Application Note

Cisco Analog Gateways Network Survivability Deployment Options

(VG3XX, VG224, VG204XM and VG202XM)

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Introduction

The Cisco VG series Analog Voice Gateways enable an IP telephony solution to continue using traditional analog devices while taking advantage of the productivity afforded by IP infrastructure. The Cisco VG series are Cisco IOS software-based analog phone gateways. They connect analog phones, fax machines, modems, and speakerphones to an enterprise voice system based on Cisco Unified Communications Manager (CUCM). The tight integration with the IP-based phone system is advantageous for increased manageability, scalability, and cost-effectiveness. Businesses can also use the Cisco VG series with Cisco Unified Communications Manager Express (CME) or Cisco Unified Communications Manager to effectively augment an integrated services router (ISR) environment.

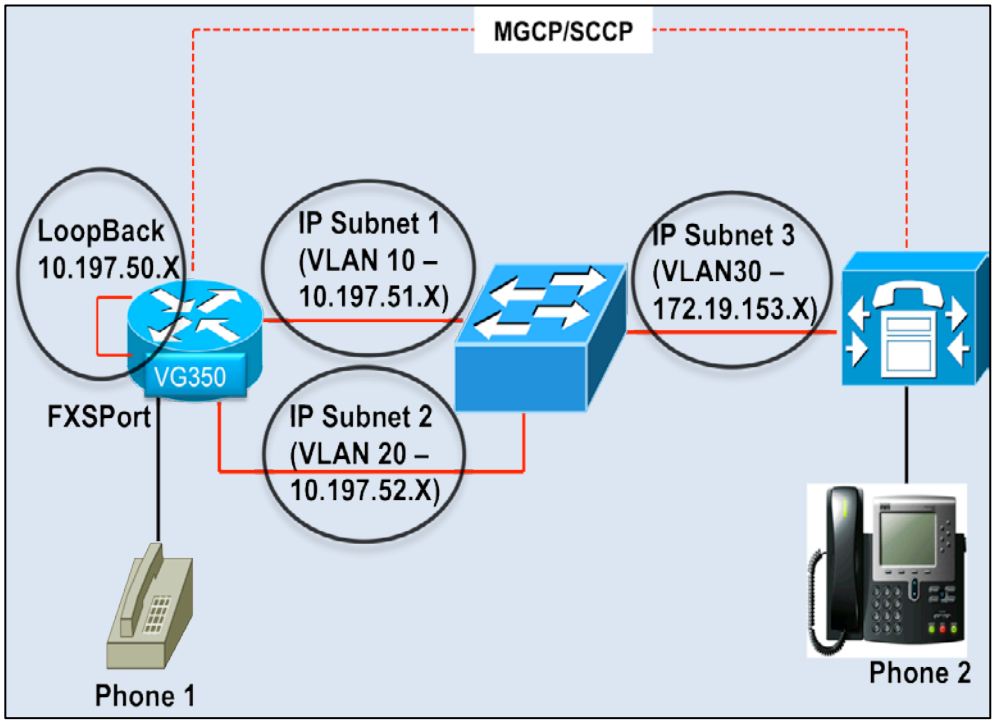
In this application note we are going to talk about the network survivability options that can be provided when you deploy a VG series in your network. There are two redundancy options available for VG deployments:

- Routed survivability, where the VG could use either MGCP or SCCP signaling to CUCM and leverages L3 equal cost multi-pathing (ECMP) for fast link failover.
- Bridged survivability, where the VG uses SCCP signaling to CUCM and relies on spanning tree for link failover.

By providing redundancy, there is always at least one active link to the call control agent, which could be a CUCM or CME, to preserve active calls in case of link failure.

Routed Survivability

Routed survivability uses the VGs capability to be controlled as an MGCP or SCCP gateway and use L3 ECMP for fast link failover. The VG registers itself to the CUCM as an MGCP or SCCP gateway and uses its physical connections to create redundant paths. The VG's loopback interface is used to register to the CUCM. Because the loopback interface is virtual, it always stays active. In case a physical link fails, the VG remains registered to the CUCM and preserves active calls by switching them to a redundant port.



Configuration

Overview

1. Create three IP subnets on the switch.
2. Connect the gigabit interfaces on the VG to subnets 1 and 2.
3. Connect CUCM to subnet 3.
4. Create a loopback interface on the VG. This is the interface used by the VG to register itself as an MGCP or SCCP gateway to the CUCM.
5. Enable MGCP or SCCP on the VG.
6. Enable EIGRP on the switch and the VG.
   After the topology converges there will be redundant paths to the CUCM. Now if a port on the VG loses connectivity, active calls switch to the other link and are preserved.

Routed Survivability Option 1 – MGCP GW

On the VG350:

Step 1 – Configure IP addresses for the physical Ethernet interfaces.

```
VG350(config)#interface GigabitEthernet0/1
VG350(config-if)#ip address 10.197.51.2 255.255.255.0
VG350(config-if)#no shut
VG350(config-if)#exit
VG350(config)#interface GigabitEthernet0/2
VG350(config-if)#ip address 10.197.52.2 255.255.255.0
VG350(config-if)#no shut
```

Step 2 – Configure a loopback interface.

```
VG350(config)#
VG350(config)#interface Loopback0
VG350(config-if)#ip address 10.197.50.2 255.255.255.0
VG350(config-if)#no shut
```

Step 3 – Enable EIGRP.[1]

```
VG350(config)#router eigrp 20
VG350(config-router)#network 10.0.0.0
VG350(config-router)#eigrp stub connected summary
```

Step 4 – Create a hostname mapping for the CUCM.

```
VG350(config)#ip host CUCM90 172.19.153.139
```

[1] The VG needs to advertise the 10.X.X.X IP subnets that are connected to the switch so enable EIGRP for this network.

Step 5.1 – Enable MGCP.

```
VG350(config)#mgcp
VG350(config)#mgcp call-agent CUCM90 2427 service-type mgcp version 0.1
VG350(config)#mgcp bind control source-interface Loopback0
VG350(config)#mgcp bind media source-interface Loopback0
VG350(config)#ccm-manager mgcp
```

Explanation:

1. 'mgcp call-agent CUCM90 2427 service-type mgcp version 0.1'
   - Specifies the call agent's name or IP address. This example uses 'CUCM90' as the call agent name.
   - Specifies call agent address UDP port number. For MGCP the standard port number is 2427.
   - Specifies the 'service-type' as 'MGCP'.
   - Specifies the version as '0.1'.

2. 'mgcp bind control source-interface Loopback0'
   - Binds the control traffic to the loopback interface, which is why this interface is used to register to the CUCM.

3. 'mgcp bind media source-interface Loopback0'
   - Binds the media traffic to the loopback interface.

4. 'ccm-manager mgcp'
   - Enables Call Manager Application in MGCP mode.

Step 5.2 – Configure analog ports to use MGCP.

```
VG350(config)#dial-peer voice 1000 pots
VG350(config-dial-peer)#service MGCPAPP
VG350(config-dial-peer)#port 4/0/25
```

Explanation:

1. 'service MGCPAPP'
   - Enables MGCP application on the dial peer.
   - Configuration tip – 'MGCPAPP' is case sensitive.

Configuration Tip:

- Dial peer needs to be created for every port and this can be done with ease using the 'dial peer group' CLI enhancement.

```
VG350(config)#dial-peer group 1
VG350(config-dial-peer)#service MGCPAPP
VG350(config-dial-peer)#port 4/0/0 -71 1
```

On the switch:

Step 1 – Configure three IP subnets.

Step 1.1 – Add VLANs in the database.

```
Switch#vlan database
Switch(vlan)#vlan 10
VLAN 10 added:
   Name: VLAN0010
Switch(vlan)#vlan 20
VLAN 20 added:
   Name: VLAN0020
Switch(vlan)#vlan 30
VLAN 30 added:
   Name: VLAN0030
```

Step 1.2 – Create SVIs for the VLANs created previously.

```
Switch(config)#interface Vlan10
Switch(config-if)#ip address 10.197.51.1 255.255.255.0
Switch(config-if)#exit
Switch(config)#interface Vlan20
Switch(config-if)# ip address 10.197.52.1 255.255.255.0
Switch(config)#interface Vlan30
Switch(config-if)# ip address 172.19.153.1 255.255.255.0
```

Step 1.3 – Add switch ports to the VLANs.

```
Switch(config)#interface FastEthernet0/1
Switch(config-if)#switchport host
Switch(config-if)#switchport access vlan 10
Switch(config-if)#exit
Switch(config)#interface FastEthernet0/2
Switch(config-if)#switchport host
Switch(config-if)#switchport access vlan 20
Switch(config)#interface FastEthernet0/3
Switch(config-if)#switchport host
Switch(config-if)#switchport access vlan 30
Switch(config-if)#exit
```

Step 2 – Enable EIGRP.[2]

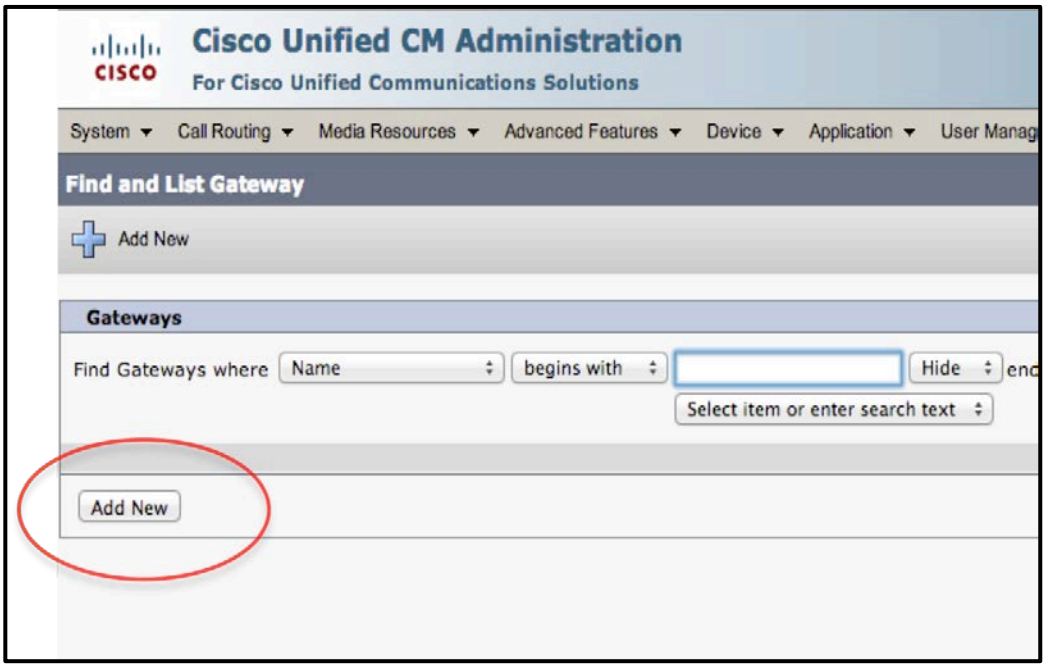
```
Switch(config)#router eigrp 20
Switch(config-router)# network 10.0.0.0
Switch(config-router)# network 172.19.0.0
```

[2] The switch needs to advertise the 10.X.X.X IP subnets connected to the VG and the 172.19.X.X subnet connected to the CUCM so enable EIGRP for these two networks.

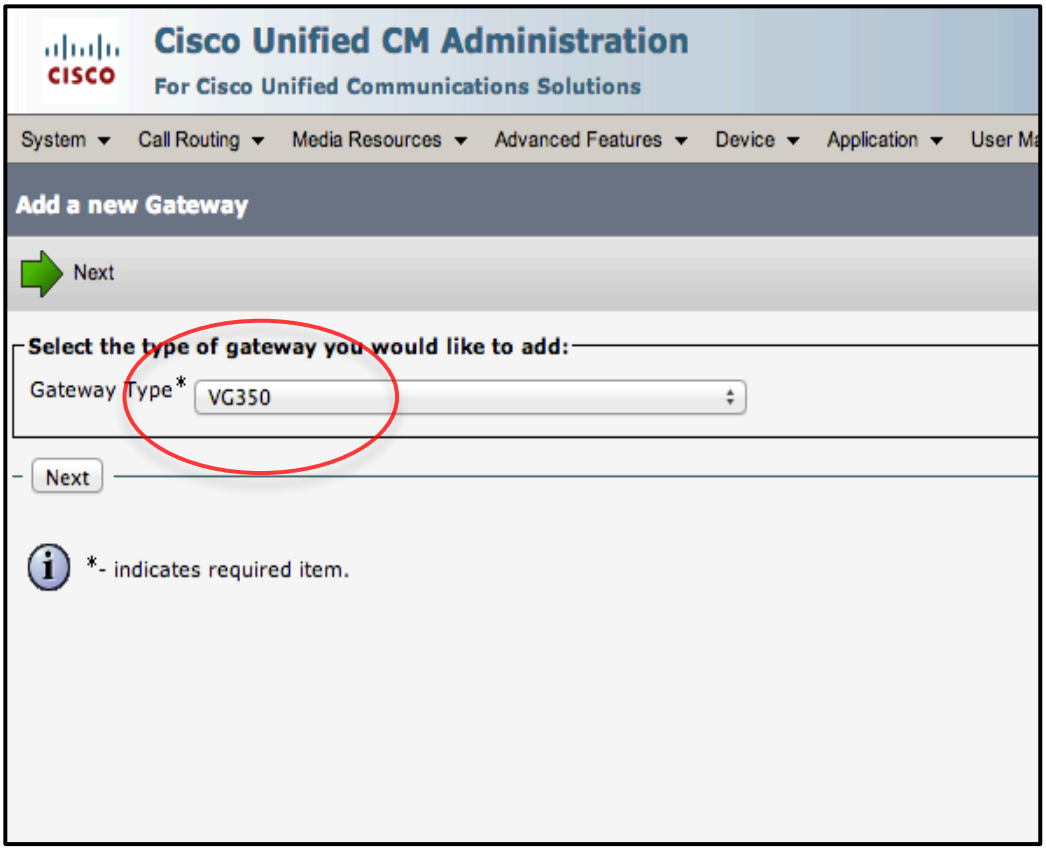
On the CUCM:

Step 1 – Register the VG350 as an MGCP gateway.

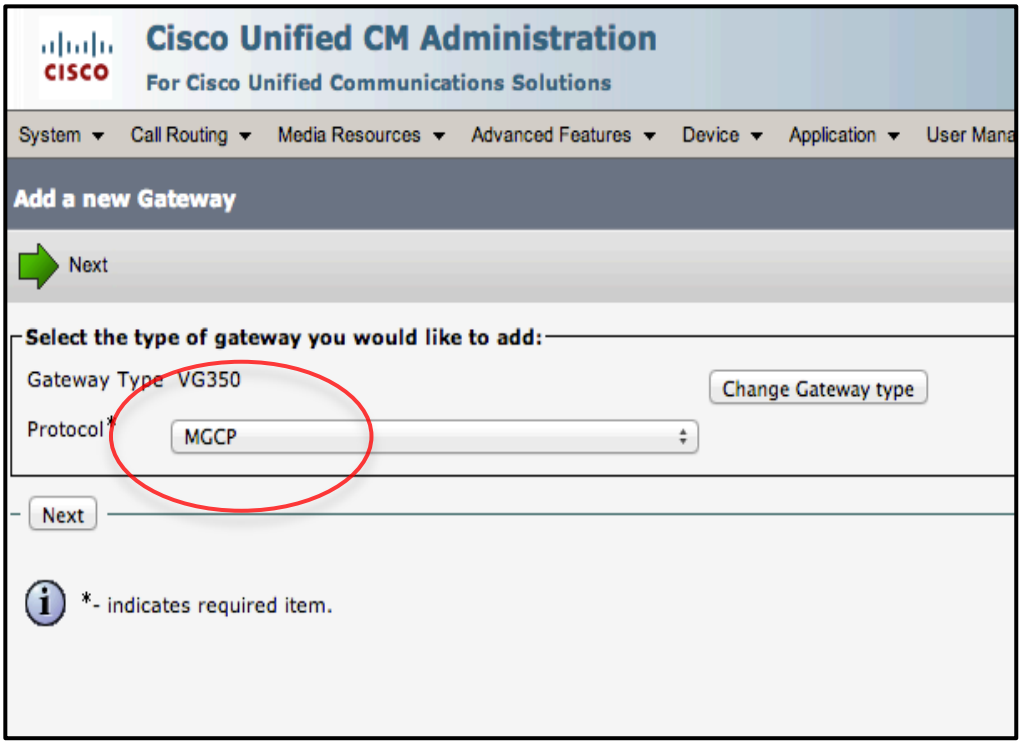
Step 1.1 – Device -> Gateway -> Add New



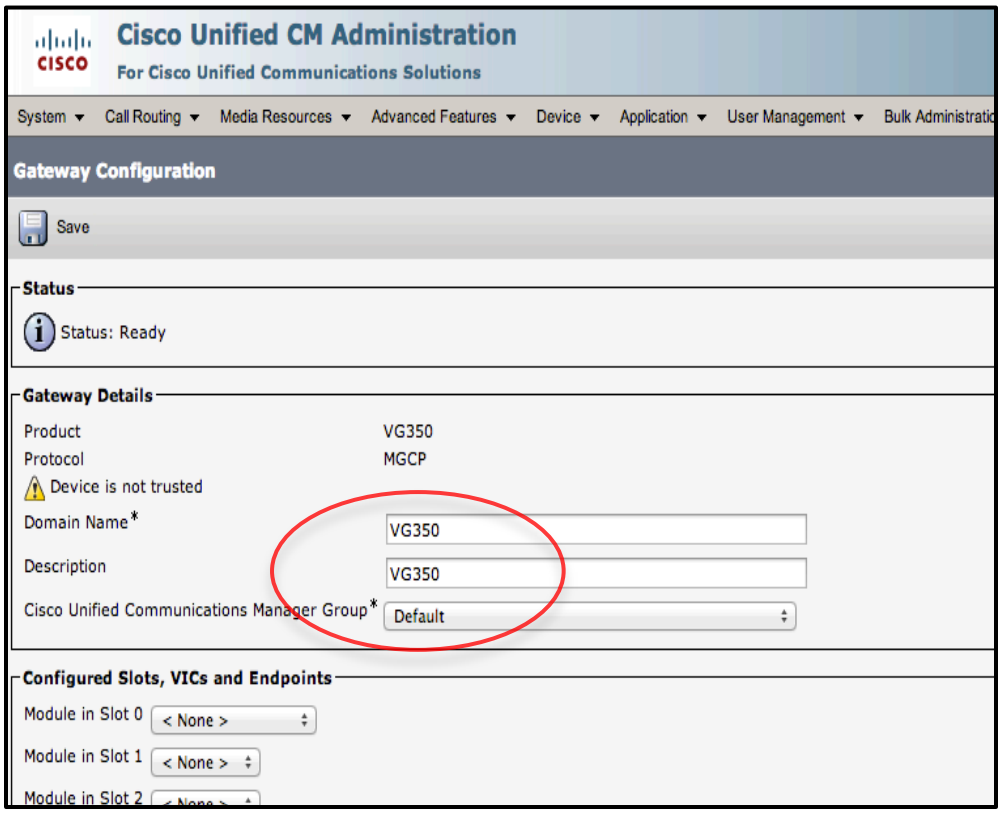
Step 1.2 – Select Gateway Type as 'VG350' and press 'Next'.



Step 1.3 – Select Protocol as 'MGCP' and press 'Next'.



