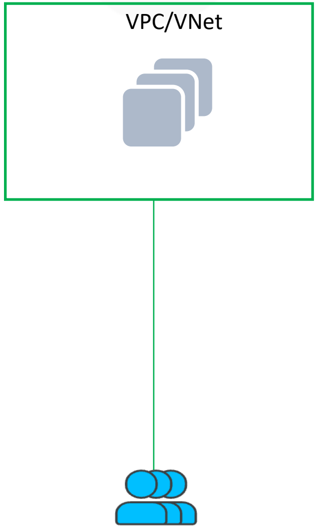
aviatrix

User VPN

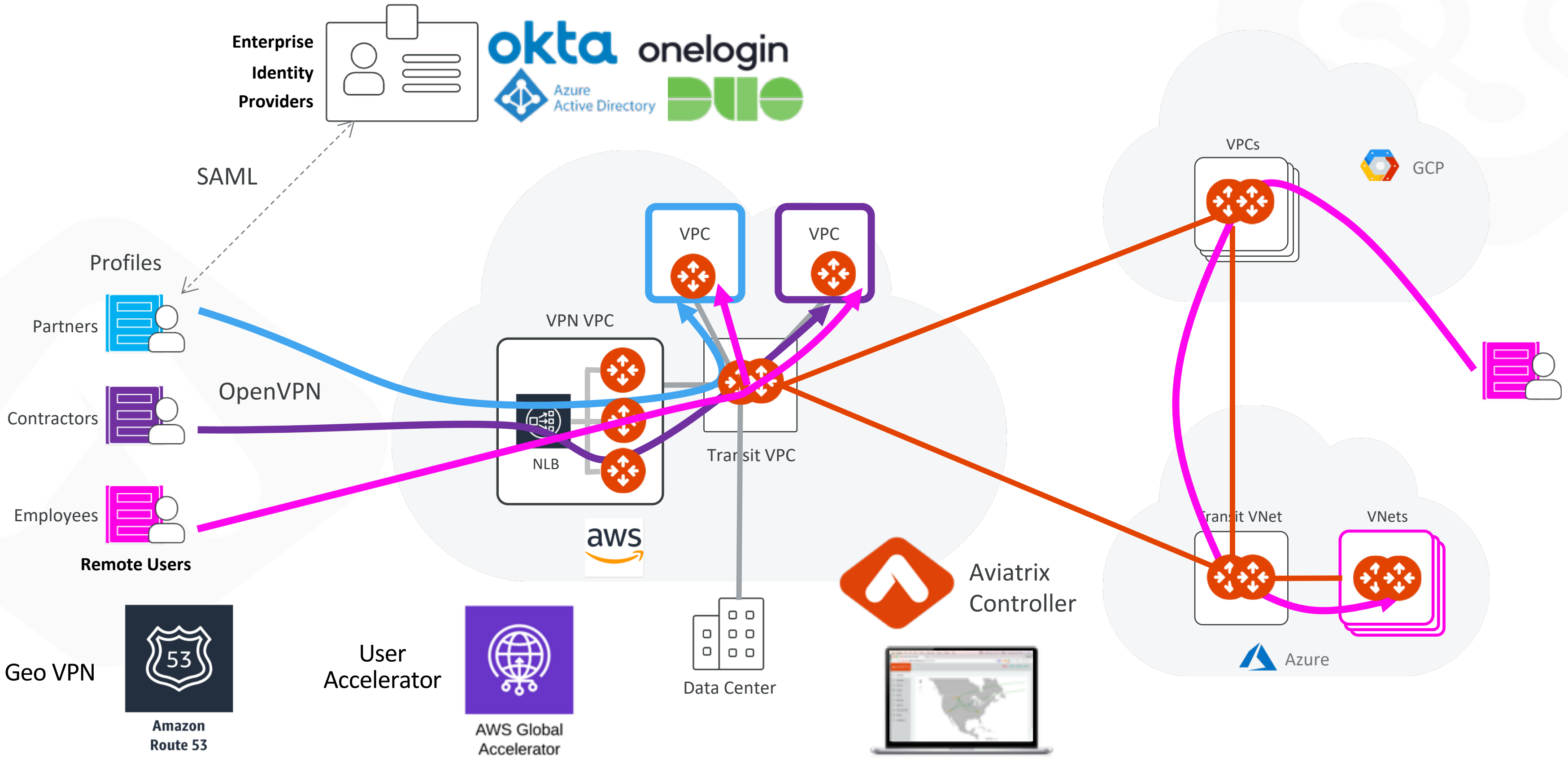
Solutions Engineering

Problem Statement

- Connect users securely and seamlessly to public cloud resources
- Least latency accessing the cloud resources
- Cloud-native: should not backhaul to on-premises Data Center first
- Enterprise-grade: Identity Provider integration
- Multicloud repeatability



User VPN Overview



Enterprise Identity Providers

okta

onelogin

Azure Active Directory

DUO

SAML

Profiles

Partners

Contractors

Employees

Remote Users

OpenVPN

VPN VPC

NLB

VPC

VPC

Transit VPC

aws

Data Center

Aviatrix Controller

VPCs

GCP

Transit VNet

VNets

Azure

Geo VPN

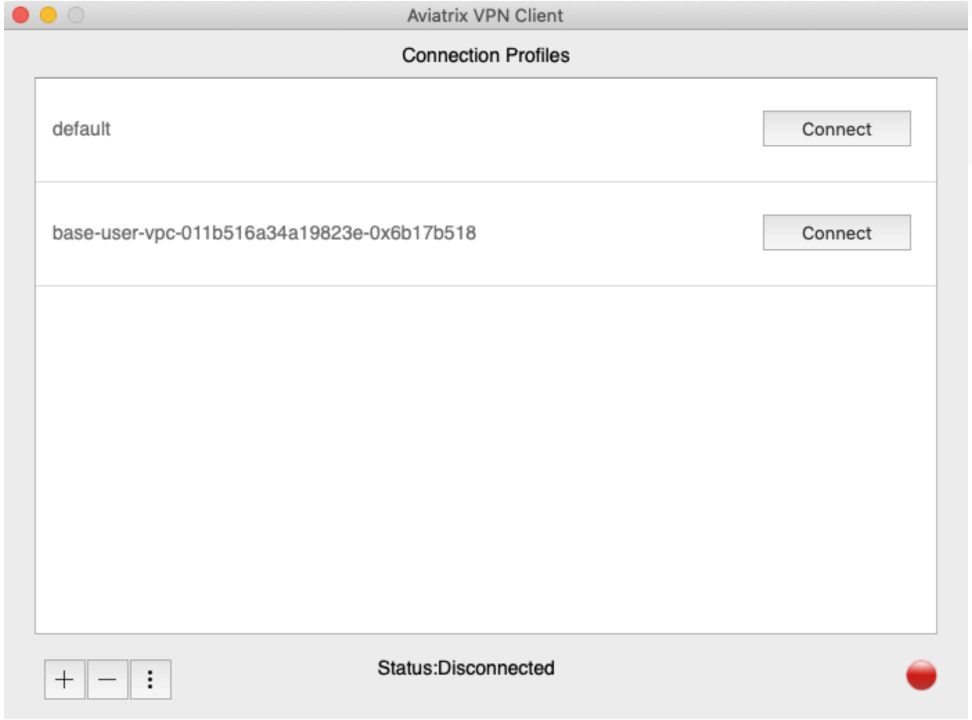
Amazon Route 53

User Accelerator

AWS Global Accelerator

Client Software

- OpenVPN Client
    - All OpenVPN client software are supported. The supported clients are macOS, Windows iOS, Android, Chromebook, Linux and BSD
- Aviatrix VPN Client
    - Aviatrix VPN Client supports macOS, Windows, Linux Debian distribution, and BSD distribution
    - Choose Aviatrix VPN Client if you require SAML authentication directly from VPN client software


Aviatrix VPN Client

Connection Profiles

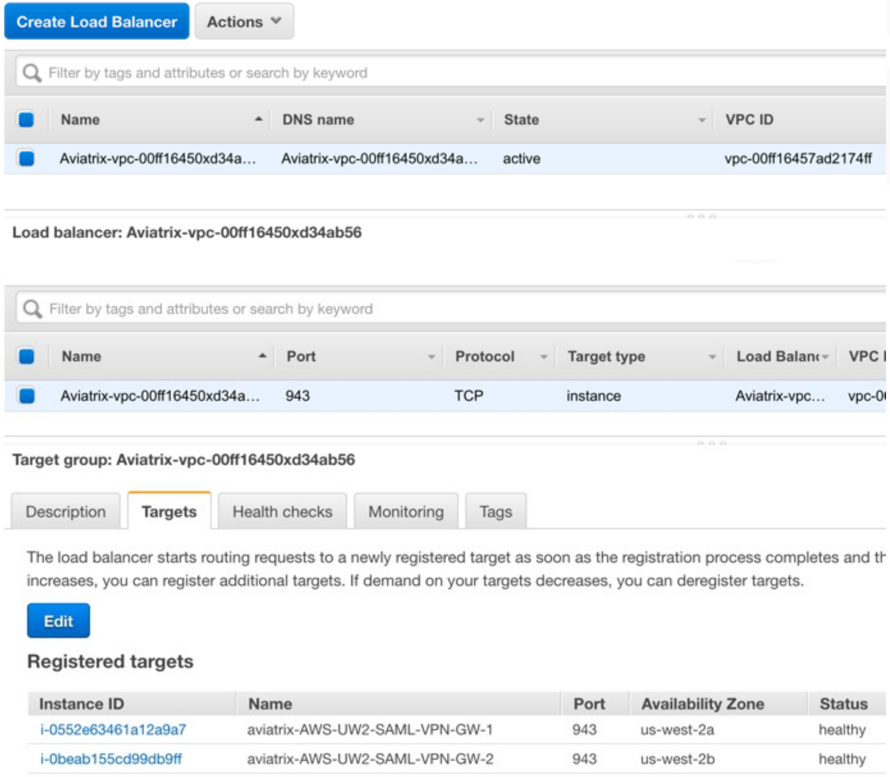
default

base-user-vpc-011b516a34a19823e-0x6b17b518

Status:Disconnected

Automated Load Balancer

- The controller automatically launches a cloud-native load balancer based on the cloud type
- Automates target groups to attach Aviatrix VPN gateways to the LB
- The domain name of the cloud provider’s load balancer, such as AWS ELB, will be the connection when a VPN user connects to the VPN gateway
- Seamless relaunch of VPN Gateways after deletion without reissuing a new .ovpn cert file


Create Load Balancer
Actions
Filter by tags and attributes or search by keyword

■	Name	DNS name	State	VPC ID
■	Aviatrix-vpc-00ff16450xd34a…	Aviatrix-vpc-00ff16450xd34a…	active	vpc-00ff16457ad2174ff

Load balancer: Aviatrix-vpc-00ff16450xd34ab56

Filter by tags and attributes or search by keyword

■	Name	Port	Protocol	Target type	Load Balanc	VPC I
■	Aviatrix-vpc-00ff16450xd34a…	943	TCP	instance	Aviatrix-vpc…	vpc-0

