

Integrated* or Cascaded CUBE with CER on a Cisco ASR Router Customer Configuration Guide (CCG) for use with AT&T IP Flexible Reach Service with AT&T Internet Access, MPLS PNT or AT&T VPN Service as the Underlying Transport Service and Microsoft® Lync™ Server 2010

Page 1



**Integrated* or Cascaded Cisco Unified Border Element (CUBE) with
Customer Edge Router (CER) on a Cisco ASR Router
Customer Configuration Guide (CCG) for use with AT&T IP Flexible
Reach Service with AT&T Internet Access, MPLS PNT or AT&T VPN
Service as the Underlying Transport Service
and Microsoft® Lync™ Server 2010**

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***The Integrated CUBE option is only available for AT&T VPN Service**

Table of Contents

1	Introduction	3
1.1	Change History.....	3
2	Network Topology.....	4
3	System Components	7
3.1	Hardware / Software Components	7
4	Features.....	8
4.1	Features Supported.....	8
4.2	Caveats	8
5	References	11
6	Cisco CUBE Configuration.....	11
6.1	Cisco IOS version.....	11
6.2	Configuring Cisco Unified Border Element (CUBE)	12

1 Introduction

AT&T IP Flexible Reach Service, on AT&T Internet Access, MPLS PNT or AT&T VPN as the Underlying Transport Service, is an offering that allows calls from a user managed VoIP network to the PSTN and offers an end customer a viable alternative to traditional PSTN connectivity via either Analog or T1 lines.

This application note describes how to configure a Cisco Unified Border Element (CUBE) to provide connectivity from a Microsoft® Lync™ Server 2010 environment to AT&T IP Flexible Reach Service. This CUBE configuration may be added to a Customer Edge Router (CER) for an integrated CUBE/CER solution for AT&T VPN or used in a standard cascaded CUBE solution for all three Underlying Transport Services. **For the Customer Managed Integrated CUBE/CER solution, the only supported router platforms are the Cisco ASR 1001 and ASR 1002.**

Laboratory testing was performed for the preparation of this guide. Key features verified are described in section 4.

The CUBE configuration detailed in this document is based on a lab environment with a simple dial-plan used to ensure proper interoperability between AT&T SIP network and Microsoft® Lync™ Server 2010. The configuration described in this document details the important commands to have enabled for interoperability to be successful and care must be taken, by the network administrator deploying CUBE, to ensure these commands are set per each dial-peer required to interoperate with the AT&T IP Flexible Reach Service.

This guide does not cover configuration of the Microsoft® Lync™ Server 2010 environment or the CER specific configuration (BGP, WAN Access, etc).

For questions or information regarding this service please contact your AT&T Account Team.

1.1 Change History

The following table will be maintained with the history of document changes and updates.

Version	Date Issued	Author(s)	Reason for Issue
1.0	3/9/2012	MDT, CMM	First issue of this CCG. Draft Pending Legal Review.
1.1	3/30/12	MDT	Post Legal Review.

2 Network Topology

These diagrams shows the topology from a high level including protocols used.

