Application Note

Connecting Cisco Unified Communication Manager [v11.5.1] to CenturyLink IQ SIP Trunks via Cisco Unified Border Element v11.5.2 [IOS-XE 16.3.2]

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Introduction

Service Providers today, such as CenturyLink, are offering alternative methods to connect to the PSTN via their IP network. Most of these services utilize SIP as the primary signaling method and centralized IP to TDM POP gateways to provide on-net and off-net services.

CenturyLink IQ SIP Trunk is a service provider offering that allows connection to the PSTN and may offer the end customer a viable alternative to traditional PSTN connectivity. A demarcation device between these services and customer owned services is recommended. As an intermediary device between CUCM 11.5.1 and CenturyLink network, Cisco Unified Border Element (Cisco UBE) v11.5.2 can be used. The Cisco Unified Border Element provides demarcation, security and inter-working and session control services for CUCM connected to CenturyLink IP network.

This document assumes the reader is knowledgeable with the terminology and configuration of CUCM. Only configuration settings specifically required for CenturyLink interoperability are presented. Feature configuration and most importantly the dial plan are customer specific and need individual approach.

- This application note describes how to configure a CUCM 11.5.1 and Cisco Unified Border Element (Cisco UBE) v11.5.2 for connectivity to CenturyLink IQ SIP Trunking service. The deployment model covered in this application note is CUCM to PSTN via Cisco Unified Border Element v11.5.2 [IOS-XE] 16.3.2.
- Testing was performed in accordance to Cisco generic SIP Trunking test methodology and among features verified were – basic calls, DTMF transport, Music on Hold (MOH), unattended and attended transfers, call forward, conferences and High Availability.
- Testing was performed in accordance to CenturyLink Dual Trunk Test with Fail-over and Load Balancing among the trunks.
- The Cisco Unified Border Element (Cisco UBE) configuration detailed in this document is based on a lab environment with a simple dial-plan used to ensure proper interoperability between CenturyLink SIP network and CUCM. The configuration described in this document details the important configuration settings to have enabled for interoperability to be successful and care must be taken by the network administrator deploying CUCM to interoperate to CenturyLink SIP Trunking network.

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Network Topology

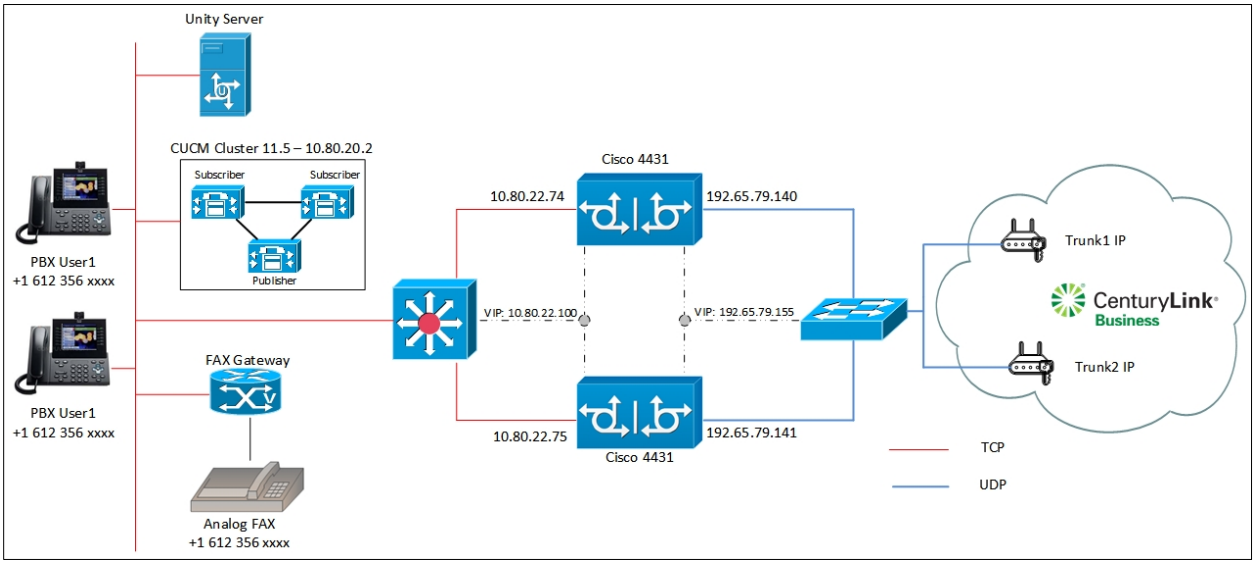

Figure 1 Network Topology

- The network topology includes the CUCM Cluster, Unity Voicemail system, Cisco Fax gateway and 2 Cisco Endpoints. CUCM has a trunk configured to CUBE's Virtual IP Address. CenturyLink was used as the service provider with Dual SIP trunks to the Cisco UBE using the WAN Virtual IP Address.
- 2 Cisco Unified Border Elements are used here for High Availability.
- SIP Trunk transport type used between Cisco Unified Border Element and CUCM is TCP and to CenturyLink is UDP.

CUCM and CUBE Settings:

Setting	Value
Transport from CUBE to CUCM	TCP with RTP
Transport from CUBE to CenturyLink	UDP with RTP
Voice Mail Support	YES
Session Refresh	YES
Early Media support with PRACK	YES
G729 Conference Support	YES

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System Components

Hardware Requirements

- Cisco UBE on Cisco ISR 4431 router
- CUCM cluster on UCS, 1 Publisher node and 2 Subscriber nodes
- Cisco 2851 with FXS ports and Analog Fax machine
- Generic Cisco IP-Phones

Software Requirements

- CUBE-Version: 11.5.2 running IOS-XE 16.3.2
- CUCM UCOS for 1 Publisher and 2 Subscriber
- Cisco IOS v12.4 for the fax gateway

Features

Features Supported

- Incoming and outgoing off-net calls using G711 and G729
- Cisco Multi-Tenant with Failover and Load Balancing in SIP Trunks.
- International Calls and digit manipulations
- Call Conference with G729 support
- CPE Voice Mail support
- Call hold & Resume with and without MoH
- Unattended and Attended Call transfer
- Call forward (all, busy and no answer)
- DTMF (RFC2833)
- Fax Pass-through
- IP-PBX Calling number privacy
- High Availability

Features Not Supported

- Blind Call transfer

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Caveats

- As of writing this application note, CenturyLink supports G.711 pass-through for faxing on IQ SIP Trunk. Currently T.38 is not supported. The Fax protocol is indicated and set at the time of implementation of the service and CenturyLink recommends that customers use our CenturyLink trial process to confirm Fax capability prior to full deployment.
- Caller ID updates are not observed on attended call transfer scenarios.
- Testing is done with only one IP PBX.
- Workaround is done for SIP header manipulations for Register, Call Forward and Call Transfer.
- The CUBE HA tested here is layer 2 box to box CUBE redundancy.

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Configuration

Configuring Cisco Unified Border Element

Network Interface

The IP address used are for illustration only, the actual IP address can vary. The Active/Standby pair share the same virtual IP address and continually exchange status messages.

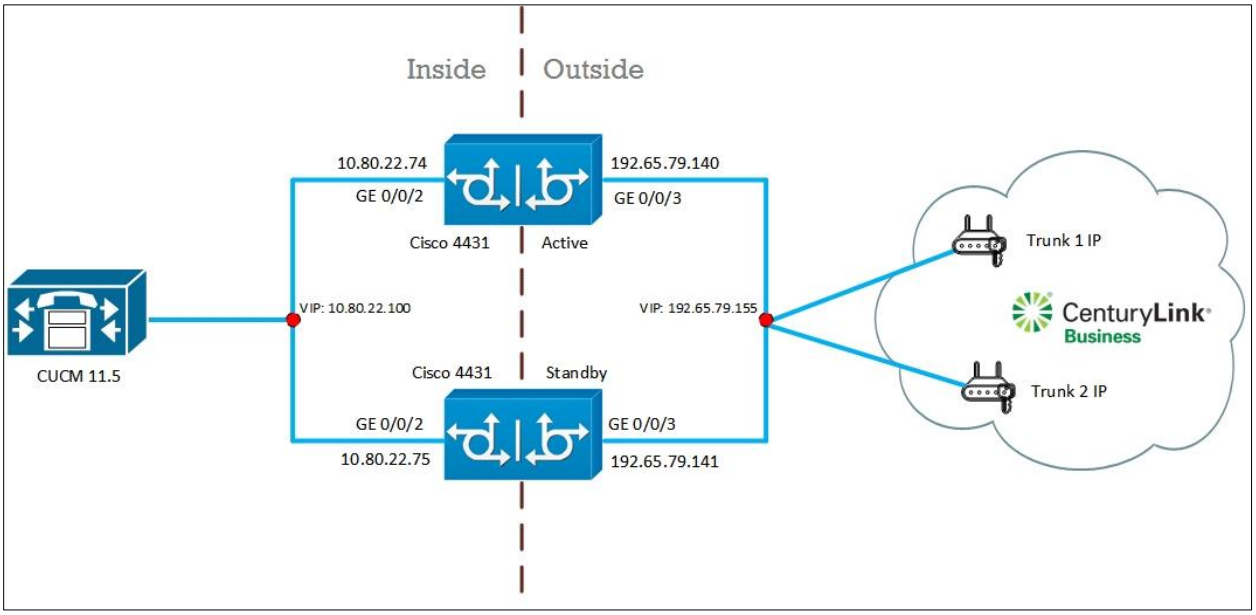

Figure 2 High Availability topology

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CUBE 1:

```
interface GigabitEthernet0/0/0
 ip address 10.64.4.19 255.255.0.0
 media-type rj45
 negotiation auto
!
interface GigabitEthernet0/0/1
 no ip address
 shutdown
 media-type rj45
 negotiation auto
!
interface GigabitEthernet0/0/2
 ip address 10.80.22.74 255.255.255.0
 media-type rj45
 negotiation auto
 redundancy rii 1
 redundancy group 1 ip 10.80.22.100 exclusive
!
interface GigabitEthernet0/0/3
 description Wan Interface
 ip address 192.65.79.140 255.255.255.128
 media-type rj45
 negotiation auto
 redundancy rii 2
 redundancy group 1 ip 192.65.79.155 exclusive
!
```

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CUBE 2:

```
! interface GigabitEthernet0/0/0
 ip address 10.64.4.20 255.255.0.0
 media-type rj45
 negotiation auto
!
interface GigabitEthernet0/0/1
 no ip address
 shutdown
 media-type rj45
 negotiation auto
!
interface GigabitEthernet0/0/2
 description WAN
 ip address 10.80.22.75 255.255.255.0
 media-type rj45
 negotiation auto
 redundancy rii 1
 redundancy group 1 ip 10.80.22.100 exclusive
!
interface GigabitEthernet0/0/3
 description Wan Interface
 ip address 192.65.79.141 255.255.255.128
 media-type rj45
 negotiation auto
 redundancy rii 2
 redundancy group 1 ip 192.65.79.155 exclusive
!
```

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Global Cisco UBE settings

In order to enable Cisco UBE IP2IP SBC functionality, following command has to be entered:

```
voice service voip
 ip address trusted list
 no ip address trusted authenticate
 rtcp keepalive
 address-hiding
 mode border-element license capacity 20
 allow-connections sip to sip
 redundancy-group 1
 no supplementary-service sip moved-temporarily
 no supplementary-service sip refer
 supplementary-service media-renegotiate
 redirect ip2ip
 fax protocol pass-through g711ulaw
 sip
  bind control source-interface GigabitEthernet0/0/2
  bind media source-interface GigabitEthernet0/0/2
  session refresh
  asserted-id pai
  early-offer forced
  midcall-signaling passthru
  pass-thru subscribe-notify-events all
  pass-thru content unsupp
  sip-profiles inbound
  sip-profiles 1
```

