Application Note

Integrating Microsoft Skype for Business Server [v6.0.9319.0] with Windstream SIP Trunk via Cisco Unified Border Element v12.0 [IOS-XE 16.06.02]

May 9, 2018

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Introduction

Service Providers today, such as Windstream Communications, 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.

Windstream 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 Microsoft Skype for Business Server 2015 (SfB) and Windstream network, Cisco Unified Border Element (v12.0.0) ISR 4321/K9 running IOS-XE 16.6.2 can be used. The Cisco Unified Border Element 16.6.2 provides demarcation, security, interworking and session control services for Microsoft Skype for Business Server 2015 connected to Windstream network.

This document assumes the reader is knowledgeable with the terminology and configuration of Microsoft Skype for Business Server 2015. Only configuration settings specifically required for Windstream 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 Microsoft Skype for Business Server 2015, and Cisco UBE (v12.0.0) on ISR 4321/K9 [IOS-XE – 16.6.2] for connectivity to Windstream SIP Trunking service. The deployment model covered in this application note is CPE (Microsoft Skype for Business Server 2015) to PSTN (Windstream) via Cisco UBE v12.0 [IOS-XE] 16.6.2.
- 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.
- The Cisco UBE configuration detailed in this document is based on a lab environment with a simple dial-plan used to ensure proper interoperability between Windstream SIP network and Cisco Unified Communications. 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 Skype for Business Server to interoperate to Windstream SIP Trunking network.

Network Topology

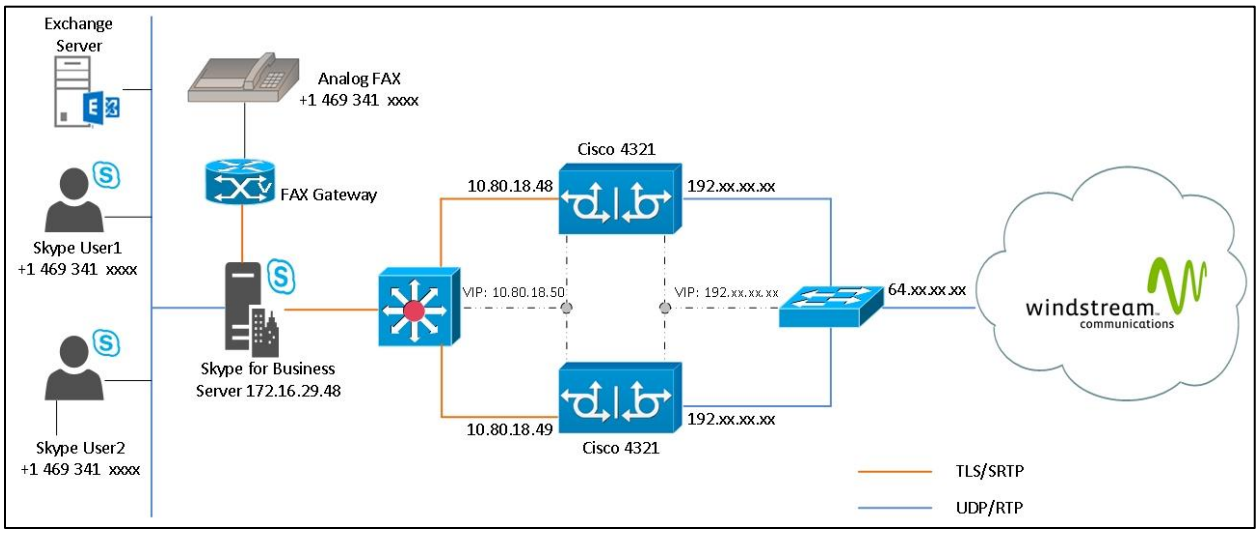

Figure 1 Network Topology

- The network topology includes the Skype for Business Server 2015 Standard Edition, Exchange Server integrated, Cisco Fax gateway and 2 SfB Clients. Cisco UBE is added as a PSTN gateway in the Skype for Business Server topology using its FQDN. Windstream Communications is used as the service provider with SIP trunk 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 Microsoft Skype for Business is TLS with SRTP.
- SIP Trunk transport type used between Cisco Unified Border Element and Windstream is UDP with RTP.
- Early media support with PRACK is enabled at Cisco UBE.

Skype for Business Server Settings:

Setting	Value
Media Bypass	ON
Encryption Support	ON
REFER Support	ON
Session Timer	ON

System Components

Hardware Requirements

- Cisco UBE on Cisco ISR 4321 router
- Generic Server for Skype for Business
- Cisco 2901 with FXS ports and Analog Fax machine

Software Requirements

- CUBE-Version: 12.0 running IOS-XE 16.6.2
- Microsoft Skype for Business Server 2015- Version: 6.0.9319.281
- Microsoft Skype for Business Client – Version 15.0.4893.1000
- Cisco IOS v15.7.3 for the fax gateway

Features

Features Supported

- Incoming and outgoing off-net calls using G711ulaw
- International Calls and digit manipulations
- Call Conference
- CPE Voice Mail support
- Call hold & Resume with and without MoH
- Unattended and Attended Call transfer
- DTMF (RFC2833)
- Fax (G711 Pass-through)
- IP-PBX Calling number privacy
- High Availability
- Early Media Support

Features Not Supported

- G729 codec is not Supported by Skype for Business
- T.38 Fax is not Supported by Skype for Business
- Skype for Business does not support Blind Call transfer
- Skype for Business does not support Call forward on Busy
- Windstream does not support Fax at Super G3 Speed

Caveats

- For basic inbound call from PSTN to SfB user, CUBE receives forked 183 response with SDP from SfB since media bypass is enabled at Skype server. CUBE handles forked 183 responses by sending UPDATE/SDP on the inbound call leg towards PSTN to renegotiate the media offer.
- Loop back calls via trunk are not successful. When call is being answered by SfB user2, originator's (SfB user1) call state is in calling state. CUBE receives forked 183 w/SDP responses in the fourth call leg from SfB user2 (Outbound from CUBE to SfB). CUBE sends UPDATE w/SDP to SfB user1 in the first call leg (Inbound to CUBE from SfB). SfB rejects UPDATE w/SDP with '491 call does not exist' since SfB does not support UPDATE w/SDP causing the first call to be in incomplete state and the call cannot be established.
- Call Forward test cases (PSTN user1 to PBX user who forwards the call to PSTN user2) are not successful. When call is being forwarded from Skype for Business user to PSTN user2, originator (PSTN user1) hears garbled audio. The issue is confirmed to be a limitation with CUBE for handling SRTP to RTP media interworking when 183 w/SDP signaling forking is involved. A future IOS software update will resolve the issue.
- Skype for Business does not support G729 voice codec. All testing is performed with g711ulaw codec.
- Ring back tone is not heard in off-net phone when the Skype user transfers the call.
- Caller ID is not updated on attended and unattended transfer scenarios.
- Only one IP PBX used for the testing.
- The Cisco UBE HA tested is layer 2 box to box redundancy.
- In HA Redundancy mode, the Primary Cisco UBE will not take over the Primary/Active role after a reboot/network outage
- Media Bypass is enabled on the trunk between Skype for Business and CUBE. So the media flows directly from Skype clients to CUBE and vice versa.
- RTCP packets are not generated by the CUBE towards Skype for Business unless ITSP sends it to CUBE.
- Skype for Business requires 3rd party FAX for FAX support. Fax clients connected to a Cisco voice gateway are used for the test.
- Skype for Business does not support Tone on Hold.
- CUBE requires an additional dial-peer to handle REFER sent by Skype for Business.
- Work around has been done in CUBE for outbound private call to manipulate P-Asserted id (PAI) with ITSP pilot number. Skype sends privacy=id with PAI header, which has no user part present in. Therefore, CUBE restricts the caller details in the outgoing requests towards ITSP. Hence no caller information is available in incoming requests causing Windstream to reject the call.
- 0+10 digit calls reaches at Windstream Operator Services.

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.

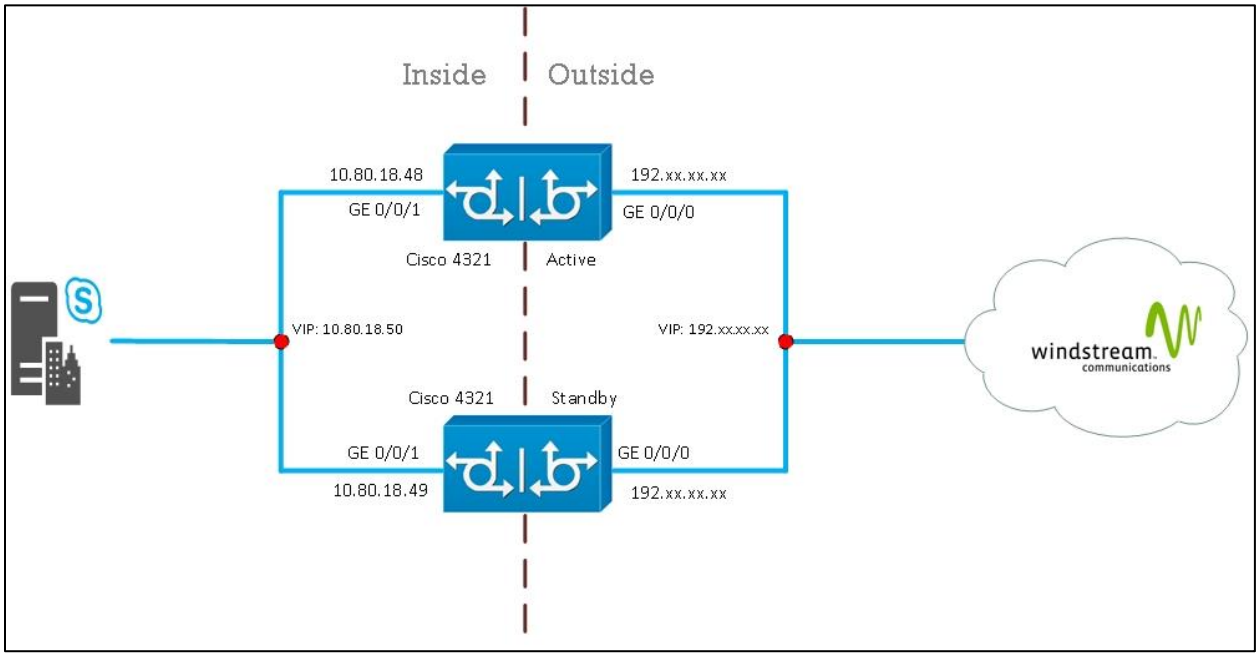

Figure 2: High Availability topology

Cisco UBE 1:

```
interface GigabitEthernet0/0/0
 description WindstreamCube WAN
 ip address 192.XX.XX.XX 255.255.255.128
 media-type rj45
 negotiation auto
 redundancy rii 15
 redundancy group 1 ip 192.XX.XX.XX exclusive
!
interface GigabitEthernet0/0/1
 description WindstreamCube LAN
 ip address 10.80.18.48 255.255.255.0
 negotiation auto
 redundancy rii 16
 redundancy group 1 ip 10.80.18.50 exclusive
!
interface GigabitEthernet0/1/0
 description WindstreamCube HA Interface
 ip address 10.70.50.100 255.255.255.0
 negotiation auto
!
interface GigabitEthernet0
 vrf forwarding Mgmt-intf
 no ip address
 shutdown
 negotiation auto
!
```

Cisco UBE 2:

```
interface GigabitEthernet0/0/0
 description WindstreamCube WAN
 ip address 192.XX.XX.XX 255.255.255.128
 media-type rj45
 negotiation auto
 redundancy rii 15
 redundancy group 1 ip 192.XX.XX.XX exclusive
!
interface GigabitEthernet0/0/1
 description WindstreamCube LAN
 ip address 10.80.18.49 255.255.255.0
 negotiation auto
 redundancy rii 16
 redundancy group 1 ip 10.80.18.50 exclusive
!
interface GigabitEthernet0/1/0
 description WindstreamCube HA Interface
 ip address 10.70.50.110 255.255.255.0
 negotiation auto
!
interface GigabitEthernet0
 vrf forwarding Mgmt-intf
 no ip address
 shutdown
 negotiation auto
!
```

Global Cisco UBE settings

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

```
voice service voip
 no ip address trusted authenticate
 address-hiding
 mode border-element license capacity 20
 allow-connections sip to sip
 redundancy-group 1
 no supplementary-service sip refer
 supplementary-service media-renegotiate
 sip
  bind control source-interface GigabitEthernet0/0/0
  bind media source-interface GigabitEthernet0/0/0
  session refresh
  privacy pstn
  conn-reuse
  midcall-signaling passthru
```

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
no supplementary-service sip refer	Prevents the router from forwarding REFER message to the destination for call transfers. The router instead attempts to initiate a hairpin call to the new target.

Codecs

G711ulaw codec is used in this testing, since Skype for Business does not support G729 codec.

```
voice class codec 1
 codec preference 1 g711ulaw
 codec preference 2 g711alaw
```

Dial peer

Dial-peers to Skype for Business using TLS with SRTP:

```
dial-peer voice 500 voip
 description ** Outbound Call From SFB to PSTN - at CUBE LAN interface **
 session protocol sipv2
 session transport tcp tls
 incoming uri via sfb
 voice-class codec 1
 voice-class sip localhost dns:isr4k.sfblabsm.local:5061
 voice-class sip asserted-id pai
 voice-class sip call-route url
 voice-class sip copy-list 1
 voice-class sip bind control source-interface GigabitEthernet0/0/1
 voice-class sip bind media source-interface GigabitEthernet0/0/1
 voice-class sip referto-passing
 dtmf-relay rtp-nte
 srtp
 no vad
!
```

```
dial-peer voice 610 voip
 description ** Inbound Call From PSTN to SFB - at CUBE LAN interface **
 translation-profile outgoing E164dialing
 destination-pattern 469341....
 session protocol sipv2
 session target dns:lync.sfblabsm.local:5067
 session transport tcp tls
 voice-class codec 1
 voice-class sip localhost dns:isr4k.sfblabsm.local:5061
 voice-class sip asserted-id pai
 voice-class sip call-route url
 voice-class sip options-ping 60
 voice-class sip profiles 103
 voice-class sip options-keepalive
 voice-class sip bind control source-interface GigabitEthernet0/0/1
 voice-class sip bind media source-interface GigabitEthernet0/0/1
 voice-class sip referto-passing
 dtmf-relay rtp-nte
 srtp
 no vad
!
```

```
dial-peer voice 700 voip
 description ** For REFER handling - at CUBE LAN interface **
 translation-profile outgoing E164dialing
 session protocol sipv2
 session target dns:lync.sfblabsm.local:5067
 session transport tcp tls
 destination uri sfbfqdn
 voice-class codec 1
 voice-class sip localhost dns:isr4k.sfblabsm.local:5061
 voice-class sip bind control source-interface GigabitEthernet0/0/1
 voice-class sip bind media source-interface GigabitEthernet0/0/1
 dtmf-relay rtp-nte
 rtcp keepalive
 srtp
 no vad
!
```

Dial-peers to Windstream using UDP and RTP:

```
dial-peer voice 510 voip
 description ** Outbound Call From SFB to PSTN - at CUBE WAN interface **
 translation-profile outgoing non-e164pstncall
 destination-pattern .T
 session protocol sipv2
 session target ipv4:64.XX.XX.XX
 session transport udp
 voice-class codec 1
 voice-class sip asserted-id pai
 voice-class sip options-ping 60
 voice-class sip profiles 104
 voice-class sip bind control source-interface GigabitEthernet0/0/0
 voice-class sip bind media source-interface GigabitEthernet0/0/0
 dtmf-relay rtp-nte
 no vad
!
dial-peer voice 600 voip
 description ** Inbound Call FROM PSTN to SFB - at CUBE WAN interface **
 session protocol sipv2
 session transport udp
 incoming called-number 469341....
 voice-class codec 1
 voice-class sip asserted-id pai
 voice-class sip options-ping 60
 voice-class sip profiles 102
 voice-class sip bind control source-interface GigabitEthernet0/0/0
 voice-class sip bind media source-interface GigabitEthernet0/0/0
 dtmf-relay rtp-nte
 no vad
!
```

```
dial-peer voice 710 voip
 description ** Loop Back Call via Trunk - at CUBE WAN interface **
 translation-profile outgoing non-e164pstncall
 huntstop
 destination-pattern 1469341....
 session protocol sipv2
 session target ipv4:64.XX.XX.XX
 session transport udp
 voice-class codec 1
 voice-class sip asserted-id pai
 voice-class sip profiles 104
 voice-class sip options-keepalive
 voice-class sip bind control source-interface GigabitEthernet0/0/0
 voice-class sip bind media source-interface GigabitEthernet0/0/0
 dtmf-relay rtp-nte
 no vad
!
```

Configuration example

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

Active Cisco UBE:

```
WindstreamCube1#sh run
Building configuration...

version 16.6
service timestamps debug datetime msec
service timestamps log datetime msec
platform qfp utilization monitor load 80
no platform punt-keepalive disable-kernel-core
!
hostname WindstreamCube1
!
boot-start-marker
boot system flash isr4300-universalk9.16.06.02.SPA.bin
boot-end-marker
!
vrf definition Mgmt-intf
 !
 address-family ipv4
 exit-address-family
 !
 address-family ipv6
 exit-address-family
!
no logging queue-limit
```

```
logging buffered 10000000
no logging rate-limit
no logging monitor
enable secret 5 $1$9JRy$HYSGC.AnbGxxxx
!
aaa new-model
!
aaa session-id common
!
ip host lync.sfblabsm.local 172.16.29.48
ip name-server 172.16.29.47
!
subscriber templating
!
multilink bundle-name authenticated
!
crypto pki trustpoint sfbca
 enrollment terminal
 fqdn isr4k.sfblabsm.local
 subject-name CN=isr4k.sfblabsm.local
 revocation-check none
 rsakeypair isr4k
!
crypto pki certificate chain sfbca
 certificate 100000005B8D119292D66E848100000000005B
  30820517 308203FF A0030201 02021310 0000005B 8D119292 D66E8481 00000000
  005B300D 06092A86 4886F70D 01010505 00304A31 15301306 0A099226 8993F22C
  64011916 056C6F63 616C3118 3016060A 09922689 93F22C64 01191608 7366626C
  6162736D 31173015 06035504 03130E73 66626C61 62736D2D 44432D43 41301E17
```

