Cisco Meraki Centralized WLC on a 3-Tier Campus LAN Architecture

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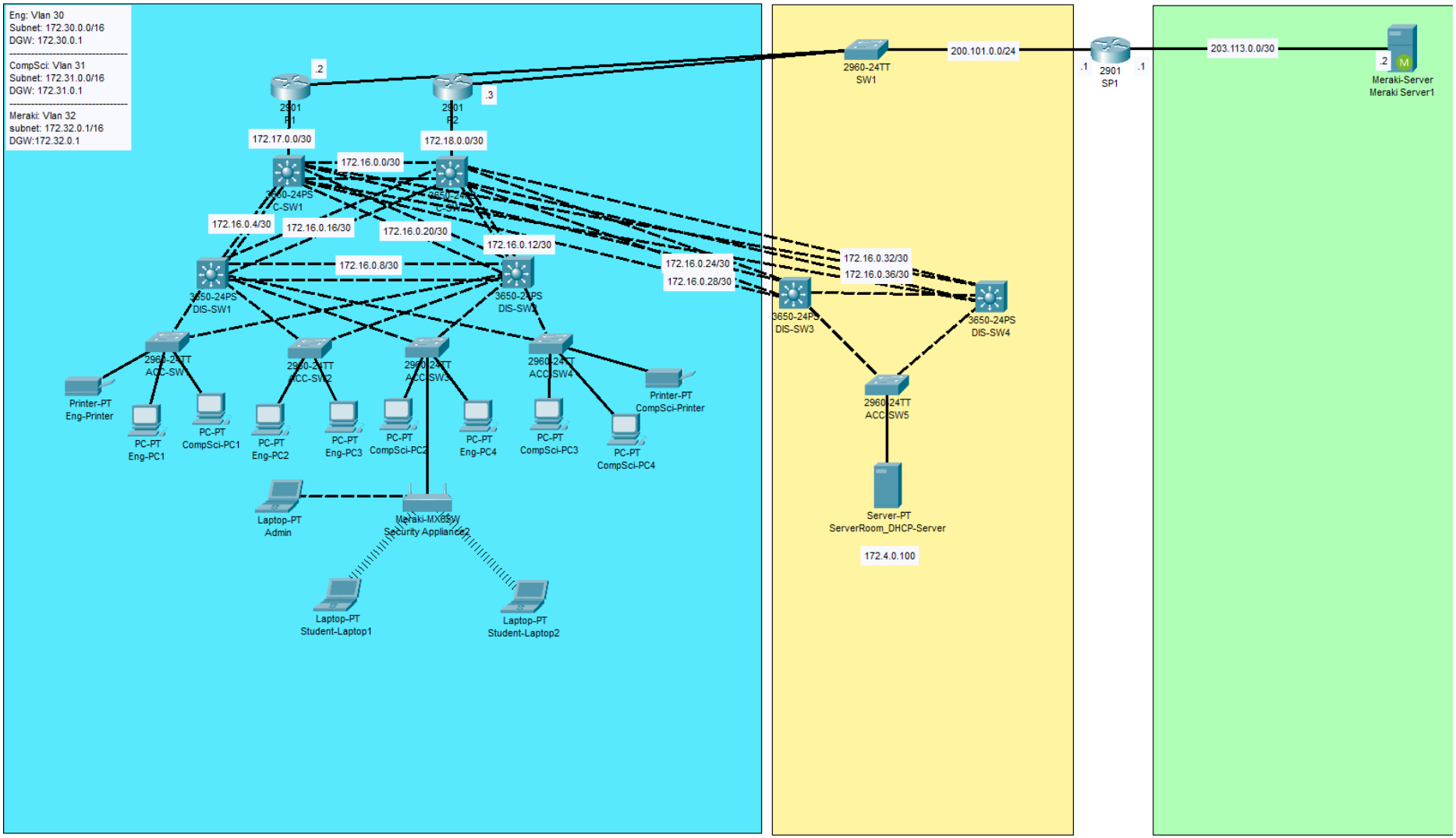
Abstract

Using the Packet tracer software, I successfully implemented a centralized cloud based WLC on a 3-Tier LAN architecture, using the Cisco Meraki server and security appliance. This is a continuation of work done on the project titled as "DHCP configuration in a 3-Tier Campus LAN Architecture." After configuring a DHCP pool for the Meraki Security Appliance, I created redundant virtual interfaces at the distribution layer for VLAN 32, for the Meraki appliance. Inter-VLAN routing was enabled and a route for all layer 3 traffic to/from the VLAN 32 virtual interface was also configured using OSPF. A default route to the service provider gateway was manually configured and thus a route to/from the Meraki server was implemented. Once the Meraki security appliance established a management connection to the Meraki server, I successfully configured the appliance via the Meraki dashboard. LAN and WAN connectivity was then achieved for all wireless end hosts on the WLAN implemented on the Meraki Security Appliance.


Eng: Vlan 30
Subnet: 172.30.0.0/16
DGW: 172.30.0.1
CompSci: Vlan 31
Subnet: 172.31.0.0/16
DGW: 172.31.0.1
Meraki: Vlan 32
subnet: 172.32.0.1/16
DGW:172.32.0.1
.2
.3
2901
R1
2901
R2
172.17.0.0/30
172.18.0.0/30
172.16.0.0/30
3650-24PS
C-SW1
3650-24PS
C-SW2
172.16.0.4/30
172.16.0.16/30
172.16.0.20/30
172.16.0.12/30
172.16.0.8/30
3650-24PS
DIS-SW1
3650-24PS
DIS-SW2
2960-24TT
ACC-SW1
2960-24TT
ACC-SW2
2960-24TT
ACC-SW3
2960-24TT
ACC-SW4
Printer-PT
Eng-Printer
PC-PT
Eng-PC1
PC-PT
CompSci-PC1
PC-PT
Eng-PC2
PC-PT
Eng-PC3
PC-PT
CompSci-PC2
PC-PT
Eng-PC4
PC-PT
CompSci-PC3
PC-PT
CompSci-PC4
Printer-PT
CompSci-Printer
Laptop-PT
Admin
Meraki-MX65W
Security Appliance2
Laptop-PT
Student-Laptop1
Laptop-PT
Student-Laptop2
2960-24TT
SW1
200.101.0.0/24
.1
2901
SP1
.1
203.113.0.0/30
.2
Meraki-Server
Meraki Server1
172.16.0.24/30
172.16.0.28/30
172.16.0.32/30
172.16.0.36/30
3650-24PS
DIS-SW3
3650-24PS
DIS-SW4
2960-24TT
ACC-SW5
Server-PT
ServerRoom_DHCP-Server
172.4.0.100

Introduction

The objective is to implement a WLAN using a centralized cloud-based Meraki server and corresponding Meraki Security Appliance. This will be executed using a 3-Tier Campus LAN architecture with DHCP that was previously configured in the project titled as "DHCP configuration in a 3-Tier Campus LAN Architecture." The objective will be achieved by first configuring hostnames on the additional network devices needed. Secondly, configuring an IP subnet for the WAN edge interfaces and the service provider interfaces. Thirdly, OSPF will be configured on the WAN edge interfaces, while static routes with load balancing will be implemented on the Service provider interfaces. Then an additional VLAN 32 for the Meraki appliance will be added to the VTP server already configured on ACC-SW1, and redundant virtual interfaces for VLAN 32 will be configured at the distribution layer using HSRP. Note that the IP addresses for the Virtual interfaces will fall within the 172.0.0.0/8 network that was pre-configured in the OSPF configuration. Next a DHCP pool for VLAN 32 will be set up on the DHCP server at 172.4.0.100. And finally, the Meraki Appliance will be configured via the Meraki dashboard on the Admin-Laptop connected to the Meraki security appliance via fast ethernet.