Explanation

Command	**Description**
allow-connections sip to sip	Allow IP2IP connections between two SIP call legs
redundancy-group 1	Enable High Availability for the VoIP service
rtcp keepalive	Enables the CUBE to send rtcp keepalive packets for the session keepalive

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fax protocol	Specifies the fax protocol
early-offer forced	Enables SIP Delayed-Offer to Early-Offer globally
asserted-id	Specifies the privacy header in the outgoing SIP requests and response messages

Codecs

G729 is used primarily towards CenturyLink until specified otherwise.

voice class codec 1

codec preference 1 g711ulaw

codec preference 2 g729r8

```
voice class codec 2
 codec preference 1 g729r8
 codec preference 2 g711ulaw
```

Dial peer

Outbound Dial-peer to CenturyLink:

```
dial-peer voice 100 voip
 description Outbound peer to CenturyLink Primary
 translation-profile outgoing ctl
 destination-pattern .T
 session protocol sipv2
 session target ipv4:<Trunk1_IP>:5100
 voice-class codec 1
 voice-class sip early-offer forced
 voice-class sip profiles 100
 voice-class sip tenant 10
 voice-class sip bind control source-interface GigabitEthernet0/0/3
 voice-class sip bind media source-interface GigabitEthernet0/0/3
 dtmf-relay rtp-nte
 fax protocol pass-through g711ulaw
```

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```
 no vad!

dial-peer voice 102 voip
 description Outbound peer to CenturyLink Secondary
 translation-profile outgoing ctl
 destination-pattern .T
 session protocol sipv2
 session target ipv4:<Trunk2_IP>:5100
 voice-class codec 1
 voice-class sip early-offer forced
 voice-class sip profiles 200
 voice-class sip tenant 20
 voice-class sip bind control source-interface GigabitEthernet0/0/3
 voice-class sip bind media source-interface GigabitEthernet0/0/3
 dtmf-relay rtp-nte
 fax protocol pass-through g711ulaw
 no vad
```

Inbound Dial-peer from CenturyLink:

```
dial-peer voice 111 voip
 description Inbound peer match FROM Centurylink
 session protocol sipv2
 session transport udp
 incoming called-number 612356599.
 voice-class codec 1
 voice-class sip profiles 100
 voice-class sip tenant 10
 voice-class sip bind control source-interface GigabitEthernet0/0/3
 voice-class sip bind media source-interface GigabitEthernet0/0/3
 dtmf-relay rtp-nte
 fax protocol pass-through g711ulaw
 no vad
```

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Outbound Dial-peer to CUCM:

```
!
dial-peer voice 200 voip
 description Outbound peer to CUCM PUB
 translation-profile outgoing cucm
 destination-pattern 612356599.
 session protocol sipv2
 session target ipv4:10.80.20.2:5060
 session transport tcp
 voice-class codec 1
 voice-class sip bind control source-interface GigabitEthernet0/0/2
 voice-class sip bind media source-interface GigabitEthernet0/0/2
 dtmf-relay rtp-nte
 fax protocol pass-through g711ulaw
 no vad!


dial-peer voice 202 voip
 description Outbound peer to CUCM SUB
 translation-profile outgoing cucm
 destination-pattern 612356599.
 session protocol sipv2
 session target ipv4:10.80.20.3:5060
 session transport tcp
 voice-class codec 1
 voice-class sip bind control source-interface GigabitEthernet0/0/2
 voice-class sip bind media source-interface GigabitEthernet0/0/2
 dtmf-relay rtp-nte
 fax protocol pass-through g711ulaw
 no vad
```

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Inbound Dial-peer from CUCM:

```
dial-peer voice 201 voip
 description Inbound peer match FROM CUCM
 session protocol sipv2
 session transport tcp
 incoming called-number .T
 voice-class codec 1
 voice-class sip bind control source-interface GigabitEthernet0/0/2
 voice-class sip bind media source-interface GigabitEthernet0/0/2
 dtmf-relay rtp-nte
 fax protocol pass-through g711ulaw
 no vad
```

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Configuration example

The following configuration snippet contains a sample configuration of Cisco UBE with all parameters mentioned previously.

Active Cisco UBE:

```
!
!
!
version 16.3
service timestamps debug datetime msec
service timestamps log datetime msec
no platform punt-keepalive disable-kernel-core
!
hostname ISR4KR1
!
boot-start-marker
boot system flash isr4400-universalk9.16.03.02.SPA.bin
boot-end-marker
!
!
vrf definition Mgmt-intf
 !
 address-family ipv4
 exit-address-family
 !
 address-family ipv6
 exit-address-family
!
enable password ********
```

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```
!
no aaa new-model
!
!
!
!
!
!
!
!
!


ip name-server 10.64.4.10


ip domain name voip.centurylink.com
!
!
!
!
!
!
!
!
!
!
subscriber templating
!
!
```

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```
!
multilink bundle-name authenticated
!
!
!
!
!
!
!



!
!
voice service voip
 ip address trusted list
 no ip address trusted authenticate
 rtcp keepalive
 address-hiding
 mode border-element license capacity 20
 allow-connections sip to sip
 redundancy-group 1
 no supplementary-service sip moved-temporarily
 no supplementary-service sip refer
 supplementary-service media-renegotiate
 redirect ip2ip
 fax protocol pass-through g711ulaw
 sip
  bind control source-interface GigabitEthernet0/0/2
  bind media source-interface GigabitEthernet0/0/2
```

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```
  session refresh
  asserted-id pai
  early-offer forced
  midcall-signaling passthru
  pass-thru subscribe-notify-events all
  pass-thru content unsupp
  sip-profiles inbound
  sip-profiles 1
!
voice class codec 1
 codec preference 1 g711ulaw
 codec preference 2 g729r8
!
voice class codec 2
 codec preference 1 g729r8
 codec preference 2 g711ulaw
!
!
voice class sip-profiles 1
 request REGISTER sip-header From modify "(<.*:.*)(@.*>)"
"\1@voip.centurylink.com>"
 request REGISTER sip-header To modify "(<.*:.*)(@.*>)"
"\1@voip.centurylink.com>"
!
voice class sip-profiles 100
 request ANY sip-header Cisco-Guid remove
 response ANY sip-header Cisco-Guid remove
 request ANY sip-header User-Agent remove
 response ANY sip-header User-Agent remove
```

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```
 request INVITE sip-header Diversion modify "(<.*:.*)(@.*)"
"<sip:7209254720@voip.centurylink.com>"
 request INVITE sip-header From modify "(<.*:.*)(@.*>)"
"\1@voip.centurylink.com>"
 request INVITE sip-header P-Asserted-Identity modify "(<.*:.*)(@.*)"
"<sip:7209254720@voip.centurylink.com>"
 request REINVITE sip-header Diversion modify "(<.*:.*)(@.*)"
"<sip:7209254720@voip.centurylink.com>"
 request REINVITE sip-header From modify "(<.*:.*)(@.*>)"
"\1@voip.centurylink.com>"
 request REINVITE sip-header P-Asserted-Identity modify "(<.*:.*)(@.*)"
"<sip:7209254720@voip.centurylink.com>"
!
voice class sip-profiles 200
 request ANY sip-header Cisco-Guid remove
 response ANY sip-header Cisco-Guid remove
 request ANY sip-header User-Agent remove
 response ANY sip-header User-Agent remove
 request INVITE sip-header Diversion modify "(<.*:.*)(@.*)"
"<sip:7209254721@voip.centurylink.com>"
 request INVITE sip-header From modify "(<.*:.*)(@.*>)"
"\1@voip.centurylink.com>"
 request INVITE sip-header P-Asserted-Identity modify "(<.*:.*)(@.*)"
"<sip:7209254721@voip.centurylink.com>"
 request REINVITE sip-header Diversion modify "(<.*:.*)(@.*)"
"<sip:7209254721@voip.centurylink.com>"
 request REINVITE sip-header From modify "(<.*:.*)(@.*>)"
"\1@voip.centurylink.com>"
 request REINVITE sip-header P-Asserted-Identity modify "(<.*:.*)(@.*)"
"<sip:7209254721@voip.centurylink.com>"
!
!
voice class tenant 10
```

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```
  registrar ipv4:<Trunk1_IP>:5100 expires 3600
  credentials number 7209254720 username 263160-7209254720 password 7
********************** realm voip.centurylink.com
  authentication username 263160-7209254720 password 7 *****************
realm voip.centurylink.com
  no remote-party-id
  retry invite 2
  timers connect 100
  sip-server ipv4:<Trunk1_IP>:5100
  connection-reuse
  bind control source-interface GigabitEthernet0/0/3
  bind media source-interface GigabitEthernet0/0/3
!
voice class tenant 20
  registrar ipv4:<Trunk2_IP>:5100 expires 3600
  credentials number 7209254721 username 263160-7209254721 password 7
**************** realm voip.centurylink.com
  authentication username 263160-7209254721 password 7 *****************
realm voip.centurylink.com
  no remote-party-id
  retry invite 2
  timers connect 100
  sip-server ipv4:<Trunk2_IP>:5100
  connection-reuse
  bind control source-interface GigabitEthernet0/0/3
  bind media source-interface GigabitEthernet0/0/3
!
!
!
!
```

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```
voice translation-rule 1
!
voice translation-rule 2
 rule 1 /6123565991/ /5991/
 rule 2 /6123565992/ /5992/
 rule 3 /6123565993/ /5993/
!
voice translation-rule 3
!
voice translation-rule 4
 rule 1 /^9\(..........$\)/ /\1/
 rule 2 /^9\(...............$\)/ /\1/
 rule 3 /^9\(...$\)/ /\1/
!
!
voice translation-profile ctl
translate calling 3
translate called 4
!
voice translation-profile cucm
translate calling 1
translate called 2
!
!
!
!
voice-card 0/1
 no watchdog
!
```

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```
license udi pid ISR4431/K9 sn FOC18261KJL
license accept end user agreement
license boot level appxk9
license boot level uck9
license boot level securityk9
!
diagnostic bootup level minimal
spanning-tree extend system-id
!
!
username cisco privilege 15 secret 5 **********************
username user password 0 user
!
redundancy
 mode none
 application redundancy
  group 1
   name voice-b2bha
   priority 100 failover threshold 75
   timers delay 30 reload 60
   control GigabitEthernet0/0/0 protocol 1
   data GigabitEthernet0/0/0
   track 1 shutdown
   track 2 shutdown
!
!
!
!
!
```

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```
vlan internal allocation policy ascending
!
track 1 interface GigabitEthernet0/0/2 line-protocol
!
track 2 interface GigabitEthernet0/0/3 line-protocol
!
!
interface GigabitEthernet0/0/0
 ip address 10.64.4.19 255.255.0.0
 media-type rj45
 negotiation auto
!
interface GigabitEthernet0/0/1
 no ip address
 shutdown
 media-type rj45
 negotiation auto
!
interface GigabitEthernet0/0/2
 description WAN
 ip address 10.80.22.74 255.255.255.0
 media-type rj45
 negotiation auto
 redundancy rii 1
 redundancy group 1 ip 10.80.22.100 exclusive
!
interface GigabitEthernet0/0/3
 description Wan Interface
 ip address 192.65.79.141 255.255.255.128
```

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```
 media-type rj45
 negotiation auto
 redundancy rii 2
 redundancy group 1 ip 192.65.79.155 exclusive
!
interface Service-Engine0/1/0
!
interface GigabitEthernet0
 vrf forwarding Mgmt-intf
 no ip address
 negotiation auto
!
interface Vlan1
 no ip address
 shutdown
!
ip forward-protocol nd
ip http server
no ip http secure-server
ip route 0.0.0.0 0.0.0.0 192.65.79.129
ip route 10.64.0.0 255.255.0.0 10.64.1.1
ip route 172.16.0.0 255.255.0.0 10.80.22.1
!
!
!
!
!
!
!
```