0D313830 31313631 38343334 335A170D 32303031 31363138 34333433 5A301F31
1D301B06 03550403 13146973 72346B2E 7366626C 6162736D 2E6C6F63 616C3082
0122300D 06092A86 4886F70D 01010105 00038201 0F003082 010A0282 010100AF
B0EAEE7F E6986921 97CF4DBE 993AF24F 31EA0022 A7709541 580DAFA0 B413FEE8
26B8DDE1 AE8CF721 F9B00D94 E1487F66 145C5E88 4DD0AC2E 49629E7E 049696A1
E9CC66DD DBAC5FF7 753A3B6C 7A5742CC 8CB50295 FE318BA5 E6114610 08BC7261
B31C2BB8 F3596804 24589CFE E6911CD1 20634D24 D91CFD29 8E59B32D 73604BFD
D02A3E0F 5ED850DA 78857410 5D922084 8FA3E508 63336442 F9FCF303 22911C41
2EEFAC1D 8845F786 FA8B13DB 95A92C38 F15511E6 30C1A9DC 45E0A8C4 235074B6
D2B23B77 7A0E258D A4BCA84A 706A1F9B 0B71E3A7 A097901A 62859D63 26AB90A8
B261FF53 C2471C75 D8D3A50C 24FDFBA3 10F20D04 13BC2FA2 CA94FEA6 4D3ADB02
03010001 A382021F 3082021B 300E0603 551D0F01 01FF0404 030205A0 301D0603
551D0E04 160414E7 D560B1B3 EF20BDCB E51A320F CB8415F8 CBF35230 1F060355
1D230418 30168014 93C1CD4B 1D9D22D6 B703551F DFC2AA62 D94FE430 3081CA06
03551D1F 0481C230 81BF3081 BCA081B9 A081B686 81B36C64 61703A2F 2F2F434E
3D736662 6C616273 6D2D4443 2D43412C 434E3D64 632C434E 3D434450 2C434E3D
5075626C 69632532 304B6579 25323053 65727669 6365732C 434E3D53 65727669
6365732C 434E3D43 6F6E6669 67757261 74696F6E 2C44433D 7366626C 6162736D
2C44433D 6C6F6361 6C3F6365 72746966 69636174 65526576 6F636174 696F6E4C
6973743F 62617365 3F6F626A 65637443 6C617373 3D63524C 44697374 72696275
74696F6E 506F696E 743081C3 06082B06 01050507 01010481 B63081B3 3081B006
082B0601 05050730 028681A3 6C646170 3A2F2F2F 434E3D73 66626C61 62736D2D
44432D43 412C434E 3D414941 2C434E3D 5075626C 69632532 304B6579 25323053
65727669 6365732C 434E3D53 65727669 6365732C 434E3D43 6F6E6669 67757261
74696F6E 2C44433D 7366626C 6162736D 2C44433D 6C6F6361 6C3F6341 43657274
69666963 6174653F 62617365 3F6F626A 65637443 6C617373 3D636572 74696669
63617469 6F6E4175 74686F72 69747930 2106092B 06010401 82371402 04141E12
00570065 00620053 00650072 00760065 00723013 0603551D 25040C30 0A06082B
06010505 07030130 0D06092A 864886F7 0D010105 05000382 0101003B CE68777F

```
 0FCB4BF0 3AE90D2D FDA9E232 9380D7D4 398849D5 620708A7 DAD6A694 0D39E26C
 21A91EA6 3730ABFE DE1F2054 608DD9AE E699C280 3BFFCC9B DED22AE6 205871F5
 D2D66BB2 001B778E 1051F6AF A528E9B5 922502DD BAD9C937 E888D62D F863F633
 80E1F489 75DD553F D36293C0 3B0C59B7 7AA5F852 F9B57CFC 28048E47 DB2AB8FF
 86AAD514 DB8EEF66 F7382355 78EDA6B1 34928C97 C9E9A758 D5C91764 603841D7
 B9EB9B0F 4512C175 1BE57480 DED66027 C90D1EAD 93E2CE7D 4F0EE3E2 A30DF2D5
 0327B9CA 280912C7 7E118A0C 7A87718C 11065D2C A0A3FD13 D21E20DB C45B3272
 ADF2ED01 1BF6D584 307C87F2 3BCC7D36 97E9C512 79270C4A F2459D
       quit
certificate ca 67101D7CE9C812B140EFC231D1BD207A
 3082036F 30820257 A0030201 02021067 101D7CE9 C812B140 EFC231D1 BD207A30
 0D06092A 864886F7 0D010105 0500304A 31153013 060A0992 268993F2 2C640119
 16056C6F 63616C31 18301606 0A099226 8993F22C 64011916 08736662 6C616273
 6D311730 15060355 0403130E 7366626C 6162736D 2D44432D 4341301E 170D3135
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 7F6A75C6 2CF708B0 52EE82C7 66D0A1FD 56AD5881 631862F0 38622546 0F3C0934
 89AFA9FF 3ECEED21 3A9EC8DB 8499E216 C68851F9 3F5B6F42 75F05F52 A4C5D95B
 487A72DB B27AE5F4 DB89193A B0F707EB E7C537F7 EDD7EC69 B4D8BA64 4D7F512F
 C522CFAB AC813224 4B9B11CD A516E181 29C255A7 795F6151 3269B541 CC93E655
 FC3A9698 4BCAE97F EB0E1035 09B0940A 53C94601 0EC47A8A B695E9DC 62A23C4E
 282E0538 DE030702 03010001 A351304F 300B0603 551D0F04 04030201 86300F06
 03551D13 0101FF04 05300301 01FF301D 0603551D 0E041604 1493C1CD 4B1D9D22
 D6B70355 1FDFC2AA 62D94FE4 30301006 092B0601 04018237 15010403 02010030
```

```
  0D06092A 864886F7 0D010105 05000382 01010064 3935BF00 067E8C7C FC8E0076
  77D0FB8C 0846697C 3A1A39A0 3A3387C5 18D4D9D3 596F540D 659F27A2 26063A21
  31666B09 3B51CB33 2A80A2D0 BEEC8C69 90A86604 E4B39966 BD48F030 299E1B49
  2F40982C D73F0E1D 1CA5C58E 239296C3 3FE1FCA6 C4F24543 F53AFF29 8570D590
  D4CEC1AE 2790EA17 D4E91959 76B1EFAD 84B041A9 7CC2E087 6FEFB750 E65AFB8B
  34FB2954 BC676B3A E11A7706 5970C4DE 9D791FC1 B91DB64A FCAA4AC7 930B213D
  99F4A877 67CA050C E448B12D 44BF94EA 055A7D37 5311F5DC D085F5F5 A16C0E96
  6337FDBD 89746ED7 A93089D8 F2383079 3D61C603 6780EE26 28C75E11 EF6CE309
  63A976AE F7C7F487 82015634 65801C48 F29AF3
        quit
!
voice service voip
 no ip address trusted authenticate
 address-hiding
 mode border-element license capacity 20
 allow-connections sip to sip
 redundancy-group 1
 no supplementary-service sip refer
 supplementary-service media-renegotiate
 sip
  bind control source-interface GigabitEthernet0/0/0
  bind media source-interface GigabitEthernet0/0/0
  session refresh
  conn-reuse
  midcall-signaling passthru
  pass-thru headers unsupp
!
!
```

```
voice class uri sfb sip
 host 172.16.29.48
!
voice class uri sfbfqdn sip
 host lync.sfblabsm.local
voice class codec 1
 codec preference 1 g711ulaw
 codec preference 2 g711alaw
!
!
voice class sip-profiles 101
 request REGISTER sip-header From modify "<sip:(.*)@(.*)>"
"<sip:\1@192.XX.XX.XX;otg=SIPTBS469341XXXX>"
!
voice class sip-profiles 102
 request INVITE sip-header Diversion modify "sip:\+1" "sip:"
 response ANY sip-header From modify "<sip:(.*@.*)(>)"
"<sip:\1;otg=SIPTBS469341XXXX\2"
 request ANY sip-header From modify "<sip:(.*)@(.*)>"
"<sip:\1@192.XX.XX.XX;otg=SIPTBS469341XXXX>"
!
voice class sip-profiles 103
 request ANY sip-header From modify "<sip:(.*)@(.*)>"
"<sip:\1@isr4k.sfblabsm.local>"
!
voice class sip-profiles 104
 request INVITE peer-header sip Referred-By copy "<sip:(.*)@" u01
 request INVITE sip-header P-Asserted-Identity modify "<(.*)@(.*)>"
"<sip:\u01@\2>"
 request INVITE sip-header P-Asserted-Identity modify "sip:\+1" "sip:"
 request INVITE sip-header From copy "<sip:(.*)>" u02
```

```
 request INVITE sip-header P-Asserted-Identity modify "<sip:@(.*)>"
"<sip:\u02>"
 request ANY sip-header From modify "<sip:(.*)@(.*)>"
"<sip:\1@192.XX.XX.XX;otg=SIPTBS469341XXXX>"
 response ANY sip-header From modify "<sip:(.*@.*)(>)"
"<sip:\1;otg=SIPTBS469341XXXX\2"
 request INVITE sip-header Diversion modify "sip:\+1" "sip:"
!
!
voice class sip-copylist 1
 sip-header REFERRED-BY
!
voice translation-rule 1
 rule 1 /\(^..........$\)/ /+1\1/
!
voice translation-rule 2
 rule 1 /^\+1\(..........\)$/ /\1/
!
!
voice translation-profile E164dialing
 translate called 1
!
voice translation-profile non-e164pstncall
 translate calling 2
!
license udi pid ISR4321/K9 sn FDO19220MQ8
diagnostic bootup level minimal
spanning-tree extend system-id
!
username cisco password 0 ******
```

```
redundancy
 mode none
 application redundancy
  group 1
   name b2bHAwindstream
   priority 100 failover threshold 75
   timers delay 30 reload 60
   control GigabitEthernet0/1/0 protocol 1
   data GigabitEthernet0/1/0
   track 1 shutdown
   track 2 shutdown
!
track 1 interface GigabitEthernet0/0/0 line-protocol
track 2 interface GigabitEthernet0/0/1 line-protocol
!
interface GigabitEthernet0/0/0
 description WindstreamCube WAN
 ip address 192.XX.XX.XX 255.255.255.128
 media-type rj45
 negotiation auto
 redundancy rii 15
 redundancy group 1 ip 192.XX.XX.XX exclusive
!
interface GigabitEthernet0/0/1
 description WindstreamCube LAN
 ip address 10.80.18.48 255.255.255.0
 negotiation auto
 redundancy rii 16
 redundancy group 1 ip 10.80.18.50 exclusive
```

```
!
interface GigabitEthernet0/1/0
 description WindstreamCube HA Interface
 ip address 10.70.50.100 255.255.255.0
 negotiation auto
!
interface GigabitEthernet0
 vrf forwarding Mgmt-intf
 no ip address
 shutdown
 negotiation auto
!
ip forward-protocol nd
no ip http server
no ip http secure-server
ip route 0.0.0.0 0.0.0.0 192.XX.XX.XX
ip route 10.64.0.0 255.255.0.0 10.80.18.1
ip route 10.70.50.0 255.255.255.0 10.80.18.1
ip route 172.16.24.0 255.255.248.0 10.80.18.1
!
ipv6 access-list preauth_v6
 permit udp any any eq domain
 permit tcp any any eq domain
 permit icmp any any nd-ns
 permit icmp any any nd-na
 permit icmp any any router-solicitation
 permit icmp any any router-advertisement
 permit icmp any any redirect
 permit udp any eq 547 any eq 546
```

```
 permit udp any eq 546 any eq 547
 deny ipv6 any any
!
control-plane
!
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
!
!
dial-peer voice 500 voip
 description ** Outbound Call From SFB to PSTN  - at CUBE LAN interface **
 session protocol sipv2
 session transport tcp tls
 incoming uri via sfb
 voice-class codec 1
 voice-class sip localhost dns:isr4k.sfblabsm.local:5061
 voice-class sip asserted-id pai
 voice-class sip call-route url
 voice-class sip copy-list 1
 voice-class sip bind control source-interface GigabitEthernet0/0/1
 voice-class sip bind media source-interface GigabitEthernet0/0/1
 voice-class sip referto-passing
 dtmf-relay rtp-nte
 srtp
 no vad
```

```
!
dial-peer voice 510 voip
 description ** Outbound Call From SFB to PSTN  - at CUBE WAN interface **
 translation-profile outgoing non-e164pstncall
 destination-pattern .T
 session protocol sipv2
 session target ipv4:64.XX.XX.XX
 session transport udp
 voice-class codec 1
 voice-class sip asserted-id pai
 voice-class sip options-ping 60
 voice-class sip profiles 104
 voice-class sip bind control source-interface GigabitEthernet0/0/0
 voice-class sip bind media source-interface GigabitEthernet0/0/0
 dtmf-relay rtp-nte
 no vad
!
dial-peer voice 600 voip
 description ** Inbound Call FROM PSTN to SFB - at CUBE WAN interface **
 session protocol sipv2
 session transport udp
 incoming called-number 469341....
 voice-class codec 1
 voice-class sip asserted-id pai
 voice-class sip options-ping 60
 voice-class sip profiles 102
 voice-class sip bind control source-interface GigabitEthernet0/0/0
 voice-class sip bind media source-interface GigabitEthernet0/0/0
 dtmf-relay rtp-nte
```

```
 no vad
!
dial-peer voice 610 voip
 description ** Inbound Call From PSTN to SFB - at CUBE LAN interface **
 translation-profile outgoing E164dialing
 destination-pattern 469341....
 session protocol sipv2
 session target dns:lync.sfblabsm.local:5067
 session transport tcp tls
 voice-class codec 1
 voice-class sip localhost dns:isr4k.sfblabsm.local:5061
 voice-class sip asserted-id pai
 voice-class sip call-route url
 voice-class sip options-ping 60
 voice-class sip profiles 103
 voice-class sip options-keepalive
 voice-class sip bind control source-interface GigabitEthernet0/0/1
 voice-class sip bind media source-interface GigabitEthernet0/0/1
 voice-class sip referto-passing
 dtmf-relay rtp-nte
 srtp
 no vad
!
```

```
dial-peer voice 700 voip
 description ** For REFER handling - at CUBE LAN interface **
 translation-profile outgoing E164dialing
 session protocol sipv2
 session target dns:lync.sfblabsm.local:5067
 session transport tcp tls
 destination uri sfbfqdn
 voice-class codec 1
 voice-class sip localhost dns:isr4k.sfblabsm.local:5061
 voice-class sip bind control source-interface GigabitEthernet0/0/1
 voice-class sip bind media source-interface GigabitEthernet0/0/1
 dtmf-relay rtp-nte
 rtcp keepalive
 srtp
 no vad
!
dial-peer voice 710 voip
 description ** Loop Back Call via Trunk - at CUBE WAN interface **
 translation-profile outgoing non-e164pstncall
 huntstop
 destination-pattern 1469341....
 session protocol sipv2
 session target ipv4:64.XX.XX.XX
 session transport udp
 voice-class codec 1
 voice-class sip asserted-id pai
 voice-class sip profiles 104
 voice-class sip options-keepalive
 voice-class sip bind control source-interface GigabitEthernet0/0/0
```

```
 voice-class sip bind media source-interface GigabitEthernet0/0/0
 dtmf-relay rtp-nte
 no vad
!
gateway
 timer receive-rtp 1200
!
sip-ua
 credentials number 469341XXXX username 469341XXXX password 7
065259781F1A5841544146 realm mcleodusa
 authentication username 469341XXXX password 7 0350OD52555B70141F5F4D realm
mcleodusa
 no remote-party-id
 registrar ipv4:64.XX.XX.XX:5060 expires 60
 connection-reuse
 crypto signaling default trustpoint sfbca
!
line con 0
 password ******
 transport input none
 stopbits 1
line aux 0
 password ******
 stopbits 1
line vty 0 4
 exec-timeout 0 0
 password ******
 transport preferred telnet
!
wsma agent exec
```

```
!
wsma agent config
!
wsma agent filesys
!
wsma agent notify
!
End
```

Standby Cisco UBE:

```
WindstreamCube2#sh run
!
version 16.6
service timestamps debug datetime msec localtime
service timestamps log datetime msec localtime
service password-encryption
service internal
service sequence-numbers
platform qfp utilization monitor load 80
no platform punt-keepalive disable-kernel-core
!
hostname WindstreamCube2
!
boot-start-marker
boot system flash isr4300-universalk9.16.06.02.SPA.bin
boot-end-marker
!
vrf definition Mgmt-intf
 !
 address-family ipv4
 exit-address-family
 !
 address-family ipv6
 exit-address-family
!
logging queue-limit 1000000000
logging buffered 30000000
logging rate-limit 10000
```

```
no logging console
logging monitor notifications
enable secret 5 $1$aEKr$TYXs2kVsHhvpeqnj4bdYn.
!
no aaa new-model
!
ip host lync.sfblabsm.local 172.16.29.48
ip name-server 172.16.29.47
!
subscriber templating
!
multilink bundle-name authenticated
!
crypto pki trustpoint sfbca
 enrollment terminal
 fqdn isr4k.sfblabsm.local
 subject-name CN=isr4k.sfblabsm.local
 revocation-check none
 rsakeypair isr4k
!
!
crypto pki certificate chain sfbca
 certificate 100000005AF2FC9CD1FACC820300000000005A
  30820517 308203FF A0030201 02021310 0000005A F2FC9CD1 FACC8203 00000000
  005A300D 06092A86 4886F70D 01010505 00304A31 15301306 0A099226 8993F22C
  64011916 056C6F63 616C3118 3016060A 09922689 93F22C64 01191608 7366626C
  6162736D 31173015 06035504 03130E73 66626C61 62736D2D 44432D43 41301E17
  0D313830 31313631 35343730 325A170D 32303031 31363135 34373032 5A301F31
  1D301B06 03550403 13146973 72346B2E 7366626C 6162736D 2E6C6F63 616C3082
```

