Cyxtera™

# Understanding some key communication concepts

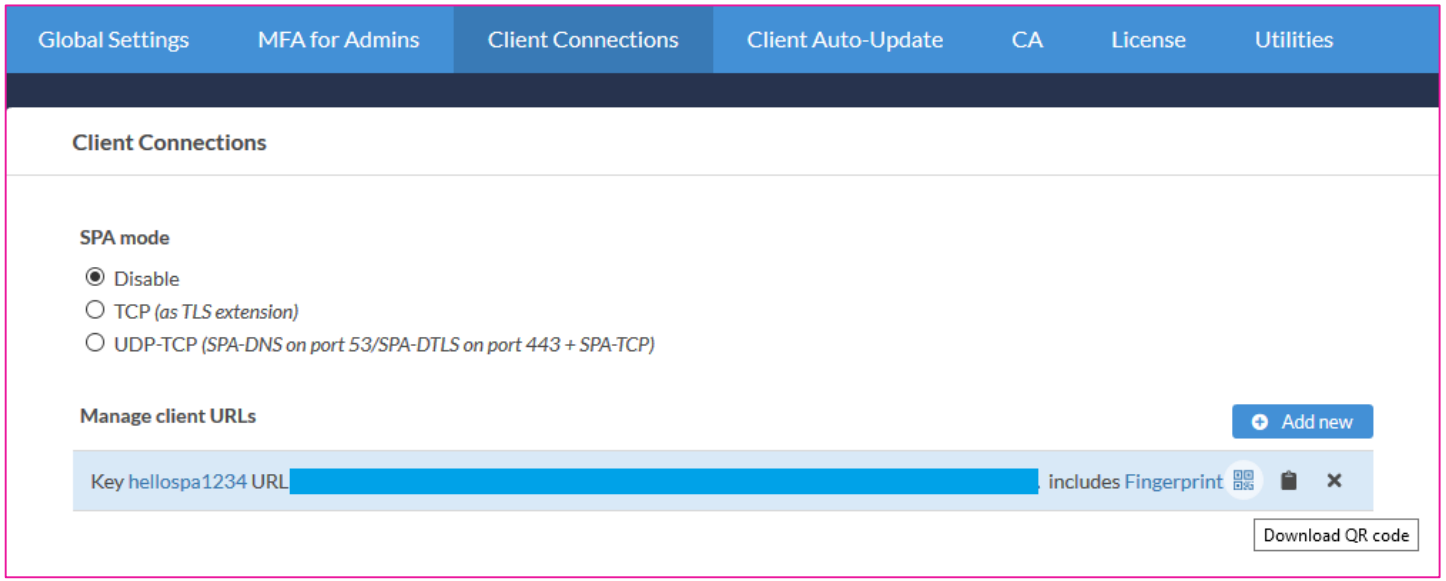
4 important ones.....
Un-hiding network resources
IP addresses, hostnaming & DNS
Control information flow
Data packet flow

AppGateSDP
Access, evolved.


Cyxtera™
Un-hiding network resources
AppGateSDP
Access, evolved.

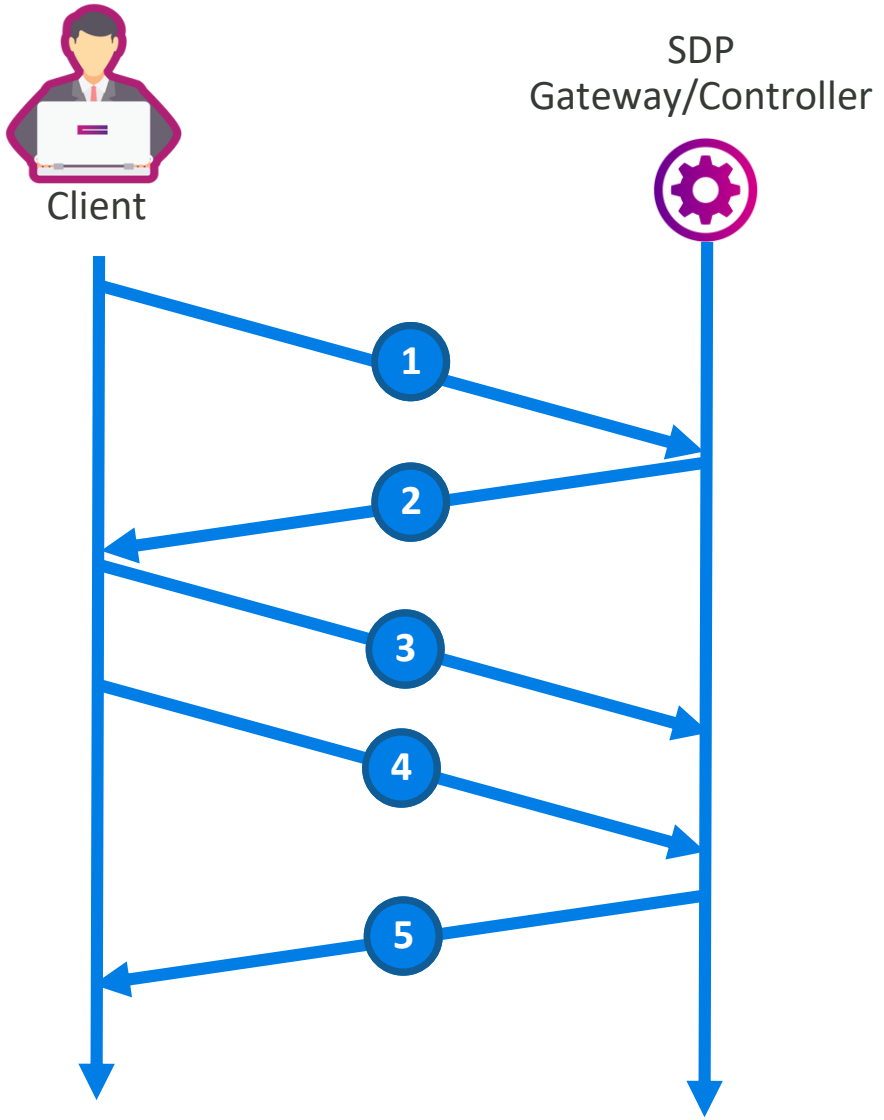
# Single Packet Authorization (SPA) – Client Connections

- SPA - allows ONLY the Client to open a TCP connection with the AppGate system because it has been pre-SEEDED with a specific key
- SPA is enabled by default
- New systems use a General 'key'
  - it should be deleted and replaced with a new SPA key
- Multiple keys may be used
- CA fingerprint is included in the key
- Option of QR code for seeding the Clients