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```
control-plane
!
!
voice-port 0/1/0
 cptone IN
 shutdown
 caller-id enable
!
voice-port 0/1/1
 !
 !
 !
 !
!
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
!
!
!
!
dspfarm profile 1 transcode
 associate application CUBE
 shutdown
!
dial-peer voice 100 voip
```

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```
 description Outbound peer to CenturyLink Primary
 translation-profile outgoing ctl
 destination-pattern .T
 session protocol sipv2
 session target ipv4:<Trunk1_IP>:5100
 voice-class codec 1
 voice-class sip early-offer forced
 voice-class sip profiles 100
 voice-class sip tenant 10
 voice-class sip bind control source-interface GigabitEthernet0/0/3
 voice-class sip bind media source-interface GigabitEthernet0/0/3
 dtmf-relay rtp-nte
 fax protocol pass-through g711ulaw
 no vad
!
dial-peer voice 102 voip
 description Outbound peer to CenturyLink Secondary
 translation-profile outgoing ctl
 destination-pattern .T
 session protocol sipv2
 session target ipv4:<Trunk2_IP>::5100
 voice-class codec 1
 voice-class sip early-offer forced
 voice-class sip profiles 200
 voice-class sip tenant 20
 voice-class sip bind control source-interface GigabitEthernet0/0/3
 voice-class sip bind media source-interface GigabitEthernet0/0/3
 dtmf-relay rtp-nte
 fax protocol pass-through g711ulaw
```

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```
 no vad
!
dial-peer voice 111 voip
 description Inbound peer match FROM Centurylink
 session protocol sipv2
 session transport udp
 incoming called-number 612356599.
 voice-class codec 1
 voice-class sip profiles 100
 voice-class sip tenant 10
 voice-class sip bind control source-interface GigabitEthernet0/0/3
 voice-class sip bind media source-interface GigabitEthernet0/0/3
 dtmf-relay rtp-nte
 fax protocol pass-through g711ulaw
 no vad
!
dial-peer voice 200 voip
 description Outbound peer to CUCM PUB
 translation-profile outgoing cucm
 destination-pattern 612356599.
 session protocol sipv2
 session target ipv4:10.80.20.2:5060
 session transport tcp
 voice-class codec 1
 voice-class sip bind control source-interface GigabitEthernet0/0/2
 voice-class sip bind media source-interface GigabitEthernet0/0/2
 dtmf-relay rtp-nte
 fax protocol pass-through g711ulaw
 no vad
```

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```
!
dial-peer voice 201 voip
 description Inbound peer match FROM CUCM
 session protocol sipv2
 session transport tcp
 incoming called-number .T
 voice-class codec 1
 voice-class sip bind control source-interface GigabitEthernet0/0/2
 voice-class sip bind media source-interface GigabitEthernet0/0/2
 dtmf-relay rtp-nte
 fax protocol pass-through g711ulaw
 no vad
!
dial-peer voice 202 voip
 description Outbound peer to CUCM SUB
 translation-profile outgoing cucm
 destination-pattern 612356599.
 session protocol sipv2
 session target ipv4:10.80.20.3:5060
 session transport tcp
 voice-class codec 1
 voice-class sip bind control source-interface GigabitEthernet0/0/2
 voice-class sip bind media source-interface GigabitEthernet0/0/2
 dtmf-relay rtp-nte
 fax protocol pass-through g711ulaw
 no vad!
!
sip-ua
 no remote-party-id
```

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```
 retry invite 1
 timers options 1000
 connection-reuse
!
!
line con 0
 exec-timeout 0 0
 logging synchronous
 stopbits 1
line aux 0
 privilege level 15
 stopbits 1
line vty 0
 exec-timeout 0 0
 password ********
 no activation-character
 logging synchronous
 login
 transport preferred ssh
 transport input telnet ssh
line vty 1 4
 exec-timeout 0 0
 password ************
 logging synchronous
 login
 transport input telnet ssh
!
ntp server 10.10.10.5
!
```

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```
!
!
end
```

Standby Cisco UBE:

```
Current configuration : 9385 bytes
!
! Last configuration change at 15:17:17 UTC Mon Mar 13 2017
!
version 16.3
service timestamps debug datetime msec
service timestamps log datetime msec
no platform punt-keepalive disable-kernel-core
!
hostname ISR4KR2
!
boot-start-marker
boot system flash isr4400-universalk9.16.03.02.SPA.bin
boot-end-marker
!
!
vrf definition Mgmt-intf
 !
 address-family ipv4
 exit-address-family
 !
 address-family ipv6
 exit-address-family
```

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```
!
logging buffered 9999999
no logging console
enable password ***********
!
no aaa new-model
!
ipc zone default
 association 1
  no shutdown
!
!
!
!
!
!
!
!
!
!


ip name-server 10.64.4.10


no ip domain lookup
!
!
!
!
```

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```
!
!
!
!
!
!
subscriber templating
!
!
!
multilink bundle-name authenticated
!
!
cts logging verbose
!
voice rtp send-recv
!
voice service voip
 ip address trusted list
 no ip address trusted authenticate
 rtcp keepalive
 address-hiding
 mode border-element license capacity 20
 allow-connections sip to sip
 redundancy-group 1
 no supplementary-service sip moved-temporarily
 no supplementary-service sip refer
 supplementary-service media-renegotiate
 redirect ip2ip
```

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```
 fax protocol pass-through g711ulaw
 sip
  bind control source-interface GigabitEthernet0/0/2
  bind media source-interface GigabitEthernet0/0/2
  session refresh
  asserted-id pai
  early-offer forced
  midcall-signaling passthru
  pass-thru subscribe-notify-events all
  pass-thru content unsupp
  sip-profiles inbound
  sip-profiles 1
!
voice class codec 1
 codec preference 1 g711ulaw
  codec preference 2 g729r8
!
voice class codec 2
 codec preference 1 g729r8
 codec preference 2 g711ulaw
!
!
voice class sip-profiles 1
 request REGISTER sip-header From modify "(<.*:.*)(@.*>)"
"\1@voip.centurylink.com>"
 request REGISTER sip-header To modify "(<.*:.*)(@.*>)"
"\1@voip.centurylink.com>"
!
voice class sip-profiles 100
```

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```
 request ANY sip-header Cisco-Guid remove
 response ANY sip-header Cisco-Guid remove
 request ANY sip-header User-Agent remove
 response ANY sip-header User-Agent remove
 request INVITE sip-header Diversion modify "(<.*:.*)(@.*)"
"<sip:7209254720@voip.centurylink.com>"
 request INVITE sip-header From modify "(<.*:.*)(@.*>)"
"\1@voip.centurylink.com>"
 request INVITE sip-header P-Asserted-Identity modify "(<.*:.*)(@.*)"
"<sip:7209254720@voip.centurylink.com>"
 request REINVITE sip-header Diversion modify "(<.*:.*)(@.*)"
"<sip:7209254720@voip.centurylink.com>"
 request REINVITE sip-header From modify "(<.*:.*)(@.*>)"
"\1@voip.centurylink.com>"
 request REINVITE sip-header P-Asserted-Identity modify "(<.*:.*)(@.*)"
"<sip:7209254720@voip.centurylink.com>"
!
voice class sip-profiles 200
 request ANY sip-header Cisco-Guid remove
 response ANY sip-header Cisco-Guid remove
 request ANY sip-header User-Agent remove
 response ANY sip-header User-Agent remove
 request INVITE sip-header Diversion modify "(<.*:.*)(@.*)"
"<sip:7209254721@voip.centurylink.com>"
 request INVITE sip-header From modify "(<.*:.*)(@.*>)"
"\1@voip.centurylink.com>"
 request INVITE sip-header P-Asserted-Identity modify "(<.*:.*)(@.*)"
"<sip:7209254721@voip.centurylink.com>"
request REINVITE sip-header Diversion modify "(<.*:.*)(@.*)"
"<sip:7209254721@voip.centurylink.com>"
 request REINVITE sip-header From modify "(<.*:.*)(@.*>)"
"\1@voip.centurylink.com>"
```

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```
 request REINVITE sip-header P-Asserted-Identity modify "(<.*:.*)(@.*)"
"<sip:7209254721@voip.centurylink.com>"
!
!
voice class tenant 10
  registrar ipv4:<Trunk1_IP>:5100 expires 3600
  credentials number 7209254720 username 263160-7209254720 password 7
******************* realm voip.centurylink.com
  authentication username 263160-7209254720 password 7 ******************
realm voip.centurylink.com
  no remote-party-id
  retry invite 2
  timers connect 100
  sip-server ipv4:<Trunk1_IP>:5100
  connection-reuse
  bind control source-interface GigabitEthernet0/0/3
  bind media source-interface GigabitEthernet0/0/3
!
voice class tenant 20
  registrar ipv4:<Trunk1_IP>:5100 expires 3600
  credentials number 7209254721 username 263160-7209254721 password 7
****************** realm voip.centurylink.com
  authentication username 263160-7209254721 password 7 *********************
realm voip.centurylink.com
  no remote-party-id
  retry invite 2
  timers connect 100
  sip-server ipv4:<Trunk1_IP>:5100
  connection-reuse
  bind control source-interface GigabitEthernet0/0/3
```

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```
  bind media source-interface GigabitEthernet0/0/3
!
!
voice translation-rule 1
!
voice translation-rule 2
 rule 1 /6123565991/ /5991/
 rule 2 /6123565992/ /5992/
 rule 3 /6123565993/ /5993/
 rule 4 /6123565994/ /2302/
!
voice translation-rule 3
!
voice translation-rule 4
 rule 1 /^9\(..........$\)/ /\1/
 rule 2 /^9\(...............$\)/ /\1/
 rule 3 /^9\(...$\)/ /\1/
!
!
voice translation-profile ctl
translate calling 3
translate called 4
!
voice translation-profile cucm
translate calling 1
translate called 2
!
!
!
```

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```
license udi pid ISR4431/K9 sn FOC18232988
license boot level appxk9
license boot level uck9
license boot level securityk9
!
diagnostic bootup level minimal
spanning-tree extend system-id
!
!
username cisco privilege 15 secret 5 **************************
!
redundancy
 mode none
 application redundancy
  group 1
   name voice-b2bha
   control GigabitEthernet0/0/0 protocol 1
   data GigabitEthernet0/0/0
   track 1 shutdown
   track 2 shutdown
!
!
vlan internal allocation policy ascending
!
track 1 interface GigabitEthernet0/0/2 line-protocol
!
track 2 interface GigabitEthernet0/0/3 line-protocol
!
!
```

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```
!
!
interface GigabitEthernet0/0/0
 ip address 10.64.4.20 255.255.0.0
 media-type rj45
 negotiation auto
!
interface GigabitEthernet0/0/1
 no ip address
 shutdown
 media-type rj45
 negotiation auto
!
interface GigabitEthernet0/0/2
 ip address 10.80.22.75 255.255.255.0
 media-type rj45
 negotiation auto
 redundancy rii 1
 redundancy group 1 ip 10.80.22.100 exclusive
!
interface GigabitEthernet0/0/3
 description Wan Interface
 ip address 192.65.79.140 255.255.255.128
 media-type rj45
 negotiation auto
 redundancy rii 2
 redundancy group 1 ip 192.65.79.155 exclusive
!
interface GigabitEthernet0
```