Method and Equipment

Hostname Configuration

SP1

```
Router>en
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#hostname SP1
SP1(config)#exit
SP1#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
```

SW1

```
Switch>en
Switch#config t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname SW1
SW1(config)#int range fa0/3-24
SW1(config-if-range)#shutdown
SW1(config-if-range)#int g0/2
SW1(config-if)#shutdown
SW1#copy run start
Destination filename [startup-config]?
Building configuration...
```

[OK]

IP subnet Configuration

SP1

```
SP1#config t
Enter configuration commands, one per line. End with CNTL/Z.
SP1(config)#int g0/0
SP1(config-if)#ip address 203.113.0.1 255.255.255.252
SP1(config-if)#int g0/0
SP1(config-if)#no shutdown
!
SP1(config)#int g0/1
SP1(config-if)#ip address 200.101.0.1 255.255.255.0
SP1(config-if)#no shutdown
```

R1

```
R1>en
R1#config t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#int g0/1
R1(config-if)#ip address 200.101.0.2 255.255.255.0
R1(config-if)#no shutdown
```

R2

```
R2>en
R2#config t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#int g0/1
R2(config-if)#ip address 200.101.0.3 255.255.255.0
R2(config-if)#no shutdown
```

OSPF Configuration

R1

```
R1(config)#router ospf 1
```

```
R1(config-router)#network 200.101.0.0 0.0.0.255 area 0
R1(config-router)#exit
R1(config)#ip route 0.0.0.0 0.0.0.0 200.101.0.1
R1(config)#router ospf 1
R1(config-router)#default-information originate
```

R2

```
R2(config)#router ospf 1
R2(config-router)#network 200.101.0.0 0.0.0.255 area 0
R2(config-router)#exit
R2(config)#ip route 0.0.0.0 0.0.0.0 200.101.0.1
```

Service Provider Static IP Route Configuration

SP1

```
SP1>en
SP1#config t
Enter configuration commands, one per line. End with CNTL/Z.
SP1(config)#ip route 172.0.0.0 255.0.0.0 200.101.0.2
SP1(config)#ip route 172.0.0.0 255.0.0.0 200.101.0.3
```

VLAN, DHCP & HSRP Configuration

ACC-SW1

```
ACC-SW1#config t
ACC-SW1(config)#vlan 32
ACC-SW1(config-vlan)#name Meraki
```

DIS-SW1

```
DIS-SW1>en
DIS-SW1#config t
Enter configuration commands, one per line. End with CNTL/Z.
DIS-SW1(config)#vlan 32
DIS-SW1(config-vlan)#name Meraki
DIS-SW1(config-vlan)#exit
DIS-SW1(config)#int vlan 32
DIS-SW1(config-if)#ip address 172.32.0.2 255.255.0.0
DIS-SW1(config-if)#standby 32 ip 172.32.0.1
DIS-SW1(config-if)#standby 32 priority 110
DIS-SW1(config-if)#standy 32 preempt
%LINK-5-CHANGED: Interface Vlan32, changed state to up
DIS-SW1(config-if)#ip helper-address 172.4.0.100
```

DIS-SW2

```
DIS-SW2>en
DIS-SW2#config t
Enter configuration commands, one per line. End with CNTL/Z.
DIS-SW2(config)#vlan 32
DIS-SW2(config-vlan)#name Meraki
DIS-SW2(config-vlan)#exit
DIS-SW2(config)#int vlan 32
DIS-SW2(config-if)#ip address 172.32.0.3 255.255.0.0
DIS-SW2(config-if)#standby 32 ip 172.32.0.1
DIS-SW2(config-if)#standby 32 priority 90
%LINK-5-CHANGED: Interface Vlan32, changed state to up
DIS-SW2(config-if)#ip helper-address 172.4.0.100
```

ACC-SW3

```
ACC-SW3>en
ACC-SW3#config t
Enter configuration commands, one per line. End with CNTL/Z.
ACC-SW3(config)#int f0/2
ACC-SW3(config-if)#switchport mode access
ACC-SW3(config-if)#switchport access vlan 32
ACC-SW3(config-if)#no shutdown
```

The security appliance in VLAN 32 receives it IP address on the internet interface from the serverPool configured on the DHCP server at 172.4.0.100.

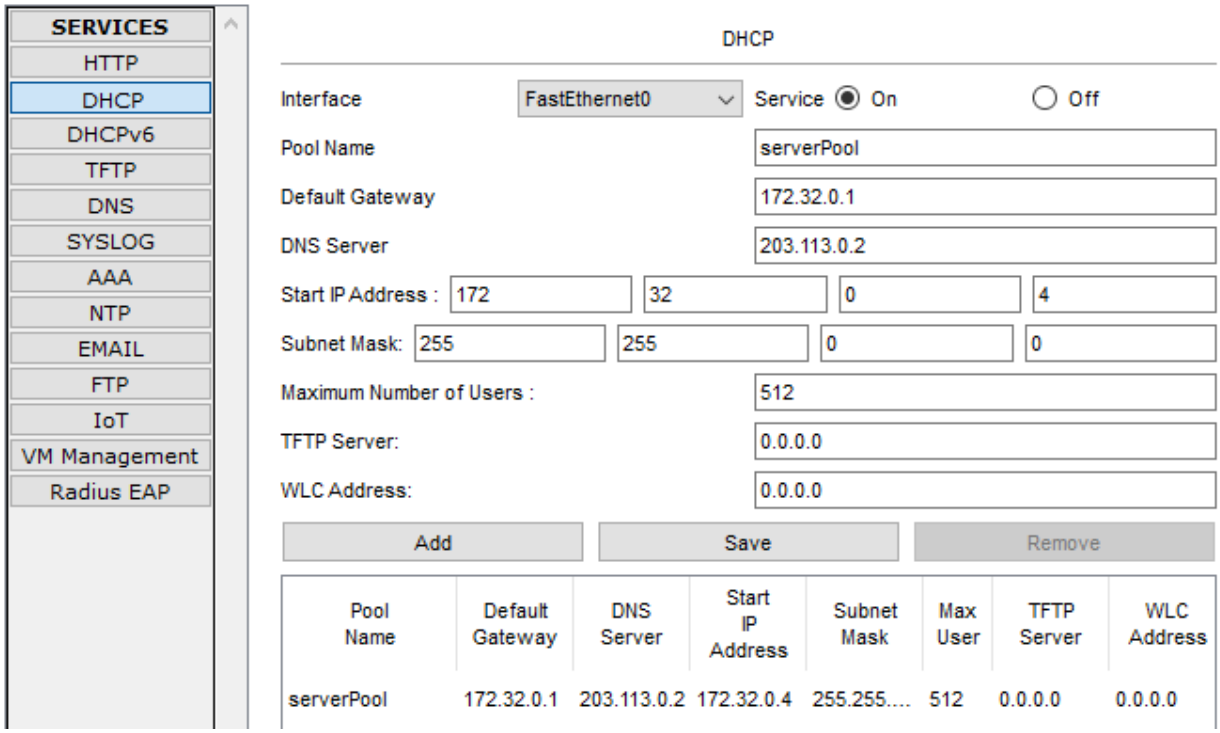


Figure 1-DHCP pool on DHCP server (172.4.0.100) for Meraki Appliances on VLAN 32

Meraki Server Configuration

The Meraki server is on the subnet 203.113.0.0/30 as seen in figure 3 and is assigned the IP 203.113.0.2 with a default gateway of 203.113.0.1 as seen in figure 2.