Target group: Aviatrix-vpc-00ff16450xd34ab56

Description
Targets
Health checks
Monitoring
Tags

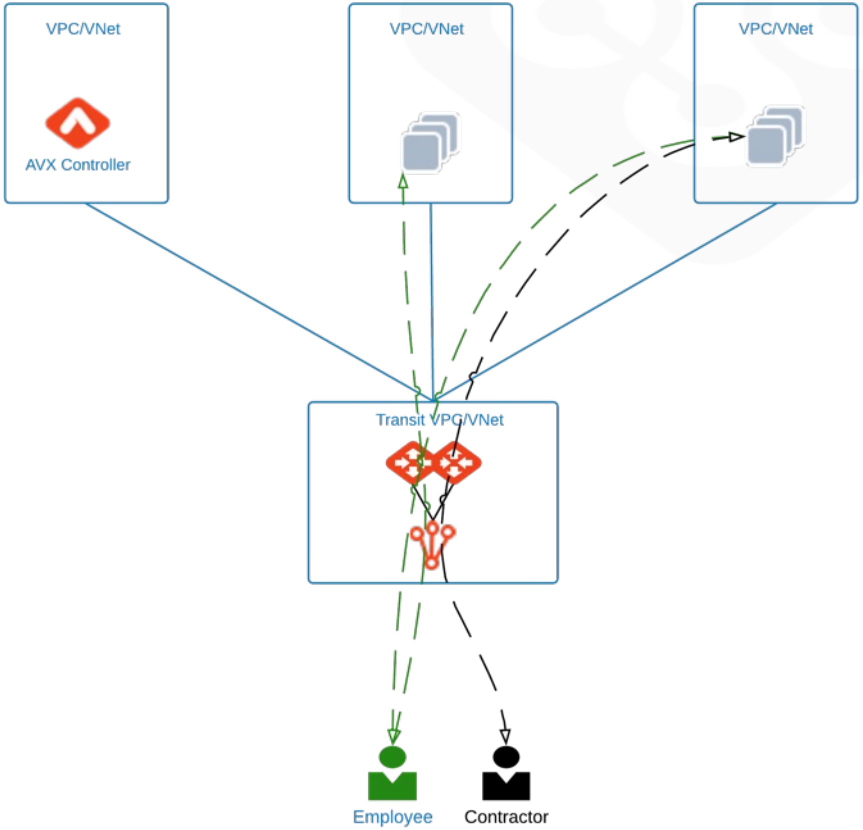
The load balancer starts routing requests to a newly registered target as soon as the registration process completes and th increases, you can register additional targets. If demand on your targets decreases, you can deregister targets.

Registered targets

Instance ID	Name	Port	Availability Zone	Status
i-0552e63461a12a9a7	aviatrix-AWS-UW2-SAML-VPN-GW-1	943	us-west-2a	healthy
i-0beab155cd99db9ff	aviatrix-AWS-UW2-SAML-VPN-GW-2	943	us-west-2b	healthy

Profile-Based Security Policies

- A user is dynamically assigned a virtual IP address when connected to a gateway
- Isolation between employees, contractors, partners, or developers
- Supports multiple profiles
- Automated firewall rules
- Security based on user not source IP
- The security policy is dynamically pushed to the landing Aviatrix VPN gateway when a VPN user connects
- It is only active when a VPN user is connected
- When a VPN user disconnects, the security policy is deleted from the VPN gateway

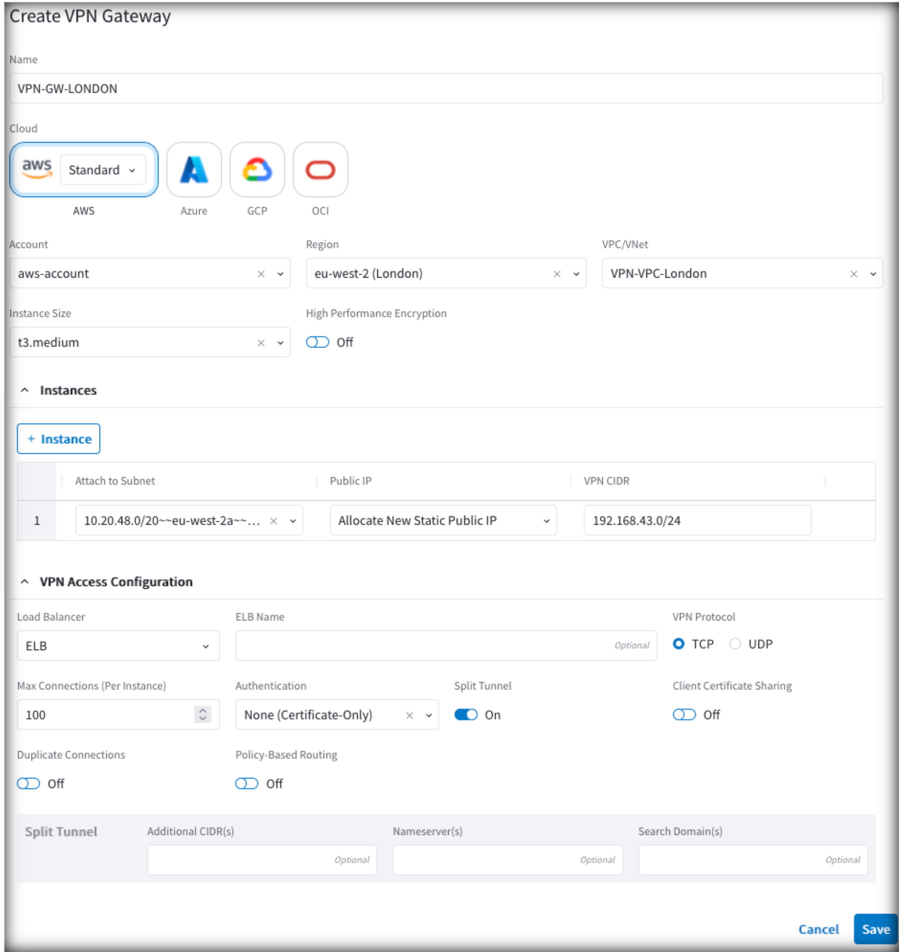


Secure Assertion Markup Language

- Supports IDPs like Azure AD, Okta, Duo, Office 365
- User accounts are onboarded on the IDP portal
- Users can be onboarded on Aviatrix controller if SAML is not required

thycotic and Centrify are now Delinea.
Delinea
Defining the boundaries of access
okta
DUO
Azure Active Directory
Ping Identity
G Suite
AWS SSO
onelogin

VPN Gateway Creation



Create VPN Gateway

Name: VPN-GW-LONDON

Cloud: AWS (Standard) ● | Azure | GCP | OCI

Account: aws-account

Region: eu-west-2 (London)

VPC/VNet: VPN-VPC-London

Instance Size: t3.medium

High Performance Encryption: Off

Instances

+ Instance

	Attach to Subnet	Public IP	VPN CIDR
1	10.20.48.0/20~~eu-west-2a~~...	Allocate New Static Public IP	192.168.43.0/24

VPN Access Configuration

Load Balancer: ELB

ELB Name: Optional

VPN Protocol: ● TCP ○ UDP

Max Connections (Per Instance): 100

Authentication: None (Certificate-Only)