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```
 vrf forwarding Mgmt-intf
 no ip address
 shutdown
 negotiation auto
!
interface Vlan1
 no ip address
 shutdown
!
ip forward-protocol nd
no ip http server
no ip http secure-server
ip route 0.0.0.0 0.0.0.0 192.65.79.129
ip route 10.64.0.0 255.255.0.0 10.64.1.1
ip route 10.80.10.0 255.255.255.0 10.80.22.1
ip route 10.80.22.0 255.255.255.0 10.80.22.1
ip route 172.16.0.0 255.255.0.0 10.80.22.1
!
!
!
!
!
!
!
control-plane
!
 !
 !
 !
```

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```
 !
!
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
!
!
!
!
dspfarm profile 1 conference security
 shutdown
!
dial-peer voice 100 voip
 description Outbound peer to CenturyLink Primary
 translation-profile outgoing ctl
 destination-pattern .T
 session protocol sipv2
 session target ipv4:<Trunk1_IP>:5100
 voice-class codec 1
 voice-class sip early-offer forced
 voice-class sip profiles 100
 voice-class sip tenant 10
 voice-class sip bind control source-interface GigabitEthernet0/0/3
 voice-class sip bind media source-interface GigabitEthernet0/0/3
 dtmf-relay rtp-nte
```

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```
 fax protocol pass-through g711ulaw
 no vad
!
dial-peer voice 102 voip
 description Outbound peer to CenturyLink Secondary
 translation-profile outgoing ctl
 destination-pattern .T
 session protocol sipv2
 session target ipv4:<Trunk2_IP>:5100
 voice-class codec 1
 voice-class sip early-offer forced
 voice-class sip profiles 200
 voice-class sip tenant 20
 voice-class sip bind control source-interface GigabitEthernet0/0/3
 voice-class sip bind media source-interface GigabitEthernet0/0/3
 dtmf-relay rtp-nte
 fax protocol pass-through g711ulaw
 no vad
!
dial-peer voice 111 voip
 description Inbound peer match FROM Centurylink
 session protocol sipv2
 session transport udp
 incoming called-number 612356599.
 voice-class codec 1
 voice-class sip profiles 100
 voice-class sip tenant 10
 voice-class sip bind control source-interface GigabitEthernet0/0/3
 voice-class sip bind media source-interface GigabitEthernet0/0/3
```

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```
 dtmf-relay rtp-nte
 fax protocol pass-through g711ulaw
 no vad
!
dial-peer voice 200 voip
 description Outbound peer to CUCM PUB
 translation-profile outgoing cucm
 destination-pattern 612356599.
 session protocol sipv2
 session target ipv4:10.80.20.2:5060
 session transport tcp
 voice-class codec 1
 voice-class sip bind control source-interface GigabitEthernet0/0/2
 voice-class sip bind media source-interface GigabitEthernet0/0/2
 dtmf-relay rtp-nte
 fax protocol pass-through g711ulaw
 no vad
!
dial-peer voice 201 voip
 description Inbound peer match FROM CUCM
 session protocol sipv2
 session transport tcp
 incoming called-number .T
 voice-class codec 1
 voice-class sip bind control source-interface GigabitEthernet0/0/2
 voice-class sip bind media source-interface GigabitEthernet0/0/2
 dtmf-relay rtp-nte
 fax protocol pass-through g711ulaw
 no vad
```

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```
!
dial-peer voice 202 voip
 description Outbound peer to CUCM SUB
 translation-profile outgoing cucm
 destination-pattern 612356599.
 session protocol sipv2
 session target ipv4:10.80.20.3:5060
 session transport tcp
 voice-class codec 1
 voice-class sip bind control source-interface GigabitEthernet0/0/2
 voice-class sip bind media source-interface GigabitEthernet0/0/2
 dtmf-relay rtp-nte
 fax protocol pass-through g711ulaw
 no vad!
sip-ua
 no remote-party-id
 retry invite 1
 timers options 1000
 connection-reuse
!
!
line con 0
 stopbits 1
line aux 0
 stopbits 1
line vty 0
 session-timeout 90
 exec-timeout 960 0
 password ********
```

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```
 no activation-character
 logging synchronous
 login
 transport preferred ssh
 transport input all
 stopbits 1
line vty 1 4
 exec-timeout 960 0
 password ********
 logging synchronous
 login
 transport input all
!
!
!
end
```

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Configuring CUCM 11.5 cluster

Trunk configuration from CUCM to the LAN side of the CUBE.

Trunk configuration

Trunk to CUBE

- Open Cisco Unified CM Administration and navigate to Devices → Trunk → Add New

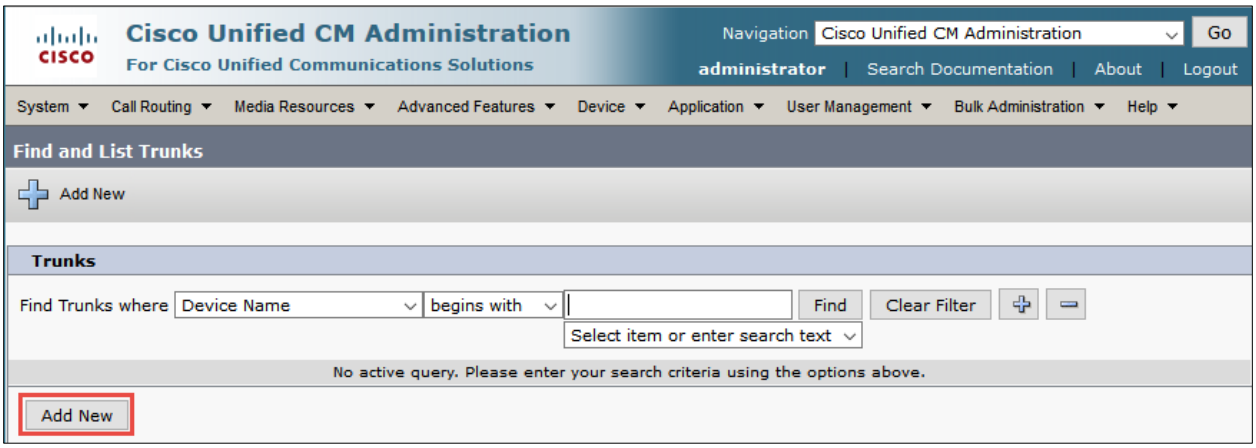

Figure 3 Add new Trunk in CUCM

- Click on "Add New" button and select the Trunk Type and Device Protocol as shown below.

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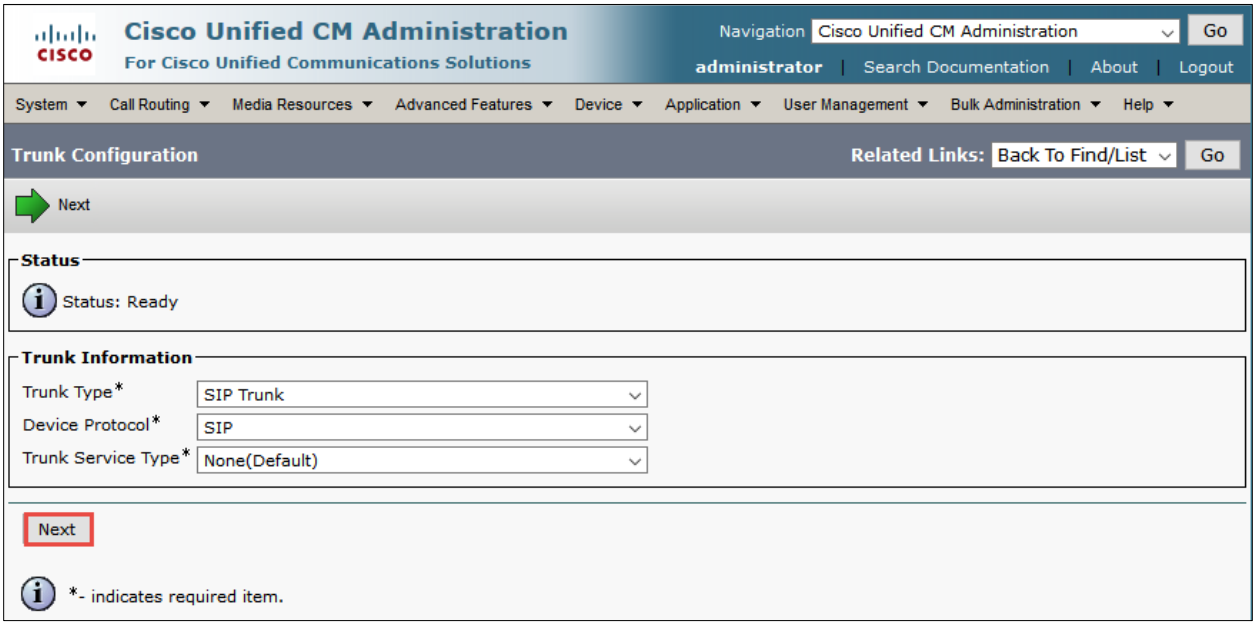

Figure 4 Add SIP Trunk Type

- Select 'Trunk Type' as SIP Trunk and 'Protocol' as SIP and select 'Next'.

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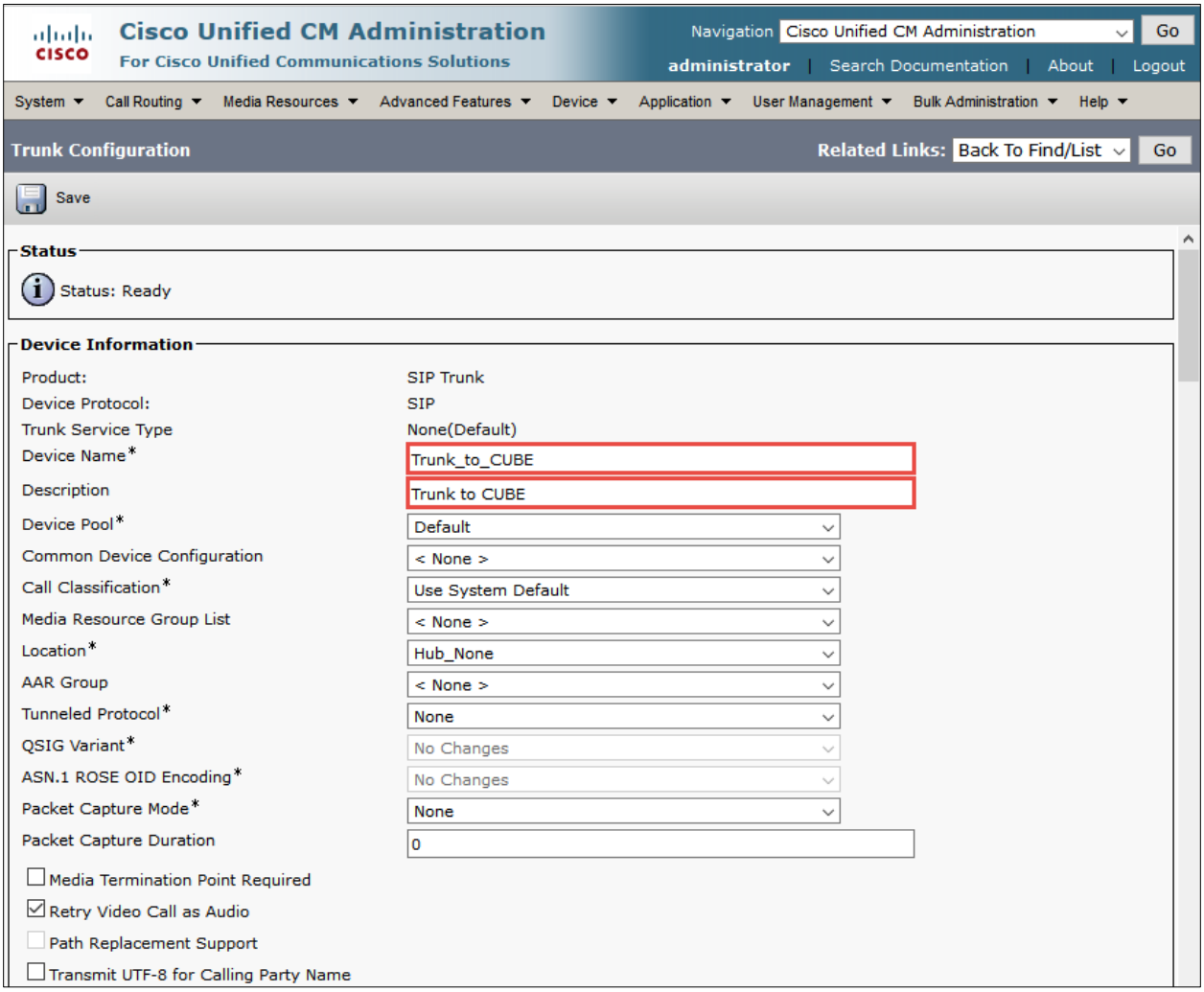