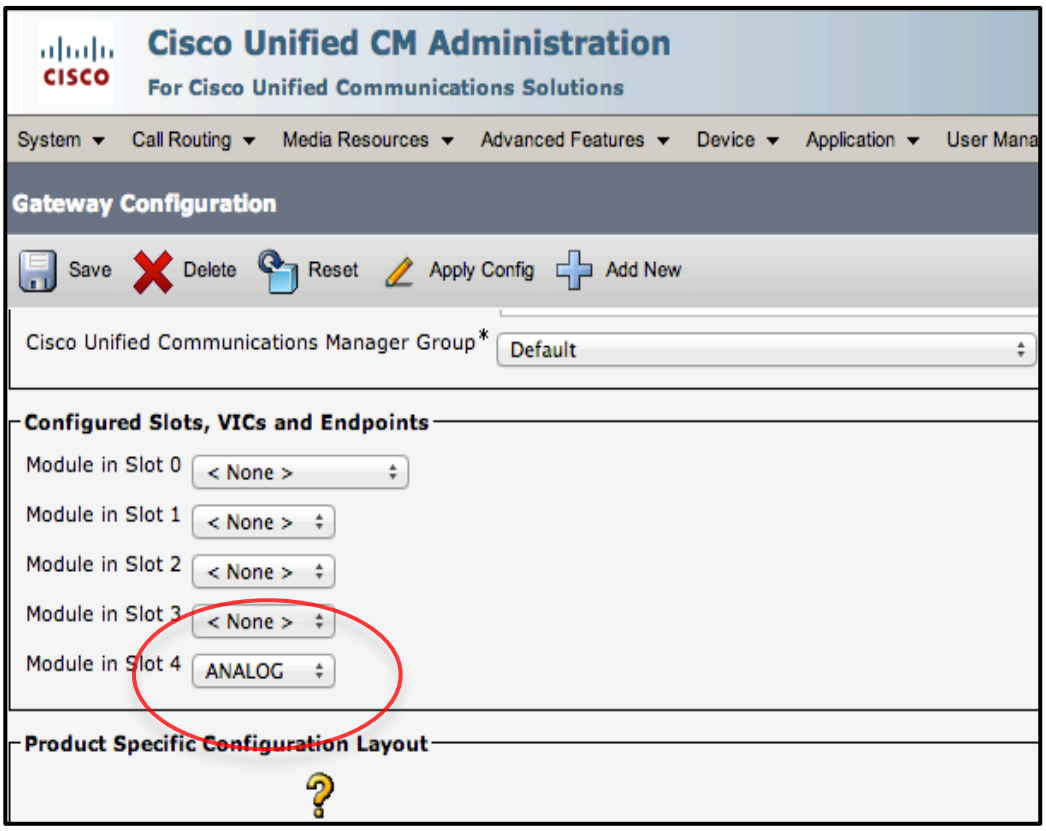
Step 1.4 – Add the 'Domain Name' and the 'Cisco Unified Communications Manager Group'. In this example it is set to 'Default'.



Leave the other properties to their default values. 'Save' the profile and 'Apply the Configuration'.

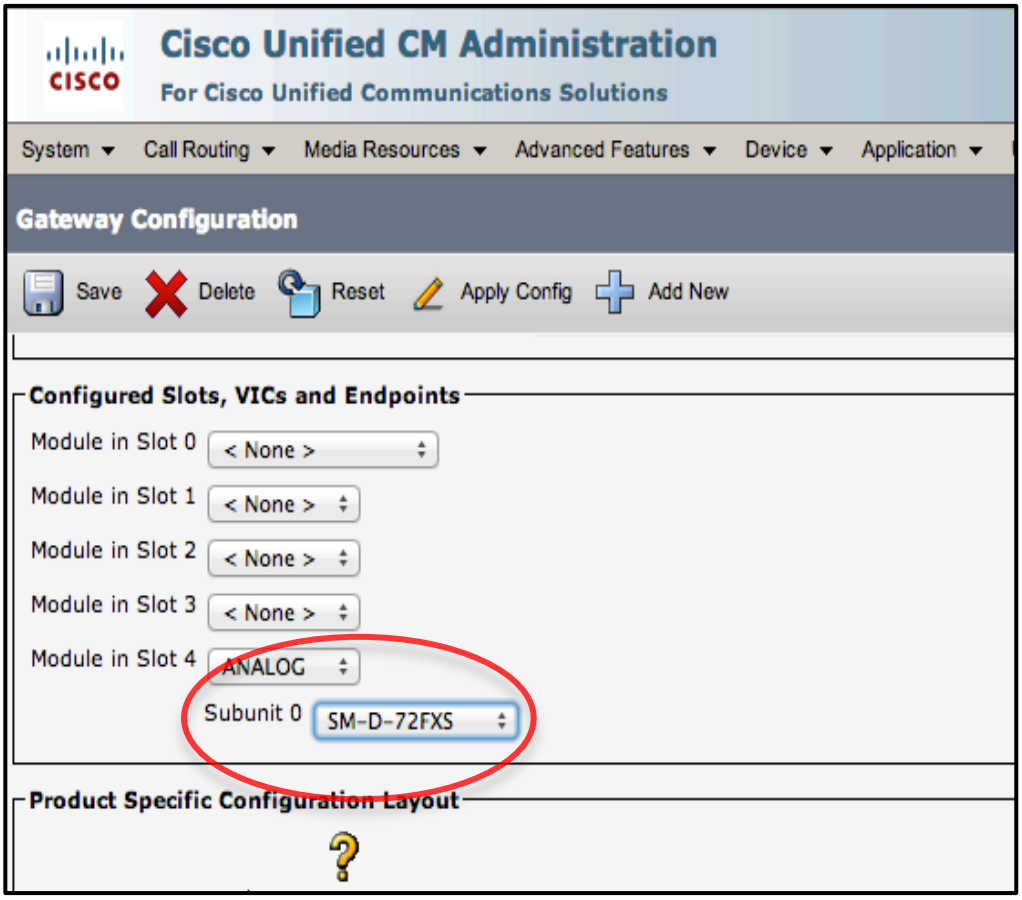
Step 2 – Configure the network module on the MGCP gateway.

Step 2.1 – Select the appropriate slot. This example uses 'Slot 4' in 'Analog' mode.



Save' the profile and 'Apply the Configuration'.

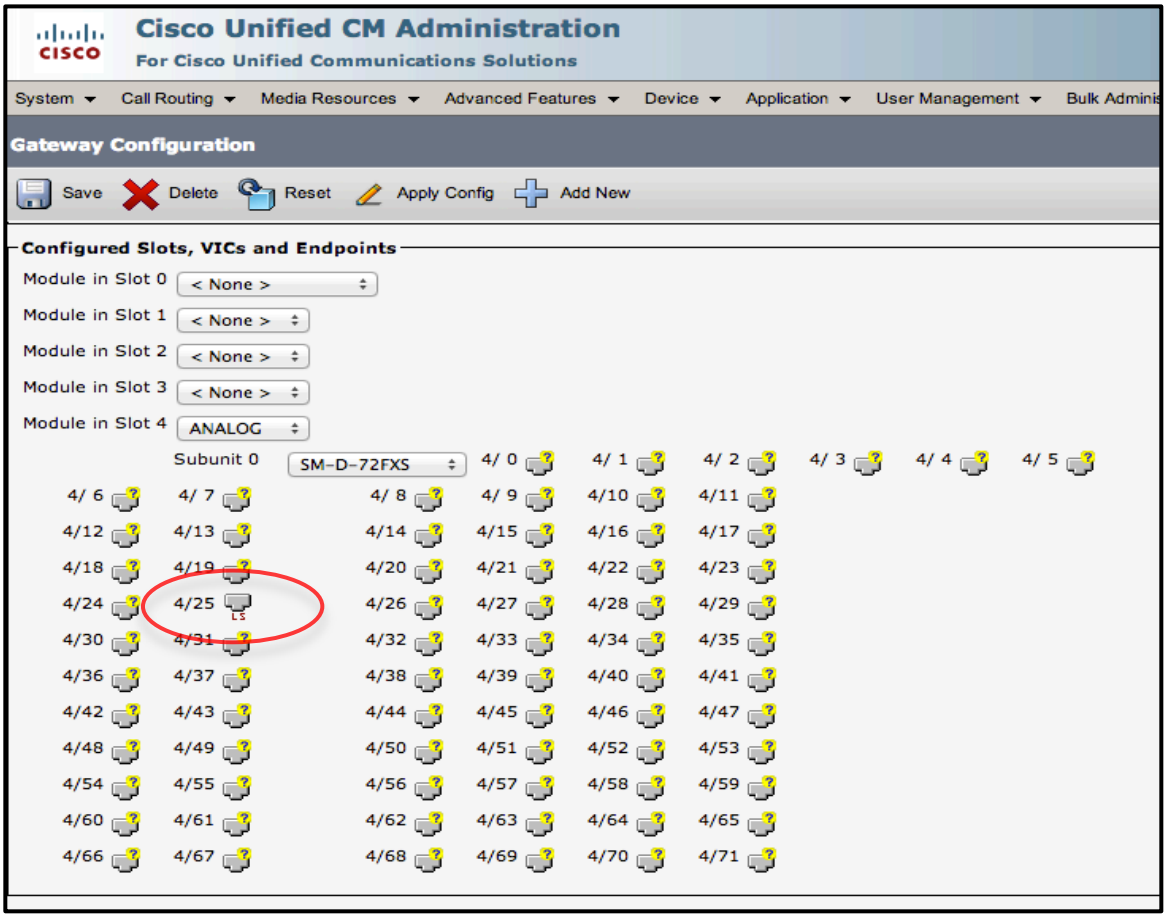
Step 2.2 – Select the appropriate 'Subunit'. This example uses Subunit 0 to 'SM-D-72FXS'.



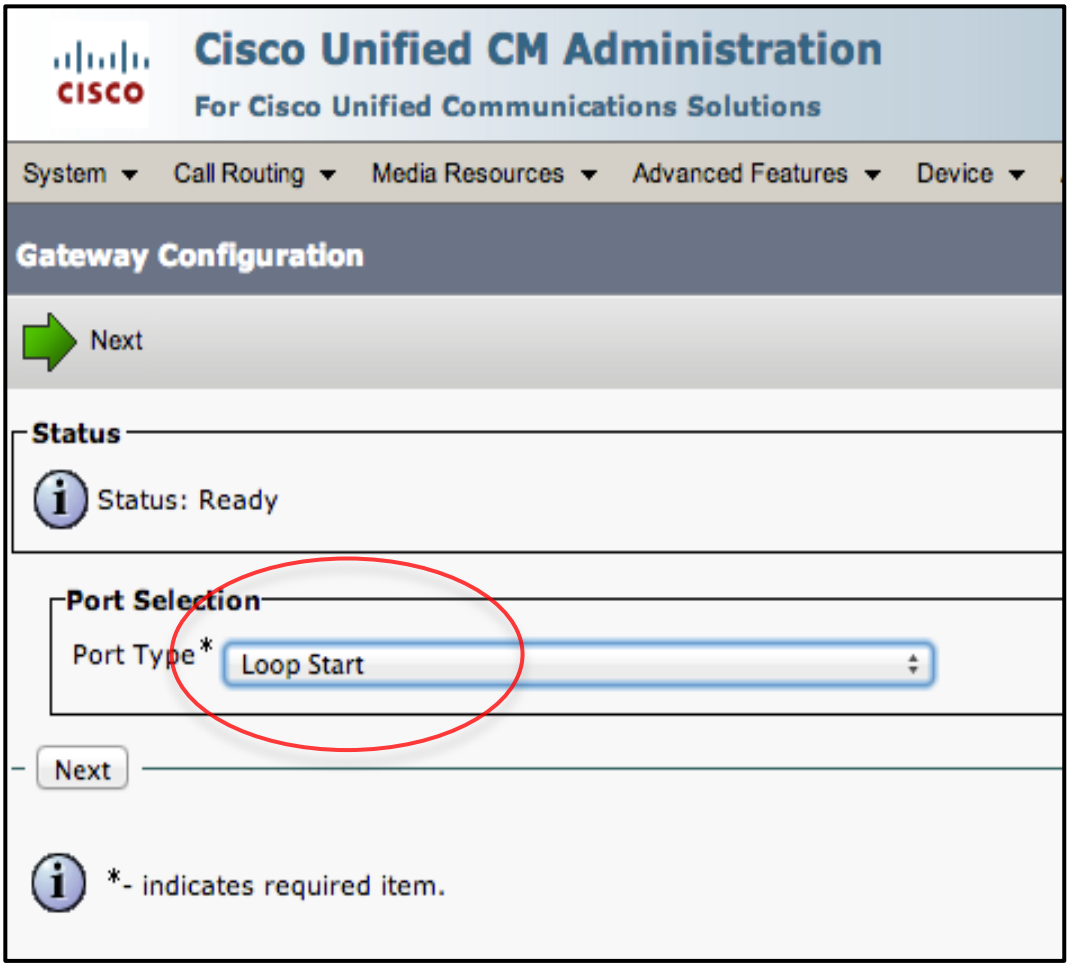
'Save' the profile and 'Apply the Configuration'

Step 3 – Configure the analog port.

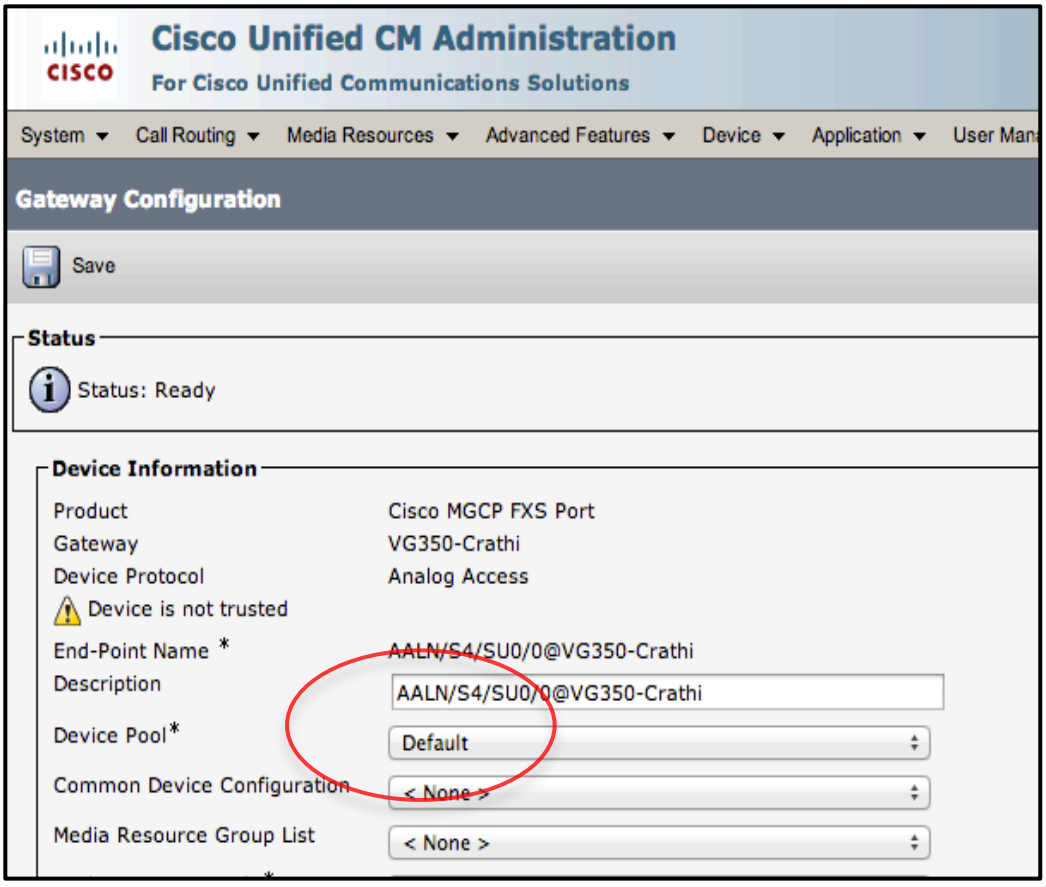
Step 3.1 – Select the appropriate port and click on it. This example uses 'Port 4/25'.

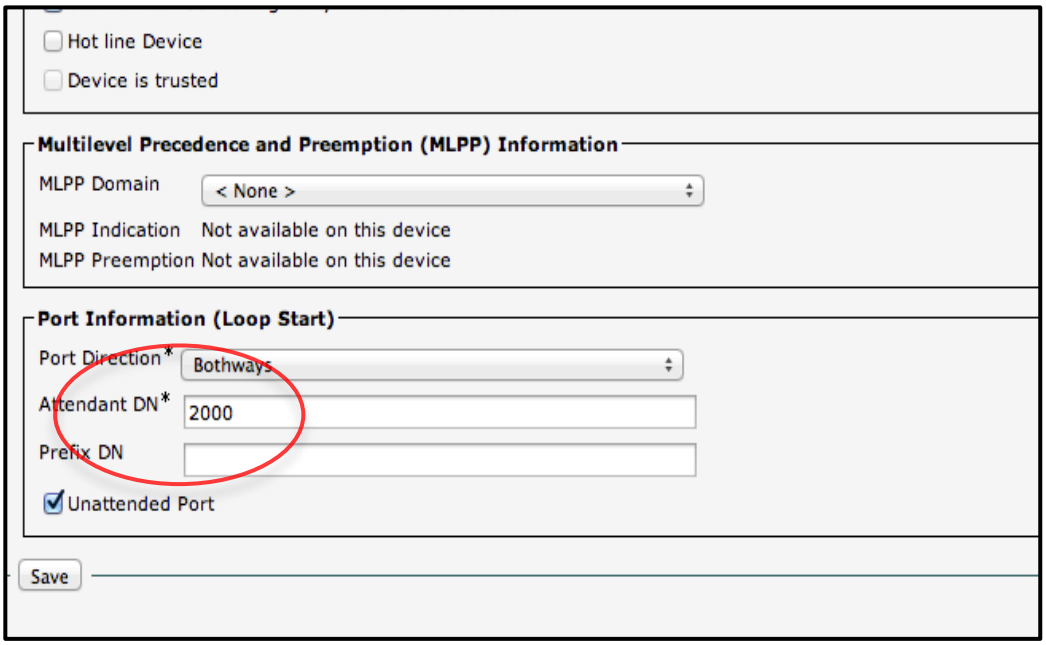


Step 3.2 – Select 'Loop Start' and click 'Next'.



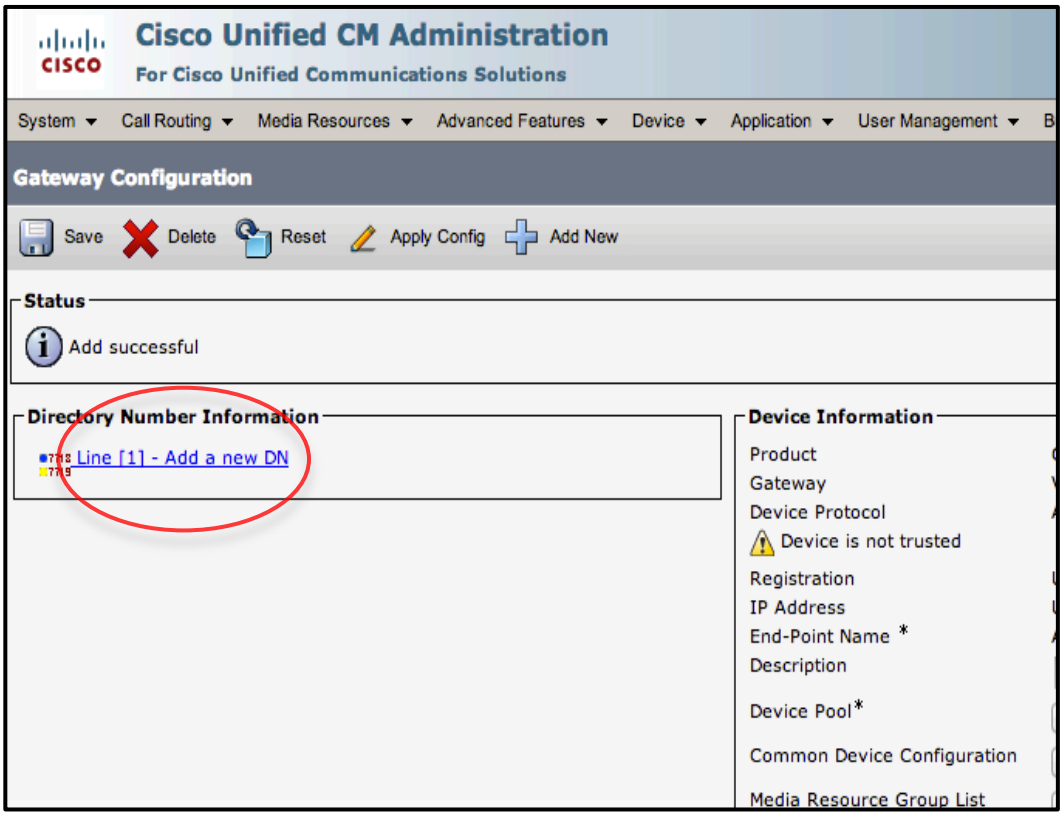
Step 3.3 – Configure the appropriate 'Device Pool' and 'Attendant DN'.



