The bridge to possible

Terraform: ThousandEyes on Catalyst 9000 Switches

Robert Csapo, Product Manager – Catalyst 9000 Switching
@robertcsapo

Cisco Live!

DEVNET-1458

Cisco Webex App

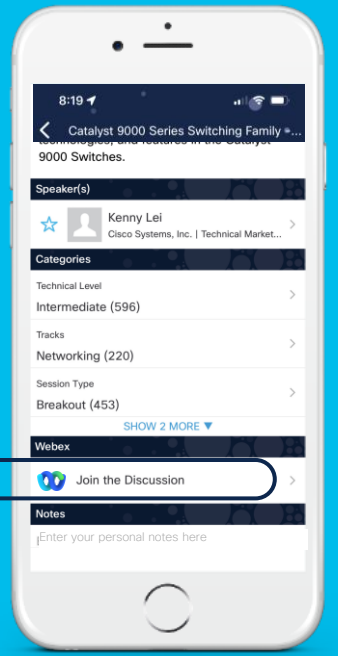
Questions?

Use Cisco Webex App to chat
with the speaker after the session

How

1. Find this session in the Cisco Live Mobile App
2. Click “Join the Discussion”
3. Install the Webex App or go directly to the Webex space
4. Enter messages/questions in the Webex space

Webex spaces will be moderated until February 24, 2023.



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Agenda

- Infrastructure as Code
- Application Hosting on Catalyst 9000
- ThousandEyes
- Terraform
- Deploy ThousandEyes on Catalyst 9000

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ROBERT CSAPO

- Product Manager for Catalyst 9000 Core Switches
- Almost 10 years at Cisco
- Cisco Certified: DevNet Associate/Professional
- Father and Husband
- From Stockholm, Sweden

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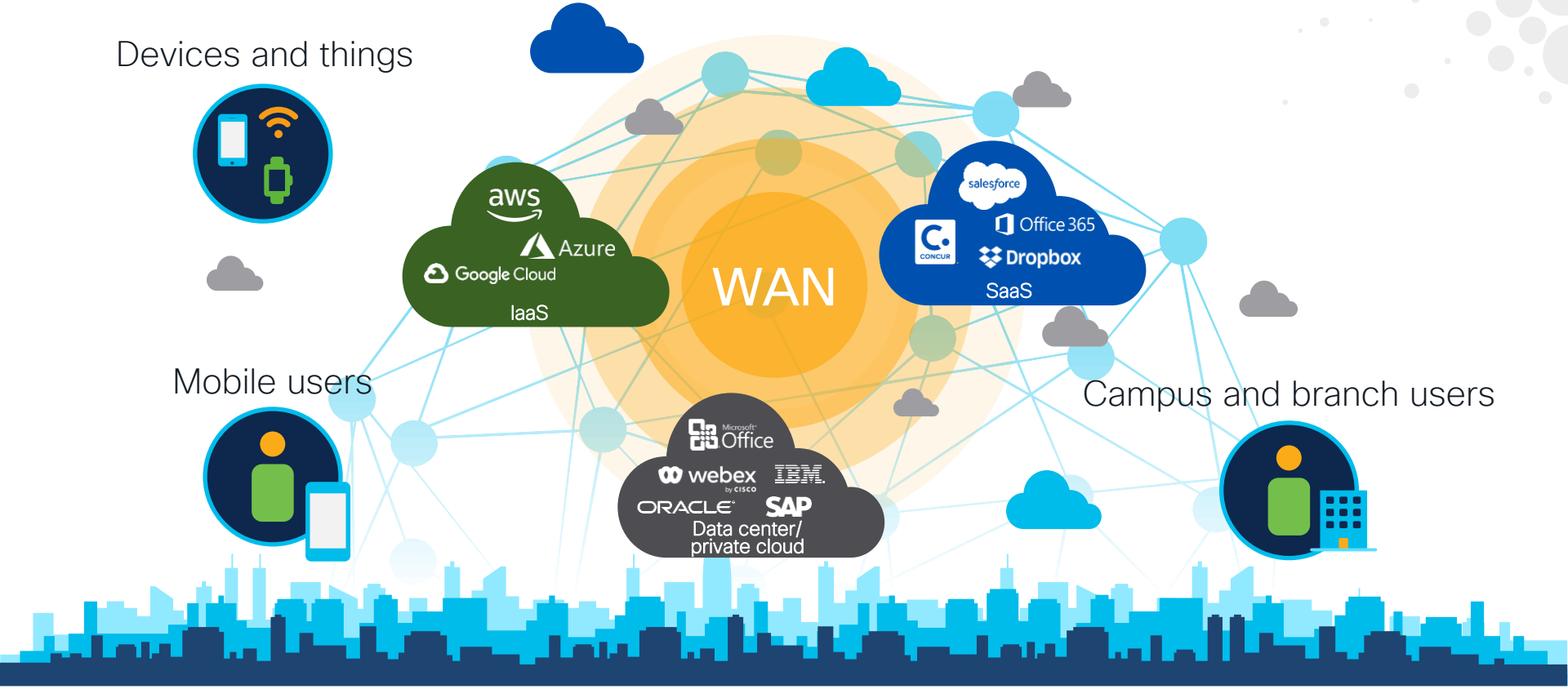
Applications live in a multicloud and distributed world



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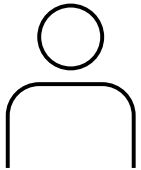
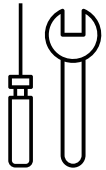
Infrastructure as Code (IAC)