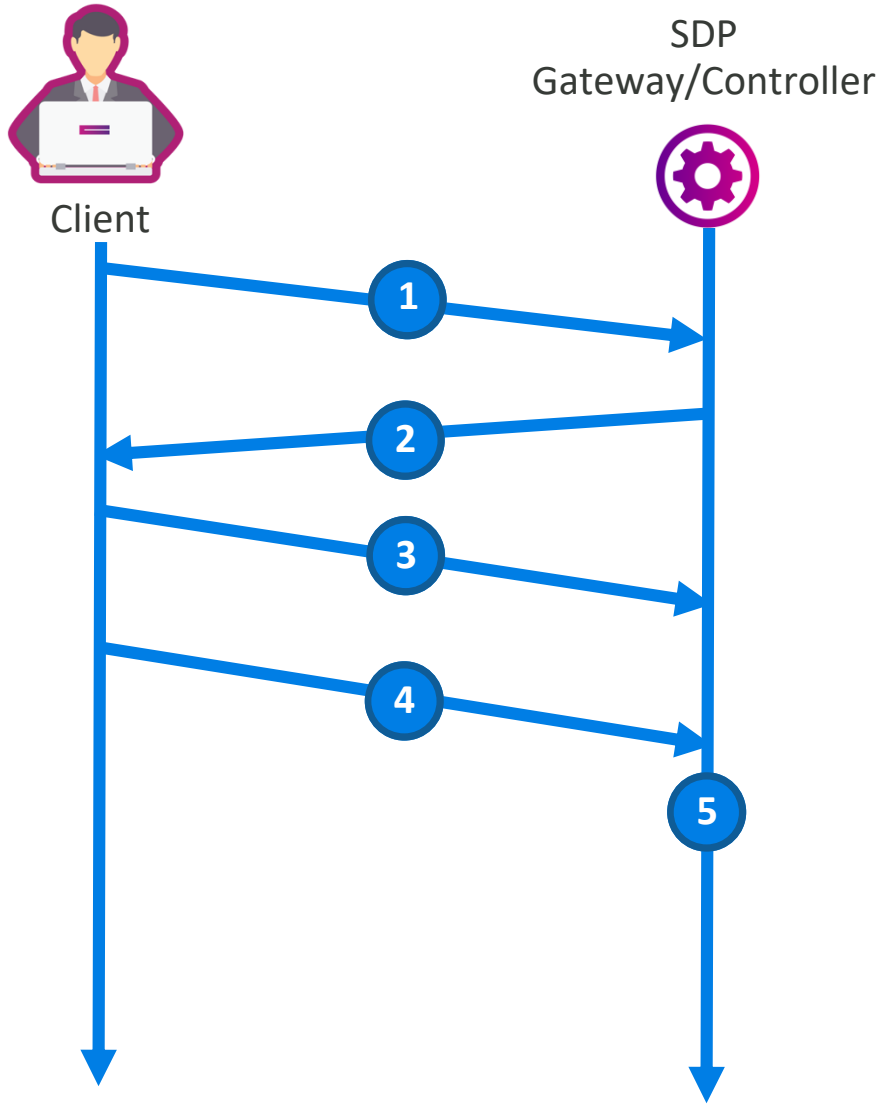
# Normal SSL/TLS traffic, no SPA

1. Client sends TCP SYN to Gateway/Controller on 443
2. SDP answers with TCP SYN ACK to acknowledge the first packet
3. Client sends TCP ACK to acknowledge previous packet
   - There is now an established TCP session on port 443, and SSL/TLS layer is **NOW** accessible
4. If Client ask for SSL/TLS (TLS/SSL client Hello packet)
5. SDP responds with server Hello packet

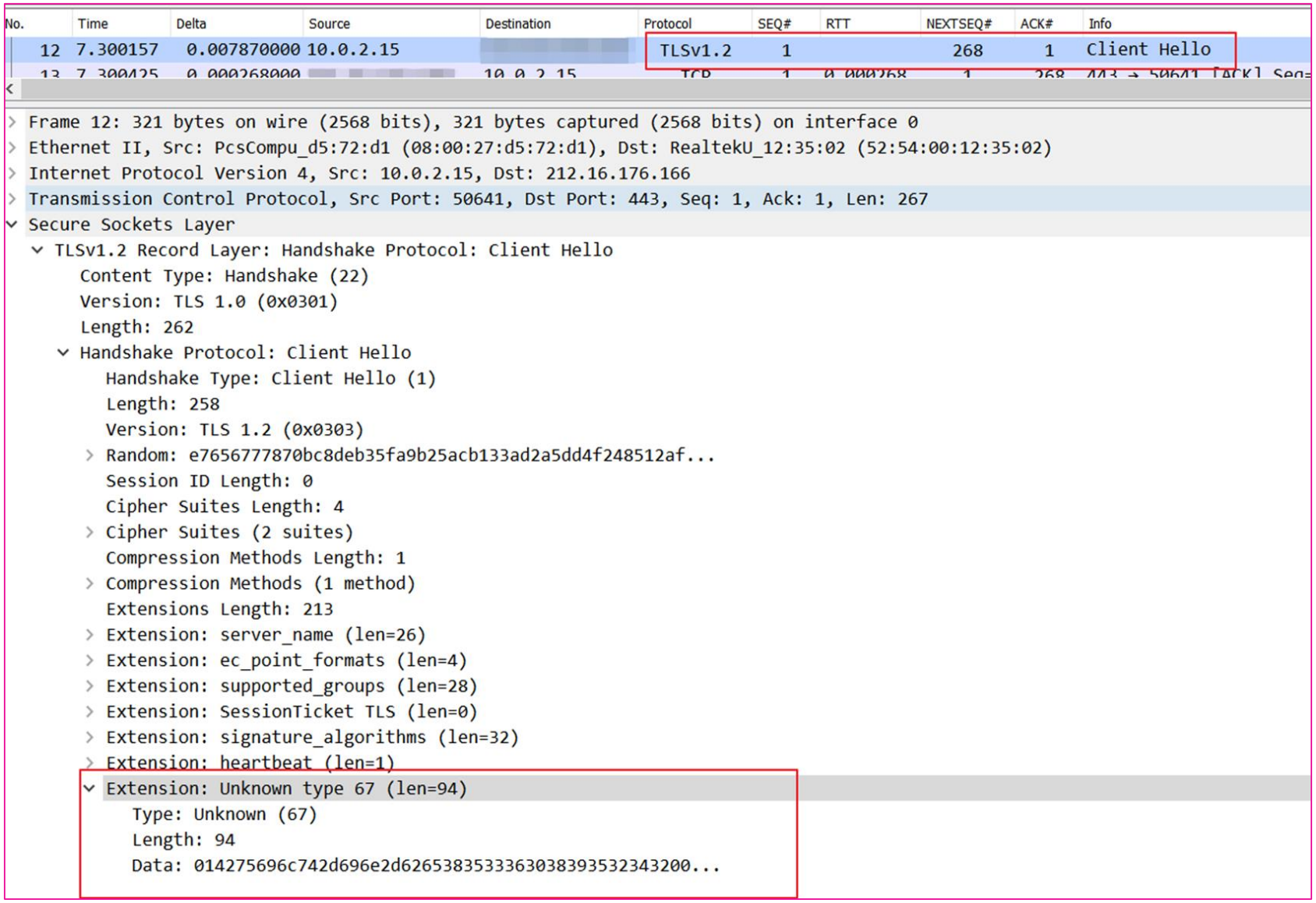


# SSL/TLS traffic, with TCP SPA

1. Client sends TCP SYN to Gateway/Controller on 443
2. SDP answers with TCP SYN ACK to acknowledge the first packet
3. Client sends TCP ACK to acknowledge previous packet
   - There is now an established TCP session on port 443, but SSL/TLS layer is NOT accessible
4. Client will send a TCP SPA packet, hidden as TLS Hello packet
5. If correct SPA packet, SDP is now ready to accept TLS traffic
6. TLS vulnerabilities are not exploitable before successful SPA packet !



# SSL/TLS traffic, with TCP SPA



| No. | Time | Delta | Source | Destination | Protocol | SEQ# | RTT | NEXTSEQ# | ACK# | Info |
|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 7.300157 | 0.007870000 | 10.0.2.15 | [redacted] | TLSv1.2 | 1 | | 268 | 1 | Client Hello |
| 13 | 7.300425 | 0.000268000 | [redacted] | 10.0.2.15 | TCP | 1 | 0.000268 | 1 | 268 | 443 → 50641 [ACK] Seq= |

```
> Frame 12: 321 bytes on wire (2568 bits), 321 bytes captured (2568 bits) on interface 0
> Ethernet II, Src: PcsCompu_d5:72:d1 (08:00:27:d5:72:d1), Dst: RealtekU_12:35:02 (52:54:00:12:35:02)
> Internet Protocol Version 4, Src: 10.0.2.15, Dst: 212.16.176.166
> Transmission Control Protocol, Src Port: 50641, Dst Port: 443, Seq: 1, Ack: 1, Len: 267
v Secure Sockets Layer
  v TLSv1.2 Record Layer: Handshake Protocol: Client Hello
      Content Type: Handshake (22)
      Version: TLS 1.0 (0x0301)
      Length: 262
    v Handshake Protocol: Client Hello
        Handshake Type: Client Hello (1)
        Length: 258
        Version: TLS 1.2 (0x0303)
      > Random: e7656777870bc8deb35fa9b25acb133ad2a5dd4f248512af...
        Session ID Length: 0
        Cipher Suites Length: 4
      > Cipher Suites (2 suites)
        Compression Methods Length: 1
      > Compression Methods (1 method)
        Extensions Length: 213
      > Extension: server_name (len=26)
      > Extension: ec_point_formats (len=4)
      > Extension: supported_groups (len=28)
      > Extension: SessionTicket TLS (len=0)
      > Extension: signature_algorithms (len=32)
      > Extension: heartbeat (len=1)
      v Extension: Unknown type 67 (len=94)
          Type: Unknown (67)
          Length: 94
          Data: 014275696c742d696e2d626538353336303839353234320 0...
```

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# SPA Demo

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# IP addresses, Hostname & DNS

Care needs to be taken when setting up a distributed system to make sure all the elements can communicate!

AppGateSDP

*Access, evolved.*

# Setting hostnames in AppGate

Because AppGate is a distributed system, there are several options when configuring 'hostnames':

System/Appliance/General>

This will identify the system in the UI, and be used by the appliance internally.

