

Working with Integrations in Your Nexus Dashboard, Release 4.2.1

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New and changed information

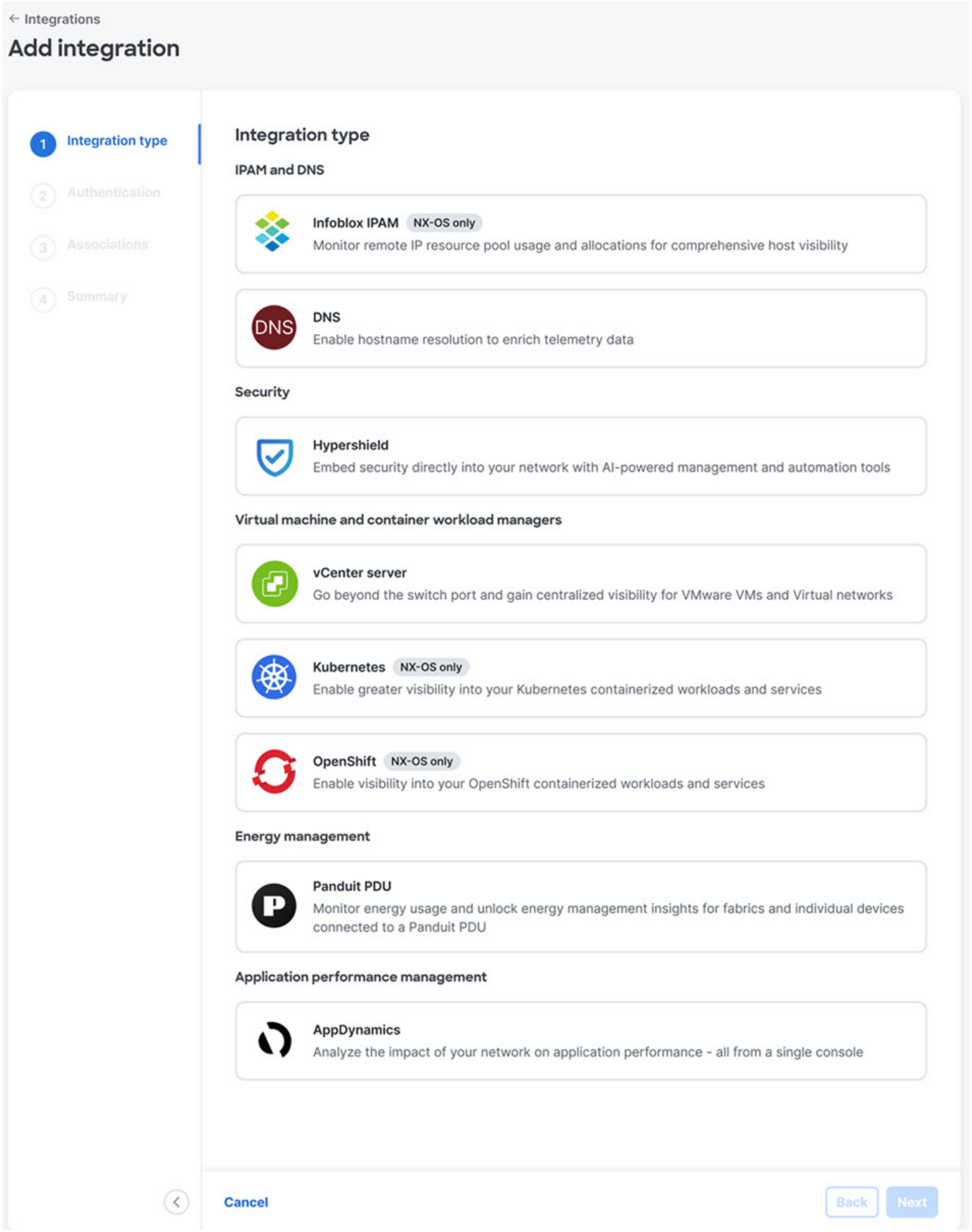
The following table provides an overview of the significant changes up to this current release. The table does not provide an exhaustive list of all changes or of the new features up to this release.

Release Version	Feature	Description
Nexus Dashboard 4.2.1	LLDP handshake to enable adaptive routing with NVIDIA NICS	With this release, Nexus Dashboard enables Adaptive Routing for NVIDIA SuperNICs by automating the LLDP handshake and 'hardware profile spectrum-x' command. This optimizes packet reordering and enhances performance for AI/ML workloads. For more information, see LLDP handshake to enable Adaptive Routing with NVIDIA.
Nexus Dashboard 4.2.1	Slack Integration	With this release, Nexus Dashboard adds support for Slack integration. You can now send alerts and notifications directly to your specified Slack channels. To ensure secure and efficient communication between Nexus Dashboard and your Slack workspace, configure your Slack app credentials and set up channel authorizations within Nexus Dashboard. For more information, see Configure Slack app and Set up Slack integration in Nexus Dashboard.

About integrations

Nexus Dashboard supports these categories for supported integration types:

Category	Integration type
IPAM and DNS	Infoblox IPAM and DNS integrations
Virtual machine and container workload managers	vCenter server, Kubernetes, and OpenShift integrations
AI endpoint discovery and management	LLDP AI endpoint discovery
Energy management	Panduit PDU integration
Application performance management	AppDynamics integration



Navigate to the **Integrations** page using either of the following paths:

- To see integrations at the Nexus Dashboard level, navigate to **Admin** > **Integrations**.
- To see integrations at the fabric level:
  1. Navigate to your fabric (**Manage > Fabrics**, then click on your fabric).
  2. Click the **Integrations** tab.

All the integrations are listed in a tabular form with the following fields:

Action Item	Description
Name	The name of the integration.
Status	The status of the integration.
Type	The type of integration.
IP/Hostname	The IP or hostname of the integration.
Last Active	When the integration was last active.
Fabric associations	Which fabric this integration is associated with, if applicable.
Derived fabrics	Shows integrations that are not configured but are derived based on the physical topology and discoverability by Nexus Dashboard.

The connected status indicates that the controller is active to fetch data. The down status indicates that the Nexus Dashboard will not fetch data from the controller. Use the filter bar to search for a specific integration. You can filter based on the name and type of integration.

At the Nexus Dashboard level:

- Click **Add Integration** to add a new integration.
- Click the ellipsis icon (...) to edit, delete, or rediscover an integration.

The following table describes the action items that appear in the **Integrations** page in the **Actions** menu drop-down list:

Action Item	Description
Add Instance	From the **Actions** drop-down list, choose **Add Instance**. For more instructions, see Adding an Instance.  Ensure that you have configured same IP address on Routes. Refer to Configuring Routes IP Address.
Edit Instance	Choose an instance to edit. From the **Actions** drop-down list, choose **Edit Instance**. Make the necessary changes and click **Save**. Click **Cancel** to discard the changes.
Delete Instance(s)	Choose one or more required instance to delete. From the **Actions** drop-down list, choose **Delete Instance(s)**. Click Confirm to delete the instance. Click **Cancel** to discard the delete.
Rediscover Instance(s)	Choose one or more required instance to rediscover. From the **Actions** drop-down list, choose **Rediscover Instance(s)**. A confirmation message appears.

At either the Nexus Dashboard level or the fabric level, click the integration names to view further details about the integration.

 DNS integrations are not clickable and do not have any further information to display apart from the data available in the table.

Guidelines and limitations for integrations

- In Nexus Dashboard, integrations are supported on both Management and Data networks.
- By default, Nexus Dashboard will use Data network to connect to the integrations such as vCenter server, DNS, AppDynamics, or orchestration. If you want to use Management network, you can add a specific route in Nexus Dashboard's Admin Console from **Admin** > **System Settings** > **General** > **Routes**. The route can be a /32 pointing to Integrations or a larger subnet that includes it.

LLDP handshake to enable Adaptive Routing with NVIDIA

This section describes the new functionality for enabling Adaptive Routing through an LLDP handshake with NVIDIA SmartNICs, crucial for optimizing AI/ML workloads.

Nexus switches now support a handshake mechanism with NVIDIA SmartNICs (BF3, CX8, CX9) to enable Adaptive Routing. This capability is essential for AI/ML workloads that utilize granular load balancing techniques (such as packet spray or per-packet load balancing), as it allows NVIDIA NICs to reassemble out-of-order packets efficiently.

- LLDP enablement: The LLDP protocol is enabled within Nexus Dashboard fabric settings to facilitate the necessary handshake between Nexus switches and NVIDIA SmartNICs.
- Enable Adaptive Routing: A new option, **Enable Adaptive Routing**, is introduced in the Dynamic Load Balancing (DLB) templates for both Cloud Scale and S1 platforms. Enabling this option generates the relevant configuration command on the switch.
  - Supported Cloud Scale platforms:
    - N9K-C93600CD-GX
    - N9K-C9332D-GX2B
    - N9K-C9348D-GX2A
    - N9K-C9364D-GX2A
  - Supported S1 platforms:
    - N9364E-SG2-O
    - N9364E-SG2-Q
- Adaptive Routing is configured only on leaf switches and is not supported on spine switches.
- The system validates NVIDIA Adaptive Routing compatibility by checking Nexus switches, network interface cards (NICs), and the handshake status. To validate the handshake, the system uses Link Layer Discovery Protocol (LLDP) Type-Length-Value (TLV) host-side packet capture.

Infoblox IPAM

The IPAM Integrator allows read-only access to the IPAM and Nexus Dashboard servers. Currently, IPv4 overlay DHCP is supported. In read-only access mode, IPAM records are retrieved and mapped to Nexus Dashboard networks in Easy Fabric and eBGP VXLAN fabric. You can also choose to sync up records on-demand between Nexus Dashboard and IPAM server. An Infoblox user who has the API permission and at least IPv4 network read permission of IPAM will be able to view the retrieved Infoblox records.

In addition to the matched subnets that exist on both IPAM server and Nexus Dashboard, the IPAM Integrator lists the subnets with conflicting netmask for review.

Accessing IPAM Integrator

This procedure shows how to access IPAM integrator.

1. To enable IPAM Integration feature, perform the following steps:
   a. Choose **Admin > System Settings > Feature Management**.
   b. Check the IPAM Integration check box and click **Apply**.
2. On Nexus Dashboard UI, choose **Virtual Management > IPAM Integrator**.
3. Click on **Authentication Access** to provide the required IPAM server authentication details.
4. Provide the required access details in the **Access Config** window.

   You can provide the access details of an Infoblox server or an Infoblox grid manager.

   - **IPAM Server IP Address** - Specifies the IP address of the IPAM server.
   - **IPAM Server Username** - Specifies the user name for the IPAM server. The Infoblox user has to be granted API permission for the application to retrieve data from Infoblox server via API.
   - **IPAM Server Password** - Specifies the password for the IPAM server with respect to the username.
   - **Poll Interval (minutes)** - Specifies the time in minutes that determines how often you want the data to be retrieved from Cisco Nexus Dashboard and IPAM server. The default value is 15 minutes.
5. Click **Authenticate**.
6. After you access IPAM, you can modify, remove the access details, or edit the poll interval using the **Edit Authentication Access**.

   Only the Nexus Dashboard users with the **admin** role can add, update, and delete the access setting. Also, only Infoblox user who has been granted with API permission and at least IPv4 network read access of IPAM permission is able to view the retrieved Infoblox network records.

Viewing Network IP Scope

Network IP Scope is the landing page after you access the IPAM Integrator.

The following table describes the fields retrieved from the IPAM server.

Field	Description
Network View	Specifies the network view, which is a single routing domain with its own networks and shared networks on the Infoblox server.
IP Subnet	Specifies the IP subnet defined in the IPAM server. A subnet, or subnetwork, is a segmented piece of a larger network. More specifically, subnets are a logical partition of an IP network into multiple, smaller network segments.
DHCP Utilization	Specifies the utilization percentage of a network in terms of the IP addresses that are leased out.Hover over the percentage value to view the number of allocated IPs and their details.In the Infoblox server, it takes time to calculate the DHCP utilization. The IPAM utilization is calculated approximately every 15 minutes on the Infoblox server, and the latest value will be reflected on the IPAM Integrator after that.
IP Range	Specifies the IP range for the network. Hover over a range to view the enabled DHCP range, the reserved DHCP range, and the fixed addresses for a network.

The following table describes the fields retrieved from Nexus Dashboard.

Field	Description
Fabric Name	Specifies the name of the fabric.
Fabric Type	Specifies the type of the fabric. It can be Multi-Site Domain (MSD), or a standalone easy fabric or an eBGP VXLAN fabric.
Network Name	Specifies the name of the network.
VRF Name	Specifies the name of the VRF.
Network ID	Specifies the network ID.
VLAN ID	Specifies the VLAN ID.
Last Updated (by Infoblox)	Specifies the date and time when the data was last updated by Infoblox. The date and time of the last poll are displayed under the **Network IP Scope** title.

Click **Export** to export the data in a .csv file.

For each field, you can sort the values by clicking the arrow icons, and search by entering the search criterion in Filter by attributes box.

The polling of data is based on the following criteria:

- Poll interval value that the user configured initially in the **Access Authentication** window. It

specifies how often you want the data to be retrieved from Cisco Nexus Dashboard and IPAM.

- User can click the **Refresh** icon to receive instantaneous data from Nexus Dashboard and IPAM server.
- Nexus Dashboard Web UI automatically refreshes every 2 minutes and displays data retrieved from Nexus Dashboard and Infoblox server.

  For example, if the poll interval is 15 minutes and user doesn't refresh (on-demand) the data during this 15-minute duration, the Nexus Dashboard Web UI displays the same polling data after every 2-minute refresh until 15 minutes. After 15 minutes, new data is polled from Nexus Dashboard and IPAM, and saved in the database. This new data is fetched by Nexus Dashboard after a total of 16 minutes.

Viewing Statistics and Summary Data for the Subnet Utilization

To view the summary data for the utilization of the IP Subnet over a time, navigate to the following path.

- Click on the IP Subnet. A **Subnet** slide-in pane displays summary data with IP Allocations, Utilization, Allocations, and DHCP Range Details.

To view the statistics for the utilization of the IP Subnet over a time, navigate to the following paths.

- Click on the IP Subnet. A **Subnet** slide-in pane displays summary data.
- Expand the **Subnet** slide-in pane. A **Subnet Details** screen appears.
- Click the **Statistics** tab.

Click the drop-down list and select the time for which you want to view the statistics. These statistics include utilization of subnet such as DHCP allocations, total allocations, dynamic allocations, and static allocations.

Viewing IP Allocation for Hosts

To view the IP allocation for each host, navigate to the following paths.

- Click on the IP Subnet. A **Subnet** slide-in pane displays summary data.
- Expand the **Subnet** slide-in pane. A **Subnet Details** screen appears with **IP Allocation** details.

The following fields are displayed for each host in the **IP Allocation** window. The data for these fields is retrieved from the IPAM server.

- IP Address
- Host Name
- State of the host, that is, active or free
- Range start time and end time
- Subnet
- VRF Name

- Protocol version
- MAC address
- DHCP server info such as IP address and server name
- Switch:Port
- Fabric Name
- Last requested by the host

The Switch:Port and Fabric Name are retrieved through Nexus Dashboard EPL (Endpoint Locator) integration. Their values are empty if EPL feature is not enabled.

For each field, you can sort the values by clicking the arrow icons, and search by entering the search criterion in **Filter by attributes** box.

By default, information about only active hosts are displayed. Click the **All** value to view information about all hosts retrieved from the IPAM server. Click **Export** to export the data in a .csv file.

Hosts that were recently freed show as "FREE" in the **All** tab. All the originally free hosts won't be shown as FREE. Only the hosts that were recently freed appear in this tab.

Viewing Conflicting Networks

IPAM Integrator detects conflicting networks defined in IPAM server and Nexus Dashboard. You can view this info by clicking **Conflicting** in the **Network IP Scope** window.

For example, if one network is a subset of another, the conflicting IP addresses of the network are displayed under **Conflicting**.

The data is displayed similar to how the **Matched** data is displayed. You can click the IP range value under the **IP Range** column to view the IP allocation for each host.

Note that this table also lists the Nexus Dashboard Gateway for the conflicting IP scopes in addition to the subnet information from the IPAM server.

For each field, you can sort the values by clicking the arrow icons, and search by entering the search criterion in **Filter by attributes** box.

DNS integration

The Domain Name System (DNS) integration feature enables the name resolution feature to telemetry data. DNS integration can be associated at the Fabric level.

For DNS integration, you can use one of multiple data source methods.

DNS file upload

This method is simple because mappings do not change often. In the GUI, you can upload a file containing mappings. Use one of the supported formats (.csv and .json). Nexus Dashboard verifies the integrity of the file. When required, you can also download or delete the file from the GUI.

If you do not specify a VRF instance, Fabric name, nor Tenant information, DNS will be applied to the fabrics for which the DNS server is configured based on the choices in **Add Integrations** and **Associations** section. If the DNS server is configured for a fabric, then DNS will be applied to all the fabrics in the group.

The DNS file upload size is limited to 1.8 MB.

Example CSV file

This section provides an example of a CSV file's contents.

```
recordType  fqdn          ips         siteName   tenant      vrf
dnsEntry    WebSrv1.foo.com 10.101.11.1 ACI-Fab1   prod        vrf_prod
dnsEntry    WebSrv2.foo.com 10.101.11.2 ACI-Fab1   prod        vrf_prod
dnsEntry    WebSrv3.foo.com 10.101.11.3 ACI-Fab1   prod        vrf_prod
dnsEntry    WebSrv4.foo.com 10.101.11.4 ACI-Fab1   prod        vrf_prod
```

Example JSON file

This section provides an example of a JSON file's contents.

```
[
   {
      " recordType" : " dnsEntry" ,
      " fqdn" : " WebSrv1.foo.com" ,
      " ips" : [
         " 10.101.11.1"
      ]
   },
   {
      " recordType" : " dnsEntry" ,
      " fqdn" : " WebSrv2.foo.com" ,
      " ips" : [
```

```
        "10.101.11.2",
        "52::2"
      ]
    },
    {
      "recordType": "dnsEntry",
      "fqdn": "WebSrv3.foo.com",
      "ips": [
        "10.101.11.3",
        "52::3"
      ]
    },   {
      "recordType": "dnsEntry",
      "fqdn": "WebSrv4.foo.com",
      "ips": [
        "10.101.11.4",
        "10::101:0:4"
      ]
    }
]
```

DNS query

Use this method one query at a time to retrieve data from the DNS server using reverse lookup. Reverse lookup zone(s) must be configured on the DNS server.