0122300D 06092A86 4886F70D 01010105 00038201 0F003082 010A0282 010100CC
5C6DA2EC 6D4DBD67 5BB25C9B 4D4BE8E8 068B8FDB 435591F6 057AB30E 9591050F
6338C1B7 755147B4 677F91AD D97DDE62 99330CC2 D5CEDB88 42344165 AB6959F2
A8AE537D FBF68F8B 9A7E3CFE E98213C8 026B93EA A016992D 37F4951B 980DF6A0
BFE8DB6D C8B3D5AF 9CC7CE01 B277C845 06D7408E E832BD2E BD730EF4 E876318F
6338543D 5E881FD8 4A570380 5BBFE0F0 DCD0C4A3 5D531A9C BC06BD1A 0DCE7EE4
923626CB 90CEA0A6 5000D6D8 D3A02FA2 385D2FA7 5CDB4E9C E8E9C603 2DE78ED3
2126B18C C82FAD9C D6550FF5 FC02405D 720A8BBE 8AC77CB5 220C77AF 1C516777
5172C357 1FB42491 BCCFCC51 0B08A62A 555028ED 4CF659A5 81FEE9A2 17CF6102
03010001 A382021F 3082021B 300E0603 551D0F01 01FF0404 030205A0 301D0603
551D0E04 1604140A 73EBD200 6A835576 E4E58C2E 064F1A2D BA191130 1F060355
1D230418 30168014 93C1CD4B 1D9D22D6 B703551F DFC2AA62 D94FE430 3081CA06
03551D1F 0481C230 81BF3081 BCA081B9 A081B686 81B36C64 61703A2F 2F2F434E
3D736662 6C616273 6D2D4443 2D43412C 434E3D64 632C434E 3D434450 2C434E3D
5075626C 69632532 304B6579 25323053 65727669 6365732C 434E3D53 65727669
6365732C 434E3D43 6F6E6669 67757261 74696F6E 2C44433D 7366626C 6162736D
2C44433D 6C6F6361 6C3F6365 72746966 69636174 65526576 6F636174 696F6E4C
6973743F 62617365 3F6F626A 65637443 6C617373 3D63524C 44697374 72696275
74696F6E 506F696E 743081C3 06082B06 01050507 01010481 B63081B3 3081B006
082B0601 05050730 028681A3 6C646170 3A2F2F2F 434E3D73 66626C61 62736D2D
44432D43 412C434E 3D414941 2C434E3D 5075626C 69632532 304B6579 25323053
65727669 6365732C 434E3D53 65727669 6365732C 434E3D43 6F6E6669 67757261
74696F6E 2C44433D 7366626C 6162736D 2C44433D 6C6F6361 6C3F6341 43657274
69666963 6174653F 62617365 3F6F626A 65637443 6C617373 3D636572 74696669
63617469 6F6E4175 74686F72 69747930 2106092B 06010401 82371402 04141E12
00570065 00620053 00650072 00760065 00723013 0603551D 25040C30 0A06082B
06010505 07030130 0D06092A 864886F7 0D010105 05000382 01010018 6AA79BAB
FE7DC285 AE60D44B 58D324CA F7B34050 C96BF70A 277C4B60 A5422132 1C0DB094
2239B3C3 E25324E2 1DB46C75 685DA2FF 6825D15E 472259F2 2F6E3089 0218E7AF

```
 ECE1A73B 8F44EA4B 9D7EDB84 BBBCBBF0 DF78D0CB AC5AEB1C A1F45352 07C481B5
 EFD36AC7 24B902F7 DCCA6103 2A53ECD8 5A10365D 23EF2CCB 43A8975A 1E0D275D
 880317E7 7BE2824F 043BB8A4 E37A0983 1DBFA255 F93EB613 3063BBC5 2CAC89A7
 E4A74805 EF7886B5 099F8C08 452A2238 F8E0144C 09E9010B 3B2761D1 83B7992A
 665C8DDB 64CF243C 7C673562 B28443B3 A13B0E83 AD5B0B28 9B6817D6 1C09ABD3
 D945C521 752F236E 328B5CA7 C216BF04 6AD54907 91A4D912 11A083
       quit
certificate ca 67101D7CE9C812B140EFC231D1BD207A
 3082036F 30820257 A0030201 02021067 101D7CE9 C812B140 EFC231D1 BD207A30
 0D06092A 864886F7 0D010105 0500304A 31153013 060A0992 268993F2 2C640119
 16056C6F 63616C31 18301606 0A099226 8993F22C 64011916 08736662 6C616273
 6D311730 15060355 0403130E 7366626C 6162736D 2D44432D 4341301E 170D3135
 30363136 30373131 34305A17 0D323030 36313630 37323133 395A304A 31153013
 060A0992 268993F2 2C640119 16056C6F 63616C31 18301606 0A099226 8993F22C
 64011916 08736662 6C616273 6D311730 15060355 0403130E 7366626C 6162736D
 2D44432D 43413082 0122300D 06092A86 4886F70D 01010105 00038201 0F003082
 010A0282 01010097 8E8BF74A 05562140 6AEDDABC 13679FF0 50BABA47 F2753452
 FDACFF61 ECF08926 F9B57BAE C647671F 3669FCD2 5E31AADA 8942E449 8DC2A156
 11D47211 AD66C0F9 F3BD5627 DB5ABD22 7BA530CD B367D88B 44680003 3A6A87DA
 7F6A75C6 2CF708B0 52EE82C7 66D0A1FD 56AD5881 631862F0 38622546 0F3C0934
 89AFA9FF 3ECEED21 3A9EC8DB 8499E216 C68851F9 3F5B6F42 75F05F52 A4C5D95B
 487A72DB B27AE5F4 DB89193A B0F707EB E7C537F7 EDD7EC69 B4D8BA64 4D7F512F
 C522CFAB AC813224 4B9B11CD A516E181 29C255A7 795F6151 3269B541 CC93E655
 FC3A9698 4BCAE97F EB0E1035 09B0940A 53C94601 0EC47A8A B695E9DC 62A23C4E
 282E0538 DE030702 03010001 A351304F 300B0603 551D0F04 04030201 86300F06
 03551D13 0101FF04 05300301 01FF301D 0603551D 0E041604 1493C1CD 4B1D9D22
 D6B70355 1FDFC2AA 62D94FE4 30301006 092B0601 04018237 15010403 02010030
 0D06092A 864886F7 0D010105 05000382 01010064 3935BF00 067E8C7C FC8E0076
 77D0FB8C 0846697C 3A1A39A0 3A3387C5 18D4D9D3 596F540D 659F27A2 26063A21
```

```
  31666B09 3B51CB33 2A80A2D0 BEEC8C69 90A86604 E4B39966 BD48F030 299E1B49
  2F40982C D73F0E1D 1CA5C58E 239296C3 3FE1FCA6 C4F24543 F53AFF29 8570D590
  D4CEC1AE 2790EA17 D4E91959 76B1EFAD 84B041A9 7CC2E087 6FEFB750 E65AFB8B
  34FB2954 BC676B3A E11A7706 5970C4DE 9D791FC1 B91DB64A FCAA4AC7 930B213D
  99F4A877 67CA050C E448B12D 44BF94EA 055A7D37 5311F5DC D085F5F5 A16C0E96
  6337FDBD 89746ED7 A93089D8 F2383079 3D61C603 6780EE26 28C75E11 EF6CE309
  63A976AE F7C7F487 82015634 65801C48 F29AF3
        quit
!
!
voice service voip
 no ip address trusted authenticate
 address-hiding
 mode border-element license capacity 20
 allow-connections sip to sip
 redundancy-group 1
 no supplementary-service sip refer
 supplementary-service media-renegotiate
 sip
  bind control source-interface GigabitEthernet0/0/0
  bind media source-interface GigabitEthernet0/0/0
  session refresh
  privacy pstn
  conn-reuse
  midcall-signaling passthru
  pass-thru headers unsupp
!
!
```

```
voice class uri sfb sip
 host 172.16.29.48
!
voice class uri sfbfqdn sip
 host lync.sfblabsm.local
voice class codec 1
 codec preference 1 g711ulaw
 codec preference 2 g711alaw
!
!
voice class sip-profiles 101
 request REGISTER sip-header From modify "<sip:(.*)@(.*)>"
"<sip:\1@192.XX.XXXX;otg=SIPTBS469341XXXX>"
!
voice class sip-profiles 102
 request INVITE sip-header Diversion modify "sip:\+1" "sip:"
 response ANY sip-header From modify "<sip:(.*@.*)(>)"
"<sip:\1;otg=SIPTBS469341XXXX\2"
 request ANY sip-header From modify "<sip:(.*)@(.*)>"
"<sip:\1@192.XX.XX.XX;otg=SIPTBS469341XXXX>"
!
voice class sip-profiles 103
 request ANY sip-header From modify "<sip:(.*)@(.*)>"
"<sip:\1@isr4k.sfblabsm.local>"
!
voice class sip-profiles 104
 request INVITE peer-header sip Referred-By copy "<sip:(.*)@" u01
 request INVITE sip-header P-Asserted-Identity modify "<(.*)@(.*)>"
"<sip:\u01@\2>"
 request INVITE sip-header P-Asserted-Identity modify "sip:\+1" "sip:"
 request INVITE sip-header From copy "<sip:(.*)>" u02
```

```
 request INVITE sip-header P-Asserted-Identity modify "<sip:@(.*)>"
"<sip:\u02>"
 response ANY sip-header From modify "<sip:(.*@.*)(>)"
"<sip:\1;otg=SIPTBS469341XXXX\2"
 request INVITE sip-header Diversion modify "sip:\+1" "sip:"
 request ANY sip-header From modify "<sip:(.*)@(.*)>"
"<sip:\1@192.XX.XX.XX;otg=SIPTBS469341XXXX>"
 request INVITE sip-header P-Asserted-Identity modify "<sip:anonymous@(.*)>"
"<sip:469341XXXX@192.XX.XX.XX>"
!
voice class sip-copylist 1
 sip-header REFERRED-BY
!
!
voice translation-rule 1
 rule 1 /469341XXXX/ /XXXX/
 rule 2 /\(^..........$\)/ /+1\1/
!
voice translation-rule 2
 rule 1 /^\+1\(..........\)$/ /\1/
!
!
voice translation-profile E164dialing
 translate called 1
!
voice translation-profile non-e164pstncall
 translate calling 2
!
license udi pid ISR4321/K9 sn FDO19220MW3
license boot level appxk9
license boot level uck9
```

```
diagnostic bootup level minimal
spanning-tree extend system-id
!
username cisco privilege 15 password 7 13111xxx97B7B2A
!
redundancy
 mode none
 application redundancy
  group 1
   name b2bHAwindstream
   priority 150 failover threshold 75
   timers delay 30 reload 60
   control GigabitEthernet0/1/0 protocol 1
   data GigabitEthernet0/1/0
   track 1 shutdown
   track 2 shutdown
!
track 1 interface GigabitEthernet0/0/0 line-protocol
track 2 interface GigabitEthernet0/0/1 line-protocol
!
interface GigabitEthernet0/0/0
 description WindstreamCube WAN
 ip address 192.XX.XX.XX 255.255.255.128
 media-type rj45
 negotiation auto
 redundancy rii 15
 redundancy group 1 ip 192.XX.XX.XX exclusive
!
interface GigabitEthernet0/0/1
```

```
 description WindstreamCube LAN
 ip address 10.80.18.49 255.255.255.0
 negotiation auto
 redundancy rii 16
 redundancy group 1 ip 10.80.18.50 exclusive
!
interface GigabitEthernet0/1/0
 description WindstreamCube HA Interface
 ip address 10.70.50.110 255.255.255.0
 negotiation auto
!
interface GigabitEthernet0
 vrf forwarding Mgmt-intf
 no ip address
 shutdown
 negotiation auto
!
ip forward-protocol nd
no ip http server
no ip http secure-server
ip tftp source-interface GigabitEthernet0
ip route 0.0.0.0 0.0.0.0 192.XX.XX.XX
ip route 10.64.0.0 255.255.0.0 10.80.18.1
ip route 10.70.50.0 255.255.255.0 10.80.18.1
ip route 172.16.24.0 255.255.248.0 10.80.18.1
!
control-plane
!
!
```

```
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
!
telephony-service
 max-conferences 8 gain -6
 transfer-system full-consult
!
!
dial-peer voice 500 voip
 description ** Outbound Call From SFB to PSTN  - at CUBE LAN interface **
 session protocol sipv2
 session transport tcp tls
 incoming uri via sfb
 voice-class codec 1
 voice-class sip localhost dns:isr4k.sfblabsm.local:5061
 voice-class sip asserted-id pai
 voice-class sip call-route url
 voice-class sip copy-list 1
 voice-class sip bind control source-interface GigabitEthernet0/0/1
 voice-class sip bind media source-interface GigabitEthernet0/0/1
 voice-class sip referto-passing
 dtmf-relay rtp-nte
 srtp
 no vad
!
```

```
dial-peer voice 510 voip
 description ** Outbound Call From SFB to PSTN  - at CUBE WAN interface **
 translation-profile outgoing non-e164pstncall
 destination-pattern .T
 session protocol sipv2
 session target ipv4:64.XX.XX.XX
 session transport udp
 voice-class codec 1
 voice-class sip asserted-id pai
 voice-class sip options-ping 60
 voice-class sip profiles 104
 voice-class sip bind control source-interface GigabitEthernet0/0/0
 voice-class sip bind media source-interface GigabitEthernet0/0/0
 dtmf-relay rtp-nte
 fax-relay ecm disable
 fax protocol pass-through g711ulaw
 no vad
!
dial-peer voice 600 voip
 description ** Inbound Call FROM PSTN to SFB - at CUBE WAN interface **
 session protocol sipv2
 session transport udp
 incoming called-number 469341....
 voice-class codec 1
 voice-class sip asserted-id pai
 voice-class sip options-ping 60
 voice-class sip profiles 102
 voice-class sip bind control source-interface GigabitEthernet0/0/0
 voice-class sip bind media source-interface GigabitEthernet0/0/0
```

```
 dtmf-relay rtp-nte
 no vad
!
dial-peer voice 610 voip
 description ** Inbound Call From PSTN to SFB - at CUBE LAN interface **
 translation-profile outgoing E164dialing
 destination-pattern 469341....
 session protocol sipv2
 session target dns:lync.sfblabsm.local:5067
 session transport tcp tls
 voice-class codec 1
 voice-class sip localhost dns:isr4k.sfblabsm.local:5061
 voice-class sip asserted-id pai
 voice-class sip call-route url
 voice-class sip options-ping 60
 voice-class sip profiles 103
 voice-class sip options-keepalive
 voice-class sip bind control source-interface GigabitEthernet0/0/1
 voice-class sip bind media source-interface GigabitEthernet0/0/1
 voice-class sip referto-passing
 dtmf-relay rtp-nte
 srtp
 no vad
!
dial-peer voice 700 voip
 description ** For REFER handling - at CUBE LAN interface **
 translation-profile outgoing E164dialing
 session protocol sipv2
 session target dns:lync.sfblabsm.local:5067
```

```
 session transport tcp tls
 destination uri sfbfqdn
 voice-class codec 1
 voice-class sip localhost dns:isr4k.sfblabsm.local:5061
 voice-class sip bind control source-interface GigabitEthernet0/0/1
 voice-class sip bind media source-interface GigabitEthernet0/0/1
 dtmf-relay rtp-nte
 rtcp keepalive
 srtp
 no vad
!
dial-peer voice 710 voip
 description ** Loop Back Call via Trunk - at CUBE WAN interface **
 translation-profile outgoing non-e164pstncall
 huntstop
 destination-pattern 1469341....
 session protocol sipv2
 session target ipv4:64.XX.XX.XX
 session transport udp
 voice-class codec 1
 voice-class sip asserted-id pai
 voice-class sip profiles 104
 voice-class sip options-keepalive
 voice-class sip bind control source-interface GigabitEthernet0/0/0
 voice-class sip bind media source-interface GigabitEthernet0/0/0
 dtmf-relay rtp-nte
 no vad
!
!
```

```
gateway
 timer receive-rtp 1200
!
sip-ua
 credentials number 469341XXXX username 469341XXXX password 7
124D534E415F5D5C7B7D70 realm mcleodusa
 authentication username 469341XXXX password 7 124D534E415F5D5C7B7D70 realm
mcleodusa
 no remote-party-id
 registrar ipv4:64.XX.XX.XX:5060 expires 60
 connection-reuse
 crypto signaling default trustpoint sfbca
!
!
line con 0
 exec-timeout 0 0
 login local
 transport input none
 stopbits 1
line aux 0
 stopbits 1
line vty 0 4
 exec-timeout 0 0
 login local
 transport input telnet
!
wsma agent exec
!
wsma agent config
!
```

```
wsma agent filesys
!
wsma agent notify
!
end
```

Configuring Microsoft Skype for Business Server

This section describes the necessary steps to configure SIP Trunk from Skype for Business Server to CUBE LAN interface.

PSTN Gateway Configuration

- Open Skype for Business Server 2015 Topology Builder and navigate to Shared Components.
- Right-click PSTN Gateways and from the pop-up menu, choose New IP/PSTN Gateway.

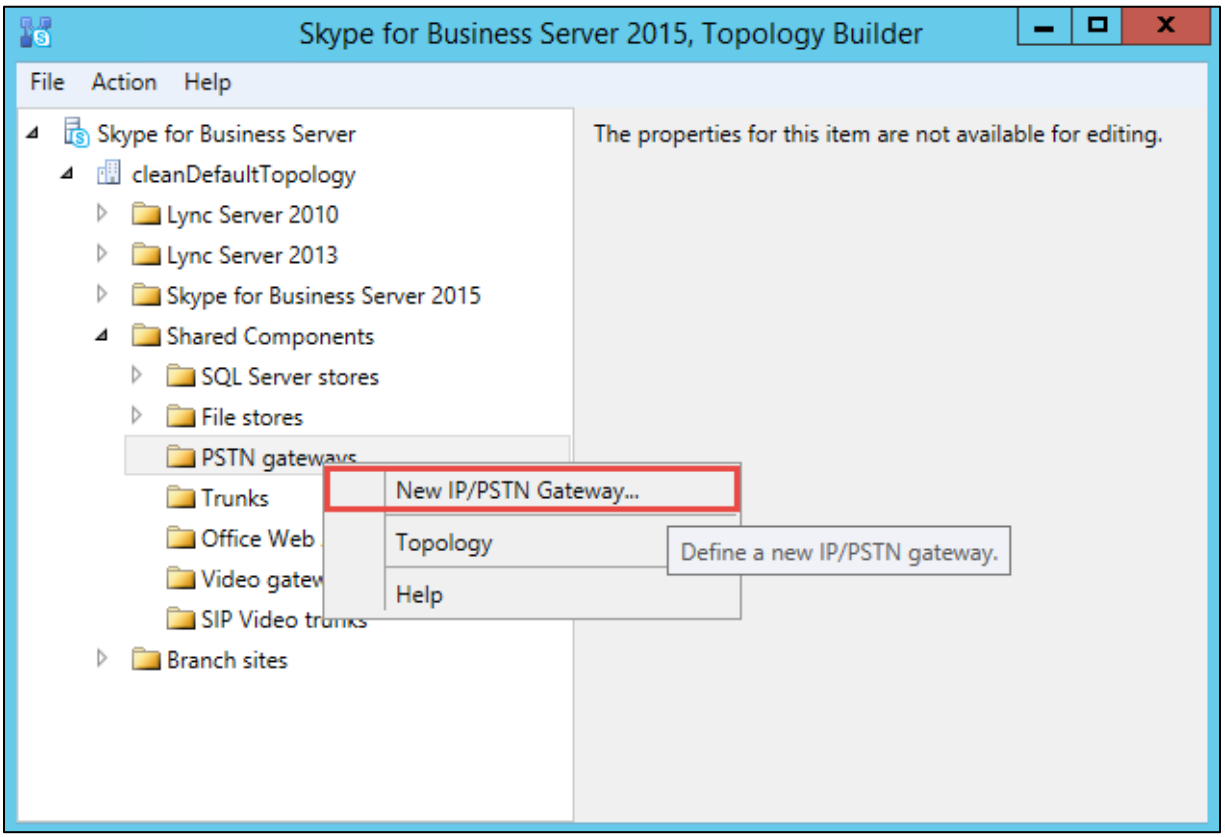

Figure 3: Add new IP/PSTN Gateway in Skype for Business Topology Builder

- Configure PSTN Gateway with CUBE FQDN

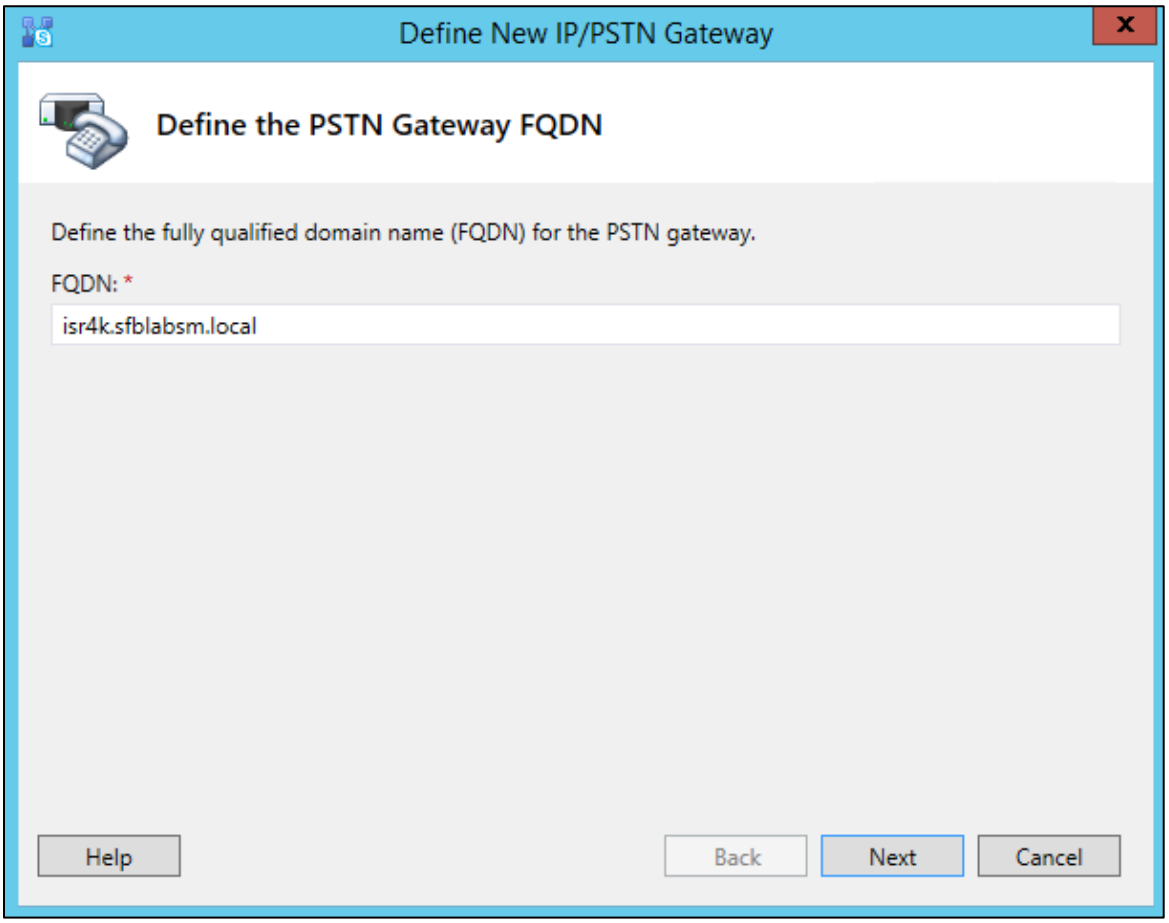

Figure 4: Define the PSTN gateway

- Select “Enable IPv4” with use all configured IP Address.

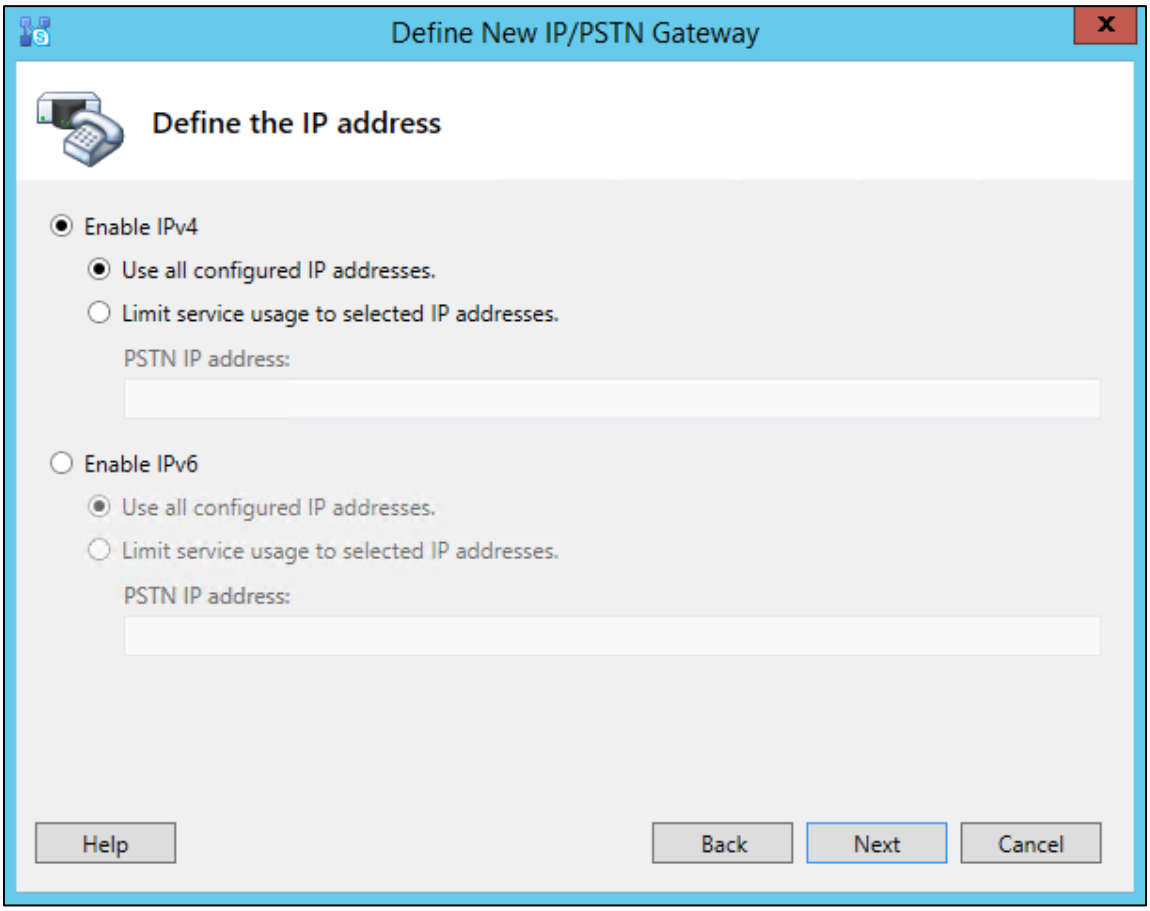

Figure 5: Define IP address

- Define trunk name and specify the Listening port for IP/PSTN gateway

- Select the SIP Transport Protocol and Associated Mediation Server with its listening port as shown below and Click Finish.

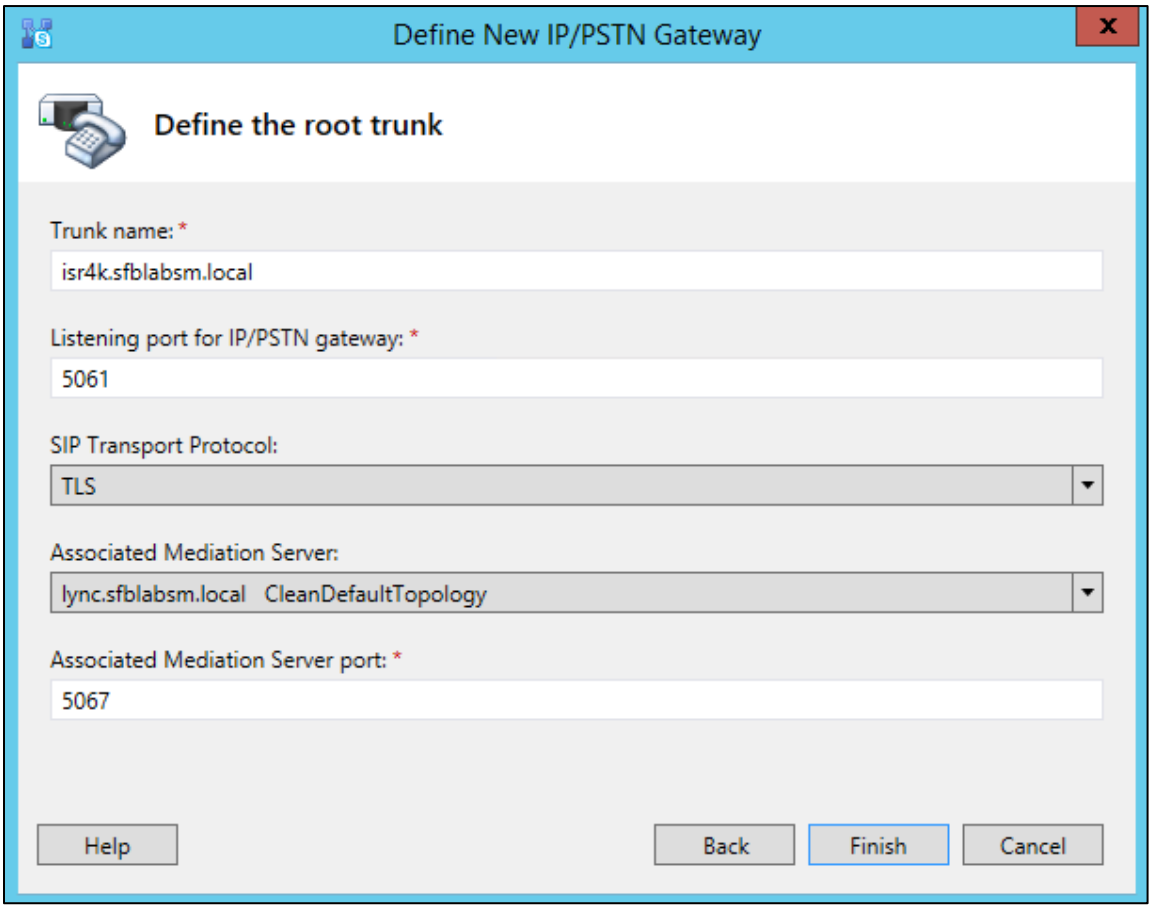

Figure 6: Define the Root Trunk details

- Newly configured “PSTN gateway” and “Trunk” will appear in the Topology Builder as shown below.

