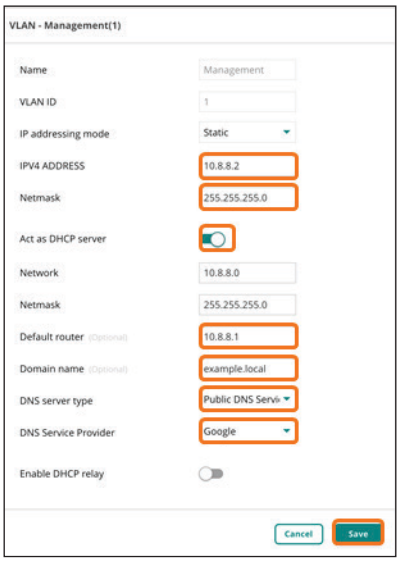
Step 1: On the Gateway tab, in the LAN section, select **VLANs**.

Step 2: In the VLANs table, select **Management**, and then click the pencil icon.



Step 3: In the VLAN - Management dialog box, implement the following settings:

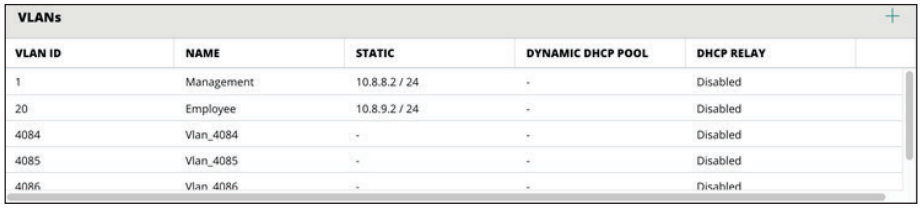
- **IPV4 Address—10.8.8.2**
- **Act as DHCP server**—Enable this option
- **DNS server type—Public DNS Server**
- **DNS Service Provider—Google**



Step 4: Click **Save**.

Step 5: Repeat Step 2 - Step 4 for any additional VLANs (example: **Employee**).

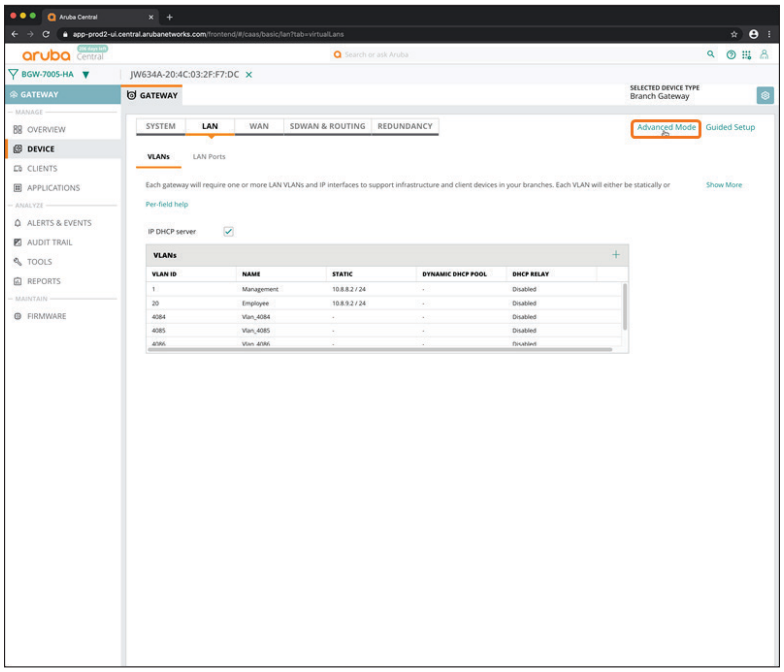
Step 6: Click **Save Settings**.



7.5 Set the DHCP Scope

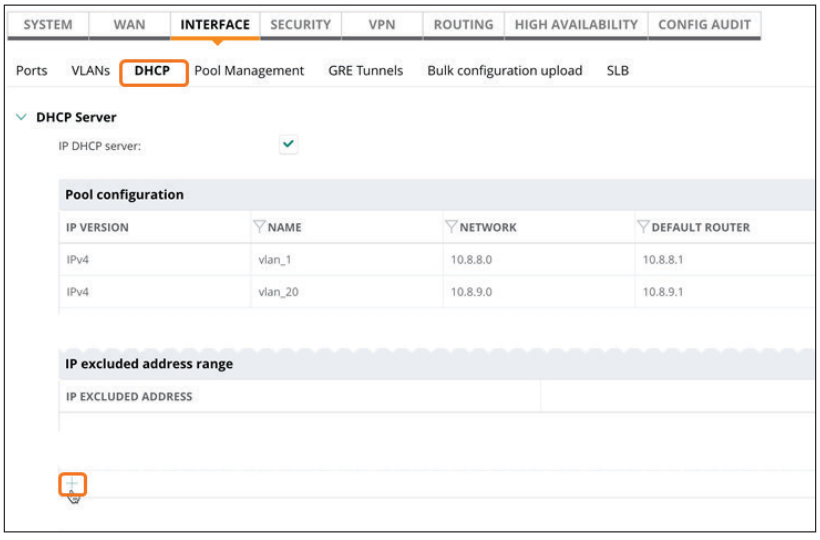
Step 1: On the Gateway tab, in the LAN section, select **VLANs**.

Step 2: Click **Advanced Mode**.

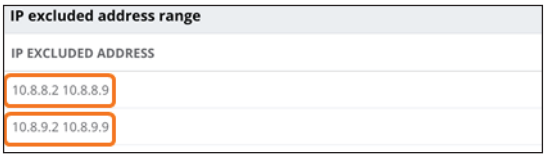


Step 3: Select the **Interface** tab, and then select **DHCP**.

Step 4: In the **IP excluded address range** table, click the plus (+) sign.



Step 5: Enter the IP address ranges that you want to exclude from the DHCP scopes.



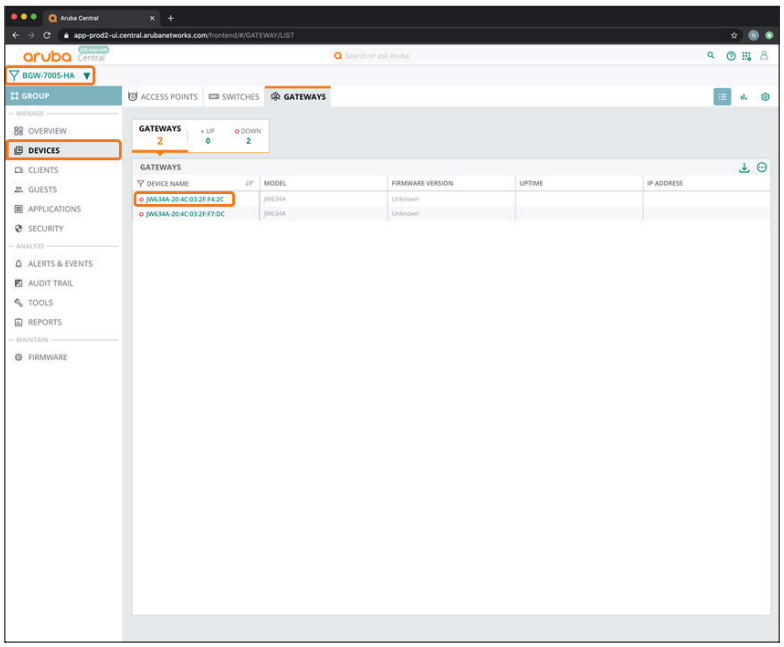
Step 6: Click **Save Settings** to return to Basic Mode.

7.6 Initiate the Secondary Branch Gateway Configuration

Step 1: In the filter drop-down list, select the branch gateway group you assigned the devices to in Procedure 7.1 (example **BGW-7005-HA**).

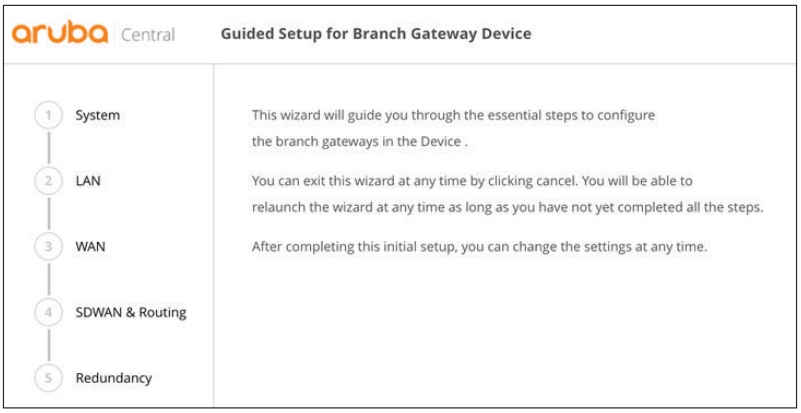
Step 2: In the left navigation pane, in the Manage section, select **Devices**, and then select the **Gateways** tab.

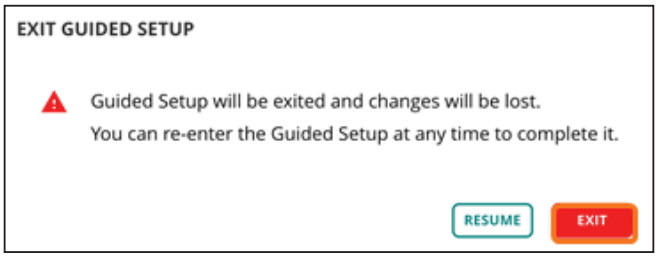
Step 3: In the **Gateways** table, select the device you intend to configure as the secondary branch gateway.



For educational purposes, the next step exits the guided setup.

Step 4: In the Guided Setup dialog box, click **Cancel**, and then click **Exit**.

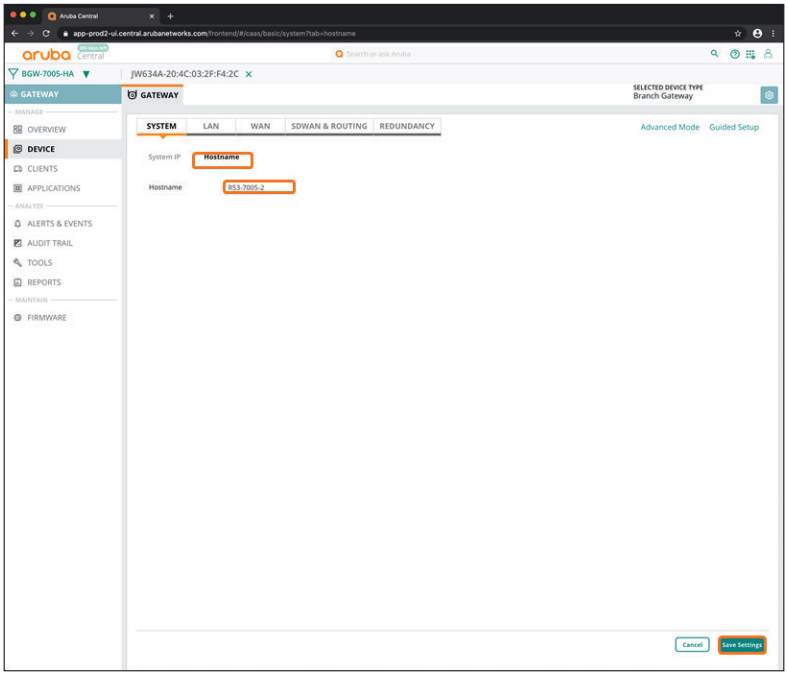




7.7 Assign a Hostname to the Secondary Branch Gateway

Step 1: On the Gateway tab, in the System section, select **Hostname**.