Nexus Dashboard queries the DNS server at regular intervals and resolves IP addresses that are learned using endpoints.

Nexus Dashboard allows one primary and multiple secondary DNS servers, the primary DNS server will be polled first. If the resolution does not succeed, the secondary servers will be polled thereafter.

DNS zone transfer

DNS zone transfer is also known as AXFR downloads. Nexus Dashboard can retrieve zone data in bulk from the DNS server using AXFR downloads. This method is convenient for large quantities of data as you no longer have to work on one query at a time.

A zone transfer requires at least one DNS zone. If you configure a forward mapping zone, then all the A and AAAA records will be fetched from a DNS server, and if you configure a reverse mapping zone, then PTR records will be fetched. When onboarding the DNS server, you must provide a list of zones from which to fetch the data. Nexus Dashboard will fetch the data from each zone configured from the DNS server.

TSIG (transaction signature) is a computer-networking protocol defined in RFC 2845. Primarily it enables the DNS to authenticate updates to a DNS database. For a secure transfer, Nexus Dashboard allows you to configure the TSIG key for a zone to initiate the transaction. Configure the zone with the TSIG key, and an associated algorithm. In the Nexus Dashboard GUI, the supported algorithms are

displayed in a drop-down list.

When you delete an onboarded DNS server, all the zones will be un-configured automatically. A zone can be a forward mapping or a reverse mapping zone.

> When information is changed on the DNS server, it may take up to 3 hours to update corresponding name mappings on Nexus Dashboard. During that interval, the old name will be displayed for endpoints until the sync is completed.

Guidelines and limitations for DNS integration

These guidelines and limitations apply to DNS integration:

- DNS onboarding can be done at a fabric level.
- Only one type of DNS integration method is supported in one fabric. For example, in a fabric, you cannot configure integration using DNS file uploads as well as DNS zone transfer methods.
- Multiple DNS integration onboarding of the same type is allowed in a fabric. For example, multiple files can be onboarded to a fabric using the DNS file uploads method.
- If you perform DNS integration onboarding for multiple fabrics, you cannot also onboard a fabric in that group.
- When a corrupted or malformed .CSV of .JSON file is uploaded to the DNS server, Nexus Dashboard raises system anomalies. However, the connectivity status of the third-party onboarding server, remains in the initialized state and does not change to display a failed state. If the third-party onboarding server remains in the initialized state, check the system anomalies for any anomalies related to the specific integration.
- Data from DNS servers will be polled or refreshed every 3 hours. Any changes in the mapping on the DNS server will be reflected after the next polling cycle.

Configure DNS

Follow these steps to configure DNS.



The .json or .csv file used in this task must be uploaded in a specific schema. See the following section for the formats to use.

1. Click **Admin** > **Integrations** > **Add Integration**.
2. Select **DNS** for the **Integration Type**.
3. In the **Authentication** section, select one of the following DNS types to view the corresponding fields:
   a. Zone Transfer - Enter the **Name**, **DNS Server IP**, **DNS Server Port**, and **Zones**. In the **Zones** area, enter the value for Zone Name. Optional values that can be entered are TSIG Key Name, TSIG Key Value, TSIG Algorithm. The **TSIG Algorithm** dropdown menu selections are hmac-sha1, hmac-sha256, hmac-sha512, hmac-md5.
   b. Query Server - Enter the **Name**, **DNS Server IP**, **DNS Server Port**, and **Secondary Servers**.
   c. Mapping File - Enter the **Name**, **Description**, and **Upload a JSON or CSV file**.

4. In the **Associations** area, click **Add Associations** to associate a fabric or multiple fabrics. The Summary displays an overview of the Integration created.
5. Click Save to add the integration. The post completion success screen allows you to **Add Another Integration** or **View Integrations**.

Edit or delete a DNS configuration

Follow these steps to edit or delete a DNS configuration.

1. To edit your DNS configuration, click the Actions icon and click **Edit**. When you have completed editing, click **Add**.
2. To delete your DNS configuration, click the Actions icon and click **Delete**.

Formats for files used in DNS file uploads

When configuring the DNS file uploads, .json and .csv formats are supported. Use the formats provided below for the files that you upload.

The fields in a DNS file upload can have optional VRF instance or fabric name information. In a Cisco ACI fabric, the upload can also have tenant information. If you specify details for one of these options, you must specify details for all of them. In a Cisco ACI fabric, if you have a file that contains the fabric name, you must also specify the VRF instance and tenant. In an NX-OS fabric, if you have a file that contains the fabric name, specifying the VRF instance is optional.

Format .json for a Cisco ACI fabric

```
[
 {
      " recordType" : " dnsEntry" ,
      " fqdn" : " host1.cisco.com" ,
      " ips" : [" 1.1.0.0" ],
      " vrf" : " vrf-1" ,
      " siteName" : " swmp3" ,
      " tenant" : " tenant-1"
 },
 {
      " recordType" : " dnsEntry" ,
      " fqdn" : " host2.cisco.com" ,
      " ips" : [" 1.1.0.1" ],
      " vrf" : " vrf-1" ,
      " siteName" : " swmp3" ,
      " tenant" : " tenant-1"
},
{
       " recordType" : " dnsEntry" ,
       " fqdn" : " host3.cisco.com" ,
       " ips" : [" 1.1.0.2" ],
```

```
 },
]
```

Format .json for an NX-OS fabric

```
[
  {
        " recordType" : " dnsEntry" ,
        " fqdn" : " host1.cisco.com" ,
        " ips" : [" 1.1.0.0" ],
        " vrf" : " vrf-1" ,
        " siteName" : " swmp3" ,
  },
  {
        " recordType" : " dnsEntry" ,
        " fqdn" : " host2.cisco.com" ,
        " ips" : [" 1.1.0.1" ],
        " vrf" : " vrf-1" ,
        " siteName" : " swmp3" ,
 },
 {
         " recordType" : " dnsEntry" ,
         " fqdn" : " host3.cisco.com" ,
         " ips" : [" 1.1.0.2" ],
 },
]
```

Format .csv

```
recordType,fqdn,ips,siteName,tenant,vrf
dnsEntry,swmp3-leaf1.cisco.com," 101.22.33.44" ,swmp3,tenant-1,vrf-1
dnsEntry,swmp5-leaf1.cisco.com," 10.2.3.4,10.4.5.6,1.2.3.4" ,fabric2,tenant-2,vrf-2
dnsEntry,swmp4-leaf1.cisco.com, " 1.1.1.1" ,,,
```

Slurm integration

Enhanced analytics is available for workloads in AI routed and VXLAN fabrics within Nexus Dashboard. This enhancement provides end-to-end visibility and actionable insights for AI infrastructures by integrating job completion and GPU statistics with network statistics, providing a detailed overview of network topologies along with GPUs.

In order to view job details for AI fabrics, you must first integrate Slurm (Simple Linux Utility for Resource Management), which is an open-source job scheduler used to manage resources on high-performance computing clusters.

Add Slurm integration

Follow these steps to add the Slurm integration.

1. Navigate to **Admin** > **Integrations** > **Add integration**.
2. In the Integration type step, choose **Slurm**, then click **Next**.
3. Complete these fields in the **Authentication** step.
    a. Enter the name of the Slurm integration.
    b. Enter the Slurm host name or IP address.
    c. Enter the username and password to authenticate the Slurm integration.
    d. Click **Next**.
4. Review the information in the **Summary** step, then click **Save**.
    - To add another Slurm integration, click **Add another integration**.
    - To view Slurm integration details, click **View integrations**.

In the **Integrations** window, the status for the Slurm integration will display as Initialize for a short period of time, and will change to Active when the integration is successfully completed. In addition, Nexus Dashboard determines which servers are connected to the Slurm cluster, then locates the fabric that contains those servers and displays that fabric in the **Derived fabrics** column.

Using enhanced analytics for AI fabrics

After you have added the Slurm integration, you can now use enhanced analytics for AI fabrics using these procedures:

- Editing AI Data Center Routed Fabric Settings
- Editing AI Data Center VXLAN Fabric Settings

VMware vCenter integration

Integrating VMware vCenter server allows Nexus Dashboard to collect data and metrics of the virtual machines and hosts monitored by VMware vCenter, and then correlate the collected information with the data collected from the Cisco ACI or Cisco NX-OS fabric.

Data collected from VMware vCenter includes

- Virtual machine data
- Network data
- Virtual machine NIC data
- Host data
- Datastore data
- Standard switch information
- DVS information

Data is collected from vCenter every 60 minutes by default. Follow these steps to modify the settings.

1. Navigate to **Admin > System Settings**.
2. Click **Fabric management**.
3. In the **Advanced settings** area, click **VMM**.
4. Change the setting in the **Background Resync Timer in minutes** field, then click **Save**.

Prerequisites for VMware vCenter Server integration

- You have installed VMware vCenter 6.5 and later.
- You have read-only privileges for VMware vCenter.
- Network reachability.
- For NXOS or ACI fabrics, ensure that the ESXi hosts are directly connected to the front panel ports of the leaf switches. Nexus Dashboard must discover this physical connectivity to update the VM inventory list.



- Ensure that you enable either LLDP or CDP to accurately discover the connection points of hosts and to determine the inventory. Therefore, the DVS should be configured with one of these protocols, and the corresponding protocol must also be configured on the switch ports facing the hosts.
- A successful VMware vCenter connection indicates only that Nexus Dashboard can communicate with the VMware vCenter server. To discover and populate the virtual machine inventory, Nexus Dashboard must discover the direct physical connectivity between the ESXi hosts and the front panel ports of the managed leaf switches.

Guidelines and limitations for VMware vCenter Server integration

- For a single node vND deployment, support includes one VMware vCenter server and up to 1000 VMs.
- For greenfield or brownfield VXLAN EVPN fabric management to Nexus Dashboard, support includes 24 VMware vCenter servers and up to 5500 VMs.
- Number of vNIC hosts supported for VMware vCenter integration is 10,000.
- Nexus Dashboard supports multiple vCenters per fabric.
- Ensure that you resync vCenter clusters after you use backup or restore operation. To synchronize individual vCenter cluster, click the ellipsis (...) in the last column of the **Integrations** table to choose the **Rediscover** option.

Supported deployment scenarios

Nexus Dashboard supports the following VMware vCenter deployment scenarios.

- NX-OS fabrics—Direct connection to server ports.
- ACI fabrics—Direct connection to server ports.
- UCS domains—NX-OS fabric connected to a UCS Fabric Interconnect (FI), which is then connected to the UCS servers (NX-OS fabric <> UCS-FI <> UCS server).

Add VMware vCenter server integration

Follow these steps to add VMware vCenter Server integration.

1. Click **Admin** > **Integrations** > **Add integration**.
2. Choose **vCenter server** for the **Integration type**, then click **Next**.
3. Configure these fields in the **Authentication** page.

Field	Description
vCenter server name	Enter the vCenter server name.
vCenter server IP address or DNS name	Enter the vCenter server IP address or domain name.
Username	Enter the vCenter username and password.
Password	

4. Click **Next**.

   The **Summary** page displays an overview of the integration.

5. Verify the information in the **Summary** page, then click **Save**.
6. Click **Save** to add the integration.

The success screen displays and allows you to **Add Another Integration** or **View**.

vCenter VM adapter state overview

To display an **Overview** page for a vCenter integration:

1. Navigate to the **Integrations** page.

   Admin > Integrations

2. Locate the integration that shows **vCenter** in the **Type** column in the **Integrations** page.
3. Click on the entry in the **Name** column for that vCenter integration.

   The **Overview** page for that vCenter integration appears.

   The following table describes the fields and description in the page.

Field	Description
VM Name	Specifies the name of the virtual machine.
IP Address	Specifies the IP address of the virtual machine.
MAC Address	Specifies the MAC address of the virtual machine.
VLAN	Specifies the VLAN associated with the virtual machine.
Network	Specifies the network associated with the virtual machine.
Network adapter	Specifies the state of the network adapter.
VM adapter state	Specifies the state of the VM adapter.
Switch	Specifies the switch connected to the virtual machine.
Switch interface	Specifies the switch interface connected to virtual machine.
Compute host	Displays the IP address of the compute host.
Physical NIC	Specifies the physical network interface card (NIC) on the host that connects to the network adapter of the VM.
ToR name	Specifies the name of the ToR switch that the VM's network traffic is routed through.
ToR interface	Specifies the interface on the ToR switch that connects to the physical NIC or network path for the VM.
ToR PO	Specifies the port channel (PO) on the ToR switch aggregating multiple physical links for redundancy and increased bandwidth to the VM.

Note that this table provides a complete inventory of the physical network path for network connections of a VM. The **ToR name**, **ToR interface**, and **ToR PO** columns display values only when a ToR switch is present in the network path.

View VM details

The VM details page displays specific operational, configuration, and inventory details for virtual machines that an integrated vCenter manages.

Follow these steps to view the VM details.

1. Navigate to the **Integrations** page.

   Go to **Admin > Integrations**.

2. Click the name of the vCenter server integration.

   The vCenter VM overview page displays.

3. In the VM inventory list, click the VM Name of the specific virtual machine you wish to inspect.

   The VM details page displays **General details** and **Network adapter** sections.

You can view the following information in **General details** section.

Field	Description
State	Specifies the power state of the VM (for example, connected or disconnected).
Status	Displays the health status of the VM as reported by vCenter.
Hostname	Displays the hostname assigned to the guest operating system.
Guest OS	Displays the operating system type and architecture running on the VM.
vCenter	Displays the IP address of the vCenter server managing the VM.
Datacenter	Displays the name of the vCenter datacenter where the VM resides.
Cluster	Displays the name of the vCenter cluster associated with the VM.
Compute host	Displays the IP address of the ESXi host where the VM is currently running.
CPU	Specifies current CPU usage of the VM.
Memory	Specifies the **Active Guest Memory** currently used by the VM.  This value represents the memory the guest operating system currently uses. Nexus Dashboard normalizes this value across integrations.
Disk	Displays the total disk storage capacity allocated to the VM.

You can view the following information in **Network adapter** section.

Field	Description
IP Address	Displays the IP address assigned to the specific network adapter.
MAC address	Displays the hardware address of the network adapter.
Network	Displays the name of the network to which the adapter connects.

Field	Description
Switch	Displays the name of the fabric switch(es) connected to the host (for example, dev2-leaf1, dev2-leaf2).
Switch Interface	Displays the specific physical interface on the switch (for example, Ethernet 1/3).
PG/DVS PG	Displays the Port Group (PG) or Distributed Virtual Switch(DVS) PG name.

Kubernetes integration

Kubernetes is an open-source platform that automates the deployment, scaling, and management of applications packaged as lightweight and portable units.

Follow these steps to enable LLDP on Nexus Dashboard:

1. Navigate to **Fabric management** page.

   Go to **Admin > System Settings > Fabric management**.

2. In the **Advanced settings** area, click the **Discovery** tab.
3. Check the **enable / disable neighbor link discovery using LLDP** check box.

   LLDP is applicable for Bare-metal Kubernetes clusters only.

- Ensure that the LLDP feature is enabled on all fabric switches for which the cluster node is connected. (switches may be spine or leaf switches).
- On the Kubernetes cluster, ensure that LLDP and SNMP services are enabled on all Bare-metal nodes.
- If the Cisco UCS is using an Intel NIC, LLDP neighborship fails to establish due to FW-LLDP.

  To resolve this, for selected devices based on the Intel® Ethernet Controller (for example, 800 and 700 Series), disable the LLDP agent that runs in the firmware. Use the following command to disable the LLDP agent.

  echo 'lldp stop' > /sys/kernel/debug/i40e/<bus.dev.fn>/command

  Execute the following command to find the bus.dev.fn for a given interface, and choose the ID associated with the interface. The ID is highlighted in the sample output.

  [ucs1-lnx1]# dmesg | grep enp6s0 [12.609679] IPv6: ADDRCONF(NETDEV_UP): enp6s0: link is not ready [12.612287] enic 0000:06:00.0 enp6s0: Link UP [12.612646] IPv6: ADDRCONF(NETDEV_UP): enp6s0: link is not ready [12.612665] IPv6: ADDRCONF(NETDEV_CHANGE): enp6s0: link becomes ready[ucs1-lnx1]#

  LLDP is enabled on the fabric switches that connect to the bare-metal cluster nodes. The nodes can also connect to the border gateway switches. If you discover the fabric (to which the Kubernetes cluster connects) after you discover the cluster, you must rediscover the cluster to display the topology correctly.

If the Bare-metal-based Kubernetes cluster is discovered after configuring LLDP, you must rediscover the Baremetal cluster to display the topology correctly.

To discover or visualize a VM-based Kubernetes cluster, you must first onboard the vCenter cluster that manages the VMs hosting the Kubernetes cluster. If you do not complete this step, Kubernetes cluster discovery fails.

Configure routes

By default, Nexus Dashboard uses the data interface to connect to the Kubernetes API endpoint. To use the management interface instead, you need to configure an alternate route on Nexus Dashboard.

Follow these steps to configure routes on Nexus Dashboard.

1. Navigate to **Admin > System Settings**.
2. In the **General** tab, under **Routes**, click **Edit**.

   The **Routes** page displays.
3. Click **Add management network routes**, enter the required IP addresses, and click the **check** icon.
4. Click **Save**.

Add a Kubernetes cluster

Follow these steps to add a Kubernetes cluster.



Ensure that the routes are configured to connect to the Kubernetes cluster through the appropriate network interface. For more information, see Configure routes.