Figure 5 SIP Trunk Device name and Device Pool selection

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- Please configure the Inbound and Outbound call settings as shown below

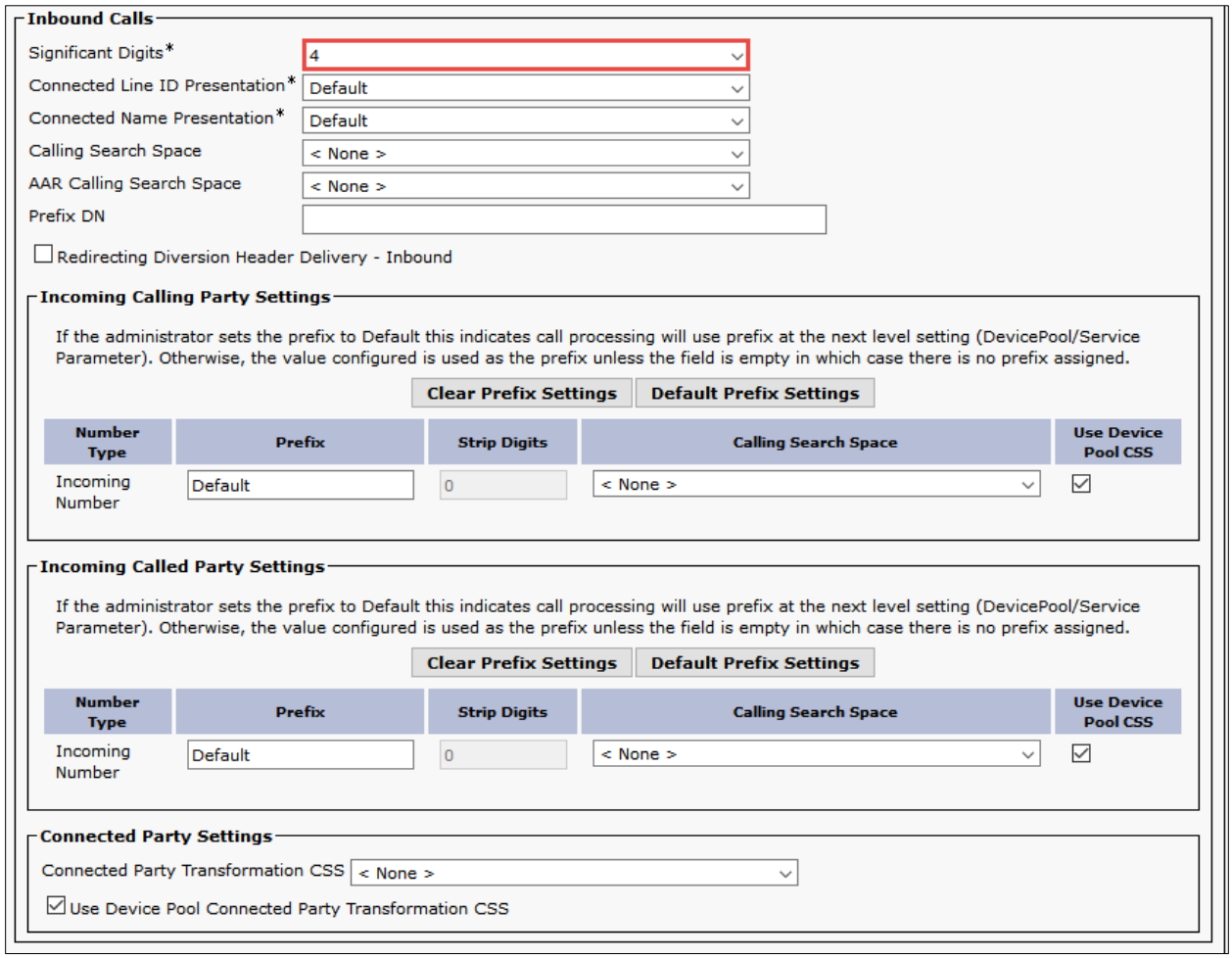

Figure 6: Inbound call Configuration

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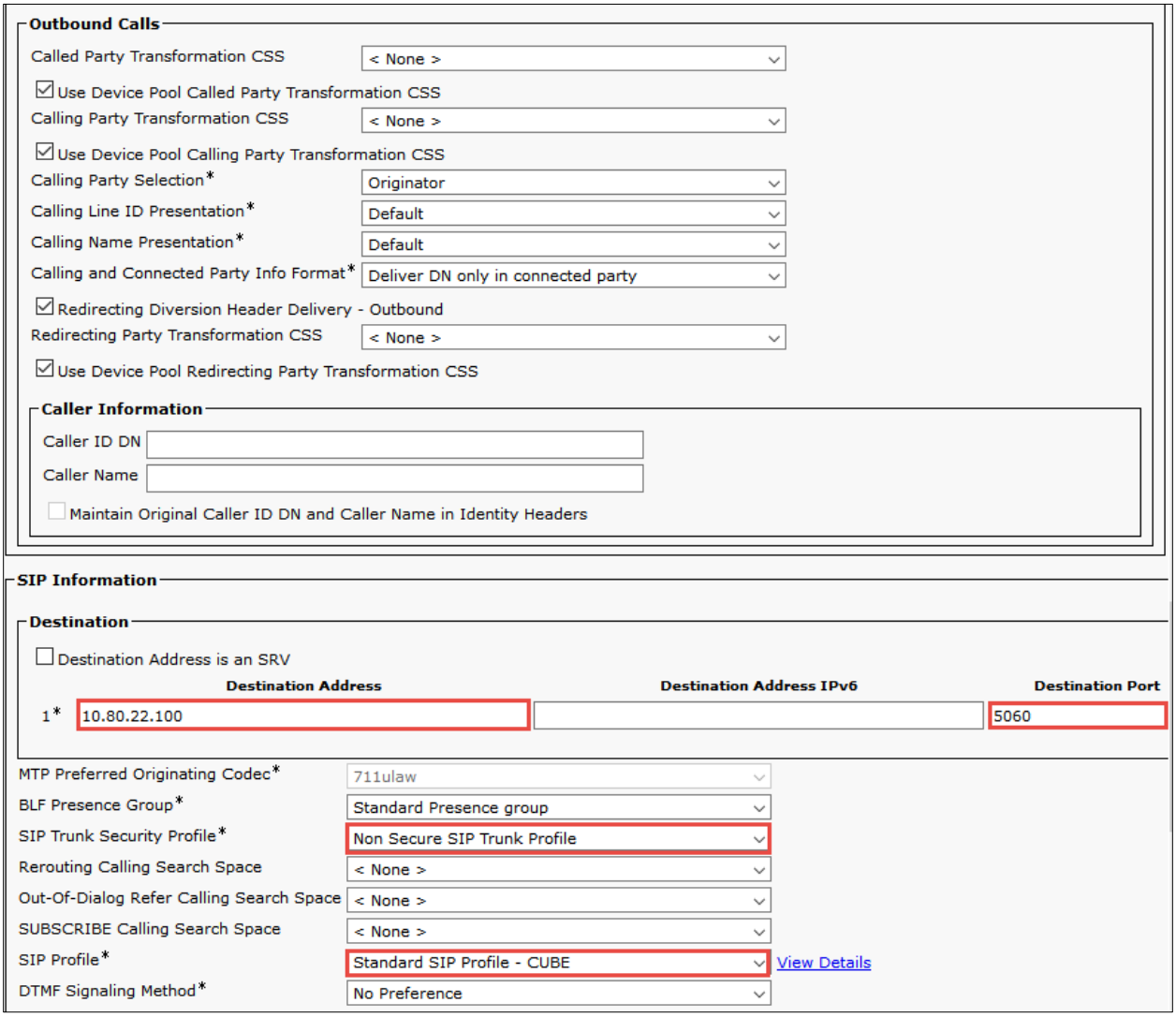

Figure 7 Trunk IP Address and security configuration

- Configure the Virtual LAN IP address of the CUBE and the port number
- Configure the SIP Profile and SIP trunk security profiles as shown below.
- The rest of the configuration is all default.
- Click Save and Reset after completion.

Trunk to FAX gateway

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- Open Cisco Unified CM Administration and navigate to Devices → Trunk → Add New

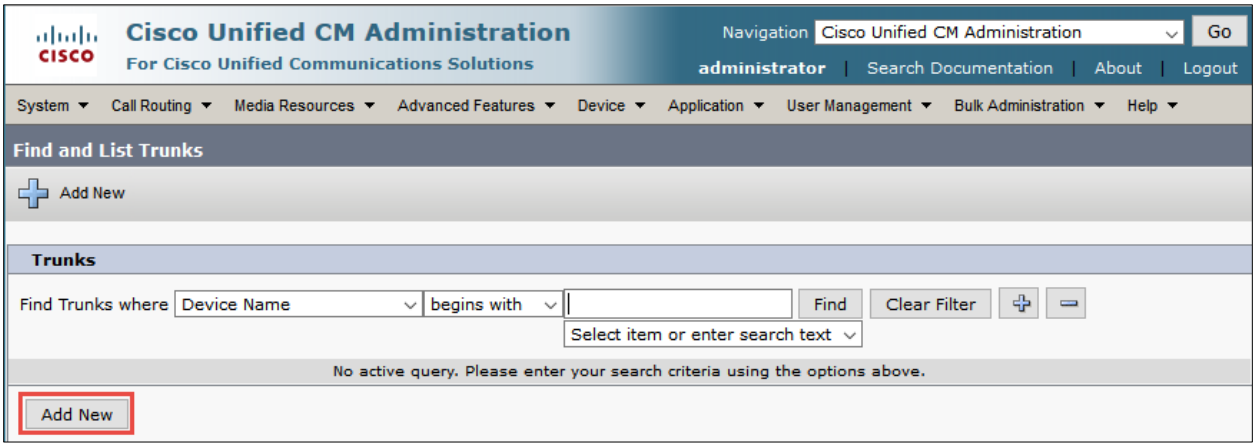

Figure 8 Add a new SIP Trunk to FAX gateway

- Click on "Add New" button and select the Trunk Type and Device Protocol as shown below.

