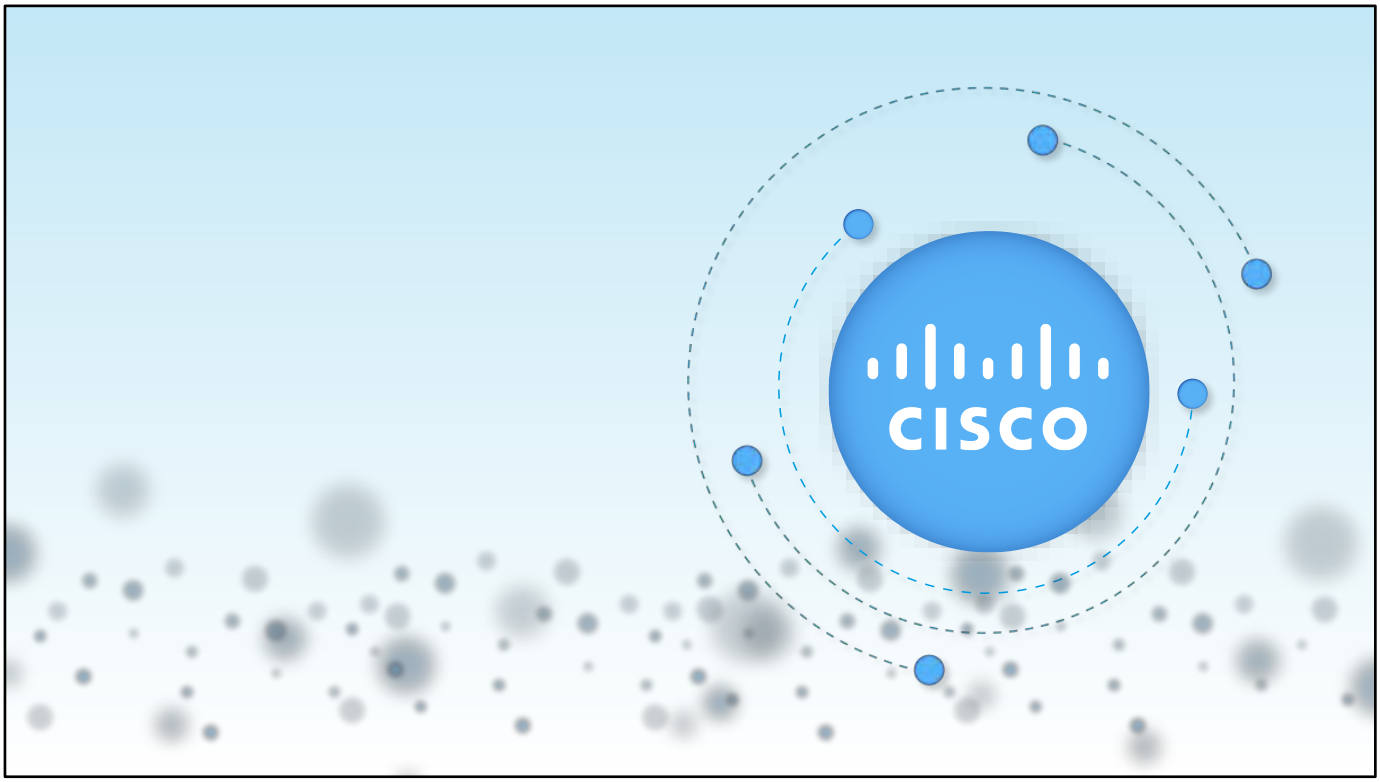


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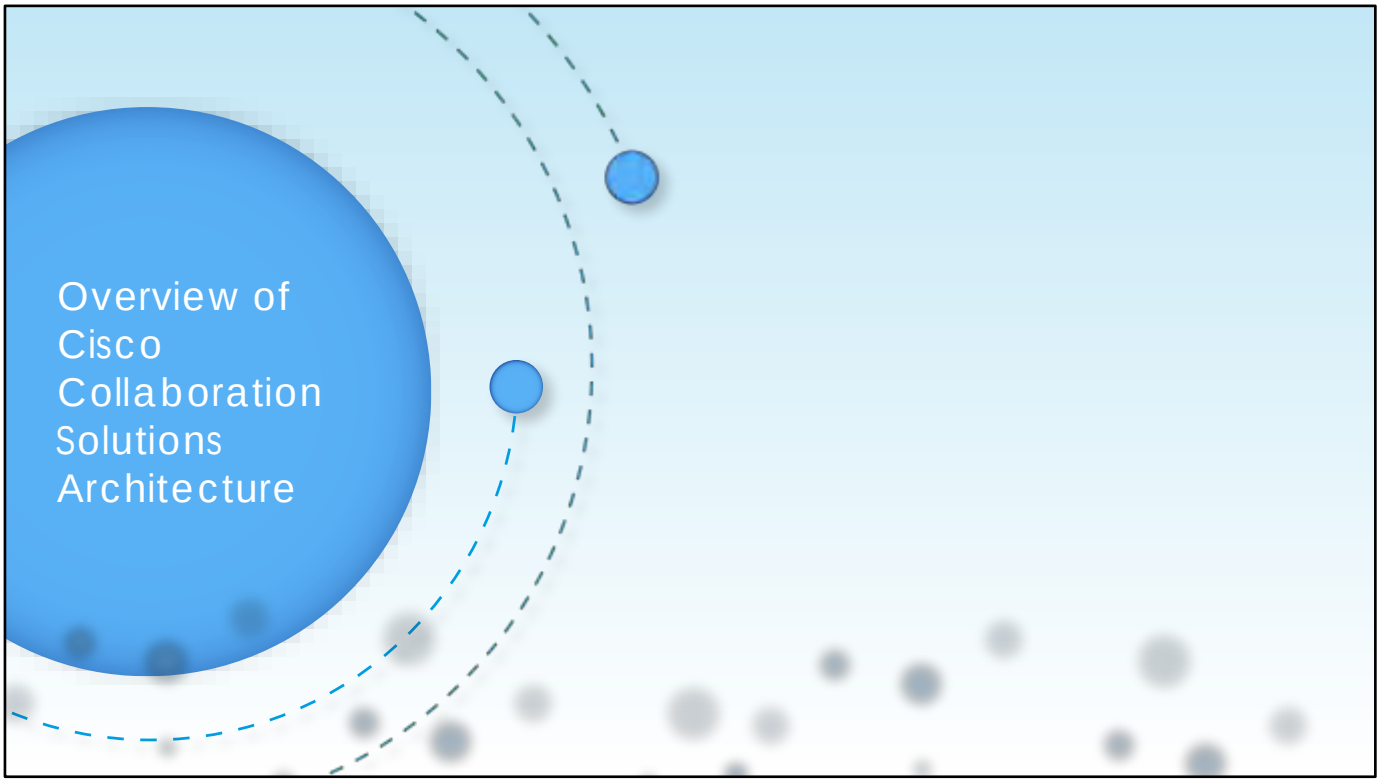


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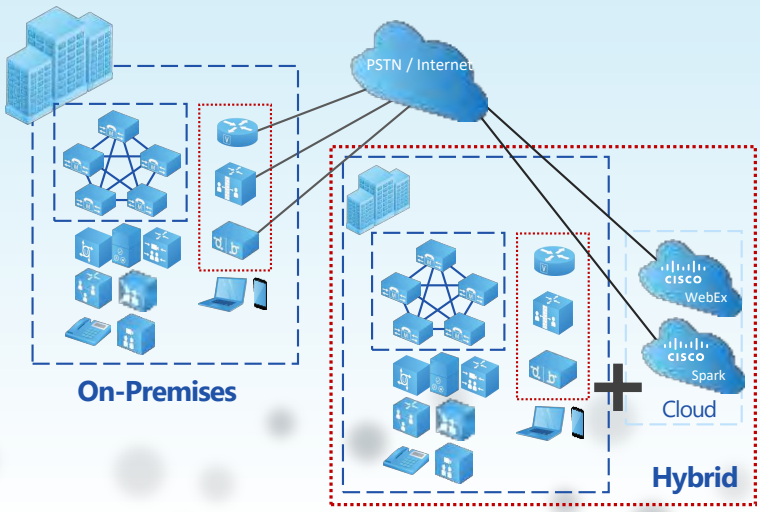
# Overview

Describing the Cisco Collaboration Solutions Architecture

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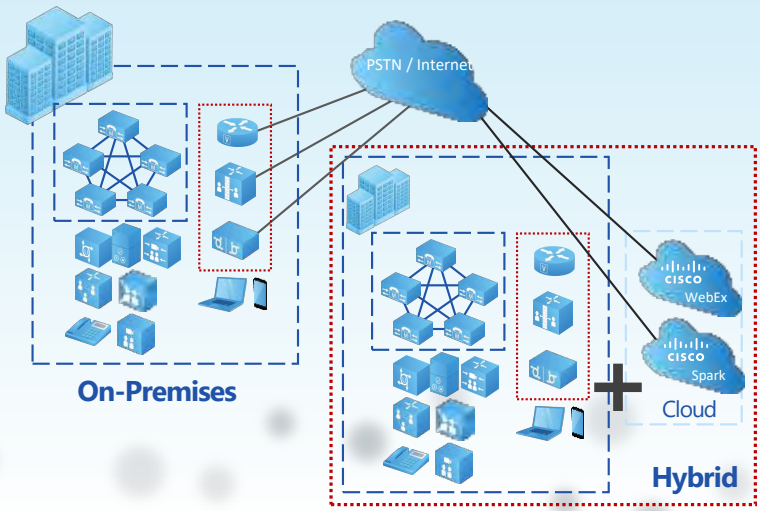
# Overview of Cisco Collaboration Solutions Architecture

The system architecture

Several advanced applications and services

- Cisco Unified CM
- IM and Presence
- Jabber
- Unity Connection

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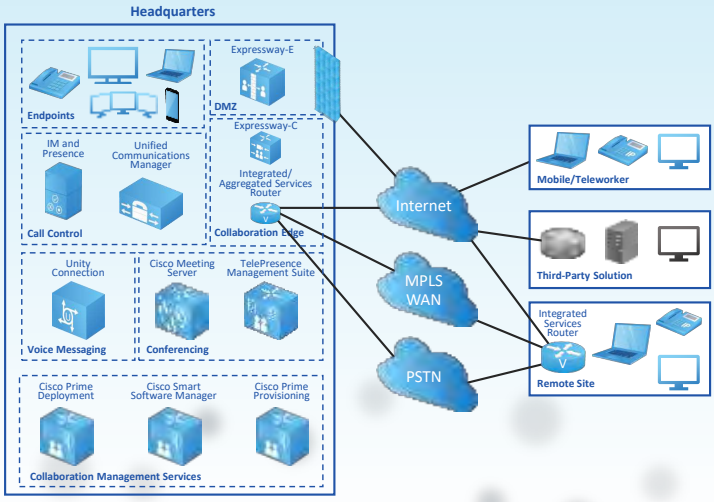
# Call Control

Cisco Unified Communications Manager

Cisco Unified Communications Manager IM and Presence Service

Cisco Integrated Services Router (Cisco ISR)

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# Conferencing

Cisco Meeting Server

Cisco TelePresence Management Suite (Cisco TMS)

Cisco Webex Software as a Service (Cloud)

| Solution | Audio | | Video | | Content Sharing | |
|---|---|---|---|---|---|---|
| | On-Premises | Cloud | On-Premises | Cloud | On-Premises | Cloud |
| Cisco WebEx Meetings Server | Yes | No | Yes | No | Yes | No |
| Cisco WebEx SaaS | No | Yes | No | Yes | No | Yes |
| Cisco Meetings Server | Yes | No | Yes | No | Yes | No |
| Cisco CMR Hybrid | Yes | Yes | Yes | Yes | Yes | Yes |
| Cisco WebEx Meetings Center Video Conferencing | No | Yes | No | Yes | No | Yes |

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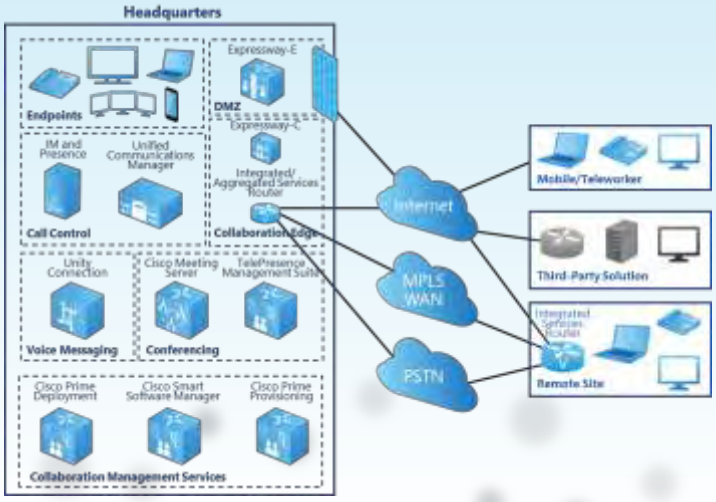
# Collaboration Edge

- Cisco Expressway-C
- Cisco Expressway-E
- Cisco ISR
- Cisco Aggregation Services Router (Cisco ASR)

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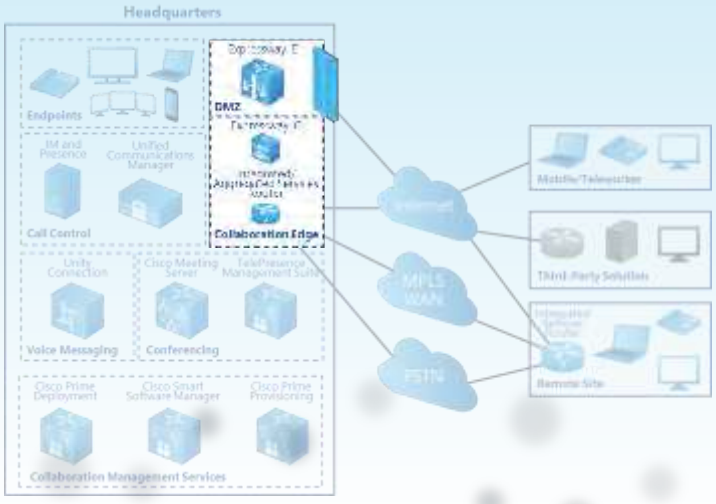
# Collaboration Edge

- Cisco Expressway-C
- Cisco Expressway-E
- Cisco ISR
- Cisco Aggregation Services Router (Cisco ASR)

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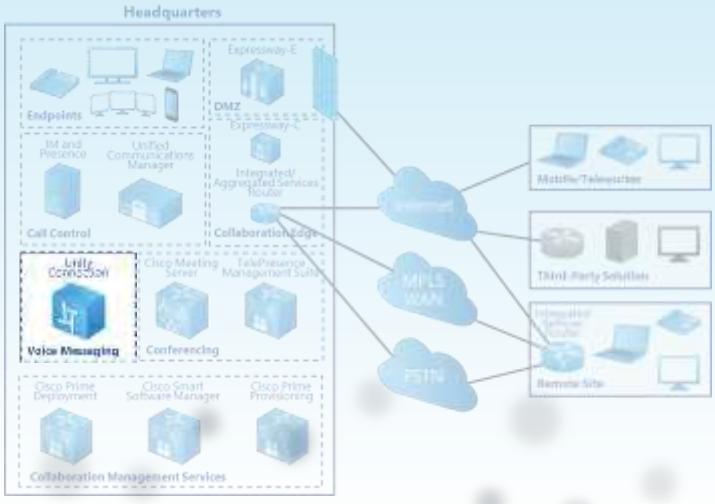
# Voice Messaging

## Cisco Unity Connection

| Messaging Type | Cisco Unity Connection | Cisco Unity Express |
|---|---|---|
| Voicemail-only | Yes | Yes |
| Integrated Messaging | Yes | Yes |
| Unified Messaging | Yes | No |

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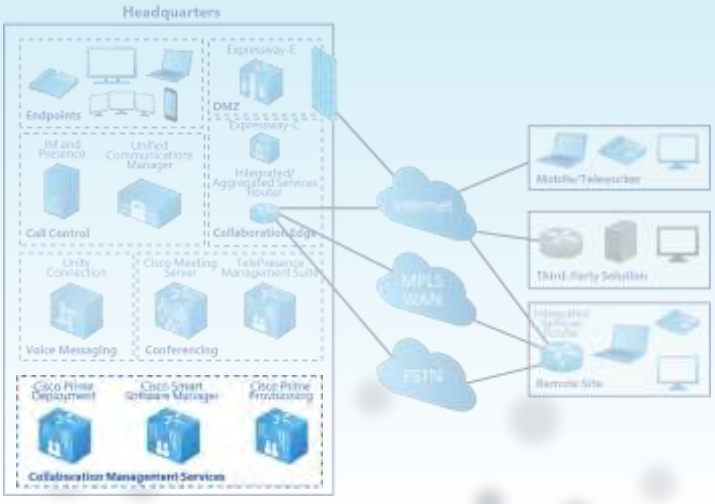
# Collaboration Management Services

Cisco Smart Software Manager (Cisco SSM)

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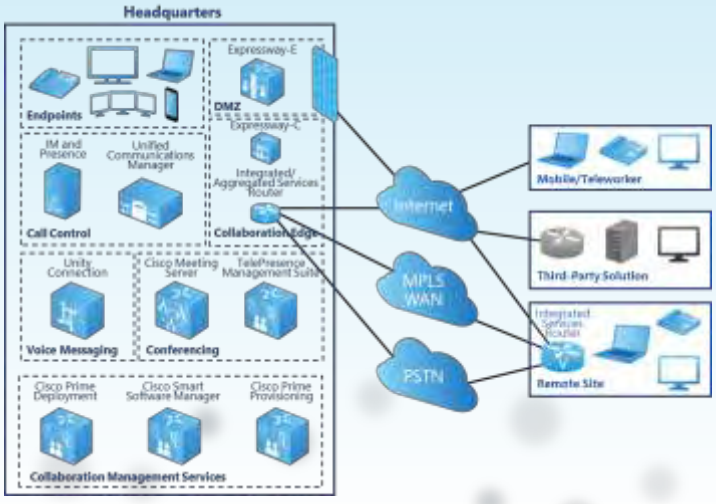
# Security

All components

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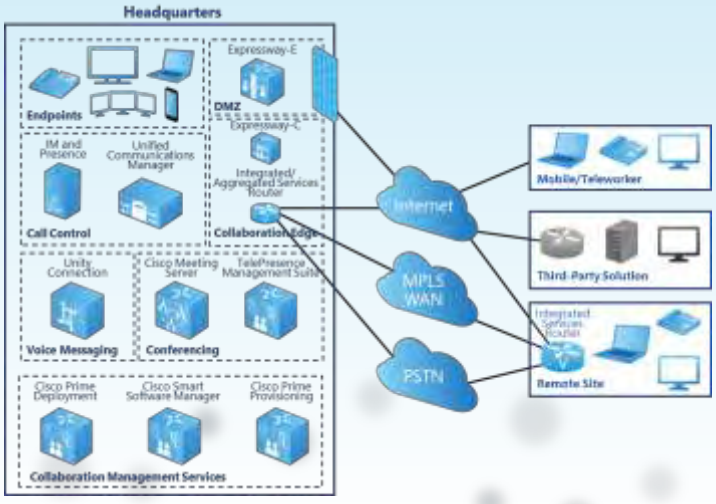
# Bandwidth Management

Network infrastructure

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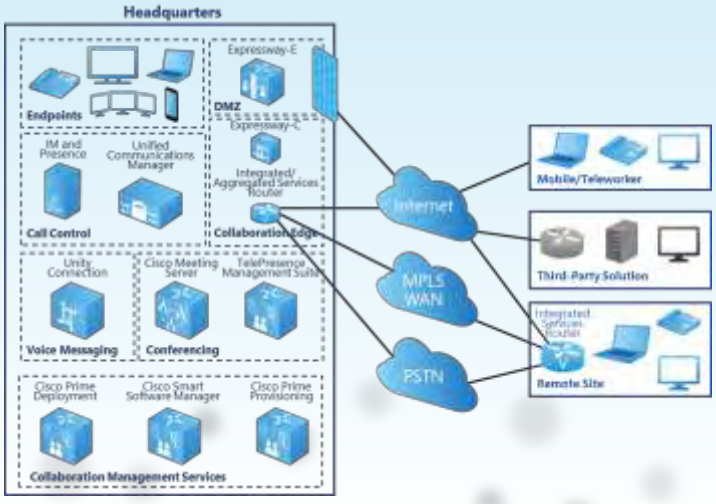
# Sizing

Network infrastructure

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# Conclusions

- Cisco Collaboration Solutions Architecture
  - Overview
  - Call control
  - Conferencing
  - Collaboration edge
  - Voice messaging
  - Collaboration management services
  - Security
  - Bandwidth and sizing

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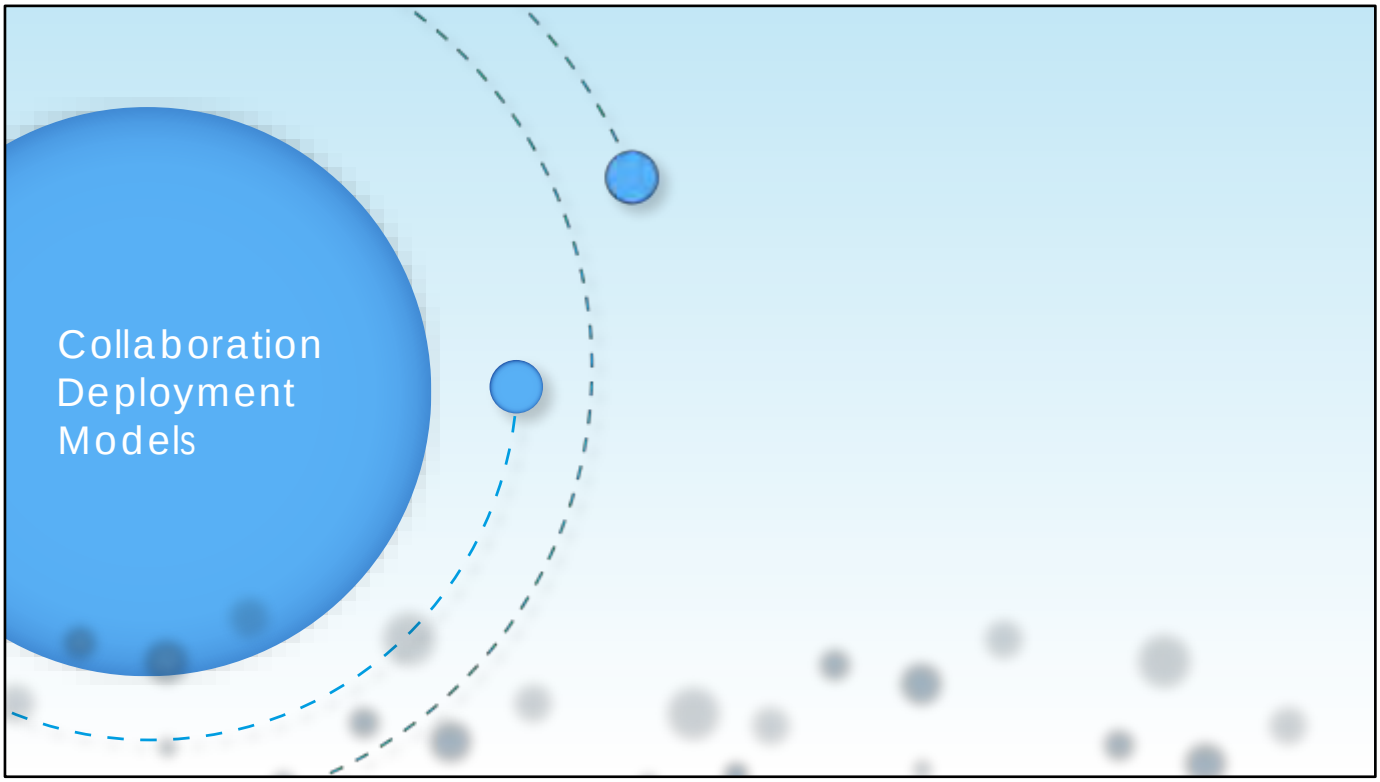


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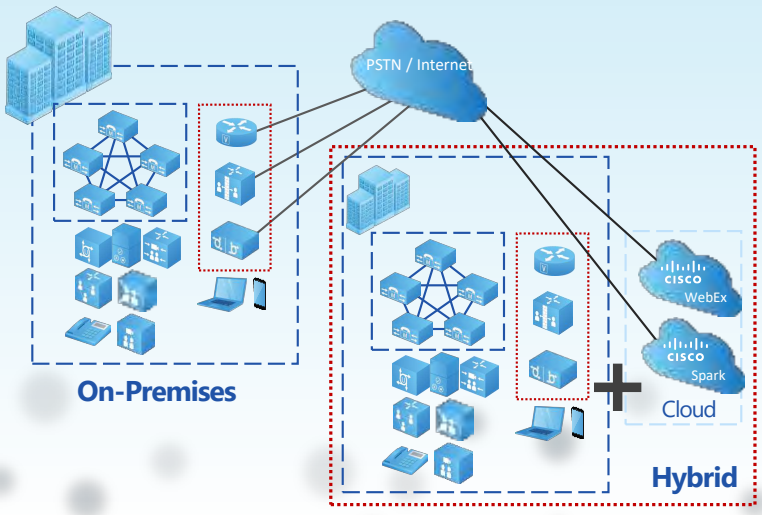
# Deployment Model

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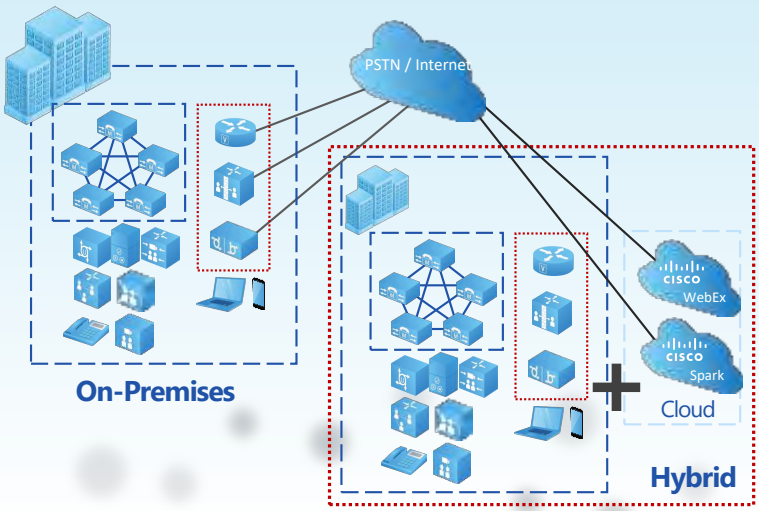
# On-premises Deployment

Collaboration applications are deployed within the enterprise premises to provide voice and video calling

These applications and services include the following:

- Cisco Unified Communications Manager
- IM and Presence Service
- Cisco Unity Connection
- Cisco Meeting Server and Cisco TMS

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# In Cloud Deployments

Collaboration services that are delivered from the cloud include voice and video calling, messaging, and meetings with video and content and screen sharing

Services that are delivered from the cloud include Cisco Webex Teams, which provides Webex Messenger

Webex Meetings (mobile, web, and desktop); Cisco Collaboration Meeting Rooms (Cisco CMRs); and other services

Cloud collaboration implementations can also include platform-based services that are provided by third-party managed service providers and integrators that deliver traditional on-premises collaboration applications and services from the cloud.

Cisco Hosted Collaboration Solution (Cisco HCS) is an example of this type of cloud platform-based service

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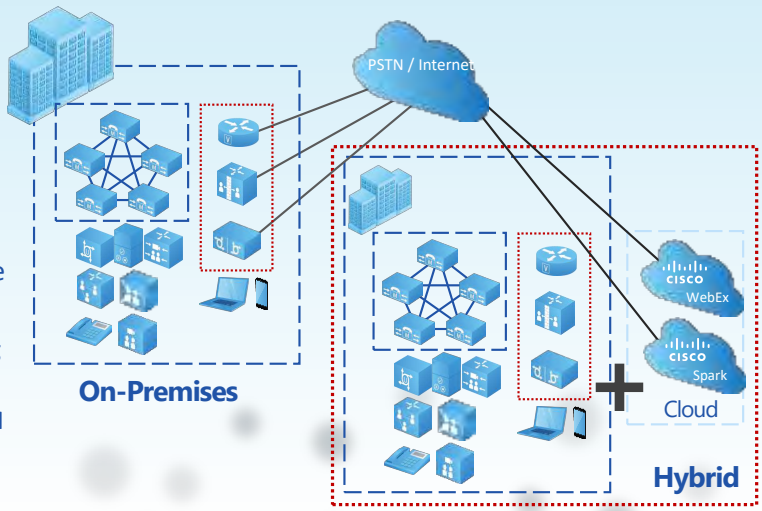
# Hybrid Deployment

Implementations can include both on-premises and cloud-based services to provide hybrid deployments that enable organizations to use the advantages of both delivery mechanism

Hybrid deployments include the following

- **Enterprise calling with cloud messaging and conferencing**
- **Enterprise calling with cloud calling and messaging**

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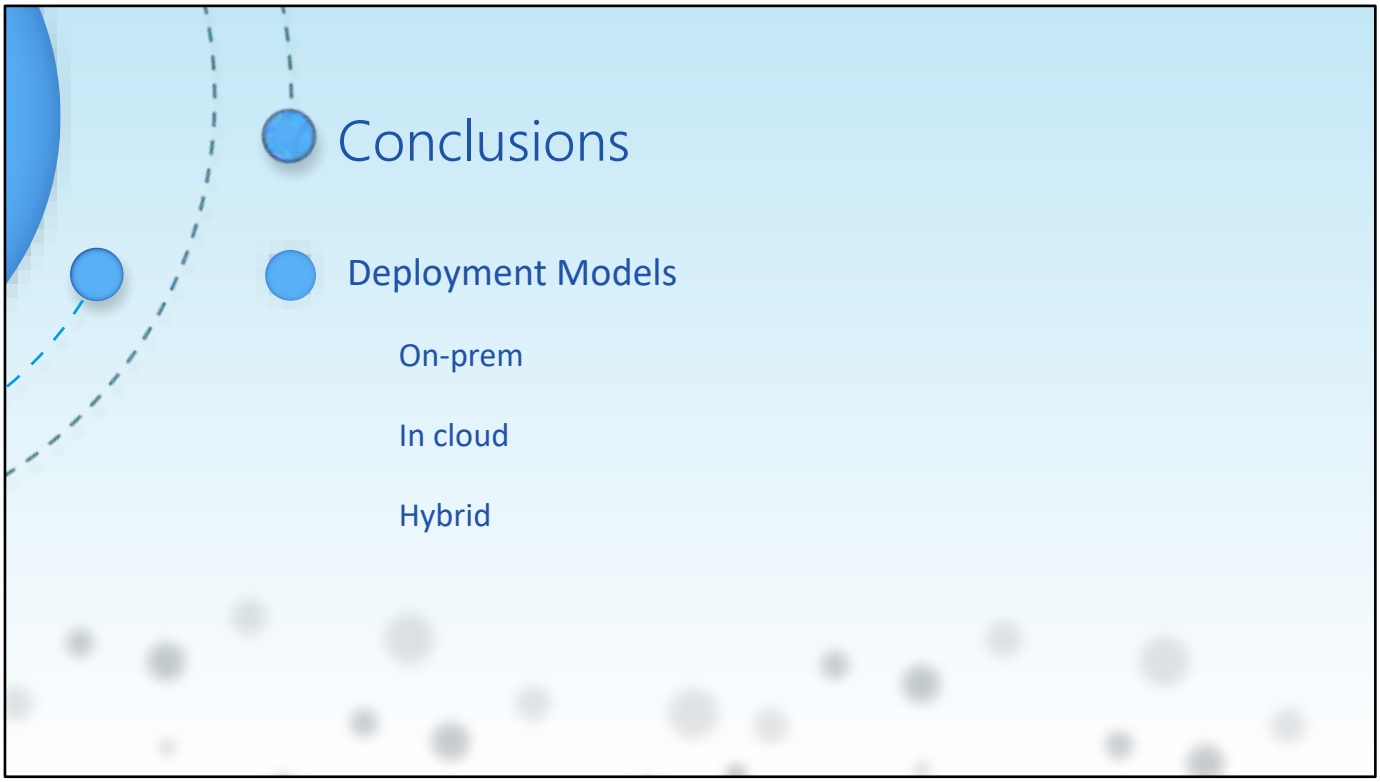


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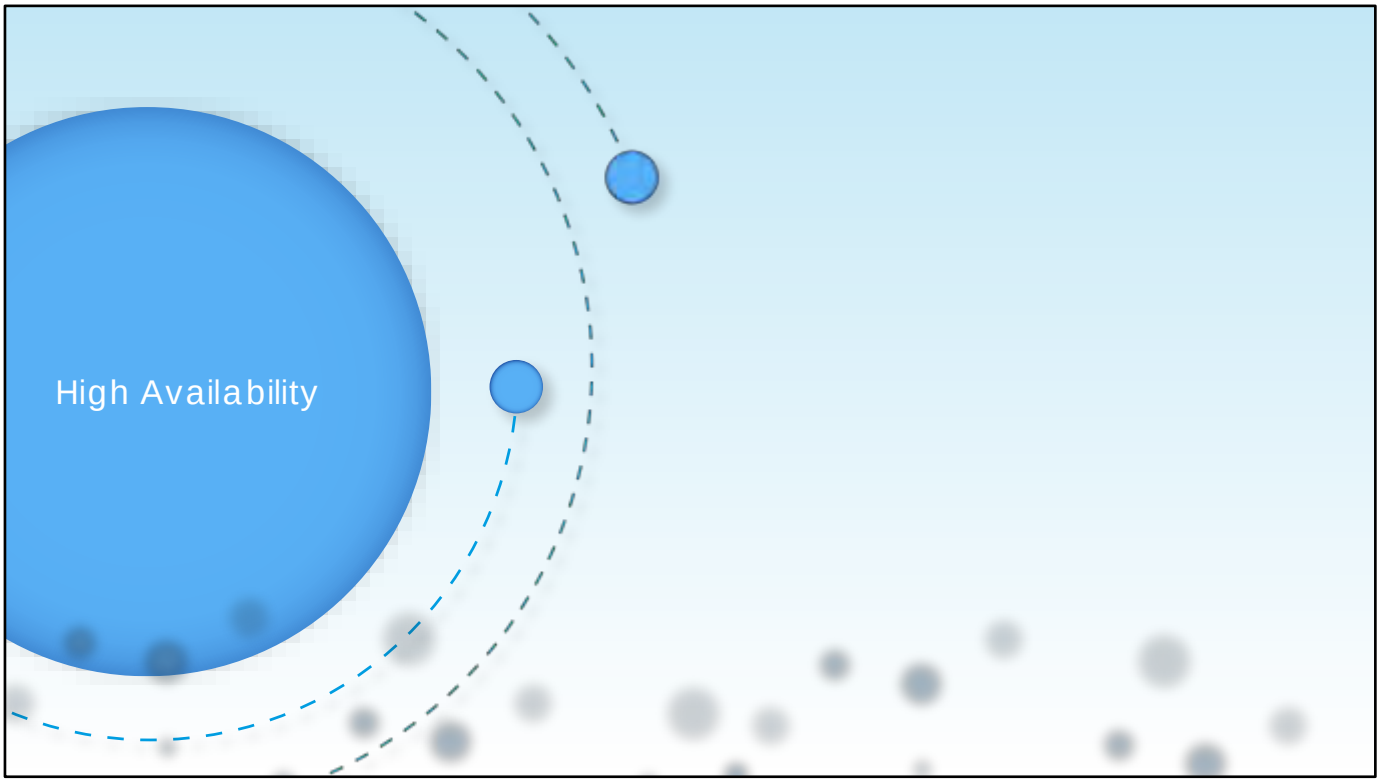


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# Two Type of HA

There are two types of HA supported by Cisco

**High Availability 1:1**

**High Availability 2:1**

Failover redundancy

Redundant links

Geographical diversity

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# Overview of High Availability

- Nodes should be deployed in a highly available infrastructure
- Use of dual power supplies combined with the use of UPS sources will provide maximum power availability
- Platform servers should be connected to multiple upstream switches
- Two Trivial File Transport Protocol (TFTP) servers should be deployed for redundancy.
- Call-processing nodes should be deployed with one-to-one (1:1) redundancy, where for every primary call-processing subscriber there is a backup call-processing subscriber
- This 100:0 percent redundancy design compared to a 50:50 percent redundancy design has several advantages

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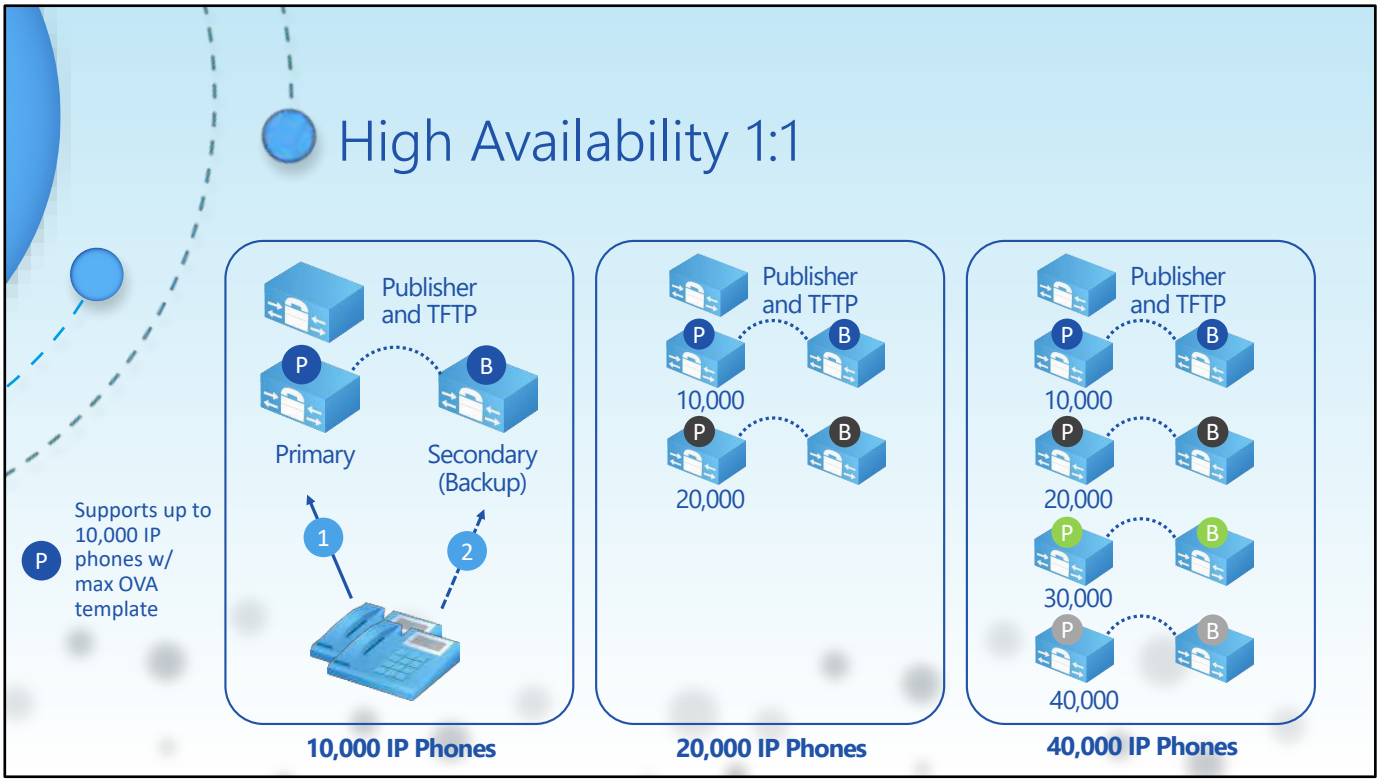


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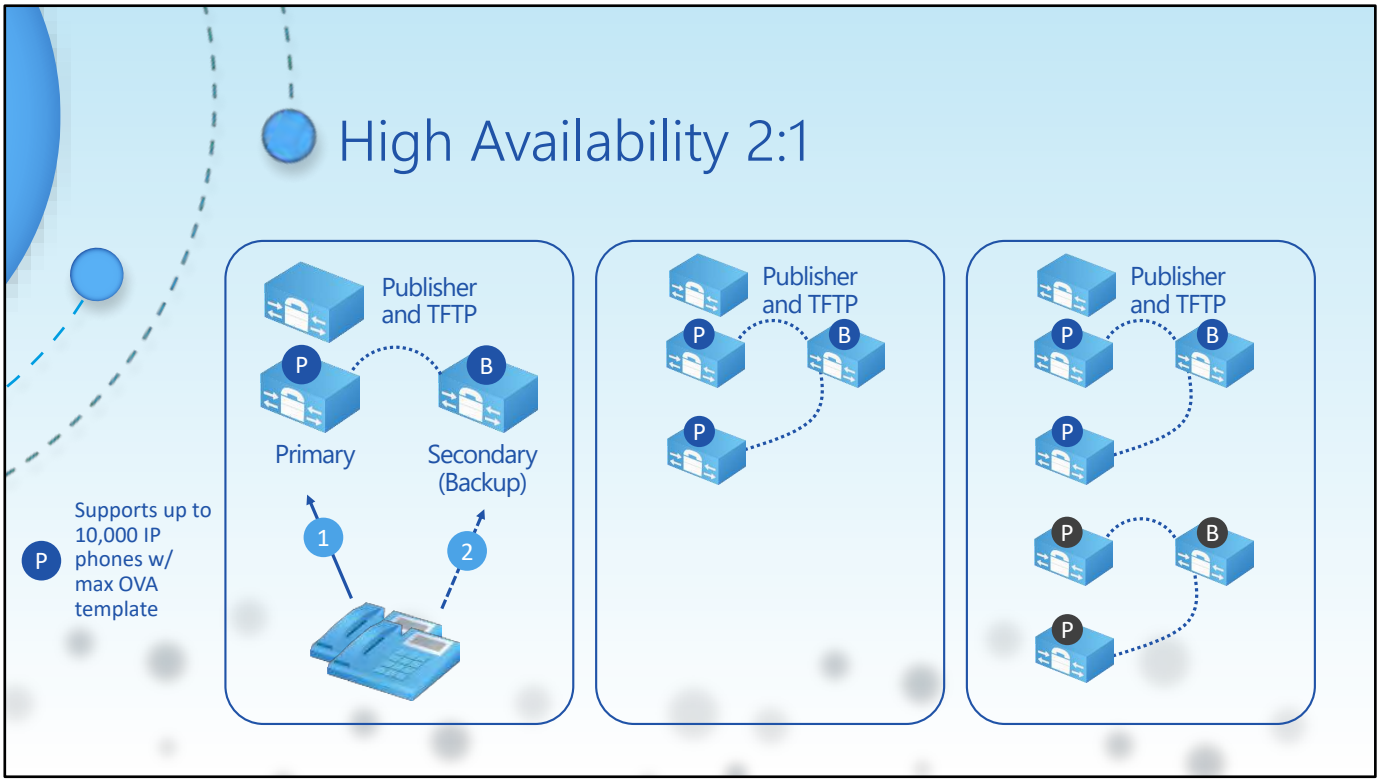


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# High Availability for Deployment Models

- Unified Communications services offer many capabilities aimed at achieving high availability
  - Failover redundancy - such as Clustering
  - Redundant links - such as IP WAN links, to guard against the failure of a single WAN link.
  - Geographical diversity - Distribution of redundant service nodes across WAN links

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# Capacity Planning for Deployment Models

- The capacities of various deployment models are typically integrally linked to the capacities of the products upon which they are based
  - Site-Based Design
    - Across all technologies that make up the Cisco Unified Communications System
      - Size - Generally refers to the number of users, which translates into a quantity of IP telephones, voice mail boxes, presence watchers, and so forth
      - Network Connectivity - e site's connectivity into the rest of the system has three main components driving the design
        - Bandwidth enabled for Quality of Service (QoS)
        - Latency
        - Reliability

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# Capacity Planning for Deployment Models (Cont'd)

- High Availability Requirements - The high availability of services is always a design goal
  - Bandwidth reliability, directly affecting the deployment model for any Unified Communications service
  - Power availability
  - Environmental factors such as heat, humidity, vibration, and so forth
  - Availability of qualified personnel

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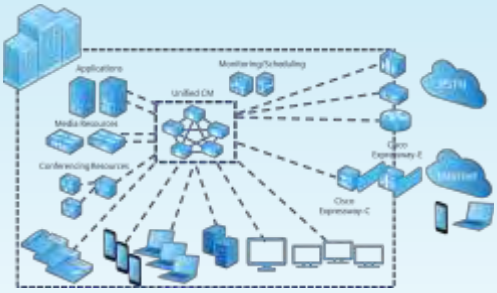
# Campus Deployment

- Single Cisco Unified CM cluster
- Cisco Business Edition 3000, 5000, or 6000 may be deployed in the campus
- Maximum of 40,000 configured and registered SCCP or SIP End point
- Maximum of 2,100 gateways and trunks
- Co-located digital signal processor (DSP) resources
- Messaging (voicemail), presence, and mobility are typically co-located
- Interfaces to legacy voice services such as PBXs and voicemail systems are connected
- High-bandwidth audio/video is available
- Cisco Expressway-C and Cisco Expressway-E provide a collaboration edge function that enables secure business-to-business telepresence and video communications
- Cisco TelePresence Video Communication Server (VCS) may also be used to register legacy H.323 and third-party telepresence endpoints
- High-bandwidth audio is available (for example, G.711 or G.722) between devices within the site
- High-bandwidth video (for example, 1.5 Mbps with 4CIF or 720p, to 2 Mbps with 1080p) is available between devices within the site

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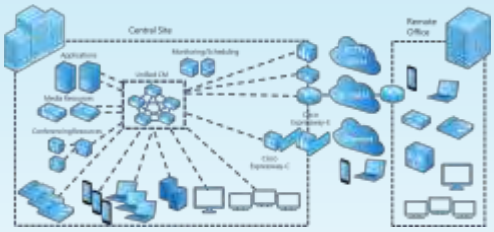
# Multisite WAN with Centralized Call Processing



- Single Unified CM cluster
- Cisco Business Edition 6000 may be deployed in centralized call processing configurations for up to 49 remote sites.
- Maximum of 40,000 configured and registered Skinny Client Control Protocol (SCCP) or SIP
- Maximum of 2,000 locations or branch sites per Unified CM cluster
- Maximum of 2,100 gateways and trunks
- PSTN connectivity for all off-net calls via PBX or SIP Trunk
- Digital signal processor (DSP) resources for conferencing, transcoding, and media termination point (MTP) are distributed locally to each site to reduce WAN bandwidth consumption on calls requiring DSPs
- Multiple codec option between HQ and Branch
- A minimum of 768 kbps or greater WAN link speed should be used when video is to be placed on the WAN
- Cisco TelePresence Video Communication Server (VCS) may also be used to register legacy H.323 and third-party telepresence endpoints
- The system allows for the automated selection of high-bandwidth video (for example, 1.5 Mbps with 4CIF or 720p, to 2 Mbps with 1080p) between devices in the same site, and low-bandwidth video (for example, 384 kbps with 448p or CIF) between devices at different sites

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# Multisite WAN with Centralized Call Processing (Cont'd)

- Call admission control is achieved through Enhanced Locations CAC or RSVP.
- AAR can be used when CAC denies the call
- Survivable Remote Site Telephony (SRST) for video,. SCCP video endpoints located at remote sites become audio-only devices if the WAN connection fails
- Cisco Unified Communications Manager Express (Unified CME) may be used for remote site survivability instead of an SRST router
- Cisco Unified Communications Manager Express (Unified CME) can be integrated with the Cisco Unity Connection server in the branch office
- Business Edition 3000 does not support SRST or remote site survivability

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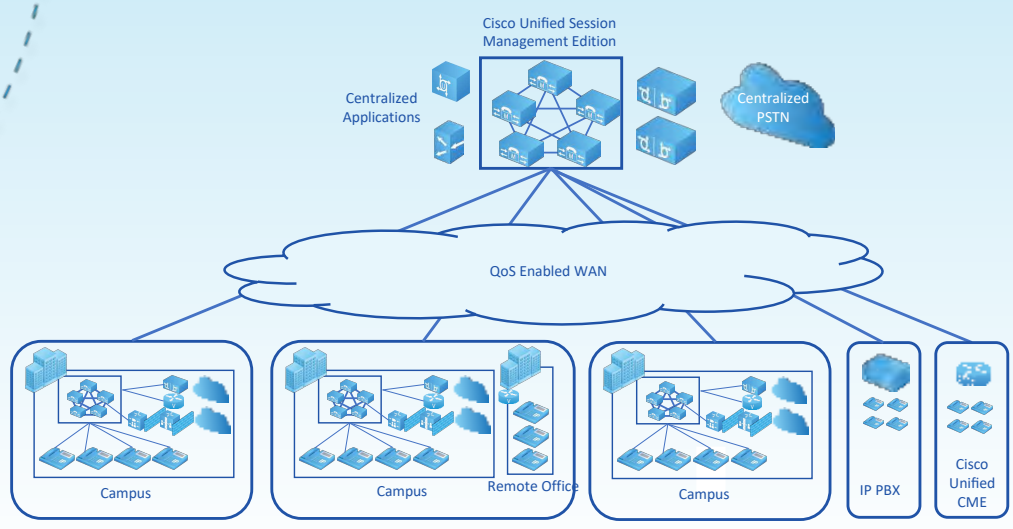
# Multisite with Distributed Call Processing

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# Multisite with Distributed Call Processing (Cont'd)

- Multisite deployment with distributed call processing consists of multiple independent sites with its own cluster
- Each site in the distributed call processing model can be one of the following
  - A single site with its own call processing agent, which can be either
  - A centralized call processing site and all of its associated remote sites
  - A legacy PBX with Voice over IP (VoIP) gateway
- Maximum of 40,000 configured and registered SCCP or SIP
- Maximum of 2,100 gateways and trunks
- High-bandwidth audio (for example, G.711 or G.722) between devices in the same site, but low-bandwidth audio (for example, G.729) between devices in different sites.
- High-bandwidth video (for example, 1.5 Mbps with 4CIF or 720p, to 2 Mbps with 1080p) between devices in the same site, but low-bandwidth video (for example, 384 kbps with 448p or CIF) between devices at different sites.
- Minimum of 1.5 Mbps or greater WAN link speeds. Video is not recommended on WAN connections that operate at speeds lower than 1.5 Mbps.
- Call admission control is achieved through Enhanced Locations CAC

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# Clustering Over the IP WAN

- 80-ms maximum round-trip delay between any two Cisco UCM servers in the cluster
- Minimum 1.544 Mb/s and 900 kb/s for every 10,000 BHCAs within the cluster
- Up to eight small sites using the remote failover deployment model
- Failover across WAN supported (more bandwidth)
- PSTN call cost savings when using the IP WAN for calls between sites.
- Use of the IP WAN to bypass toll charges by routing calls through remote site gateways, closer to the PSTN number dialed, that is, TEHO.
- Maximum utilization of available bandwidth by allowing voice traffic to share the IP WAN with other types of traffic.
- Failover across WAN is supported.

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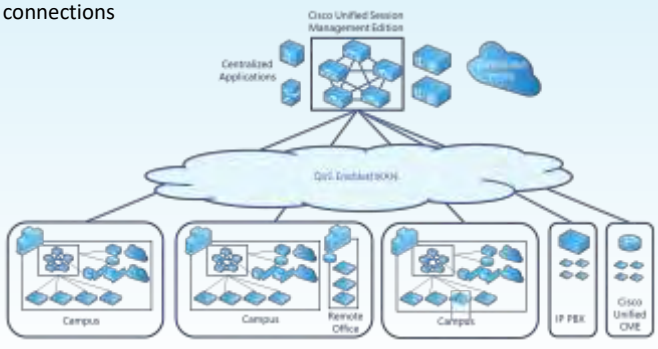
# Unified CM Session Management Edition

- Cisco Unified CM Session Management Edition is essentially a Unified CM cluster with trunk interfaces only and no IP endpoints
- It enables aggregation of multiple Unified CM, referred to as leaf systems
- Can be used to migrate a deployment of multiple PBXs and associated phones to a Unified CM cluster with IP phones and relatively few trunks.
- Used to connect to third-party unified communications systems such as PSTN connections

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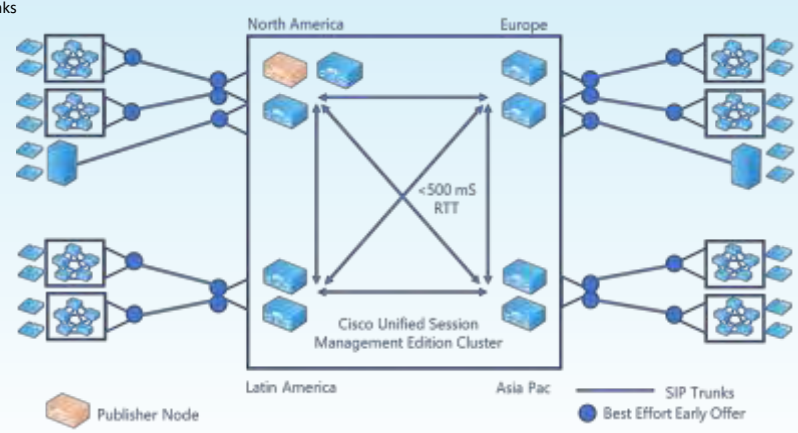
# Unified CM Session Management Edition (Cont'd)

- With Cisco Unified CM 8.0 and later releases, Unified CM Session Management Edition supports the following features
  - H.323 Annex M1 intercluster trunks
  - SIP intercluster trunks
  - SIP trunks
  - H.323 trunks
  - MGCP trunks
  - Voice calls
  - Video calls
  - Encrypted calls
  - Fax calls

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# When to Deploy Unified CM Session Management Edition

Cisco recommends deploying Unified CM Session Management Edition if you want to do any of the following

- Create and manage a centralized dial plan
- Provide centralized PSTN access
- Centralize applications
- Aggregate PBXs for migration to a Unified Communications system

The Unified CM Session Management Edition software is exactly the same as Unified CM  but Session Management is designed to support a large number of trunk-to-trunk connections

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# Clustering Over the IP WAN

- You may deploy a single Unified CM cluster across multiple sites that are connected by an IP WAN with QoS features enabled
  - WAN Considerations
    - Delay - The maximum one-way delay between any two Unified CM servers should not exceed 40 ms (6,000 km approx), or 80 ms round-trip time
    - Jitter - Jitter for the IP Precedence 3 ICCS traffic must be minimized using Quality of Service
    - Packet loss and errors - The network should be engineered to provide sufficient prioritized bandwidth for all ICCS traffic
    - Bandwidth - Provision the correct amount of bandwidth between each server for the expected call volume
    - Quality of Service

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# Cisco UCM Redundancy

- Maximum of eight call-processing servers in a cluster.
  - Remaining 12 Servers can be used as additional resources such as Conference, MTP, TFTP etc
- Redundancy is provided by Cisco UCM groups.
  - Prioritized list of call-processing servers (one or more).
  - Multiple Cisco UCM groups can exist in the same cluster.
  - Each call-processing server can be assigned to more than one Cisco UCM group.
  - Max 3 Server can be part of a Group
  - Each device has a Cisco UCM group assigned determines the primary and backup server to which it will register.

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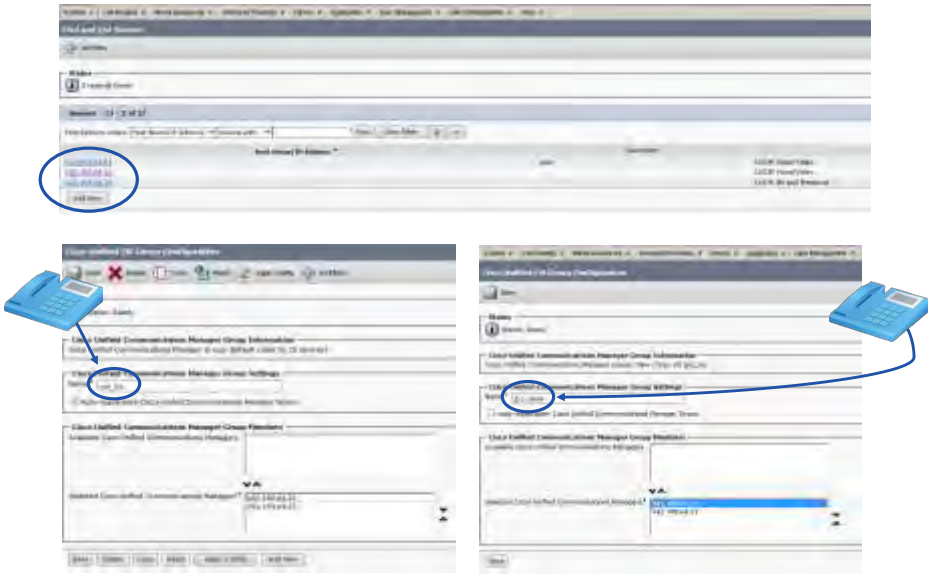
# List of Servers



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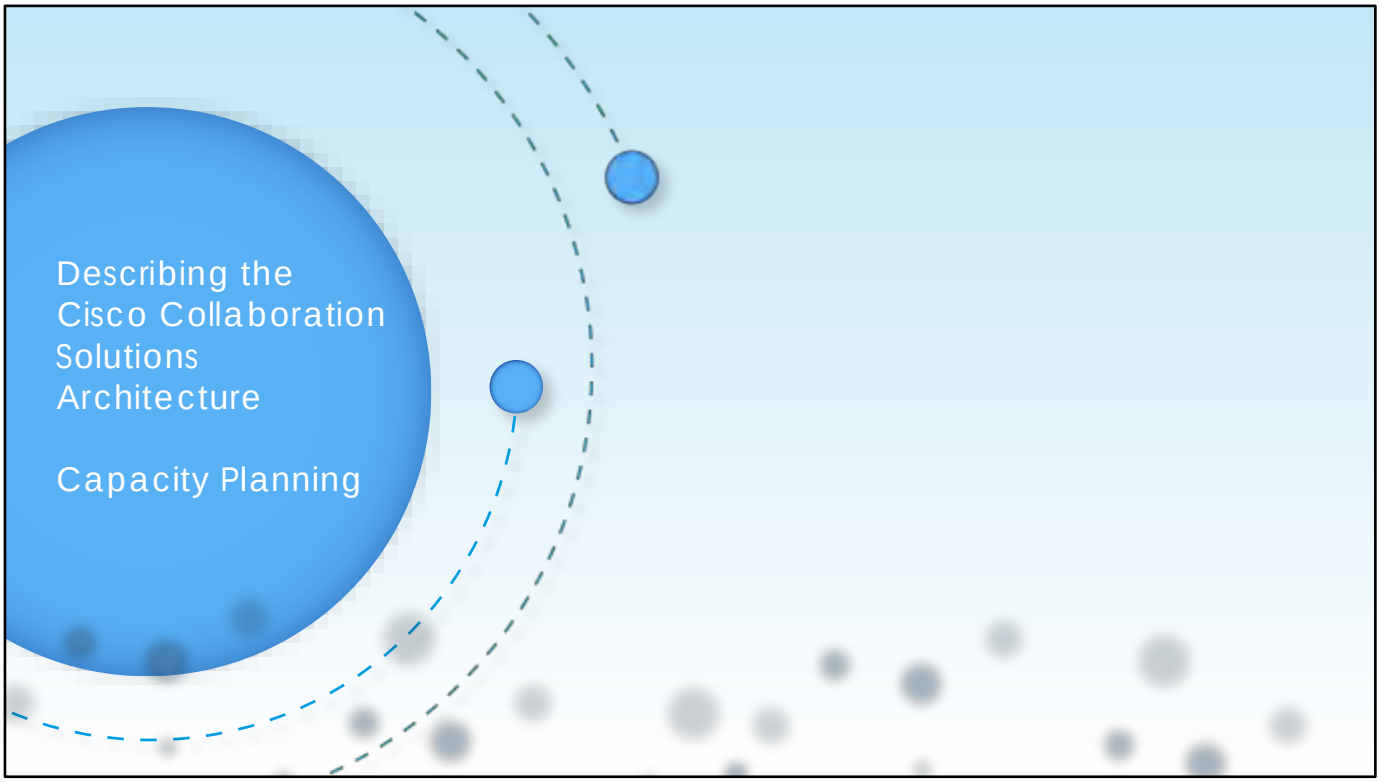


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# Capacity Planning

- Cluster sizes
- Interaction between individual products
- Server capabilities
- Optional capabilities and features
- Mix of call types
- Mix of endpoint types
- System release
- Use of external applications
- Anticipated system growth
- Average and peak usage

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# Cisco Collaboration Sizing Tool

This tool guides the user through a complete system deployment

- Cisco Unified Communications Manager
- IM and Presence Services
- Voice messaging
- Conferencing
- Gateways
- Cisco Unified Communications Management Suite
- Cisco Unified Contact Center components

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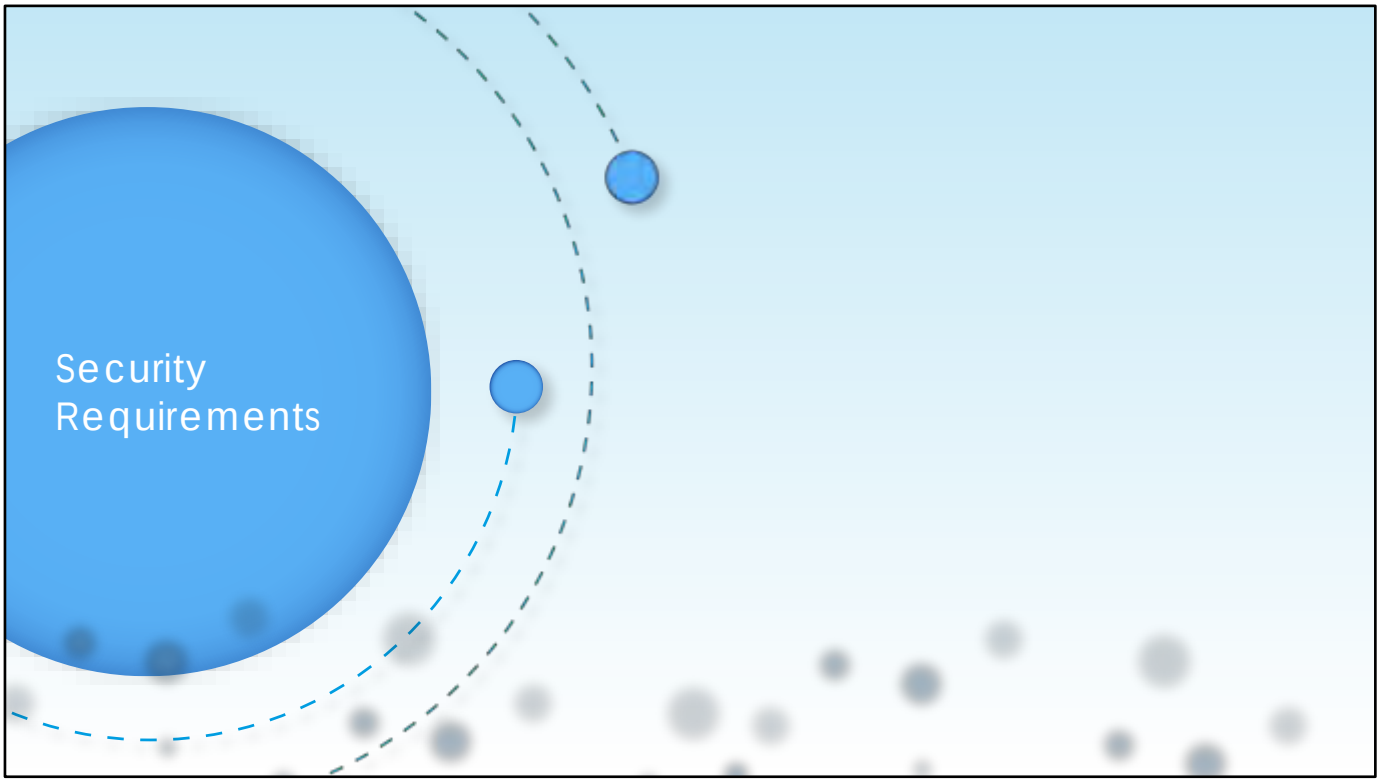


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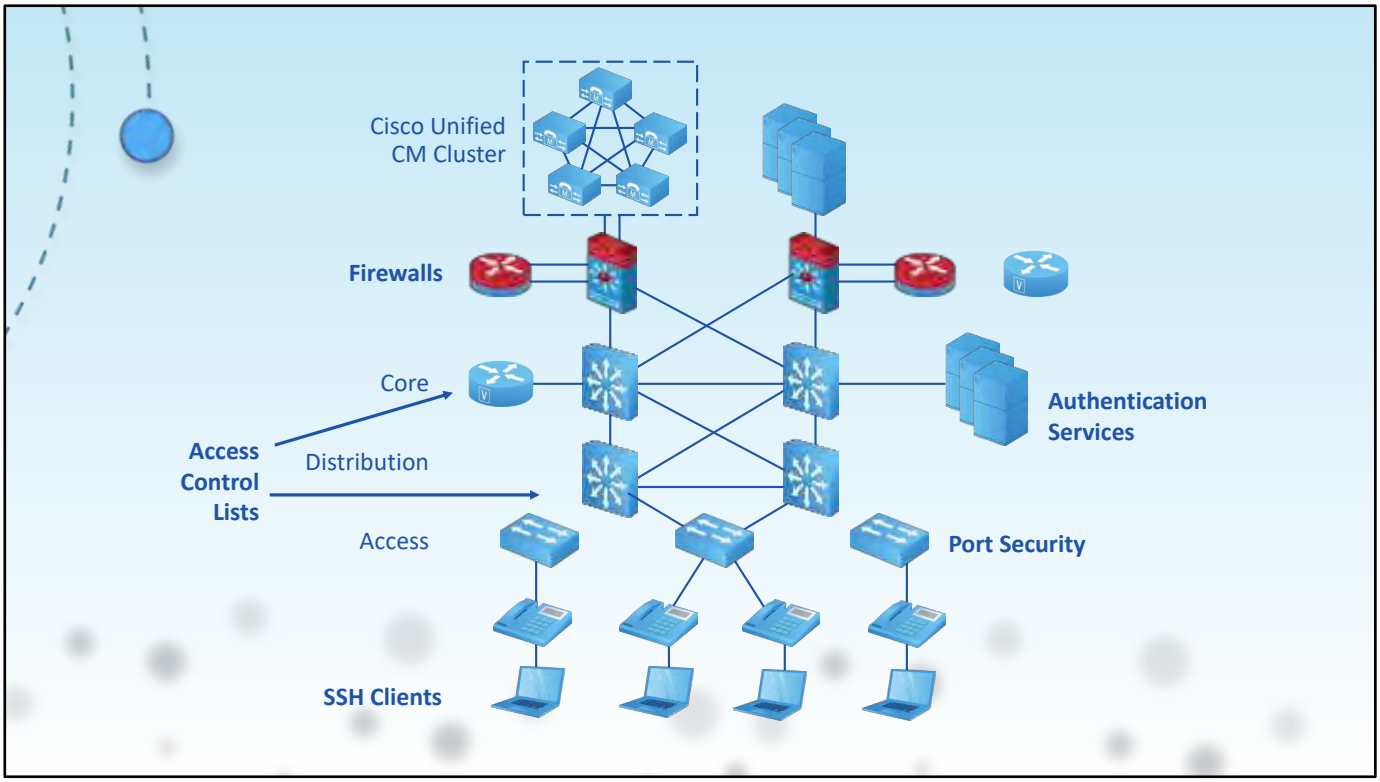


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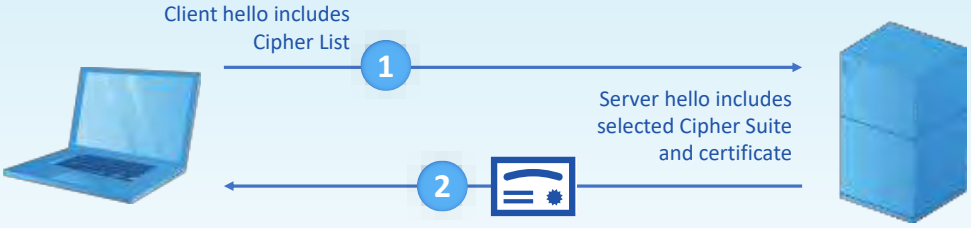
# Encryption with TLS and MTLS

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# CTL and ITL

The Certificate Trust List (CTL) and Identity Trust List (ITL) are files that include Cisco Unified Communications Manager certificates

Cisco endpoints download these files when they boot, restart, or reset

These trust lists allow the endpoints to get the minimum set of Cisco Unified Communications Manager certificates to build trust in Cisco Unified Communications Manager Services

The CTL and ITL files are signed by the System Administrator Security Token and contain a list of records

Each record contains a certificate, a certificate role or function, and pre-extracted certificate fields for easy lookup by the endpoints.

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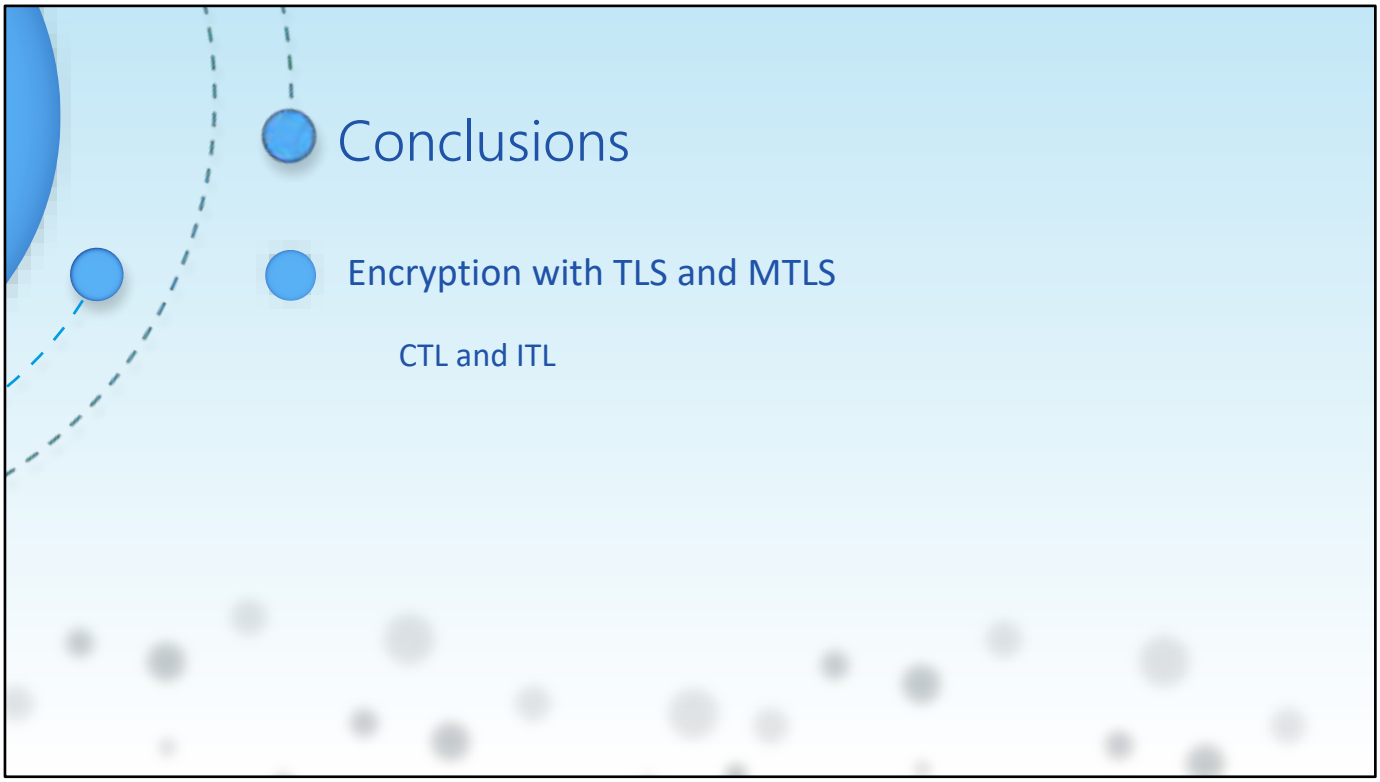


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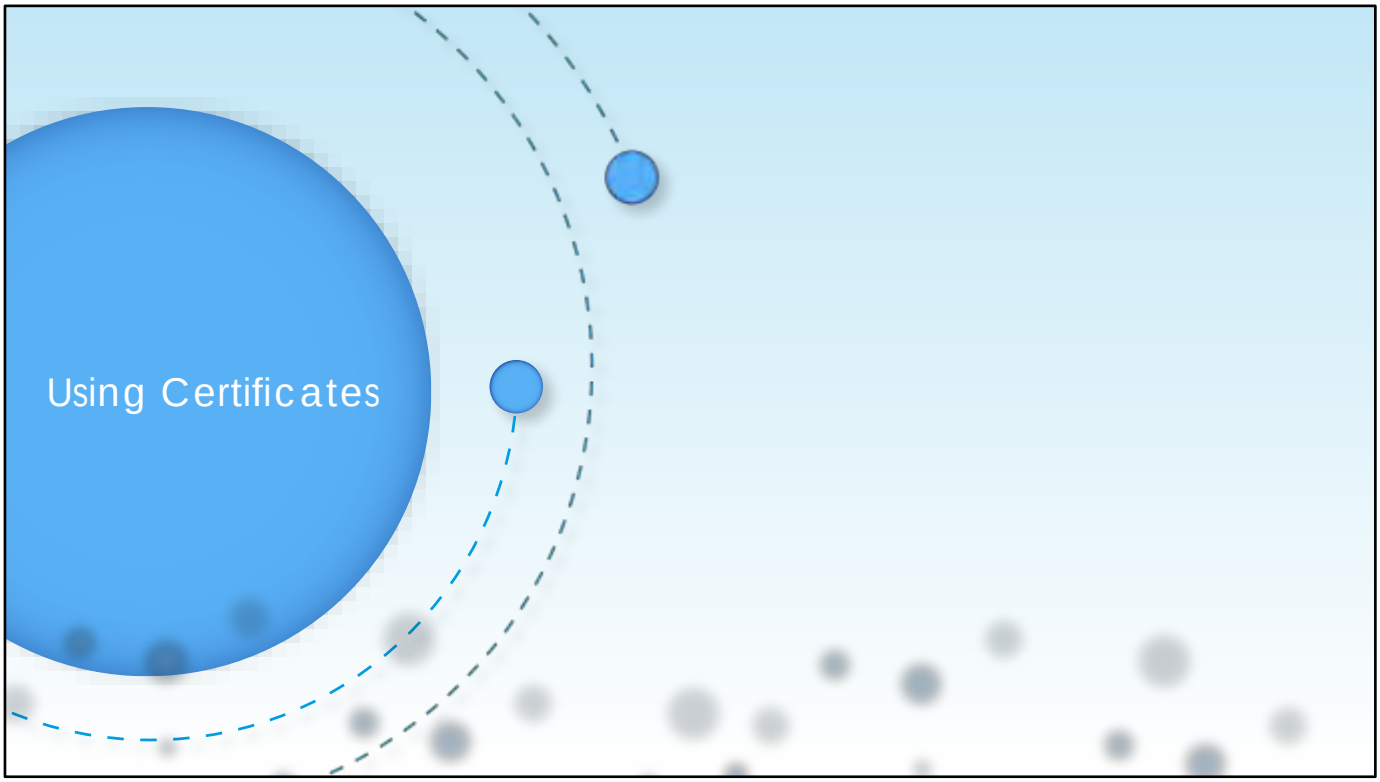


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# Certificates Overview

Unified Communications Manager uses certificates that use the public-key infrastructure (PKI) in order to validate server and client identity and to enable encryption

Its presents its certificate to Unified Communications Manager in order to verify its identity, When another system (for example, a phone or media server) tries to connect to Unified Communications Manager

Unified Communications Manager will not trust the other system, and will deny access, unless it has a matching certificate in the appropriate trust store

A certificate is a file that contains the certificate holder name, public key and digital signature of the certificate authority that is issuing the certificate

A certificate proves the identity of the owner of the certificate

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# Mixed Mode

For Cisco UCM to be able to process encrypted communications, Mixed Mode must be enabled.

Mixed Mode simply means that Cisco UCM will be able to process encrypted and unencrypted signaling.

By default, Mixed Mode is disabled, which means that only unencrypted calls are supported

Starting with Cisco UCM version 10.0, Mixed Mode is enabled by default. Prior to version 10.0, it required the use of two hardware keys

From **Cisco Unified CM Administration System > Enterprise Parameters** page

To enable Mixed Mode, connect to the command line and enter the following command - utils ctl set-cluster mixed-mode

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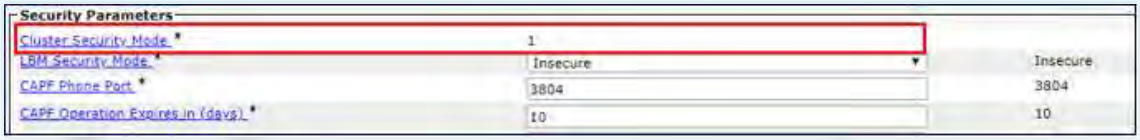
# Enable Mixed Mode

```
utils ctl set-cluster mixed-mode
```

```
admin: utils ctl set-cluster mixed-mode

This operation will set the cluster to Mixed mode. Do you want to
continue: (y/n):
```

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# Certificates

- There are many different types of certificates
- Server and Certificate Authority certificates
- Server certificates are used to validate that a device (PC, phone, endpoint, etc.) that is connecting to the network can be trusted and whether or not a security risk exists

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- Server certificates are issued by a Certificate Authority (CA)
- When the CA receive a request for a server certificate they perform a check on the request to validate its legitimacy
- If the check passes, they will issue a certificate which can be loaded onto the server

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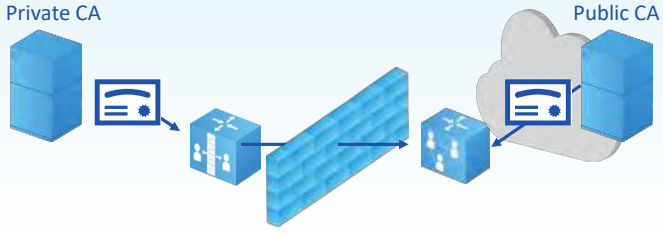
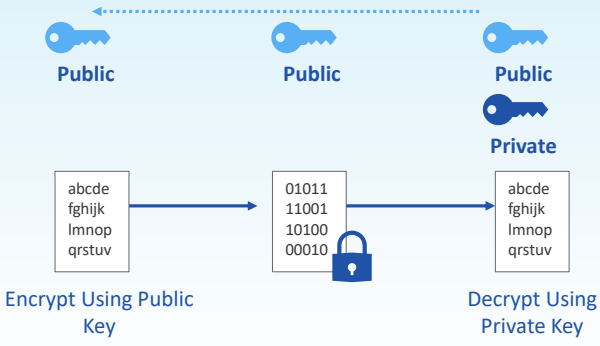
- A public CA issued certificate will be required on servers that are providing services (Cisco Expressway-E, online banking servers, secure payment sites, etc.) on the public internet
- Private CA's are deployed behind the firewall and issue certificates that will be accepted within the enterprise

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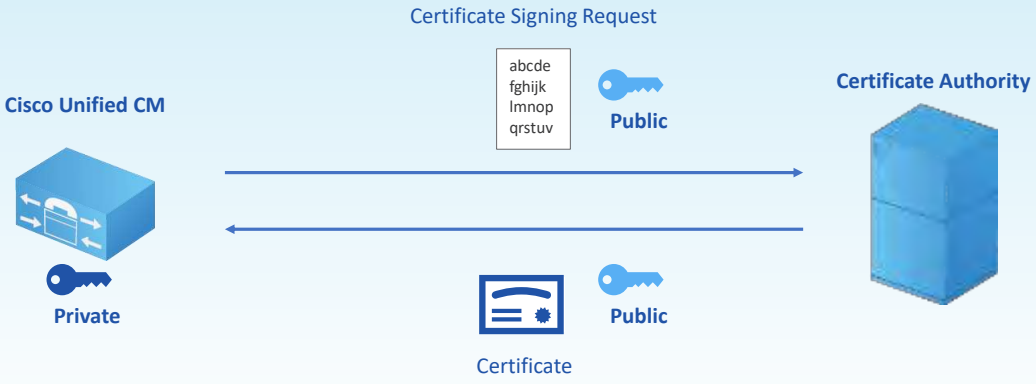
# Certificate Signing Request

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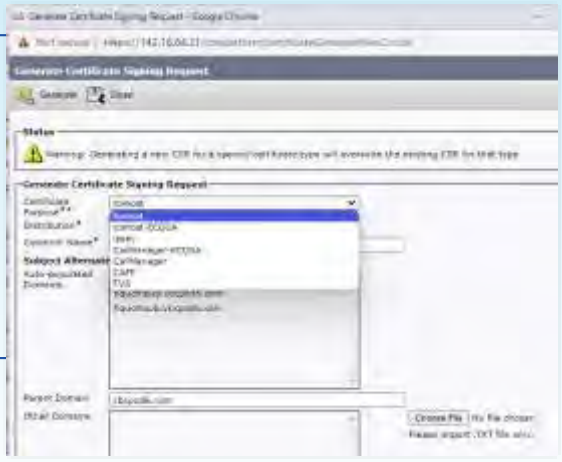
# Cisco Unified CM Certificates

- Cisco Unified CM certificates
  - Tomcat
  - Tomcat Trust
  - CallManager
  - CallManager Trust



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# Certificate Formats

Cisco Unified CM supports two certificate formats:

**Privacy Enhanced Mail (PEM)** — This format contains the X.509 certificate encoded in text (base64 and encrypted). Supported by Cisco VCS and Unified CM. Most common format in Unified Communications

**Distinguished Encoding Rules (DER)** — contains the X.509 certificate in binary form. Supported by Unified CM but not by other Cisco Unified Communication applications

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# Conclusions

- Certificate overview
  - Mixed mode
  - Certificates
    - Signing request
  - Cisco Unified CM certificates
    - Formats

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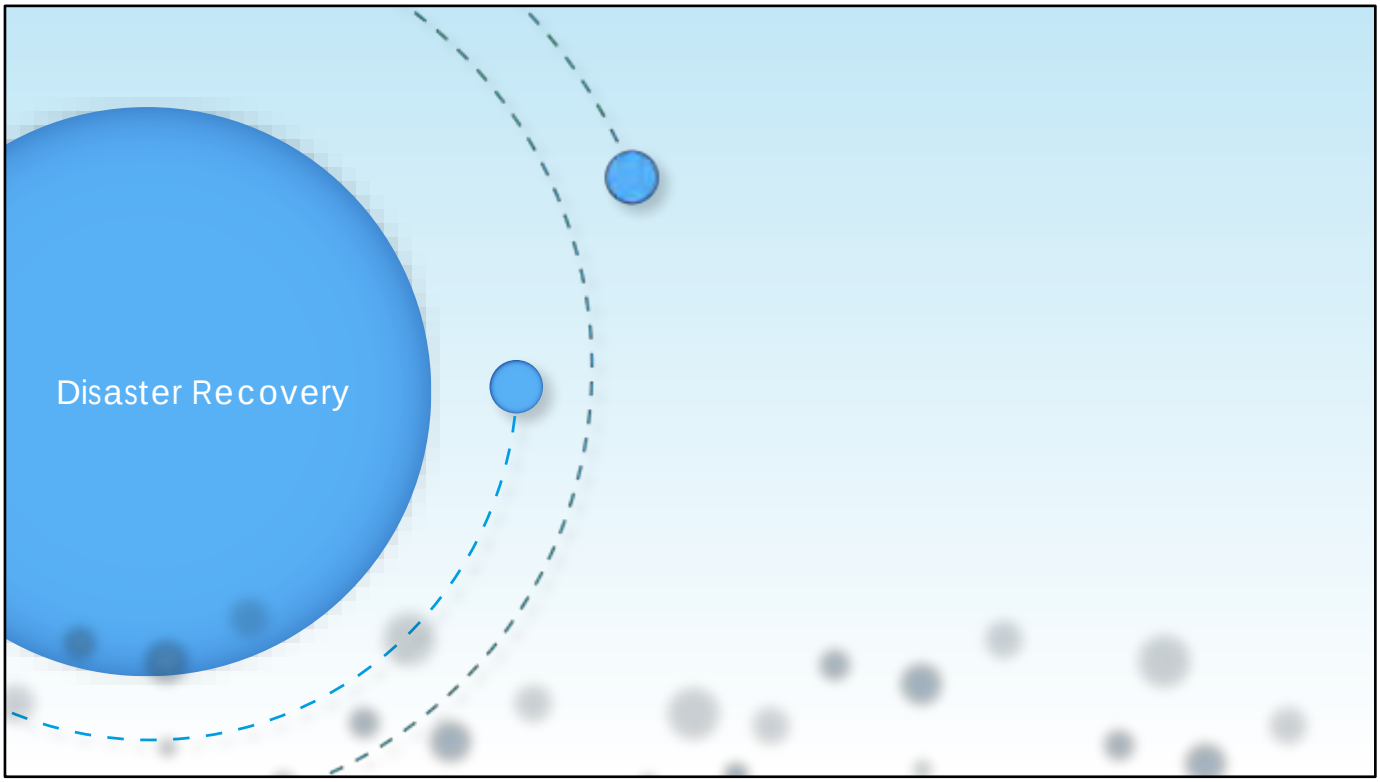


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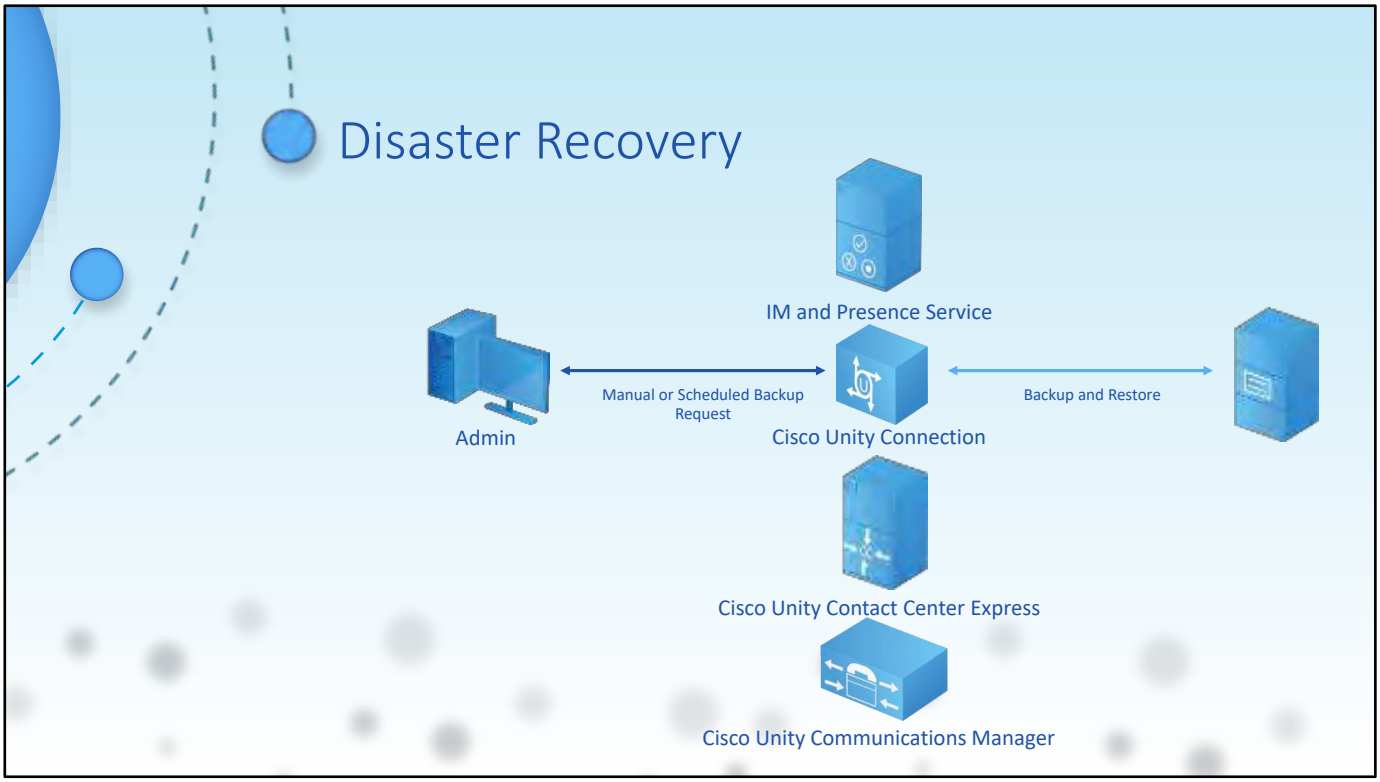
# Disaster Recovery

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# Dial Plan

- Endpoint addressing (numbering plan)
- Call routing and path selection
- Digit manipulation
- Calling privileges
- Call coverage

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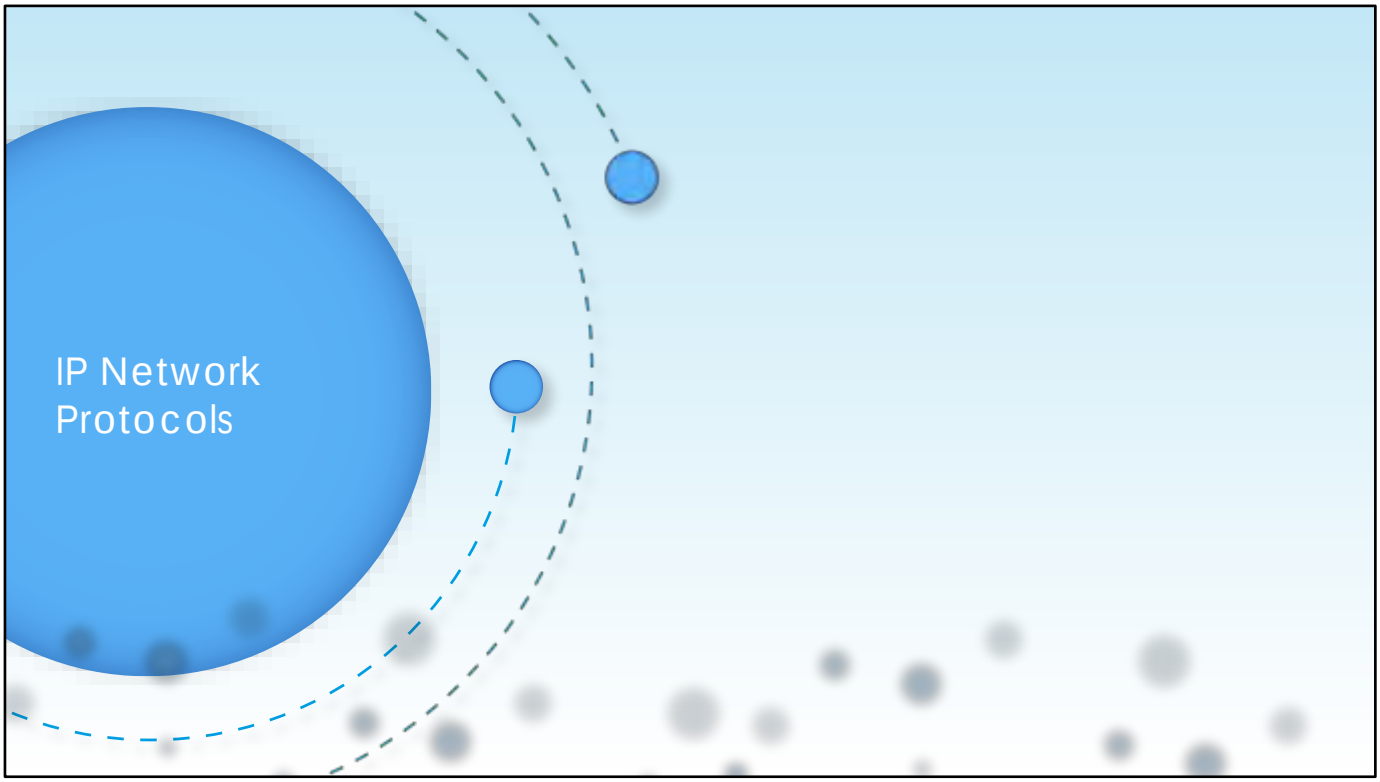


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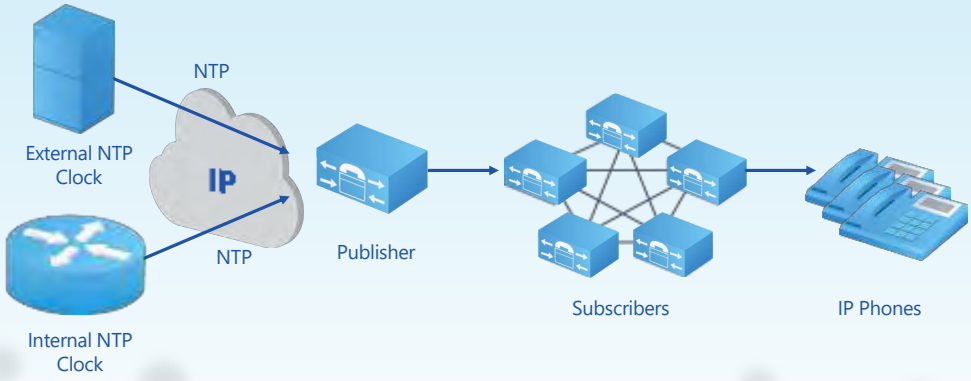
# IP Network Protocols

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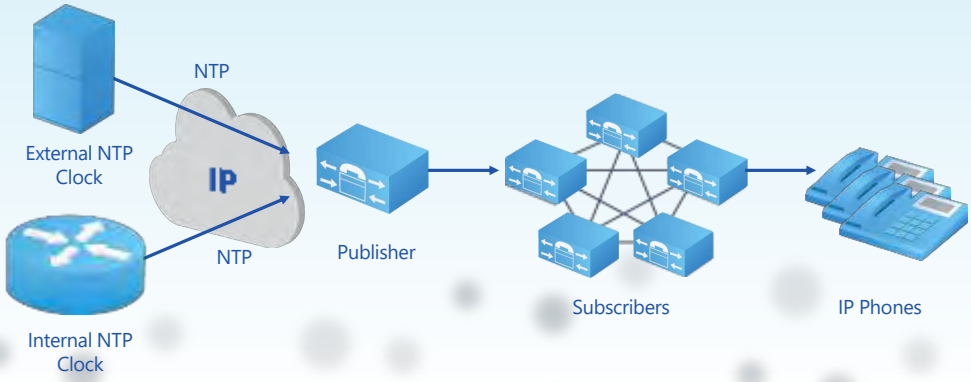
# Network Time Protocol

NTP is designed to synchronize computer system clocks across IP networks

NTP servers provide a reference clock for device time synchronization, usually from an external source

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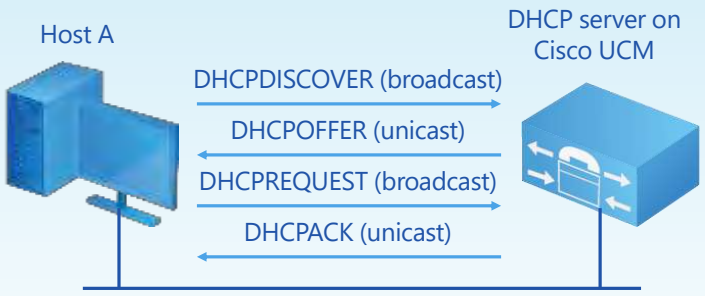
# Dynamic Host Configuration Protocol

DHCP is a protocol that allows IP endpoints to obtain their IP settings from a server

The most important settings are the IP address, subnet mask, and default gateway

DNS server address and special functions, such as the TFTP server address used by Cisco IP phones, can be assigned to the client

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# Domain Name System

DNS is a name-resolution protocol that allows IP applications to refer to other systems by logical names instead of IP addresses.

A Cisco Unified Communications Manager cluster can be configured to use either DNS or IP addresses.

| Advantages of Using IP Addresses | Advantages of Using DNS |
|---|---|
| Does not require a DNS server | Simplifies management because of the use of names instead of numbers |
| Prevents the IP telephony network from failing when the DNS server is unavailable | Easier IP address changes because of name-based IP paths |
| Decreases the amount of time required when a device attempts to contact the Cisco Unified Communications Manager server | Server-to-IP phone NAT possible |
| Simplifies troubleshooting | Possibility to have redundant IP phone services |

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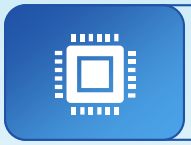
# Configure and Troubleshoot DNS



The DNS is a distributed database in which you can map hostnames to IP addresses through the DNS protocol from a DNS server. Each unique IP address can have more than one associated hostname

You will configure DNS on the Windows server to resolve A records and AAAA records for HQ-UCM

You will create an SRV record, but you will not use it

As an example, you will create an SRV record for the XMPP client service that points to the cms.cll-collab.internal host.