Help to reduce Cost, increase Speed, and minimize Risk



User

Version Control

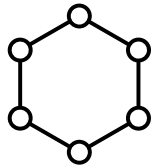


Tool

Automation Software

Code

Templates/Plugins



Infrastructure

Platforms

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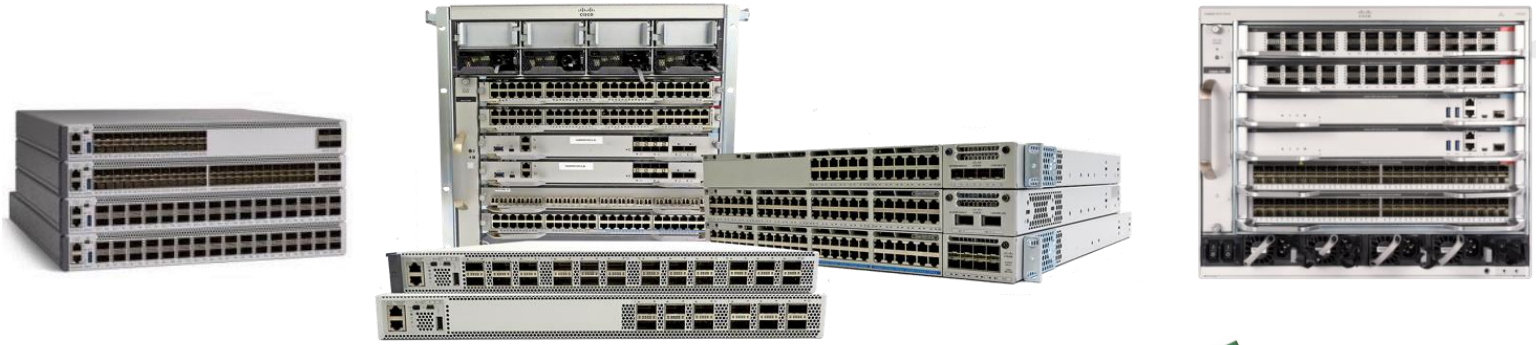
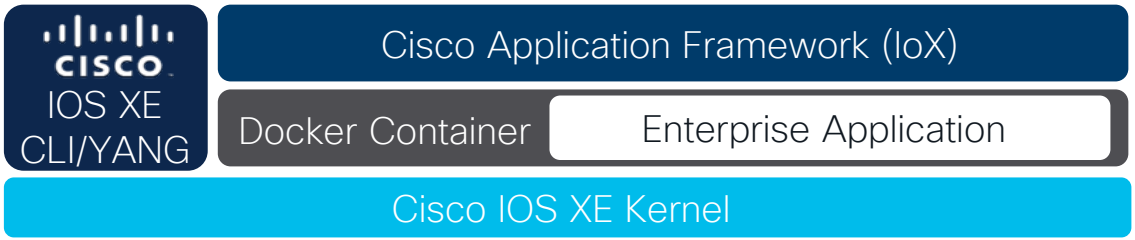
Application Hosting on Catalyst 9000

Enables hosting docker containers and third-party apps



x86 CPU | Linux-based OS | Memory/Storage



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Network Visibility for the Applications

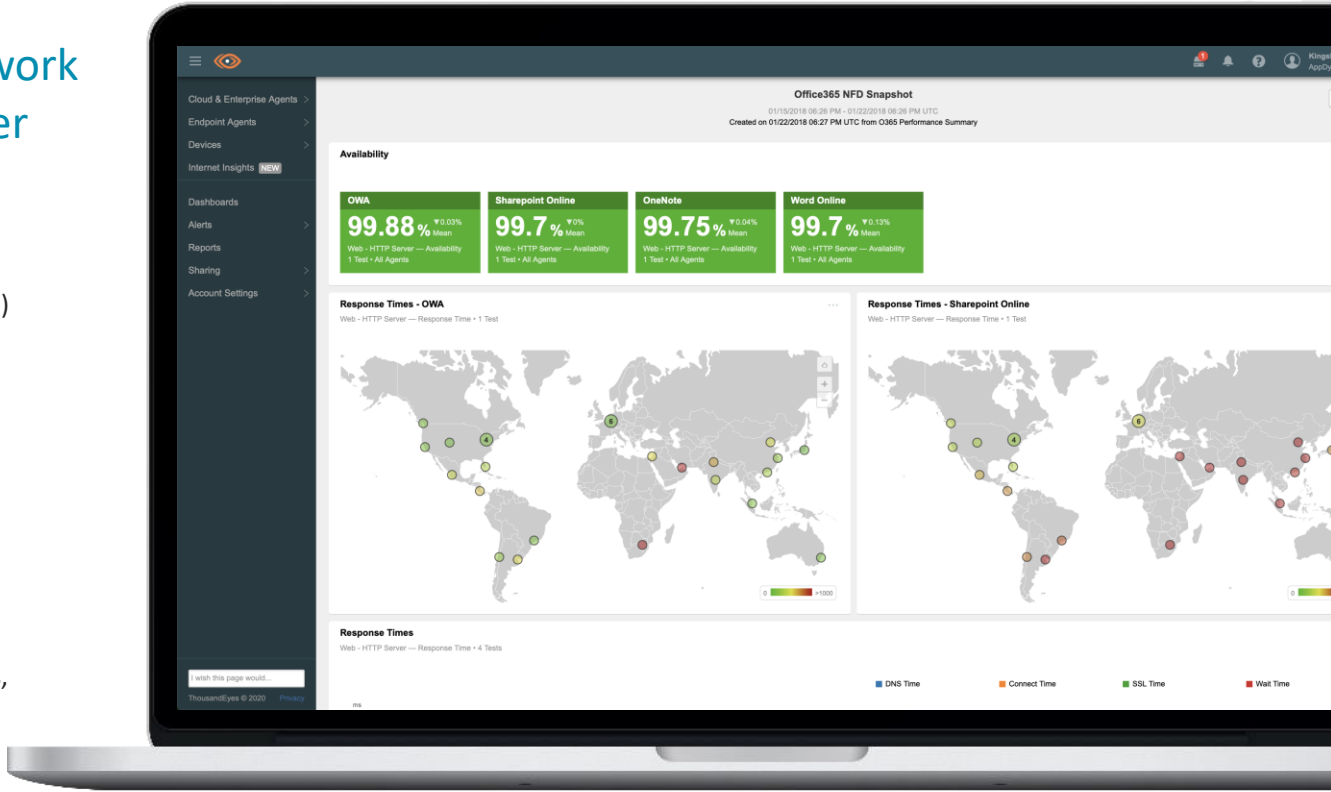
Cisco ThousandEyes

Proactively diagnose network issues that affect customer experience

Extending Root Cause Analysis (MTTI/MTTR) for network & internet related problems

Extending our coverage and root cause analysis for Enterprise Collaboration and Productivity SaaS Applications

Monitor & troubleshoot connectivity and network performance to IaaS, PaaS services, whilst understanding 3rd party service dependencies