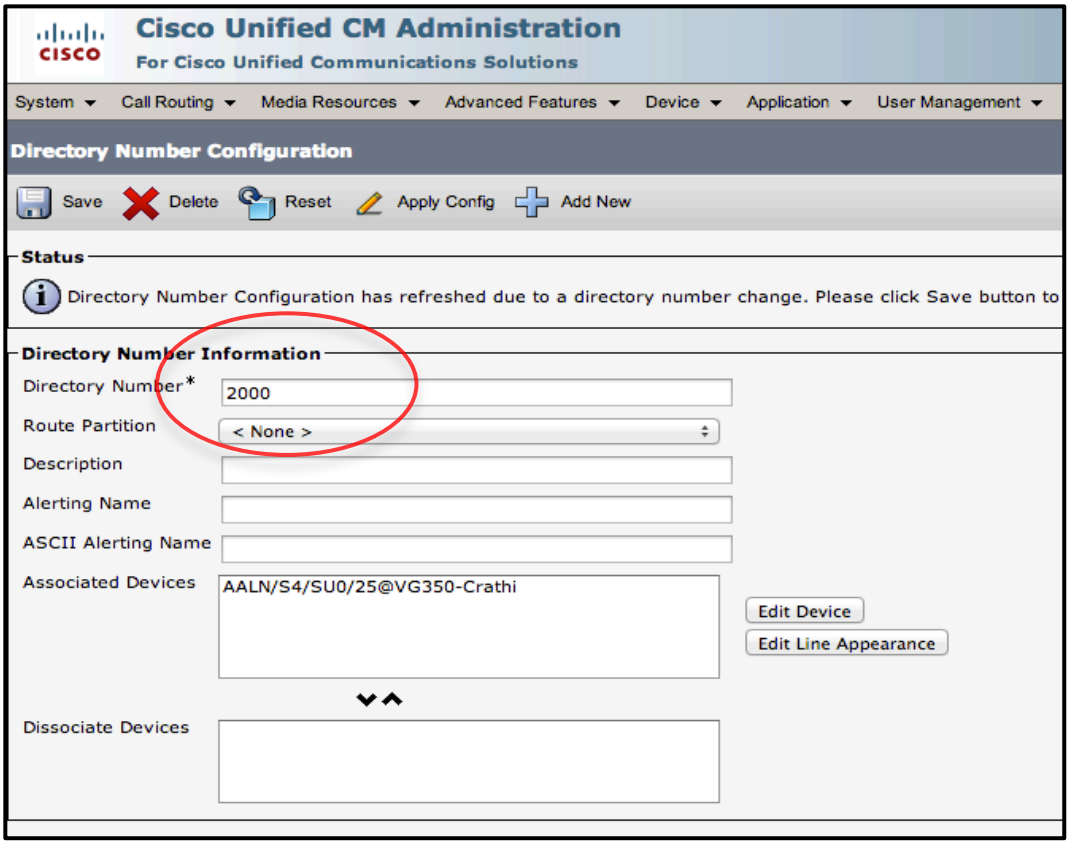


Leave the other properties to their default values. ‘Save’ the profile and ‘Apply the Configuration’.

Step 3.4 – Add the ‘Directory Number Information’. Click on ‘Line [1] – Add a new DN’.

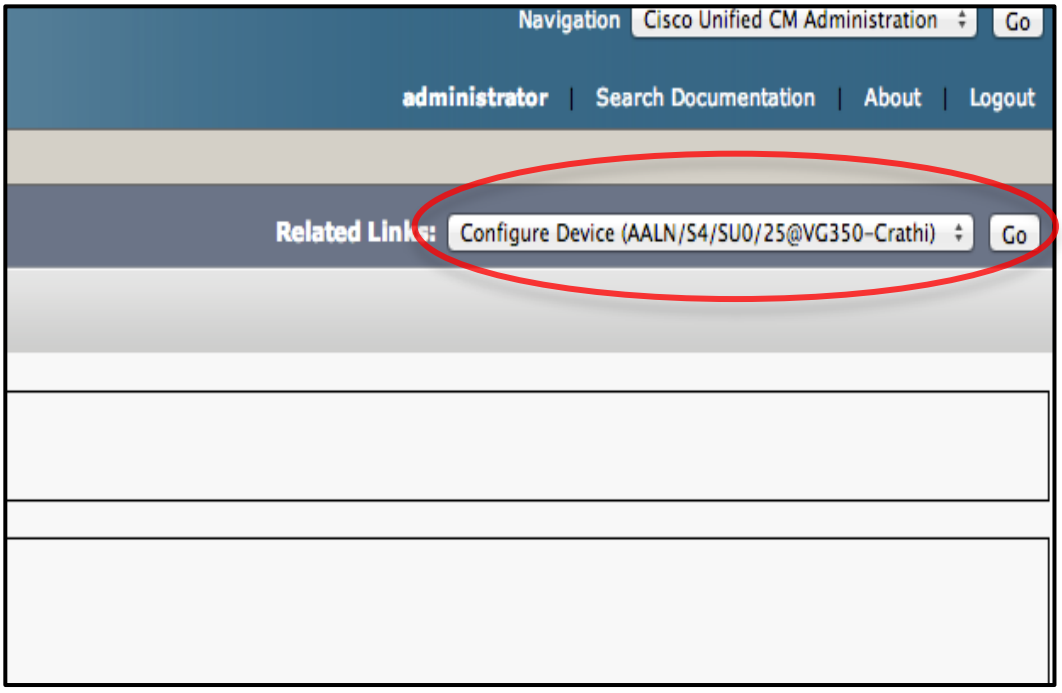


Now configure the ‘Directory Number’.

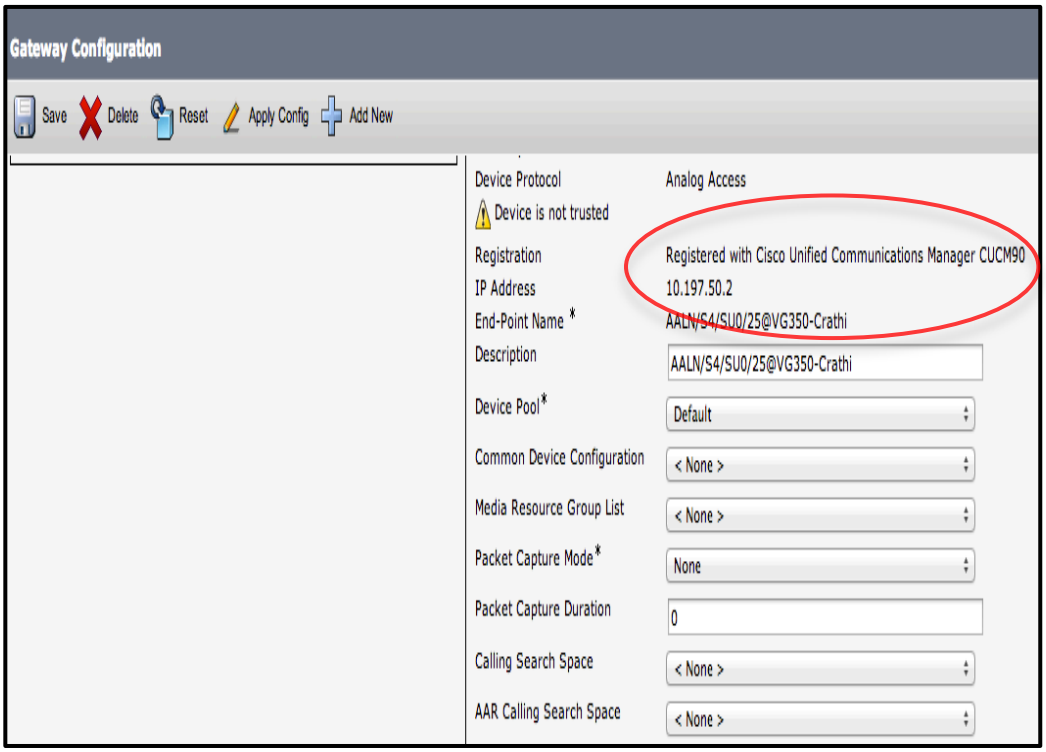


Leave the other properties to their default values. ‘Save’ the profile and ‘Apply the Configuration’.

Step 3.5 – Go back to the port page to check that the port is registered to the CUCM.



Ensure that the port is 'Registered with Cisco Unified Communications Manager'.



Routed Survivability Option 2 – SCCP GW:

On the VG350:

Step 1 – Configure IP addresses for the physical Ethernet interfaces.

```
VG350(config)#interface GigabitEthernet0/1
VG350(config-if)#ip address 10.197.51.2 255.255.255.0
VG350(config-if)#no shut
VG350(config-if)#exit
VG350(config)#interface GigabitEthernet0/2
VG350(config-if)#ip address 10.197.52.2 255.255.255.0
VG350(config-if)#no shut
```

Step 2 – Configure a loopback interface.

```
VG350(config)#
VG350(config)#interface Loopback0
VG350(config-if)#ip address 10.197.50.2 255.255.255.0
VG350(config-if)#no shut
```

Step 3 – Enable EIGRP.[3]

```
VG350(config)#router eigrp 20
VG350(config-router)#network 10.0.0.0
VG350(config-router)#eigrp stub connected summary
```

Step 4 – Create a hostname mapping for the CUCM.

```
VG350(config)#ip host CUCM90 172.19.153.139
```

[3] The VG needs to advertise the 10.X.X.X IP subnets that are connected to the switch so enable EIGRP for this network.

Step 5.1 – Enable SCCP.

```
VG350(config)#sccp local Loopback0
VG350(config)#sccp ccm 172.19.153.139 identifier 1 version 7.0
VG350(config)#sccp
VG350(config)#sccp ccm group 1
VG350(config-sccp-ccm)#associate ccm 1 priority 1
VG350(config-sccp-ccm)#bind interface  Loopback0
VG350(config-sccp-ccm)#exit
```

Explanation:

1. 'sccp local Loopback0'
   - Forces SCCP to use the Loopback0 interface for its communication to the CUCM.

2. 'sccp ccm 172.19.153.139 identifier 1 version 7.0'
   - Specifies the call agent's IP address. This example uses '172.19.153.139'.
   - Specifies the call agent's identifier. This example uses '1'.
   - Specifies the call agent's version. This example uses '7'.

3. 'sccp ccm group 1'
   - Creates a SCCP group with identifier '1'.

4. 'associate ccm 1 priority 1'
   - Under the 'sccp ccm group 1', associate a CUCM with priority 1.

5. 'bind interface Loopback0'
   - Under the 'sccp ccm group 1', binds the Loopback0 interface to the SCCP group.

Step 5.2 – Enable SCCP control of analog ports.

```
VG350(config)#stcapp ccm-group 1
VG350(config)#stcapp
```

Explanation:

1. 'stcapp ccm-group 1'
   - Specifies the STCAPP Call Manager group id. This example uses '1'.

2. 'stcapp'
   - Starts the SCCP Telephony Control Application.

Step 5.3 – Configure analog port to use SCCP.

```
VG350(config)#dial-peer voice 1 pots
VG350(config-dial-peer)#service stcapp
VG350(config-dial-peer)#port 4/0/24
```

Explanation:

1. 'service stcapp'
   - Enables 'stcapp' service on the dial peer.

Configuration Tip:

- Dial peer needs to be created for every port and this can be done easily using the 'dial peer group' CLI enhancement.

```
VG350(config)#dial-peer group 1
VG350(config-dial-peer)#service stcapp
VG350(config-dial-peer)#port 4/0/0 -71 1
```

Step 5.4 – Configure analog port.

```
VG350(config)#voice-port 4/0/24
VG350(config-voiceport)#timeouts ringing infinity
```

On the switch:

Step 1 – Configure three IP subnets.

Step 1.1 – Add VLANs in the database.

```
Switch#vlan database
Switch(vlan)#vlan 10
VLAN 10 added:
   Name: VLAN0010
Switch(vlan)#vlan 20
VLAN 20 added:
   Name: VLAN0020
Switch(vlan)#vlan 30
VLAN 30 added:
   Name: VLAN0030
```

Step 1.2 – Create SVIs for the VLANs created previously.

```
Switch(config)#interface Vlan10
Switch(config-if)#ip address 10.197.51.1 255.255.255.0
Switch(config-if)#exit
Switch(config)#interface Vlan20
Switch(config-if)# ip address 10.197.52.1 255.255.255.0
Switch(config)#interface Vlan30
Switch(config-if)# ip address 172.19.153.1 255.255.255.0
```

Step 1.3 – Add switch ports to the VLANs.

```
Switch(config)#interface FastEthernet0/1
Switch(config-if)#switchport host
Switch(config-if)#switchport access vlan 10
Switch(config-if)#exit
Switch(config)#interface FastEthernet0/2
Switch(config-if)#switchport host
Switch(config-if)#switchport access vlan 20
Switch(config)#interface FastEthernet0/3
Switch(config-if)#switchport host
Switch(config-if)#switchport access vlan 30
Switch(config-if)#exit
```

Step 2 – Enable EIGRP.[4]

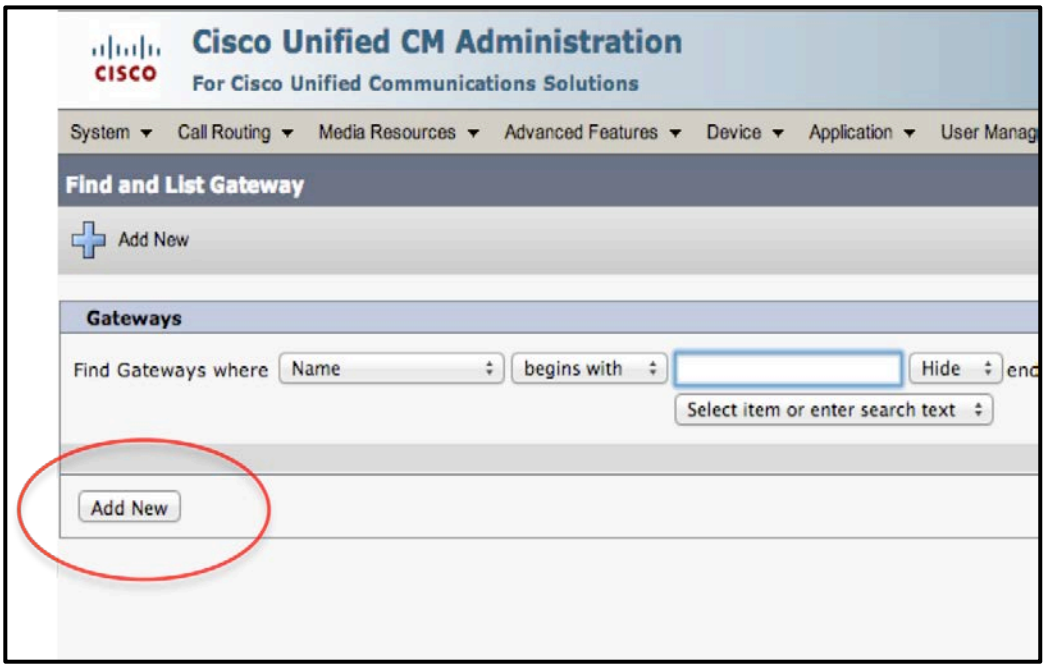
```
Switch(config)#router eigrp 20
Switch(config-router)# network 10.0.0.0
Switch(config-router)# network 172.19.0.0
```

[4] The switch needs to advertise the 10.X.X.X IP subnets connected to the VG and the 172.19.X.X subnet connected to the CUCM so enable EIGRP for these two networks.

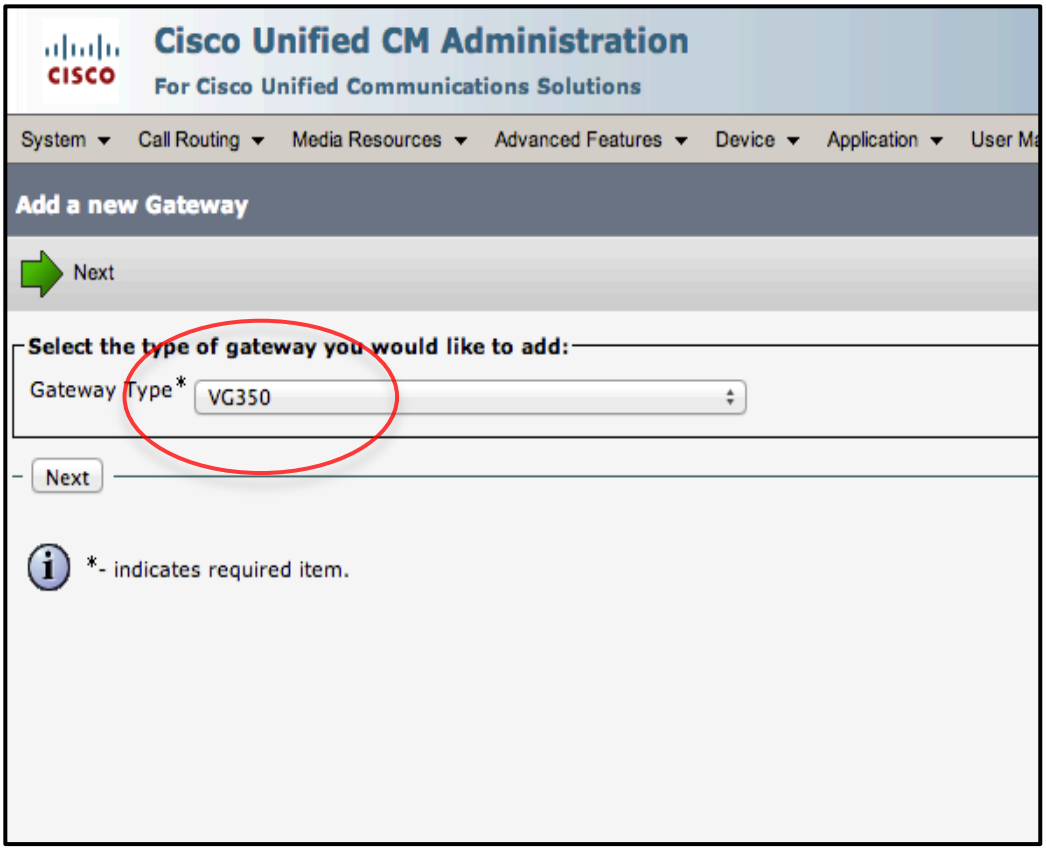
On the CUCM:

Step 1 – Register the VG350 as an SCCP gateway.