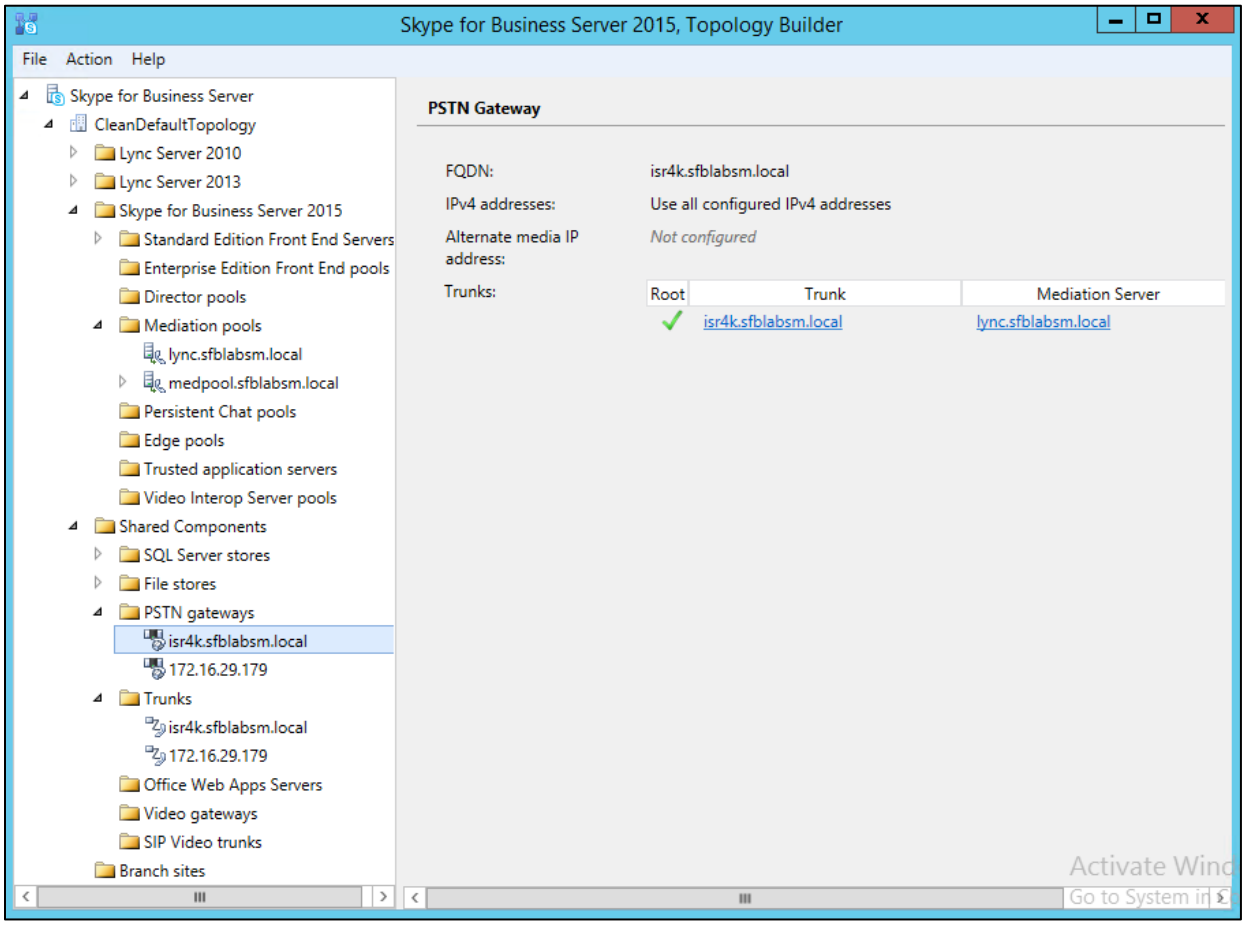

Figure 7: Configured PSTN Gateway to CUBE

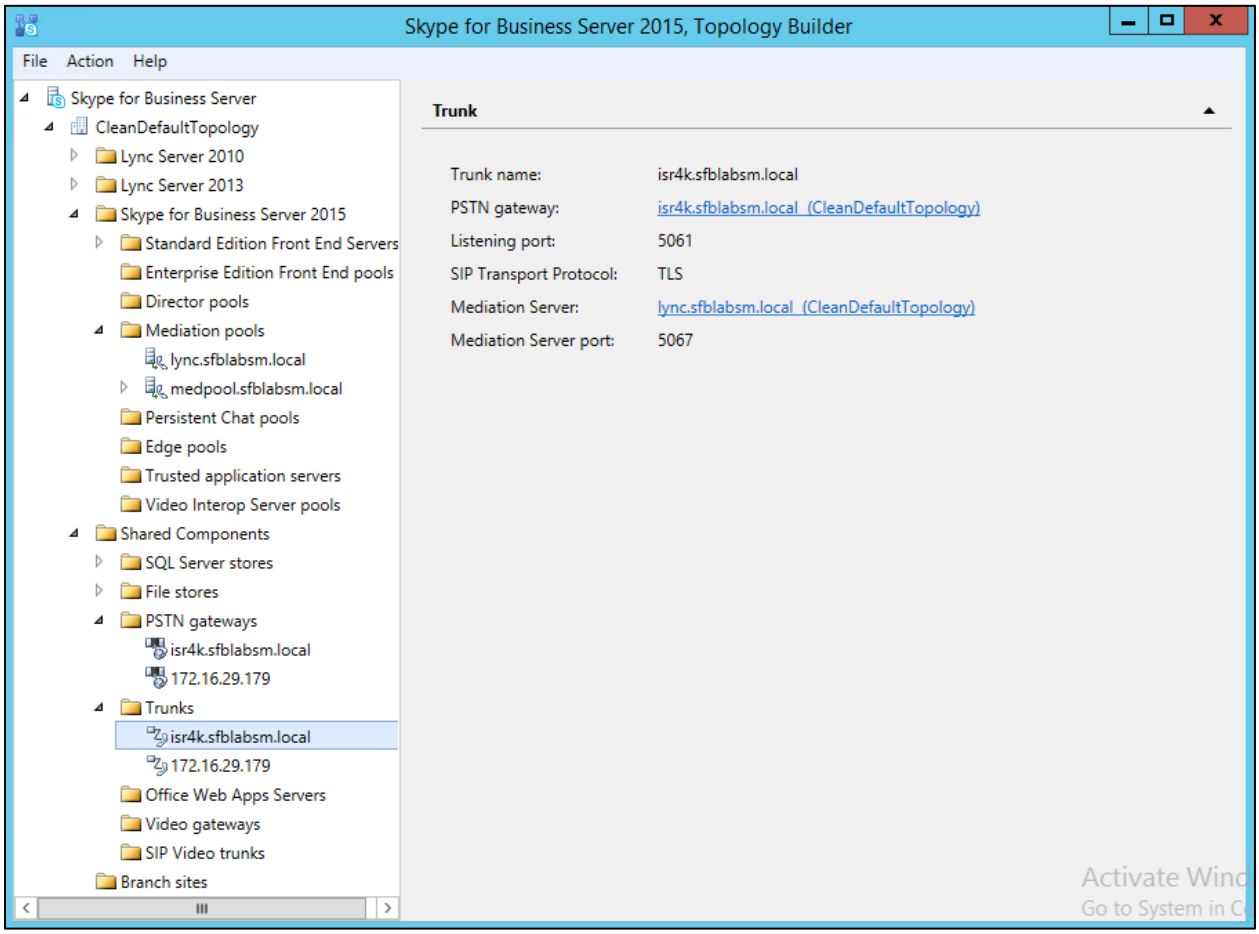

Figure 7: Configured Trunk details

- For voice mail and fax support, two other PSTN gateways has configured in Topology Builder towards

Exchange Server and to Fax gateway.

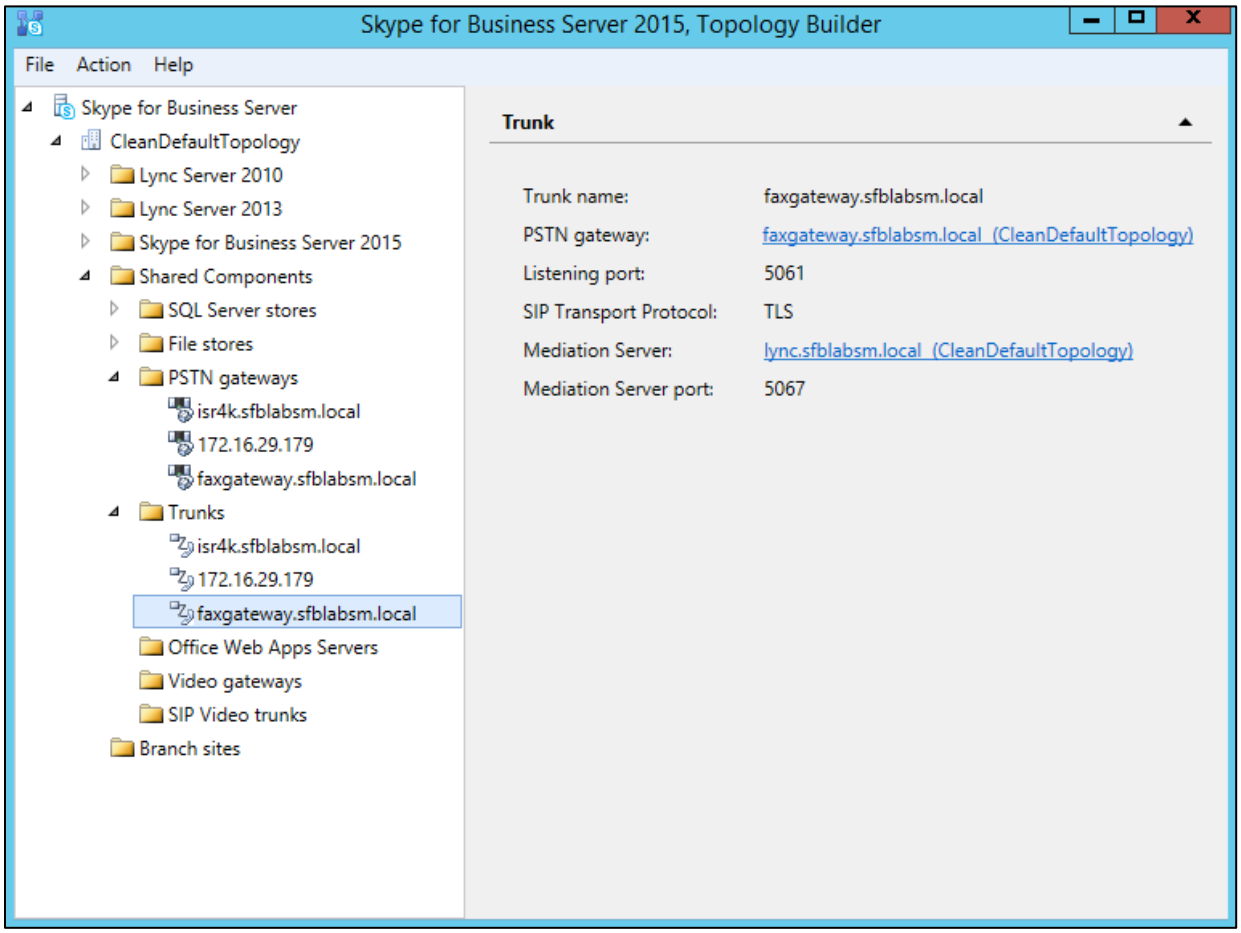

Figure 8: Configured PSTN Gateways in SfB Topology Builder

- Next publish the Topology by selecting “Action → Topology → Publish…”

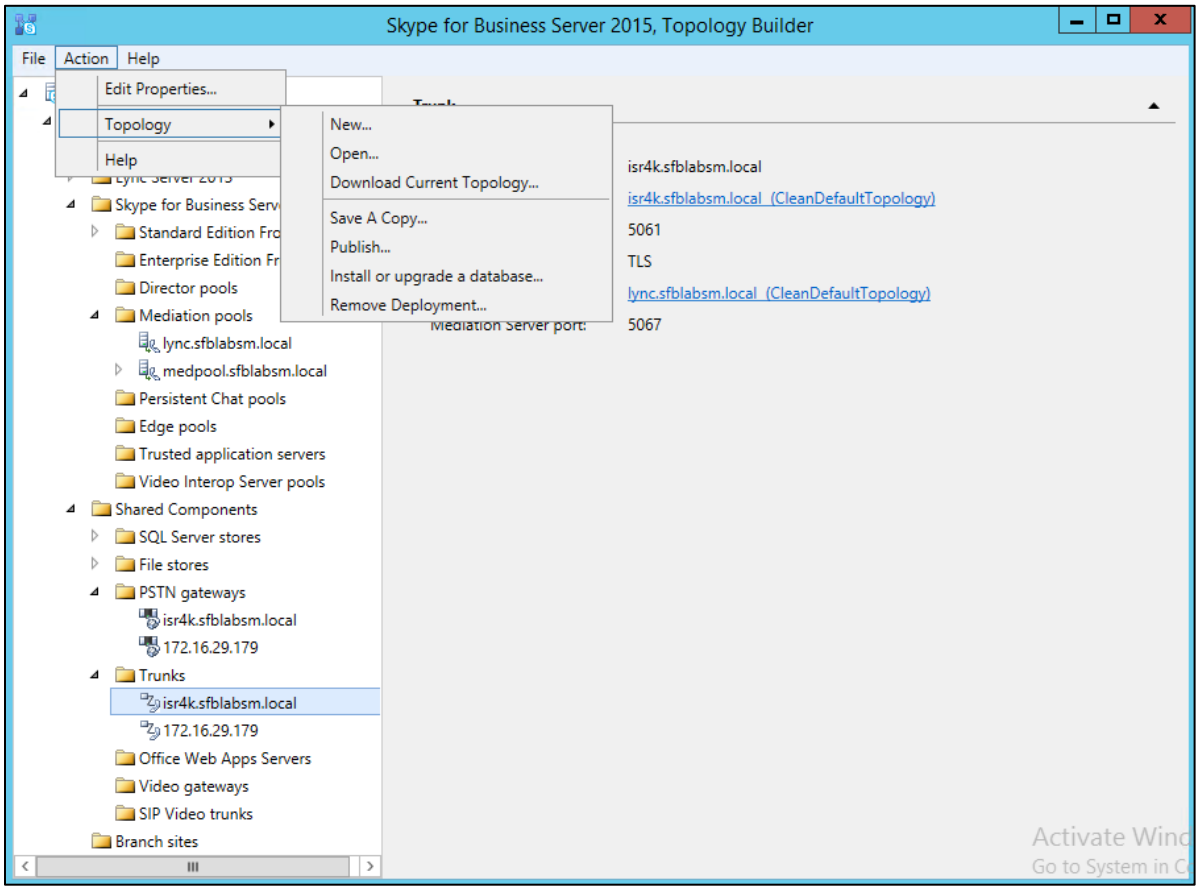

Figure 9: Publishing the Topology

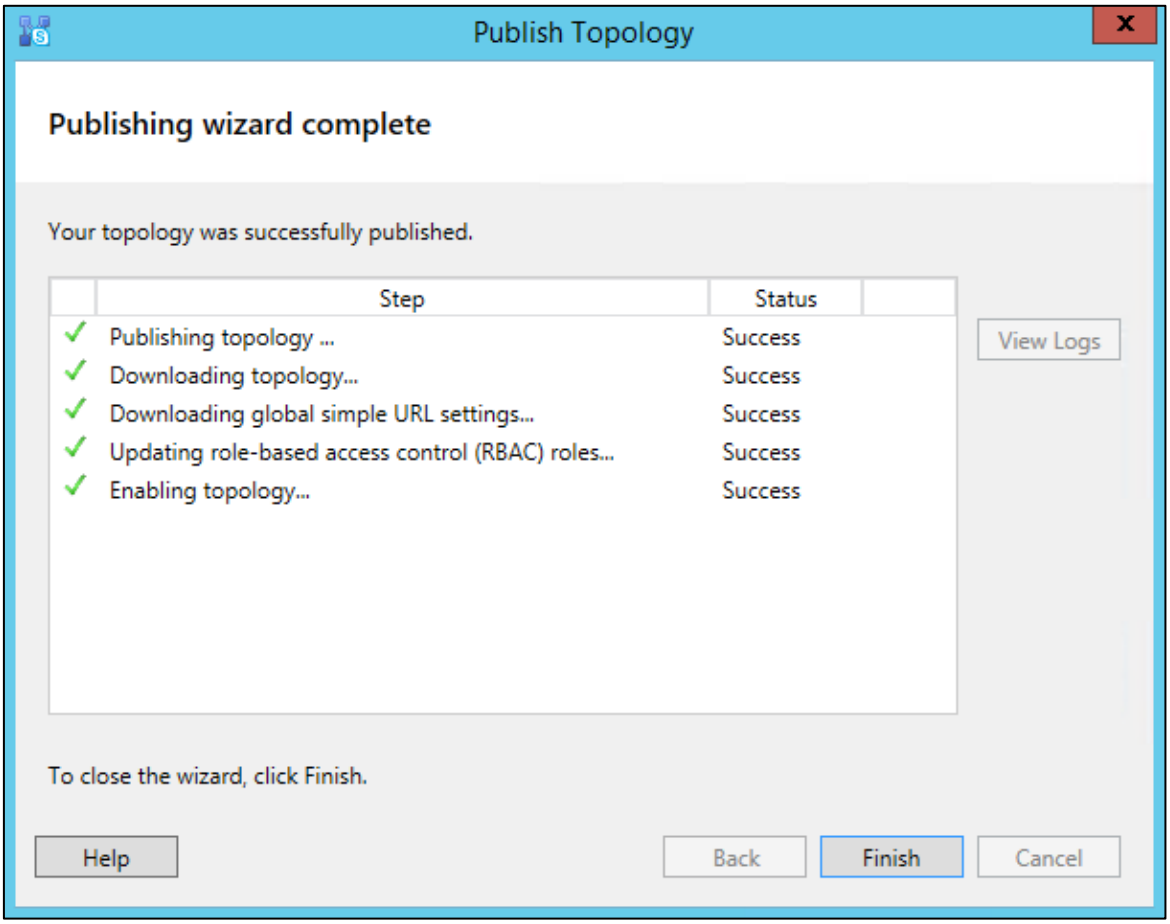

Figure 10: Changes to the Topology published successfully

Voice Routing Configuration

This section describes the Route and Trunk configuration in Skype for Business Server and associating it with the IP/PSTN gateway (configured in Topology Builder).

- Open Skype for Business Server 2015 Control Panel. In the left navigation bar, click “Voice Routing” and then click “Dial Plan”.

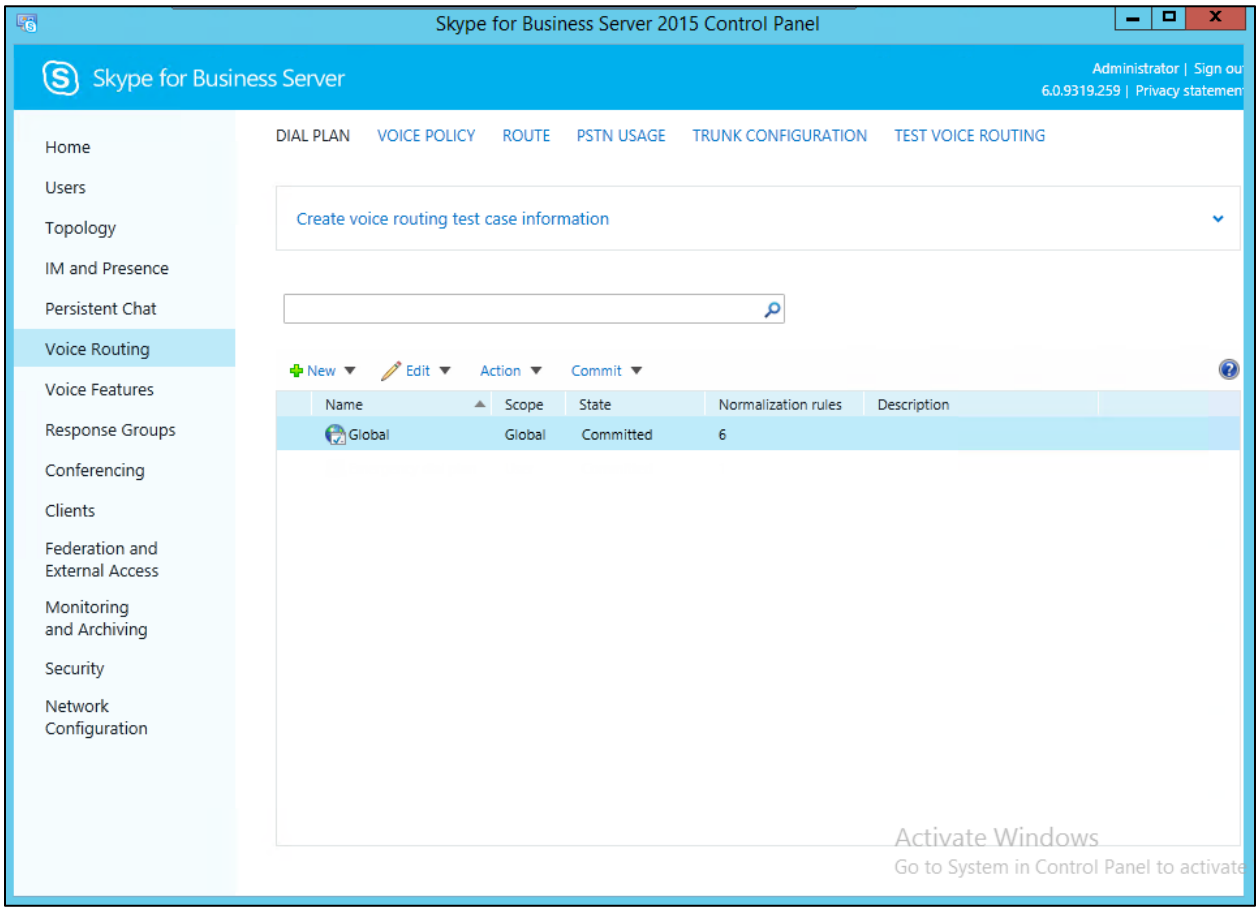

Figure 11: Voice Routing Menu

- From the “Dial Plan” page, Click on “New” and select “Pool Dial Plan”.