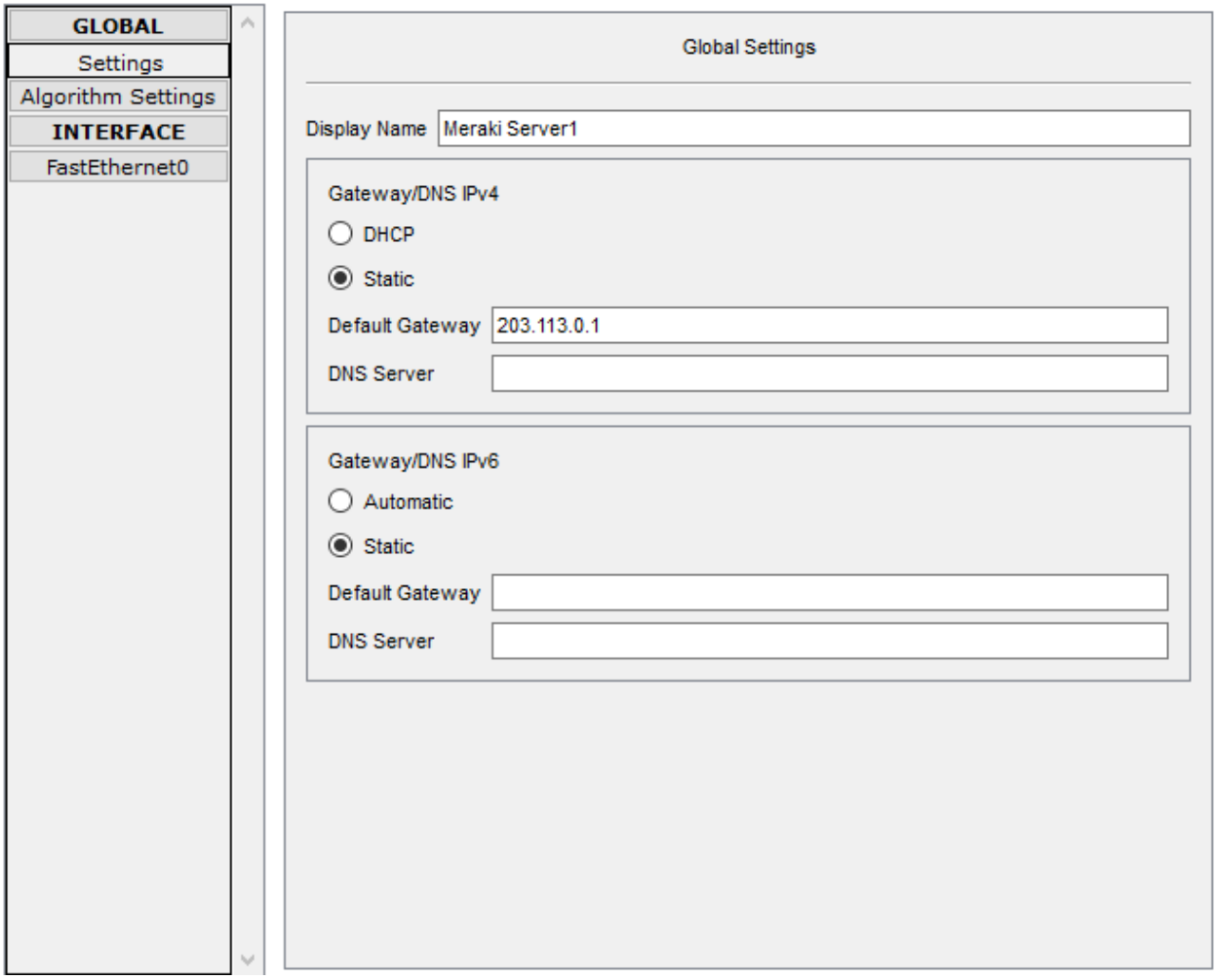


Figure 2-Meraki server gateway configuration

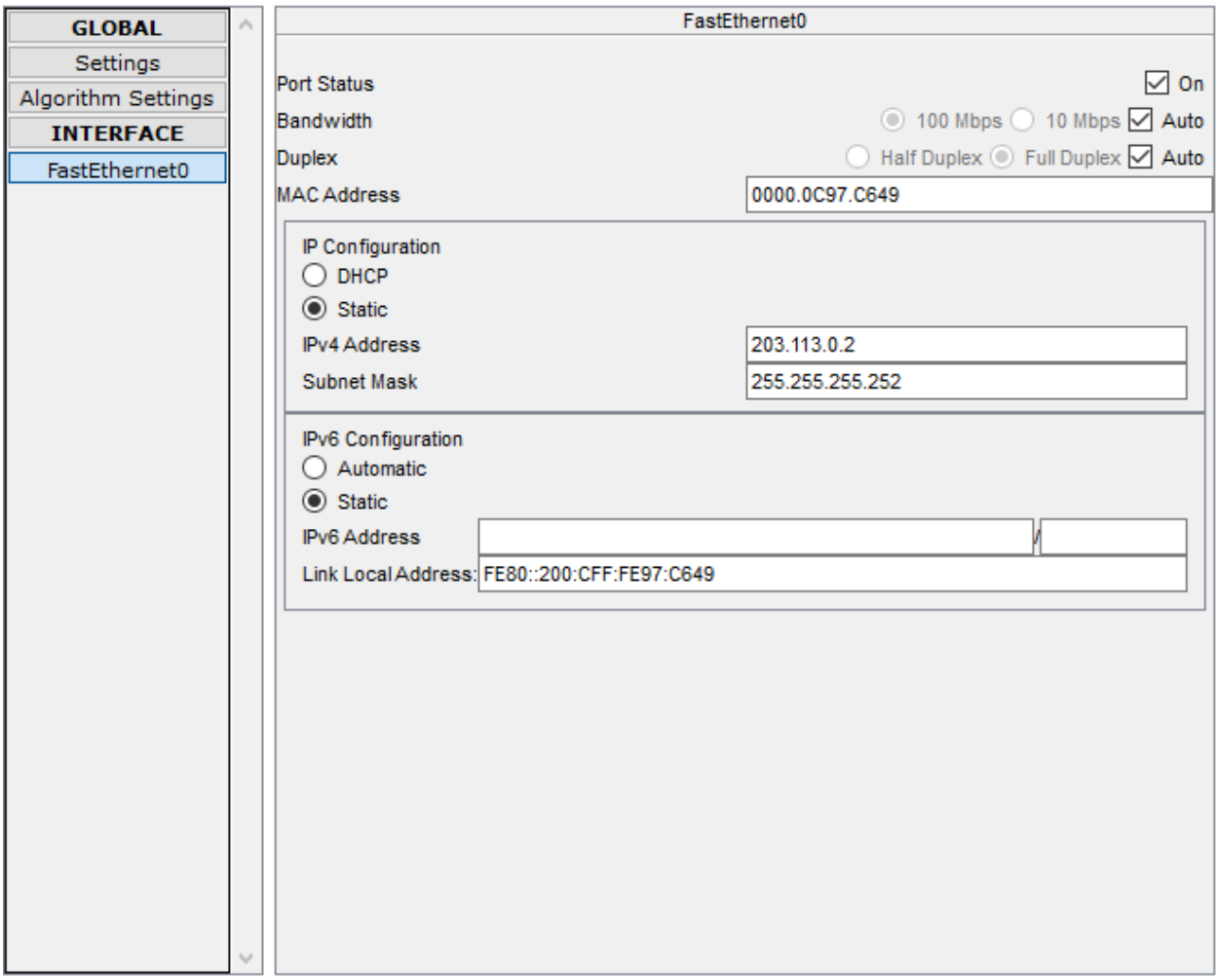


Figure 3- Meraki server fast ethernet interface configuration

Meraki Security Appliance Configuration

After the internet 1 interface was connected to the access layer switch ACC-SW3, the Meraki security appliance was powered up, the serial number of the device was noted, as it is essential for further configuration of the device.