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# Resource Records in DNS

- Resource records comprise the data within a DNS zone.
- There are different resource records available in DNS, including A, AAAA, PTR, and SRV records
- Record A specifies the IPv4 address for given host. A records are used for conversion of domain names to corresponding IP addresses
- Record AAAA (quad-A) specifies the IPv6 address for a given host
- Although the main purpose of the DNS is to point domains to IP addresses, a PTR record works in the opposite way
- It associates an IP with a domain name
- Because of its purpose, a PTR record is sometimes called a reverse DNS record
- The purpose of a PTR record is mostly administrative; it shows that an IP is, in fact, used with a particular domain
- An SRV record is intended to provide information on available services for your systems

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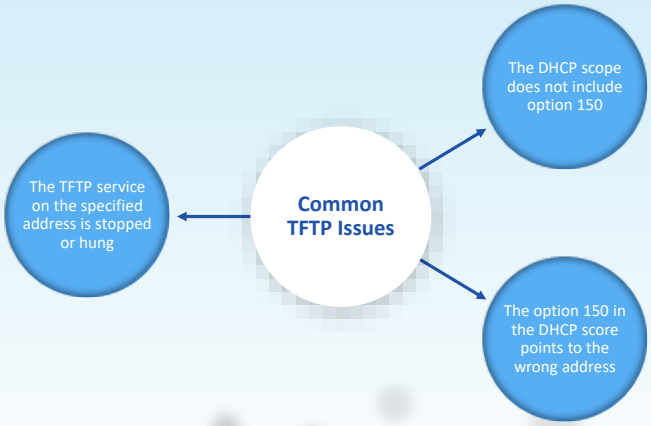
# Trivial File Transfer Protocol

TFTP is a simple file transfer protocol and is used by Cisco IP phones to obtain configuration files and their software. A Cisco Unified Communications Manager cluster must run the TFTP service on at least one server to support IP phones.

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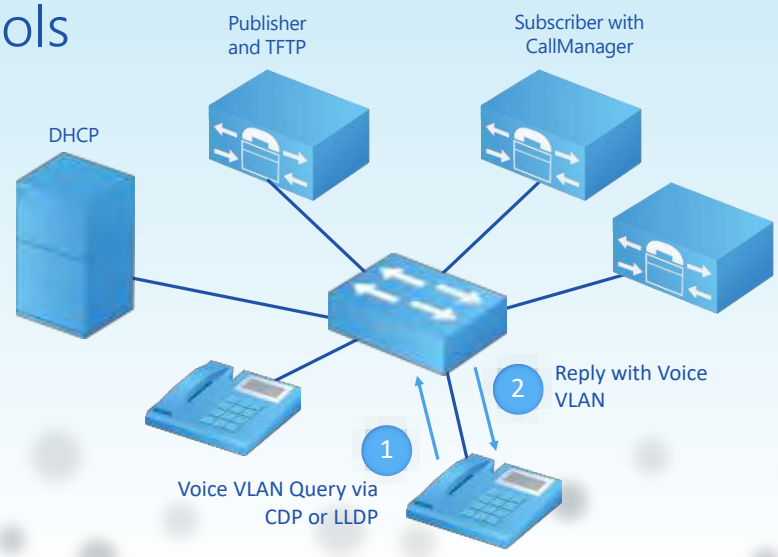
# Cisco Discovery Protocol and LLDP-MED Protocols

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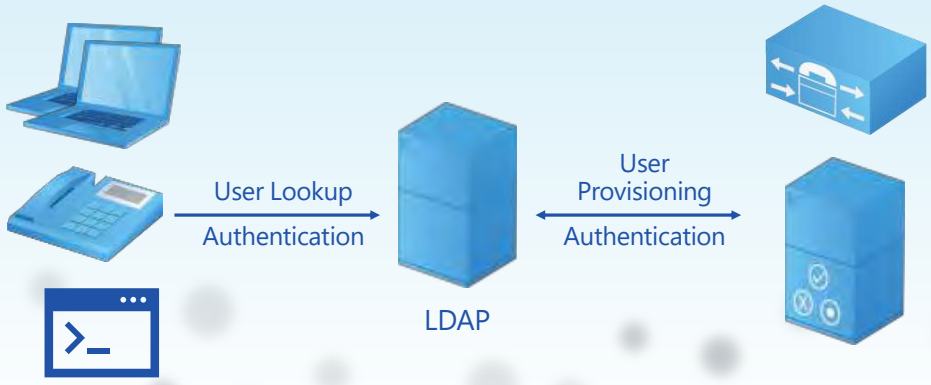
# Lightweight Directory Access Protocol

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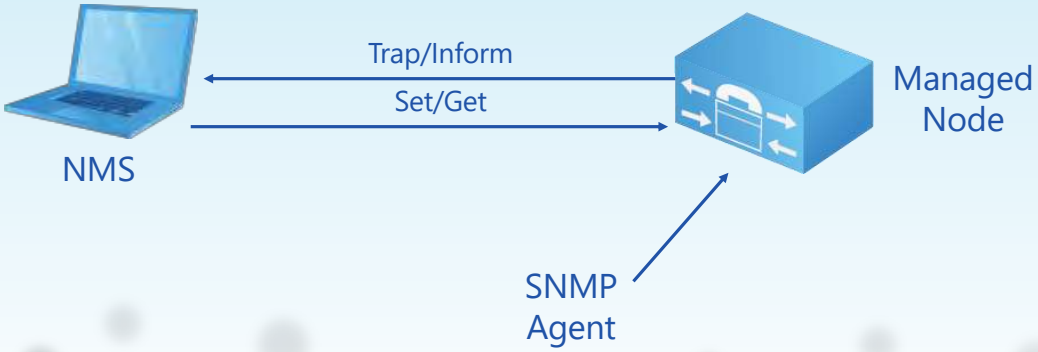
# Simple Network Management Protocol

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# Conclusions

- IP network protocols
- Network Time Protocol
- DHCP
- DNS
- TFTP
- CDP and LLDP
- LDAP
- SNMP

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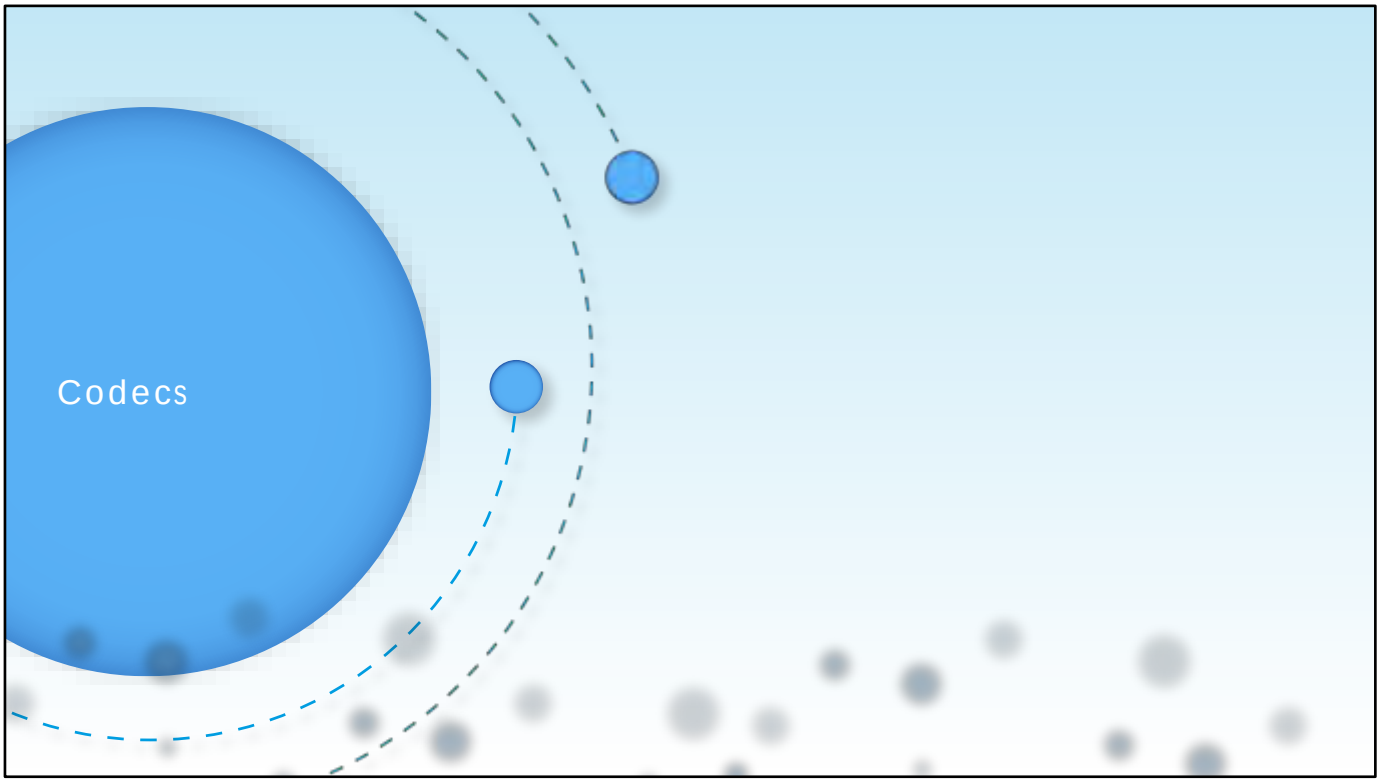


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# Codecs

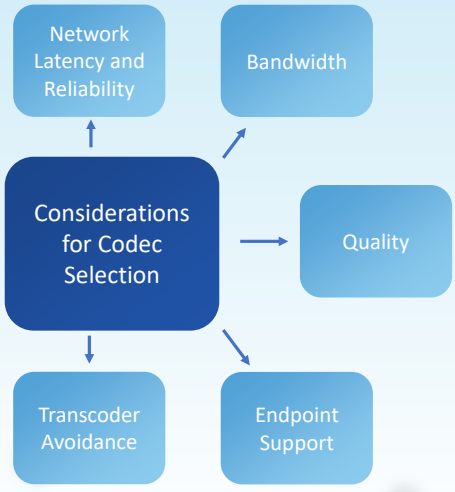
A codec is a software algorithm that compresses and decompresses speech or audio signals. There are many standardized codecs that are used in VoIP networks

Every VoIP endpoint must support the G.711 audio codec, but most endpoints support additional audio codecs.

Support for audio and video codecs depends on the product and includes the following

**Audio codecs:** G.711, G.722, G.729, Opus, iLBC, iSAC, and so on

**Video codecs:** H.264, H.263, H.261, H.265, H.264 SVC, and so on

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# Converting Voice to Packets

- 1930, Dr. Harry Nyquist laid the mathematical foundations for the technology used to this day to convert analog signals
- It is important to understand this process because it will inform your understanding of VoIP audio sample sizes, DSP resources, and codecs
- The process of converting analog to digital consists of three (sometimes four) steps: sampling, quantization, and encoding
- The origin of the digital conversion process (which fed many of the developments discussed earlier) takes us back to the 1920
- The Bell Systems Corporation tried to find a way to deploy more voice circuits with less wire because analog voice technology required one pair of wires for each voice line

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# Converting Voice to Packets

- The telephone channel frequency range (300–3400 Hz) gives you enough sound quality to identify the remote caller and sense their mood
- Nyquist proved that you can accurately reproduce an audio signal by sampling at twice the highest frequency
- Because he was after audio frequencies from 300–4000 Hz, it would mean sampling 8000 times (2 * 4000) every second
- A sample is a numeric value of the analog waveform, measured at regular intervals
- More specifically, in the voice realm, a sample is a numeric value that is encoded by a single byte (8 bits) of information

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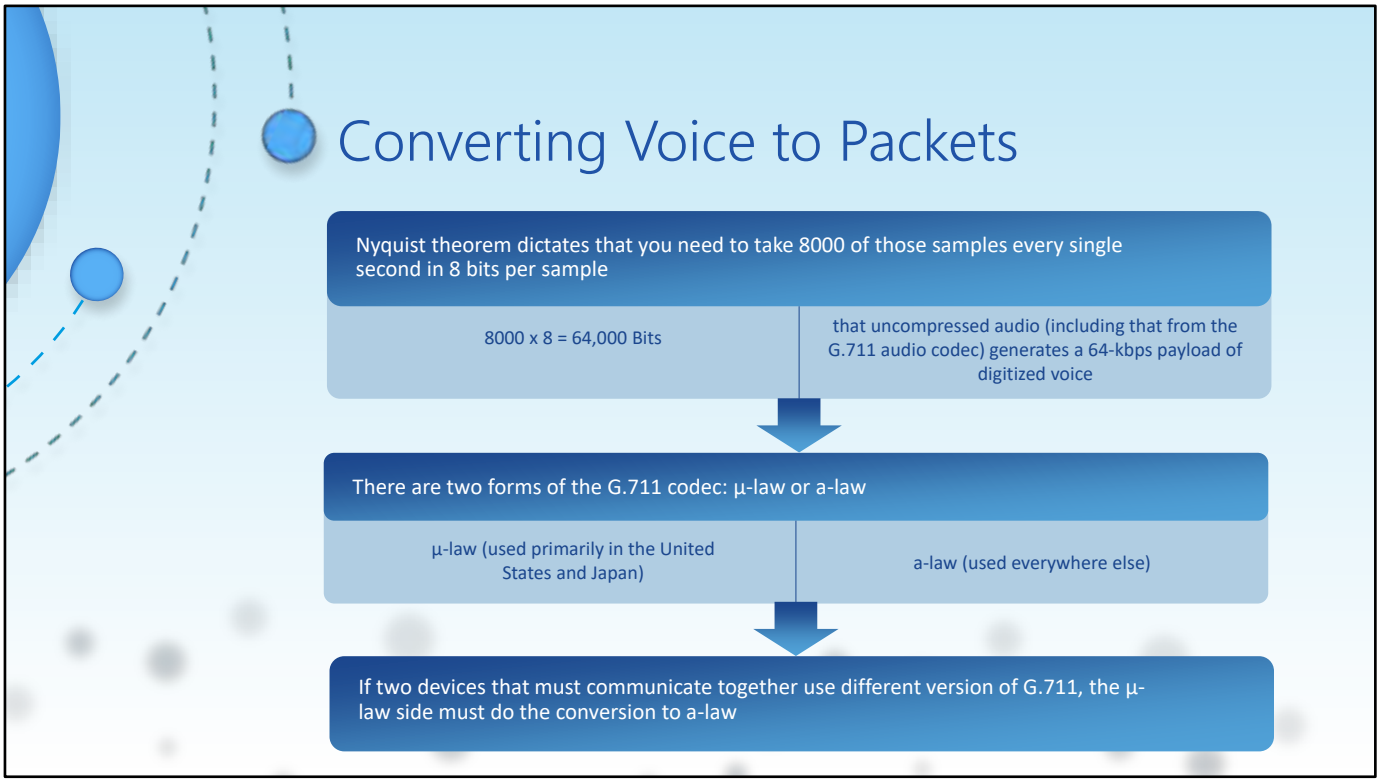


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# G.711

G.711 is an ITU-T standard that uses Pulse Code Modulation (PCM) to encode signals

The voice samples that the PCM process creates generate 64 kbps of data.

This data is carried across a network for a G.711 call

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# G.722

- G.722 is an ITU-T standard wideband speech codec that operates at 48, 56, and 64 kbps
- G.722 is typically used in LAN deployments
- Offers a significant improvement in audio quality compared to older narrowband codecs such as G.711
- Cisco Unified Communications Manager calculates G.722 with 64 kbps

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# G.729

- G.729 is the compression algorithm that Cisco uses for high-quality 8-kbps voice
- G.729 is a high-complexity, processor-intensive compression algorithm that monopolizes processing resources
- Although G.729A is also an 8-kbps compression algorithm, it is not as processor-intensive as G.729
- G.729A is a medium-complexity variant of G.729 with slightly lower voice quality
- Is more susceptible to network irregularities such as delay, variation, and “tandeming.
- Tandeming causes distortion that occurs when speech is coded, decoded, then coded and decoded again, much like the distortion that occurs when a videotape is repeatedly copied.

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# The Annex B variant of G.729

Is also a high-complexity algorithm that adds Voice Activity Detection (VAD) and Comfort Noise Generation (CNG) to the codec

VAD detects silence that occurs in typical conversations

This silence is present when one end is talking and the other is listening

The listening end can temporarily suppress the RTP stream that is going toward the talker

The benefit of this suppression is an approximate 35-percent savings in bandwidth

The RTP stream is reactivated upon the detection of sound on the listening end, which can cause clipping of the first syllable when the RTP stream restarts

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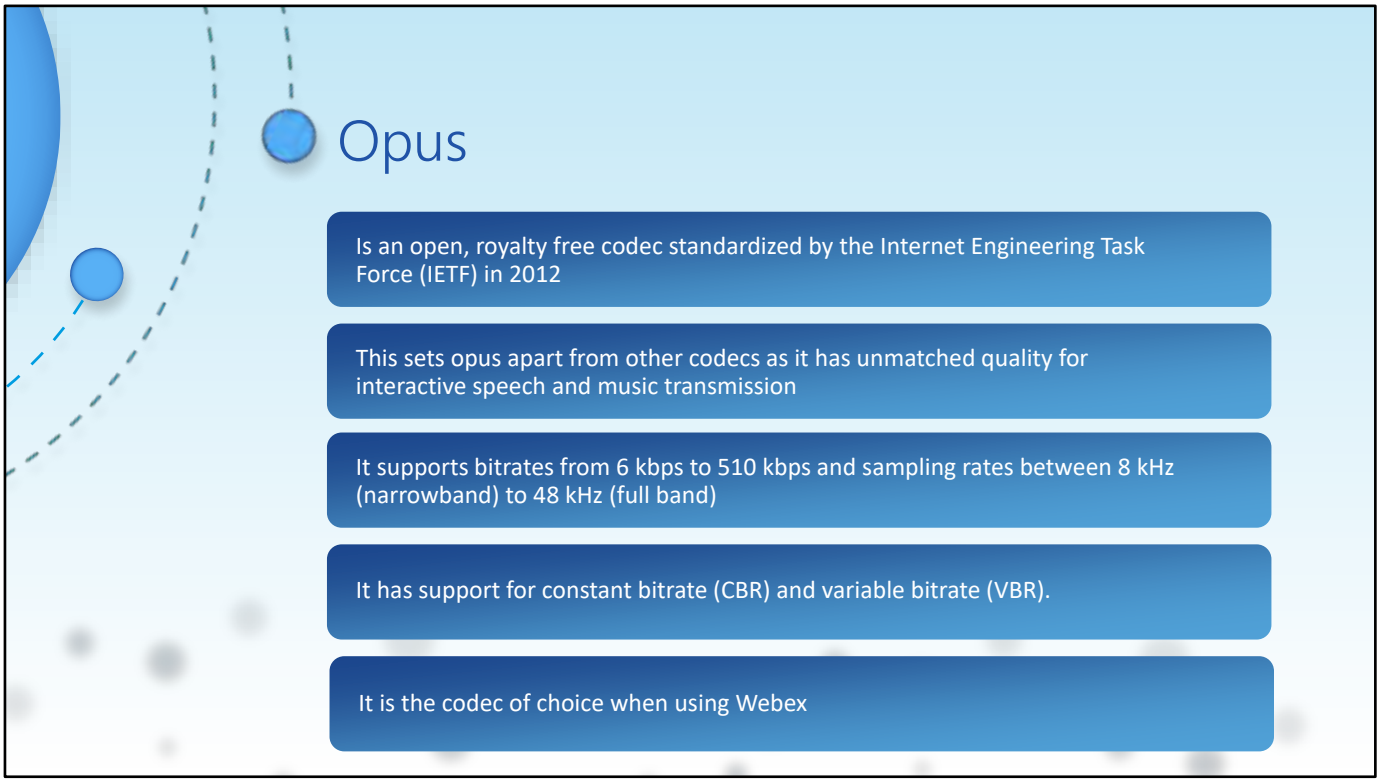


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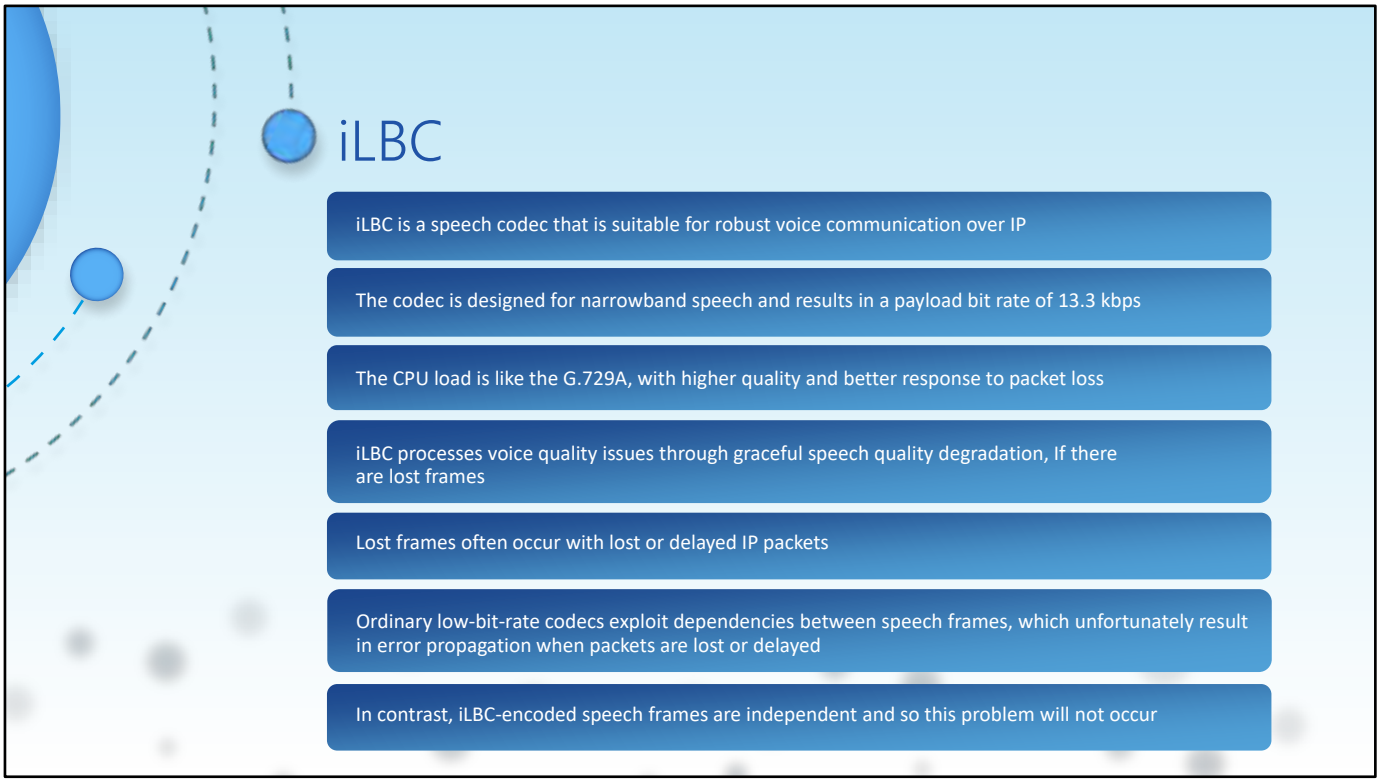


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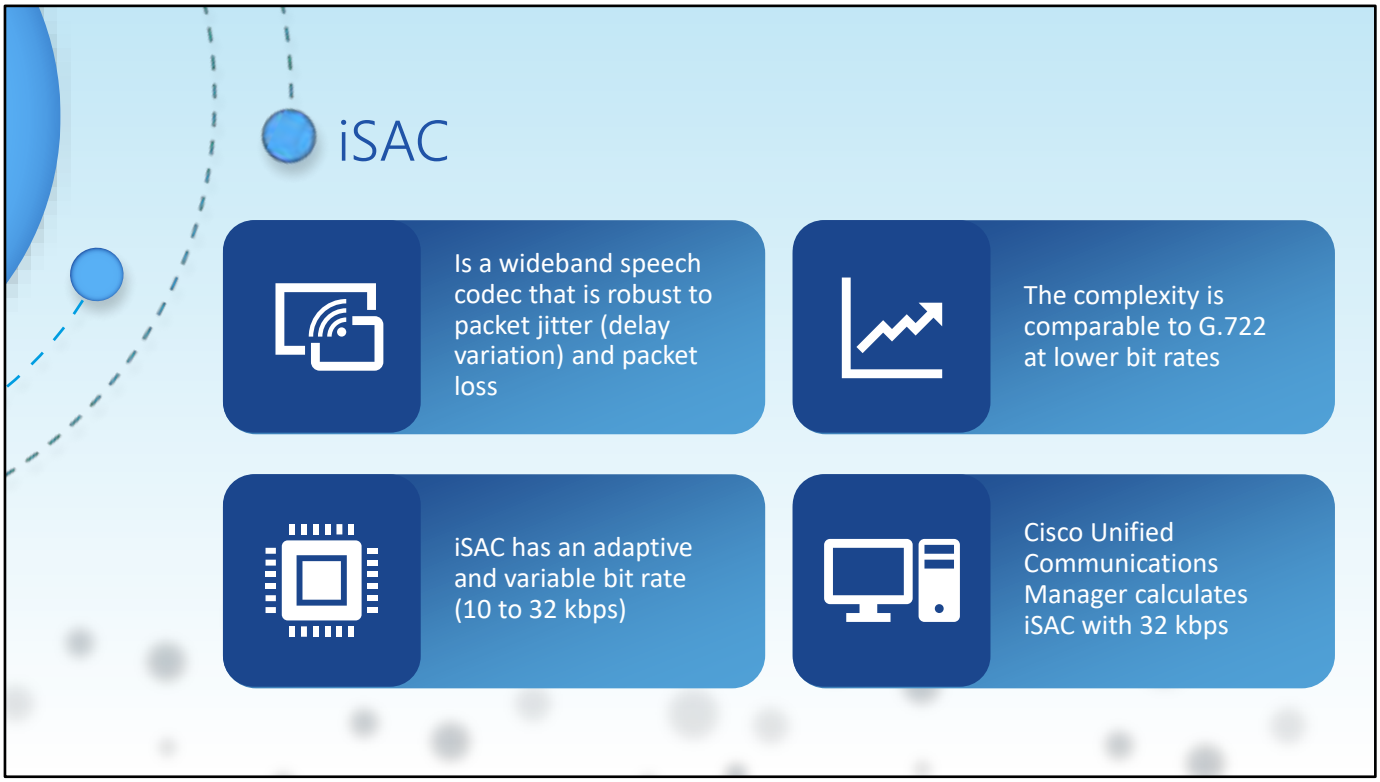


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# SIP OAuth Mode Overview

SIP OAuth Mode Overview

SIP OAuth Mode Prerequisites

SIP OAuth Mode Configuration Task Flow

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | Upload CA Certificate to the Phone Edge Trust | Upload CA Certificate to the phone edge trust to get the tokens. This step is not applicable for Cisco Jabber device. |
| **Step 2** | Configure Refresh Logins | Enable OAuth with refresh login flow on Unified Communications Manager to register the device via SIP OAuth. |
| **Step 3** | Configure OAuth Ports | Assign the ports for OAuth for each node that has OAuth registration. |
| **Step 4** | Enable SIP OAuth Mode | Enable OAuth services using a CLI command on the publisher node |
| **Step 5** | Restart Cisco CallManager Service | Restart this service on all nodes that have OAuth registrations. |
| **Step 6** | Configure Device Security Mode in Phone Security Profile | Configure OAuth support within a Phone Security Profile if you are deploying encryption for the endpoints |

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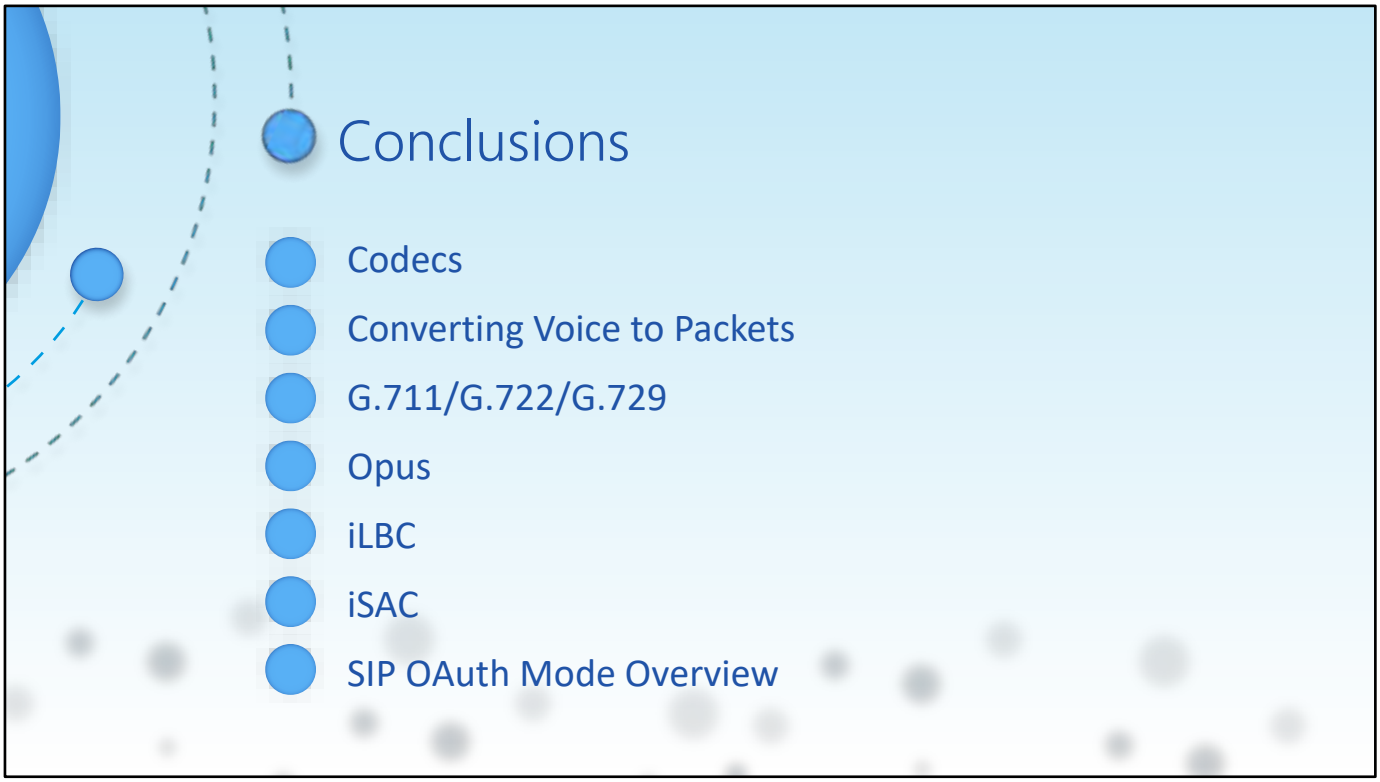


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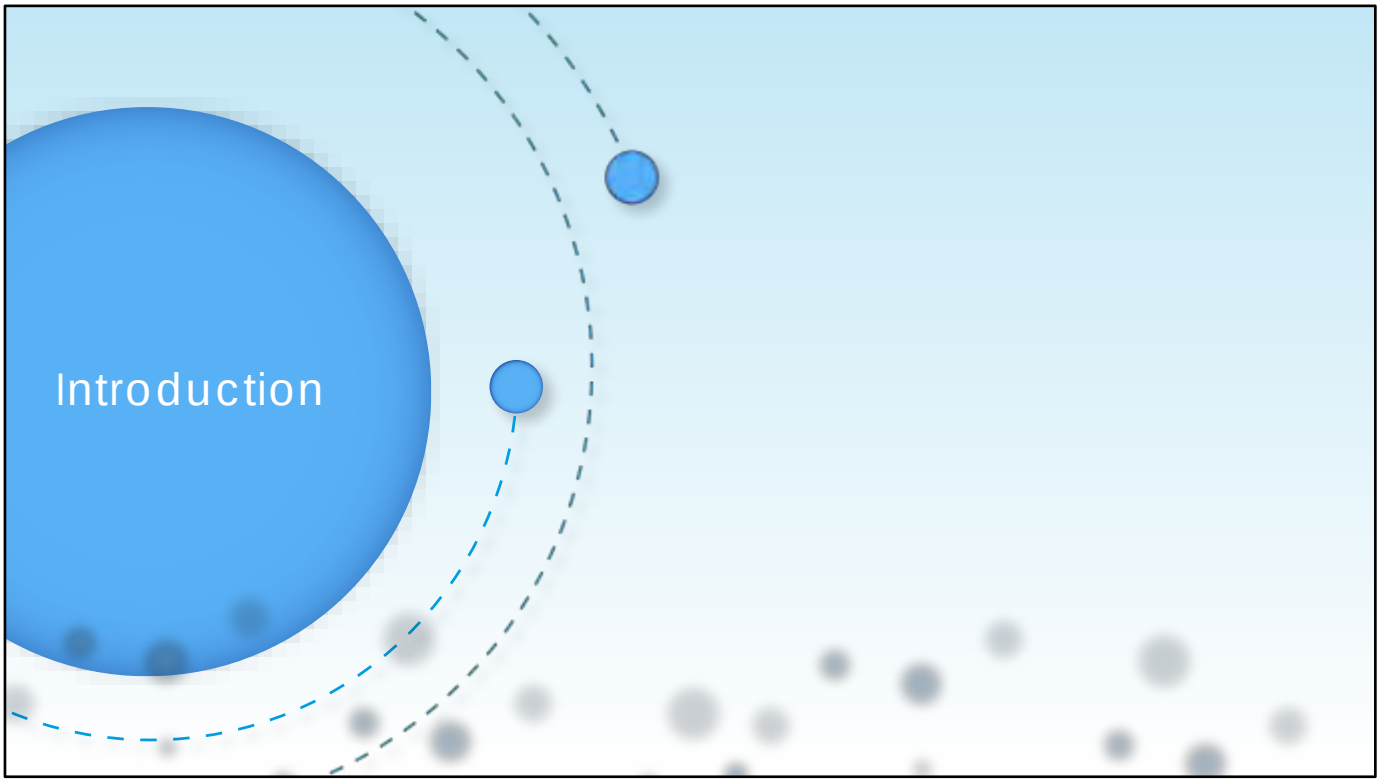


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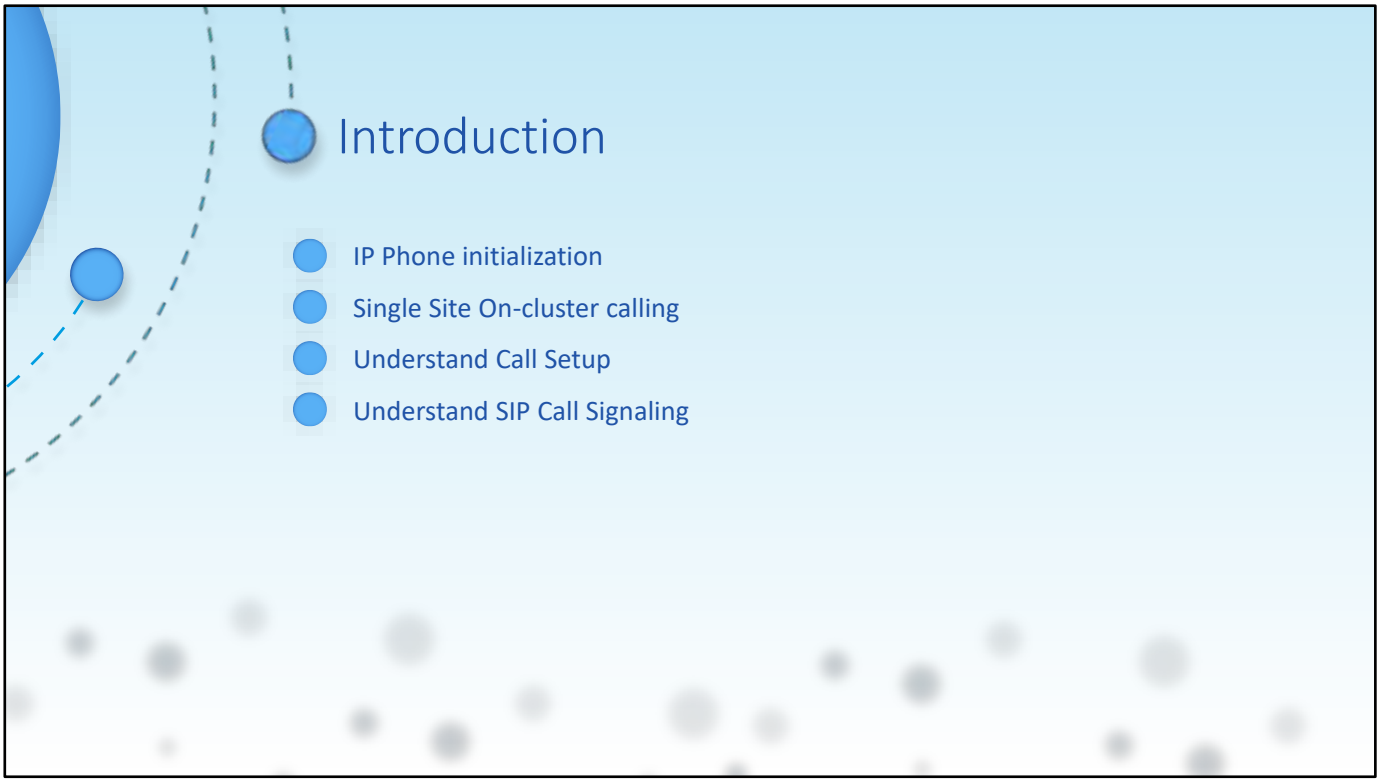


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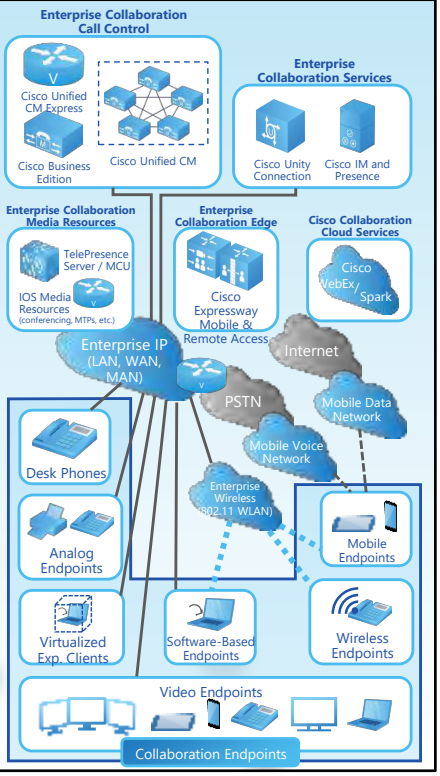
# Collaboration Endpoints Architecture

- SCCP
  - TCP 2000
- SIP
  - TCP/UDP – 5060
- Analog Endpoints
- Standalone Analog Gateways
- Analog Interface Module
- Paging Systems
- Desk Phones
  - Cisco Unified IP Phone 7900 Series
  - Cisco IP Phone 8800 Series
  - Cisco Unified SIP Phone 3900 Series
  - Cisco DX Series

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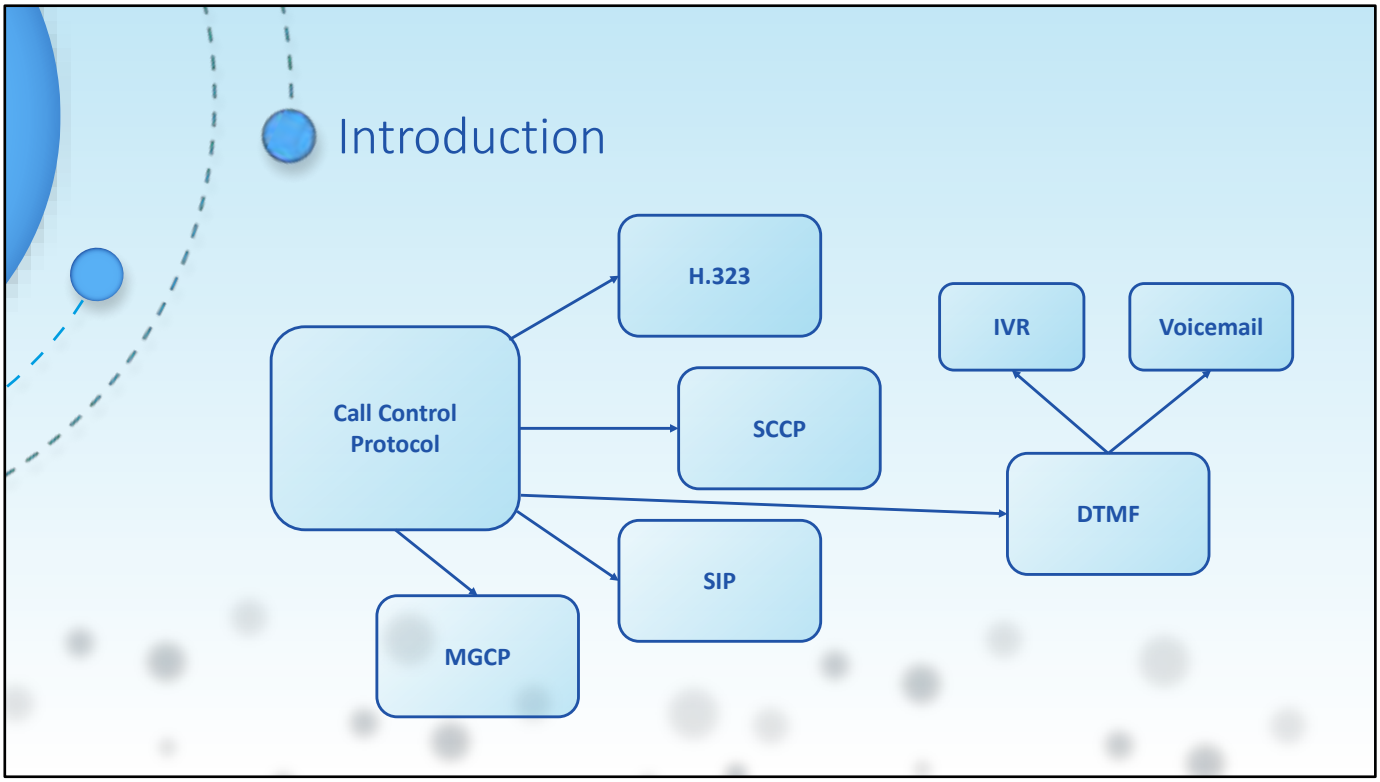


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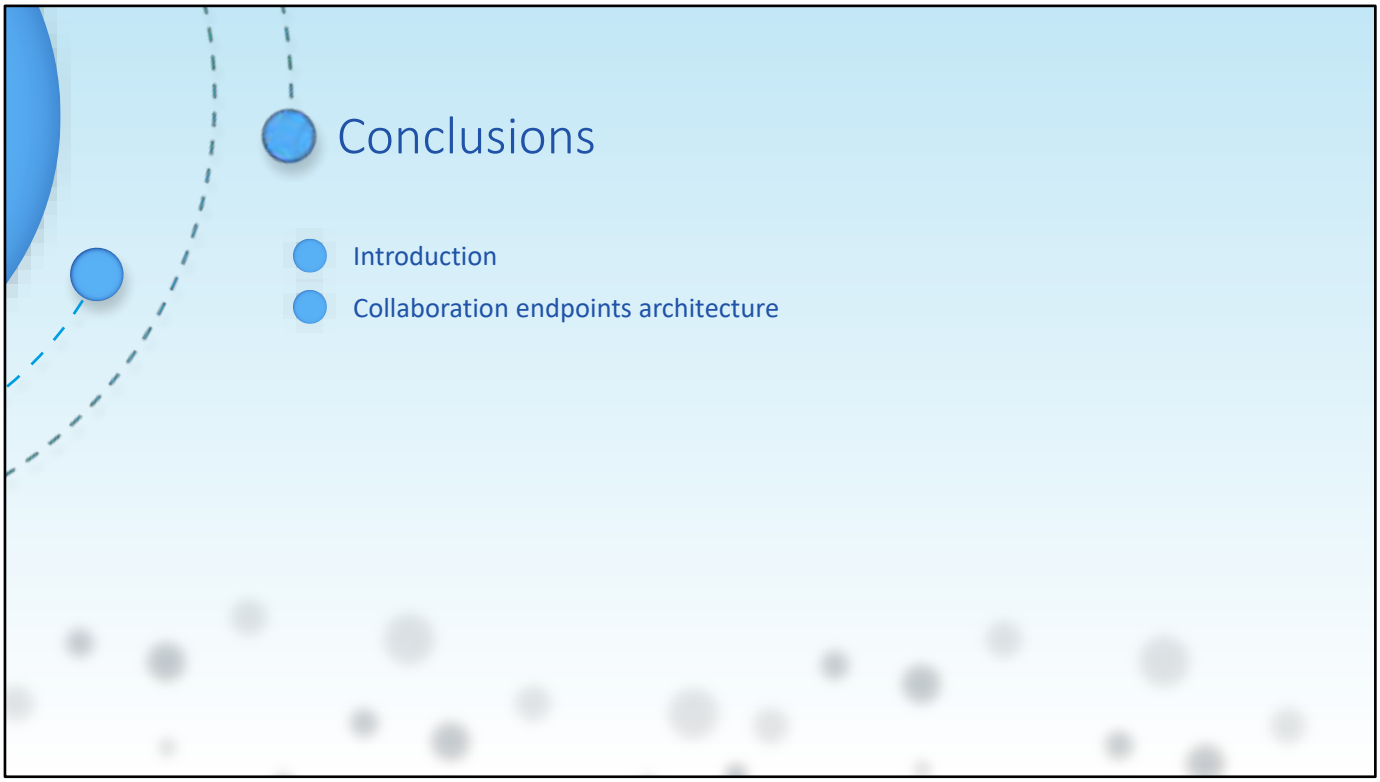


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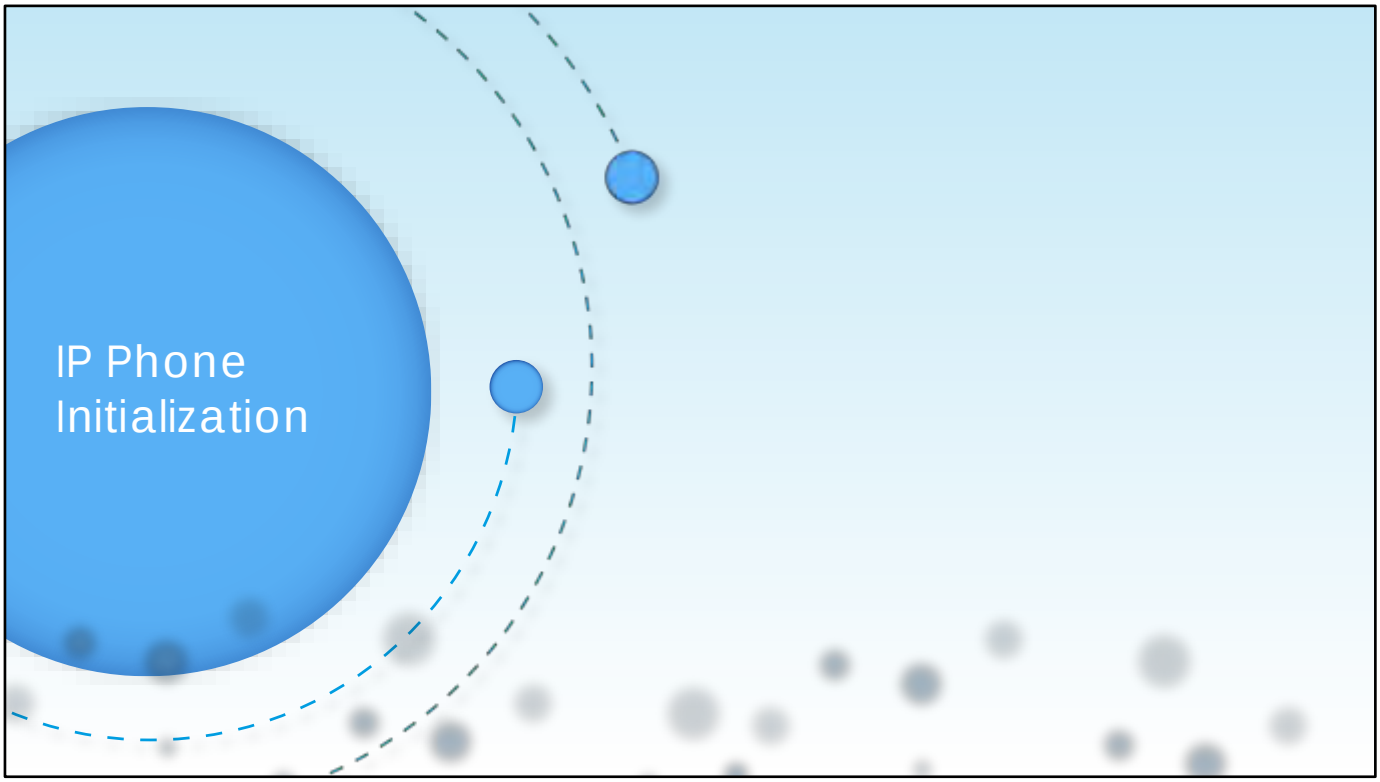


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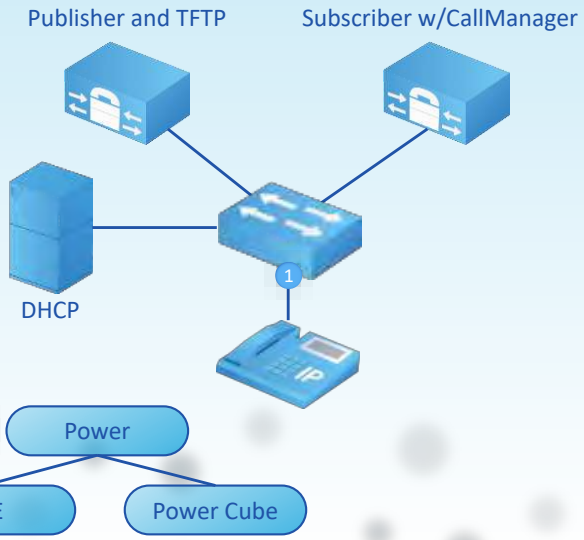
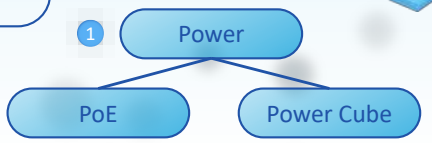
# Step 1 - IP Phone Boot up Process

Phone Power via

- PoE
- Power Cubes
- Midspan injectors

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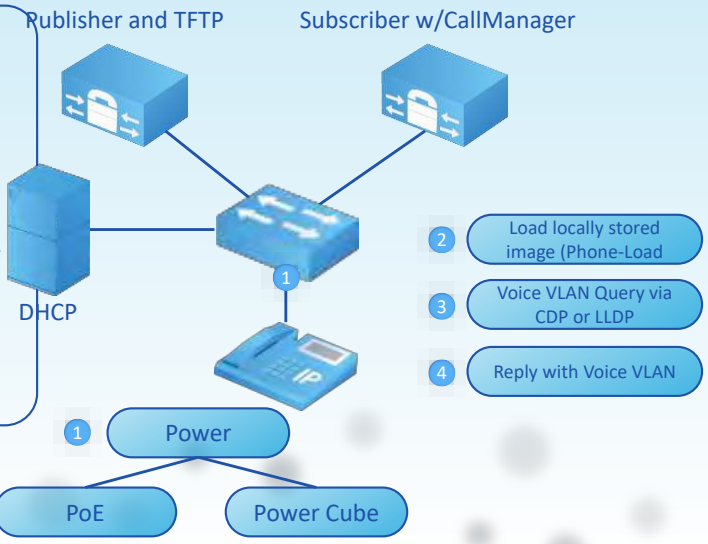
# Step 2 to 4 Phone Boot up Process

Identify if a Voice VLAN has been configured

If voice VLAN configured, it will reply to the phone with the information

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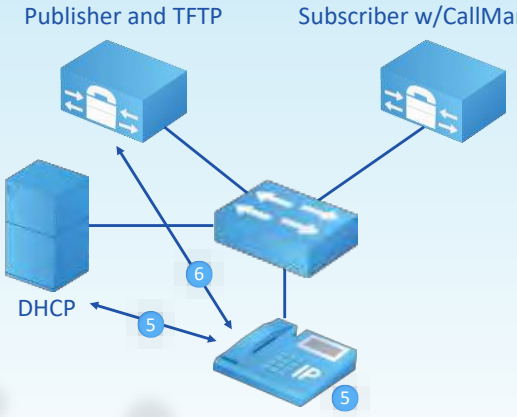
# Step 5 to 6 IP Phone Boot up Process




5 IP Settings

IP Address Subnet Mask Default Gateway DNS Option 150

6 Configuration from TFTP

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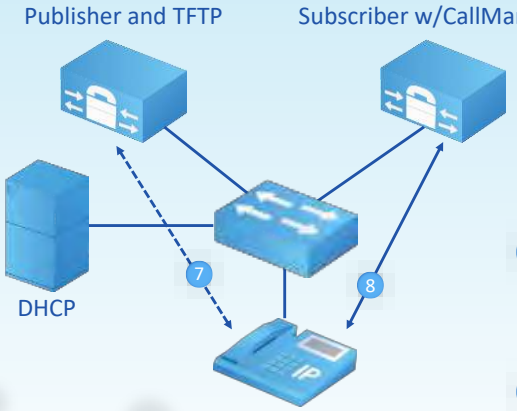
# Step 7 to 8 IP Phone Boot up Process




7 Download phone load is local version doesn't match configuration file

8 Registration

Secondary | Secondary | Secondary

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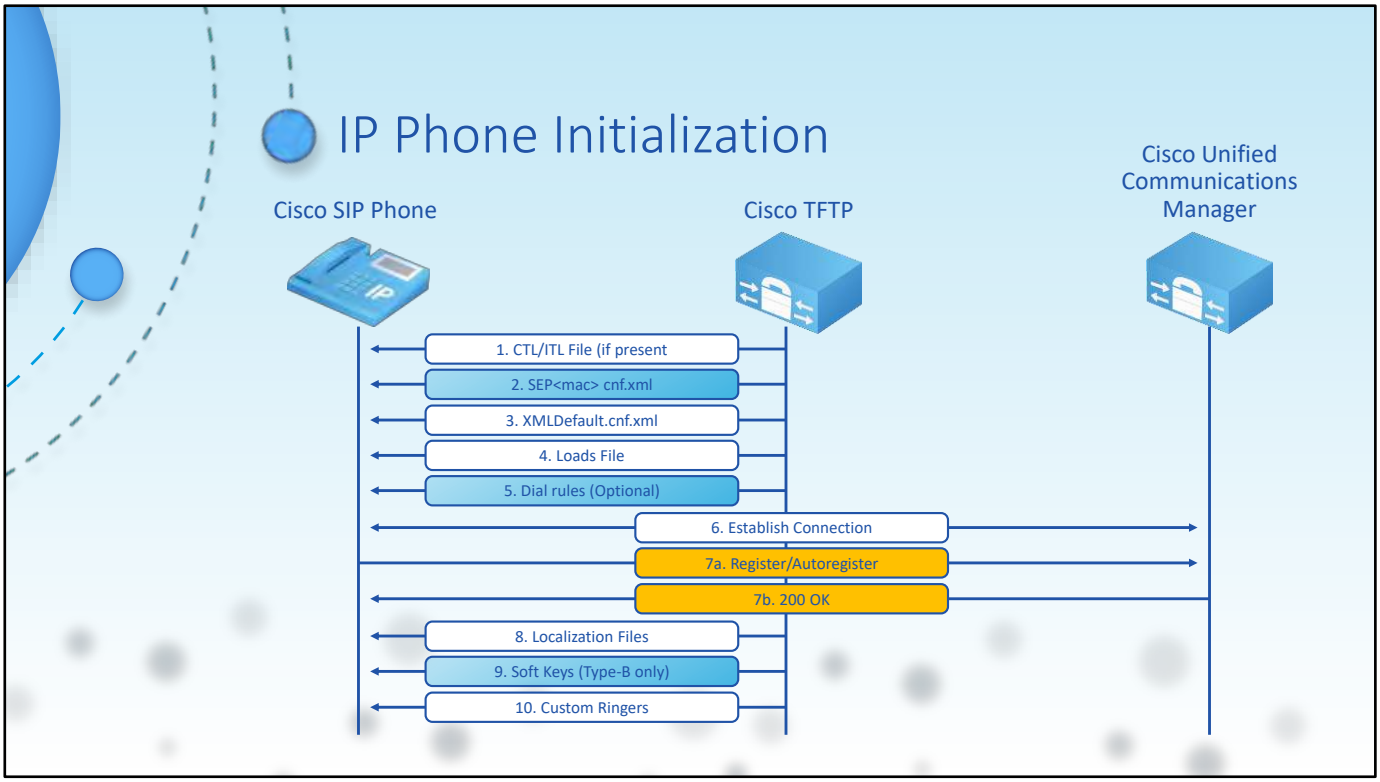


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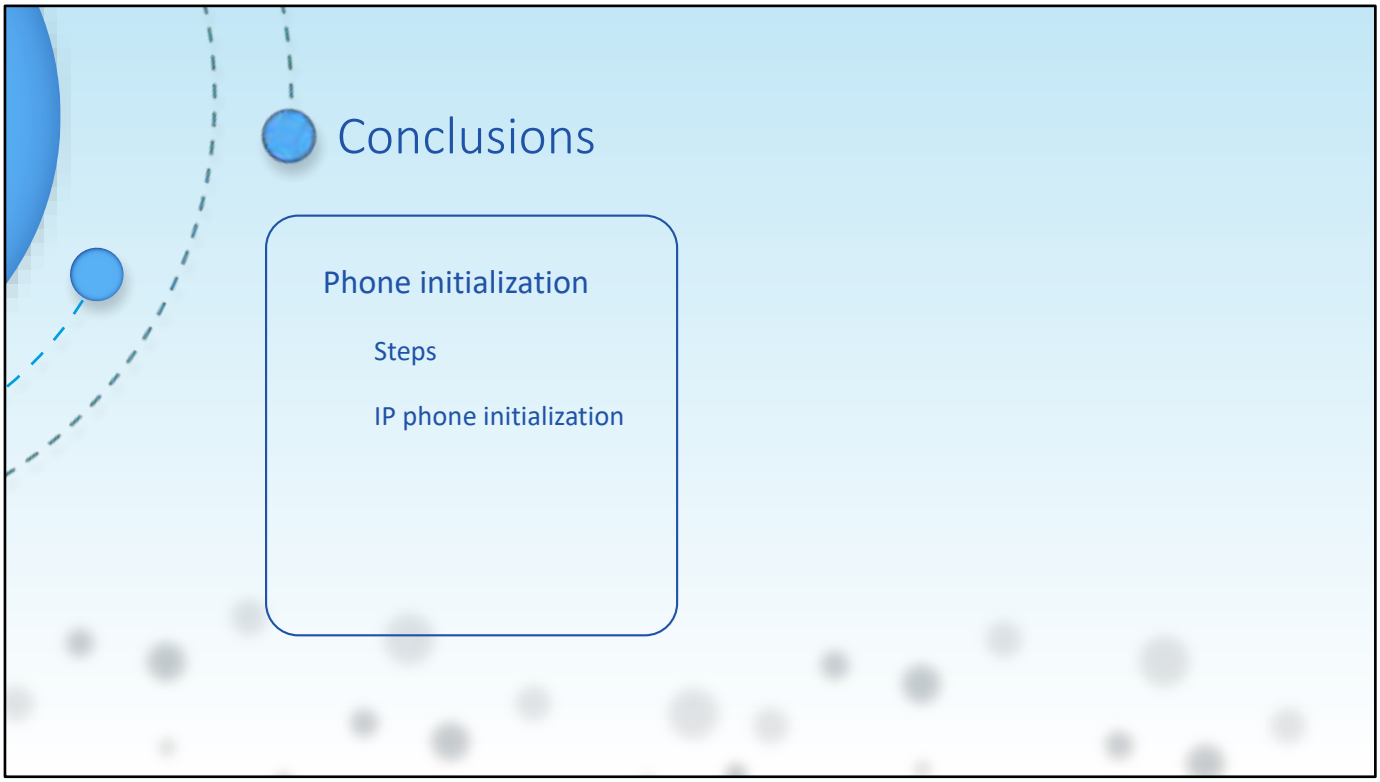


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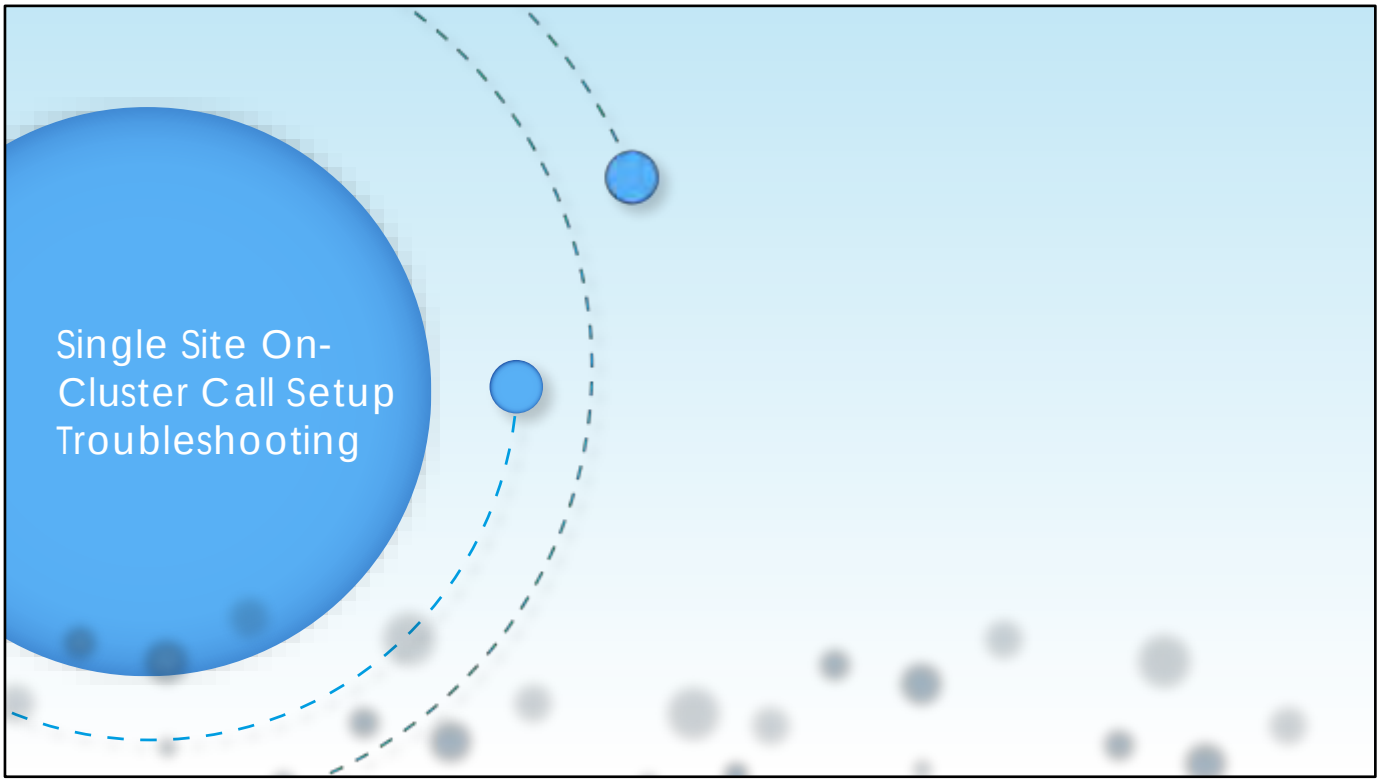


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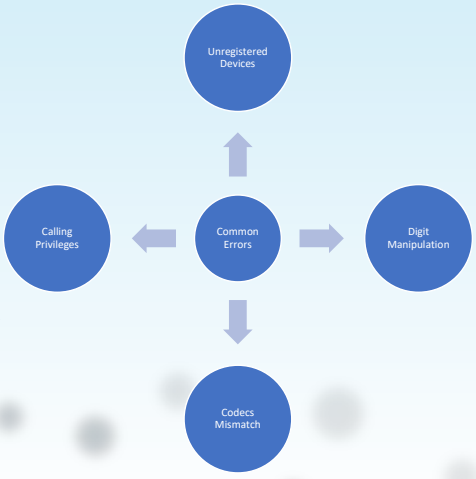
# Troubleshooting

Configuration errors can cause problems in many areas

Can cause a call to fail within a single site for the following reasons

- A translation pattern is configured with incorrect digit manipulation.
- The destination might not be registered to Cisco Unified Communications Manager.
- Calling privileges might be misconfigured.
- Codec negotiation issues exist

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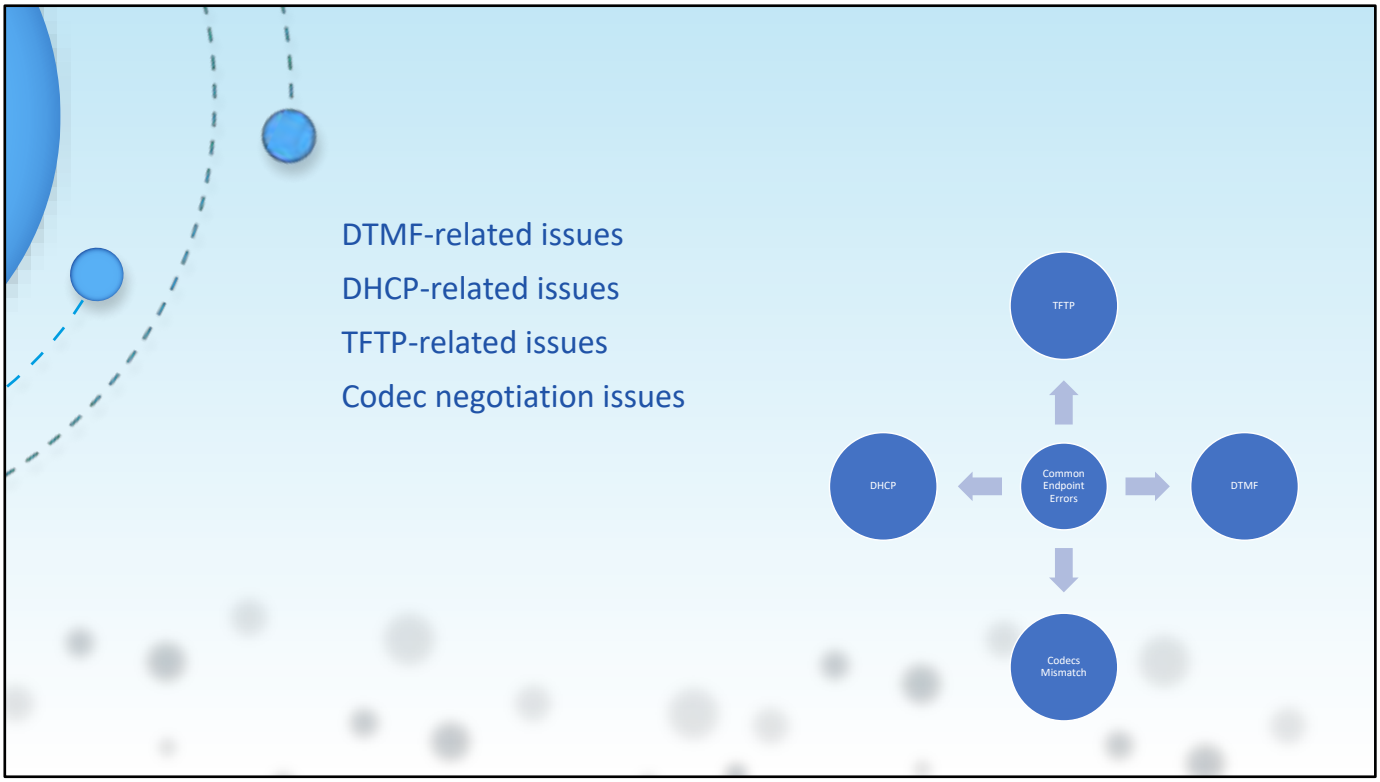


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# Codec Negotiation Process and Issues

A codec is a device or software that is capable of encoding or decoding a digital data stream or signal.

Audio codecs can code or decode a digital audio data stream, and video codecs enable compression or decompression of digital video.

A successful codec negotiation is mandatory for a successful call between two parties.

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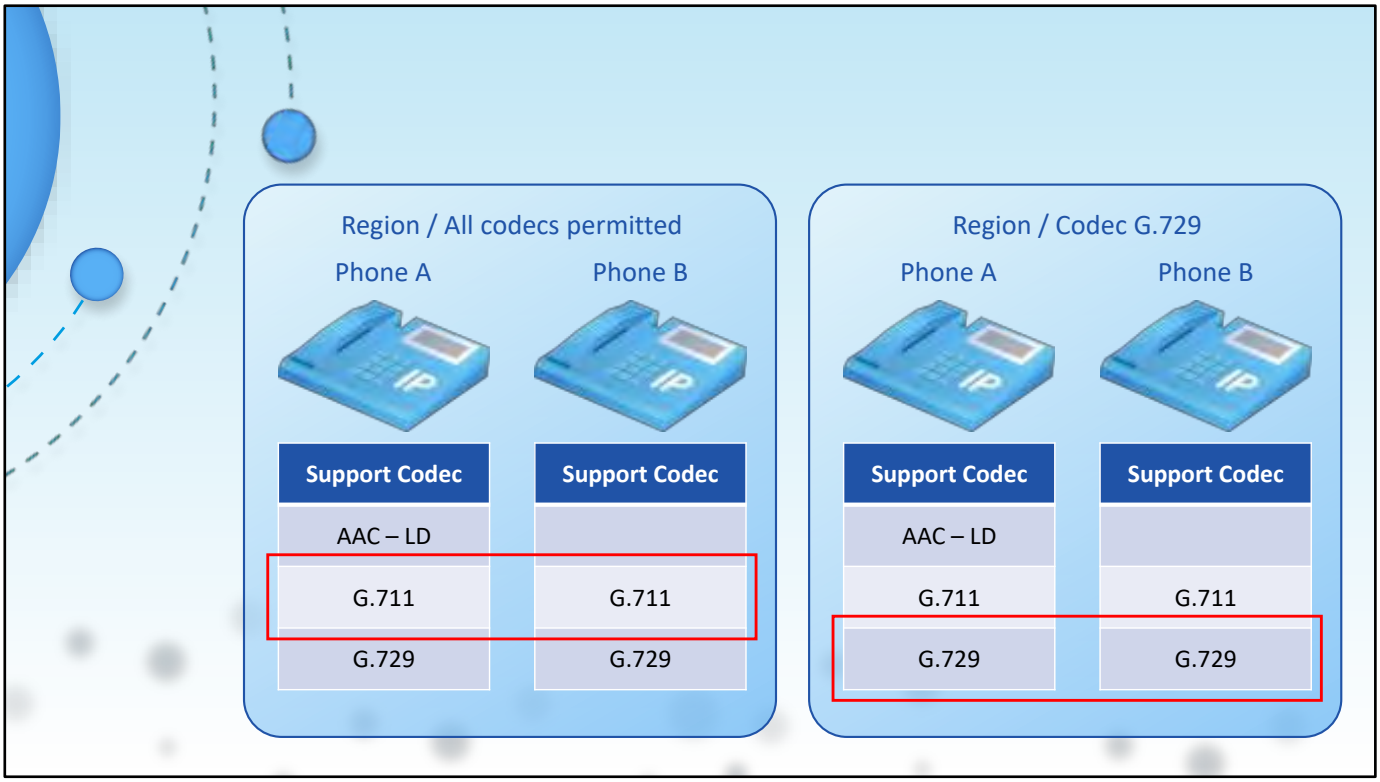


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# Conclusions

Single site on cluster call setup troubleshooting

Codec Negotiation

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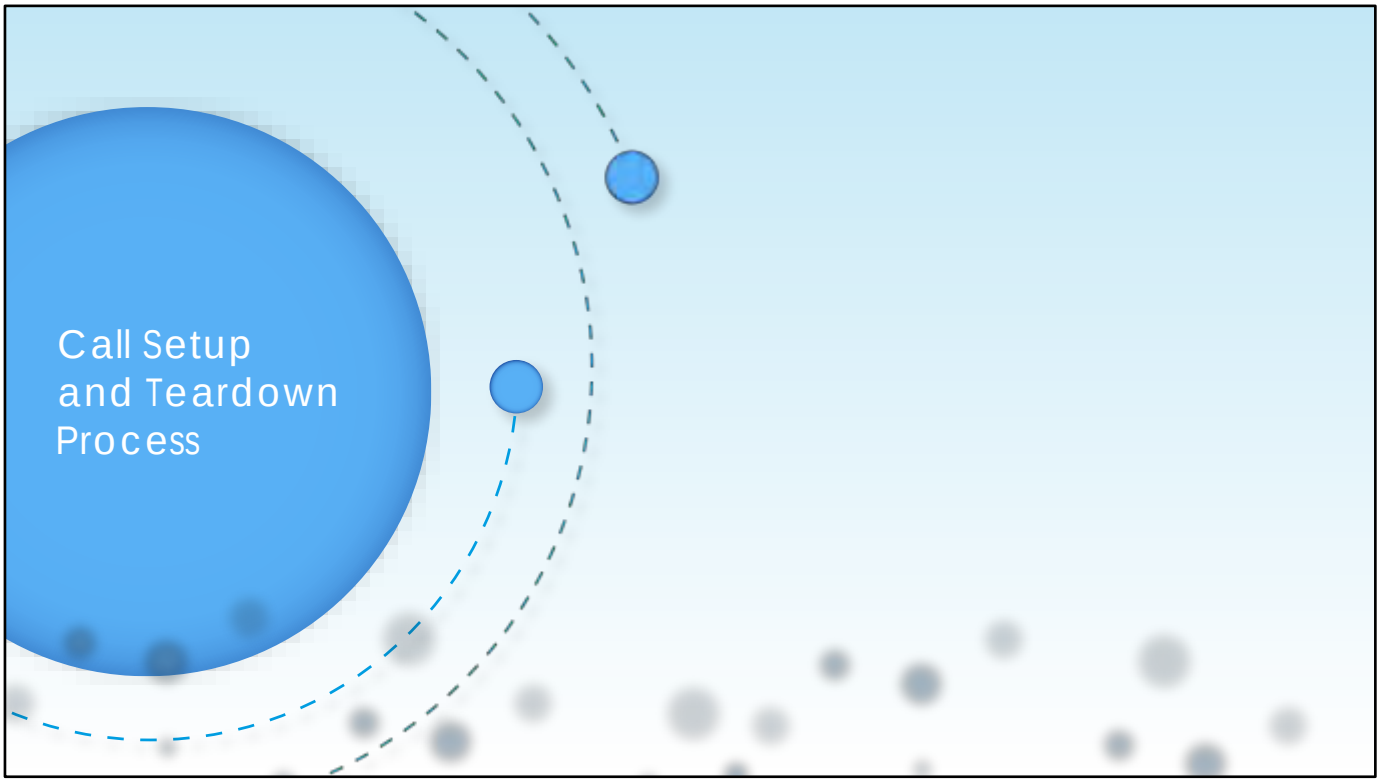


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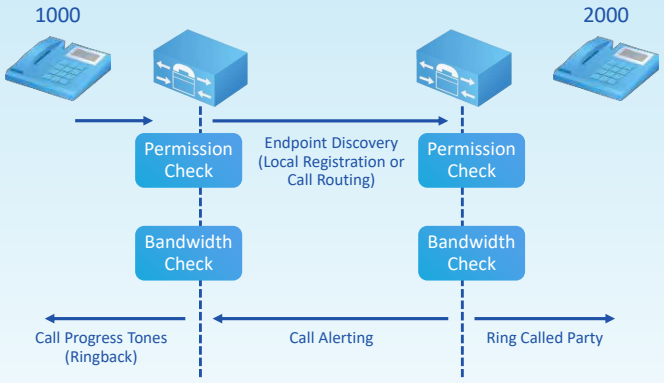
# Call Setup

There are many different protocols and methods for call setup and tear down. However, they all have a few fundamental steps in common.

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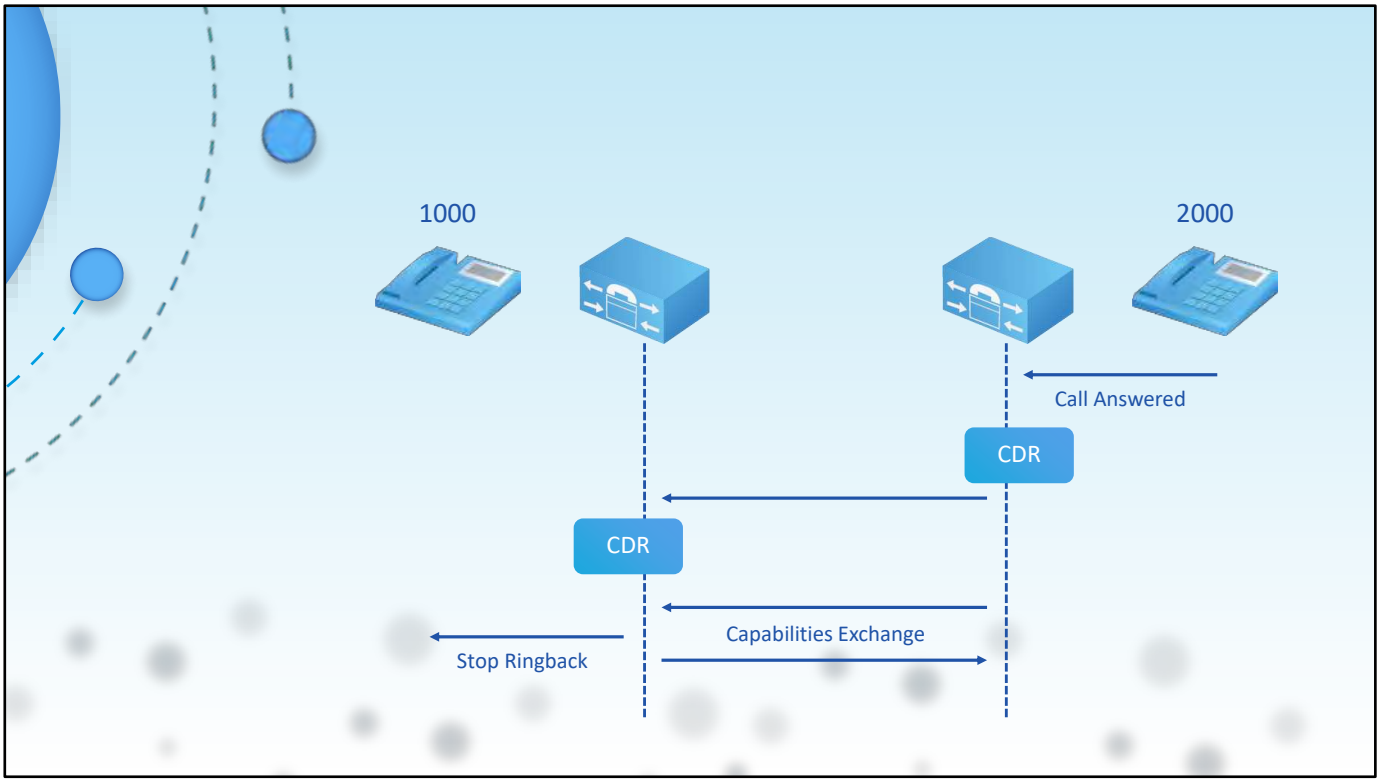


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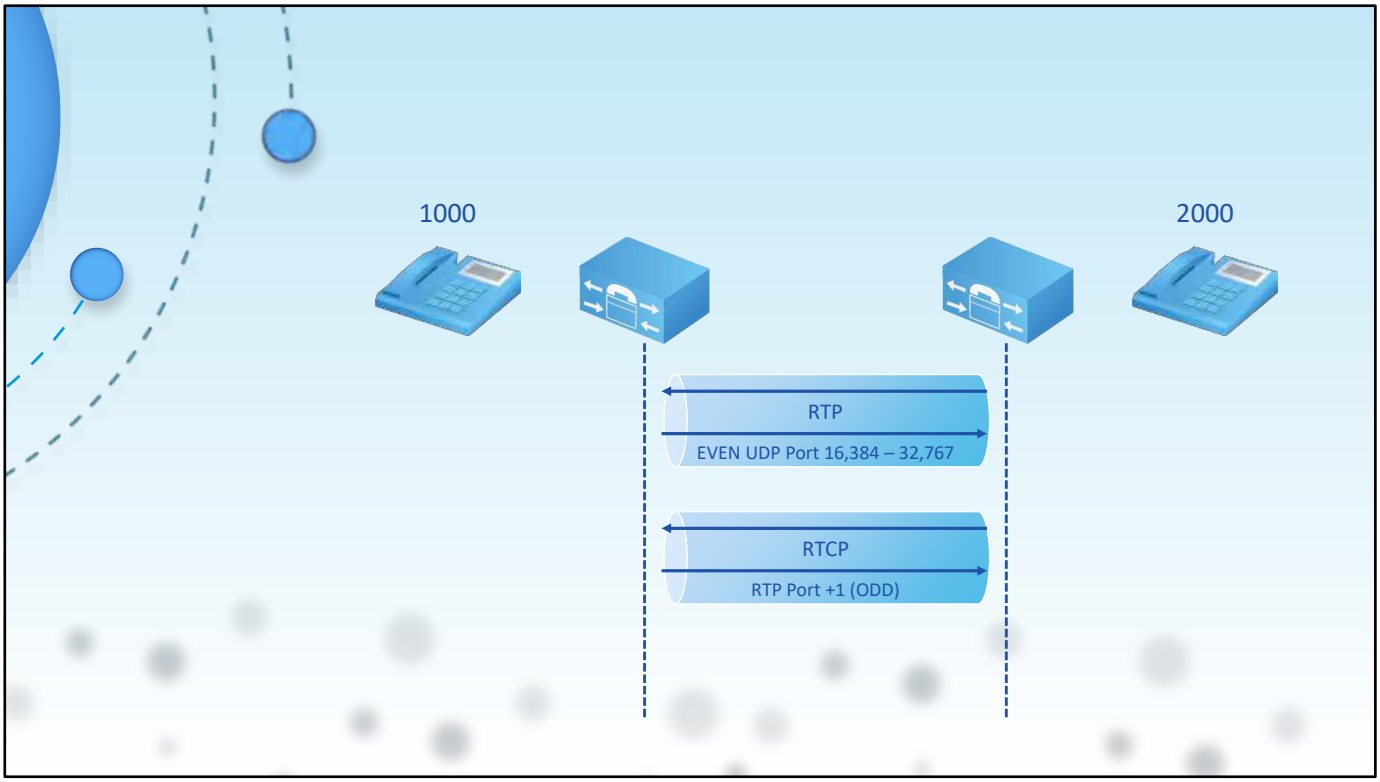


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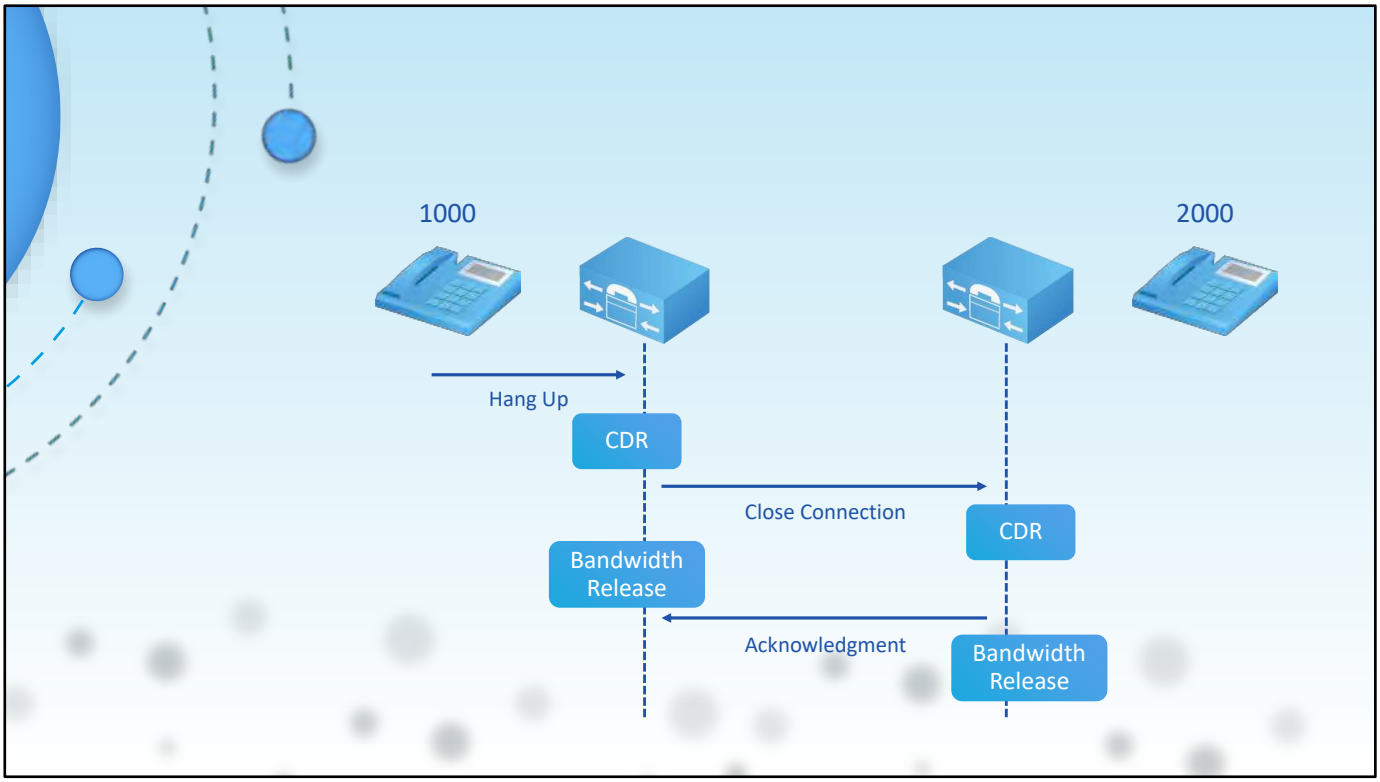


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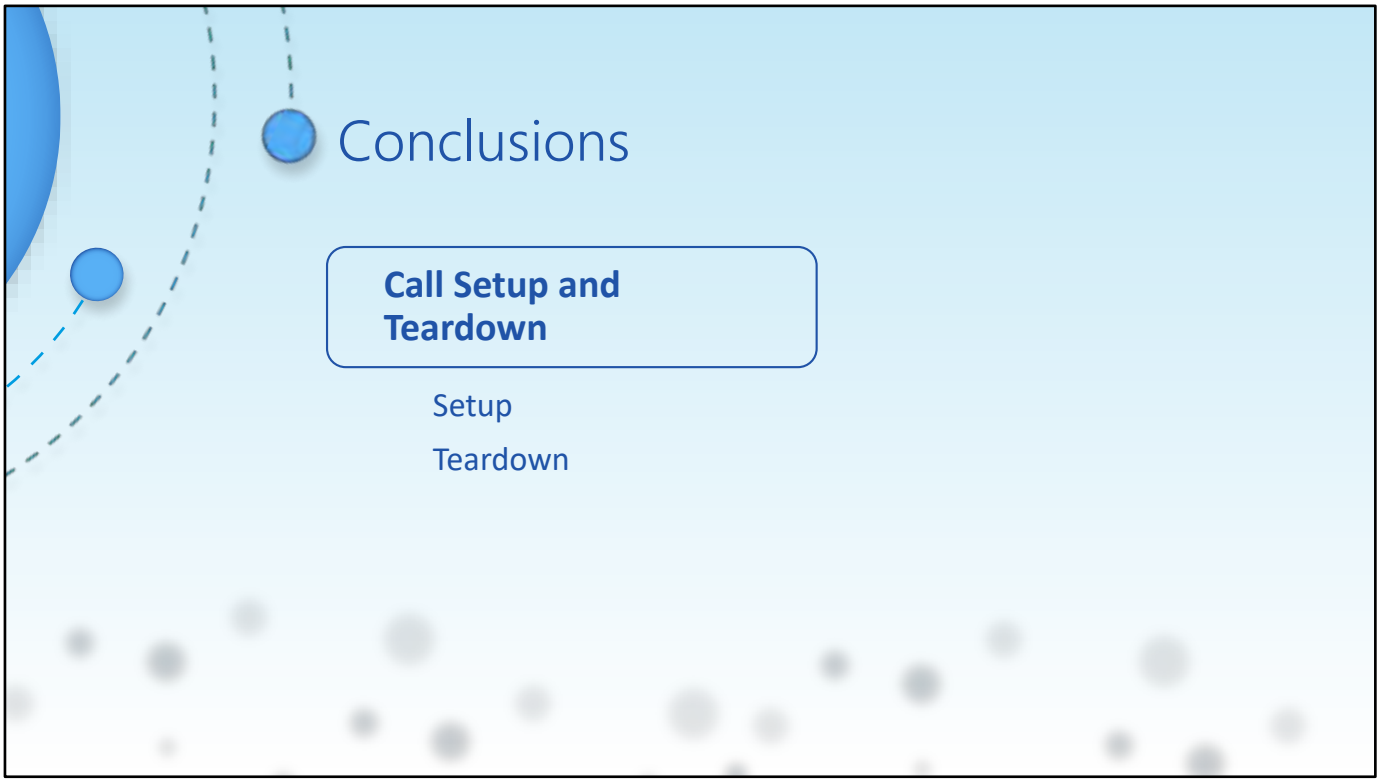


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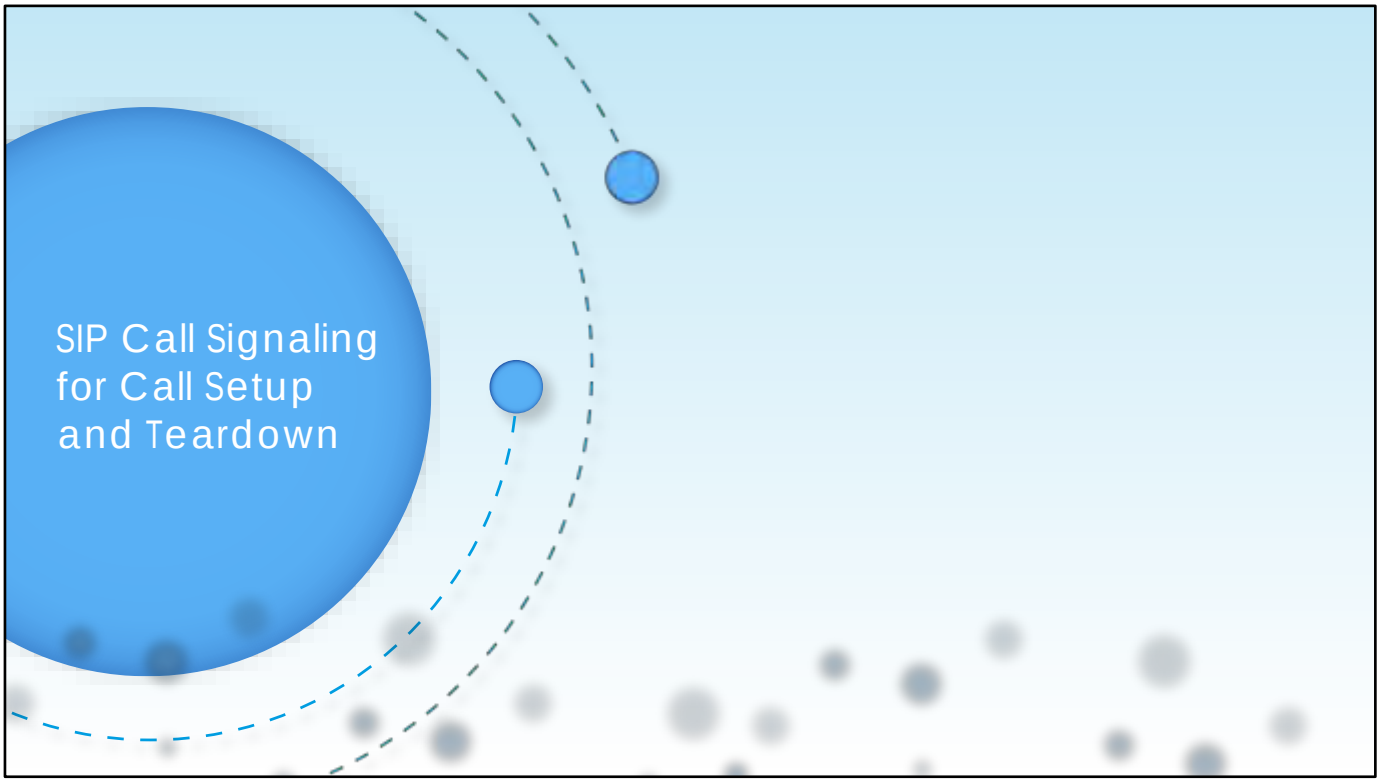


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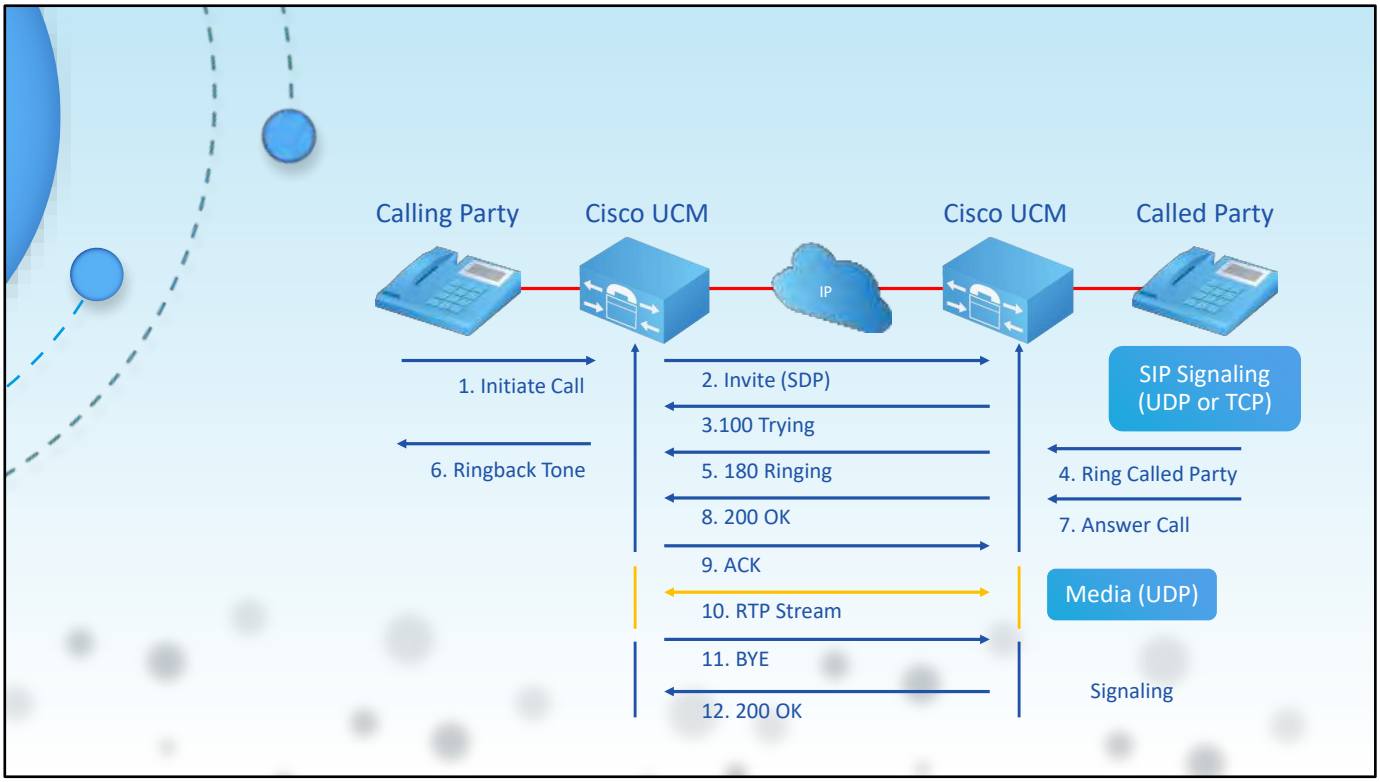


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# SDP

- Example 1: Audio, RTP/49100, G.711 mu-law)

```
v=0
0-bjoe +1-201-555-1212 IN IP4
s-Example1
t=0 0
c-IN IP4 192.168.1.1
m=audio 49100 RTP/AVP 0
```

Example 2: Audio, RTP/3456, G.729 most preferred, G7.11 mu-law second chaice, G.711 a-law third choice)

```
v=0
0-asmith 13015556789 IN IP4 cisco.com
s-Example2
t=0 0
c-IN IP4 192.234.1.1
m=audio 3456 RTP/AVP 18 0 8
```