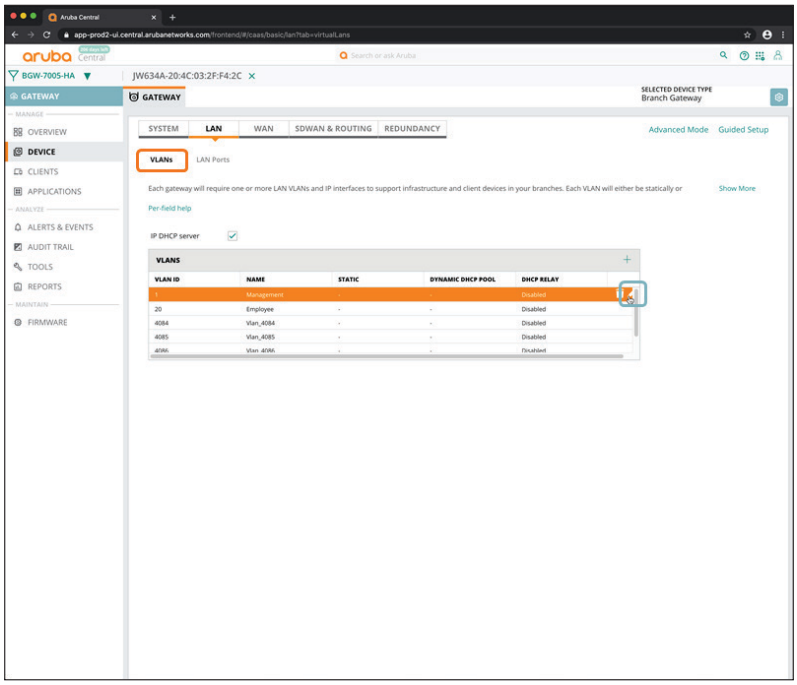
Step 2: In the **Hostname** box, enter a name (example: **RS3-7005-2**), and then click **Save Settings**.



7.8 Assign IP Addresses to the VLANs

Step 1: On the Gateway tab, in the LAN section, select **VLANs**.

Step 2: In the VLANs table, select **Management**, and then click the pencil icon.



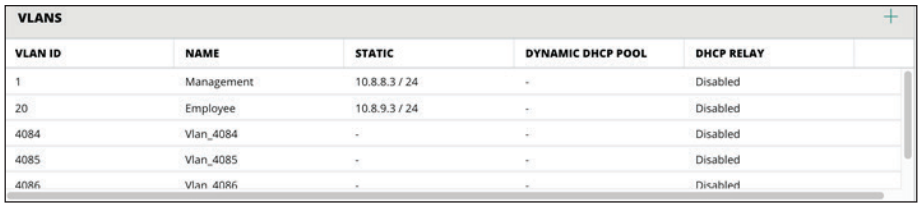
Step 3: In the VLAN - Management dialog box, implement the following settings:

- **IPV4 Address—10.8.8.3**
- **Act as DHCP server**—Enable this option
- **DNS server type—Public DNS Server**
- **DNS Service Provider—Google**

Step 4: Click **Save**.

Step 5: Repeat Step 2 - Step 4 for each additional VLAN (example: **Employee**).

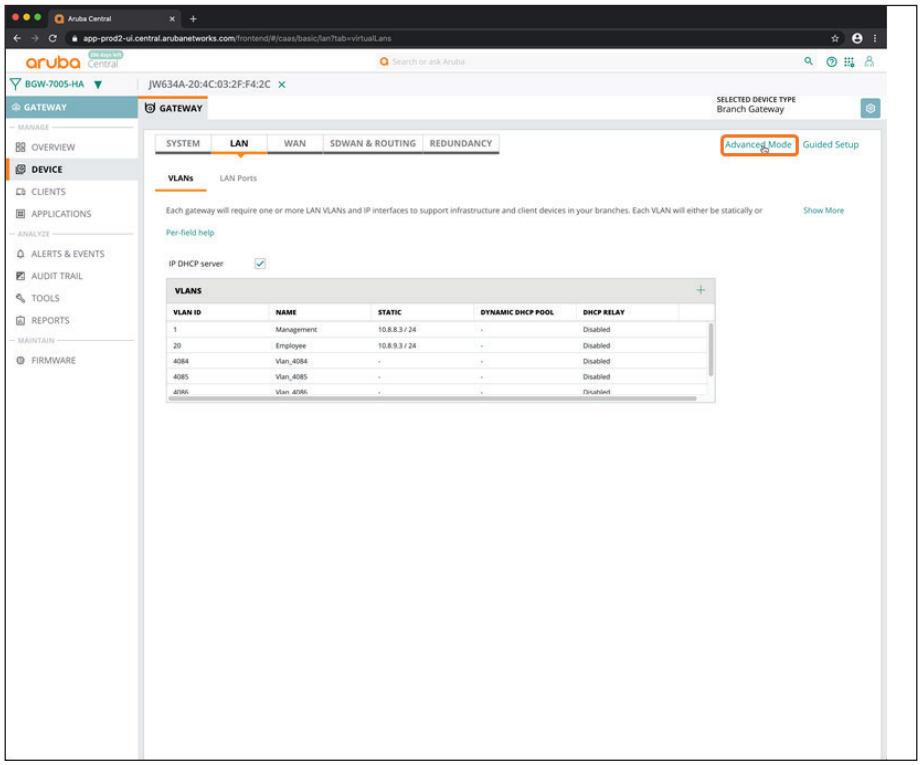
Step 6: Click **Save Settings**.



7.9 Set the DHCP Scope

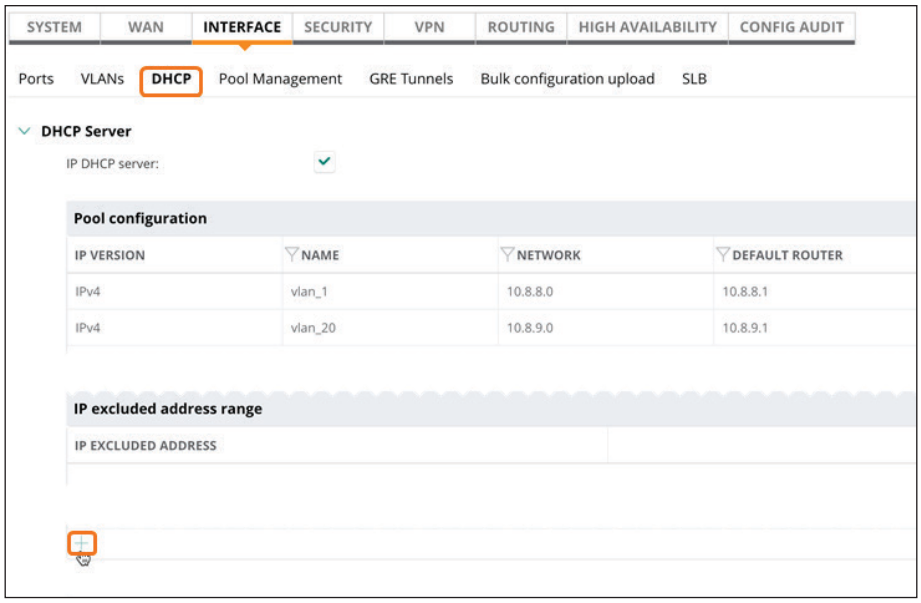
Step 1: On the Gateway tab, in the LAN section, select **VLANs**.

Step 2: Click **Advanced Mode**.

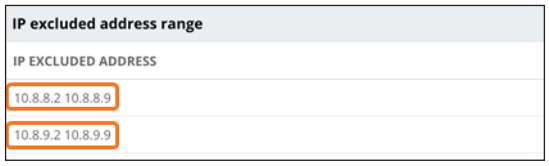


Step 3: Select the **Interface** tab, and then select **DHCP**.

Step 4: In the **IP excluded address range** table, click the plus (+) sign.



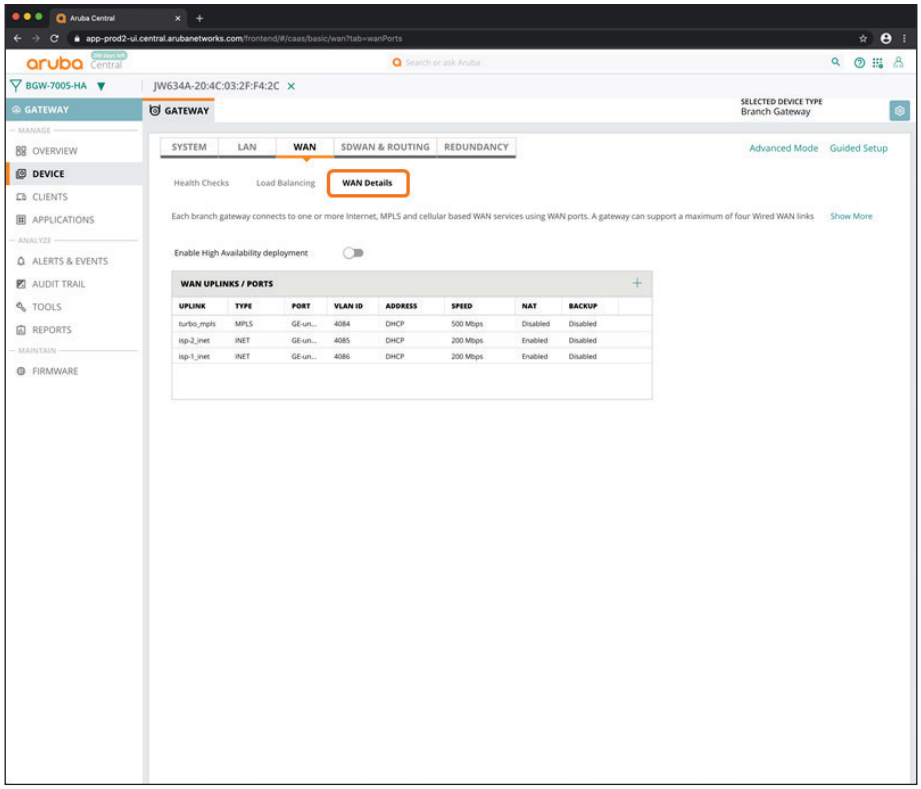
Step 5: Enter the IP address ranges that you want to exclude from the DHCP scopes.



Step 6: Click **Save Settings** to return to Basic Mode.

7.10 Specify the WAN Ports

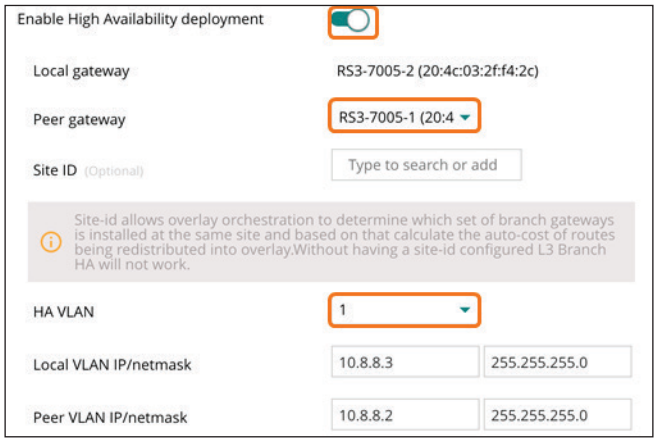
Step 1: On the Gateways tab, in the WAN section, select **WAN Details**.



Step 2: Click **Enable High Availability deployment** to allow the workflow to configure both gateways in the HA pair.

Step 3: In the **Peer gateway** drop-down list, select the primary gateway device (example: **RS3-7005-1**).

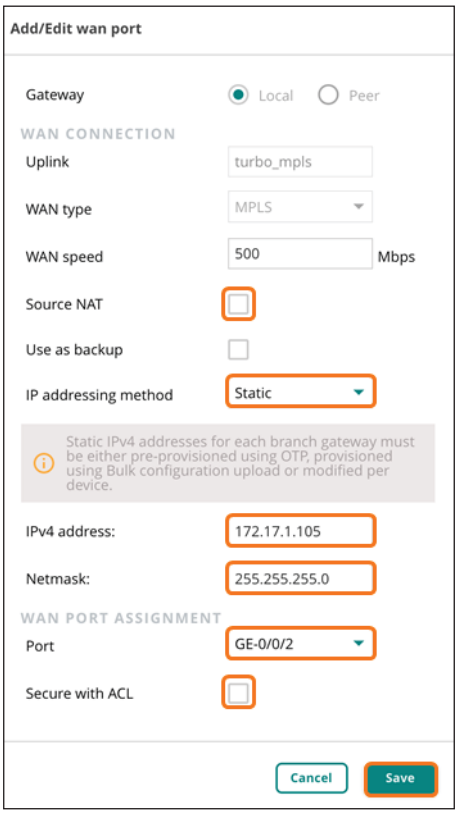
Step 4: In the **HA VLAN** drop-down list, select the **Management** VLAN ID. The Local VLAN IP/netmask and the Peer VLAN IP/netmask addresses should auto-populate.