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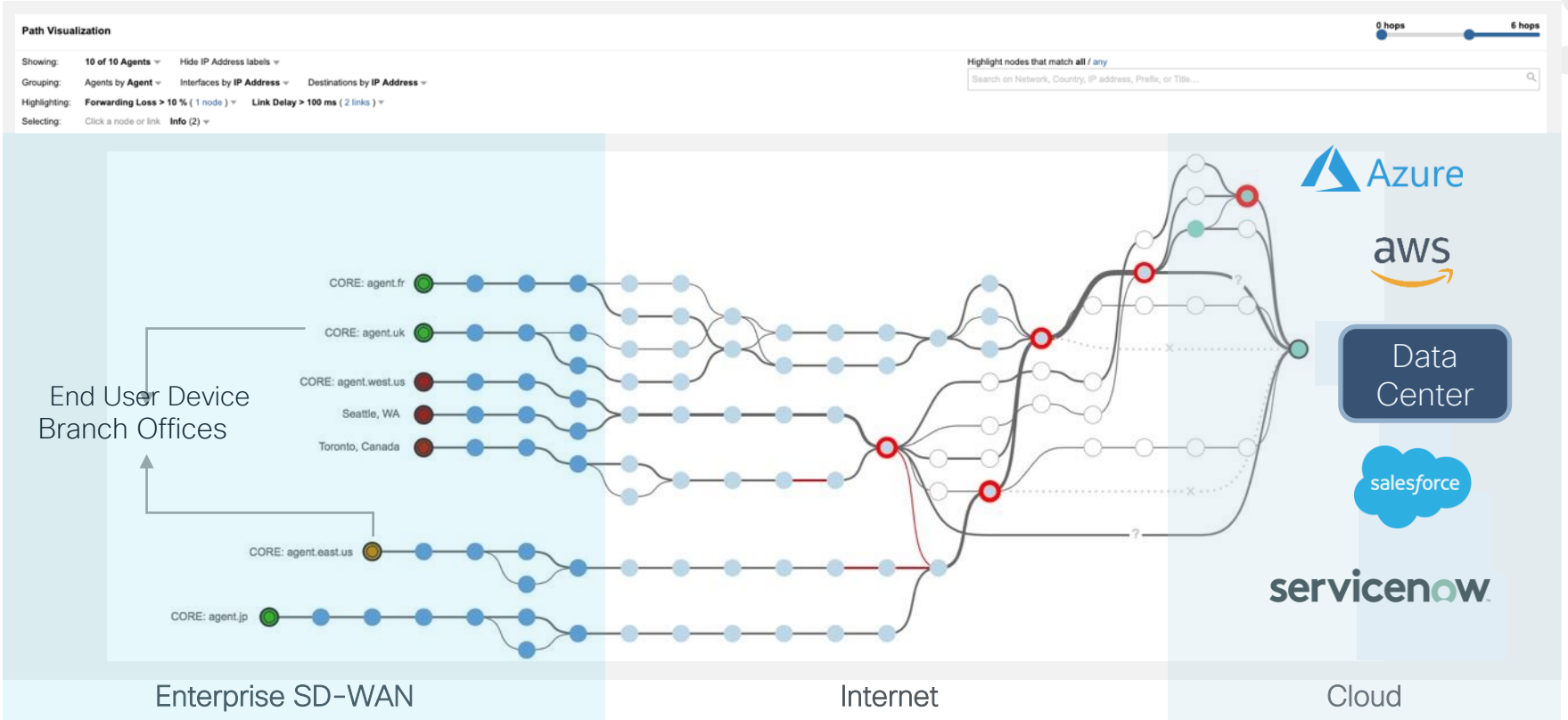
Public Internet – no longer a black box



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What is ThousandEyes?

ThousandEyes is a Digital Experience Monitoring SaaS platform to see, understand, and improve digital experiences of customers and employees over any network. We offer a distribution of global vantage points from where users can run a variety of tests.

Cloud Agent

Globally distributed agents installed and managed by ThousandEyes in 200+ cities.

External Vantage Points

Enterprise Agent

Lightweight software-based agents, easily installed on your own network, provide visibility from within the enterprise campus, data centers, cloud VPCs/VNets, and branches.
Supports active monitoring, SNMP-based monitoring, and topological mapping of internal network devices.

Enterprise Agent is applicable to Enterprise Switching Infra

Internal Vantage Points

Endpoint Agent

Lightweight service installed on end-user laptops and desktops that provides proactive and real-time monitoring of application experience and network connectivity

End-User Experience

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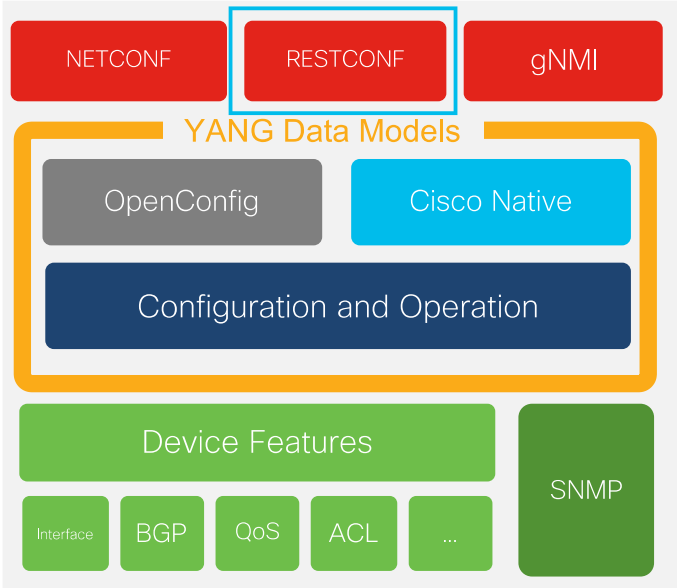
Terraform is...

Open-source Infrastructure as Code (IaC) Software Tool providing a consistent CLI workflow to manage hundreds of cloud services. Terraform codifies cloud APIs into declarative configuration files.

- Cloud Native Tooling circa 2014 from HashiCorp
- Agentless, single binary file
- Zero server-side dependencies

Terraform uses the RESTCONF API



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Why Terraform with Catalyst 9000 Switches?

