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Introduction

Campus network deployments expand and evolve at a rapid pace. IT managers must support an increasing variety of users and devices throughout their organizations. They must adapt their networks to address the needs of key business functions while simultaneously providing reliability, performance and flexibility.

Today's businesses need campus networks to provide reliable, high-performance wired and wireless connectivity. These networks must be capable of delivering rich applications and access to corporate resources across all device form factors. As wired and wireless access to information and applications becomes synonymous, the network must keep up. Users want a seamless and consistent experience regardless of which device they use. Therefore, IT managers must deliberately design and manage their networks with access network solutions in mind.

In addition, business owners today ask their IT staff to be more agile by delivering network access in ever-shorter deployment times with fewer resources.

The Wired + Wireless Cloud-managed Campus Reference Architecture provides solutions to address these key problems facing businesses large and small. This Reference Architecture is a blueprint for a modern campus network, providing an understanding of the network design principles and best practices. This Reference Architecture also enables network designers to get a running start on their deployments so they can quickly deliver valued solutions to their businesses.
This Reference Architecture addresses the following scenarios:

- Mass deployment of wired and wireless access devices with minimal touch
- Cloud management of wired and wireless access devices
- Cloud management of a modern, end-to-end campus network
- Delivery of a modern approach to access and aggregation that minimizes downtime in campus networks
- Providing the latest technology to address speed, bandwidth, redundancy and failure-resistant networks

A network that performs best is one that meets both the business and user’s needs. It is built on a solid infrastructure, enabling the business and its goals to scale on demand and maintains simplicity in deployment and ongoing operations.
Access networks designed for cloud management

Dell Networking provides customers with flexible and scalable options to adapt to any campus or distributed network’s size and scope. Dell Networking switches with HiveManager NG, enable small to large businesses to use the latest cloud management features to deploy reliable, high-performance campus networks. Figure 2 lists the components that might be used in such a network.

Dell provides all the components, support and services necessary to successfully deploy and maintain your cloud-managed campus network.

The Dell Networking Cloud-managed Campus Network includes the following advantages:

- Wired and wireless convergence
- Network simplification
- Operational cost reduction
- Ease of scalability
- Cloud management
  - Provides flexible, anytime/anywhere management of the mobility-focused network
- Support and Professional Services
  - Extends Dell’s world-class services and support to customers for deployment, installation and assessment services

Figure 2  Dell Cloud-managed campus network components
2 Cloud-managed networking hardware

HiveManager NG supports Dell Networking N-Series switches and Aerohive access points (AP). The Dell Networking N-Series switch product line delivers modern, end-to-end, campus network solutions using the latest switching technologies. The design of these energy-efficient, 1/10 GbE switches enables modernization and scaling of campus networks. Aerohive APs provide the latest wireless technology to include 802.11ac and 802.11n functionality.

2.1 Dell Networking N3000 Series switches

The Access Layer of this architecture can contain N3000 Series 1 GbE, Layer 3 switches, as in Figure 3:

![Dell Networking N3000 Series](image)

Figure 3   Dell Networking N3000 Series

N3000 Series switches provide a resilient 1 GbE switching solution with 10 GbE uplinks for advanced Layer 3 distribution. Dual hot swappable 80 Plus-certified power supplies add resiliency and the capacity to provide up to 48 ports of Power over Ethernet Plus (PoE+) in a 1 RU footprint.

2.2 Dell Networking N2000 Series switches

The Access Layer of this architecture can contain N2000 Series 1 GbE, Layer 3, standard-feature-set switches, as in Figure 4:

![Dell Networking N2000 Series](image)

Figure 4   Dell Networking N2000 Series

The N2000 switch series offers a power-efficient, Gigabit Ethernet (GbE), network-access, switching solution with integrated 10 GbE uplinks. The N2000 switch series has high-performance capabilities and wire-speed performance utilizing a non-blocking architecture to easily handle unexpected traffic loads. The Dell Networking N2000 Series has options for up to 48 ports of PoE+.

2.3 Dell Networking N1500 Series switches

The Access Layer of this architecture can contain N1500 Series 1 GbE Layer 3 Lite switches, as in Figure 5:

![Dell Networking N1500 Series](image)

Figure 5   Dell Networking N1500 Series

The N1500 switch series offers a power-efficient, GbE network-access switching solution with integrated 10 GbE uplinks. The N1500 switch series has high-performance capabilities and wire-speed performance...
utilizing a non-blocking architecture to easily handle unexpected traffic loads. The Dell Networking N1500 Series has options for up to 48 ports of Power-over-Ethernet Plus (PoE+).

2.4 Aerohive wireless APs

The wireless LAN (WLAN) in this reference architecture is comprised of Aerohive’s enterprise grade 802.11ac wireless APs, as in Figure 6:

Aerohive's APs provide 802.11ac Gigabit Wi-Fi technology along with advanced security and mobility management together in one economic package.
3 Next generation network management

HiveManager NG is the next-generation, enterprise-class, cloud-enabled network management solution for Aerohive wireless APs and Dell Networking switches. It provides streamlined configuration workflows, real-time client and event monitoring, simplified troubleshooting, versatile RF planner tools and API integrations for wired and wireless devices.