Step 5: In the **WAN Uplinks/Ports** table, select one of the physical ports you added in Procedure 6.11 (examples: **Turbo** or **ISP-1**) to assign to the local WAN uplink for the primary gateway.

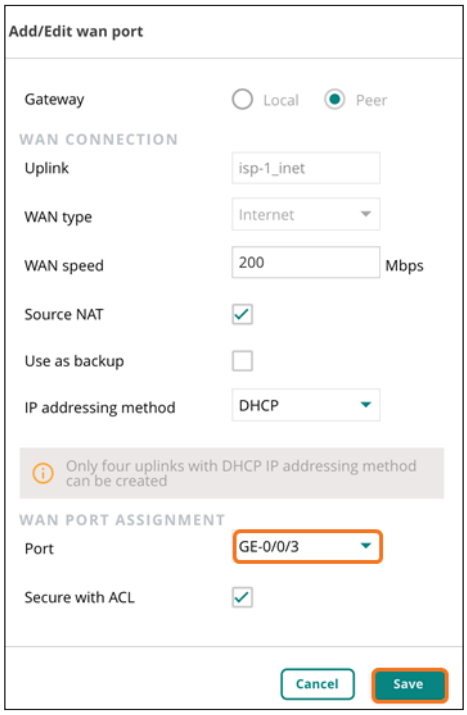
Step 6: In the Add/Edit wan port dialog box, implement the following settings:

- Port—**GE-0/0/2**
- **IP addressing method**—**Static** or **DHCP**
- **Secure with ACL**—Select this option only for Internet WAN



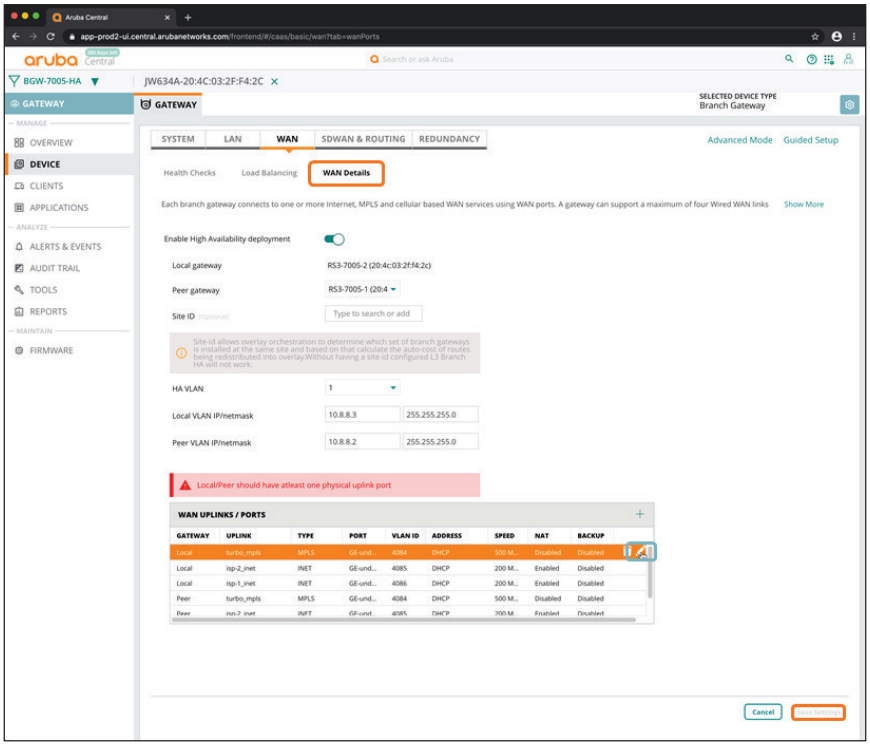
Step 7: Click **Save**.

Step 8: Repeat Step 5 - Step 7 to assign the remote (peer) WAN uplink for the primary gateway.



Step 9: Click **Save Settings**.

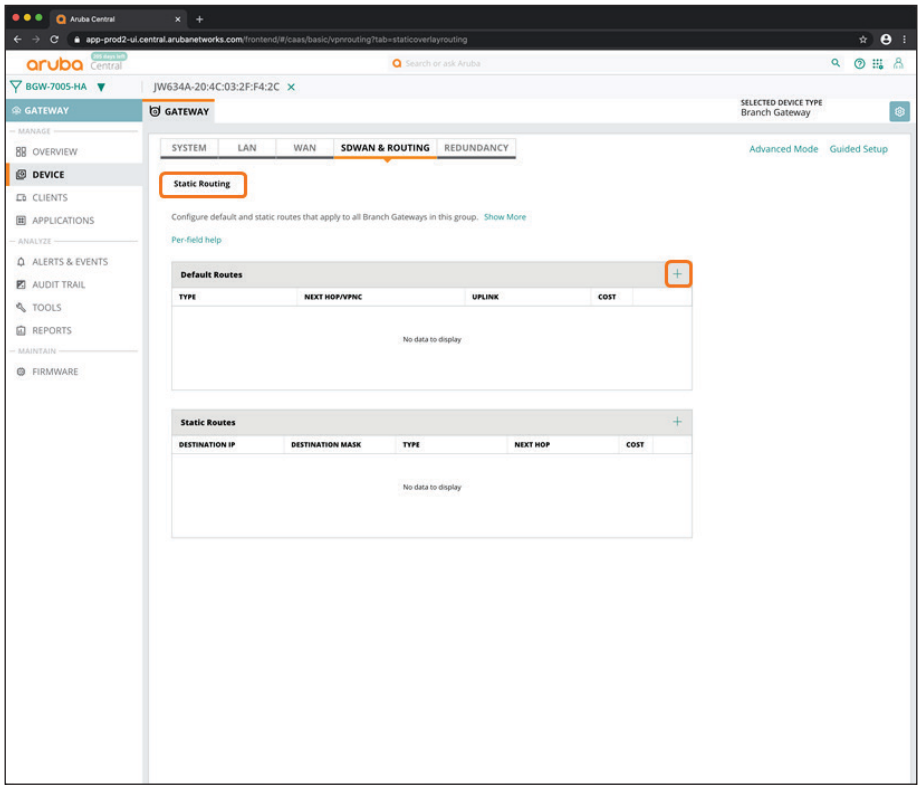
Step 10: In the **WAN Uplinks/Ports** table, verify that the WAN ports have been allocated to both gateways.



7.11 Assign a Default Route for MPLS

Step 1: On the Gateway tab, in the SDWAN & ROUTING section, select **Static Routing**.

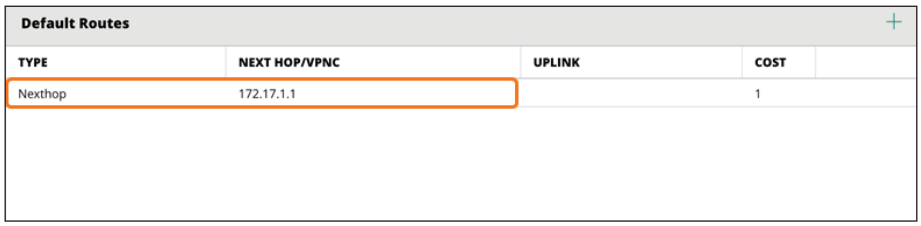
Step 2: In the **Default Routes** table, click the plus (+) sign to create a new static route.



Step 3: In the **Type** column, enter a name for the new route (example: **Nexthop**).

Step 4: In the **Next Hop/VPNC** column, enter the IP address for the route (example: **172.17.1.1**).

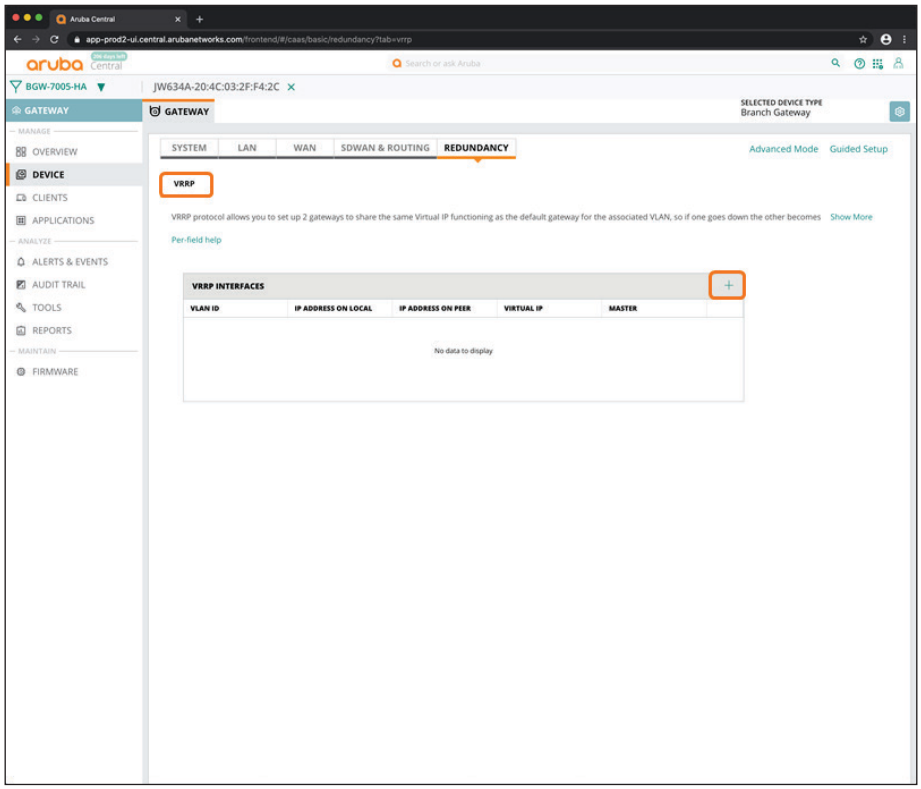
Step 5: Click **Save Settings**.



7.12 Configure the LAN Redundancy

Step 1: On the Gateway tab, in the Redundancy section, select **VRRP**.

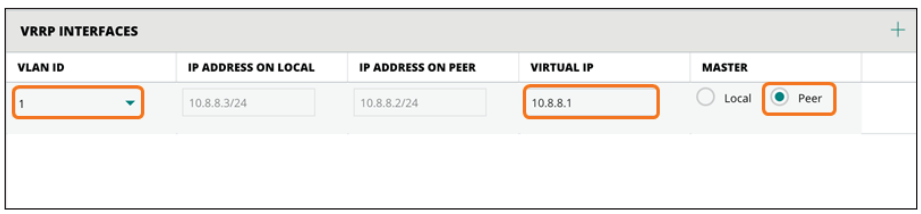
Step 2: In the **VRRP interfaces** table, click the plus (+) sign.



Step 3: In the **VLAN ID** drop-down list, select a LAN VLAN. The IP Address on Local and IP Address on Peer columns should auto-populate with the IP address values.

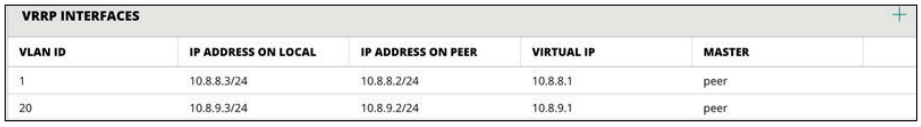
Step 4: In **Virtual IP** column, enter an IP address (typically .1 is used). For example, **10.8.8.1**.

Step 5: In the **Master** column, select which gateway you intend to use as the VRRP master.