SDP Content Varies Depending on the Message Type

| Field | Description |
|---|---|
| Version | V=0 |
| Origin | 0=<username> <session id> <version> <network type> <address type> <address> |
| Session Name | s=<session name> |
| Times | t=<start time> <stop time> |
| Connection Data | c=<network type <address type> <connection address> |
| Media | m=<media> <port> <transport> <media format list> |
| Audio<br><br>Video<br>Profile<br>(AVP) codes | 0: G.711 mu-law<br><br>8: G.711 a-law<br>3:GSM codec<br>18.G729 |

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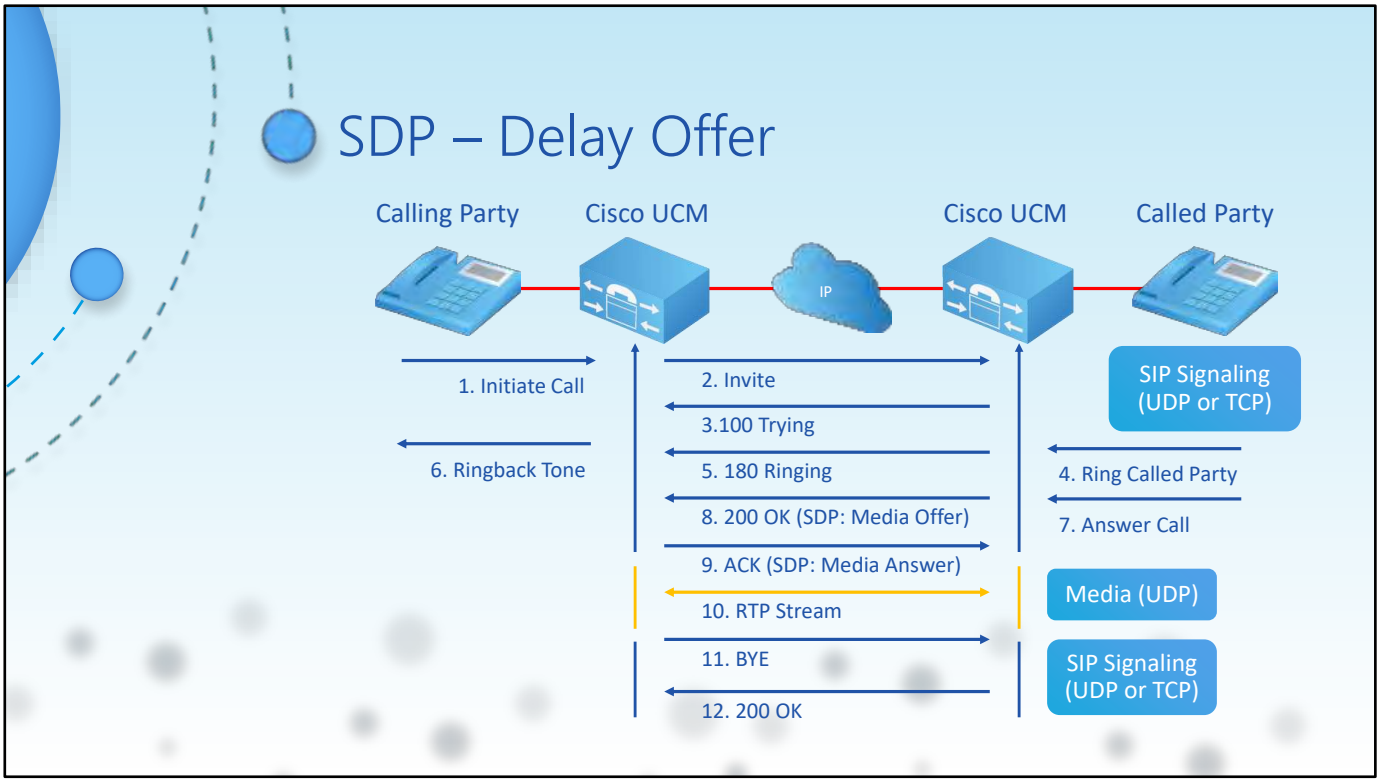
# SDP – Delay Offer

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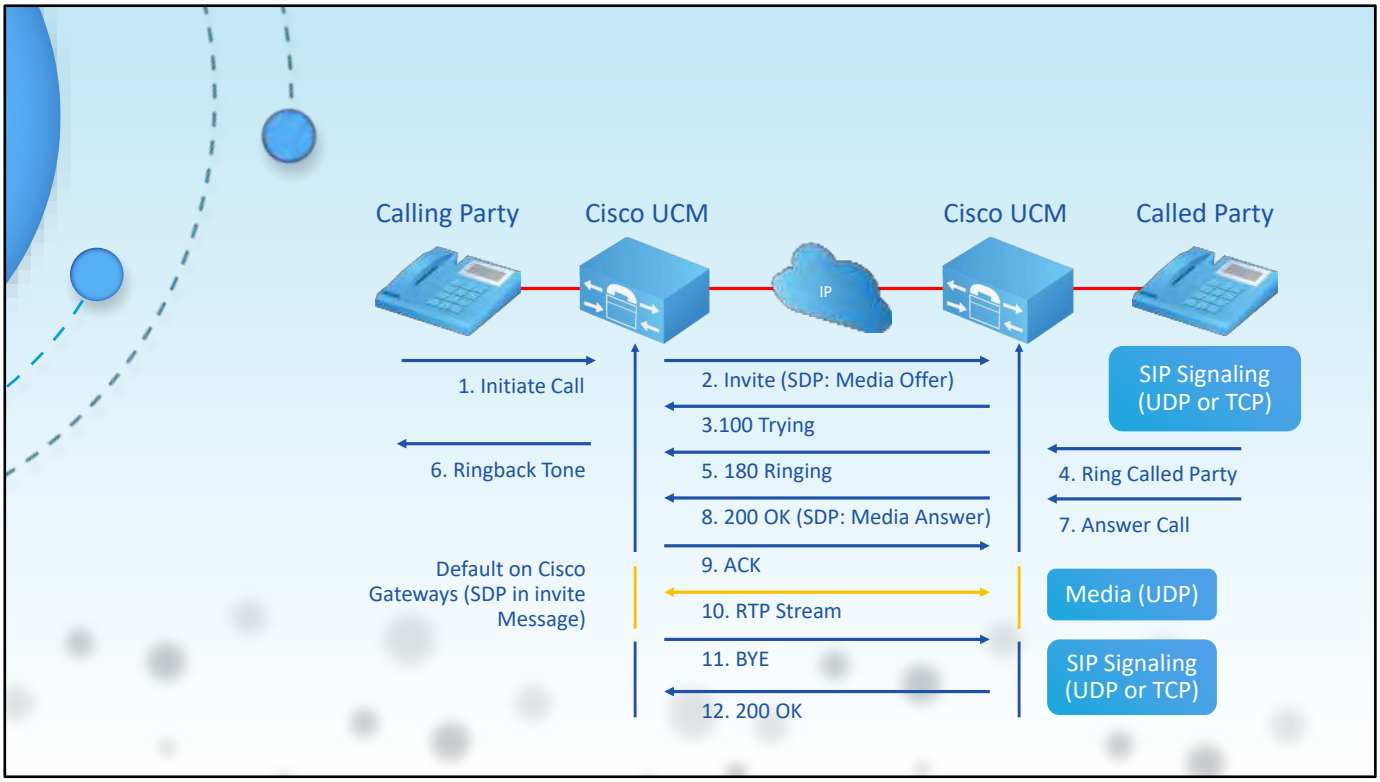


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# Conclusions

- SIP call signaling for call setup and teardown
  - SDP
    - Delay offer

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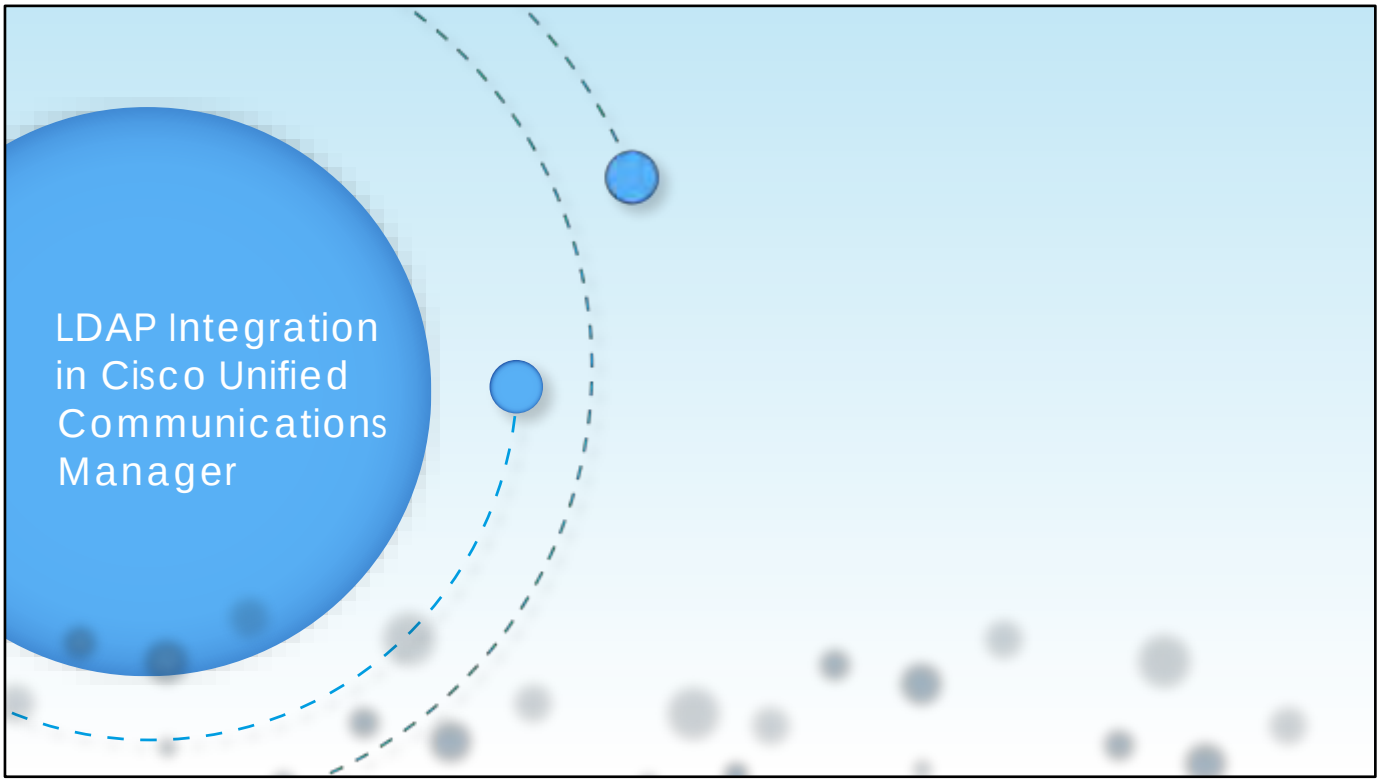


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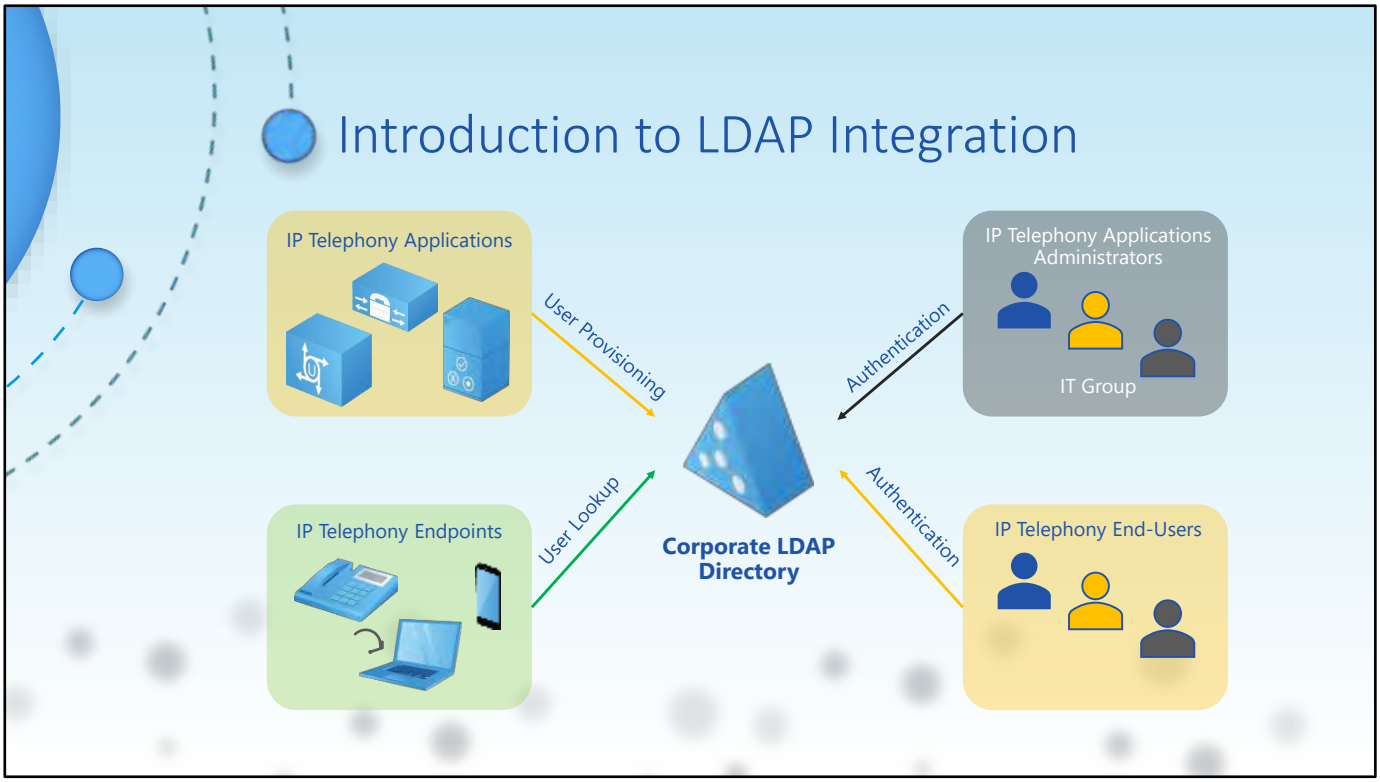


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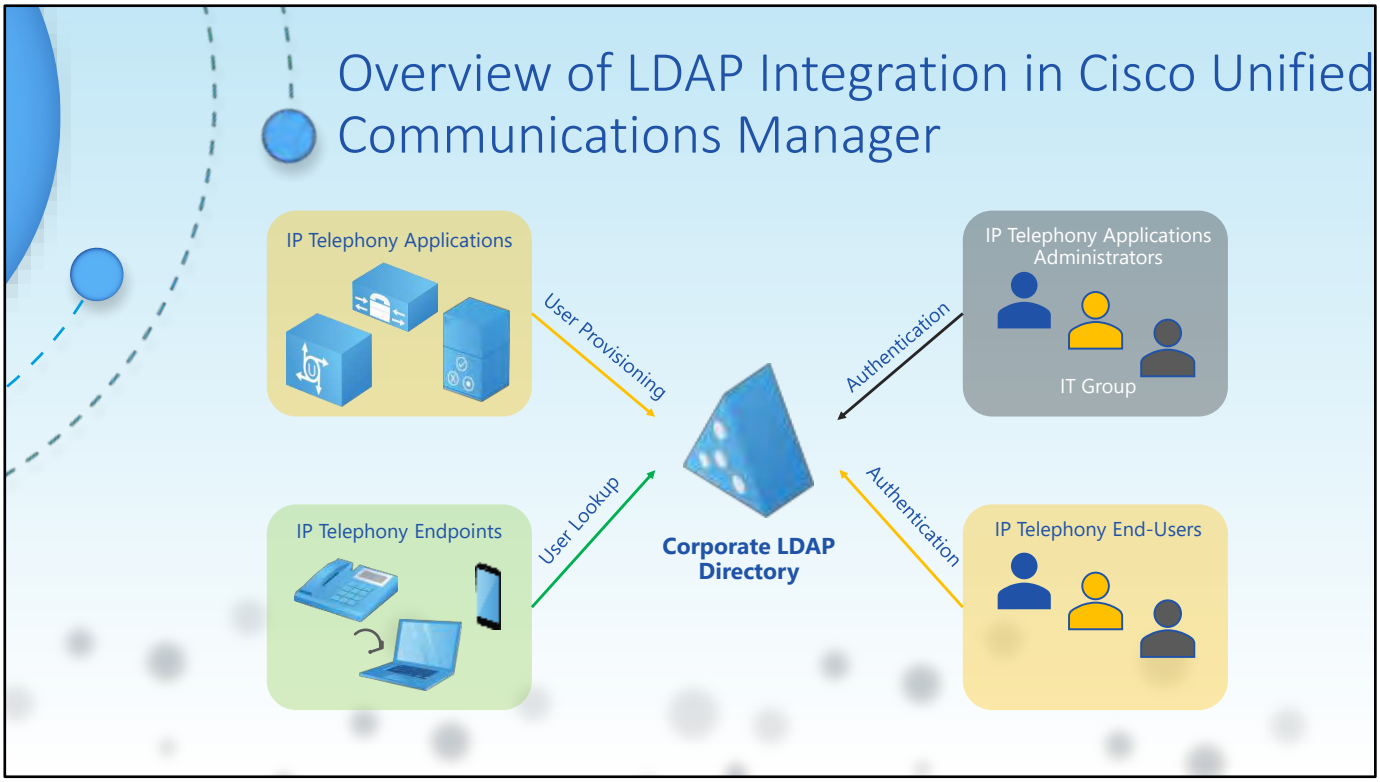


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# Cisco Unified Communications Manager User Accounts

- You cannot use LDAP with application users. LDAP is only applicable for end users.

| | End Users | Application Users |
|---|---|---|
| Association | Individual User | Application |
| Interactive Login | Yes | No |
| Use | User Features and Administrator Login | Application Authorization |
| User Directory | Included | Not Included |
| LDAP | Yes | No |

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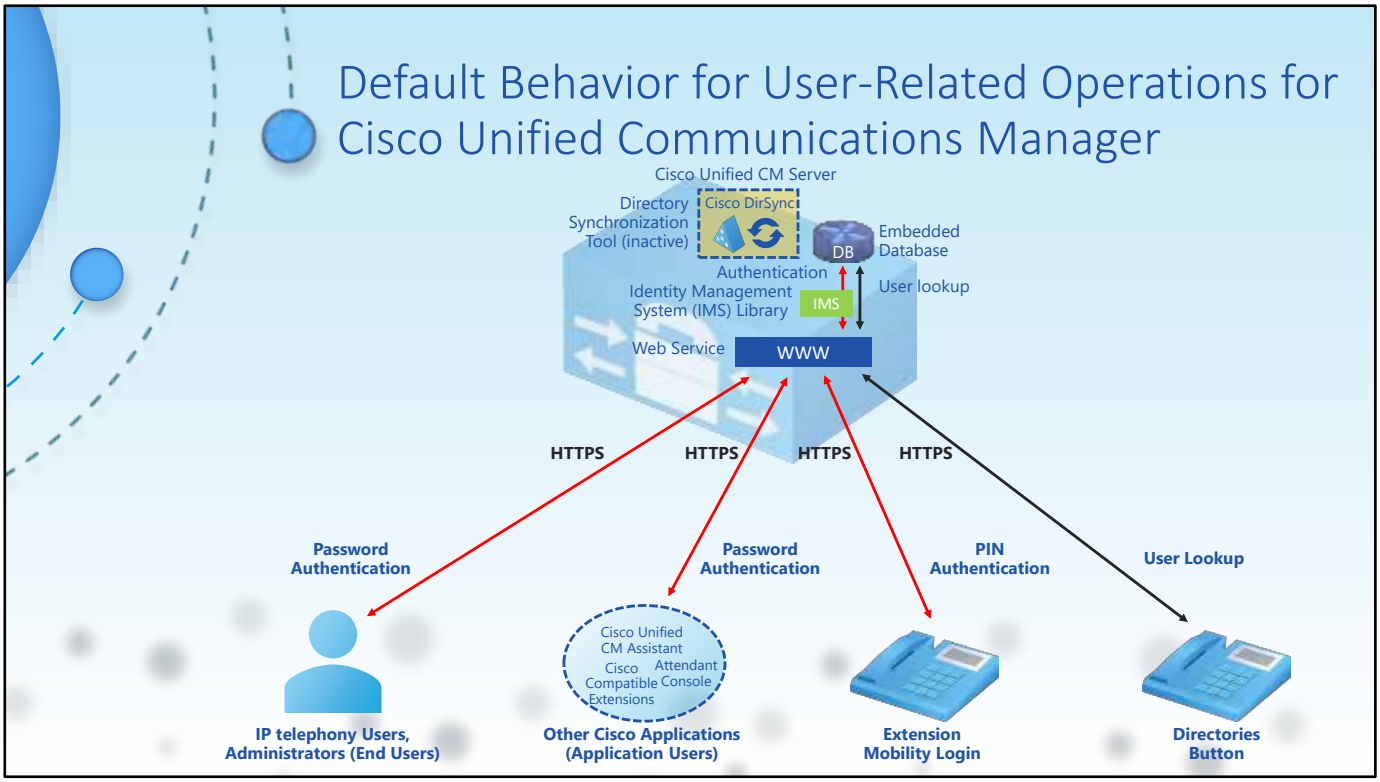
# Default Behavior for User-Related Operations for Cisco Unified Communications Manager

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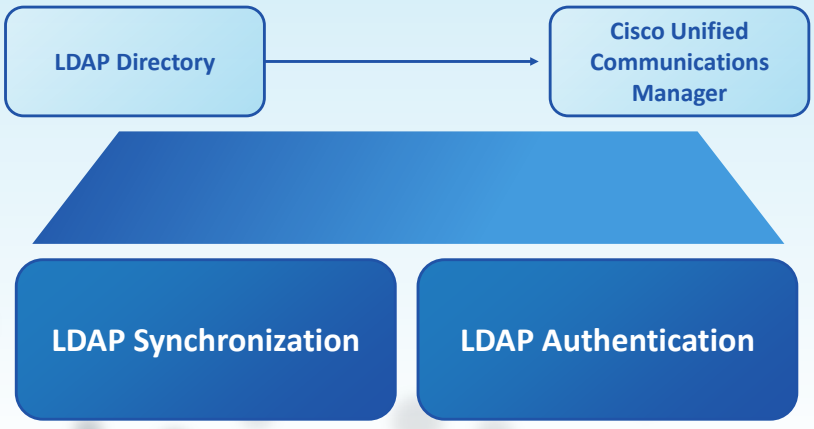
# Cisco Unified Communications Manager LDAP Support

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# LDAP Integration Options

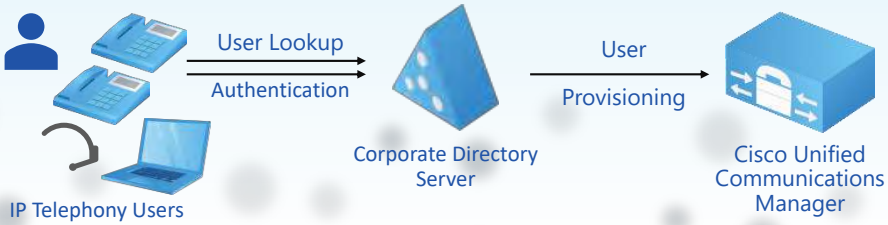
**LDAPv3**

**Specialized Database stores info about users:**

Centralized storage of user information
Available to all enterprise applications

**Examples**

Microsoft Active Directory
Sun Directory Services
OpenLDAP

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# Supported LDAP Directories

**Cisco Unified Communications Manager supports synchronization with the following LDAP directories:**

- Microsoft Active Directory 2003 R1 and R2 (32-bit)
- Microsoft Active Directory 2008 R1 (32-bit) and R2 (64-bit)
- Microsoft Active Directory Application Mode 2003 R1 and R2 (32-bit)
- Microsoft Active Directory 2012
- Microsoft Active Directory 2016
- Microsoft Lightweight Directory Services 2008 R1 (32-bit) and R2 (64-bit)
- Microsoft Lightweight Directory Services 2012
- Sun ONE Directory Server 7.0
- OpenLDAP 2.3.39
- OpenLDAP 2.4
- Oracle Directory Server Enterprise Edition 11g Release 1
- Other LDAPv3 compliant directories

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# Conclusions

- LDAP Integration in Cisco Unified Communications Manager
  - Overview
  - CUCM User accounts
  - Default behavior
  - CUCM LDAP support
  - LDAP Integration options
  - Supported LDAP directories

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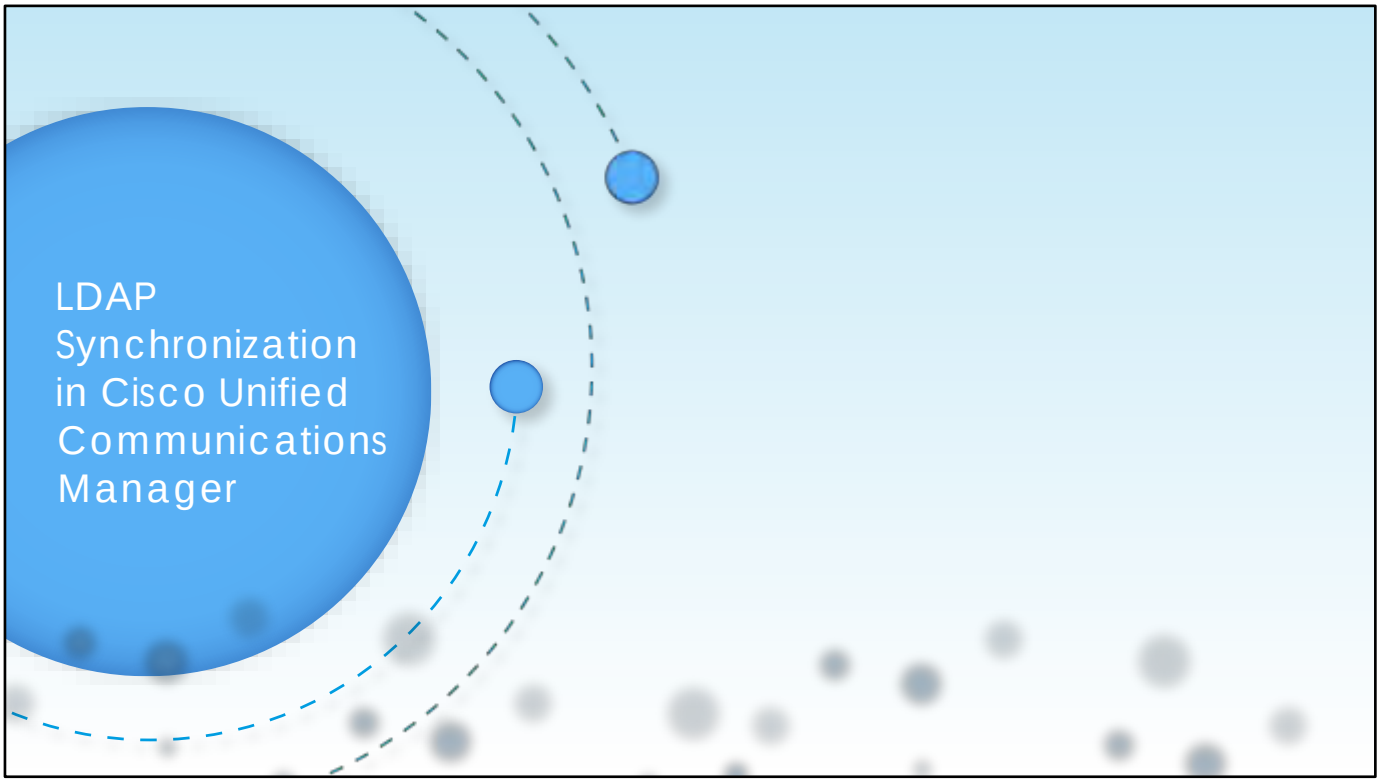


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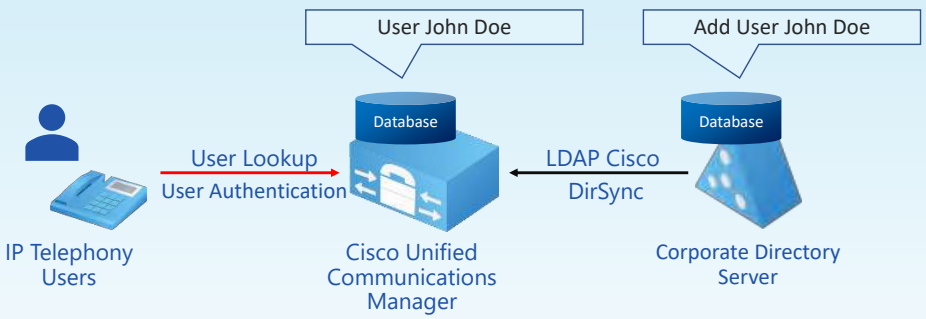
# LDAP Synchronization

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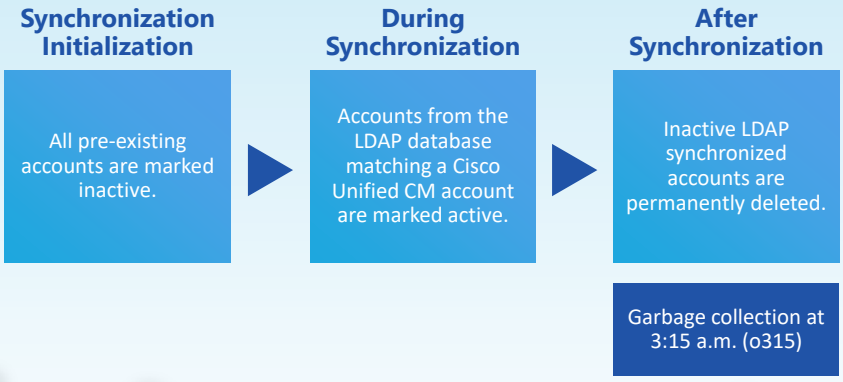
# Synchronization Mechanism

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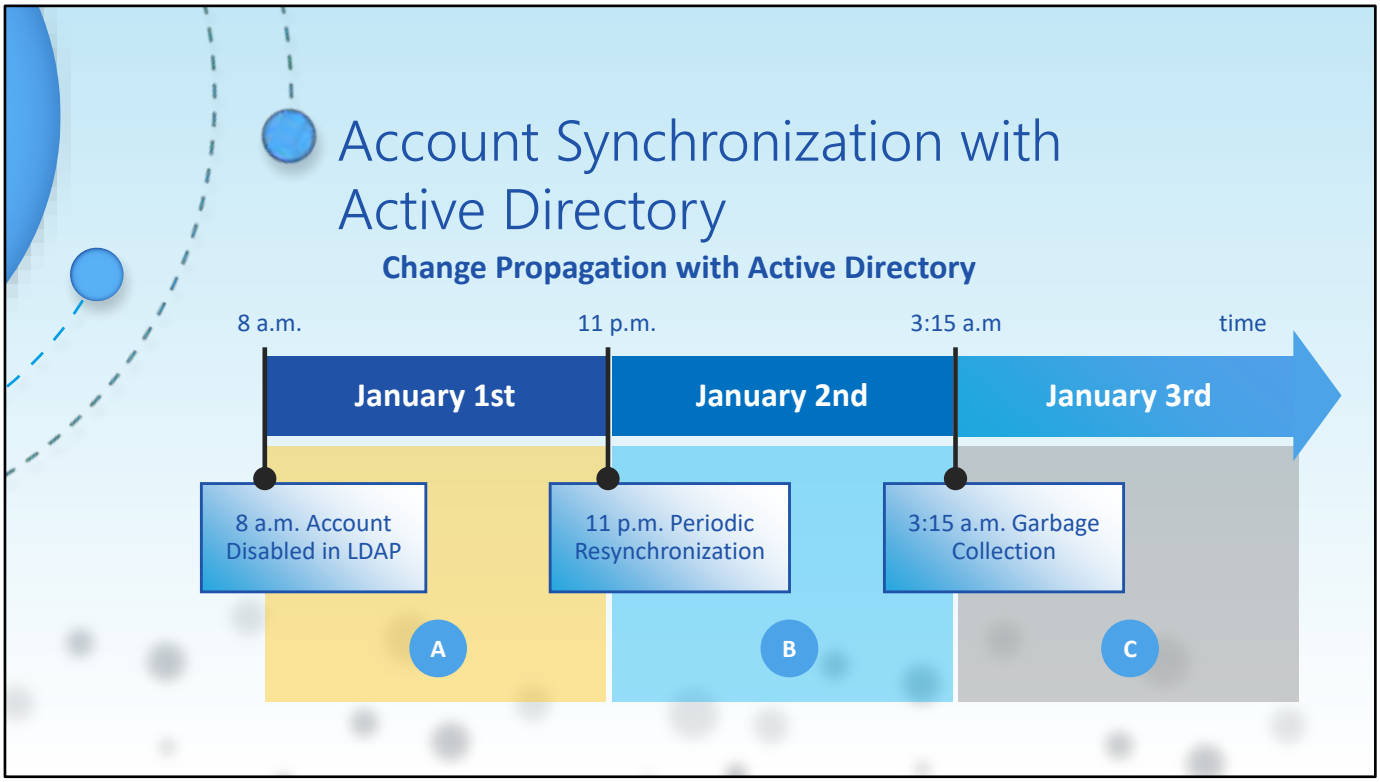
# Account Synchronization with Active Directory

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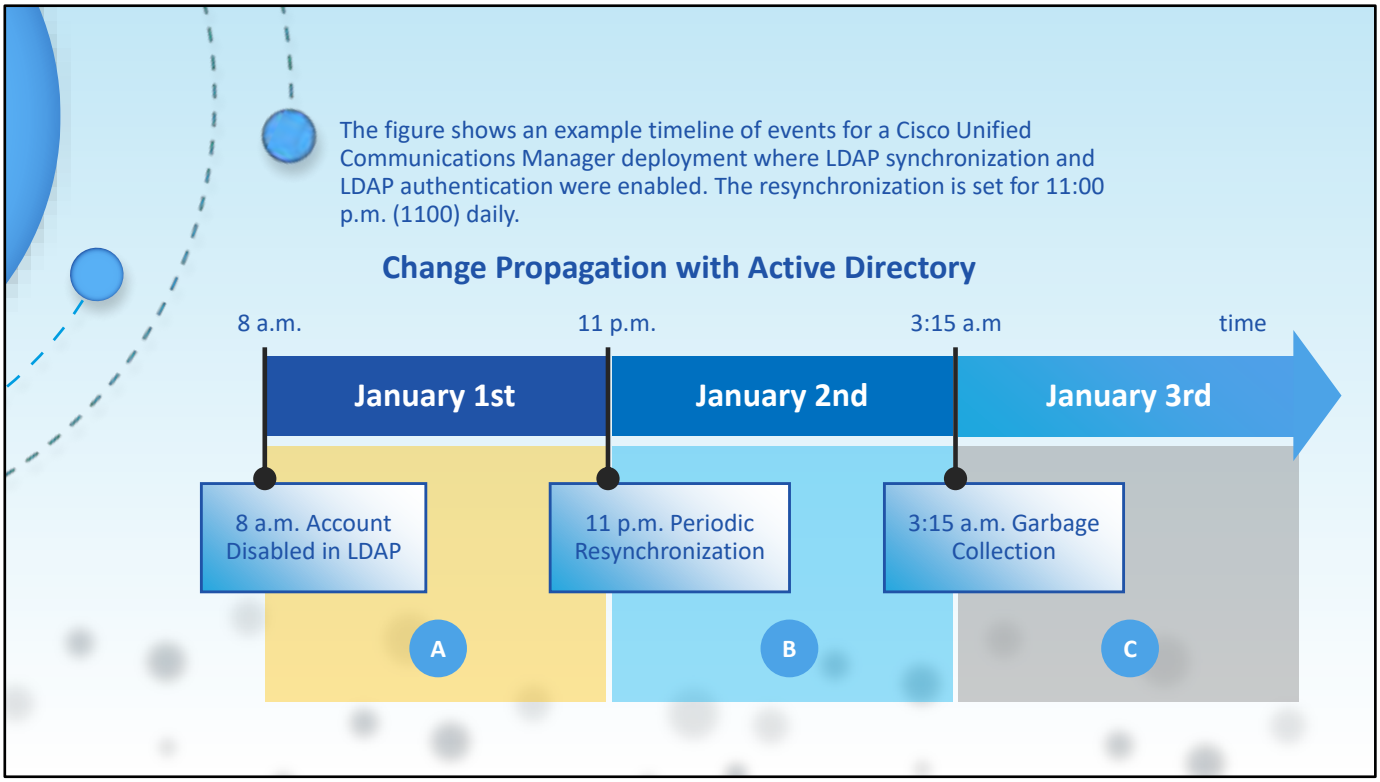


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# Conclusions

**LDAP Synchronization in Cisco Unified Communications Manager**

Synchronization

Mechanism

Account sync with AD

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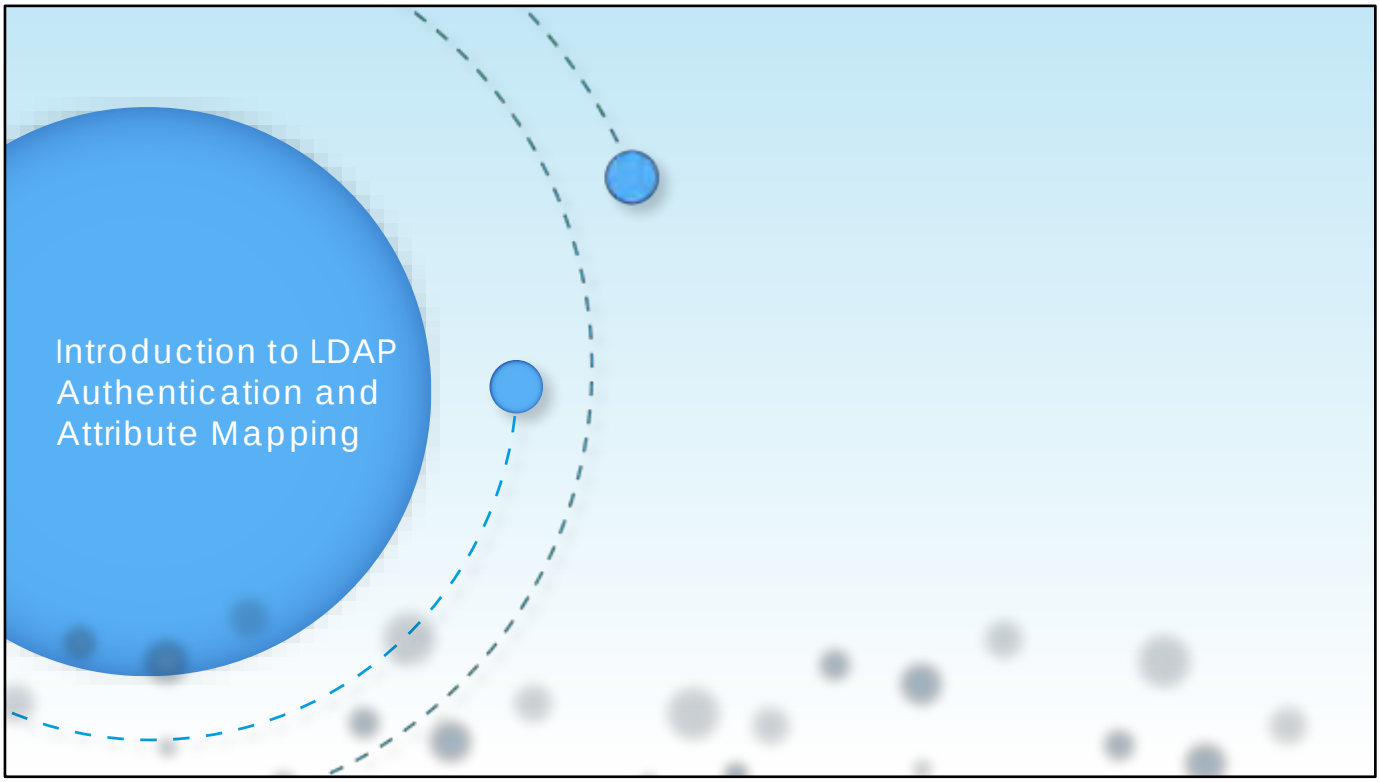


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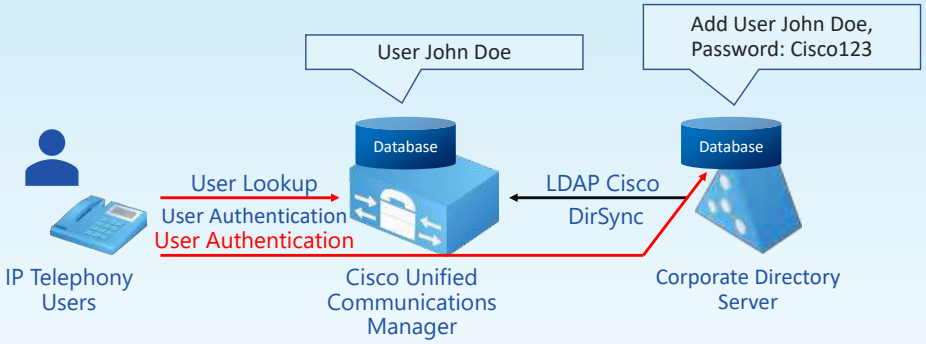
# LDAP Synchronization

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# Introduction to Attribute Mapping

**When LDAP synchronization is performed, LDAP directory attributes are mapped to Cisco Unified Communications Manager attributes**

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# Attribute Mapping

| Cisco Unified Communications Manager | Microsoft Active Directory |
|---|---|
| User ID | sAMAccountName, mail, employeeNumber, telphoneNumber, UserPrincipalName |
| First Name | givenName |
| Middle Name | middleName, Initials |
| Last Name | sn |
| Manager ID | manager |
| Department | department |
| Phone Number | telephoneNumber, ipPhone |
| Mail ID | mail, sAMAccountName |
| Directory URI | msRTCSIP-primaryuseraddress, Mail, None |

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# Conclusions

**Introduction to Authentication**

**Introduction to Attribute mapping**

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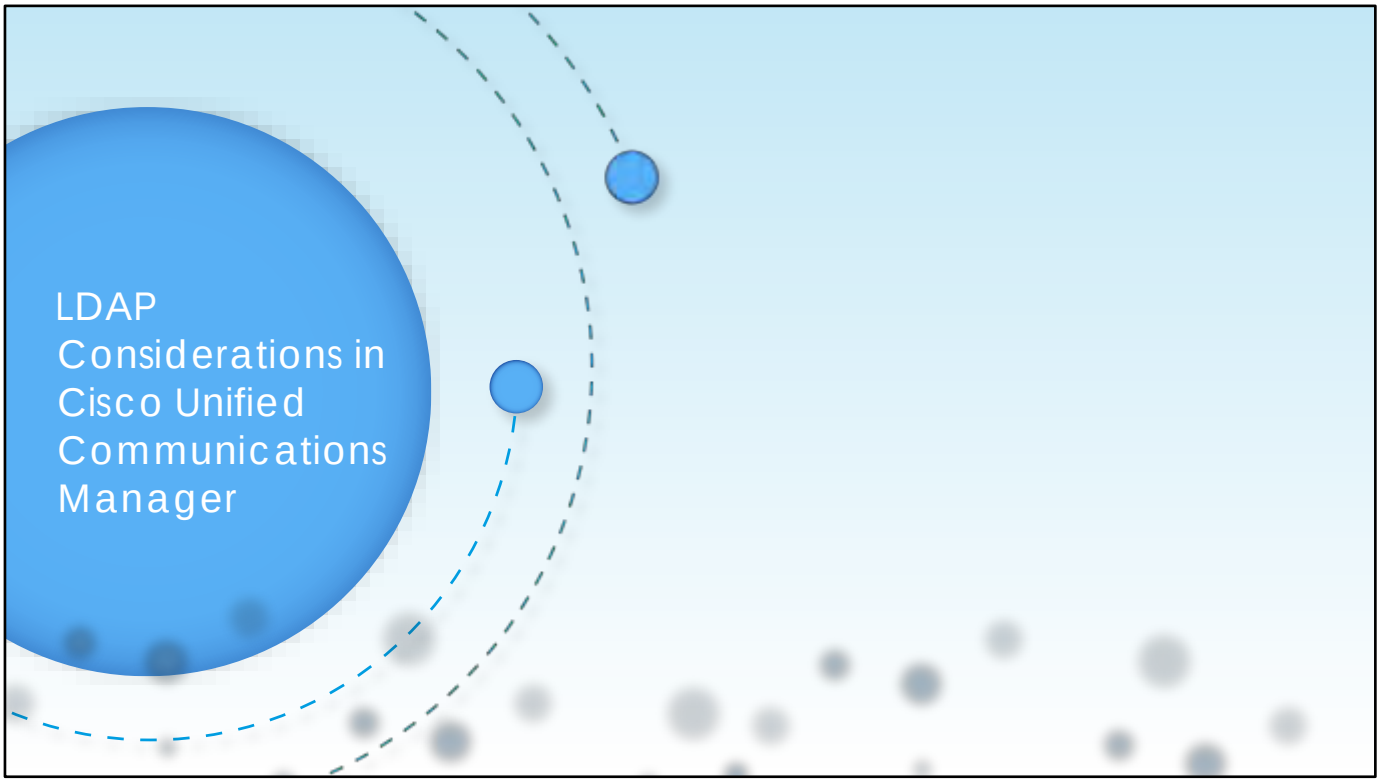


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# Design Considerations for LDAP Synchronization

The Cisco Unified Communications Manager User ID and the unique LDAP attribute require a corporate directory account to read the user objects from the directory

**Full synchronization:**

**Incremental synchronization**

Attributes

- sAMAccountName
- UserPrincipalName
- mail
- TelephoneNumber
- employeeNumber

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# Design Considerations for LDAP Synchronization

User Search Base: Mandatory parameter: Gets all users from LDAP

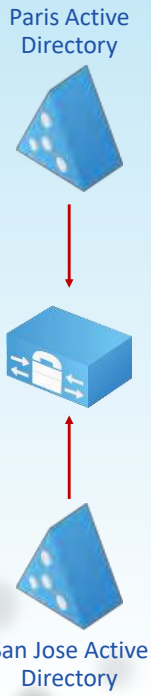
Custom Filter Match: Optional parameter: Gets certain users based on filter rules (i.e. user IDs starting with the letter “m”)

- Sun Directory Server 7.x
- Sun 6.x
- OpenLDAP 2.3.39 and 2.4
- Oracle DSEE 11gR1

All synchronization agreements must integrate with the same LDAP family (Microsoft Active Directory or Netscape. iPlanet, and Sun ONE).

Cisco Unified Communications Manager uses standard LDAPv3 to access data.

One LDAP user attribute is chosen to map to the Cisco Unified Communications Manager User ID field.

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# Attribute Mapping

| Cisco Unified Communications Manager | Microsoft Active Directory |
|---|---|
| User ID | sAMAccountName, mail, employeeNumber, telphoneNumber, UserPrincipalName |
| First Name | givenName |
| Middle Name | middleName, Initials |
| Last Name | sn |
| Manager ID | manager |
| Department | department |
| Phone Number | telephoneNumber, ipPhone |
| Mail ID | mail, sAMAccountName |
| Directory URI | msRTCSIP-primaryuseraddress, Mail, None |

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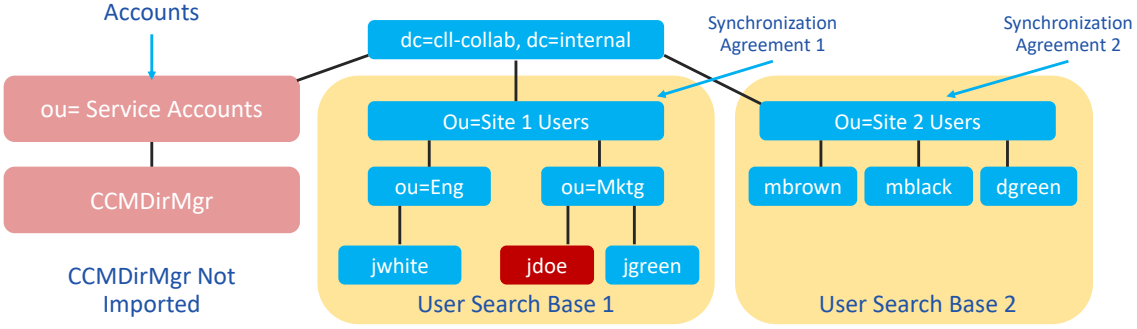
# Synchronization Agreements

**Synchronization agreements**

- ou = Site 1 users
- ou = Site 2 users
- Service Accounts

**Two synchronization agreements are represented:**

- One synchronization agreement specifies user search base 1 and imports users jwhite, jdoe, and jgreen.
- The other synchronization agreement specifies user search base 2 and imports users mbrown, mblack, and dgreen.

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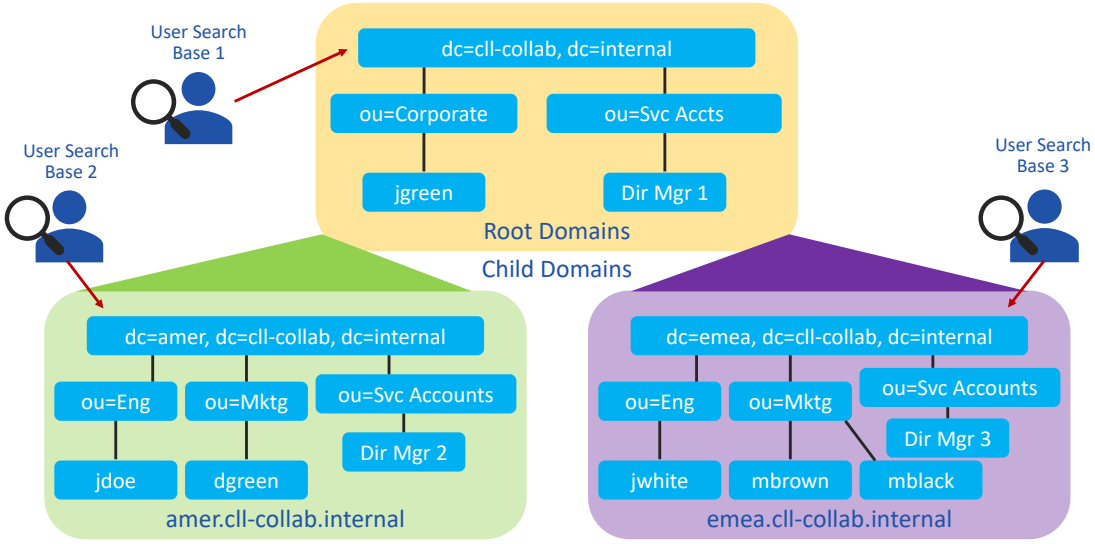
# Design Considerations for Active Directory Synchronization

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# Design Considerations for LDAP Authentication

Specific user account within the corporate directory with Read access

Manage end-user passwords for LDAP synchronized users from within the corporate directory interface.

Manage application user passwords from the Cisco Unified Communications Manager Admin pages.

Manage end-user PINs from the CUCM Admin pages.

Enable single login for CUCM administrators by adding their corresponding end user to the CUCM Super Users group.

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# Design Considerations for LDAP Authentication

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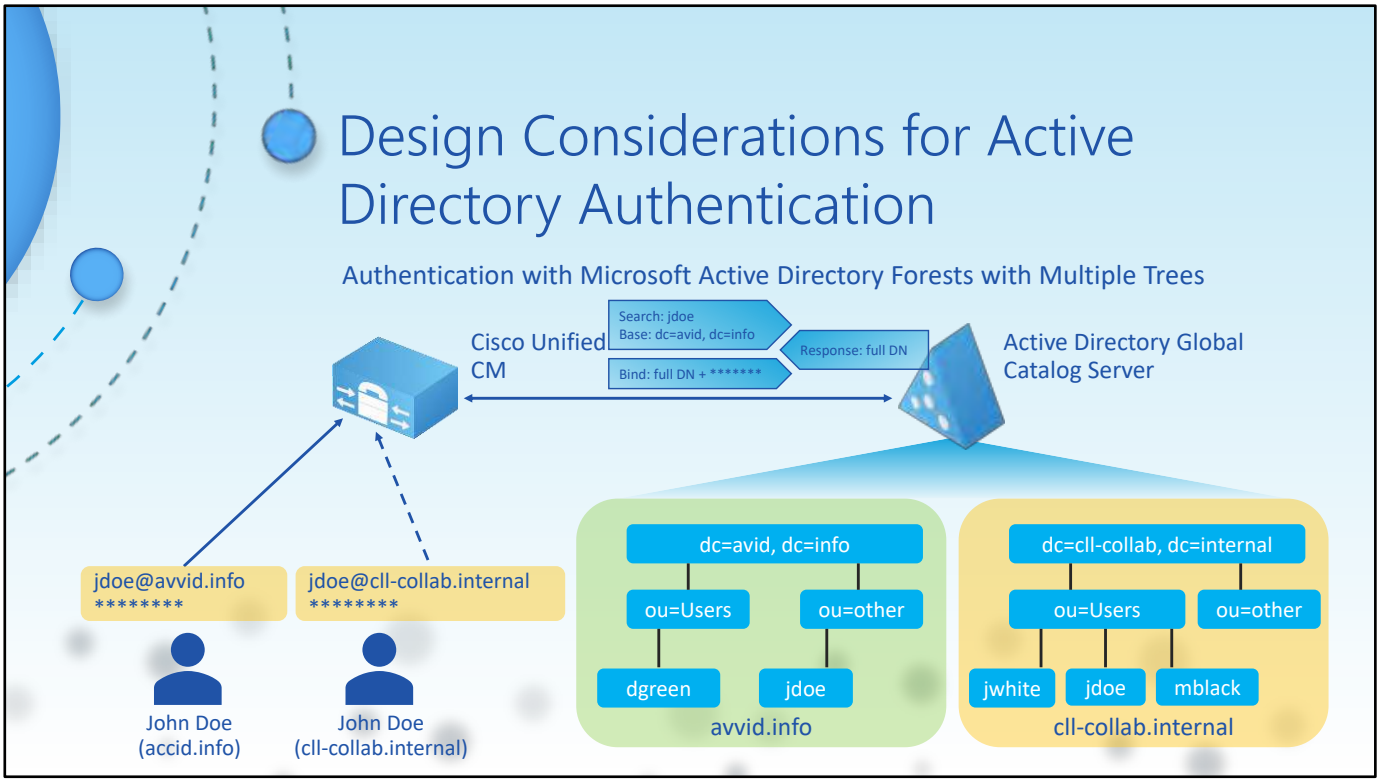
# Design Considerations for Active Directory Authentication

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# Conclusions

LDAP Considerations in CUCM

- Design considerations for LDAP sync
- Attribute mapping
- Sync agreements
- Design considerations for AD sync
  - Authentication
- Considerations for LDAP authentication and integration

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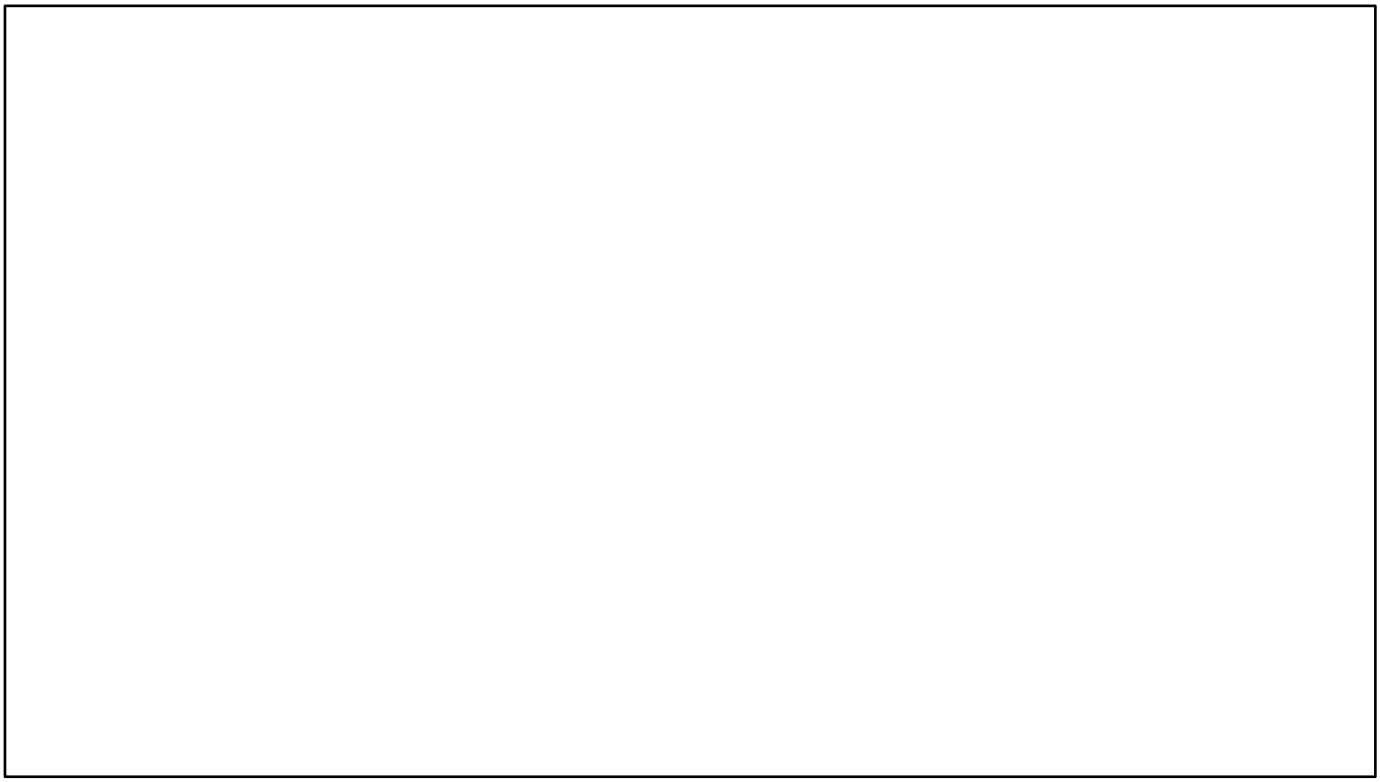

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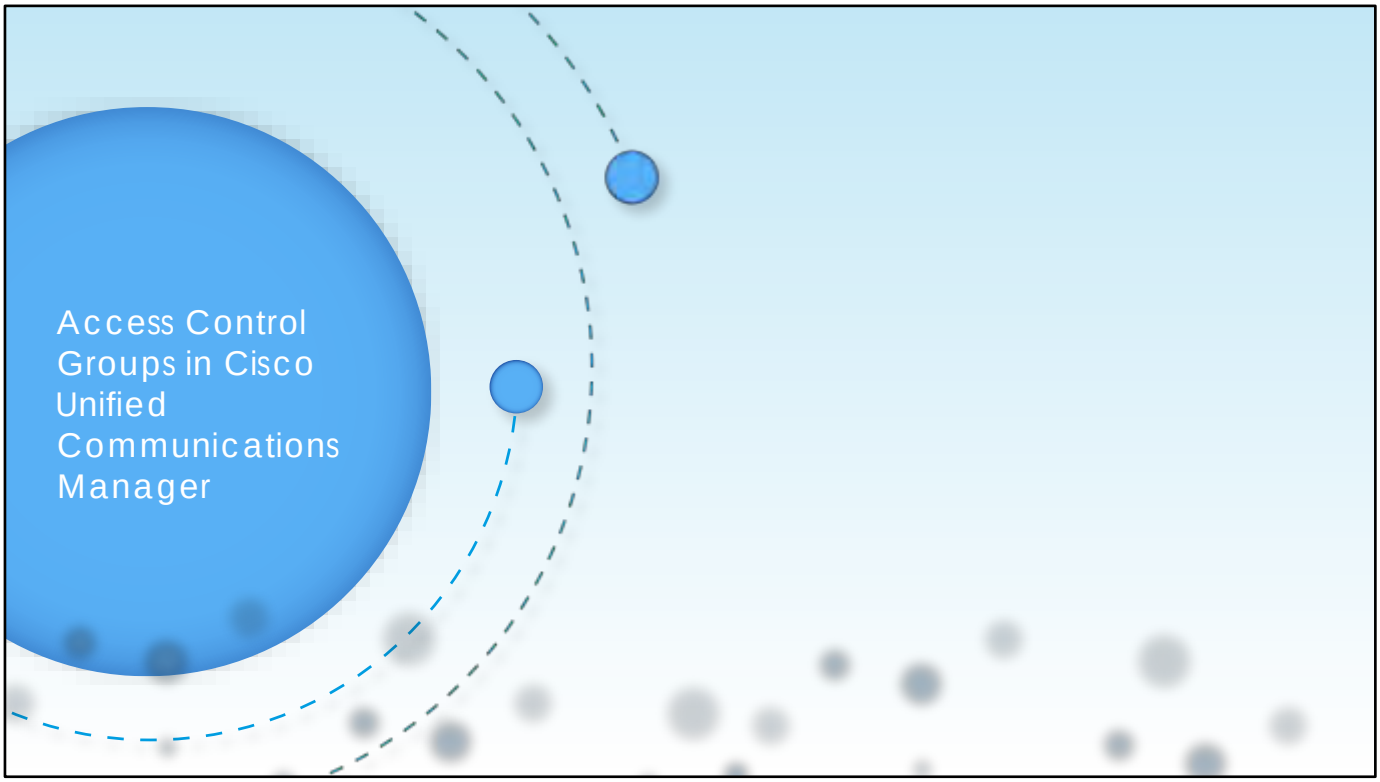


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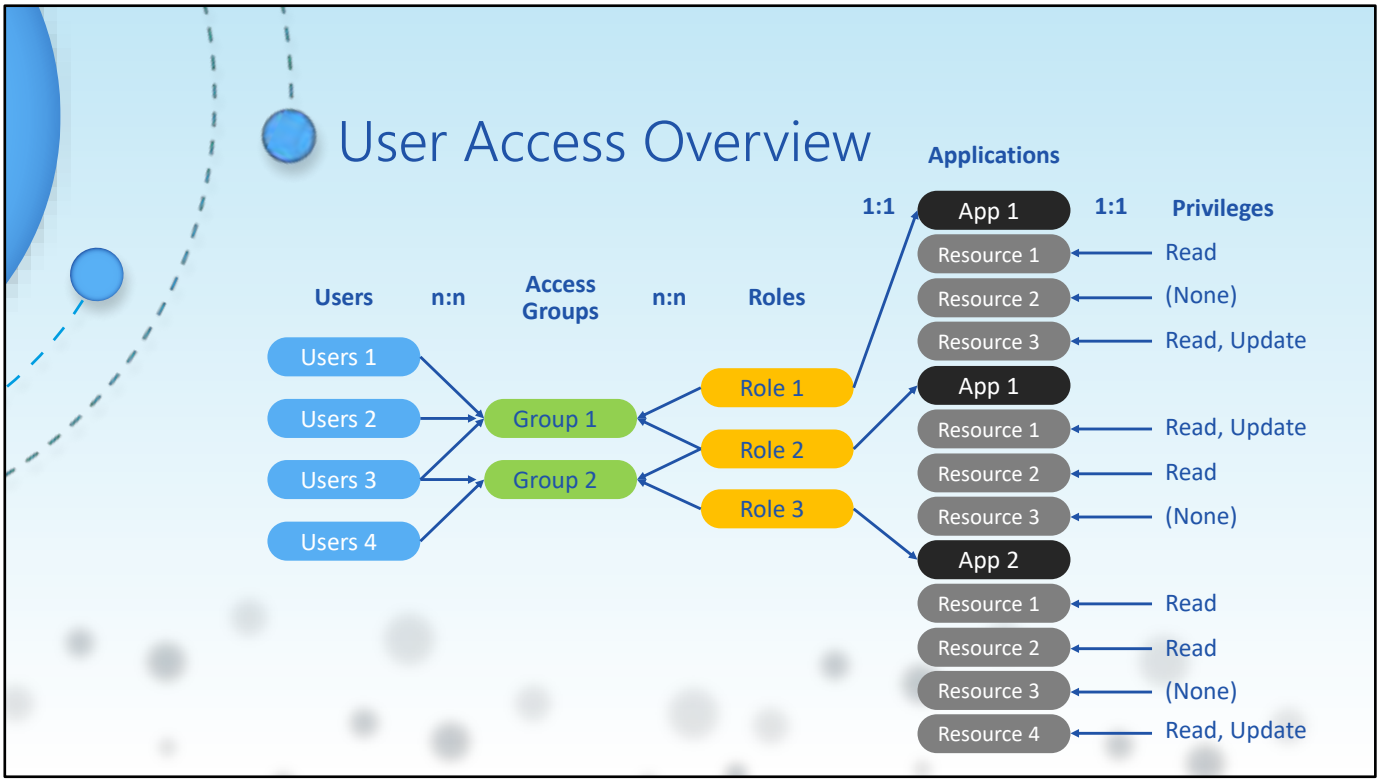


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# Roles Overview

| Role | Application | Resource | Privilege |
|---|---|---|---|
| Standard CCMADMIN Admin | Cisco Unified CM Admin | Call Park pages<br>AAR Group pages<br>Unified CM Group pages | Update |
| Standard CCMADMIN Ready-Only | | DRF Show Status page<br>… | Read-Only |

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# Configuring and Assigning Roles

- You must decide if you want to assign standard roles to your users, or you want to create custom roles:

  **Standard roles:** Standard roles are predefined, default roles that come installed in Cisco Unified Communications Manager. You cannot edit the privileges or modify the role.

  **Custom roles:** Custom roles are roles that you create. You can create custom roles when no standard roles exist that contain the privileges that you want to assign to your users. For example, if you want to assign a standard role, but want to modify one of the privileges, you can copy the privileges of the standard role into a custom role and edit the privileges in that custom role

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# Privilege Types

- Each role contains a set of privileges that are attached to a given resource. You can assign two types of privileges to a resource:

  **Read:** Read privilege gives the user the ability to view the settings for that resource, but the user cannot perform configuration updates. For example, the privilege may allow the user to view the settings on a particular configuration window, but the configuration window for that application does not display update buttons or icons

  **Update:** Update privileges give the user the ability to modify the settings for that resource. For example, the privileges may allow the user to perform updates in a particular configuration window.

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# End User and Administrator Roles

- The **Standard CCM End-Users** role provides end users with access to the Cisco Unified Communications Self-Care Portal. For additional privileges, such as CTI access, you must assign additional roles, such as the Standard CTI Enabled role
- The **Standard CCM Admin Users** role is the base role for all administration tasks and serves as the authentication role. This role provides users with administrative access to the Cisco Unified Communications Manager Administration user interface. Cisco Unified Communications Manager Administration defines this role as the role that is necessary to log in to Cisco Unified Communications Manager Administration

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# Advanced Role Configuration

- The page provides details about the role information in Cisco Unified Communications Manager Administration. This page helps you to determine what access is granted to the user by choosing one or the other of the following options from the Resource page drop-down list.

  **Application User pages**

  **End User pages**

- After choosing the required resource, a Sub Resource Access Information section is displayed, which displays the user level access. The privileges are populated when the role is set up. You change levels of access at the user level in the **Advanced Role Configuration** page. Click **Save** to save changes on this page.

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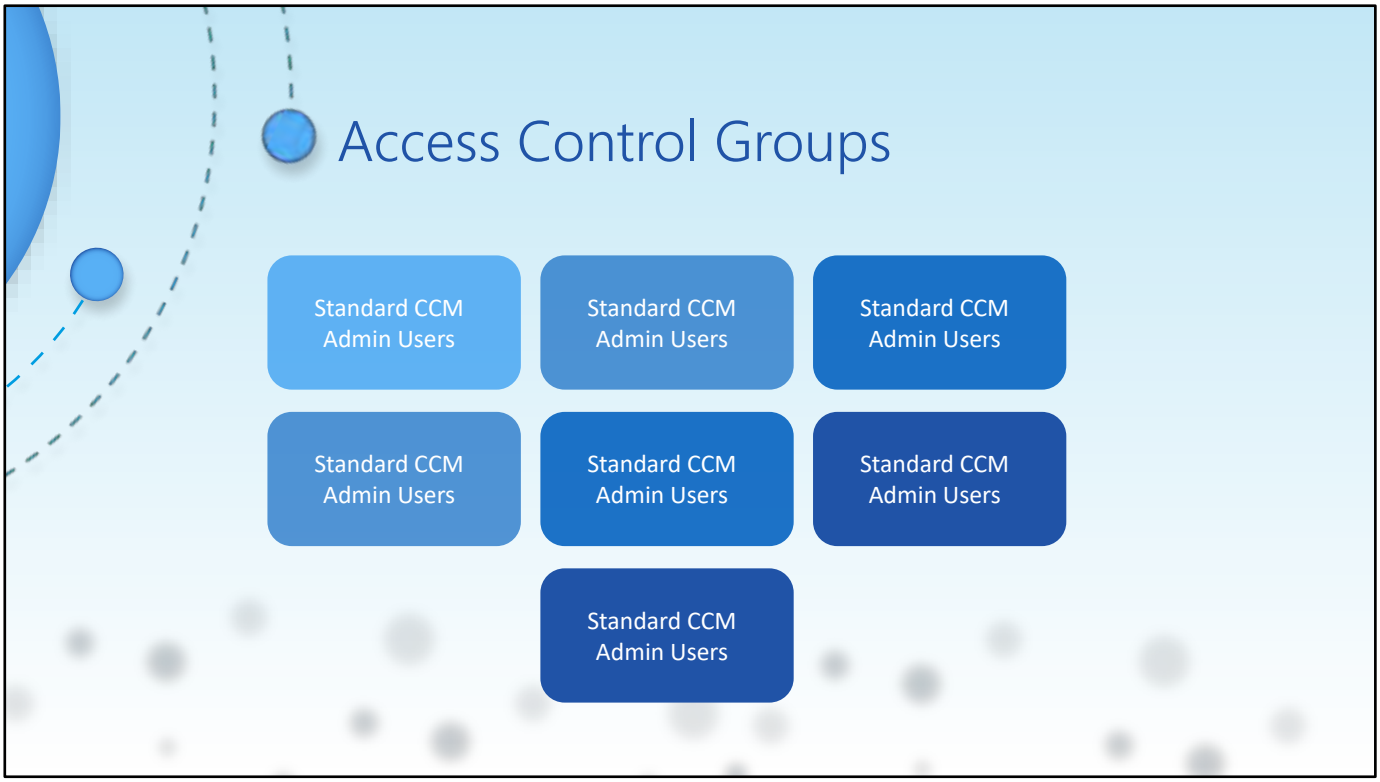


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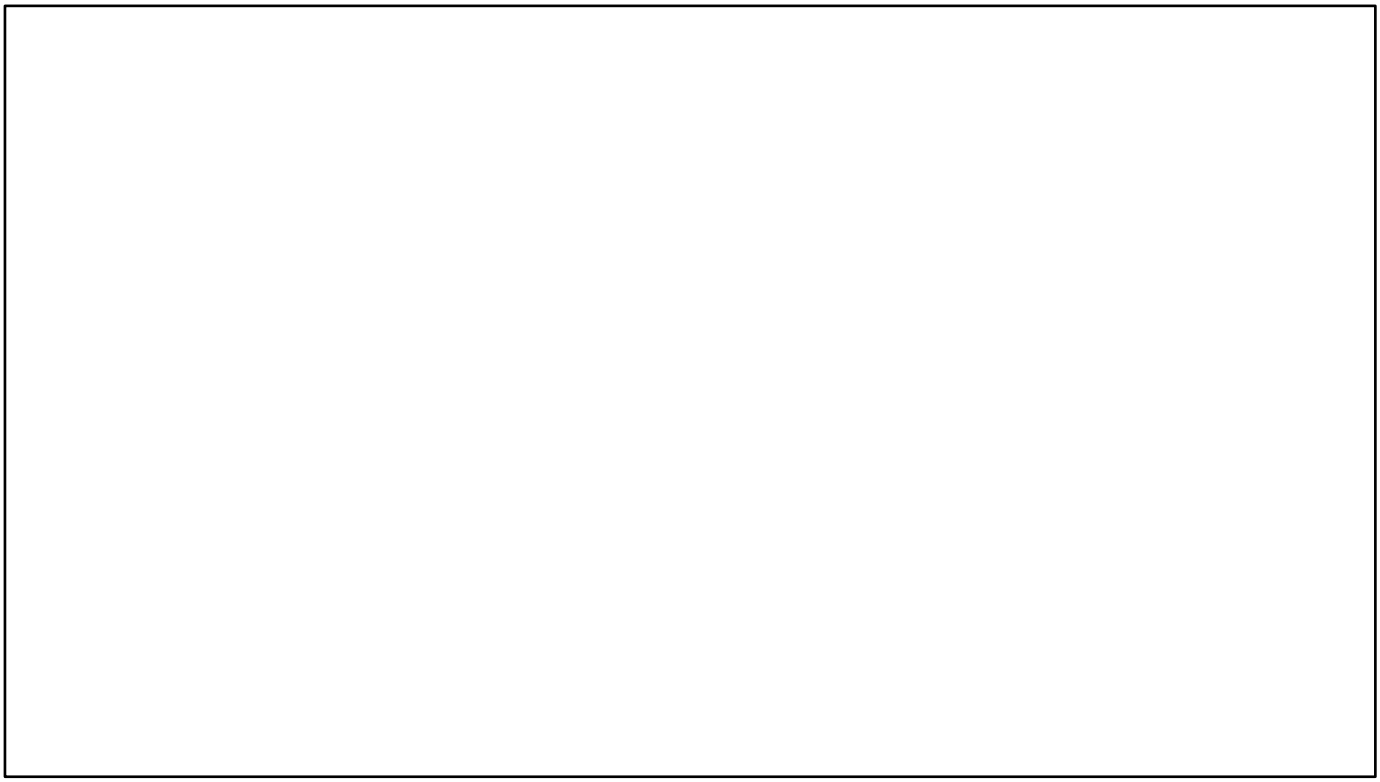

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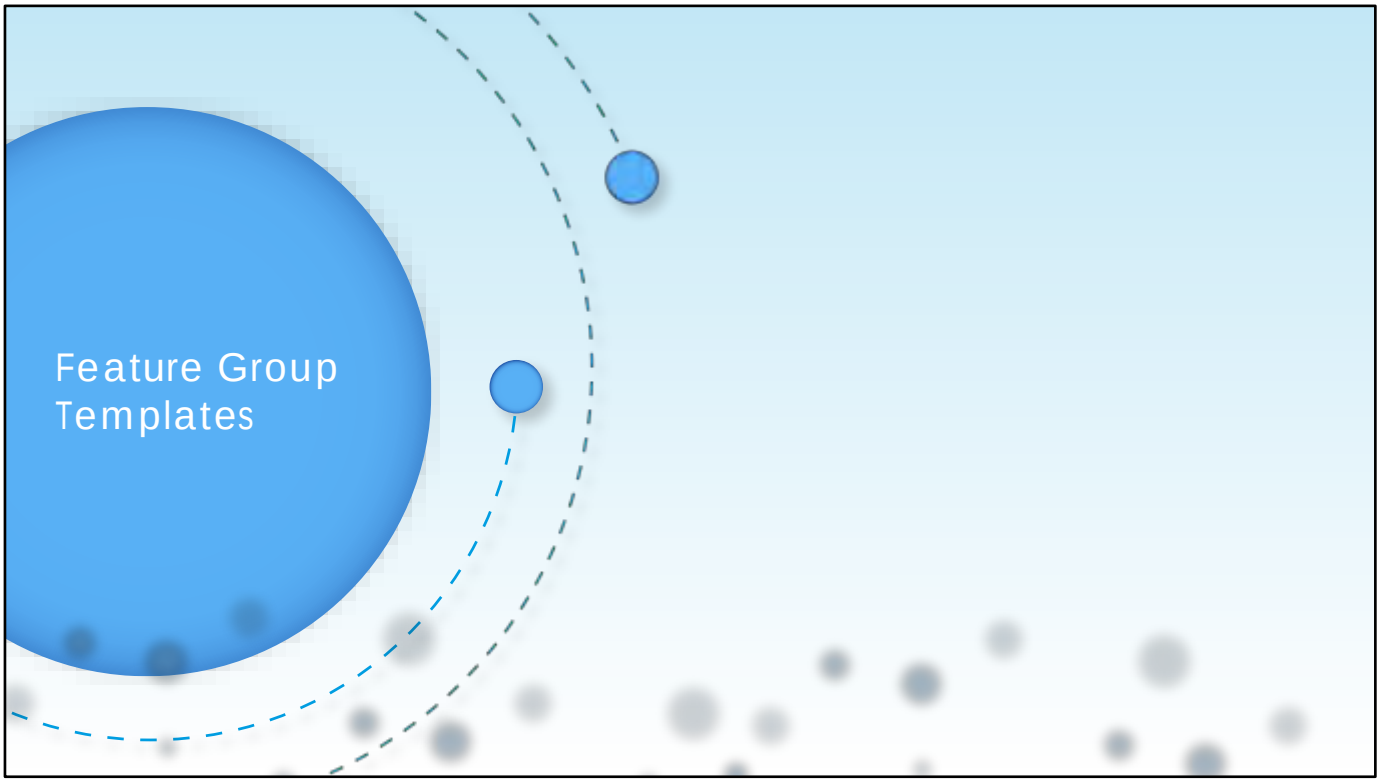


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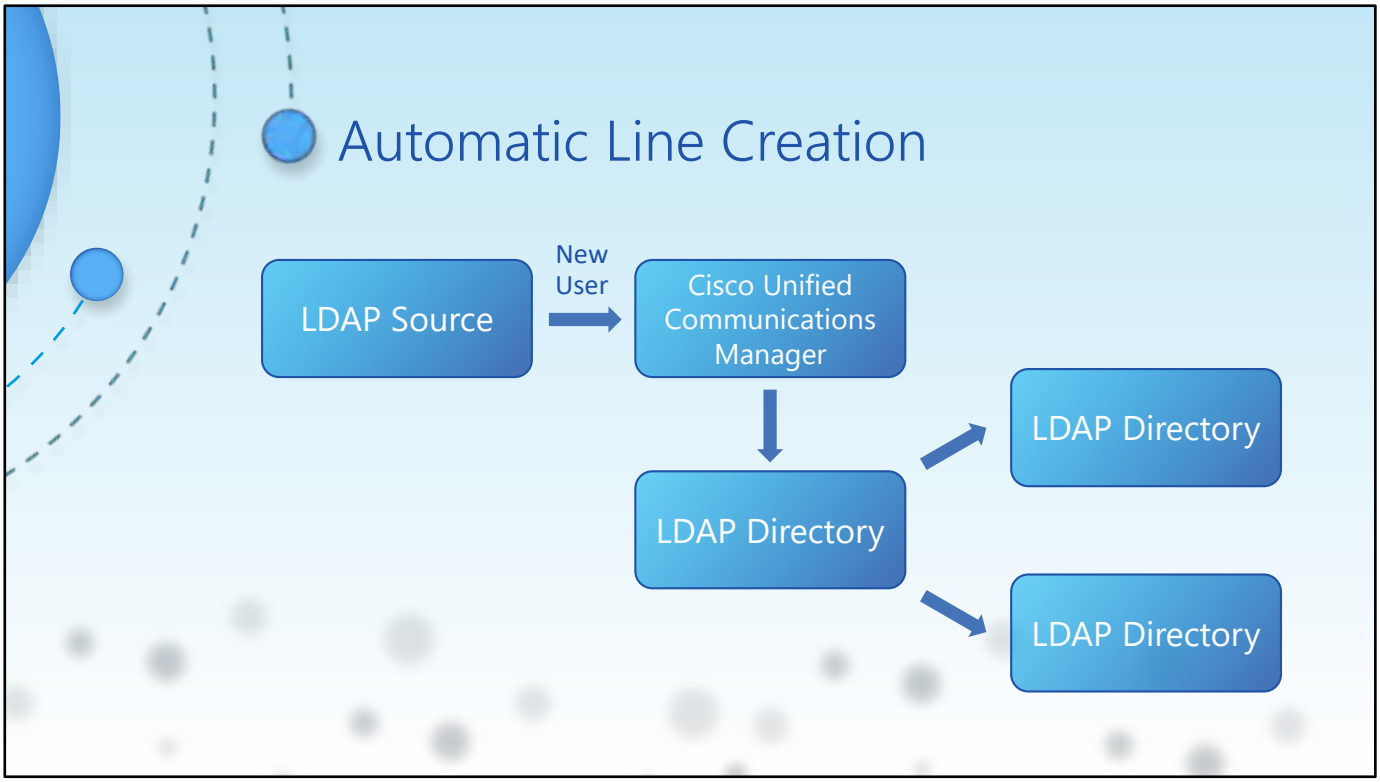


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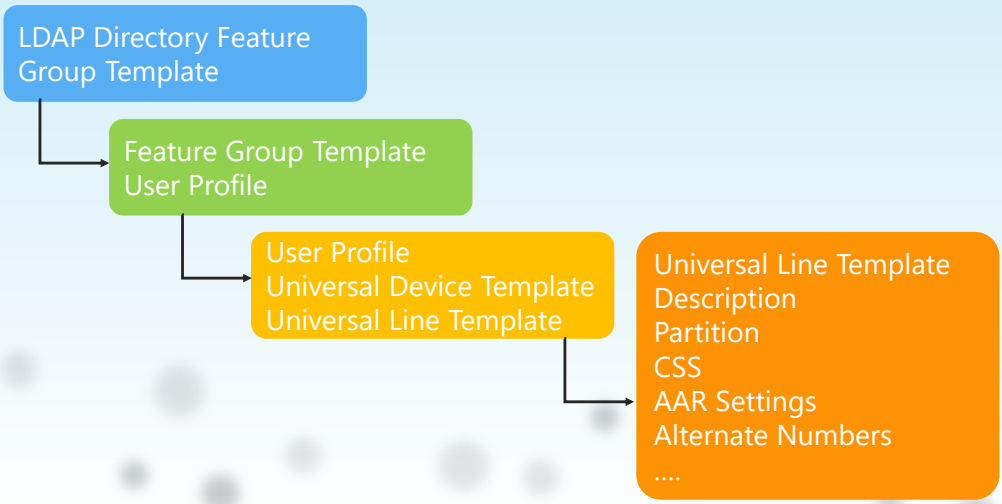
# Automatic Line Creation Configuration

A feature group template is a prerequisite for automatic line creation.

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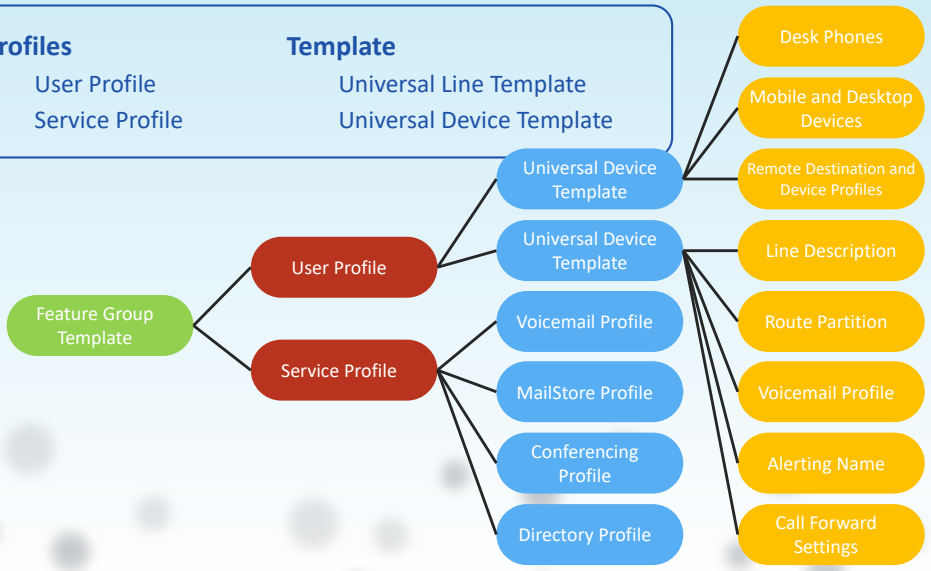
# Feature Group Template Configuration

| Profiles | Template |
| --- | --- |
| User Profile | Universal Line Template |
| Service Profile | Universal Device Template |

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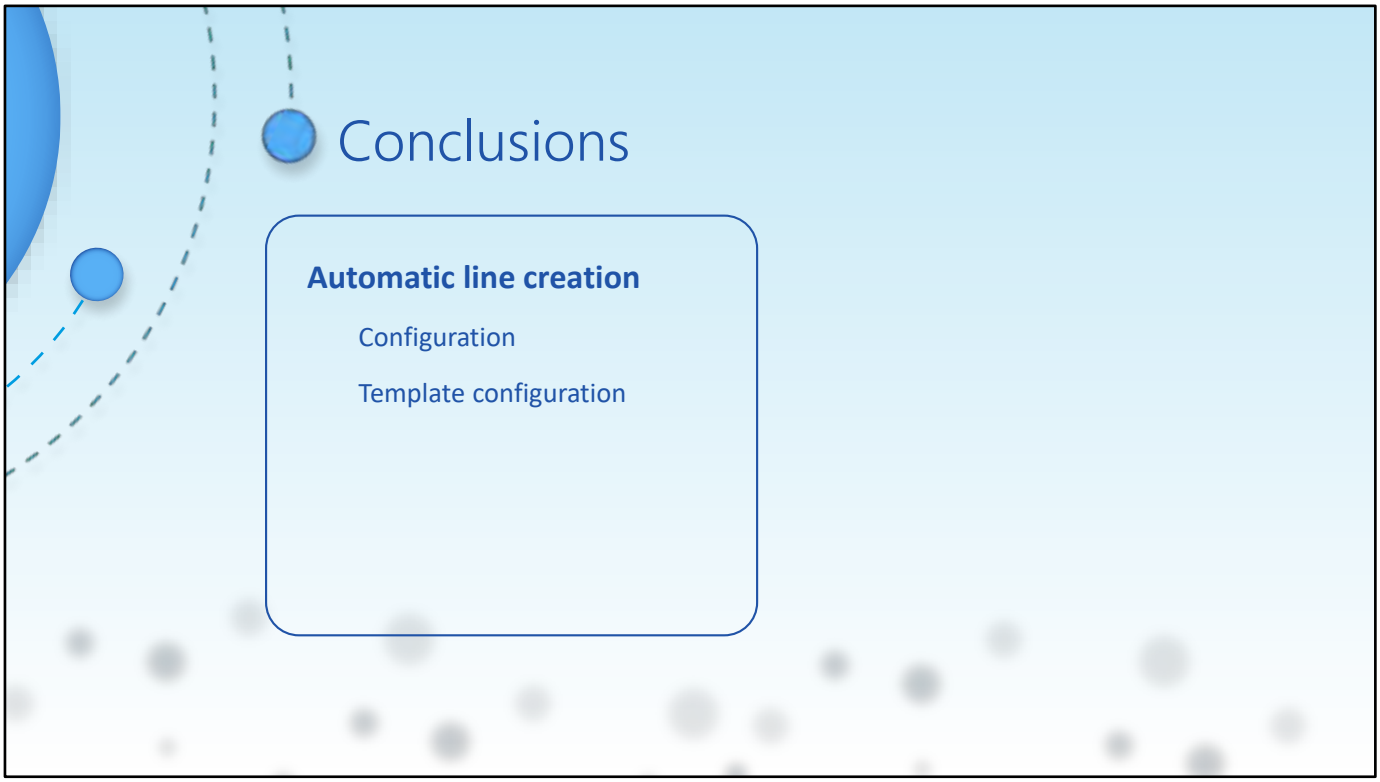


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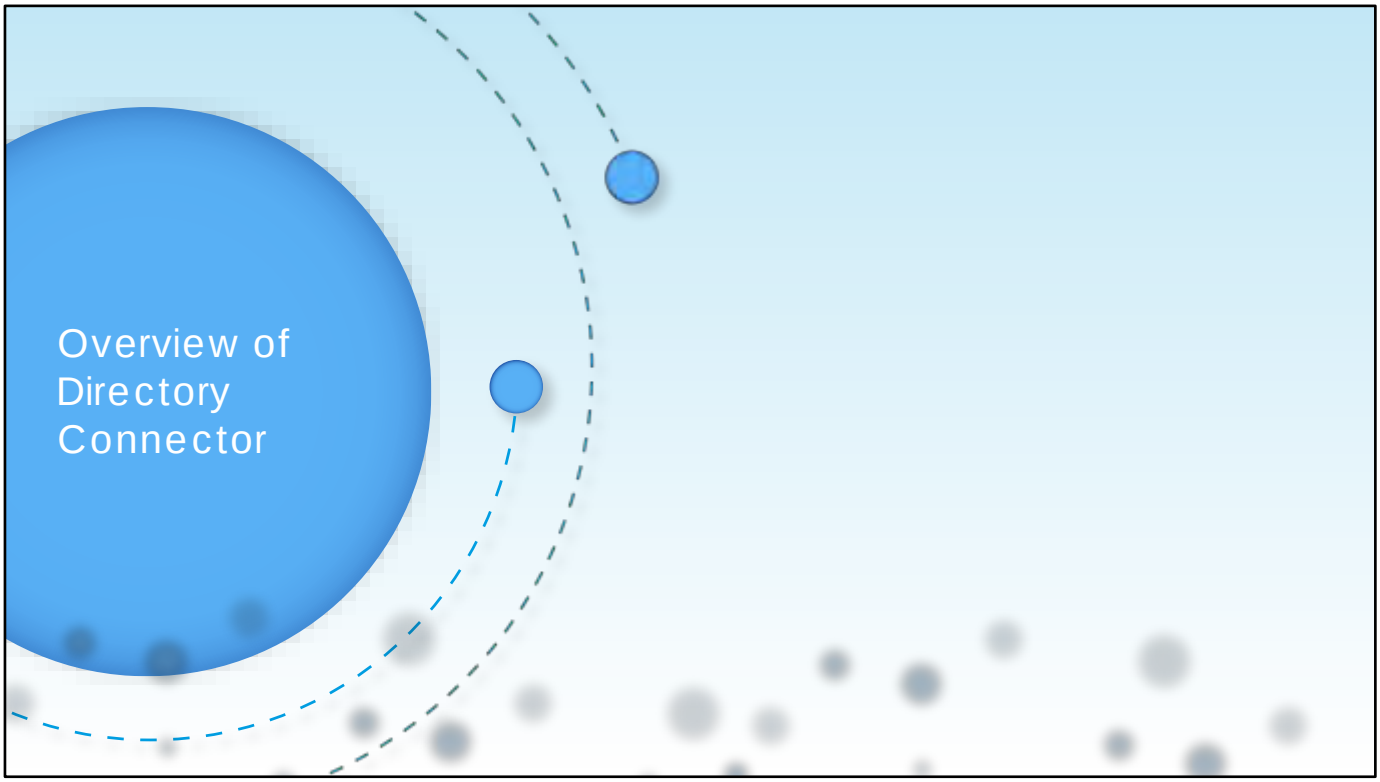


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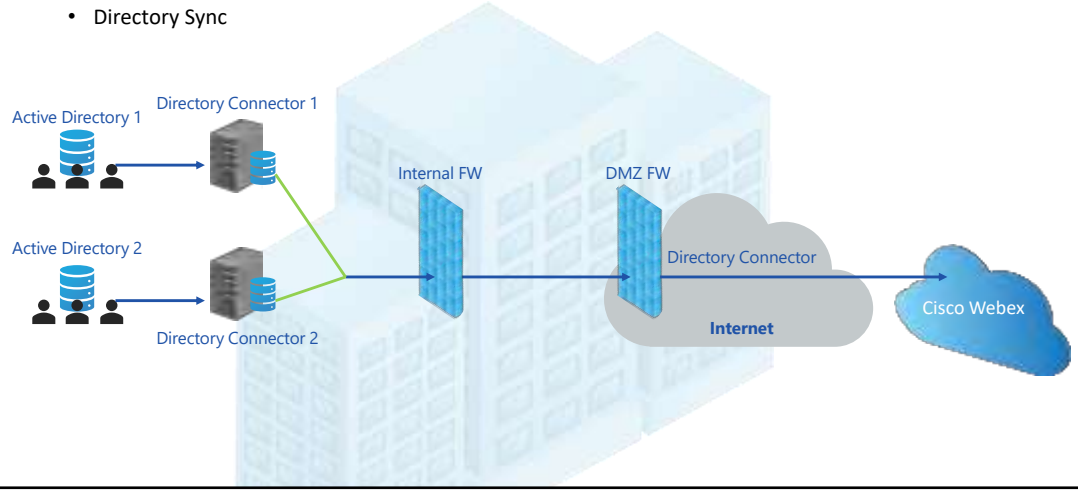
# Architecture for Directory Connector

- Control Hub
- Directory Connector Management Interface
- Directory Sync

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# Windows Server

- You can install Directory Connector on these supported Windows Servers:
  - Windows Server 2022
  - Windows Server 2019
  - Windows Server 2016
  - Windows Server 2012 R2
  - Windows Server 2012
  - Windows Server 2008 R2
  - Windows Server 2003

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# Webex Organization Requirements

- To access the Directory Connector software from Control Hub, you require a Webex organization with a trial or any paid subscription.
- (Optional) If you want new Webex App user accounts to be Active before they sign in for the first time, we recommend that you do the following:
  - Add, verify, and optionally claim domains that contain the user email addresses you want to synchronize into the cloud.
  - Do a single sign-on (SSO) integration of your Identity

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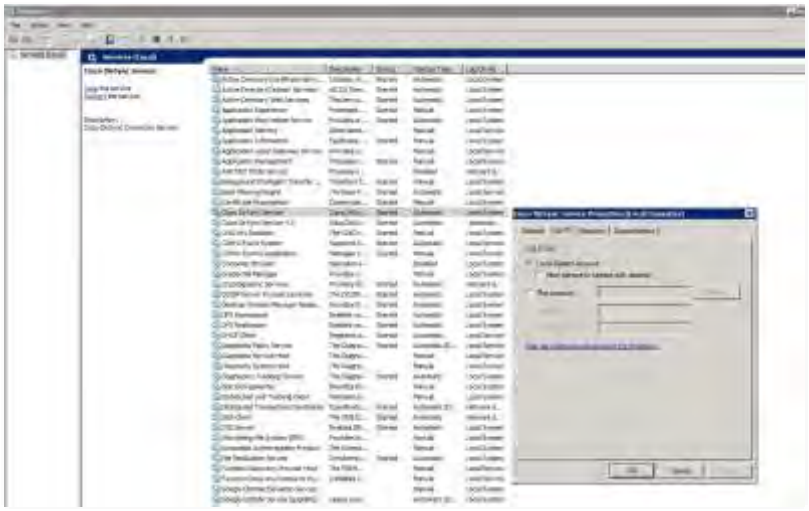
# Installation Requirements



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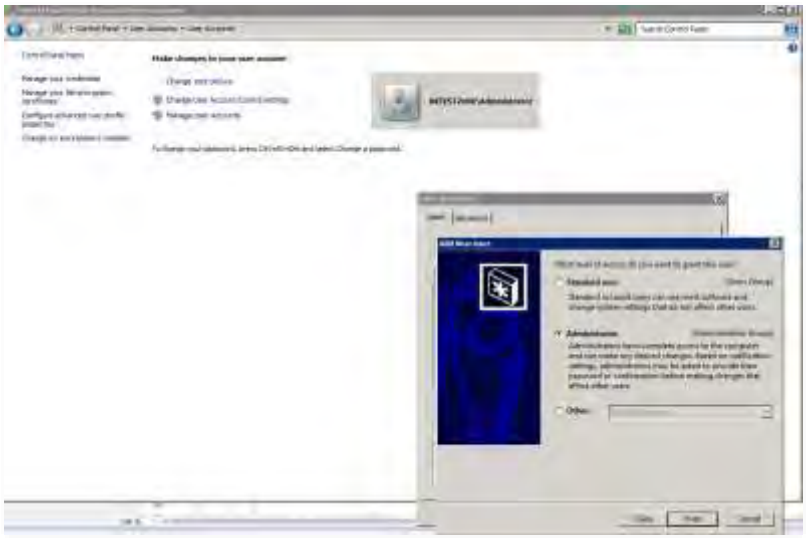
# Local Account



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# Group and Users

Distribution Groups

Security Groups

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# Check SafeDllSearchMode in Windows Registry

| | |
|---|---|
| **Step 1** | In Windows search or the Run window, type regedit and then press Enter. |
| **Step 2** | Go to HKEY_LOCAL_MACHINE\System\CurrentControlSet\Control\Session Manager. |
| **Step 3** | Choose one:<br>SafeDllSearchMode isn't listed—No further action is needed.<br>SafeDllSearchMode is listed—Ensure that the value is set to 1. |

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# Web Proxy Integration

- Web Proxy Integration
- Use a Web Proxy Through The Browser
- Configure Web Proxy Through a PAC file
- NTLM Proxy
- Configure Transparent Proxy
- Set Proxy Authentication

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# Deploy Directory Connector

- Cisco directory connector Deployment Task Flow
- Install Directory Connector
- Sign In To Directory Connector
- Set Automatic Upgrades
- Choose Active Directory Objects to Synchronize
- Map User Attributes
- Synchronize Directory Avatars From an Active Directory Attribute to the Cloud
- Synchronize Directory Avatars From a Resource Server to the Cloud
- Synchronize On-Premises Room Information to the

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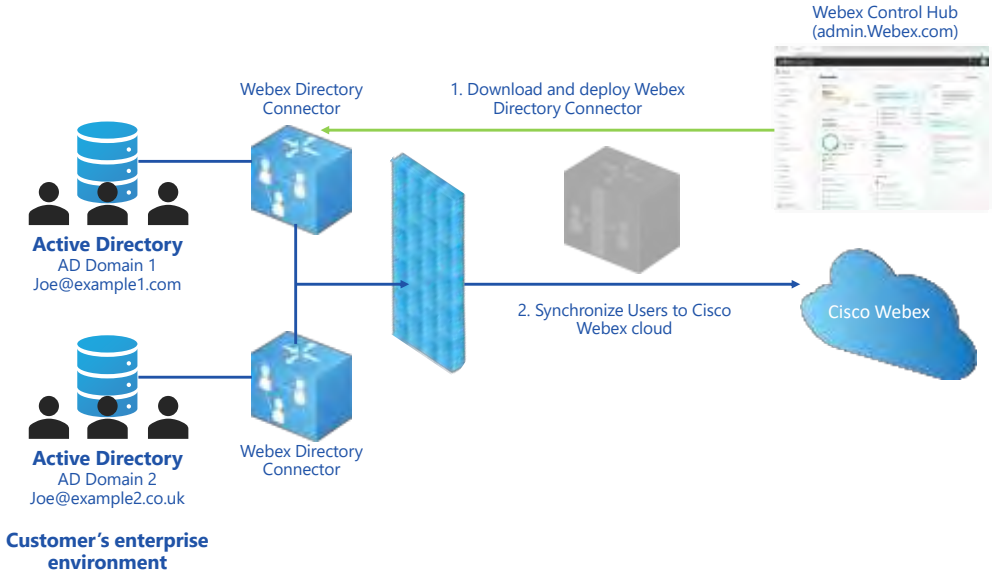
# Install Directory Connector

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# Directory Connector Dashboard

- When you first sign in to Directory Connector, the Dashboard appears. Here you can view a summary of all synchronization activities, view cloud statistics, perform a dry run synchronization, start a full or incremental synchronization and launch the event view to see error information.