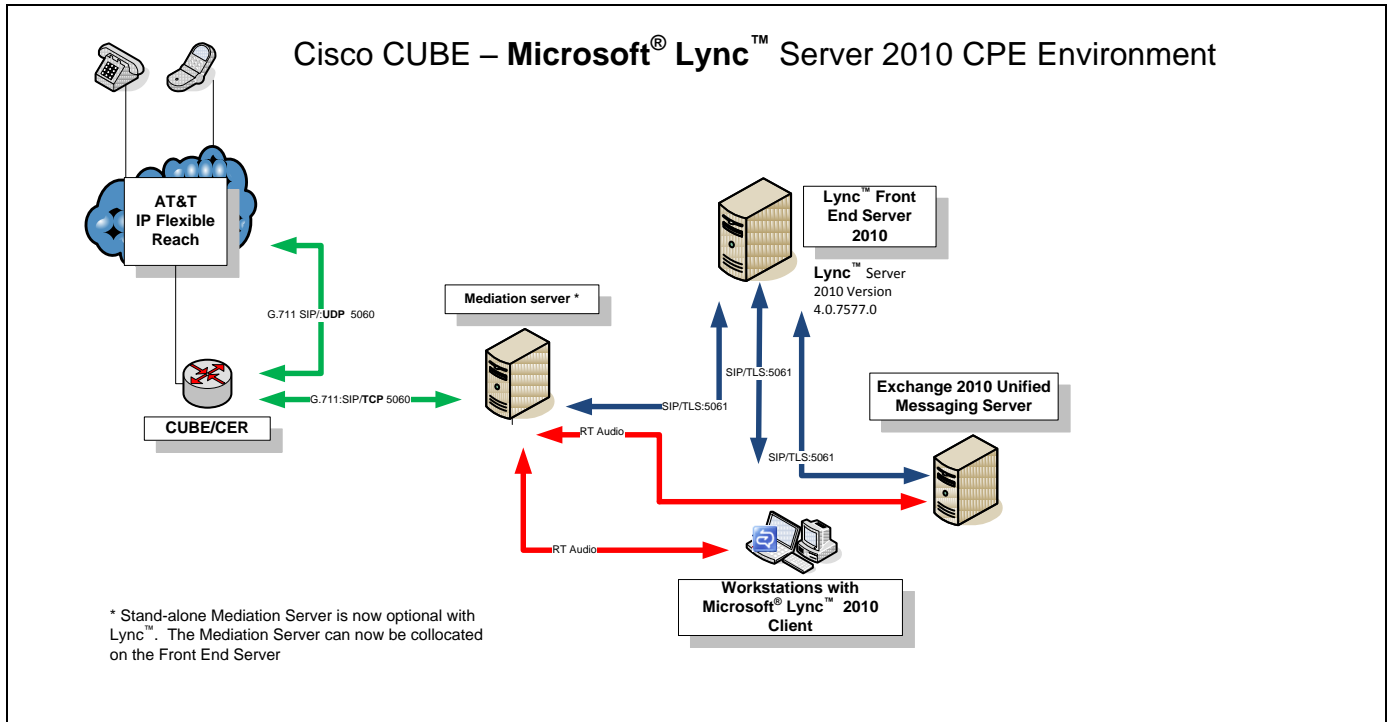


Figure 1: Sample Configuration showing Combined CUBE/CER (AT&T VPN Service ONLY)