Step 6: Repeat Step 2 - Step 4 for all user VLANs.

Step 7: Click **Save Settings**.



VRRP INTERFACES

VLAN ID	IP ADDRESS ON LOCAL	IP ADDRESS ON PEER	VIRTUAL IP	MASTER
1	10.8.8.3/24	10.8.8.2/24	10.8.8.1	peer
20	10.8.9.3/24	10.8.9.2/24	10.8.9.1	peer

Procedures

Configuring the Branch Switch UI Group

8.1 Create the Branch Switch UI Group

8.2 Configure the Switch VLANs

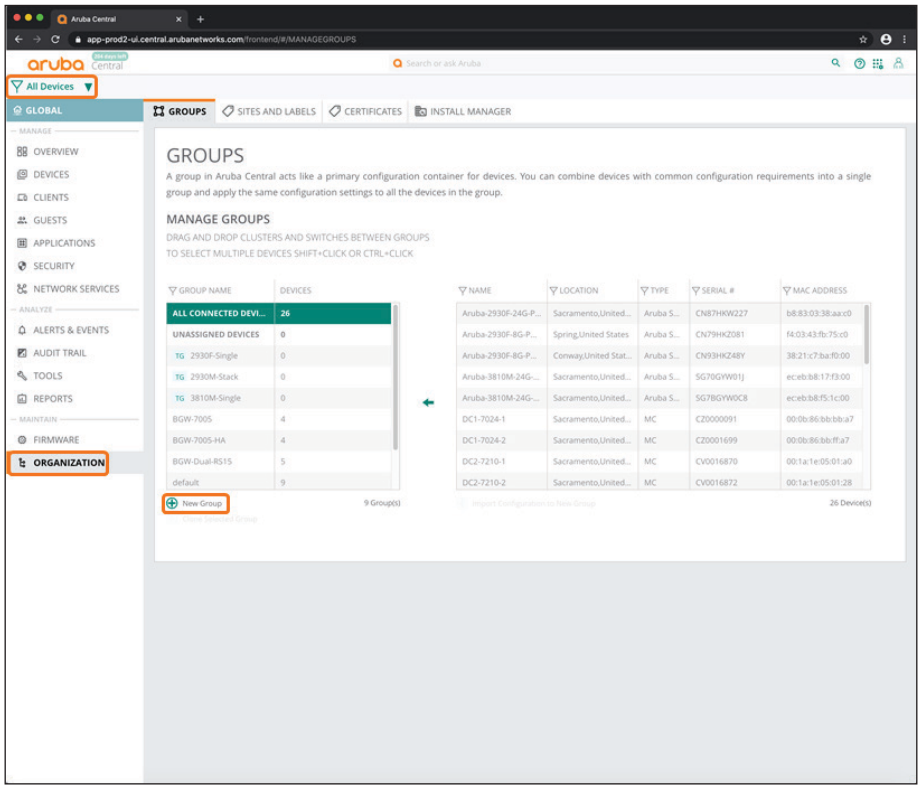
8.3 Configure the Uplinks for the VLANs

For branch switches, you can create a single UI group that includes different hardware models. You can configure common items like VLANs and uplink ports at the group level, and configure other settings, such as VLAN assignments at the user ports, at the device level.

8.1 Create the Branch Switch UI Group

Step 1: In the filter drop-down list, select **All Devices**, and then in the left navigation pane, select **Groups** or **Organization**.

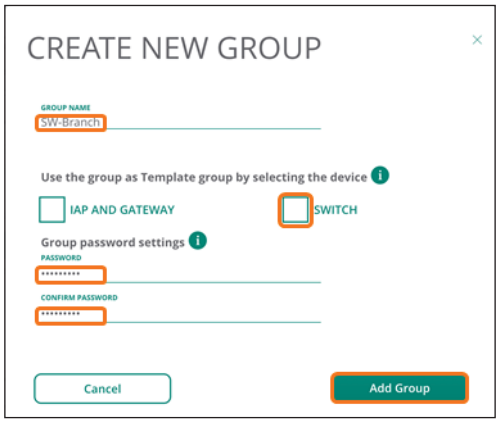
Step 2: On the Groups tab, click **New Group**.



Step 3: In the Create New Group dialog box, implement the following settings:

- **Group Name**—**SW-Branch**
- **Switch**—Unselect this option
- **Password**—**password**
- **Confirm Password**—**password**

Step 4: Click **Add Group**.



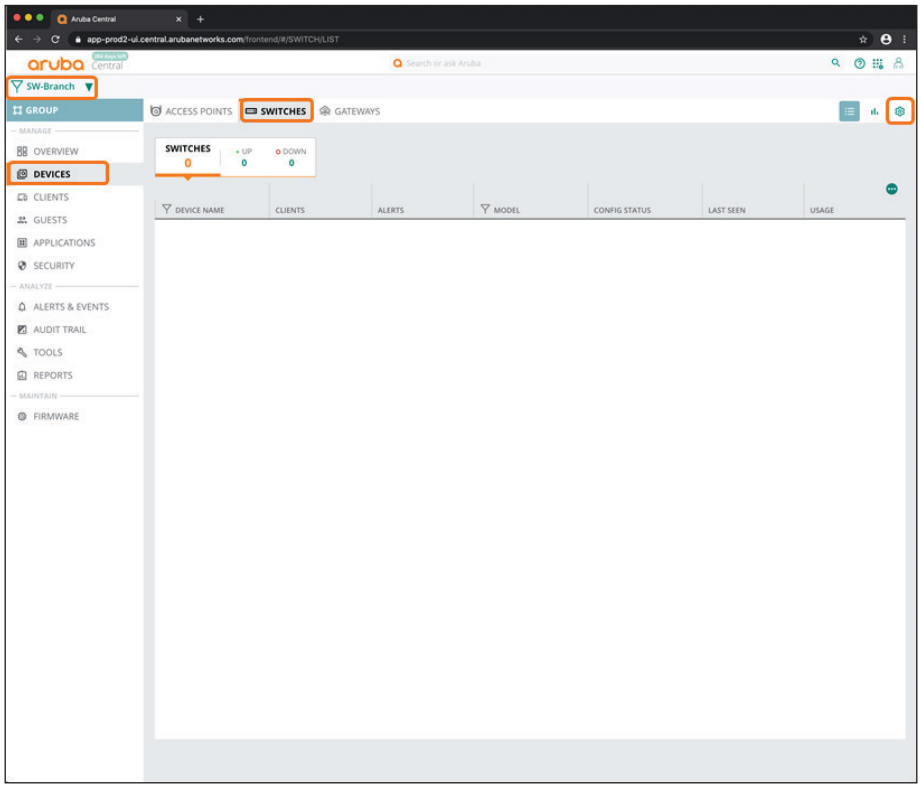
Note If you intend to use the Install Manager App, assign the group to the sites at this point.

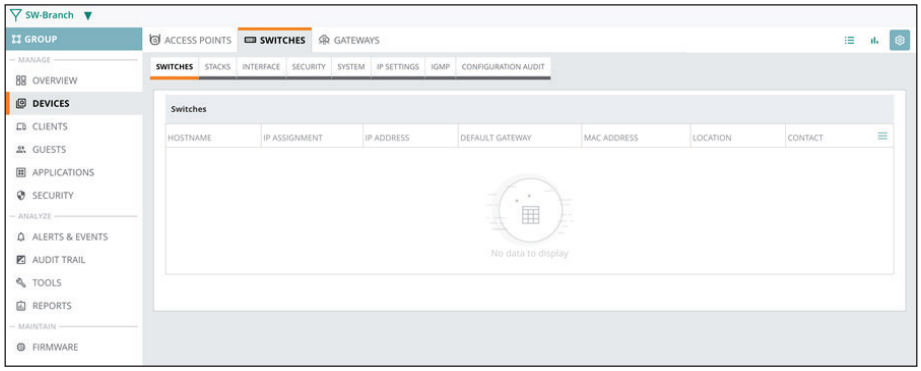
Use the following steps to navigate to the switch UI group configuration menu.

Step 5: In the filter drop-down list, select the new group you created for the branch switches (example: **SW-Branch**).

Step 6: In the left navigation pane, in the Manage section, select **Devices**.

Step 7: Select the **Switches** tab, and then click the gear icon in top right.

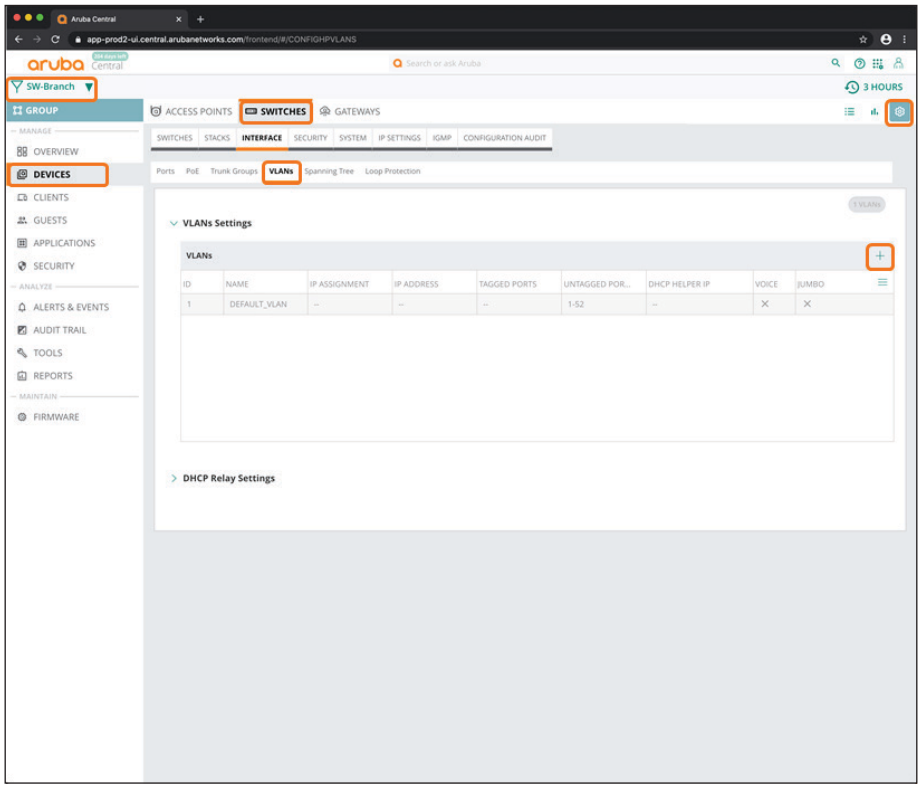




8.2 Configure the Switch VLANs

Step 1: On the Switches tab, in the Interface section, select **VLANs**.

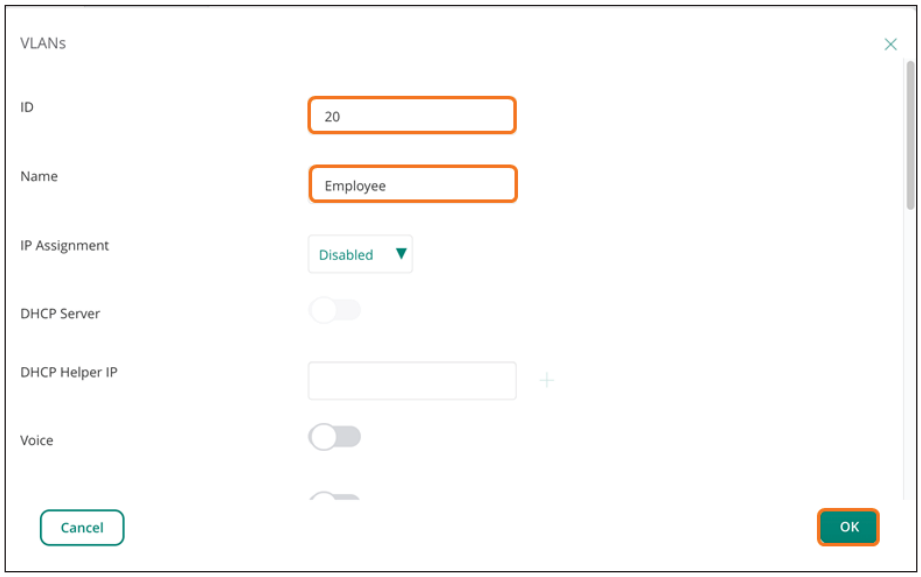
Step 2: In the **VLANs** table, click the plus (+) sign.