Appliance /Networking>Interfaces

Etho would normally be configured with the same hostname as above

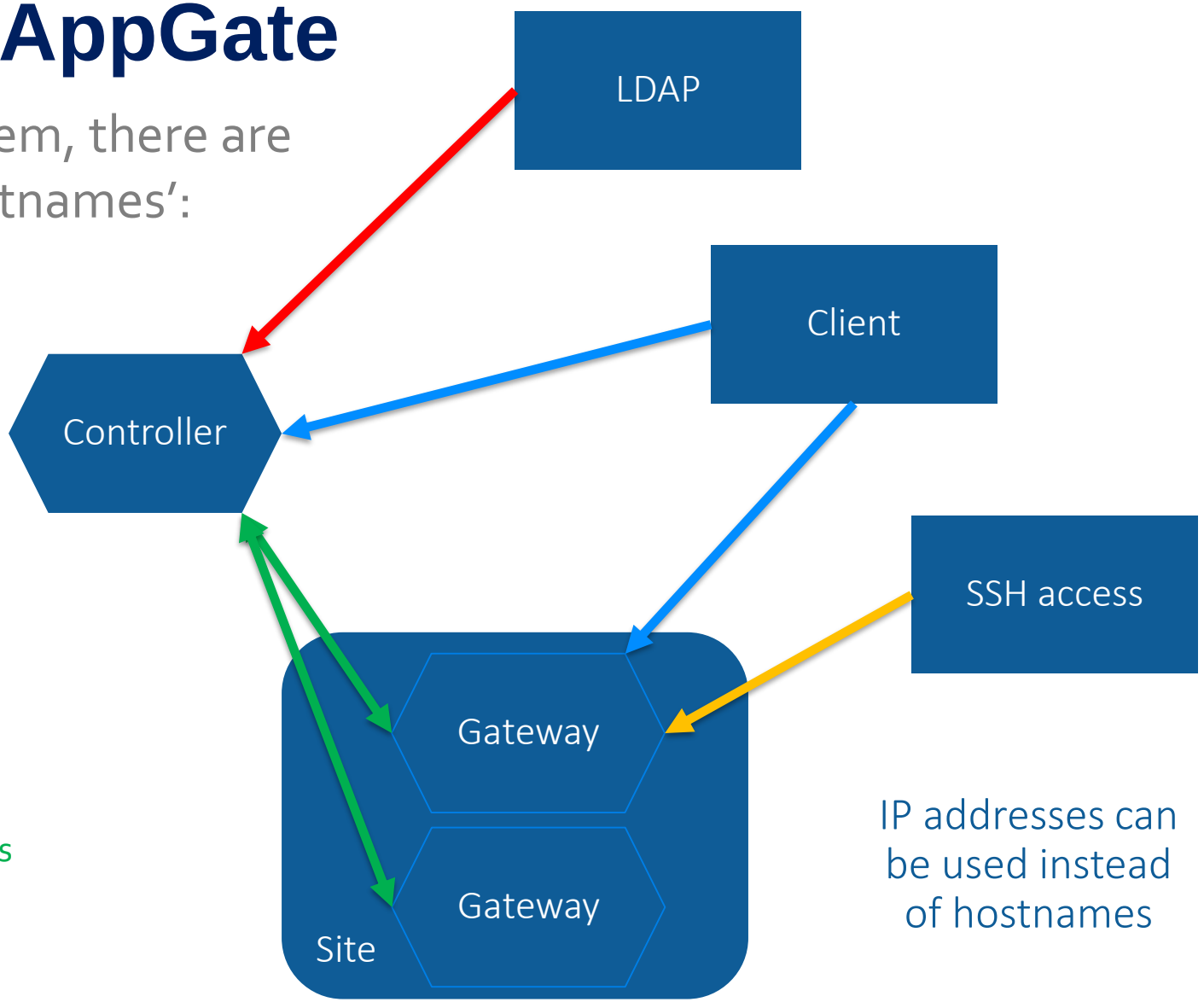
Eth1,2,3,etc would be other (internal?) interface names

Appliance/>Client Interface

You can change the hostname the client will try to resolve/connect to.

Appliance/>Peer Interface

You can change the hostname the other appliances in the collective will try to resolve/connect to.




IP addresses can be used instead of hostnames

# Setting up DNS – done in 3 places

Identity providers

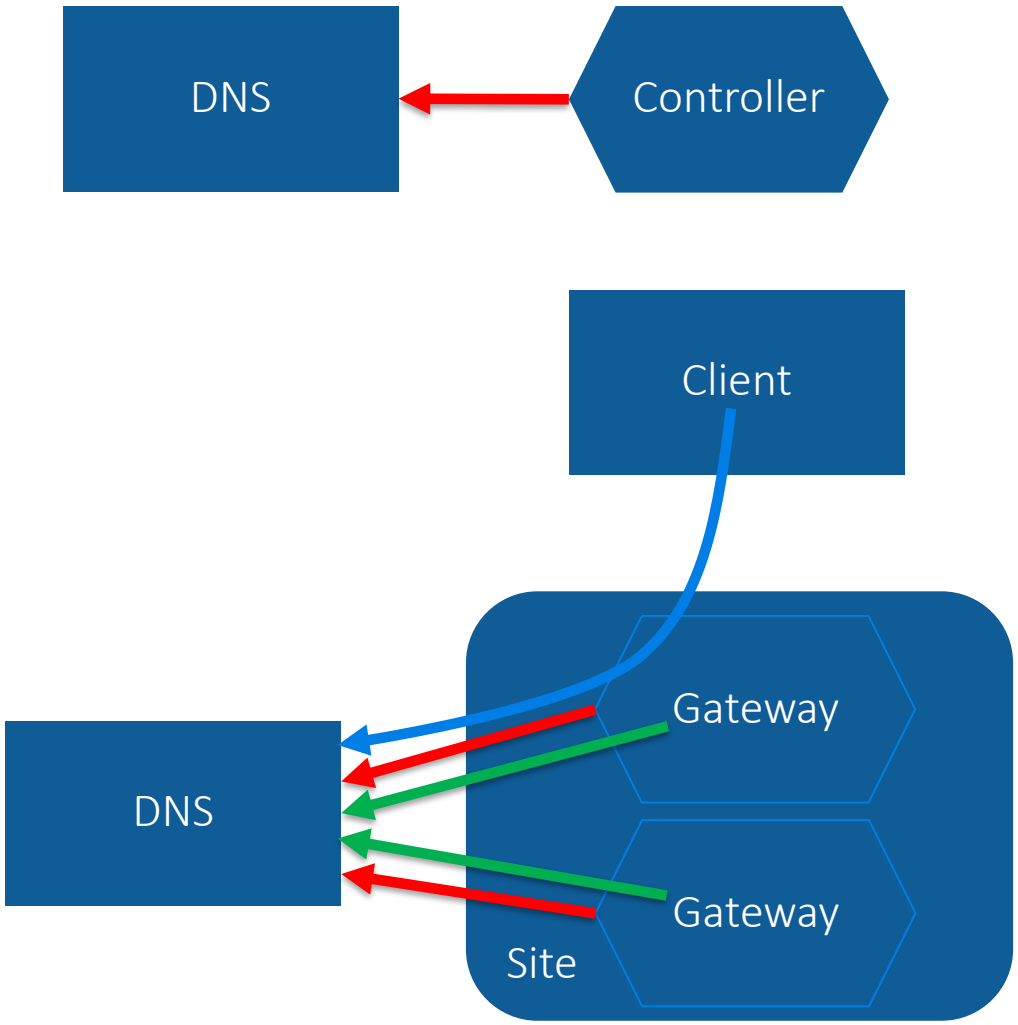
- Used by the Client to resolve hostnames in entitlements. These will typically be an internal DNS server through the tunnel - so add DNS entitlement!
- Configured by IdP so that it is easy to configure for multiple tenants

Sites (one of the Name Resolver options)

- DNS settings used by the Gateway's firewall engine to resolve the hostnames in the Entitlements
- Configured by Site so that DNS services are where the protected hosts actually reside