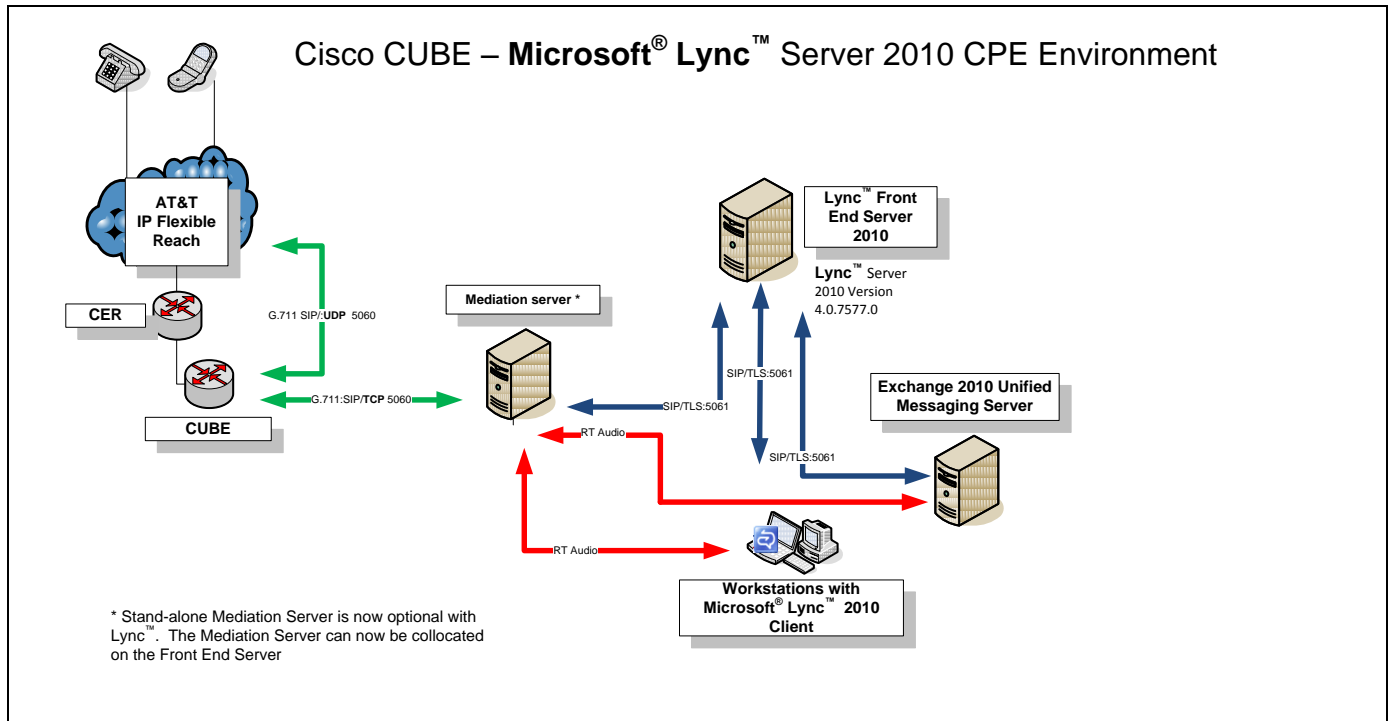
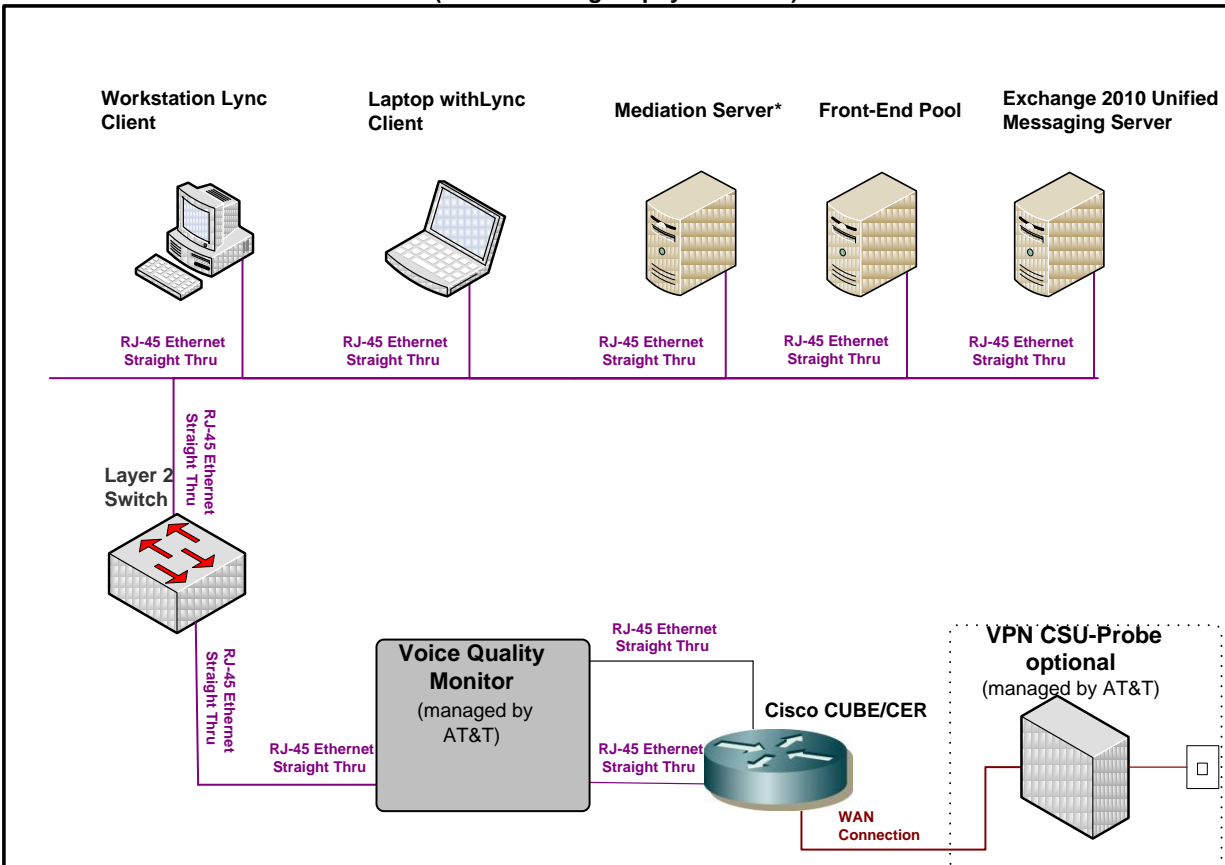