1. Navigate to **Admin > Integrations**.
2. If there are no existing integrations, click **Add integration**.

   The **Add integration** page displays.
3. Under **Integration type**, choose **Kubernetes** and click **Next**.
4. In the **Cluster name** field, provide a unique name for the cluster.
5. In the **API server name/address** field, provide a hostname or IP address of the API server.
6. In the **API server port number** field, enter the port number used by the API server.
7. In the **Username** field, provide a username that Nexus Dashboard uses for authentication.
8. Click the **Fetch CSR** button to obtain a certificate signing request (CSR) from the Kubernetes visualizer application. This option remains disabled until you provide a valid cluster IP address and username.

   Click the **Fetch CSR** button only if you do not have the SSL certificate for the Nexus Dashboard Kubernetes client.

   Click **Download CSR** to download the **<username>.csr** file in your directory. The username is the one provided in step 7.

   The CSR file name must adhere to the naming convention **<username>.csr**.
9. Login to the Kubernetes cluster controller node.
10. Copy the genk8clientcert.sh and <username>.csr files from the Nexus Dashboard server location to the Kubernetes Cluster controller node.

11. Execute the **genk8sclientcert.sh** script file to generate the CSR for the user name using this command.

    (k8s-root)# **./genk8sclientcert.sh kubereader x.x.x.x** where,

    - kubereader is the username of the API Client to connect to Kubernetes. (as defined in Step 7).
    - x.x.x.x is the IP address of the Nexus Dashboard server.

    The script **genk8sclientcert.sh** generates these files.

    - k8s_cluster_ca.crt
    - *username_IP.crt*

      For example: kubereader_x.x.x.x.crt (where, kubereader is the username, and x.x.x.x is the Nexus Dashboard IP address).

12. Use the cat command to extract the certificate from these 2 files.

    ```
    (k8s-root)# cat kubereader_10.x.x.x.crt
    (k8s-root)# cat k8s_cluster_ca.crt
    ```

13. Copy the content in the kubereader_x.x.x.x.crt to **Client certificate** field.

    Ensure that all the characters are copied correctly with no spaces.

14. Copy the content in the k8s_cluster_ca.crt to **Cluster certificate** field.

    Ensure that all the characters are copied correctly with no spaces.

15. Click **Next**.

    You can view the summary of details that you added.

16. Click **Add**.

    You can view the Kubernetes cluster that you added in the **Integrations** page.

View a Kubernetes cluster

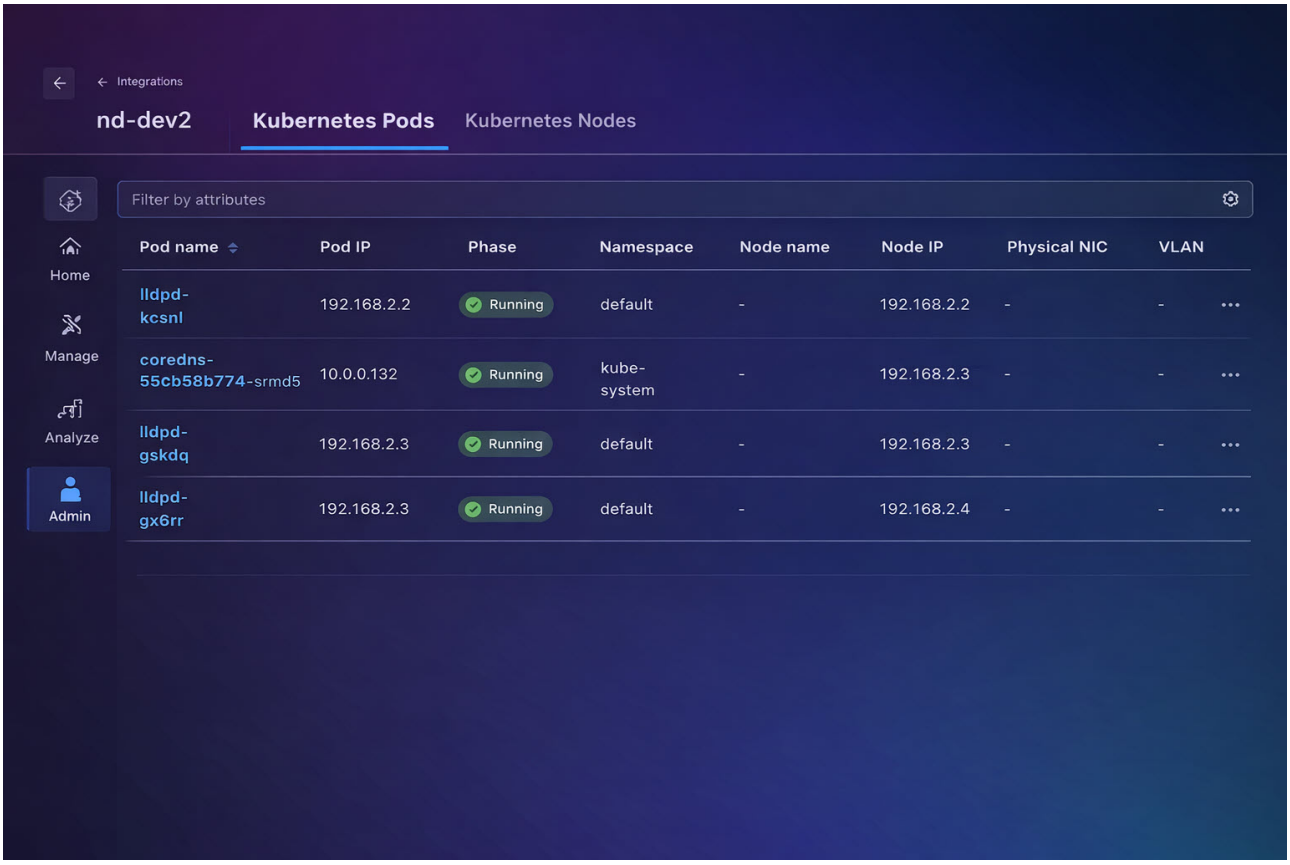
Follow these steps to view the Kubernetes visualizer details.

1. Navigate to **Admin > Integrations**.

   The **Integrations** page displays.

2. In the **Integrations** page, click the Kubernetes cluster that you added.

   The **Cluster** page opens and displays details about **Kubernetes Pods** and **Kubernetes Nodes** .



Edit a Kubernetes cluster

Follow these steps to edit a Kubernetes cluster.

1. Choose the appropriate cluster.
2. From the **Actions** drop-down list, choose **Edit Instance**.
3. Click **Edit** to modify the cluster settings.

   You can also update the cluster and the client certificates.

   For the Kubernetes cluster in unmanaged status, you cannot view the topology and the Kubernetes cluster details in the **Integrations** page.

4. Click **Save** to save the changes or click **Cancel** to discard the changes.

Delete a Kubernetes cluster

Follow these steps to delete a Kubernetes cluster.

1. Choose the appropriate cluster.
2. From the **Actions** drop-down list, choose **Delete Instance(s)**.
3. Click **Confirm** to delete the cluster.

   All the data is deleted if you delete the cluster. The cluster is removed from the **Topology** view as well.

Rediscover a Kubernetes cluster

Follow these steps to rediscover a Kubernetes cluster.

1. Choose the appropriate cluster.
2. From the **Actions** drop-down list, choose **Rediscover Instance(s)**.

   A confirmation message appears to verify your action. Click **Confirm** to proceed with rediscovery.

Renew certificate for an Kubernetes cluster

If the **Integration summary** page indicates that the certificate for the integrated Kubernetes cluster has expired, delete the existing Kubernetes integration. Then, follow the steps outlined in Add a Kubernetes cluster again to re-register the cluster. Note that the certificate validity period is ultimately determined by the signer on the cluster side. This approach ensures that the cluster is properly re-registered with valid certificates.

Guidelines and limitations

Ensure that you resync Kubernetes clusters after you use backup or restore operation. To synchronize individual Kubernetes cluster, click the ellipsis (...) in the last column of the **Integrations** table to choose the **Rediscover** option.

OpenShift integration

OpenShift is a Kubernetes-based platform from Red Hat that includes tools for developing and running applications. OpenShift integration in Nexus Dashboard focuses on showing OpenShift resources and their placement within the network. OpenShift will now appear as a new integration option under **Virtual machine and container workload managers** similar to Kubernetes. You can add an existing OpenShift cluster to Nexus Dashboard through this integration. Once added, Nexus Dashboard regularly fetches data from the OpenShift cluster to display information about pods, nodes, and their connections. For network discovery, Nexus Dashboard assumes LLDP/CDP data is available. OpenShift integration provides the capability to visualize connectivity through topology and fabric management interfaces.

Prerequisites for OpenShift integration

- All OpenShift nodes must be connected to one of the fabrics managed by Nexus Dashboard.
- The OpenShift cluster API endpoint must be reachable by Nexus Dashboard data interface. Alternatively, the OpenShift cluster API endpoint must be reachable by Nexus Dashboard management interface and the specific routes must be configured from **Admin > System Settings > General > Routes**.

Prerequisites for OpenShift bare-metal nodes

- Enable neighbor discovery using LLDP in Nexus Dashboard.

Follow these steps to enable neighbor discovery using LLDP.

1. Enable advanced settings for TAC support.
    a. Navigate to **Admin > System Settings**.
    b. Click the **General** tab.
    c. Under **Advanced settings**, click **Edit**.

    The **Advanced settings** page displays

    d. Check the **Display advanced settings and options for TAC support** check box.
    e. Click **Save**.
2. Enable LLDP neighbor discovery.
    a. Navigate to **Admin > System Settings**.
    b. Click the **Fabric management** tab.
    c. Under **Advanced settings**, click the **Discovery** tab.
    d. Check the **enable/disable neighbor link discovery using LLDP** check box.
    e. Click **Save**.

- The OpenShift cluster must run an agent to send LLDP packets. You must configure the system name in the agent to match the node name.

  Example configuration for LLDP daemonSet.

This configuration creates a daemonSet that deploys the lldpd container on each node. The container runs with the necessary privileges and mounts the /etc/os-release file from the host.

```
apiVersion: apps/v1
kind: DaemonSet
metadata:
  name: " lldpd"
spec:
  selector:
    matchLabels:
      name: lldpd
  template:
    metadata:
      labels:
        name: lldpd
    spec:
      tolerations:
        - key: node-role.kubernetes.io/control-plane
          operator: Exists
          effect: NoSchedule
        - key: node-role.kubernetes.io/master
          operator: Exists
          effect: NoSchedule
      containers:
        - name: lldpd
          image: ghcr.io/lldpd/lldpd
          command: [" lldpd" ]
          args: [" -d" ]
          imagePullPolicy: IfNotPresent
          securityContext:
            capabilities:
              drop: [" ALL" ]
              add: [" NET_ADMIN" , " NET_RAW" ]
            privileged: true
          volumeMounts:
            - name: os-release
              mountPath: /etc/os-release
      volumes:
        - name: os-release
          hostPath:
            path: /etc/os-release
      hostNetwork: true
```

Prerequisites for OpenShift virtualizer nodes

- The OpenShift nodes should be running on hypervisors managed by a vCenter integrated with Nexus Dashboard .
- Integration with the vCenter must be done before the OpenShift integration.

Add an OpenShift cluster

Follow these steps to add an OpenShift cluster.

1. Navigate to **Admin > Integrations**.
2. If there are no existing integrations, click **Add integration**.

   The **Add integration** page displays.
3. Under **Integration type**, choose **OpenShift** and click **Next**.
4. In the **Cluster name** field, provide a unique name for the cluster.
5. In the **API server name/address** field, provide a hostname or IP address of the API server.
6. Optional: If the TLS server name differs from the API server name, provide the **TLS server name** in the **TLS server name** field to ensure secure communication.

   The following combinations of **API server name/address** and **TLS server name** values are supported.

Fields		**OpenShift API Server Reachability from Nexus Dashboard**	
API server name/address	**TLS server name**	**Direct**	**Through HTTP Proxy**
FQDN	Empty	Supported if Nexus Dashboard can resolve the FQDN	Supported if 1. FQDN is added to the SAN of the server certificate (if not present already). 2. Nexus Dashboard can resolve the FQDN.
IP Address	Valid TLS server name	Supported	Supported (not required to add to SAN, no FQDN resolution needed).
FQDN	Valid TLS server name	Supported	Supported (not required to add to SAN, but FQDN resolution is needed).
IP Address	Empty	Not supported	Not supported

7. In the **API server port number** field, enter the port number used by the API server.

   The default port number for the OpenShift API server is 6443.
8. In the **Username** field, provide your username for authentication.
9. Click the **Fetch CSR** button to obtain a certificate signing request (CSR) from the OpenShift visualizer application. This option remains disabled until you provide a valid cluster IP address and username.

Nexus Dashboard saves the certificate details in the <username>.csr file in your directory.

10. Click the **Fetch CSR** button only if you do not have the SSL certificate for the Nexus Dashboard OpenShift client.

    If you already have a valid client certificate, you need not fetch the CSR. You can use the base64 encoded client certificate and the cluster certificate in the **Cluster certificate** and **Client certificate** fields respectively.

11. Click the **Get CertGen tool** button to download the script file, genclientcert.sh, which generates the client certificate and retrieves the API server certificate.

    You need OpenShift cluster administrator privileges to generate client certificates. Ensure that the previously obtained <username>.csr file is placed in the same directory as the script file.

    Execute the script file on any server configured with the appropriate kubeconfig to access the OpenShift API server using this command.

    (osp-root)# **./genclientcert.sh Ospreader 10.x.x.x** where,

    - Ospreader is the username of the API Client to connect to OpenShift. (as defined in Step 4)
    - 10.x.x.x is the IP address of the Nexus Dashboard server.

      These are the two new certificates generated in the same location.

    - k8s_cluster_ca.crt
    - username_ND_IP.crt

      For example: Ospreader_10.x.x.x.crt (where, Ospreader is the username, and 10.x.x.x is the Nexus Dashboard IP address).

12. Copy the content in the <username>_<ND_IP>.crt to **Client certificate** field.

    Ensure that all the characters are copied correctly with no spaces.

13. Copy the content in the k8s_cluster_ca.crt to **Cluster certificate** field.

    Ensure that all the characters are copied correctly with no spaces.

14. Click **Next**.

    You can view the summary of details that you added.

15. Click **Save**.

    You can view the OpenShift cluster that you added in the **Integrations** page. For more information, see View an OpenShift cluster.

Edit an OpenShift cluster

Follow these steps to edit an OpenShift cluster.

1. Choose the appropriate cluster.
2. From the **Actions** drop-down list, choose **Edit Instance**.
3. Click **Edit** to modify the cluster settings.



You can also update the cluster and the client certificates.

4. Click **Save** to save the changes or click **Cancel** to discard the changes.

Delete an OpenShift cluster

Follow these steps to delete an OpenShift cluster.

1. Choose the appropriate cluster.
2. From the **Actions** drop-down list, choose **Delete Instance(s)**.
3. Click **Confirm** to delete the cluster.

Rediscover an OpenShift cluster

Follow these steps to rediscover an OpenShift cluster in case the discovery failed or you need to update the information to connect to the OpenShift cluster.

1. Choose the appropriate cluster.
2. From the **Actions** drop-down list, choose **Rediscover Instance(s)**.

   A confirmation message appears to verify your action. Click **Confirm** to proceed with rediscovery.

Renew certificate for an OpenShift cluster

If the integrated OpenShift cluster shows certificate expired in integration-summary page, then delete the existing OpenShift integration and perform the steps mentioned in Add an OpenShift cluster section again to re-register the cluster. Certificate validity duration is ultimately controlled by the signer on the cluster side.

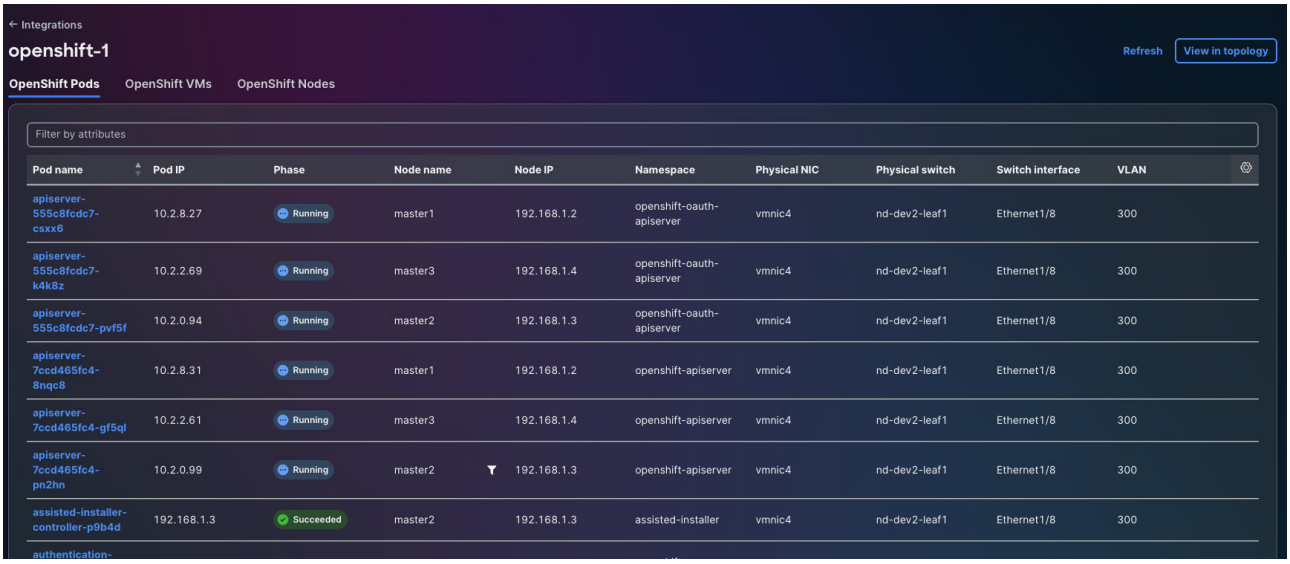
View an OpenShift cluster

Follow these steps to view an OpenShift cluster.

1. Navigate to **Admin > Integrations**.

   The **Integrations** page displays.