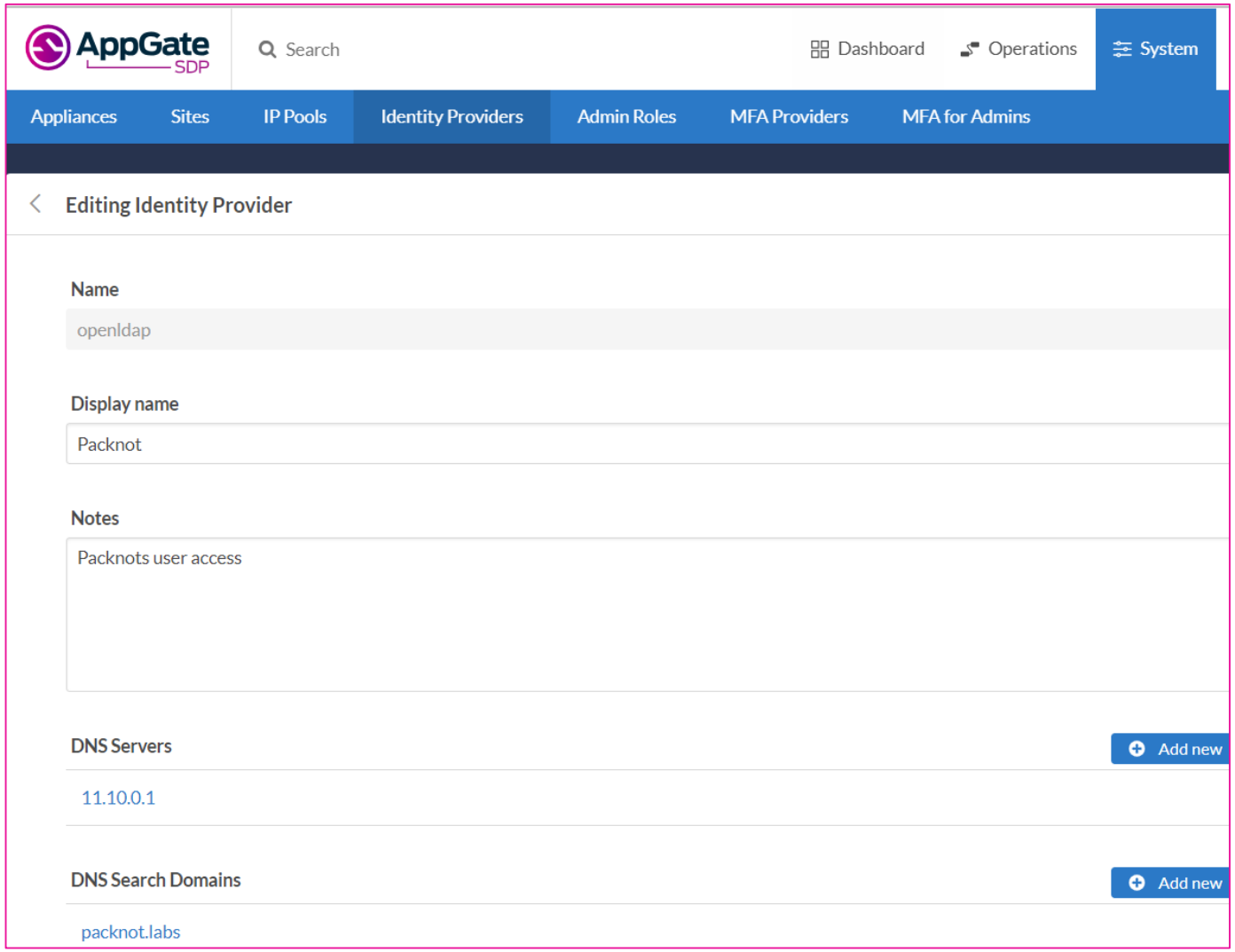
Appliances>Basic Settings>Networking

- DNS settings used by the appliance operating system to resolve hostnames
- Configured by appliance so that local services (RADIUS etc) can be resolved