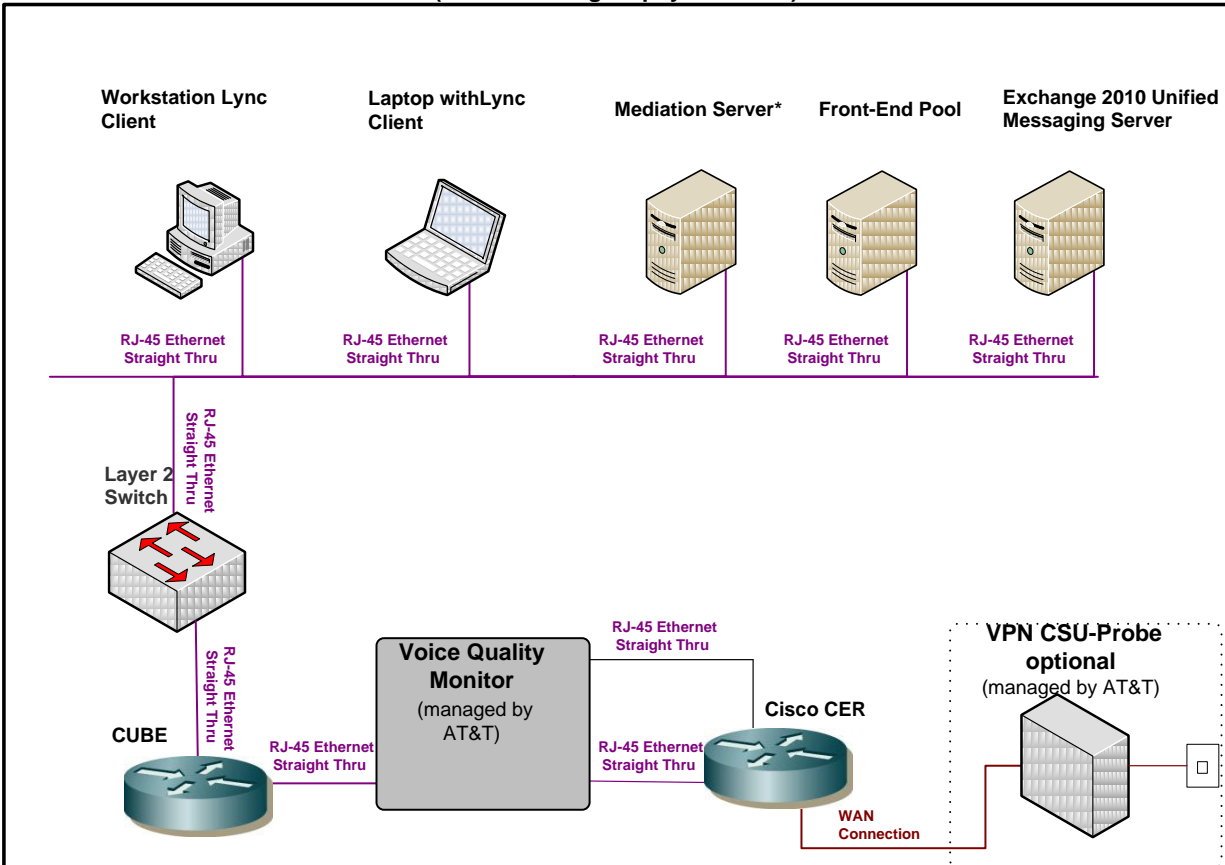
Figure 2: Sample Configuration showing a Cascaded CUBE/CER

These diagrams show the topology including the Voice Quality Monitor. The Combined CUBE/CER solution is for AT&T VPN Service only.