Split Tunnel: On

Client Certificate Sharing: Off

Duplicate Connections: Off

Policy-Based Routing: Off

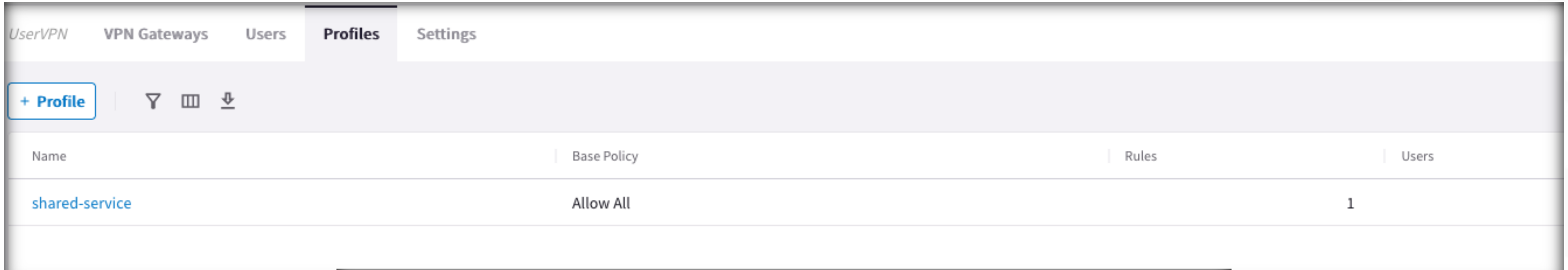
Split Tunnel

Additional CIDR(s): Optional

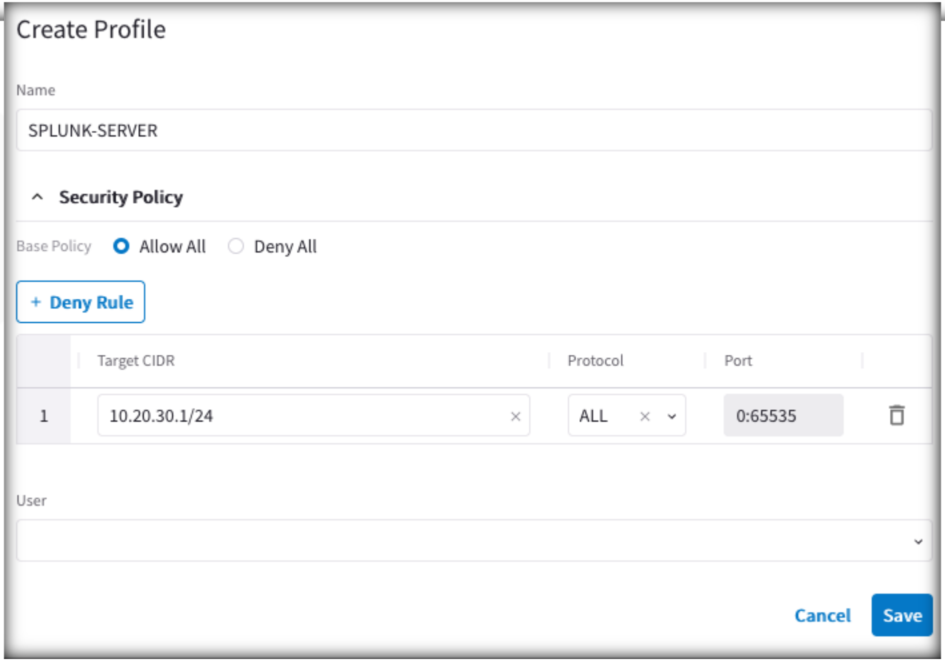
Nameserver(s): Optional

Search Domain(s): Optional

Profiles



Name	Base Policy	Rules	Users
shared-service	Allow All	1	



Name

SPLUNK-SERVER

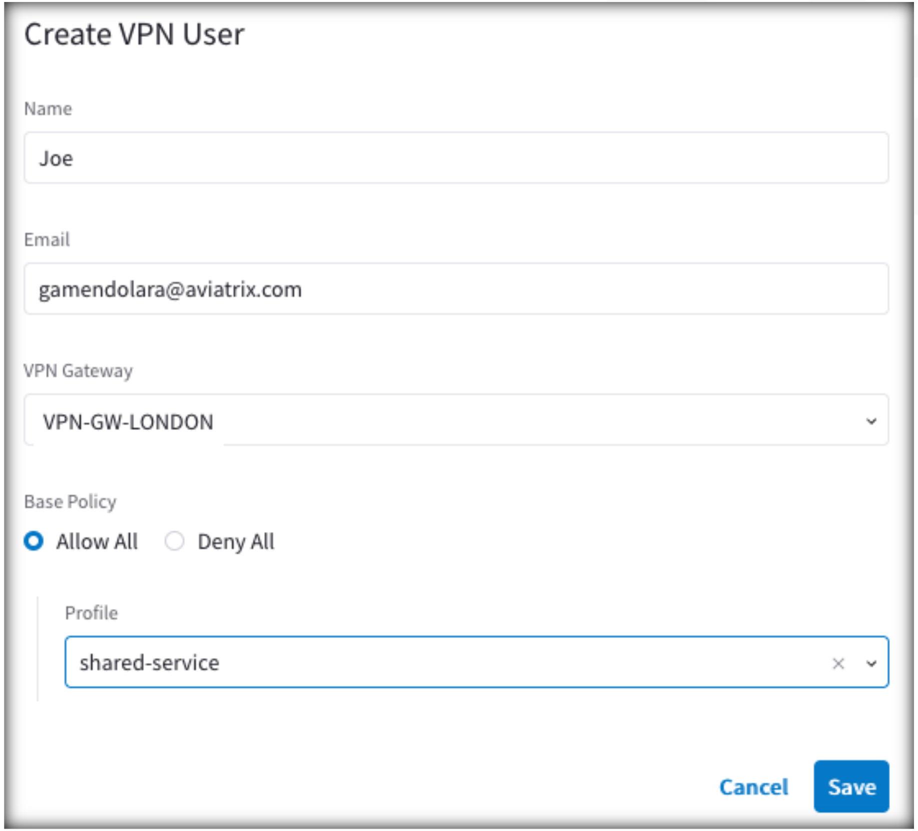
Base Policy ● Allow All ○ Deny All

	Target CIDR	Protocol	Port
1	10.20.30.1/24	ALL	0:65535

User

Profiles ←→ Users

- A profile can be associated with multiple users.
- A user can be associated with multiple profiles.



Create VPN User

Name

Joe

Email

gamendolara@aviatrix.com

VPN Gateway

VPN-GW-LONDON

Base Policy

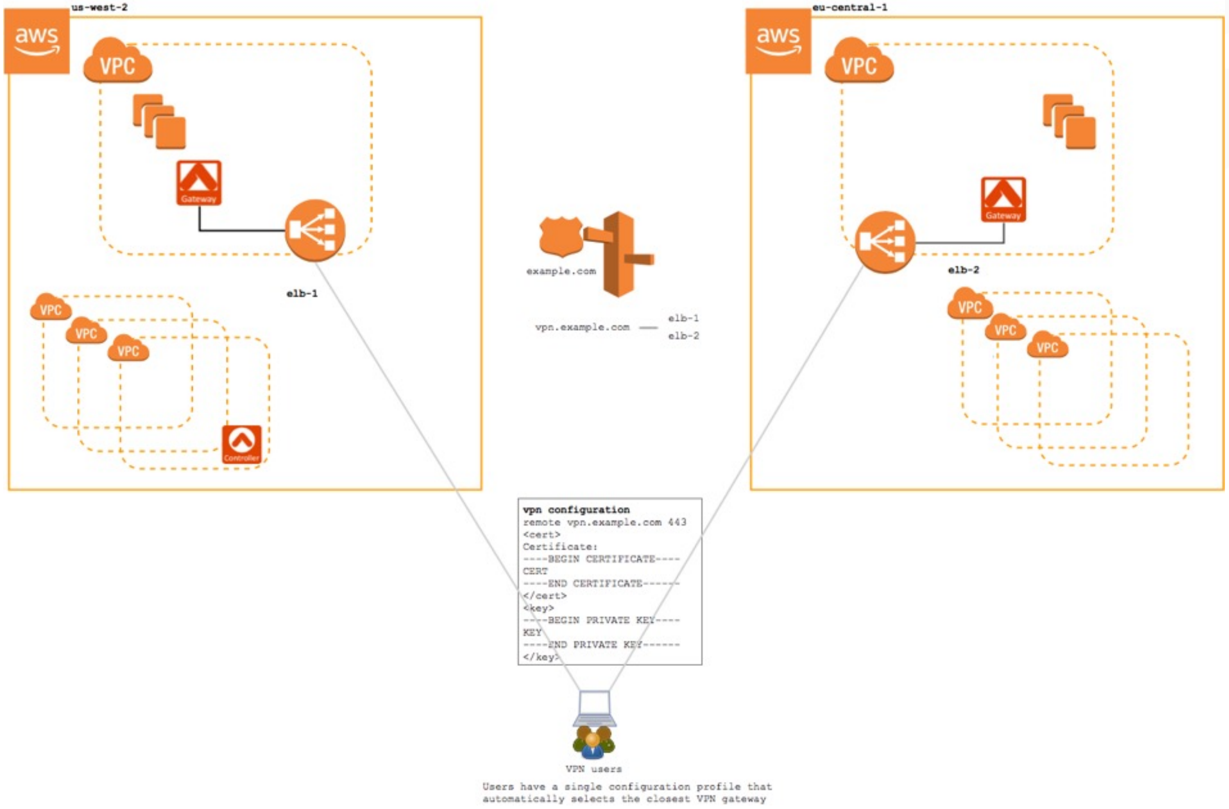
● Allow All ○ Deny All

Profile

shared-service

Geo VPN – VPN User Accelerator

- Combines the Aviatrix scale-out VPN solution with latency-based routing to dynamically route VPN users to the nearest Aviatrix VPN gateway based on the latency between the user and the gateways
- Users are directed to an Amazon Route 53 DNS or Azure DNS, that uses a latency-based routing policy to choose between the available regions

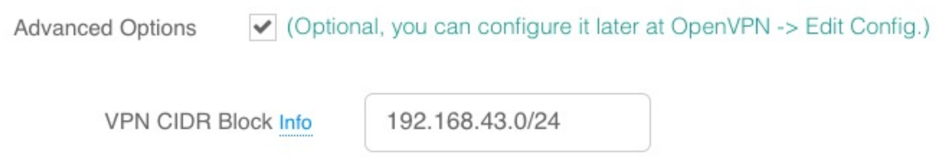


```
vpn configuration
remote vpn.example.com 443
<cert>
Certificate:
----BEGIN CERTIFICATE----
CERT
----END CERTIFICATE------
</cert>
<key>
----BEGIN PRIVATE KEY----
KEY
----END PRIVATE KEY------
</key>
```

Users have a single configuration profile that automatically selects the closest VPN gateway

Custom VPN CIDR Block

- The default IP address pool is 192.168.43.0/24
- This is a configurable parameter

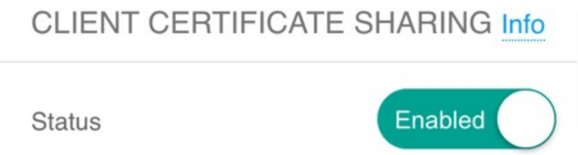


Advanced Options ☑ (Optional, you can configure it later at OpenVPN -> Edit Config.)

VPN CIDR Block Info: 192.168.43.0/24

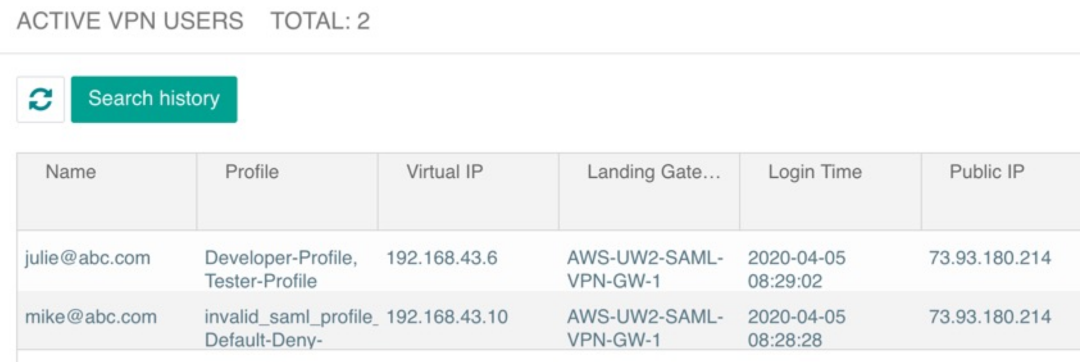
Client Certificate Sharing

- Disabled by default
- Multiple VPN users can share the same .ovpn file
- Can only be used when authenticating users via IDP
- The controller still sees individual users and maintains full history



CLIENT CERTIFICATE SHARING Info

Status: Enabled

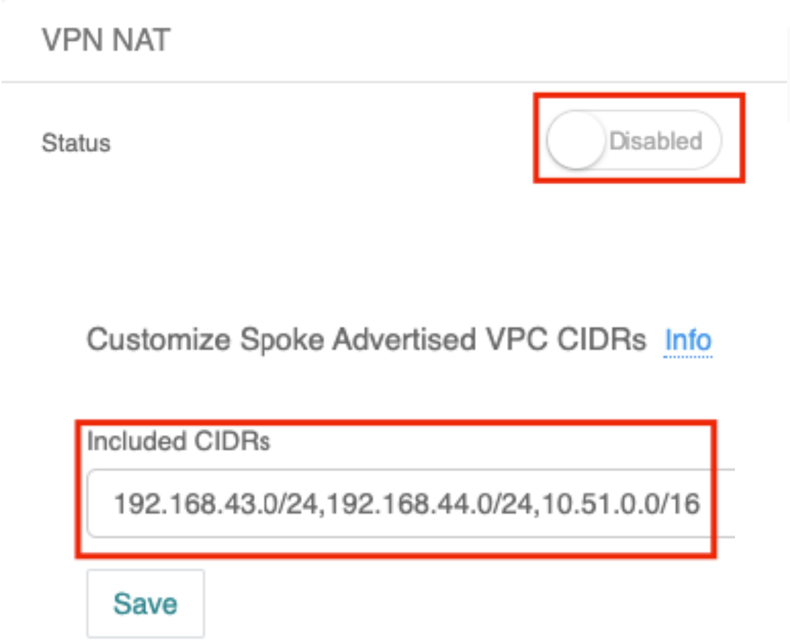


ACTIVE VPN USERS TOTAL: 2

Name	Profile	Virtual IP	Landing Gate...	Login Time	Public IP
julie@abc.com	Developer-Profile, Tester-Profile	192.168.43.6	AWS-UW2-SAML-VPN-GW-1	2020-04-05 08:29:02	73.93.180.214
mike@abc.com	invalid_saml_profile_ Default-Deny-	192.168.43.10	AWS-UW2-SAML-VPN-GW-1	2020-04-05 08:28:28	73.93.180.214