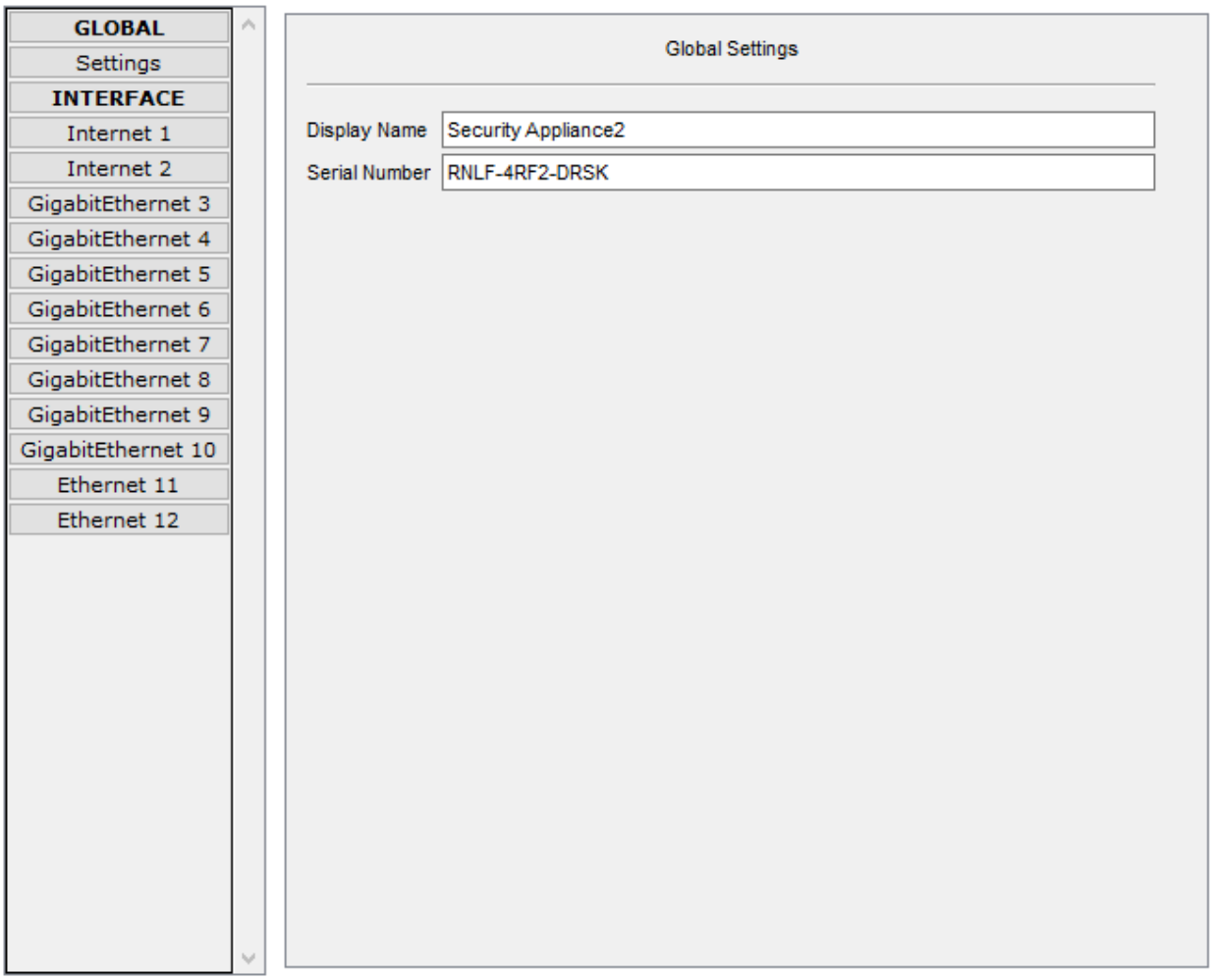


Figure 4-Meraki Appliance GUI shows the appliance serial number that is used by the Admin to configure the appliance

The Meraki security appliance was then connected to the Admin laptop via fast ethernet, and the DHCP server on the security appliance, operating in NAT mode, assigned an IP to the Admin laptop on a new subnet 192.168.0.0/24 with default gateway 192.168.0.1, as shown in figure 5. Note that the appliance itself received an IP from the DHCP server pool configured on the DHCP server at 172.4.0.100, as seen in figure 1. This was essential for the appliance to have a route to the Meraki server.

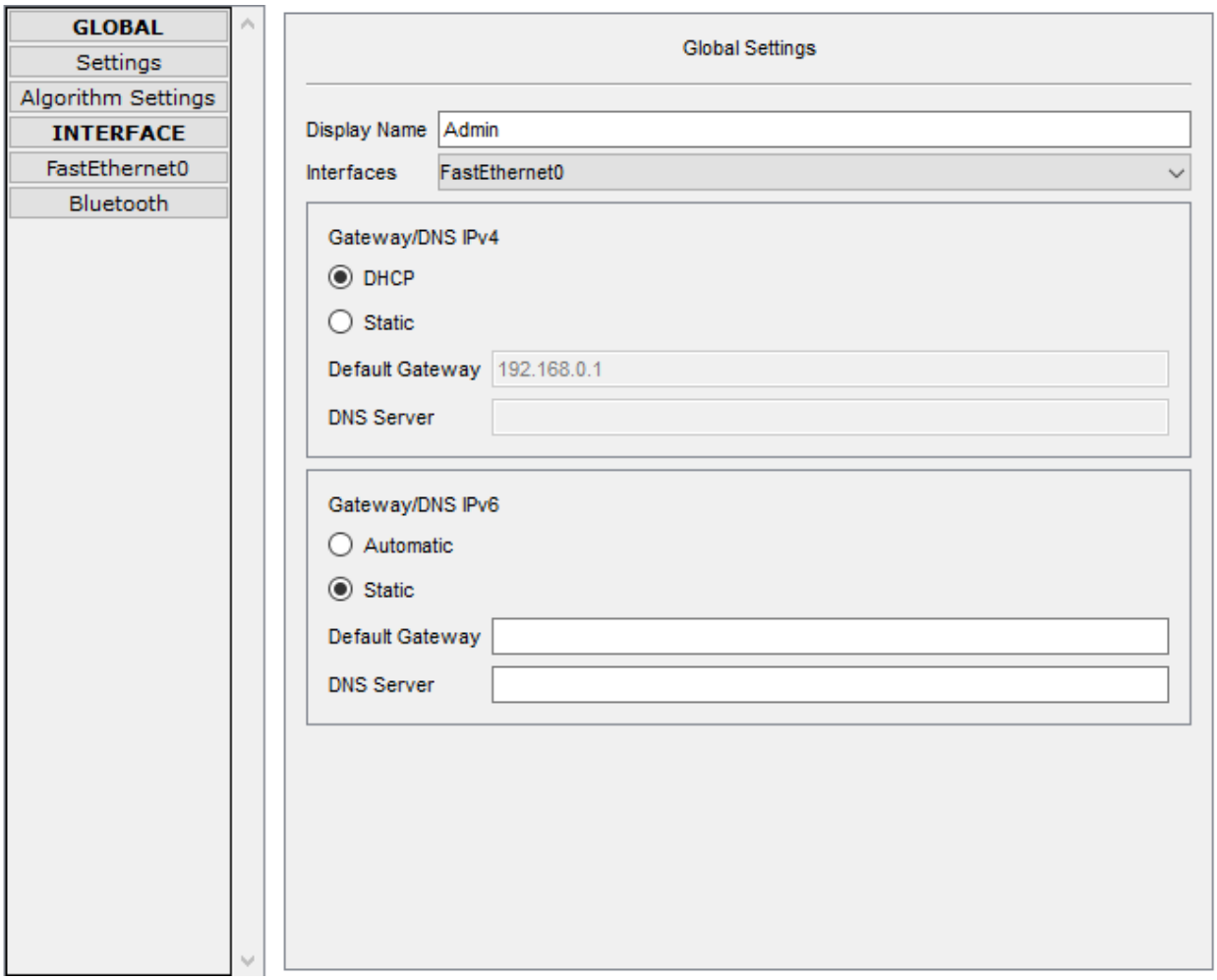


Figure 5-The Admin end host is set for DHCP and the received gateway is used for further configuration

The Meraki Security Appliance configuration menu was accessed via the web browser on the Admin laptop. The serial number of the appliance is entered as the User Name while the password field is left blank. The address of the configuration page is the default gateway on the appliance, as seen in figure 6.