Terraform is a single tool that is used to configure networks and applications
Now support for Terraform with IOS XE is being introduced

Cisco Catalyst 9300X IOS XE
RESTCONF / YANG

IPSEC crypto tunnel configuration

Users

Terraform (.tf)
Plan Execution File

Terraform

Cisco
vManage

Cisco DNA
Center

Compute and VPC, application, network configuration, transit gateway

Google Cloud

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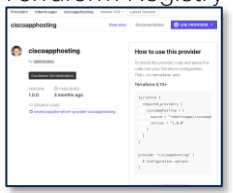
Terraform with Cisco Application Hosting

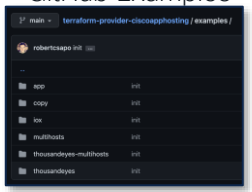
```
terraform {
  required_providers {
    ciscoapphosting = {
      source  = "robertcsapo/ciscoapphosting"
      version = "1.0.0"
    }
  }
}
```

```
resource "ciscoapphosting_app" "app" {
  host                = var.hosts.0
  image               = "https://example.tld/file.tar"
  app_gigabit_ethernet = "1/0/1"
  vlan_trunk          = false
  vlan                = 1
  env = {
    TOKEN = "example"
  }
}
```

Terraform Registry



GitHub Examples



Terraform CLI

Plan

Apply

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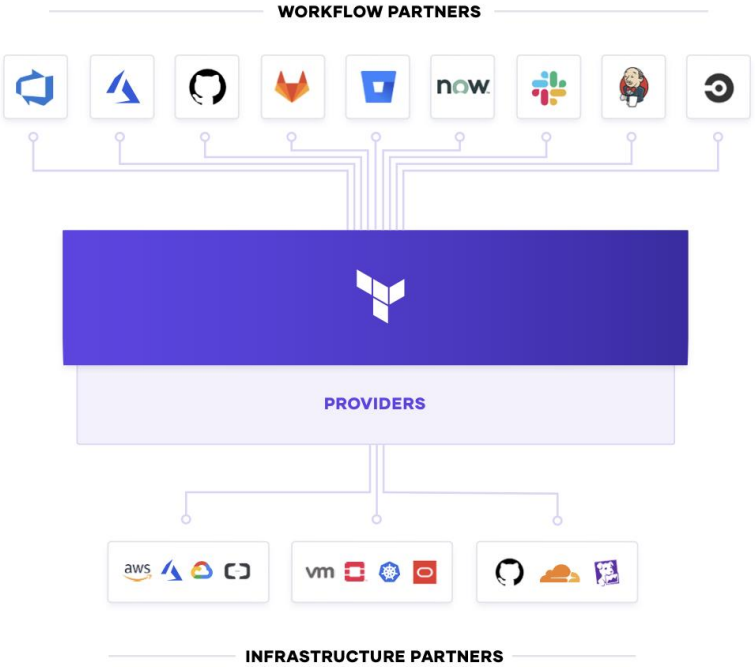
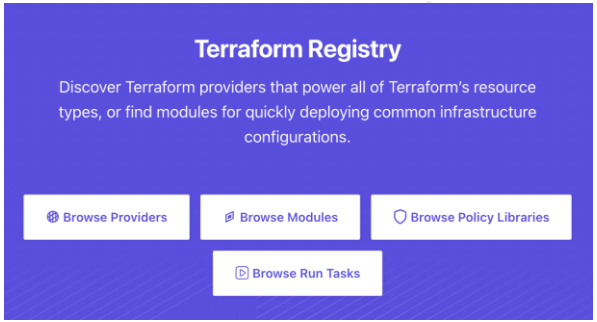
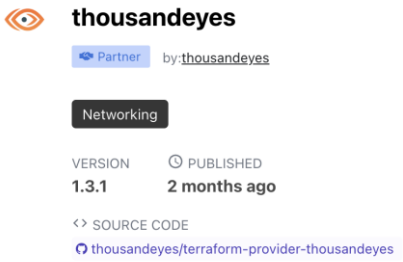
Terraform with multiple providers

End-to-End deployment with Cisco ThousandEyes







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Getting started with Terraform

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Install Terraform

macOS

```
brew tap hashicorp/tap
brew install hashicorp/tap/terraform
```

CentOS/RHEL

```
sudo yum install -y yum-utils
sudo yum-config-manager --add-repo
https://rpm.releases.hashicorp.com/RHEL/hashicorp.repo
sudo yum -y install terraform
```

Windows

```
choco install terraform
```

More details https://developer.hashicorp.com/terraform/downloads

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Code in Terraform language

```
terraform {
  required_providers {
    ciscoapphosting = {
      source  = "robertcsapo/ciscoapphosting"
      version = "1.0.0"
    }
  }
}
```

Terraform Provider

Download from the Terraform Public Registry

```
provider "ciscoapphosting" {
  username = var.username
  password = var.password
  insecure = var.insecure
  timeout  = var.timeout
}
```

Terraform Provider Settings

Cisco IOS XE RESTCONF

```
locals {
  te_agent_token = "thousandeyes_agent_token"
}
```

Terraform Variables

```
resource "ciscoapphosting_app" "app" {
  host                = var.hosts.0
  image               = "https://downloads.thousandeyes.com/enterprise-agent/thousandeyes-enterprise-agent-4.2.2.cisco.tar"
  app_gigabit_ethernet = "1/0/1"
  vlan_trunk          = false
  vlan                = 1
  env = {
    TEAGENT_ACCOUNT_TOKEN = local.te_agent_token
  }
}
```

Application Settings

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Initialize Terraform

The folder with all the .tf files

```
~/terraform-provider-ciscoapphosting/examples/thousandeyes# ls -all
total 28
drwxr-xr-x 3 root root 4096 Dec 19 17:26 .
drwxr-xr-x 8 root root 4096 Dec 19 17:26 ..
drwxr-xr-x 3 root root 4096 Dec 19 17:26 .terraform
-rw-r--r-- 1 root root 3510 Dec 19 17:26 .terraform.lock.hcl
-rw-r--r-- 1 root root 1517 Dec 19 17:26 main.tf
-rw-r--r-- 1 root root   27 Dec 19 17:26 terraform.tfvars
-rw-r--r-- 1 root root  537 Dec 19 17:26 variables.tf
```