2. In the **Integrations** page, click the OpenShift cluster that you added.
3. The **Cluster** page opens and displays details about **OpenShift Pods**, **OpenShift VMs**, and **OpenShift Nodes**.



You can also view the OpenShift cluster from the **Topology** page. Navigate to **Home > Topology** to view the OpenShift Nodes and VMs represented with OpenShift-specific icons. In the topology view, a specific VM is represented by both the pod that launches it and an icon for the VM itself. This occurs because OpenShift visualization, which is built on KubeVirt, treats VMs as pods.

Guidelines and limitations for OpenShift integration

- Security groups for OpenShift VMs, like those used for VMware VMs, are not supported.

  This is because OpenShift traffic uses the fabric as an underlay, unlike regular vCenter traffic. Policy enforcement in these cases is managed through fabric-level policies or Kubernetes-native network policies.

- OpenShift integration is compatible only with bare metal and virtual nodes running on VMware ESX.
- Ensure that you resync OpenShift clusters after you use backup or restore operation. To synchronize individual OpenShift cluster, click the ellipsis (...) in the last column of the **Integrations** table to choose the **Rediscover** option.
- Anomaly detection and endpoint analytics for OpenShift nodes are not available.
- OpenShift integration is only supported for OpenShift clusters connected to an NX-OS based fabric. ACI fabrics are not supported in this release.
- OpenShift cluster bare-metal nodes are supported. In order to discover bare-metal nodes, LLDP is required.
- OpenShift cluster virtualized nodes are supported only if they run on VMware hypervisors. In order to discover virtual nodes running on ESXi hosts, it is required to integrate Nexus Dashboard with the VMware vCenter where the nodes are running. For more information see, Add VMware vCenter server integration.
- If the OpenShift nodes are virtualized, the discovery of the nodes on vCenter happens matching the IP address of the nodes with the known virtual machines. If multiple virtual machines across the same or multiple vCenters integrated with Nexus Dashboard are overlapping the same IP address, the discovery may fail.

Panduit PDU integration

Panduit Power Distribution Unit (PDU) Integration in Nexus Dashboard enables you to monitor energy usage and unlock sustainability insights for fabrics and individual devices connected to a Panduit PDU. Monitoring energy consumption gives you insight into how much electricity your devices and/or Panduit PDUs are using.

The workflow for integration of Panduit PDU consists of the following steps:

1. Install Panduit PDU collector and PDUs.
2. Add PDU collector to Nexus Dashboard. The PDU collector collects telemetry from PDUs in your environment.
3. Associate PDUs to the PDU collector. The associated PDUs sends telemetry to the Panduit PDU collector, and Nexus Dashboard displays PDU statistics in the Sustainability Report. See Sustainability Report.

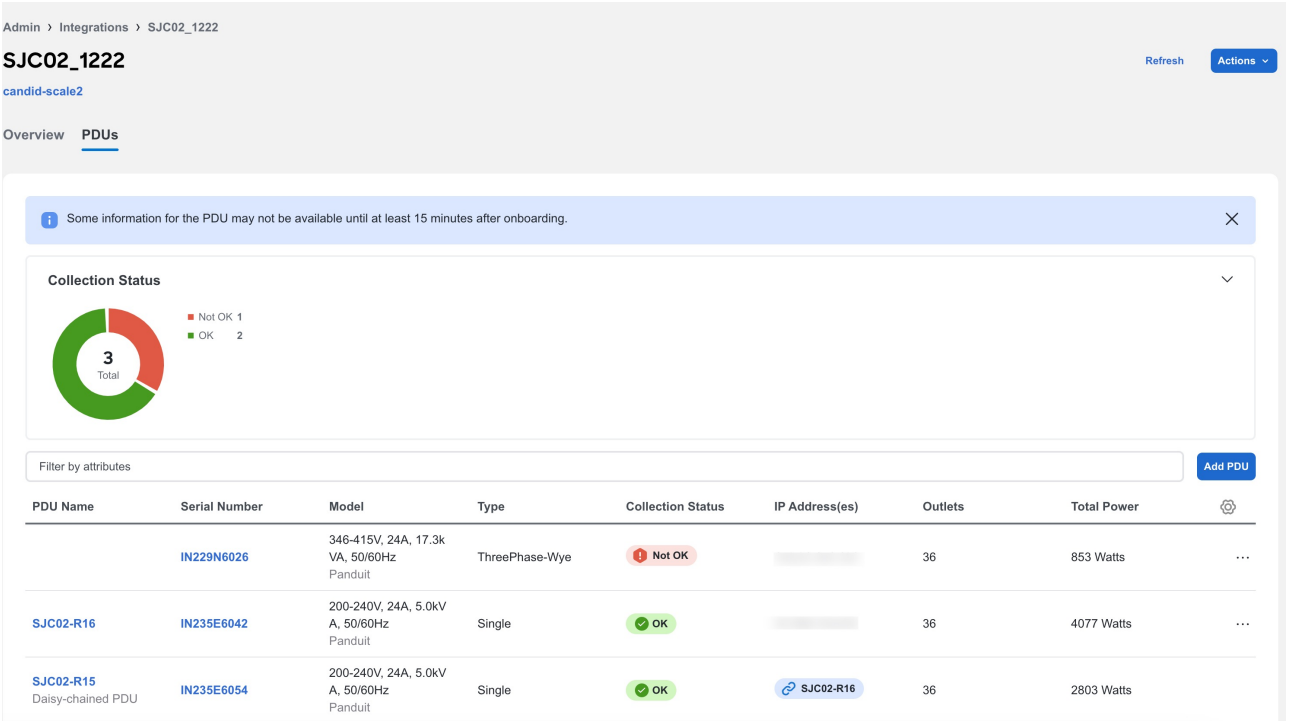
Prerequisites for Panduit PDU integration

- Install Panduit Collector and PDUs. See Panduit Data Collector for Cisco Nexus Dashboard.
- Associate the PDUs with the collector.
- Configure a persistent IP address for the PDU collector in the Nexus Dashboard Admin Console to stream telemetry information for one or more PDUs in your fabric. To set this up, navigate to **Admin** > **System Settings** > **General** > **External Service Pools** > **Add Data Service IP Address** to configure the persistent IP address.
- Ensure that you configure the SNMP protocol in the PDU. For more information, see Simple Network Management Protocol.

Guidelines and limitations for Panduit PDU integration

These guidelines and limitations apply for Panduit PDU integration:

- After you onboard the PDU collector, Nexus Dashboard requires at least 15 minutes to display the connected devices in the GUI.
- Once the devices appear in the GUI, Nexus Dashboard updates the PDU data every 15 minutes.
- If the PDU collection status is **Not OK**, see the "Troubleshooting" section in the Installation Guide (https://www.panduit.com/content/dam/panduit/en/website/support/download-center/documents/Panduit-Collector-for-Nexus-Installation-Guide_v1.2.pdf) to check the streaming issues.
- If you have not configured the PDU name in the Panduit PDU GUI, the PDU name is not displayed in the PDU table in Nexus Dashboard.



Add PDU integration

Follow these steps to add PDU integration.

1. Navigate to **Admin** > **Integrations** > **Add Integration**.
2. Select Integration Type **Panduit PDU**.
3. Complete the following fields for **PDU Collector**.
   a. Enter the name of the PDU Collector.
   b. Enter the IP address of the PDU Collector.
   c. Enter the username and password to authenticate the PDU Collector.
   d. Select an online fabric to associate with the PDU Collector. A PDU Collector is associated with single fabric.

      Snapshot fabric is not supported.

   e. Click **Next**.
4. Complete the following fields for **Add PDUs** to add PDUs to the PDU collector.
   a. The PDU collector version and status is displayed in the summary. Once the PDU collector is added successfully, you can add the PDUs to the collector.
   b. Enter the IP address of the PDU.
   c. Click **Add to Collector**.
5. Complete the following fields for PDU credentials.

   Ensure that you have configured the SNMP protocol in the PDU.

   a. Select the SNMP protocol version.

b. For SNMP protocol version 2, enter the community string and click **Submit**.

c. For SNMP protocol version 3, enter the user name.

d. Select the Authentication Type and Protocol.

e. Enter the Authentication password.

f. Select the Privacy Protocol and enter the password.

g. Click **Submit**.

h. After the PDU credentials are verified, the PDU is added to the collector and the PDU status is displayed in the table. In the table you can view details such as PDU status, PDU name, IP address of primary and secondary PDU, model, and serial number. For secondary PDU or Daisy-chained PDUs, you can view all the PDUs linked to the primary PDU.

i. Click **Next**.

6. Review the PDU information in the PDU Summary and click **Done**.

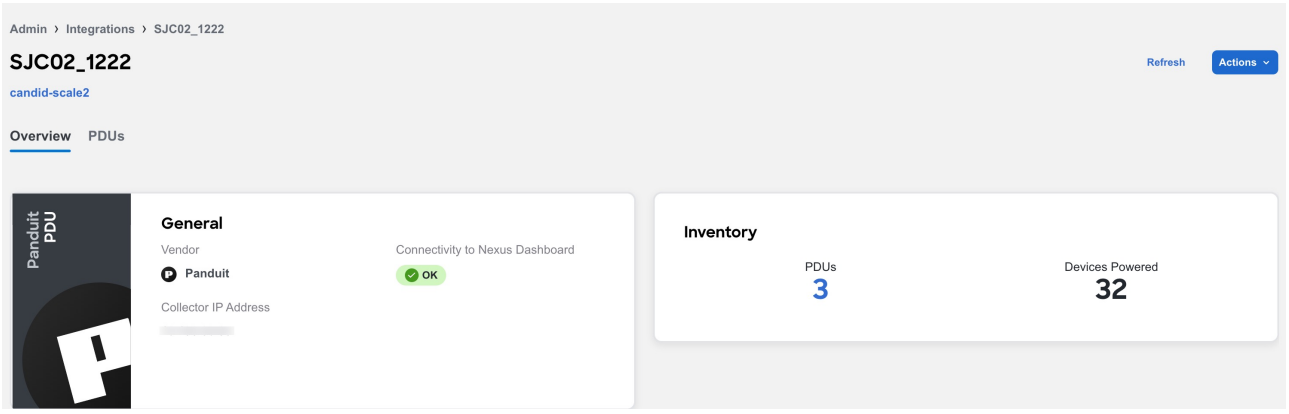
   a. To add another PDU Collector click **Add Another PDU Collector**.

   b. To view PDU Collector details, click **View PDU Collector**.

View PDU integration

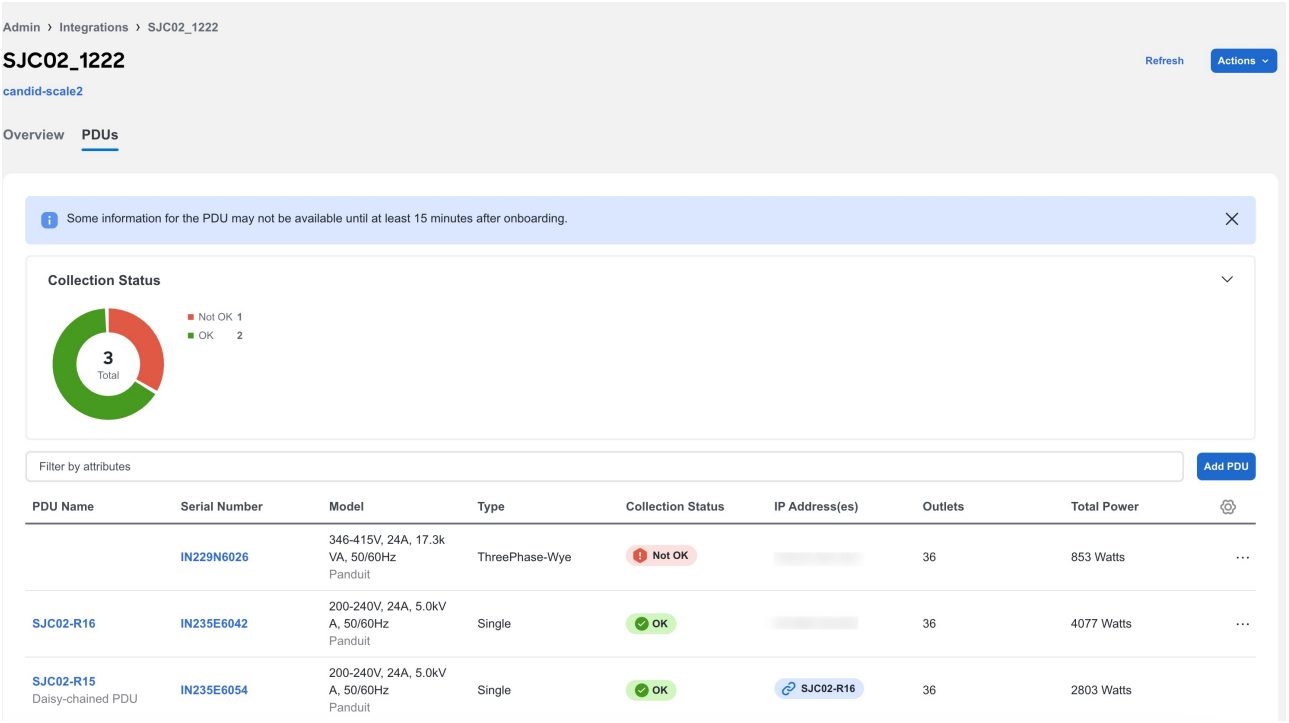
Follow these steps to view PDU integration.

1. Navigate to **Admin** > **Integrations**. In the Integrations Dashboard you can view the list of Panduit PDUs associated with a fabric. For each PDU integration you can view the Name, Connectivity Status, Type, IP address, Last Active, and Associations.
2. Click PDU collector name to view additional details.
3. Click **Overview** to view information such as collector IP address, connectivity to Nexus Dashboard, number of PDUs associated with the PDU collector, and number of devices powered by the PDU collector.



4. Click **PDUs** to view the onboarding status of the PDUs associated with the PDU collector as a doughnut chart.
5. Use the search bar to filter the PDUs by name, serial number, model, type, collection status, IP addresses, outlets, and total power.
6. The PDUs table displays the filtered PDUs. The PDU table displays the PDU name name, serial number, model, type (single or three phase), collection status, IP addresses, outlets, and total power.

7. Click the column heading to sort the PDUs in the table.
8. Click the gear icon to configure the columns in the PDUs table.
9. Click the ellipsis icon and click **Remove from this Collector** to remove the PDU.



10. Click PDU name to view additional details such as general information, phases, and circuits. For Three Way type PDUs, you can the view the different phases.

PDU IN229N6026

SJC02_1222

General

Serial Number	Vendor	Model	Type	IP address(es)	Total Power
IN229N6026	**Panduit**	**346-415V, 24A, 17.3kVA, 50/60Hz**	**ThreePhase-Wye**		**851 Watts**

Phases

L1-N L2-N L3-N

Total Power

685 Watts

Circuits

Circuit 1

Output Power **421** Connected Outlets **3/6**

- Outlet 1 0 Watts
- Outlet 2 0 Watts
- Outlet 3 139 Watts
- Outlet 4 139 Watts
- Outlet 5 142 Watts
- Outlet 6 0 Watts

Circuit 4

Output Power **263** Connected Outlets **1/6**

- Outlet 19 263 Watts
- Outlet 20 0 Watts
- Outlet 21 0 Watts
- Outlet 22 0 Watts
- Outlet 23 0 Watts
- Outlet 24 0 Watts

AppDynamics integration

Nexus Dashboard provides the ability to monitor the most common and complex challenges in the maintenance of infrastructure operations, which involves monitoring, troubleshooting, identification and resolving the network issues.

AppDynamics provides application performance management (APM) and IT operations analytics that helps manage the performance and availability of applications in the data center. It also provides the required metrics for monitoring, identifying, and analyzing the applications that are instrumented with AppDynamics agents.

> AppDynamics is associated only at the Fabric level. Onboarding of the AppDynamics controller is only at the Fabric level.

AppDynamics hierarchy consists of the following components:

- Network Link—Provides the functional means to transfer data between network entities.
- Node—A working entity of an application and is a process running on a virtual machine.
- Tier—Grouping of nodes into a logical entity. Each tier can have one or more nodes.
- Application—A set of tiers make up an application.
- Controller—A controller consists of a set of accounts with each account comprising a list of applications. Each account in the controller is an instance.

Integrating AppDynamics allows Nexus Dashboard to collect operational data and metrics of the applications monitored by AppDynamics, and then correlate the collected information with the data collected from the fabric.

In a scenario where an application communicates through the fabric, AppDynamics provides various metrics about the application and the network, which can be used to isolate the cause of the anomaly. The anomaly can be in the application or the underlying network. This in turn allows network operators to monitor the network activity and detect anomalies.

The AppDynamics agents are plug-ins or extensions, hosted on the application. They monitor the health, and performance of the network nodes and tiers with minimal overhead, which in turn report to the AppDynamics controller. The controller receives real-time metrics from thousands of agents and helps troubleshoot and analyze the flows.

Nexus Dashboard connects to the AppDynamics controller and pulls the data periodically. This data from AppDynamics controller, rich in application specific information is fed to Nexus Dashboard, thereby providing Nexus Dashboard for the traffic flowing through the fabric.

From AppDynamics, you can create your own health rule on the available metrics, which contributes to the overall anomaly score of the entity.

The integration of Nexus Dashboard with AppDynamics enables the following:

- Monitoring and presenting AppDynamics hierarchy in Nexus Dashboard.
- Gathering and importing network related metrics into Nexus Dashboard.

- Presenting statistics analytics, flow analytics, and topology view on the data collected from AppDynamics controller.
- Detecting anomaly trends on metrics collected from AppDynamics controller and raising anomalies on detection of such events.
- The AppDynamics integration uses API server and multiple instances of Telegraph data collecting container to support load balancing of the onboarded controllers.
- Fabric flow impact calculation for AppDynamics anomalies.