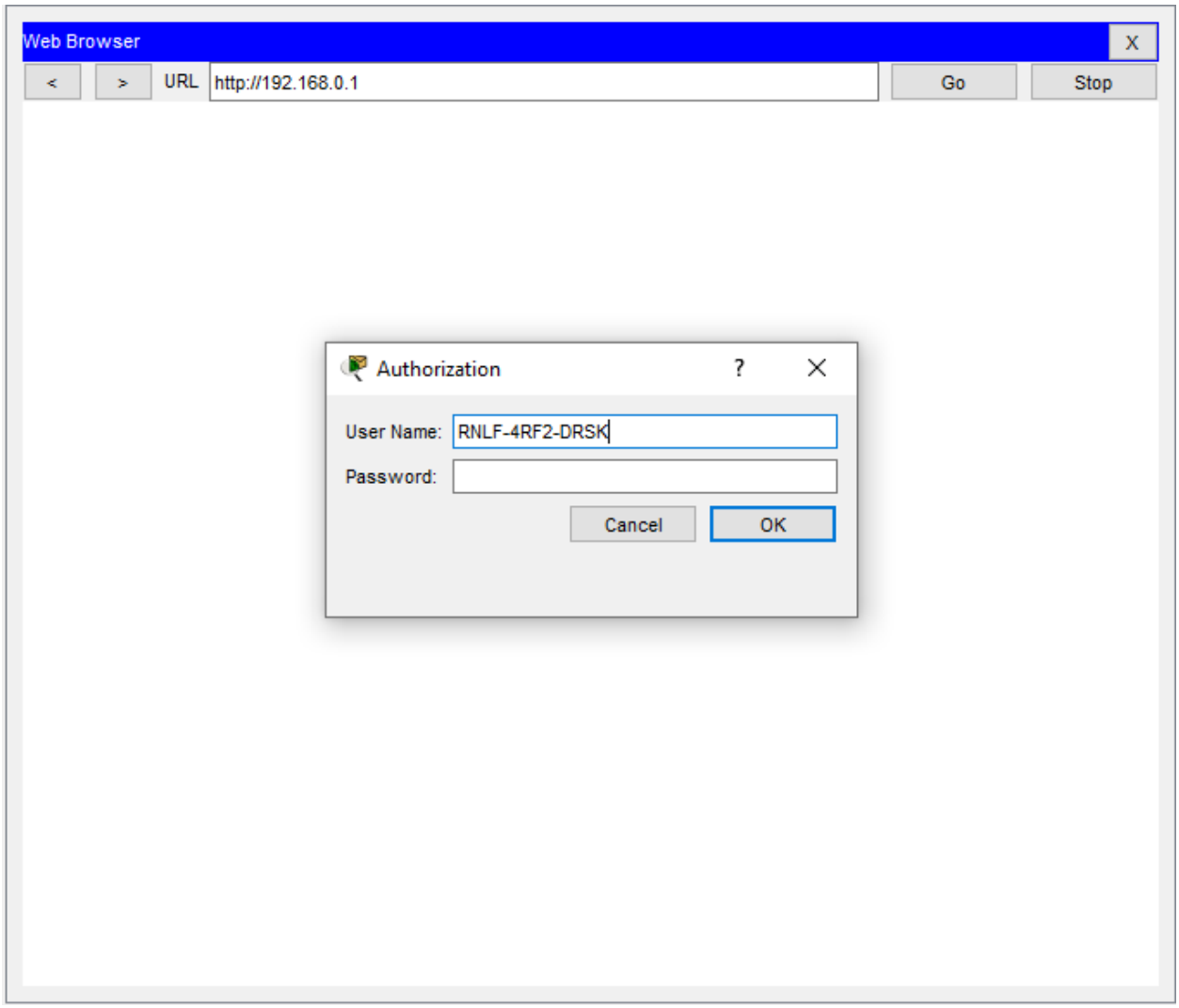


Figure 6-The web browser on the Admin end host is used to connect the Meraki appliance using the Appliance serial number as the User Name and the Password field is left blank

Once logged in to the configuration page, the MAC address of the security appliance is noted for further configuration, as shown in figure 7.

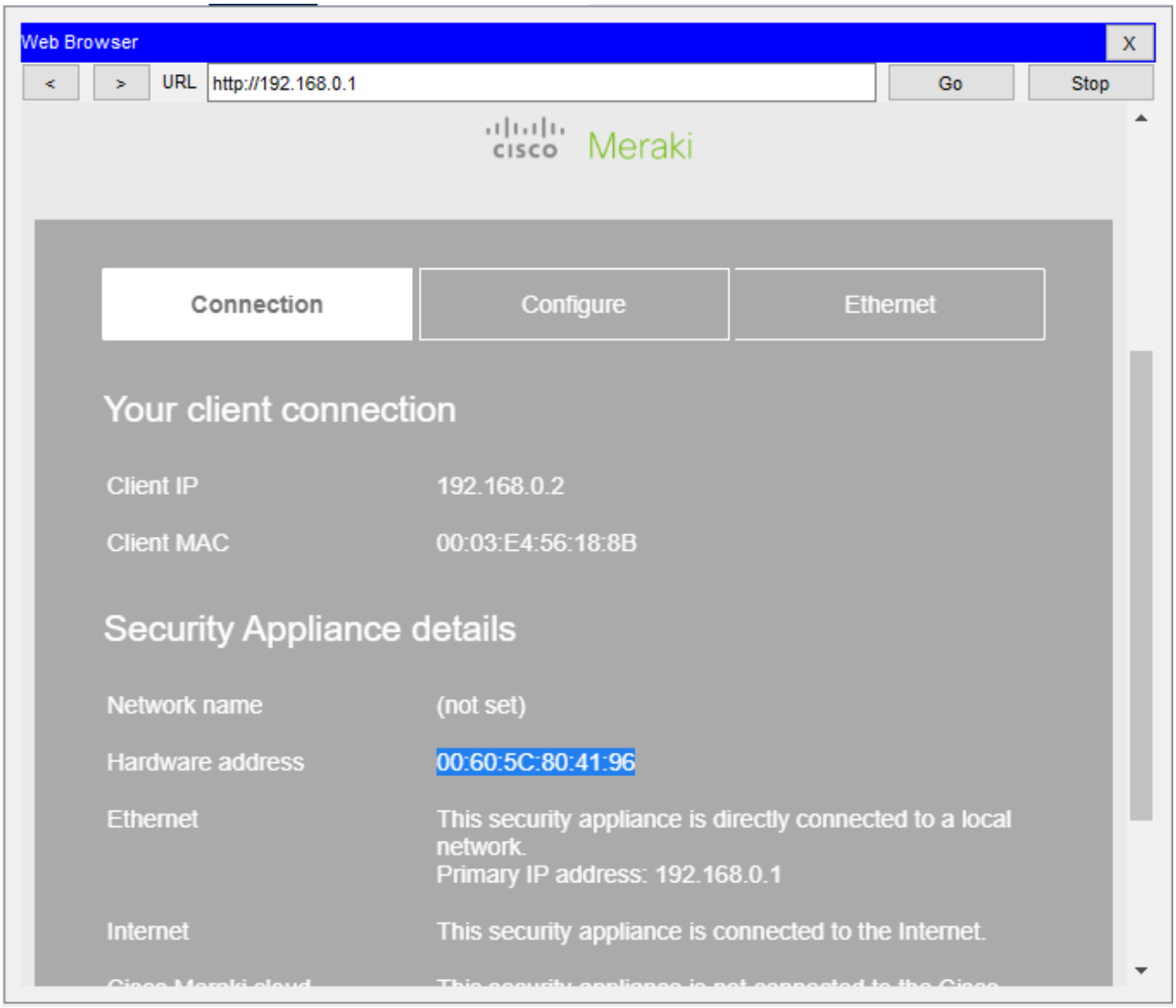


Figure 7-The Meraki Appliance MAC address on the connection page is used for further configuration

The uplink interface i.e. Internet 1 is configured as a direct connection with DHCP for IP assignment in this case. This is done on the configure page, as shown in figure 8.

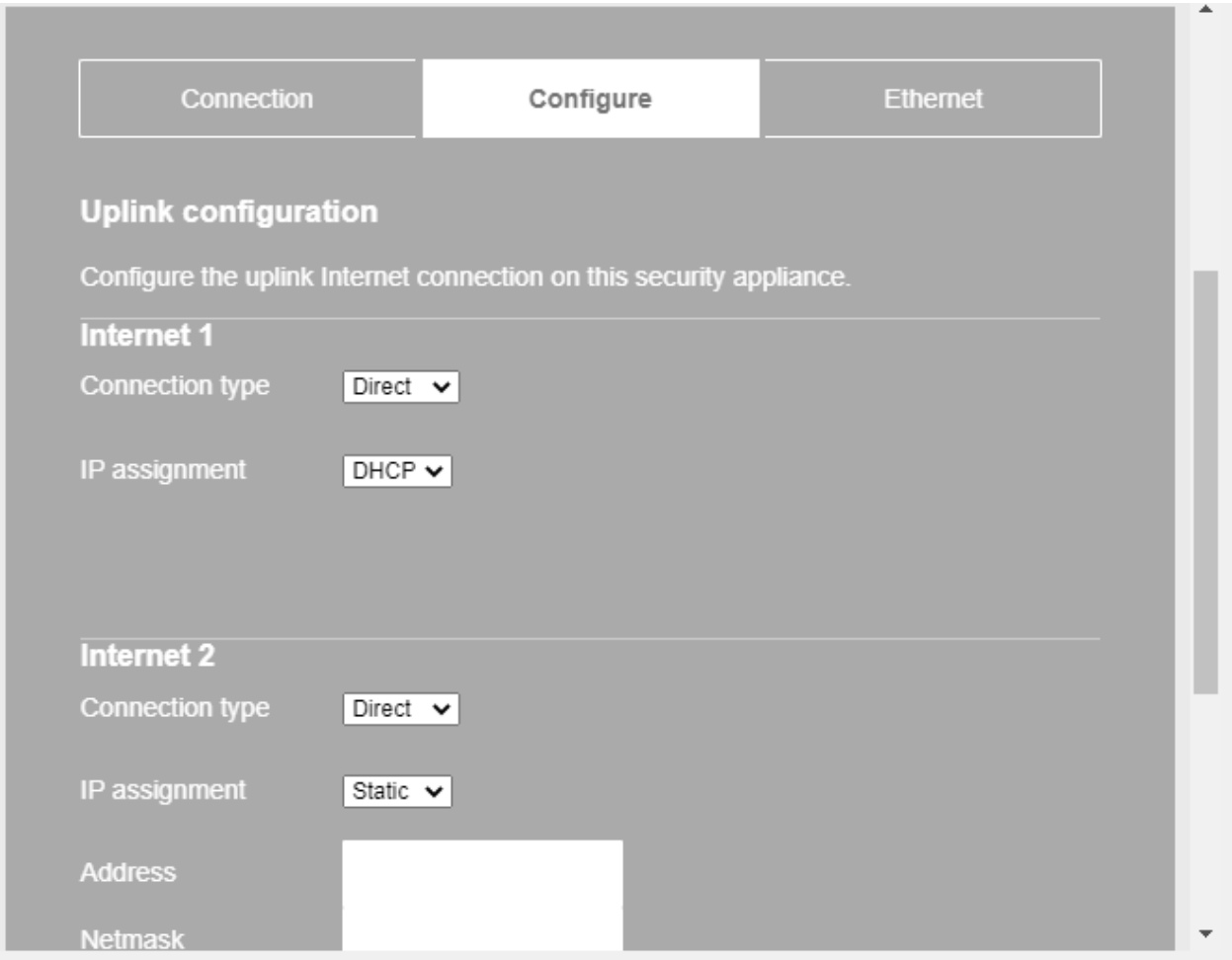


Figure 8-The uplink used (Internet 1) is set to DHCP on the Uplink configuration page

After it is confirmed that the Security Appliance interface Internet 1 has received an IP address via DHCP, then the Meraki cloud based server dashboard can be accessed via its IP address of 203.113.0.2, as seen in figure 9.