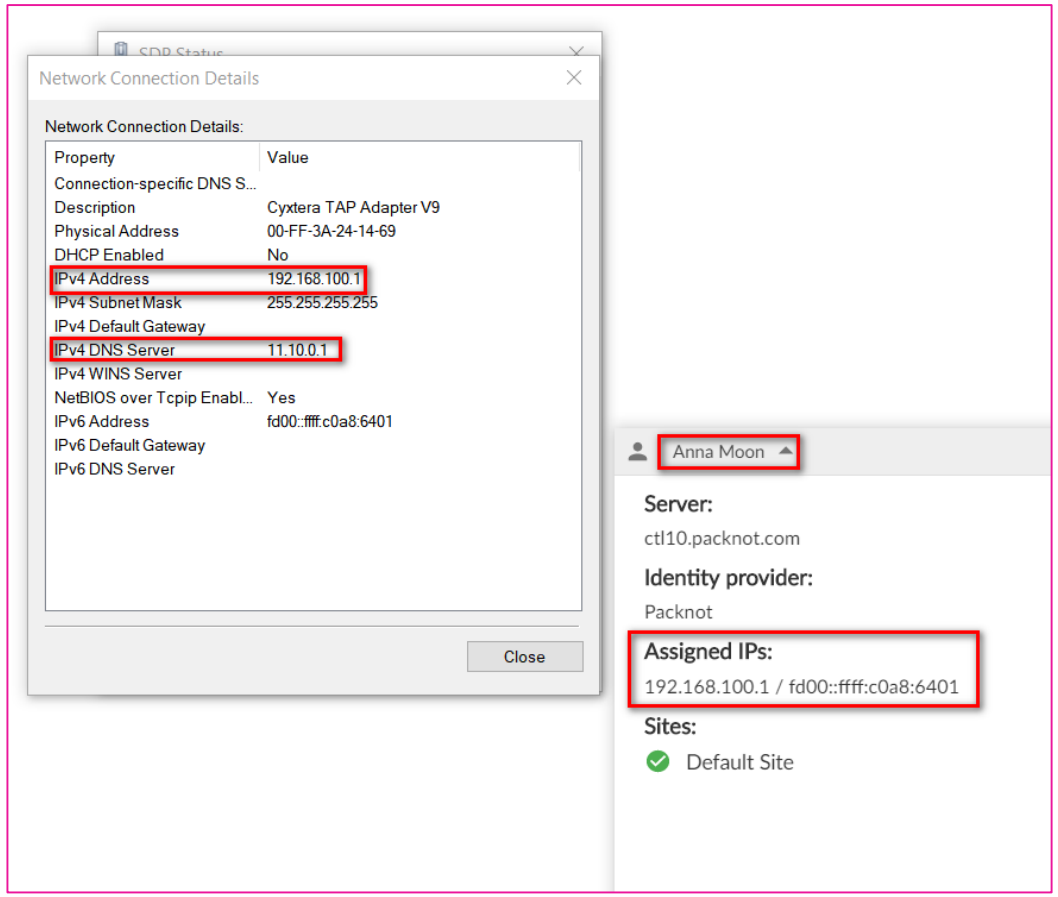
# Setting up DNS – cont'd

1. IdP



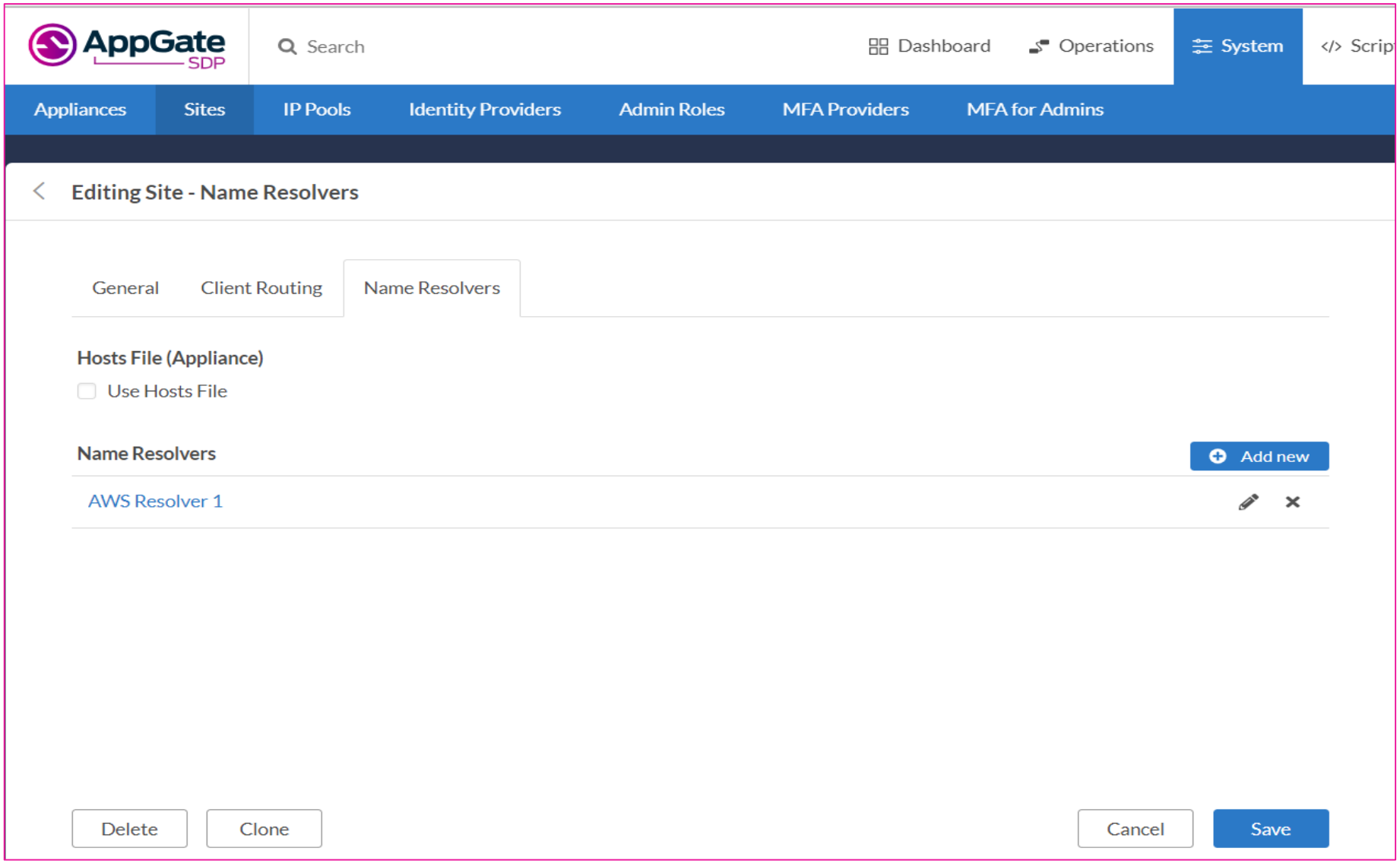
# Setting up DNS – cont'd

1. IdP



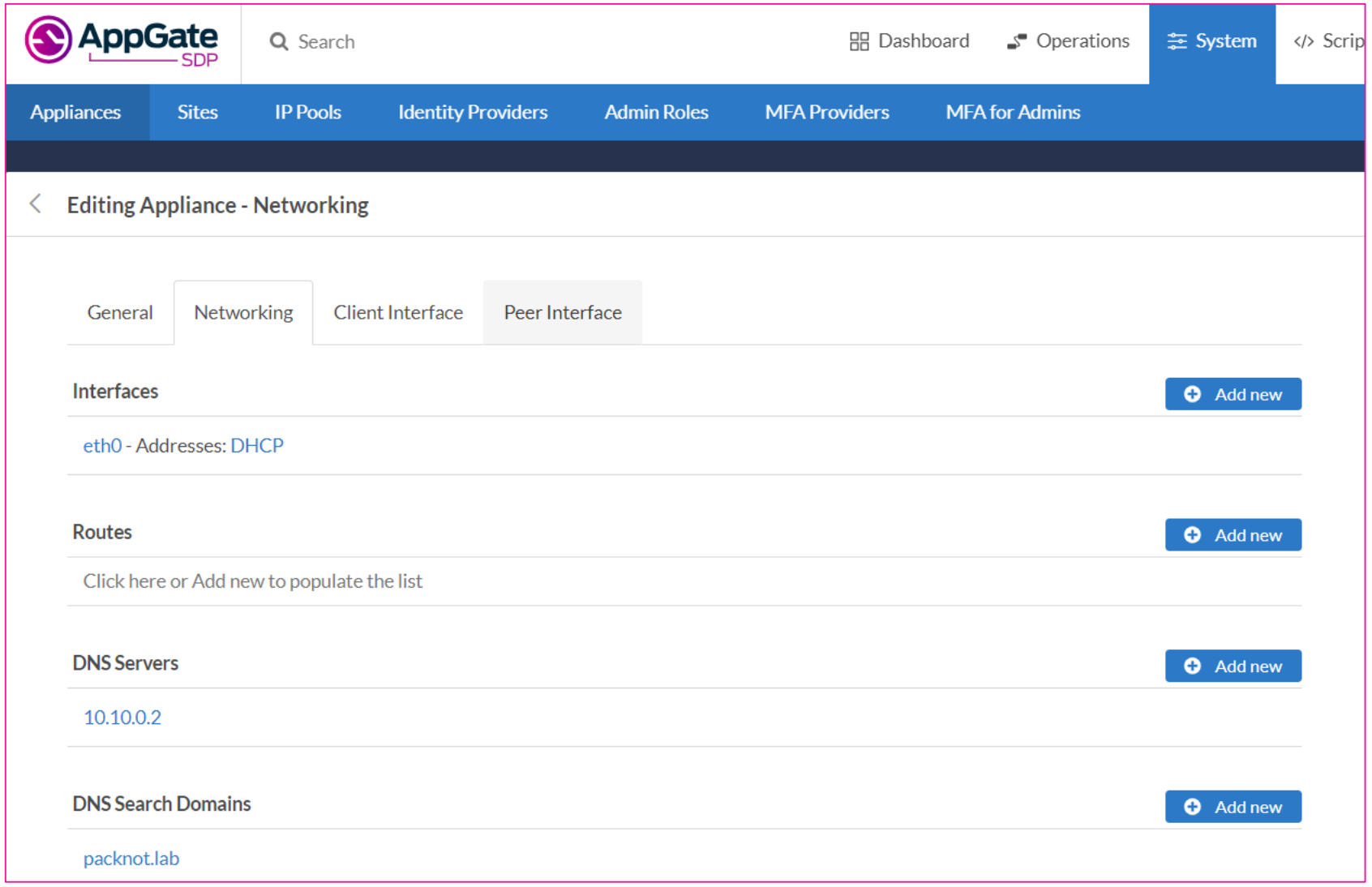
# Setting up DNS – cont'd

## 2. Site



# Setting up DNS – cont'd

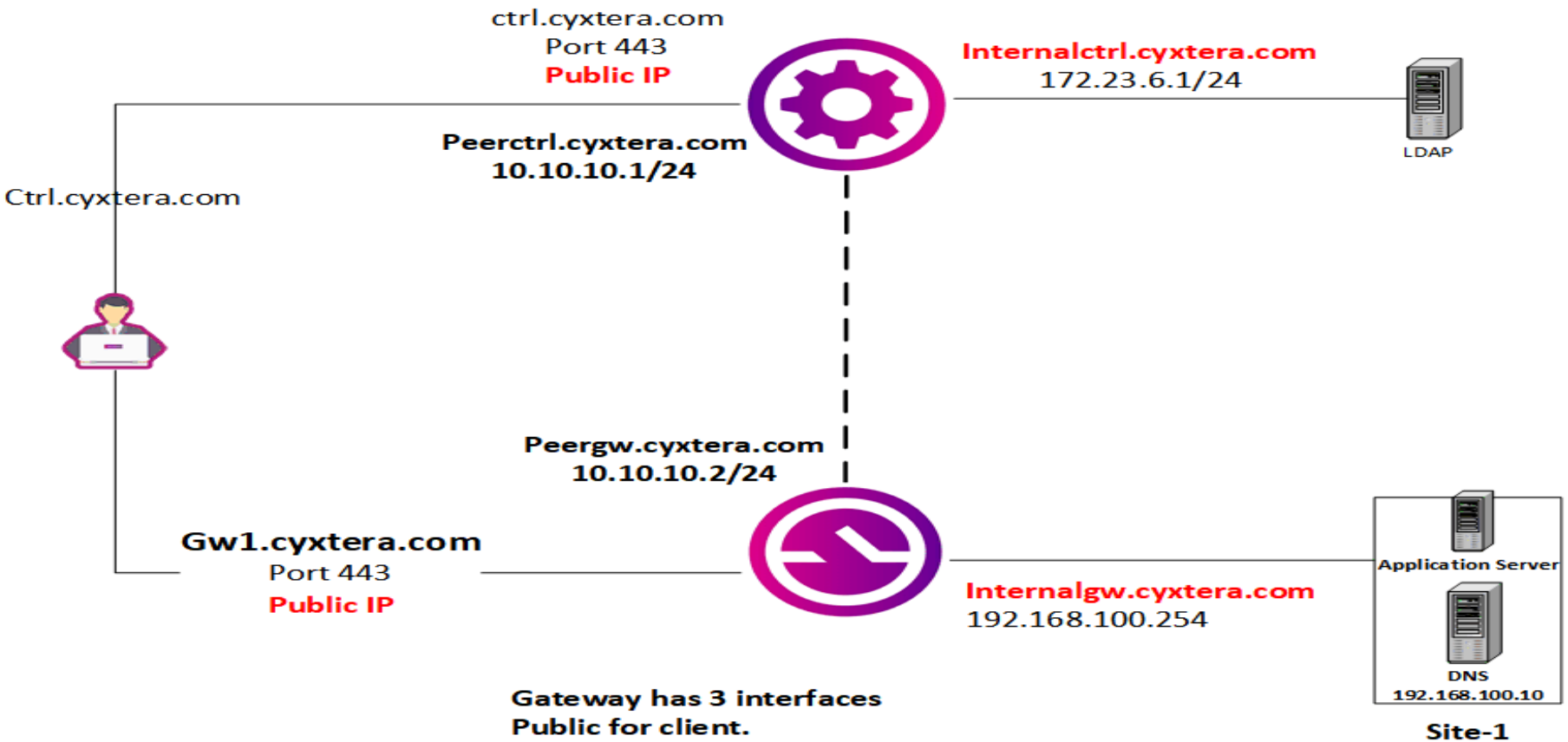
## 3- Appliance



Controller has 3 interfaces

1- **ctrl.cyxtera.com** public for client connection
2- **internalctrl.cyxtera.com** for internal servers such as LDAP
3- **peerctrl.cyxtera.com** for AppGate collective appliances such as GW , another Log server and another controller