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# Choose Active Directory Objects to Synchronize

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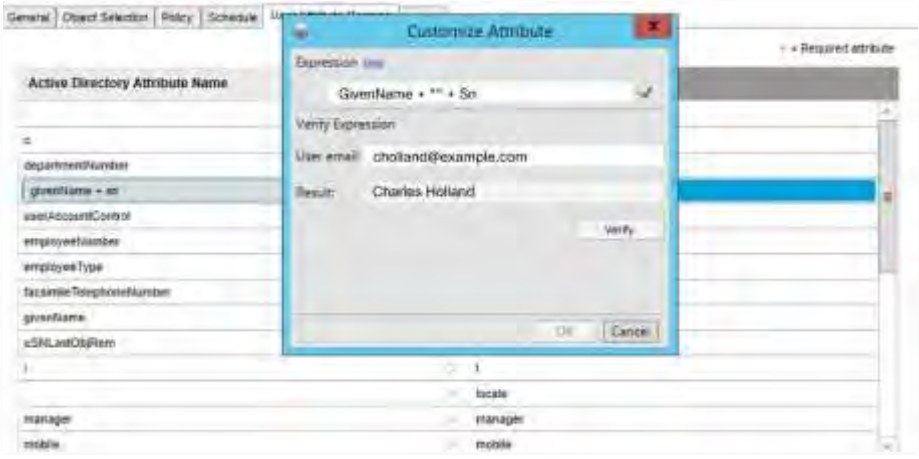
# Map User Attributes

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# After Attribute Mapping

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# Active Directory and cloud attributes

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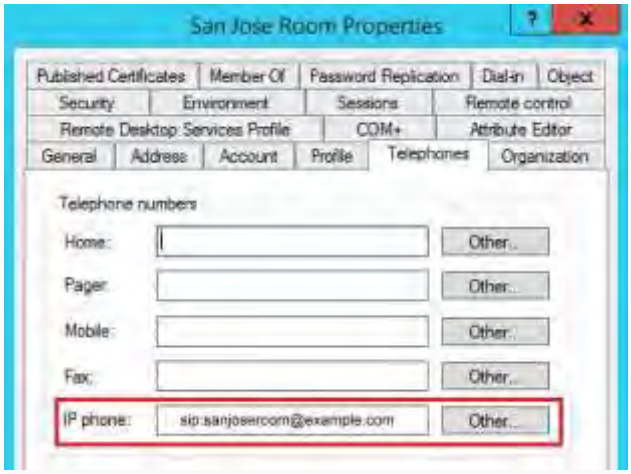
# Synchronize On-Premises Room Information to the Webex Cloud

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# Send Email Reports on Directory Synchronization Results

| | |
|---|---|
| **Step 1** | From Directory Connector, click **Configuration**, and then choose **Notification**. |
| **Step 2** | Check **Enable notification** if you want to override the default notification behavior and add one or more email recipients. |
| **Step 3** | Click **Add** and then enter an email address.<br>If you enter an email address with an invalid format, a message pops up telling you to correct the issue before you can save and apply the changes. |
| **Step 4** | If you need to edit any email addresses that you entered, double-click the email entry in the left column and then make any changes you need to. |
| **Step 5** | After you added all the valid email addresses, click **Apply**. |

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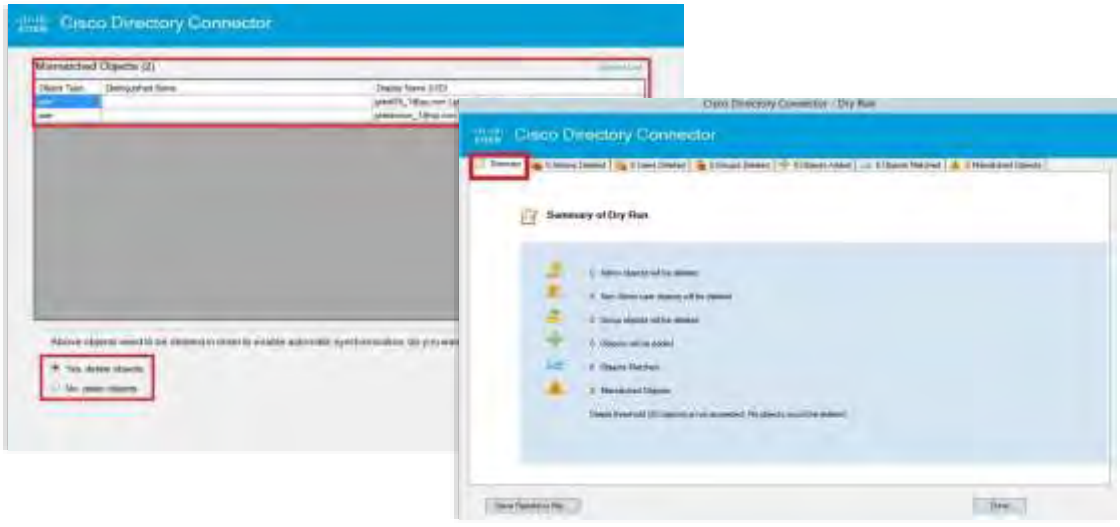
# Do a Dry Run Synchronization on Your Active Directory Users

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# Troubleshooting and Fixes for Directory Connector

- Directory Connector Stopped Working
- Reinstallation Error
- Directory Connector Crashes During SSO Sign In
- Cisco DirSync Service Connector Could Not Be Registered
- Sign in Prompt Appears
- Unable to Connect to the Remote Server
- Unable to Register the Connector

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# Conclusions

- **Directory Connector**

Requirements

Accounts

- Local
- Groups and users
- Web proxy integration

Deployment and installation

Dashboard

AD object sync

Attribute meetings

AD and cloud attributes

Sync on prem and cloud

Synchronization

Troubleshooting

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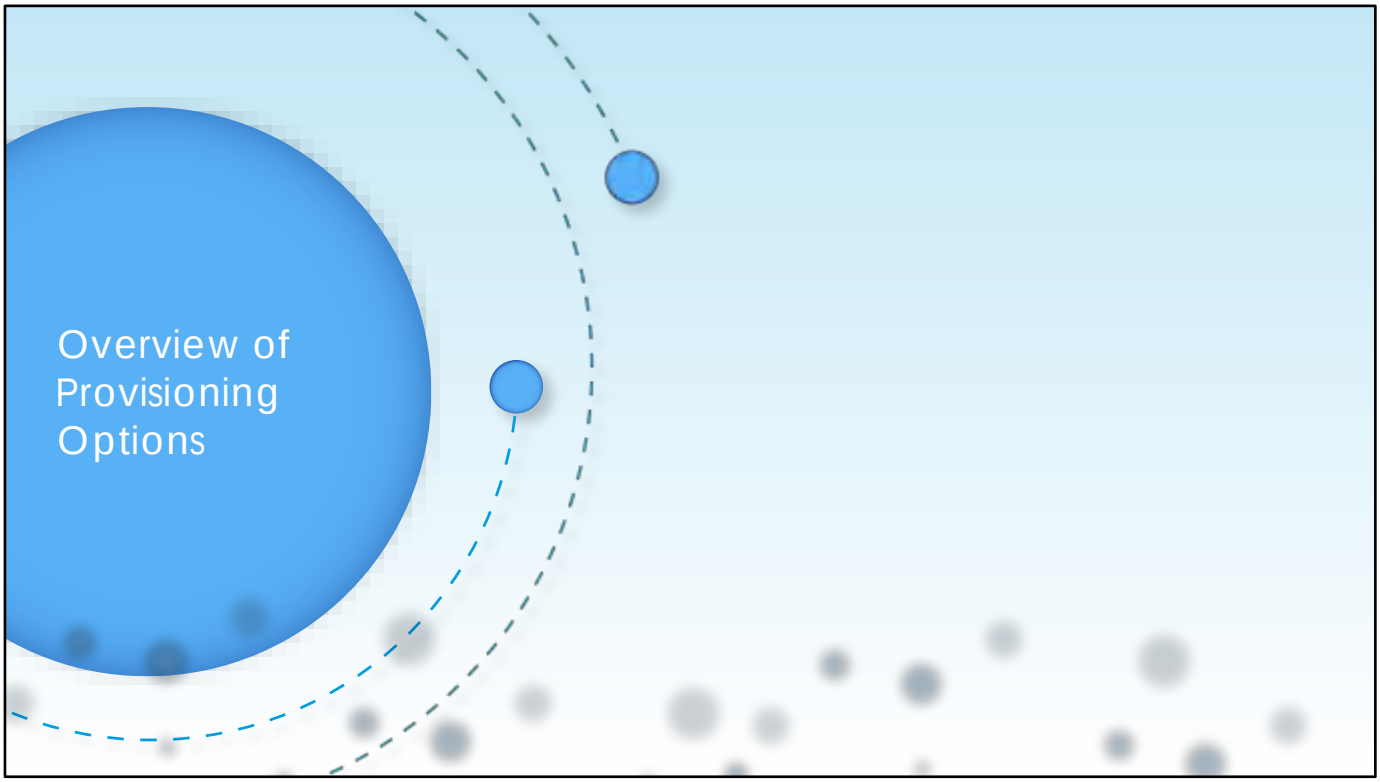


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# In This Module

Deploy using Manual and auto registration

Configure provisioning feature

- Phone Button Template
- SoftKey Template

Troubleshooting bootup method

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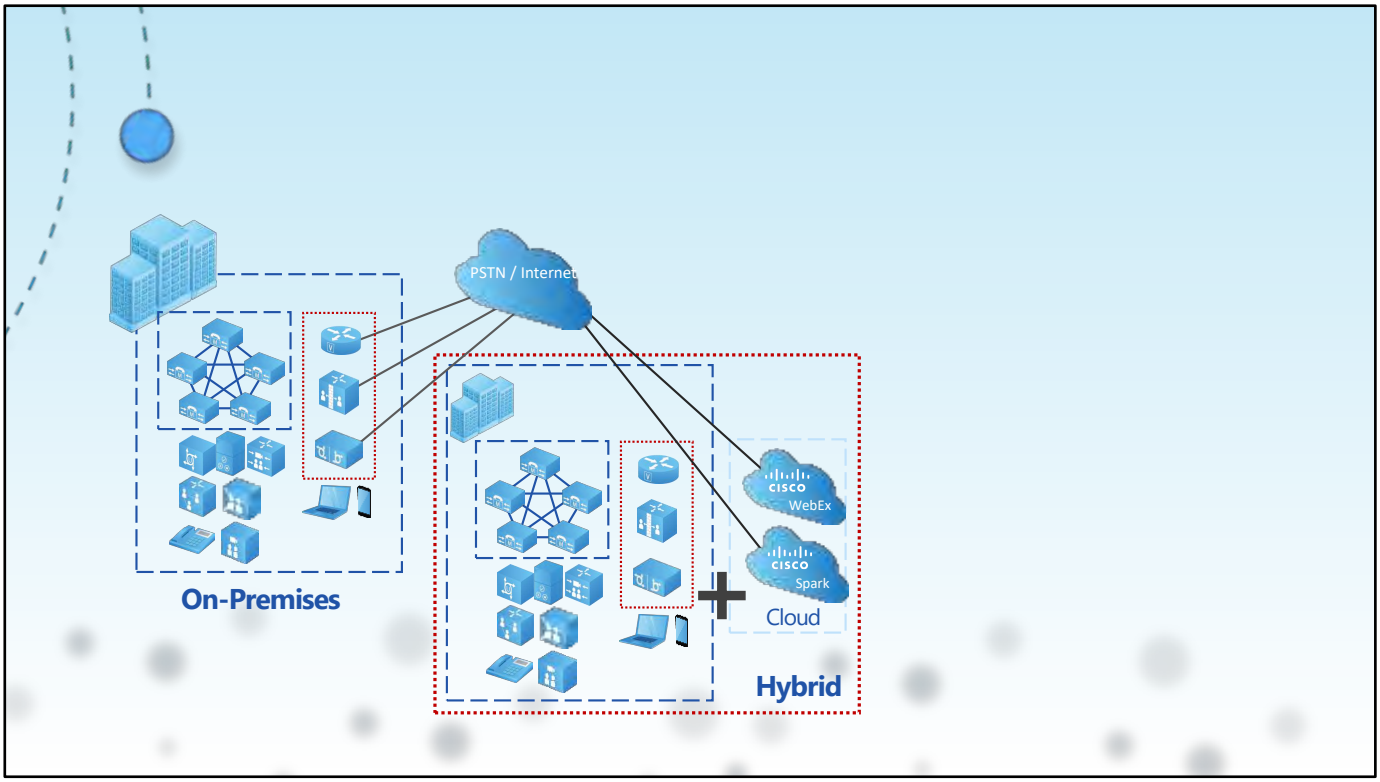


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# Method of Registration

- Manual
- Auto-Registration
- Bulk-Administration Tools (BAT)
- Self-Provisioning

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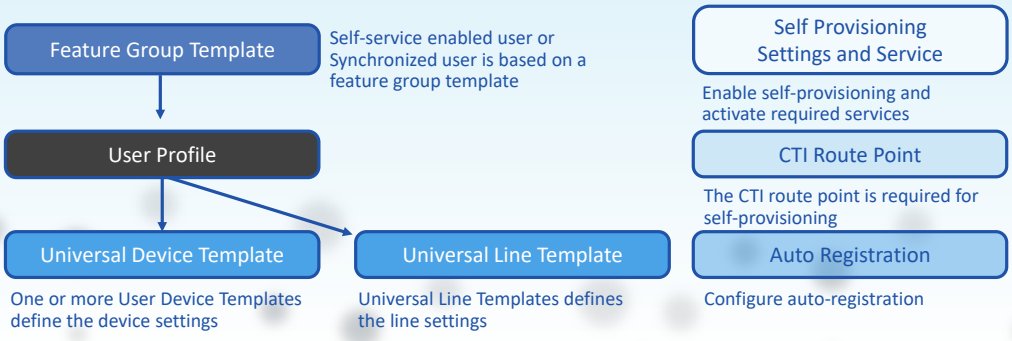
# Self Provisioning

Administrator can provision end user
End user can provision themselves
Explore Self Provisioning requirement
Need to understand self provisioning component

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# Overview of Provisioning Options

| Method for Adding IP Phones | Advantages | Disadvantages |
|---|---|---|
| Auto Registration | Devices automatically added | Default settings<br><br>Modifications needed |
| Bulk Administration Tool (BAT) | Bulk add | MAC addresses required in BAT files |
| Manual Configuration | Simple | MAC addresses required<br><br>Time consuming |
| Cisco Self-Provisioning | Ease of use<br><br>End users can provision themselves<br><br>Admin can provision for the end user | Create universal device templates, universal line template, user profiles, and feature group template<br><br>Configure Auto Registration<br><br>Create CTI route point for the IVR Service<br><br>Activate the IVR Service on the Publisher<br><br>Populate the Self-Service ID using LDAP, BAT or manually |

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# CUC BAT Overview

- Bulk transactions to the Cisco Unified Communications Manager Database
- Efficient method for adding, updating or deleting a large number of devices
- Data export (phones, users, gateways, etc.)
- Supports localization

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# Conclusions

- Registration
- Self provisioning
  - Provision options
  - CUC BAT Overview

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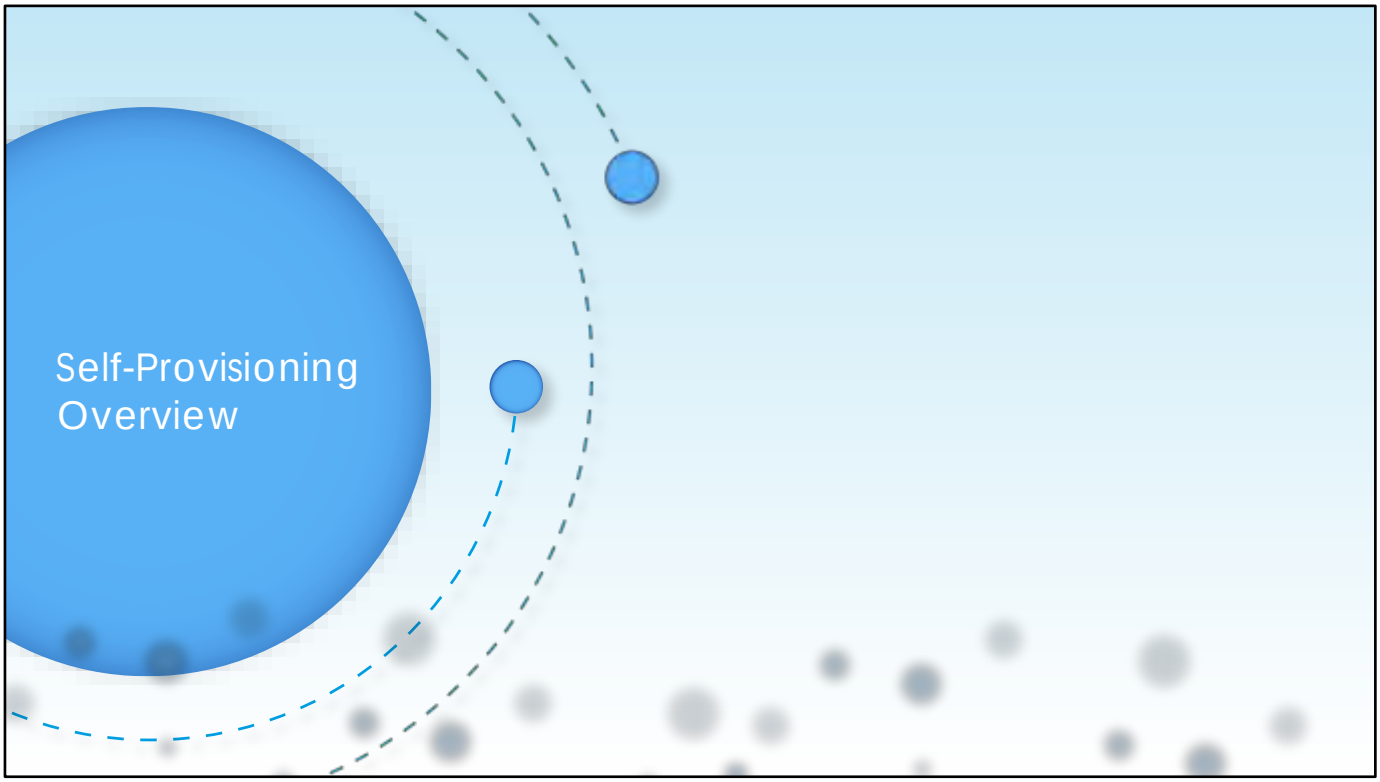


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# Overview

Allows an administrator or end user to provision an auto registered phone to the system with a few simple steps

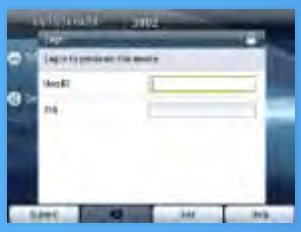
End users can add a desk phone or soft client without contacting the administrator

Administrators must preconfigure templates and user profiles

User profiles contain settings for a group of users that include the following tools:

- Universal device templates
- Universal line template
- End-user self-provisioning settings

**IVR Service**



**XML**

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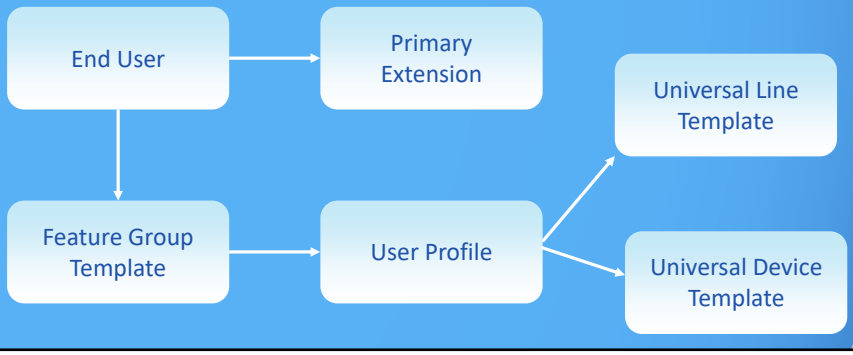
# Self-Provisioning Prerequisites

You must ensure that the end user is configured correctly before configuring self-provisioning

Before end users can use self-provisioning, the end users be configured with the following items:

- A primary extension
- A user profile or feature group template that includes a universal line template and universal device template
- A user profile that is enabled for self-provisioning

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# Self-Provisioning Components

Activate Services for Self-Provisioning

Enable Auto Registration for Self-Provisioning

Configure CTI Route Point

Assign a Directory Number to the CTI Route Point

Configure Application User for Self-Provisioning

Configure the System for Self-Provisioning

Enable Self-Provisioning in a User Profile

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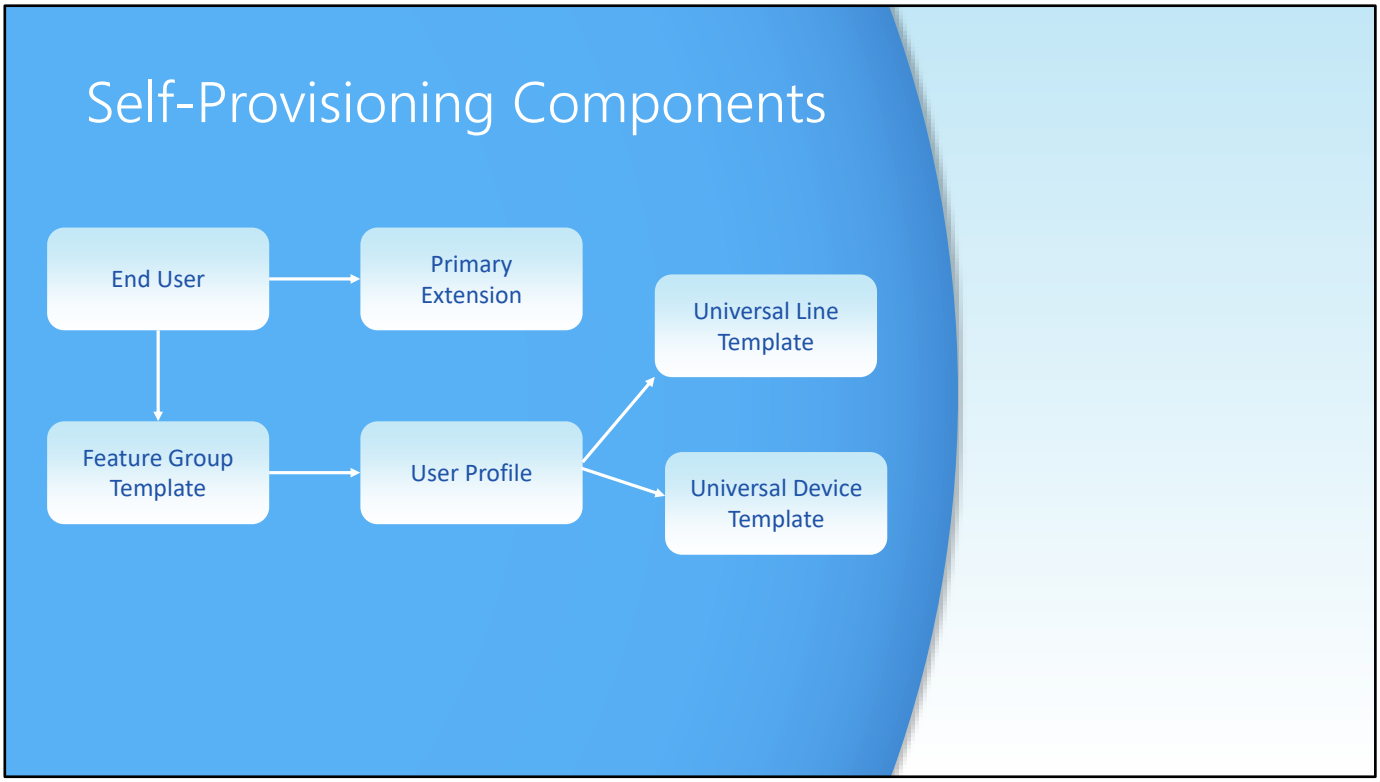


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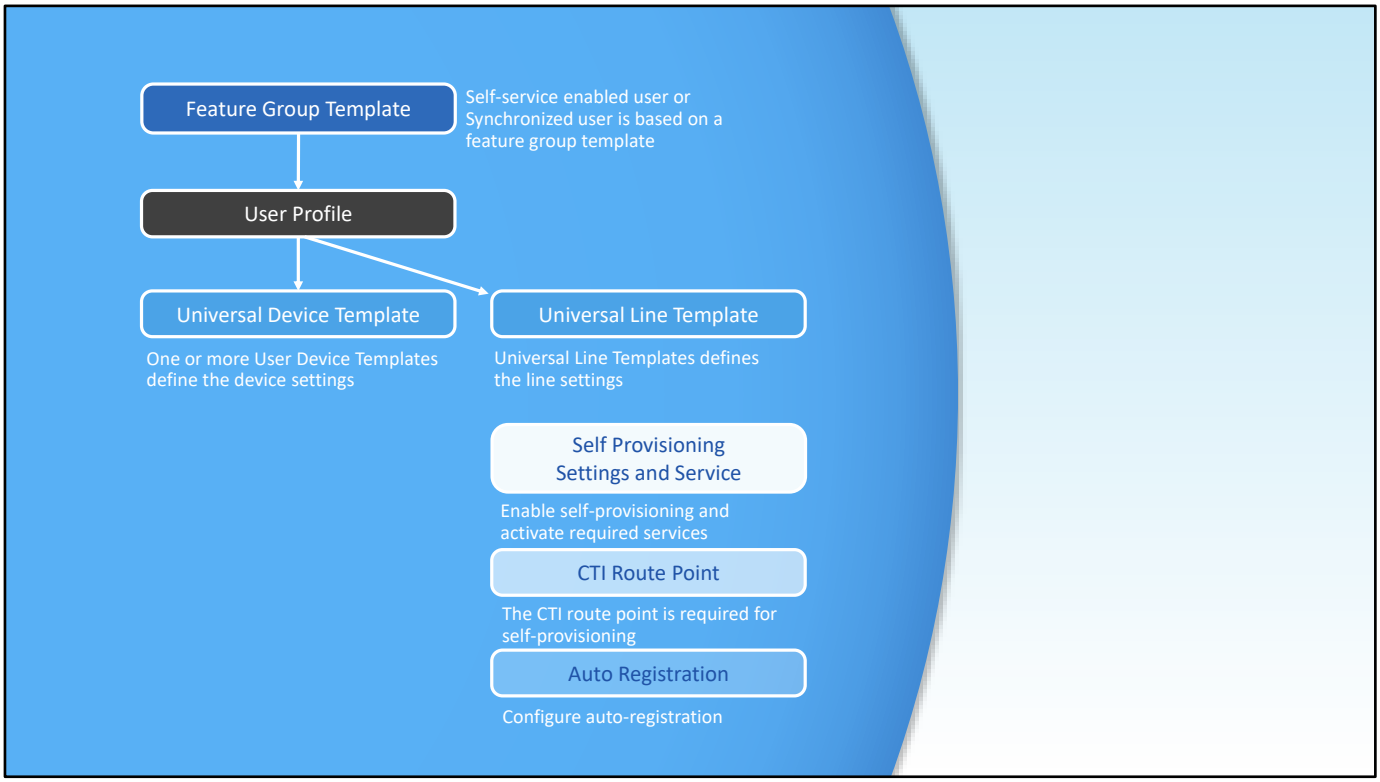


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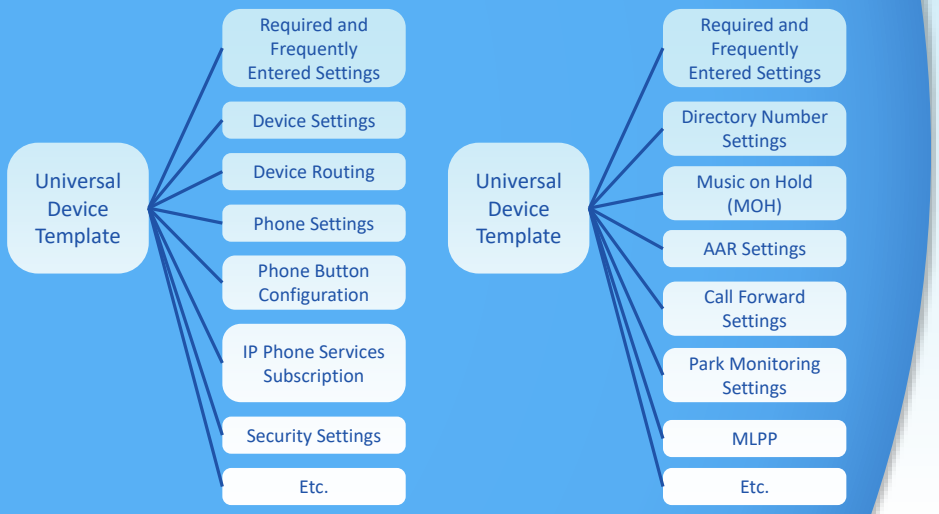
# Configure the Universal Device and Line Templates

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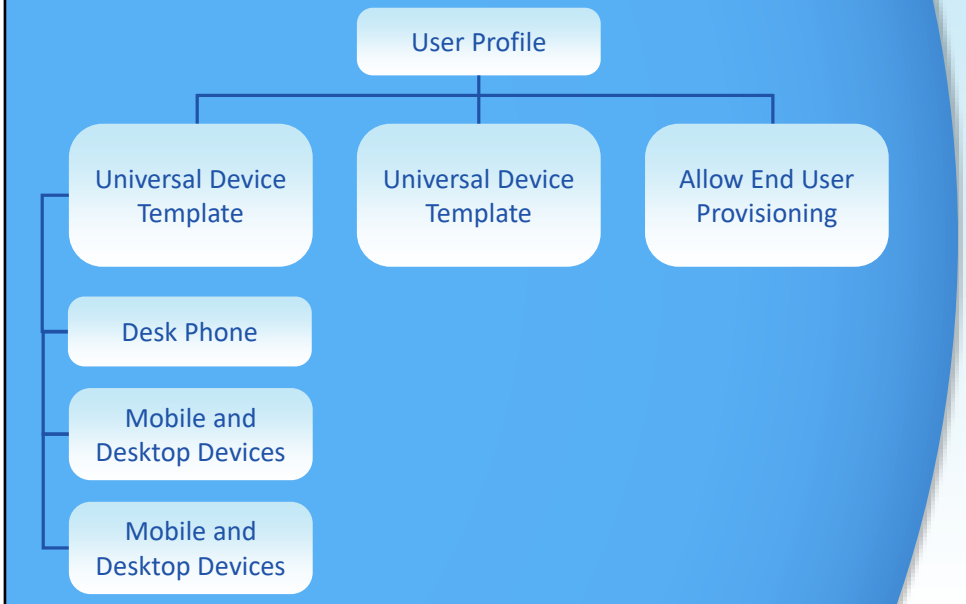
# Configure a User Profile

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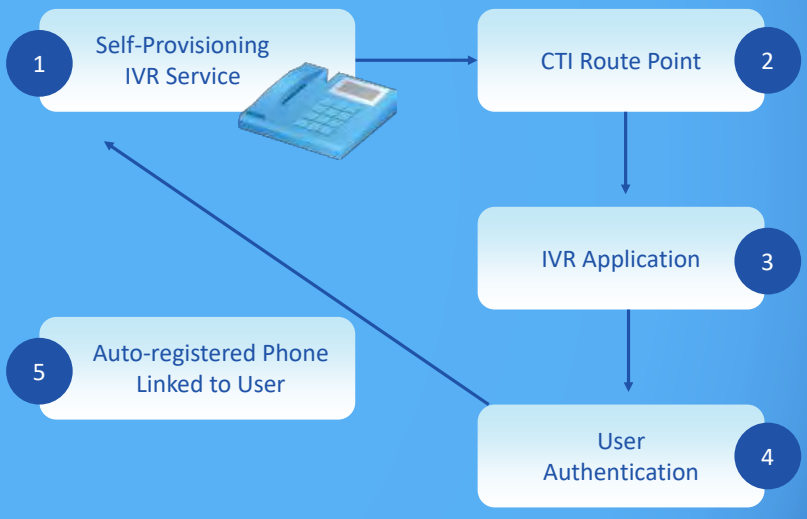
# Self-Provisioning IVR Service

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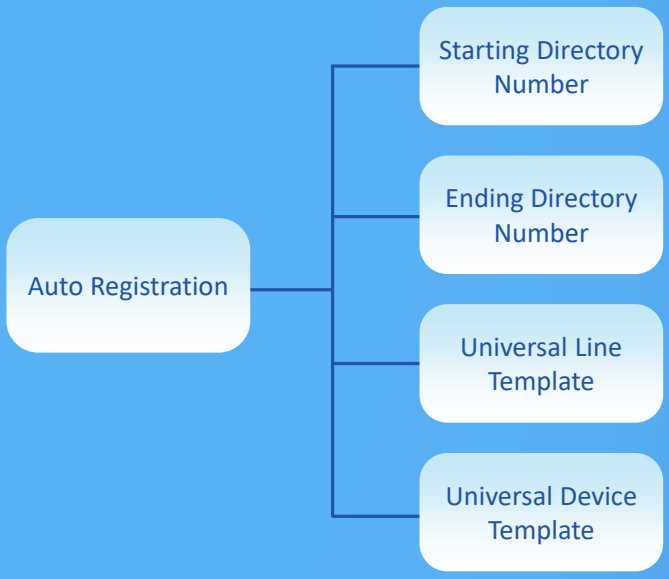
# Set Up Auto Registration

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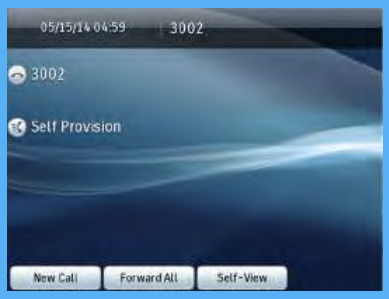
# Provision the Device




**IVR Service**

**XML**

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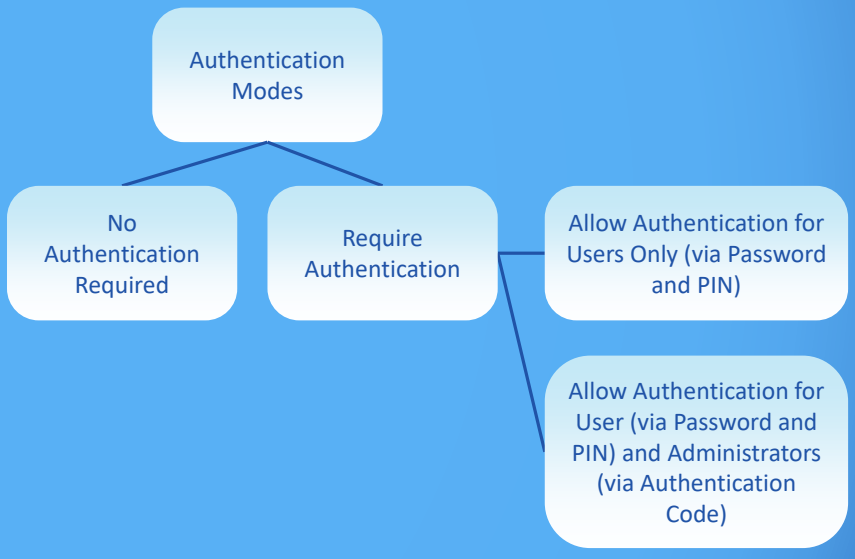
# Self-Provisioning Authentication Modes

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# Conclusions

- Self-Provisioning
  - Prerequisites
  - Components
  - User profiles
  - Group templates
  - IVR
  - Auto registration
  - Device provisioning
  - Authentication modes

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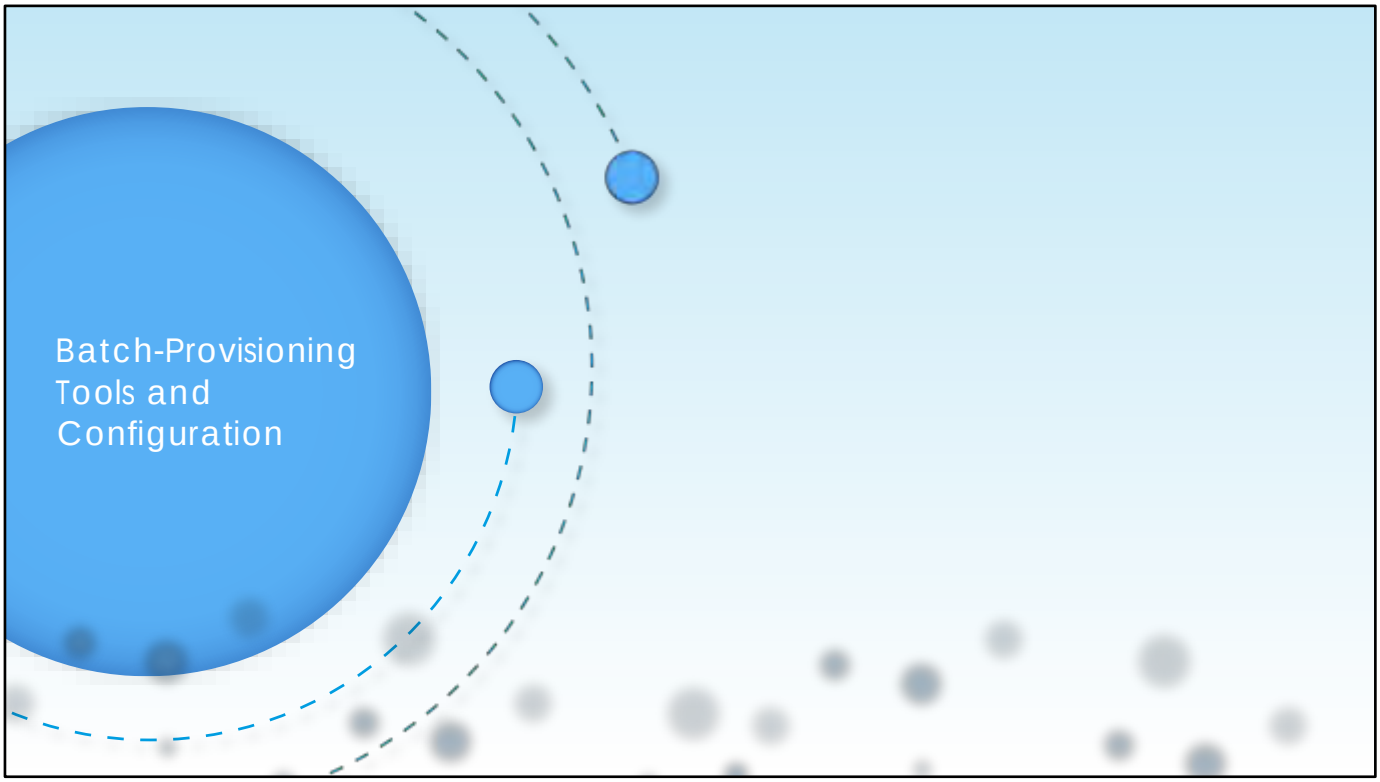


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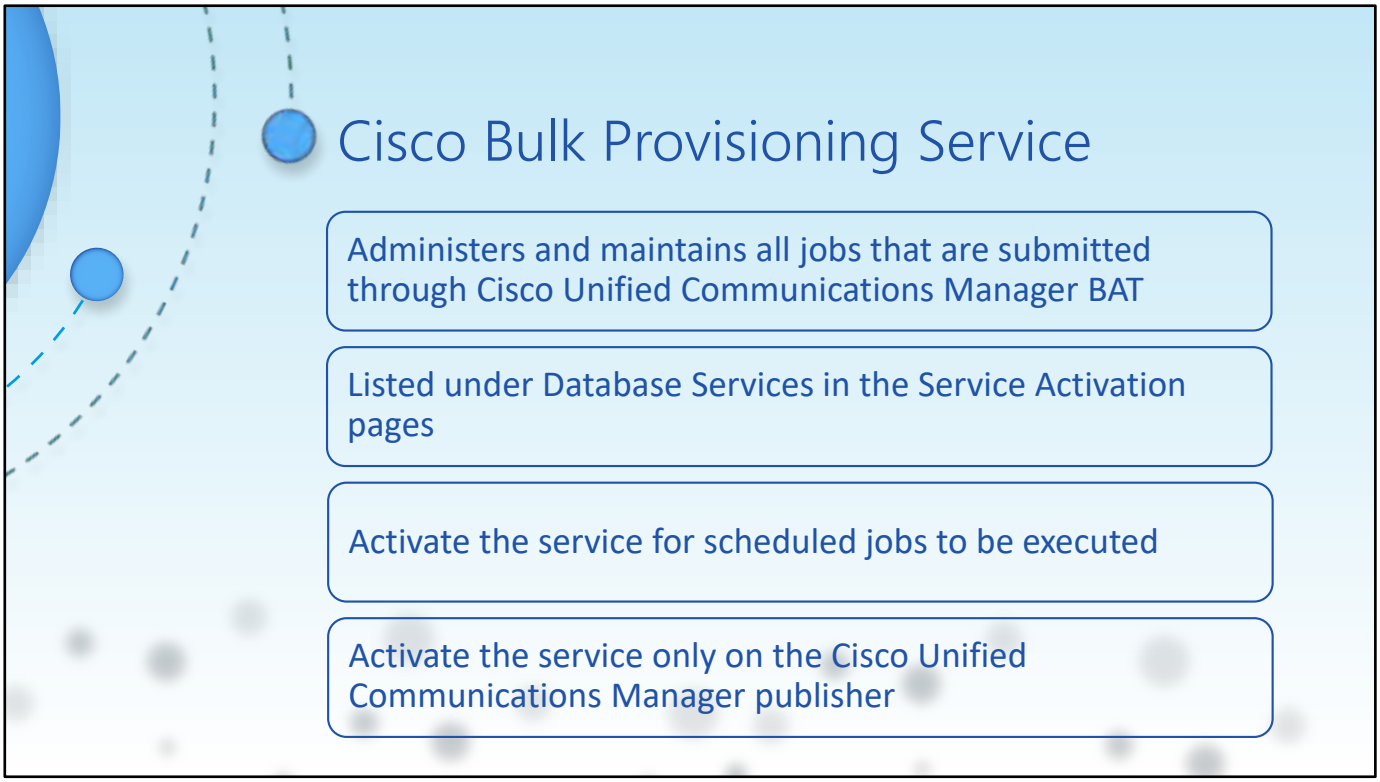


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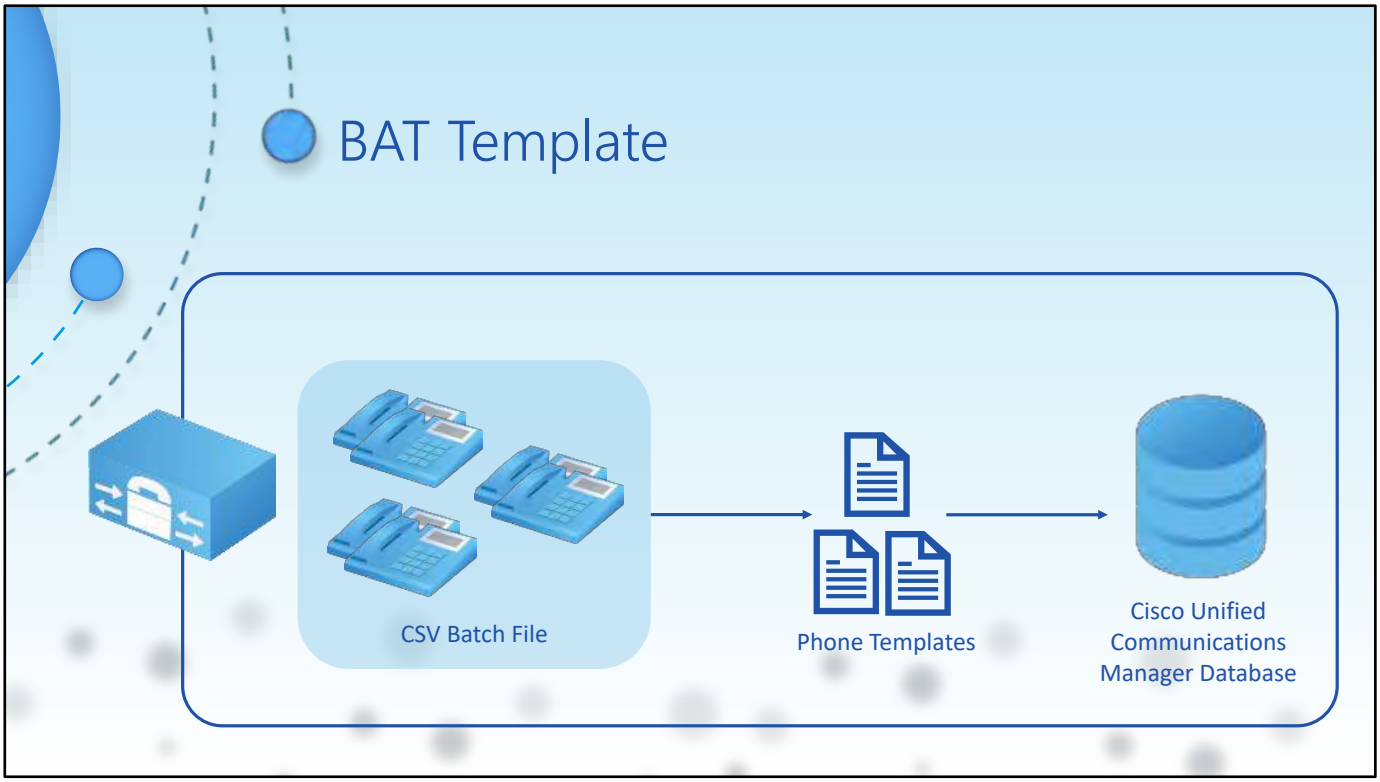


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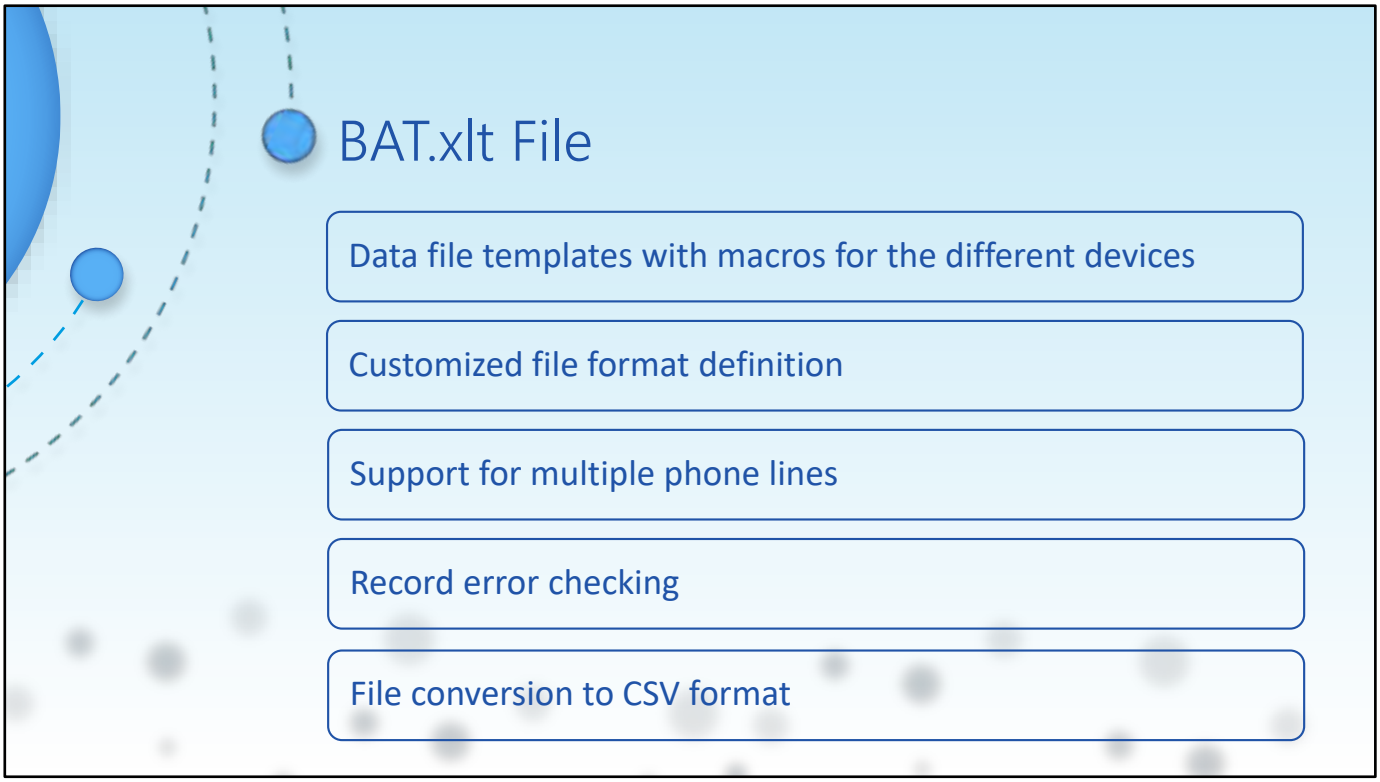


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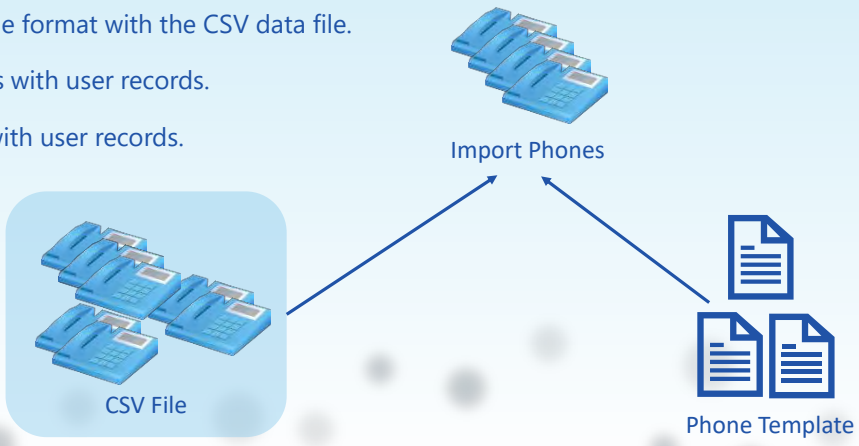
# Add Phones

Create a CSV data file with individual values for each phone or user record that must be updated.

Associate the file format with the CSV data file.

Validate phones with user records.

Insert phones with user records.

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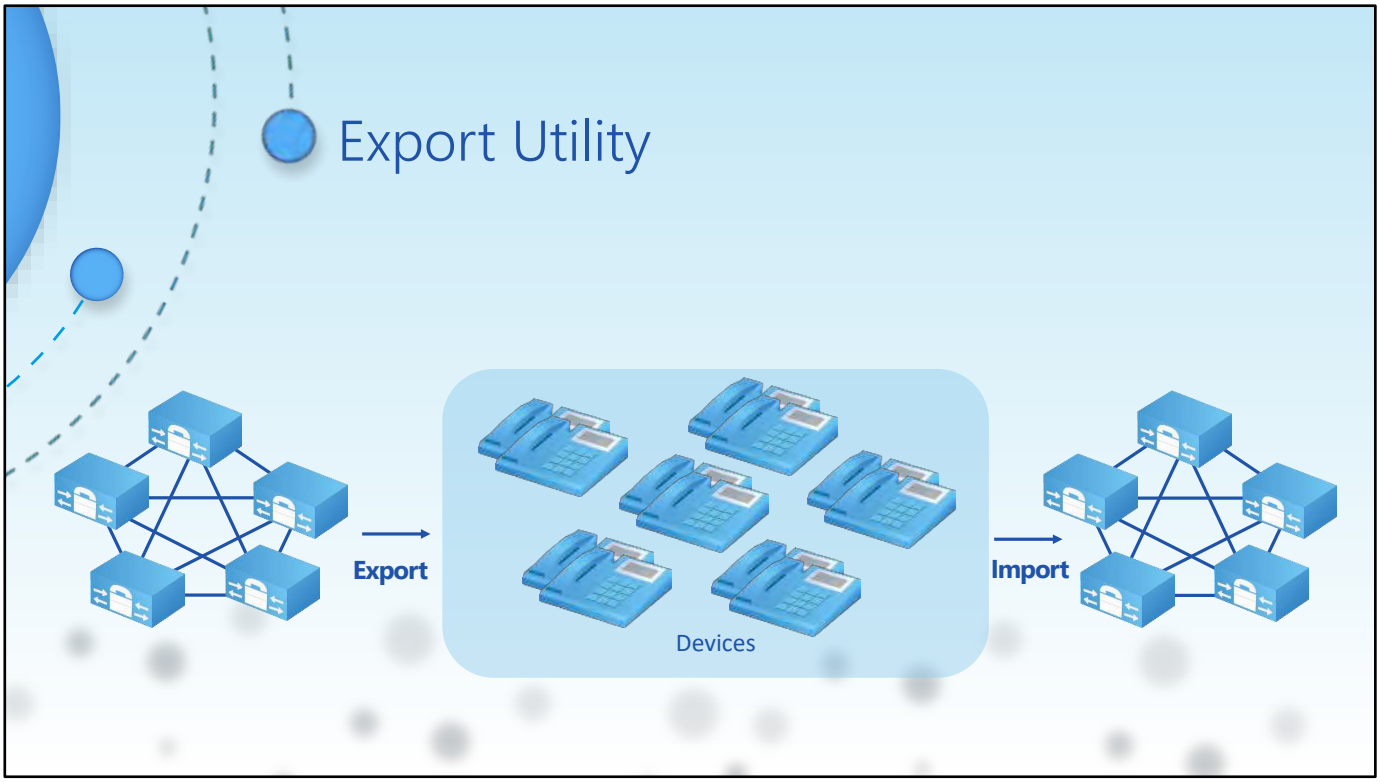


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# Configure Batch Provisioning

The batch provisioning feature can help you when you need to deploy many devices, users, gateways, or trunks. Batch provisioning combines a BAT template and a CSV file to import specific devices or users. You can even use the Bulk Administration menu in Cisco Unified Communications Manager Administration to update settings on existing configuration elements, like users, phones, pickup groups, and gateways.

**Demo Lab**

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# Conclusions

- Batch-Provisioning tools and configuration
  - BAT Components
  - Bulk provisioning
  - BAT Template
  - .xlt file
  - Add phones
  - Export
  - Configuration

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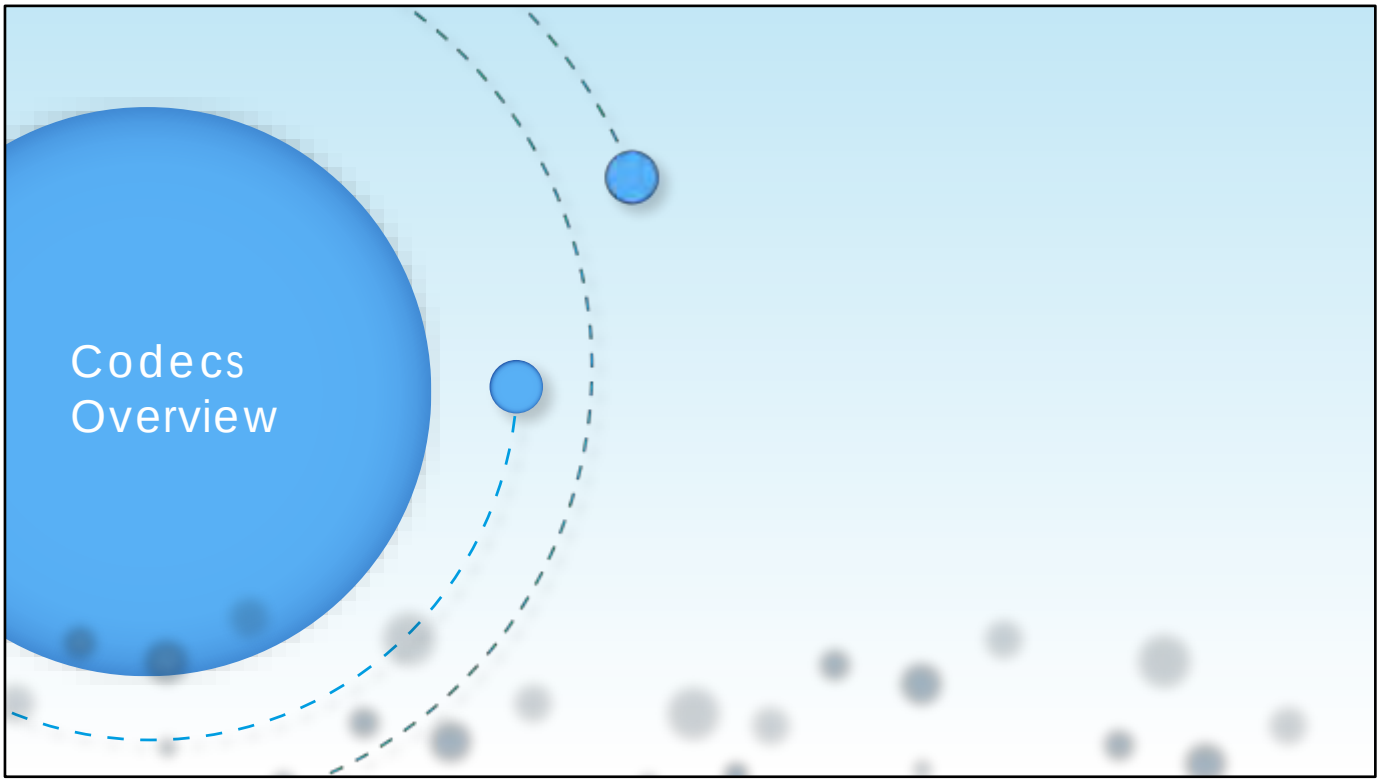


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# Step 1 - IP Phone Boot up Process

- Compare Audio Codecs
- Compare Video Codecs
- Evaluate Effects of Codec
- Bandwidth Calculator
- CAC
- Regions/Location

| Codec | Bandwidth [kbps] |
|---|---|
| G.711 | 64 |
| G.722 | 48/56/64 |
| iLBC | 15.2, 13.3 |
| G.729 | 8 |
| Opus | 6-510 |

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# What is codec?

Pulse Code Modulation (PCM)

1. Sample the analog signal regularly.
2. Quantize the sample.
3. Encode the value into a binary expression.

Codec Compression

4. Compress the samples to reduce bandwidth (optional).

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# Codec Compression

| Codec | Bandwidth [kbps] |
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| G.711 | 64 |
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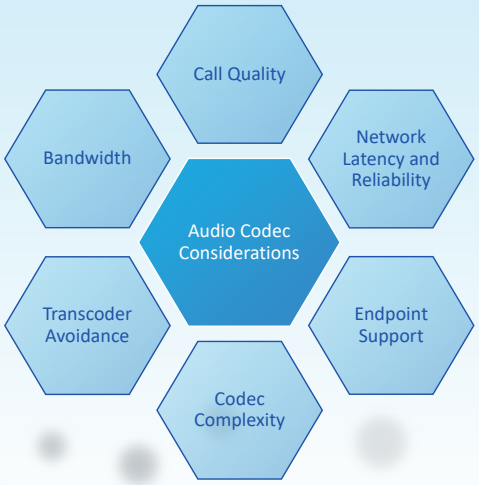
# Audio Codec Selection

A codec is a software algorithm that compresses and decompresses speech or audio signals.

There are many standardized codecs that are used in VoIP networks

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# Audio Codec Selection

- G.711
- G.722
- iLBC
- G.729
- G.729A
- G.729AB
- Opus

| Codec | Bandwidth (kbps) | Developed | Band | Sampling (kHz) | License | Released | MOS |
|---|---|---|---|---|---|---|---|
| G.711 | 64 | ITU-T | Narrowband | 8 | Free | 1972 | 4,3 |
| G.722 | 48 / 56 / 64 | ITU-T | Wideband | 16 | Free | 1988 | --- |
| iLBC | 15,2 / 13,3 | Global IP Solutions* | Narrowband | 8/16 | Open-Source | 2002 | 4,14 |
| OPUS | 6-510 | IETF | Mixed | 8/12/16/24/48 | Royalty-Free | 2012 | --- |
| G.729 | 8 | ITU-T | Narrowband | 8 | Royalty-Free** | 1996 | 3,92 |

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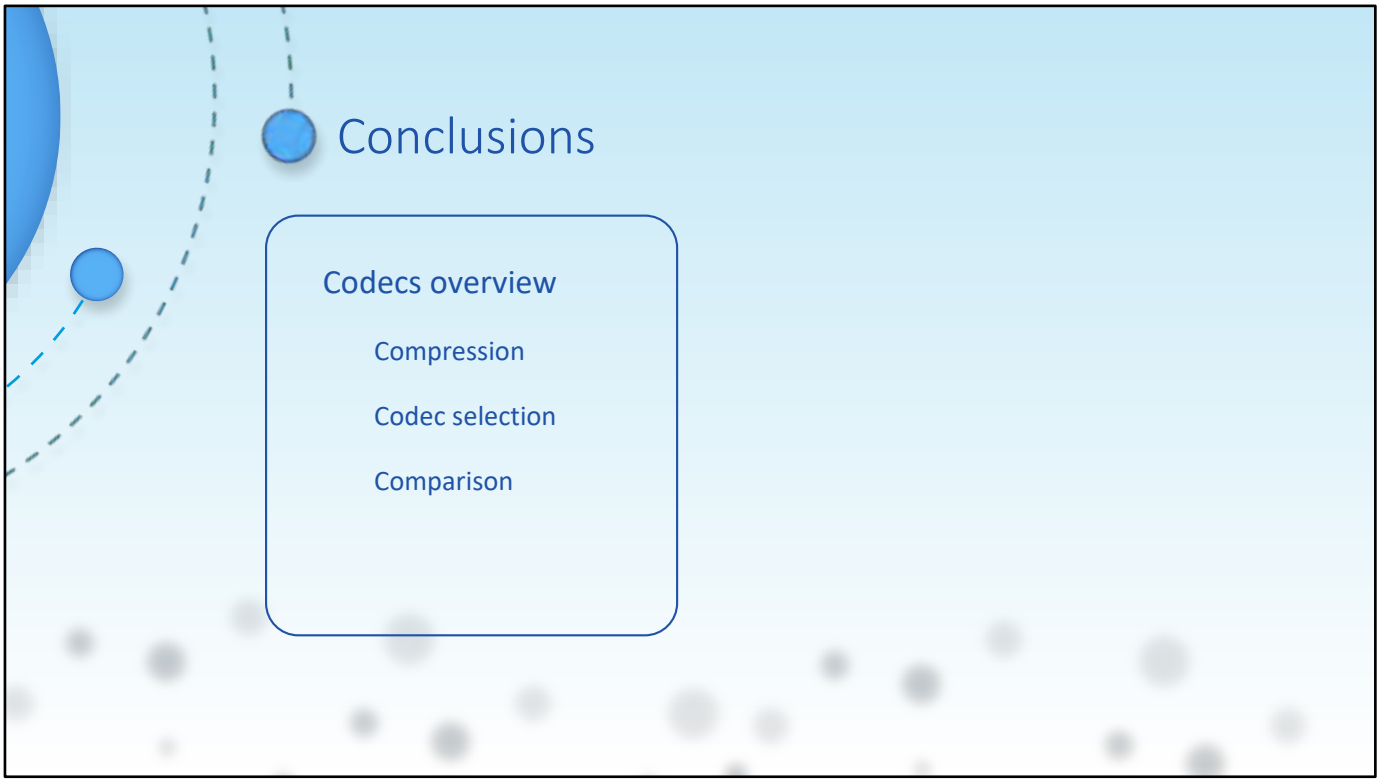


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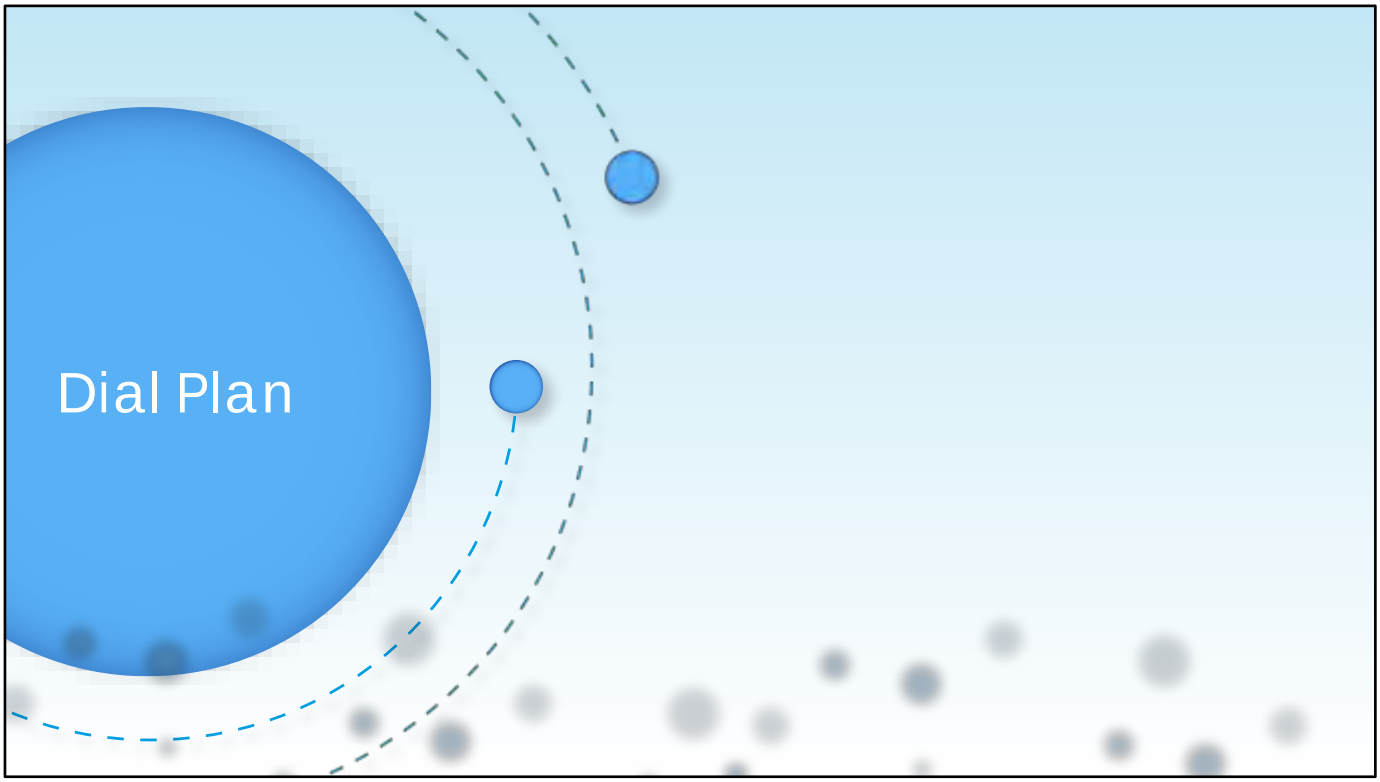


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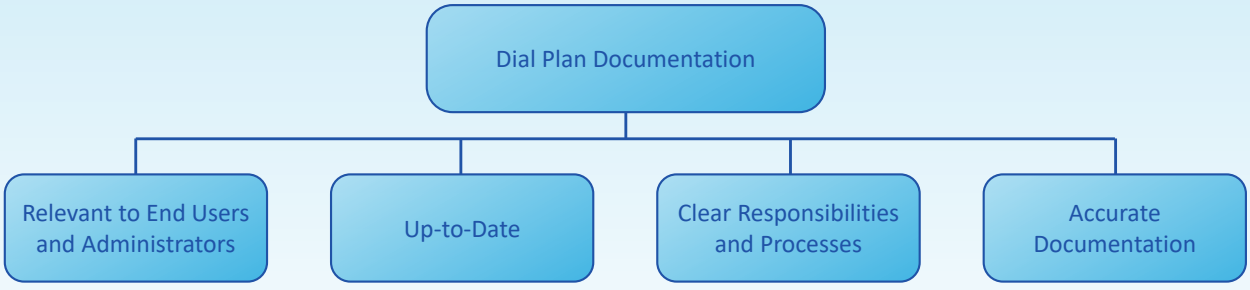
# Dial Plan Design Concept

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# Defining Dial Plans

The dial plan defines the format in which connected parties are presented and determines the dial plan features and applications such as classes of service and call coverage.

- Endpoint Addressing
- Dial Rules for Internal and External Numbers
- Digit Manipulation
- Classes of Service
- Call Coverage
- Call Routing
- Path Selection

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# Dial Plan Design

You must have greater knowledge about how to design a dial plan when you have larger deployments and a greater number of dialing domains.

- Endpoint Types
- Internal Directory Numbers and PSTN Numbers
- E. 164 Structure
- Dialing Domains
- Avoiding Overlaps
- Emergency Dialing
- Cost-Avoidance Methods

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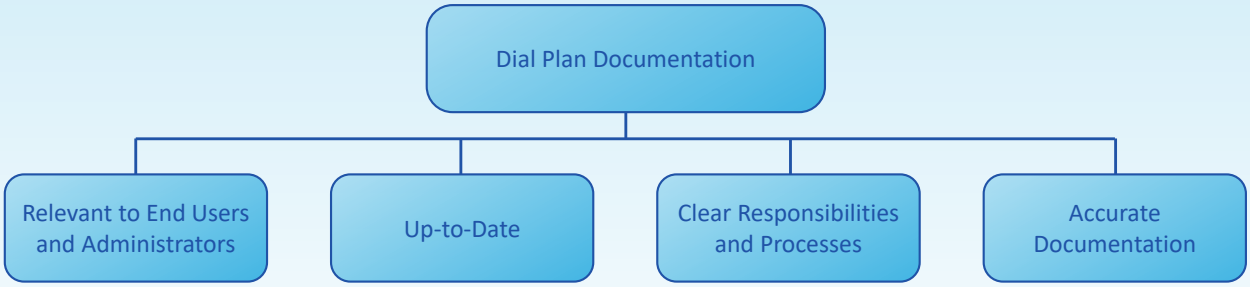
# Dial Plan Documentation

Dial plans can be very complex and involve many geographic areas and devices

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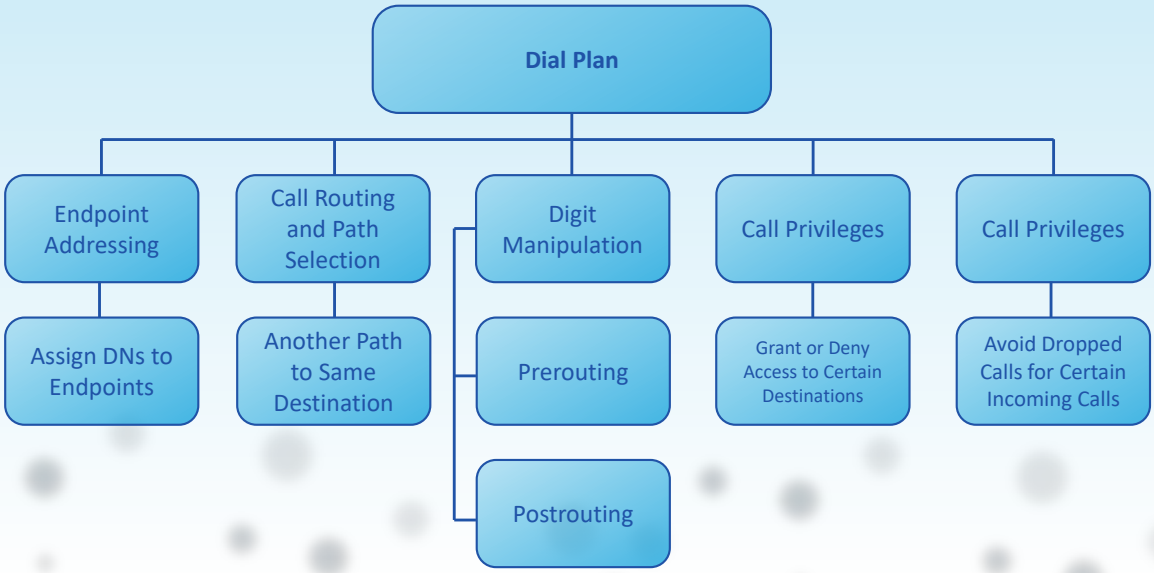
# Dial Plan Components

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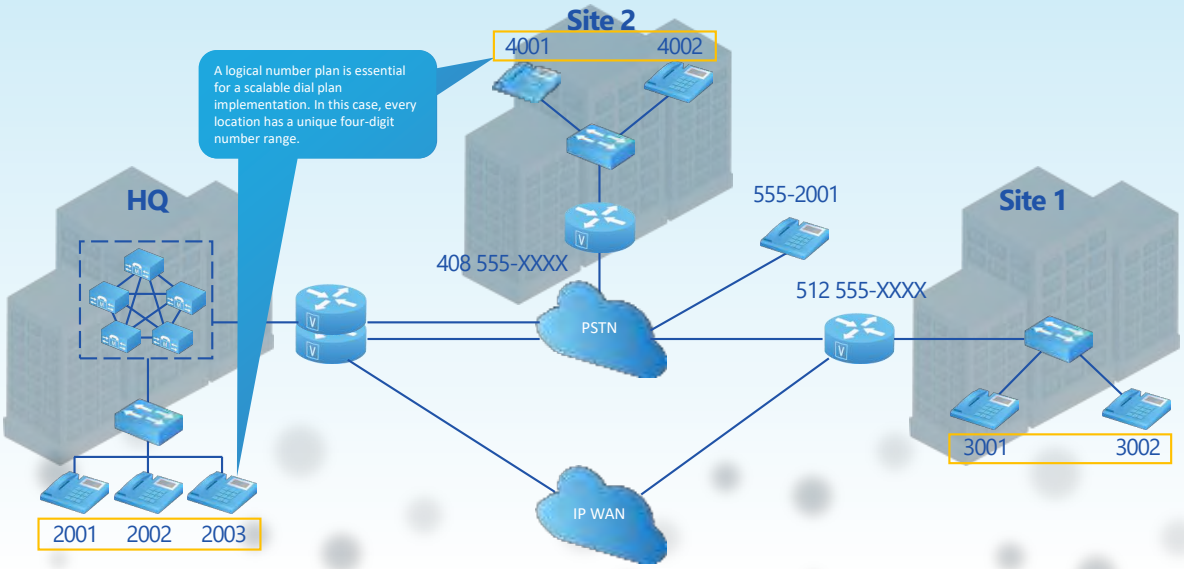
# Dial Plan Components and Functions: Endpoint Addressing

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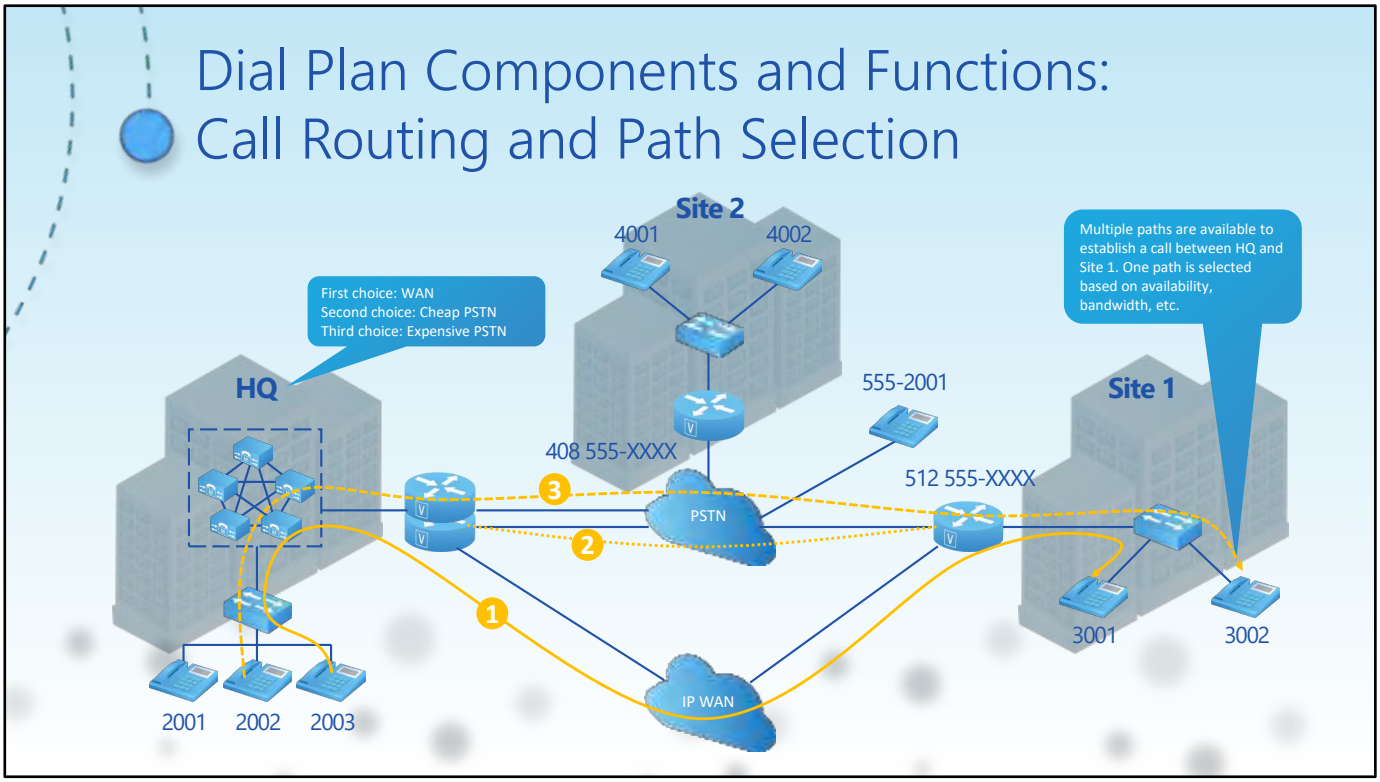
# Dial Plan Components and Functions: Call Routing and Path Selection

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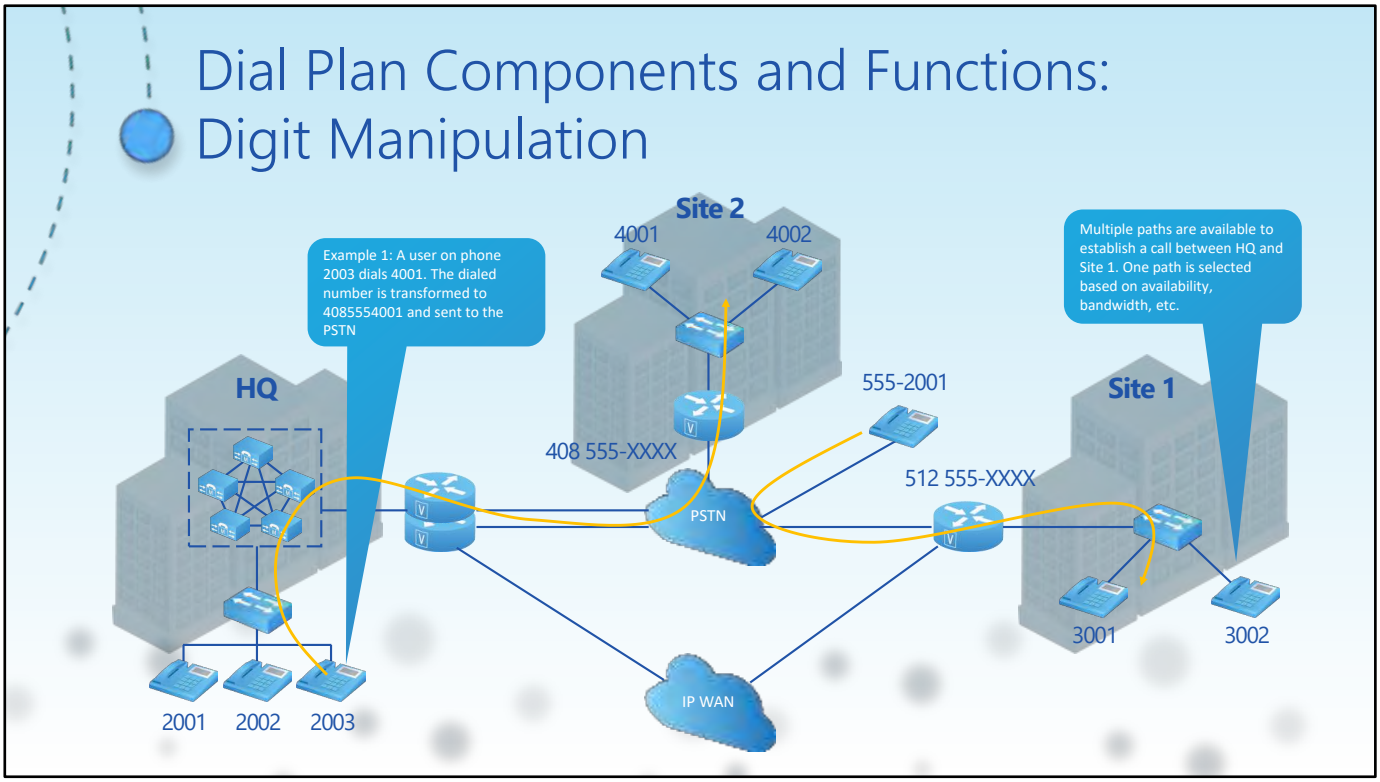
# Dial Plan Components and Functions: Digit Manipulation

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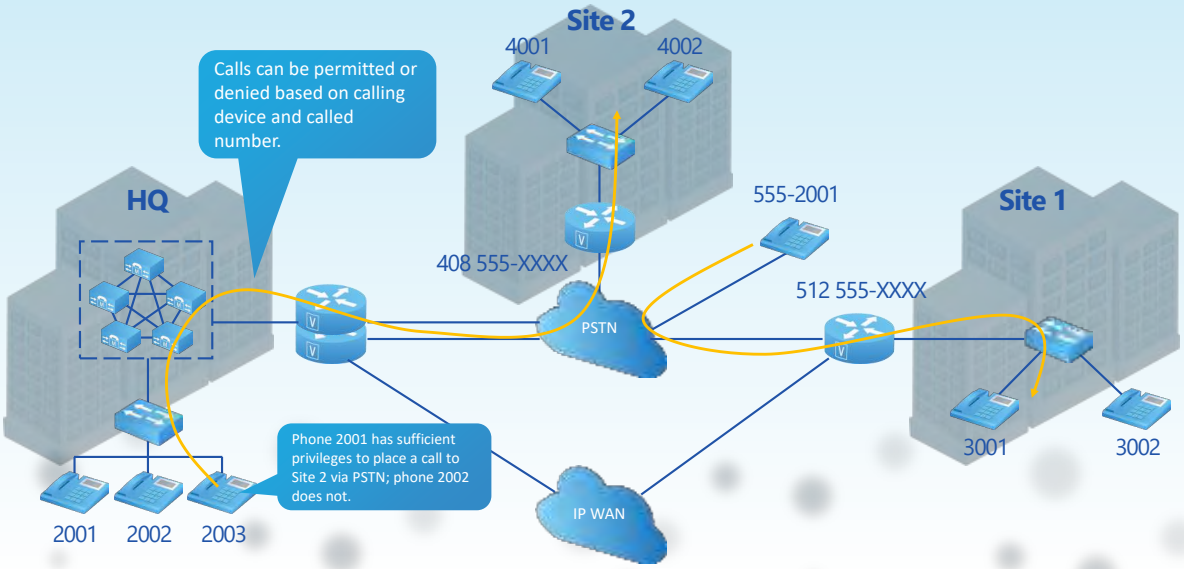
# Dial Plan Components and Functions: Digit Privileges

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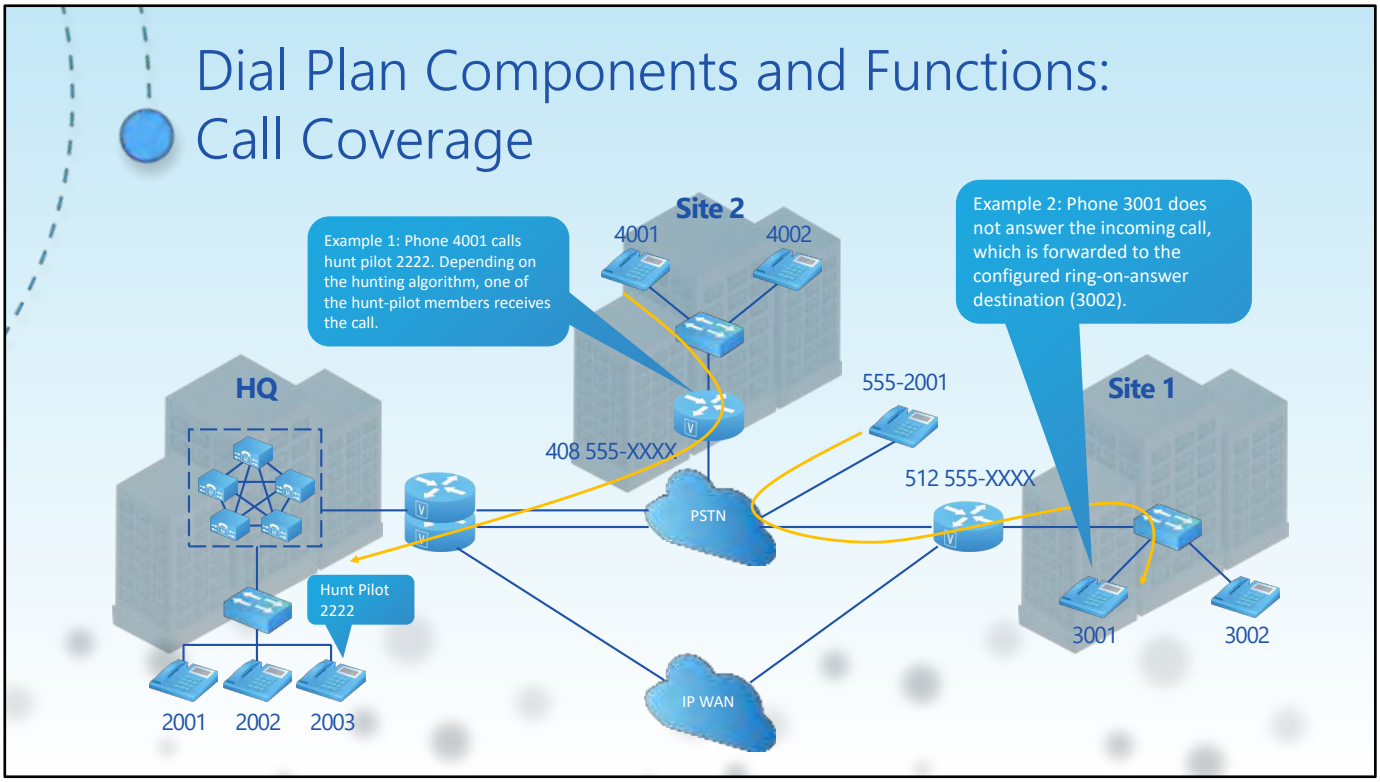
# Dial Plan Components and Functions: Call Coverage

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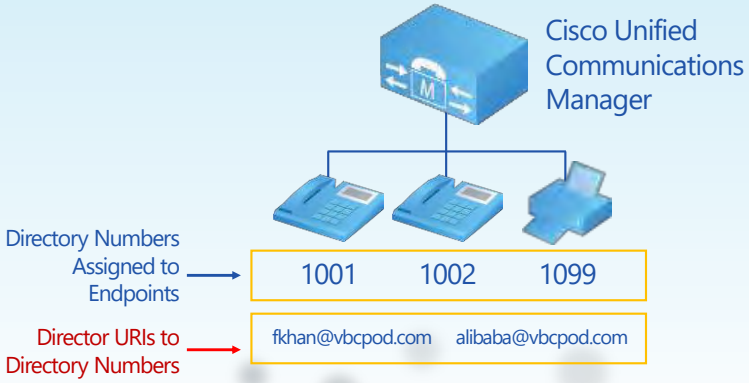
# Endpoint Addressing Overview

You can assign a directory number to an endpoint in Cisco Unified Communications Manager

To reach internal endpoints such as IP phones or fax machines and applications (such as voicemail systems, auto-attendants, and conferencing systems) you must assign at least one directory number to each endpoint

In addition, you can assign directory URIs as aliases to directory numbers

By calling a configured directory number or directory URI, you can reach the corresponding device

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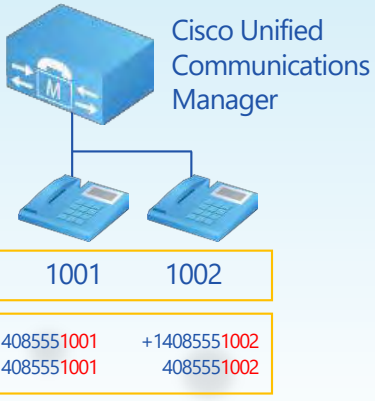
# Endpoint Addressing by Numbers

First, you must decide on the length of the internal extension. Depending on the number of required extensions, you should choose longer or shorter extensions. With four-digit extensions, you can address as many as 10,000 endpoints

Typically, the phones should also be reachable from the PSTN. You can address internal endpoints from outside the system in two ways:

- **Two-stage dialing**
- **Direct inward dialing**

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# Endpoint Addressing by URIs

Directory URIs are aliases for directory DNs.

Format: <user portion>@<host portion>

Fillable Format:

- Full qualified URI format i.e fkhan@vbcpod.com
- Not fully qualified format i.e. fkhan

For a not full qualified format, the OTLD of the cluster is added to the user portion.