Onboarding for SaaS or cloud deployments

Starting from Nexus Dashboard release 6.0.2, you can connect to an AppDynamics controller using a proxy for SaaS or cloud deployments. For onboarding an AppDynamics Controller running on a cloud, Nexus Dashboard uses a proxy configured in Nexus Dashboard's Admin Console to connect to the AppDynamics Controller.

Guidelines and limitations for AppDynamics integration

- After upgrading Nexus Dashboard, AppDynamics takes about 5 minutes to report the information in the AppDynamics GUI.
- The health and count of AppDynamics business transactions displayed in the application details do not match the flow count in Nexus Dashboard.
- Nexus Dashboard does not support fabric topologies as a transit-leaf switch does not have the VRF instance deployed and the flow table in the transit-leaf switch will not export the flow record to Nexus Dashboard. Hence, Nexus Dashboard will not stitch the path fully and will not display complete path summary with all the information.
- To connect an HTTPS AppDynamics controller using an HTTP proxy you must configure HTTPS proxy in Nexus Dashboard's Admin Console with the HTTP proxy server URL address.
- To connect an HTTP AppDynamics controller using an HTTP proxy you must configure HTTP proxy in the Admin Console with the HTTP proxy server URL address.
- In Cisco ACI fabrics, configuration import and export are not supported for AppDynamics integrations.

Installing AppDynamics

Before you begin using Nexus Dashboard integrations, you must install the AppDynamics Application Performance Management and Controller. For more information, see Getting Started.

Onboard an AppDynamics controller

For Nexus Dashboard and AppDynamics integration, Nexus Dashboard's data network must provide IP reachability to the AppDynamics controller. For more information, see the Cisco Nexus Dashboard Deployment Guide.

Prerequisites

- You must have installed AppDynamics application and controller.

- You must have administrator credentials for Nexus Dashboard.
- You must have user credentials for AppDynamics controller.
- You must have configured a proxy in the Nexus Dashboard Admin Console to connect to an AppDynamics controller using a proxy. For more information, see the "Connecting Nexus Dashboard clusters" section in Connecting Clusters.

Procedure

Follow these steps to onboard an AppDynamics controller.

1. Click **Admin** > **Integrations** > **Add Integration**.
2. Choose **App Dynamics** for **Integration Type**.
3. AUTHENTICATION
   - Enter the Controller Name, Controller IP or Hostname, Controller Protocol, and Controller Port. The Controller Name can be alphanumeric, but spaces are not allowed.

     The AppDynamics Controller Name cannot be the same name as the Nexus Dashboard fabric name.

   - Put a check in the **Enable** box to connect to the AppDynamics controller using a proxy. The proxy must be configured in the Admin Console.
   - Enter the AppDynamics Account Name, User Name, and Password.
4. ASSOCIATIONS
   - Choose a fabric or multiple fabrics. You can view the number of anomalies for each severity level, SW Analytics, Flow Collection, and the Anomaly Trend for each fabric before selecting it.
   - Click **Select**.
5. The **Summary** displays an overview of the Integration created.
6. Click **Submit** to add the integration. The post completion success screen allows you to **Add Another Integration** or **View Integrations**. When the **Status** is **Connected**, the onboarding for the controller is complete.

Each controller supports multiple account names for the same host name. Each account name supports multiple applications monitored by the controller. Therefore, a controller can support multiple applications monitored by AppDynamics.

Nexus Dashboard and AppDynamics integration dashboard

The AppDynamics Dashboard allows you to onboard controllers and presents a view of the **Top 5 Applications by Anomaly Score** along with various metrics. After a controller is onboarded, data related to applications monitored by that controller is pulled by Nexus Dashboard. It can take up to 5 minutes for the first set of data to appear on the GUI. The AppDynamics health state information provided for each entity is aggregated and reported by Nexus Dashboard on the dashboard.

The AppDynamics dashboard displays the overview of the applications monitored by the AppDynamics controller.

- **Controller Connectivity**—Represents the number of integrations that are **Up** or **Down**.
- **Anomalies by Severity**—The Nexus Dashboard runs statistical analytics on the metrics received from the AppDynamics controller.
- **Top 5 Applications by Anomaly Score**—Displays top five out of all the applications based on the anomaly score.
- **Anomalies by Severity**—Shows the Anomalies page.
- **Application Widget**—Displays the top application by anomaly score. This includes the anomaly score of the application as computed in Nexus Dashboard, health state of tiers and nodes as reported by AppDynamics. Click the widget for additional details about the monitored application.

AppDynamics integration application

Detailed information including operational, statistics, and metrics, for each tier or application is also presented.

- **Summary** lists the anomaly score, controller name, account, application name, number of tiers, number of nodes, throughput, TCP loss, and errors.
- **Analyze Anomaly** details displays estimated impact application, recommendations, mutual occurrences, and other details affected by the anomaly. Click an anomaly in the summary to display additional details.
- **View Report** displays the flow groups affected where each flow group can correspond to multiple fabric flows. View reports also display the proxy/entity IP address, node source, and node destination IP address.
- **Number of Tiers** to list the available tiers. Click each tier from the list to display health score, number of nodes, and usage statistics.
- **Number of Nodes** to list the available nodes. Click each node from the list to display statistics about the node.
- **Application Name** to display additional details such as general information of the application, controller name, controller IP, account name, health of the tier, health of the node, business transaction health, and usage analytics.
- icon to open **AppDynamics Application** details. This displays application statistics details such as anomaly score, application tiers summary, application nodes summary, network charts for the node communication, and summary table of anomalies.
- **Application Network Links** table shows how the different components of AppDynamics application network flow map are communicating among each other. Detailed information about a network link, including flow counts and anomalies are used for further analysis.
- **AppDynamics Application View** shows the summary for the particular AppDynamics monitored application to display page.

AppDynamics application view

The AppDynamics application view presents an overview of the application health state including tier health, node health, and business transaction health.

- **Application Statistics** displays the graphical representation of the flow properties and a timeline graph representing the properties.
- **Tiers** displays the health state of the tiers in the application. Click each row in the tier section for the side panel to display additional tier usage details.
- **Nodes** displays the health state of the nodes in the application. Click each row in the node section for the side panel to display additional node usage details.
- **Application Network Links** displays the link summary for the nodes.
- **Network Connection** displays additional flow connection details.
- **Browse Network Flows** to navigate to **Browse Flows Records** with the flow properties set in the filter.
- **Anomalies** summarizes the anomalies with severity and other essential details of the anomaly. Click each row in the **Anomalies** section to see additional details of the anomaly.
- **Analyze** for in-depth analysis, mutual occurrences, estimated impact, lifespan, and recommendations on the anomaly.

AppDynamics integration application for standalone NX-OS fabrics

Detailed information including operational, statistics, and metrics, for each tier or application is also presented.

- **Summary** lists the anomaly score, controller name, account, application name, number of tiers, number of nodes, throughput, TCP loss, and errors.
- *Anomaly in the summary to display additional details.
- **Analyze Anomaly** details displays estimated impact application, recommendations, mutual occurrences, and other details affected by the anomaly.
- **View Report** displays the flow groups affected where each flow group can correspond to multiple fabric flows. View reports also display the proxy/entity IP address, node source, and node destination IP address.
- **Number of Tiers** lists the available tiers. Click each tier from the list to display health score, number of nodes, and usage statistics.
- **Number of Nodes** lists the available nodes. Click each node from the list to display statistics about the node.
- **Application Name** displays additional details such as general information of the application, controller name, controller IP, account name, health of the tier, health of the node, business transaction health, and usage analytics.
- icon on the right top corner is to open **AppDynamics Application** details. This page displays application statistics details such as anomaly score, application tiers summary, application nodes summary, network charts for the node communication, and summary table of anomalies.
- **Application Network Links** table shows how the different components of AppDynamics application network flow map are communicating among each other. Detailed information about a network link, including flow counts and anomalies are used for further analysis.
- **AppDynamics Application View** - Double-click each row in the summary for the particular AppDynamics monitored application.

AppDynamics application view

AppDynamics application view presents an overview of the application health state including tier health, node health, and business transaction health.

- **Application Statistics** displays the graphical representation of the flow properties and a timeline graph representing the properties.
- **Tiers** displays the health state of the tiers in the application. Click each row in the tier section for the side panel to display additional tier usage details.
- **Nodes** displays the health state of the nodes in the application. Click each row in the node section for the side panel to display additional node usage details.
- **Application Network Links** displays the link summary for the nodes.
- **Network Connection** displays additional flow connection details.
- **Browse Network Flows** to navigate to Browse Flow Records with the flow properties set in the filter.
- **Anomalies** summarizes the anomalies with severity and other essential details of the anomaly. Click each row in the **Anomalies** section for the side pane to pop up with additional details of the anomaly.
- **Analyze** for in-depth analysis, mutual occurrences, estimated impact, lifespan, and recommendations on the anomaly.

Topology view

The topology view represents the stitching between nodes where these nodes are connected to the fabric.

The topology view includes application nodes and leaf nodes. Toggle between show or not show to view/hide the nodes with anomaly score. The anomaly score is represented by the dot in the topology.

The topology view represents a hierarchical view of **Application > Node > Leaf** and the links between them with a logical or network view of how various objects are related.

AppDynamics anomalies

From AppDynamics application, you can create your own health rule on the available metrics, which contributes to the overall anomaly score of the entity. If the health rules are violated and a violation is generated by the AppDynamics controller, then Nexus Dashboard pulls these health violations and generates anomalies on these violations.

The anomalies in the summary table include the following:

- Anomalies raised on the metrics from the AppDynamics controller.
- Health violation on the network metrics that the AppDynamics controller raised.
- Anomalies at the application level and node level.

If there is an anomaly on the interface of application(s) impacted by the interface, then an anomaly is identified and shown.

Depending on the anomaly score and the level at which the anomaly occurs, the corresponding flows impacted are identified. Information related to the flow metrics with the leaf information enable statistics analytics, pin point the source of the anomaly, whether it is the application or network, and the impacted entities.

The fabric flow impact calculation for AppDynamics anomalies calls flow APIs to fetch the fabric flows corresponding to the AppDynamics flow groups that were affected by the anomaly. Nexus Dashboard displays the top 100 fabric flows ordered by the anomaly score for AppDynamics anomalies.

Slack integration

Overview

Slack integration with Nexus Dashboard allows you to query Nexus Dashboard directly from Slack messenger across various Slack channels, enabling seamless collaboration and real-time interaction.

Key features of Slack integration

- Direct queries from Slack—You can perform on-demand queries to retrieve monitoring and operational data from Nexus Dashboard without leaving Slack.
- Channel mapping—Each Slack channel must be mapped to one or more security domains and a single tenant domain within Nexus Dashboard. This mapping ensures that any queries initiated from the channel adhere to the permissions defined for those security and tenant domains.
- Secure authentication—Nexus Dashboard authenticates the WebSocket connection to Slack using the Slack CA certificate and a Slack app-level token configured on Nexus Dashboard. This ensures a secure and trusted link between Slack workspaces, channels, and Nexus Dashboard domains.
- User-initiated interaction—Slack channels allow users to actively query Nexus Dashboard secure domains and receive responses within Slack, supporting interactive collaboration.

Slack integration in Nexus Dashboard includes these steps.

- Configure Slack app
- Set up Slack integration in Nexus Dashboard
  - Add Slack CA certificate
  - Add Slack integration

Guidelines and limitations of Slack integration

- Slack integration requires specific configurations in the Slack app, including app setup and token management.
- Only users with super-admin privileges can configure Slack integration on Nexus Dashboard. The super-admin must provide the Slack App ID for Nexus Dashboard to validate incoming requests.
- You can link each Slack channel to one or more secure domains and a single tenant domain. This setup allows users in these channels to access Nexus Dashboard resources (such as fabrics and switches) and run slash command queries directly from Slack.
- Currently, Slack integration does not support real-time notifications from Nexus Dashboard. You must manually run commands to retrieve the latest information.

Configure Slack app

To integrate your Slack app with Nexus Dashboard and enable real-time interactions, you need to perform the following steps.

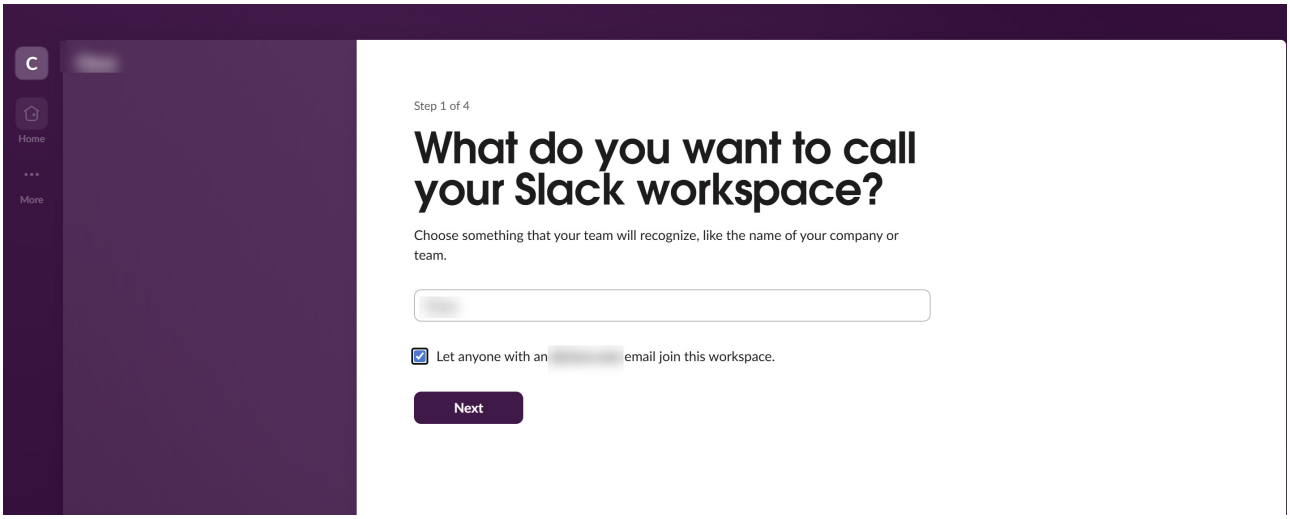
- Create Slack workspace
- Create Slack app
- Generate app-level token
- Enable socket mode
- Create slash commands
- Enable org readiness

Create Slack workspace

Follow these steps to create Slack workspace.

1. Navigate to the Slack.com.
2. Click **Get Started**.
3. Provide a name for your Slack workspace.
4. Click **Next**.

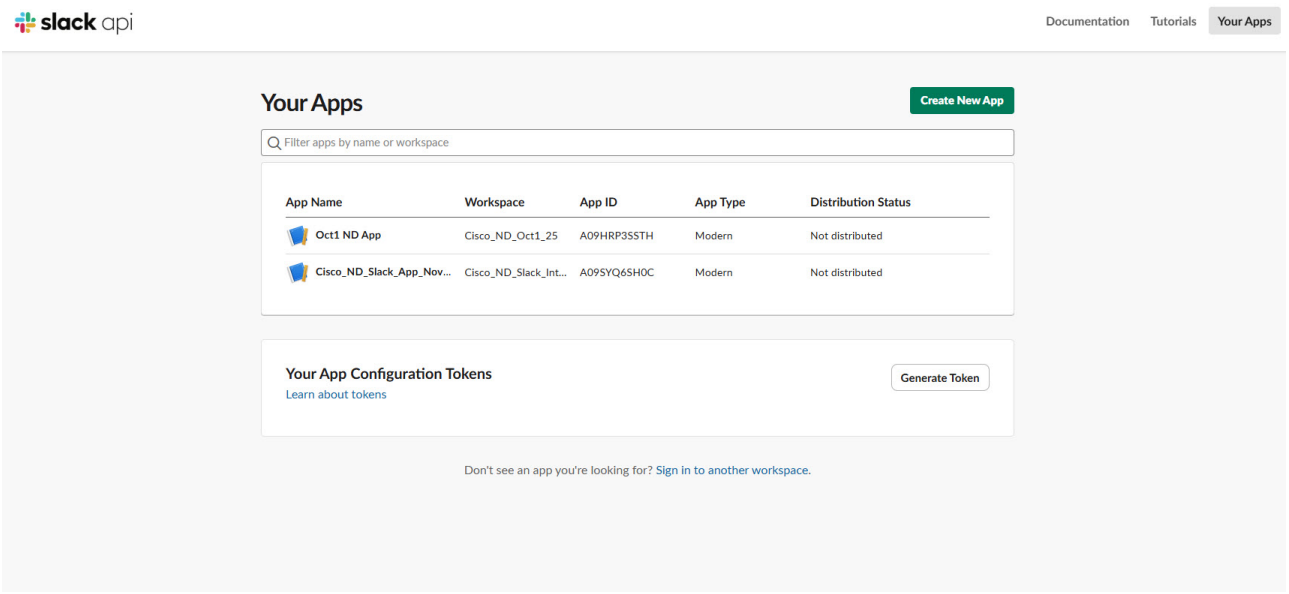
   After you create your workspace, you can create and configure Slack apps.



View Slack app settings dashboard

Follow these steps to view Slack app settings dashboard.

1. Navigate to the Slack API Portal: Go to Slack API: Your Apps.
2. Click the required app name to view the Slack app settings dashboard.