**IP pool for client is 192.168.100.0/24**
**DNS 192.168.100.10**




**Gateway has 3 interfaces**
**Public for client.**
**gw1.cyxtera.com allow port 443**
**Internalgw.cyxtera.com**
**Peer interface**
**Peergw.cyxtera.com port 444**

# Control flow in AppGate

Almost all interactions between elements in the AppGate system are tokenized

AppGateSDP

Access, evolved.

# Security & the token based model

The Controller is the **Certificate Authority** and uses a self-signed CA certificate.
When any appliance is configured, all the hostnames and IP addresses are added to the appliance certificate.

- These certificates are used to establish trusted (TLS) communications between appliances (peer-interface) and between client and appliance (client-interface).

The CA certificate is also used for creating signed tokens.

- The Client is responsible for acquiring the necessary Claims and Entitlement tokens from the Controller and for pushing them to the Gateway.
- The Gateway uses the tokens for each user to configure firewall rules and control access on a per-user basis.

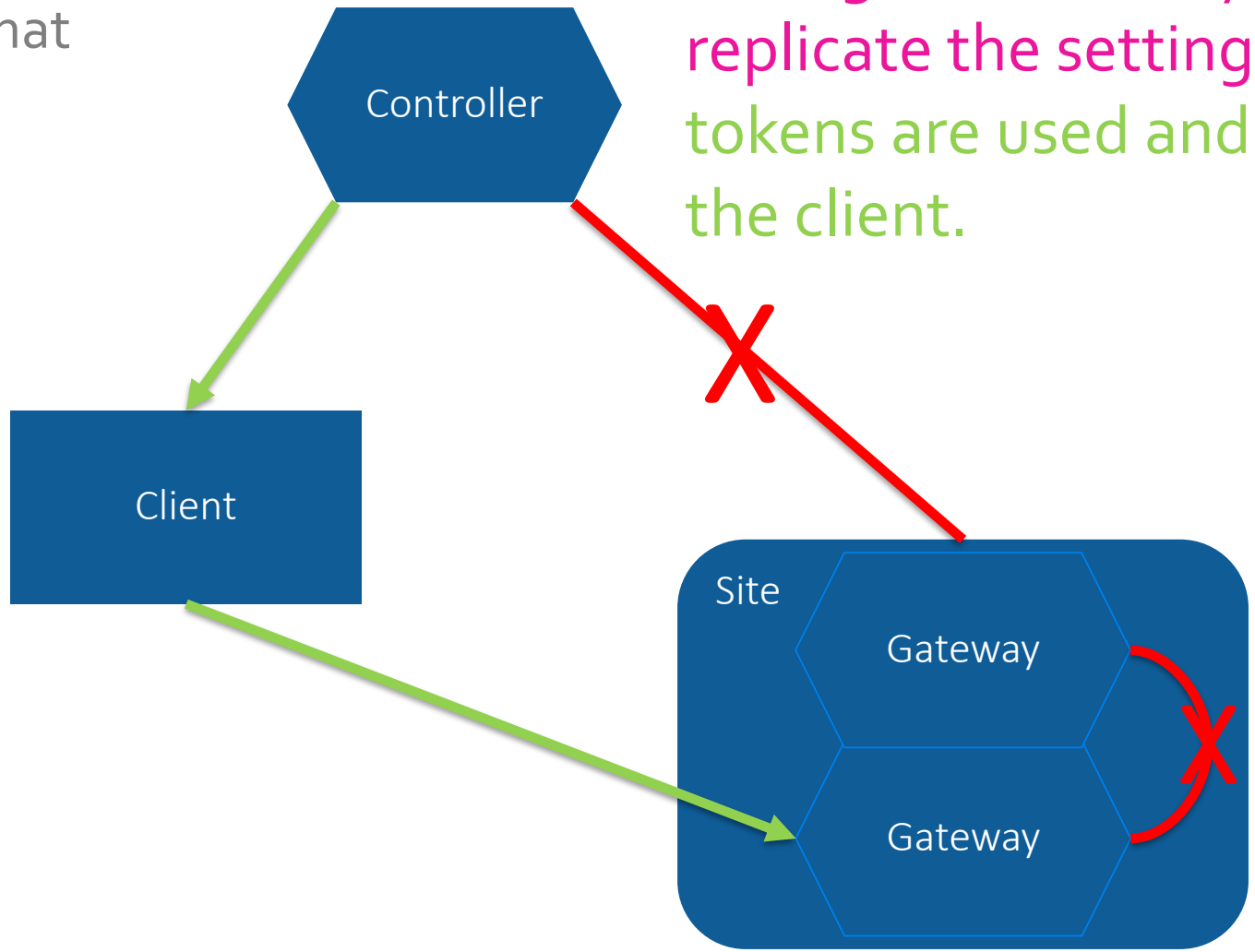
The CA cert can be renewed – a new license is required!

- Required when built in one expires.
- Replacing CA cert for security reasons

# Tokens

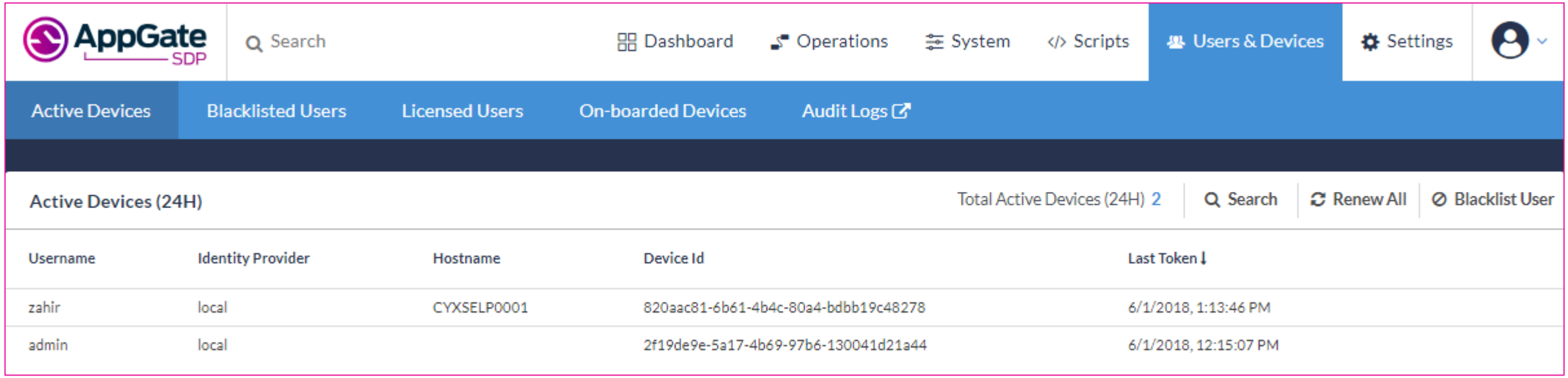
- The control flow uses "Tokens"
  - JSON Web Token format
- Two Tokens:
  - Claims
  - Entitlements
- One x509 cert:
  - VPN Certificate

Instead of the Controller 'writing' to the Site and having the Gateways replicate the settings, tokens are used and sent via the client.