**AT&T BVoIP on AT&T VPN site
with AT&T VPN CSU-Probe, Voice Quality Monitor, Combined CUBE/CER, MS Lync 2010
(CPE site design – physical view)**



**AT&T BVoIP on AT&T VPN site
with AT&T VPN CSU-Probe, Voice Quality Monitor, Cascaded CUBE/CER, MS Lync 2010
(CPE site design – physical view)**



3 System Components

3.1 Hardware / Software Components

- Cisco Router running CUBE 1.4 (IOS image version **15.1(1)S1**) on a Cisco ASR 1002.
 - System image file is "**asr1000rp1-adventerprise.03.02.01.S.151-1.S1.bin** "
 - Cisco Unified Border Element (CUBE) is an integrated Cisco IOS Software application that runs on various IOS platforms. The following link provides more details: <http://www.cisco.com/go/cube>
- Customer Edge Router (CER) Configuration – Contact AT&T for Customer-managed router and AT&T-managed router options.
- Microsoft® Lync™ Server 2010 version 4.0.7577.0.
- Microsoft® Exchange Server 2010 Service Pack 1
 - RTM version 14.00.0639.021

- SP1 version 14.01.0218.013
- AdminDisplayVersion 14.1 Build (218.15).
- Microsoft® Lync™ 2010 clients – Version 4.0.757.0

4 Features

4.1 Features Supported

- Basic Call using G.711 including outbound basic calls (Lync™ to AT&T IP Flexible Reach Service) to N11 endpoints.
- Attended and unattended intra-site transfers
- Intra-site Conference
- Call Hold and Resume
- Call Forward
- AT&T IP Teleconferencing (see caveats)

4.2 Caveats

- For the Customer Managed Integrated CUBE/CER solution, the only supported router platforms are the Cisco ASR 1001 and ASR 1002.
- G.711 is the only supported codec. AT&T IP Flexible Reach Service supports the G.711 codec for bandwidths of 1.544 Mbps (T1) or greater.
- Fax is not supported.
- In order for call transfers and conference calls to work when a Lync Client transfers or conferences an off-net call, **the "Enable refer support" option under the Trunk Configuration for the AT&T facing Trunk must be disabled.** This option is in the Microsoft Lync Server 2010 Control Panel under: *Voice Routing -> Trunk Configuration*. Please note that the default configuration when configuring a trunk has this option enabled. This option forces Lync to send CUBE a SIP Refer instead of a Re-Invite, which results in a failed call.
- Calling number privacy is not supported by Lync™ 2010 on Lync™ 2010 to AT&T IP Flexible Reach Service calls.

- Call hold, transfer and conference initiated by a Lync™ 2010 client are not supported on native IP calls to the AT&T IP Teleconferencing Service. The Lync™ client informs the user that the “call cannot be placed on hold” and closes the voice channel. The user must disconnect the call and reconnect.
- The dial peers in this configuration guide are currently configured to accommodate Lync™ 2010 / CUBE installations in the US. Additional customization of the dial peers will be required to accommodate non US sites.
- The Microsoft® servers required for the Lync™ 2010 IP-PBX environment are not AT&T managed devices. The configuration and management of these devices are the responsibility of the customer.
- For management of the CUBE and CE Router, AT&T supports the following options:
 - Customer Managed CUBE and CE Router.
 - AT&T Managed Router Service (MRS) offers management of the CUBE (**ISR G2 only**) and/or CE Router (offered for AT&T VPN only).
 - AT&T Managed CE Router with Customer Managed CUBE (offered for MIS/PNT only).
- For outbound calls from Lync™ 2010 to AT&T IP Flexible Reach Service , Lync™ 2010 must send “+” followed by country code and number. CUBE will then send all numbers with a leading “+” to the AT&T IP Flexible Reach Service.
 - There is one exception to this rule: For N11 calls, CUBE will remove the “+” otherwise AT&T IP Flexible Reach Service will not process the N11 call. Note that custom configuration is required on Lync™ 2010 to support N11 dialing.
- For inbound calls, a customer may receive one of 2 types of DID’s from AT&T IP Flexible Reach Service: Virtual TN’s and Non-Virtual TN’s.
 - A Virtual TN is one that has an NPA that is different from the NPA at the customer site to which it is being routed. For a Virtual TN, AT&T will pass 10 digits to the PBX. For example, if a PBX telephone is associated with a Virtual TN, the number received from AT&T would be 10 digits (i.e. 732-216-2700). Dial peers are provided in this guide for adding a “+1” to these types of TN’s.
 - A Non-Virtual TN has an NPA that is the NPA at the customer site. For a Non-Virtual TN, AT&T will pass the length of the phone extension plus some prefix if needed (typically a 4 digit extension without a prefix). If a PBX telephone is associated with a Non-Virtual TN, the number received from AT&T would be 7

digits (i.e. 368-4997 for a 732-368-4997 TN). Dial peers are provided in this guide for adding a “+1” and an NPA to these types of TN’s.