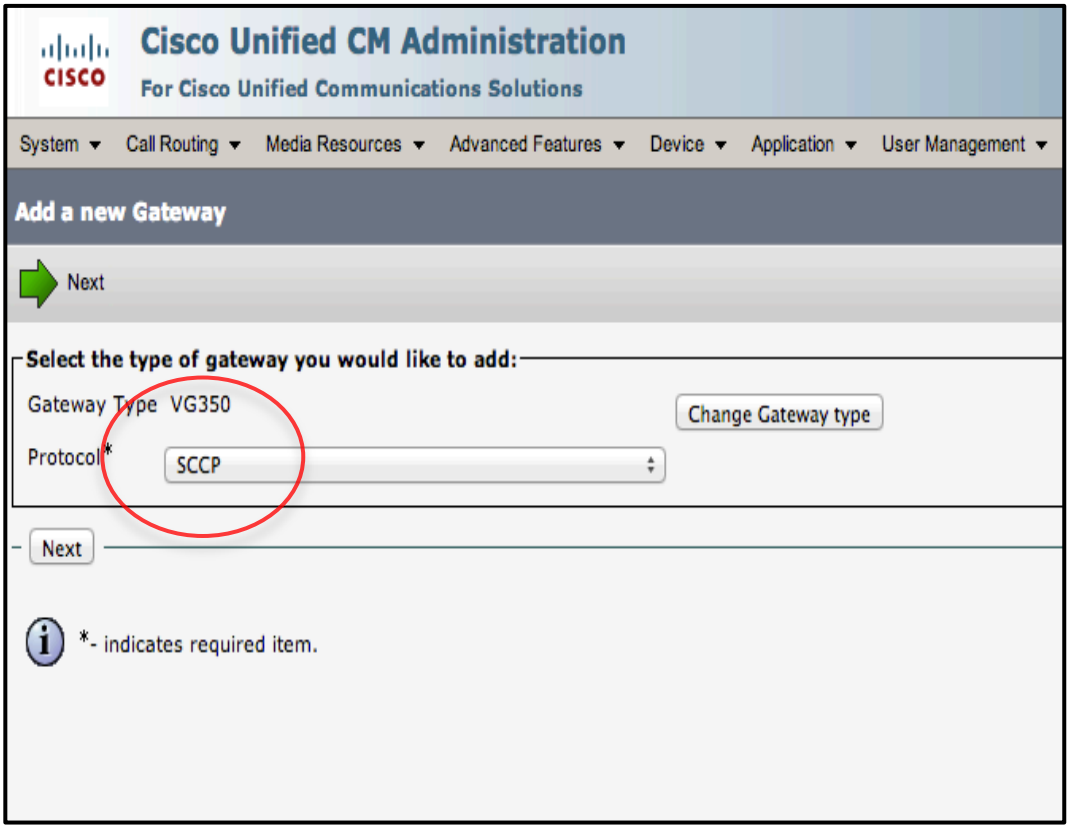
Step 1.1 – Device -> Gateway -> Add New



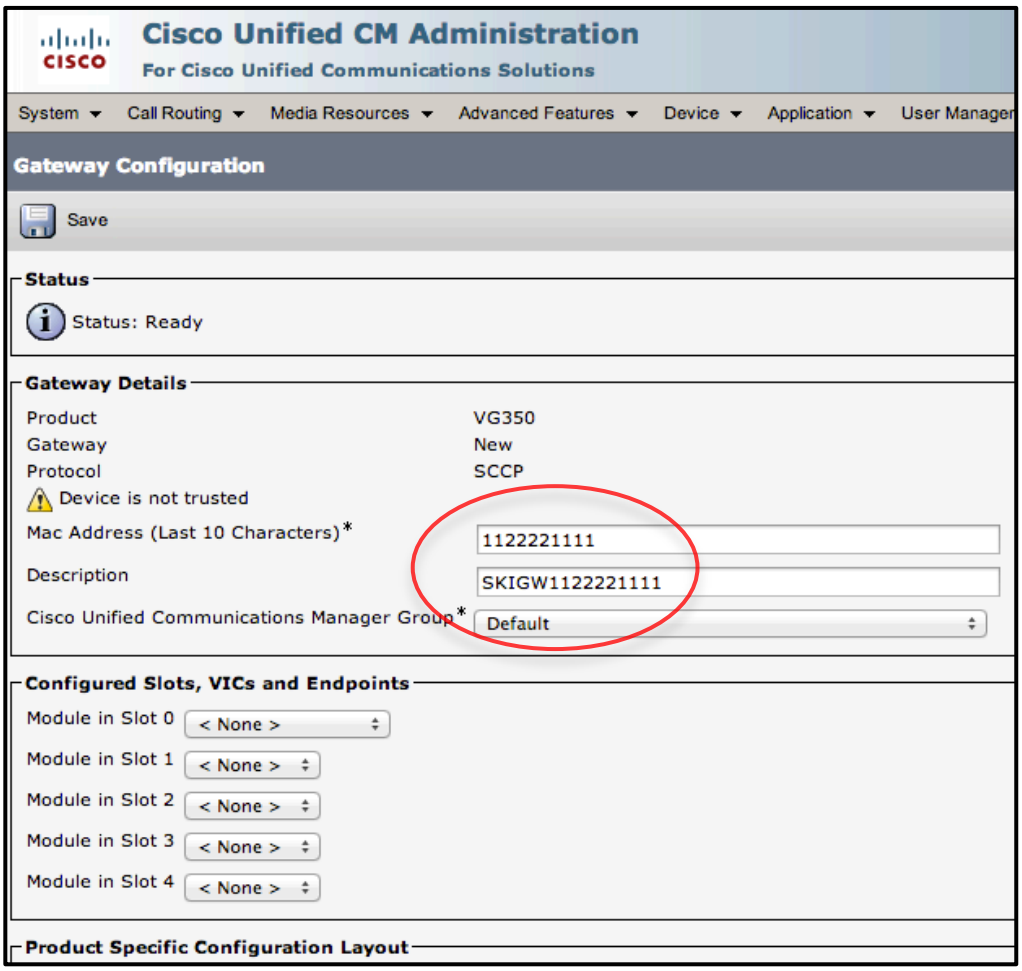
Step 1.2 – Select Gateway Type as 'VG350' and press 'Next'.



Step 1.3 – Select Protocol as 'SCCP' and press 'Next'.



Step 1.4 – Add the last 10 characters of the VG's Gigabit 0/0's MAC address into the 'MAC address' field. In this example, the VG350's Gigabit 0/0 address is 111122221111, therefore, '1122221111' is entered. Set the 'Cisco Unified Communications Manager Group'. In this example it is set to 'Default'.

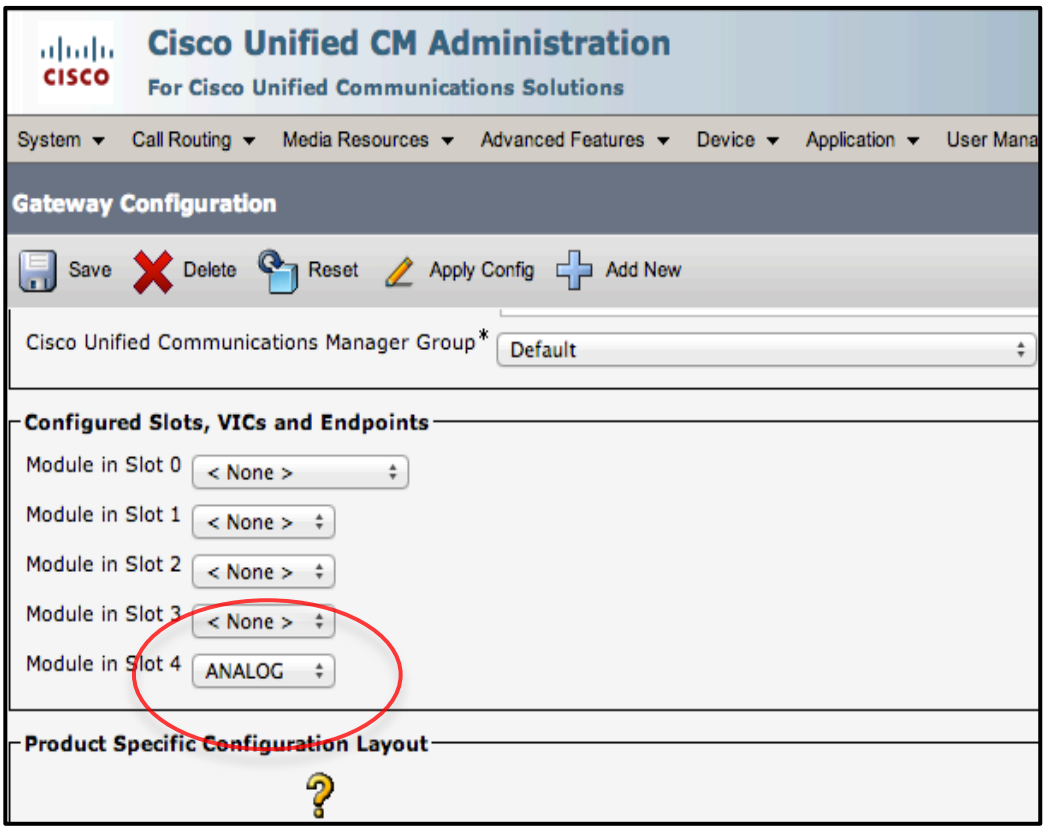


Leave the other properties to their default values. 'Save' the profile and 'Apply the Configuration'.

Note: The VG will use the GE0/0 MAC address to create the SCCP MAC address identity (last 10 characters of the MAC address) This device id is used at layer7 (SCCP) to register the device on CUCM, no matter which L2/L3 interface is forwarding the SCCP signaling packet.

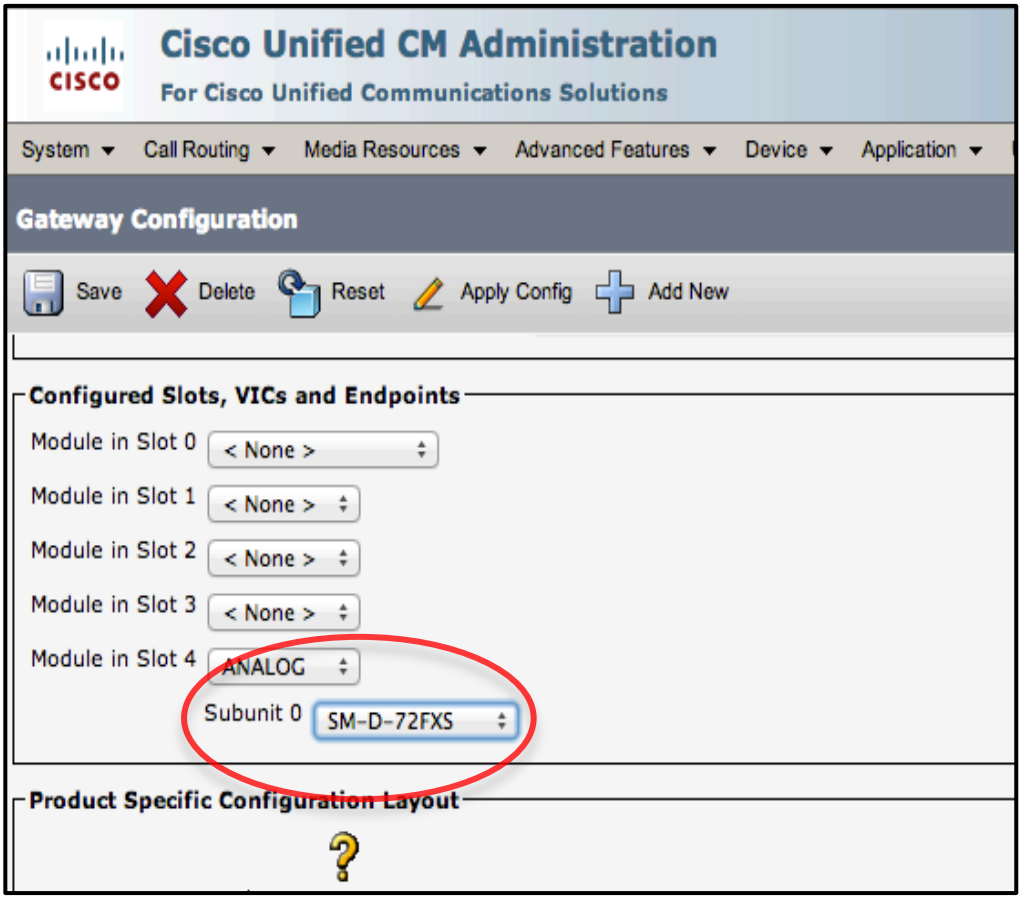
Step 2 – Configure the network module on the SCCP gateway.

Step 2.1 – Select the appropriate slot. This example uses 'Slot 4' in 'Analog' mode.



'Save' the profile and 'Apply the Configuration'.

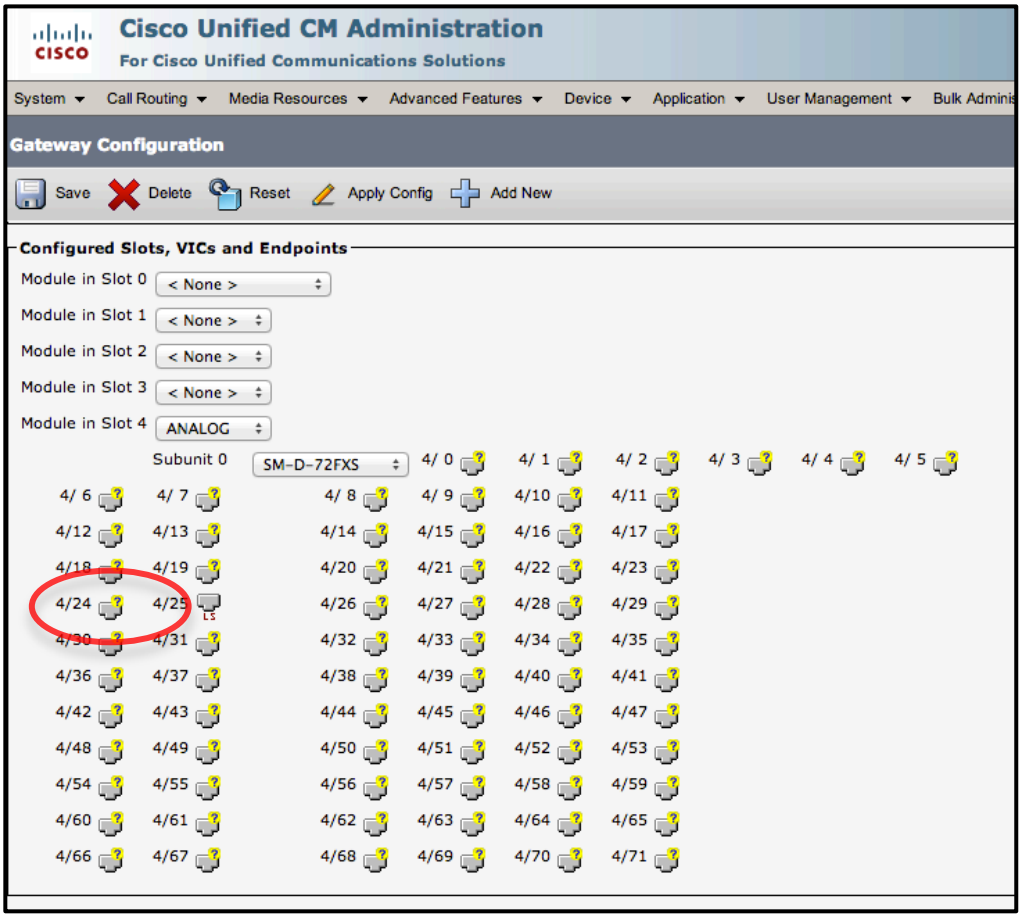
Step 2.2 – Select the appropriate 'Subunit'. This example uses Subunit 0 to 'SM-D-72FXS'.



'Save' the profile and 'Apply the Configuration'.

Step 3 – Configure the analog port.

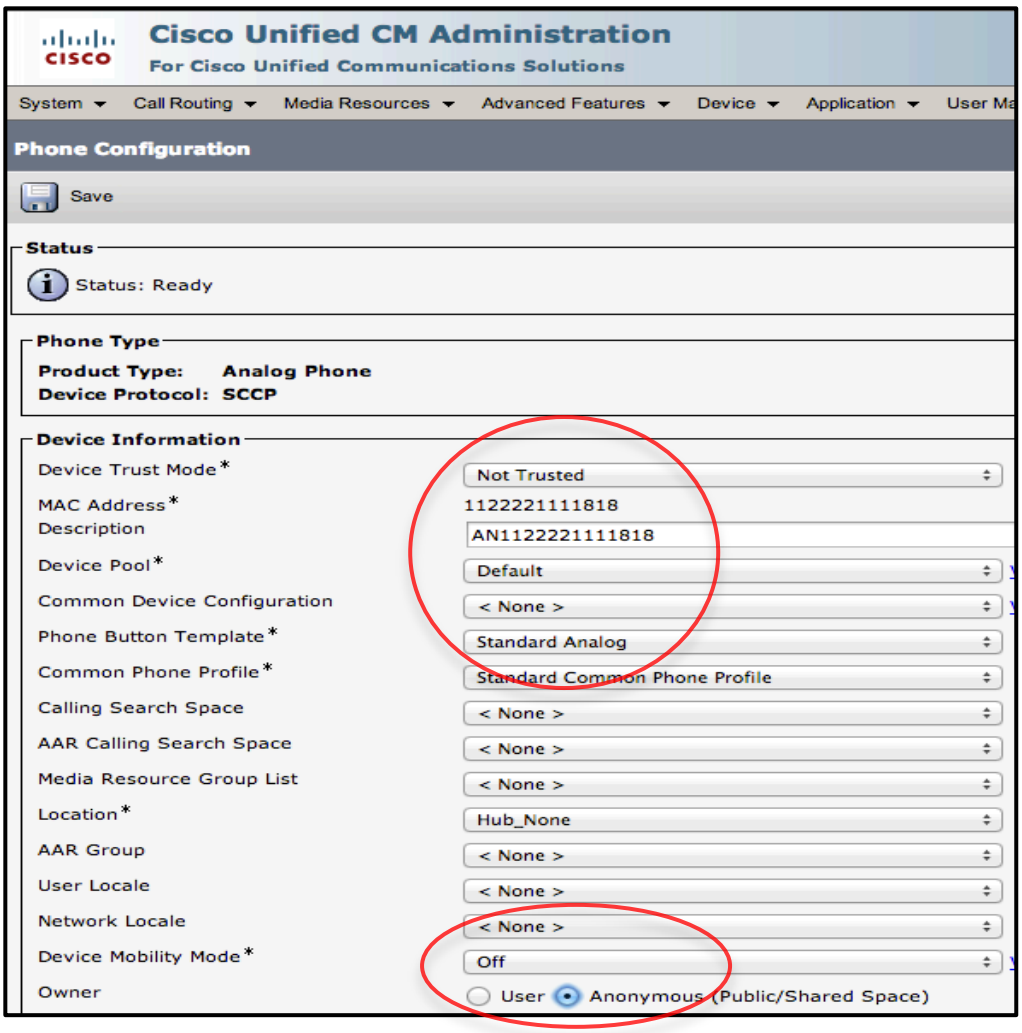
Step 3.1 – Select the appropriate port and click on it. This example uses 'Port 4/24'.