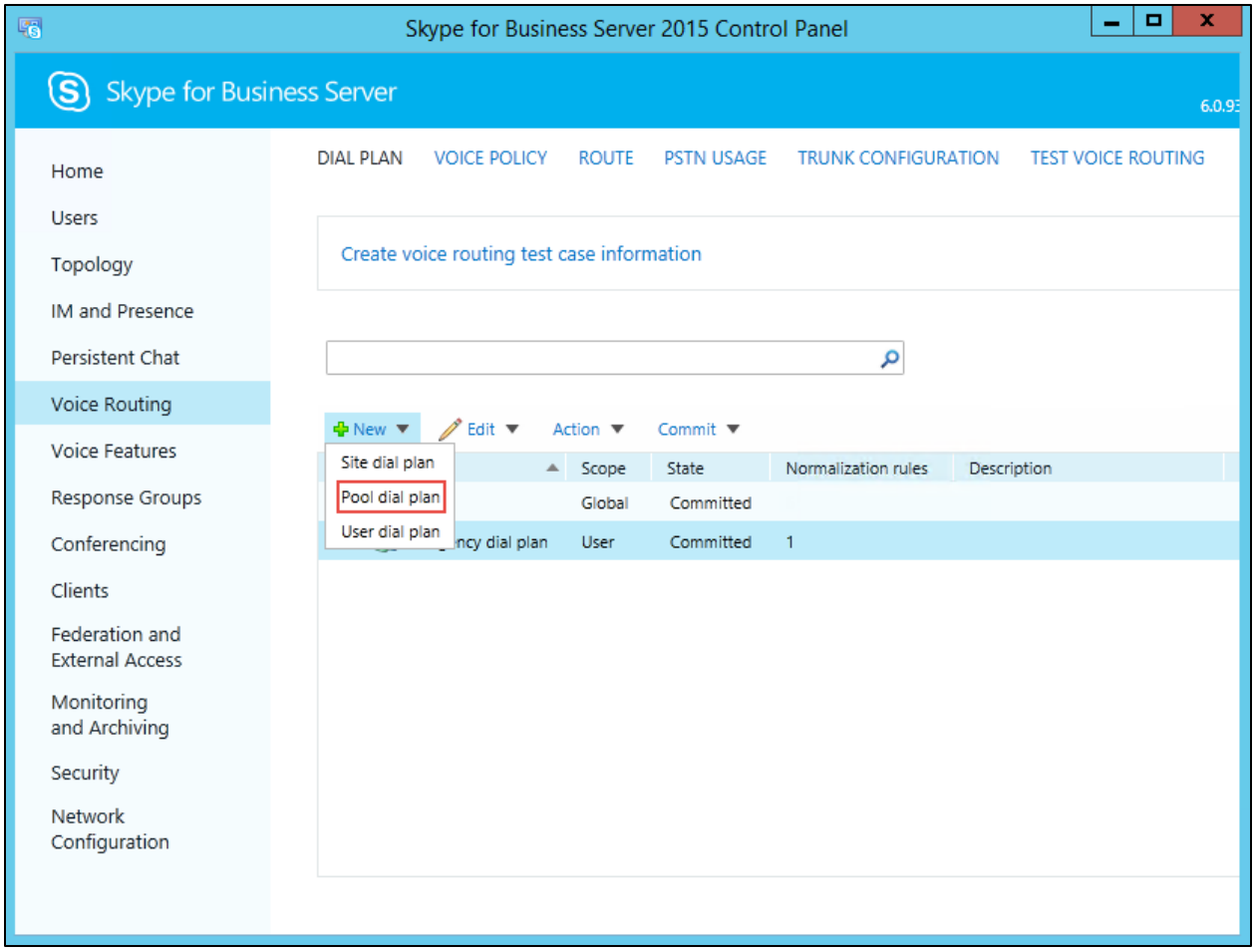

Figure 12: Adding New Dial Plan

- Select “Pool” for dial plan scope from “Select Service” dialog box. Here Registrar is selected.

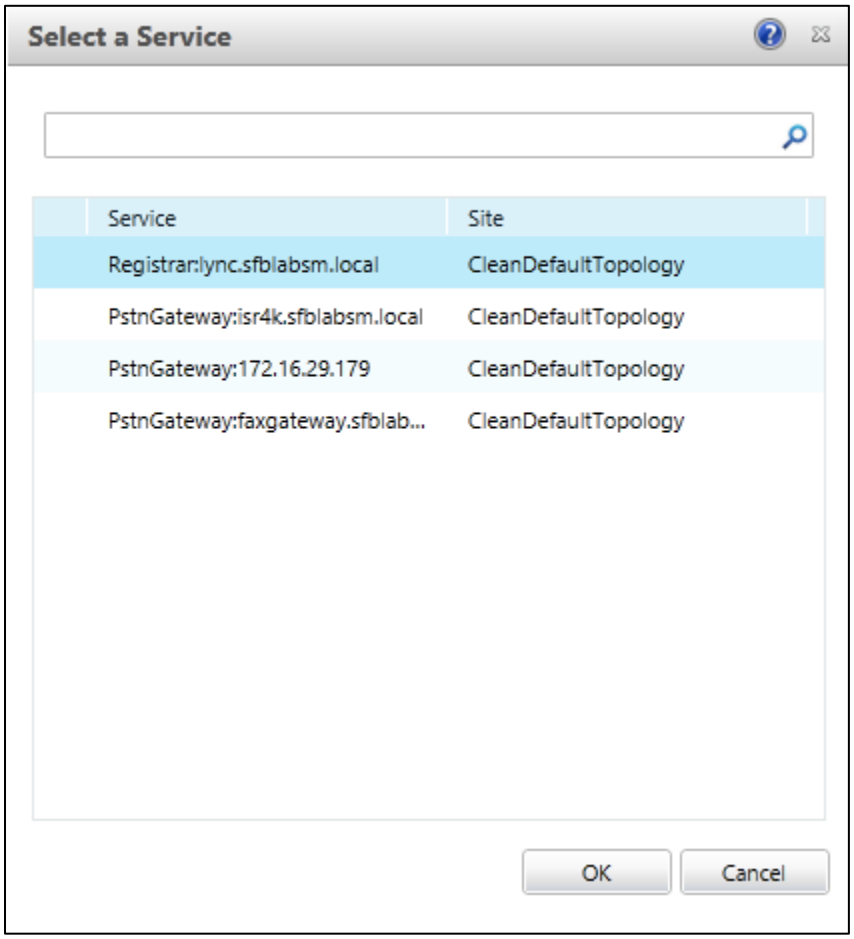

Figure 13: Select the service for Dial Plan

- Specify the Name and configure required normalization rules for the dial plan.

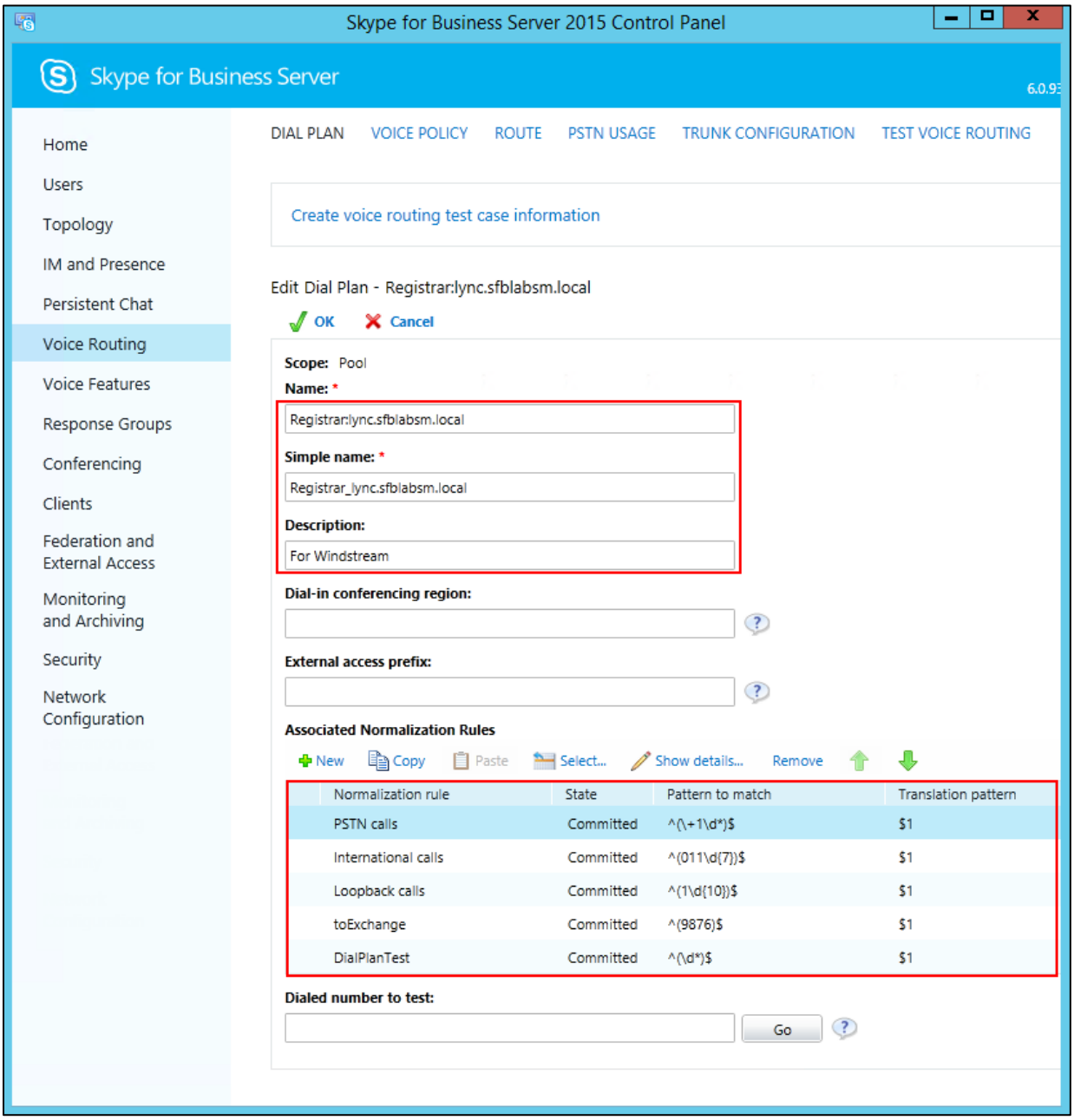

Figure 14: Dial Plan with added Normalization Rule

- On the “Dial Plan” page, click “Commit”, and then click “Commit all”.

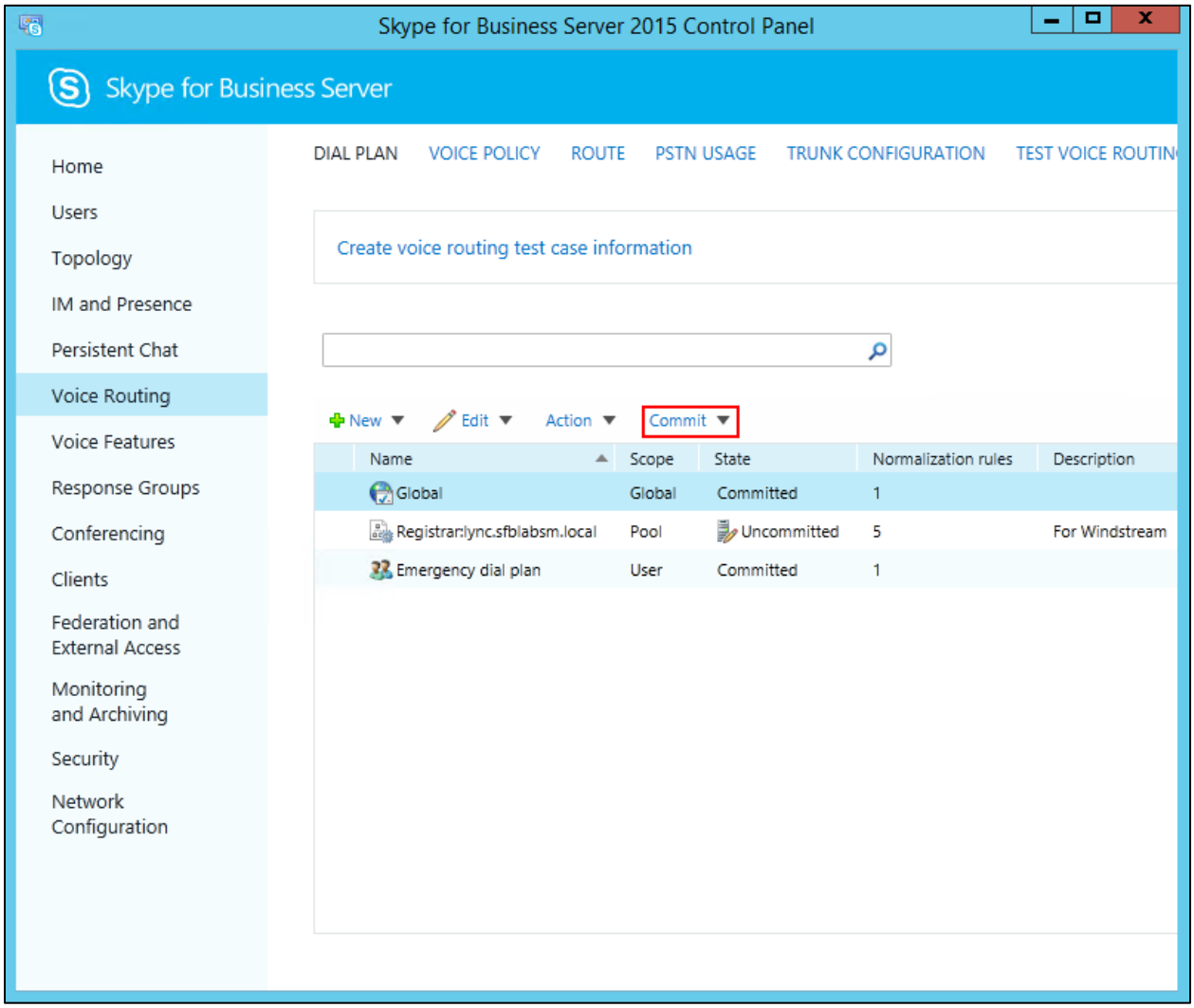

Figure 15: Uncommitted Dial Plan

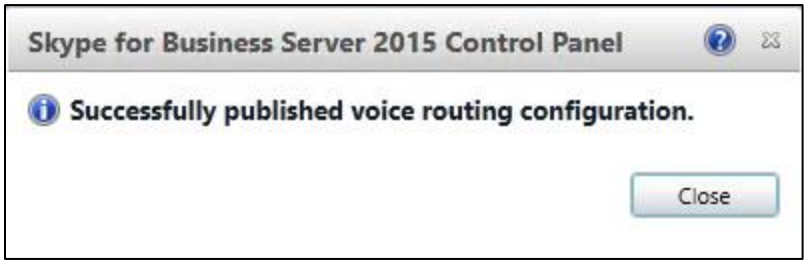

Figure 16: Committed Dial Plan Configuration successfully

- Navigate to “Voice Policy” tab, click on “New” and select “User Policy” to add the new user Voice Policy as shown below.

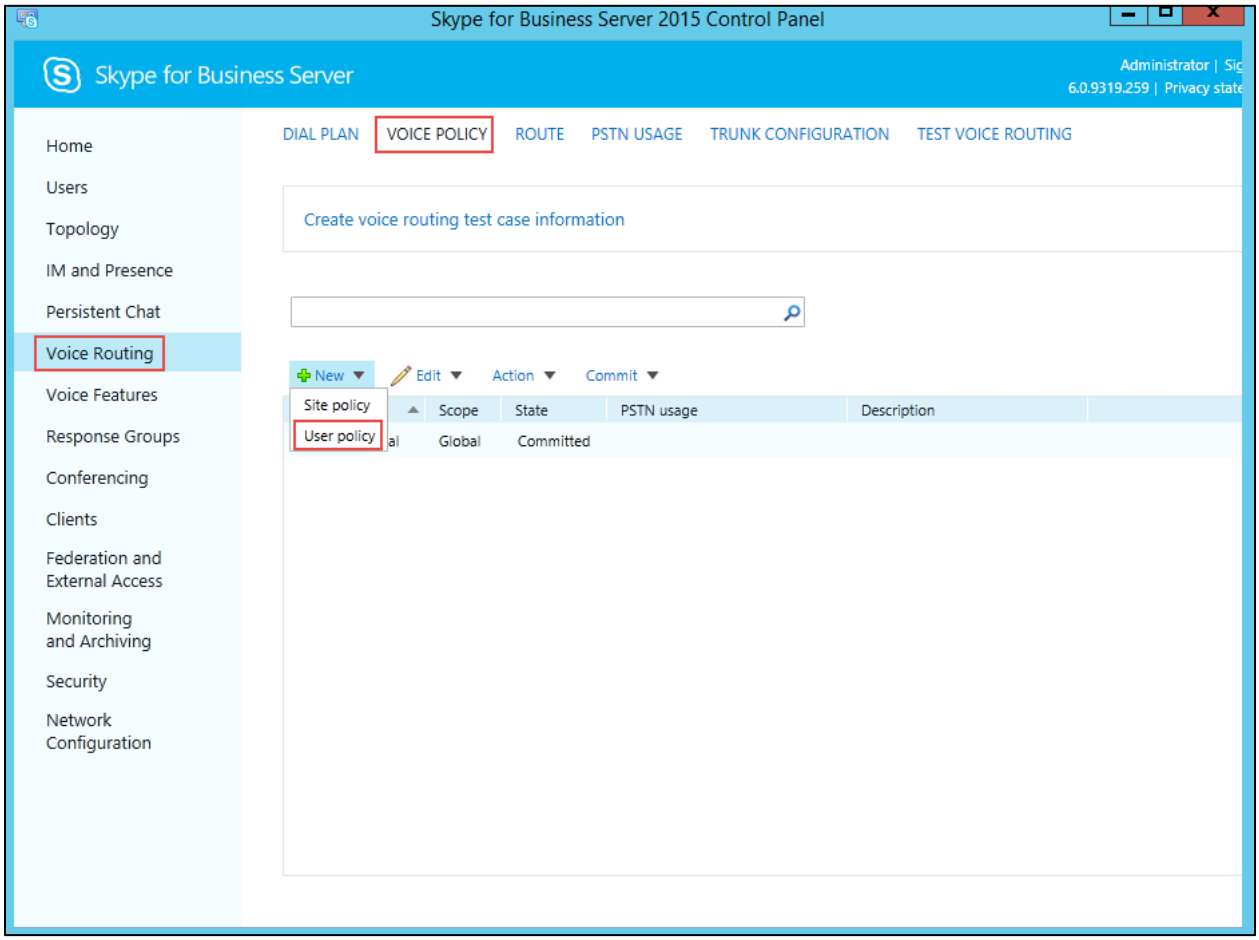

Figure 17: Voice policy Window

- Specify name for “Voice Policy”, description (optional) and enable required features then scroll down to “Associated PSTN Usages”. Click on “New” in the Associated PSTN Usage box.