- The Lync™ 2010 identity should always be +1 followed by the 10 digit TN.
- Private dialing plans will require dial-peer customization beyond the scope of this document.
- Display name is not supported. Lync™ 2010 did not pass display name in the tested configuration.
- The following redundancy is supported:
 - Outbound calls from a single CUBE to multiple AT&T IP Flexible Reach Service Border Elements.
 - Lync™ 2010 to the Mediation server is part of the standard Microsoft® configuration.
- Redundancy from the Mediation Server to the CUBE is not currently supported.
- Lync™ 2010 does not currently support the Diversion header for forwarded calls, a fixed CPN (calling party number) will be added to all Lync™ 2010 originated calls with the following clarifications. The CPN must be one of the AT&T assigned TN’s for the Lync™ 2010 site.
 - The Diversion header with the fixed CPN will **not** be added to the N11 calls. Thus the true CPN from Lync™ 2010 will be sent to the AT&T IP Flexible Reach Service network for these calls.
 - Calls forwarded to N11 numbers (except 911) will be blocked by AT&T IP Flexible Reach Service .
 - 911 calls will always be routed by AT&T IP Flexible Reach Service regardless of the presence of CPN.
- Dial peer configuration can be modified at the customer’s request to accommodate special needs.
- **Emergency 911/E911 Services Limitations and Restrictions - Although AT&T provides 911/E911 calling capabilities, AT&T does not warrant or represent that the equipment and software (e.g., IP PBX) reviewed in this customer configuration guide will properly operate with AT&T IP Flexible Reach to complete 911/E911 calls; therefore, it is Customer’s responsibility to ensure proper operation with its equipment/software vendor.**

- **While AT&T IP Flexible Reach supports E911/911 calling capabilities under certain Calling Plans, there are circumstances when that E911/911 service may not be available, as stated in the Service Guide for AT&T Business Voice over IP Services found in the SG Library at <http://new.serviceguide.att.com>. Such circumstances include, but are not limited to, relocation of the end user's CPE, use of a non-native or virtual telephone number, failure in the broadband connection, loss of electrical power, and delays that may occur in updating the Customer's location in the automatic location information database. Please review the AT&T Business Voice over IP (BVoIP) Services Service Guide in detail to understand the limitations and restrictions.**

5 References

The following are some useful references relating to Microsoft® Lync™ Server 2010.

- The technical library for Microsoft® Lync™ Server 2010 communications software
 - <http://technet.microsoft.com/en-us/library/gg293124.aspx>
- Microsoft® Lync™ Server 2010 home page
 - <http://lync.microsoft.com/En-us/Pages/default.aspx>
- Microsoft® Lync™ Server 2010 Protocol Workloads Poster Download
 - <http://www.microsoft.com/downloads/en/details.aspx?FamilyID=ad8ff3fb-014e-4fd7-8003-436d896ab0c6>

6 Cisco CUBE Configuration

6.1 Cisco IOS version

```
Lync_CUBE#show ver
```

```
Cisco IOS Software, IOS-XE Software (PPC_LINUX_IOSD-ADVENTERPRISE-M), Version 15.1(1)S1, RELEASE SOFTWARE (fc1)
```

```
Technical Support: http://www.cisco.com/techsupport
```

```
Copyright (c) 1986-2011 by Cisco Systems, Inc.
```

```
Compiled Thu 10-Feb-11 23:35 by mcpre
```

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ROM: IOS-XE ROMMON

Lync_CUBE uptime is 1 day, 4 hours, 24 minutes
Uptime for this control processor is 1 day, 4 hours, 26 minutes
System returned to ROM by reload
System image file is "bootflash:/asr1000rp1-adventerprise.03.02.01.S.151-1.S1.bin"
Last reload reason: PowerOn

cisco ASR1002 (2RU) processor with 1716690K/6147K bytes of memory.
4 Gigabit Ethernet interfaces
32768K bytes of non-volatile configuration memory.
4194304K bytes of physical memory.
7798783K bytes of eUSB flash at bootflash:.