Preserve Client IP

- Client IP can be preserved up to the application
- NAT needs to be disabled on the VPN gateway
- VPN CIDRs must be advertised to the transit for return traffic



VPN NAT

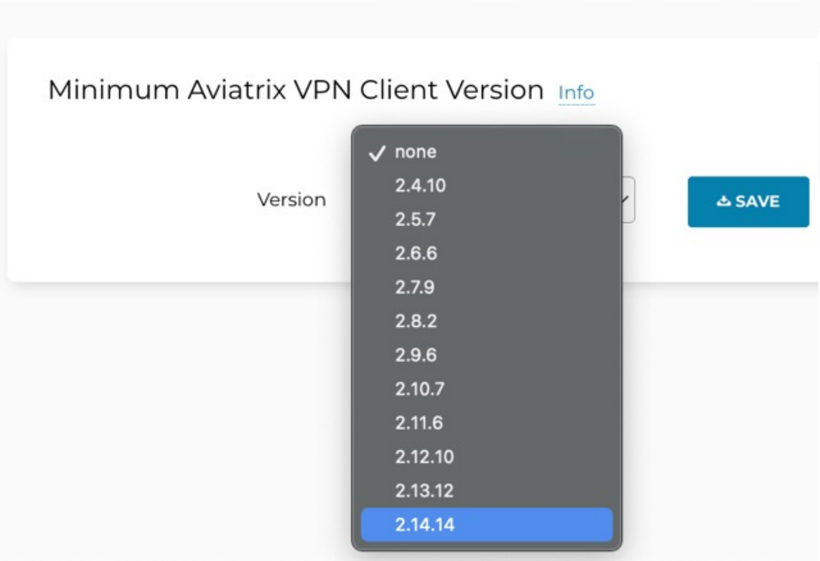
Status: Disabled

Customize Spoke Advertised VPC CIDRs

Included CIDRs: 192.168.43.0/24,192.168.44.0/24,10.51.0.0/16

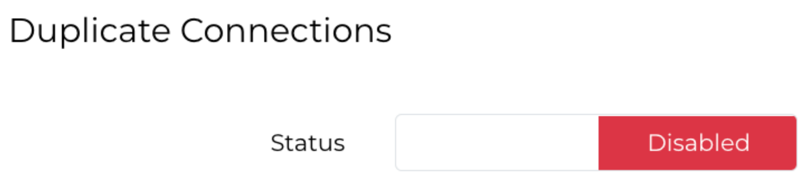
Minimum Client Version & Duplicate Connections

- Enforcement of Minimum VPN Client Version
- Duplicate Connections
  - User can connect simultaneously from multiple devices
  - When disabled, simultaneous sessions are not allowed, and existing VPN connection gets disconnected



Minimum Aviatrix VPN Client Version Info

Version ✓ none

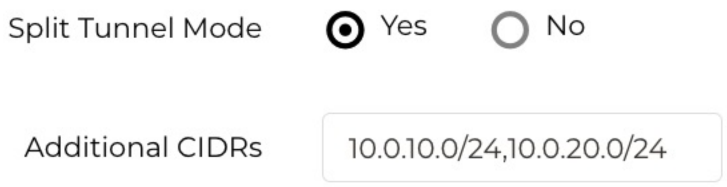


Duplicate Connections

Status Disabled

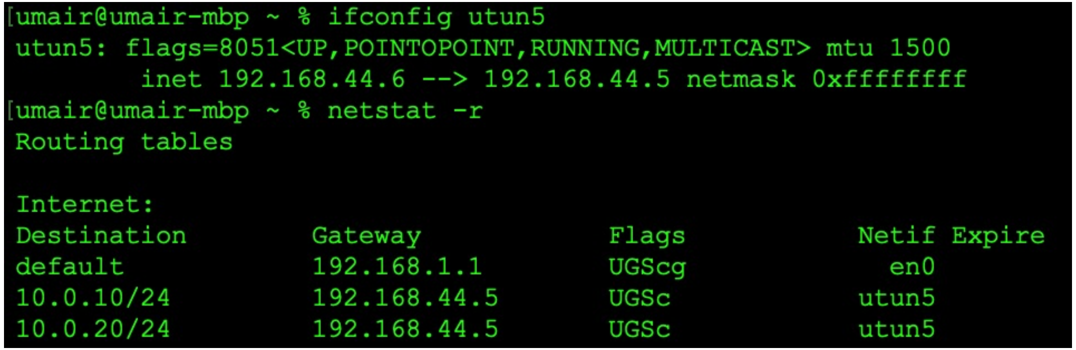
Split Tunnel or Full Tunnel

- Split Tunnel
  Only specified CIDRs ranges go through the VPN tunnel
- Full Tunnel
  All user IP sessions including Internet browsing go through the VPN tunnel



Split Tunnel Mode ● Yes ○ No

Additional CIDRs: 10.0.10.0/24,10.0.20.0/24

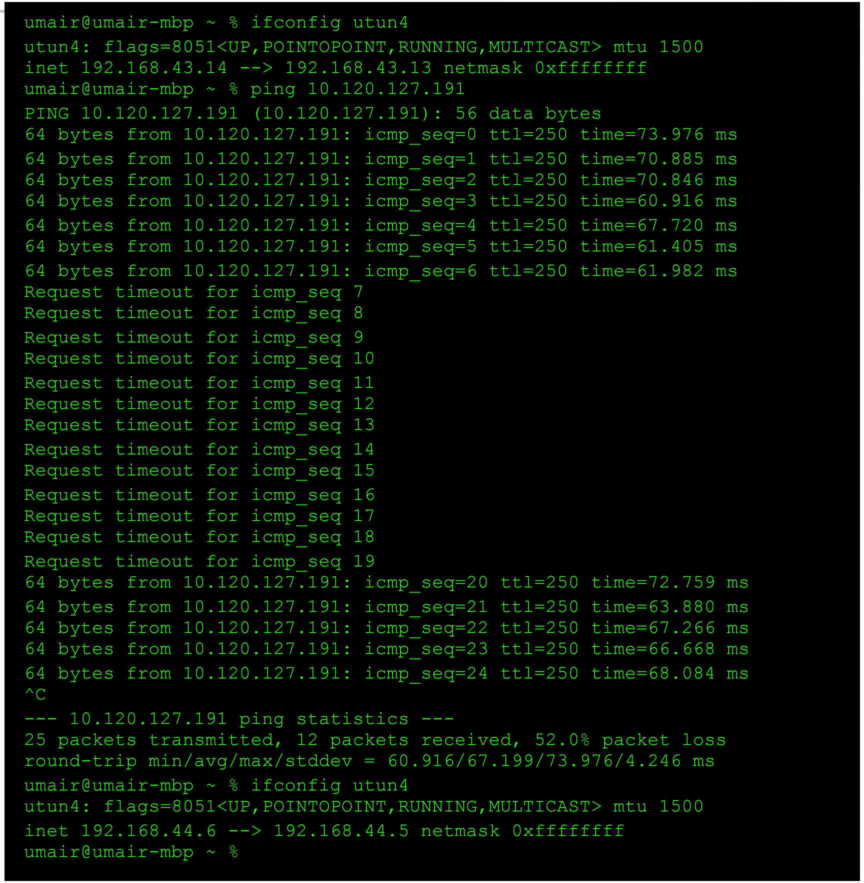


```
[umair@umair-mbp ~ % ifconfig utun5
utun5: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1500
        inet 192.168.44.6 --> 192.168.44.5 netmask 0xffffffff
[umair@umair-mbp ~ % netstat -r
Routing tables

Internet:
Destination        Gateway            Flags           Netif Expire
default            192.168.1.1        UGScg             en0
10.0.10/24         192.168.44.5       UGSc            utun5
10.0.20/24         192.168.44.5       UGSc            utun5
```

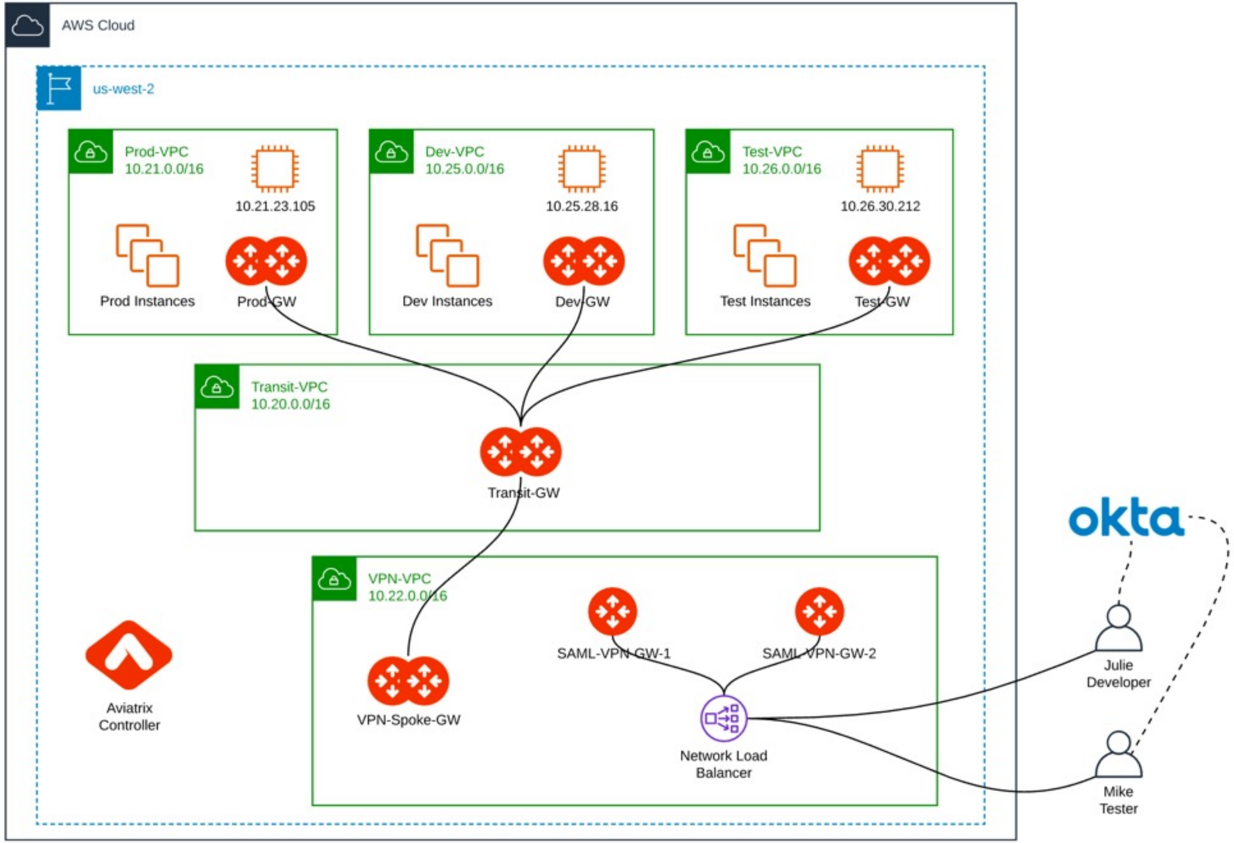
Gateway Failover

- Users will automatically get reconnected to another VPN gateway behind the load-balancer
- No change of certificate or user intervention