$ terraform init

```
# terraform init

Initializing the backend...

Initializing provider plugins...
- Finding robertcsapo/ciscoapphosting versions matching "1.0.0"...
- Finding thousandeyes/thousandeyes versions matching "1.0.0-beta"...
- Finding hashicorp/time versions matching "0.8.0"...
- Installing hashicorp/time v0.8.0...
- Installed hashicorp/time v0.8.0 (signed by HashiCorp)
- Installing robertcsapo/ciscoapphosting v1.0.0...
- Installed robertcsapo/ciscoapphosting v1.0.0 (self-signed, key ID 70B9B6D8DE032DD2)
- Installing thousandeyes/thousandeyes v1.0.0-beta...
- Installed thousandeyes/thousandeyes v1.0.0-beta (self-signed, key ID 02BB91CE566497C7)

Partner and community providers are signed by their developers.
If you'd like to know more about provider signing, you can read about it here:
https://www.terraform.io/docs/cli/plugins/signing.html

Terraform has created a lock file .terraform.lock.hcl to record the provider
selections it made above. Include this file in your version control repository
so that Terraform can guarantee to make the same selections by default when
you run "terraform init" in the future.

Terraform has been successfully initialized!

You may now begin working with Terraform. Try running "terraform plan" to see
any changes that are required for your infrastructure. All Terraform commands
should now work.

If you ever set or change modules or backend configuration for Terraform,
rerun this command to reinitialize your working directory. If you forget, other
commands will detect it and remind you to do so if necessary.
```


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Deploy ThousandEyes Agent on Catalyst 9000 switches

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Prerequisites for Terraform

With Catalyst 9000 and ThousandEyes

- Catalyst 9000 Switching Series
  - Catalyst 9300/9400
- Cisco IOS XE 17.8.1+
  - RESTCONF enabled
- Cisco DNA Advantage
  - Application Hosting
  - ThousandEyes Agent
- Cisco ThousandEyes
  - Activate the Dashboard
- Enterprise Agents
  - Account Token
- Internet Access
  - HTTPS access

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Download the examples from Github

GitHub

Link

terraform-provider-ciscoapphosting / examples / thousandeyes / main.tf

robertcsapo init — History

1 contributor

64 lines (57 sloc) | 1.48 KB

```
terraform {
  required_providers {
    ciscoapphosting = {
      source  = "robertcsapo/ciscoapphosting"
      version = "1.0.0"
    }
    thousandeyes = {
      source  = "thousandeyes/thousandeyes"
      version = "1.0.0-beta"
    }
    time = {
      source  = "hashicorp/time"
      version = "0.8.0"
    }
  }
}

provider "ciscoapphosting" {
  username = var.username
  password = var.password
  insecure = var.insecure
  timeout  = var.timeout
}

provider "thousandeyes" {
  token = "thousandeyes_api_token"
}

locals {
  te_agent_token = "thousandeyes_agent_token"
}

resource "ciscoapphosting_app" "thousandeyes" {
  host                = var.hosts.0
  name                = "thousandeyes"
  image               = "https://downloads.thousandeyes.com/enterprise-agent
```

terraform-provider-ciscoapphosting / examples / thousandeyes /

robertcsapo ... on Oct 3

..

main.tf	2 months ago
terraform.tfvars	2 months ago
variables.tf	2 months ago

Edit the files

Catalyst 9300/9400 Config

ThousandEyes Account Token

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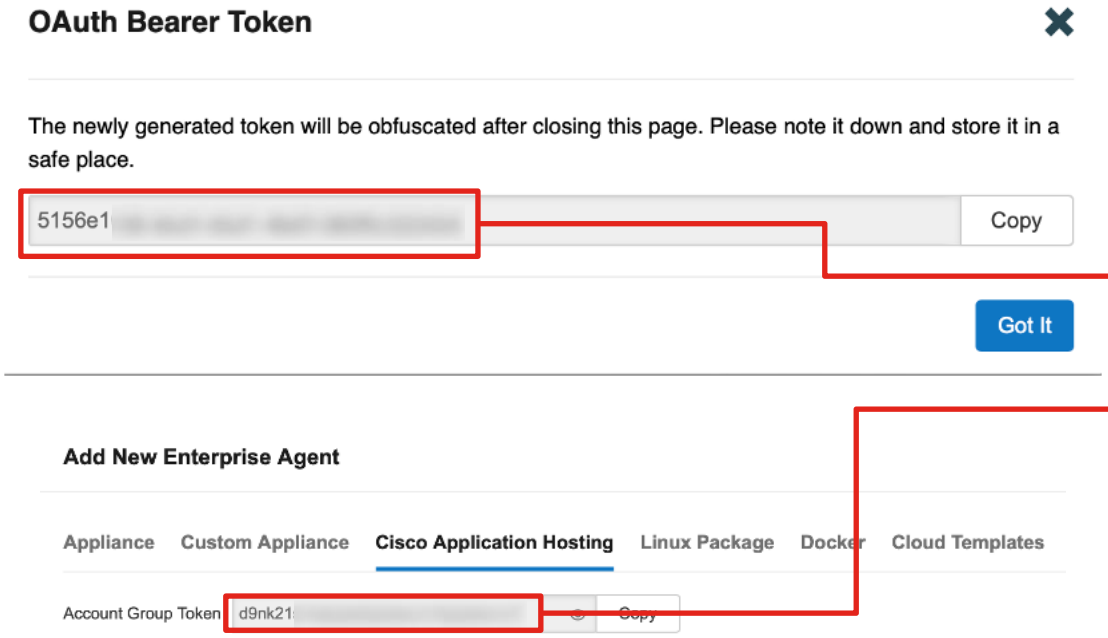
ThousandEyes Token