Configuration register is 0x2102

6.2 Configuring Cisco Unified Border Element (CUBE)

The following is an example CUBE configuration with all critical commands marked in bold and with footnotes. This output was taken from a combined CUBE/CER but can be used for the Cascaded solution also (the only difference being the WAN interface shown below will face the CER instead). Additional dial-peers similar to dial-peer 1001 and 1003 will be required for secondary IP Border Elements.

Lync_CUBE#show runn
Building configuration...

Current configuration : 7538 bytes
!
! Last configuration change at 12:57:40 UTC Thu Mar 1 2012
!
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no platform punt-keepalive disable-kernel-core
!
hostname Lync_CUBE
!
boot-start-marker
boot system bootflash:/asr1000rp1-adventerprise.03.02.01.S.151-1.S1.bin
boot-end-marker

```
!  
!  
vrf definition Mgmt-intf  
!  
address-family ipv4  
exit-address-family  
!  
address-family ipv6  
exit-address-family  
!  
!  
no aaa new-model  
!  
!  
!  
ip source-route  
!  
!  
!  
no ip domain lookup  
!  
!  
!  
!  
multilink bundle-name authenticated  
!  
!  
!  
voice service voip  
address-hiding  
allow-connections sip to sip1  
redirect ip2ip  
sip  
bind control source-interface Loopback0  
bind media source-interface Loopback0  
rel1xx disable2  
header-passing error-passthru3  
asserted-id pai  
privacy pstn
```

¹ This command enables the basic IP-to-IP CUBE feature fro SIP calls.

² Prack Processing is turned off to simplicity the call flow.

³ This command allows for SIP error messages to pass-through end-to-end without modification through CUBE

```
no update-callerid
midcall-signaling passthru 4
privacy-policy passthru
!
voice class codec 1
codec preference 1 g711ulaw 5
!
voice class sip-profiles 2
request INVITE sip-header Diversion add "Diversion: <sip:7323204038@135.16.170.156>" 6
request INVITE sip-header From modify "(<sip:[A-Za-z].*)@(.*)" "<sip:7323204038@\2" 7
!
!
!
voice translation-rule 1111
rule 1 /^\(.*\) / +1& / 8
!
voice translation-rule 3333
rule 1 /^+\(.*11\) / \1 / 9
!
voice translation-rule 4444
rule 1 /^368\(.*\) / +1732& / 10
!
voice translation-profile AddPlusOne 11
translate called 1111
!
voice translation-profile RemovePlusN11 12
translate called 3333
!
voice translation-profile AddNPA 13
```

⁴ This command must be enabled at a global level to maintain integrity of SIP signaling across SIP end-points.

⁵ G.711 is the supported CODEC

⁶ This command adds a Diversion header with a fixed calling party number (CPN) so that calls can be forwarded by to 8YY and NPA5551212 endpoints if needed. The CPN (7323684896 is an example) must be one of the AT&T assigned TNs for this Lync™ site. The right hand side (135.16.170.156) must be the IP address of the AT&T facing side of the CUBE.

⁷ If the user part of the From header contains a string that begins with an alphabetic character (e.g. Microsoft® Lync™ user name) instead of an E.164 number, this command replaces the user part with a CPN. The CPN (7323684992 is an example) must be one of the AT&T assigned TNs for this Lync™ site. This scenario will occur if an Lync™ user is conferencing in a 3rd party on the AT&T IP Flexible Reach Network.

⁸ This rule adds a "+1" to a called number.

⁹ This rule removes a "+" from a called number of the form +N11.

¹⁰ This rule adds +1732 to a 7 digit number that starts with "368". This type of rule is required for non virtual TNs for which AT&T IP Flexible Reach sends a maximum of 7 digits to the customer premises.

¹¹ Translation Profile for adding a "+1"

¹² Translation Profile for removing a "+" from a N11 number

¹³ Translation Profile for adding "+1NPA" to a 7 digit number.

translate called 4444

!
!

redundancy
mode none

!

interface Loopback0

ip address 135.16.170.156 255.255.255.255

!

interface GigabitEthernet0/0/0

description - WAN Link To S4-3750 - Port 1/0/4

no ip address

load-interval 30

no negotiation auto

hold-queue 512 in

hold-queue 2048 out

!

interface GigabitEthernet0/0/0.221 ¹⁴

description - Link to MSE 5 PE router - Gig10/0.2021

encapsulation dot1Q 211

ip address 195.18.31.137 255.255.255.252

service-policy output GIGE-SHAPE

!

interface GigabitEthernet0/0/1 ¹⁵

description LAN to Lync Environment

ip address 10.60.60.20 255.255.255.0

negotiation auto

!