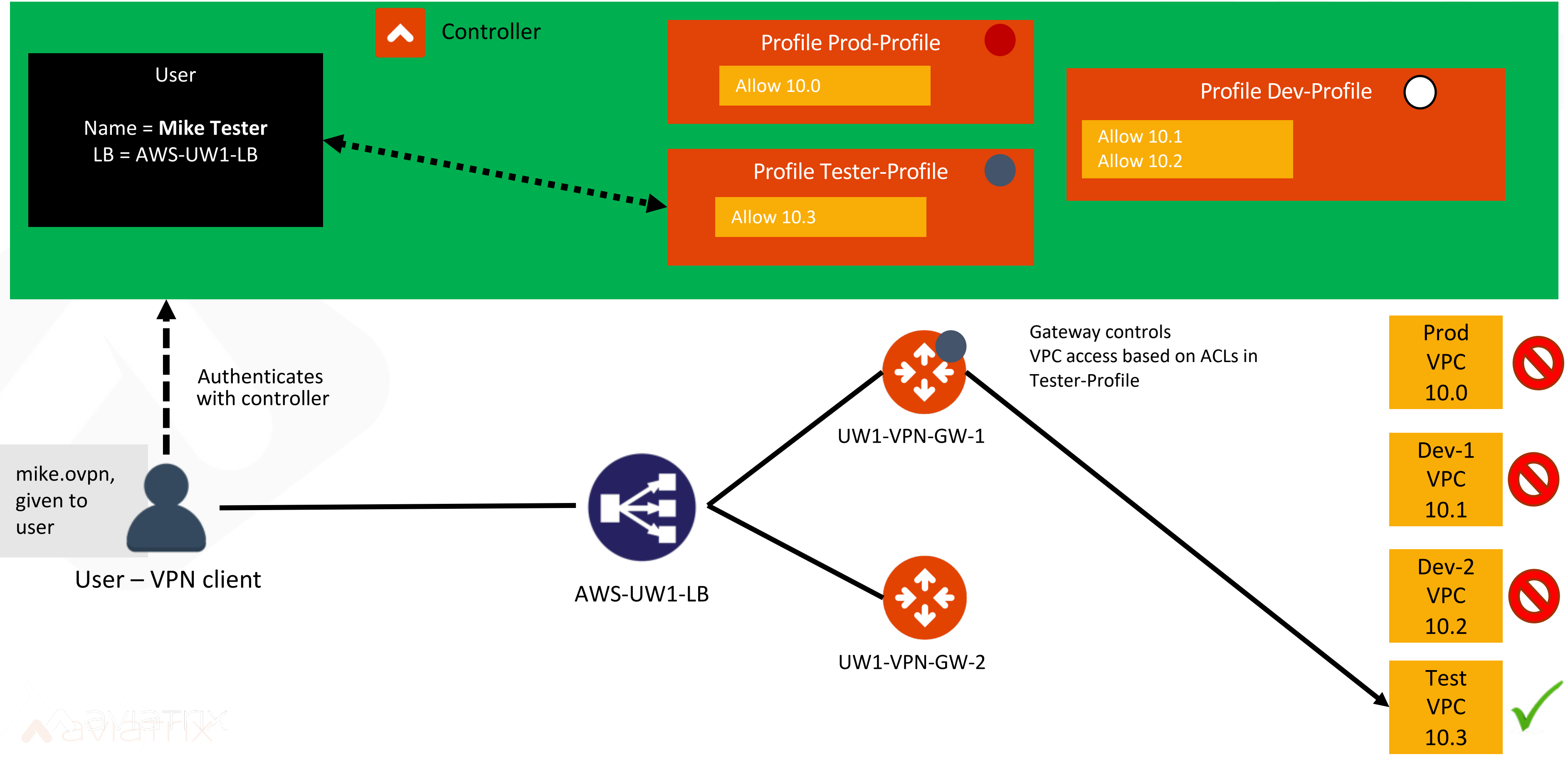


```
umair@umair-mbp ~ % ifconfig utun4
utun4: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1500
inet 192.168.43.14 --> 192.168.43.13 netmask 0xffffffff
umair@umair-mbp ~ % ping 10.120.127.191
PING 10.120.127.191 (10.120.127.191): 56 data bytes
64 bytes from 10.120.127.191: icmp_seq=0 ttl=250 time=73.976 ms
64 bytes from 10.120.127.191: icmp_seq=1 ttl=250 time=70.885 ms
64 bytes from 10.120.127.191: icmp_seq=2 ttl=250 time=70.846 ms
64 bytes from 10.120.127.191: icmp_seq=3 ttl=250 time=60.916 ms
64 bytes from 10.120.127.191: icmp_seq=4 ttl=250 time=67.720 ms
64 bytes from 10.120.127.191: icmp_seq=5 ttl=250 time=61.405 ms
64 bytes from 10.120.127.191: icmp_seq=6 ttl=250 time=61.982 ms
Request timeout for icmp_seq 7
Request timeout for icmp_seq 8
Request timeout for icmp_seq 9
Request timeout for icmp_seq 10
Request timeout for icmp_seq 11
Request timeout for icmp_seq 12
Request timeout for icmp_seq 13
Request timeout for icmp_seq 14
Request timeout for icmp_seq 15
Request timeout for icmp_seq 16
Request timeout for icmp_seq 17
Request timeout for icmp_seq 18
Request timeout for icmp_seq 19
64 bytes from 10.120.127.191: icmp_seq=20 ttl=250 time=72.759 ms
64 bytes from 10.120.127.191: icmp_seq=21 ttl=250 time=63.880 ms
64 bytes from 10.120.127.191: icmp_seq=22 ttl=250 time=67.266 ms
64 bytes from 10.120.127.191: icmp_seq=23 ttl=250 time=66.668 ms
64 bytes from 10.120.127.191: icmp_seq=24 ttl=250 time=68.084 ms
^C
--- 10.120.127.191 ping statistics ---
25 packets transmitted, 12 packets received, 52.0% packet loss
round-trip min/avg/max/stddev = 60.916/67.199/73.976/4.246 ms
umair@umair-mbp ~ % ifconfig utun4
utun4: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1500
inet 192.168.44.6 --> 192.168.44.5 netmask 0xffffffff
umair@umair-mbp ~ %
```