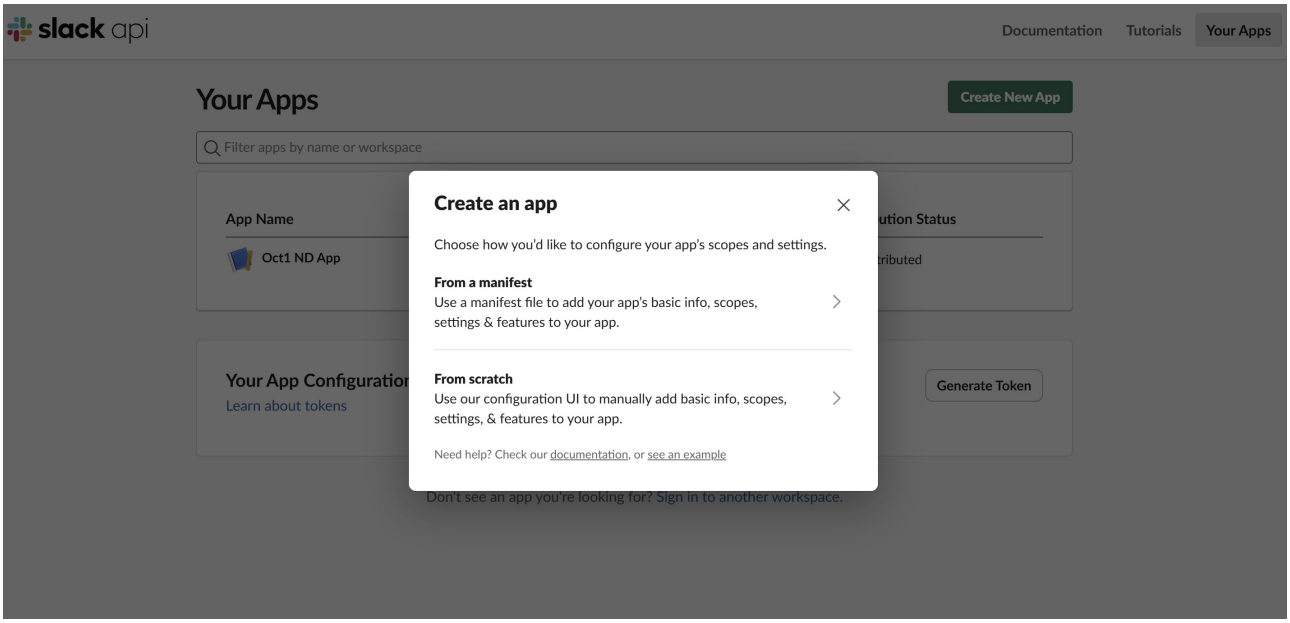


Create Slack app

Follow these steps to create and configure Slack app.

1. Navigate to the Slack API Portal: Go to Slack API: Your Apps.
2. Click **Create New App**.

   The **Create an app** dialog box displays.



3. Choose one of the following options.
   - **From a manifest**
   - **From scratch**

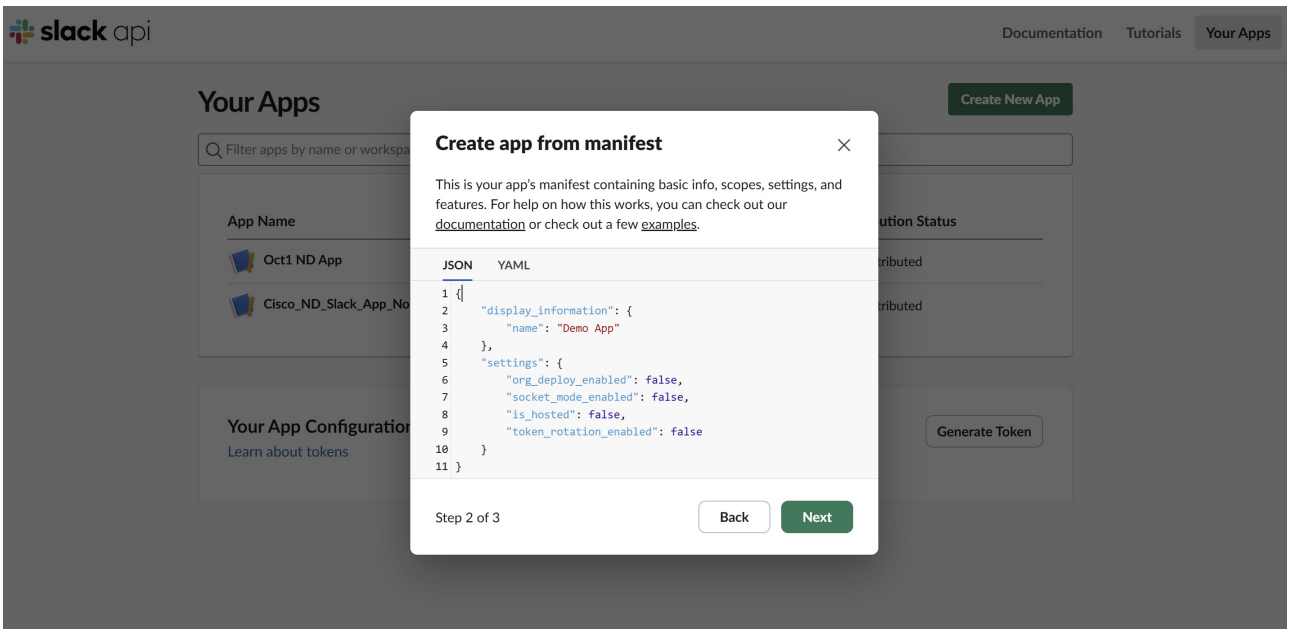
Create Slack app from manifest

Follow these steps to create Slack app from a manifest file.

1. In the **Create an app** dialog box, choose **From a manifest**.

2. Choose a workspace to install Slack app.
3. Click **Next**.

   The **Create app from manifest** dialog box containing basic info, scopes, settings, and features displays.



4. Choose the format (JSON or YAML) and paste the entire content of your manifest file into the text area.

   For more information, see View app manifest.

5. Click **Next**.
6. Review the details and click **Create to create Slack app**.

   The Slack app settings dashboard displays.

View app manifest

The app manifest displays the current configuration of your Slack app. You can change your basic information, settings, or feature configurations.

Follow these steps to view the app manifest

1. In the Slack app settings dashboard, go to **App Manifest**.
2. Choose the format (**JSON** or **YAML**) and copy the entire content of your manifest file.

   Sample JSON manifest file

```
{
    " display_information" : {
        " name" : " Cisco_ND_Slack_App_Nov13"
    },
    " features" : {
        " bot_user" : {
```

```
        "display_name": "Cisco_ND_Slack_App_Nov13",
        "always_online": false
      },
      "slash_commands": [
        {
          "command": "/get_switch_health",
          "description": "gets switch health from Nexus Dashboard",
          "usage_hint": "fabricName* switchName* interfaceName severity startDate
endDate maxResults",
          "should_escape": false
        },
        {
          "command": "/get_endpoint_location",
          "description": "gets endpoints data from Nexus Dashboard using ip or mac",
          "usage_hint": "endPointIpOrMacAddress* maxResults",
          "should_escape": false
        },
        {
          "command": "/get_link_util_alerts",
          "description": "Retrieves real-time link utilization alerts to monitor network
traffic load",
          "should_escape": false
        },
        {
          "command": "/get_link_util_alert_details",
          "description": "Provides detailed information about specific link utilization
alerts",
          "should_escape": false
        },
        {
          "command": "/get_switch_anomaly_details",
          "description": "Retrieves detailed anomaly reports detected on network
switches",
          "should_escape": false
        }
      ]
    },
    "oauth_config": {
      "scopes": {
        "bot": [
          "commands"
        ]
      }
    },
    "settings": {
```

```
        "interactivity" : {
            "is_enabled" : true
        },
        "org_deploy_enabled" : true,
        "socket_mode_enabled" : true,
        "token_rotation_enabled" : false
    }
}
```

Sample YAML manifest file

```
display_information:
  name: Cisco_ND_Slack_App_Nov13
features:
  bot_user:
    display_name: Cisco_ND_Slack_App_Nov13
    always_online: false
  slash_commands:
    - command: /get_switch_health
      description: gets switch health from Nexus Dashboard
      usage_hint: fabricName* switchName* interfaceName severity startDate endDate
maxResults
      should_escape: false
    - command: /get_endpoint_location
      description: gets endpoints data from Nexus Dashboard using ip or mac
      usage_hint: endPointIpOrMacAddress* maxResults
      should_escape: false
    - command: /get_link_util_alerts
      description: Retrieves real-time link utilization alerts to monitor network traffic load
      should_escape: false
    - command: /get_link_util_alert_details
      description: Provides detailed information about specific link utilization alerts
      should_escape: false
    - command: /get_switch_anomaly_details
      description: Retrieves detailed anomaly reports detected on network switches
      should_escape: false
oauth_config:
  scopes:
    bot:
      - commands
settings:
  interactivity:
    is_enabled: true
  org_deploy_enabled: true
```

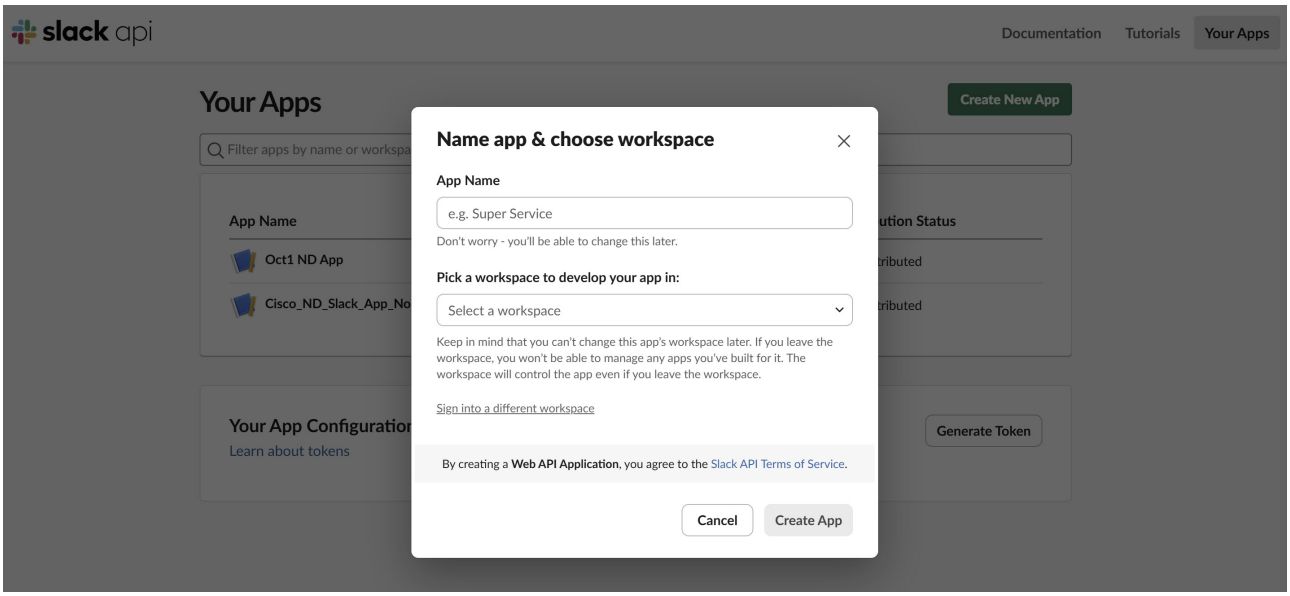
```
socket_mode_enabled: true
token_rotation_enabled: false
```

Create Slack app from scratch

Follow these steps to create Slack app from scratch.

1. In the **Create an app** dialog box, choose **From scratch**.

   The **Name app & choose workspace** dialog box displays.



2. In the **App Name** field, provide a name for your Slack app.
3. Choose a workspace to install Slack app.
4. Click **Create App**.

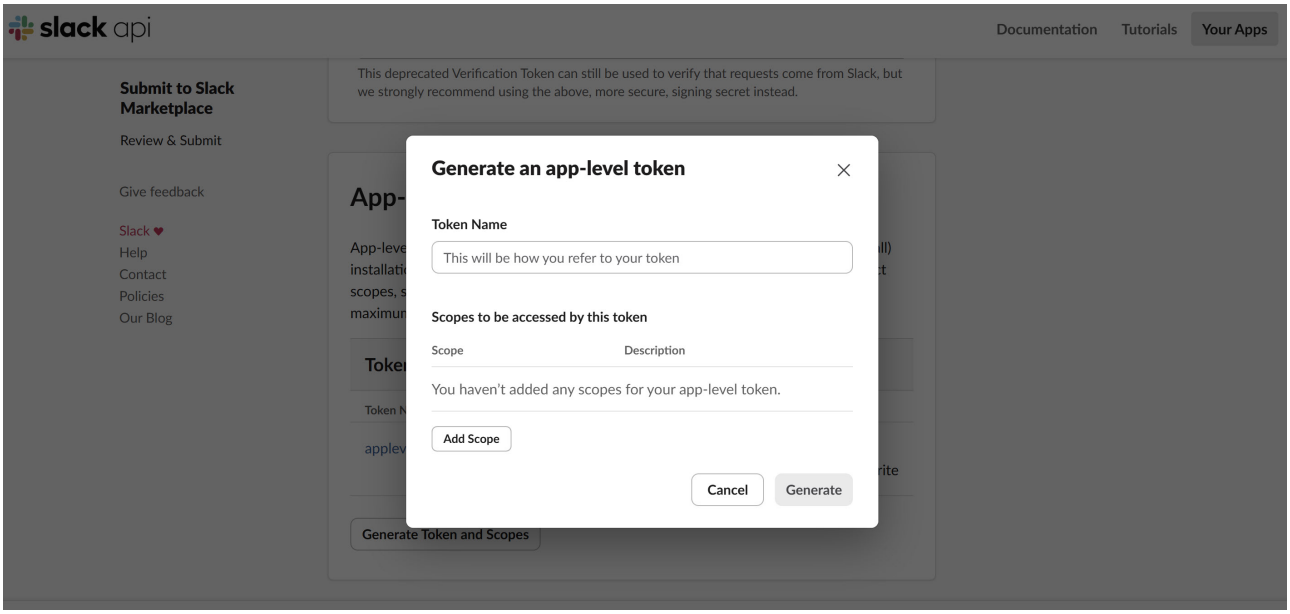
Generate app-level token

You need app-level tokens to enable socket mode, which allows your Slack app to communicate with Slack using WebSockets.

Follow these steps to generate app-level token.

1. In the Slack app settings dashboard, go to **Basic Information**.
2. Scroll to **App-Level Tokens** and click **Generate Token and Scopes**.

   The **Generate an app-level token** dialog box displays.

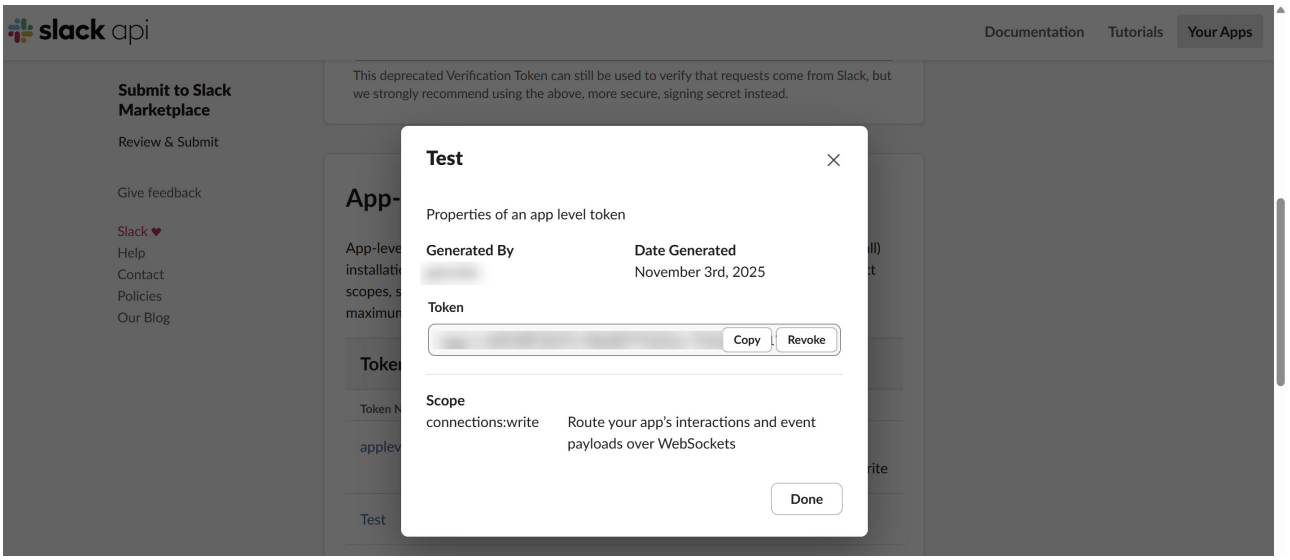


3. In the **Token Name** field, enter a name for your token.
4. Click **Add Scope** and choose connections:write.

> The connections:write scope grants permission to generate WebSocket URIs and connect to socket mode.

5. Click **Generate**.
6. Copy the token.

   This token is necessary to connect your app to Nexus Dashboard using WebSockets.



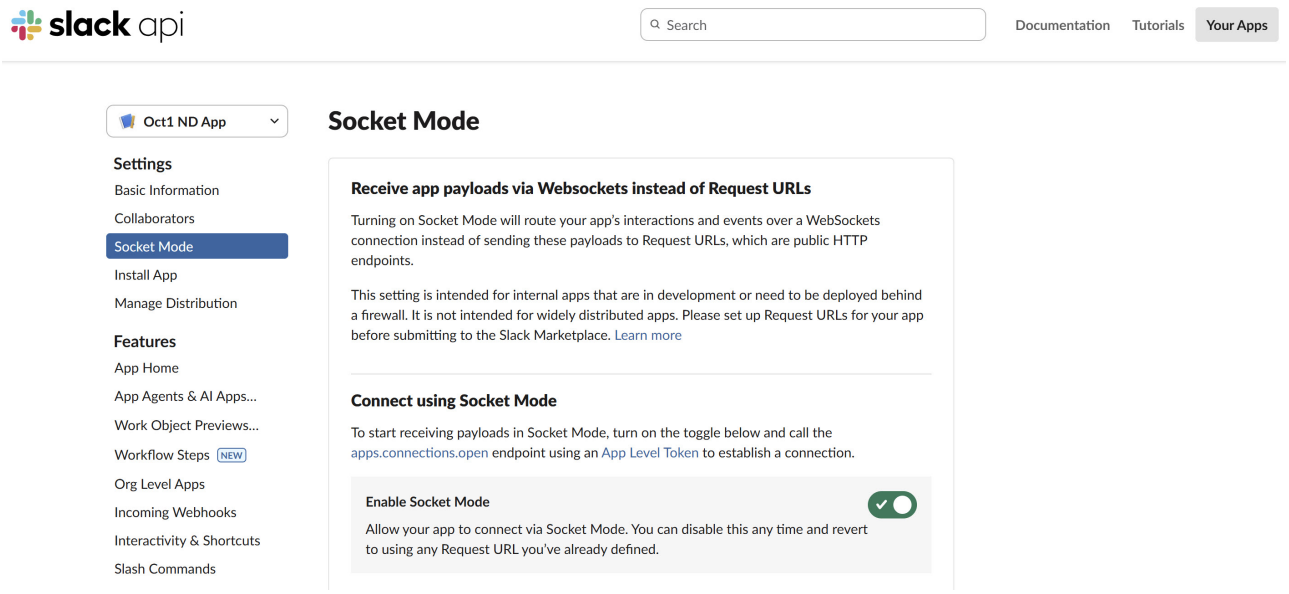
7. (Optional) Click **Revoke**, if you need to invalidate the token later.