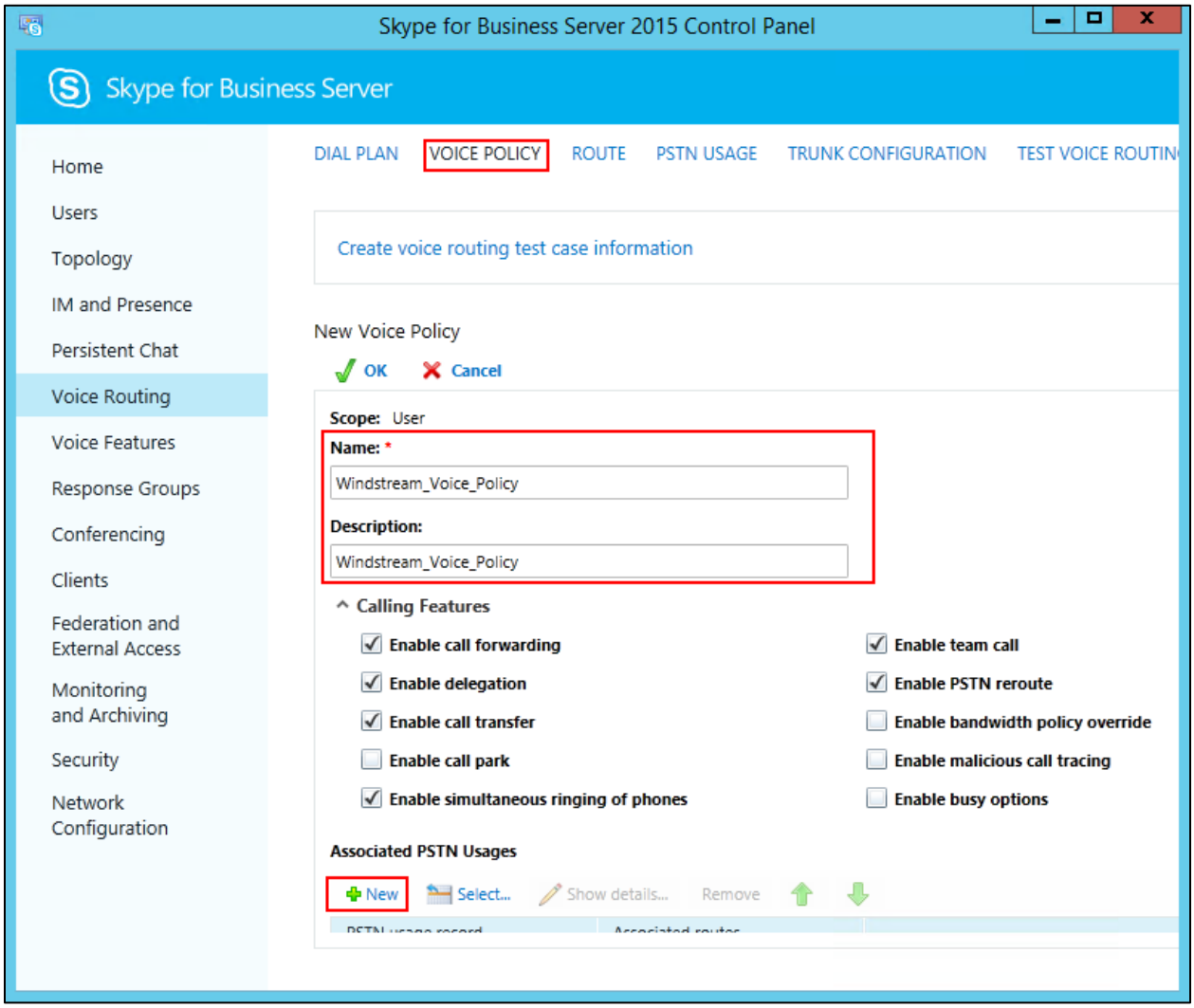

Figure 18: Adding a New Voice Policy

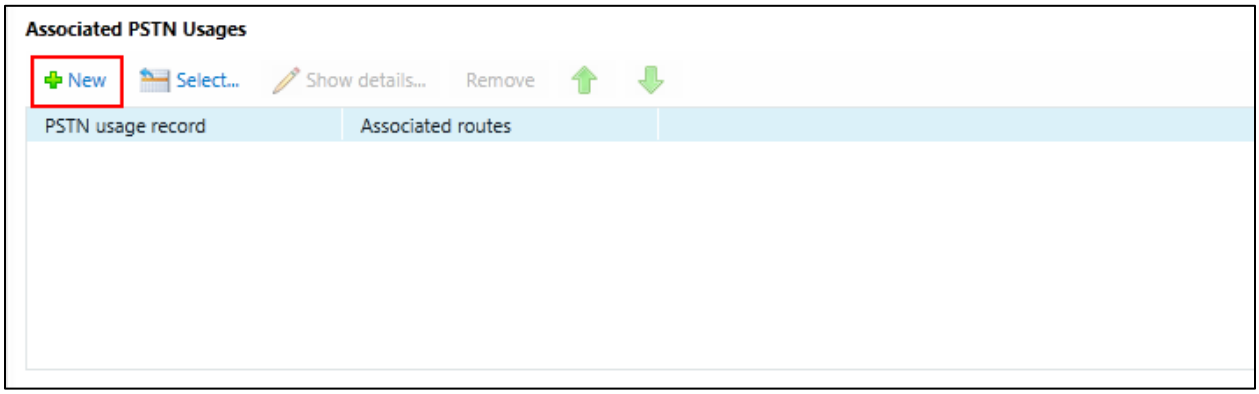

Figure 19: Associated PSTN Usages

- Specify the name for new “PSTN Usage” and click on “New” to add a new Route.

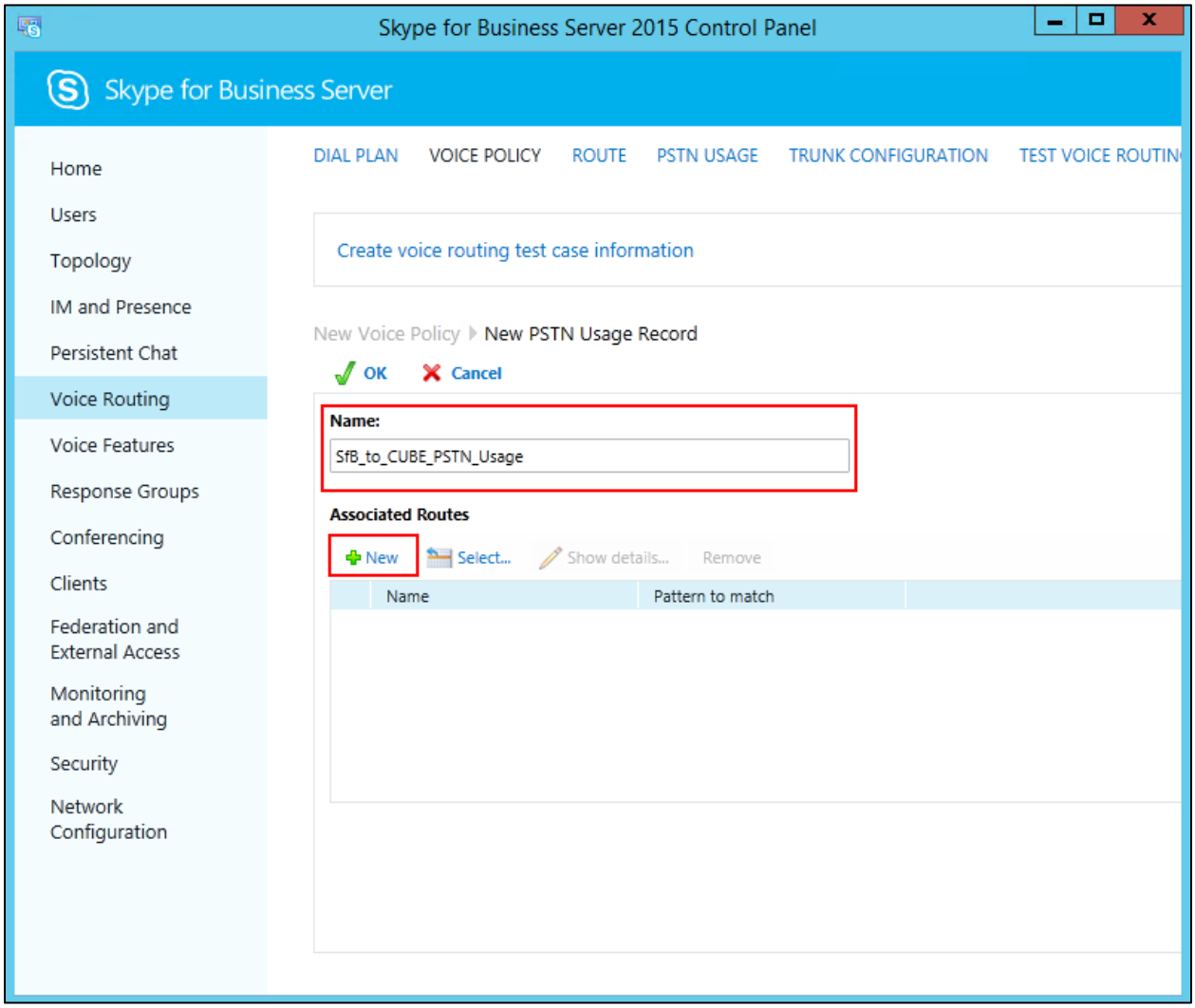

Figure 20: New PSTN Usage configuration

- Add a new route for CUBE. The Pattern to Match is set to ".*" which matches any dialed number from this Voice Policy.
- Under Associated Trunks, select "Add" to choose the trunk to associate with newly created route.

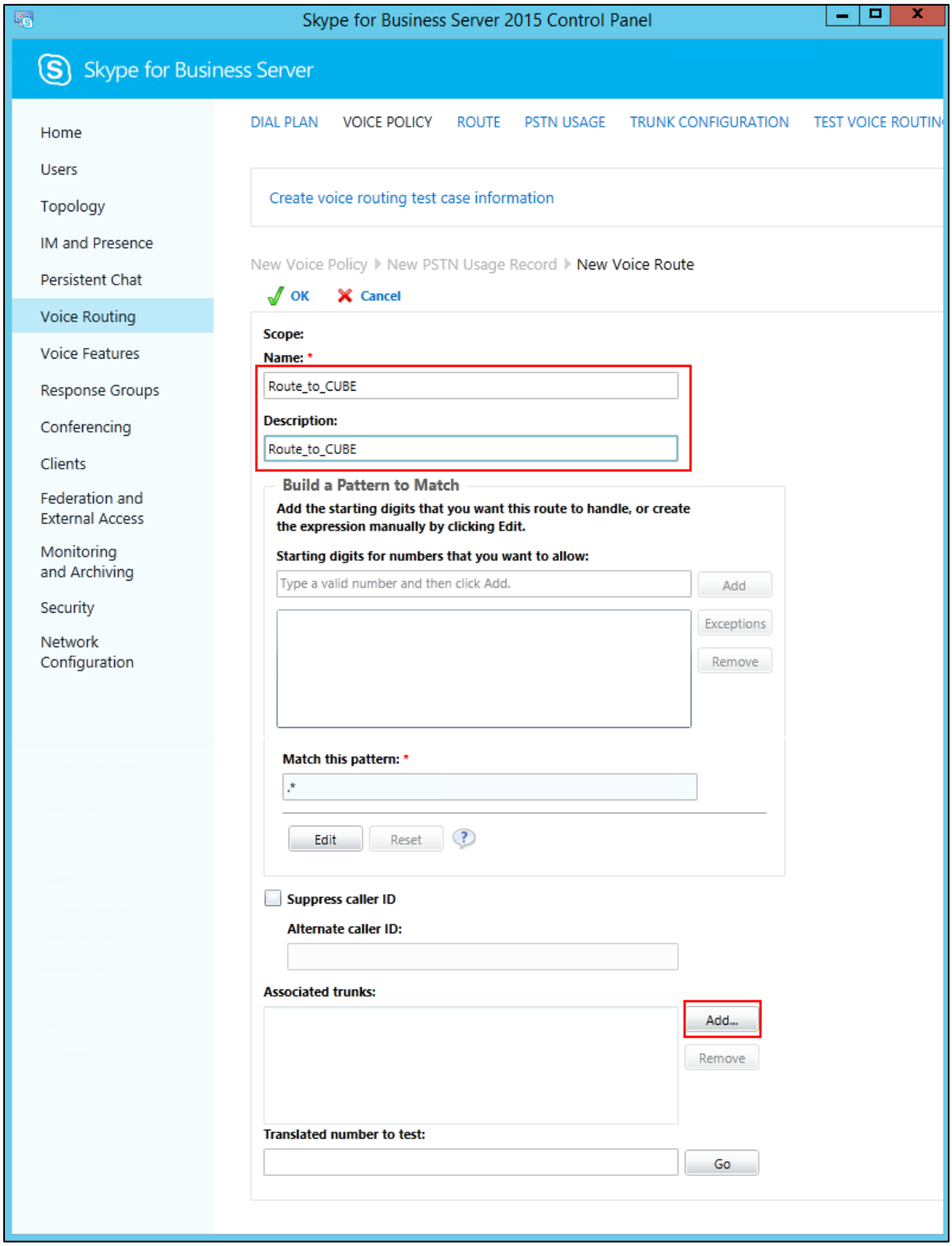

Figure 21: New Voice Route details and Add Trunk to associate

- Double click on the appropriate route (or) Click “OK” after selecting a route. Selected route will displayed as shown below. Then click on “OK” to apply the newly created PSTN Usage. This will roll back to the “Voice Policy’ page with the newly added PSTN Usage and Route.

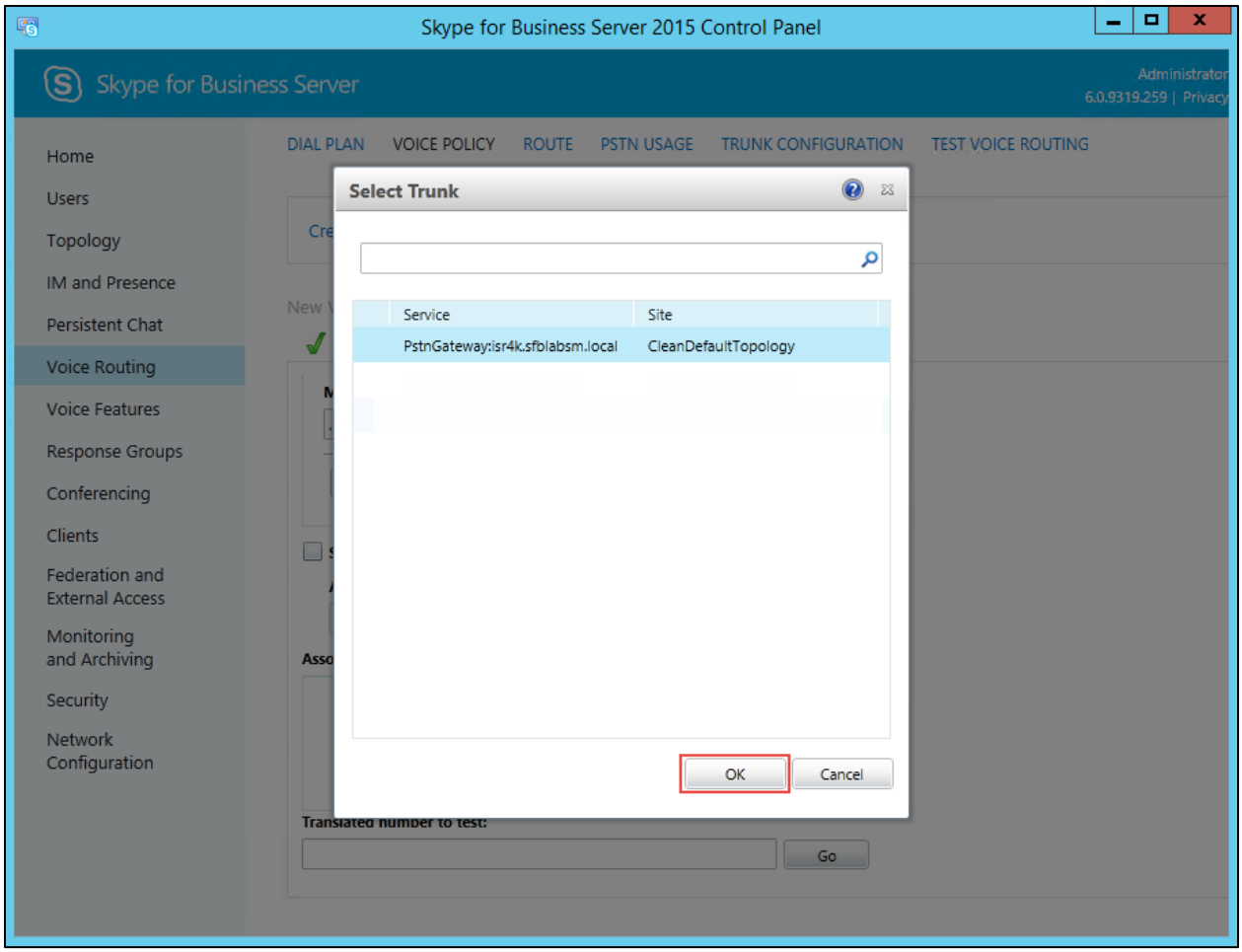

Figure 22: Select Trunk to associate with Route

- Click “OK” to apply the new Voice Policy settings. Now the “Voice Policy” page will be shown with the newly added voice policy as “uncommitted”.

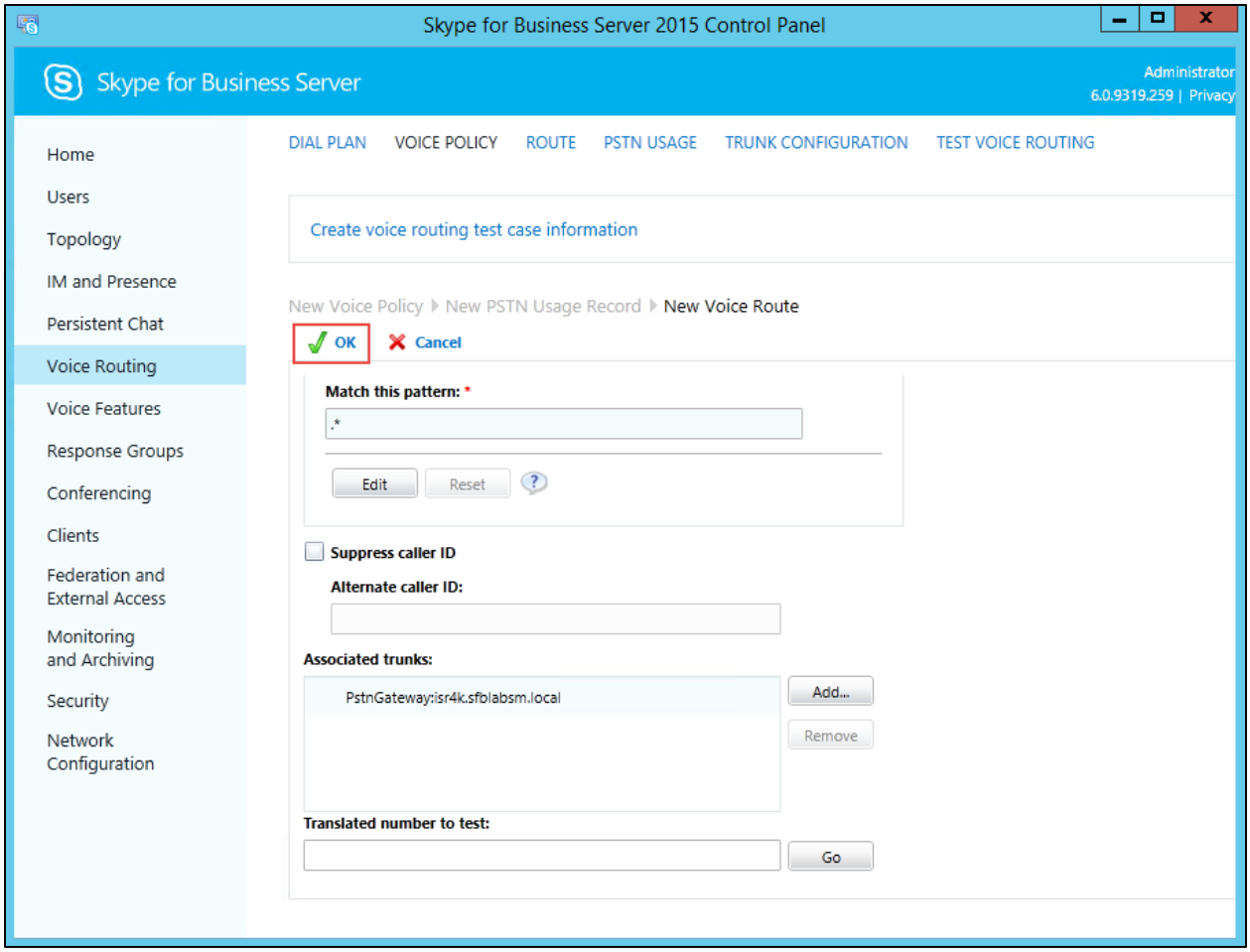

Figure 23: Voice Policy configuration with trunk associated

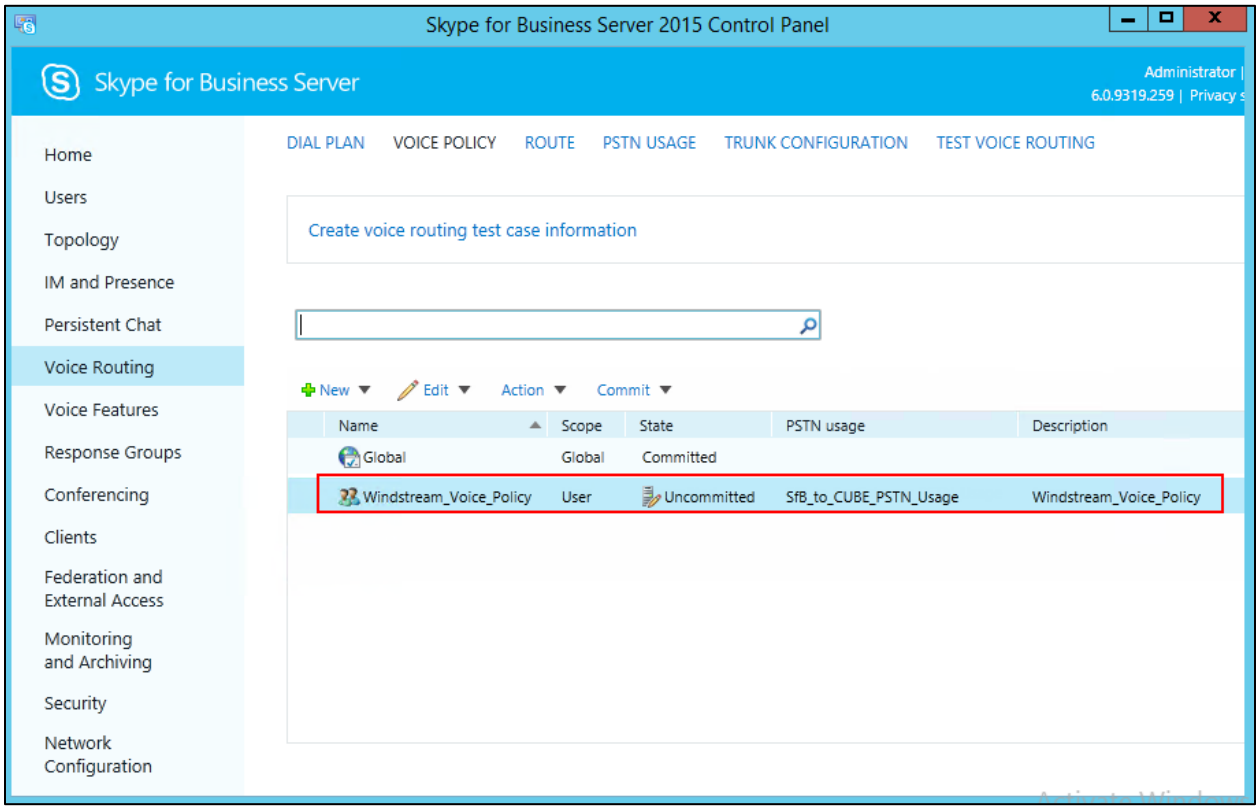

Figure 24: Uncommitted Voice Policy Configuration

- Click on “Commit” and select the “Commit All” menu to commit the changes made.