# Managing tokens using *User and Devices*

- AppGate adapts to changes in the environment automatically. To push any changes made within the AppGate itself…..
- Use the Users and Devices console to renew Users' or all tokens



# Data flow in AppGate

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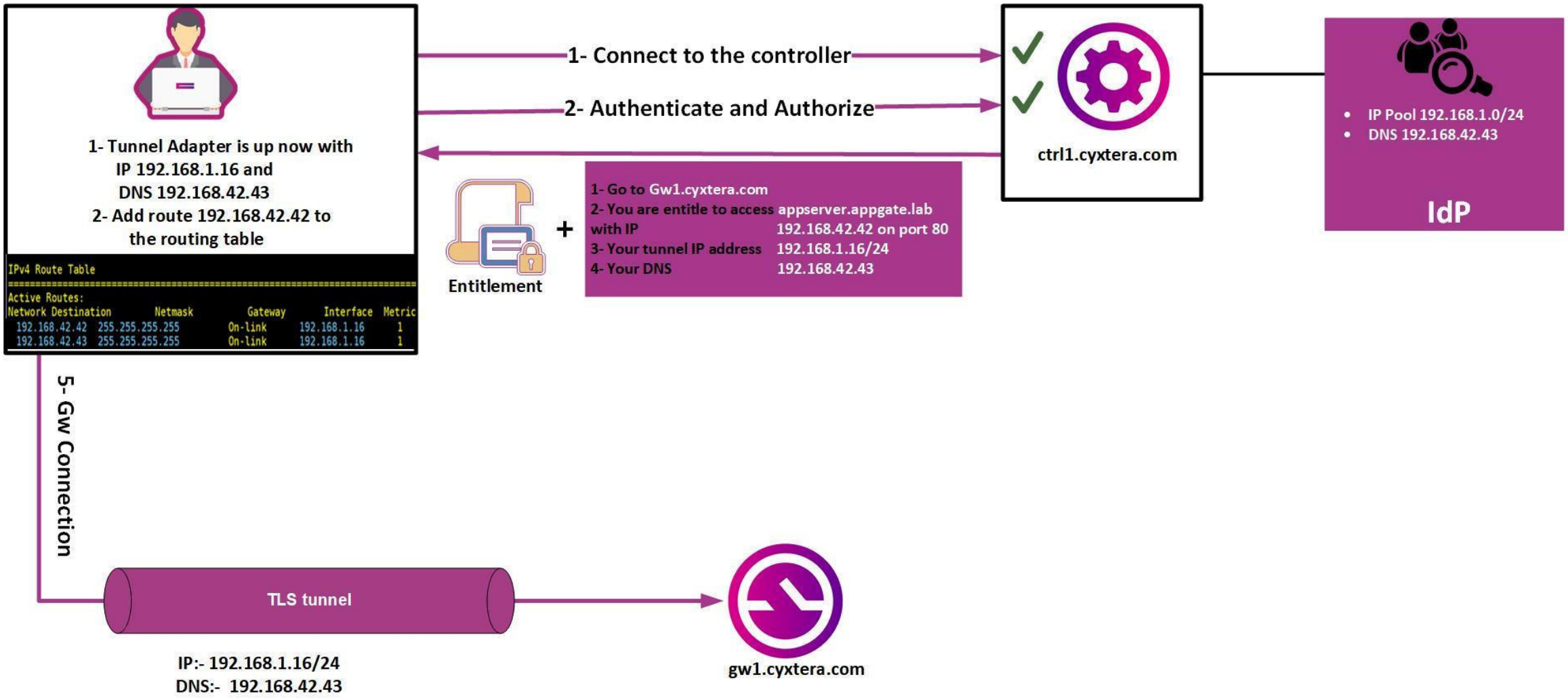
# IP pool management

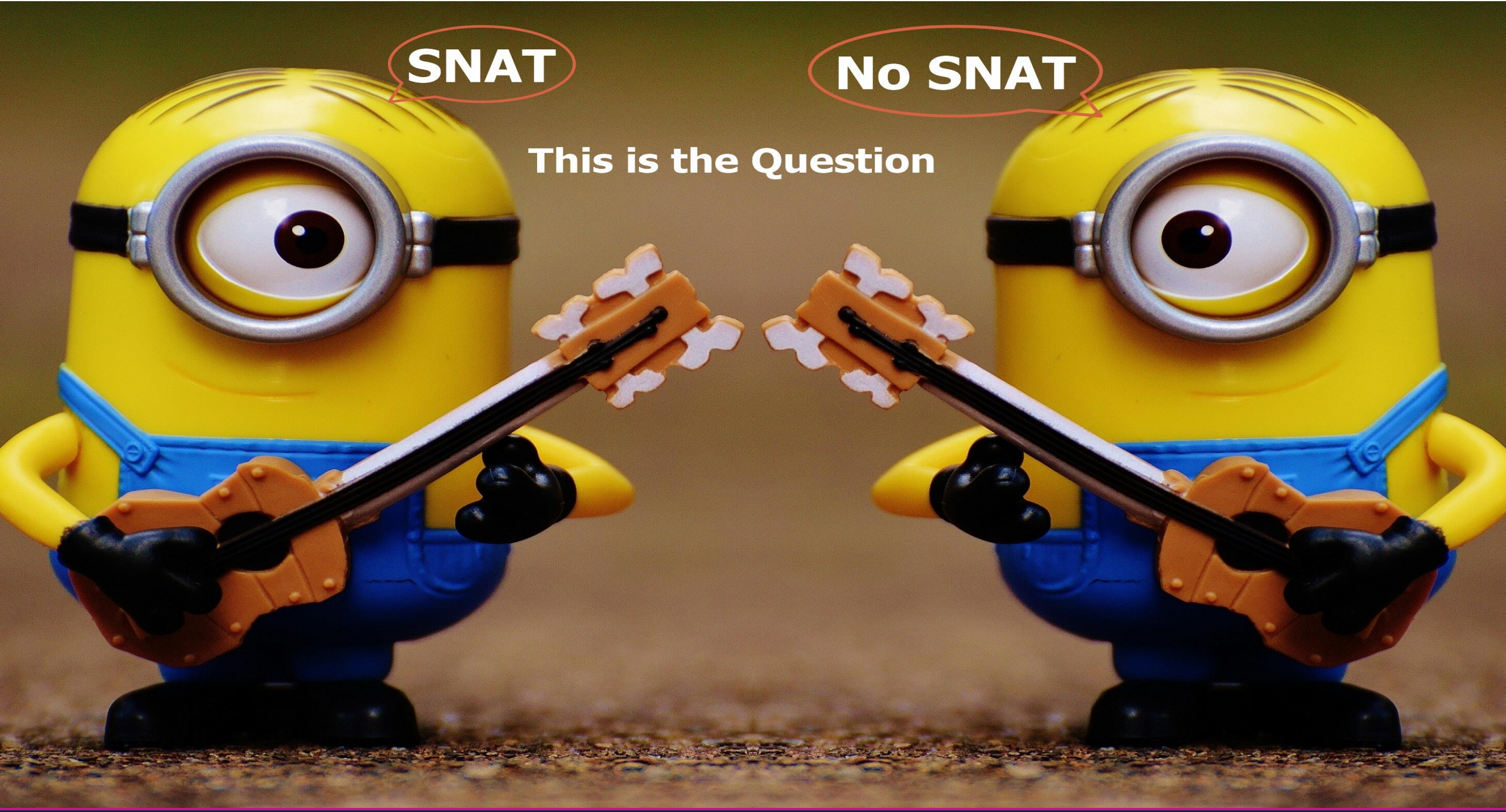
- Every device is allocated it own IP address from the pool – same user connecting from two devices will consume 2 IP's
- If multiple Identity Providers are configured, every time a user connects using a different IdP, another unique IP address will be consumed
- The IP address will remain reserved until the lease time (30 days default) has expired – lease time can be set per pool
- IP Pools console – stats on *currently used* and *reserved* IP's
- Health check warning when any pool's *currently used* and *reserved* IPs reach 90% of the Total size

# Host routing and IP Pools

- Client creates a **tun** device: a virtual NIC
- Controller registers an IP (tun-ip) from the IP Pool and assigns it to the client after authorization
- tun-ip is given to the tun device on client
- Host routes are added (based on Entitlements and/or Sites)
- Applications resolve hosts using DNS
- The packets in the tunnel are sent from the tun-ip