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# Conclusions

- Dial plans
  - Concept
  - Plans
  - Design and documentation
  - Components
    - Endpoint addressing
    - Routing and path selection
    - Digit manipulation
    - Calling privileges
    - Call coverage
  - Endpoint addressing
    - Numbers and URI

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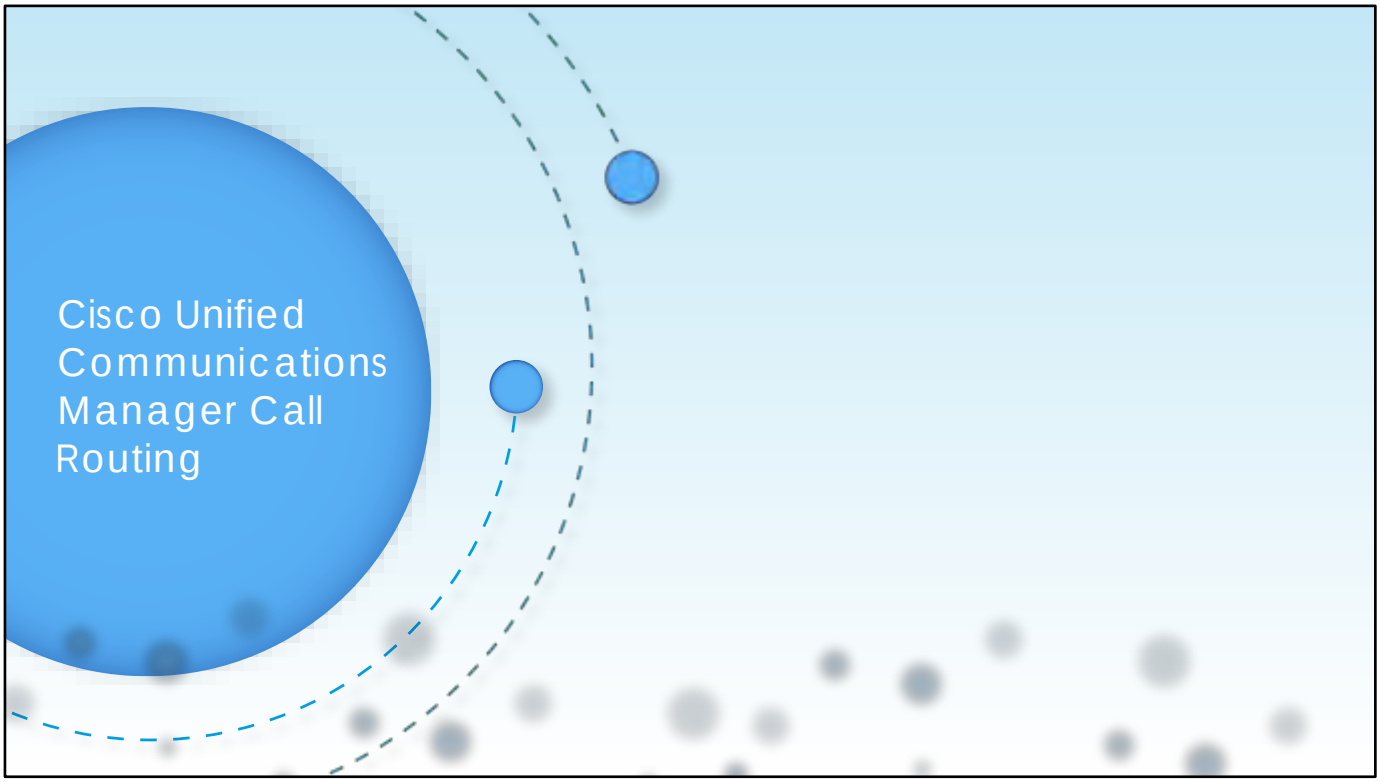


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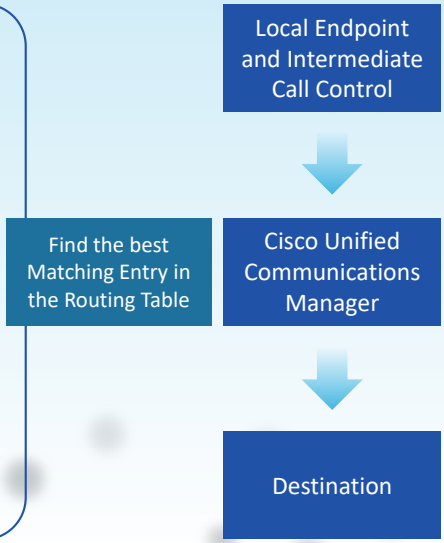
# Call-Routing Steps

The call-routing process starts when a local endpoint or intermediate call control system sends a call setup request to Cisco Unified Communications Manager. At this point, Cisco Unified Communications Manager analyzes the target of the received request to find the best match and forwards the call setup request to the destination

Three main types of call routing are used:

- **Intrasite routing:** This type of call routing occurs within a single site
- **Intersite routing:** This type of call routing occurs between multiple site
  - A translation pattern is used for centralized and distributed call-processing deployment models.
  - A route pattern is used only for a distributed call-processing deployment
- **PSTN routing:** This type of call routing occurs between a site and the PSTN

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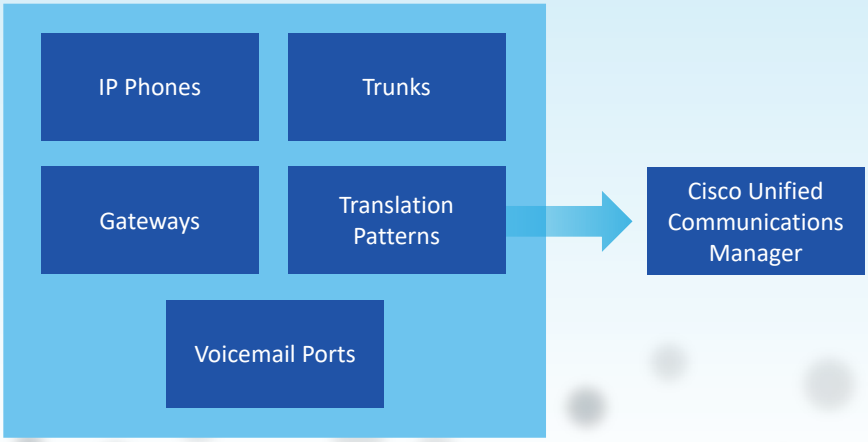
# Sources of Call-Routing Requests (Entities Requiring Call-Routing Table Lookups)

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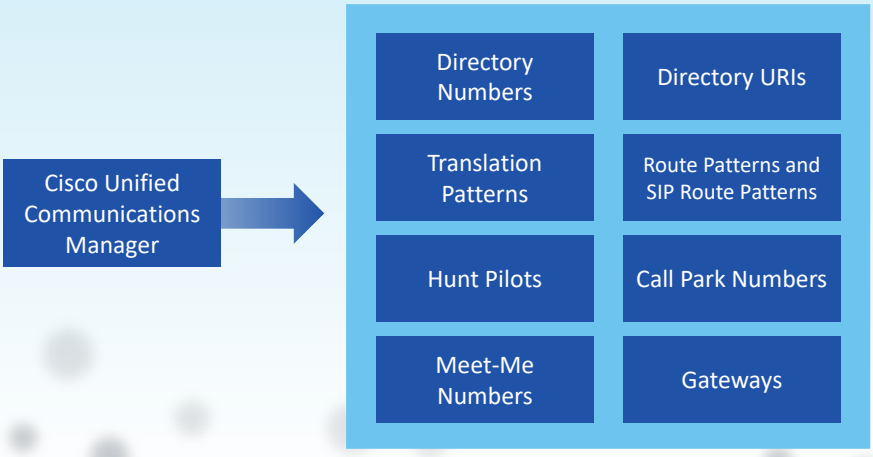
# Call-Routing Table Entries (Call-Routing Targets)

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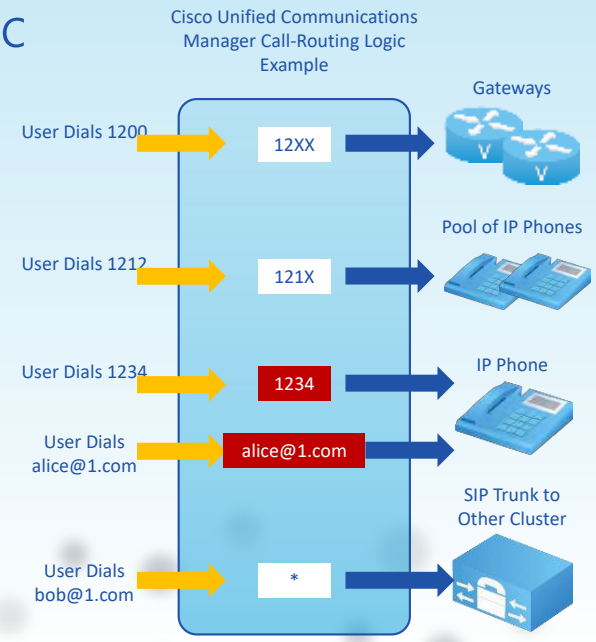
# Call-Routing Logic

## Closest Match

If multiple matches are present, the following criteria determine the destination pattern:

- The pattern matches the dialed string
- The pattern matches the entry representing the smallest number of endpoints

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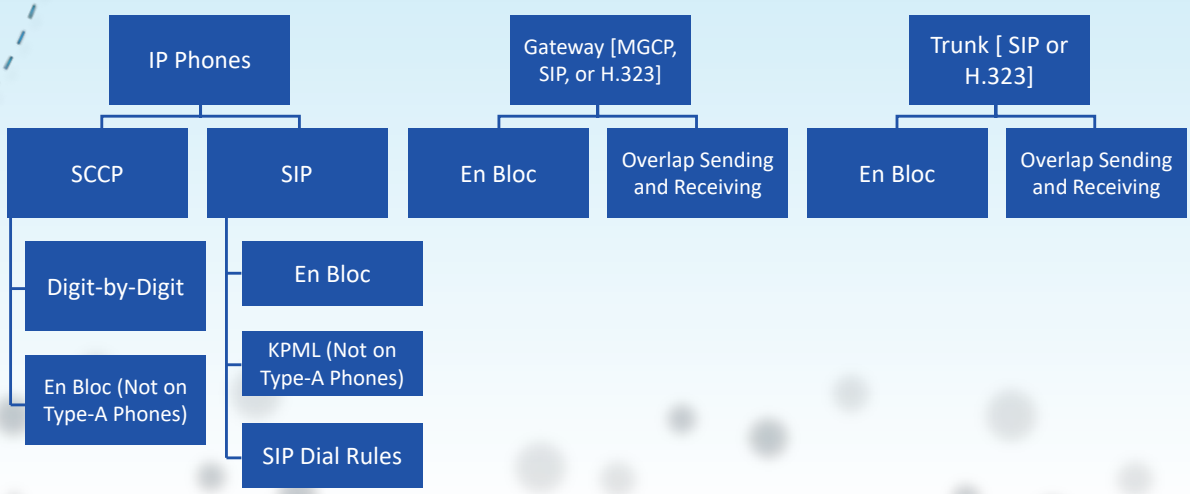
# Address Methods for Destination Numbers

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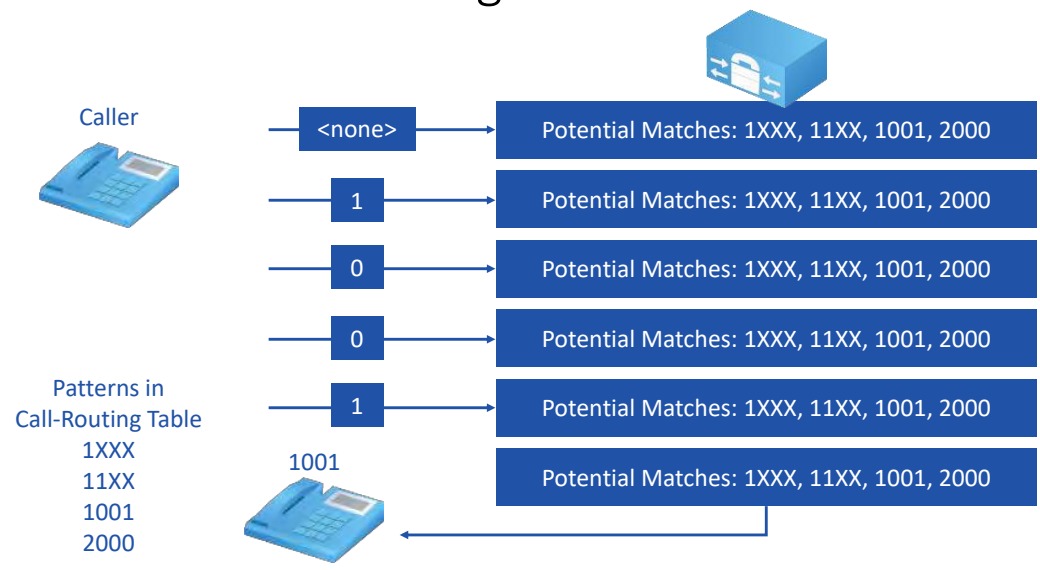
# Digit-by-Digit Analysis of Numbers Not Received in a Single Block

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# Exclamation Point (!) Wildcard

**One or More Digits**

**Variable-Length Route Patterns**

**T302 Timer (Interdigit Timer)**

- 15 seconds (default)
- Service Parameter > Call Manger > Clusterwide Parameters

**Users can use # to indicate end of dialing**

- Implementation requires an identical route pattern with the # sign
- Cisco Unified Communications Manager implementation is unlike Cisco IOS dial peers implementation

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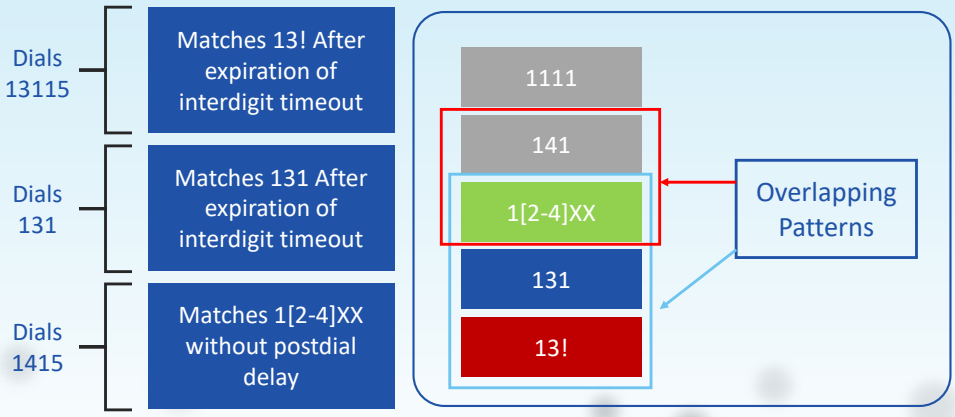
# Overlaps and Interdigit Timeout

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# Urgent Priority

**Urgent Priority is configured under the following components:**

- Route Patterns
- Translation Patterns
- Directory Numbers

**Immediate Routing When Matched**

**Used for Emergency Numbers**

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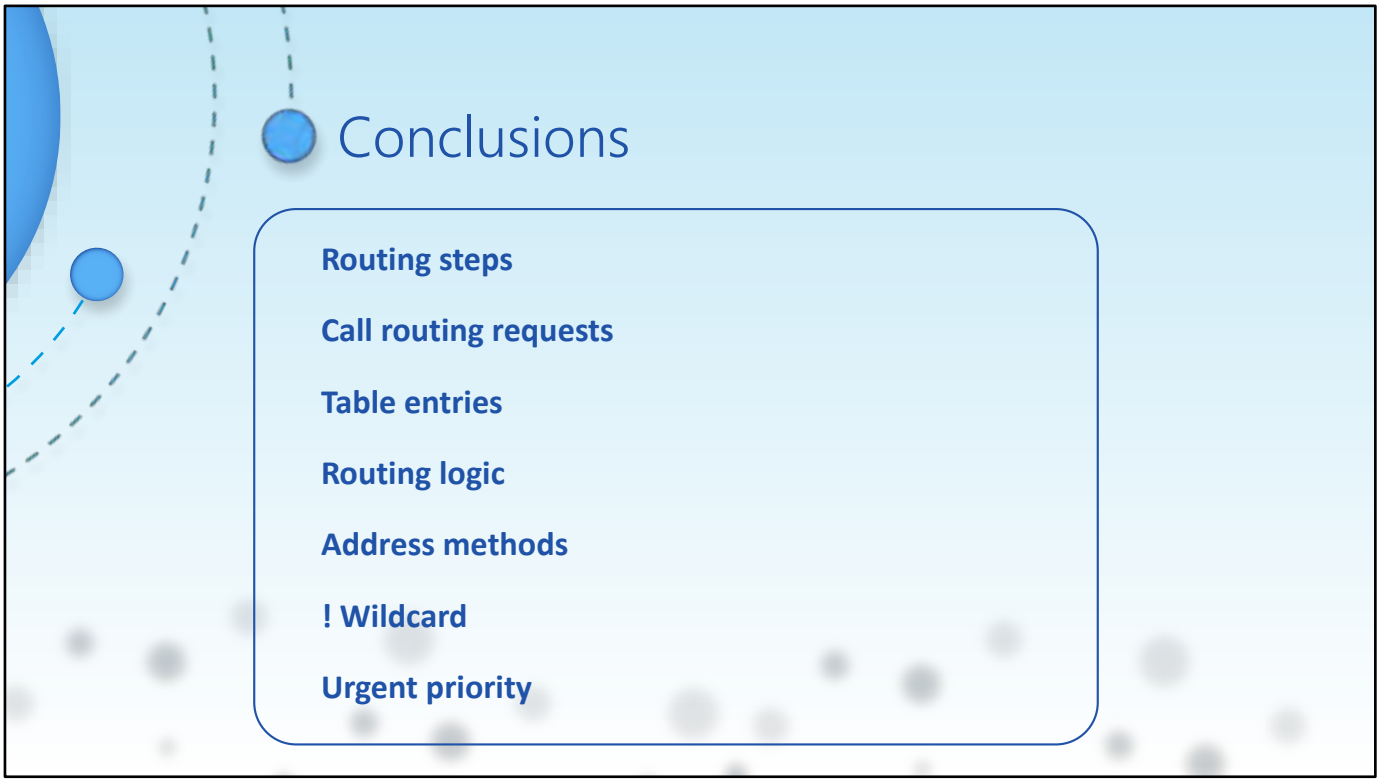


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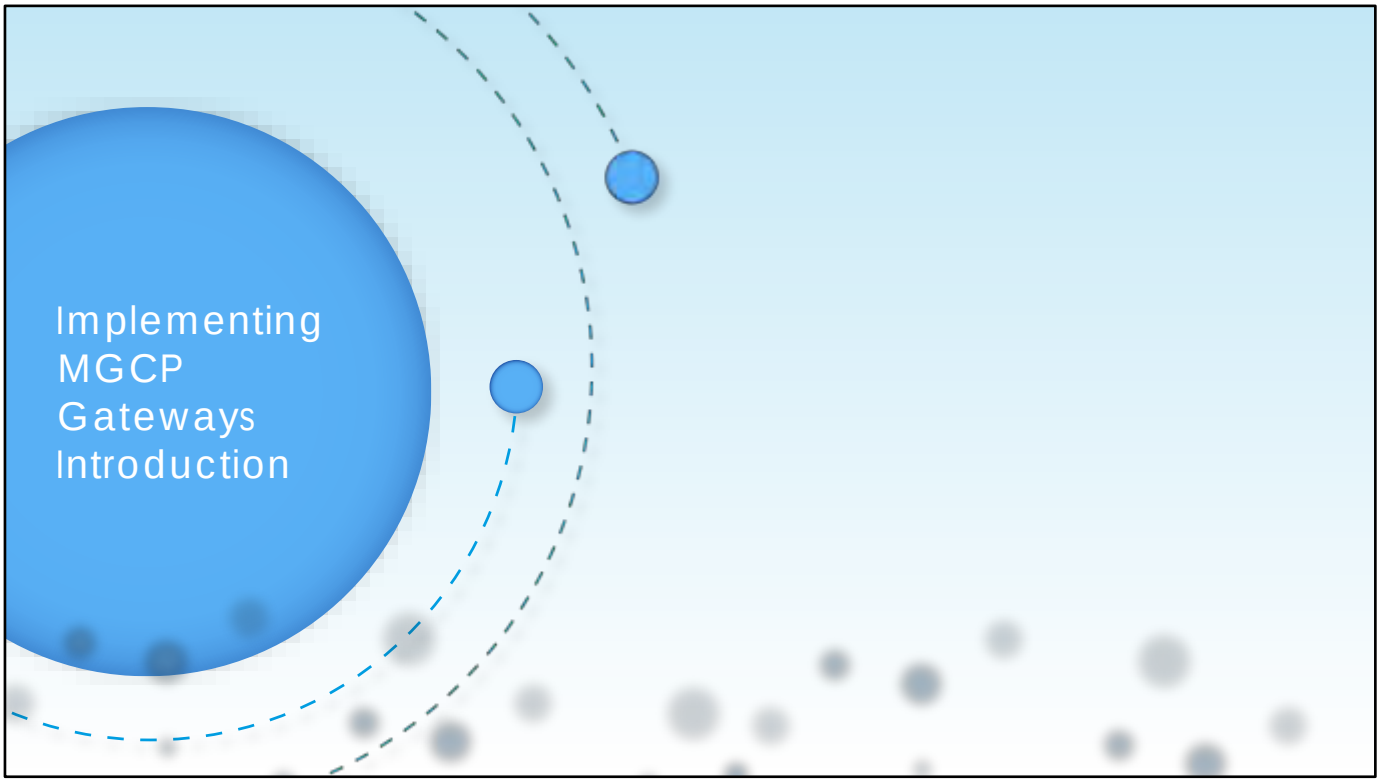


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# MGCP Gateway

Gateways are needed for call routing to and from the IP telephony network

Gateway require routing protocols (H.323,SIP or MGCP)

Explore Media Gateway Control Protocol (MGCP)

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# Overview of MGCP Gateways

- Simplified configuration for dial peers
- Migration paths
- Centralized dial plan configured on Cisco Unified Communications Manager
- Centralized gateway configuration on Cisco Unified Communications Manager
- Simple Cisco IOS gateway configuration
- Supports QSIG supplementary services with Cisco Unified Communications Manager

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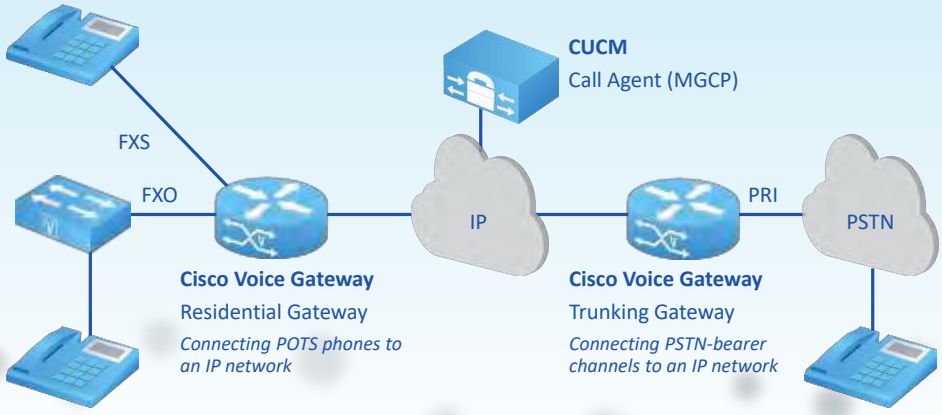
# MGCP Components

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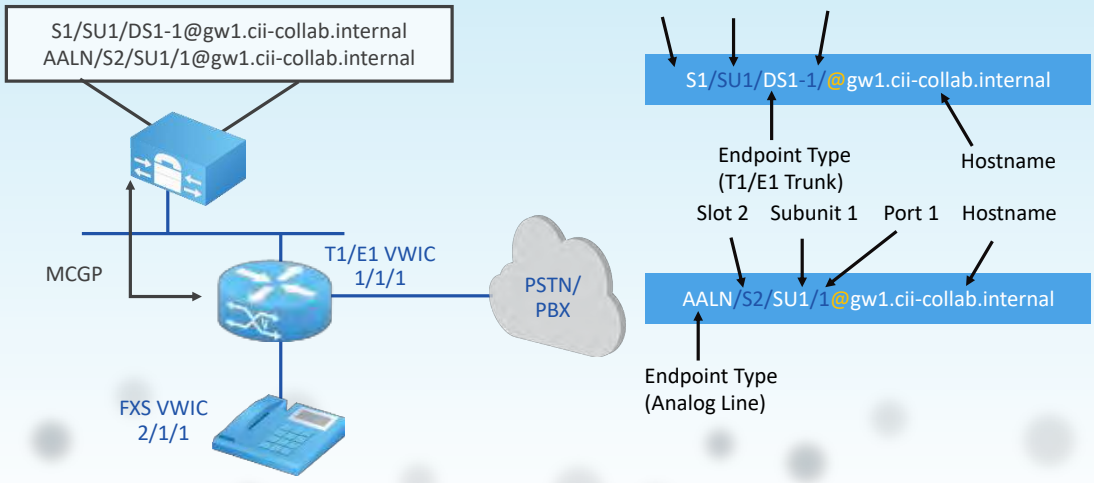
# MGCP Endpoint Identifiers

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# MGCP Call Flows

There are multiple MGCP messages, two of which are used by a call agent to query the state of a media gateway:

**AuditEndpoint (AUEP)**

**AuditConnection (AUCX)**

**EndpointConfiguration (EPCF)**

**CreateConnection (CRCX)**

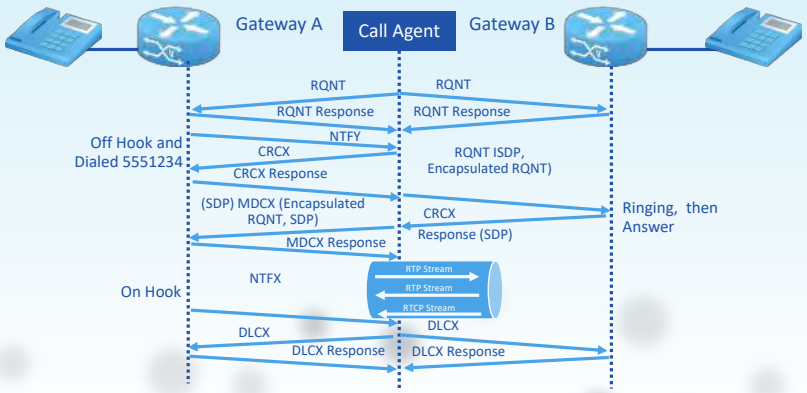
**DeleteConnection (DLCX)**

**ModifyConnection (MDCX)**

**NotificationRequest (RQNT)**

**Notify (NTFY)**

**RestartInProgress (RSIP)**

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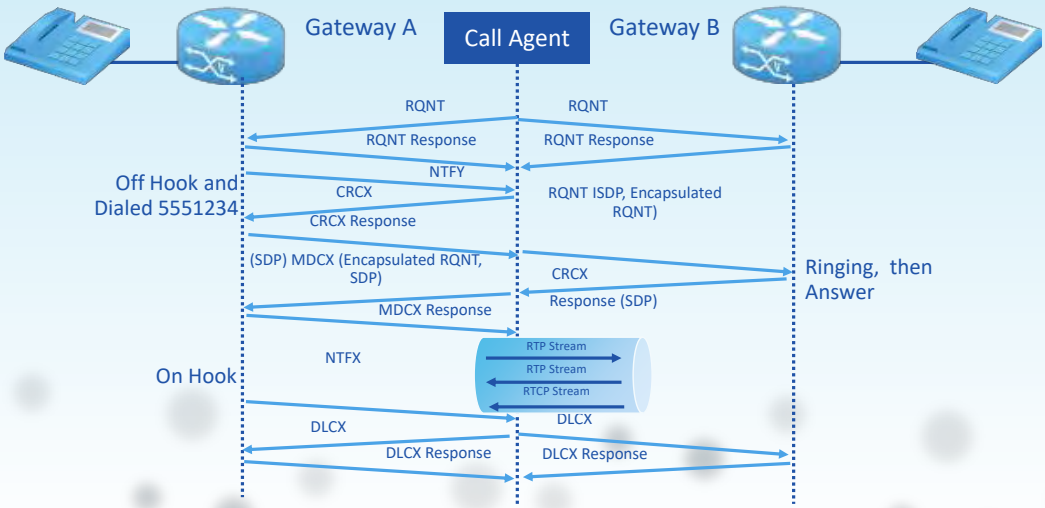
# MGCP Call Flows

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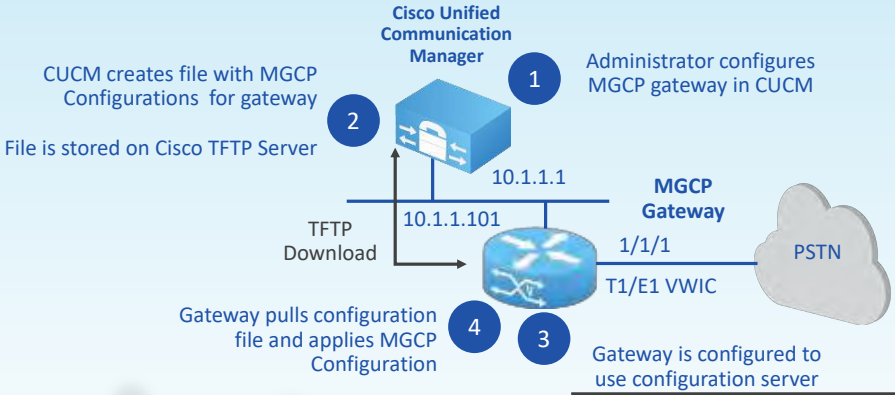
# Implementation




```
GW (config) # ccm-manager config server 10.1.1.1
GW (config) # ccm-manager config
```

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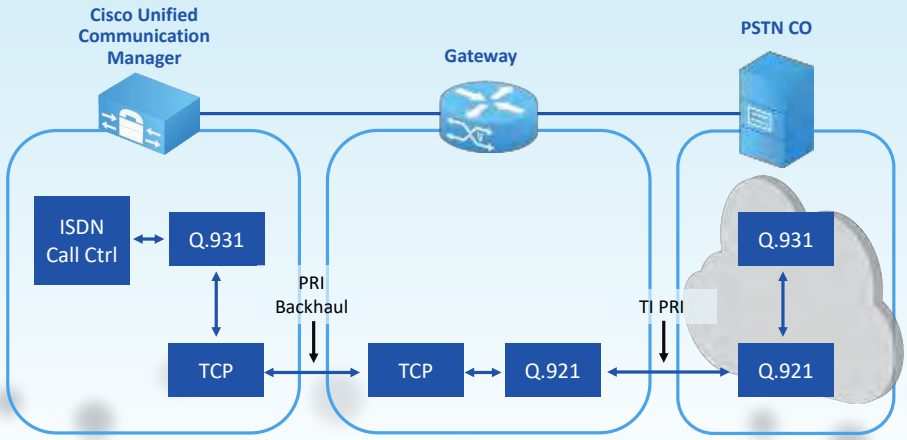
# Primary Rate Interface Backhaul

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# MGCP Gateway Implementation Considerations

Because of the master-slave architecture of MGCP, a constant connection must be present between the Cisco IOS MGCP gateway and Cisco Unified Communications Manager.

If the connection between Cisco Unified Communications Manager and the MGCP gateway is unavailable, the following occurs:

- If the gateway was configured for failover (by using the ccm-manager fallback-mgcp command), the MGCP gateway can fail over to local call control. All active calls are dropped (there is no call survivability), and a complete local dial plan must be present.
- If no failover configuration is present, all calls are dropped and the PRI interface goes down.

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# Conclusions

- Media Gateway Control Protocol
  - Gateways Overview
  - Components
  - Endpoint identifiers
  - Call flows
  - Implementation
    - PRI backhaul
    - MGCP Implementation considerations

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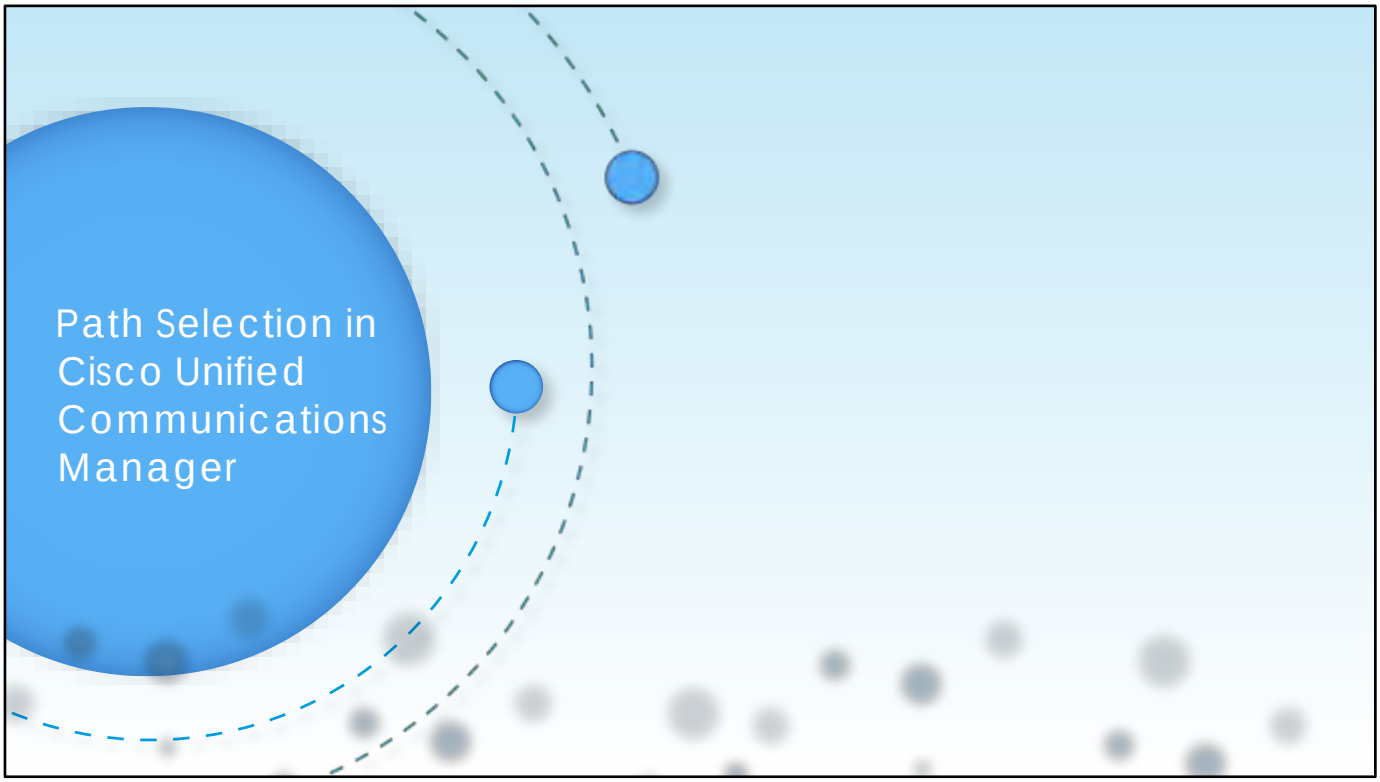


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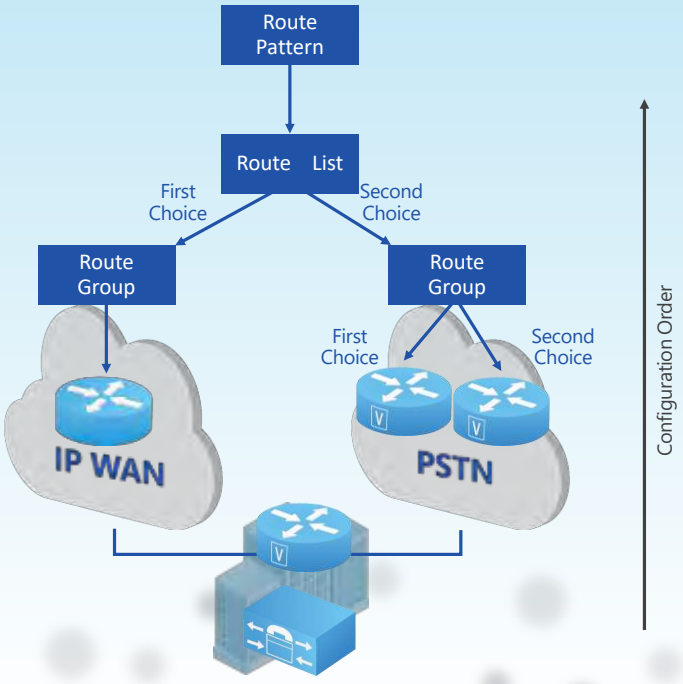
# Path Selection

**Route Pattern**
- Matches dialed number for external calls
- Performs digit manipulation (optional)
- Points to a route list, trunk, or gateway

**Route List**
- First level of path selection
- Performs digit manipulation
- Points to prioritized route group(s)

**Route Group**
- Second level of path selection
- Points to the actual device(s)
- Circular or top-down distribution

**Devices**
- Gateways (H.323, MGCP)
- Trunks (SIP. H.323)

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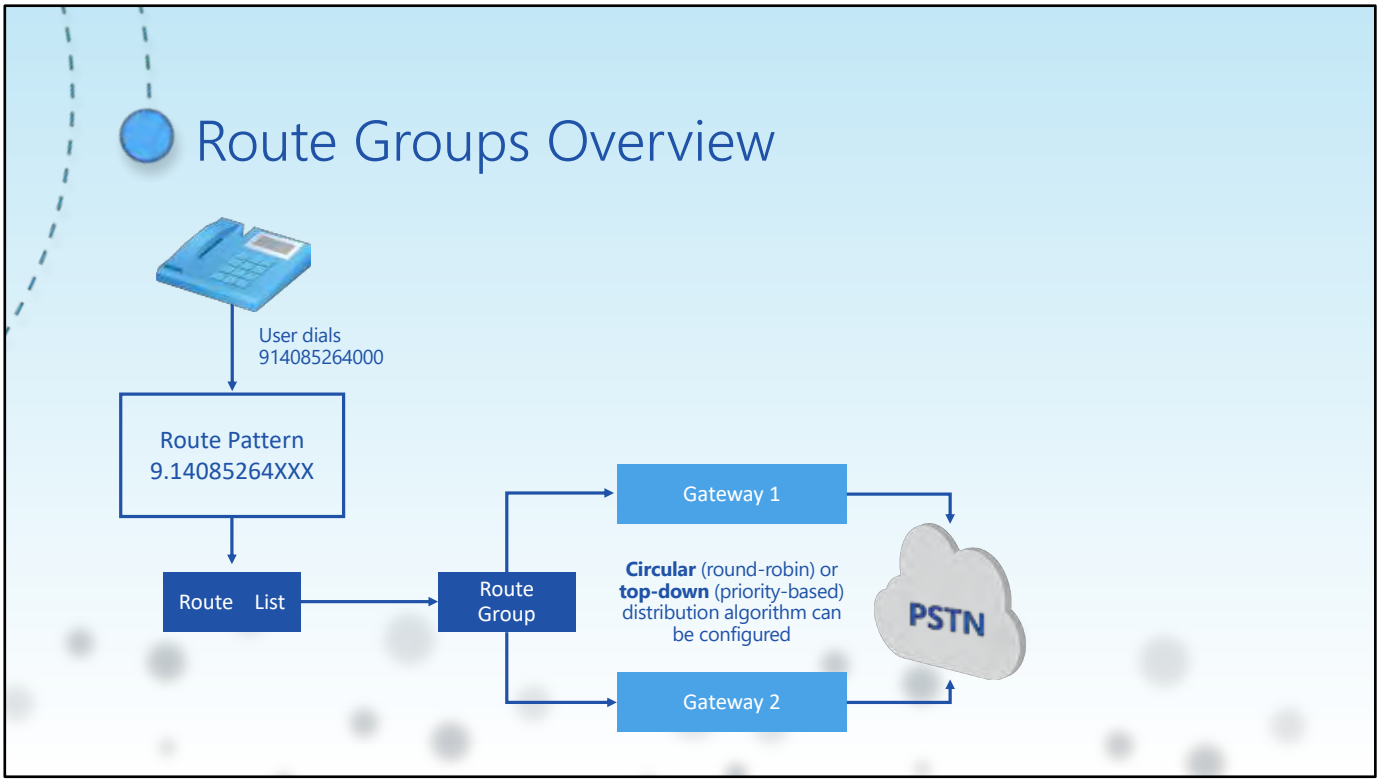
# Route Groups Overview

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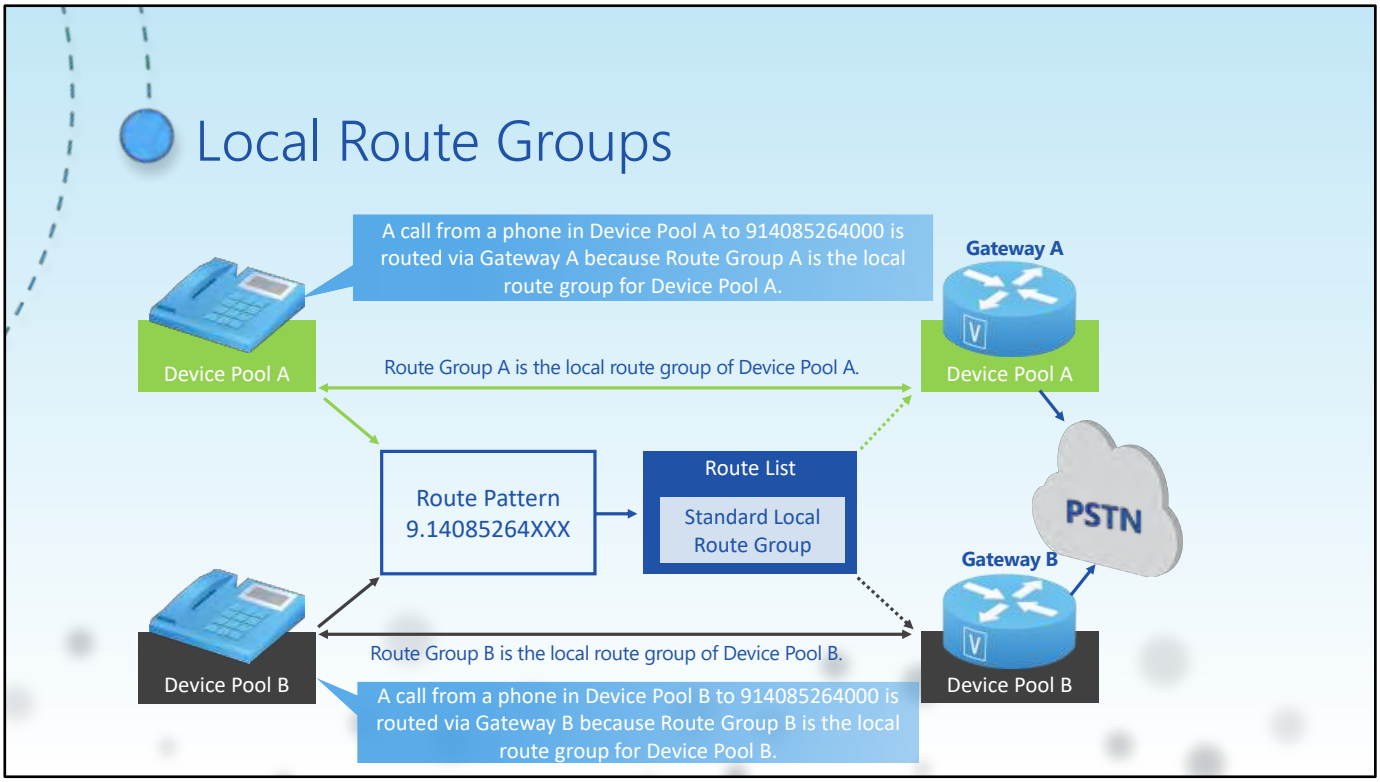
# Local Route Groups

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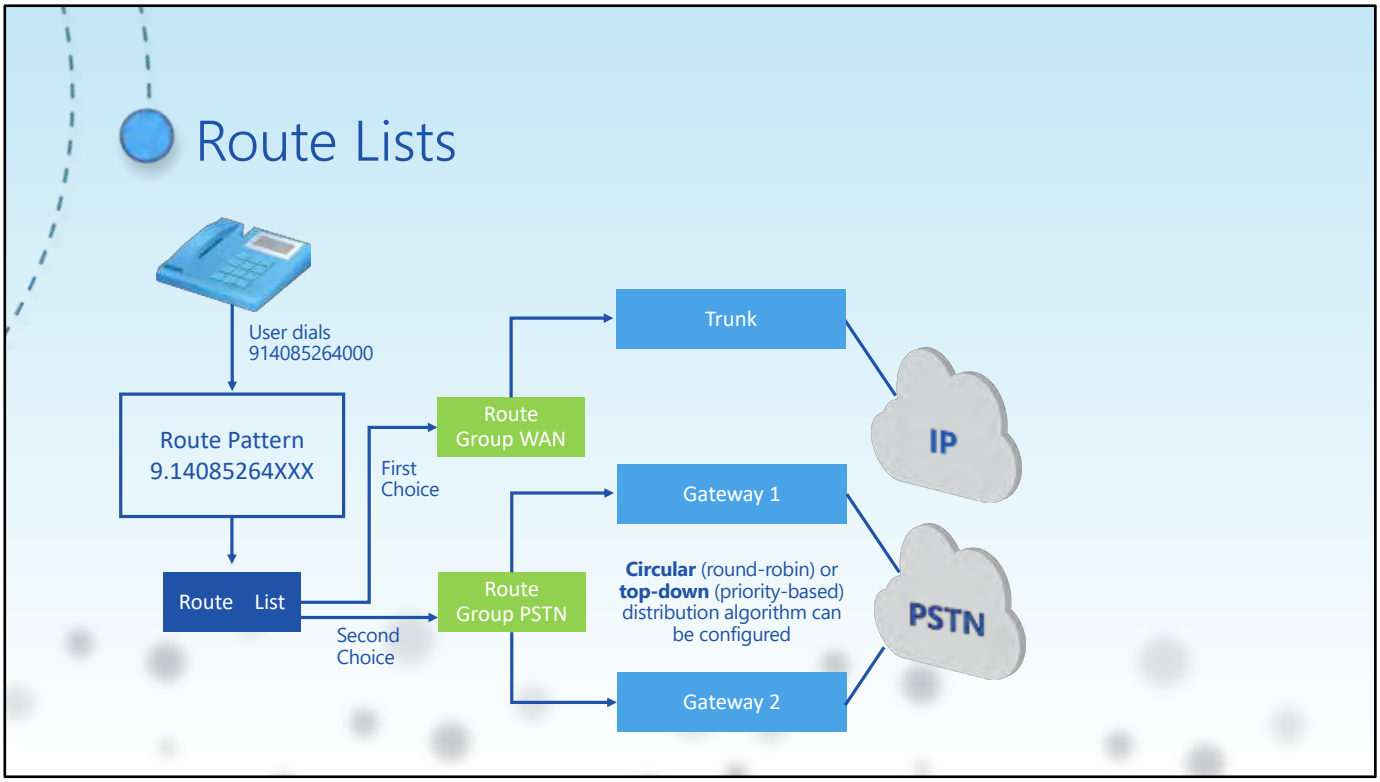
# Route Lists

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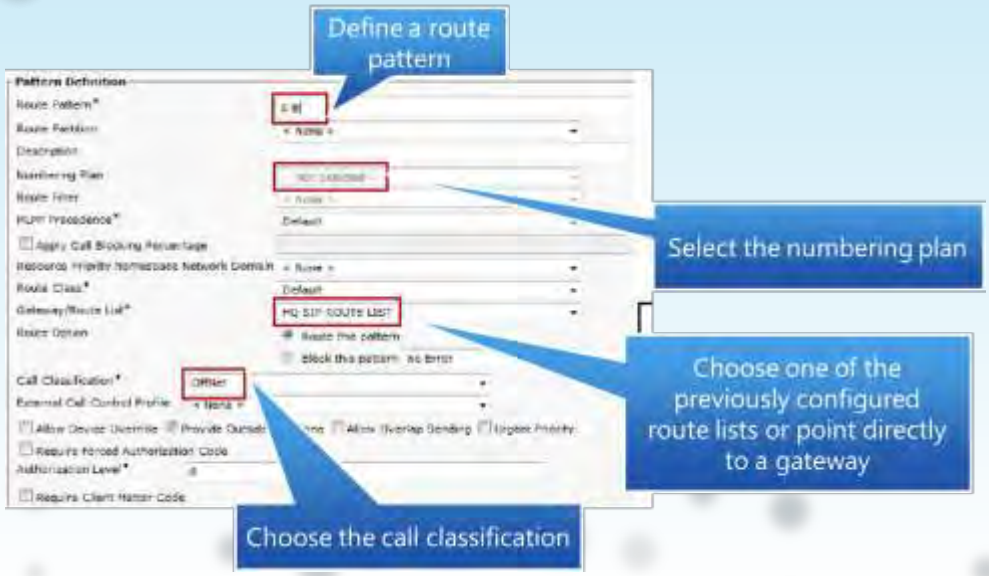
# Route Patterns

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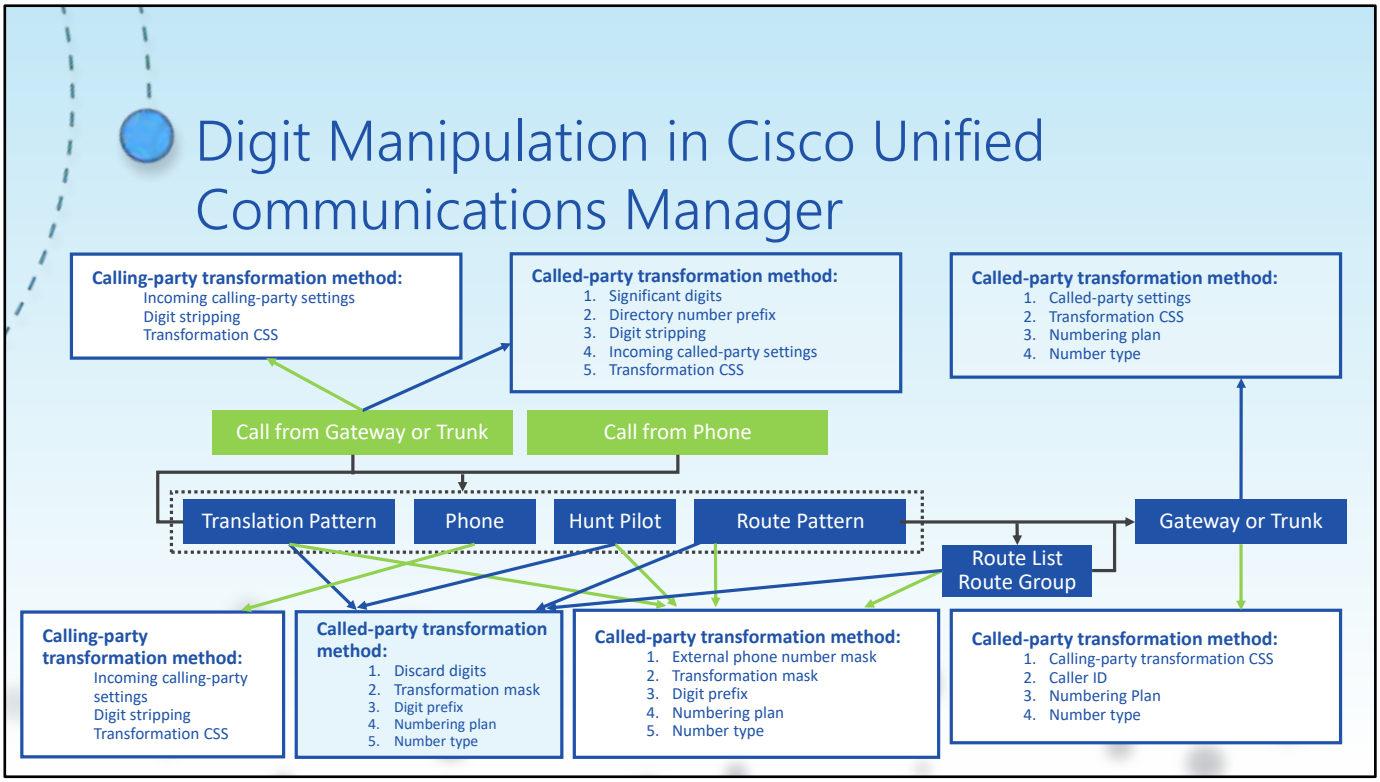
# Digit Manipulation in Cisco Unified Communications Manager

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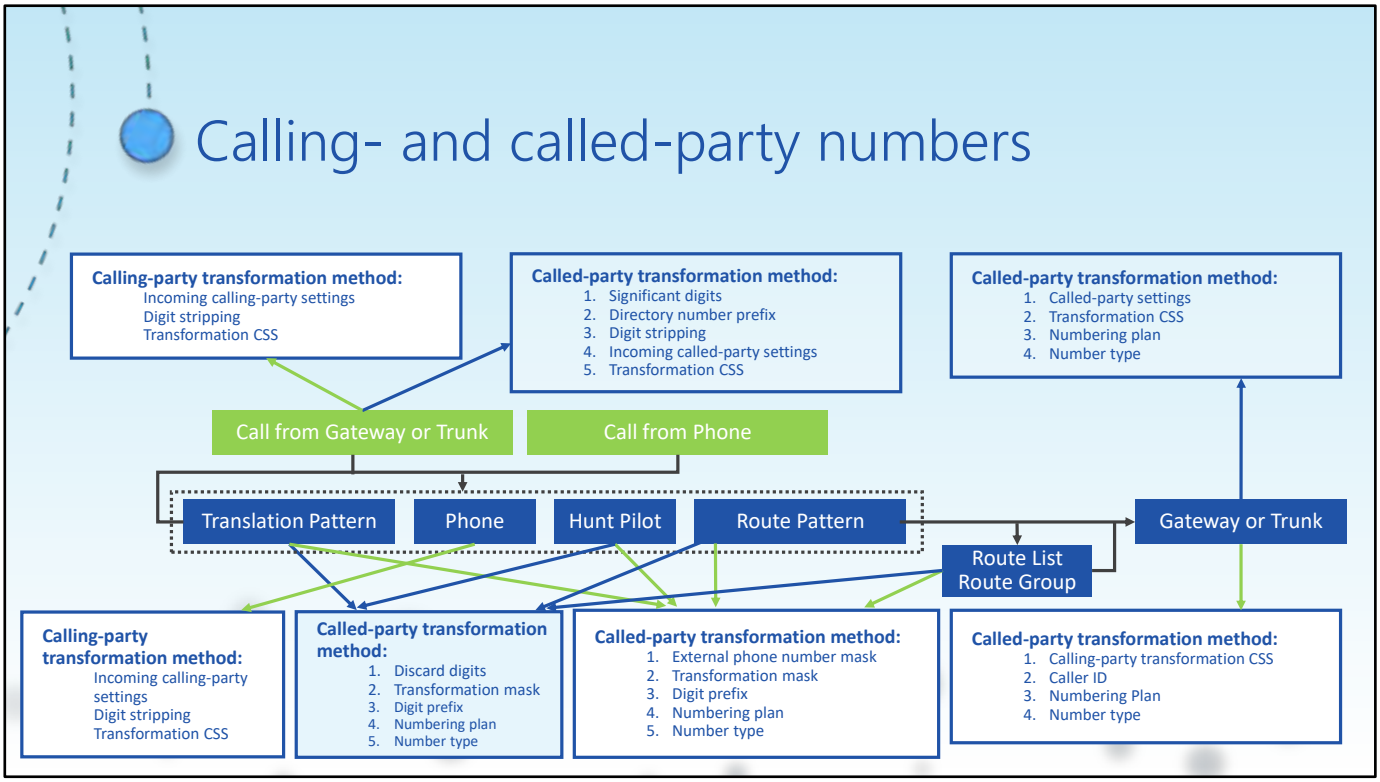
# Calling- and called-party numbers

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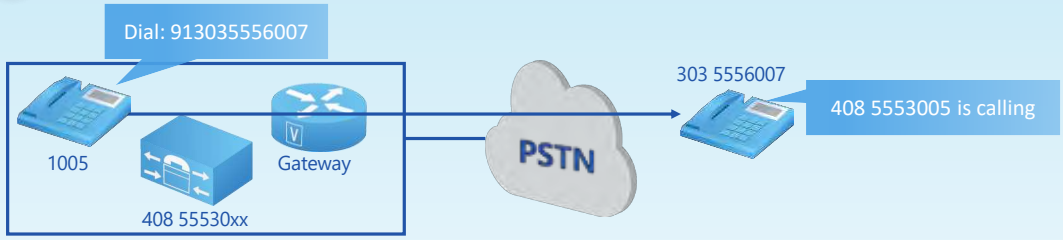
# PSTN Access Digit Manipulation Example




1. Extension 1005 dials 913035556007
2. Dialed number matches 9.1 route pattern configured with the following:
   - Called-party transformations > Discard digits: **PreDot**
   - Calling-party transformations: **40855530XX**
3. CUCM strips off (discards) digit 9 from the dialed number and sends 13035556007 to PSTN via the Gateway, after modifying the calling-party number from 1005 to 408 5553005
4. The PSTN phone 303 5556007 rings and sees 408 5553005 as the calling number

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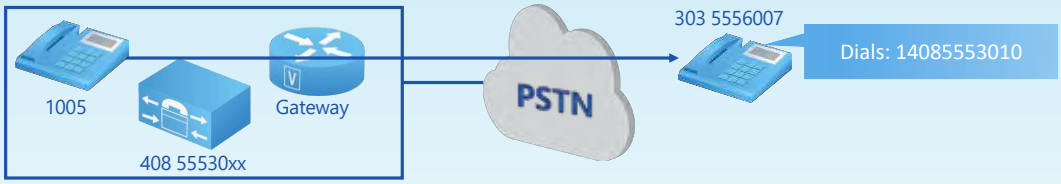
# PSTN Access Digit Manipulation Example




1. PSTN phone dials 14085553010; PSTN switch routes the call to the gateway and CUCM
2. Incoming called dialed number matches 40855530XX translation pattern, configured as follows:
   - Called-party transformation > Called-party transform mask: 10XX
   - (Optional) Calling-party transformation > Prefix digit: 91
3. CUCM translates 408 5553010 to 1010
   CUCM looks up 1010 and finds a registered phone with the directory number
4. CUCM presents the call to extension 1010. The CUCM optionally (see Step 2) prefixes the calling number with 91 to allow the internal user to call back the PSTN caller from an IP phone via the Directory button

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# Conclusions

- Path selection
- Route groups
  - Local
- Lists and patterns
- Digit manipulation in CUCM
- Calling and called-party numbers
- PSTN Access digit manipulation example
- Digit manipulation flow example

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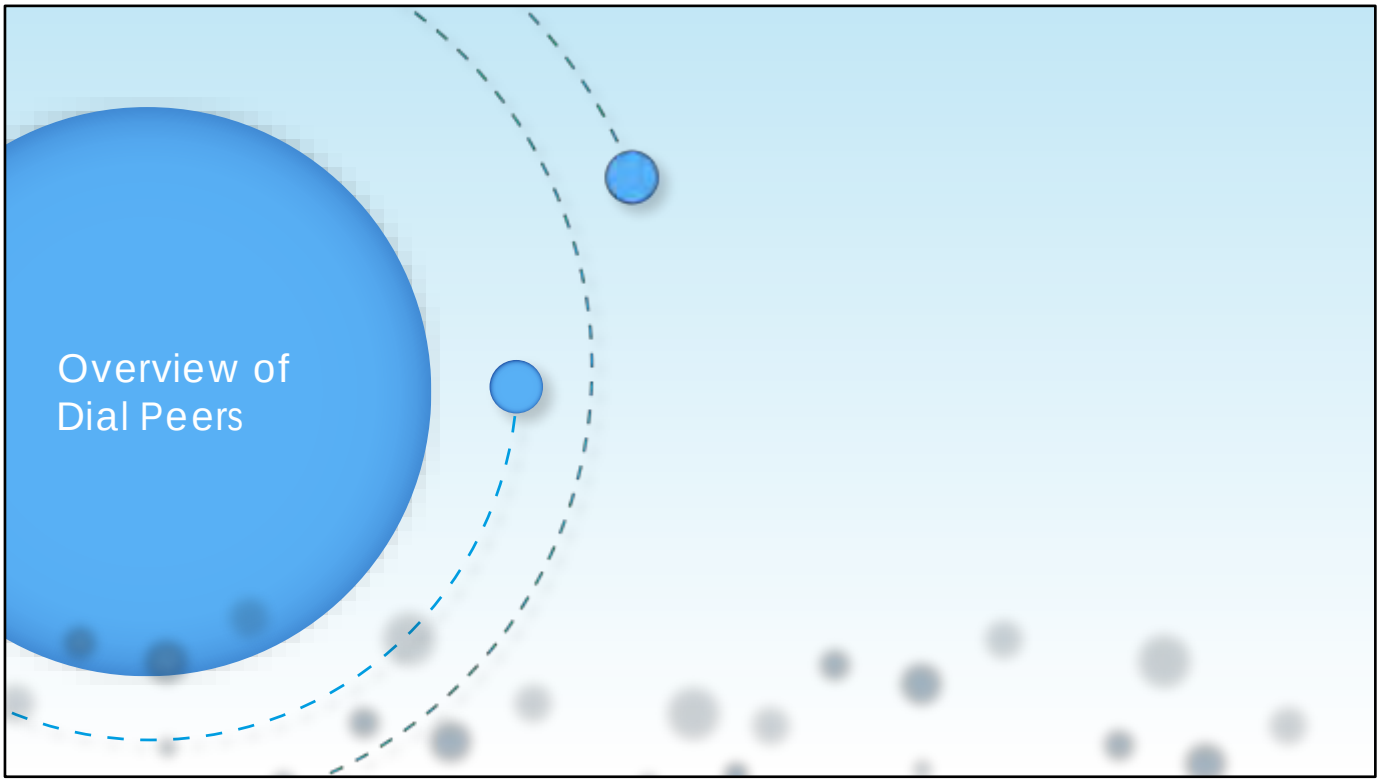


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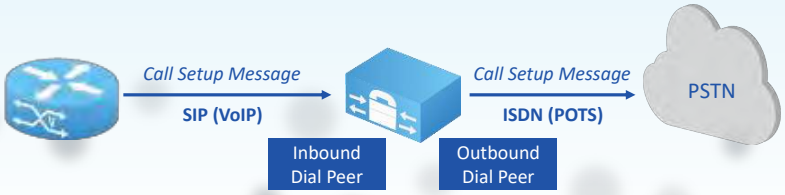
# Overview of Dial Peers

Connects incoming call leg to outgoing call leg

Configuration applicable to each call leg is taken from selected inbound and outbound dial peers

A dial peer can be used as an inbound and outbound dial peer

Separate dial peers are configured for POTS versus VoIP call legs

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# Main Components of VoIP and POTS Dial Peers

| VoIP dial peer dial-peer voice n voip | POTS dial peer dial-peer voice n pots |
|---|---|
| Destination-pattern 408555 | Destination-pattern 9 |
| Session target ipv4:10.0.0.1 | Port 1/0/0 |
| Translation-profile incoming pstn | Translation-profile incoming pstn |
| Voice-class codec 3 | Preference 3 |
| Preference 3 | Digit-strip/forward digits all/prefix 9 |
| Incoming called-number 408555 | Incoming called-number 408555 |
| Answer-address 1001 | Answer-address 1001 |
| Corlist incoming cucm | Corlist incoming cucm |

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# TDM Gateway Inbound Dial-Peer Selection

**Called number:** The called number is part of the received call setup message.

**Calling number:** If provided, the calling number is also part of the received call setup message.

**Port:** This port is the voice port from which the call was received. The port is only applicable to inbound POTS call legs. VoIP dial peers are not configured with a port.

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# Match Orders

1. Called number match with incoming called-number attribute
2. Calling number match with answer-address attribute
3. Calling number match with destination-pattern attribute:
4. Voice port
5. No match

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# Dial peer 0

Dial peer 0 for inbound VoIP calls applies the following configuration:

- G.729 and G.711 codecs are supported.
- IP precedence is set to 0.
- VAD is enabled.
- RSVP is not supported.
- Fax-rate service is supported.

Dial peer 0 for inbound POTS calls applies the following configuration:

- No applications.
- No direct inward dialing.

You cannot change the configuration of dial peer 0

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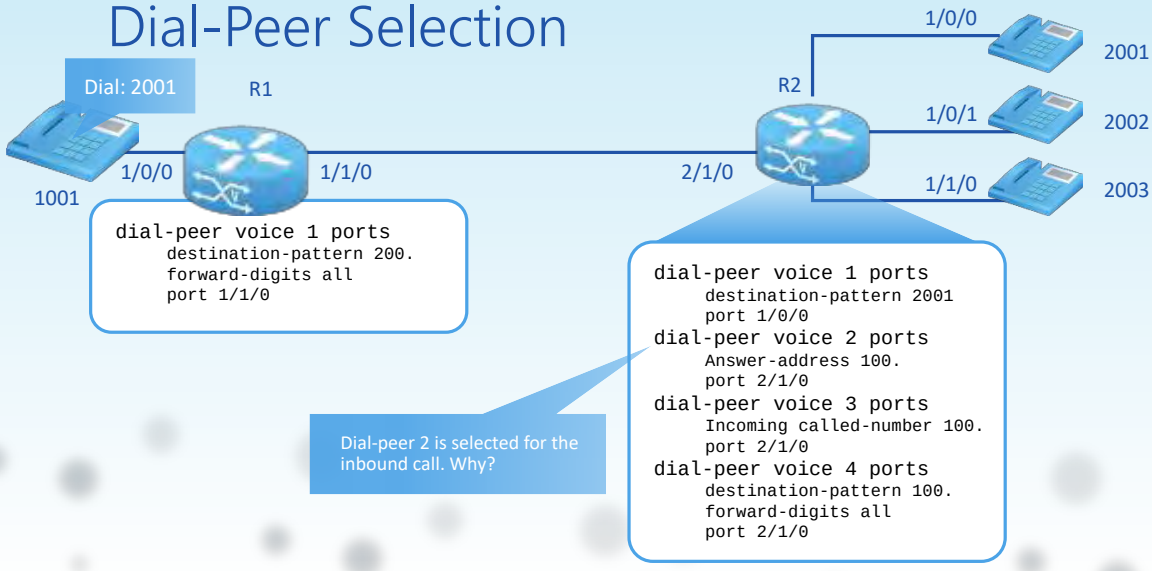
# Example: TDM Gateway Outbound Dial-Peer Selection

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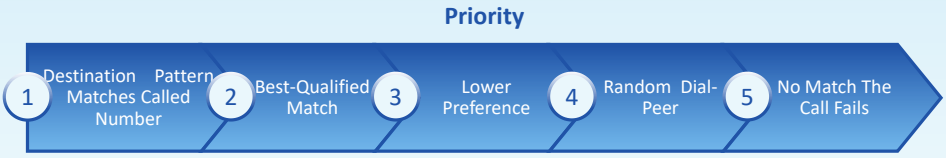
# TDM Gateway Outbound Dial-Peer Selection

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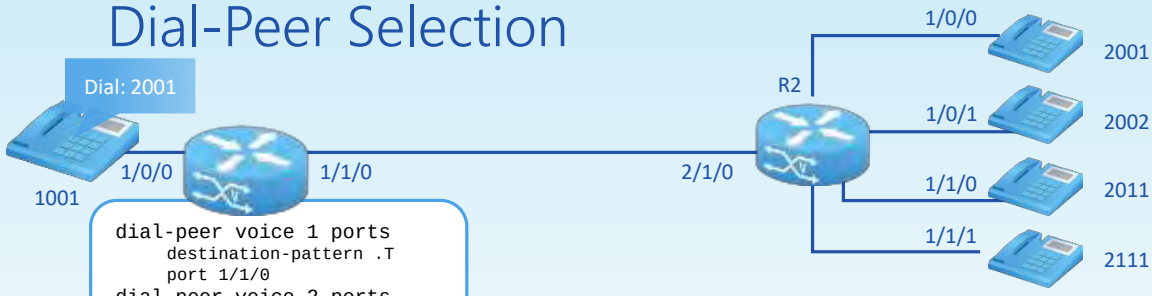
# Example: TDM Gateway Outbound Dial-Peer Selection




```
dial-peer voice 1 ports
     destination-pattern .T
     port 1/1/0
dial-peer voice 2 ports
     destination-pattern 20(0-1)
     forward-digits all
     port 1/1/0
dial-peer voice 3 ports
     destination-pattern 200.
     forward-digits all
     port 1/1/0
dial-peer voice 4 ports
     destination-pattern 2001
     forward-digits all
     port 1/1/0
```

Dialed number 2001 matches outbound dial peer 4
Dialed number 2001 matches outbound dial peer 3
Dialed number 2001 matches outbound dial peer 2
Dialed number 2001 matches outbound dial peer 1

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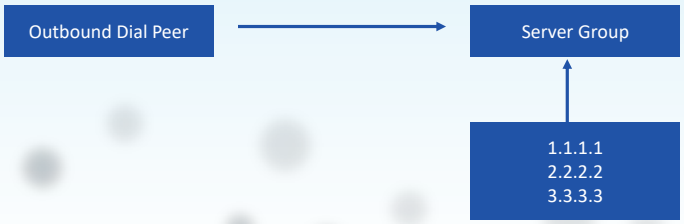
# Destination Server Group

- Supports multiple destinations per outbound dial peer
- Round-robin or preference order
- Up to 5 servers per group
- Reduce the need to configure multiple dial peers
- Uses Option-Keepalive Profile

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# Option-Keepalive Example with a Server Group

**Voice class server-group 1**

- Hunt-scheme round-robin
- Ipv4 14.50.244.2
- Ipv4 14.50.244.62

**Dial-peer voice 1 voip**

- Session protocol sipv2
- Session server-group 1
- Voice-class sip options-keepalive profile 1

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# Conclusions

- Dial peers overview
- VOIP and POTS dial peers
- TDM Gateway inbound dial-peer selection
- Match orders
- Dial peer 0
- Destination server group
- **Option:** Keepalive example with a server group

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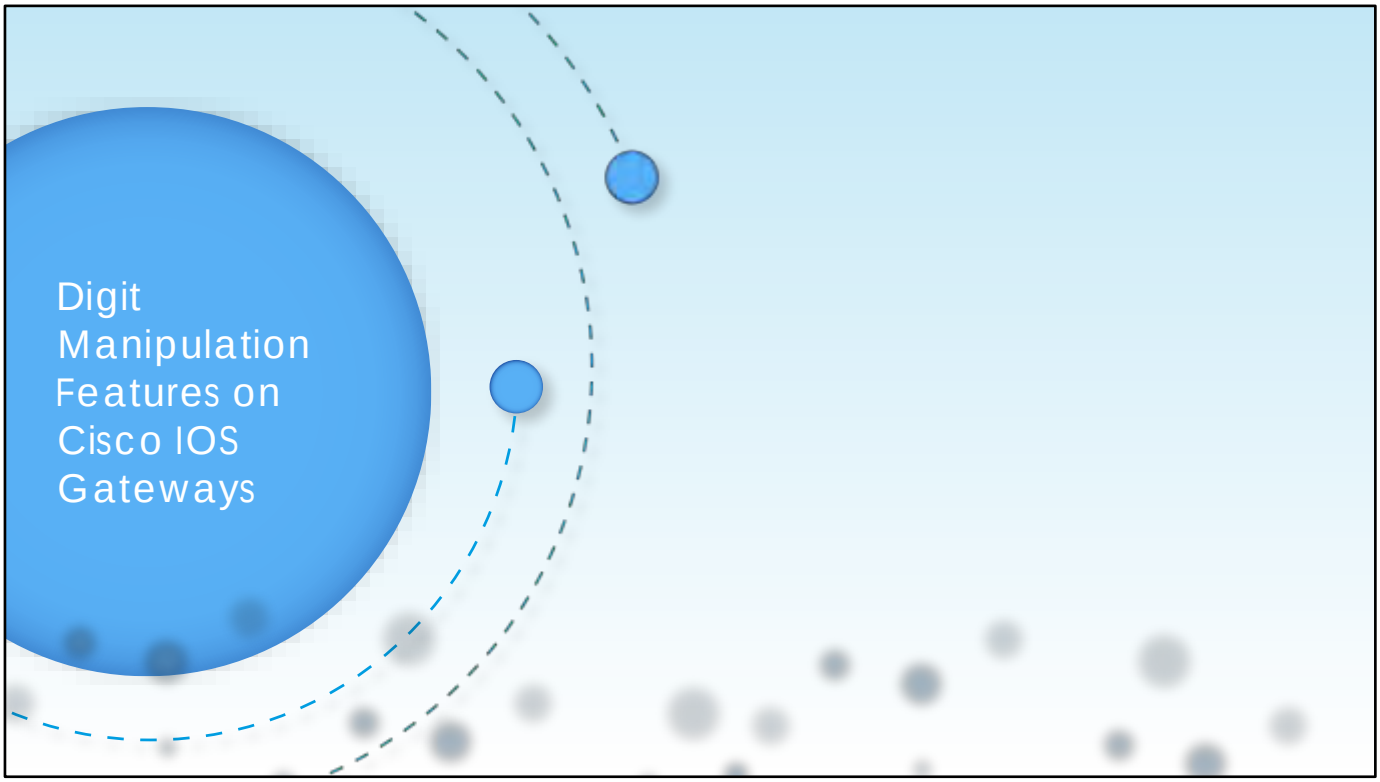


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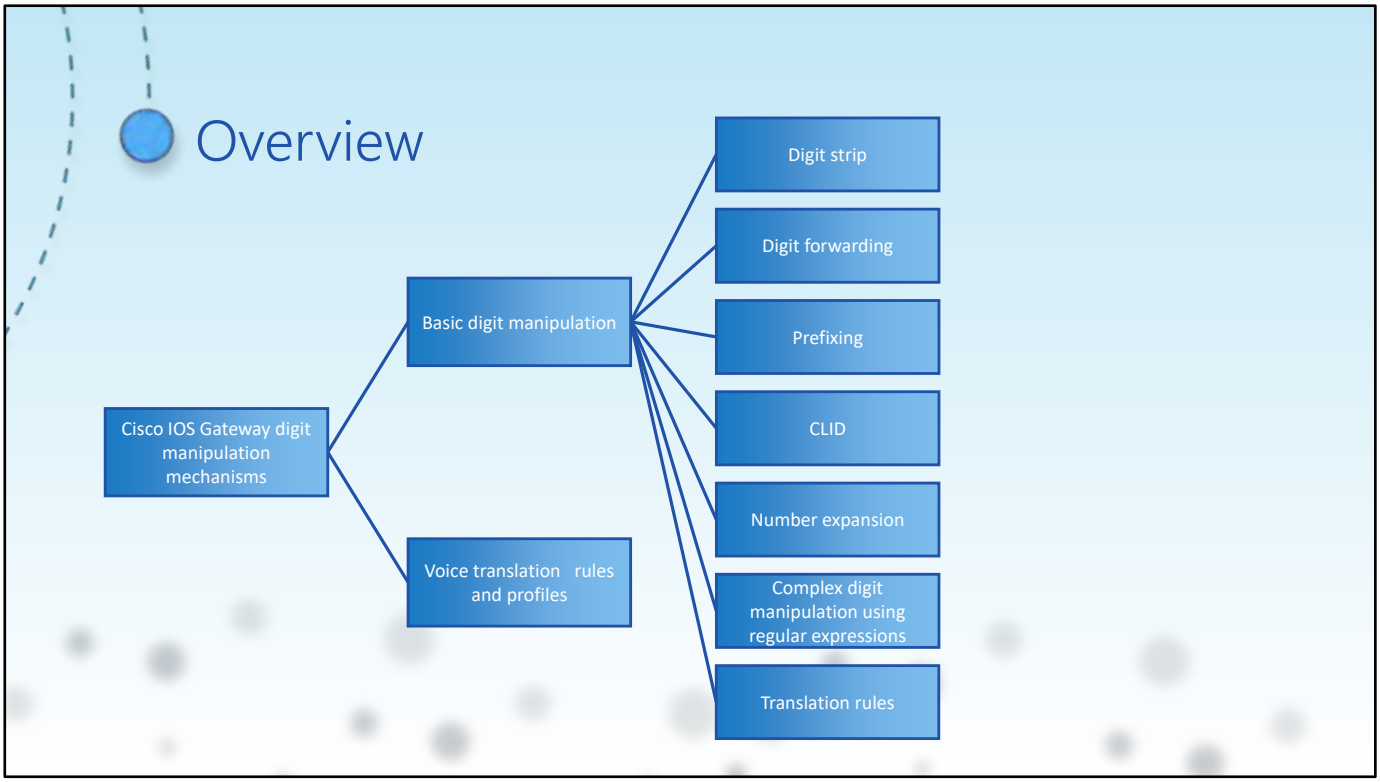


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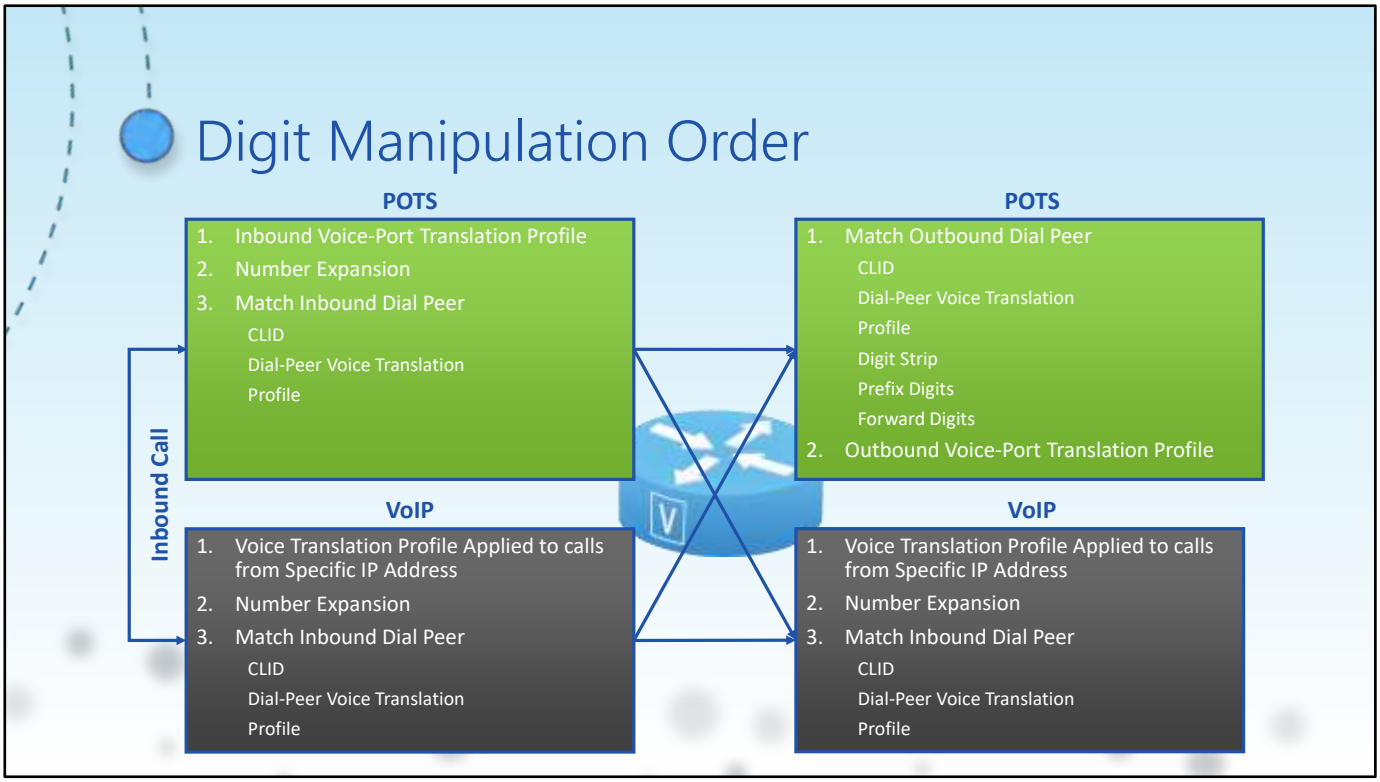
# Digit Manipulation Order

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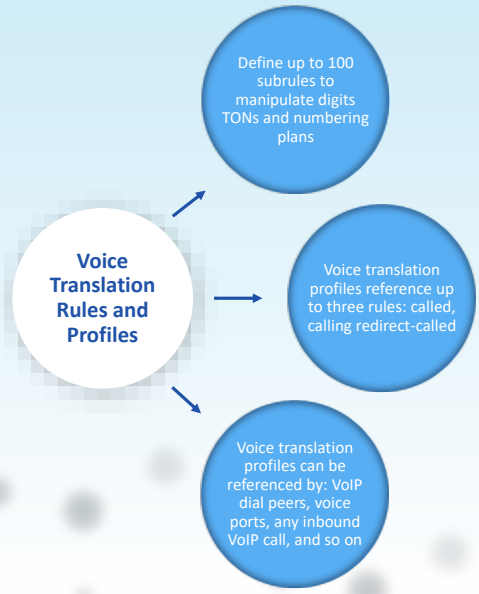
# Voice Translation Rules and Profiles

The resulting voice translation profile can be attached to these elements for incoming or for outgoing calls as follows

- VoIP dial peers
- Voice ports
- Any inbound VoIP call
- A specific range of source IP addresses in VoIP calls
- A trunk group
- A T1/E1 controller that is used for NFAS trunks
- Cisco Unified Survivable Remote Site Telephony (Cisco Unified SRST)

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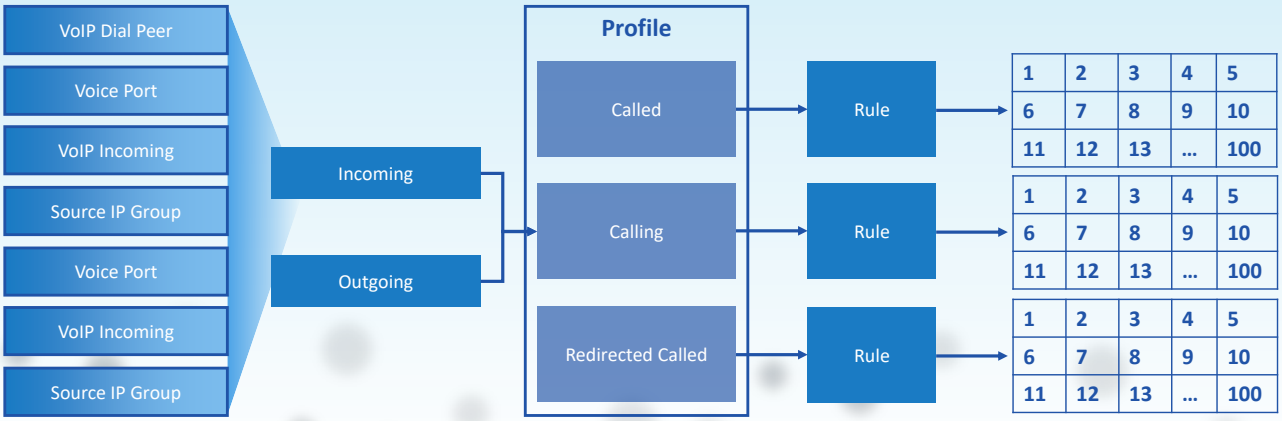
# Voice Translation Rules and Profiles Hierarchy

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# Conclusions

- Digit manipulation features on Cisco IOS gateways overview
  - Order
  - Voice translation
    - Rules
    - Profiles
    - Hierarchy

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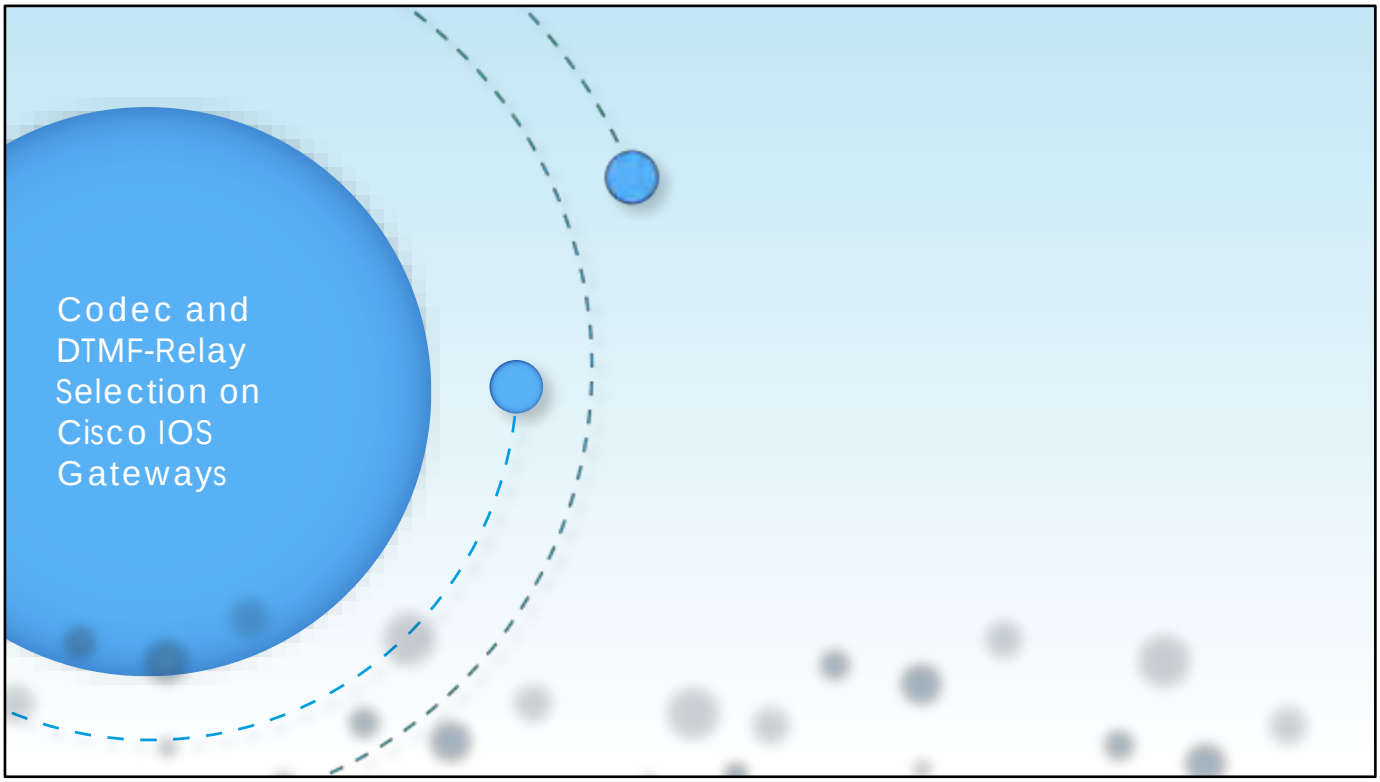


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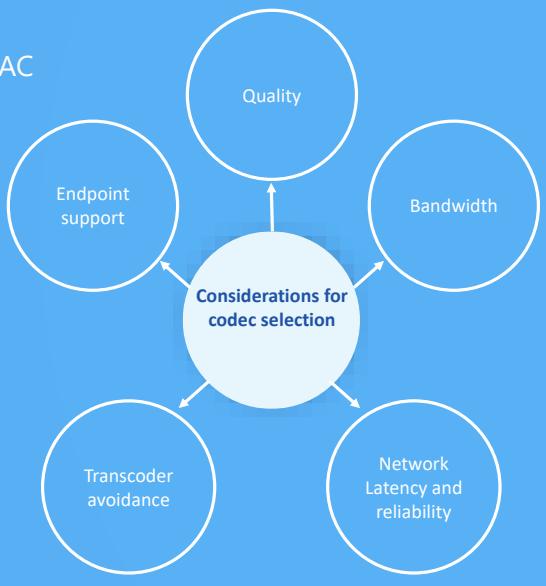
# Overview Codec

Audio codecs: G.711, G.722, G.729, iLBC, iSAC

Video codecs: H.264, H.263, H.261, H.265, H.264 SVC

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# Dual Tone Multi-Frequency (DTMF)

h245-alphanumeric and h245-signal

sip-notify

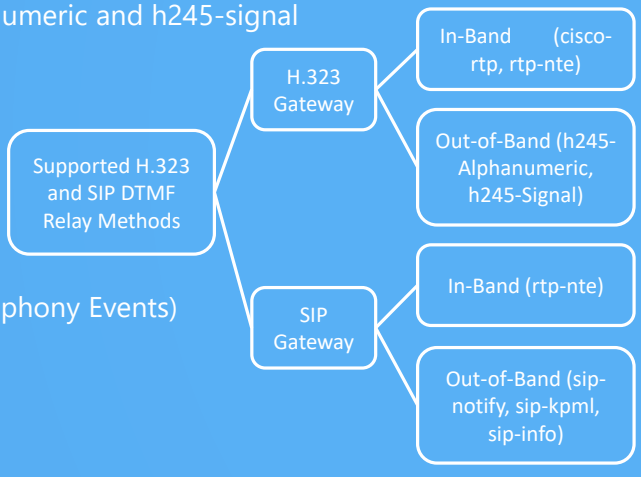
sip-kpml

sip-info

RTP-NTE
(Named Telephony Events)

Cisco RTP

G711 audio

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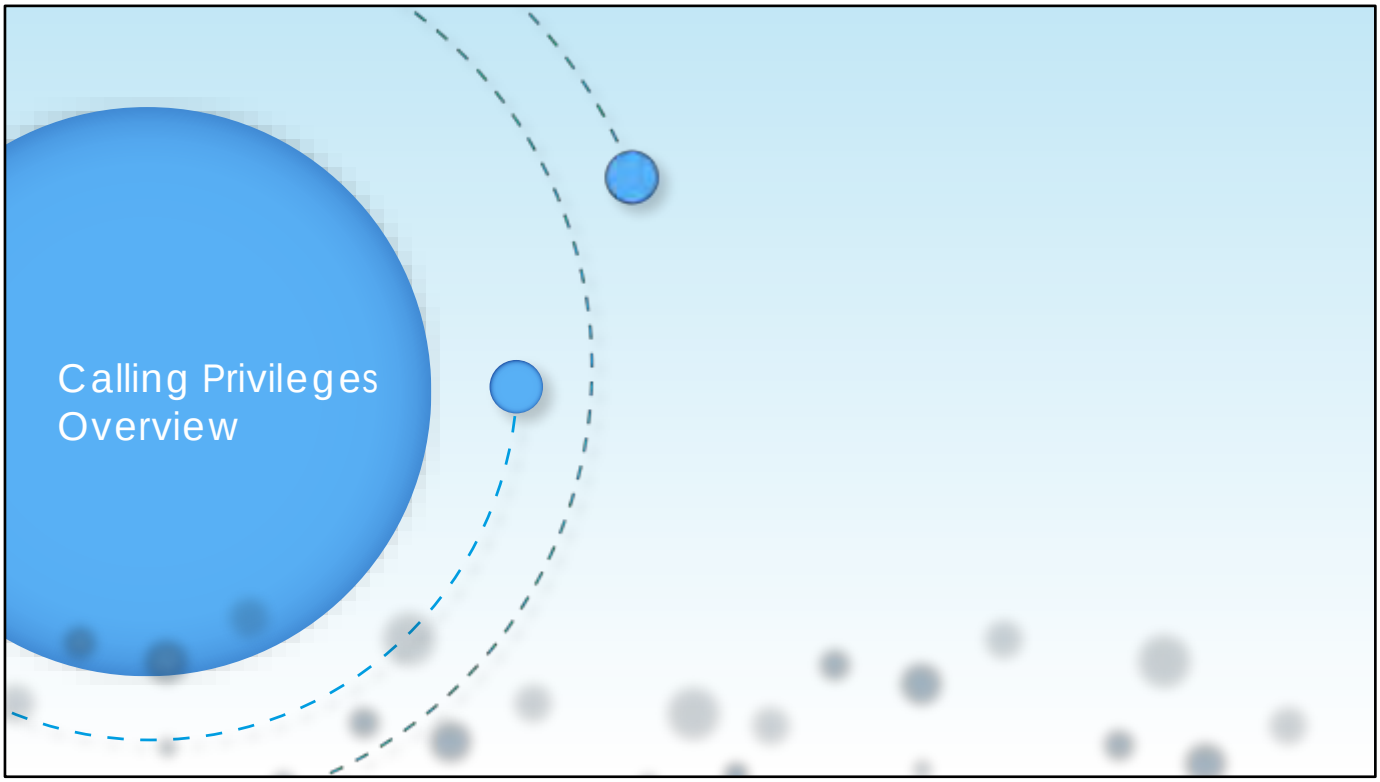


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# Overview

- CoS
- 911 emergency calls and vanity numbers
- Time of day-based carrier selection
- Mandatory call accounting
- PLAR
- Partition/CSS
- Time of Day
- Client Matter Code
- Forced Authorization Code

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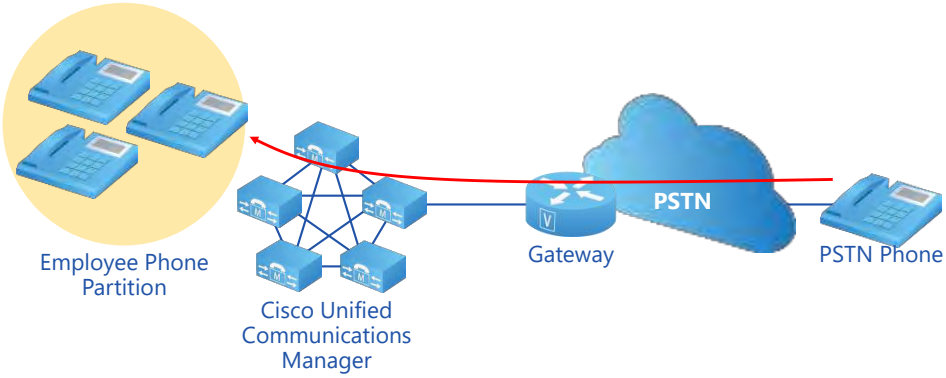
# Partitions

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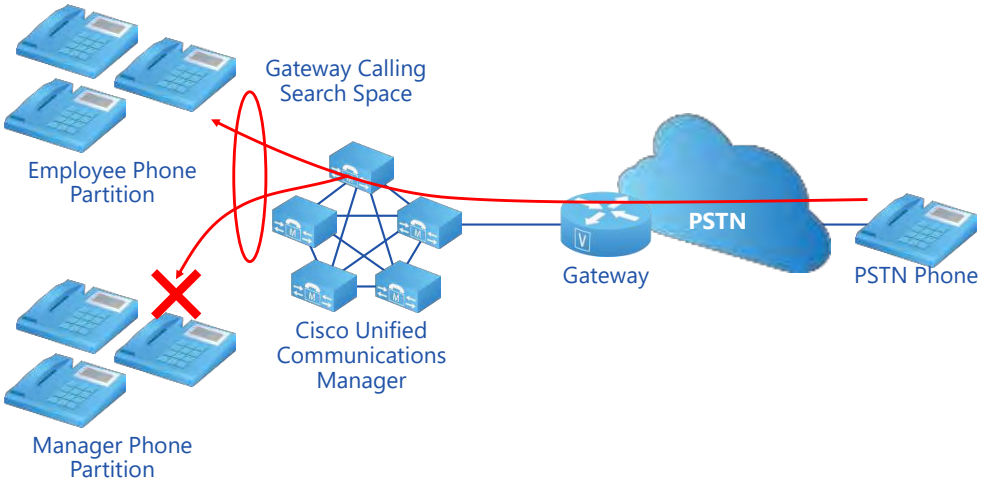
# Calling Search Spaces

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# Partition None and CSS None

By default, all entities that can be configured with a partition are in the partition <None>. All entities that can be configured with a CSS are assigned CSS <None> by default.

Members of partition <None> (also called the null partition) are always accessible by sources of a call-routing request, regardless of the CSS of that call-routing source.

Entities that do not have a CSS assigned (for example, CSS <None>) can only access call-routing targets that are in partition <None>.

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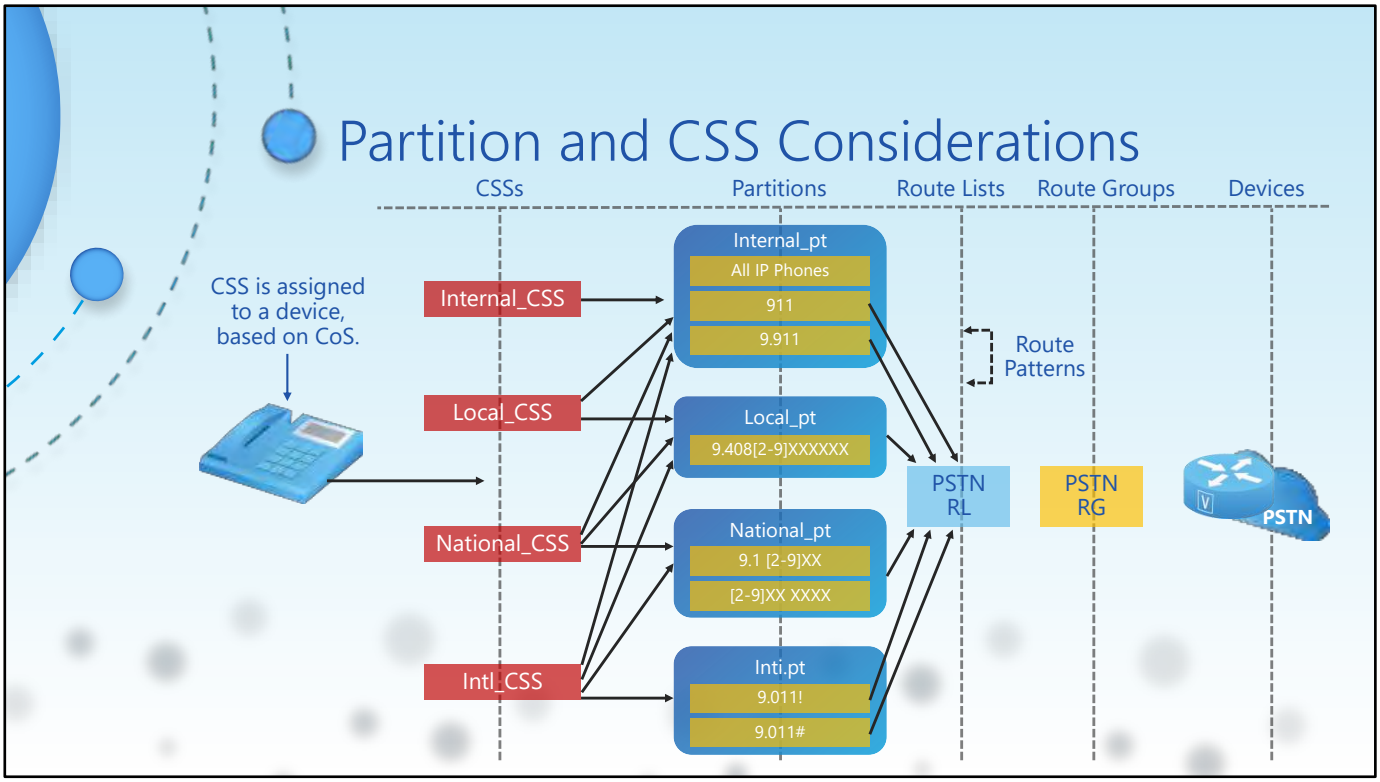


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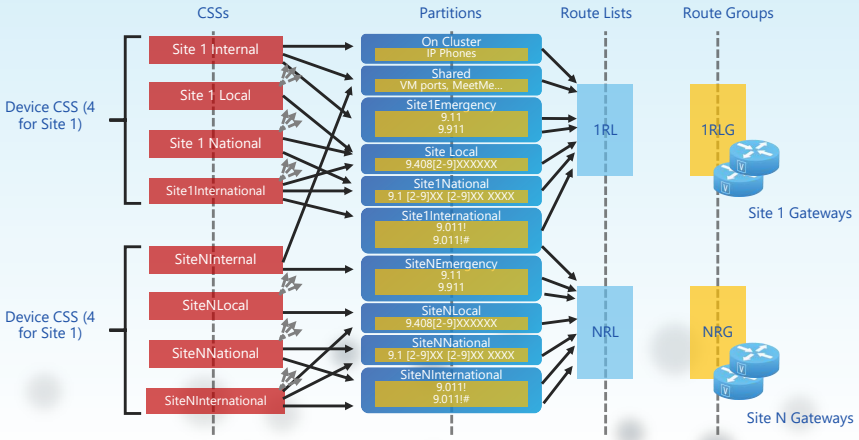
# Traditional-Approach Example: Multiple Sites

The problem in multisite environments is that partitions and CSSs must provide two functions:

- Select the local PSTN gateway for each site.
- Control who is allowed to dial which number.

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# Line/Device Approach: Improves Scalability

Use the device CSS to provide call-routing information; for example, which gateway to select for all PSTN calls.

Use the line CSS to block route patterns that a certain CoS prohibits (independent of the used PSTN gateway).

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# Local Route Group Functionality

Since Cisco Unified Communications Manager Release 7, you do not need a site-specific device-level CSS, but the device-level CSS can be the same for all phones. The gateway selection is done by the Local Route Group feature and not by a site-specific device-level CSS.