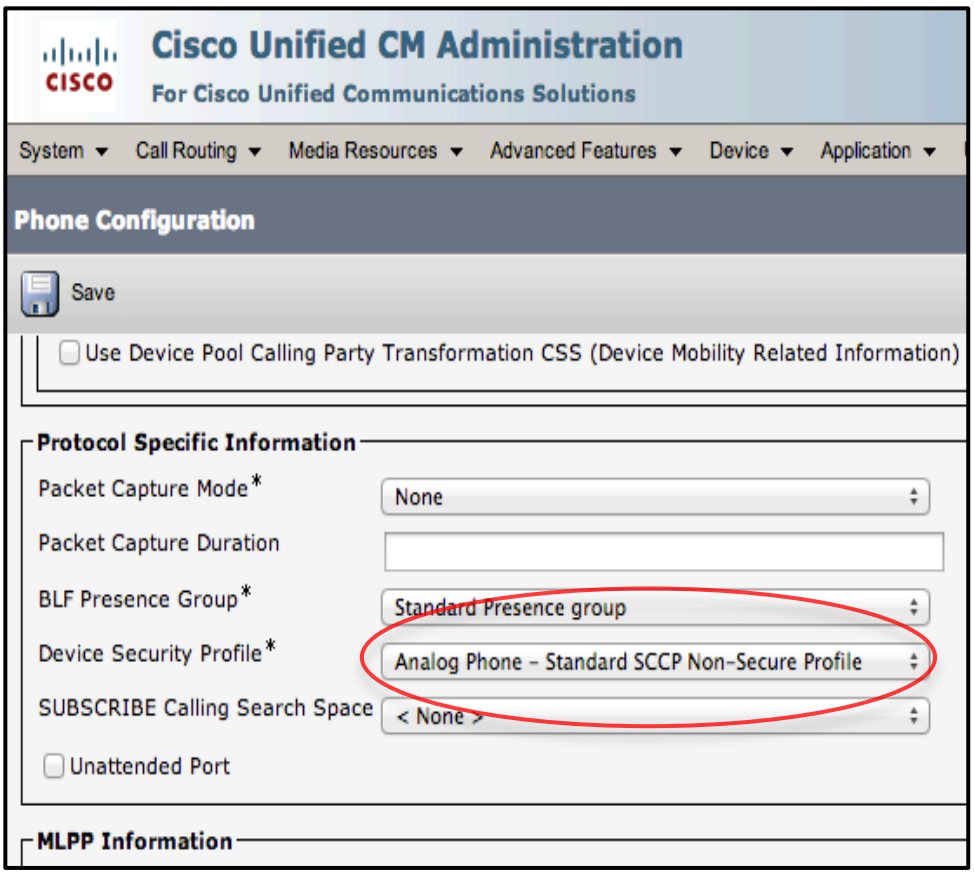


Step 3.2 – Set the appropriate values for:

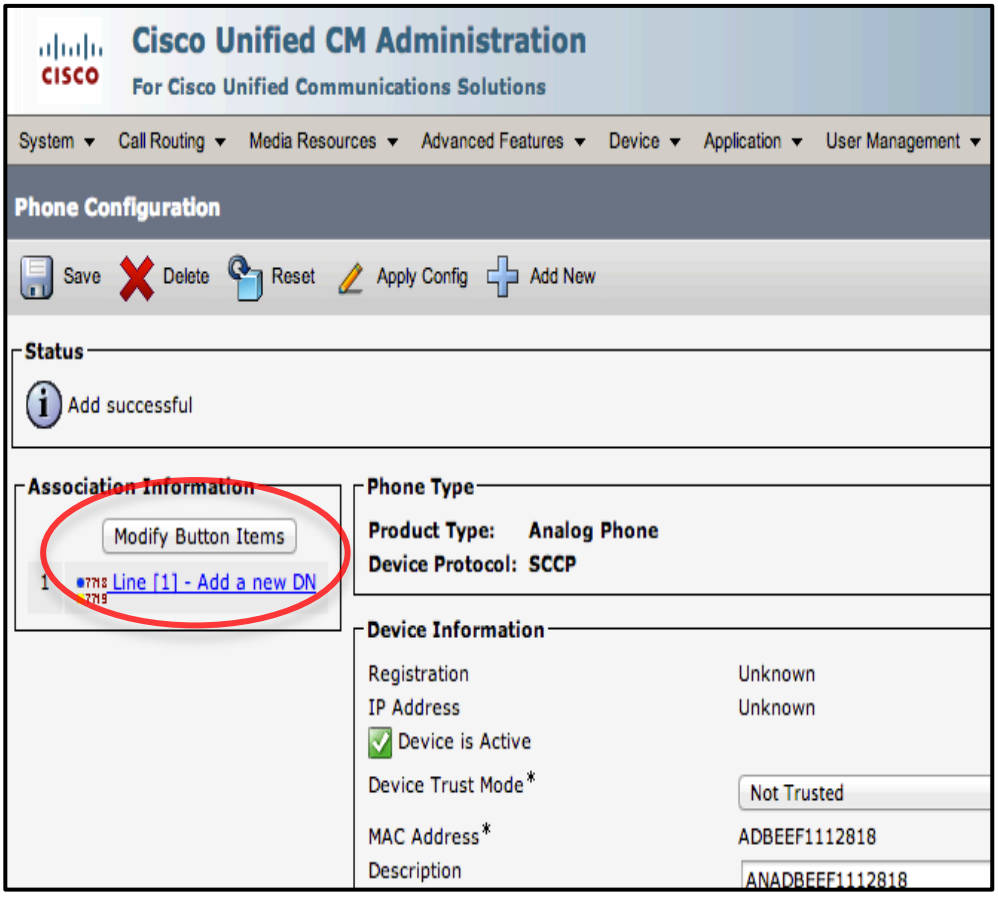
- 'Device Trust Mode', this example uses 'Not Trusted'.
- 'Device pool', this example uses 'Not Trusted'.
- 'Phone Button Template', this example uses'Standard Analog'.
- 'Device Mobility Mode', this example uses 'Off'.
- 'Owner', this example uses 'Anonymous'.
- 'Device Security Profile',this example uses 'Analog Phone – Standard SCCP Non-Secure Profile'.

Leave the other properties to their default values. 'Save' the profile and 'Apply the Configuration'.

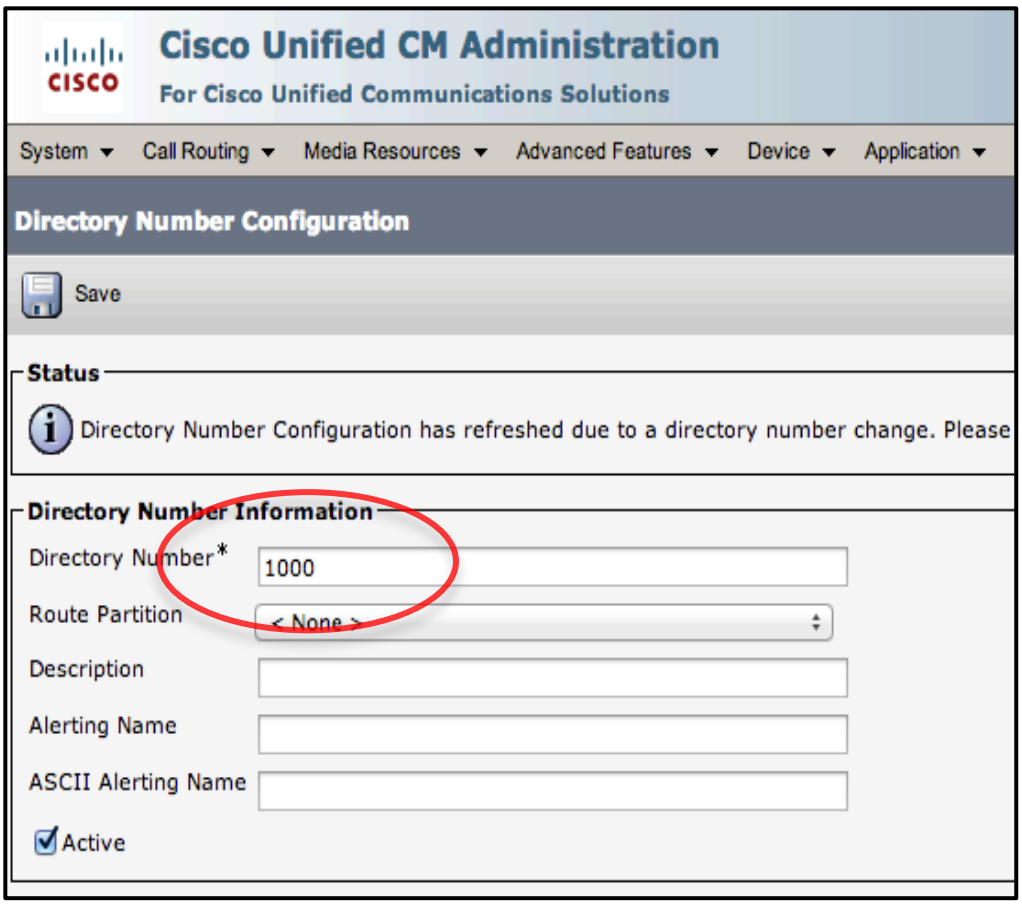

Cisco Unified CM Administration
For Cisco Unified Communications Solutions
System
Call Routing
Media Resources
Advanced Features
Device
Application
User Ma
Phone Configuration
Save
Status
Status: Ready
Phone Type
Product Type: Analog Phone
Device Protocol: SCCP
Device Information
Device Trust Mode*
Not Trusted
MAC Address*
1122221111818
Description
AN1122221111818
Device Pool*
Default
Common Device Configuration
< None >
Phone Button Template*
Standard Analog
Common Phone Profile*
Standard Common Phone Profile
Calling Search Space
< None >
AAR Calling Search Space
< None >
Media Resource Group List
< None >
Location*
Hub_None
AAR Group
< None >
User Locale
< None >
Network Locale
< None >
Device Mobility Mode*
Off
Owner
User
Anonymous (Public/Shared Space)


Cisco Unified CM Administration
For Cisco Unified Communications Solutions
System
Call Routing
Media Resources
Advanced Features
Device
Application
Phone Configuration
Save
Use Device Pool Calling Party Transformation CSS (Device Mobility Related Information)
Protocol Specific Information
Packet Capture Mode*
None
Packet Capture Duration
BLF Presence Group*
Standard Presence group
Device Security Profile*
Analog Phone - Standard SCCP Non-Secure Profile
SUBSCRIBE Calling Search Space
< None >
Unattended Port
MLPP Information

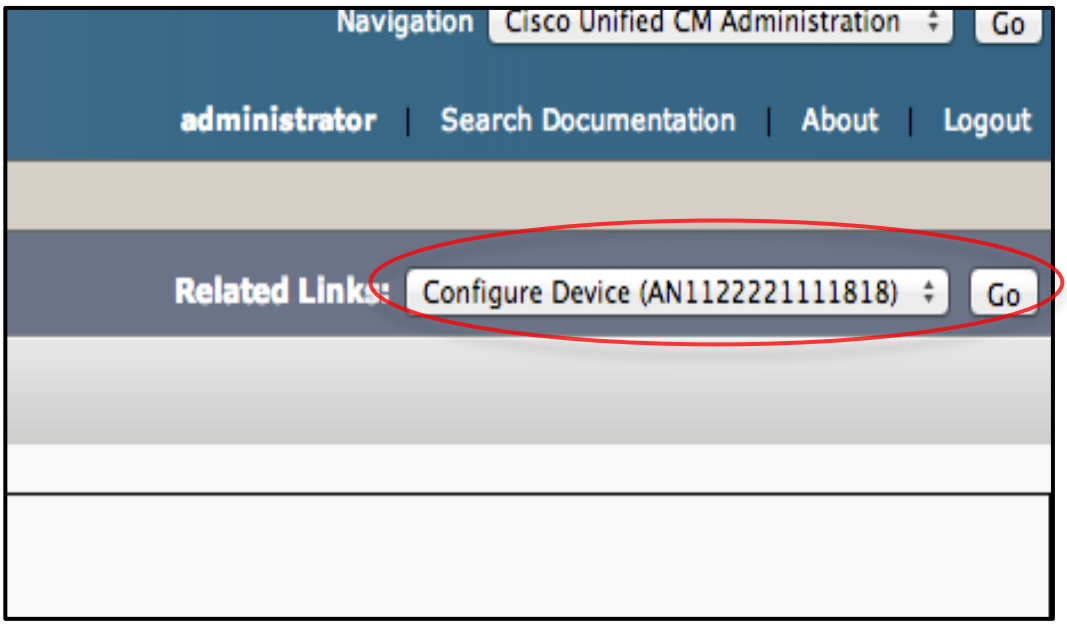
Step 3.3 – Add the 'Directory Number Information'. Click on 'Line [1] – Add a new DN'.



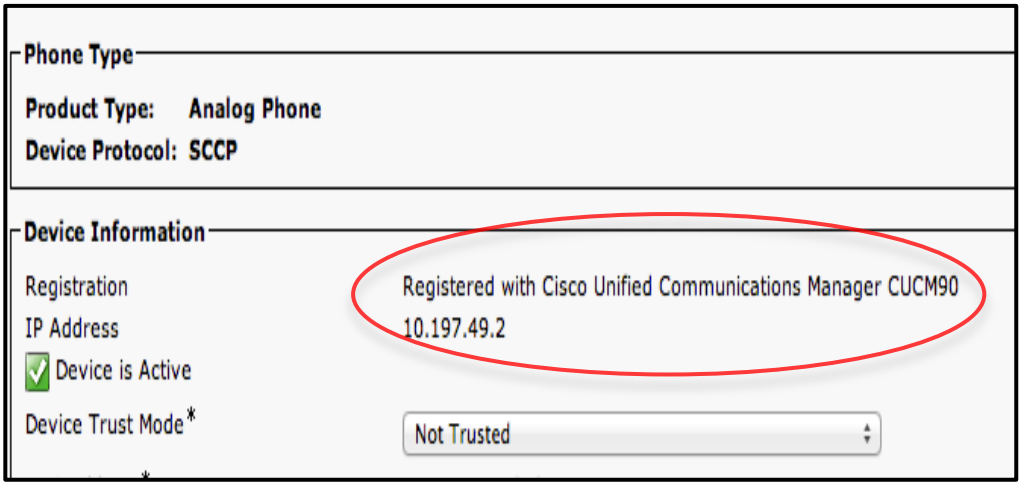
Now configure the 'Directory Number', this example uses '1000'. Leave the other properties to their default values. 'Save' the profile and 'Apply the Configuration'.



Step 3.4 – Go back to the port page to check that the port is registered to the CUCM.



Ensure that the port is ‘Registered with Cisco Unified Communications Manager’.



Show Commands

On the VG350:

```
VG350#show ip eigrp neighbors
EIGRP-IPv4 Neighbors for AS(20)
H   Address          Interface        Hold Uptime   SRTT   RTO  Q  Seq
                                      (sec)        (ms)       Cnt Num
1   10.197.51.1      Gi0/1              13 04:36:33    1  4500  0  167
0   10.197.52.1      Gi0/2              12 04:40:02    5   100  0  169
```

```
VG350#show ip eigrp topology
EIGRP-IPv4 Topology Table for AS(20)/ID(10.197.50.2)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status
P 172.19.153.0/24, 2 successors, FD is 30976
        via 10.197.51.1 (30976/28416), GigabitEthernet0/1
        via 10.197.52.1 (30976/28416), GigabitEthernet0/2
```

Redundant paths to CUCM

VG350#show ip route

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C        10.197.50.0/24 is directly connected, Loopback0
L        10.197.50.2/32 is directly connected, Loopback0
C        10.197.51.0/24 is directly connected, GigabitEthernet0/1
L        10.197.51.2/32 is directly connected, GigabitEthernet0/1
C        10.197.52.0/24 is directly connected, GigabitEthernet0/2
L        10.197.52.2/32 is directly connected, GigabitEthernet0/2
      20.0.0.0/30 is subnetted, 1 subnets
D        20.20.20.0 [90/28416] via 10.197.52.1, 04:44:33, GigabitEthernet0/2
                    [90/28416] via 10.197.51.1, 04:44:33, GigabitEthernet0/1
      172.19.0.0/16 is variably subnetted, 8 subnets, 2 masks
D        172.19.153.0/24
         [90/30976] via 10.197.52.1, 04:44:33, GigabitEthernet0/2
         [90/30976] via 10.197.51.1, 04:44:33, GigabitEthernet0/1
```

Redundant paths to CUCM

On the switch:

Switch#show ip eigrp neighbors

```
EIGRP-IPv4 Neighbors for AS(20)
H   Address                 Interface       Hold Uptime   SRTT   RTO  Q  Seq
                                            (sec)         (ms)       Cnt Num
2   10.197.51.2             Vl10             10 04:52:23    1   200  0  48
1   10.197.52.2             Vl20             14 04:55:52  331  1986  0  46
```

Switch#show ip eigrp topology
EIGRP-IPv4 Topology Table for AS(20)/ID(172.19.153.27)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
r - reply Status, s - sia Status

P 10.197.50.0/24, 2 successors, FD is 130816
via 10.197.51.2 (130816/128256), Vlan51
via 10.197.52.2 (130816/128256), Vlan52

Redundant paths to VG350

Switch#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

D 10.197.50.0 [90/130816] via 10.197.52.2, 04:54:40, Vlan20
[90/130816] via 10.197.51.2, 04:54:40, Vlan10

Redundant paths to VG350

Test Procedure

Step 1 – Call Phone 2 from Phone 1. Both interfaces on the VG350 are active and the call starts on Gig 0/1.

VG350#show call active voice
Telephony call-legs: 1
SIP call-legs: 0
H323 call-legs: 0
Call agent controlled call-legs: 1
SCCP call-legs: 0
Multicast call-legs: 0
Total call-legs: 2

The call between Phone 1 and Phone 2 is active.

VG350#show ip interface brief

Interface	IP-Address	OK?	Method	Status	Protocol
GigabitEthernet0/1	10.197.51.2	YES	NVRAM	up	up
GigabitEthernet0/2	10.197.52.2	YES	NVRAM	up	up
Loopback0	10.197.50.2	YES	NVRAM	up	up

Step 2 – Shutdown Gig 0/1 and notice that the EIGRP topology changes. The following messages are seen on the VG350.

VG350#
*Feb 7 21:22:11.565: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to down
*Feb 7 21:22:12.565: %LINK-3-UPDOWN: Interface GigabitEthernet0/1, changed state to down
*Feb 7 21:22:12.565: %DUAL-5-NBRCHANGE: EIGRP-IPv4 20: Neighbor 10.197.51.1 (GigabitEthernet0/1) is down: interface down

VG350#show ip eigrp topology
EIGRP-IPv4 Topology Table for AS(20)/ID(10.197.50.2)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
r - reply Status, s - sia Status

P 172.19.153.0/24, 1 successors, FD is 30976
via 10.197.52.1 (30976/28416), GigabitEthernet0/2

VG350 still has one active path to the CUCM and the call gets routed on to this active link.

VG350#show call active voice
Telephony call-legs: 1
SIP call-legs: 0
H323 call-legs: 0
Call agent controlled call-legs: 1
SCCP call-legs: 0
Multicast call-legs: 0
Total call-legs: 2

The call is active on the VG350 even after the first link Gig0/1 went down.