!

dial-peer voice 2000 voip

description "Incoming – AT&T to CUBE match on [2-9]T"

session protocol sipv2

incoming called-number [2-9]T ¹⁶

voice-class codec 1

voice-class sip asserted-id pai

dtmf-relay rtp-nte

fax-relay sg3-to-g3 ¹⁷

fax rate 14400

¹⁴ AT&T facing interface on CUBE

¹⁵ Lync™ facing interface on CUBE

¹⁶ Match on a called number starting with 2 through 9.

¹⁷ Fax is **not** supported but this command and the following command are here for potential future use.

```
no vad 18
!  
dial-peer voice 2001 voip 19  
description "Incoming – CUBE to Lync match on [2-9]..... – virtual TNs"  
translation-profile outgoing AddPlusOne 20  
destination-pattern [2-9].....  
session protocol sipv2  
session target ipv4:10.60.60.15 21  
session transport tcp 22  
voice-class codec 1  
voice-class sip asserted-id pai  
voice-class sip block 183 sdp absent  
dtmf-relay rtp-nte  
fax-relay sg3-to-g3  
fax rate 14400  
  
!  
dial-peer voice 2002 voip 23  
description "Incoming - CUBE to Lync match on 368.... – non virtual TN"  
translation-profile outgoing AddNPA  
destination-pattern 368.... 24  
session protocol sipv2  
session target ipv4:10.60.60.15  
session transport tcp  
voice-class codec 1  
voice-class sip asserted-id pai  
voice-class sip block 183 sdp absent 25  
dtmf-relay rtp-nte  
fax-relay sg3-to-g3  
fax rate 14400  
  
!  
dial-peer voice 1003 voip  
description "Outgoing – CUBE to AT&T match on+[1-9]11"  
translation-profile outgoing RemovePlusN11  
destination-pattern+[1-9]11
```

¹⁸ Disables voice activity detection (VAD).

¹⁹ Dial peer for matching virtual TN's for which AT&T IP Flexible Reach sends 10 digits to the customer premises.

²⁰ Add a "+1" to the called number before sending to Lync™.

²¹ IP Address of the Microsoft® Lync™ Mediation Server.

²² Support of TCP on calls to Lync™.

²³ Dial peer for matching for non virtual TNs for which AT&T IP Flexible Reach sends a maximum of 7 digits to the customer premises.

²⁴ Replace "368" with the sites exchange.

²⁵ Remove 183 messages without SDP from Lync™ to eliminate ringback problems on certain PSTN originated calls.


```
session protocol sipv2
session target ipv4:135.25.29.74
voice-class codec 1
voice-class sip asserted-id pai
voice-class sip early-offer forced
dtmf-relay rtp-nte
!
dial-peer voice 1001 voip
description "Outgoing – Lync to CUBE matching on +T"
session protocol sipv2
session transport tcp
incoming called-number +T
voice-class codec 1
voice-class sip asserted-id pai
voice-class sip early-offer forced
dtmf-relay rtp-nte
fax-relay sg3-to-g3
fax rate 14400
no vad
!
dial-peer voice 1000 voip
description "Outgoing – CUBE to AT&T matching on +T"
destination-pattern +T
session protocol sipv2
session target ipv4:135.25.29.74
voice-class codec 1
voice-class sip asserted-id pai
voice-class sip early-offer forced
voice-class sip profiles 2 26
no voice-class sip block 183
dtmf-relay rtp-nte
fax-relay sg3-to-g3
fax rate 14400
no vad
!
!
!
gateway
timer receive-rtp 1200
!
sip-ua
retry invite 2 27
```

²⁶ Add diversion header with fixed Calling Party Number (CPN).

```
!  
!  
line con 0  
  stopbits 1  
line aux 0  
  stopbits 1  
line vty 0 4  
  password voip  
  login  
!  
end
```

²⁷ CUBE will attempt 2 invites to a dial peer (e.g. AT&T IP Flexible Reach Border Element) before routing to an alternate dial peer (e.g. other AT&T IP Flexible Reach Border Element).

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