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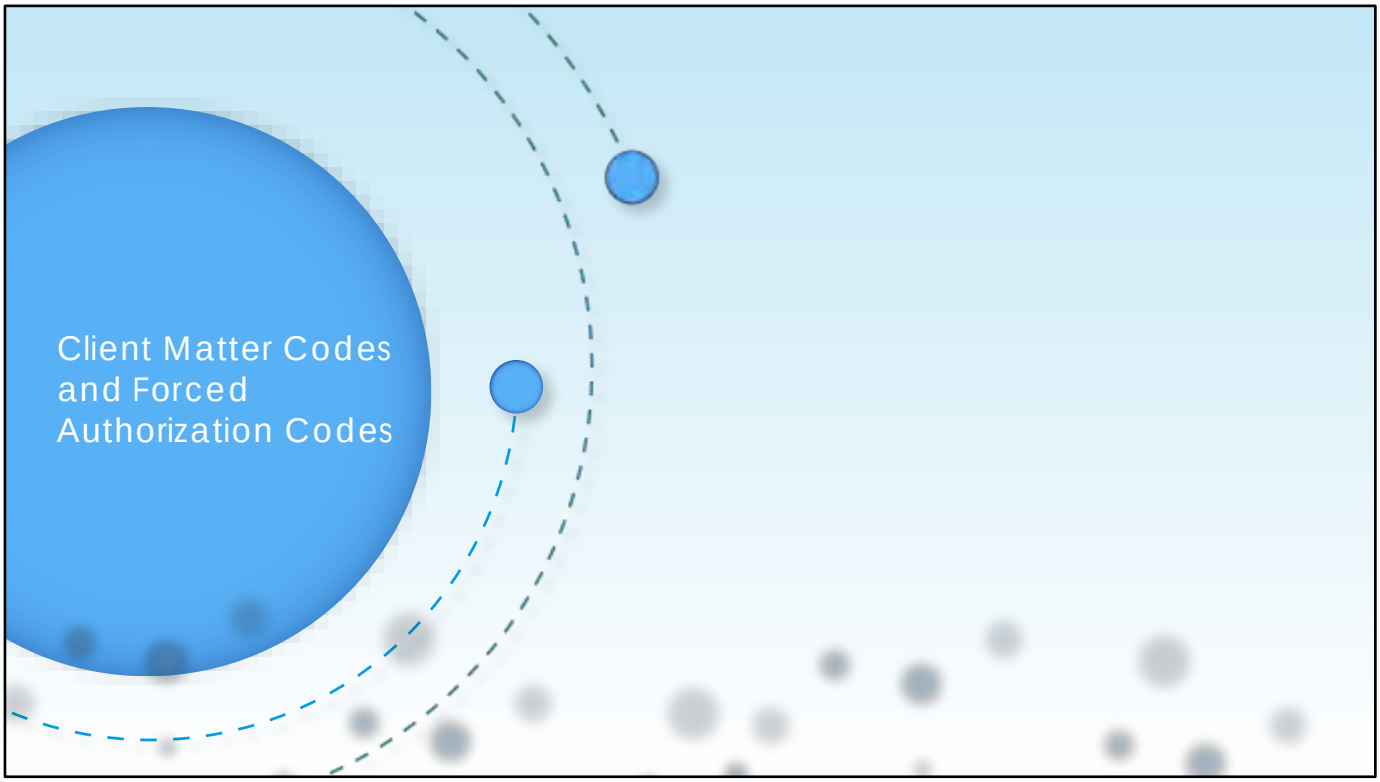


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# Client Matter Codes and Forced Authorization Codes Overview

FACs and CMCs allow you to effectively manage call access and accounting. CMCs assist with call accounting and billing for clients

CMCs and FACs can be applied to route patterns

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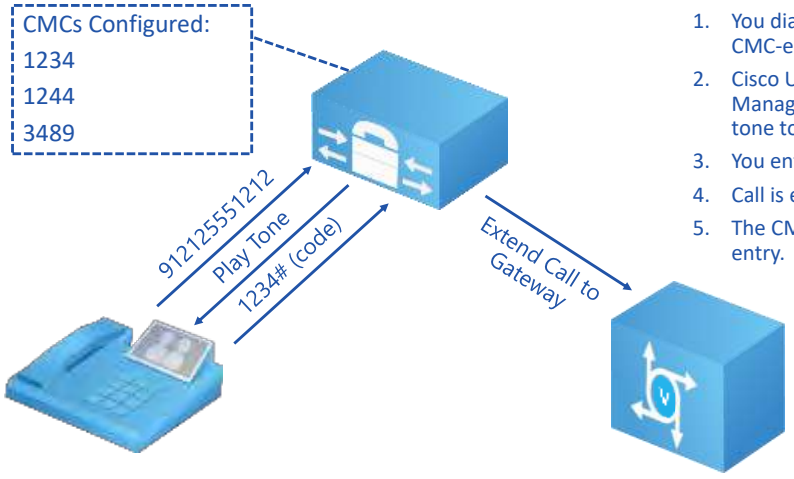
# CMC Call: Successful Call




1. You dial a number that goes to a CMC-enabled route pattern.
2. Cisco Unified Communications Manager tells the phone to play a tone to prompt for the code.
3. You enter the valid code (1234)
4. Call is extended.
5. The CMC code is added to the CDR entry.

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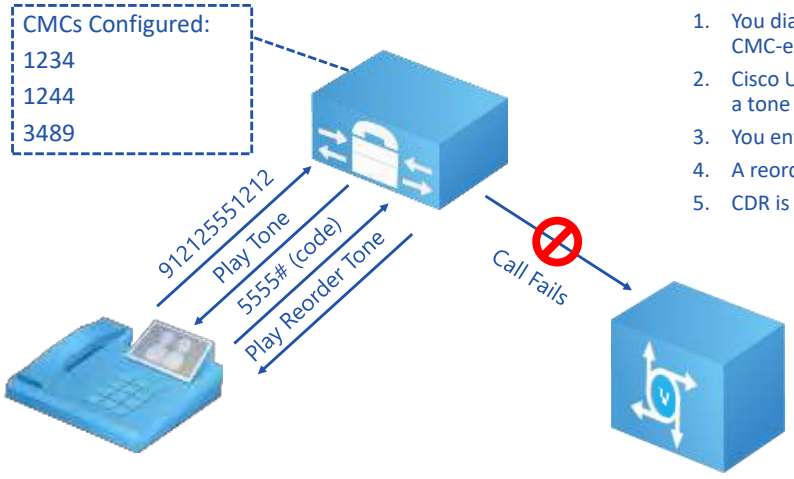
# CMC Call: Call Failure




1. You dial a number that goes to a CMC-enabled route pattern.
2. Cisco UCM signals the phone to play a tone to prompt you for a code.
3. You enter the valid code (5555).
4. A reorder tone is played
5. CDR is generated to log the attempt.

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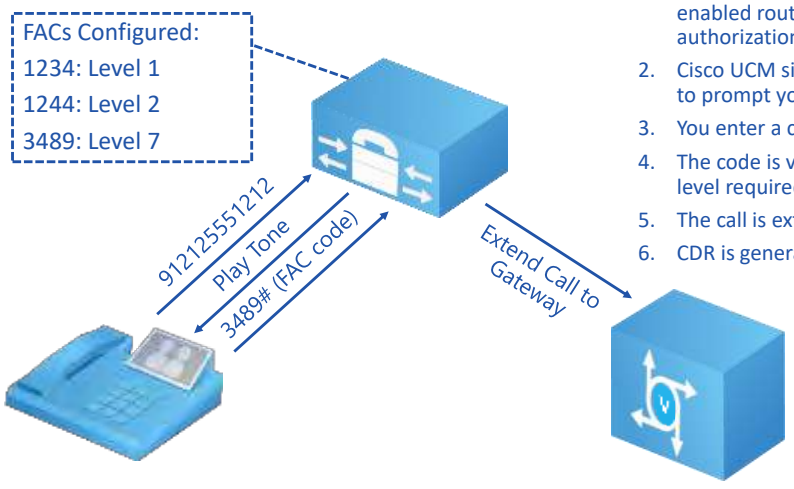
# FAC Call: Successful Call




1. You dial a number that matches a FMC-enabled route pattern with level 3 authorization required.
2. Cisco UCM signals the phone to play a tone to prompt you for a code.
3. You enter a code (3489).
4. The code is valid and is not lower than the level required.
5. The call is extended.
6. CDR is generated.

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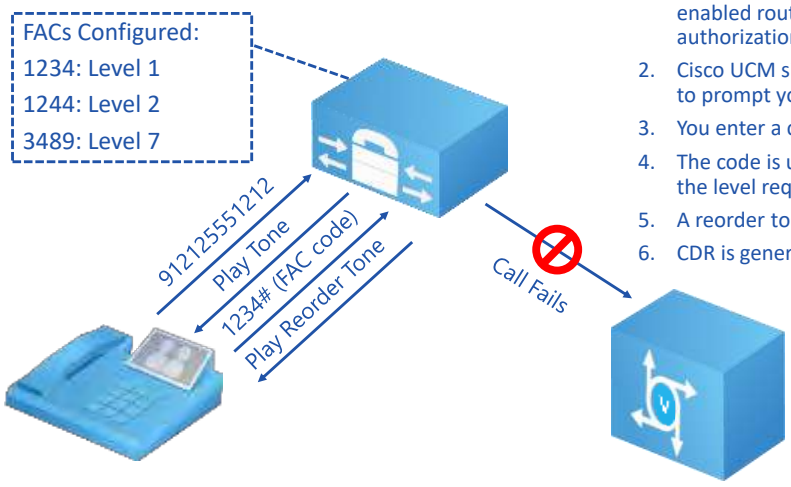
# FAC Call: Call Failure




1. You dial a number that matches a FMC-enabled route pattern with level 3 authorization required.
2. Cisco UCM signals the phone to play a tone to prompt you for a code.
3. You enter a code (1234).
4. The code is unknown or its level is lower than the level required.
5. A reorder tone is played.
6. CDR is generated to log the attempt.

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# Conclusions

- Calling privileges overview
  - Partitions and CSSs
    - Considerations
  - Client matter codes and forced authorization codes

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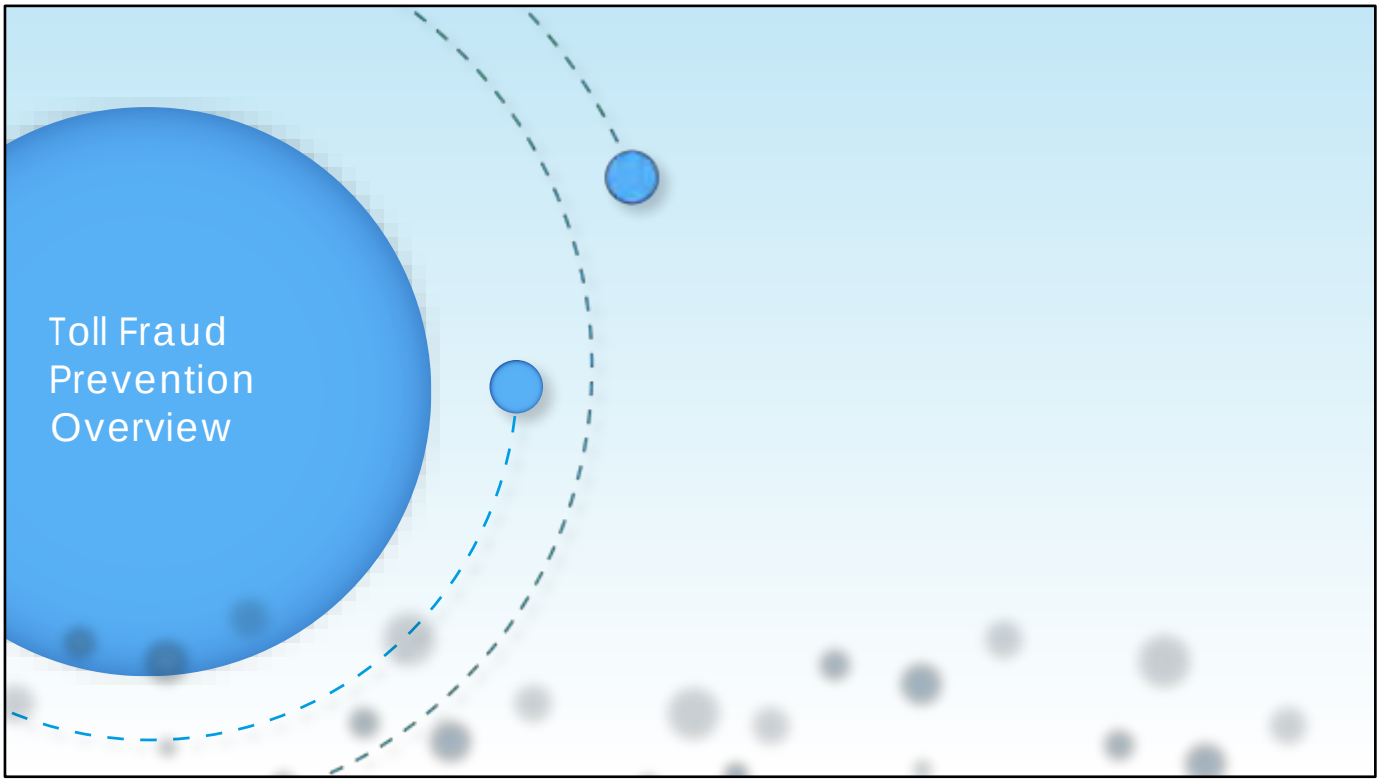


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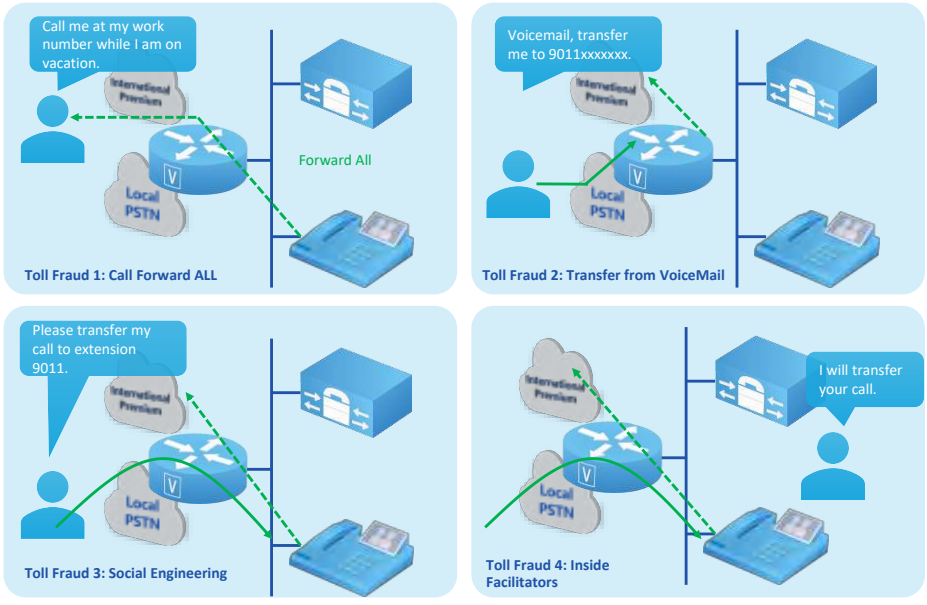
# Introduction

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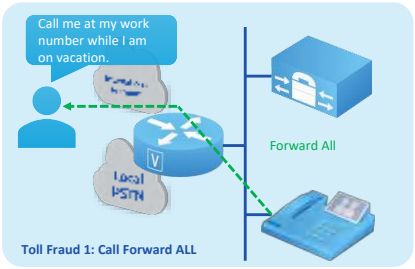
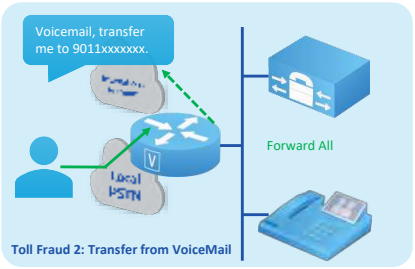
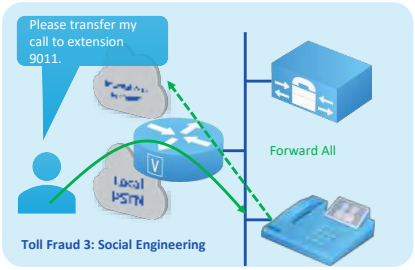
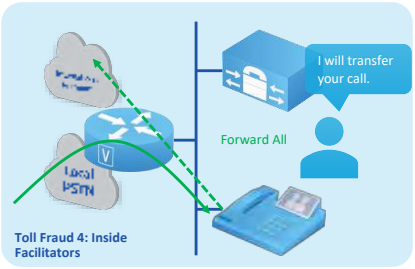
# Introduction

- **Types of Toll Fraud**
  - CFA (Call Forward All)
  - Transfer from voicemail
  - Social engineering
  - Inside facilitators

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# Cisco Toll Fraud Prevention Tools

- Cisco Unified Communications Manager CoS
- Voice gateway Toll Fraud Prevention Application
- Voice Gateway COR
- Cisco Unity Connection Restriction Rules

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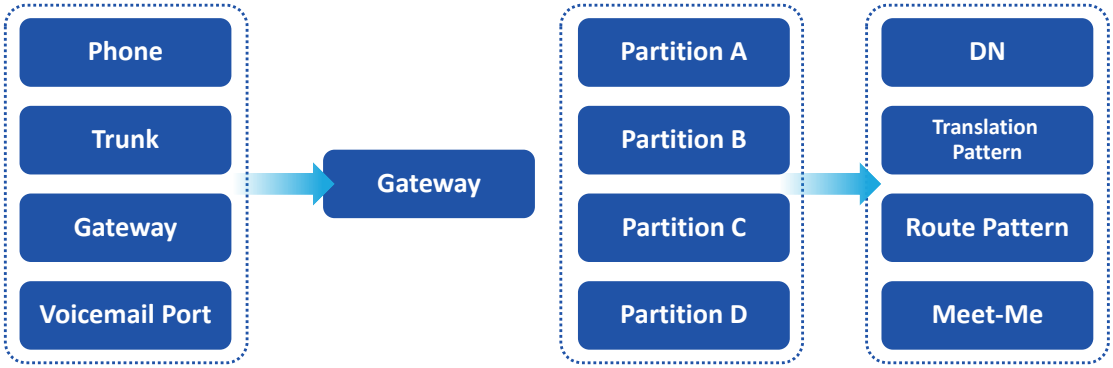
# Cisco Toll Fraud Prevention Tools

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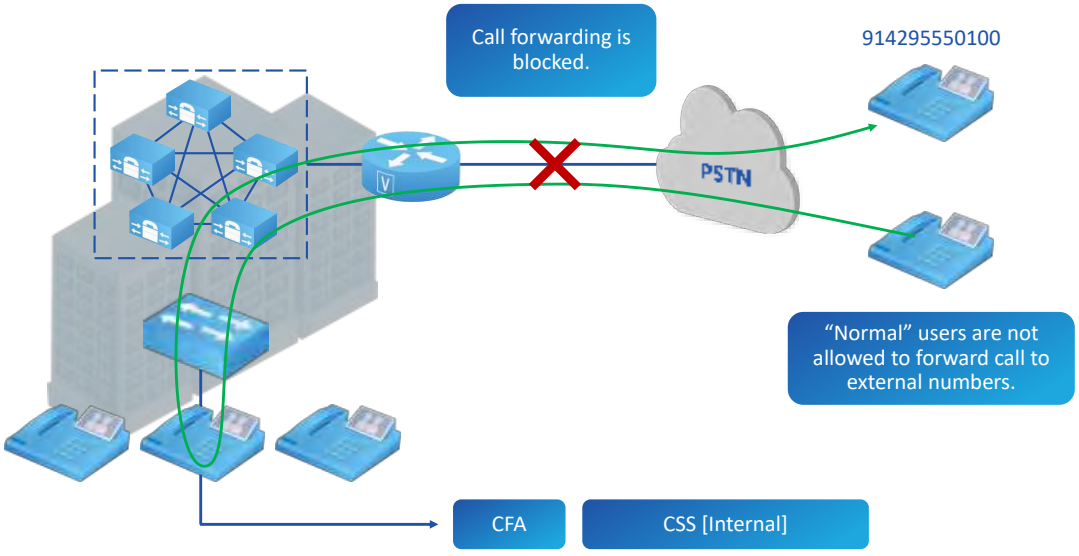
# CFA Restriction Example

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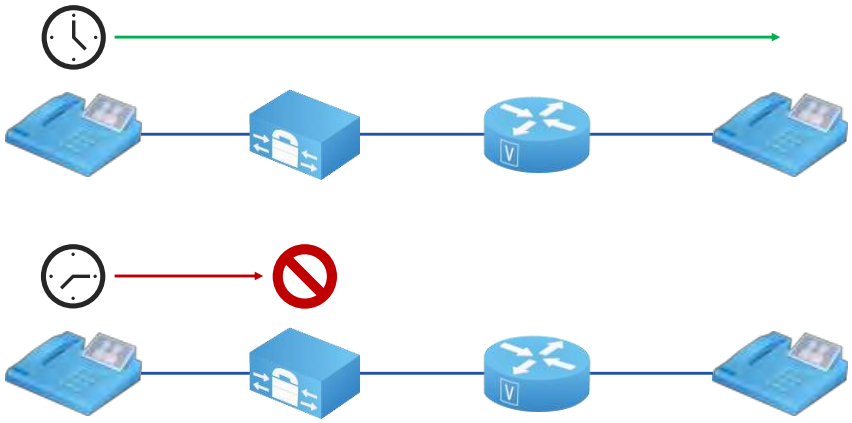
# Time-of-Day Routing



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# ToD Routing Example

1. Phone A dials 9011442088248000
2. Cisco CallManager extends the call to the VoIP gateway

Friday
3:00 p.m.

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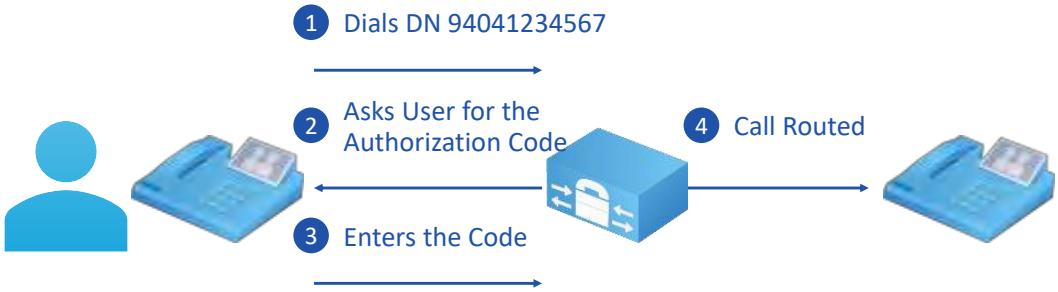
# Forced Authorization Code

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# FAC Example

Dials DN 94045550100
FAC Code 11155
FAC Level 100

FAC-Enable Route Pattern
FAC Level of 50 Configured

Dials DN 94045550100
FAC Code 65319
FAC Level 20

The call is blocked and a fast busy tone is played.

FAC-Enable Route Pattern
FAC Level of 50 Configured

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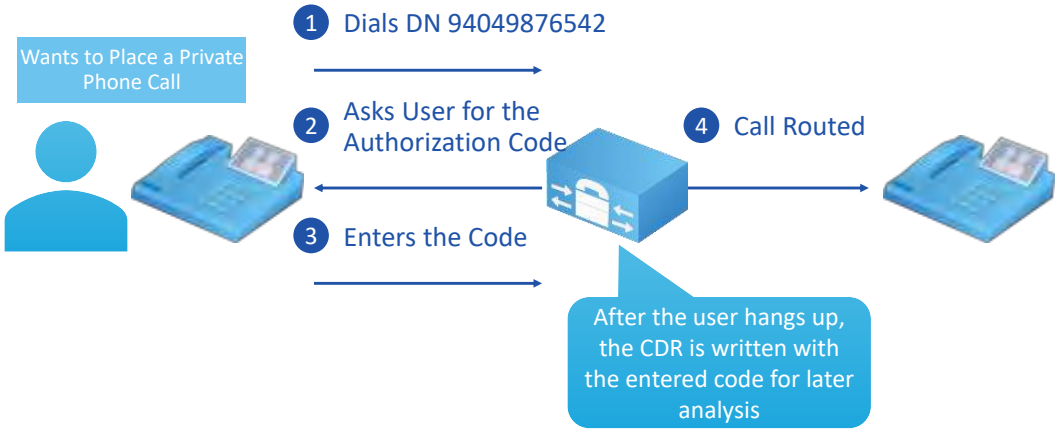
# Forced Authorization Code

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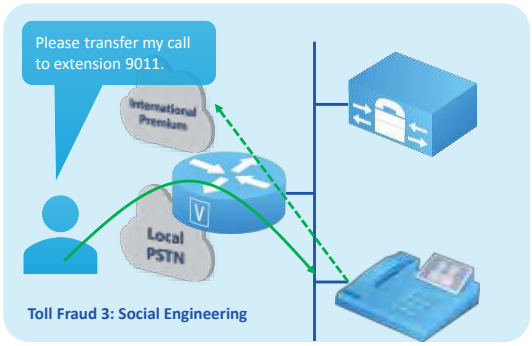
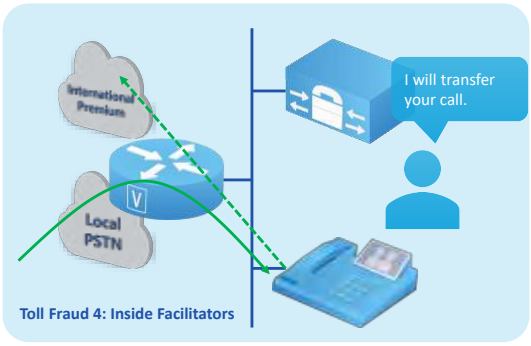
# Restricting External Transfers

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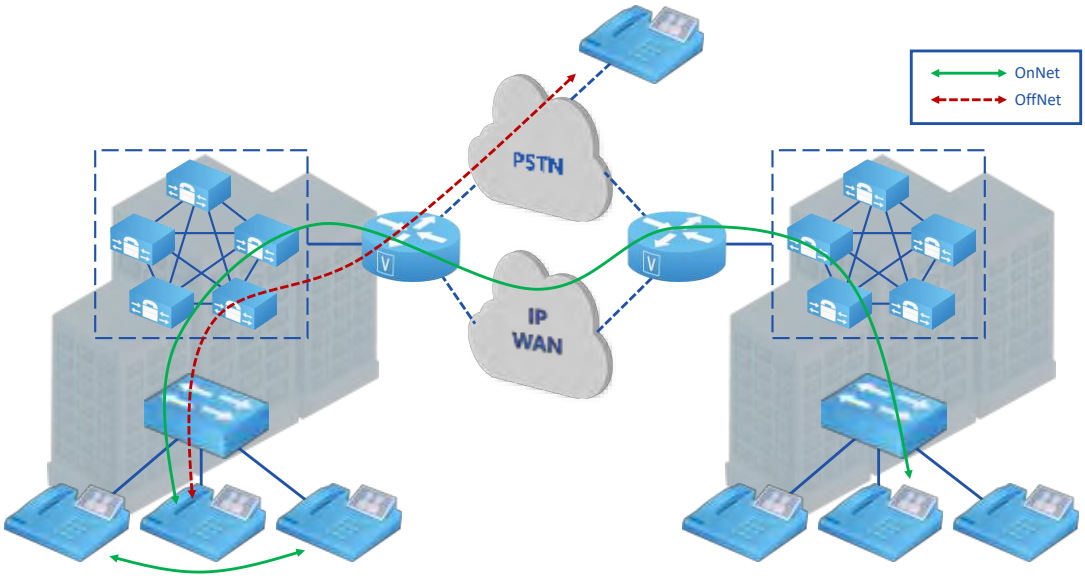
# OffNet and OnNet Definition

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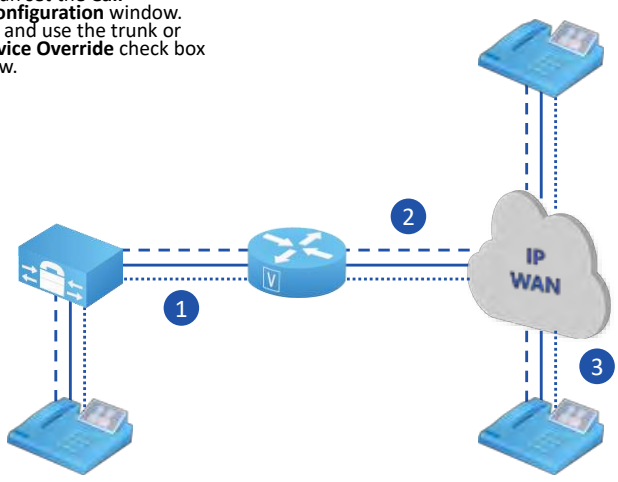
# Route Patterns/Block OffNet to OffNet Transfers

- To classify a call as OnNet or OffNet, you can set the **Call Classification** field in the **Route Pattern Configuration** window. You can override the route pattern setting and use the trunk or gateway setting by checking the **Allow Device Override** check box in the **Route Pattern Configuration** window.

1. Party A calls party B
2. Party A presses the transfer softkey and calls party C.
3. Party A cannot transfer party B to party C because both parties are Offnet

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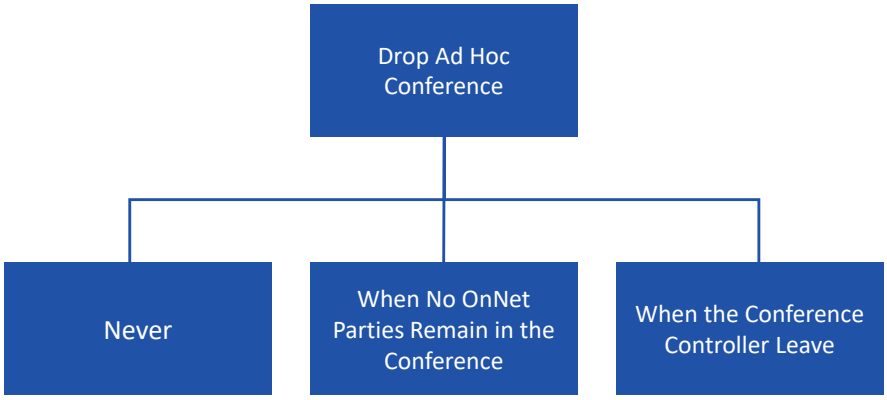
# Ad Hoc Conference Restriction

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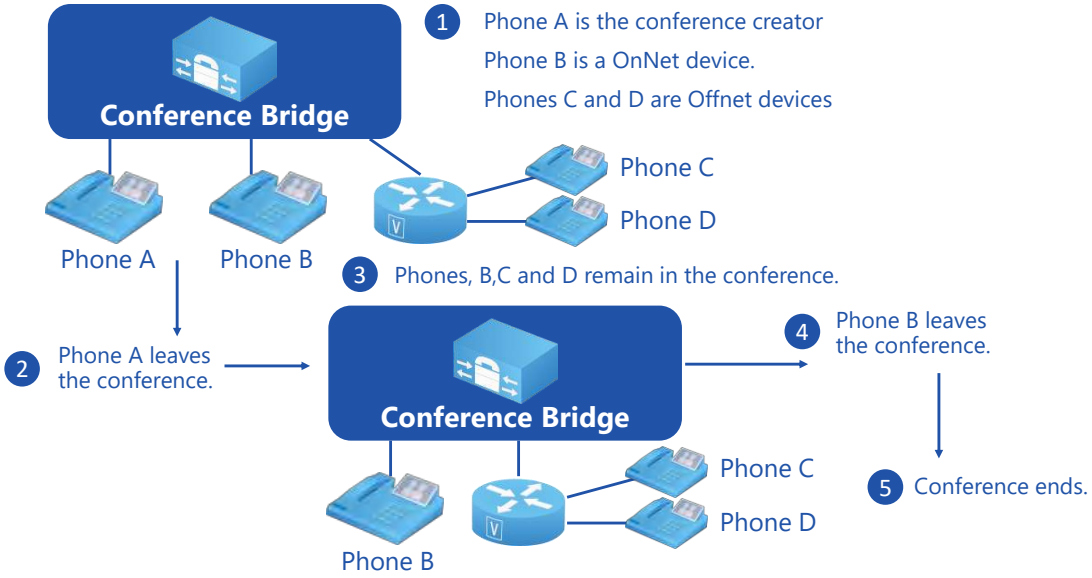
# Ad Hoc Conference Restriction Example

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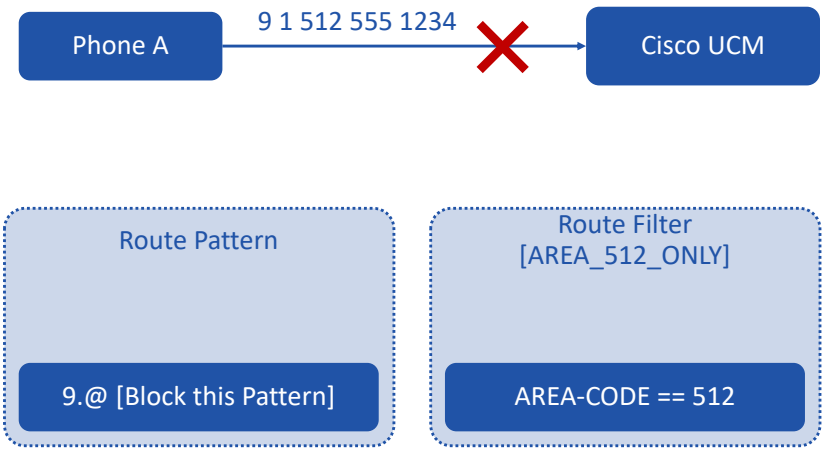
# Ad Hoc Conference Restriction

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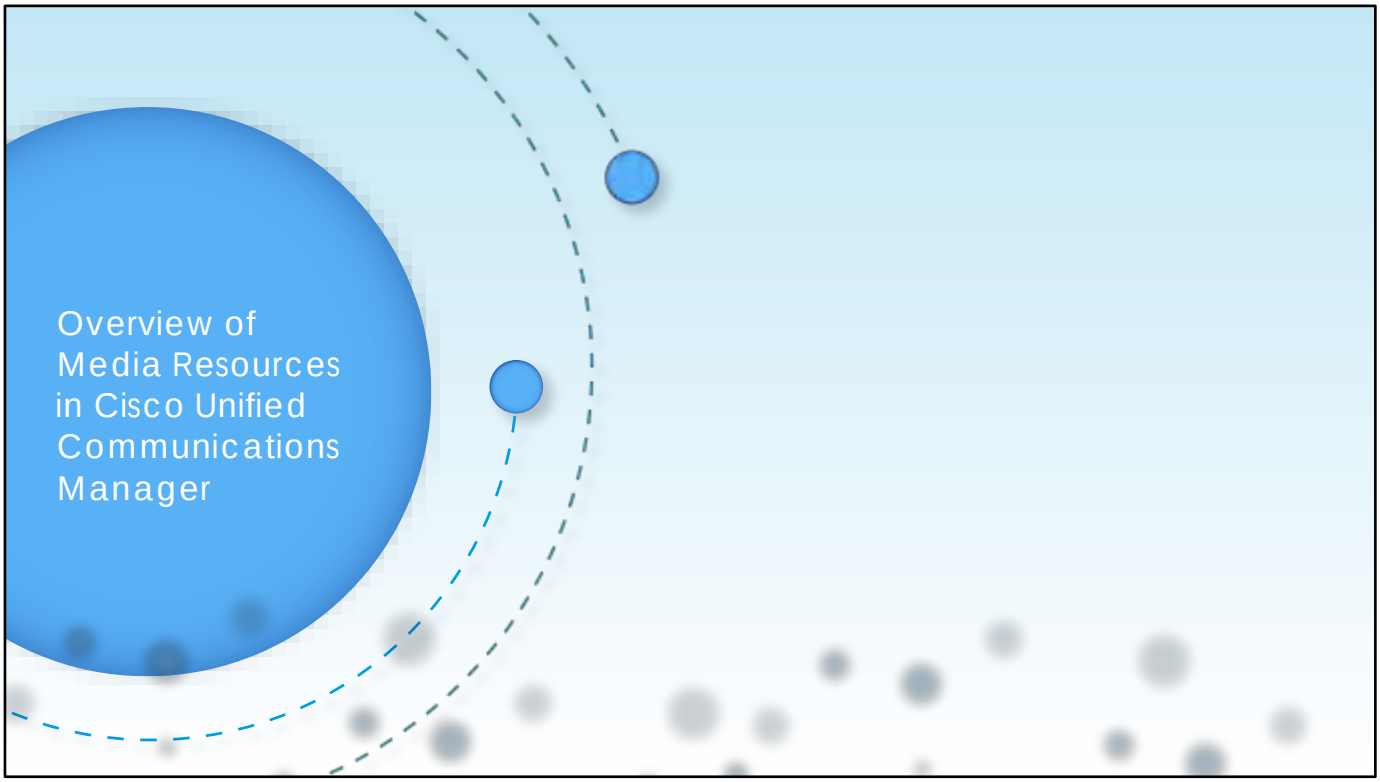


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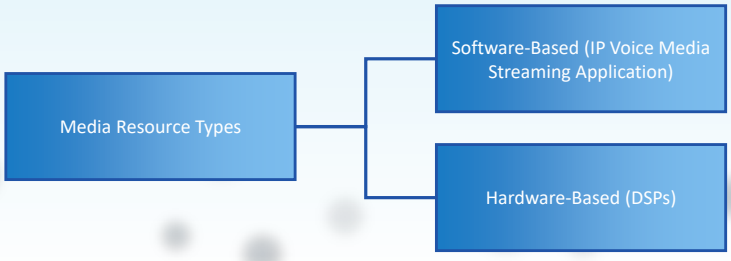
# Media Resources Overview

Media Resources perform media-processing functions on the media streams

Media Service provided through the Cisco IP Voice Media Streaming Application service

Resource can be provided by Software or hardware

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# Media Resource Functions

The following list describes the Cisco Unified Communications Manager media resources and their functions:

**Rich-media conference bridge**

**Transcoder**

**MTP**

**Annunciator**

**Music on Hold (MOH)**

**Trusted Relay Point (TRP)**

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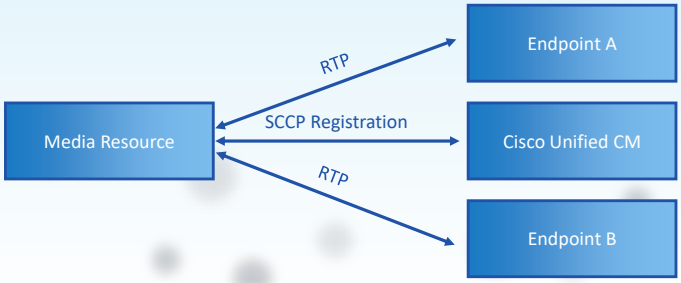
# Media Resource Signaling and Media Streams

All media resources must register with Cisco Unified Communications Manager

Signaling between external (hardware) media resources and Cisco Unified Communications Manager usually involves SCCP

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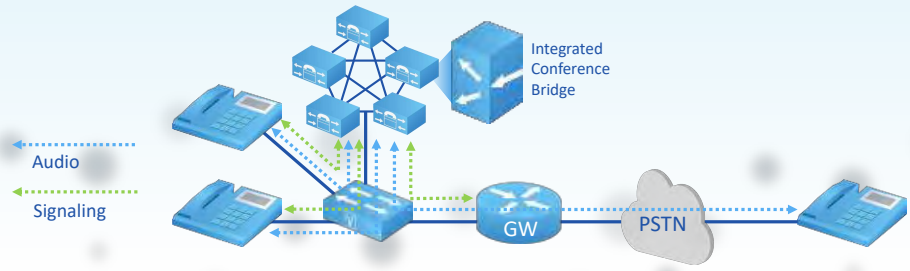
# Audio Conferences

An audio conference bridge joins multiple participants into a single call

A software conference bridge can run on one or more Cisco Unified Communications Manager servers in a cluster

A software conference bridge can run on one or more Cisco Unified Communications Manager servers in a cluster

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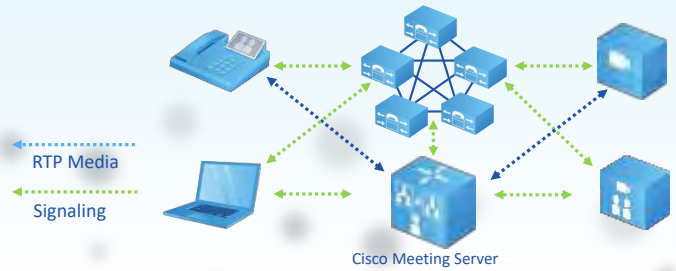
# Video Conferences

A video conference bridge joins multiple participants into a single video call

Video conferencing resources are hardware or software types

The Cisco IP Voice Media Streaming Application service does not support video conferences

Media streams exist between each conference participant and the conference bridge

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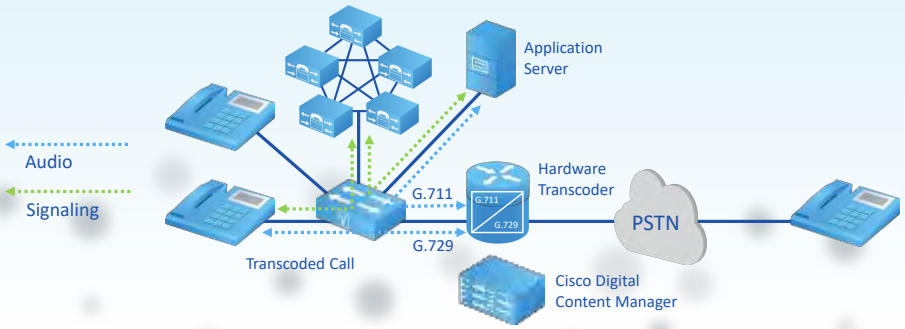
# Transcoders

A transcoder converts an input audio stream that uses one codec into an output stream that uses a different codec

The transcoder in the figure is implemented by using the Cisco IOS router DSP resources that perform transcoding

Audio streams exist from the IP phones to the transcoder and from the application server to the transcoder.

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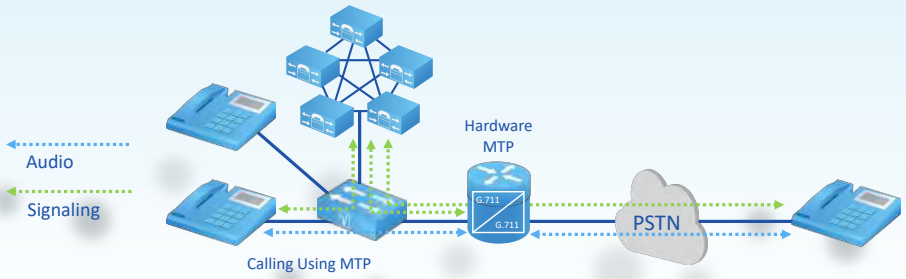
# Media Termination Points

An MTP bridges two media streams and allows them to be set up and torn down independently

An MTP can be used as an instance of translation between incompatible audio streams, to synchronize clocking, or to enable certain devices for supplementary services

Audio streams exist between IP phones and an MTP

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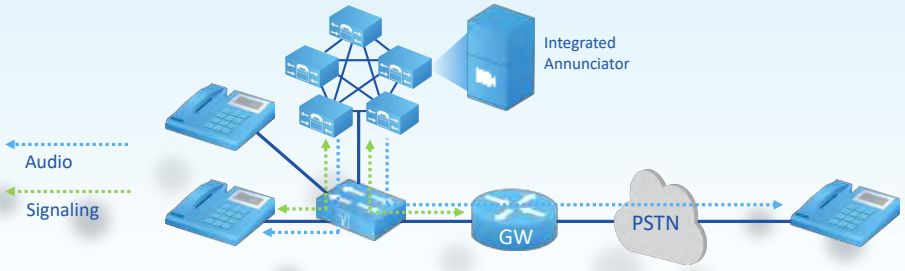
# Annunciators

An annunciator is a software function of the Cisco IP Voice Media Streaming Application

An annunciator can stream spoken messages or various call-progress tones from the system to a user

An annunciator can send multiple one-way RTP streams to devices such as Cisco IP phones or gateways and uses SCCP messages to establish the RTP stream

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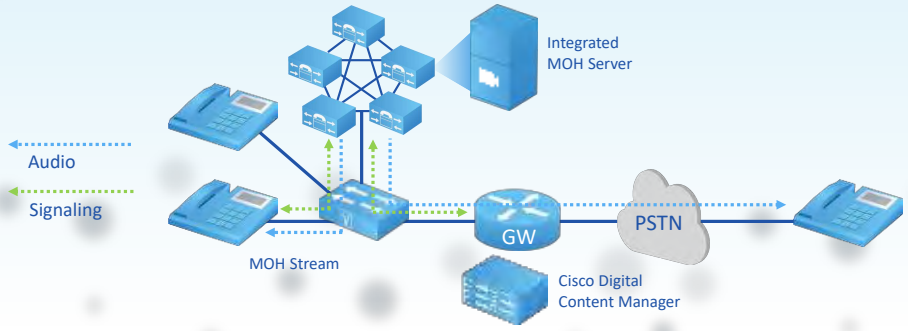
# Music on Hold

MOH is an integrated feature of Cisco Collaboration Systems

The MOH feature allows two types of holds:

- End-user hold
- Network hold, which includes transfer hold, conference hold, and Call Park hold

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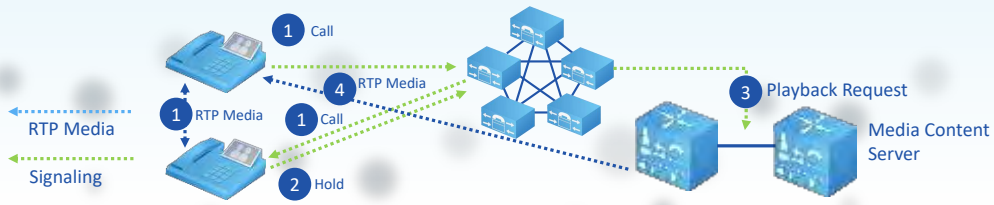
# Video on Hold

Allows video streams to be sent to a caller while the call is placed on hold

A media Content Server can stream audio and video content to a video endpoint when directed by Cisco Unified Communications Manager

The media Content Server is an external device, that can store and streaming audio and video content under Cisco Unified Communications Manager control using SIP as the signal protocol.

The media Content Server can provide high-definition video content at 1080p and 720p, or lower resolutions such as 360p.

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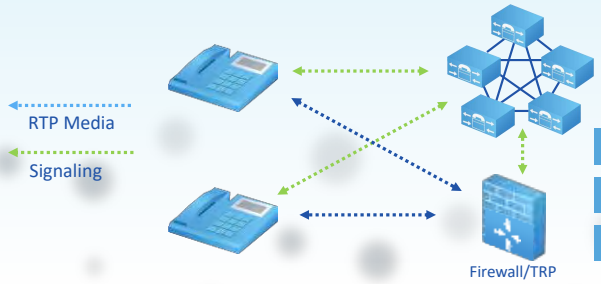
# Trusted Relay Points

A TRP is a device that can be inserted into a media stream to act as a control point for that stream

The TRP functionality can invoke an MTP device to act as that anchor point

Use cases for TRPs include QoS enforcement at the anchor point, firewall traversal, and inter-VRF communication




- QoS Enforcement
- Media Firewall Traversal
- Inter-VRF Communication

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# Conclusions

- Overview of Media Resources in Cisco Unified Communications Manager
  - Media resources
    - Functions
    - Signaling and media streams
  - Audio conferences
  - Video conferences
  - Transcoders
  - Media termination points
  - Annunciators
  - Hold music
  - Hold video
  - Trusted relay points

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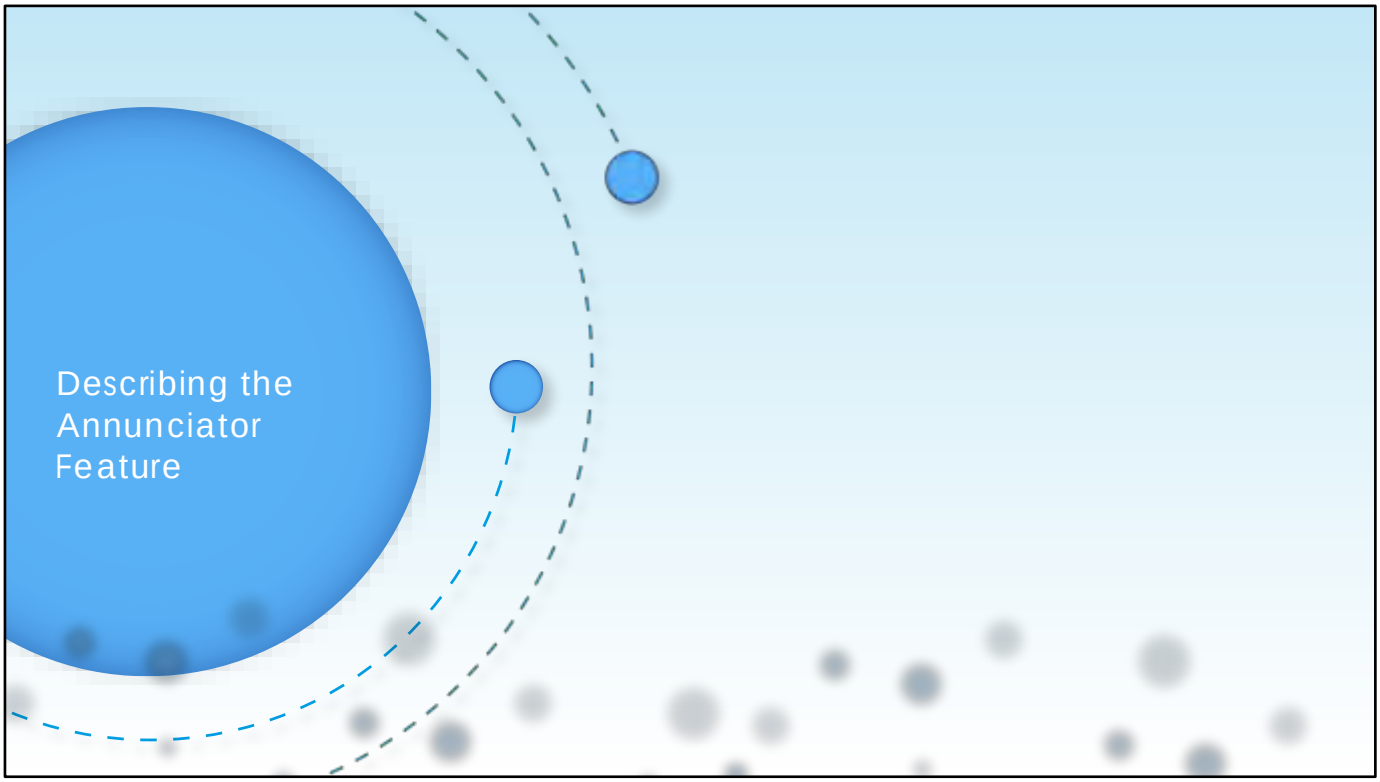


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# Annunciator Support in Cisco Unified Communications Manager

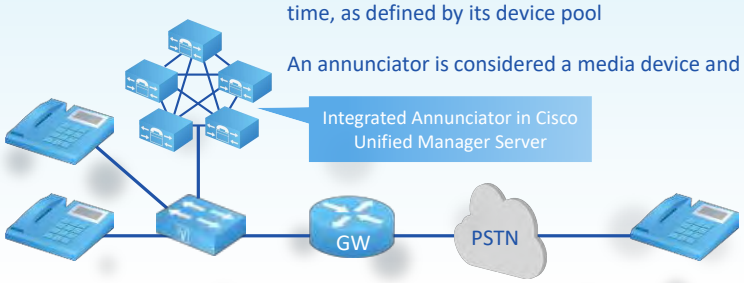
An annunciator is automatically enabled in the system when the Cisco IP Voice Media Streaming Application service is activated on a server

The annunciator streams spoken messages and various call-progress tones

If the Cisco IP Voice Media Streaming Application service is deactivated, the annunciator is disabled

The annunciator registers with one Cisco Unified Communications Manager at a time, as defined by its device pool

An annunciator is considered a media device and can be included in an MRG

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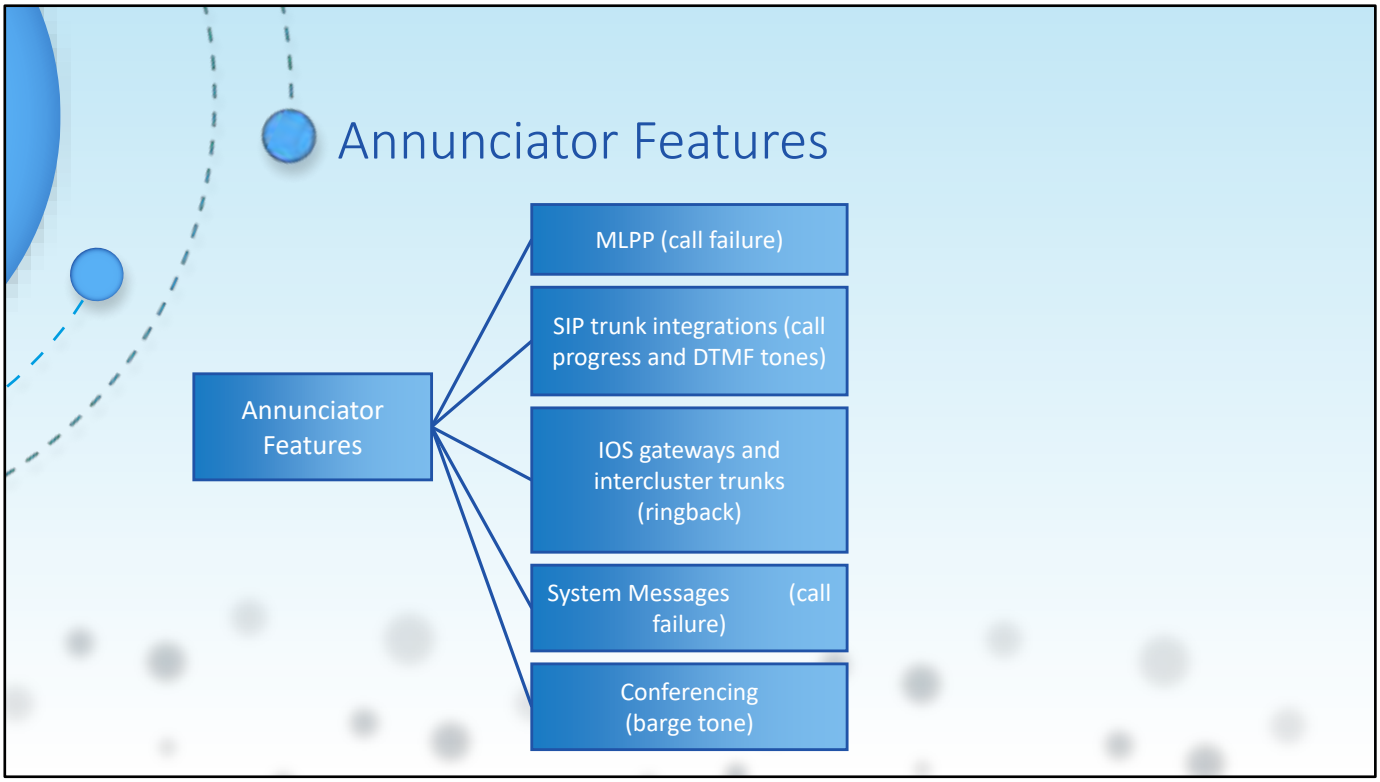


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# Annunciator Server Capacity

| | |
|---|---|
| **Standalone Without Cisco CallManager Service** | 250 Streams |
| **High Performance Server (Dual CPU)** | 400 Streams |
| **Coresident with Cisco CallManager Service** | 48 Streams |

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# Annunciator Server Capacity

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# Conclusions

- Annunciator
  - Features
  - Support
  - Server capacity
  - Configuration

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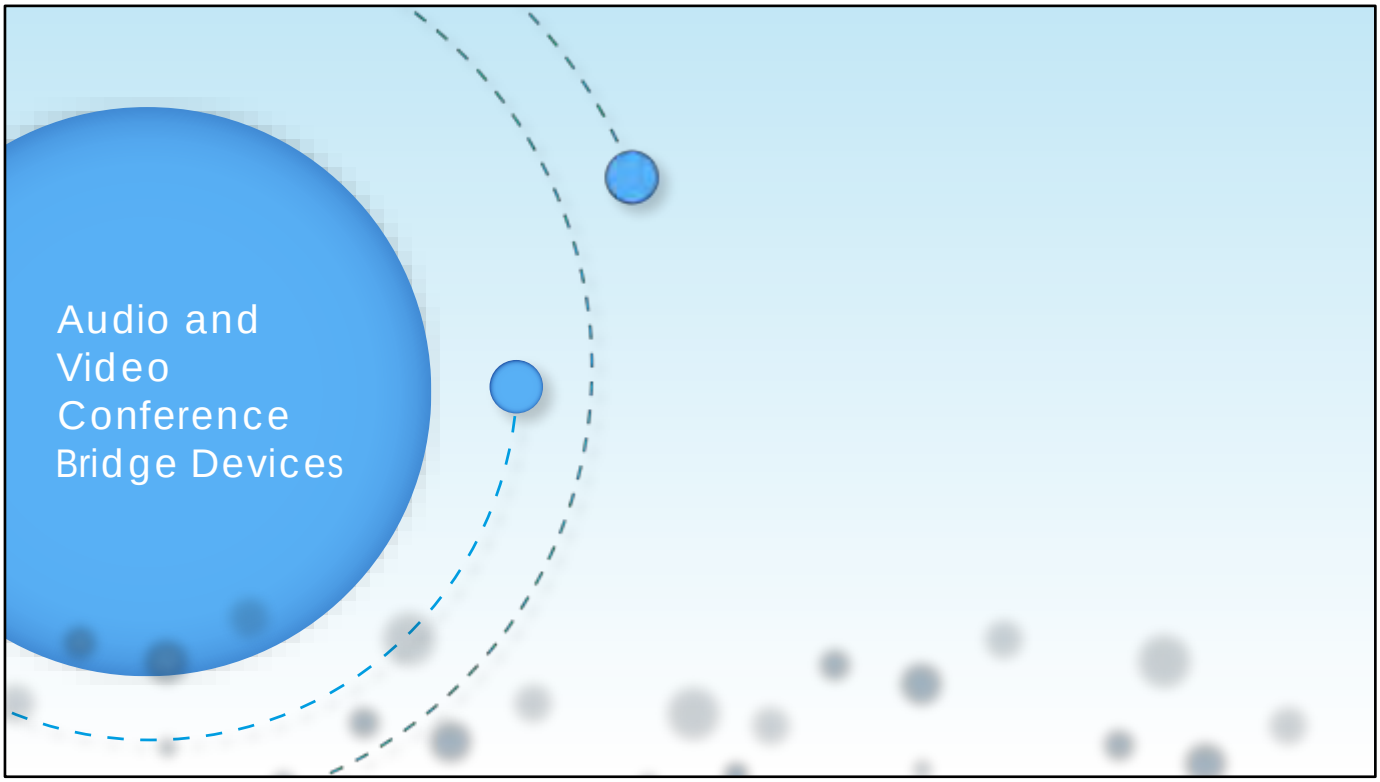


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# Devices That Support Audio or Video Conferencing

- Software Conference Bridge in Cisco Unified CM
- Hardware Conference Bridge in Cisco IOS
- Cisco Meeting Server

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# Cisco Unified Communications Manager Audio Conference Bridge

Cisco IP Voice Media Streaming Application Service

Supports G.711 a-law, G.711 mu-law, and wideband audio codecs

Up to 128 audio streams per server

**Ad Hoc**

Minimum Participants: 3

Maximum Participants: 64

**Meet-Me**

Minimum Participants: 1

Maximum Participants: 128

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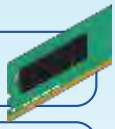
# Cisco IOS Conference Bridge

PVDM2 / PVDM3 / PVDM4



Voice-Activated Switching and Lecture Mode

Video Conference Types

- Homogenous Conference (Video Switching)
- Heterogenous Conference (Video Switching and Video Conversion)
- Guaranteed Audio (Video Switching)

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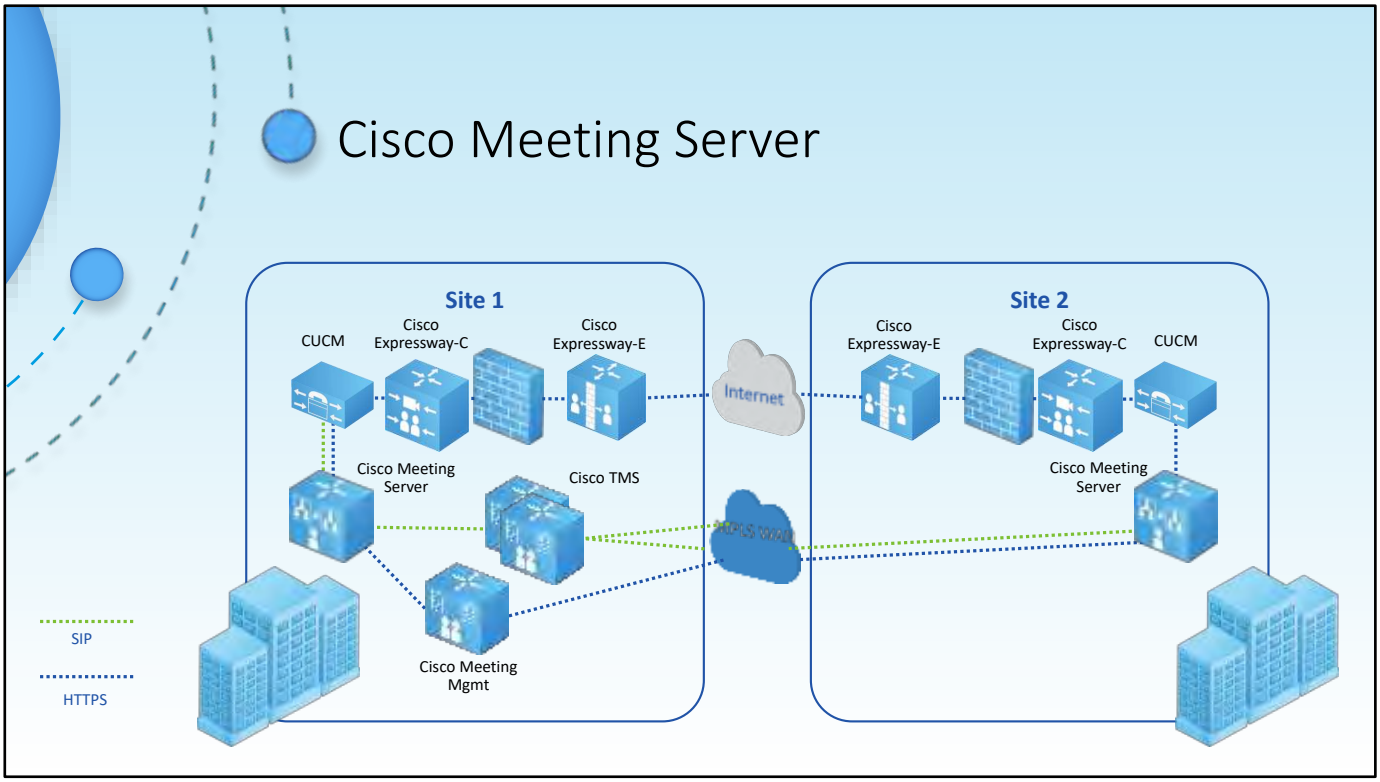
# Cisco Meeting Server

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# Cisco Meeting Server Platforms

There are different Cisco Meeting Server platforms:

Cisco Meeting Server 1000 is a preconfigured version of the Cisco UCS C220 M5 Rack Server.

Cisco Meeting Server 2000 is a preconfigured Cisco UCS 5108 chassis with eight Cisco UCS B200 M5 blades.

**Cisco Meeting Server 1000**

**Cisco Meeting Server 2000**

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# Cisco Meeting Server Call Capacity

| Type of Call | Cisco Meeting Server 1000 | Cisco Meeting Server 2000 |
|---|---|---|
| Full HD calls (1080p60) | 24 | 175 |
| Full HD calls (1080p30) | 48 | 350 |
| HD calls (720p30) | 96 | 700 |
| SD calls (448p30) | 192 | 1000 |
| Audio calls | 2200 | 3000 |

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# Comparison of Audio-Conference Bridges

| Conferences Resource | Bridge Type | Participants per Resources (G.711/G.729) | Participants per Conference |
|---|---|---|---|
| Cisco IP Voice Media Streaming Application service | Software | 128 participants per server<br>42 conferences per server | 128 |
| Cisco Catalyst WS-X6608-T1 and WS-X6608-E1 Digital Gateway cards | Hardware | 32 per port<br>256 per module | 6 |
| PVMD3 | Hardware | •Up to 64 participants for G.711 conferences<br>•Up to 32 participants for G.729, G.729A, and G.722 conferences<br>•Up to 16 participants for iLBC conferences | 8 |

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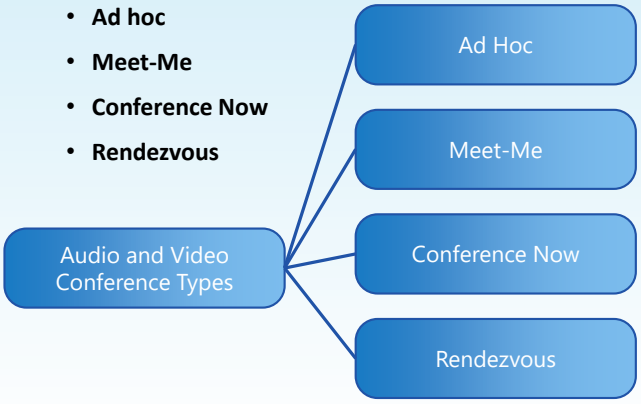
# Audio and Video Conference Types

- There are multiple audio and video conference types and each one of them provides a different user experience.
- Multiple types of audio and video conferences
  - **Ad hoc**
  - **Meet-Me**
  - **Conference Now**
  - **Rendezvous**

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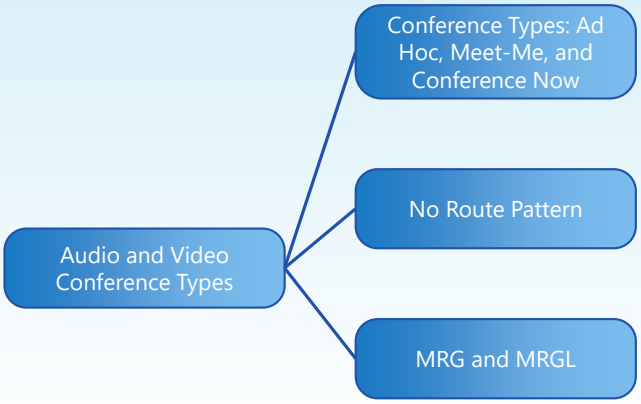
# Cisco Unified Communications Manager Provides the Conference Service Locally

- MRGs and MRGLs are considered during the allocation process

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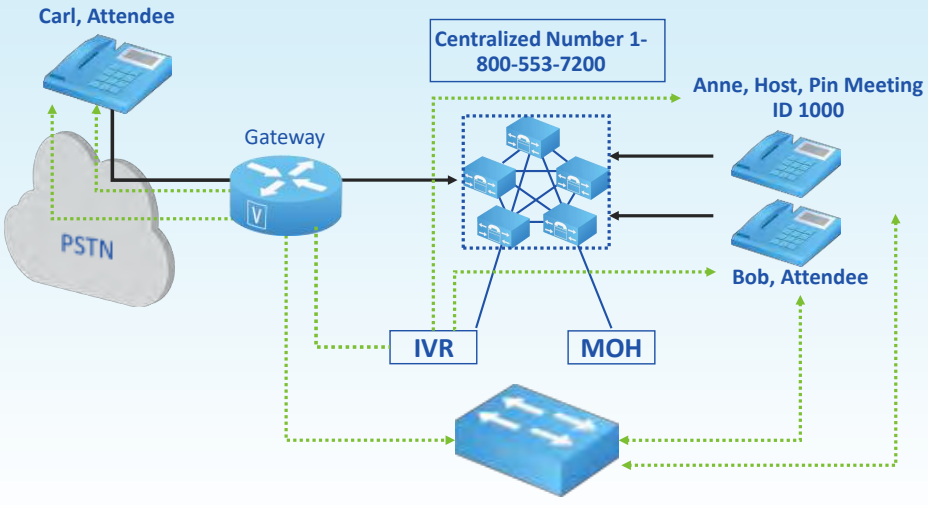
# Cisco Conference Now

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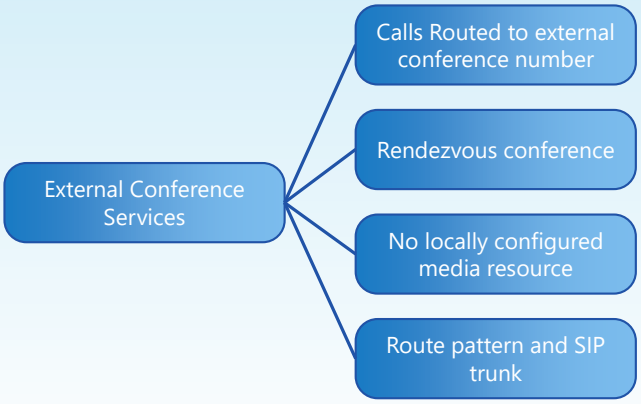
# Cisco Unified Communications Manager Routes Calls to Conference Numbers of Another System

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# Conclusions

- Audio and video conference bridge devices
  - Devices that support audio or video
  - CUCM Audio conference bridge
  - Cisco IOS conference bridge
  - Cisco meeting server
- Bridge integration options
  - Audio and video conference types
  - Cisco Conference Now

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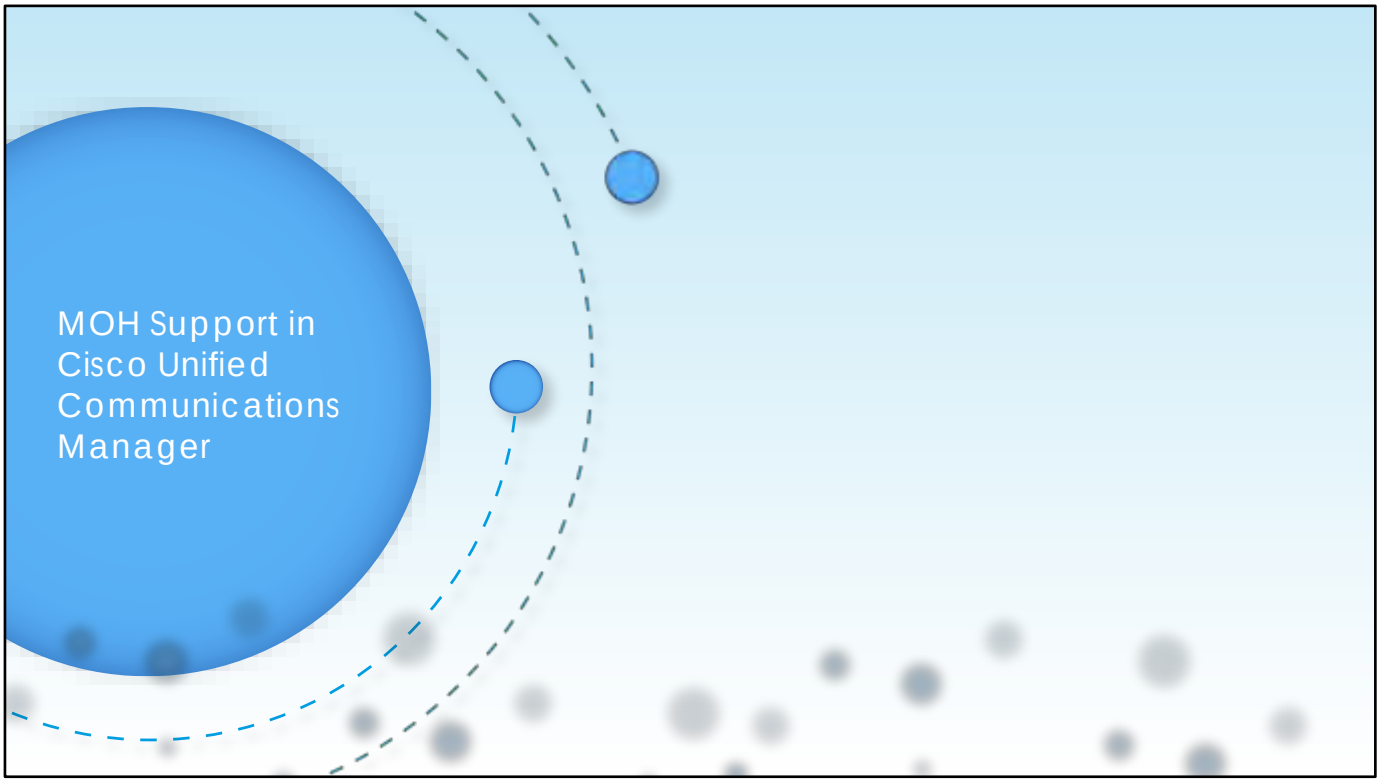


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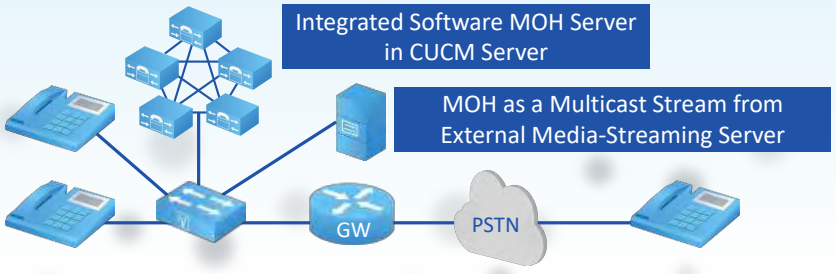
# MOH Support in Cisco Unified Communications Manager

In order for callers to hear MOH, Cisco Unified Communications Manager must be configured to support the MOH feature

The MOH feature has two main requirements:

An MOH server to provide the MOH audio-stream sources

A Cisco Unified Communications Manager system that is configured to use the MOH streams that the MOH server provides when a call is placed on hold

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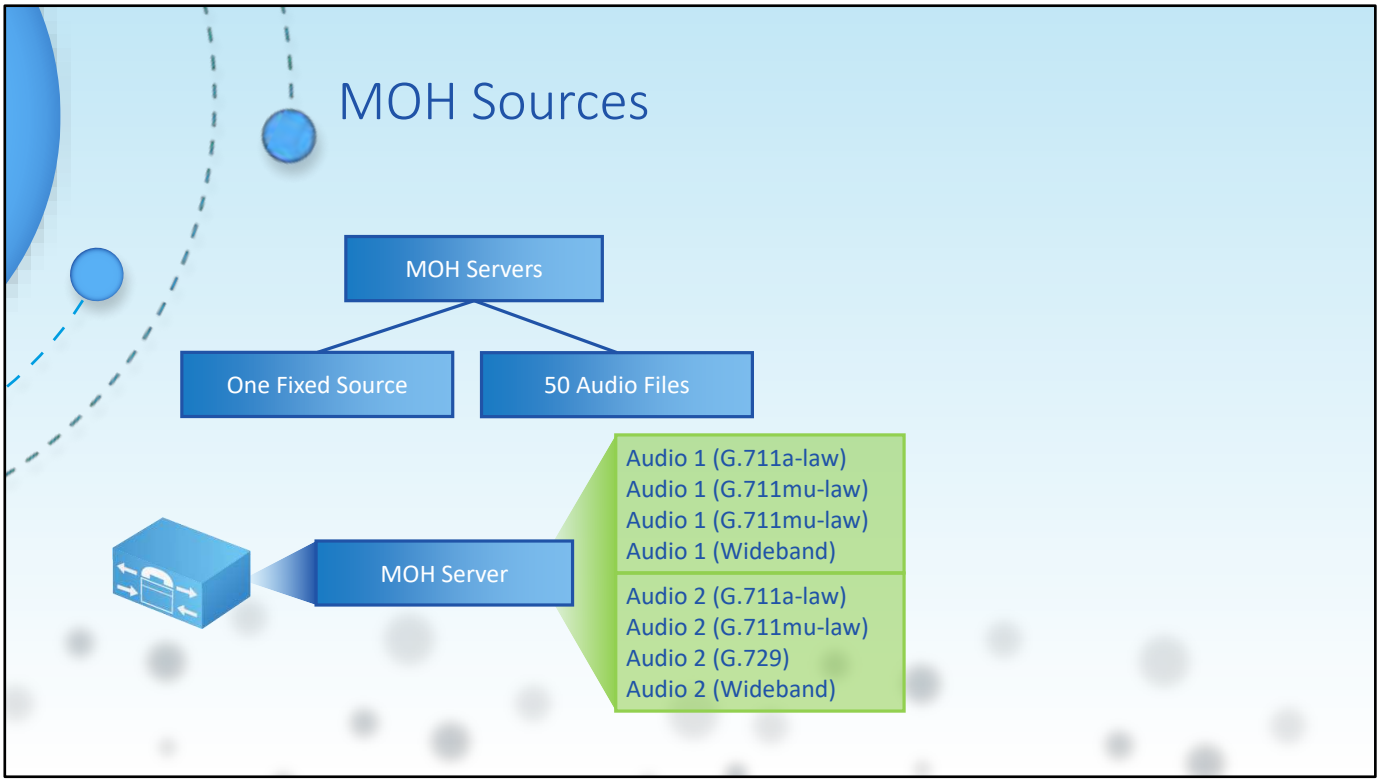


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# MOH Server Capacity

Capacity planning is crucial to make certain that the hardware, after being deployed and configured, can support the anticipated call volume of the network

When MOH sessions reach these limits, additional load can result in poor MOH quality, erratic MOH operation, or even loss of MOH functionality

The following MOH server configuration parameters affect MOH server capacity:

**Maximum Half Duplex Streams**

**Maximum Multicast Connections**

- 501 Audio Sources/Cluster
- 1000 MOH Streams Using 10K OVA Template
- 2,004 Multicast Streams (501 Sources * 4 Codec Types)

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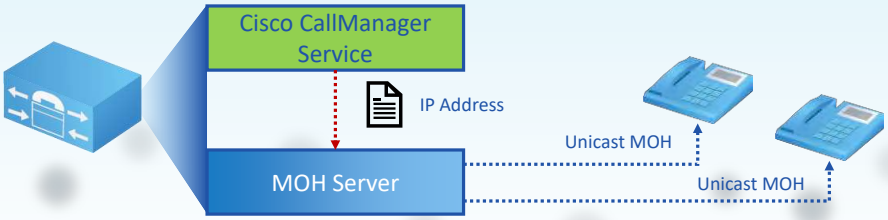
# Unicast MOH

Unicast MOH consists of streams that are sent individually from the MOH server to each endpoint that requests an MOH audio stream

A unicast MOH stream is a point-to-point, one-way audio RTP stream between the server and the endpoint device

Unicast MOH uses a separate source stream for each user or connection

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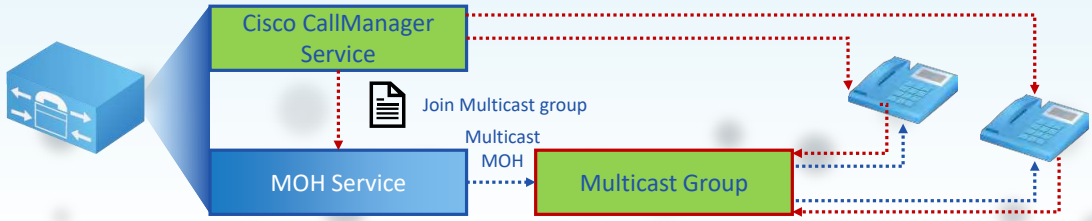
# Multicast MOH

Multicast MOH consists of streams that are sent from the MOH server to a multicast group IP address

Endpoints that request an MOH audio stream can join multicast MOH, as needed.

- Streams Sent to Multicast Group IP Address
- Point-to-Multipoint
- Conserve System Resources and Bandwidth
- Multicast Group 239.1.1.1 to 239.255.255.255

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# MOH Audio Source Selection

Basic operation of MOH in a Cisco Unified Communications environment consists of a holder and a holdee

- Holder decide which music file holdee will listen to
- Holdee decide which server to receive stream

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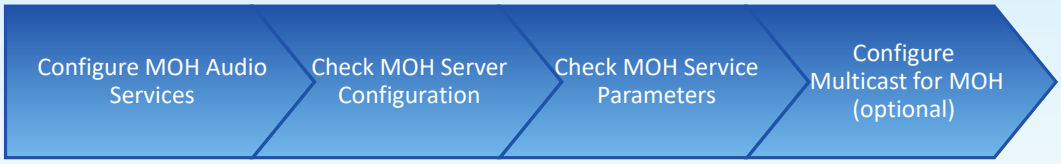
# MOH Configuration

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# Conclusions

- MOH Support
  - Sources
  - Server capacity
  - Unicast
  - Multicast
  - Audio source
  - Configuration

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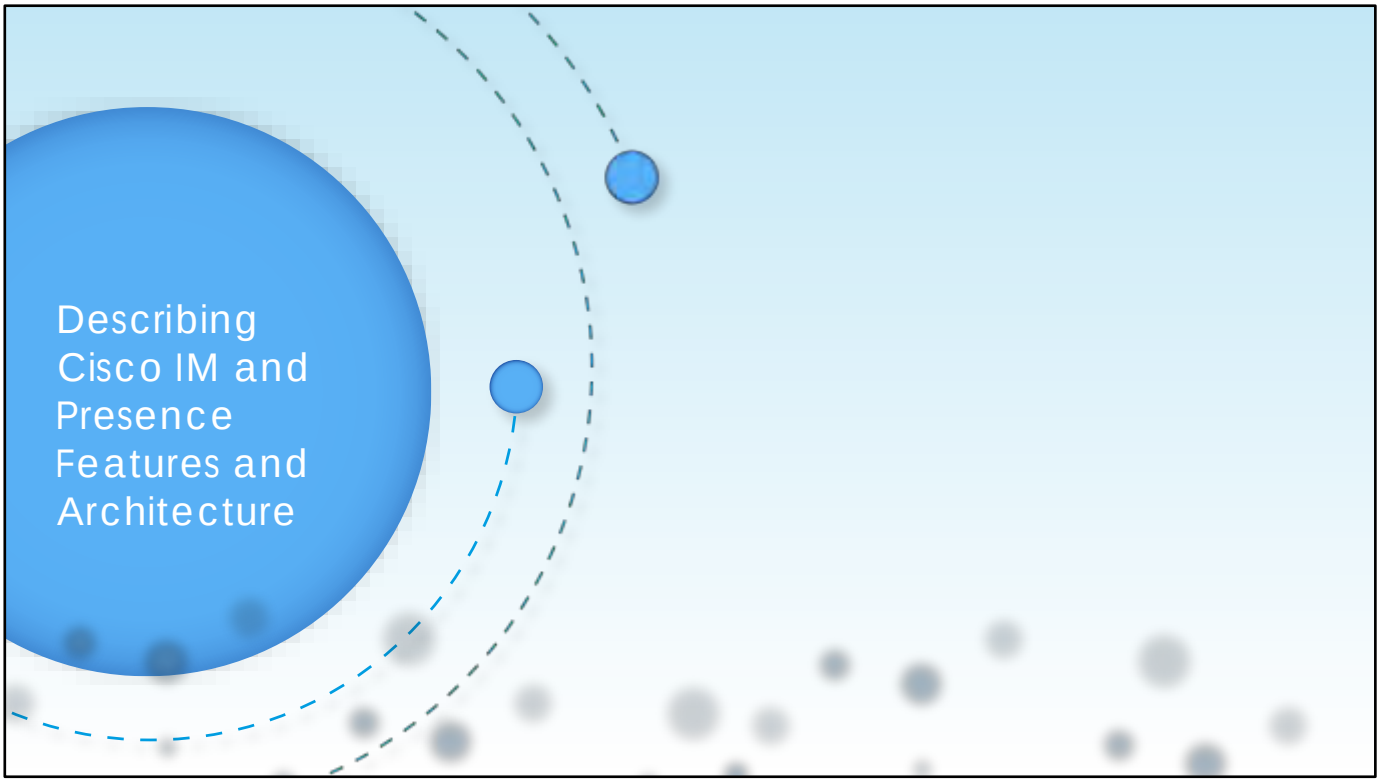


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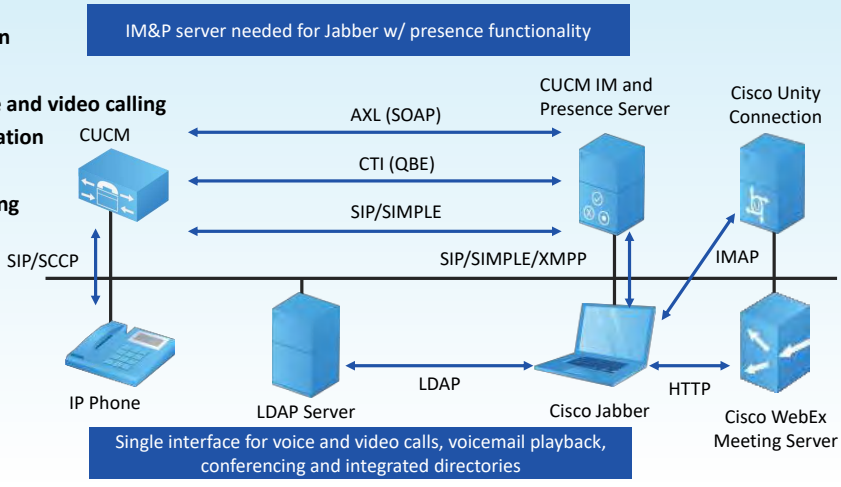
# Cisco IM and Presence Features and Architecture

- **Real-time availability**
- **Contact list**
- **Media escalation**
- **Click-to-call**
- **Integrated voice and video calling**
- **IP phone association**
- **Conferencing**
- **Web conferencing**
- **Voice messages**

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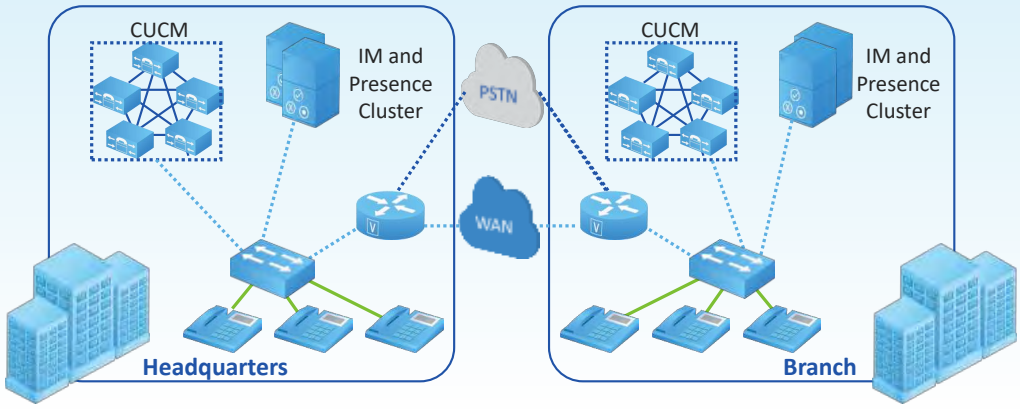
# Cisco Unified Communications Manager Deployment Options

**Supported Deployment Models**

Single-site
Multisite WAN w/ centralized call processing
Clustering over the WAN

**Multisite WAN with Distributed Call Processing w/ IM and Presence Intercluster Peers**

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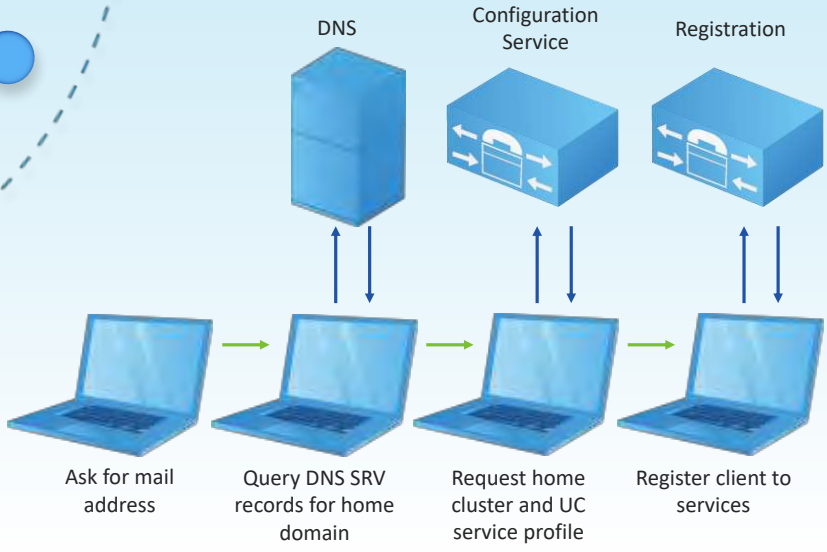
# Service Discovery

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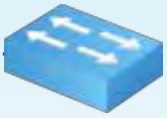
# Quality of Service

Computer untrusted by default

Network devices must allow DSCP marking on ports used for voice and video

Jabber marks signaling with DSCP 24

Jabber marks voice with DSCP 46



| Application | IP-Precedence | PHB | DSCP | CoS |
|---|---|---|---|---|
| Voice | 5 | EF | 46 | 5 |
| Video | 4 | AF41 | 34 | 4 |
| Immersive Video | 4 | CS4 | 32 | 4 |
| Call Signaling | 3 | CS3 | 24 | 3 |

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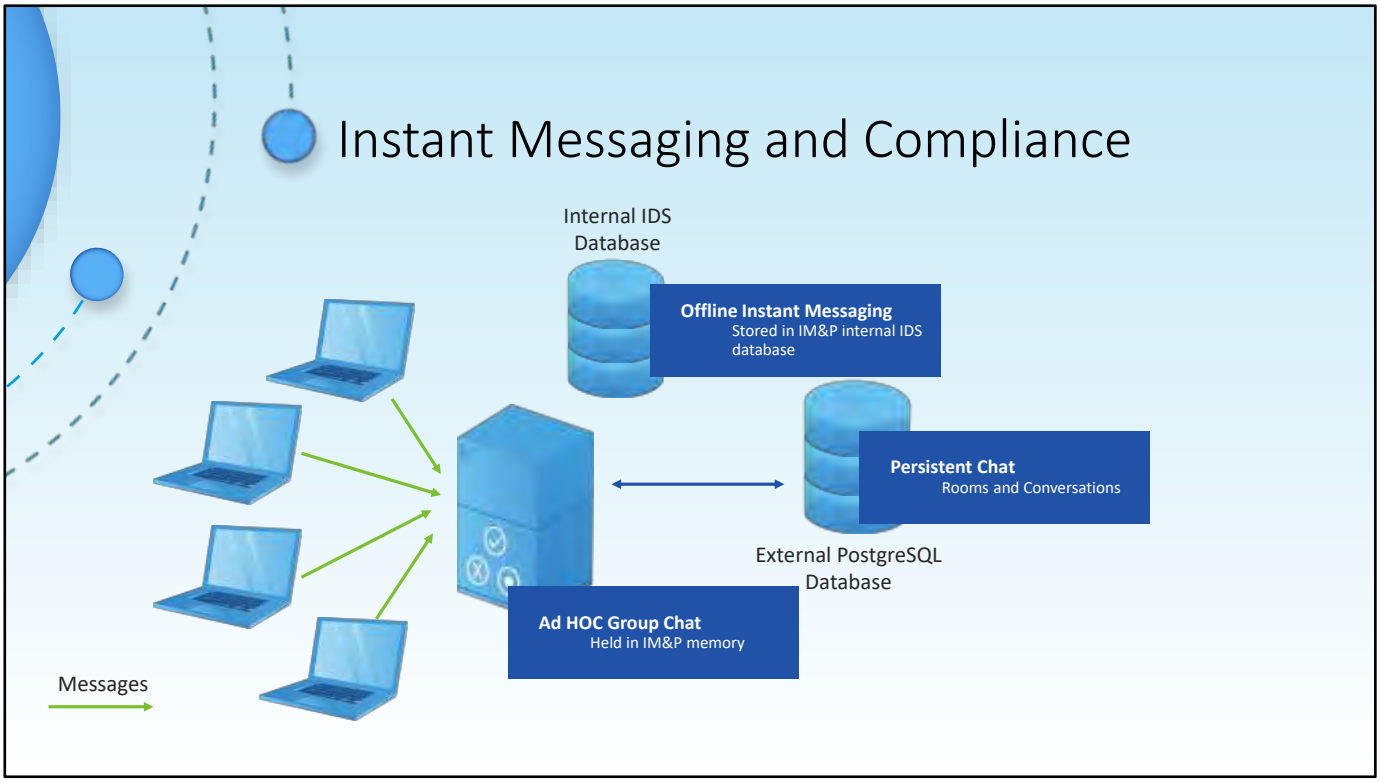


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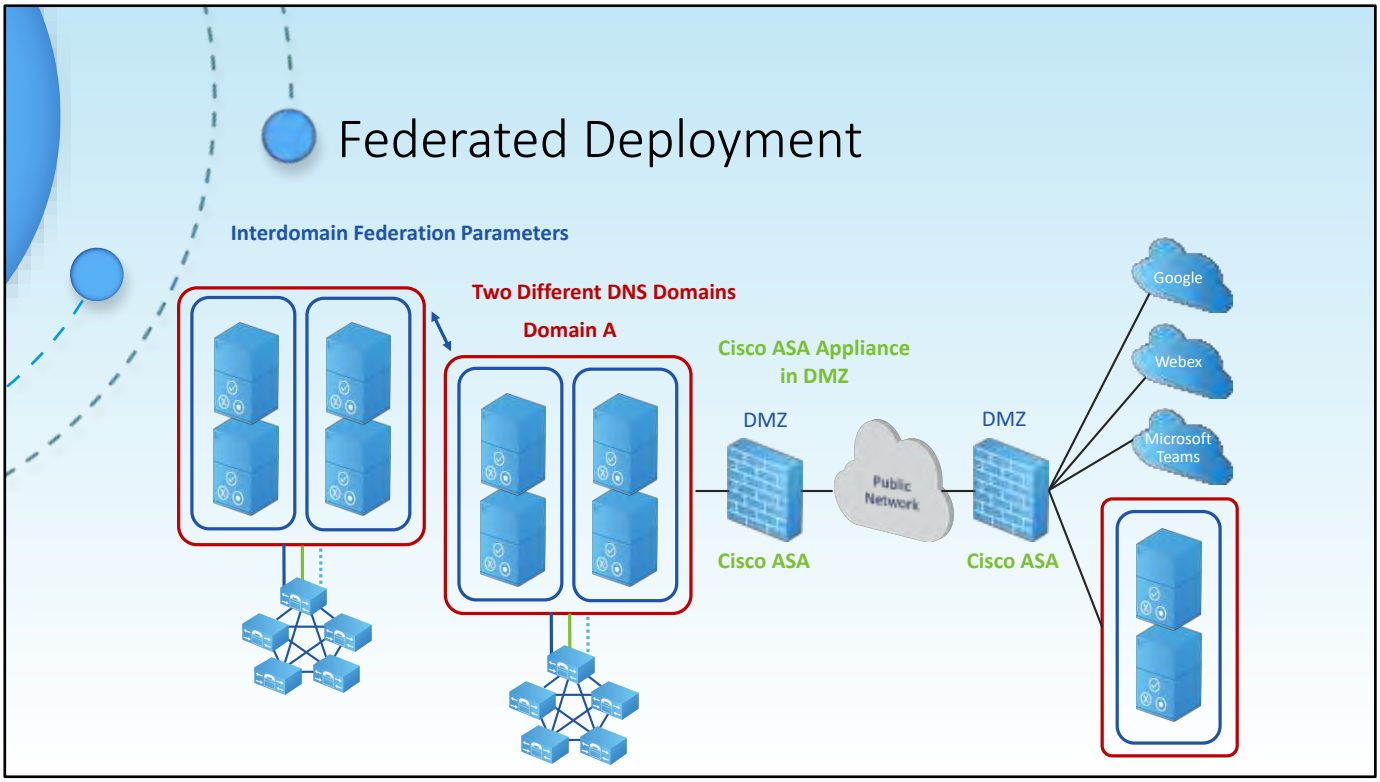


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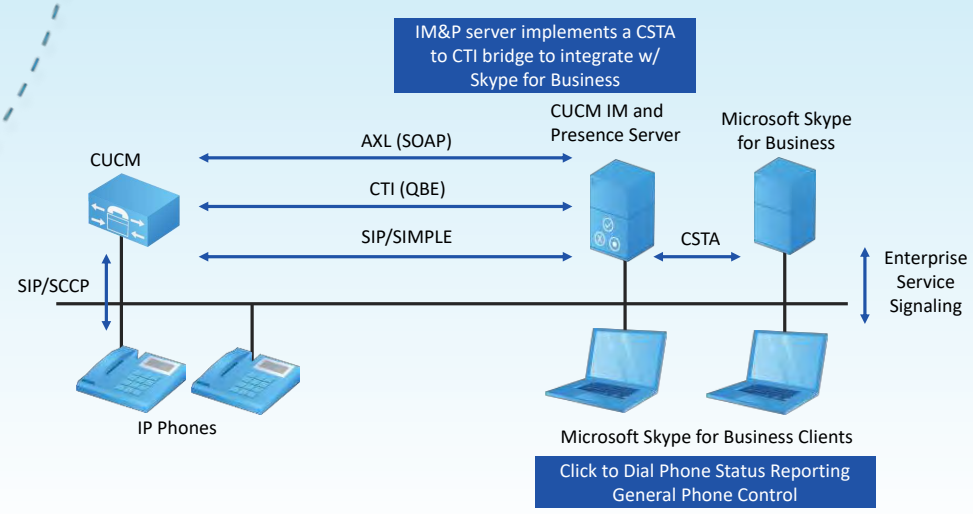
# Microsoft Integration