https://app.thousandeyes.com/



Terraform Config

```
provider "thousandeyes" {
  token = "5156e106-123c-1231-aaad-123f0c123424"
  account_group_id = "1181146" // Optional
}

locals {
  te_agent_token = "d9nkaaahlo1s5ylwfwrm1lz4n0kzzabcd"
}
```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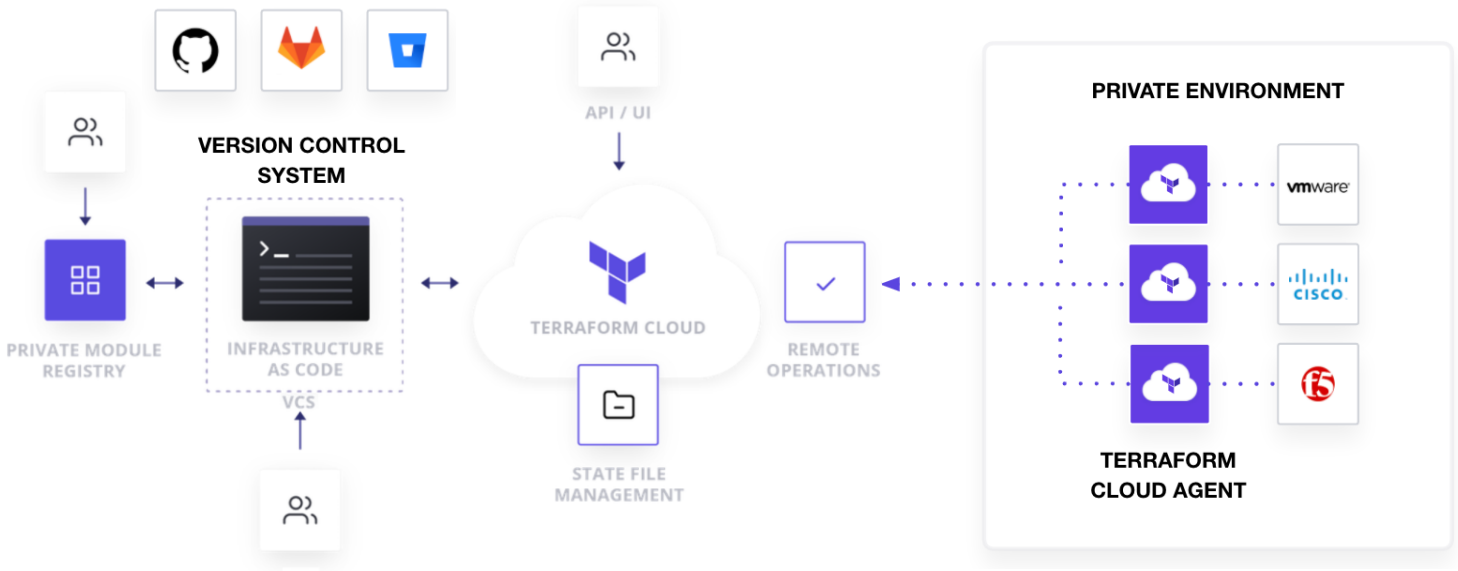
Terraform Cloud



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Plan and Apply using Terraform

$ terraform plan

Preview of the configuration

```
+ follow_redirects        = true
+ http_target_time        = 1000
+ http_time_limit         = 5
+ http_version            = 2
+ id                      = (known after apply)
+ interval                = 120
+ live_share              = (known after apply)
+ modified_by             = (known after apply)
+ modified_date           = (known after apply)
+ network_measurements    = true
+ path_trace_mode         = "classic"
+ probe_mode              = "AUTO"
+ protocol                = "TCP"
+ saved_event             = (known after apply)
+ ssl_version             = (known after apply)
+ ssl_version_id          = 0
+ test_id                 = (known after apply)
+ test_name               = "Terraform - cisco.webex.com"
+ type                    = (known after apply)
+ url                     = "https://cisco.webex.com"
+ verify_certificate      = true

+ agents {
    + agent_id     = (known after apply)
    + agent_type   = (known after apply)
```

$ terraform apply

Deploying the configuration

```
terraform — -zsh — 158×25
ciscoapphosting_app.thousandeyes["100.119.0.5"]: Still creating... [2m10s elapsed]
ciscoapphosting_app.thousandeyes["100.119.0.5"]: Still creating... [2m20s elapsed]
ciscoapphosting_app.thousandeyes["100.119.0.5"]: Creation complete after 2m20s [id=100.119.0.5]
time_sleep.wait: Creating...
time_sleep.wait: Still creating... [10s elapsed]
time_sleep.wait: Still creating... [20s elapsed]
time_sleep.wait: Still creating... [30s elapsed]
time_sleep.wait: Still creating... [40s elapsed]
time_sleep.wait: Still creating... [50s elapsed]
time_sleep.wait: Still creating... [1m0s elapsed]
time_sleep.wait: Still creating... [1m10s elapsed]
time_sleep.wait: Still creating... [1m20s elapsed]
time_sleep.wait: Still creating... [1m30s elapsed]
time_sleep.wait: Still creating... [1m40s elapsed]
time_sleep.wait: Still creating... [1m50s elapsed]
time_sleep.wait: Creation complete after 2m0s [id=2022-10-03T12:41:56Z]
data.thousandeyes_agent.catalyst9k["100.119.0.5"]: Reading...
data.thousandeyes_agent.catalyst9k["100.119.0.6"]: Reading...
data.thousandeyes_agent.catalyst9k["100.119.0.6"]: Read complete after 1s [id=0x14000038088]
data.thousandeyes_agent.catalyst9k["100.119.0.5"]: Read complete after 2s [id=0x140003633e0]
thousandeyes_http_server.webex_http_test: Creating...
thousandeyes_http_server.webex_http_test: Creation complete after 6s [id=3167595]

Apply complete! Resources: 4 added, 0 changed, 0 destroyed.
rcsapo@RCSAPO-M-HW9M terraform %
```