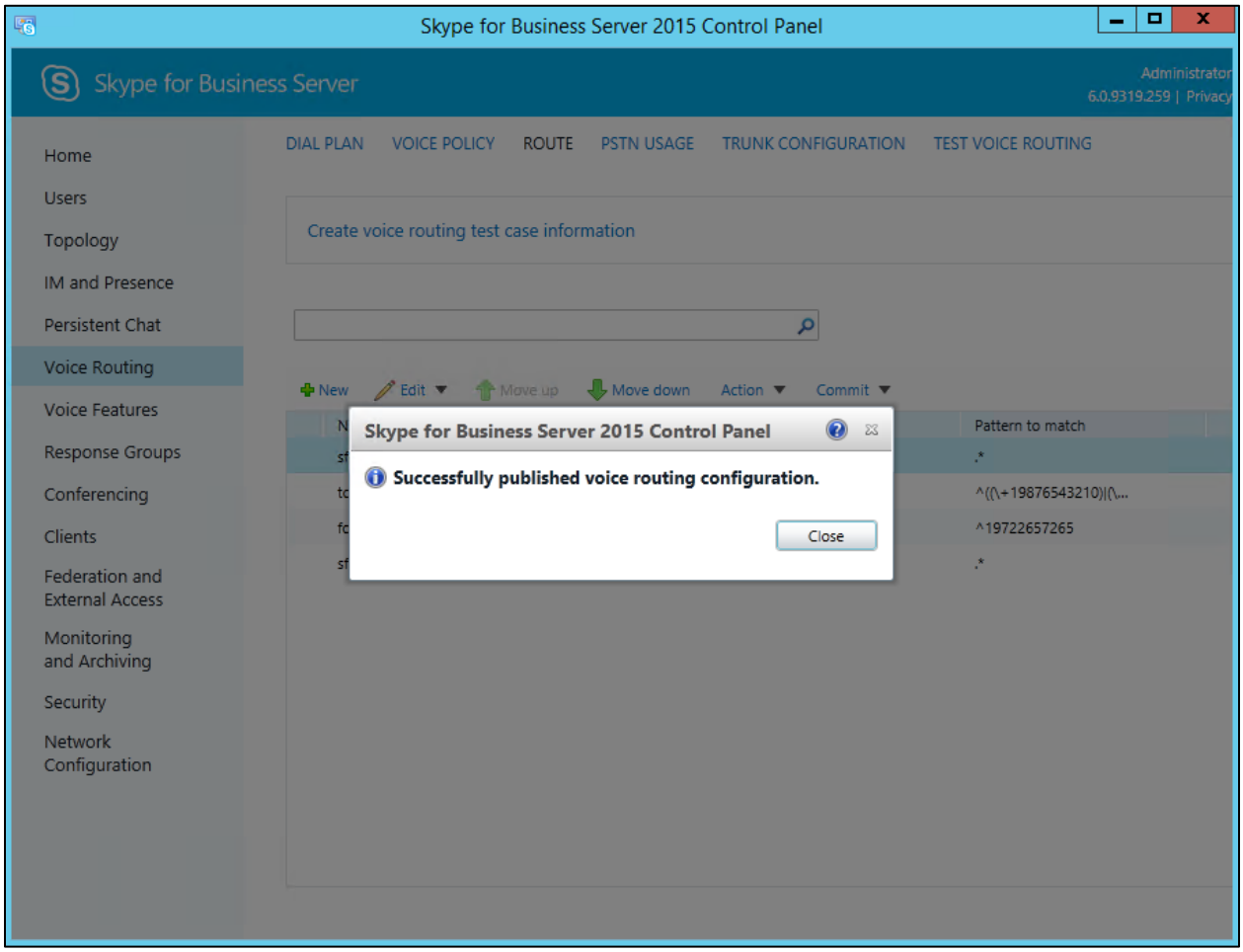

Figure 25: Committed Voice Policy successfully

Trunk configuration

- In Skype for Business Server Control Panel, navigate to “Voice Routing” → “Trunk Configuration”
- Select “New” → “Pool Trunk” to add the trunk to CUBE

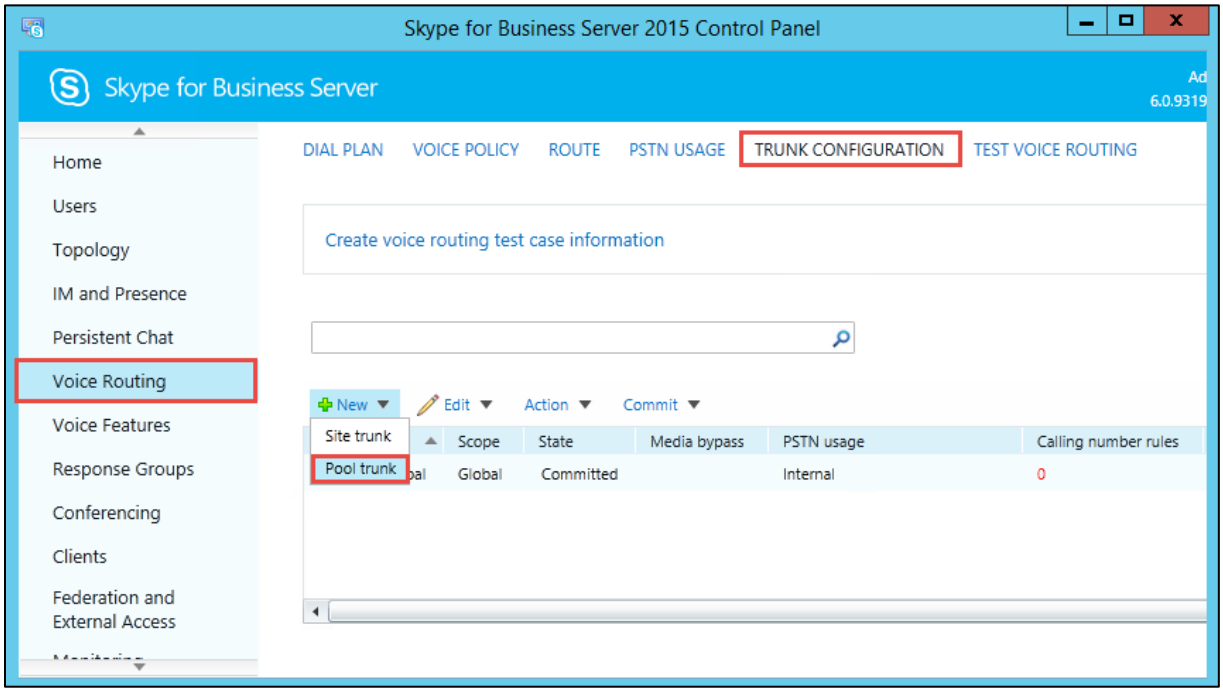

Figure 26: New Pool Trunk

- Configure the trunk with the required parameters selected as shown below.

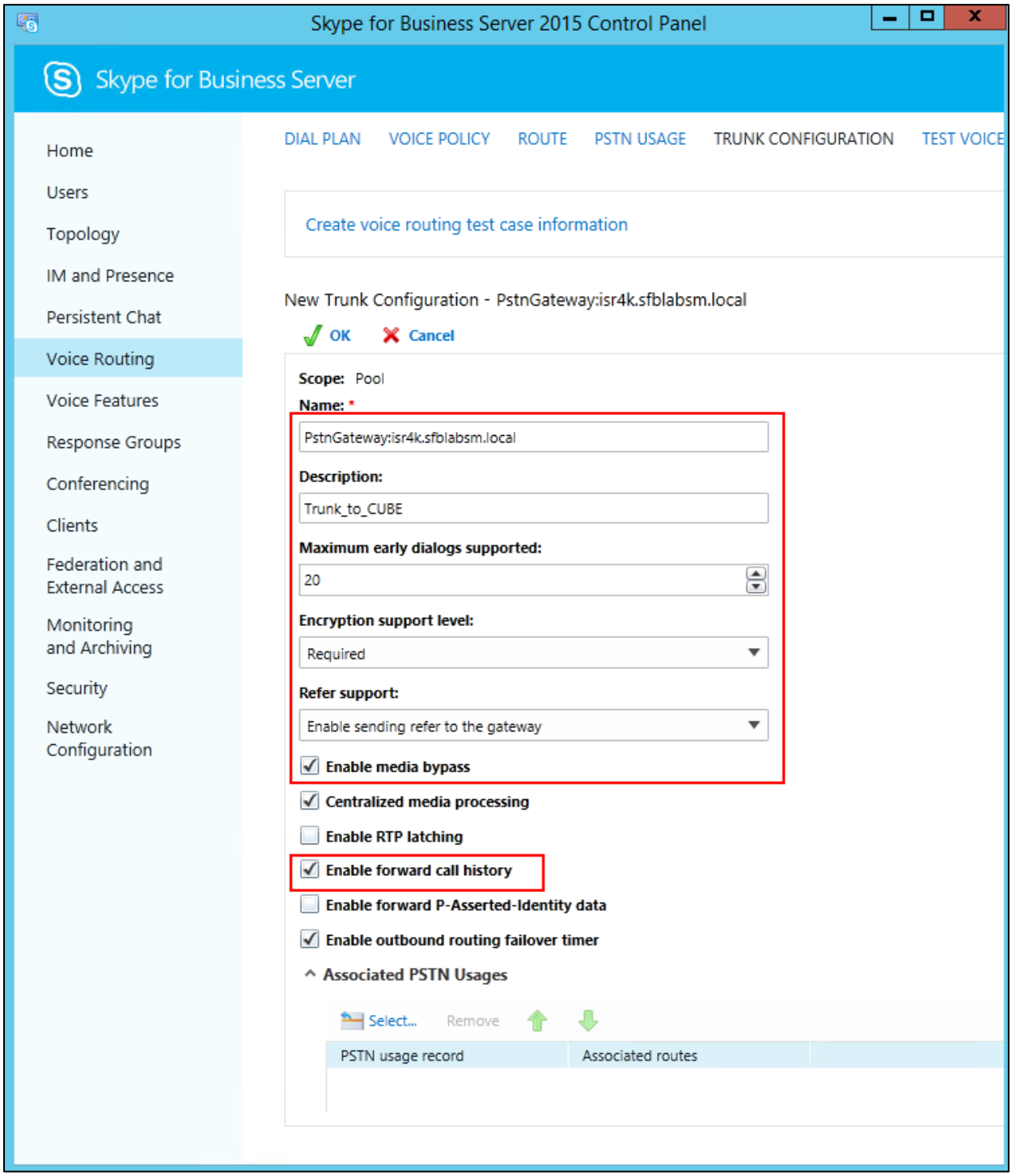

Figure 27: SIP Trunk to Cisco UBE

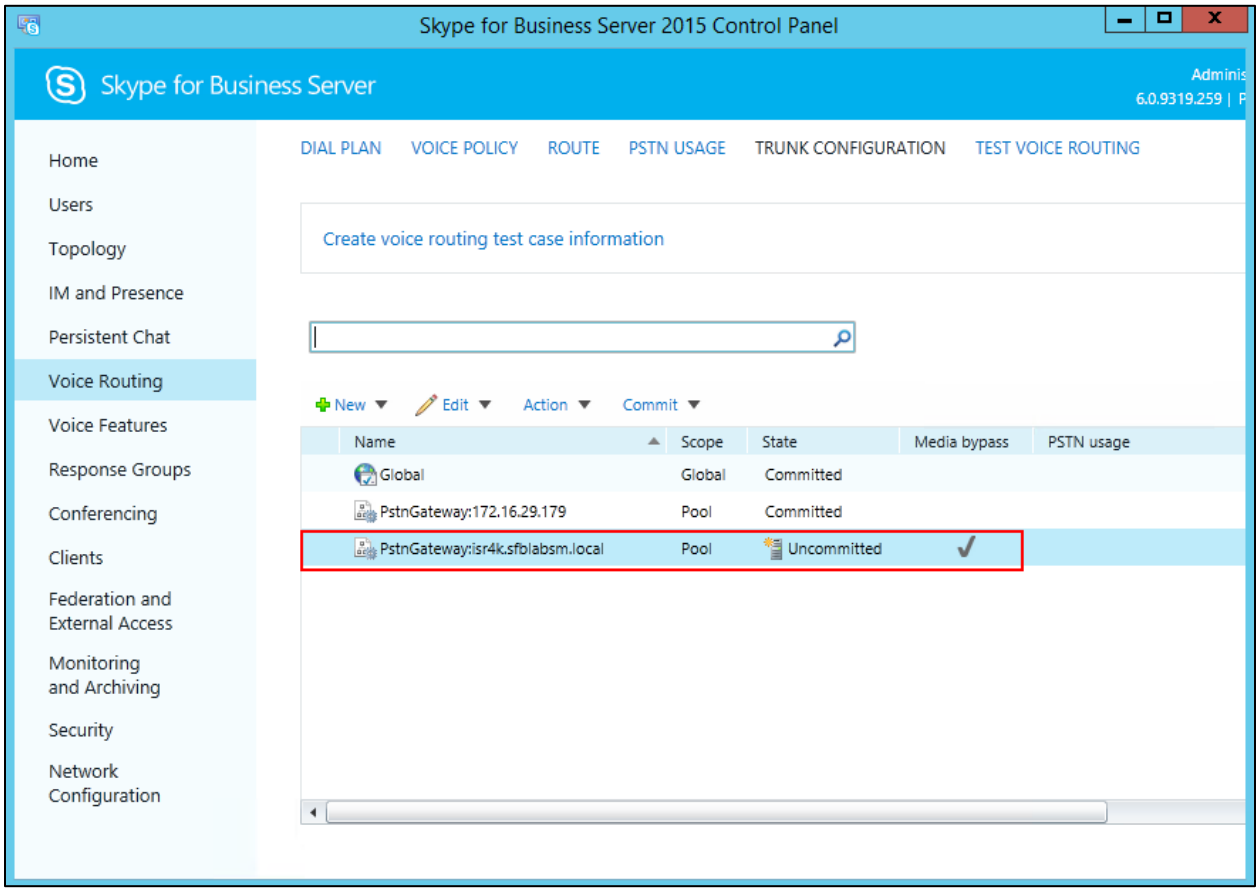

Figure 28: Uncommitted Trunk Configuration

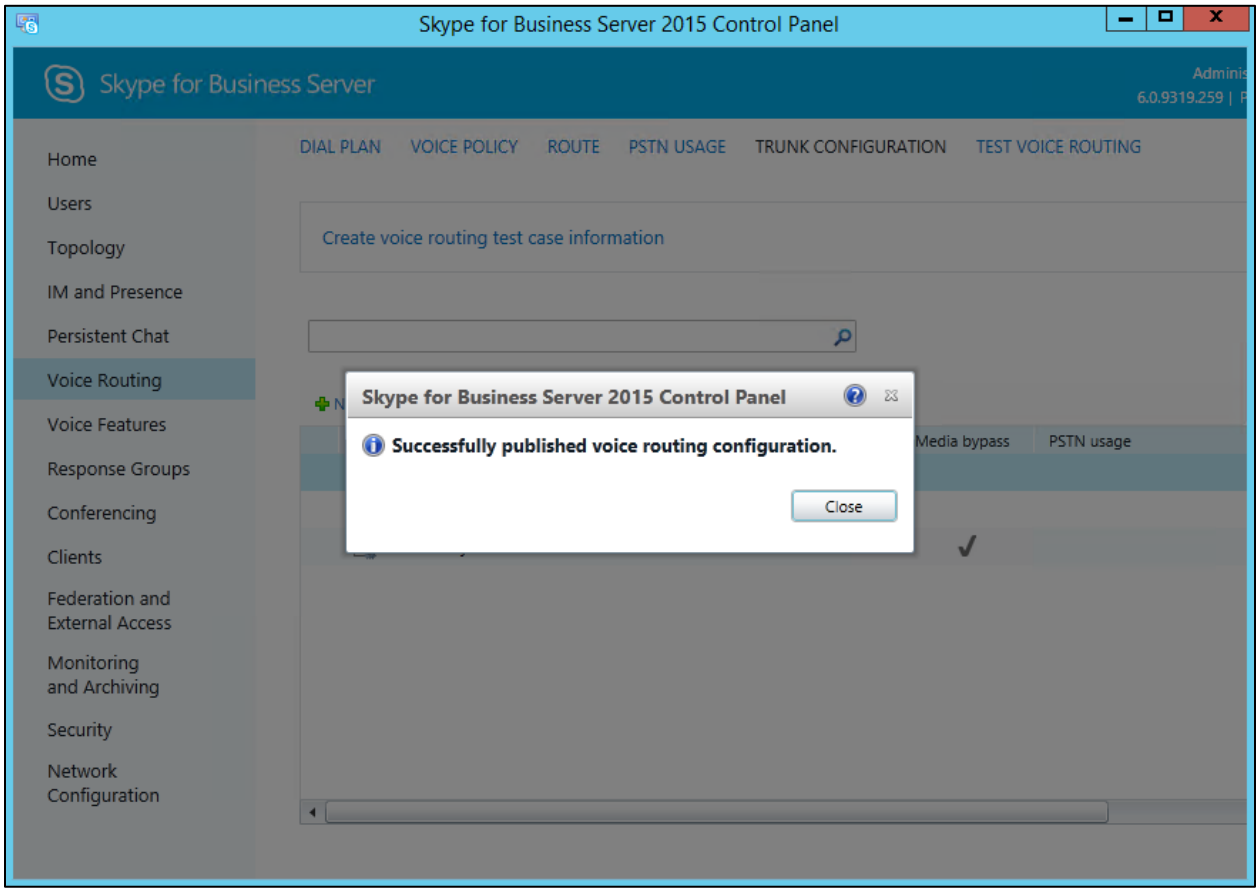

Figure 29: Committed Trunk Configuration successfully

- Repeat the above procedure for the trunks towards Fax gateway and to Exchange Server. Configured Trunk is as follows.