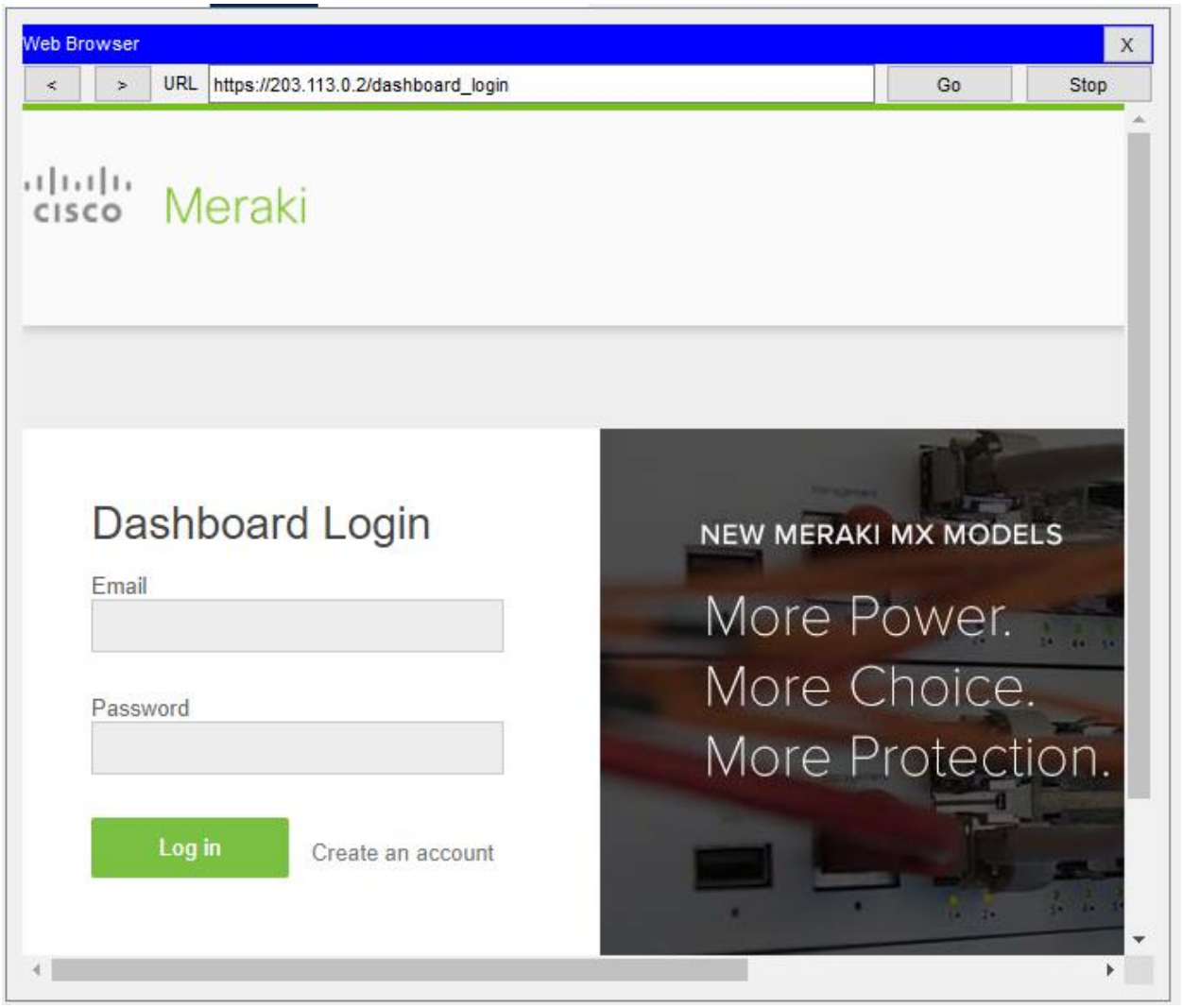


Figure 9-The Meraki Dashboard is accessed via the web browser on the Admin end host using the Meraki server IP (https://203.113.0.2), then an account must be created

A user account was first created, as shown in figures 10. And once authenticated you enter the landing page of the Meraki Dashboard as seen in figure 11.

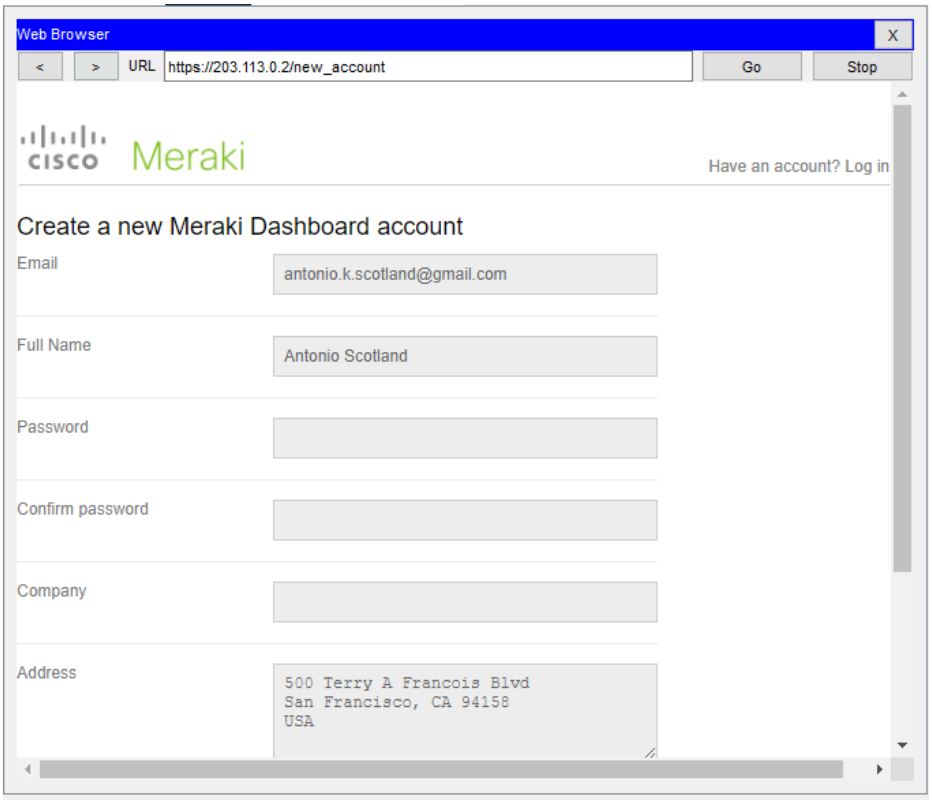


Figure 10-The account creation page

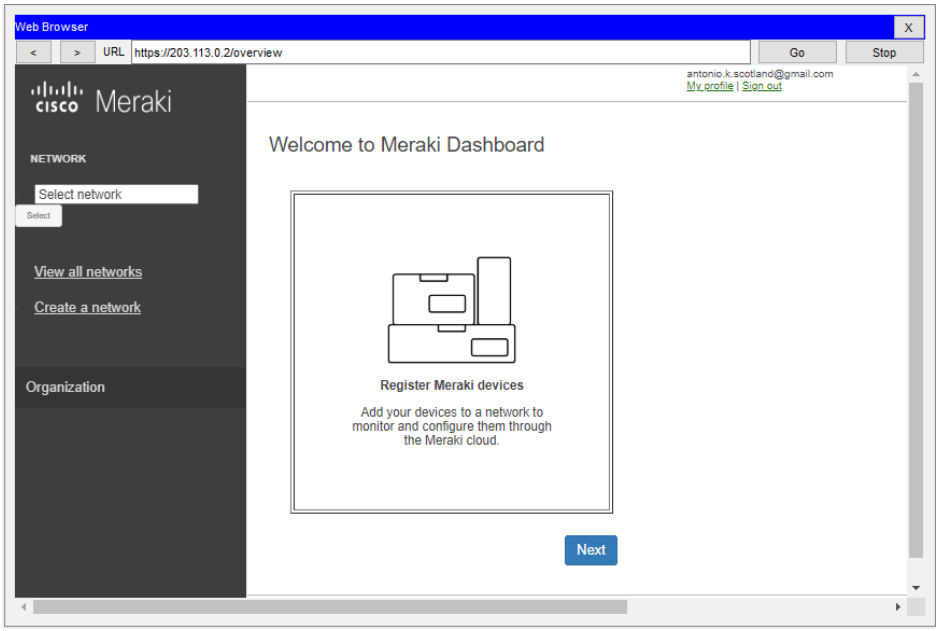


Figure 11-Meraki Dashboard landing page where the Meraki Security Appliance device must be registered

The network name and network type are then set and a network is created as seen in figure 12.