```
VG350#show ip eigrp neighbors
EIGRP-IPv4 Neighbors for AS(20)
H   Address                 Interface       Hold Uptime   SRTT   RTO  Q  Seq
                                            (sec)         (ms)       Cnt Num
0   10.197.52.1             Gi0/2            13 00:02:03    6   100  0  159
```

```
VG350#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks

D        172.19.153.0/24
         [90/28672] via 10.197.52.1, 00:00:29, GigabitEthernet0/2
```

VG350 still has one active path to the CUCM and the call gets routed on to this active link.

Notice there is still an active link to the CUCM and the call seamlessly switches to the stand-by connection when the first link goes down. The link switching takes a second and is almost transparent to the end user, thus providing a seamless call experience.

Debugging Tips

MGCP

1. Domain names on the CUCM should match the hostname of the VG350.
2. The MGCP version on the CUCM should match the MGCP version of the VG350.

SCCP

1. To register the VG to the CUCM, the last ten character's of the interface Gig0/0, no matter which interfaces you are using or even if Gig0/0 is down.

Running Configuration

MGCP

VG350

```
!
hostname VG350
!
!
interface Loopback0
 ip address 10.197.50.2 255.255.255.0
!
!
interface GigabitEthernet0/1
 ip address 10.197.51.2 255.255.255.0
 duplex auto
 speed auto
!
interface GigabitEthernet0/2
 ip address 10.197.52.2 255.255.255.0
 duplex auto
 speed auto
!
!
router eigrp 20
 network 10.0.0.0
 eigrp stub connected summary
!
ip forward-protocol nd
!
!
voice-port 4/0/25
!
mgcp
mgcp call-agent CUCM90 2427 service-type mgcp version 0.1
mgcp rtp unreachable timeout 1000 action notify
mgcp modem passthrough voip mode nse
mgcp package-capability rtp-package
mgcp package-capability sst-package
mgcp package-capability pre-package
no mgcp package-capability res-package
no mgcp timer receive-rtcp
mgcp sdp simple
mgcp fax t38 inhibit
mgcp bind control source-interface Loopback0
```

```
mgcp bind media source-interface Loopback0
mgcp behavior rsip-range tgcp-only
mgcp behavior comedia-role none
mgcp behavior comedia-check-media-src disable
mgcp behavior comedia-sdp-force disable
!
mgcp profile default
!
!
ccm-manager music-on-hold
!
ccm-manager mgcp
no ccm-manager fax protocol cisco
!
dial-peer voice 2000 pots
 service mgcpapp
 port 4/0/25
!
!
end
```

SCCP

VG350

```
Current configuration : 3669 bytes
!
hostname VG350-Crathi
!
stcapp ccm-group 1
stcapp
!
stcapp supplementary-services
 port 4/0/24
  fallback-dn 1000
!
!
!
interface Loopback0
 ip address 10.197.50.2 255.255.255.0
!
!
interface GigabitEthernet0/1
 ip address 10.197.51.2 255.255.255.0
 duplex auto
 speed auto
```

```
!
interface GigabitEthernet0/2
 ip address 10.197.52.2 255.255.255.0
 duplex auto
 speed auto
!
!
router eigrp 20
 network 10.0.0.0
 eigrp stub connected summary
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
!
!
control-plane
!
voice-port 0/0/0
!
voice-port 0/0/1
!
voice-port 4/0/23
!
voice-port 4/0/24
 timeouts ringing infinity
!
voice-port 4/0/25
!
!
sccp local Loopback0
sccp ccm 172.19.153.139 identifier 1 version 7.0
sccp
!
sccp ccm group 1
 bind interface Loopback0
 associate ccm 1 priority 1
!
dial-peer voice 1 pots
 service stcapp
 port 4/0/24
!
!
```

```
login
 transport input all
!
scheduler allocate 20000 1000
!
end
```

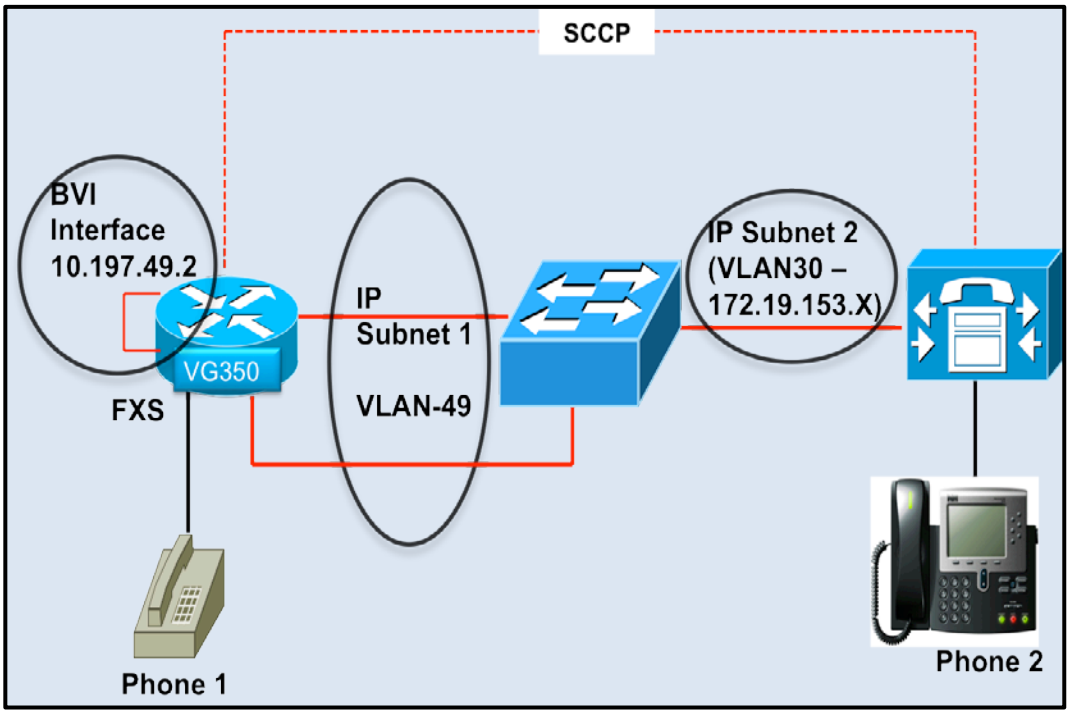
Switch

```
!
hostname Switch
!
!
!
!
no aaa new-model
system mtu routing 1500
ip routing
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
vlan internal allocation policy ascending
!
!
!
!
interface FastEthernet0/1
 switchport host
 switchport access vlan 10
!
interface FastEthernet0/2
 switchport host
 switchport access vlan 20
!
interface FastEthernet0/3
 switchport host
 switchport access vlan 30
!
interface Vlan1
 no ip address
!
interface Vlan10
 ip address 10.197.51.1 255.255.255.0
!
```

```
interface Vlan20
 ip address 10.197.52.1 255.255.255.0
!
interface Vlan30
 ip address 172.19.153.1 255.255.255.0
!
router eigrp 20
 network 10.0.0.0
 network 172.19.0.0
!
!
end
```

Bridged Survivability

Bridged survivability uses the VG's capability to be controlled as an SCCP gateway and utilizes Spanning Tree Protocol for the link failover. The VG registers itself to the CUCM as an SCCP gateway and uses its physical connections to create redundant paths. The VG's BVI interface's MAC address is used to register to the CUCM. Because the BVI interface is virtual, in case a physical link fails, the VG switches to the standby physical link to remain registered to the CUCM and preserve active calls.



Configuration

Overview

1. Create two IP subnets on the switch.
2. Create a BVI interface on the VG. This is the interface used by the VG to register itself as an SCCP gateway to the CUCM.
3. Enable STP on the switch.
4. Enable bridging and STP on the VG and bind the gigabit interfaces to the configured bridge group.
5. Enable SCCP on the VG.
6. Connect the gigabit interfaces on the VG to subnet 1.
7. Connect CUCM to subnet 2.

8. Enable EIGRP on the switch and the VG for routing.

After the VG registers as a SCCP gateway, there will be redundant paths to the CUCM. Now if a link on the VG loses connectivity, active calls switch to the other link and are preserved.

On the VG350:

Step 1 – Enable bridging.

```
VG350#conf t
VG350(config)#bridge irb
```

Step 2 – Create a bridge group.

```
VG350(config)#bridge 49 priority 65535
VG350(config)#bridge 49 protocol ieee
VG350(config)#bridge 49 route ip
```

Configuration Tip:

- The bridge group ID should match the VLAN on the switch, for example here ID is '49'.
- Be sure not to become the root bridge, set the bridge group's priority to '65535'.

Step 3 – Create a BVI interface. Assign it a MAC and IP address.

```
VG350(config)#interface BVI49
VG350(config-if)#mac-address 1111.2222.1111
VG350(config-if)#ip address 10.197.49.2 255.255.255.0
```

Configuration Tip:

- The BVI interface's ID should match the bridge group ID, for example here the bridge group ID is '49' and therefore the BVI Interface is 'BVI49'.
- Assign a static MAC address to the BVI interface otherwise the auto generated address is inherited from one of the physical interfaces and when this link goes down the BVI is not able to transmit traffic, even if the stand-by link is active.

Step 4 – Bind gigabit interfaces to the bridge group.

```
VG350(config)#interface GigabitEthernet0/1
VG350(config-if)#no ip address
VG350(config-if)#bridge-group 49
VG350(config)#interface GigabitEthernet0/2
VG350(config-if)#no ip address
VG350(config-if)#bridge-group 49
```

Step 5 – Enable SCCP.

```
VG350(config)#sccp local BVI49
VG350(config)#sccp ccm 172.19.153.139 identifier 1 version 7.0
VG350(config)#sccp
VG350(config)#sccp ccm group 1
VG350(config-sccp-ccm)#associate ccm 1 priority 1
VG350(config-sccp-ccm)#bind interface BVI49
VG350(config-sccp-ccm)#exit
```

Explanation:

1. 'sccp local BVI49'
   - Forces SCCP to use the BVI interface for its communication to the CUCM.

2. 'sccp ccm 172.19.153.139 identifier 1 version 7.0'
   - Specifies the call agent's IP address. This example uses '172.19.153.139'.
   - Specifies the call agent's identifier. This example uses '1'.
   - Specifies the call agent's version. This example uses '7'.

3. 'sccp ccm group 1'
   - Creates a SCCP group with identifier '1'.

4. 'associate ccm 1 priority 1'
   - Under the 'sccp ccm group 1', associate a CUCM with priority 1.

5. 'bind interface BVI49'
   - Under the 'sccp ccm group 1', binds the BVI interface to the SCCP group.

Step 6 – Enable SCCP control of analog ports.

```
VG350(config)#stcapp ccm-group 1
VG350(config)#stcapp
```

Explanation:

1. 'stcapp ccm-group 1'
   - Specifies the STCAPP Call Manager group id. This example uses '1'.

2. 'stcapp'
   - Starts the SCCP Telephony Control Application.

Step 7 – Configure analog port to use SCCP.

```
VG350(config)#dial-peer voice 1 pots
VG350(config-dial-peer)#service stcapp
VG350(config-dial-peer)#port 4/0/24
```

Explanation:

1. 'service stcapp'
   - Enables 'stcapp' service on the dial peer.

Configuration Tip:

- Dial peer needs to be created for every port and this can be done easily using the 'dial peer group' CLI enhancement.

```
VG350(config)#dial-peer group 1
VG350(config-dial-peer)#service stcapp
VG350(config-dial-peer)#port 4/0/0 -71 1
```

Step 8 – Configure analog port.

```
VG350(config)#voice-port 4/0/24
VG350(config-voiceport)#timeouts ringing infinity
```

Step 9 – Enable EIGRP.[5]

```
VG350(config)#router eigrp 20
VG350(config-router)#network 10.0.0.0
VG350(config-router)#eigrp stub connected summary
```

[5] The VG needs to advertise the 10.X.X.X IP subnets that are connected to the switch so enable EIGRP for this network.

On the switch:

Step 1 – Configure two IP subnets.

Step 1.1 – Add VLANs in the database.

```
Switch#vlan database
Switch(vlan)#vlan 49
VLAN 49 added:
   Name: VLAN0040
Switch(vlan)#vlan 30
VLAN 30 added:
   Name: VLAN0030
```

Step 1.2 – Create SVIs for the VLANs created previously.

```
Switch(config)#interface Vlan49
Switch(config-if)#ip address 10.197.49.1 255.255.255.0
Switch(config-if)#exit
Switch(config)#interface Vlan30
Switch(config-if)# ip address 172.19.153.0 255.255.255.0
```

Step 1.3 – Enable spanning tree for VLAN49.

```
Switch(config)#spanning-tree vlan 49 priority 24576
```

Step 1.4 – Add switch ports to VLAN49 and enable STP on these ports.

```
Switch(config)#interface FastEthernet0/1
Switch(config-if)#switchport host
Switch(config-if)#switchport access vlan 49
Switch(config-if)#exit
Switch(config)#interface FastEthernet0/2
Switch(config-if)#switchport host
Switch(config-if)#switchport access vlan 49
```

Step 1.4 – Add the switch port connecting to the CUCM on VLAN30.

```
Switch(config)#interface FastEthernet0/3
Switch(config-if)#switchport host
Switch(config-if)#switchport access vlan 30
Switch(config-if)#exit
```

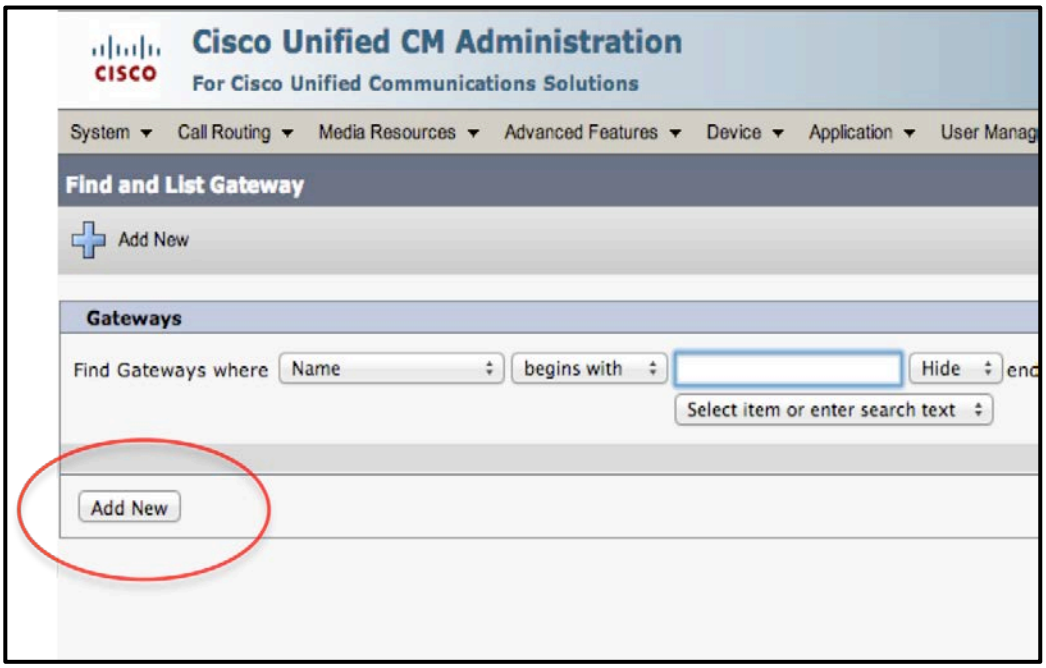
Step 2 – Enable EIGRP.[6]