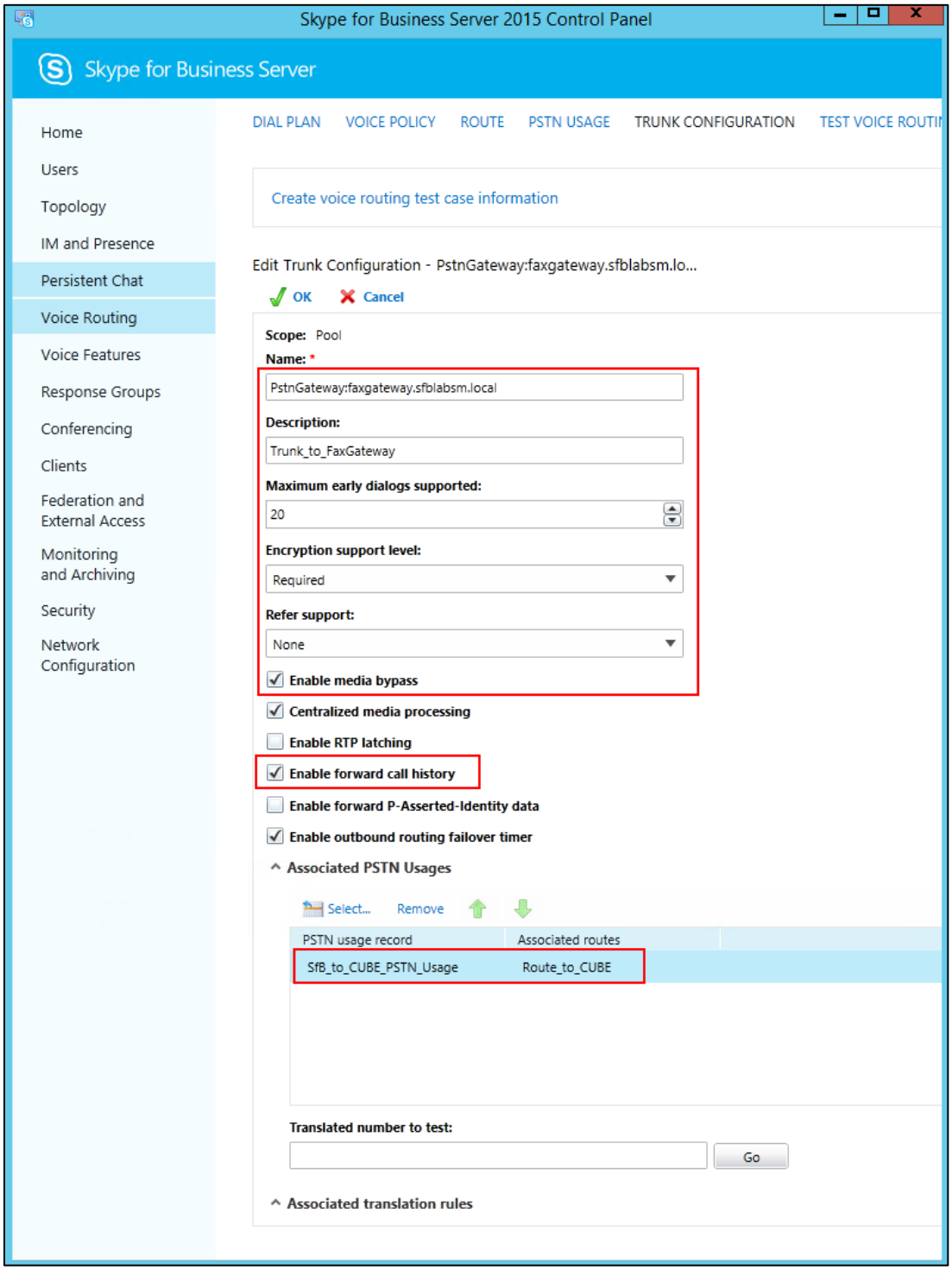

Figure 30: Trunk towards Fax Gateway

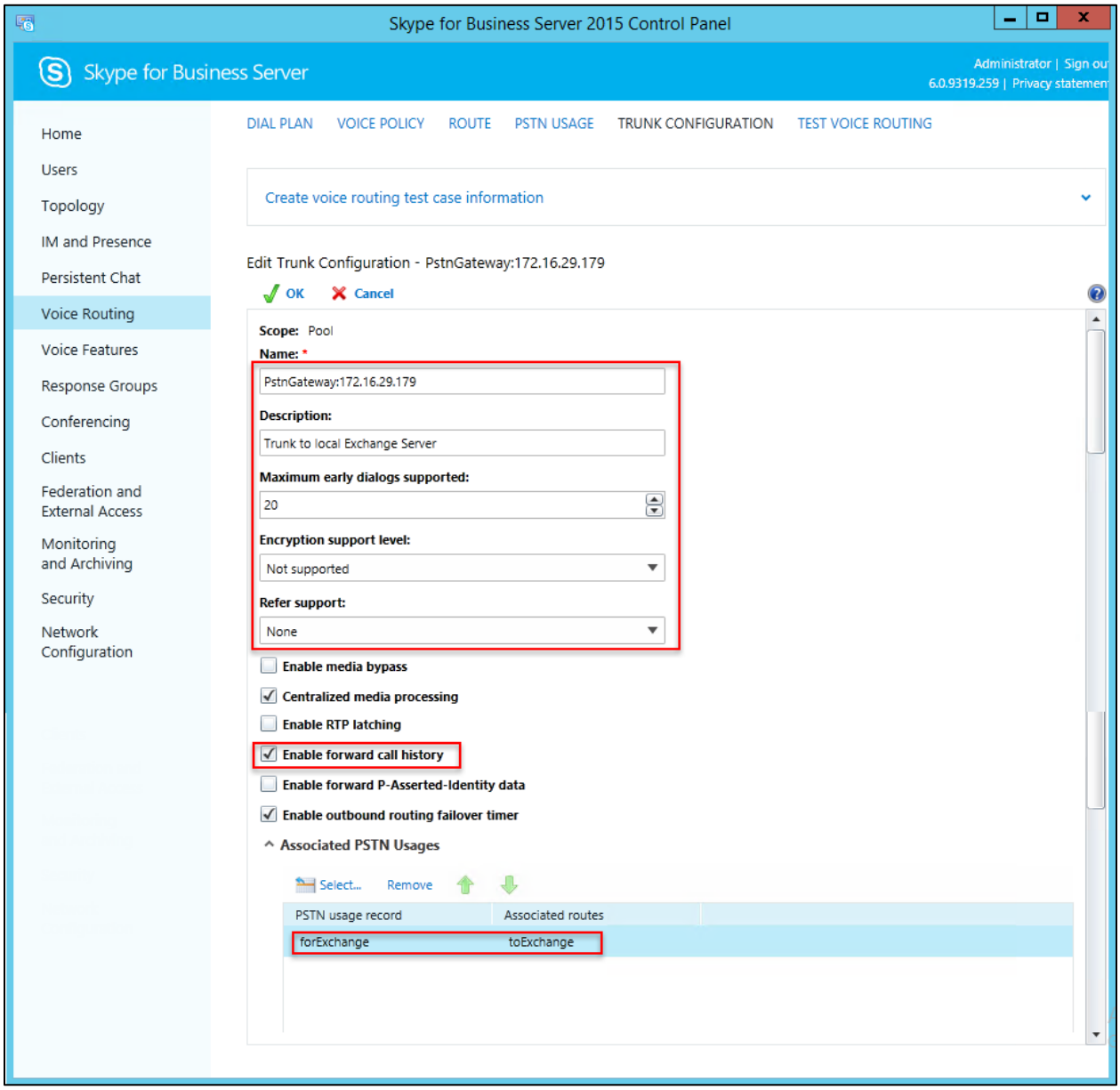

Figure 31: Trunk to Exchange Server

User Configuration

- Select the Skype Users who are intend to use the Enterprise Voice feature and fill the Windstream DID in the Line URI field. Select the newly added User Voice Policy in “Voice Policy” field.

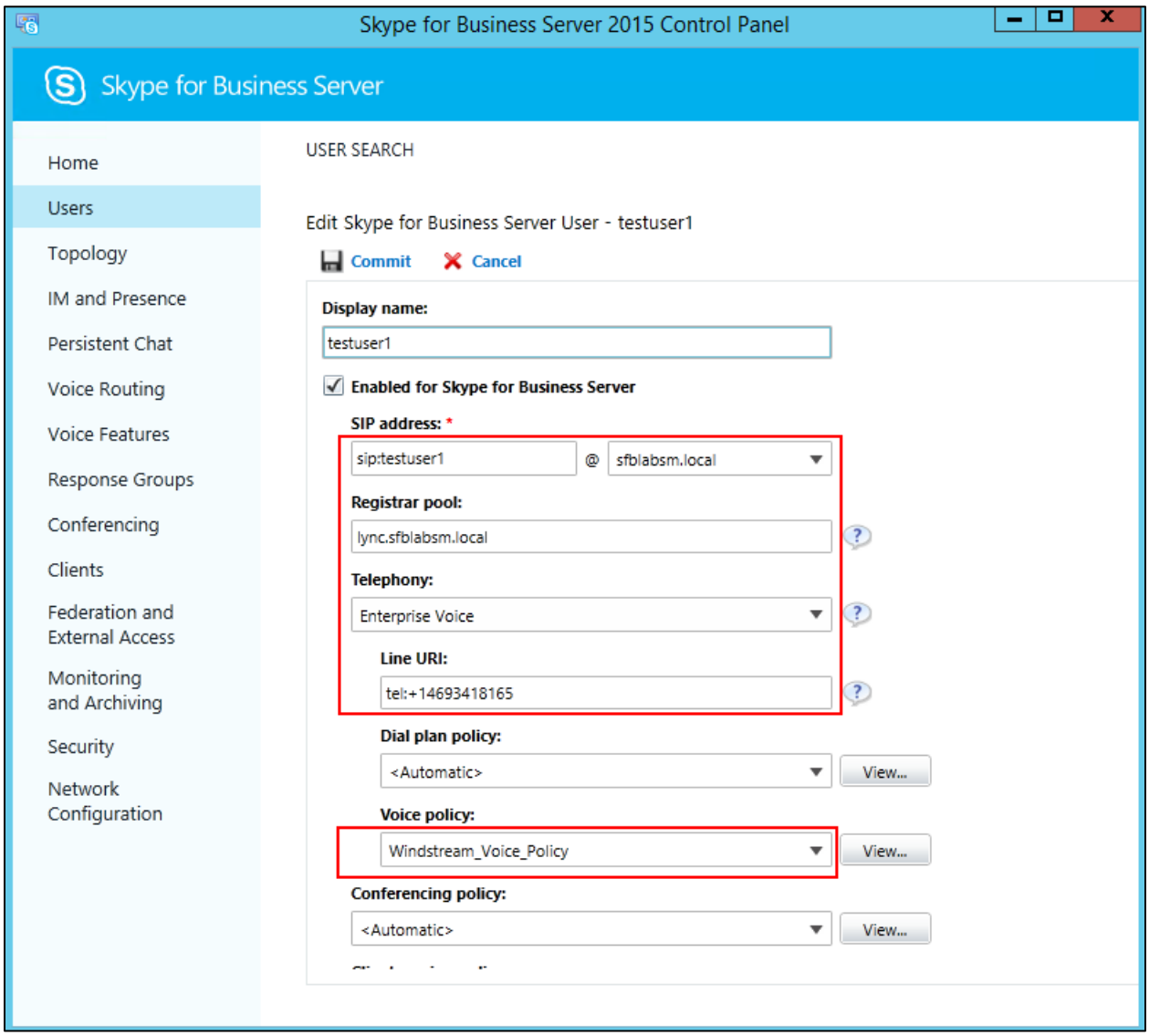

Figure 32: Skype for Business User Configuration

Configuring Cisco Voice Gateway for Fax

Global Settings

```
voice service voip
 no ip address trusted authenticate
 address-hiding
 allow-connections sip to sip
 redirect ip2ip
 fax protocol pass-through g711ulaw
 no fax-relay sg3-to-g3
 sip
  rel1xx disable
  conn-reuse
  early-offer forced
  midcall-signaling passthru
!
```

Codecs

G711ulaw is used for this testing.

```
voice class codec 1
 codec preference 1 g711ulaw
```

Dial peer

Outbound Dial-peer to Skype for Business:

```
dial-peer voice 5001 voip
 description ** Windstream Outbound FAX **
 translation-profile outgoing E164dialing
 destination-pattern 9722657262
 session protocol sipv2
 session target dns:lync.sfblabsm.local:5067
 session transport tcp tls
  voice-class sip srtp-auth sha1-80
 voice-class sip localhost dns:gateway.sfblabsm.local:5061
 voice-class sip options-keepalive
 dtmf-relay rtp-nte
 srtp
 codec g711ulaw
 fax-relay ecm disable
 no vad
!
```

Inbound Dial-peer from Skype for Business:

```
dial-peer voice 5000 voip
 description ** Windstream Inbound FAX **
 session protocol sipv2
 session transport tcp tls
 incoming called-number +1469341XXXX
 incoming uri to sfb
  voice-class sip srtp-auth sha1-80
 dtmf-relay rtp-nte
 srtp
 codec g711ulaw
 fax-relay ecm disable
 no vad
```

POTS and Port Configuration:

Based on configured POTS destination pattern, gateway forwards the call to designated voice port.

```
dial-peer voice 50 pots
 service session
 destination-pattern +1469341XXXX
 no digit-strip
 port 0/0/1
 forward-digits all
!
voice-port 0/0/1
 no vad
 cptone IN
 station-id name WindstreamFax
 station-id number +1469341XXXX
 caller-id enable
!
```

Configuration example

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

```
User Access Verification

Username: cisco
Password:
FAX-GATEWAT1#sh run

version 15.7
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname FAX-GATEWAT1
!
boot-start-marker
boot system flash:c2900-universalk9-mz.SPA.157-3.M.bin
boot-end-marker
!
aqm-register-fnf
!
logging queue-limit 1000000000
logging buffered 10000000
logging rate-limit 10000
no logging console
enable secret 4 xxxxxx1QCmm7yYduKGZI
!
no aaa new-model
!
!
```

```
ip host lync.sfblabsm.local 172.16.29.48
ip name-server 172.16.29.47
ip cef
no ipv6 cef
!
multilink bundle-name authenticated
!
!
stcapp feature access-code
!
stcapp feature speed-dial
!
!
cts logging verbose
!
crypto pki trustpoint skypelab
 enrollment terminal
 fqdn faxgateway.sfblabsm.local
 subject-name CN=faxgateway.sfblabsm.local
 revocation-check none
 rsakeypair faxtest
!
!
crypto pki certificate chain skypelab
 certificate 10000000870DA687FA273CDCF6000000000087
  3082051C 30820404 A0030201 02021310 00000087 0DA687FA 273CDCF6 00000000
  0087300D 06092A86 4886F70D 01010505 00304A31 15301306 0A099226 8993F22C
  64011916 056C6F63 616C3118 3016060A 09922689 93F22C64 01191608 7366626C
  6162736D 31173015 06035504 03130E73 66626C61 62736D2D 44432D43 41301E17
  0D313830 33323131 34313431 335A170D 32303033 32303134 31343133 5A302431
  22302006 03550403 13196661 78676174 65776179 2E736662 6C616273 6D2E6C6F
  63616C30 82012230 0D06092A 864886F7 0D010101 05000382 010F0030 82010A02
  82010100 A49A3134 5E08009B EE26CDAF 7FF649EC C1D8AEC4 10AF2E82 E1E074CE
```

10A6BB4C 5612AFCA B2237C64 A5F78975 69C92D31 86F93EA9 F1379146 A013EB2A
EBEB3915 90DDF719 478EE0D9 BF094062 9630F5D3 EDBA5324 A0C4C86B 070438D6
D4E8F6F2 0554FD69 D5DC3B23 EA3CBCC2 6CF4E031 B853B9E6 43A71734 22513C10
E833D0B9 8BDF72B4 7009F28B ECF8F898 8CC62C5F 0F8C2562 7EBA3A89 8CC9F732
29A53E7A CFD3393F 24B6A8EF A6CAC1B8 C2C6EBF5 DB6B83CC AA198AA8 D8E5D711
F97E9FEC BB11C7E1 E15B5455 50A86BF0 65FD8CD1 E28180B8 429902DF 503888DF
A6259543 D1EB14A8 98804996 756865E6 EED15C89 88C77EB9 DCAC2D96 4F8FBF81
587CB389 02030100 01A38202 1F308202 1B300E06 03551D0F 0101FF04 04030205
A0301D06 03551D0E 04160414 5C7DA3A3 95F680C4 1BEE5B67 9F191C77 4ED7FBAC
301F0603 551D2304 18301680 1493C1CD 4B1D9D22 D6B70355 1FDFC2AA 62D94FE4
303081CA 0603551D 1F0481C2 3081BF30 81BCA081 B9A081B6 8681B36C 6461703A
2F2F2F43 4E3D7366 626C6162 736D2D44 432D4341 2C434E3D 64632C43 4E3D4344
502C434E 3D507562 6C696325 32304B65 79253230 53657276 69636573 2C434E3D
53657276 69636573 2C434E3D 436F6E66 69677572 6174696F 6E2C4443 3D736662
6C616273 6D2C4443 3D6C6F63 616C3F63 65727469 66696361 74655265 766F6361
74696F6E 4C697374 3F626173 653F6F62 6A656374 436C6173 733D6352 4C446973
74726962 7574696F 6E506F69 6E743081 C306082B 06010505 07010104 81B63081
B33081B0 06082B06 01050507 30028681 A36C6461 703A2F2F 2F434E3D 7366626C
6162736D 2D44432D 43412C43 4E3D4149 412C434E 3D507562 6C696325 32304B65
79253230 53657276 69636573 2C434E3D 53657276 69636573 2C434E3D 436F6E66
69677572 6174696F 6E2C4443 3D736662 6C616273 6D2C4443 3D6C6F63 616C3F63
41436572 74696669 63617465 3F626173 653F6F62 6A656374 436C6173 733D6365
72746966 69636174 696F6E41 7574686F 72697479 30210609 2B060104 01823714
0204141E 12005700 65006200 53006500 72007600 65007230 13060355 1D25040C
300A0608 2B060105 05070301 300D0609 2A864886 F70D0101 05050003 82010100
5C1B0229 2C7936CE B01FD274 16A43C8D 484BC91D DB8BE974 BEEE2D5C F11C11BB
15050BE9 4EEE21C6 8A0755B0 FE44CE7D A27A8B71 24C45D00 4C3F4E44 A1A88A81
CF61308E 0438102D B905D295 80A6CF4B 9DDEC2C6 34B63695 5615A4C1 7FCCA8BC
816D1951 C9F43DC5 0B8152D7 921607AF E91070A9 5DC2C7B9 52A90289 066C53FF
89390D64 D578919B 02344E4F 2385A8D7 7EBE00AE 5904F40B 35DC2E70 48F0220A
ED6A77F3 88340740 50A7FCA5 E56AA428 99F9CDEF 7F3D39CB C062F78B DF9CA3CE
3171FE9A 3E1F5A7E FFB72158 64B38F3E 6550E8B3 F36C66CC 3A990E9D 35861C99
EFCAC4EE FD84AAF3 DB1B71FC 5C79ABEC 5A5254C7 23024448 CAF9B282 CE41372D

```
        quit
 certificate ca 67101D7CE9C812B140EFC231D1BD207A
  3082036F 30820257 A0030201 02021067 101D7CE9 C812B140 EFC231D1 BD207A30
  0D06092A 864886F7 0D010105 0500304A 31153013 060A0992 268993F2 2C640119
  16056C6F 63616C31 18301606 0A099226 8993F22C 64011916 08736662 6C616273
  6D311730 15060355 0403130E 7366626C 6162736D 2D44432D 4341301E 170D3135
  30363136 30373131 34305A17 0D323030 36313630 37323133 395A304A 31153013
  060A0992 268993F2 2C640119 16056C6F 63616C31 18301606 0A099226 8993F22C
  64011916 08736662 6C616273 6D311730 15060355 0403130E 7366626C 6162736D
  2D44432D 43413082 0122300D 06092A86 4886F70D 01010105 00038201 0F003082
  010A0282 01010097 8E8BF74A 05562140 6AEDDABC 13679FF0 50BABA47 F2753452
  FDACFF61 ECF08926 F9B57BAE C647671F 3669FCD2 5E31AADA 8942E449 8DC2A156
  11D47211 AD66C0F9 F3BD5627 DB5ABD22 7BA530CD B367D88B 44680003 3A6A87DA
  7F6A75C6 2CF708B0 52EE82C7 66D0A1FD 56AD5881 631862F0 38622546 0F3C0934
  89AFA9FF 3ECEED21 3A9EC8DB 8499E216 C68851F9 3F5B6F42 75F05F52 A4C5D95B
  487A72DB B27AE5F4 DB89193A B0F707EB E7C537F7 EDD7EC69 B4D8BA64 4D7F512F
  C522CFAB AC813224 4B9B11CD A516E181 29C255A7 795F6151 3269B541 CC93E655
  FC3A9698 4BCAE97F EB0E1035 09B0940A 53C94601 0EC47A8A B695E9DC 62A23C4E
  282E0538 DE030702 03010001 A351304F 300B0603 551D0F04 04030201 86300F06
  03551D13 0101FF04 05300301 01FF301D 0603551D 0E041604 1493C1CD 4B1D9D22
  D6B70355 1FDFC2AA 62D94FE4 30301006 092B0601 04018237 15010403 02010030
  0D06092A 864886F7 0D010105 05000382 01010064 3935BF00 067E8C7C FC8E0076
  77D0FB8C 0846697C 3A1A39A0 3A3387C5 18D4D9D3 596F540D 659F27A2 26063A21
  31666B09 3B51CB33 2A80A2D0 BEEC8C69 90A86604 E4B39966 BD48F030 299E1B49
  2F40982C D73F0E1D 1CA5C58E 239296C3 3FE1FCA6 C4F24543 F53AFF29 8570D590
  D4CEC1AE 2790EA17 D4E91959 76B1EFAD 84B041A9 7CC2E087 6FEFB750 E65AFB8B
  34FB2954 BC676B3A E11A7706 5970C4DE 9D791FC1 B91DB64A FCAA4AC7 930B213D
  99F4A877 67CA050C E448B12D 44BF94EA 055A7D37 5311F5DC D085F5F5 A16C0E96
  6337FDBD 89746ED7 A93089D8 F2383079 3D61C603 6780EE26 28C75E11 EF6CE309
  63A976AE F7C7F487 82015634 65801C48 F29AF3
        quit
voice-card 0
 codec complexity medium
```

```
!
!
voice service voip
 no ip address trusted authenticate
 address-hiding
 allow-connections sip to sip
 redirect ip2ip
 fax protocol pass-through g711ulaw
 no fax-relay sg3-to-g3
 sip
  rel1xx disable
  conn-reuse
  early-offer forced
  midcall-signaling passthru
!
!
voice class uri sfb sip
 host 10.80.22.7
voice class codec 1
  codec preference 1 g711ulaw
!
!
voice translation-rule 1
 rule 1 /\(^..........$\)/ /+1\1/
!
!
voice translation-profile E164dialing
 translate called 1
!
!
license udi pid CISCO2901/K9 sn FTX174081SJ
license boot module c2900 technology-package securityk9
hw-module pvdm 0/0
```

```
username <myuser> privilege 15 secret 5 $1$Afjl$f7FNxxxxxdttg76H4G1.
username cisco privilege 15 secret 4 xxxx6S2i4ntXrpb4RFmfqY
!
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
!
interface GigabitEthernet0/0
 ip address 10.80.22.7 255.255.255.0
 duplex half
 speed auto
!
interface GigabitEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
ip forward-protocol nd
!
ip http server
no ip http secure-server
ip http timeout-policy idle 60 life 86400 requests 10000
!
ip route 0.0.0.0 0.0.0.0 10.80.22.1
ip ssh server algorithm encryption aes128-ctr aes192-ctr aes256-ctr
ip ssh client algorithm encryption aes128-ctr aes192-ctr aes256-ctr
!
control-plane
!
voice-port 0/0/0
 no vad
 cptone IN
```

```
 !
voice-port 0/0/1
 no vad
 cptone IN
 station-id name WindstreamFax
 station-id number +1469341XXXX
 caller-id enable
 !
mgcp profile default
!
dial-peer voice 50 pots
 service session
 destination-pattern +1469341XXXX
 no digit-strip
 port 0/0/1
 forward-digits all
!
dial-peer voice 5000 voip
 description ** Windstream Inbound FAX **
 session protocol sipv2
 session transport tcp tls
 incoming called-number +1469341XXXX
 incoming uri to sfb
  voice-class sip srtp-auth sha1-80
 dtmf-relay rtp-nte
 srtp
 codec g711ulaw
 fax-relay ecm disable
 no vad
!
dial-peer voice 5001 voip
 description ** Windstream Outbound FAX **
 translation-profile outgoing E164dialing
```

```
 destination-pattern 9722657262
 session protocol sipv2
 session target dns:lync.sfblabsm.local:5067
 session transport tcp tls
  voice-class sip srtp-auth sha1-80
 voice-class sip localhost dns:gateway.sfblabsm.local:5061
 voice-class sip options-keepalive
 dtmf-relay rtp-nte
 srtp
 codec g711ulaw
 fax-relay ecm disable
 no vad
!
!
gateway
 timer receive-rtp 1200
!
sip-ua
 crypto signaling default trustpoint skypelab
!
gatekeeper
 shutdown
!
credentials
!
line con 0
 login local
line aux 0
line 2
 no activation-character
 no exec
 transport preferred none
 transport output pad telnet rlogin lapb-ta mop udptn v120 ssh
```

```
 stopbits 1
line vty 0 4
 exec-timeout 0 0
 logging synchronous
 login local
 transport input telnet ssh
line vty 5 15
 login local
 transport input telnet ssh
!
scheduler allocate 20000 1000
!
end
```

Acronyms

Acronym	Definitions
CPE	Customer Premise Equipment
Cisco UBE	Cisco Unified Border Element
SfB	Skype for Business
MTP	Media Termination Point
POP	Point of Presence
PSTN	Public Switched Telephone Network
ESBC	Enterprise Session Border Controller
SIP	Session Initiation Protocol

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Printed in the USA