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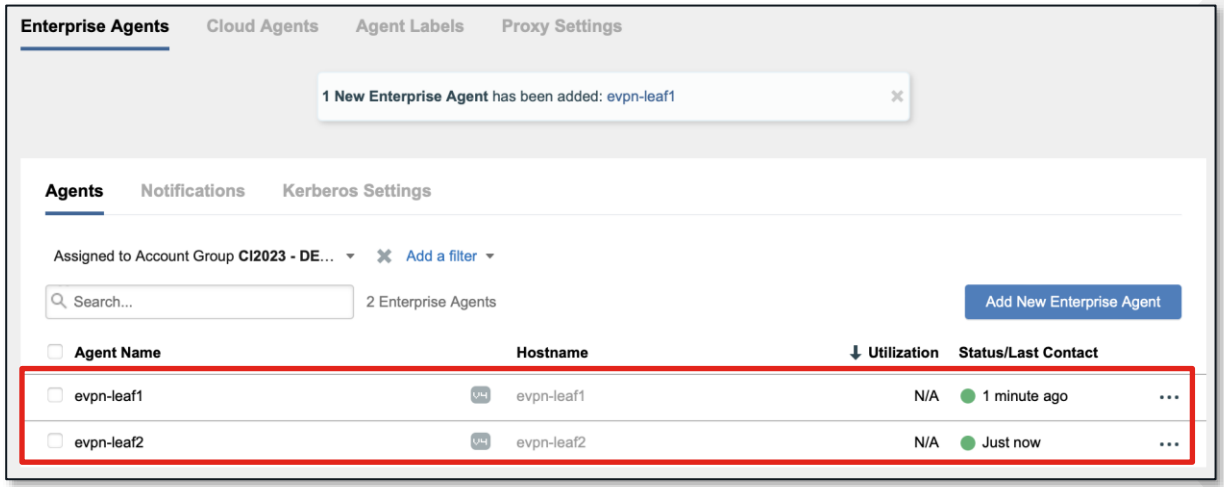
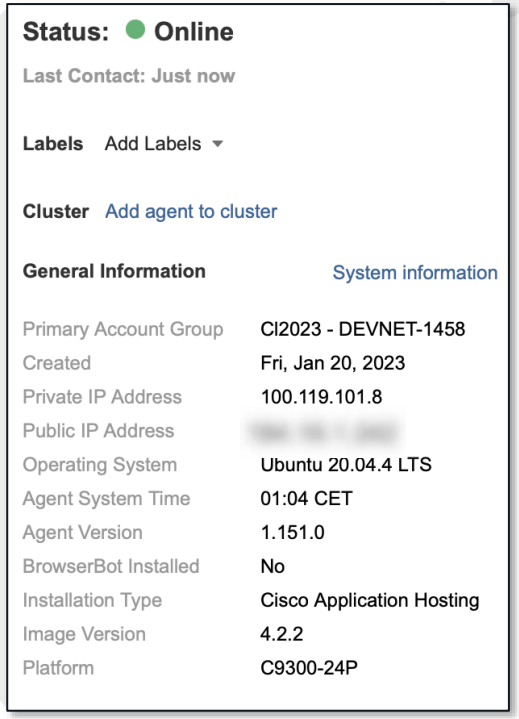
ThousandEyes Dashboard





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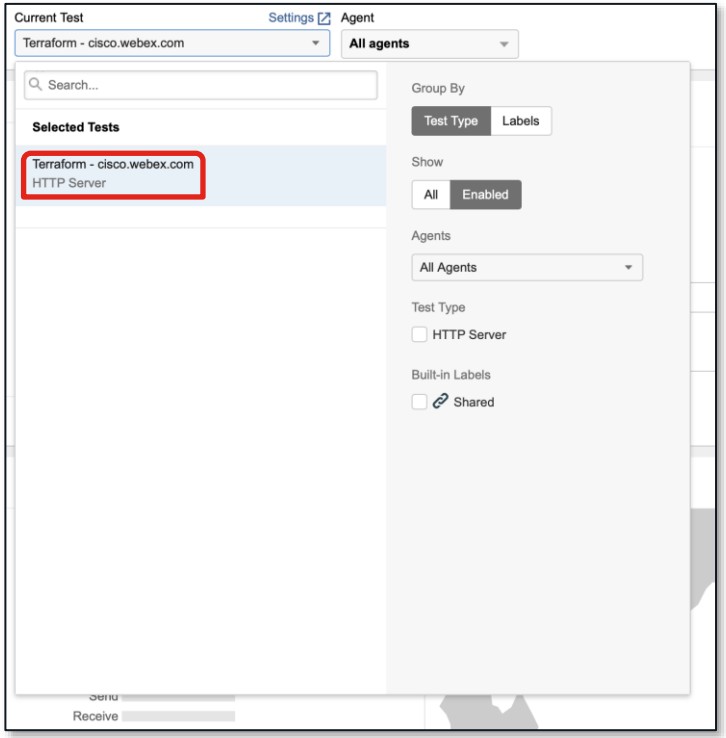
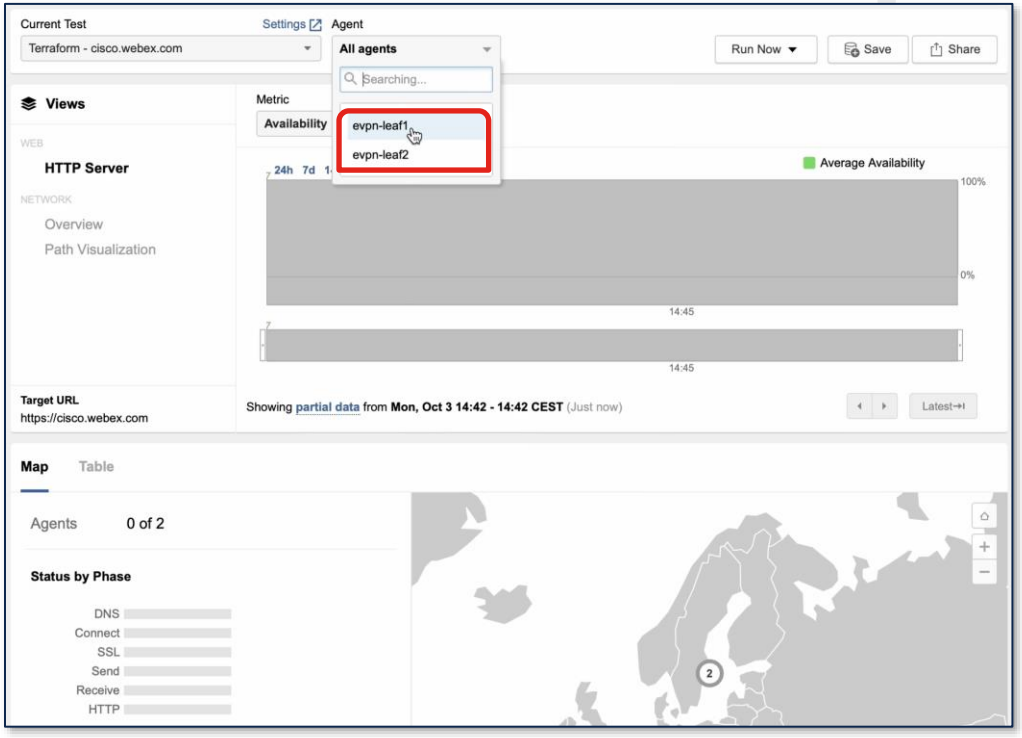
Application Monitoring