UserVPN Reference Architecture



Users and Profiles



Controller

User

Name = **Mike Tester**
LB = AWS-UW1-LB

Profile Prod-Profile
Allow 10.0

Profile Tester-Profile
Allow 10.3

Profile Dev-Profile
Allow 10.1
Allow 10.2

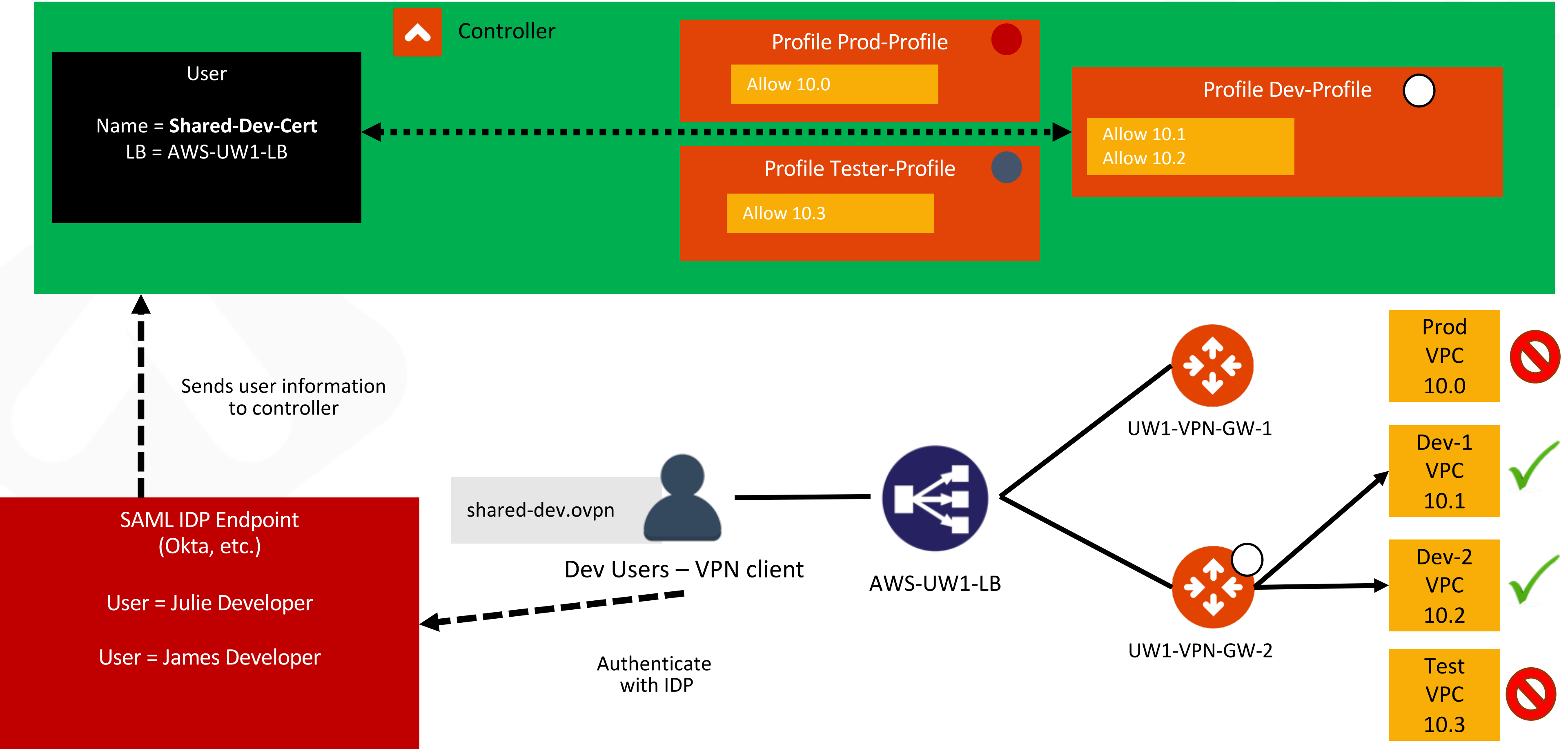
Authenticates with controller

mike.ovpn, given to user

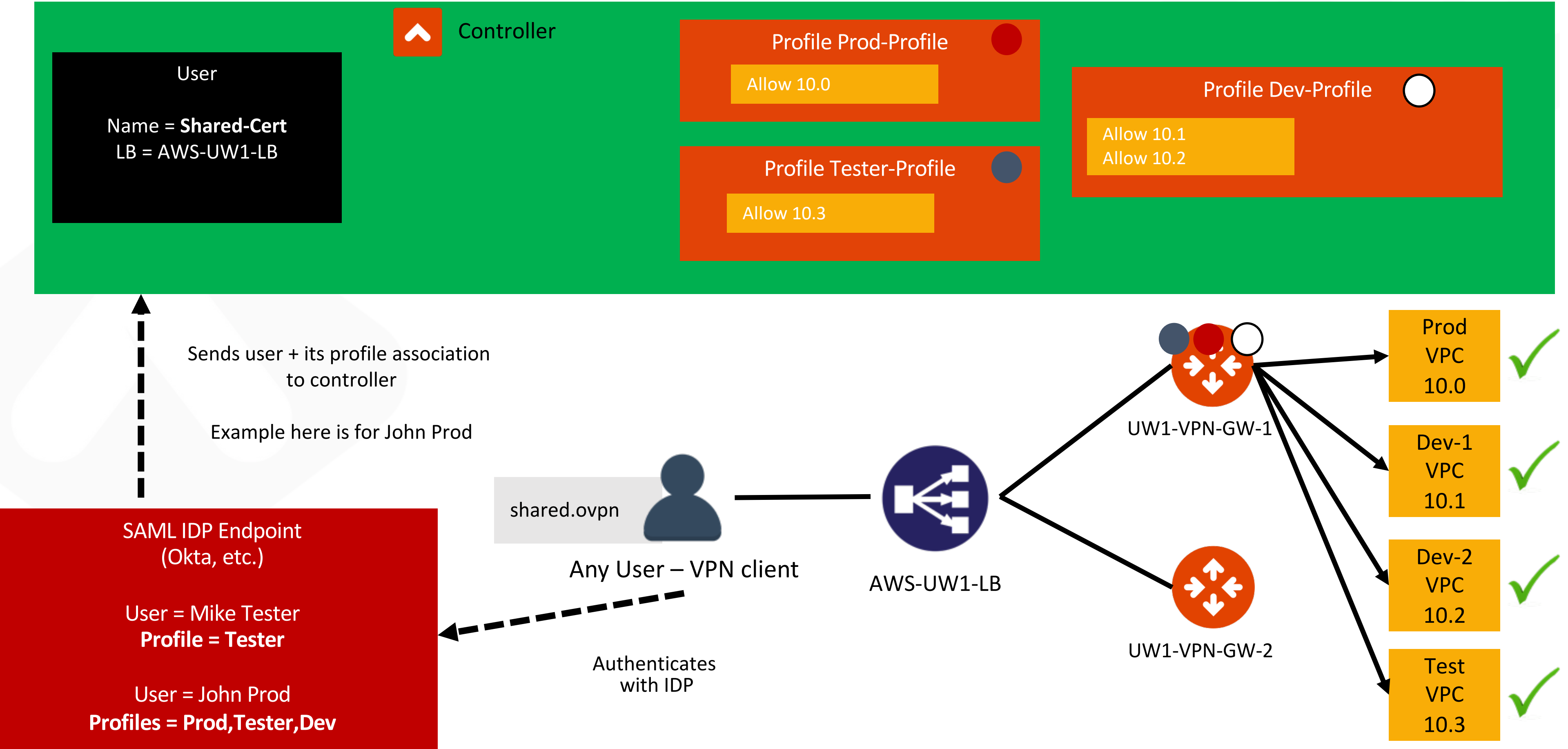
User – VPN client

Gateway controls VPC access based on ACLs in Tester-Profile

Users in IDP, Profile Association in Controller



Users in IDP, Profile Association in IDP Profile as SAML Attribute



Controller

User

Name = **Shared-Cert**
LB = AWS-UW1-LB

Profile Prod-Profile

Allow 10.0

Profile Tester-Profile

Allow 10.3

Profile Dev-Profile

Allow 10.1
Allow 10.2

Sends user + its profile association to controller

Example here is for John Prod

SAML IDP Endpoint
(Okta, etc.)

User = Mike Tester
Profile = Tester

User = John Prod
Profiles = Prod,Tester,Dev

Authenticates with IDP

Architecture Guidelines

Key Elements to Consider

- Performance Numbers - https://docs.aviatrix.com/HowTos/openvpn_design_considerations.html#simultaneous-clients-on-a-given-vpn-gateway
- (VPN gateway throughput) / (throughput requirement per client) = number of clients per gateway
  - Take into account the client-to-VPN gateway latency, and client type (Windows vs. Linux)
  - Example:
    - 100 ms latency → 200 Mbps VPN gateway with Windows clients
    - Requirement of 10 Mbps max burst per client → 20 clients per VPN gateway
- Region
  - LBs and VPN gateways are regional constructs
  - User location determines which LB they will connect to
  - Geo VPN or not?

Key Elements to Consider (cont.)

- Split-tunnel vs. full-tunnel.
  - Currently defined on a per LB/GW basis.
- Max number of connections per LB/VPN gateway is very high, so it’s typically not a limiting factor.
  - For reference, AWS LB can handle 50K connections, Aviatrix VPN gateway can handle 64K connections.
- Max number of targets between a LB is not typically a limiting factor.
  - For reference, AWS LB can handle 1000 targets.

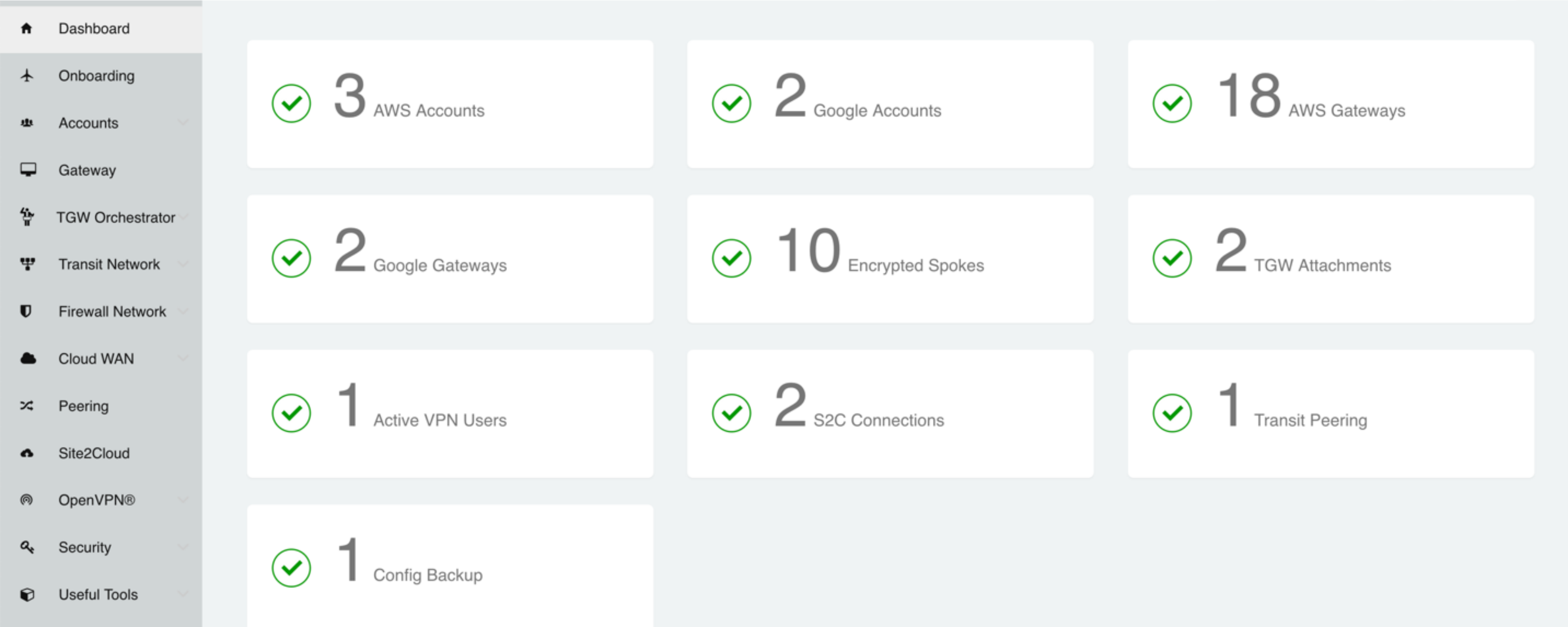
Best Practices

- Separate VPN functionality from other functionalities (Spoke, Transit, Egress FQDN, …)
- Separate VPC/VNet for VPN.
  - VPN gateway ←→ Spoke gateway traffic is routed in the VPC underlay.