Step 3: In the New VLANs dialog box, implement the following settings:

- ID—**20**
- Name—**Employee**

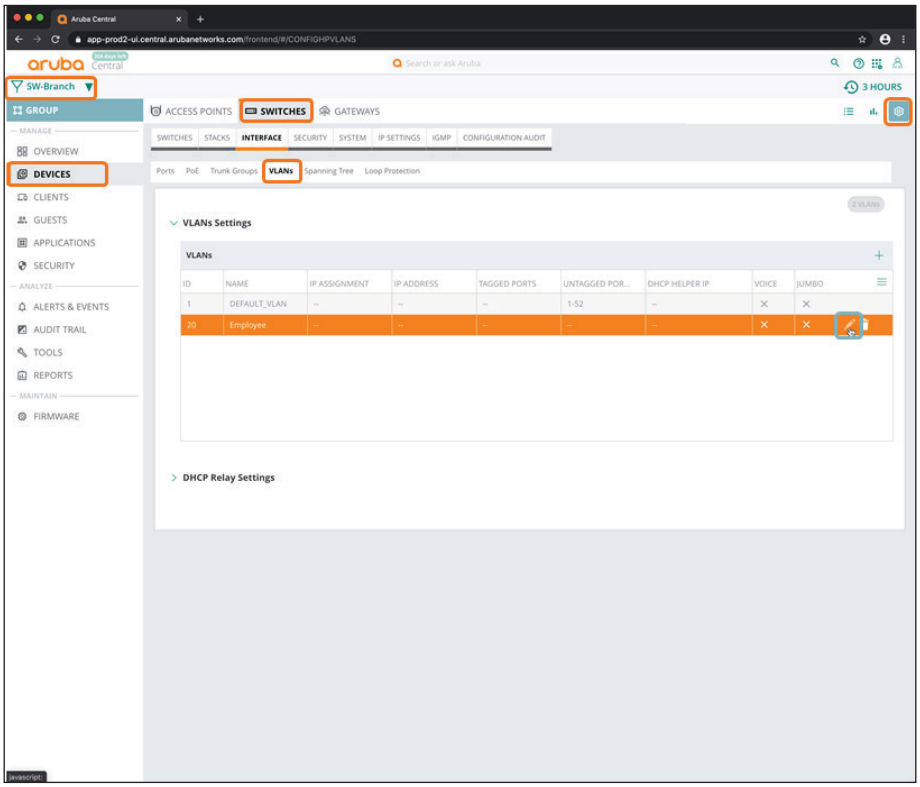
Step 4: Click **OK**, and then click **Save Settings**.



8.3 Configure the Uplinks for the VLANs

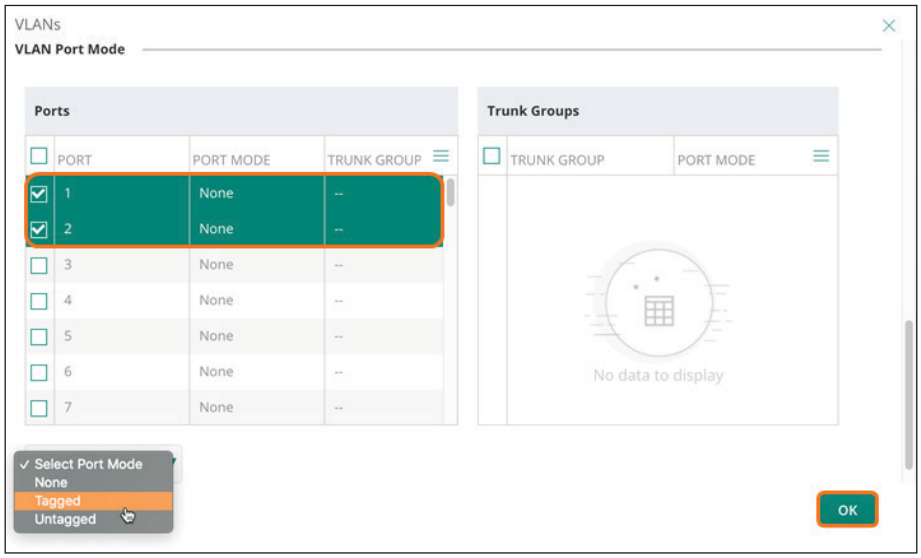
Step 1: On the Switches tab, in the Interface section, select **VLANs**.

Step 2: In the **VLANs** table, select the VLAN you configured in Procedure 8.2 (example: **Employee**), and then click the pencil icon.



Step 3: In the VLAN Port Mode section, in the **Ports** table, select the uplink ports for the branch gateway(s).

Step 4: In the Select Port Mode drop-down list, select **Tagged**, and then click **OK**.



Step 5: Click **Save Settings**.

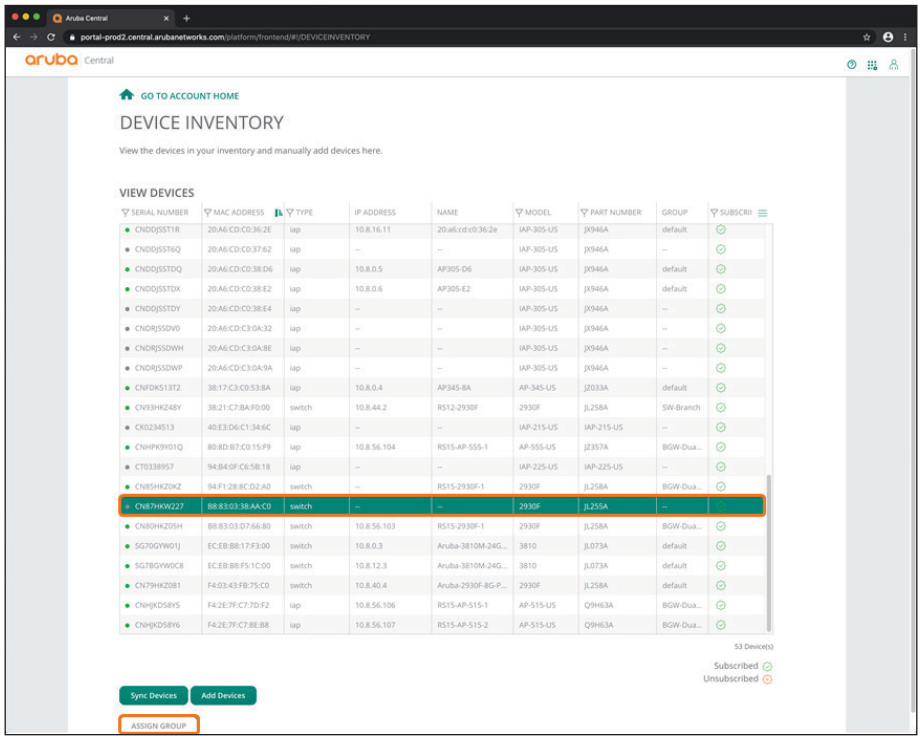
Procedures

In the case of branch switches a single UI group that includes different models can be created. Common items like VLANs and uplink port configurations can be done at the group level while VLAN assignments at the user ports can be configured at the device level.

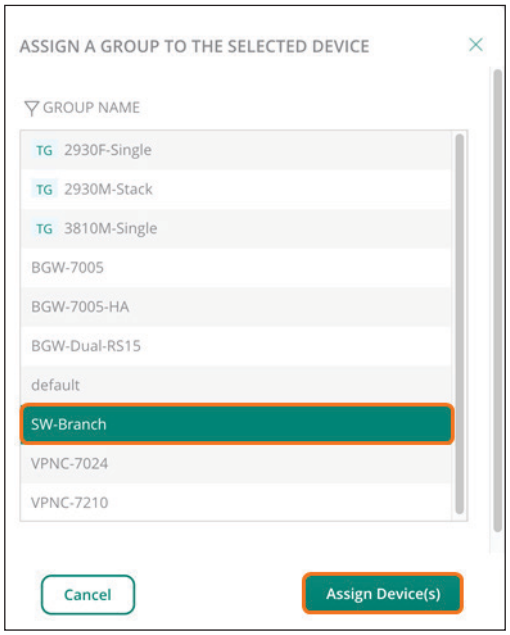
9.1 Assign a Switch Device to a Switch UI Group

Step 1: On the Aruba Central Account Home page, select **Device Inventory**.

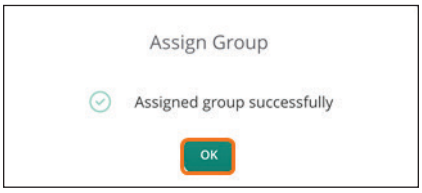
Step 2: In the View Devices table, select a switch, and then click **Assign Group**.



Step 3: In the Assign a Group to the Select Device dialog box, select the switch UI group you created in Procedure 8.1 (example: **SW-Branch**).



Step 4: Click **Assign device(s)**, and then click **OK**.



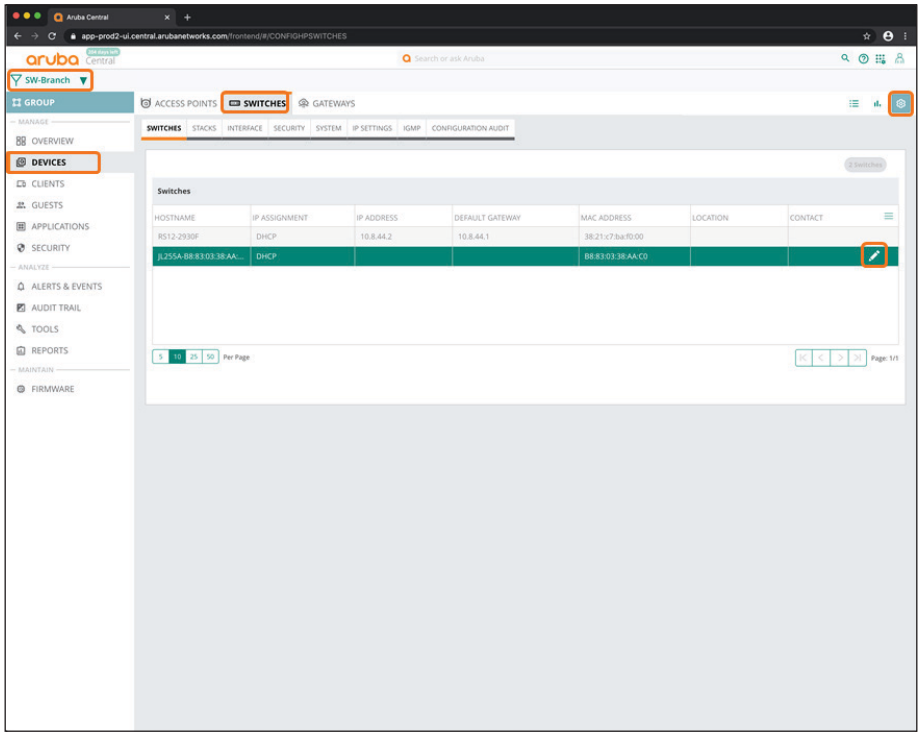
9.2 Configure the Device Switch Hostname

Step 1: On the Aruba Central Account home page, launch the **Networks Operations** app.

Step 2: In the filter drop-down list, select the switch UI group you created in Procedure 8.1 (example: **SW-Branch**).