```
Switch(config)#router eigrp 20
Switch(config-router)# network 10.0.0.0
Switch(config-router)# network 172.19.0.0
```

On the CUCM:

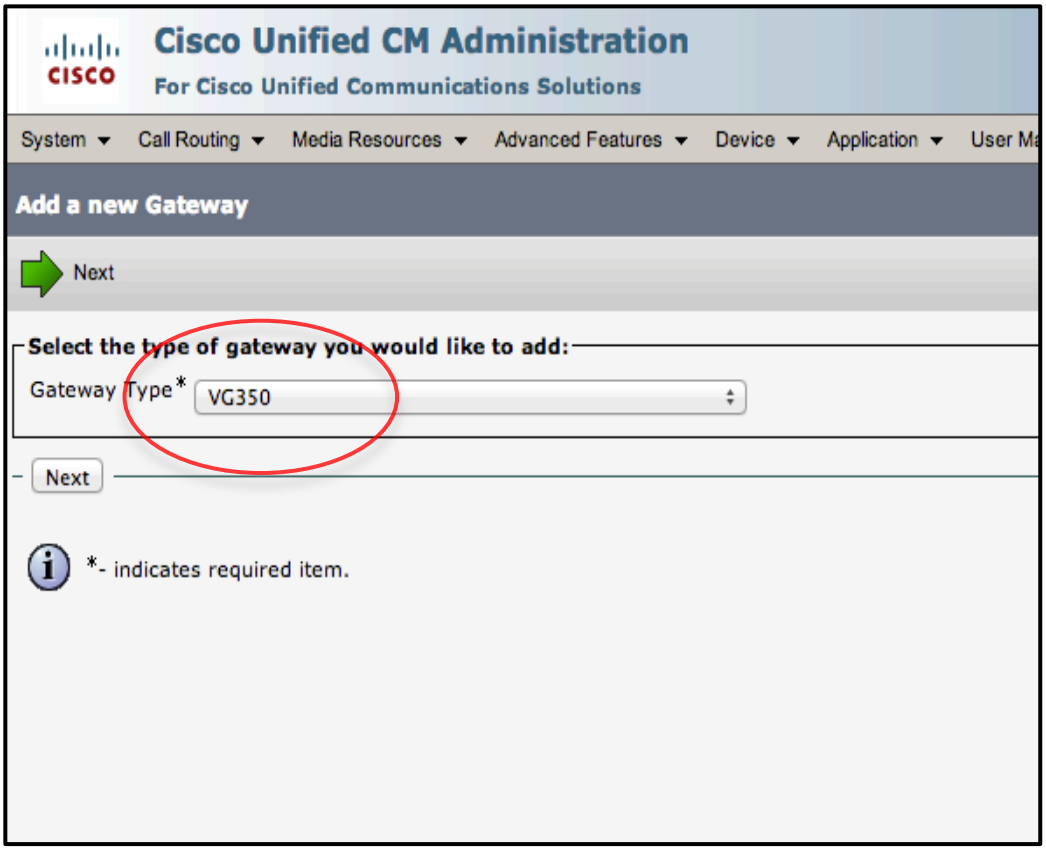
Step 1 – Register the VG350 as an SCCP gateway.

Step 1.1 – Device -> Gateway -> Add New

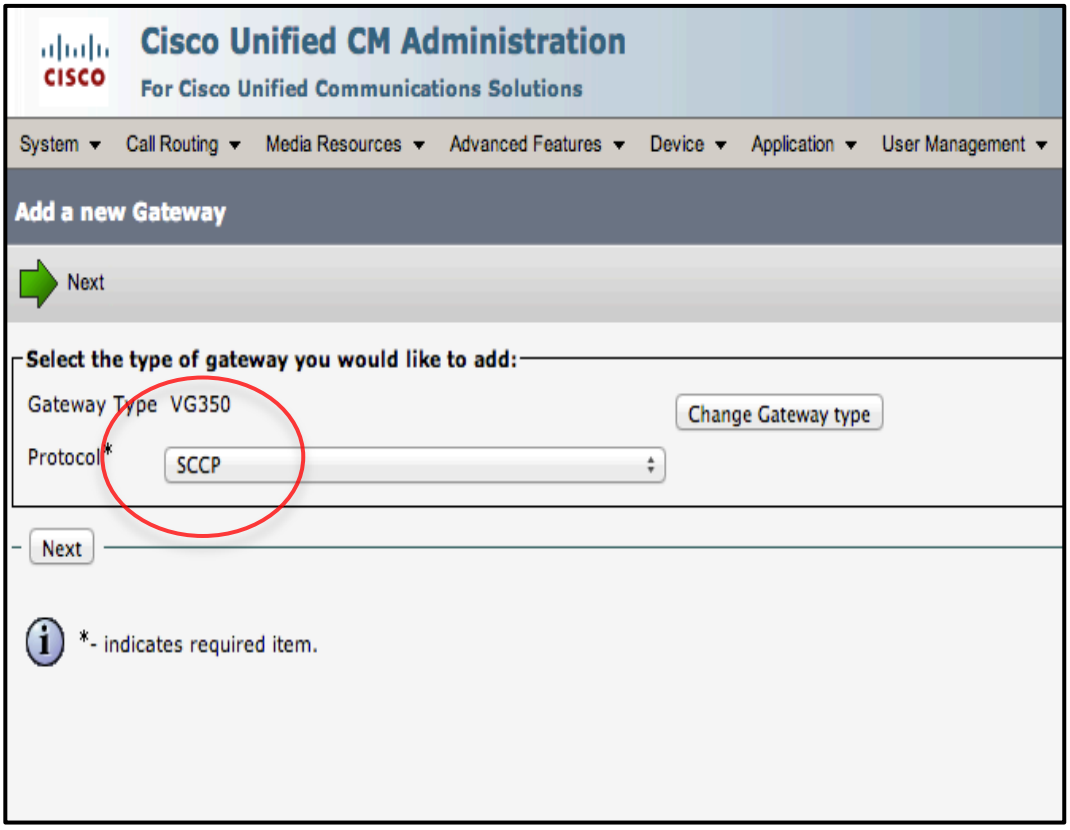


[6] The switch needs to advertise the 10.X.X.X IP subnets connected to the VG and the 172.19.X.X subnet connected to the CUCM so enable EIGRP for these two networks.

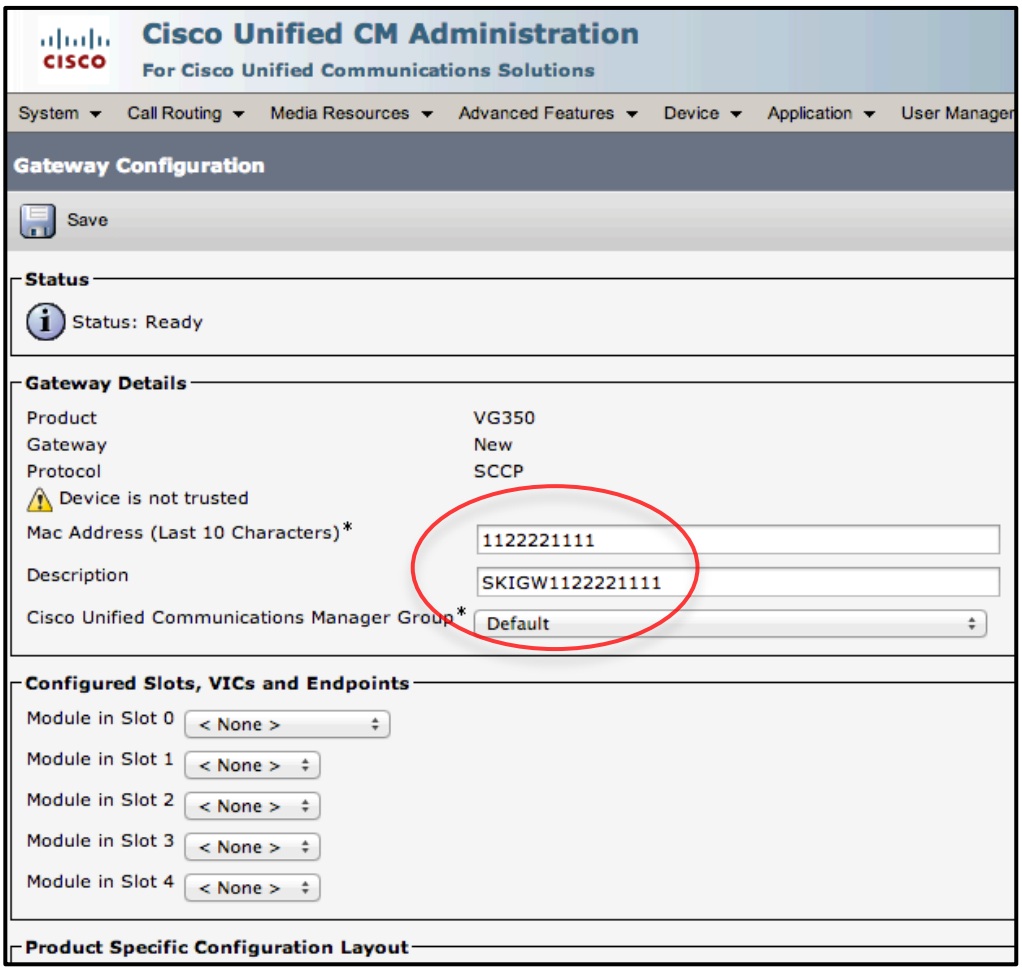
Step 1.2 – Select Gateway Type as 'VG350' and press 'Next'.



Step 1.3 – Select Protocol as 'SCCP' and press 'Next'.



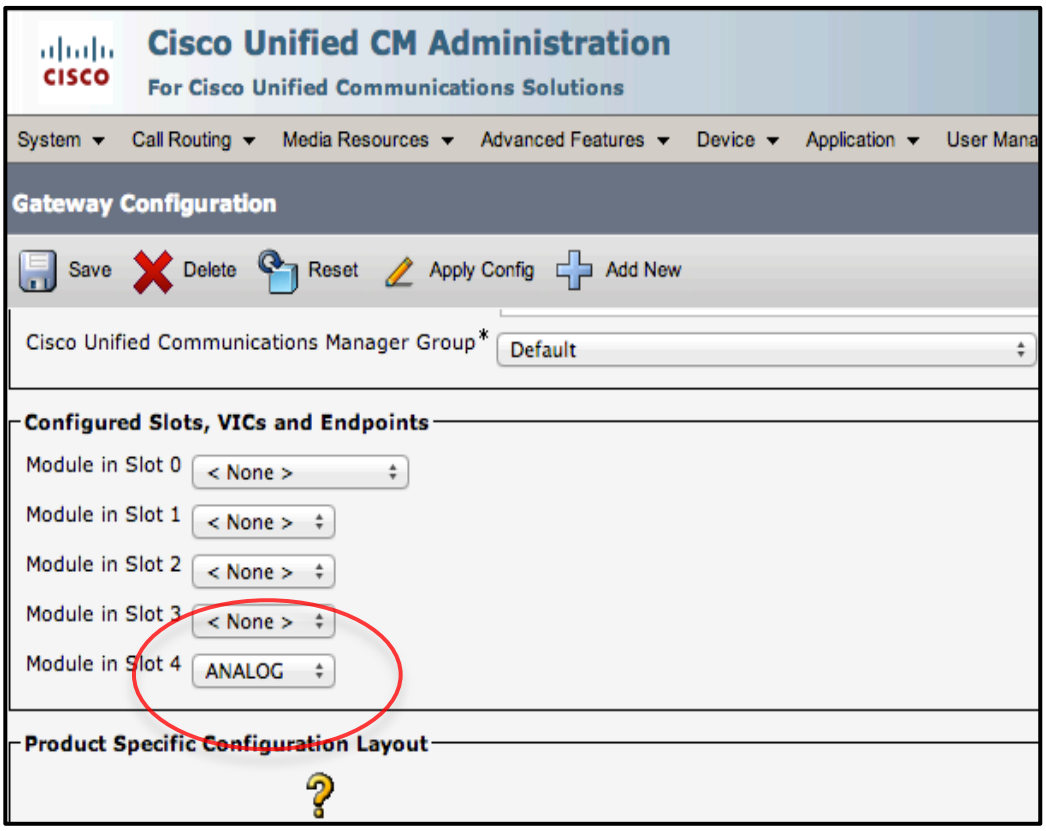
Step 1.4 – Add the last 10 digits of the VG's BVI MAC address into the 'MAC address' field. In this example, the VG350's BVI address is set to 111122221111, therefore, '1122221111' is entered. Set the 'Cisco Unified Communications Manager Group'. In this example it is set to 'Default'.



Leave the other properties to their default values. 'Save' the profile and 'Apply the Configuration'.

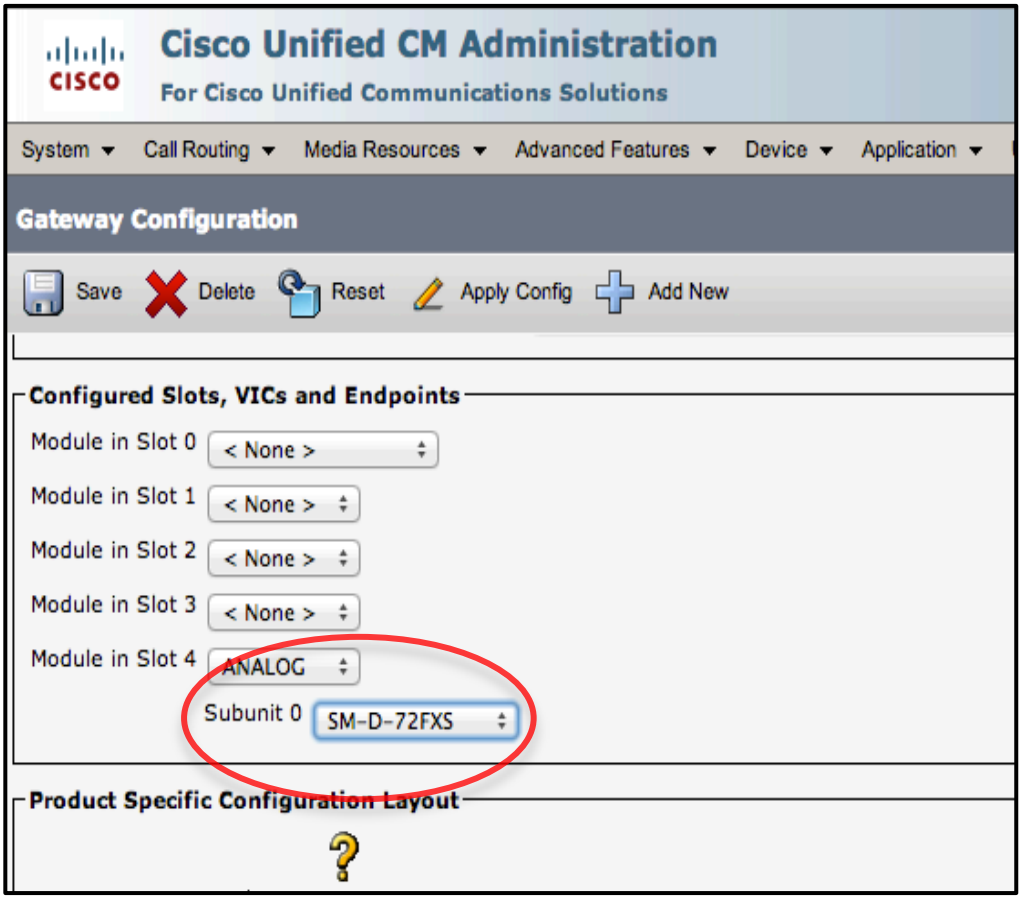
Step 2 – Configure the network module on the SCCP gateway.

Step 2.1 – Select the appropriate slot. This example uses 'Slot 4' in 'Analog' mode.



'Save' the profile and 'Apply the Configuration'.

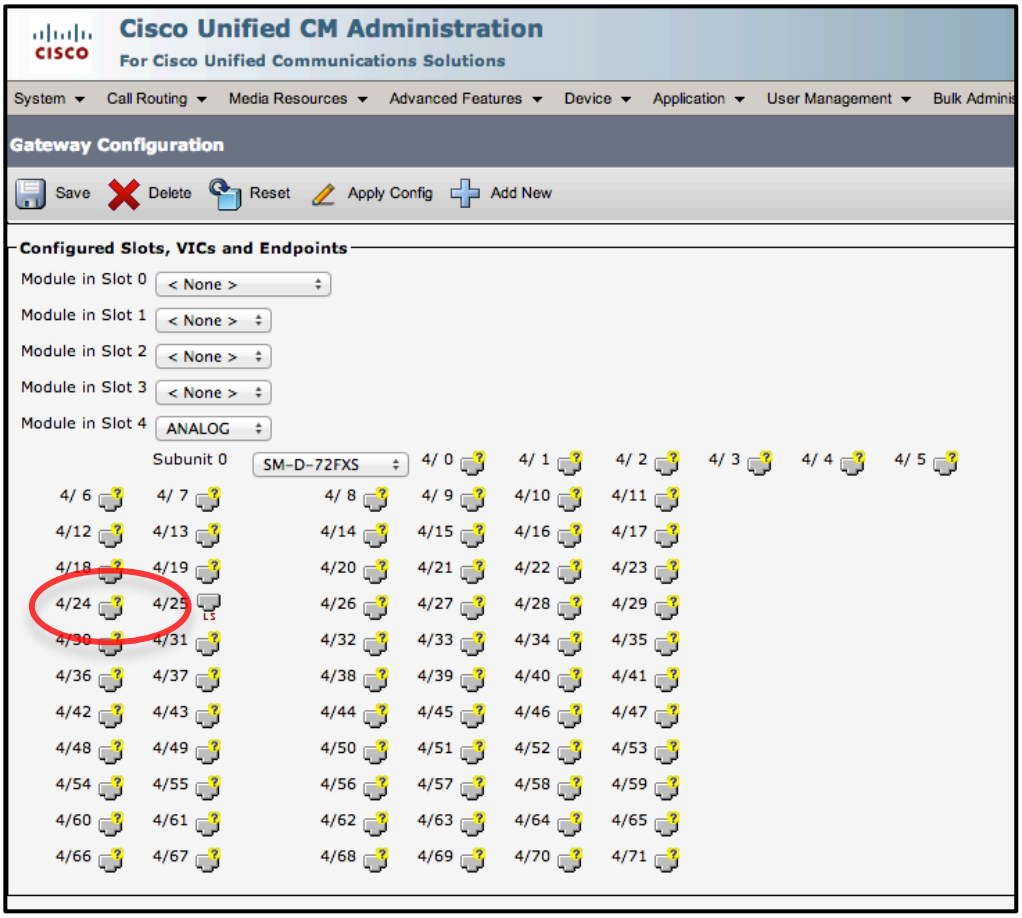
Step 2.2 – Select the appropriate 'Subunit'. This example uses Subunit 0 to 'SM-D-72FXS'.



'Save' the profile and 'Apply the Configuration'.

Step 3 – Configure the analog port.

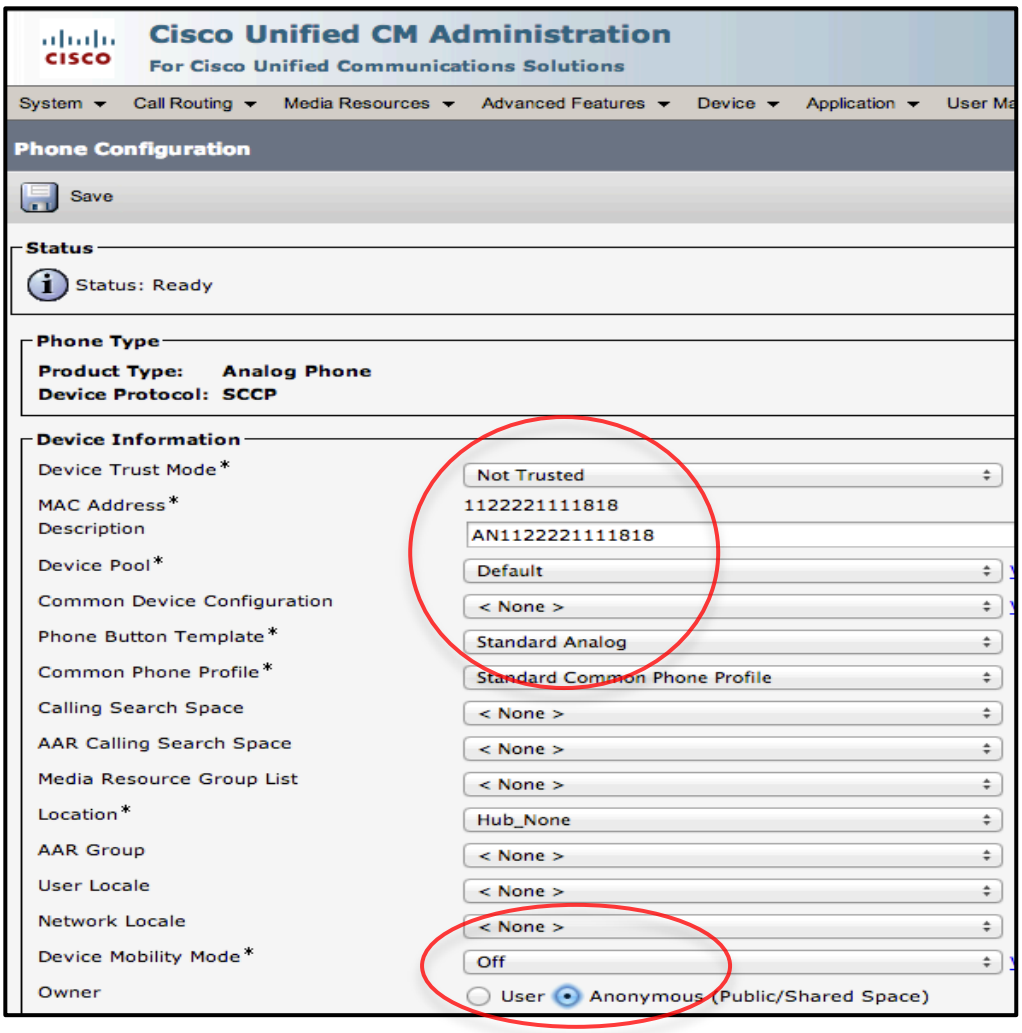
Step 3.1 – Select the appropriate port and click on it. This example uses 'Port 4/24'.

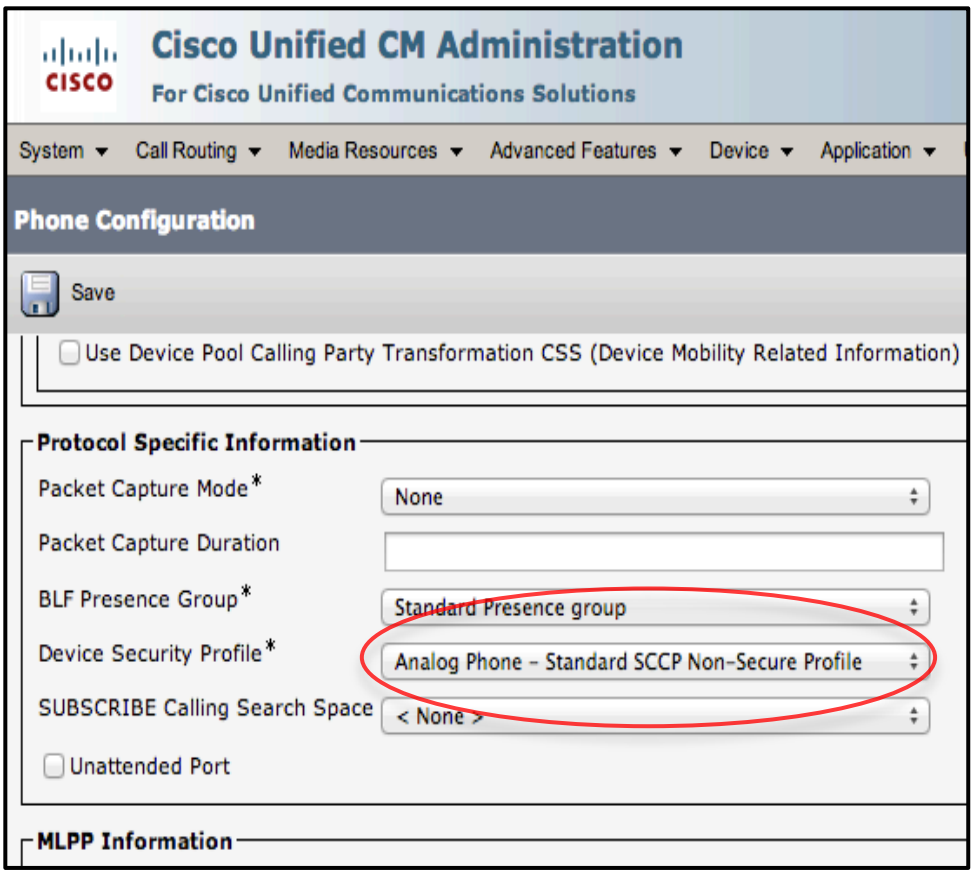


Step 3.2 – Set the appropriate values for:

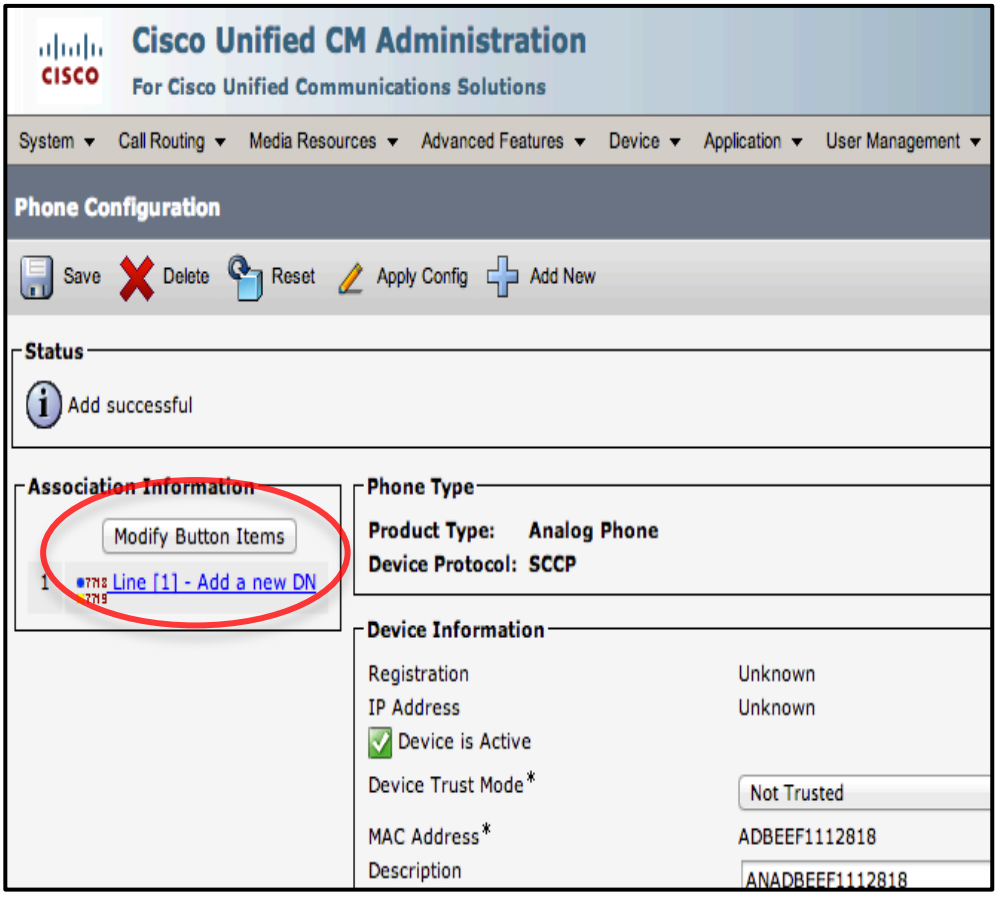
- 'Device Trust Mode', this example uses 'Not Trusted'.
- 'Device pool', this example uses 'Not Trusted'.
- 'Phone Button Template', this example uses'Standard Analog'.
- 'Device Mobility Mode', this example uses 'Off'.
- 'Owner', this example uses 'Anonymous'.
- 'Device Security Profile',this example uses 'Analog Phone – Standard SCCP Non-Secure Profile'.

Leave the other properties to their default values. 'Save' the profile and 'Apply the Configuration'.

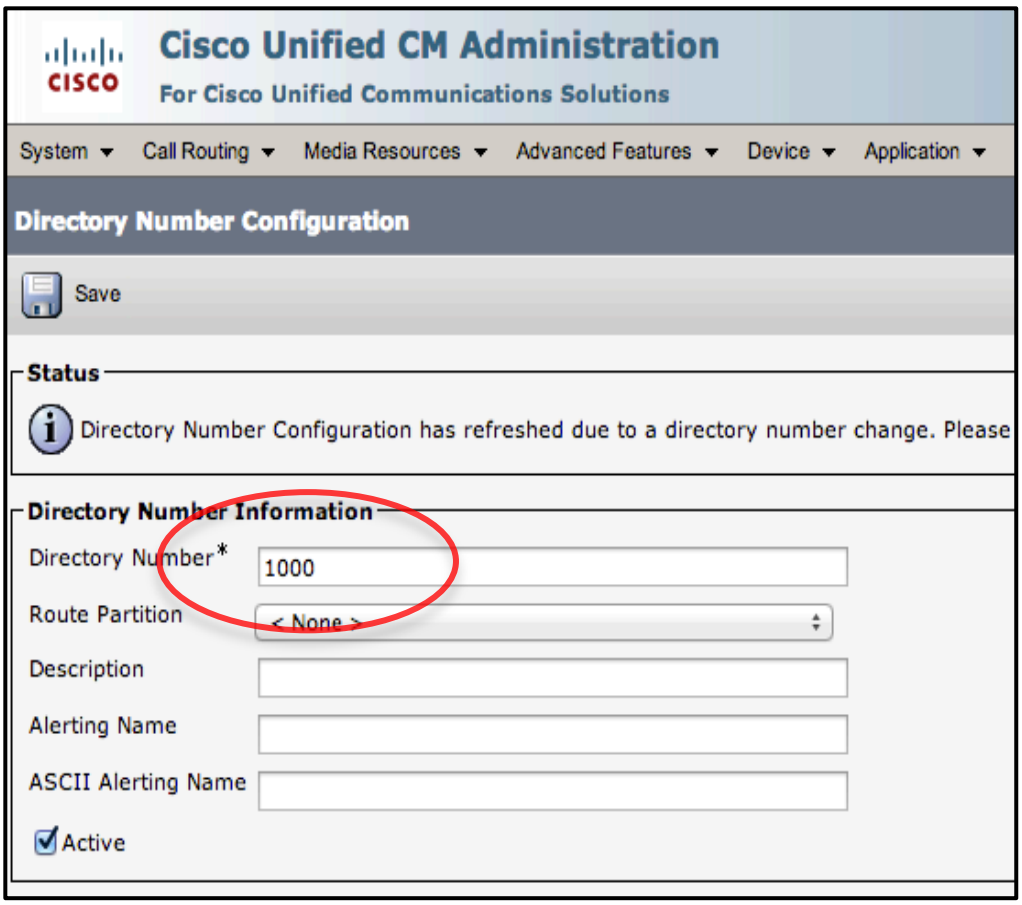

Cisco Unified CM Administration
For Cisco Unified Communications Solutions
System
Call Routing
Media Resources
Advanced Features
Device
Application
User Ma
Phone Configuration
Save
Status
Status: Ready
Phone Type
Product Type: Analog Phone
Device Protocol: SCCP
Device Information
Device Trust Mode*
Not Trusted
MAC Address*
1122221111818
Description
AN1122221111818
Device Pool*
Default
Common Device Configuration
< None >
Phone Button Template*
Standard Analog
Common Phone Profile*
Standard Common Phone Profile
Calling Search Space
< None >
AAR Calling Search Space
< None >
Media Resource Group List
< None >
Location*
Hub_None
AAR Group
< None >
User Locale
< None >
Network Locale
< None >
Device Mobility Mode*
Off
Owner
User
Anonymous (Public/Shared Space)


Cisco Unified CM Administration
For Cisco Unified Communications Solutions
System
Call Routing
Media Resources
Advanced Features
Device
Application
Phone Configuration
Save
Use Device Pool Calling Party Transformation CSS (Device Mobility Related Information)
Protocol Specific Information
Packet Capture Mode*
None
Packet Capture Duration
BLF Presence Group*
Standard Presence group
Device Security Profile*
Analog Phone - Standard SCCP Non-Secure Profile
SUBSCRIBE Calling Search Space
< None >
Unattended Port
MLPP Information

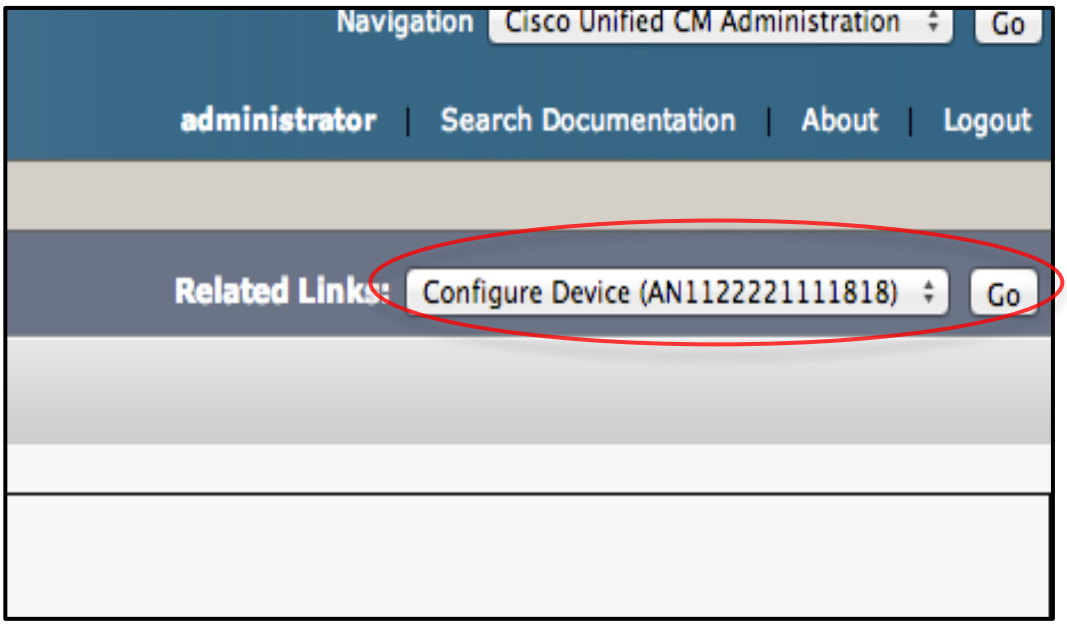
Step 3.3 – Add the 'Directory Number Information'. Click on 'Line [1] – Add a new DN'.



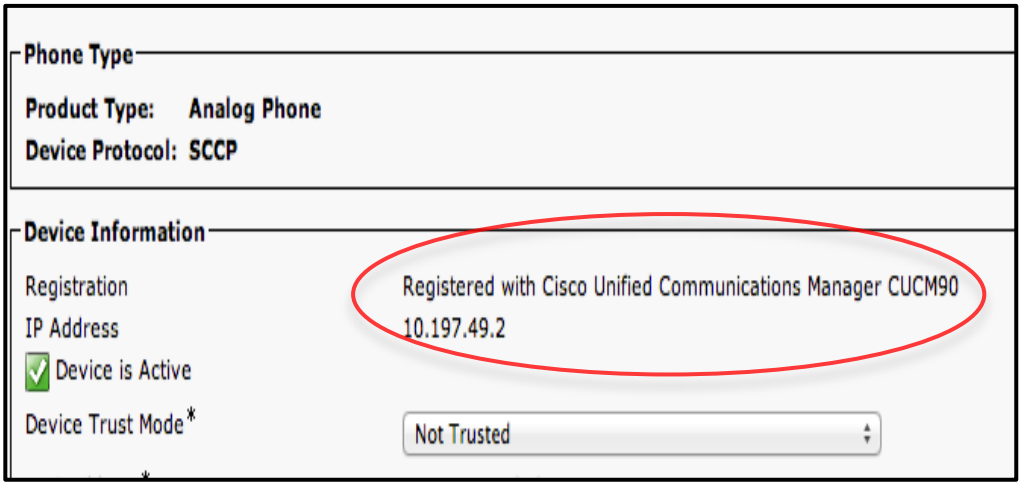
Now configure the 'Directory Number', this example uses '1000'. Leave the other properties to their default values. 'Save' the profile and 'Apply the Configuration'.



Step 3.4 – Go back to the port page to check that the port is registered to the CUCM.



Ensure that the port is 'Registered with Cisco Unified Communications Manager'.



Show Commands

On the VG350:

```
VG350#show interface BVI49
BVI49 is up, line protocol is up
Hardware is BVI, address is 1111.2222.1111 (bia 0000.0000.0000)
  Internet address is 10.197.49.2/24
  MTU 1500 bytes, BW 100000 Kbit/sec, DLY 5000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
```

Static Address gets assigned to the BVI interface.

```
VG350#show sccp
SCCP Admin State: UP
Gateway Local Interface: BVI49
        IPv4 Address: 10.197.49.2
        Port Number: 2000
IP Precedence: 5
User Masked Codec list: None
Call Manager: 172.19.153.139, Port Number: 2000
Priority: N/A, Version: 7.0, Identifier: 1
Trustpoint: N/A

Alg_Phone Oper State: ACTIVE - Cause Code: NONE
Active Call Manager: 172.19.153.139, Port Number: 2000
TCP Link Status: CONNECTED, Device Name: AN1122221111818
```

VG registers to the CUCM as SCCP endpoint, using the BVI interface.

VG350#show spanning-tree 49

Bridge group 49 is executing the ieee compatible Spanning Tree protocol
  Bridge Identifier has priority 65535, address 2c54.2d20.3b81
  Configured hello time 2, max age 20, forward delay 15
  Current root has priority 32817, address 0016.47be.8b80
  Root port is 6 (GigabitEthernet0/1), cost of root path is 19
  Topology change flag not set, detected flag not set
  Number of topology changes 0 last change occurred 03:23:19 ago
  Times: hold 1, topology change 35, notification 2
        hello 2, max age 20, forward delay 15
  Timers: hello 0, topology change 0, notification 0, aging 300

Port 6 (GigabitEthernet0/1) of Bridge group 49 is forwarding
  Port path cost 19, Port priority 128, Port Identifier 128.6.
  Designated root has priority 32817, address 0016.47be.8b80
  Designated bridge has priority 32817, address 0016.47be.8b80
  Designated port id is 128.34, designated path cost 0
  Timers: message age 1, forward delay 0, hold 0
  Number of transitions to forwarding state: 1
  BPDU: sent 0, received 6085

Port 7 (GigabitEthernet0/2) of Bridge group 49 is blocking
  Port path cost 19, Port priority 128, Port Identifier 128.7.
  Designated root has priority 32817, address 0016.47be.8b80
  Designated bridge has priority 32817, address 0016.47be.8b80
  Designated port id is 128.35, designated path cost 0
  Timers: message age 1, forward delay 0, hold 0
  Number of transitions to forwarding state: 0
  BPDU: sent 0, received 6085

Gig0/1 is the forwarding port.

Gig0/2 is the blocking port.

On the switch:

```
Switch#show spanning-tree vlan 49

VLAN0049
  Spanning tree enabled protocol ieee
  Root ID    Priority    24625
             Address     0016.47be.8b80
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    24625  (priority 24576 sys-id-ext 49)
             Address     0016.47be.8b80
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  300 sec

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/30           Desg FWD 19        128.34   P2p Edge
Fa0/31           Desg FWD 19        128.35   P2p Edge
```

Ports in STP

Test Procedure

Step 1 – Call Phone 2 from Phone 1. Both interfaces on the VG350 are active and the call starts on Gig 0/1.

```
VG350#show call active voice
Telephony call-legs: 1
SIP call-legs: 0
H323 call-legs: 0
Call agent controlled call-legs: 1
SCCP call-legs: 0
Multicast call-legs: 0
Total call-legs: 2
```

The call between Phone 1 and Phone 2 is active.

```
VG350-Crathi#show spanning-tree 49
Bridge group 49 is executing the ieee compatible Spanning Tree protocol
  Bridge Identifier has priority 65535, address 2c54.2d20.3b81

  Port 6 (GigabitEthernet0/1) of Bridge group 49 is forwarding

  Port 7 (GigabitEthernet0/2) of Bridge group 49 is blocking
```

Gig0/1 is in forwarding state

```
VG350#show ip int bri
Interface              IP-Address      OK? Method  Status                Protocol
GigabitEthernet0/1     10.197.51.2     YES NVRAM   up                    up
GigabitEthernet0/2     10.197.52.2     YES NVRAM   up                    up
Loopback0              10.197.50.2     YES NVRAM   up                    up
```

Step 2 – Shutdown Gig 0/1 and notice that the EIGRP topology changes. The following messages are seen on the VG350.

```
VG350#show spanning-tree 49
……

 Port 6 (GigabitEthernet0/1) of Bridge group 49 is down

 Port 7 (GigabitEthernet0/2) of Bridge group 49 is forwarding
```

Gig0/2 is in forwarding state

```
VG350#show call active voice
Telephony call-legs: 1
SIP call-legs: 0
H323 call-legs: 0
Call agent controlled call-legs: 1
SCCP call-legs: 0
Multicast call-legs: 0
Total call-legs: 2
```

The call between Phone 1 and Phone 2 is still active.

Notice that when Gig0/1 goes down, Gig0/2 becomes the forwarding port and the BVI interface uses this physical link to communicate with the CUCM. The call switches to the stand-by connection when the first link goes down. The link switching takes about thirty seconds to switch over, during this time no audio can be heard until the network re-converges. Once the network re-converges audio is resumed.

Warning – When Gig0/1 comes back up, the call loses audio again for about thirty seconds until the Gig0/1 gets in the forwarding state. During this time no new calls can be made either. Once Gig 0/1 is in the forwarding state the call regains audio and new calls can be placed successfully.

Debugging Tips

SCCP

1. Make sure you enter the last ten digits of the BVI interface's MAC address in the SCCP gateway configuration on the CUCM.

Running Configuration

VG350

```
Current configuration : 3669 bytes
!
hostname VG350-Crathi
!
stcapp ccm-group 1
stcapp
!
stcapp supplementary-services
 port 4/0/24
  fallback-dn 1000
!
!
bridge irb
!
interface GigabitEthernet0/1
 no ip address
 duplex auto
 speed auto
 bridge-group 49
!
interface GigabitEthernet0/2
 no ip address
 duplex auto
 speed auto
 bridge-group 49
!
interface BVI49
 mac-address 1111.2222.1111
 ip address 10.197.49.2 255.255.255.0
!
!
router eigrp 20
 network 10.0.0.0
 eigrp stub connected summary
!
ip forward-protocol nd
```

```
!
!
no ip http server
no ip http secure-server
!
!
!
control-plane
!
bridge 49 priority 65535
bridge 49 protocol ieee
bridge 49 route ip
!
voice-port 0/0/0
!
voice-port 0/0/1
!
voice-port 4/0/23
!
voice-port 4/0/24
 timeouts ringing infinity
!
voice-port 4/0/25
!
!
sccp local BVI49
sccp ccm 172.19.153.139 identifier 1 version 7.0
sccp
!
sccp ccm group 1
 bind interface BVI49
 associate ccm 1 priority 1
!
dial-peer voice 1 pots
 service stcapp
 port 4/0/24
!
!
login
 transport input all
!
scheduler allocate 20000 1000
!
end
```

Switch

```
Current configuration : 4528 bytes
!
version 12.2
no service pad
!
hostname Switch
!
!
spanning-tree mode pvst
spanning-tree extend system-id
spanning-tree vlan 49 priority 24576
!
vlan internal allocation policy ascending
!
!
!
!
interface FastEthernet0/1
 switchport access vlan 49
 switchport host
 spanning-tree portfast
!
interface FastEthernet0/2
 switchport access vlan 49
 switchport host
 spanning-tree portfast
!
interface FastEthernet0/3
 switchport access vlan 30
 switchport mode access
!
interface Vlan49
 ip address 10.197.49.1 255.255.255.0
!
interface Vlan30
 ip address 172.19.153.1 255.255.255.0
!
router eigrp 20
 network 10.0.0.0
 network 172.19.0.0
!
line con 0
 exec-timeout 0 0
```

```
line vty 0 4
 login
line vty 5 15
 login
!
end
```