Visibility and Troubleshooting

Reference

Visibility and Troubleshooting



✓ 3 AWS Accounts

✓ 2 Google Accounts

✓ 18 AWS Gateways

✓ 2 Google Gateways

✓ 10 Encrypted Spokes

✓ 2 TGW Attachments

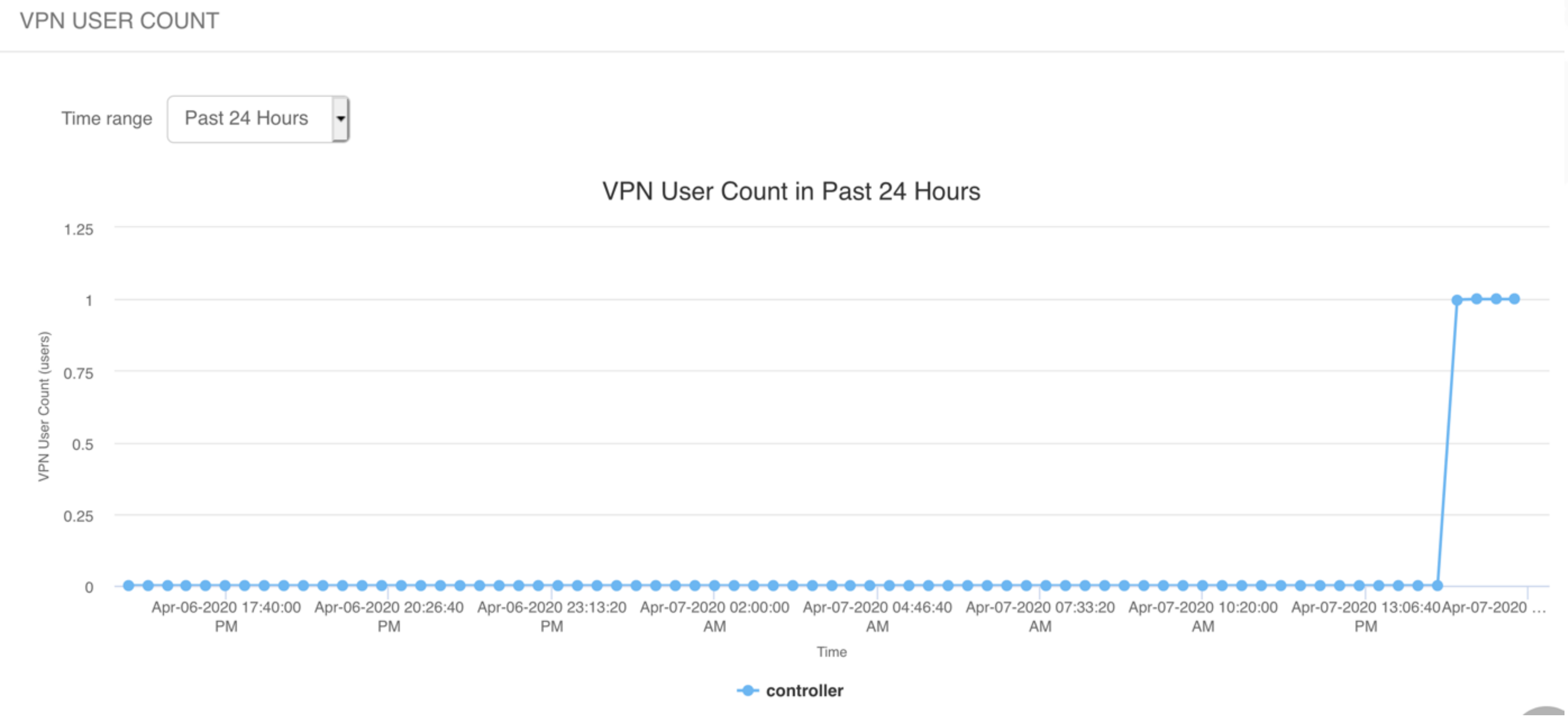
✓ 1 Active VPN Users

✓ 2 S2C Connections

✓ 1 Transit Peering

✓ 1 Config Backup

Visibility and Troubleshooting

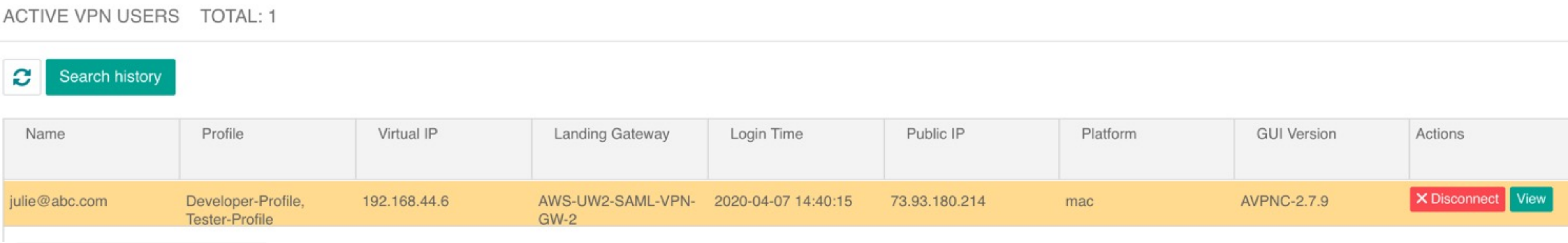


VPN USER COUNT

Time range: Past 24 Hours

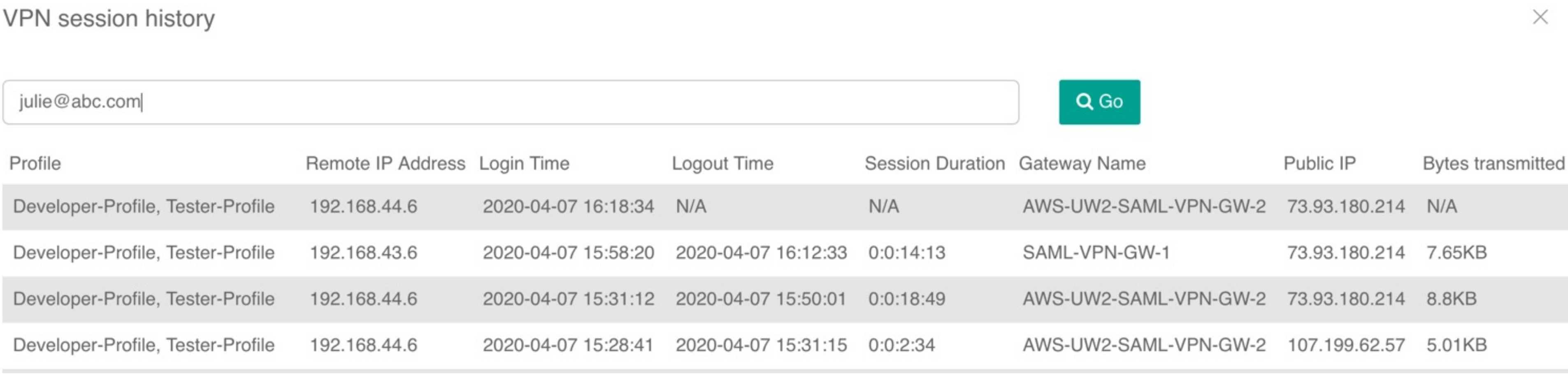
VPN User Count in Past 24 Hours

Visibility and Troubleshooting



ACTIVE VPN USERS TOTAL: 1

Name	Profile	Virtual IP	Landing Gateway	Login Time	Public IP	Platform	GUI Version	Actions
julie@abc.com	Developer-Profile, Tester-Profile	192.168.44.6	AWS-UW2-SAML-VPN-GW-2	2020-04-07 14:40:15	73.93.180.214	mac	AVPNC-2.7.9	✕ Disconnect View

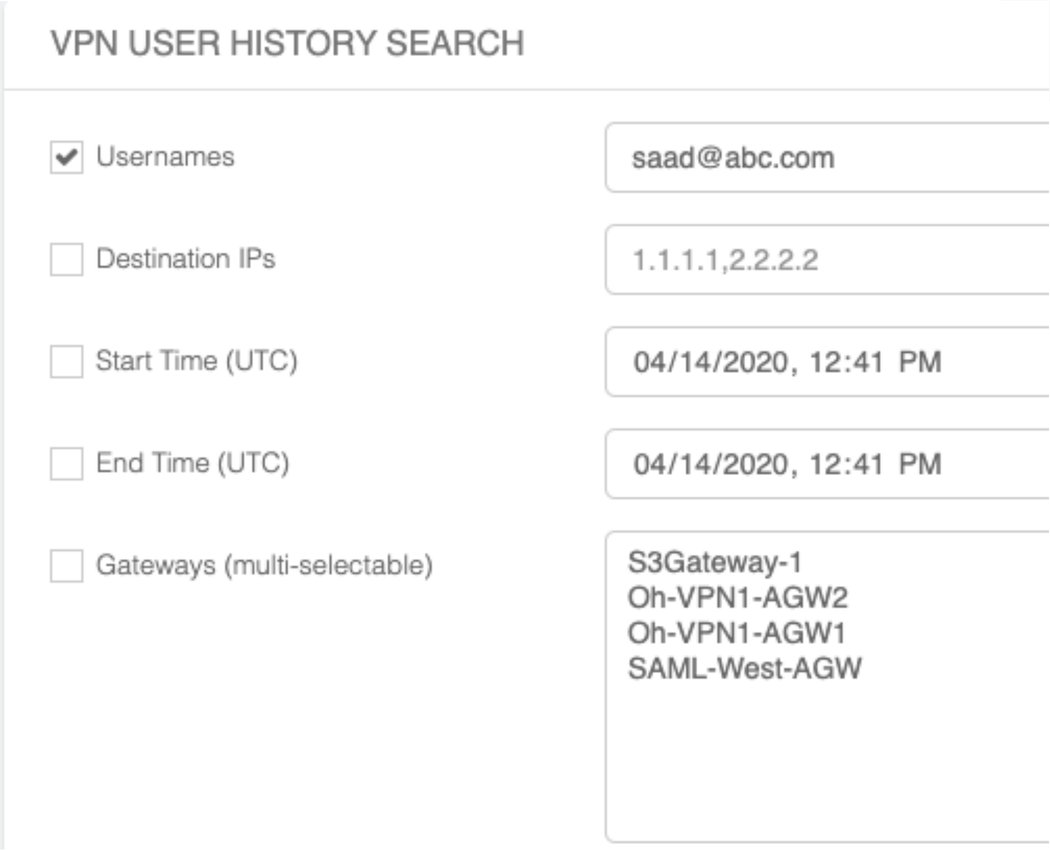


VPN session history

julie@abc.com

Profile	Remote IP Address	Login Time	Logout Time	Session Duration	Gateway Name	Public IP	Bytes transmitted
Developer-Profile, Tester-Profile	192.168.44.6	2020-04-07 16:18:34	N/A	N/A	AWS-UW2-SAML-VPN-GW-2	73.93.180.214	N/A
Developer-Profile, Tester-Profile	192.168.43.6	2020-04-07 15:58:20	2020-04-07 16:12:33	0:0:14:13	SAML-VPN-GW-1	73.93.180.214	7.65KB
Developer-Profile, Tester-Profile	192.168.44.6	2020-04-07 15:31:12	2020-04-07 15:50:01	0:0:18:49	AWS-UW2-SAML-VPN-GW-2	73.93.180.214	8.8KB
Developer-Profile, Tester-Profile	192.168.44.6	2020-04-07 15:28:41	2020-04-07 15:31:15	0:0:2:34	AWS-UW2-SAML-VPN-GW-2	107.199.62.57	5.01KB