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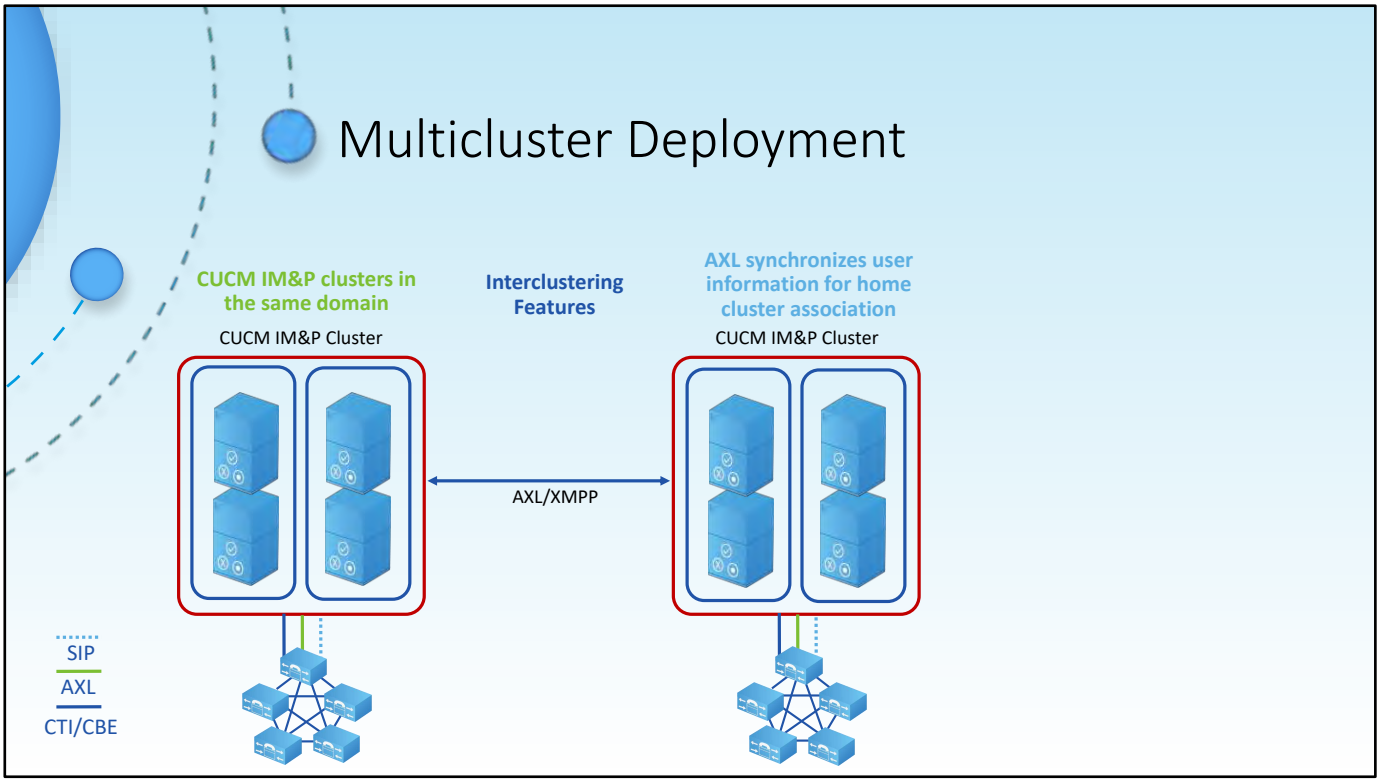


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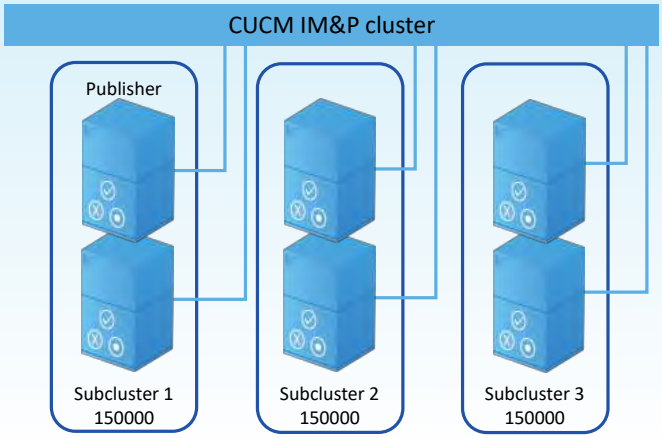
# Cisco Unified CM IM and Presence Cluster

- Up to six servers per cluster
- Two servers per subcluster for redundancy
- Communications Manager cluster supports one IM&P cluster

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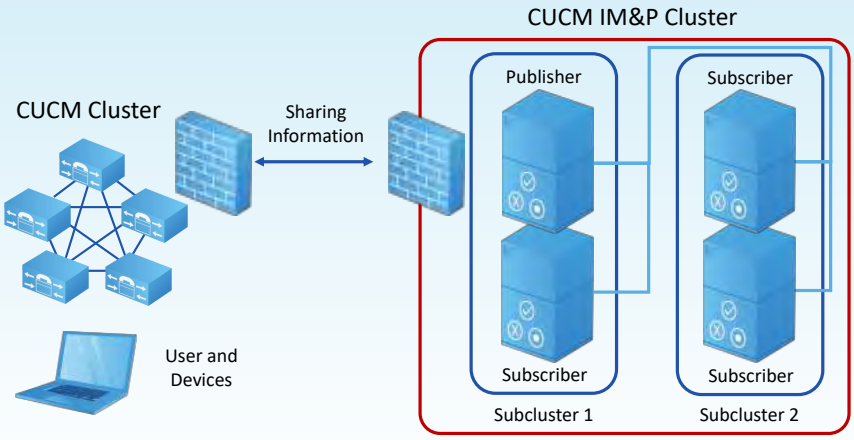
# Cisco Unified Communications Manager and IM and Presence Service Clusters

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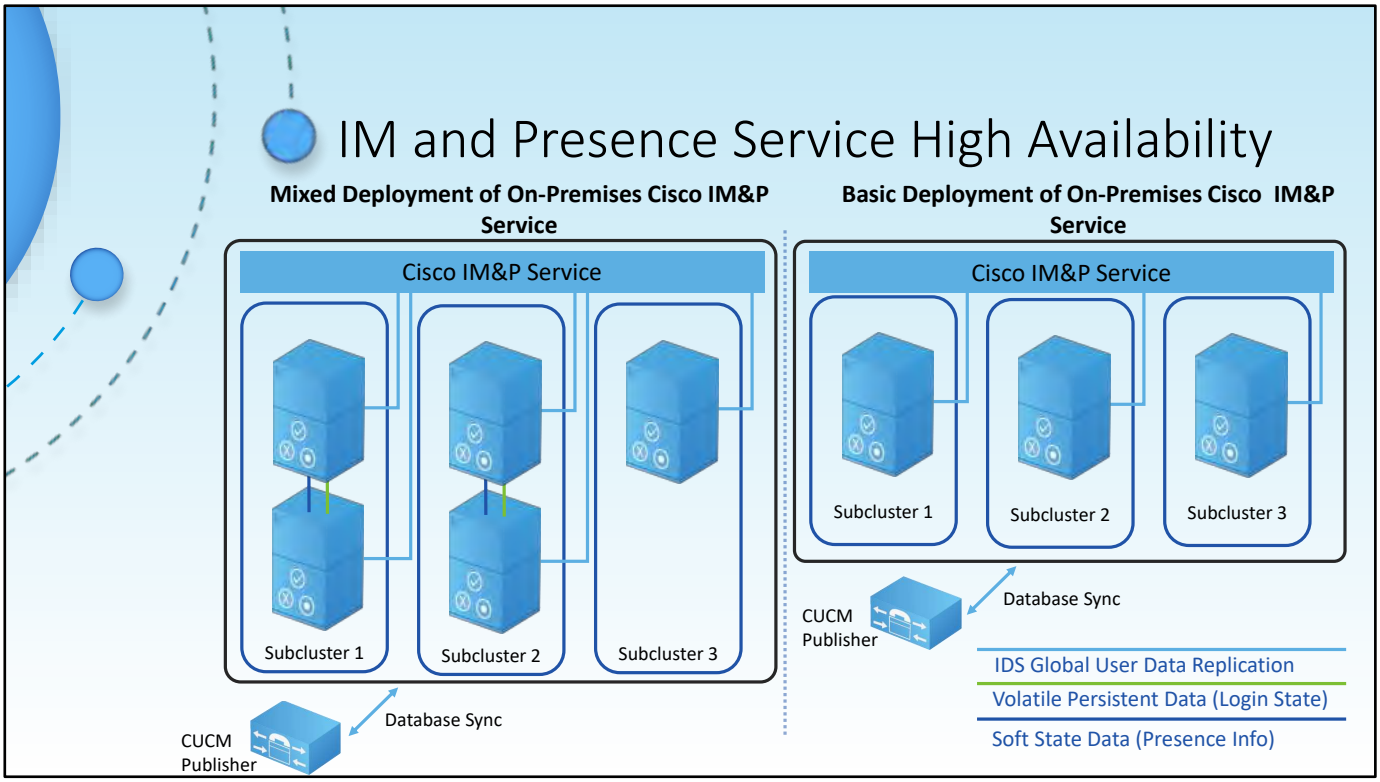
# IM and Presence Service High Availability

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# Conclusions

- Cisco IM and Presence Features and Architecture
  - CUCM Deployment options
  - Service discovery
  - QoS
  - Instant messaging and compliance
  - Federated deployment
  - Microsoft integration
  - Clustering
  - Multicluster

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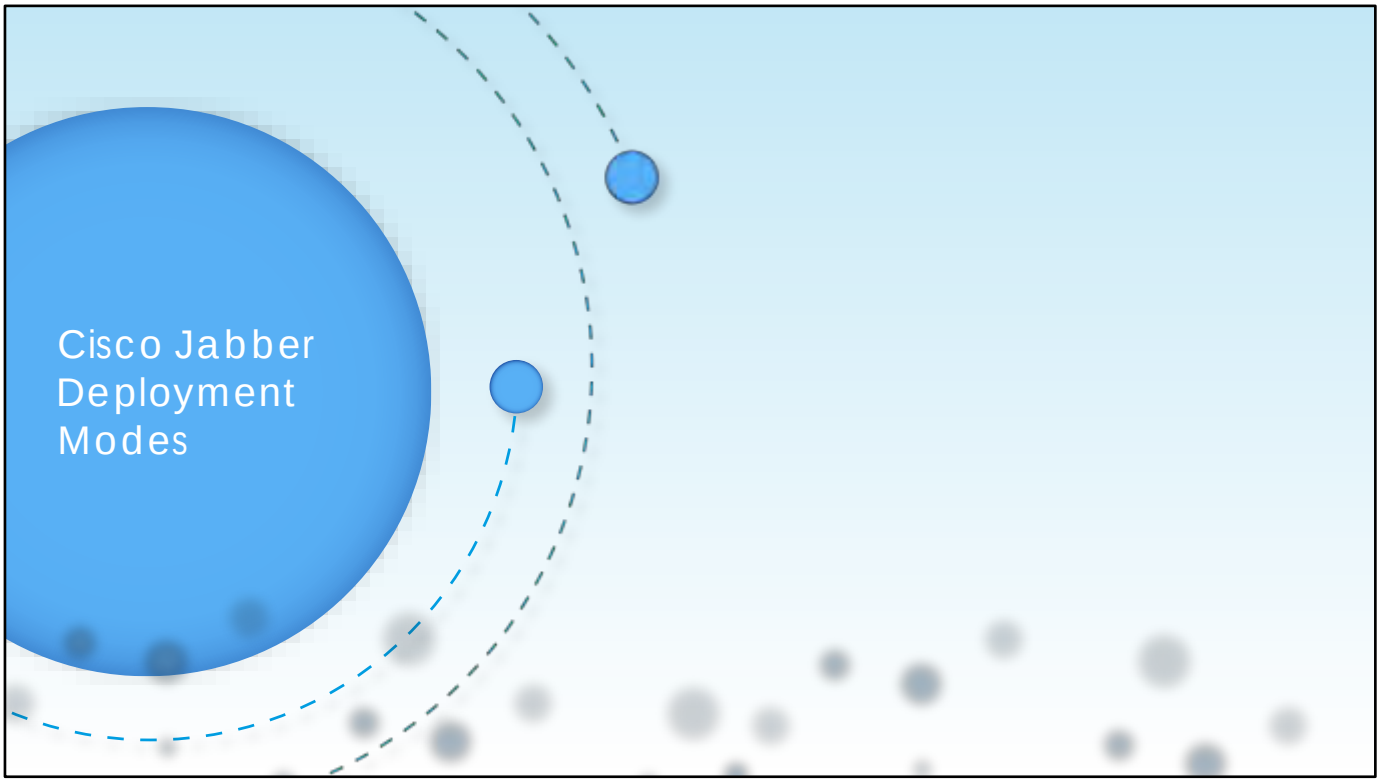


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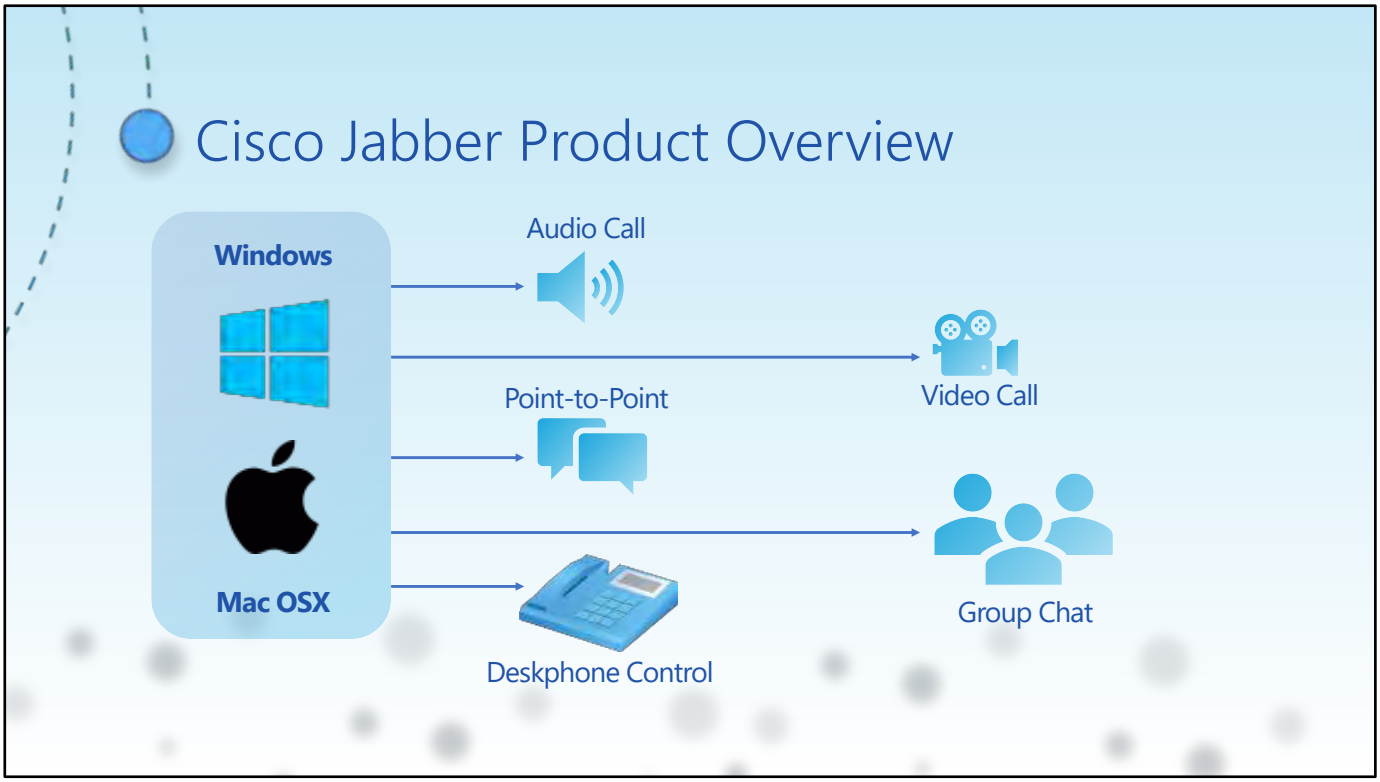


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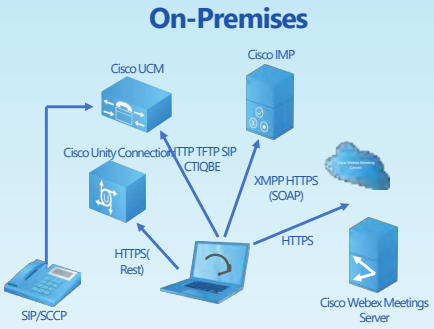
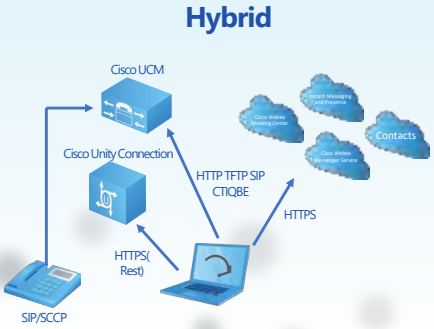
# Deployment Modes

Cisco Jabber has a few different deployment models:

- On-Premise
  - Full UC
  - IM-Only
  - Phone-Only Mode
- Cloud-Based Deployment
- Hybrid Cloud-Based Deployment



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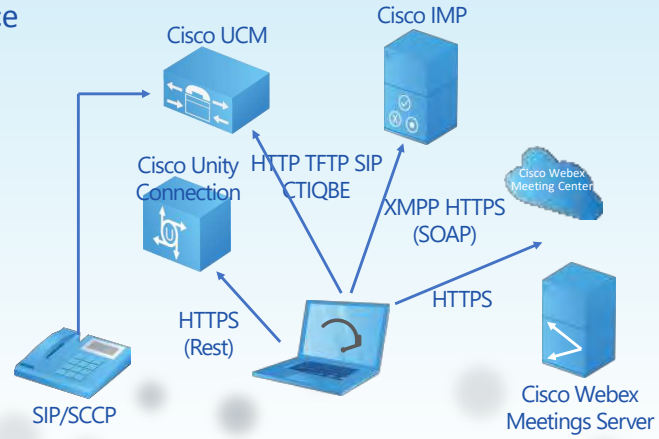
# Deployment: On-Premise Full UC Mode

The following services are available in an on-premises deployment with Cisco Unified Communications Manager IM and Presence Service

- Presence
- Instant Messaging (IM)
- File Transfers
- Audio Calls
- Video
- Voicemail
- Conferencing

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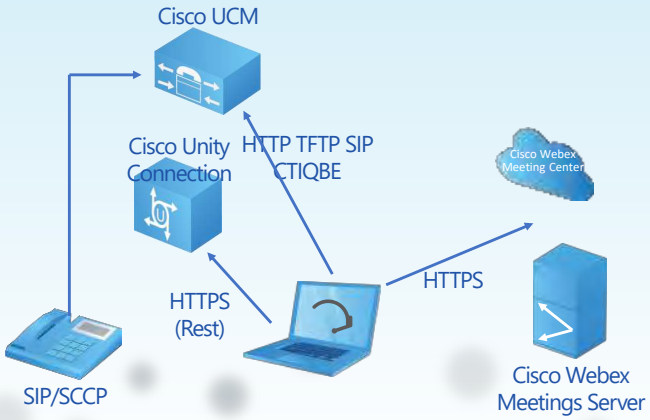
# Deployment: On-Premise Full UC Mode

The following services are available in a phone mode deployment:

- Contact
- Audio Calls
- Video
- Voicemail
- Conferencing

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# Deployment: Cloud-Based

The following services are available in a cloud-based deployment:

- Contact Source
- Presence
- Instant Messaging
- Conferencing

On Premises

- Audio
- Video
- Voicemail

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# Conclusions

- Product overview
- Deployment modes
  - On-prem: Full UC mode, phone only mode
  - Cloud-based

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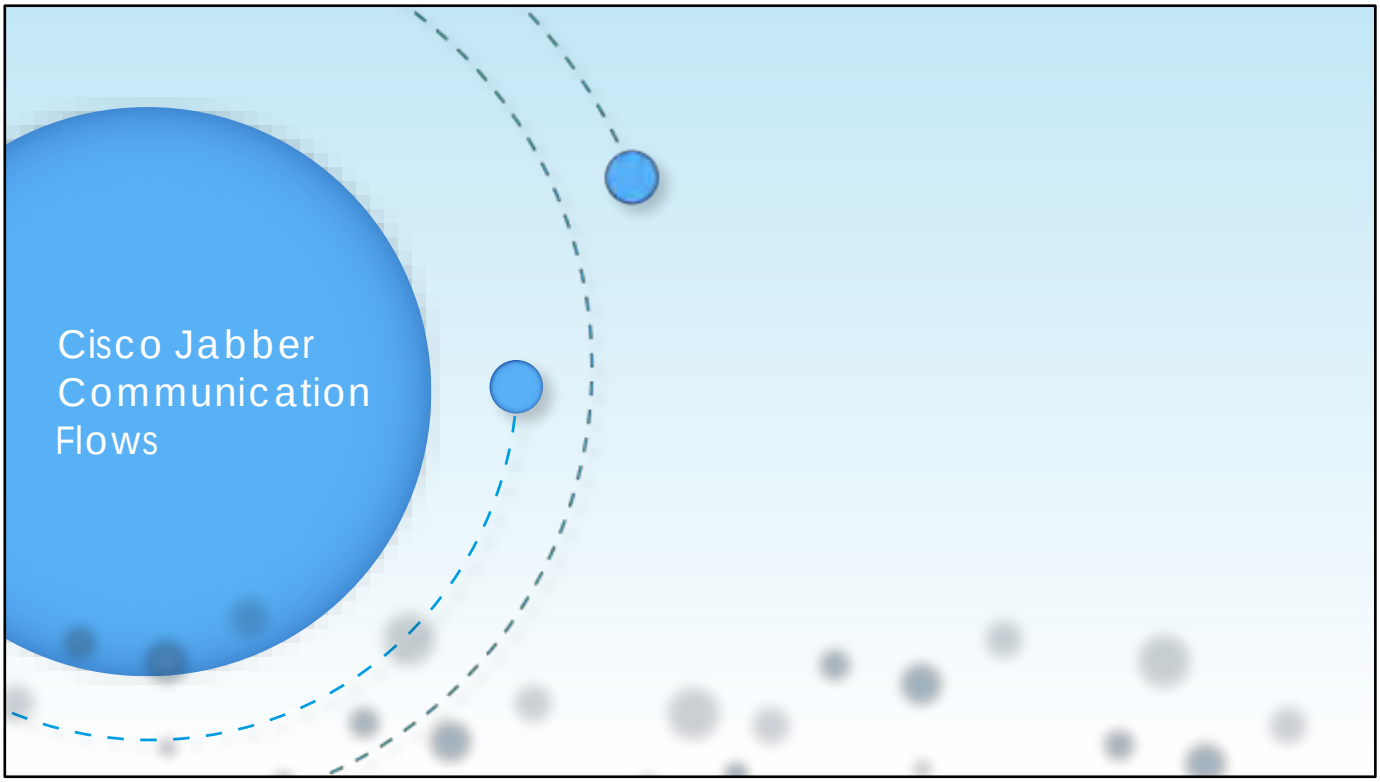


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# Cisco Jabber Information Flow in Deskphone Mode

**Deskphone Mode**

Cisco Jabber registers with IM and Presence using xMPP for chat

The end user is associated with an IP phone that is configured from CUCM

Using Cisco Jabber, the end user can control the IP phone via the CTIQBE interface.

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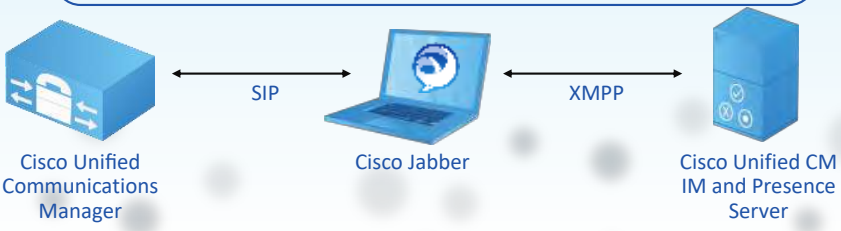
# Cisco Jabber Information Flow in Softphone Mode

**Softphone Mode**

- Cisco Jabber registers as a CSF device with Cisco Unified Communications Manger
- The CSF device uses SIP as the signaling protocol
- The end user must be associated with the CSF
- The CSF is configured as an end point with normal settings
- Cisco Jabber uses IM and Presence for chat

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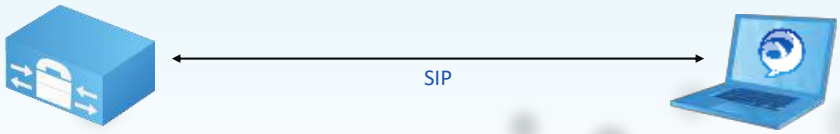
# Cisco Jabber in Phone-Only Mode

Phone Only Mode

Cisco Jabber can be registered with Cisco Unified Communications Manager in phone-only mode

- No IM and Presence server required
- No IM and Presence functionality available
- Does not download UC Profile or services




Cisco Unified Communications Manager

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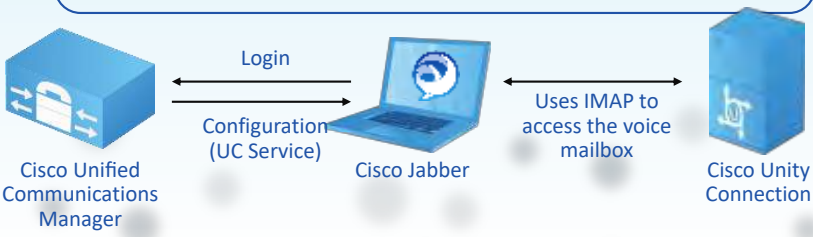
# Cisco Jabber and Voicemail

Jabber with Voicemail

Integrating Cisco Unity Connection

- Cisco Jabber users are able to view, play, sort, and delete voicemail messages
- Cisco UCM must have voicemail UC service configured
- Cisco Jabber receives configuration info from Cisco UCM during login.
- Cisco Jabber users need to enter user credentials for voicemail

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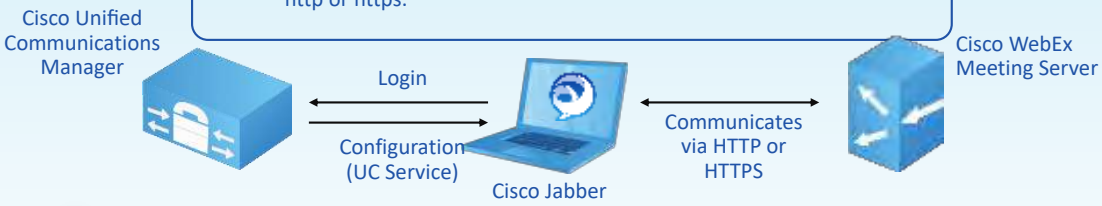
# Cisco Jabber and Conferencing

Cisco Jabber and Conferencing

Integrating Conferencing Systems for Cisco Jabber

- Cisco Meeting Server and Cico WebEX are supported
- Cisco Jabber communicates with the conferencing servers using http or https.




Conferencing servers are configured on Cisco UCM in a UC Service

Telepresence Management Suite (TMS) can be added as well

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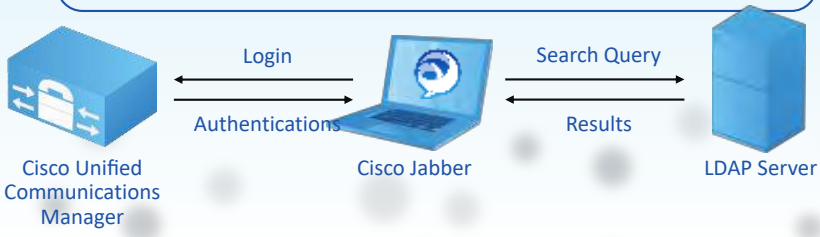
# Cisco Jabber and Voicemail

## Integrating LDAP Directory Servers for Cisco Jabber

- Cisco Unified Communications Manger can use synchronization and authentication of end users
- LDAP profile allows users to search and add contacts from the LDAP directory into Cisco Jabber
- Photo retrieval to show user pictures in Cisco Jabber for contacts
- Contact photos are best at 128x128 pixels with an aspect ratio of 1:1
- Cisco Unified CM User Data Service (UDS) can be used instead of LDAP

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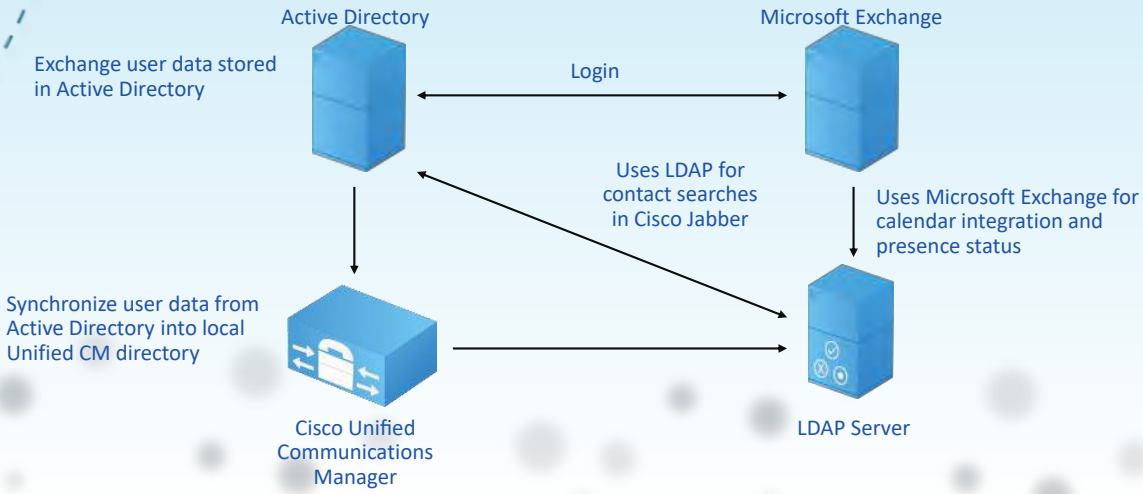
# Cisco Unified Communications IM and Presence, Active Directory, and Exchange

## Integrating LDAP Directory Servers for Cisco Jabber

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# Conclusions

**Jabber information flow in deskphone and softphone mode**

- Phone-only mode
- Jabber and voicemail
- Jabber and conferencing
- Integration with LDAP
- CUC IM and Presence, Active Directory, and Exchange

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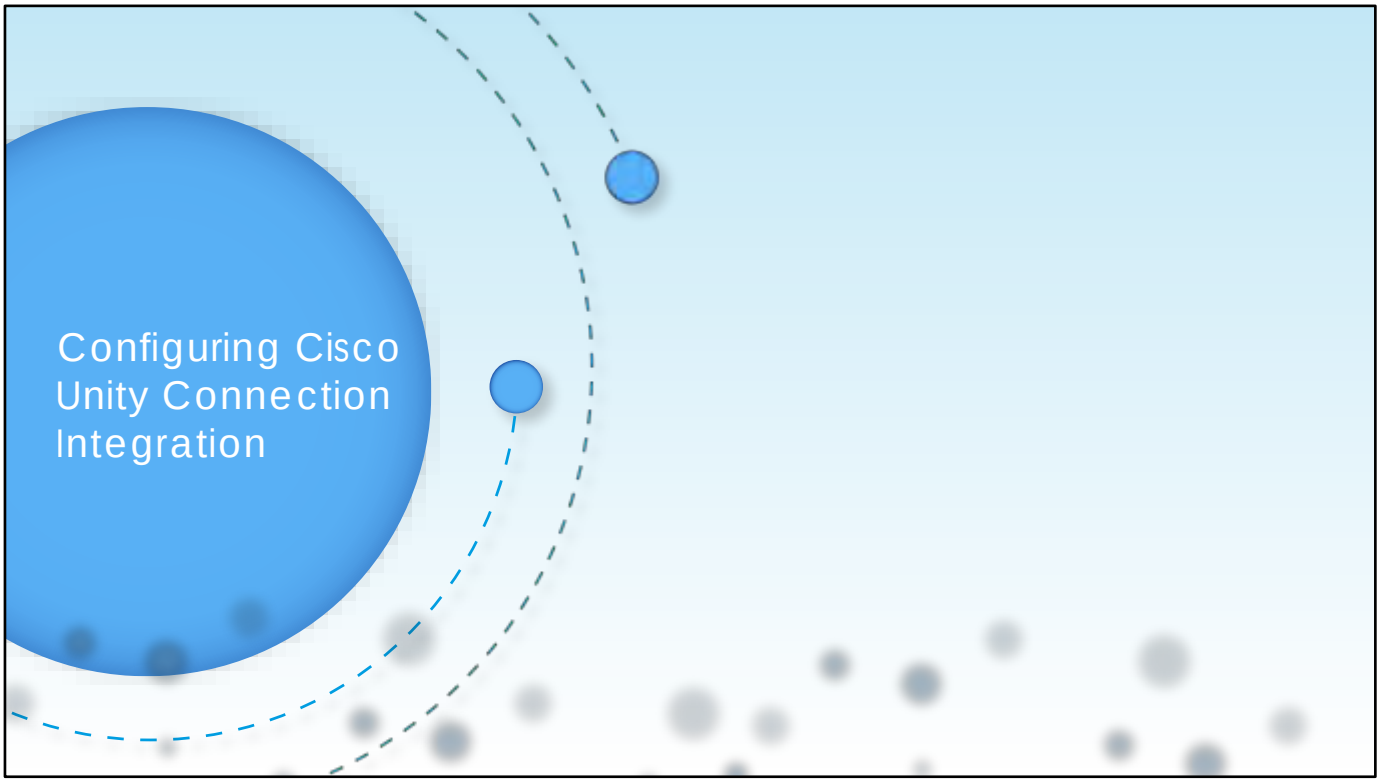


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# Introduction

- Calls to a user extension that does not answer are forwarded to the personal greeting of the user
- Calls to a user extension that is busy are forwarded to the busy greeting of the user
- Cisco Unity Connection receives caller ID information from the phone system (if available)
- A user has easy access to messages by pressing a button on the phone and entering a password
- Cisco Unity Connection identifies the user who leaves a message during a forwarded internal call, based on the extension from which the call originated
- Messages that are left for a user activate the MWI on the extension

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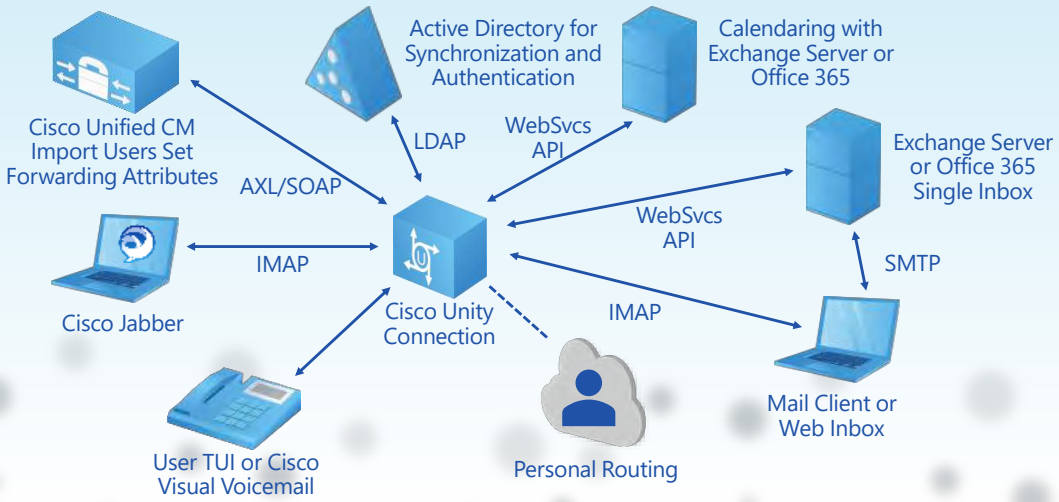
# Overview of Cisco Unity Connection Integration

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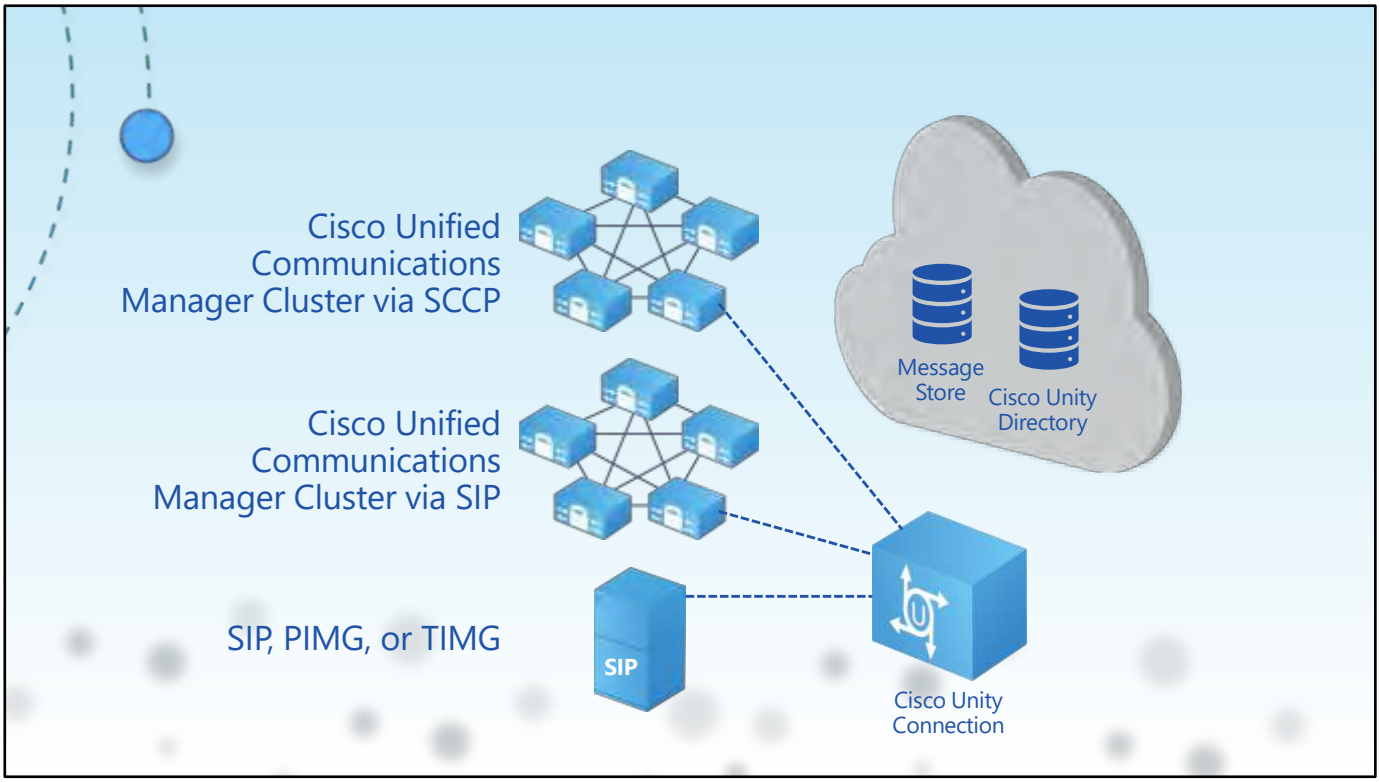


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# SIP Integration

VM Profile

VM Pilot

Route Pattern

SIP Trunk

Phone System

Cisco Unified CM

Port Group

Ports

Port1 Port N

The voicemail pilot and a route pattern are used to call the voice-messaging system
No explicit MWI numbers are required
SIP integration is required for video greetings
SIP integration uses TCP/UDP port 5060 for regular communication and port 5061 for secure communication

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# Typical Integration Mistakes

| Calls to Cisco Unity Connection are failing | Ports are failing to register | MWI problems |
|---|---|---|
| Phone system settings do not match<br>Routing rules are working incorrectly. | Device name prefix issues | MWI is not enabled for voicemail ports<br>Voicemail ports for MWI are too busy<br>Incorrect MWI extensions<br>MWI is disabled for the user<br>Incorrect phone system<br>CSS issues<br>Dial plan overlap |

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- You can experience problems if another port group on the Cisco Unity Connection server or another Cisco Unity Connection server uses the same device name prefix to connect ports to the Cisco Unified Communications Manager server.
- You may find that Cisco Unity Connection voice messaging ports do not register with Cisco Unified Communications Manager in an SCCP integration.
- Another possible issue is that the Cisco Unity Connection ports repeatedly disconnect from Cisco Unified CM in an SCCP integration.
- The MWI is a lamp, flashing LCD panel, or special dial tone on user phones that lets users know that a voice message is waiting. The type of indicator depends on the phone system and the user phones. When a message for a user arrives on the Cisco Unity Connection message store, Cisco Unity Connection notifies the phone system to turn on an MWI on the phone for that user.
- If there are integration problems with the phone system, your MWI might exhibit these problems:

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**MWI does not turn on or off**: Typical reasons for this problem are as follows:

There are no voice messaging ports for the phone system integration that are assigned to send MWI requests.

Voice messaging ports that are assigned to send MWI requests are not enabled.

An inadequate number of voice messaging ports for the phone system integration are assigned to send MWI requests. The ports may be too busy to dial out immediately to turn MWIs on and off.

Port groups for the phone system integration disable MWIs.

(For SCCP integrations only) The MWI On Extension field and the MWI Off Extension field settings are incorrect.

MWIs for the phone system are forced off. This situation occurs when the Force All MWIs Off for This Phone System check box is checked.

MWI is disabled for the user.

An incorrect phone system is assigned to the MWI for the user.

(For SCCP integrations only) The extensions that turn MWIs on and off are not in the CSS that contains the phones and voicemail ports.

(For SCCP integrations only) The dial plan overlaps the MWI extensions.

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- **MWIs turn on but do not turn off:** This problem applies to PIMG and TIMG integration and the cause may be port memory. For Avaya, Rolm, and Siemens Hicom phone system integrations, Cisco Unity Connection must use the same port to turn off an MWI that was used to turn on the MWI. When Cisco Unity Connection is integrated with one of these phone systems and uses a different port to turn off an MWI, the MWI request to turn off the MWI fails.
- **Delay for MWIs to turn on or off:** If MWIs are being synchronized for a phone system integration, this synchronization may result in delayed MWIs for messages. This situation is due to the additional MWI requests that are being processed. Another reason for this problem could be an insufficient number of ports that are assigned to process MWI requests.

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# Integration Considerations

| MWI | Class of service | Security |
|---|---|---|
| This extension that is configured in Cisco Unity Connection can be four digits or +E.164 and should equal the dialed number in Cisco UCM. The MWI is sent only to the configured extension in Cisco Unity Connection, not to alternate extensions. | The CSS on the voicemail pots or SIP trunk should be restricted. The restriction can be combined with restriction tables on Cisco Unity Connection | Harden the PINs and use the lockout mechanism. When authentication is used, the LDAP security policies are applied. |

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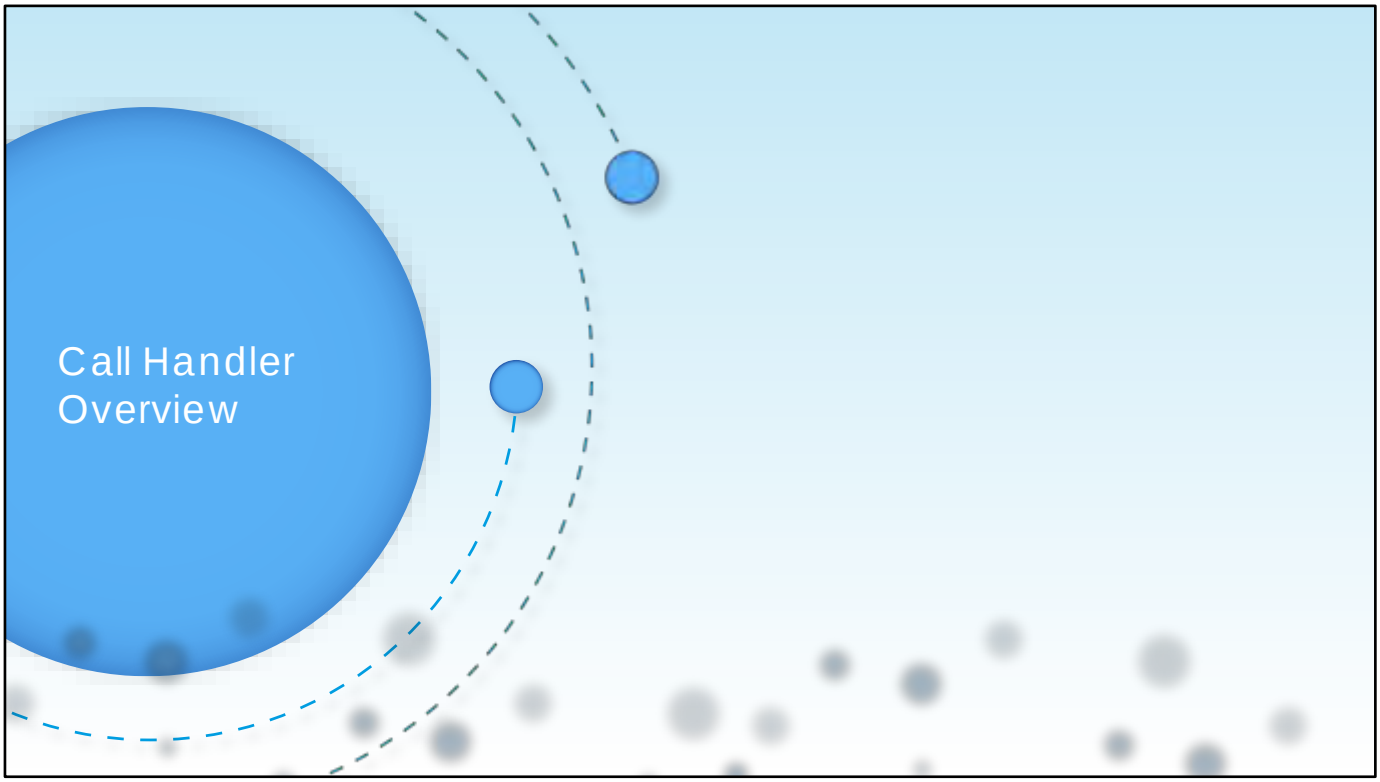


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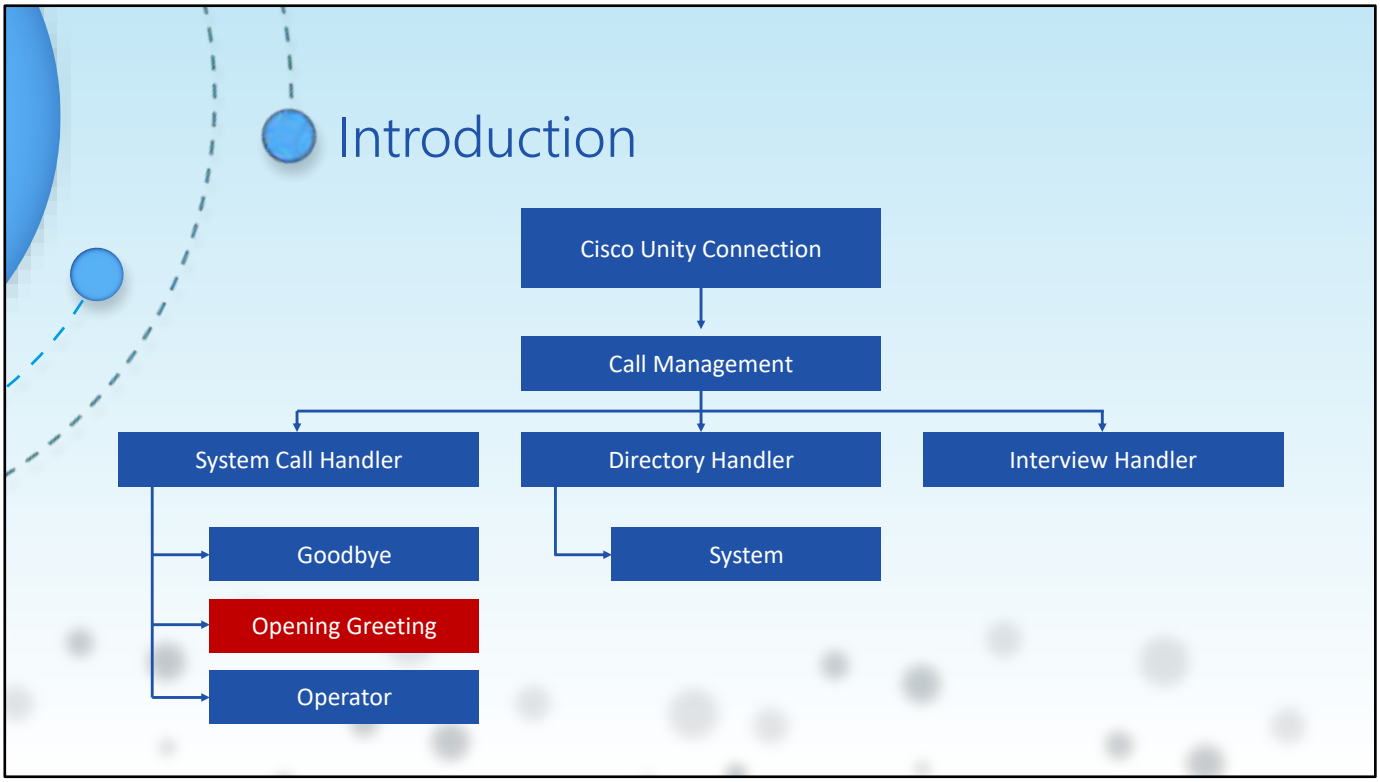


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# Call Handler Comparison

| Options | System Call Handler | Directory Handler | Interview Handler |
|---|---|---|---|
| Call handler templates | Yes | | |
| Transfer rules | Yes | | |
| Caller input | Yes | Limited | |
| Greeting management | Yes | Limited | |
| Postgreeting recording | Yes | | |
| After message or interview action | Yes | | Yes |
| Interview questions | | | Yes |
| Call handler owners | Yes | | |

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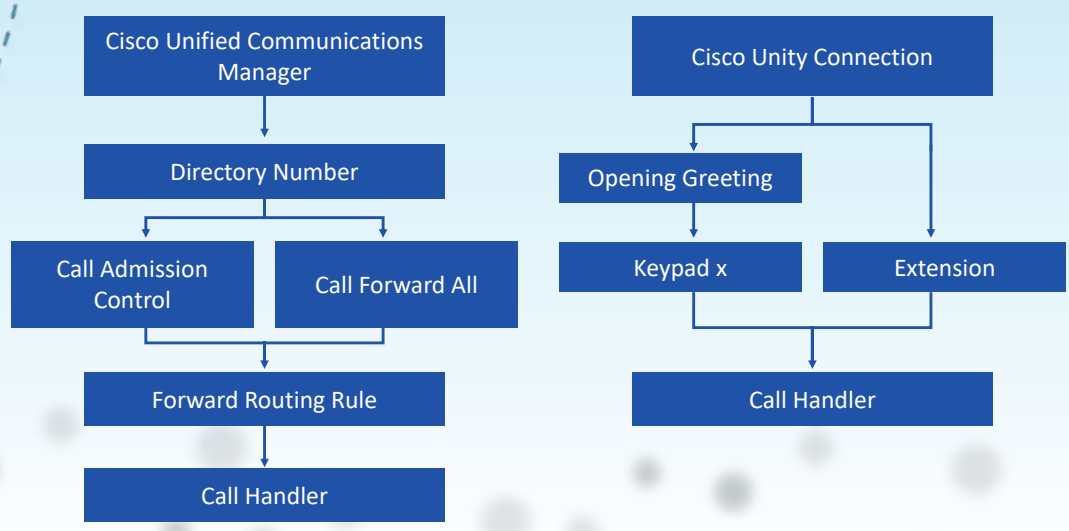
# Call Handler Reachability

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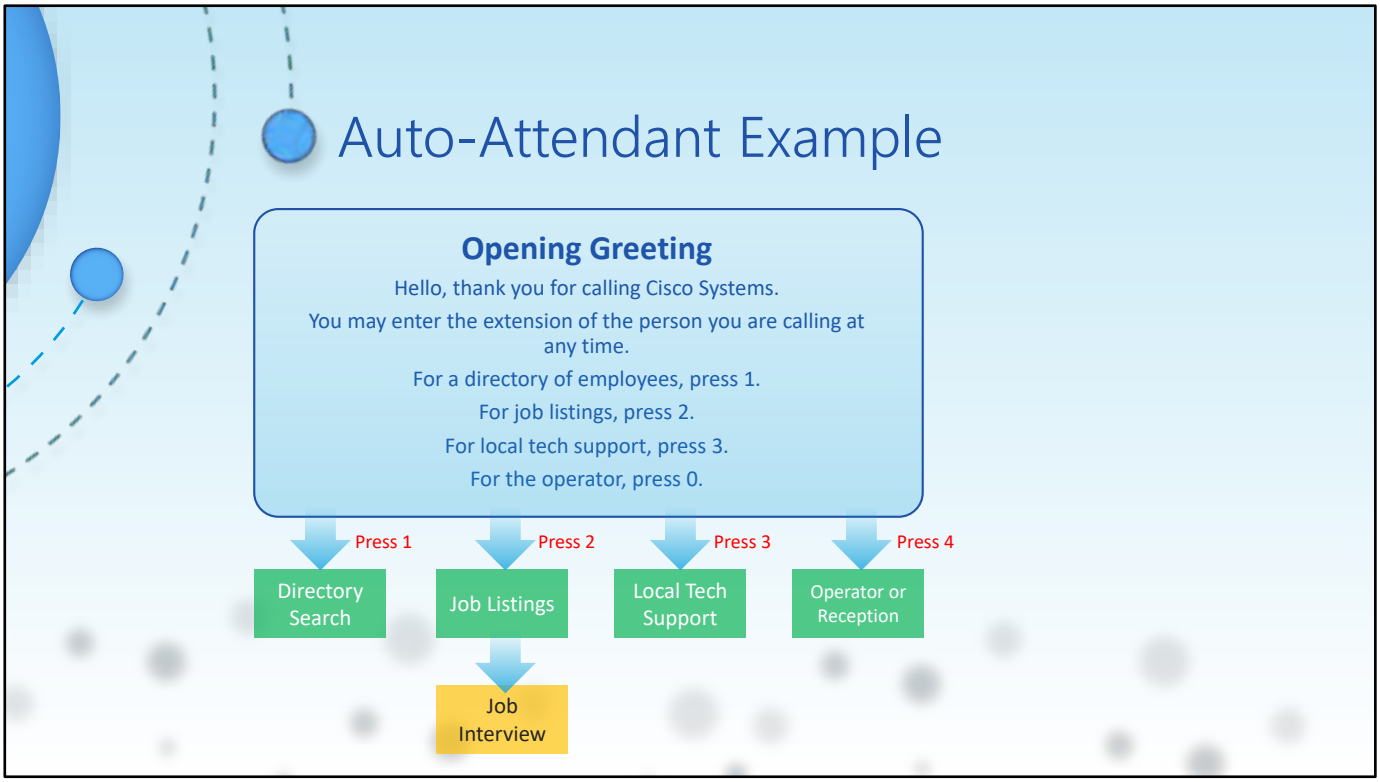


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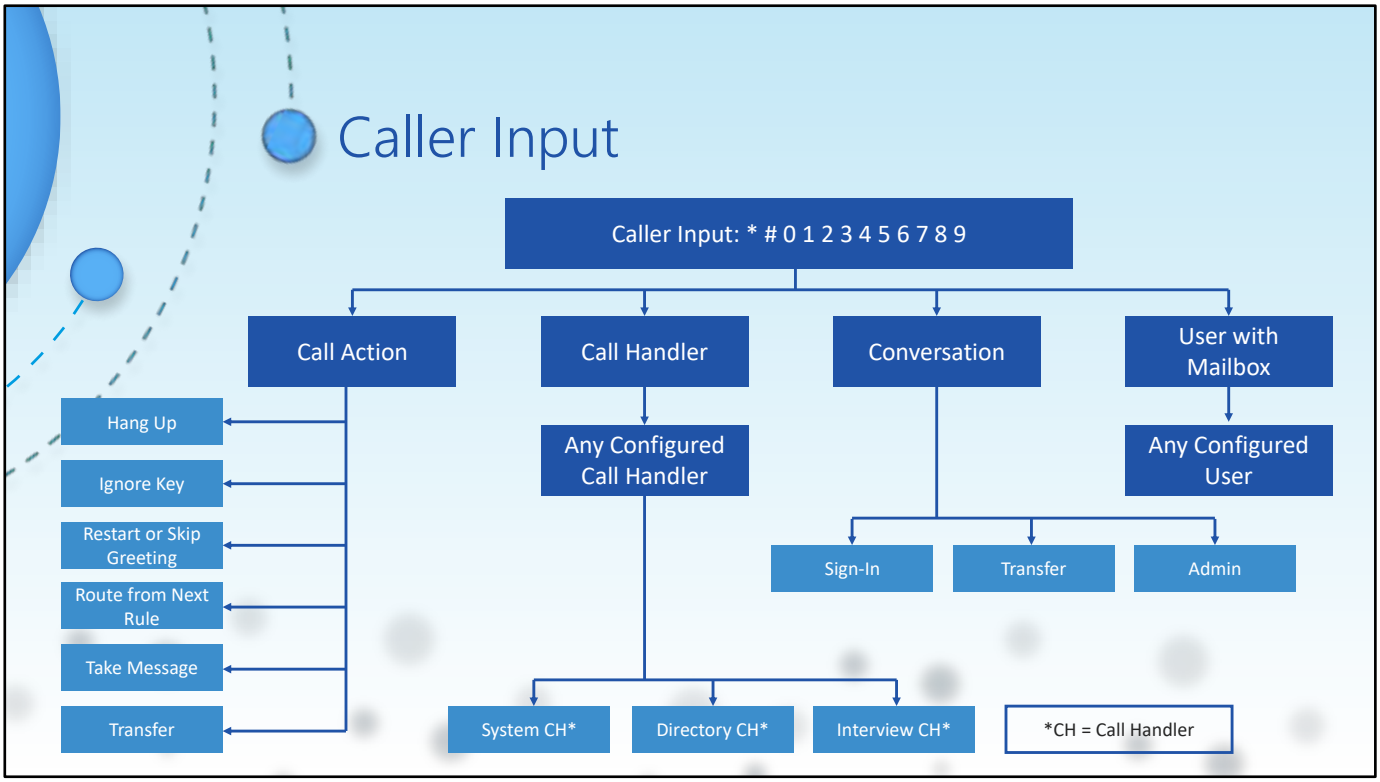


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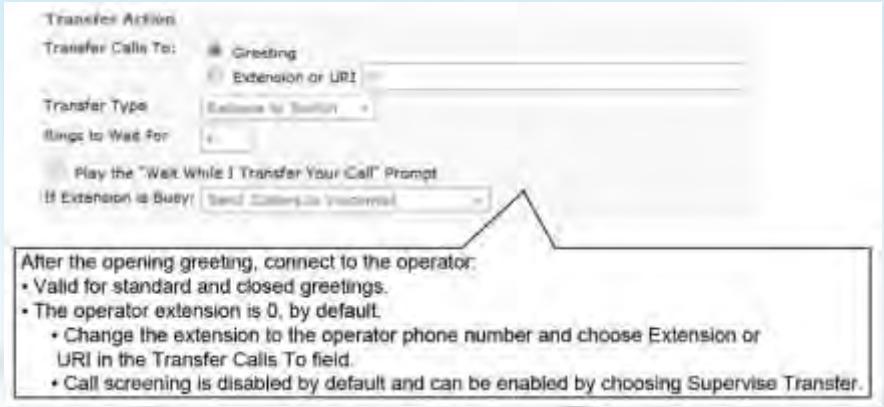
# Operator Call Handler

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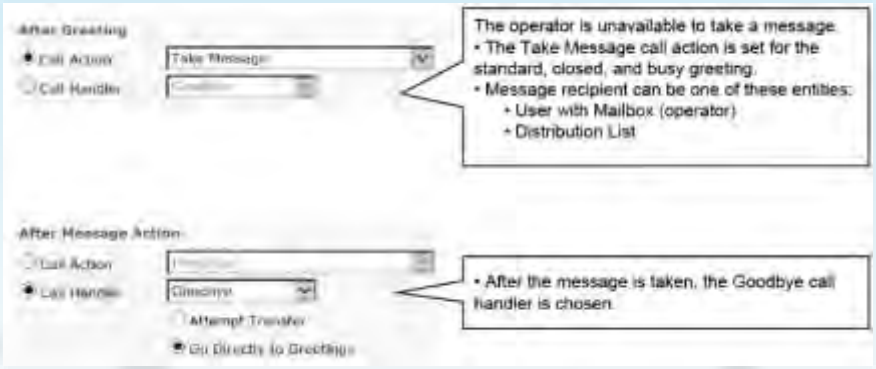
# Operator Not Available

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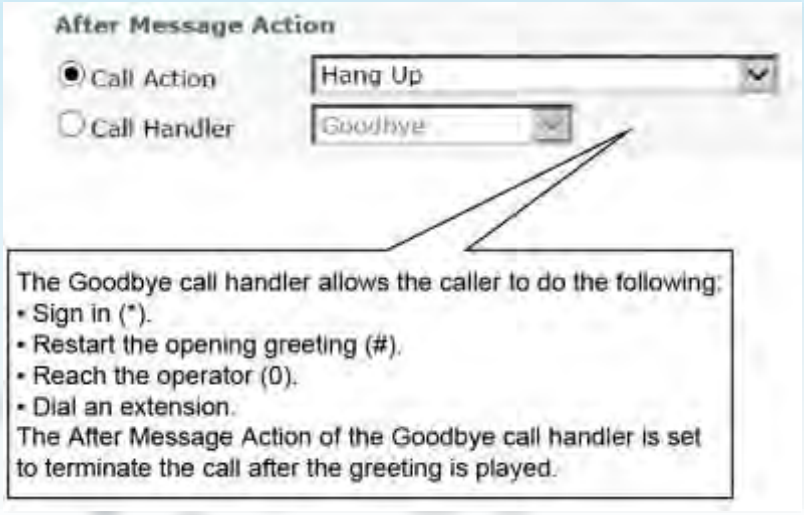
# Goodbye Call Handler

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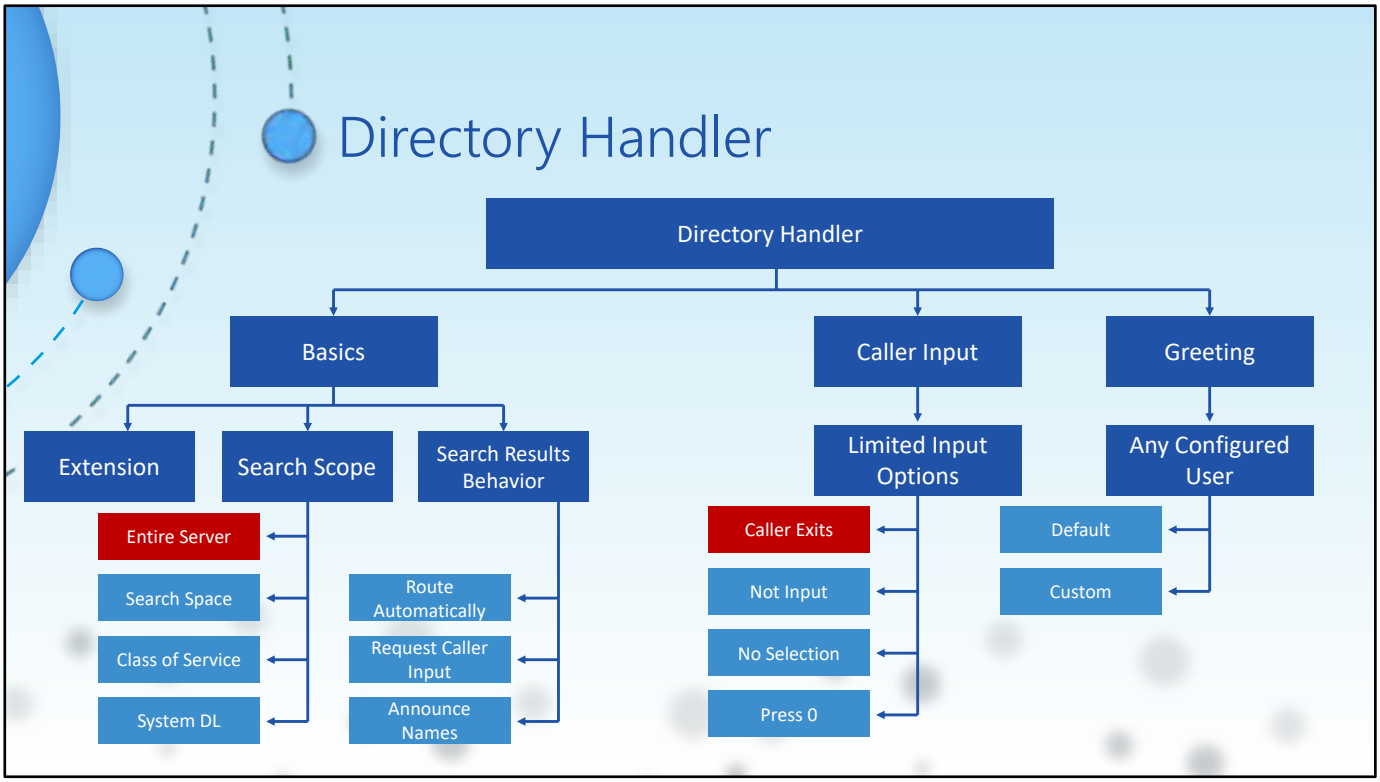


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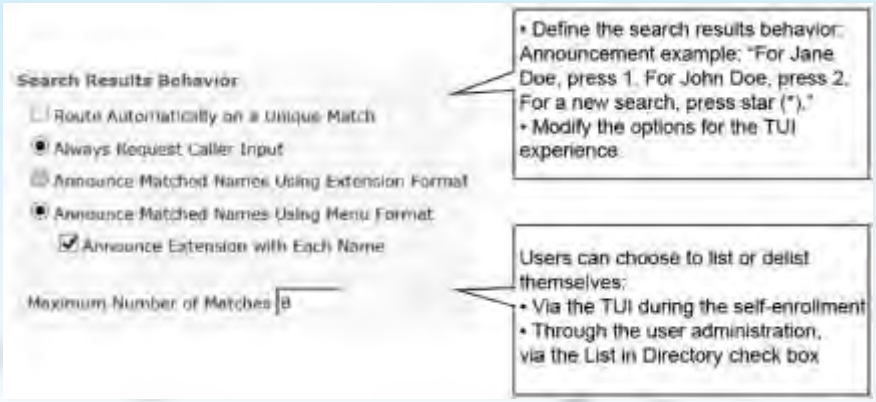
# Search Results Behavior

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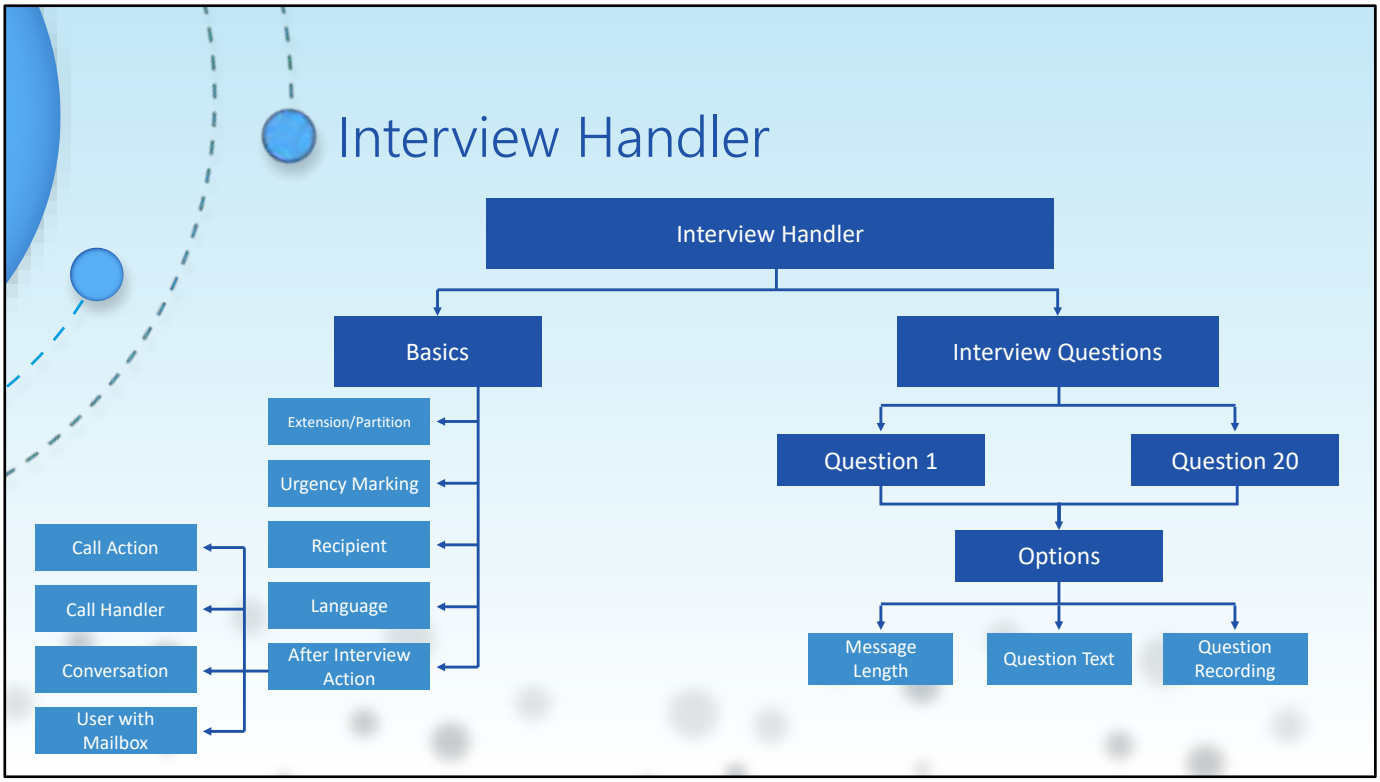


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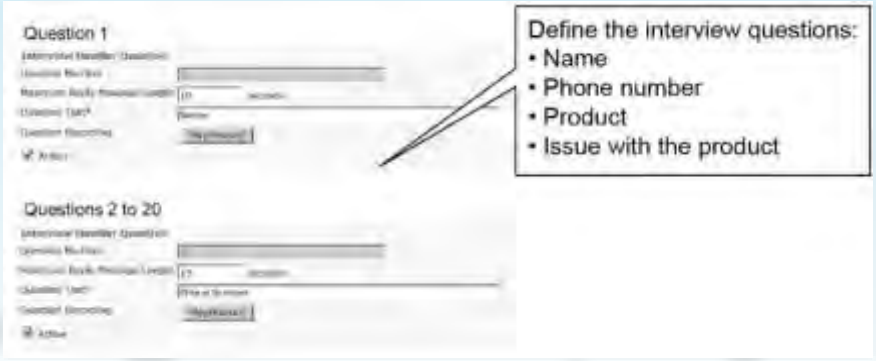
# Product Line Use Case Example

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# Conclusions

**Call handler overview**

- Reachability and comparison

**System call handler**

**Caller input**

**Operator call handler**

- Not available

**Goodbye call handler**

**Interview handler**

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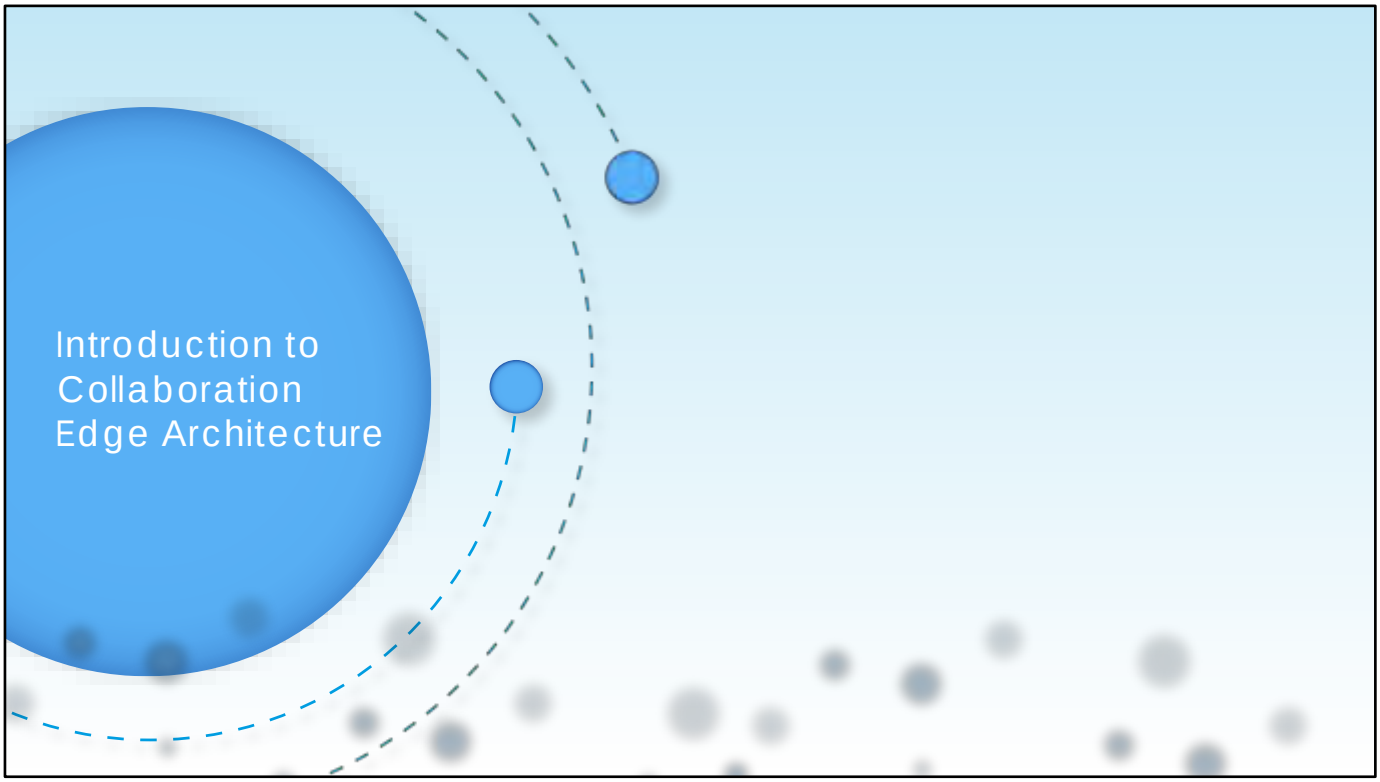


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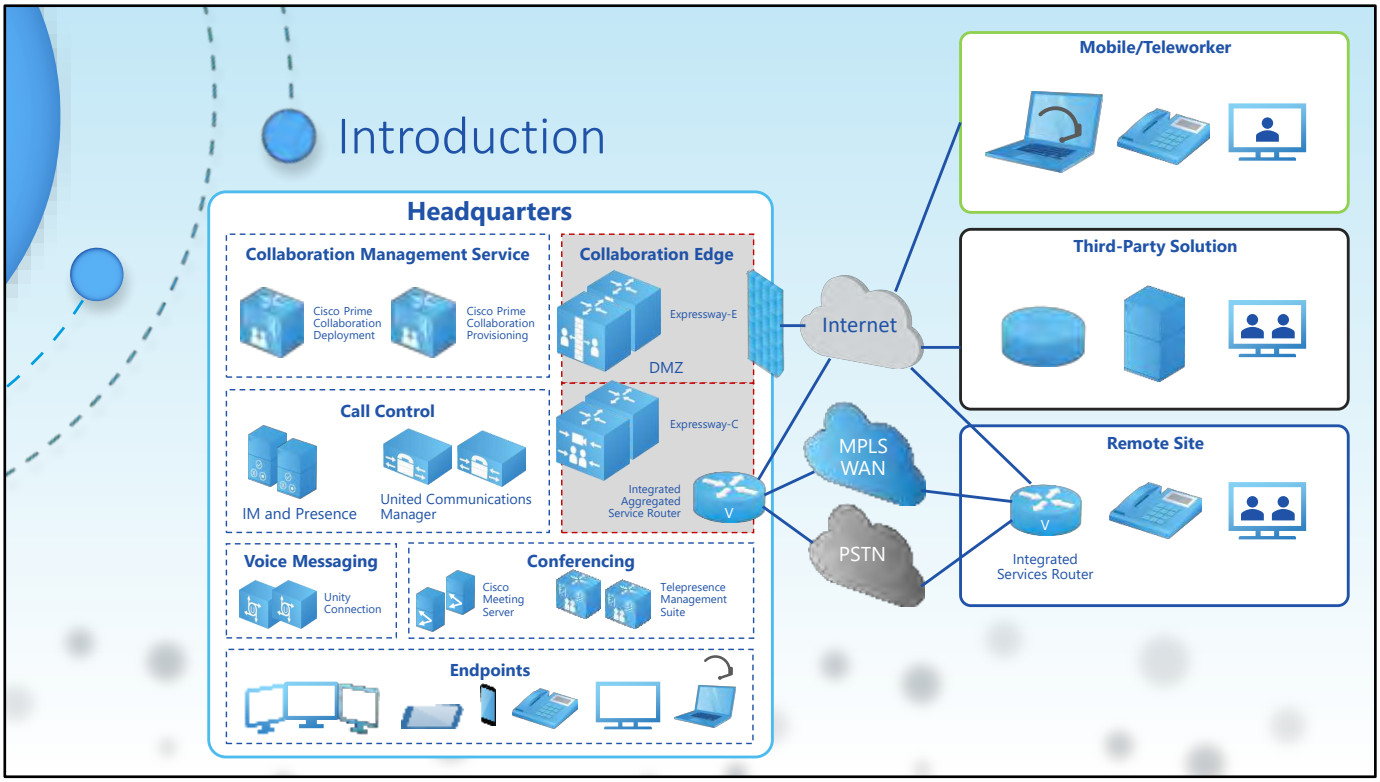


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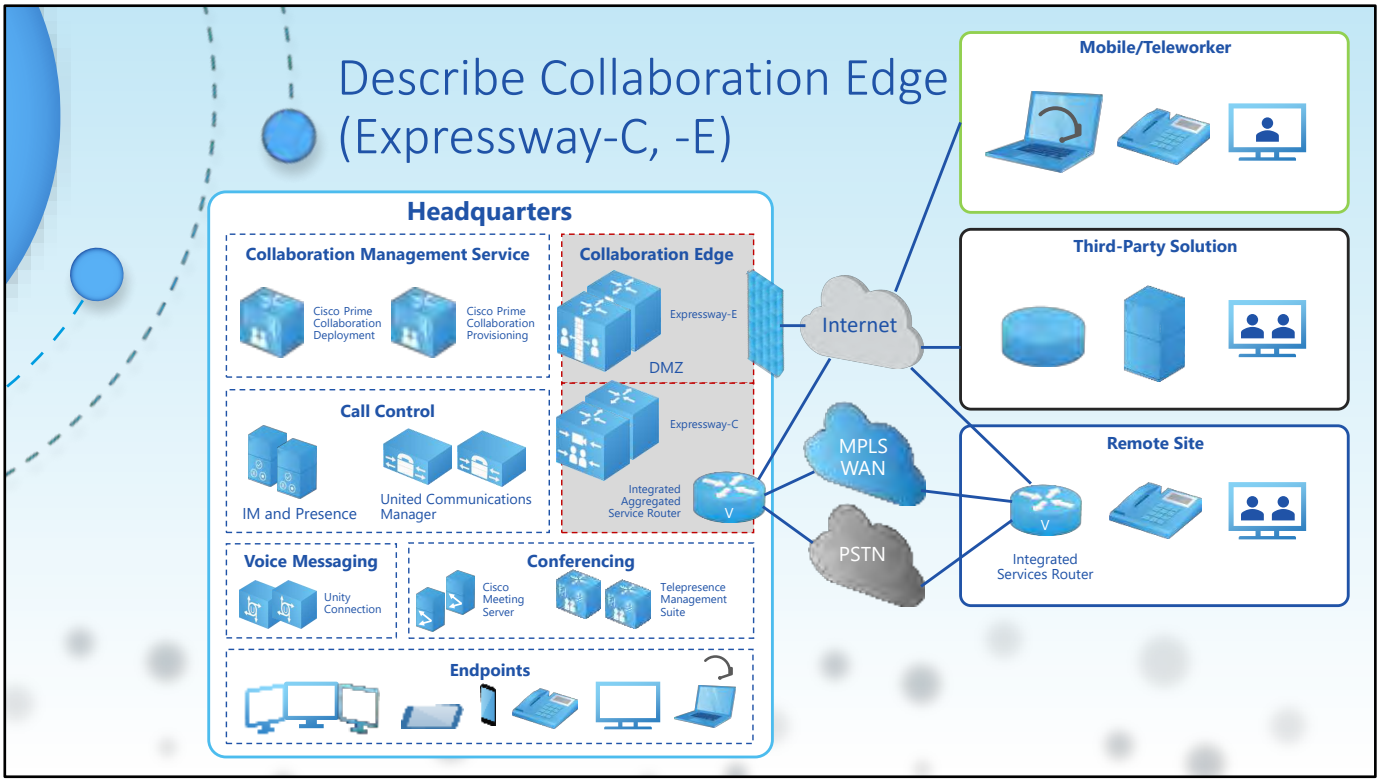


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# Introduction

| Module | Component | Description |
|---|---|---|
| Collaboration Edge | Expressway-E (Edge) | The Traversal server that enables secure VPN-less mobile and remote access for TelePresence endpoints and Jabber clients. The traversal server resides in the DMZ. The solution also provides business–to–business calling, protocol interworking, and cloud connectivity. |
| | Expressway-C (Core) | The traversal client that creates a secure, trusted connection through the firewall to Expressway-E. The traversal client resides inside the organization's network. The solution provides mobile and remote access, business-to-business calling, protocol interworking, and cloud connectivity. |
| | Cisco Integrated Services Router (ISR) or Aggregation Services Router (ASR) with PSTN interfaces | Enables local PSTN connectivity |
| | Cisco ISR or ASR with Cisco Unified Border Element (CUBE) software | Enables connectivity from an organization's network to the service provider network for Session Information Protocol (SIP) trunks via CUBE |

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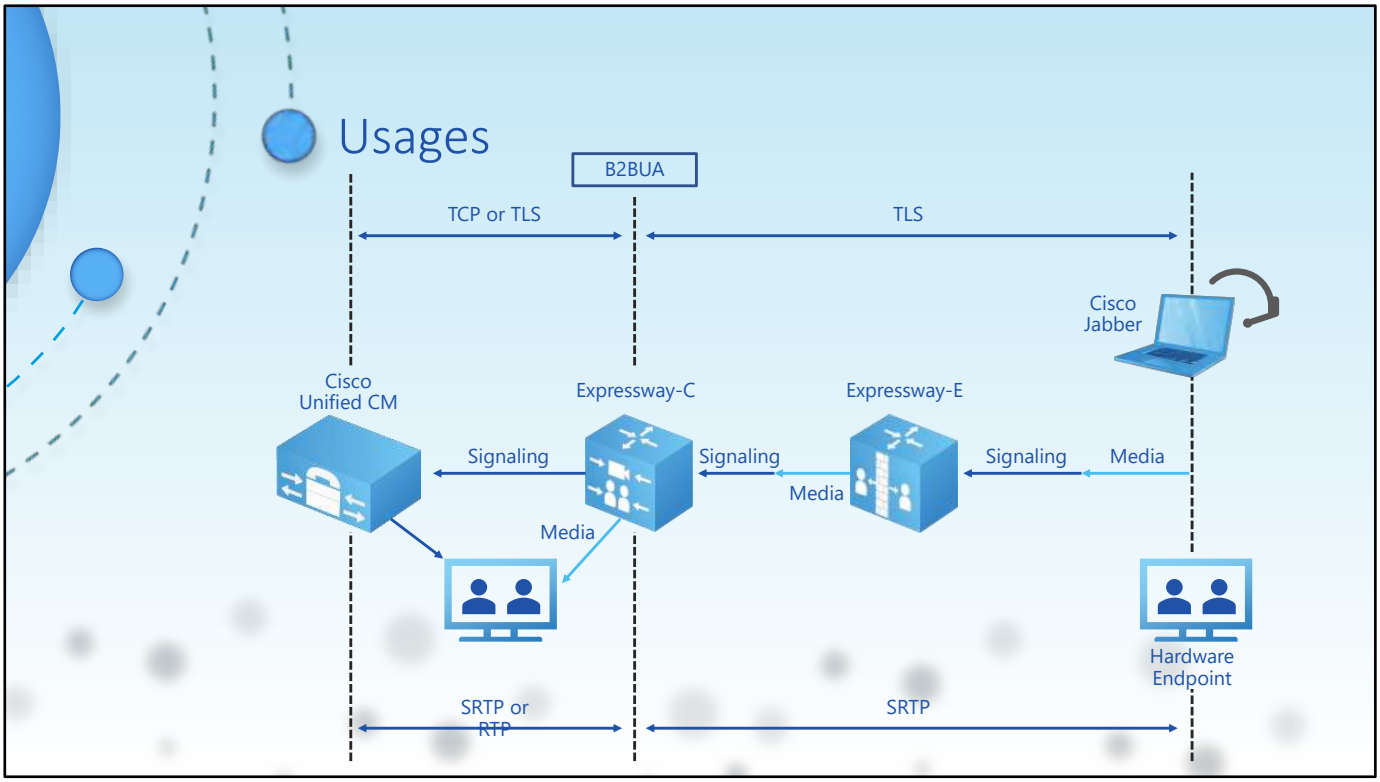


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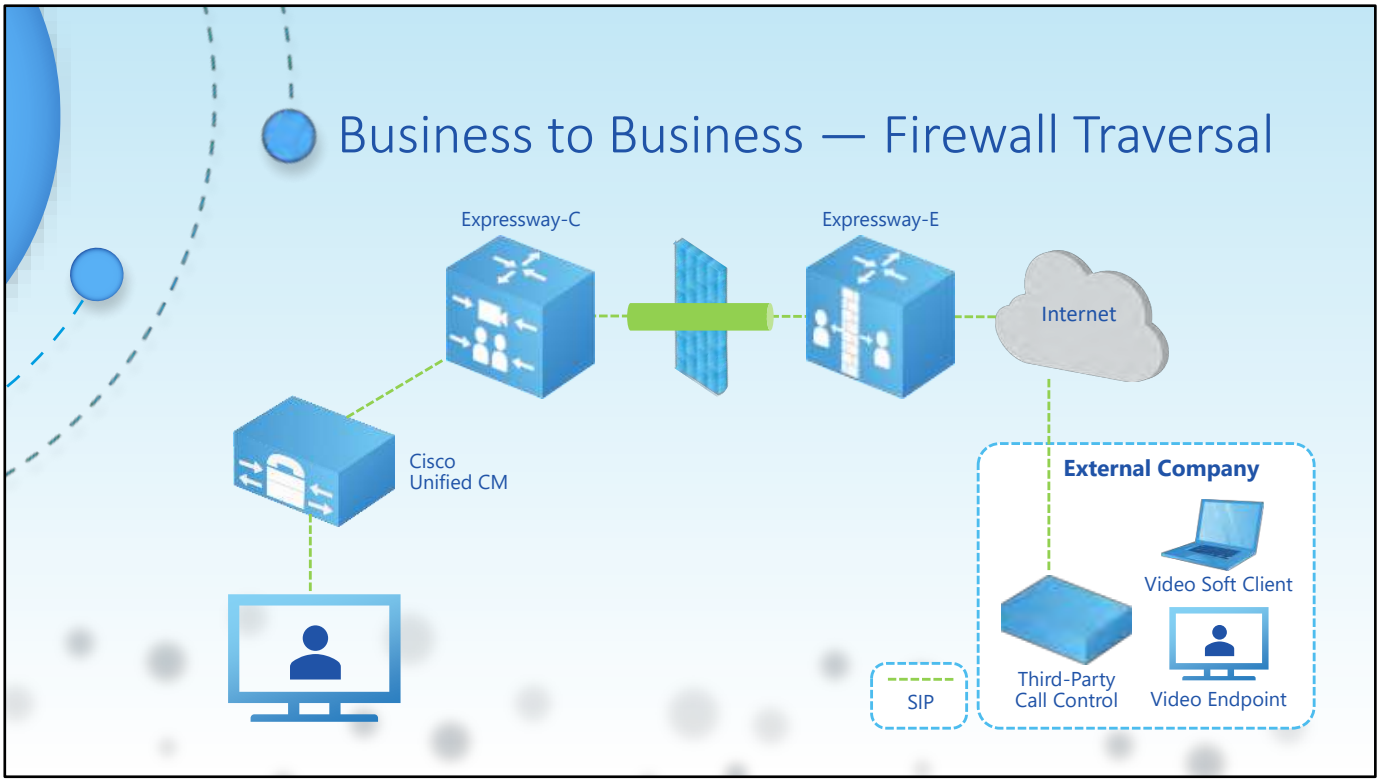


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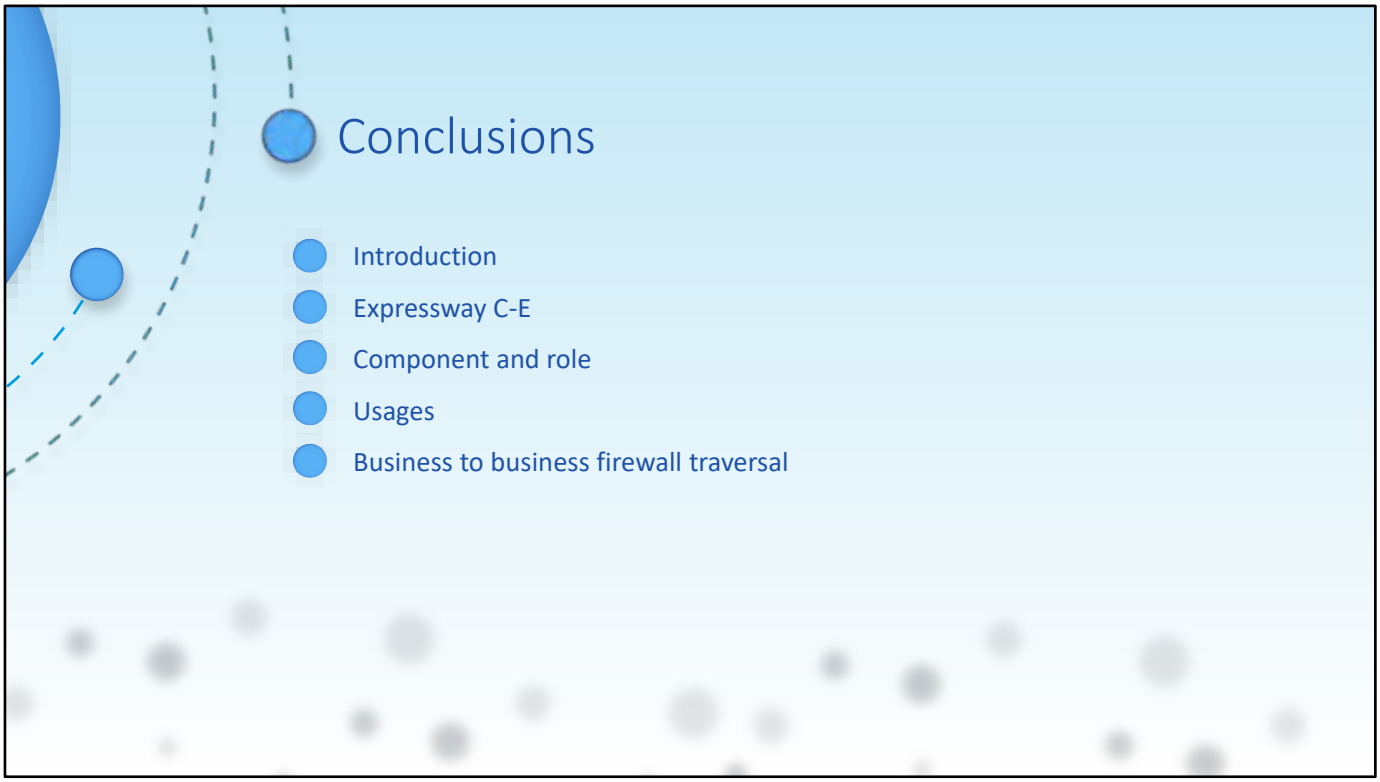


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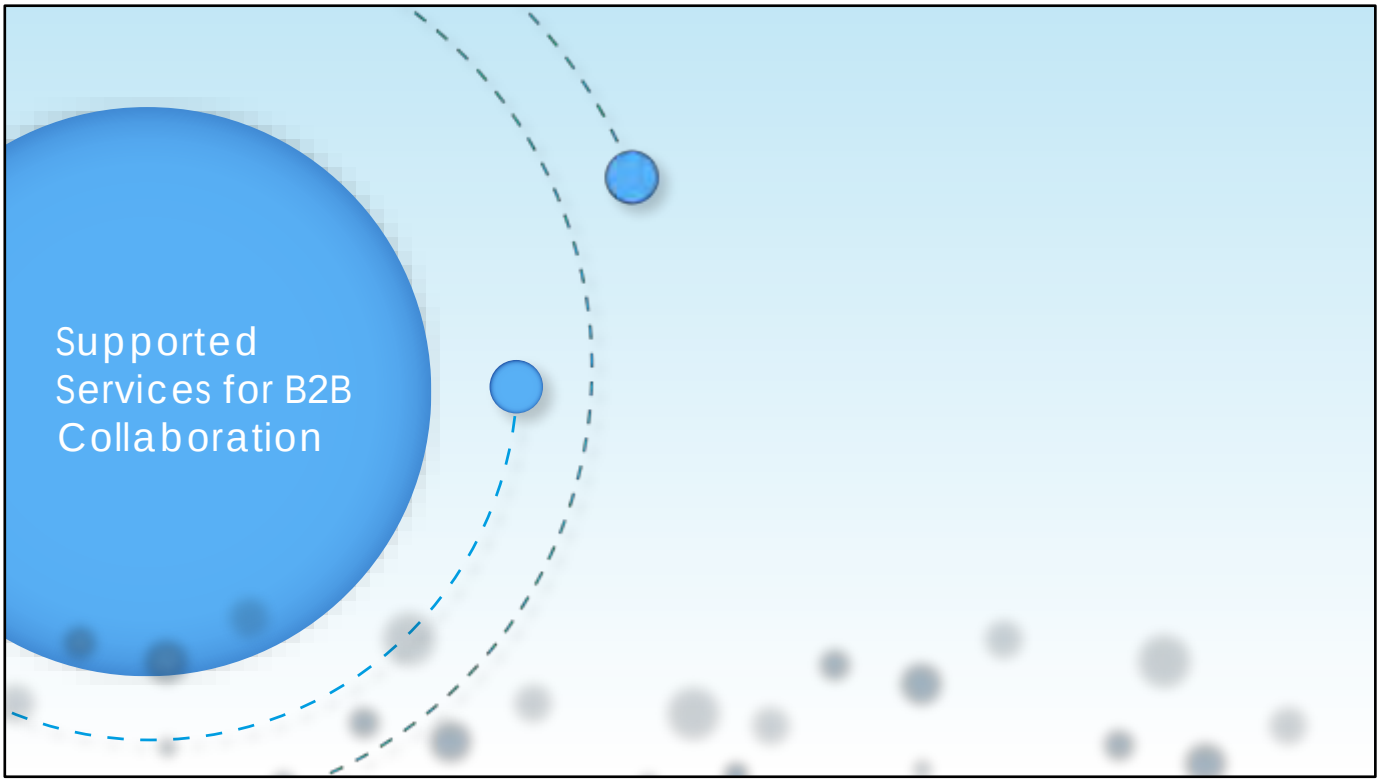