Enable socket mode

The socket mode allows Nexus Dashboard to receive events and interactions directly from Slack over WebSockets, bypassing the need for public HTTP endpoints.

Follow these steps to enable socket mode in Slack app settings.

1. In the Slack app settings dashboard, go to **Socket Mode**.
2. Under **Connect using Socket Mode**, toggle the **Enable Socket Mode** option on.



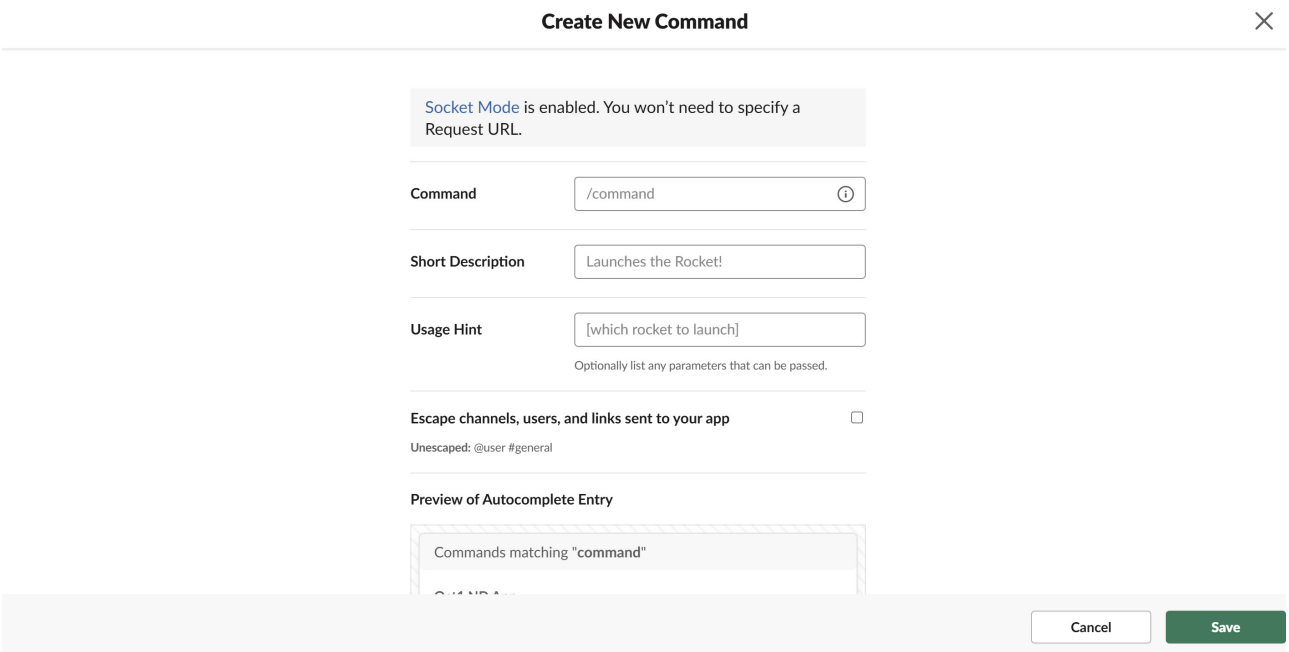
Create slash commands

Slash commands allow you to interact with your app directly from Slack messages.

Follow these steps to create slash commands.

1. In the Slack app settings dashboard, go to **Slash Commands**.
2. Click **Create New Command**.

   The **Create New Command** page displays.



3. Fill in the command details for each of your required commands.
   - **Command**—Provide the keyword, starting with a slash (/).

- **Short Description**—Provide brief description of the command.
- **Usage Hint**—(Optional) Provide help text for users. For mandatory parameters, add an asterisk (*) beside the parameter name (For example, *Username).

  You can add one or more of the following commands as needed.

Slack slash commands	Description	Command parameters
/get_link_util_alerts	Retrieves real-time link utilization alerts to monitor network traffic load.	1. fabricName* 2. switchName* 3. interfaceName 4. severity 5. startDate 6. endDate 7. maxResults
/get_link_util_alert_details	Provides detailed information about specific link utilization alerts.	1. fabricName* 2. anomalyId* 3. startDate* 4. endDate*

/get_switch_health	Performs an on-demand health check of network switches to assess device status.	1. fabricName*
		2. switchName*
		3. severity
		4. startDate
		5. endDate
		6. maxResults
		  ◦ If a severity level is specified, the function returns anomalies with that severity. If there are no anomalies matching the specified severity, it returns "no data found". If no severity is specified, the function returns anomalies of all severity levels.
		  ◦ If the maxResults parameter is not specified, the function returns all results.

Slack slash commands	Description	Command parameters
/get_switch_anomaly_details	Retrieves detailed anomaly reports detected on network switches.	1. fabricName* 2. anomalyId* 3. startDate* 4. endDate*

/get_endpoint_location	Searches for the location of an end host within the network.	1. endPointIpOrMacAddress*
		2. maxResults
		  ○ If maxResults is not specified, the function returns all results.
		  ○ The maxResults parameter limits the number of returned IP or MAC addresses associated with the input address.

- The asterisk (*) indicates a mandatory (non-empty) input parameter.
- Parameters without an asterisk (*) are optional. You can leave optional parameters empty by using empty single quotes (' ').
- All command parameters are strings except for maxResults, which is an integer.
- Provide the input dates in the following formats.
  - Dates are in ISO 8601 formats as follows.
    - YYYY-MM-DDTHH:MM:SSZ
    - YYYY-MM-DDTHH:MM:SS±hh:mm
  - You can also specify the start and end dates as now-7h/d/w or now.
    - now-7h indicates hours, d indicates days, and w indicates weeks. If you omit the unit (For example, now-7), the system interprets it as now minus 7 days.
  - If you do not provide input dates, the system sets the start date to now-2h and end date to now.

4. Click **Save**.
5. Repeat steps 2-4 for each command you want to configure.

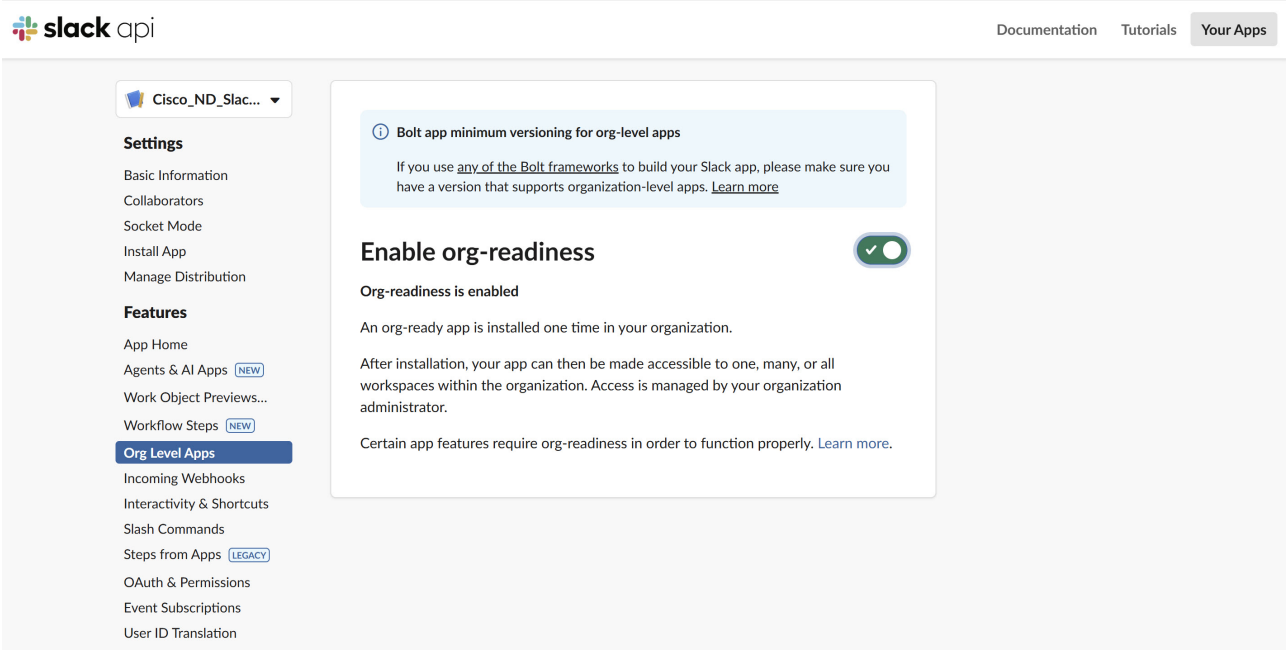
You can configure as many slash commands as needed, with each command pointing to the appropriate endpoint.

After you complete the setup, install the app to your Slack workspace from the **OAuth & Permissions** section in the Slack app settings dashboard.

Enable org readiness

Follow these steps to enable readiness.

1. In the Slack app settings dashboard, navigate to **Org Level Apps**.
2. Click **Enable org-readiness**.



Set up Slack integration in Nexus Dashboard

Add Slack CA certificate

Before you integrate Slack with Nexus Dashboard, you must add the Slack CA certificate to ensure secure communication between Nexus Dashboard and Slack.

Configure the proxy settings before you add a Slack CA certificate. For more information on configuring proxy settings, see Proxy configuration. You need to configure an HTTPS proxy only on Nexus Dashboard setups that use a proxy for external connectivity.

Follow these steps to add Slack CA certificate.

1. Navigate to **Admin > Integrations**.
2. If there are no existing integrations, click **Add integration**.

   The **Add integration** page displays.

3. Under **Integration type**, go to **Bot integration > Slack**.
4. Click **Before adding integration, add a Slack CA Certificate here**.

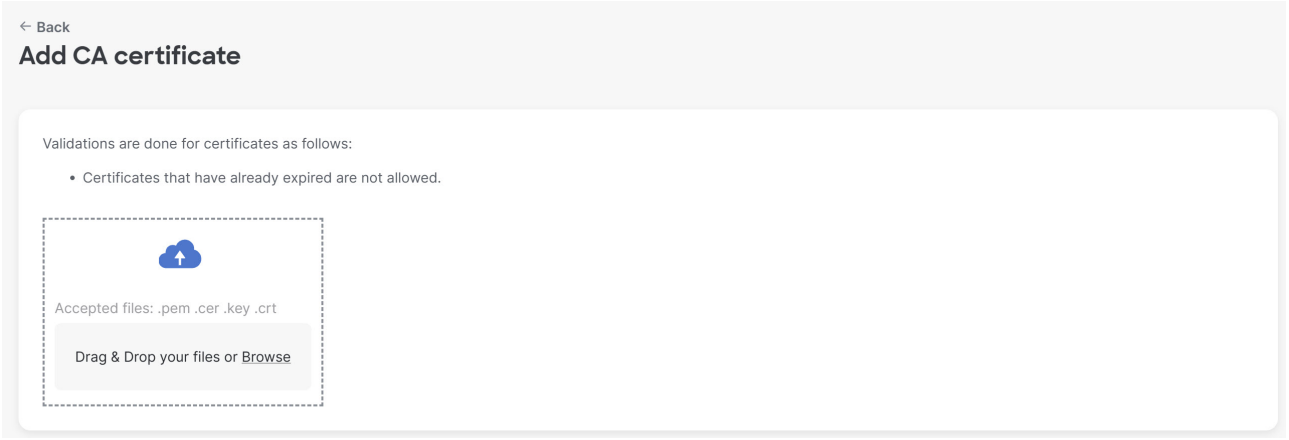
   The **Certificate Management** page displays.

You can also go to the **Certificate Management** page by navigating to **Admin >**

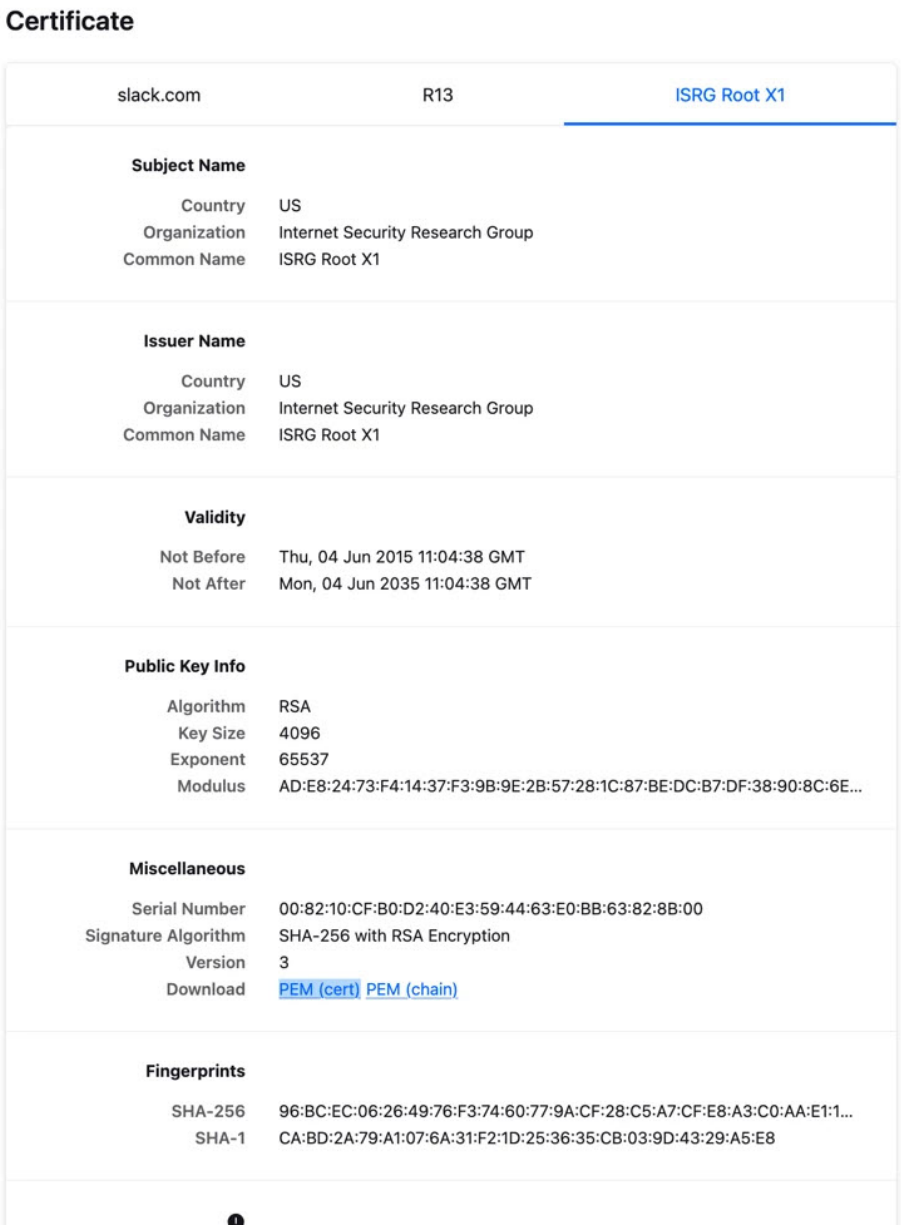
Certificate Management.

5. Click the **CA certificates** tab.
6. From the **Actions** drop-down list, choose **Add CA certificate**.

   The **Add CA certificate** page displays.

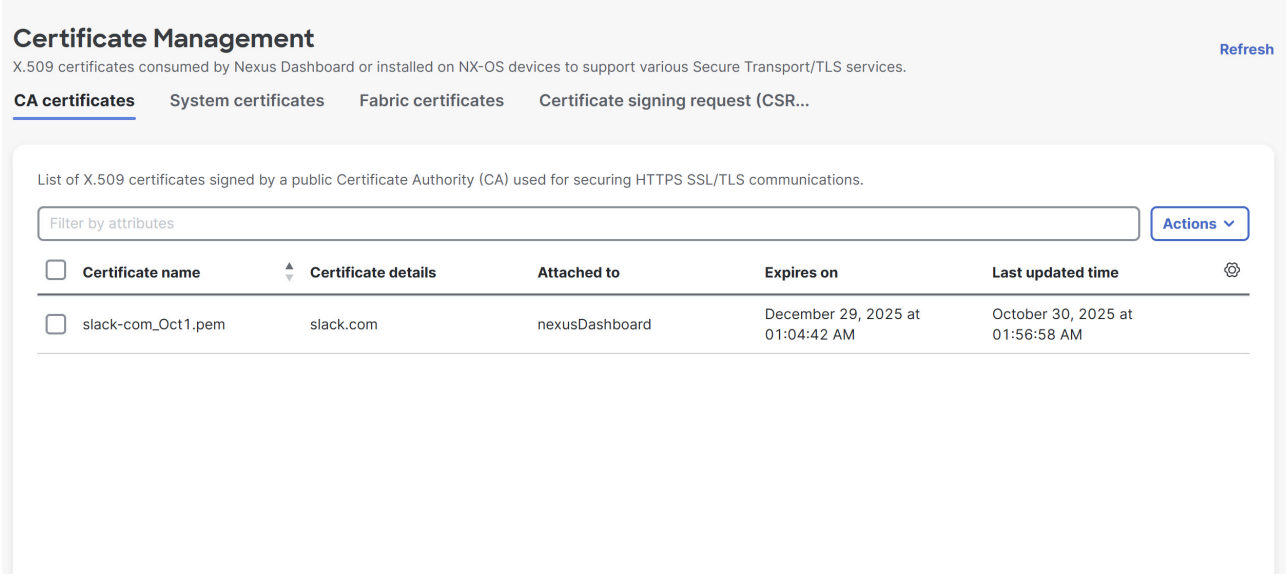


You can download the Slack CA certificate from Slack.com. The certificate is downloaded in Privacy Enhanced Mail (PEM) format from ISRG Root X1.