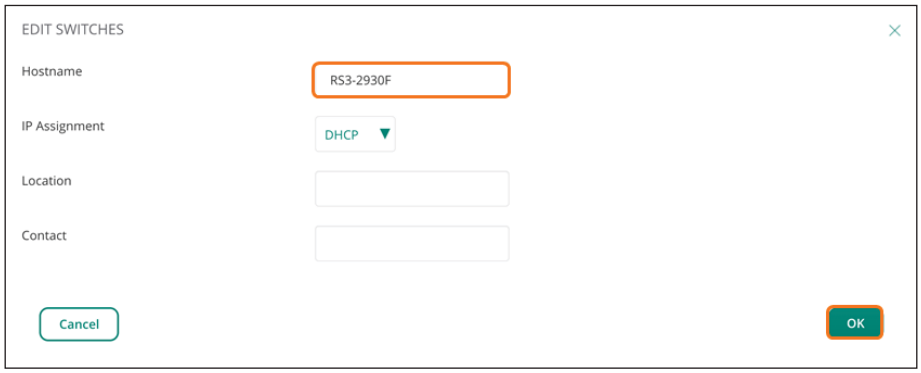
Step 3: In the left navigation pane, in the Manage section, select **Devices**, and then select the **Switches** tab.

Step 4: In the **Switches** table, select the switch you intend to configure, and then click the pencil icon.



Step 5: In the Edit Switches dialog box, in the **Hostname** box, enter a name (example: **RS3-2930F**).

Step 6: Click **OK**.



Step 7: Click **Save Settings**.

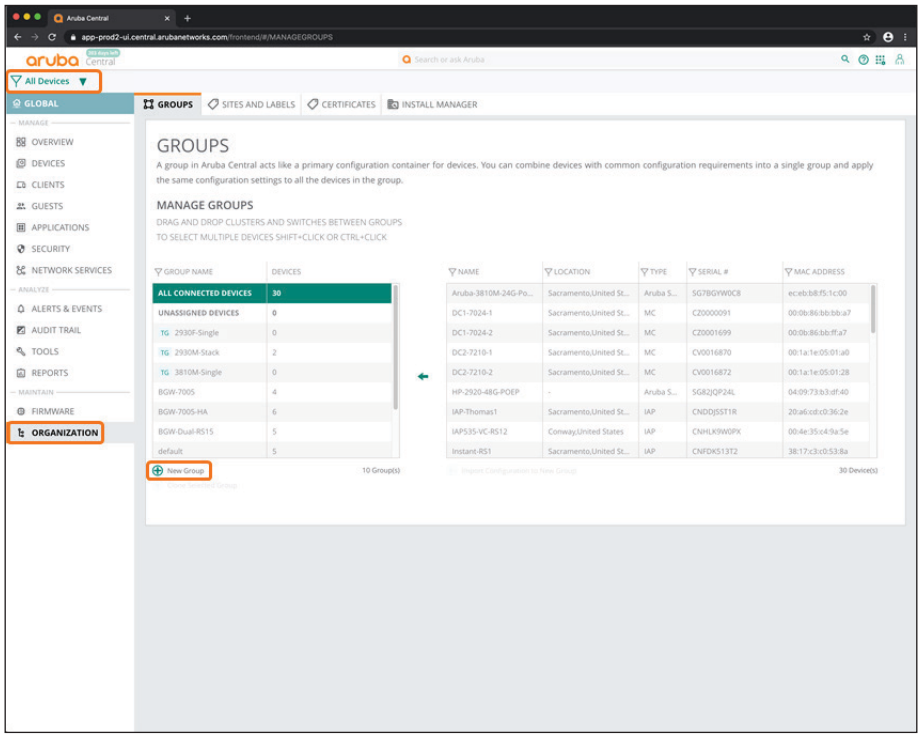
Procedures

Configuring the Branch Access Points Group

10.1 Create the Access Point Group

Step 1: In the filter drop-down list, select **All Devices**, and then in the left navigation bar, select **Groups** or **Organization**.

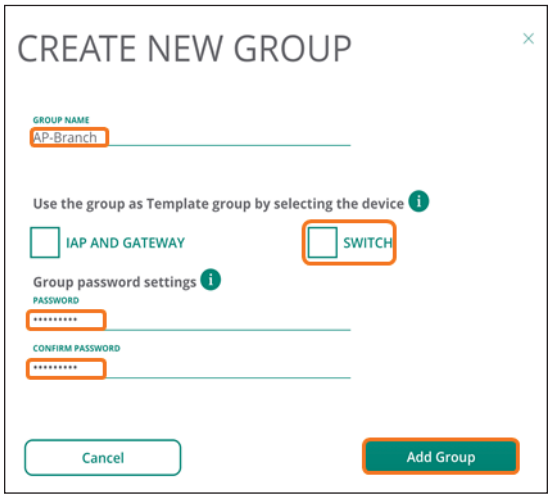
Step 2: On the Groups tab, click **New Group**.



Step 3: In the Create New Group dialog box, implement the following settings:

- **Group Name—AP-Branch**
- **Switch**—Unselect this option
- **Password—password**
- **Confirm Password—password**

Step 4: Click **Add Group**.



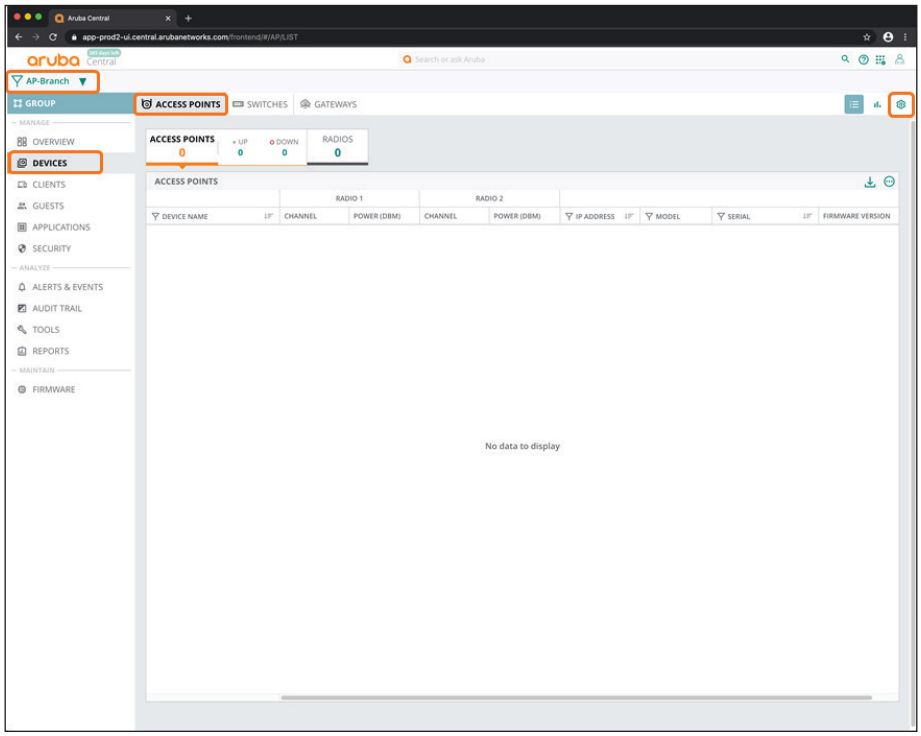
> **Note** If you intend to use the Install Manager App, assign the group to the sites at this point.

Use the following steps to navigate to the AP group configuration menu.

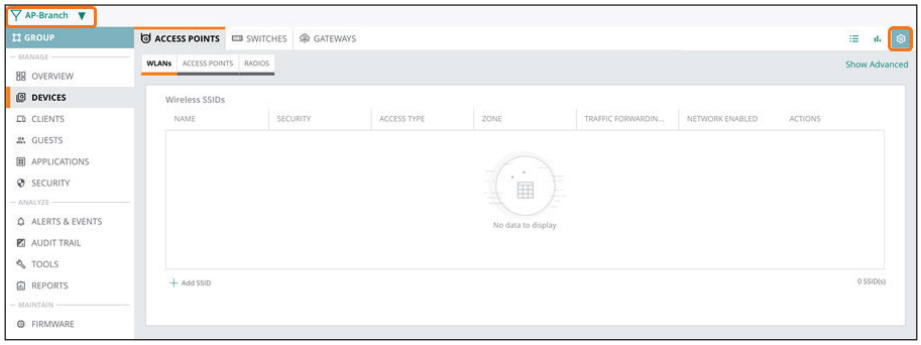
Step 5: In the filter drop-down list, select the group you created for the branch access points in Procedure 10.1 (example: **AP-Branch**).

Step 6: In the left navigation pane, in the Manage section, click **Devices**.

Step 7: Select the **Access Points** tab, and then click the gear icon in the top right.

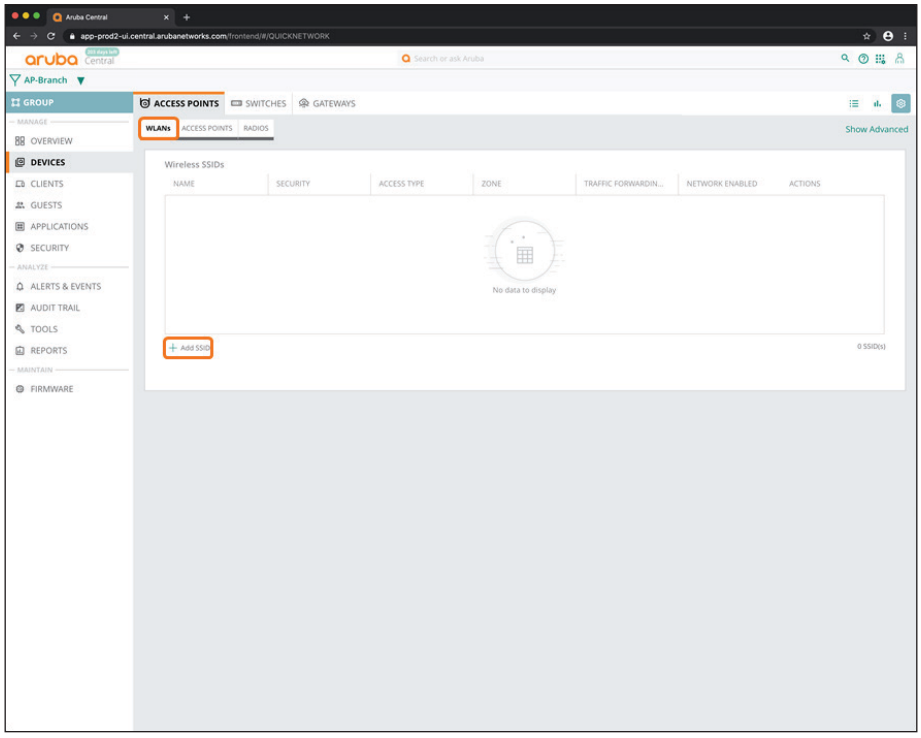


Step 8: Notice the group name in the filter and that the gear icon is selected.



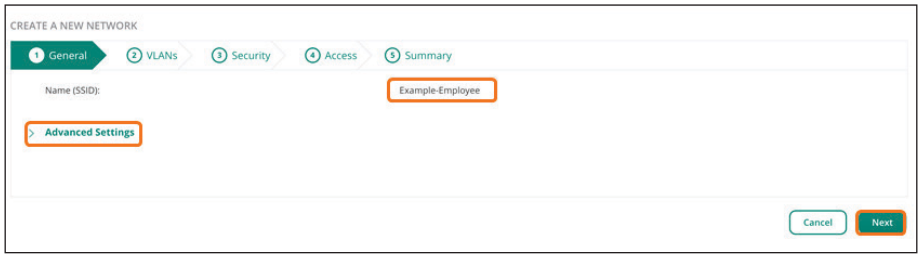
10.2 Create A New Network: SSID General Settings

Step 1: On the Access Points tab, in the WLANs section, click **Add SSID**.



Step 2: In the Create a New Network dialog box, in the General section, enter an SSID name (example: **Example-Employee**).

Step 3: Click **Next**.