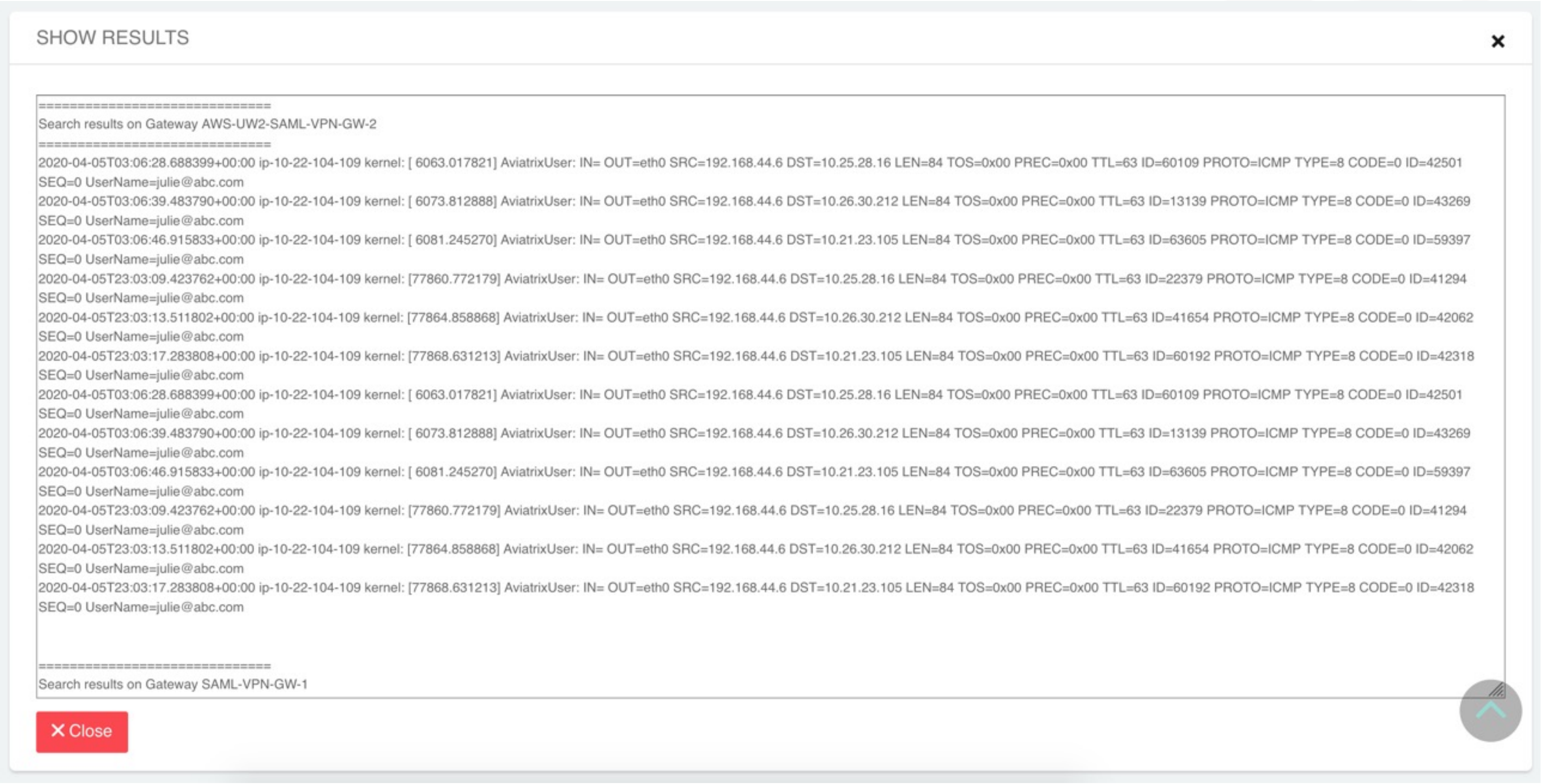
Visibility and Troubleshooting



VPN USER HISTORY SEARCH

☑ Usernames	saad@abc.com
□ Destination IPs	1.1.1.1,2.2.2.2
□ Start Time (UTC)	04/14/2020, 12:41 PM
□ End Time (UTC)	04/14/2020, 12:41 PM
□ Gateways (multi-selectable)	S3Gateway-1 Oh-VPN1-AGW2 Oh-VPN1-AGW1 SAML-West-AGW

Visibility and Troubleshooting



```
================================
Search results on Gateway AWS-UW2-SAML-VPN-GW-2
================================
2020-04-05T03:06:28.688399+00:00 ip-10-22-104-109 kernel: [ 6063.017821] AviatrixUser: IN= OUT=eth0 SRC=192.168.44.6 DST=10.25.28.16 LEN=84 TOS=0x00 PREC=0x00 TTL=63 ID=60109 PROTO=ICMP TYPE=8 CODE=0 ID=42501
SEQ=0 UserName=julie@abc.com
2020-04-05T03:06:39.483790+00:00 ip-10-22-104-109 kernel: [ 6073.812888] AviatrixUser: IN= OUT=eth0 SRC=192.168.44.6 DST=10.26.30.212 LEN=84 TOS=0x00 PREC=0x00 TTL=63 ID=13139 PROTO=ICMP TYPE=8 CODE=0 ID=43269
SEQ=0 UserName=julie@abc.com
2020-04-05T03:06:46.915833+00:00 ip-10-22-104-109 kernel: [ 6081.245270] AviatrixUser: IN= OUT=eth0 SRC=192.168.44.6 DST=10.21.23.105 LEN=84 TOS=0x00 PREC=0x00 TTL=63 ID=63605 PROTO=ICMP TYPE=8 CODE=0 ID=59397
SEQ=0 UserName=julie@abc.com
2020-04-05T23:03:09.423762+00:00 ip-10-22-104-109 kernel: [77860.772179] AviatrixUser: IN= OUT=eth0 SRC=192.168.44.6 DST=10.25.28.16 LEN=84 TOS=0x00 PREC=0x00 TTL=63 ID=22379 PROTO=ICMP TYPE=8 CODE=0 ID=41294
SEQ=0 UserName=julie@abc.com
2020-04-05T23:03:13.511802+00:00 ip-10-22-104-109 kernel: [77864.858868] AviatrixUser: IN= OUT=eth0 SRC=192.168.44.6 DST=10.26.30.212 LEN=84 TOS=0x00 PREC=0x00 TTL=63 ID=41654 PROTO=ICMP TYPE=8 CODE=0 ID=42062
SEQ=0 UserName=julie@abc.com
2020-04-05T23:03:17.283808+00:00 ip-10-22-104-109 kernel: [77868.631213] AviatrixUser: IN= OUT=eth0 SRC=192.168.44.6 DST=10.21.23.105 LEN=84 TOS=0x00 PREC=0x00 TTL=63 ID=60192 PROTO=ICMP TYPE=8 CODE=0 ID=42318
SEQ=0 UserName=julie@abc.com
2020-04-05T03:06:28.688399+00:00 ip-10-22-104-109 kernel: [ 6063.017821] AviatrixUser: IN= OUT=eth0 SRC=192.168.44.6 DST=10.25.28.16 LEN=84 TOS=0x00 PREC=0x00 TTL=63 ID=60109 PROTO=ICMP TYPE=8 CODE=0 ID=42501
SEQ=0 UserName=julie@abc.com
2020-04-05T03:06:39.483790+00:00 ip-10-22-104-109 kernel: [ 6073.812888] AviatrixUser: IN= OUT=eth0 SRC=192.168.44.6 DST=10.26.30.212 LEN=84 TOS=0x00 PREC=0x00 TTL=63 ID=13139 PROTO=ICMP TYPE=8 CODE=0 ID=43269
SEQ=0 UserName=julie@abc.com
2020-04-05T03:06:46.915833+00:00 ip-10-22-104-109 kernel: [ 6081.245270] AviatrixUser: IN= OUT=eth0 SRC=192.168.44.6 DST=10.21.23.105 LEN=84 TOS=0x00 PREC=0x00 TTL=63 ID=63605 PROTO=ICMP TYPE=8 CODE=0 ID=59397
SEQ=0 UserName=julie@abc.com
2020-04-05T23:03:09.423762+00:00 ip-10-22-104-109 kernel: [77860.772179] AviatrixUser: IN= OUT=eth0 SRC=192.168.44.6 DST=10.25.28.16 LEN=84 TOS=0x00 PREC=0x00 TTL=63 ID=22379 PROTO=ICMP TYPE=8 CODE=0 ID=41294
SEQ=0 UserName=julie@abc.com
2020-04-05T23:03:13.511802+00:00 ip-10-22-104-109 kernel: [77864.858868] AviatrixUser: IN= OUT=eth0 SRC=192.168.44.6 DST=10.26.30.212 LEN=84 TOS=0x00 PREC=0x00 TTL=63 ID=41654 PROTO=ICMP TYPE=8 CODE=0 ID=42062
SEQ=0 UserName=julie@abc.com
2020-04-05T23:03:17.283808+00:00 ip-10-22-104-109 kernel: [77868.631213] AviatrixUser: IN= OUT=eth0 SRC=192.168.44.6 DST=10.21.23.105 LEN=84 TOS=0x00 PREC=0x00 TTL=63 ID=60192 PROTO=ICMP TYPE=8 CODE=0 ID=42318
SEQ=0 UserName=julie@abc.com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Search results on Gateway SAML-VPN-GW-1
```
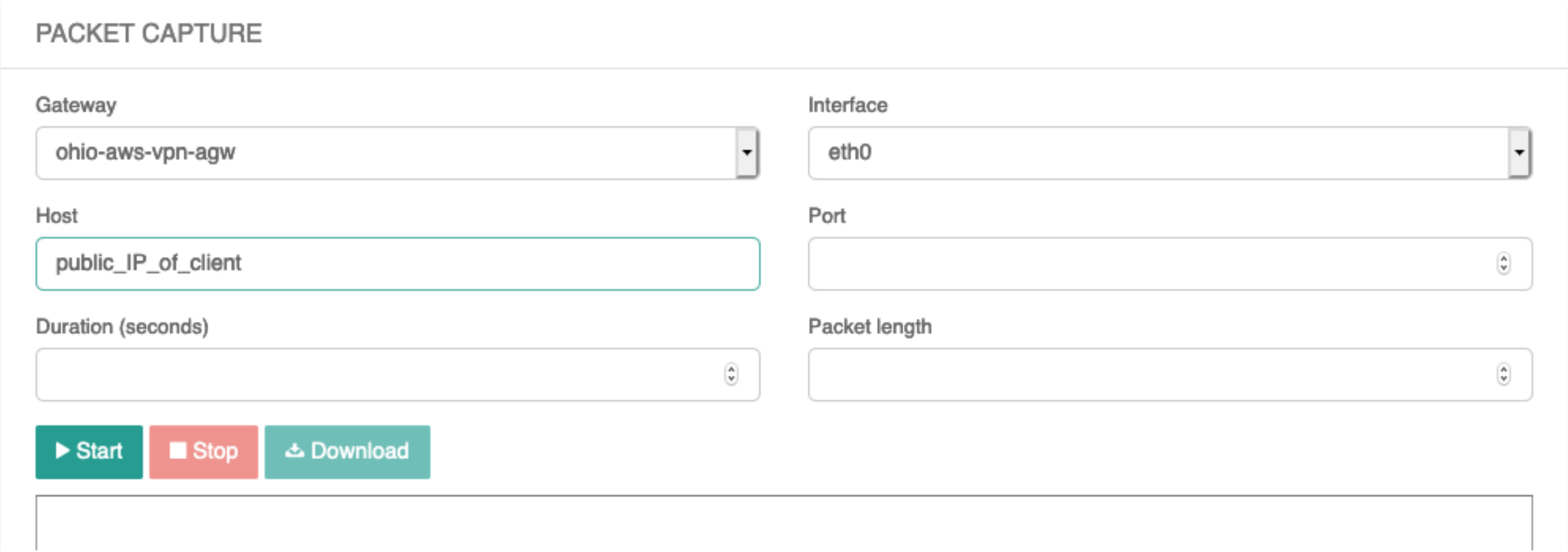

Take Packet Capture for Troubleshooting



PACKET CAPTURE

Gateway: ohio-aws-vpn-agw

Interface: eth0

Host: public_IP_of_client

Port:

Duration (seconds):

Packet length:

aviatrix

Thank You