7. You can drag and drop your Slack CA certificate files or click **Browse** to locate and choose the Slack certificate files from your device.
8. Click **Save**.

   The CA certificate that you added appears in the certificates table on the **Certificate Management** page.



Guidelines and limitations of CA certificate

- When you renew a CA certificate, Nexus Dashboard issues a new server certificate. Client applications, including the Slack integration, must trust this new certificate.
- For WebSocket connections (used by Slack integration), Nexus Dashboard explicitly checks the validity of the CA certificate during connection. A CA certificate renewal triggers a reconnection attempt to ensure secure communication.
- Nexus Dashboard reconnects to Slack after you renew the CA certificate or change HTTPS proxy settings only if it is currently disconnected and attempting to reconnect, or during specific integration events (such as when Slack disconnects due to a stale certificate, or when a super admin disables and re-enables the Slack integration).
- If Nexus Dashboard is already connected to Slack, removing the CA certificate or HTTPS proxy does not immediately disconnect it. Nexus Dashboard only attempts to reconnect when it needs to re-establish the Slack integration.

Add Slack integration

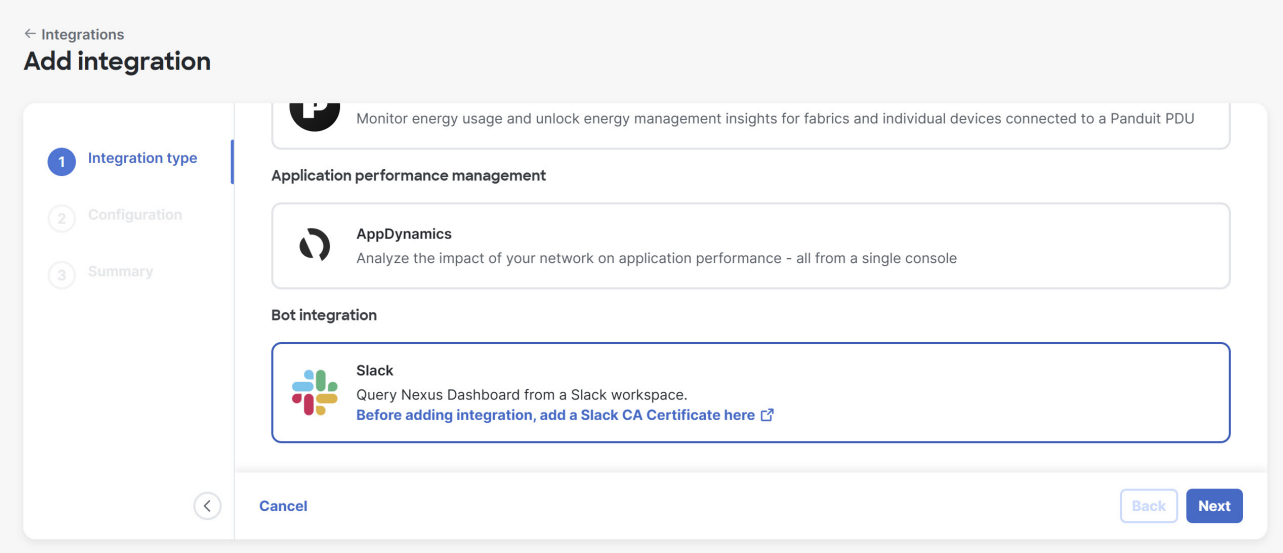
Slack integration allows Nexus Dashboard to communicate and collaborate with Slack channels. To establish secure and seamless communication, you must configure the Slack app with the appropriate tokens and authorizations.

Follow these steps to add Slack integration.

1. Navigate to **Admin > Integrations**.
2. If there are no existing integrations, click **Add integration**.

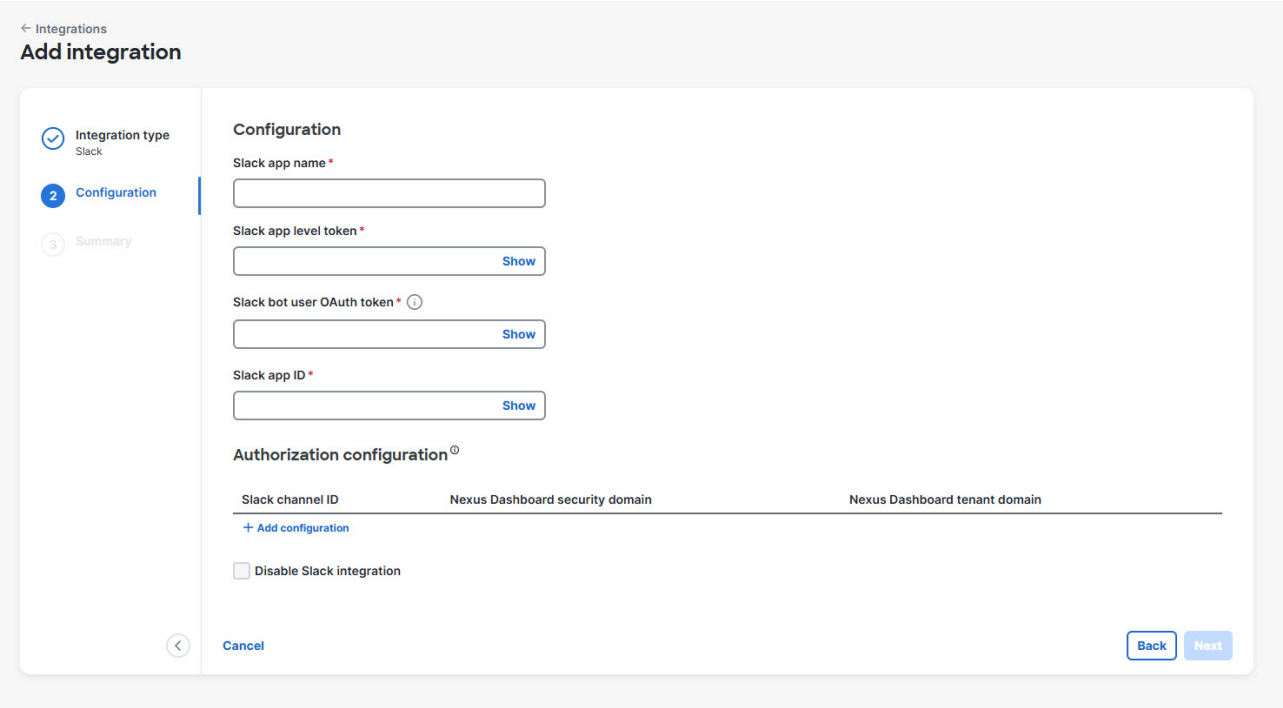
   The **Add integration** page displays.

3. Under **Integration type**, go to **Bot integration > Slack**.



4. Click **Next**.

   The **Configuration** page displays.



5. In the **Slack app name** field, provide the name of the Slack app.
6. In the **Slack app level token** field, enter the Slack app level token.

   This is the token that you generate in Slack app and is essential for Nexus Dashboard to authenticate with Slack and establish a WebSocket connection for real-time communication. For more information, see Generate app-level token.

   If the Slack app level token is invalid, Nexus Dashboard displays an error message and prevents further setup until you provide a valid token.

7. In the **Slack bot user OAuth token** field, provide the OAuth token.

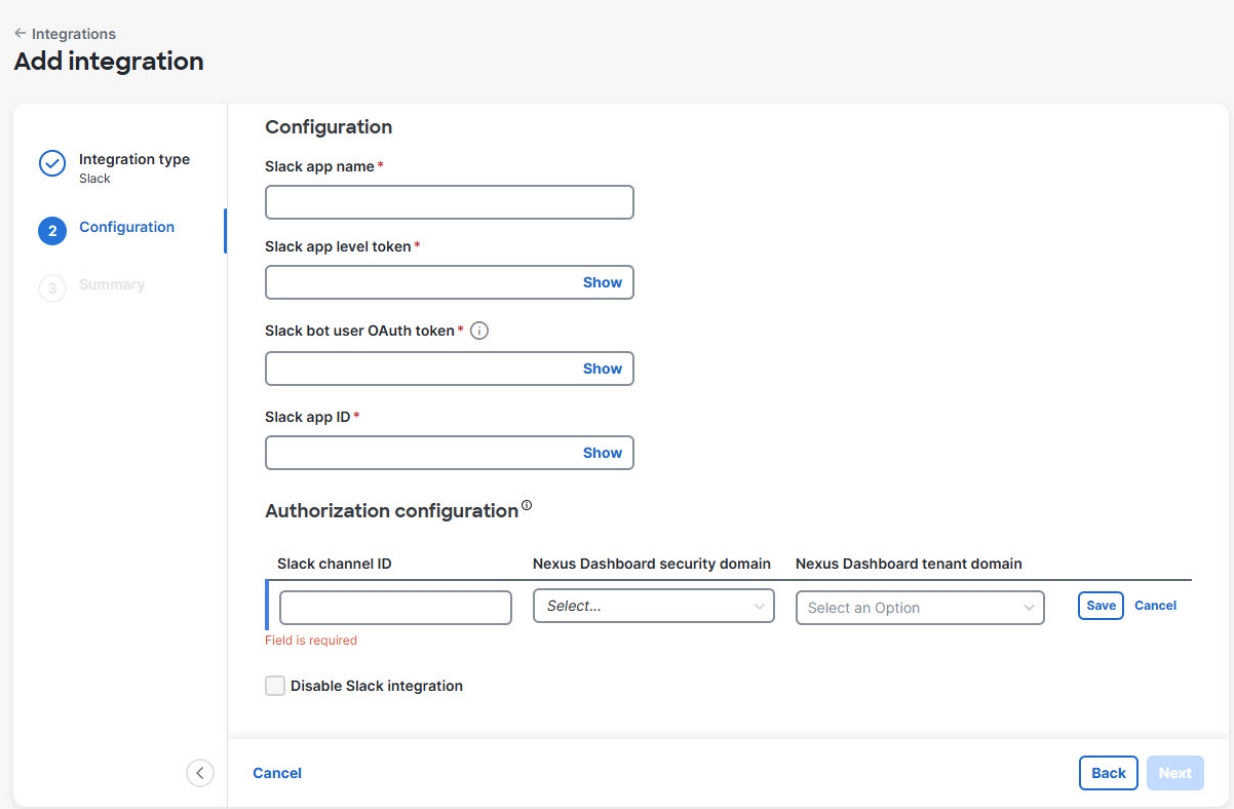
   This token is automatically generated when you install the Slack app and is required to authorize

uploading files to Slack from Nexus Dashboard. To get the OAuth token, in the Slack app settings dashboard go to **OAuth & Permissions** and copy the token under **Bot User OAuth Token** field.

8. In the **Slack app ID** field, enter the Slack app ID.

   You can get the Slack app ID from the Slack app settings dashboard under **Basic Information**.

9. Under **Authorization configuration**, click **Add configuration** to configure the following parameters.
   - **Slack channel ID**—Obtain this from your Slack app for the channel where notifications will be sent.
   - **Nexus Dashboard security domain**—Specify the relevant security domain.
   - **Nexus Dashboard tenant domain**—Specify the tenant domain.



You must configure at least one and no more than four Slack channel IDs. When you add a fourth channel, the system disables the option to add new channels. Authorize each channel ID for one or more security domains and one tenant domain.

10. Optionally, check the **Disable Slack integration** check box to temporarily suspend the integration. This option is disabled when you add integration for the first time.
11. Click **Next**.

    The **Summary** page displays.

12. Review the summary and click **Save** to complete the integration setup.

Query using Slack slash commands

Once the integration setup is complete, you can use the slash commands directly within Slack to query.

As a sample query to test your Slack integration, you can use the following command to query an endpoint.

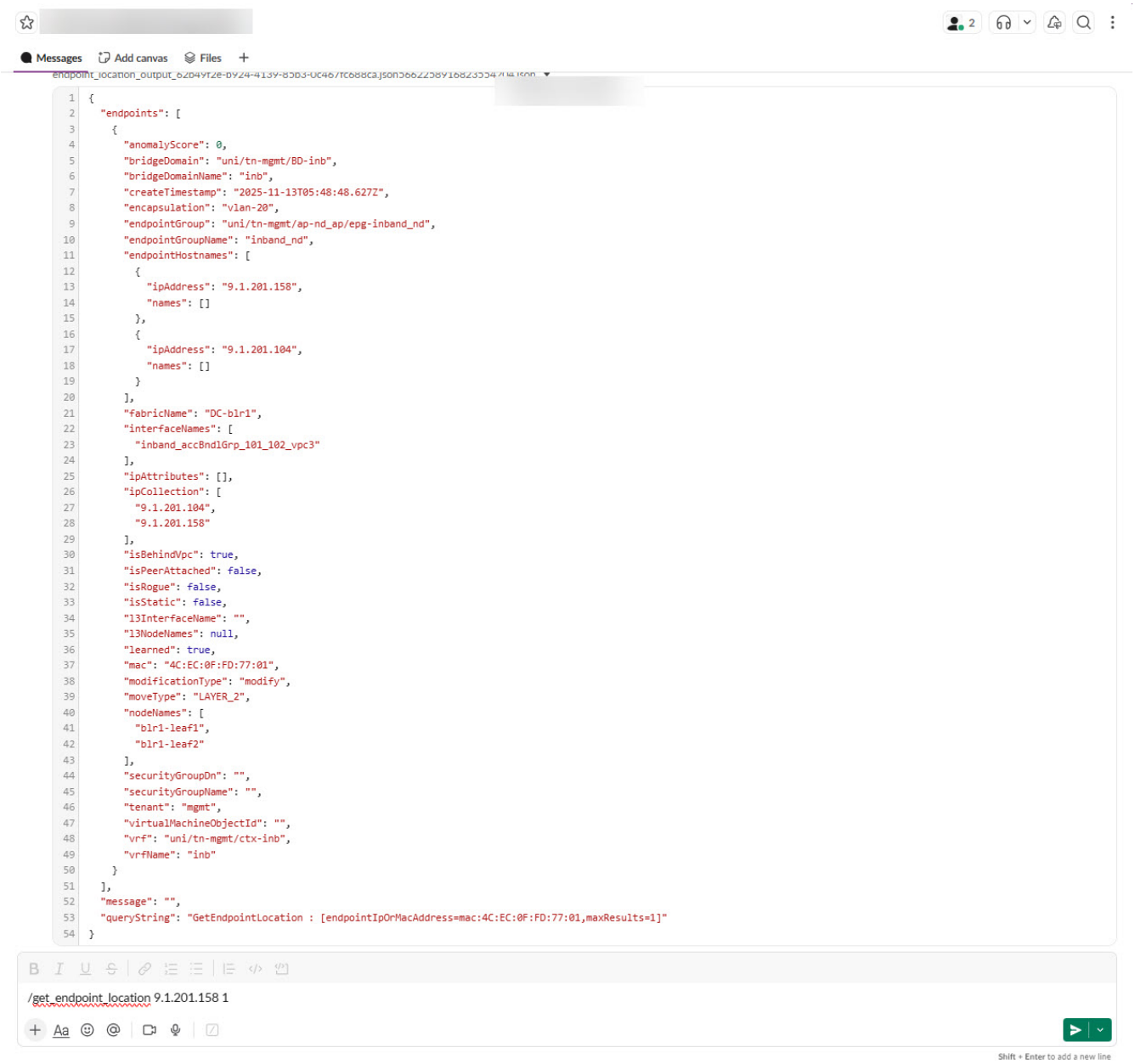
/get_endpoint_location <identifier> [maxResults]

- <identifier>—This is a mandatory parameter. It can be either the IP address or the MAC address of the network endpoint you wish to query.
- [maxResults]—This is an optional parameter. It specifies the maximum number of endpoint records to return. However, you cannot omit optional parameters. If you do not want to provide a value, enter ("). The system defaults to returning a single, most relevant result. If you omit the parameter entirely, the Slack app displays a message indicating that the number of parameters is incorrect.

For example, to query for an endpoint with the IP address 9.1.201.158 and retrieve a result, provide the following command.

/get_endpoint_location 9.1.201.158 1

When you execute the command, you receive a comprehensive JSON-formatted response containing various details about the endpoint.



Troubleshoot Slack integration

This section provides guidance on resolving common anomalies that may arise with your Slack integration on Nexus Dashboard.

You can find the anomalies related to Slack integration in Nexus Dashboard under system anomalies. For more information, see View platform and system alerts in global anomalies table.

Anomaly	Category	Impact	How to fix it?
Nexus Dashboard fails to connect to Slack using WebSocket connection (Severity: **CRITICAL**).	System	Nexus Dashboard loses its connection to the Slack app and prevents queries.	1. **Authentication**—Verify that the Slack app-level token on Nexus Dashboard matches the token in your Slack workspace. Confirm that you have configured a valid Slack CA certificate. 2. **Network**—Configure the HTTPS proxy in **Admin > System Settings > Proxy configuration**, if your network requires one for external connectivity. Check the network connectivity and firewall settings between Nexus Dashboard and Slack.
Nexus Dashboard fails to upload files to Slack (Severity: **MAJOR**).	System	Users do not receive query results for large data sets. However, users can view small query results directly in Slack.	1. **Token**—Verify the Slack user OAuth token configuration on Nexus Dashboard. 2. **Permissions**—Add the Slack app manually to the specific Slack channel where you use commands.

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