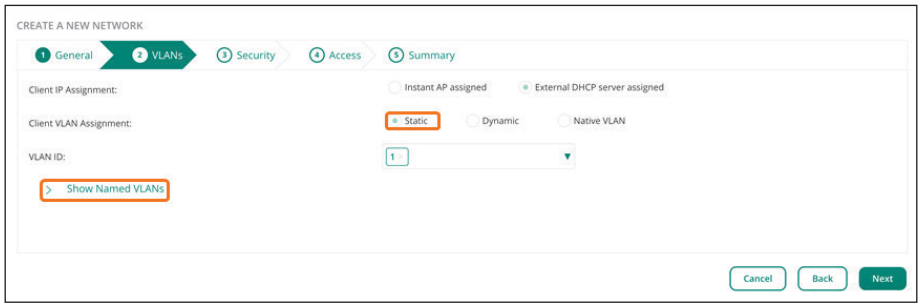


Note You can customize the non-default SSID parameters by clicking Advanced Settings.

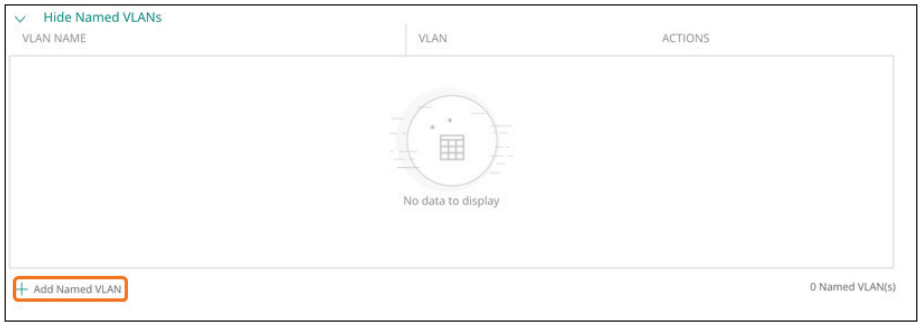
10.3 Create a New Network: Client VLANs

The client VLANs need to match the switch and branch gateway VLANs in order to establish connectivity. The branch switch ports that connect to the access points must allow the VLANs and configure the access point (AP) ports on the switches as tagged.

Step 1: In the Create a New Network dialog box, in the VLANs section, select **Static**.

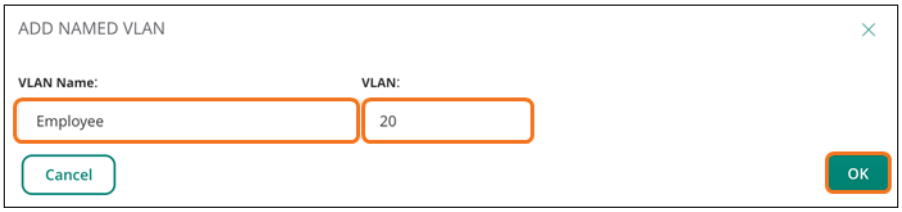


Step 2: Click **Show Named VLANs**, and then click **Add Named VLAN**.

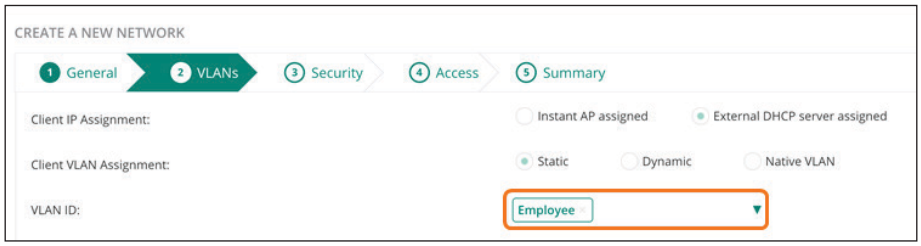


Step 3: In the Add Named VLAN dialog box, implement the following settings:

- VLAN Name—**Employee**
- VLAN—**20**



Step 4: Click **OK**.



Step 5: In the **VLAN ID** drop-down list, select the VLAN you created (example: **Employee**), and then click **Next**.

10.4 Create a New Network: WLAN Security

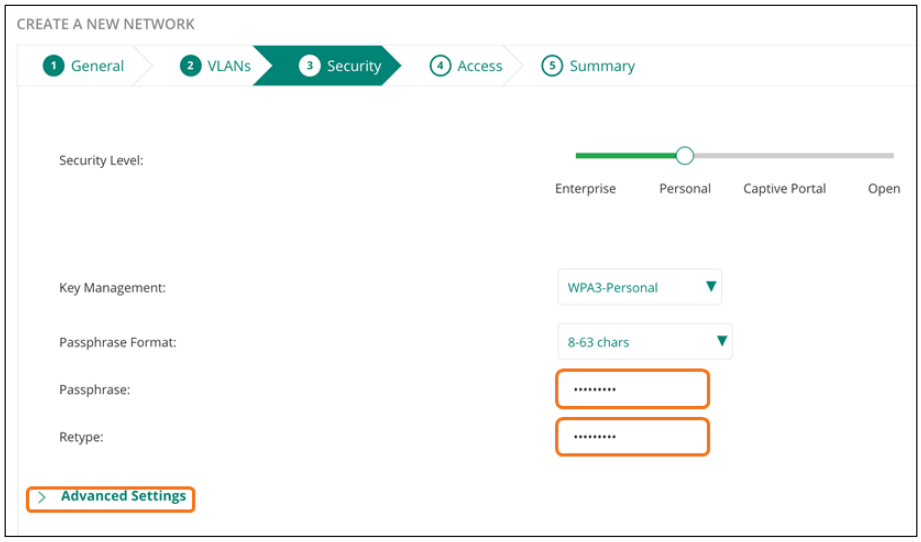
Option 1: Passphrase Authentication

Use the following steps to enable authentication by using a WPA3 personal passphrase.

Step 1: In the Create a New Network dialog box, in the Security section, click **Personal**.

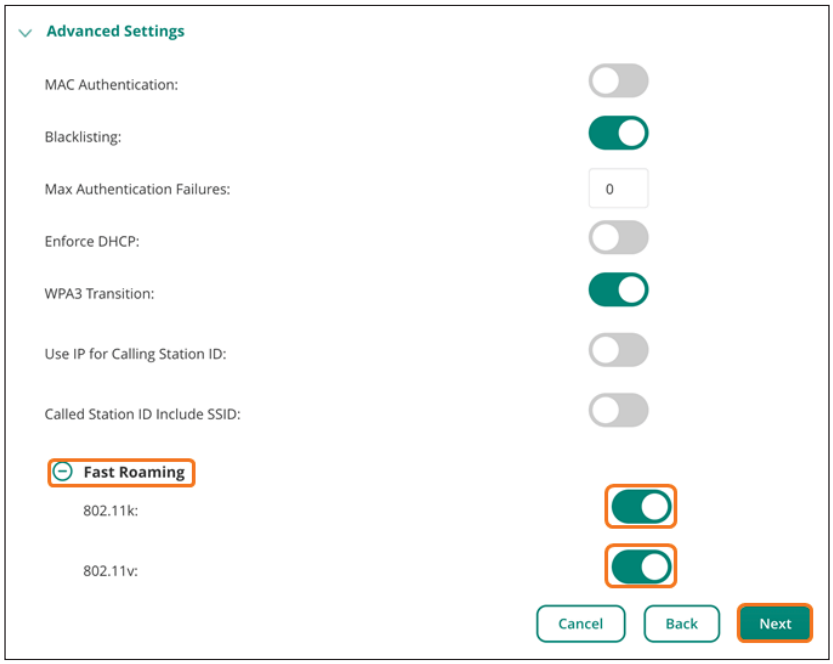
Step 2: In the **Passphrase** box, enter a password, and then in the **Retype** box, re-enter the password.

Step 3: Click **Advanced Settings**.



Step 4: Click **Fast Roaming**, and then select **802.11k** and **802.11v**

Step 5: Click **Next**.



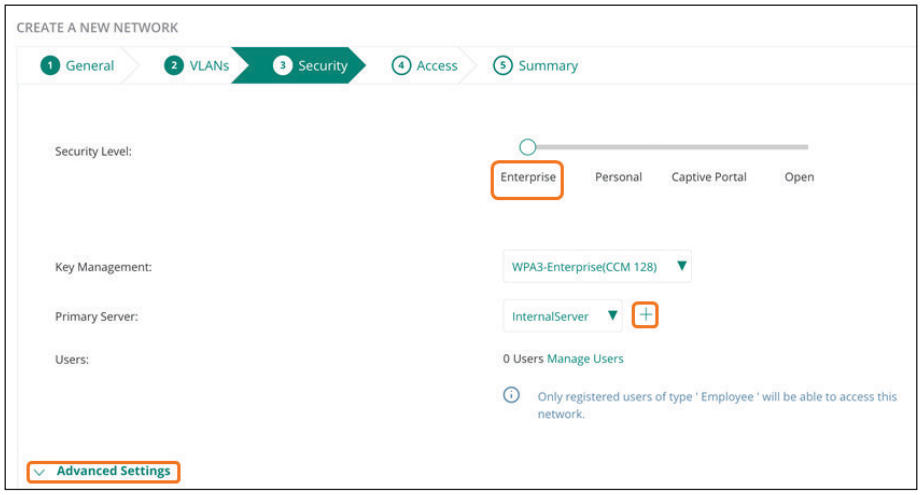
Option 2: Username and Password Authentication

In this procedure, you enable WPA3 Enterprise authentication.

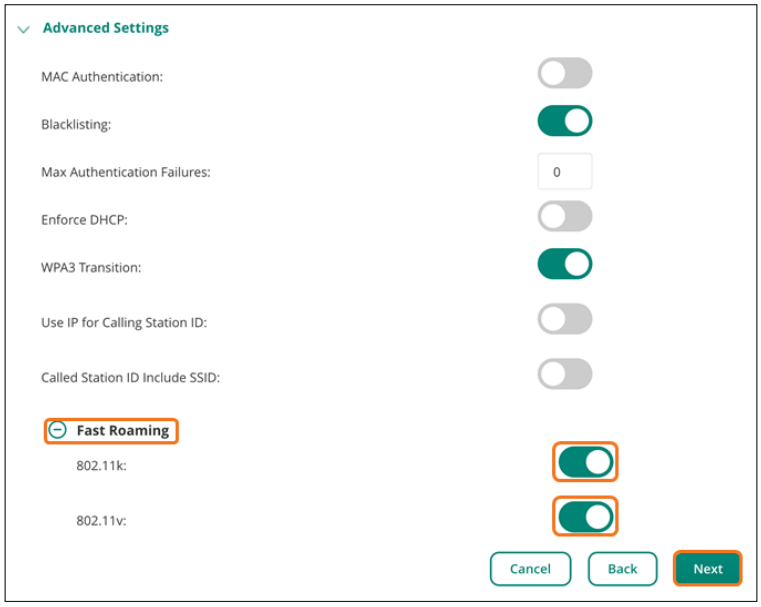
Step 1: In the Create a New Network dialog box, in the Security section, click **Enterprise**.

Step 2: In the **Primary Server** drop-down list, select a server, and then click the plus (+) sign to define the authentication server parameters.

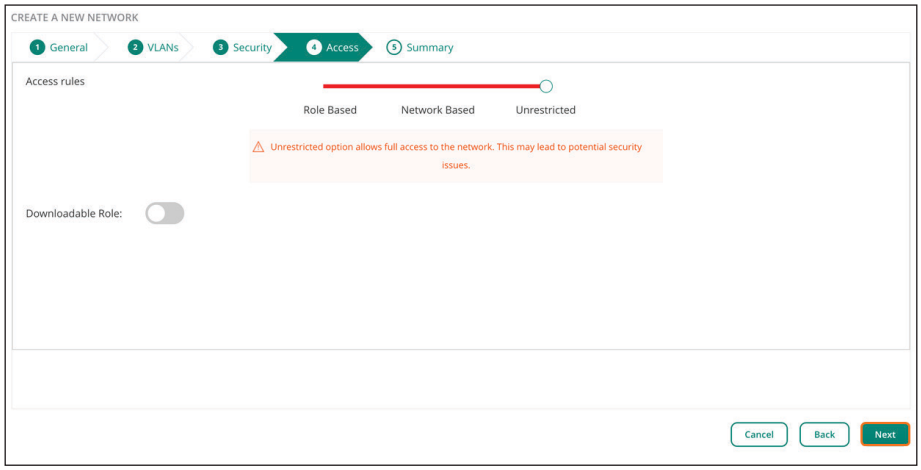
Step 3: Click **Advanced Settings**, and then click **Fast Roaming**.