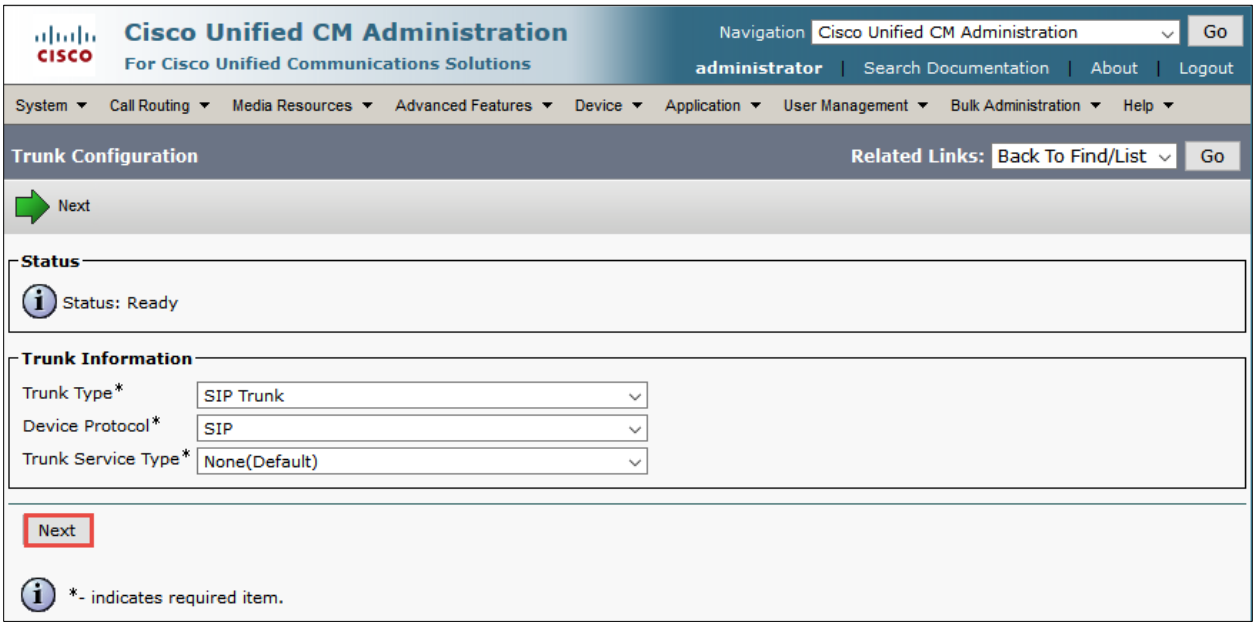

Figure 9 Trunk Type and Device Protocol configuration

- Select 'Trunk Type' as SIP Trunk and 'Protocol' as SIP and select 'Next'.

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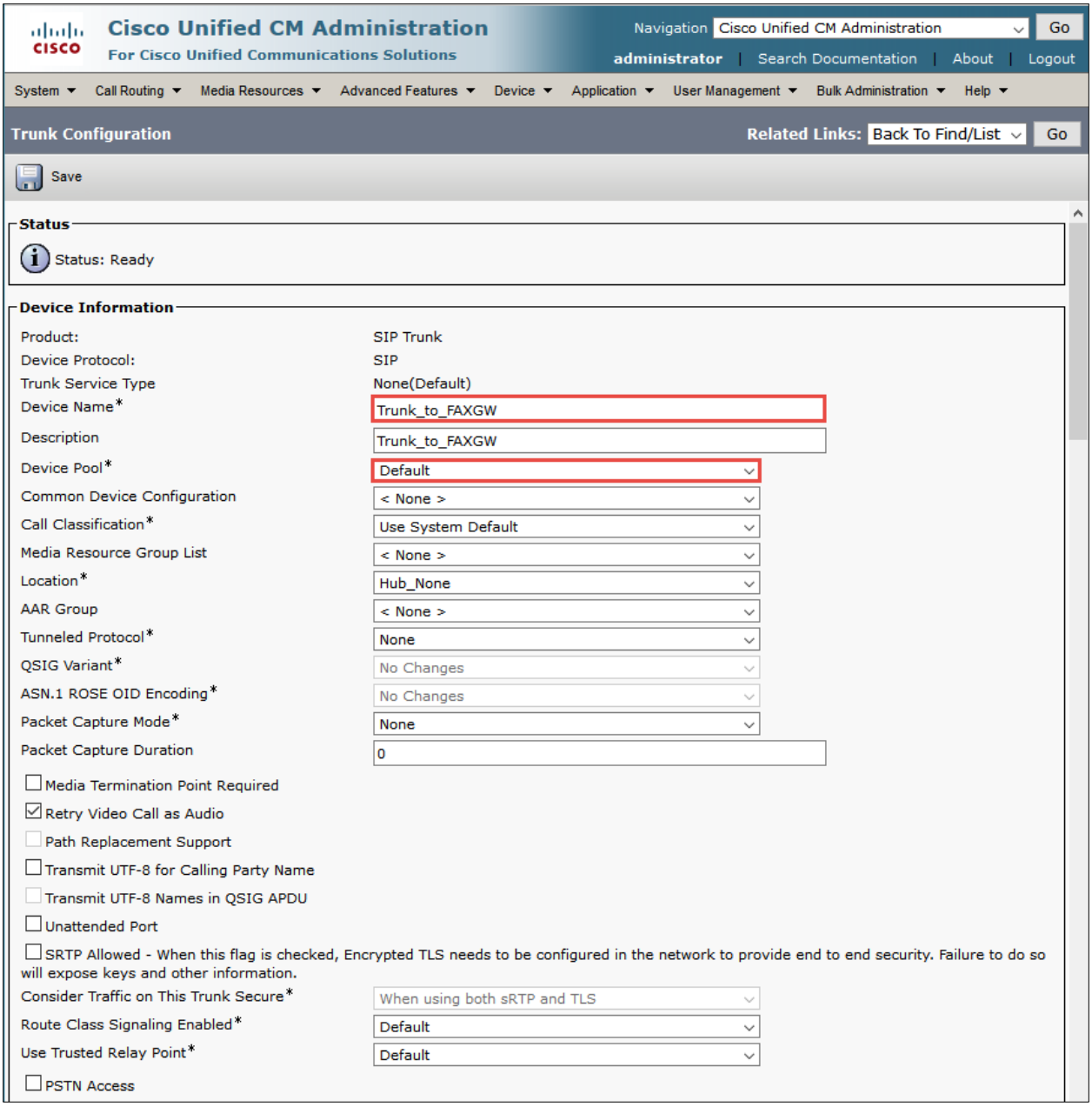

Figure 10 SIP Trunk Device name and Device Pool selection

- Please configure the Inbound and Outbound call settings as shown below

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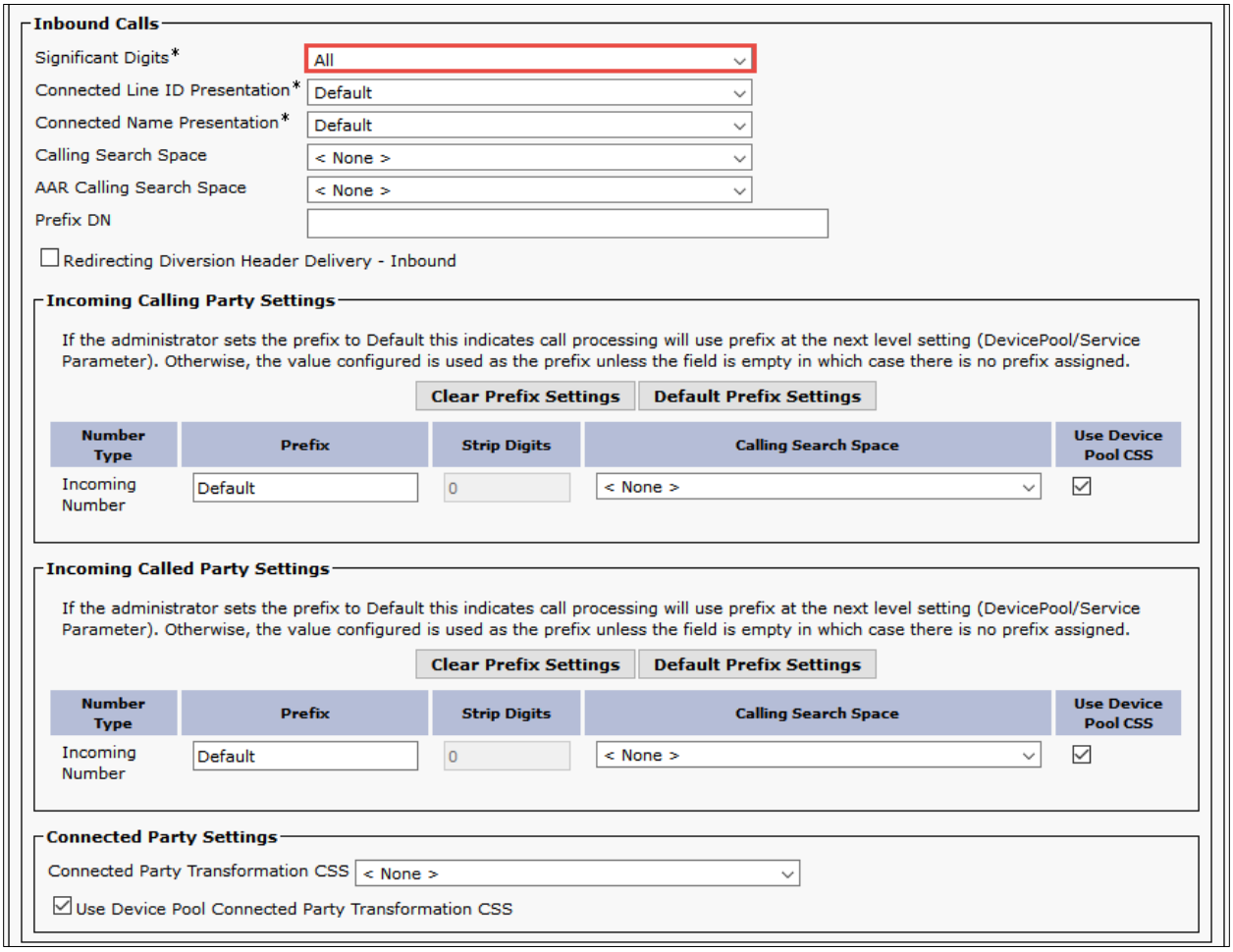