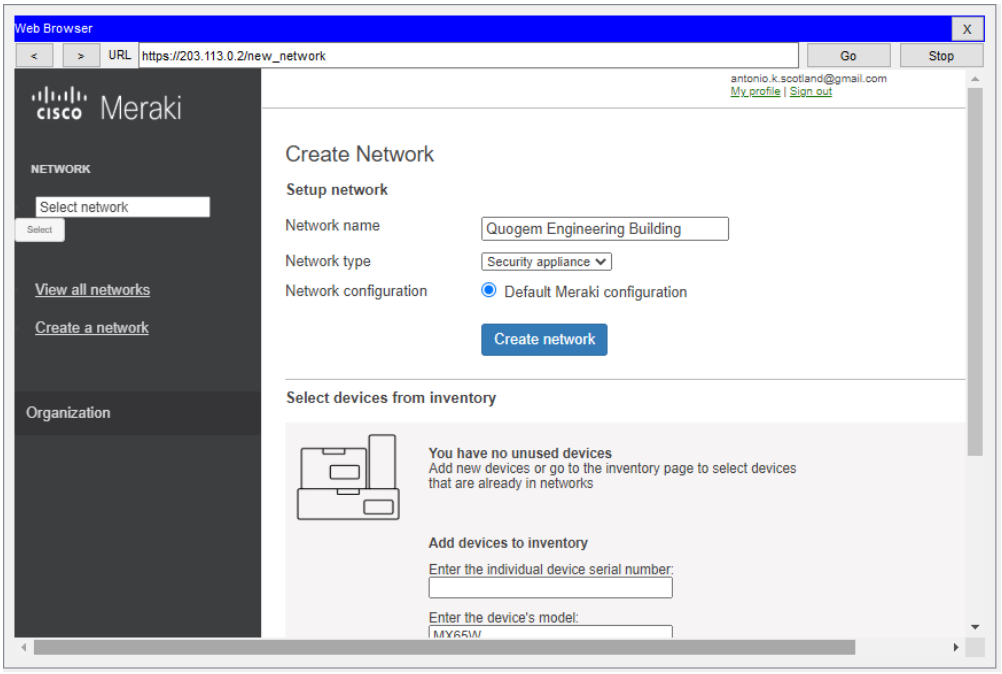


Figure 12-Page where a network can be created

The Meraki devices on the network are then added to the network via the dashboard using the device serial number, model number, MAC address and the name of the network the device is to be added to, as shown in figure 13.

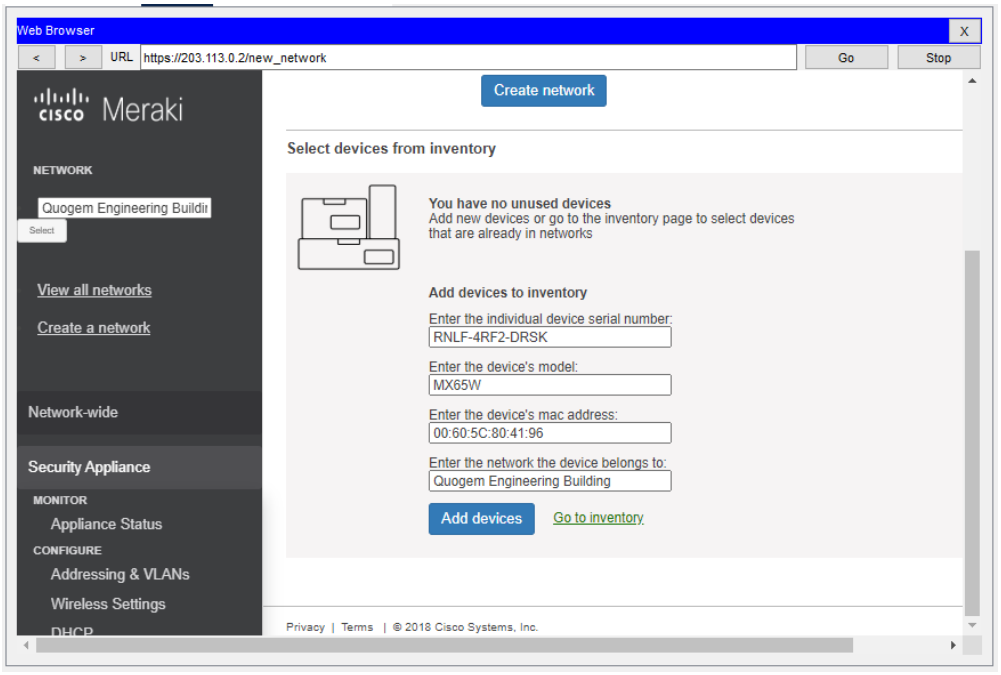


Figure 13-The Meraki Appliance serial number and MAC address must be entered at this point

SSID's are then created for each wireless device. The SSID, security encryption is configured as seen in figure 14. In this case WPA2 +PSK is selected as the authentication and encryption scheme for the SSID, *Student*.

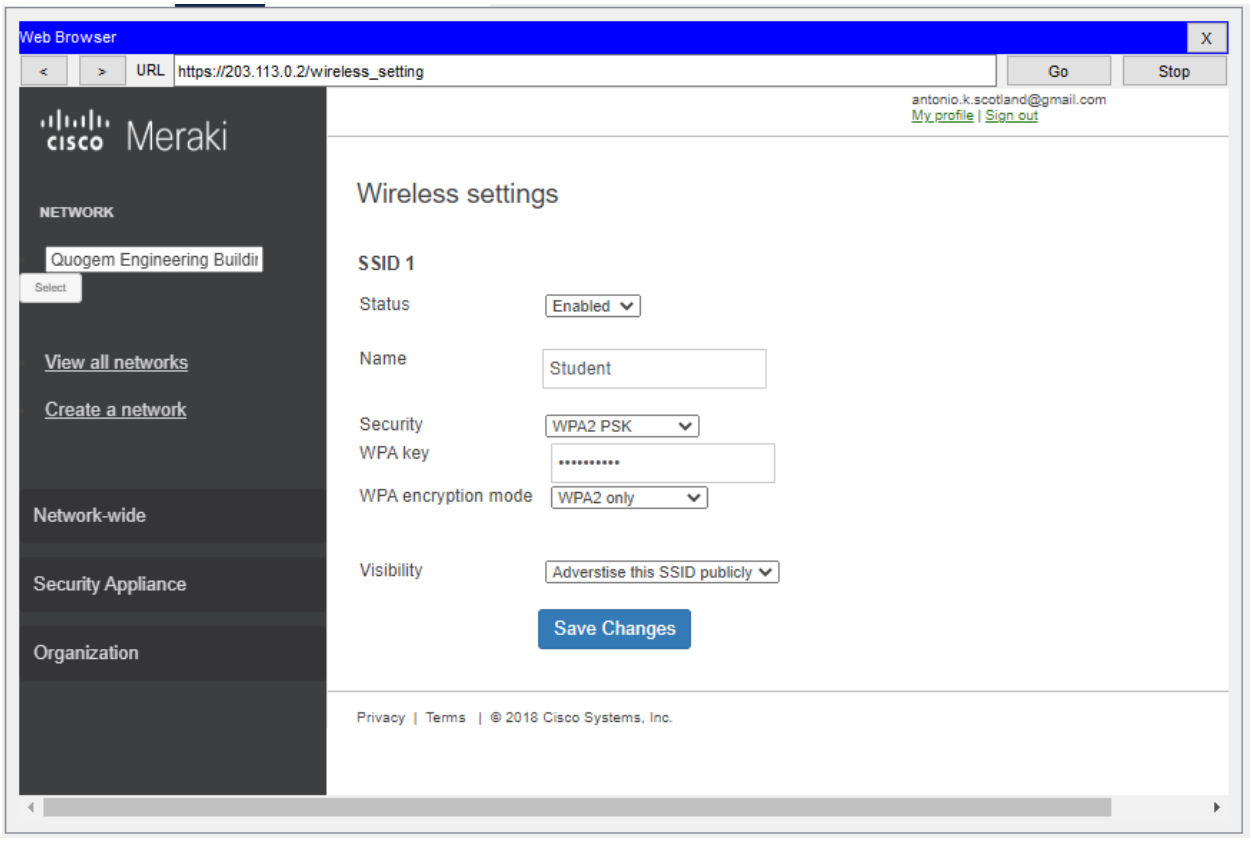


Figure 14-Under the wireless settings page an authentication and encryption method are configured