Network Visibility using Cisco Catalyst 9000 and Cisco ThousandEyes





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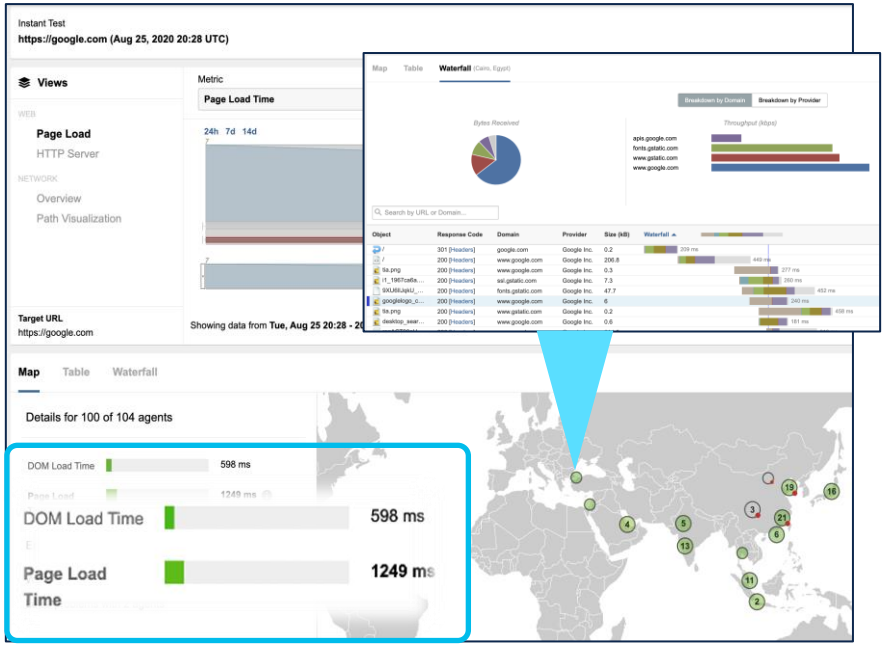
Web performance monitoring

Web tests: HTTP, page load, transaction

- Monitor and validate web applications' usability and performance, including SaaS and internally-hosted apps
- HTTP Server Test
  - Measure availability, response time and throughput of an HTTP service
- Page Load Tests
  - Measure page load times of individual web components using **waterfall analysis**
- Transaction Tests
  - Monitor application usability by emulating user journey through an app with multi-step transactions scripts
  - Validate third-party API performance and application logic of complex workflows

Page load test view



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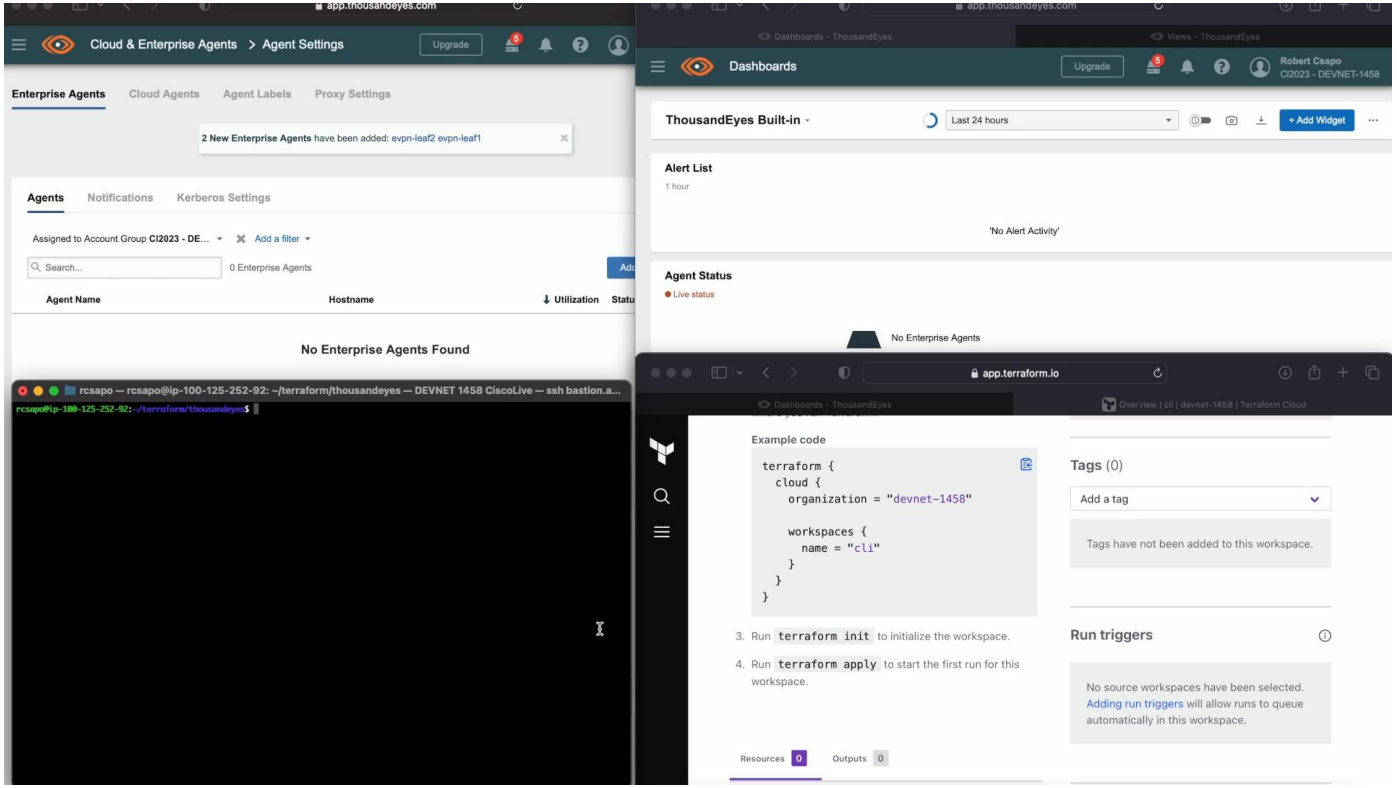
Demo

Demo: Terraform Cloud – ThousandEyes- Catalyst 9000



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Key Takeaways

Infrastructure as Code with Catalyst 9000

Hardware

ThousandEyes

Monitoring

Terraform

Automation

GitHub with Examples

More information about Cisco Application Hosting

https://developer.cisco.com/docs/app-hosting/

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