# Host routing and IP Pools cont'd

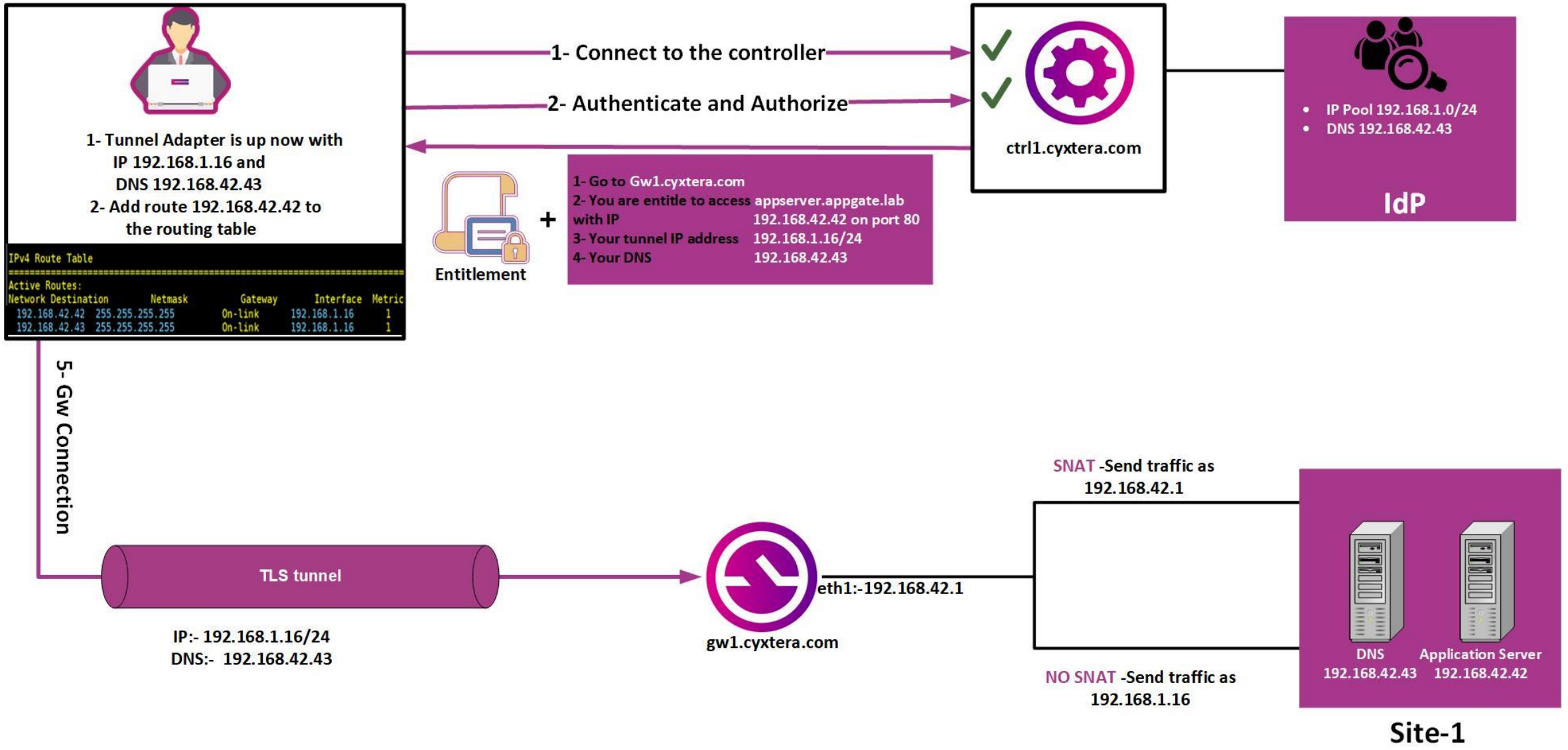



SNAT
No SNAT
This is the Question

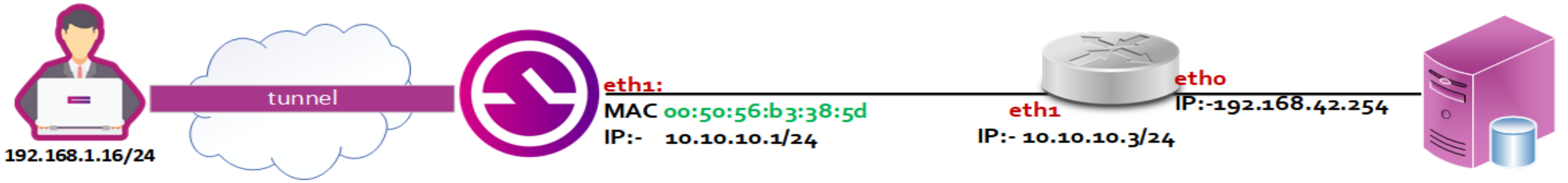
# Firewalling and Source NAT

- VPN traffic hits the gateway and is firewalled on a per-user basis.
- When the traffic is forwarded over the network there are two options:
  1. Gateway sends the packet to the network as-is
     - Routers needs to be configured to forward tun-ip range
     - Endpoints receive and send to the individual tun-ips
  2. Gateway does a Source-NAT (replaces the tun-ip with the Gateway-ip)
     - No need for router configuration in the network
     - Endpoints receive and send to the Gateway IP

# Firewalling and Source NAT cont'd



# No-SNAT (ARP Proxy)




**Routing table**
192.168.42.0/24 via
10.10.10.3 dev eth1

**Routing table**
192.168.1.0/24 via
10.10.10.3 dev eth1

IP:- 192.168.42.46/24
GW:- 192.168.42.254

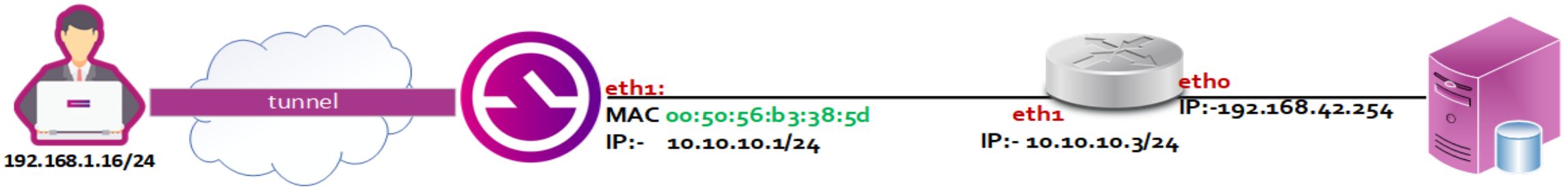
```
Broadcast          ARP   Who has 192.168.1.16? Tell 10.10.10.3   <-- Router ARP request
Vmware_b3:40:8d    ARP   192.168.1.16 is at 00:50:56:b3:38:5d    --> AppGate GW ARP answer
```

```
> Frame 18: 60 bytes on wire (480 bits), 60 bytes captured (480 bits)
> Ethernet II, Src: Vmware_b3:38:5d (00:50:56:b3:38:5d), Dst: Vmware_b3:40:8d (00:50:56:b3:40:8d)
v Address Resolution Protocol (reply)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: reply (2)
    Sender MAC address: Vmware_b3:38:5d (00:50:56:b3:38:5d)
    Sender IP address: 192.168.1.16
    Target MAC address: Vmware_b3:40:8d (00:50:56:b3:40:8d)
    Target IP address: 10.10.10.3
```

# No SNAT

- Good: Great auditing
- Good: Track packets over the internal network
- Good: Can separate tenant traffic by IP
- Good: Allows stateful Failover
- Bad: Requires network configuration on the infrastructure
  - Return routes need defining.
- Bad: limited use in Cloud deployments

# SNAT




**Routing table**
192.168.42.0/24 via
10.10.10.3 dev eth1

**Routing table**
192.168.1.0/24 via
10.10.10.3 dev eth1

IP:- 192.168.42.46/24
GW:- 192.168.42.254

```
Broadcast         ARP     Who has 10.10.10.1? Tell 10.10.10.3   <-- Router ARP request
Vmware_b3:40:8d   ARP     10.10.10.1 is at 00:50:56:b3:38:5d    --> AppGate GW ARP answer
```

```
> Frame 4: 60 bytes on wire (480 bits), 60 bytes captured (480 bits)
> Ethernet II, Src: Vmware_b3:38:5d (00:50:56:b3:38:5d), Dst: Vmware_b3:40:8d (00:50:56:b3:40:8d)
v Address Resolution Protocol (reply)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: reply (2)
    Sender MAC address: Vmware_b3:38:5d (00:50:56:b3:38:5d)
    Sender IP address: 10.10.10.1
    Target MAC address: Vmware_b3:40:8d (00:50:56:b3:40:8d)
    Target IP address: 10.10.10.3
```

# SNAT

- Good: Requires NO network configuration on the infrastructure
- Good: Most compatible, works everywhere
- Good: Ideal for Cloud
- IP pool changes have no impact
- Bad: Packets lost the original source IP
- Bad: No full state-full failover is possible

# What you have learnt

- SPA – what it is and how to ensure users can connect
- Hostnaming & DNS - Because SDP is a distributed system care needs to be taken when setting up networking
- Tokens – are the backbone of AppGate's control system and allow all the elements in the system to work independently of one another
- Data packet flow – How to connect with applications/servers on (multiple) protected sites

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# Lab 5 &6

AppGateSDP

*Access, evolved.*