Figure 11 Inbound call Routing Configuration

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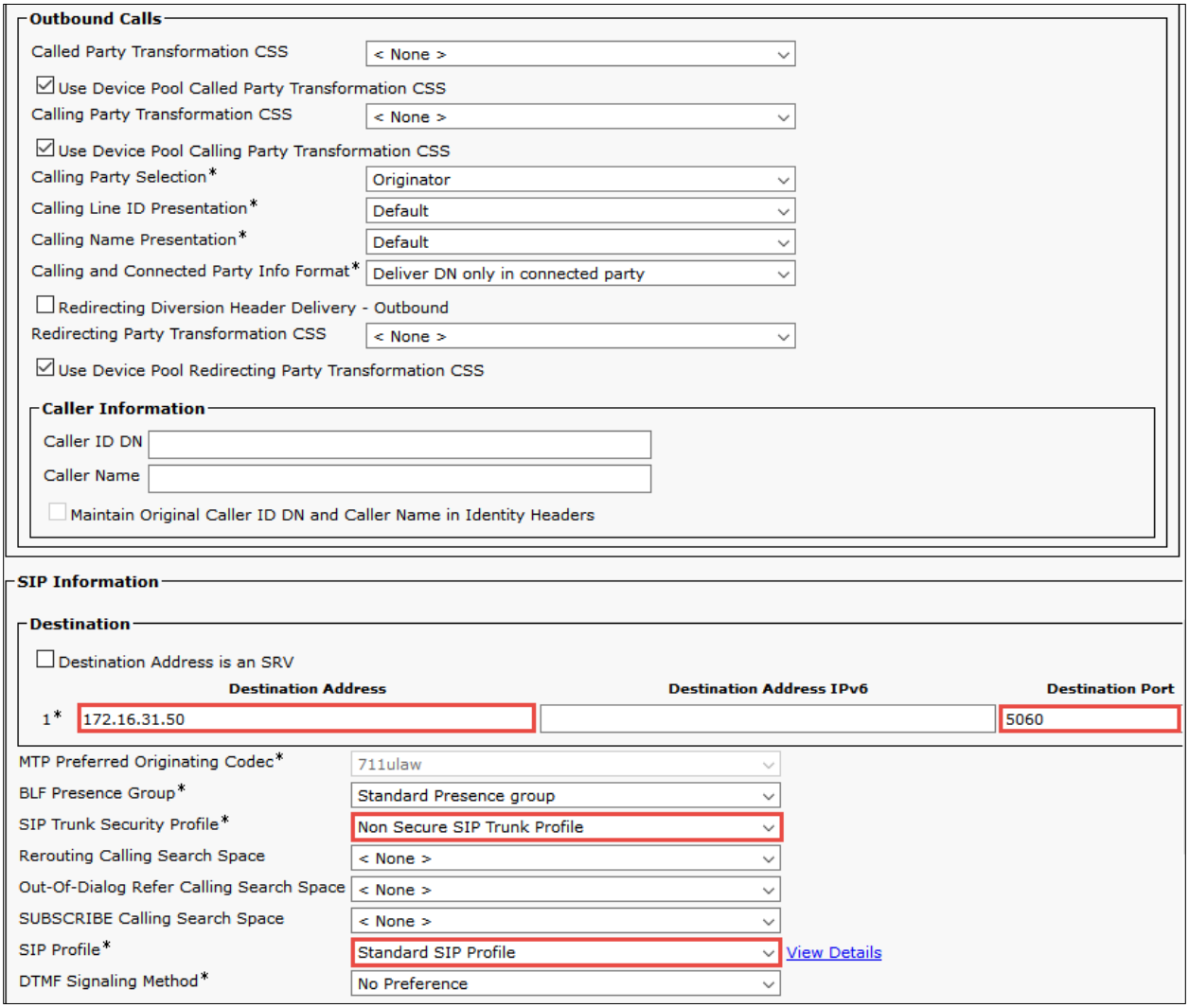

Figure 12 Outbound Call Routing and Trunk Security Settings

- Configure IP address of the FAX Gateway and the port number
- Configure the SIP Profile and SIP trunk security profiles as shown below.
- The rest of the configuration is all default.
- Click Save and Reset after completion.

Routing configuration

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Route Pattern to CUBE

- Open Cisco Unified CM Administration and navigate to Call Routing → Route/Hunt → Route Pattern
- Click on "Add New" button to add a new route pattern to CUBE

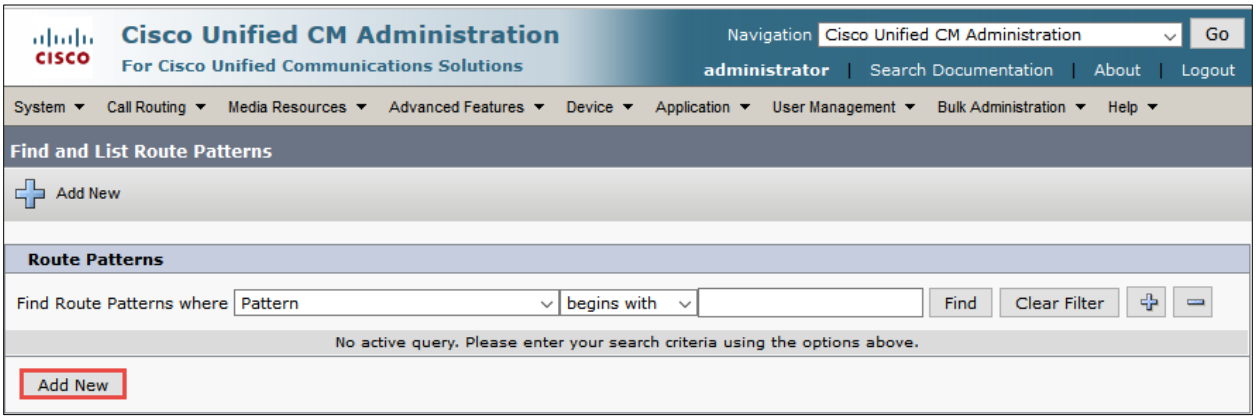

Figure 13 Add New Route Pattern to CUBE

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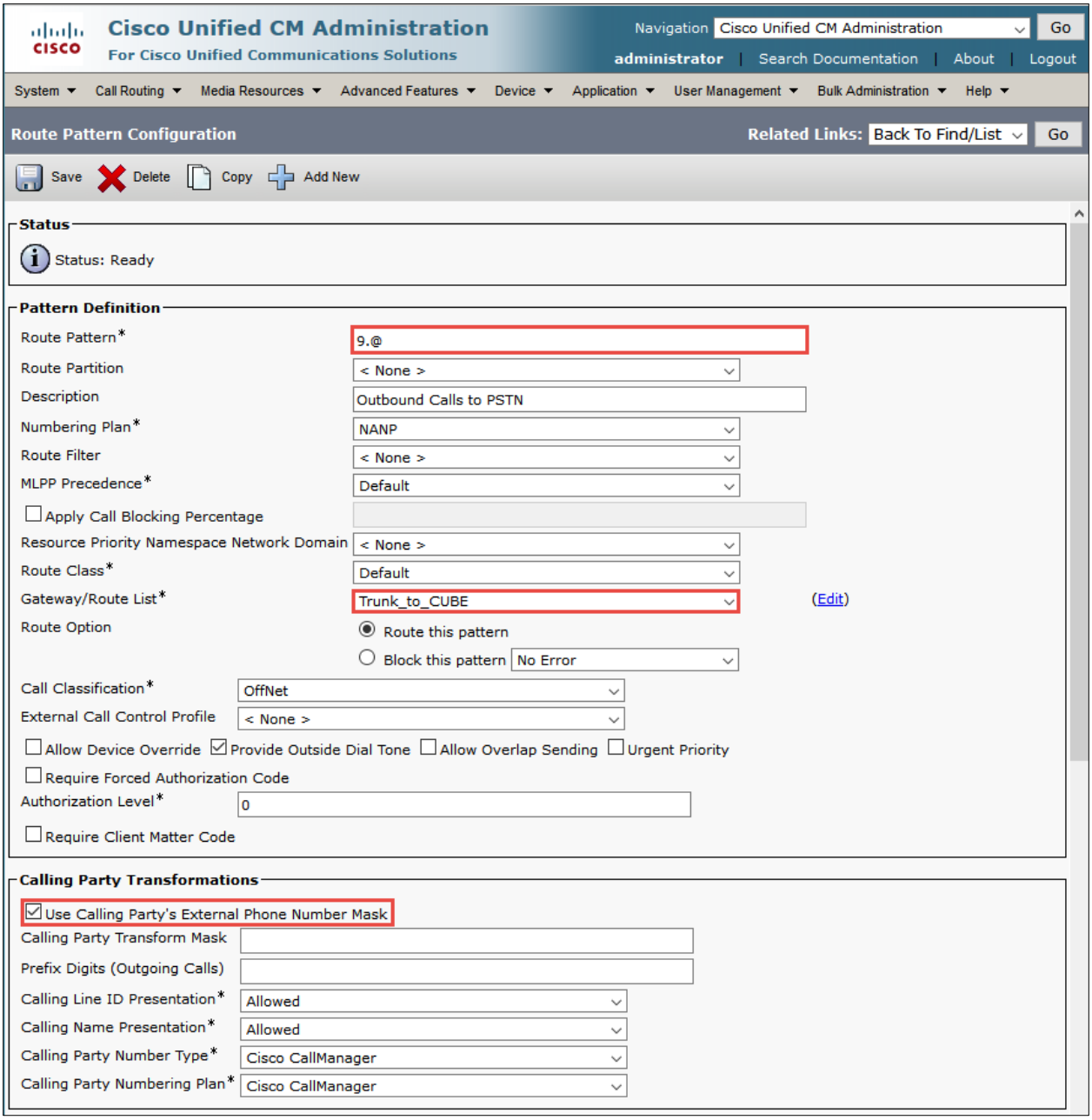

Figure 14 Route Pattern Configuration for CUBE

- Click on “Save” button to complete the route pattern configuration

Route Pattern to Fax Gateway

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- Open Cisco Unified CM Administration and navigate to Call Routing → Route/Hunt → Route Pattern
- Click on "Add New" button to add a new route pattern to Fax Gateway