Step 4: Select **802.11k** and **802.11v**.



Step 5: Click **Next**.



Step 6: On the Access tab, click **Next**, and then on the Summary tab, click **Finish**.

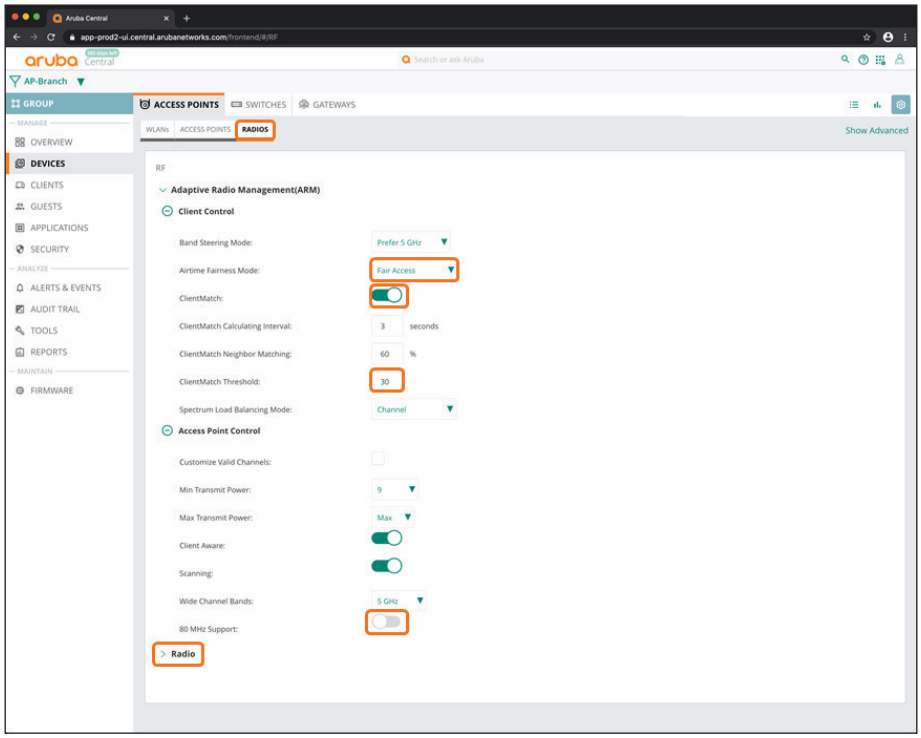
10.5 Specify the Radio Settings

Step 1: On the **Access Points** tab, select **Radios**.

Step 2: In the Client Control section, implement the following settings:

- **Airtime Fairness Mode—Fair Access**
- **ClientMatch**—Enable this option
- **ClientMatch Threshold—30**

Step 3: If you use multiple access points in the sites, use the slider to disable **80 MHz Support**.



Step 4: Expand **Radio**, and then in the 5 GHz band table, click the plus (+) sign.

Step 5: In the **MIN/MAX Power** column, enter **15/18** for walled-office environments.

Procedures

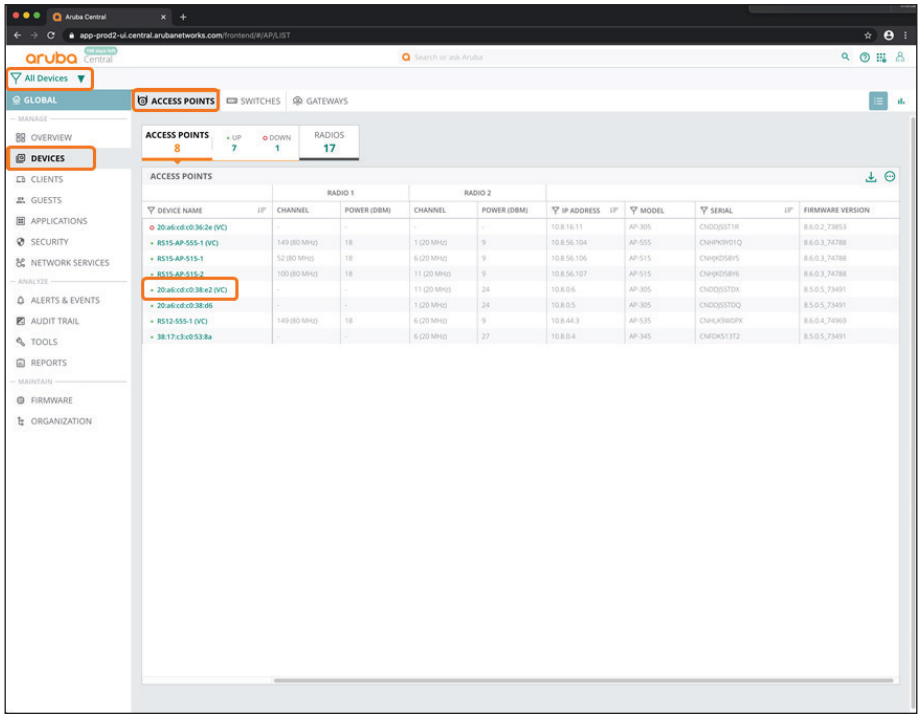
Once a branch is operational, the access points automatically create a virtual controller (VC) cluster and join the default group.

11.1 Assign the WLAN AP Group

Step 1: In the filter drop-down list, verify that **All Devices** is selected.

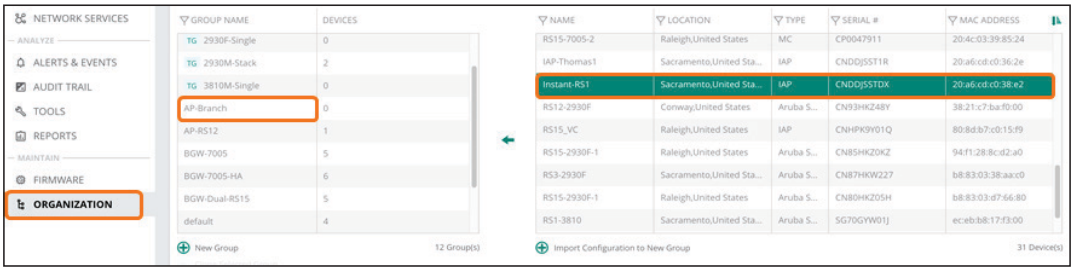
Step 2: In the left navigation pane, in the Manage section, select **Devices.**

Step 3: On the **Access Points** tab, in the Access Points section, identify the MAC addresses of the virtual controller clusters and assign the virtual controller clusters to the AP group you created in Procedure 10.1 (example: **AP-Branch**).



Step 4: In the left navigation pane, in the Maintain section, select **Organization**.

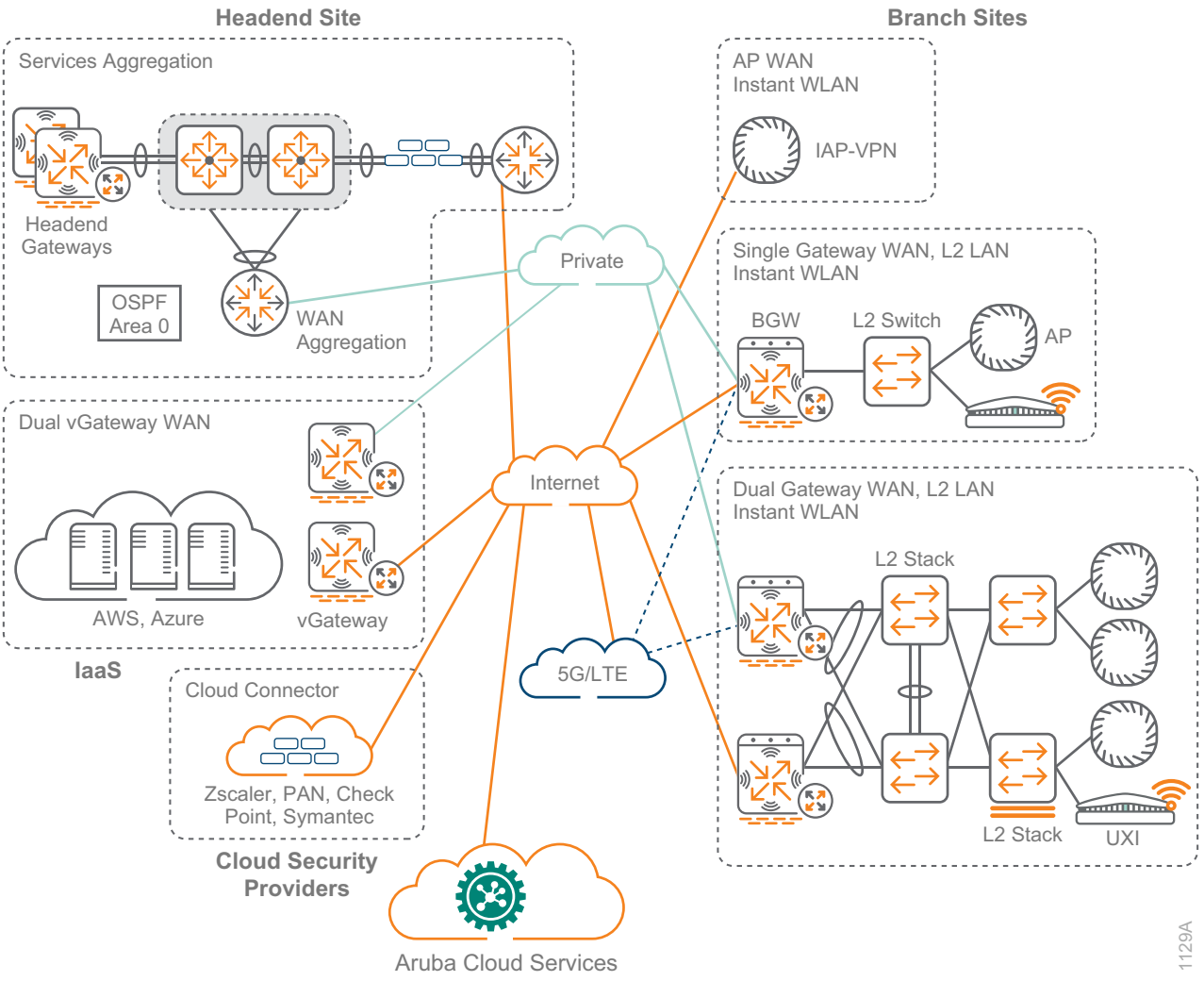
Step 5: Drag the virtual controller into the configured AP group. All access points in the site will be automatically moved to the AP group.



Summary

The flow of information is a critical component to a well-run organization. The Aruba SD-Branch design is a prescriptive solution based on best practices and tested topologies. This allows you to build a robust WAN network that accommodates your organization's requirements. Whether users are located at a headend site or a smaller branch site, this design provides a consistent set of features and functionality for network access, which helps improve user satisfaction and productivity while reducing operational expense.

Figure 29 SD-Branch design



The Aruba SD-Branch design provides a consistent and scalable methodology of building your network, improving overall usable network bandwidth and resilience and making the WAN easier to deploy, maintain, and troubleshoot.

What's New in This Version

The following changes have been made since Aruba last published this guide:

- SD-WAN Orchestrator components Tunnel Orchestrator and Route Orchestrator
- Aruba virtual gateways for Amazon Web Services and Microsoft Azure
- Support for single and multiple VNET/VPCs
- Hub mesh topologies
- Dynamic Path Selection and Policy Based Routing comparison
- Reverse path pinning
- Health checks and Aruba Path Quality Monitoring service
- Third-party cloud-security providers
- SaaS optimization with SaaS Express
- SD-LAN design with two-tier LAN support and dynamic segmentation
- Aruba 9000 gateways and Aruba 500 access points
- Aruba threat detection with IDS/IPS

You can use the feedback form to send suggestions and comments about this guide.

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