Wireless End Host Configuration

Once the Security Appliance is configured from the Meraki dashboard, wireless clients can now be added to the network using one of the SSIDs created. Figure 15 shows the, *Student,* SSID created on the dashboard. Once the pre-shared key is entered for the connection with SSID*, Student*, a connection to the WLAN is secured, as seen in figure 16.

Figure 15-Student laptop wireless configuration GUI detecting the configured Students SSID

Figure 16-The Student wireless end host is now securely connect using WPA2+PSK

Verification & Discussion

In the appliance status menu of the Meraki Dashboard, a live data status can be seen on the uplink and access ports on the device. Figure 17 shows that the uplink internet 1 and Gigabit ethernet access port 3 are now active. Port 3 is connected to the Admin laptop while the internet uplink connects to the access layer switch, ACC-SW3.

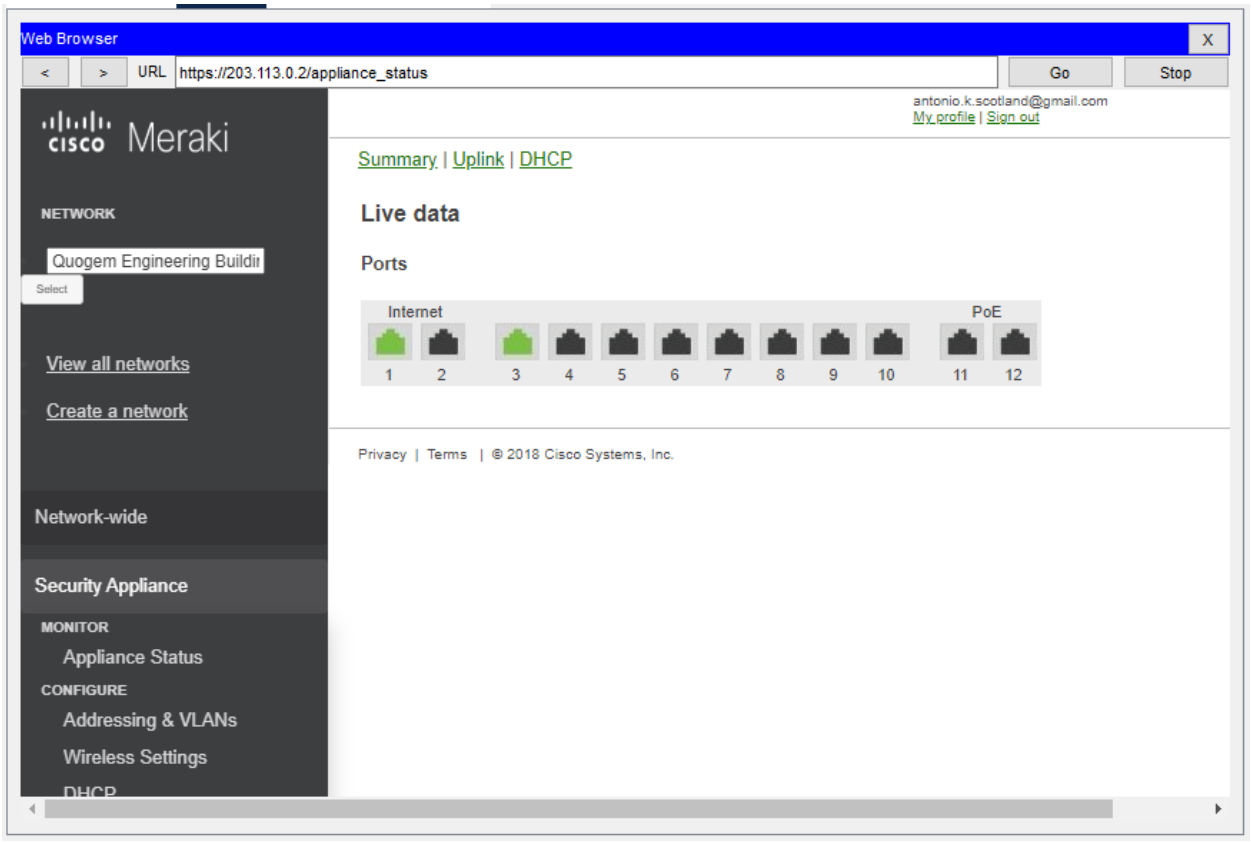


Figure 17-Appliance status on dashboard shows uplink and port 3 are now active

Using NAT, the gateway 192.168.0.1 is mapped to IP address 172.32.0.6 assigned via DHCP to the internet 1 port. The Security Appliance DHCP sever assigns Student-Laptop1 an IP on the 192.168.0.0/24 subnet, as seen in figure 18. The wireless end hosts, including Student-Laptop1 now have two way connectivity to the service provide gateway of 200.101.0.1, as shown in figure 19. The wireless hosts also have access to networked resources on the Eng and CompSci VLANs, 30 and 31 repsctively. This is shown in figure 20.

```
C:\>arp -a
  Internet Address      Physical Address      Type
  192.168.0.1           0060.5c80.4196        dynamic

C:\>ipconfig

Wireless0 Connection:(default port)

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.....: FE80::260:5CFF:FE12:B964
   IPv6 Address.....: ::
   IPv4 Address.....: 192.168.0.3
   Subnet Mask.....: 255.255.255.0
   Default Gateway.....: ::
                                 192.168.0.1

Bluetooth Connection:

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.....: ::
   IPv6 Address.....: ::
   IPv4 Address.....: 0.0.0.0
   Subnet Mask.....: 0.0.0.0
   Default Gateway.....: ::
                                 0.0.0.0
```

Figure 18-IP configuration on Student-Laptop 1

```
C:\>ping 200.101.0.1

Pinging 200.101.0.1 with 32 bytes of data:

Reply from 200.101.0.1: bytes=32 time=22ms TTL=251
Reply from 200.101.0.1: bytes=32 time=33ms TTL=251
Reply from 200.101.0.1: bytes=32 time=84ms TTL=251
Reply from 200.101.0.1: bytes=32 time=16ms TTL=251

Ping statistics for 200.101.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 16ms, Maximum = 84ms, Average = 38ms
```

Figure 19-Student-Laptop 1 has two connectivity to the service provider gateway

```
C:\>ping 172.30.0.15

Pinging 172.30.0.15 with 32 bytes of data:

Reply from 172.30.0.15: bytes=32 time=36ms TTL=126
Reply from 172.30.0.15: bytes=32 time=25ms TTL=126
Reply from 172.30.0.15: bytes=32 time=15ms TTL=126
Reply from 172.30.0.15: bytes=32 time=29ms TTL=126

Ping statistics for 172.30.0.15:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 15ms, Maximum = 36ms, Average = 26ms

C:\>ping 172.31.0.20

Pinging 172.31.0.20 with 32 bytes of data:

Reply from 172.31.0.20: bytes=32 time=17ms TTL=126
Reply from 172.31.0.20: bytes=32 time=34ms TTL=126
Reply from 172.31.0.20: bytes=32 time=7ms TTL=126
Reply from 172.31.0.20: bytes=32 time=26ms TTL=126

Ping statistics for 172.31.0.20:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 7ms, Maximum = 34ms, Average = 21ms

C:\>
```

Figure 20-Student-Laptop1 now has two-way connectivity to Eng-Printer at 172.30.0.15 in VLAN30 and CompSci-Printer at 172.31.0.20 in VLAN 31