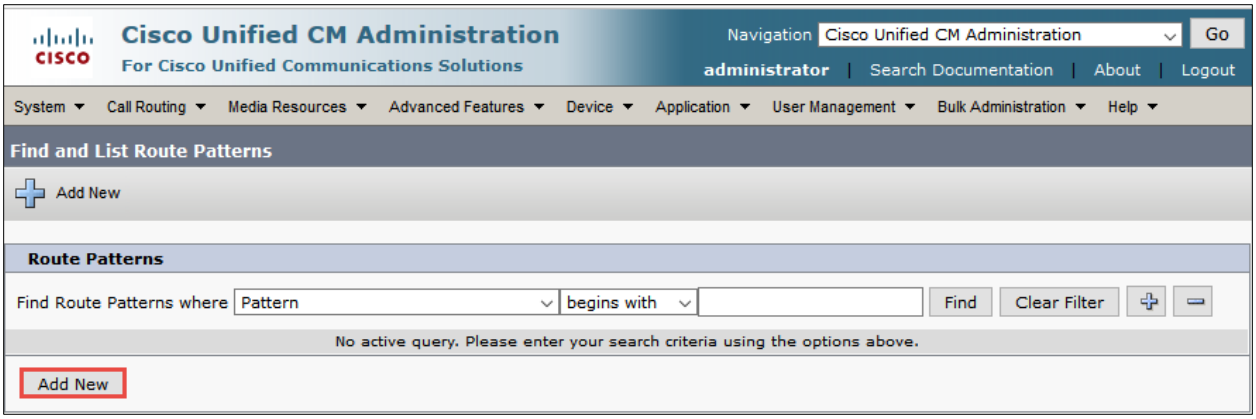

Figure 15 Add New Route patter to Fax Gateway

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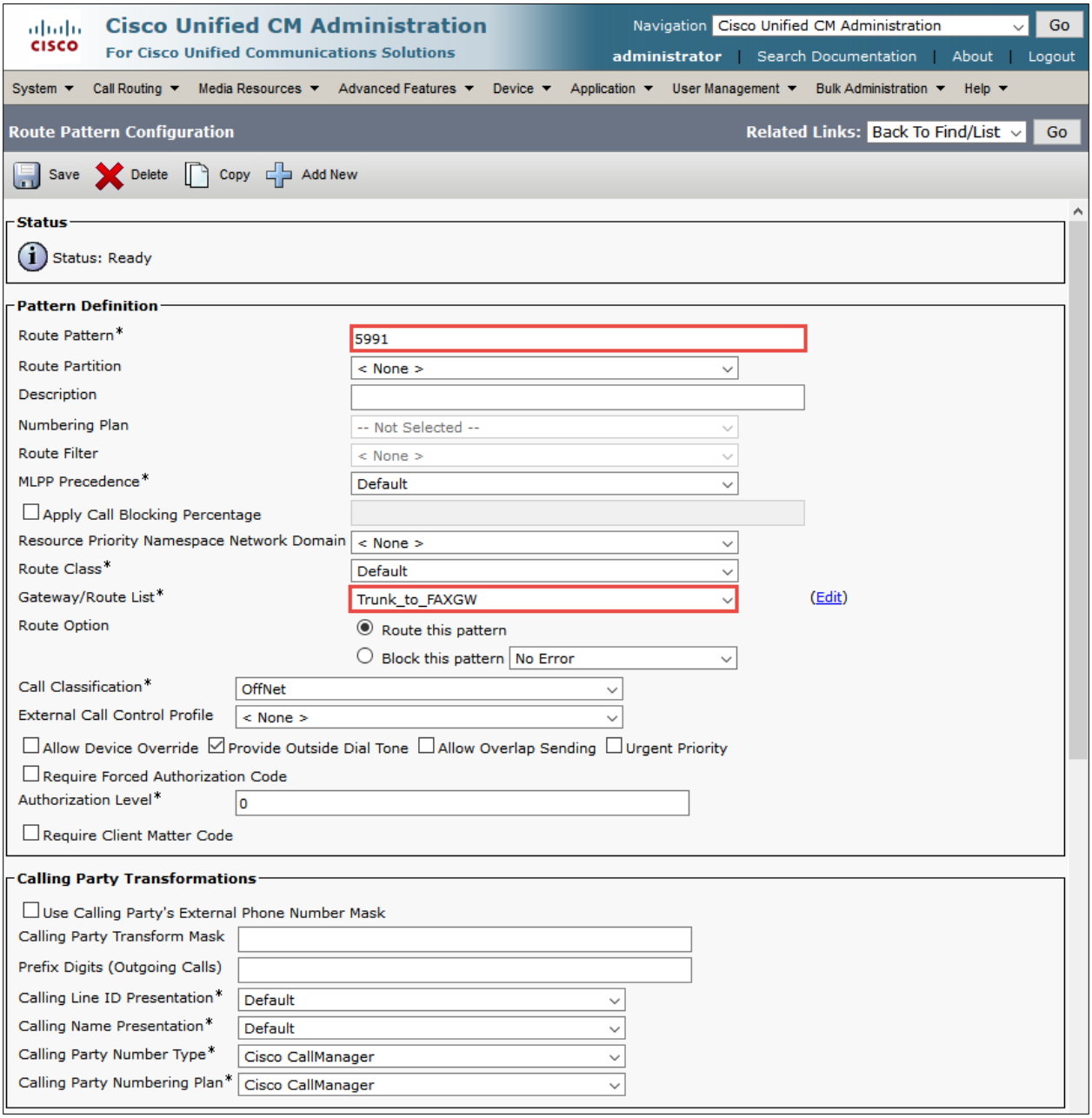

Figure 16 Route Pattern Configuration to Fax Gateway

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SIP Trunk Security Profile

- We have used the default Non-Secure SIP Trunk Security Profile.

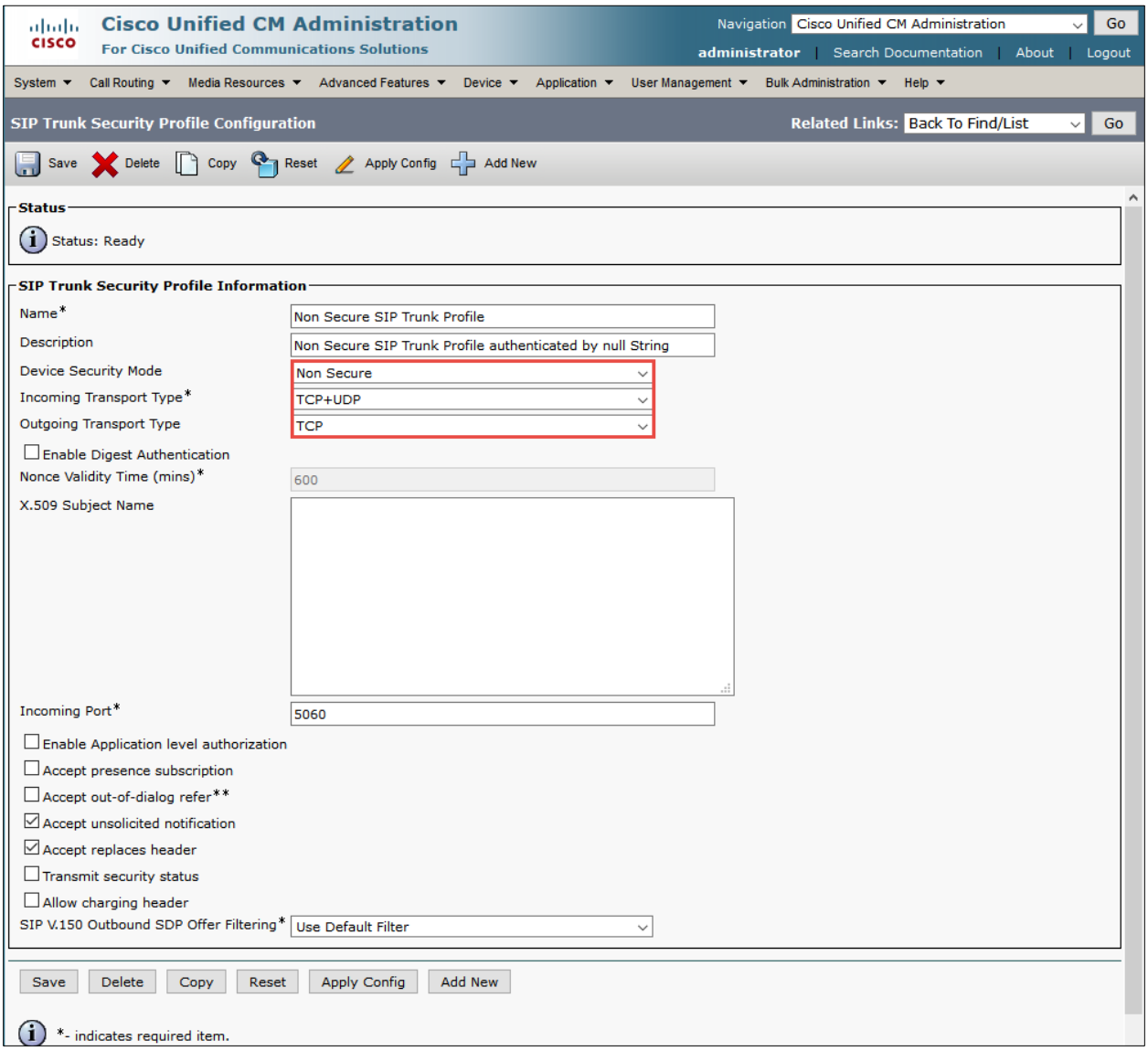

Figure 17 SIP Trunk Security Profile

Fax Gateway Configuration

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The following configuration snippet contains a sample configuration of Cisco FAX Gateway.

```
Current configuration : 9949 bytes
!
! Last configuration change at 16:34:05 IST Wed Apr 19 2017 by cisco
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname faxgateway
!
boot-start-marker
boot-end-marker
!
!
enable password ********
!
aaa new-model
!
!
aaa authentication login local_auth local
!
!
!
!
aaa session-id common
clock timezone IST 5 30
network-clock-participate wic 2
```

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```
network-clock-participate wic 3
!
dot11 syslog
ip source-route
!
!
ip cef
!
!
!
multilink bundle-name authenticated
!
!
!
!
isdn switch-type primary-qsig
!
!
voice rtp send-recv
!
voice service pots
!
voice service voip
 address-hiding
 allow-connections sip to sip
 no supplementary-service sip handle-replaces
 redirect ip2ip
 fax protocol pass-through g711ulaw
 no fax-relay sg3-to-g3
```

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```
 sip
  midcall-signaling passthru
  g729 annexb-all
!
voice class codec 3
 codec preference 1 g711ulaw
!
voice class codec 2
 codec preference 1 g711alaw
 codec preference 2 g729br8
 codec preference 3 g729r8
!
voice class codec 1
 codec preference 1 g729r8
 codec preference 2 g711ulaw
!
voice class codec 4
 codec preference 1 g711alaw
 codec preference 2 g722-64
!
!
!
!
!
!
voice-card 0
!
crypto pki token default removal timeout 0
!
```

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```
!
!
!
license udi pid CISCO2851 sn FHK1137F4LY
!
!
controller E1 0/2/0
 pri-group timeslots 1-31 service mgcp
!
controller E1 0/3/0
 clock source internal
 pri-group timeslots 1-31
!
ip tftp source-interface GigabitEthernet0/0
!
!
!
!
!
!
interface GigabitEthernet0/0
 ip address 172.16.31.50 255.255.255.0
 duplex auto
 speed auto
!
interface Service-Engine0/0
 no ip address
 shutdown
!
```

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```
interface GigabitEthernet0/1
 no ip address
 ip nat outside
 ip virtual-reassembly in
 shutdown
 duplex auto
 speed auto
!
interface Serial0/2/0:15
 no ip address
 encapsulation hdlc
 isdn switch-type primary-qsig
 isdn timer T310 120000
 isdn protocol-emulate network
 isdn incoming-voice voice
 isdn map address .* plan isdn type national
 isdn bind-l3 ccm-manager
 isdn send-alerting
 isdn sending-complete
 no cdp enable
!
interface Serial0/3/0:15
 no ip address
 encapsulation hdlc
 isdn switch-type primary-qsig
 isdn timer T310 120000
 isdn protocol-emulate network
 isdn incoming-voice voice
 no cdp enable
```

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```
!
interface Service-Engine1/0
 no ip address
 shutdown
!
ip forward-protocol nd
!
ip http server
no ip http secure-server
!
ip route 0.0.0.0 0.0.0.0 172.16.31.1
!
ipv6 route ::/0 2620:96:C000:8::1
!
snmp-server community public RO
snmp-server location Chennai
!
!
!
!
ipv6 access-list ipv6
 permit ipv6 any any
!
control-plane
!
voice-port 0/0/0
 no echo-cancel enable
 no vad
 cptone IN
```

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```
 station-id number 6123565991
 caller-id enable
!
voice-port 0/0/1
 no echo-cancel enable
 no vad
!
voice-port 0/3/0:15
!
voice-port 0/2/0:15
!
voice-port 0/1/0
 no echo-cancel enable
 no vad
!
voice-port 0/1/1
 no echo-cancel enable
 no vad
!
dspfarm profile 1 transcode
 shutdown
!
!
dial-peer voice 111 pots
 service session
 destination-pattern 5991
 no digit-strip
 port 0/0/0
 forward-digits all
```

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```
!
!
dial-peer voice 113 voip
 description Gateway to CUCM
 shutdown
 destination-pattern .T
 session protocol sipv2
 session target ipv4:10.80.20.2:5060
 session transport udp
 incoming called-number 5991
 voice-class codec 1
 dtmf-relay rtp-nte
 fax protocol pass-through g711ulaw
!
!
sip-ua
 no remote-party-id
 retry register 5
 no timers hold
 protocol mode dual-stack
!
!
line con 0
line aux 0
line 66
 no activation-character
 no exec
 transport preferred none
 transport input all
```

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```
line 194
 no activation-character
 no exec
 transport preferred none
 transport input all
 transport output all
line vty 0 4
 session-timeout 180
 exec-timeout 0 0
 login authentication local_auth
 transport input all
!
scheduler allocate 20000 1000
end
!
!
```

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Acronyms

Acronym	Definitions
CPE	Customer Premise Equipment
Cisco UBE	Cisco Unified Border Element
Cisco UCM	Cisco Unified Communications Manager
MTP	Media Termination Point
POP	Point of Presence
PSTN	Public Switched Telephone Network
ESBC	Enterprise Session Border Controller
SCCP	Skinny Client Control Protocol
SIP	Session Initiation Protocol

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