Figure 7: HiveManager NG user interface. Top: Device view Bottom: Plan view
3.1 Network management

HiveManager NG allows administrators the flexibility to plan, configure and deploy wired and wireless networks while maintaining complete control of those networks through a powerful cloud platform. The HiveManager NG architecture sets a new standard for simplicity and flexibility by combining the following characteristics:

- Public or private cloud deployment
- Streamlined user experience
- Simplified troubleshooting
- Operational intelligence

3.2 Deployment

HiveManager NG offers a simplified deployment workflow and seamless transition from demo to production, featuring the following attributes:

- Guided workflow for network policy deployment
- Interactive, step-by-step configuration assistance
- Ability to swap simulated devices with real devices on RF planner map
- Automatic connection to HiveManager NG for provisioning
- Auto-provisioning devices with network policy and firmware updates

3.3 Configuration

HiveManager NG facilitates streamlined device and network configuration through the following features:

- Device templates for switches and APs with a centralized view of all configuration objects
- The ability to bulk-edit device properties
- The ability to back up and restore objects, inventory and configuration
- A command-line interface for device access

3.4 Policy management

Context-aware user policies with granular and flexible centralized control enable an optimized end-user experience through the following features:

- Device classification by location
- Client classification by the following characteristics:
  - Location
  - OS type
  - Media access control (MAC) address
- Customer application definition
- Multiple user profiles for each service set identifier (SSID)
- Time-based firewall and quality of service (QoS) policy
- Application, network and MAC layer firewall policy rules
• Wireless intrusion prevention system (WIPS) policy for rogue AP detection and mitigation
• Security policies supporting 802.1X, WPA2 and Aerohive’s PPSK (Private Pre-Shared Key)

3.5 User-focused dashboard

The HiveManager NG dashboard includes contextual filters to monitor assets, health status, data usage, and security standpoints. The dashboard includes the following features:

• Key performance indicator (KPI) status cards and widgets with drill-down capabilities
• Time-range slider on dashboard for historical view with 360 views of any of the following attributes:
  - Network policies
  - APs
  - Client devices
  - Users
  - Applications
• Global search function by the following criteria:
  - Network policy
  - MAC address
  - Serial number
  - User
  - Application name
• Historic monitoring and reporting data covering the previous seven days with easy sharing capabilities and featuring interactive network summary reports
• Contextual filters can be saved by the following criteria:
  - Location
  - SSID
  - Policy
  - User profile
  - Client OS type

3.6 Versatile monitoring and troubleshooting

HiveManager NG provides real-time and historical views of devices, clients, alarms and events with the ability to act immediately from the monitor interface. The monitoring function includes the following features:

• Device list with rich utilities for advanced configuration and investigation
• Alarm and event lists with historical and real-time data
• Savable and reusable filters shared across dashboard and monitor
• Rogue AP and client monitoring plus Maps API
• Help-desk-style interface to triage historical and real-time client problems with actionable data for easy resolutions
4 Network deployment and management

Dell Networking’s cloud-based management scales from small offices to large campus networks and distributed multi-site networks. Whether you are deploying single-layer remote offices or multilayer large campus networks, HiveManager NG can deploy and manage your wired and wireless networking devices.

Dell Networking N-Series switches automatically connect to either the HiveManager NG public cloud or a HiveManager NG on-premises instance. An application pre-installed on the switches establishes a secure connection to HiveManager NG. After the onboarding process completes, the switch is ready to be managed.

4.1 Branch, small campus and distributed sites

Deploy branch, small campus and distributed sites entirely through HiveManager NG. Dell N-Series switches with HiveManager NG can be deployed out-of-the-box to enable a simple, no-touch process. Click the link below for a supplemental deployment guide that provides step-by-step instructions for deploying the network:

Wired + Wireless Cloud-managed Campus Deployment Guide – Branch, Small Campus and Distributed Sites
Figure 8  Single-layer access network - branch, small campus and distributed sites
4.2 Large campuses

Deploy large campus access devices through HiveManager NG. Dell N-Series switches with HiveManager NG can be deployed out-of-the-box to enable a simple, no-touch process. Click the link below for a supplemental deployment guide that provides step-by-step instructions for deploying the network:

[Wired + Wireless Cloud-managed Campus Deployment Guide – Large Campus](#)
Figure 9  Multilayer network – large campus
## Software versions

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<th>Component</th>
<th>Description</th>
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<tr>
<td>Dell Networking OS</td>
<td>v6.3.0.16 or later (N1500, N2000, N3000 series switches)</td>
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<tr>
<td>HiveManager NG cloud</td>
<td>Automatic updates</td>
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<tr>
<td>HiveManager NG Virtual Appliance</td>
<td>v11.14.0.3</td>
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## Supplemental documents

### Table 2 Related documentation

Support and feedback

Please use the information below to provide feedback on how we could make this reference architecture more useful for your circumstances.

Contacting Technical Support

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<tr>
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<td>Telephone: USA: 1-800-945-3355</td>
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Feedback for this document

We encourage readers of this publication to provide feedback on the quality and usefulness of this deployment guide by sending an email to Dell_Networking_Solutions@Dell.com.

Note: Please include the document title and version in the subject of the email.

About Dell EMC

Dell EMC is a worldwide leader in data center and campus solutions, which includes the manufacturing and distribution of servers, network switches, storage devices, personal computers, and related hardware and software. For more information on these and other products, please visit the Dell EMC website at [http://www.dell.com](http://www.dell.com).