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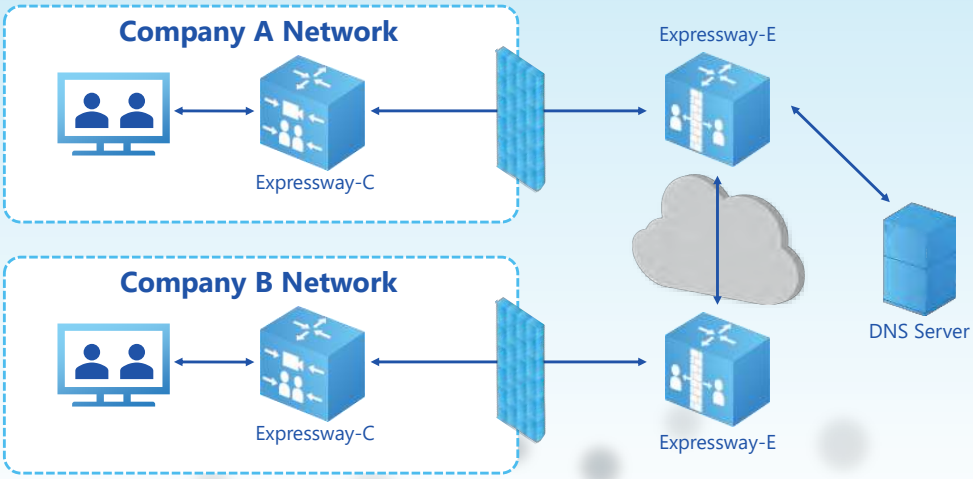
# Describe Supported Services for B2B Collaboration

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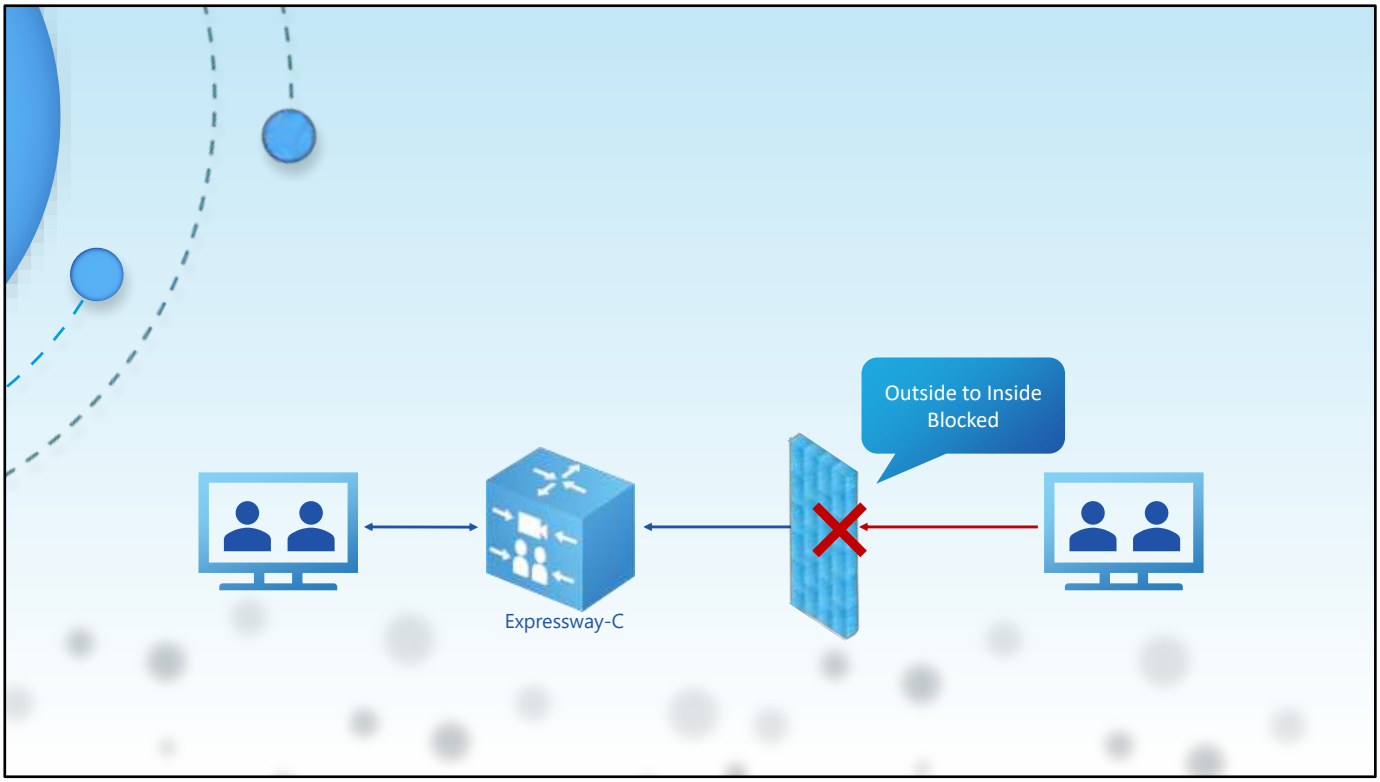


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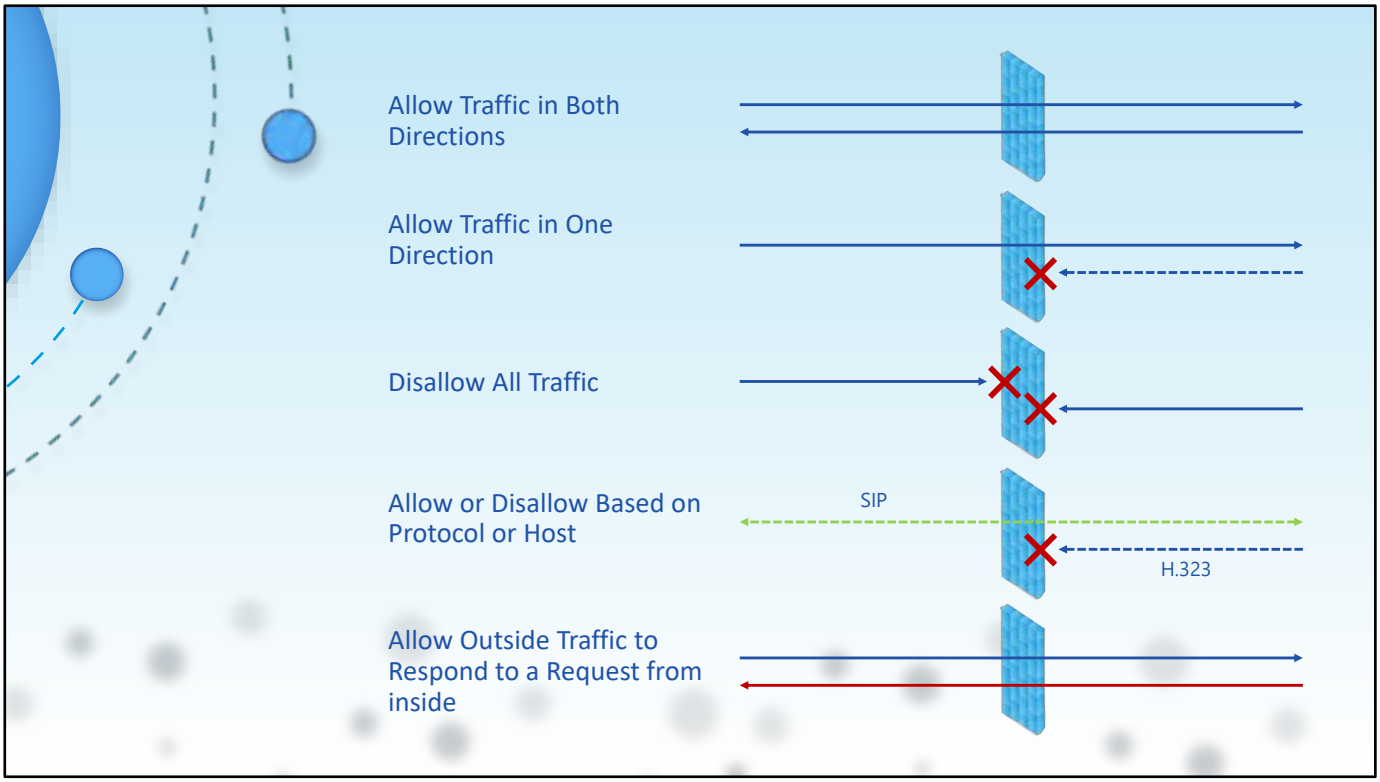


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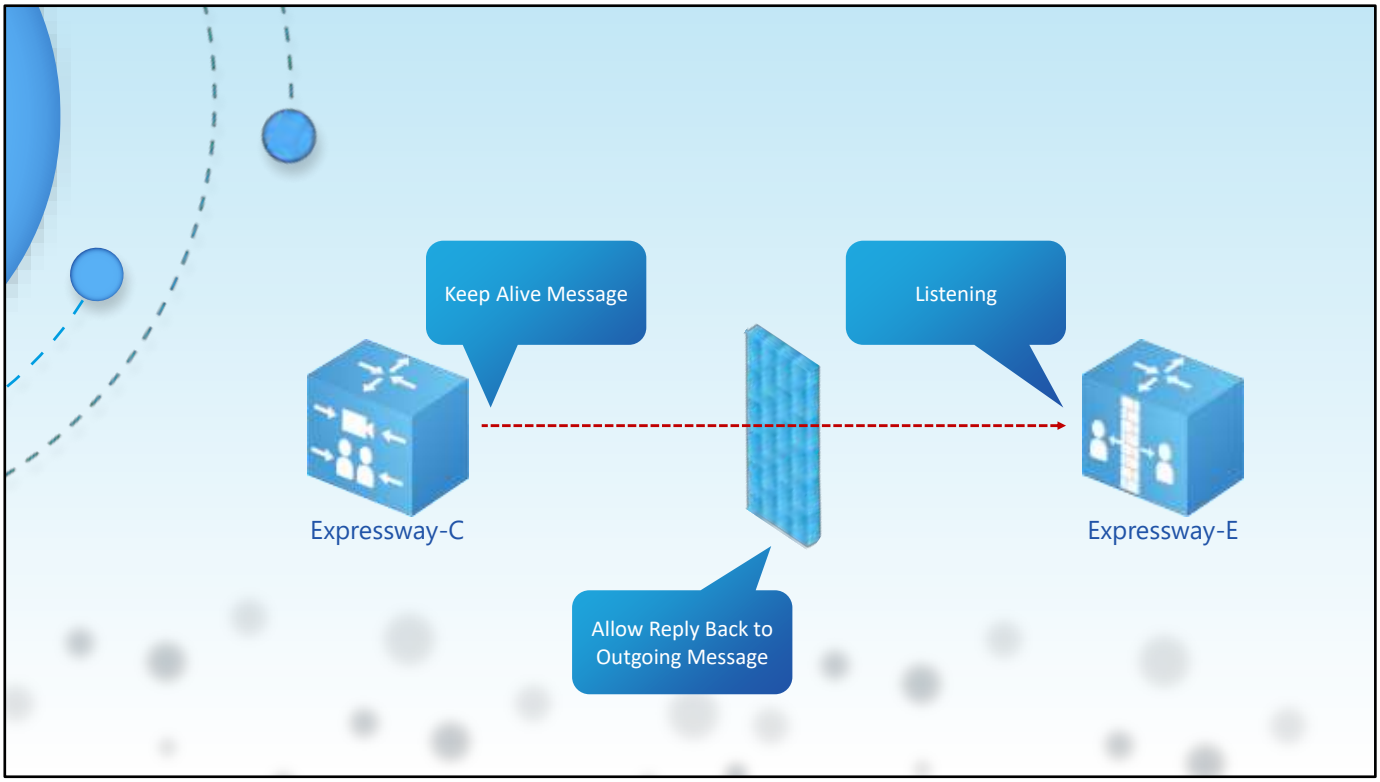


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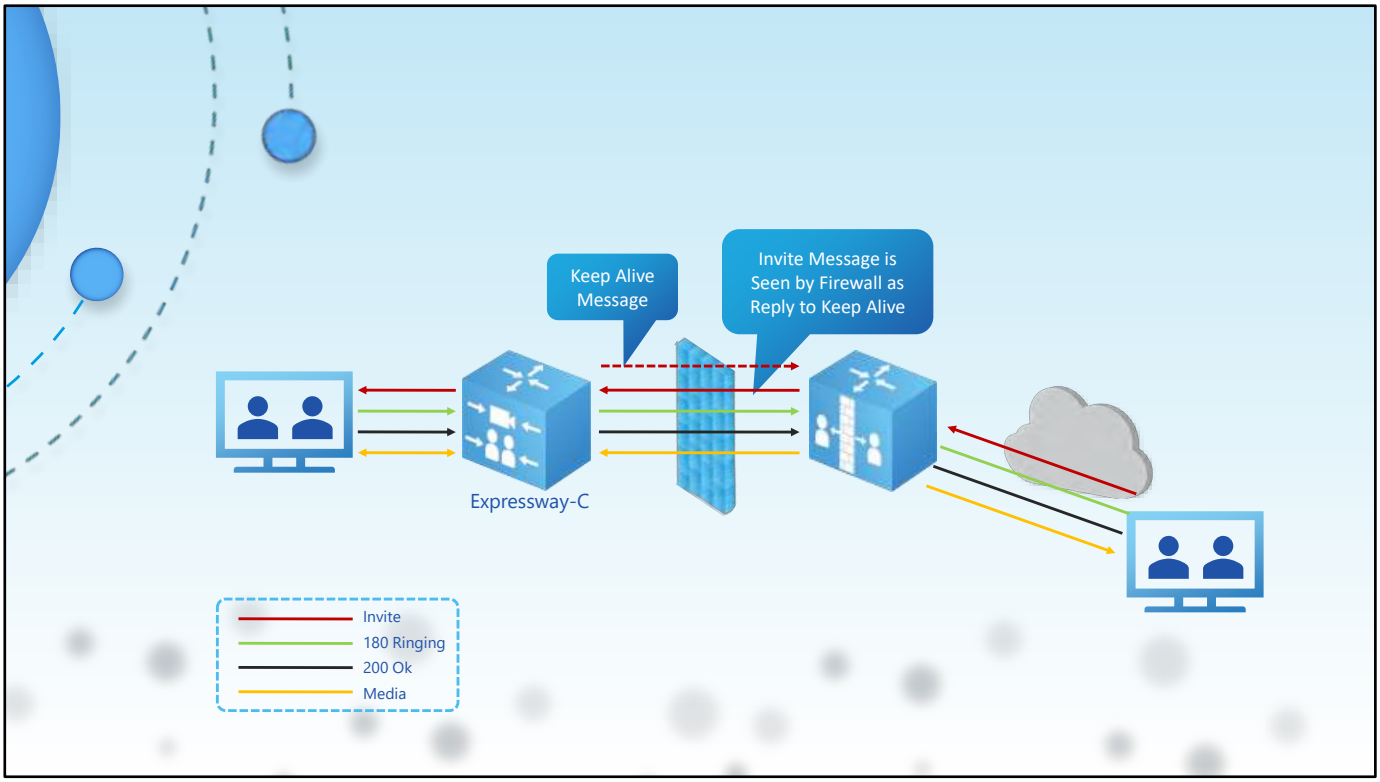


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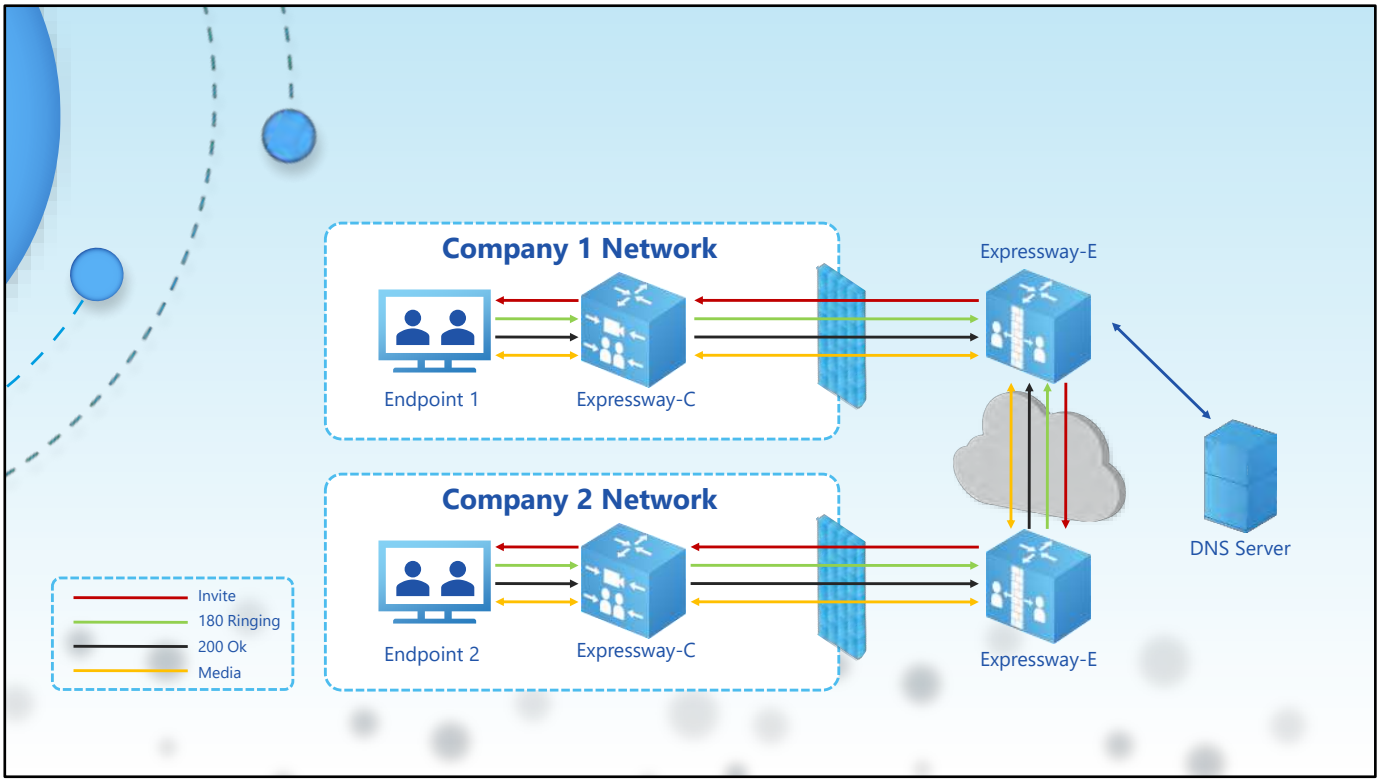


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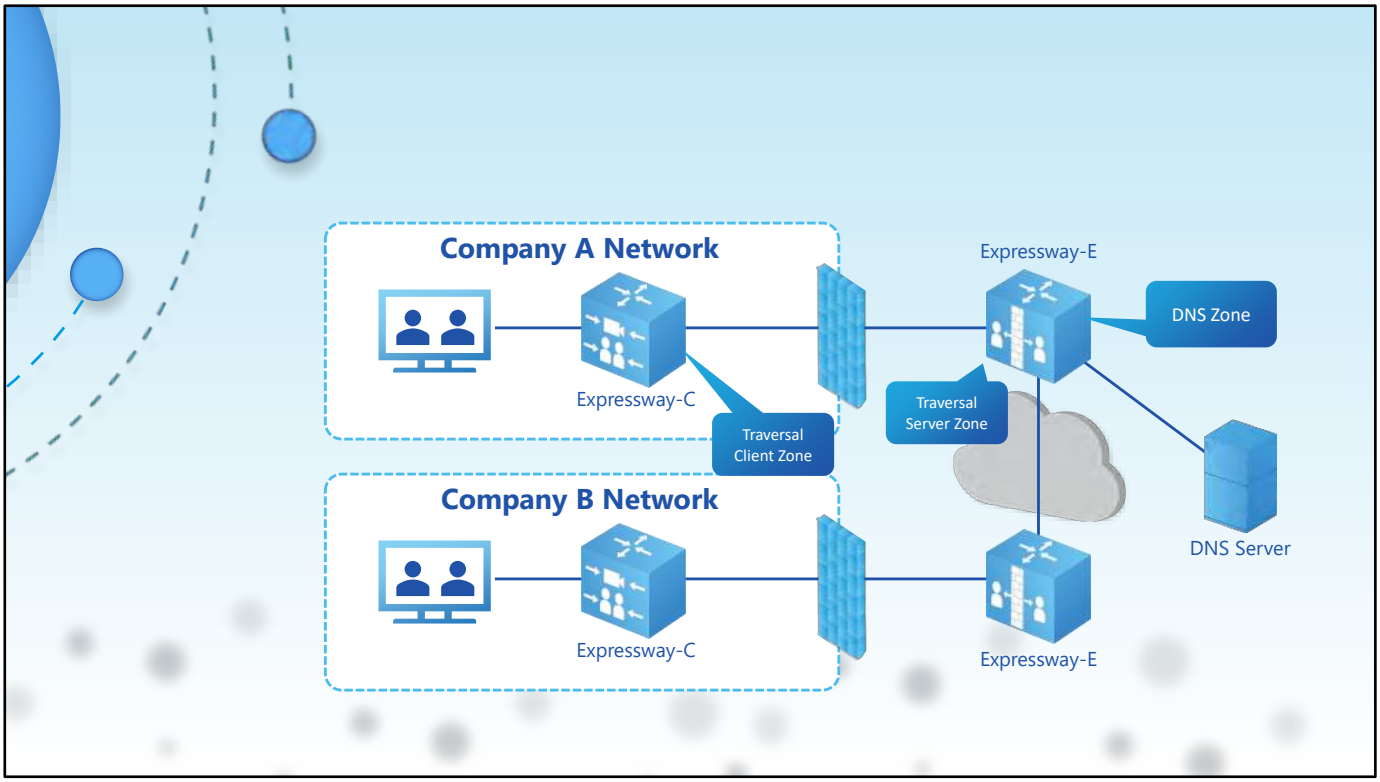


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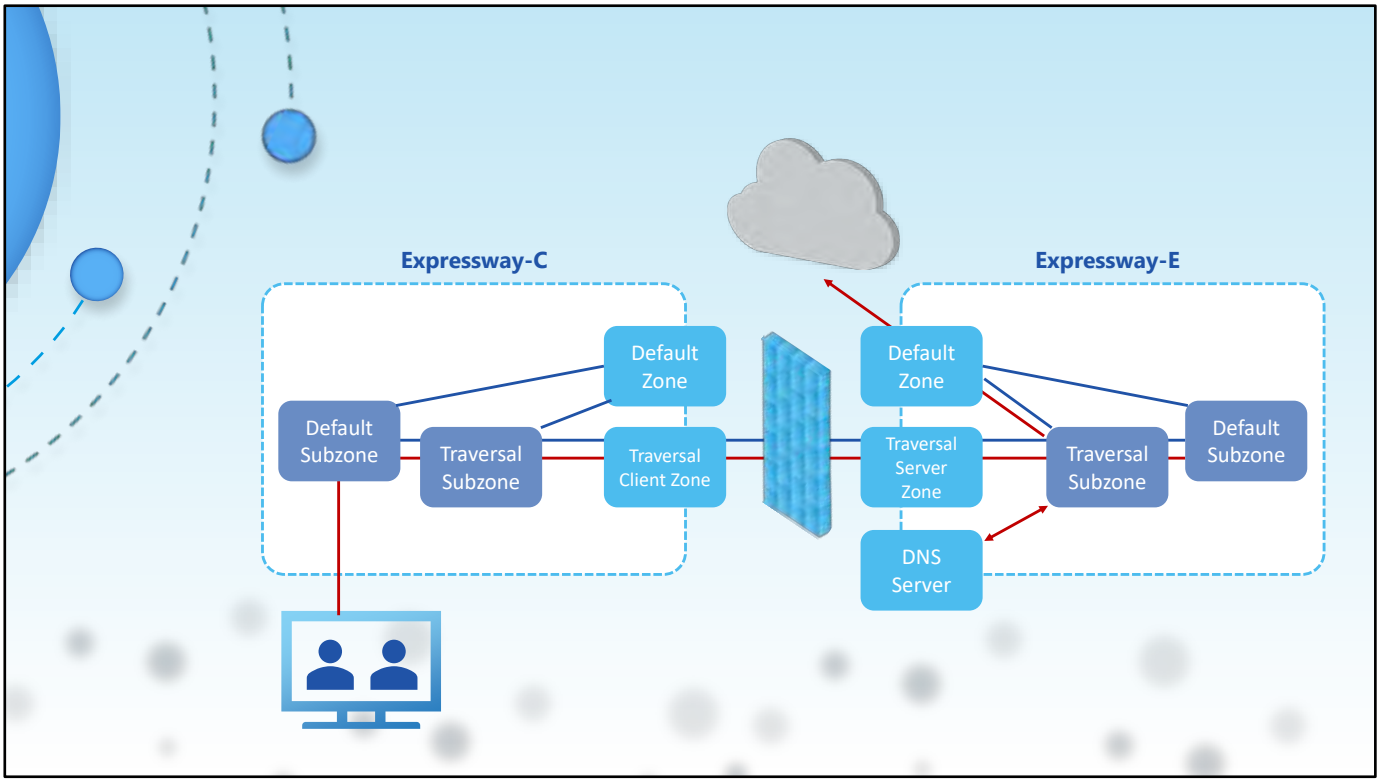


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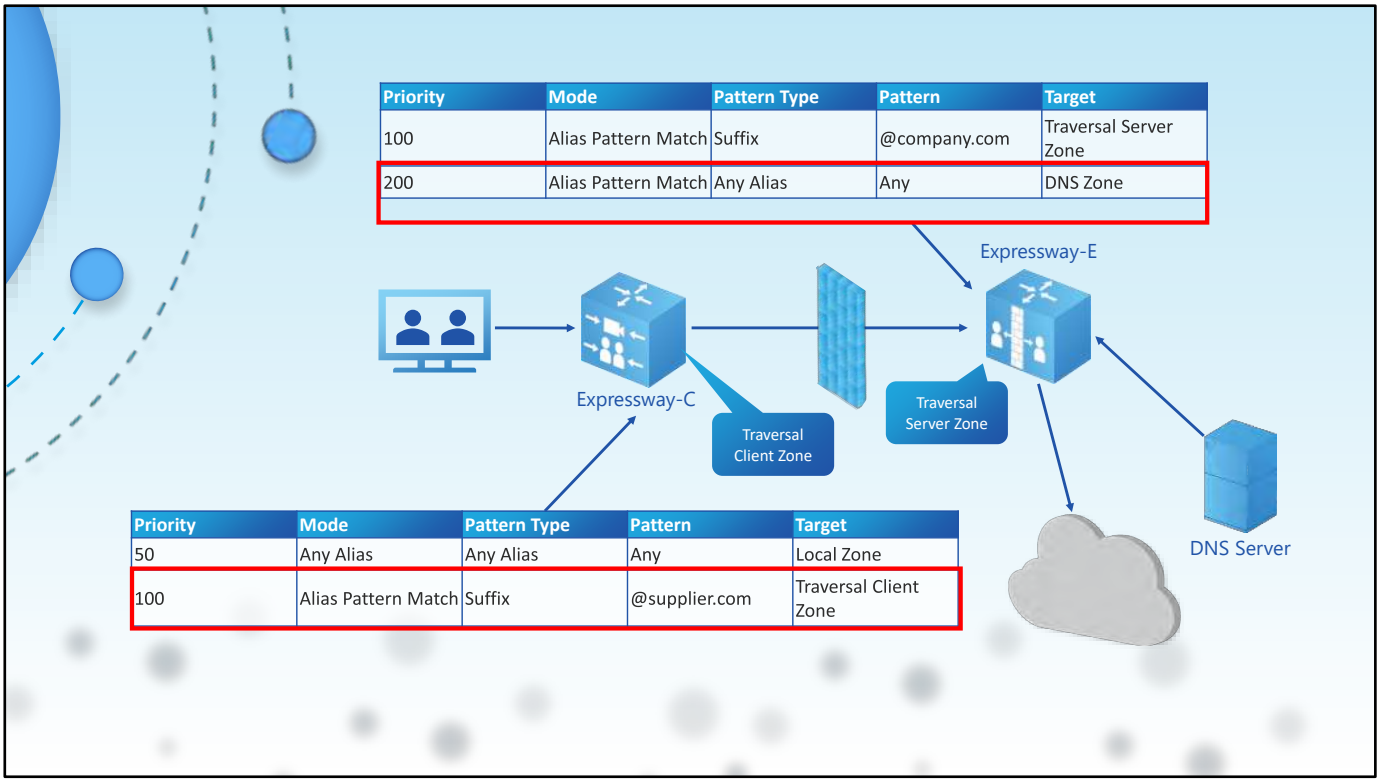


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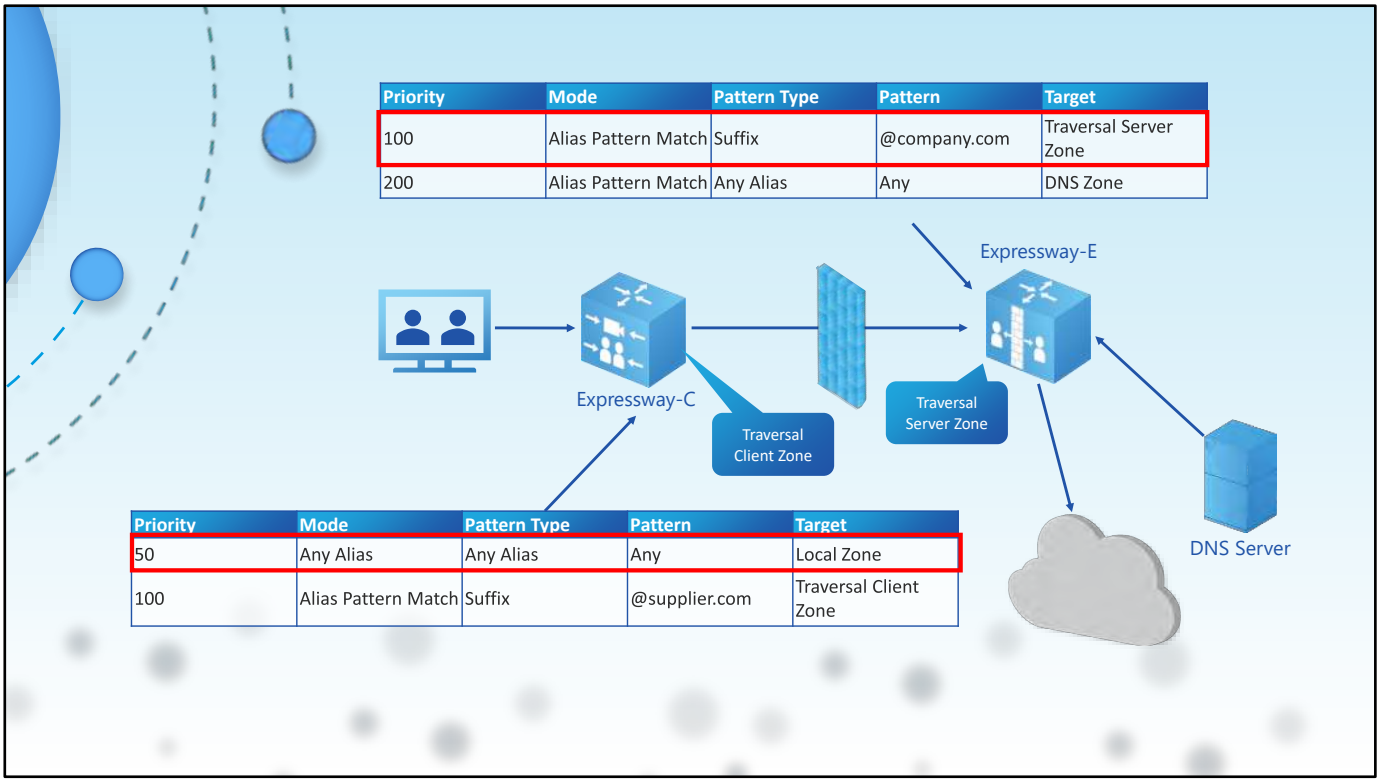


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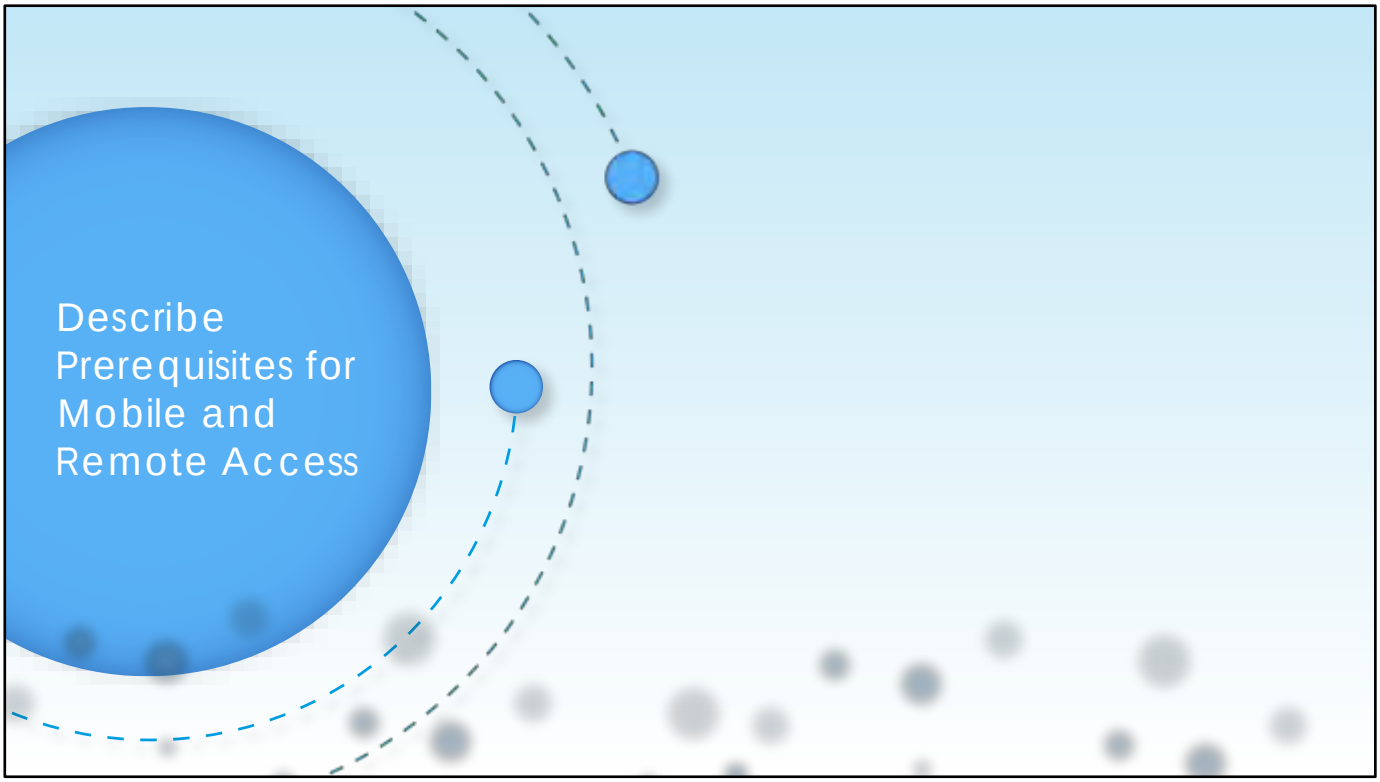


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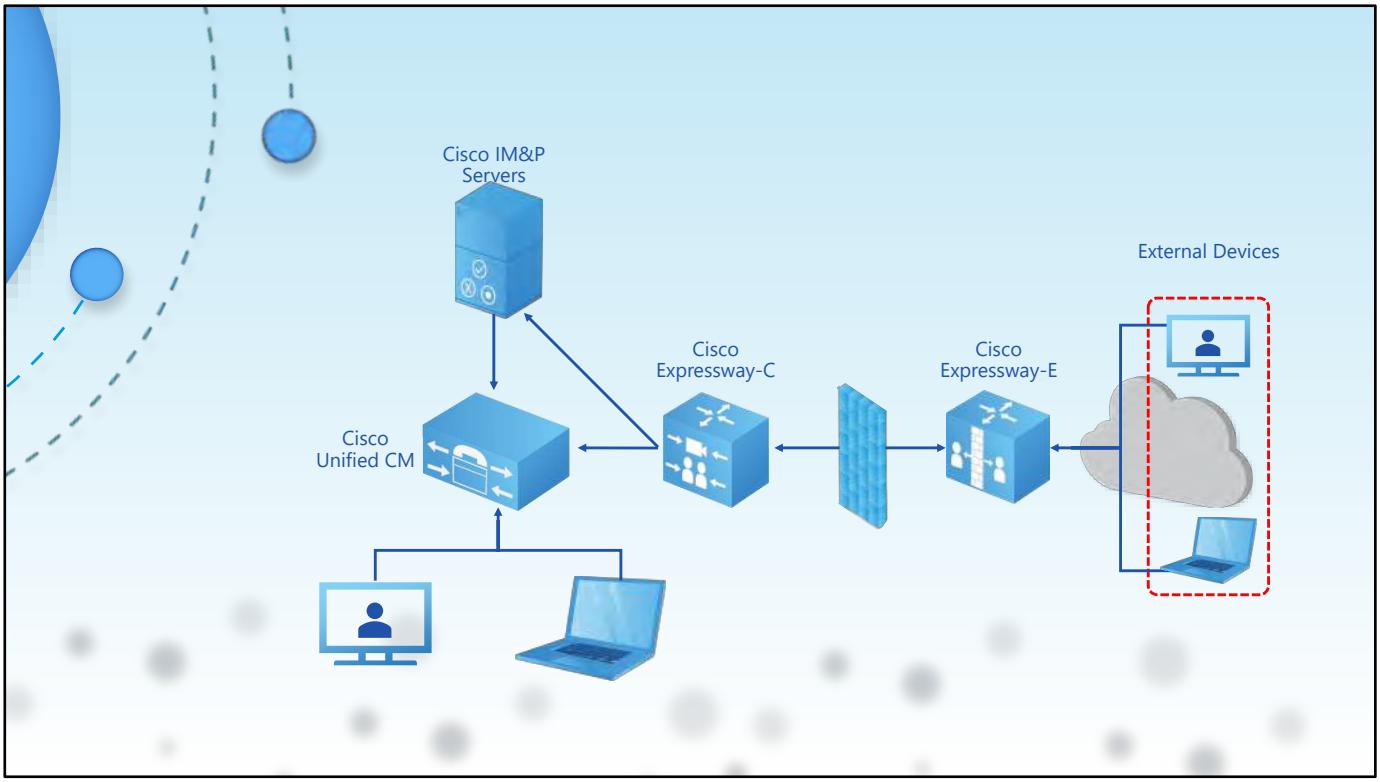


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# Mobile and Remote Access Deployment Guide

Check Deployment Guide for endpoint supported software versions and unsupported features

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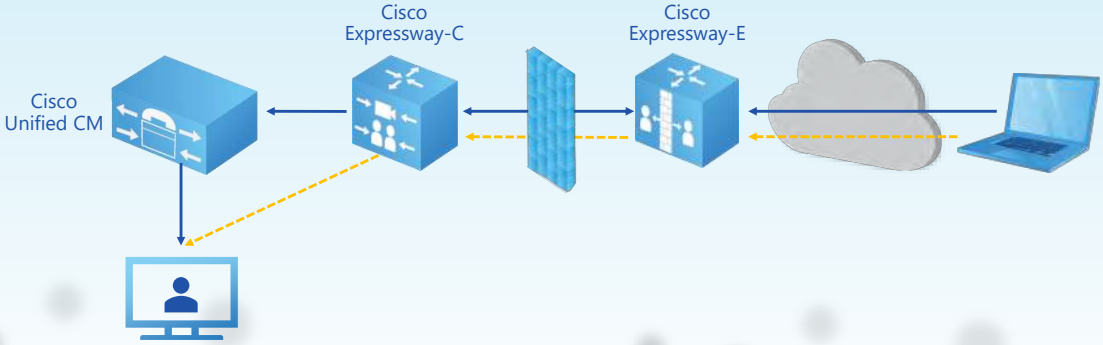
# Cisco MRA Call Flow

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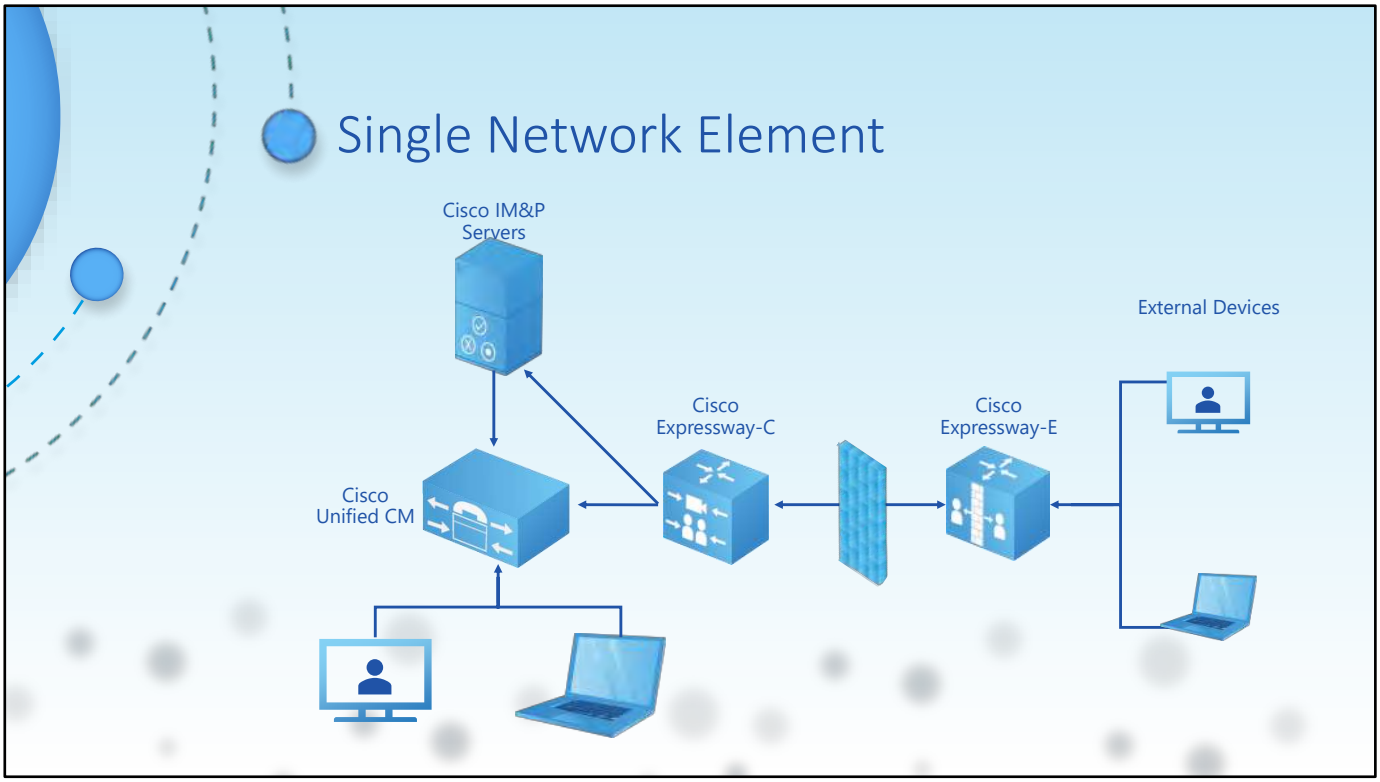


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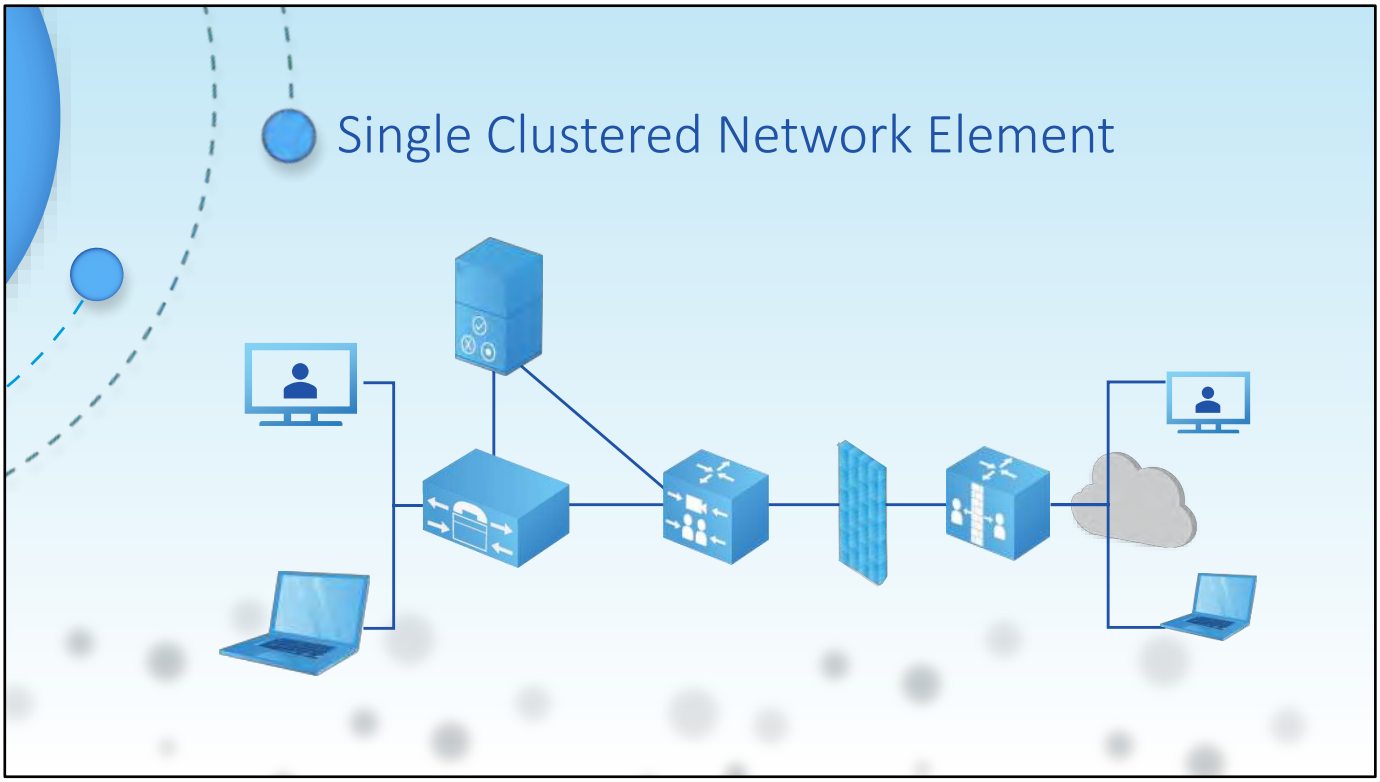


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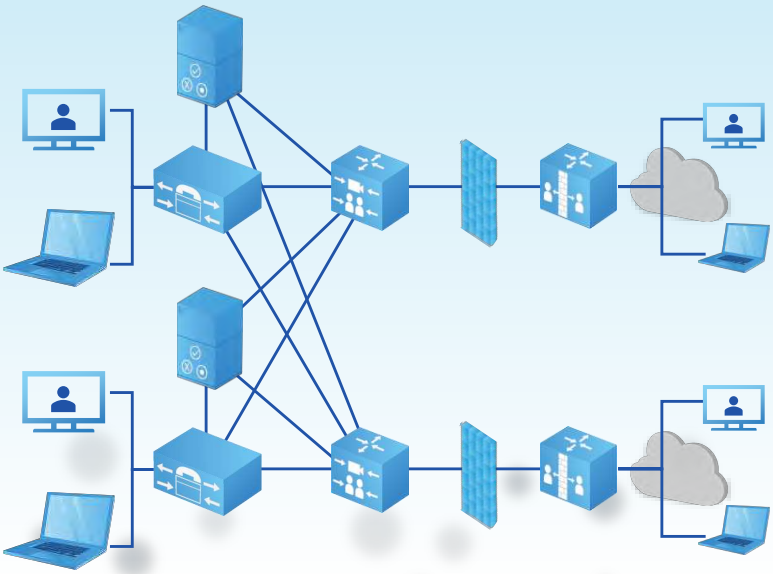
# Multiple Clustered Network Element



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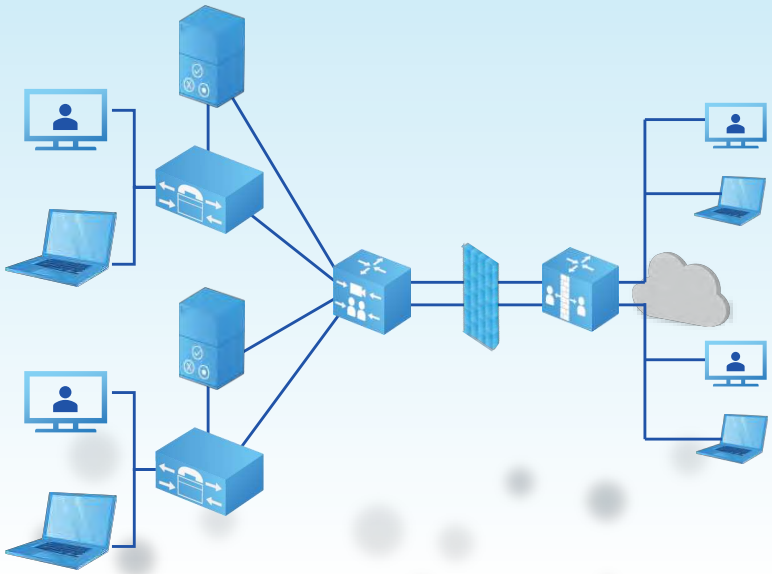
# Multiple Cisco Unified CM Clusters with Single Cisco Expressway Cluster



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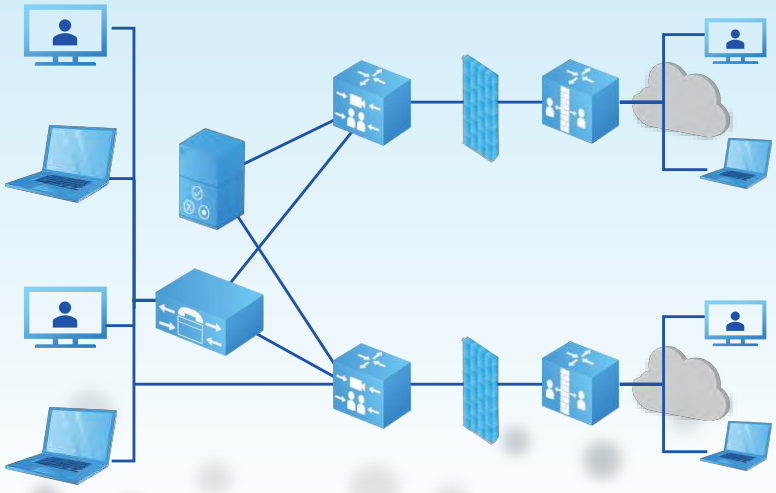
# Single Cisco Unified CM Cluster with Multiple Cisco Expressway Clusters



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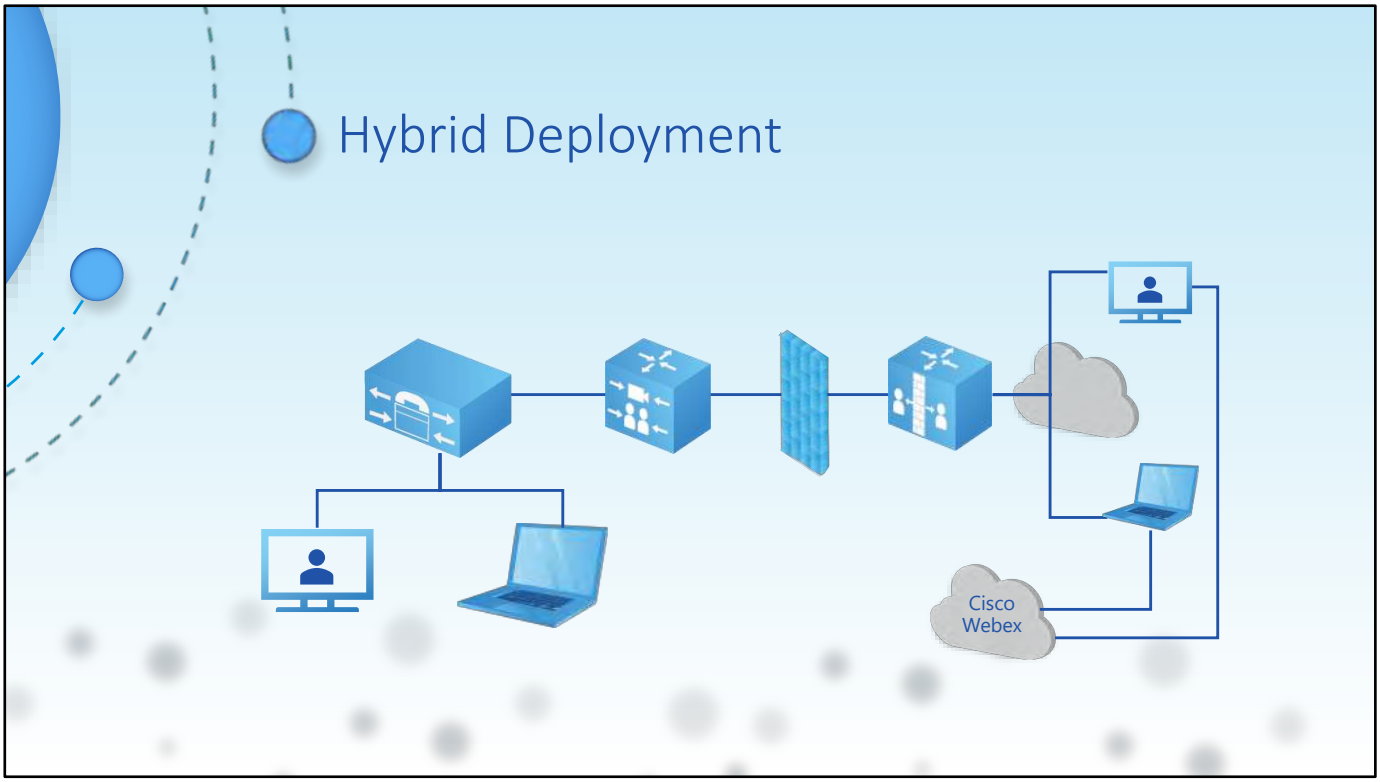


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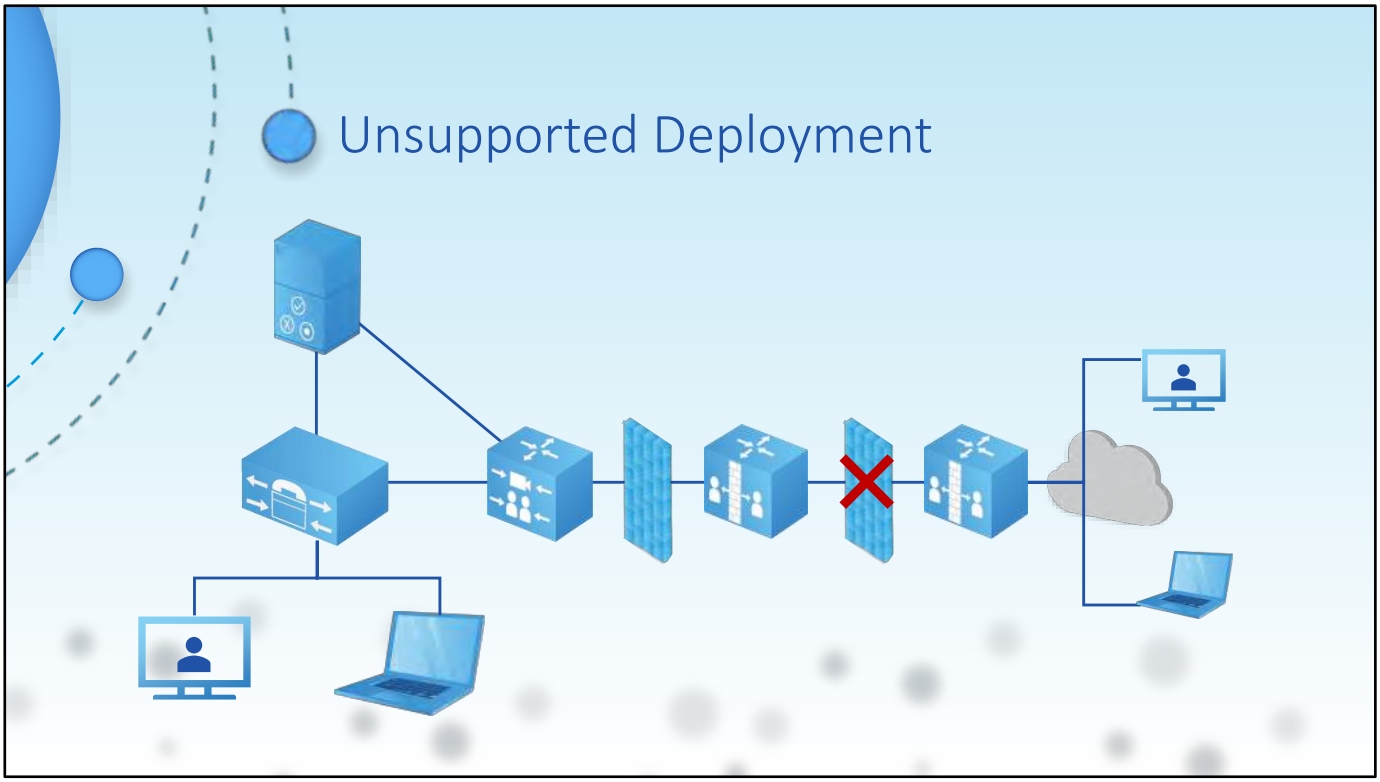


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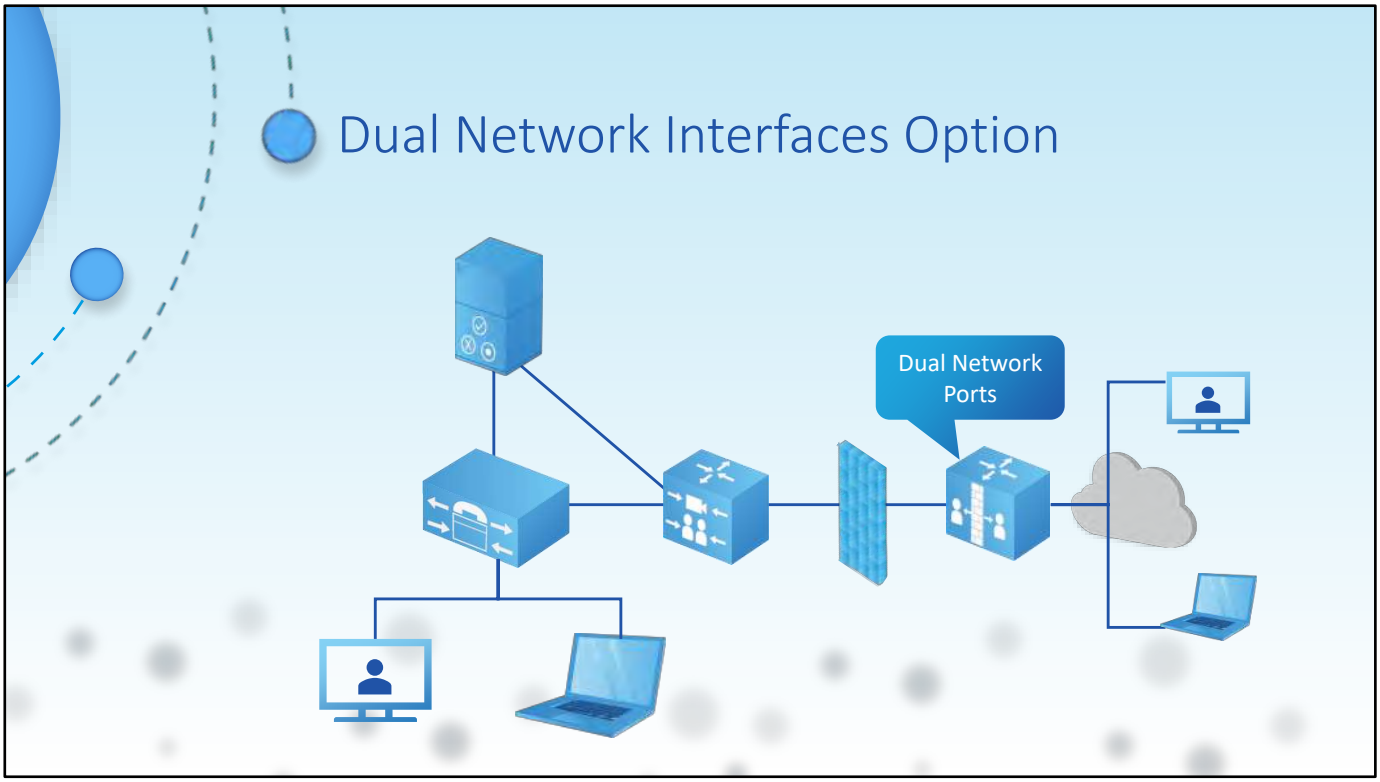


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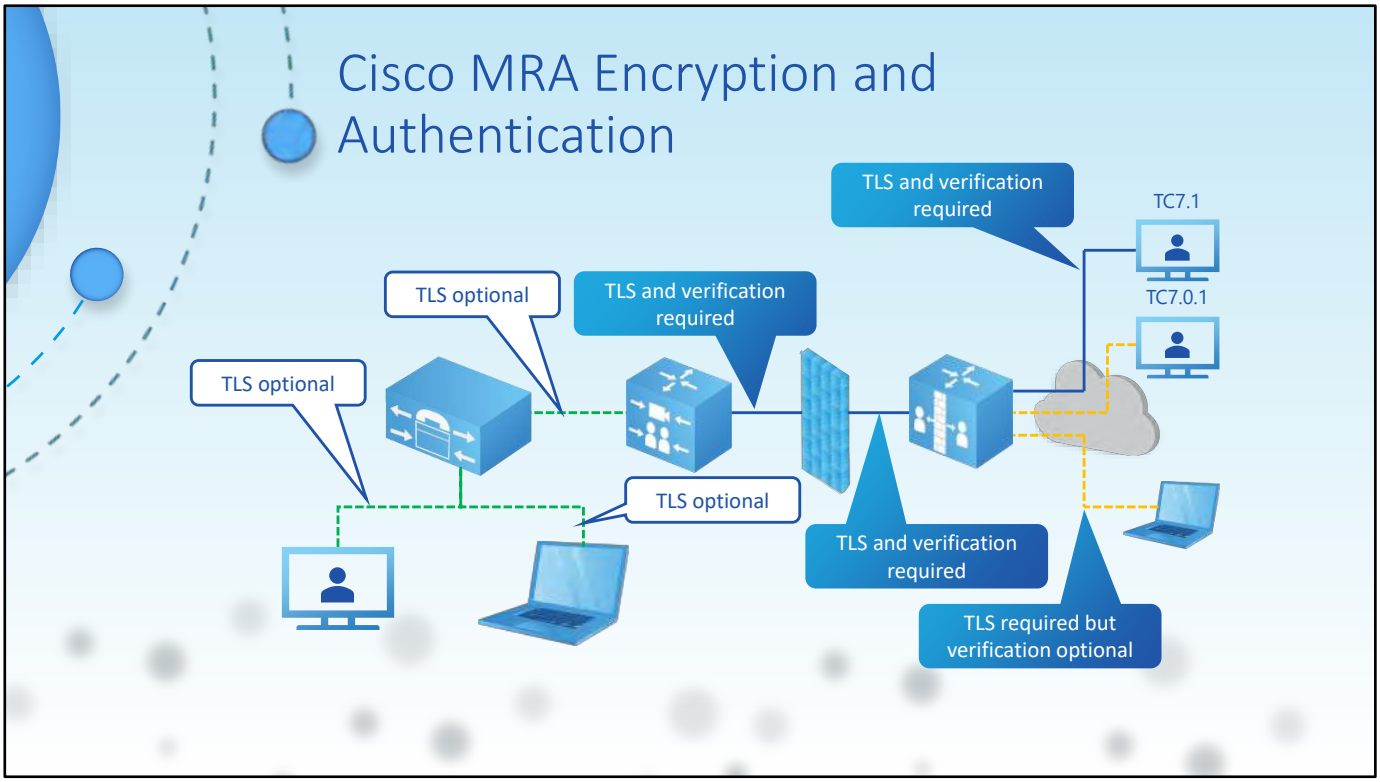


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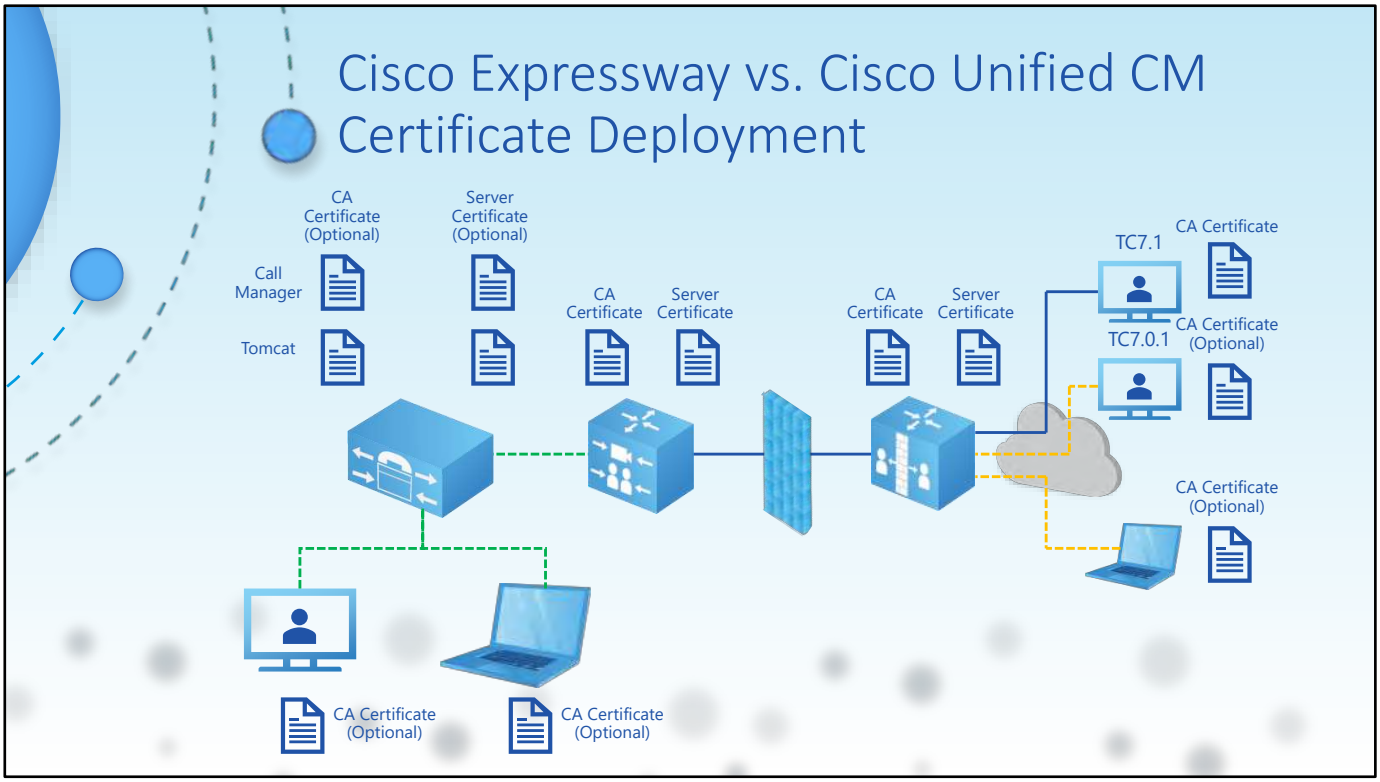
# Cisco Expressway vs. Cisco Unified CM Certificate Deployment

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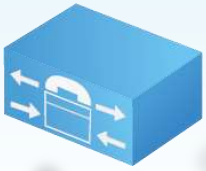
# Cisco Expressway vs. Cisco Unified CM Certificate Deployment

Cisco Expressway



Cisco Unified CM

Server Certificate

Server Certificate

| | |
|---|---|
| Expressway Certificate | Certificate Authority (Root CA) |
| Call Manager Certificate | Call Manager-Trust (Root CA) |
| Tomcat Certificate | Tomcat Trust (Root CA) |

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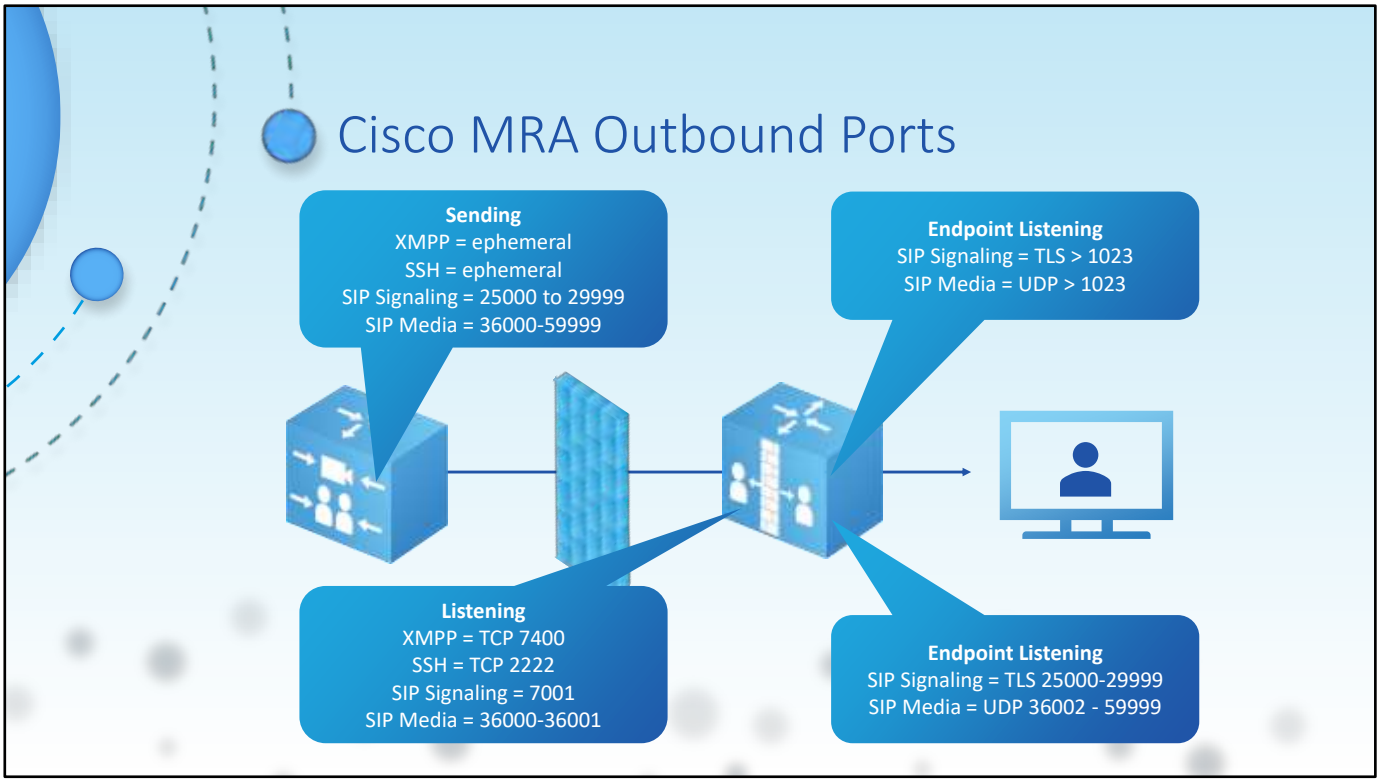


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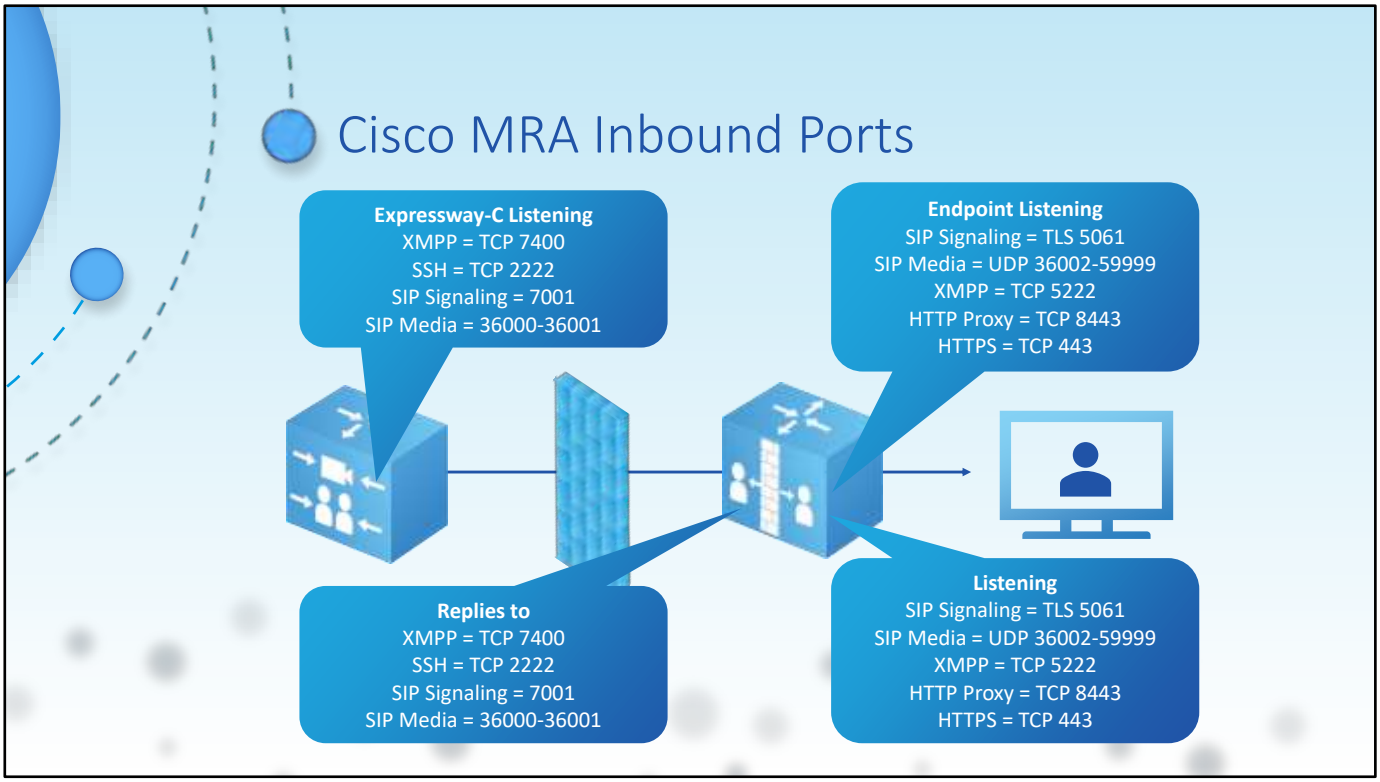


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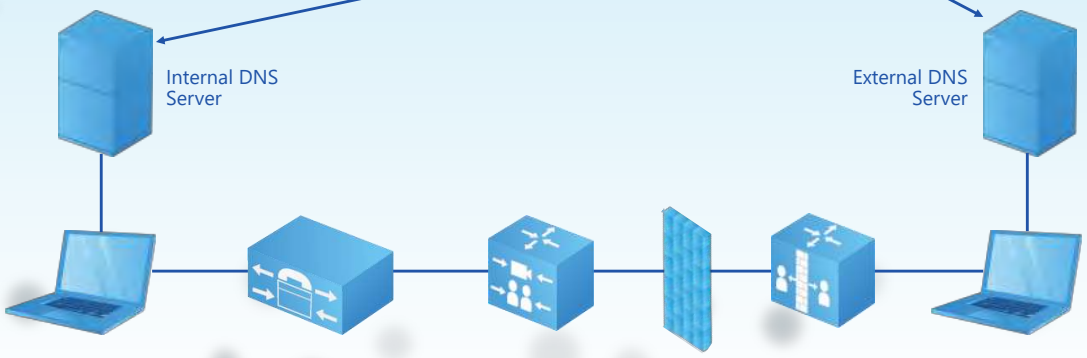
# Cisco MRA DNS SRV Records

| Protocol | Service | Transport | Port | Location |
|---|---|---|---|---|
| SIP | _collab-edge | _tls | 8443 | expe.customer.com |
| SIP | _sips | _tcp | 5061 | expe.customer.com |

| Protocol | Service | Transport | Port | Location |
|---|---|---|---|---|
| SIP | _cisco-uds | _tcp | 8443 | cucm.customer.com |

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# Conclusions

- Mobile and Remote Access Deployment Guide
- Cisco MRA Call Flow
- Single / Multiple Network Element
- Hybrid / Multiple / Dual network deployment
- Cisco Expressway vs. Cisco Unified CM Certificate Deployment
- MRA inbound / outbound ports

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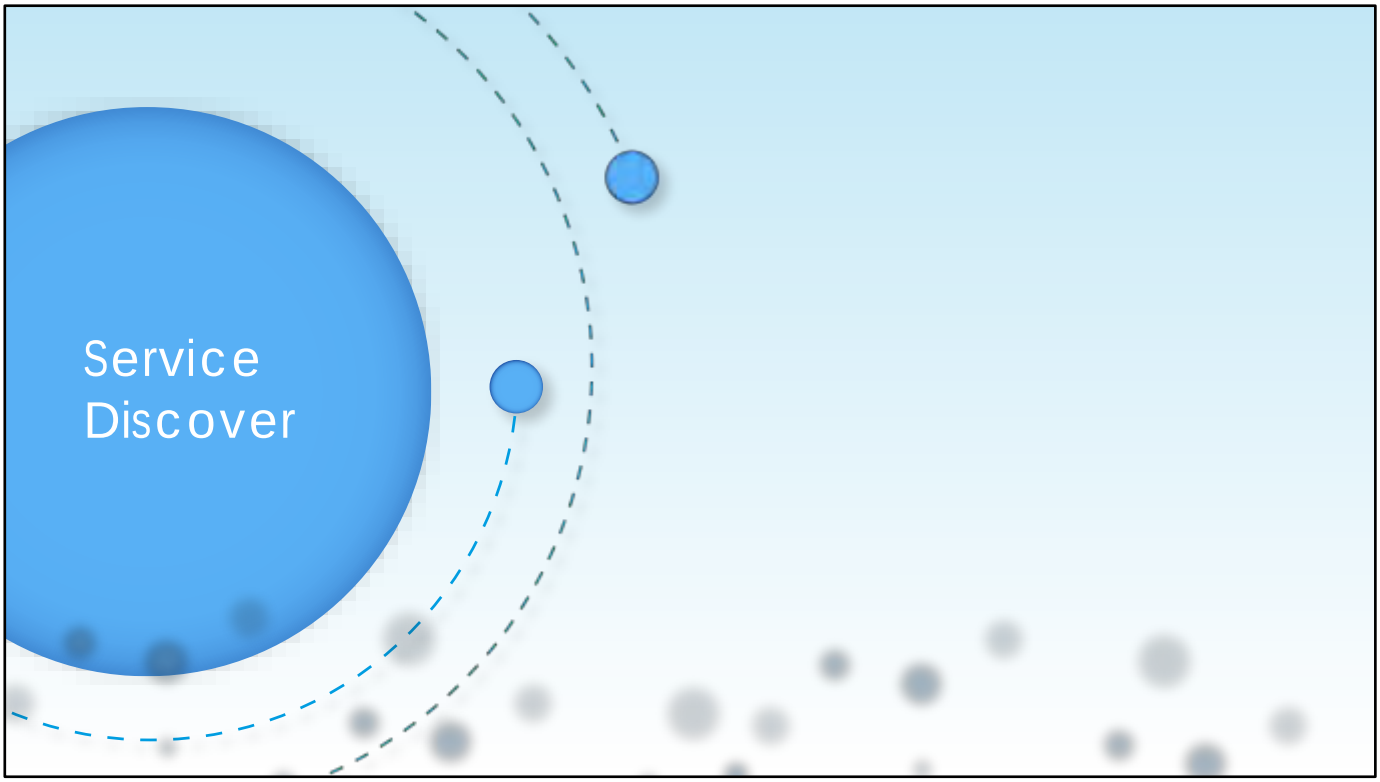


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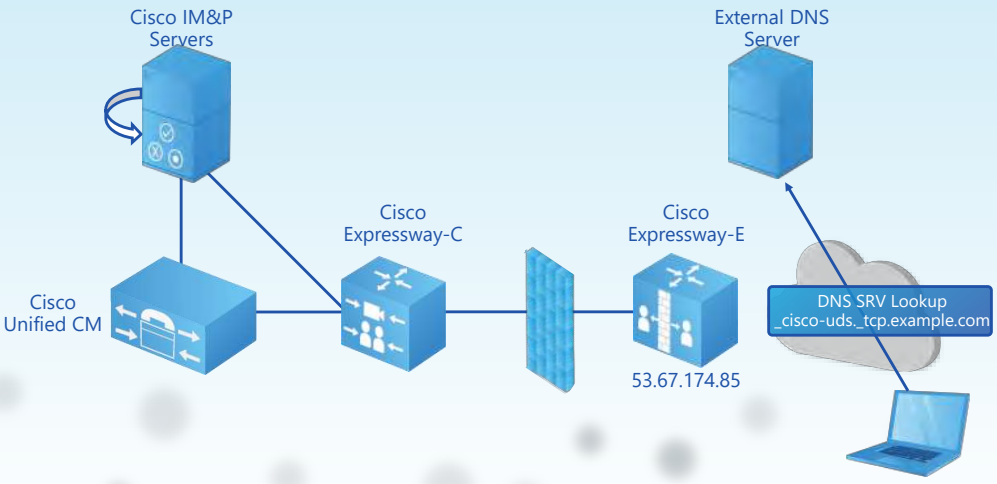
# Describe Service Discover

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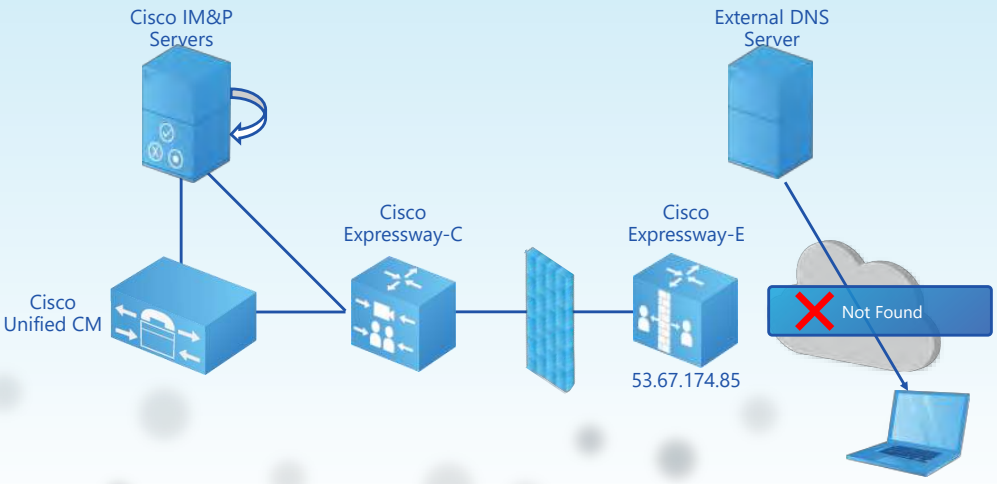


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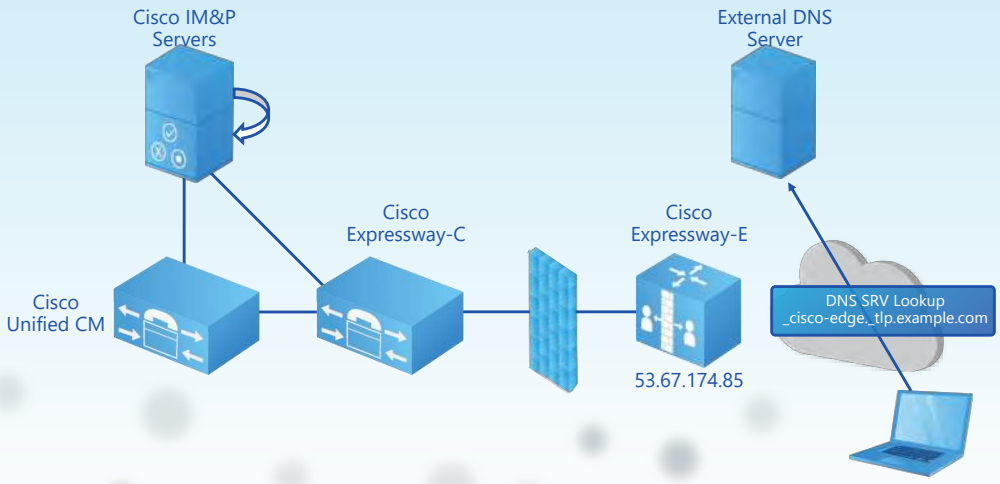


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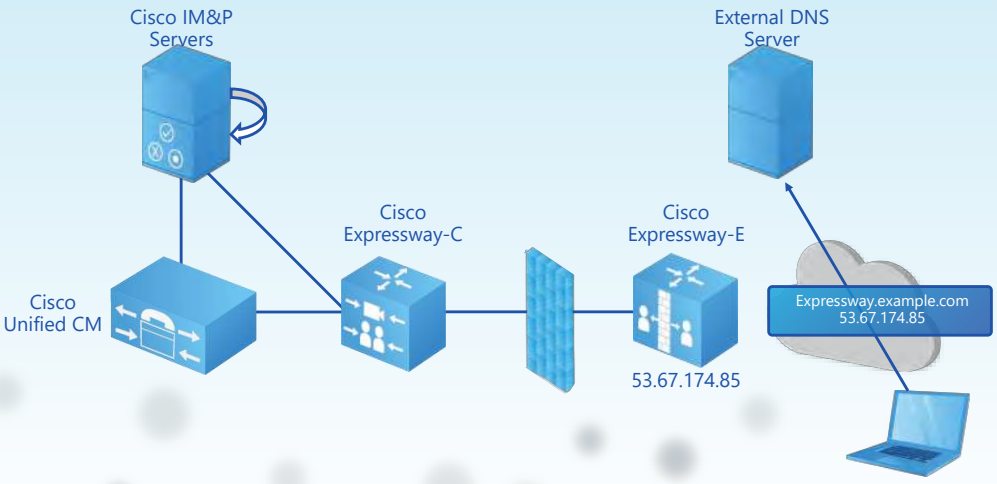


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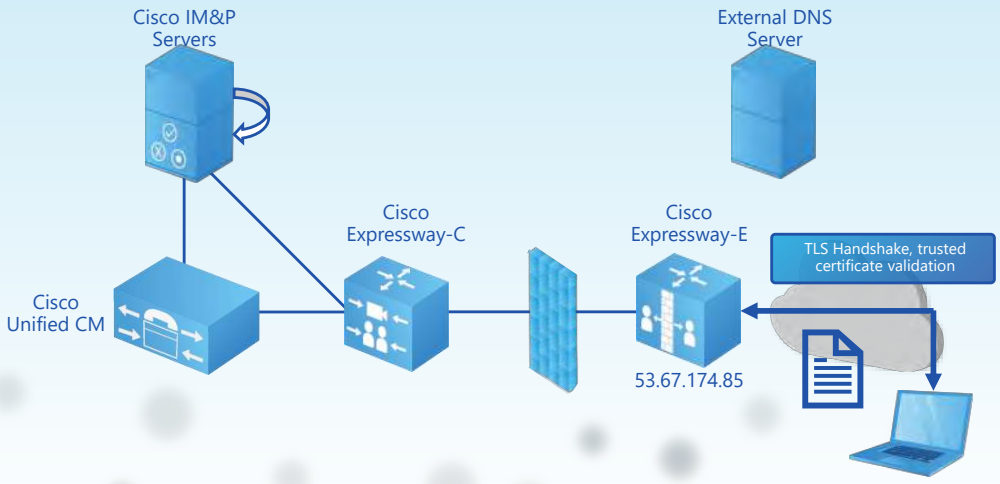


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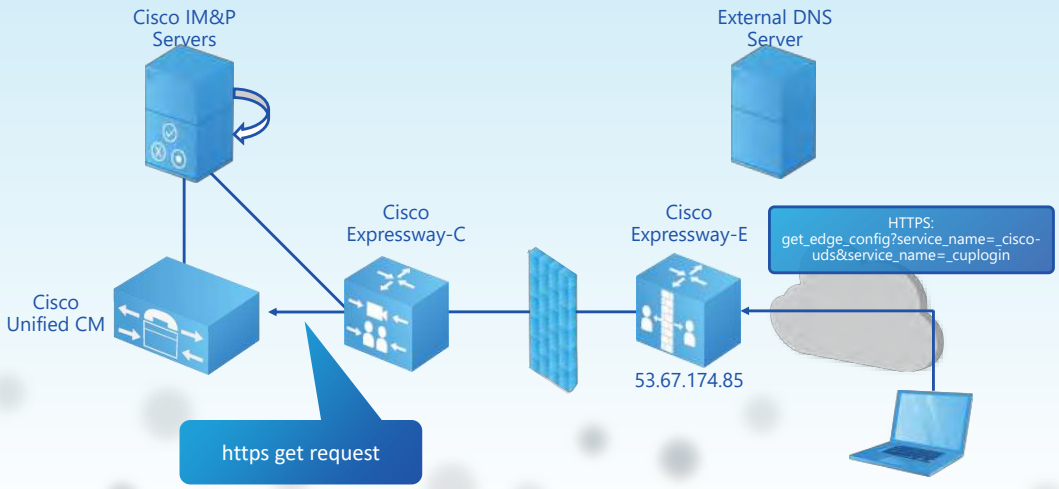


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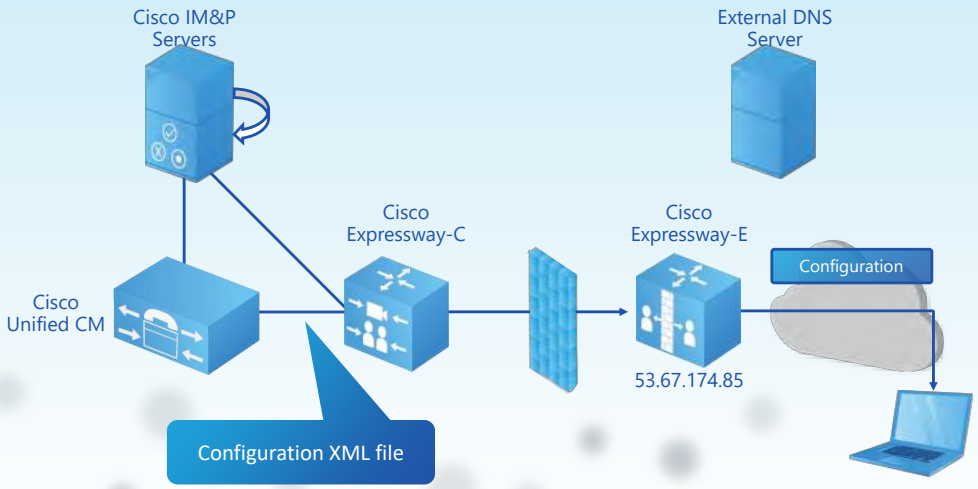


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# Service Configuration File Example

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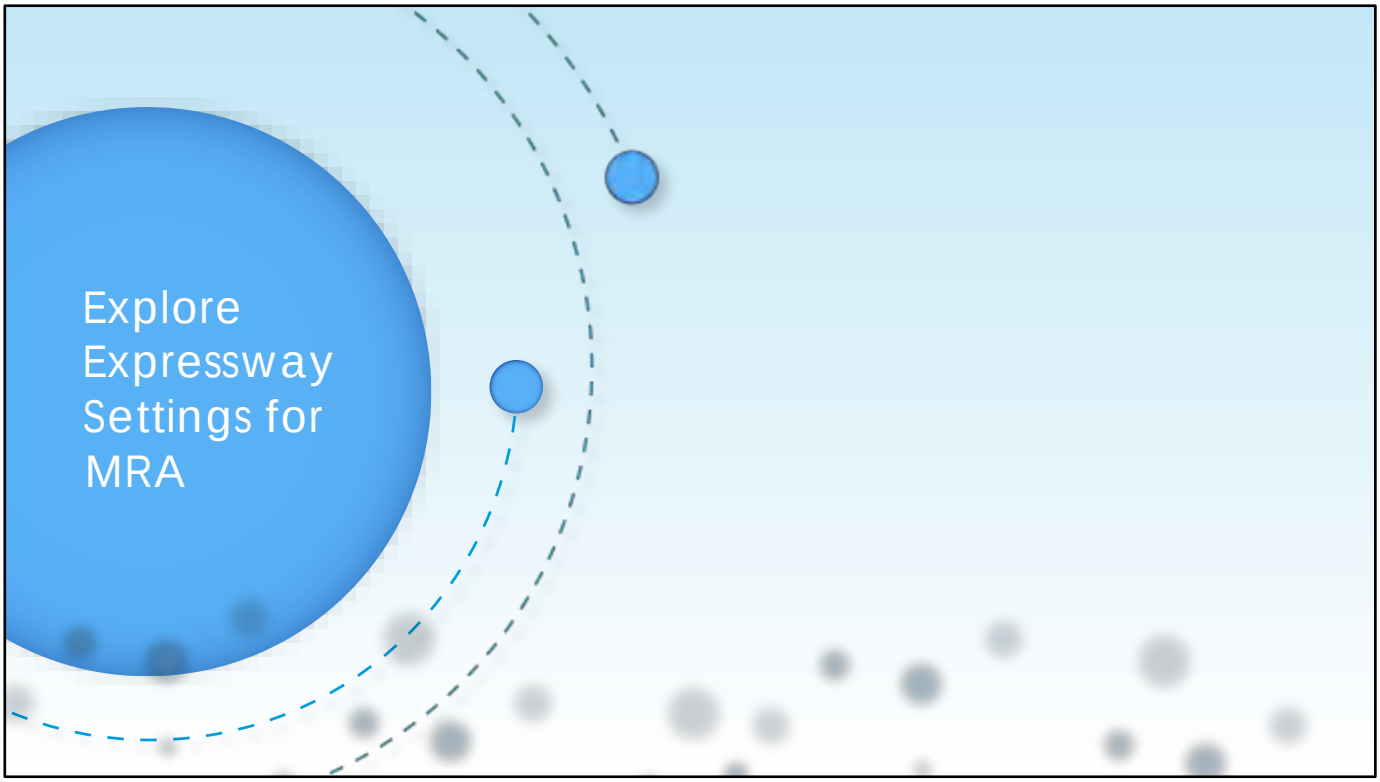


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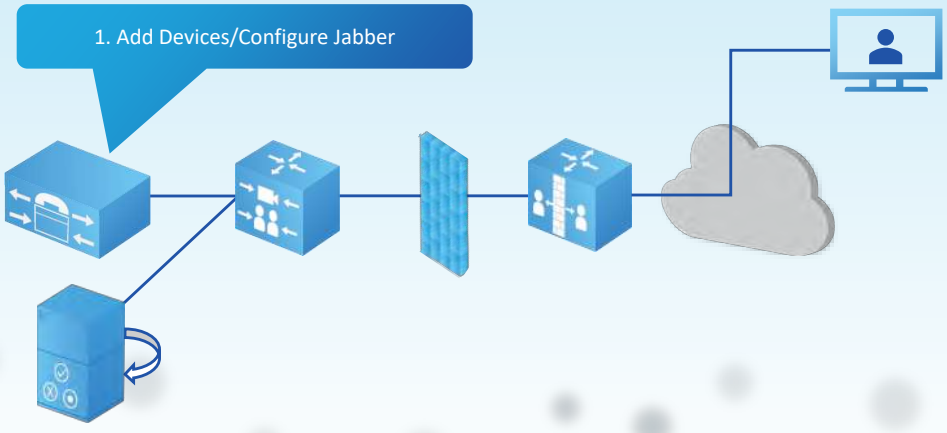
# Explore Expressway Settings for MRA

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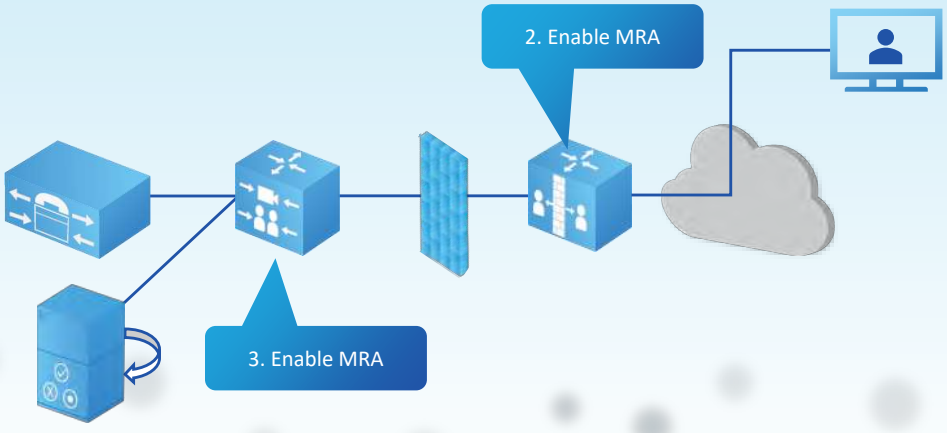


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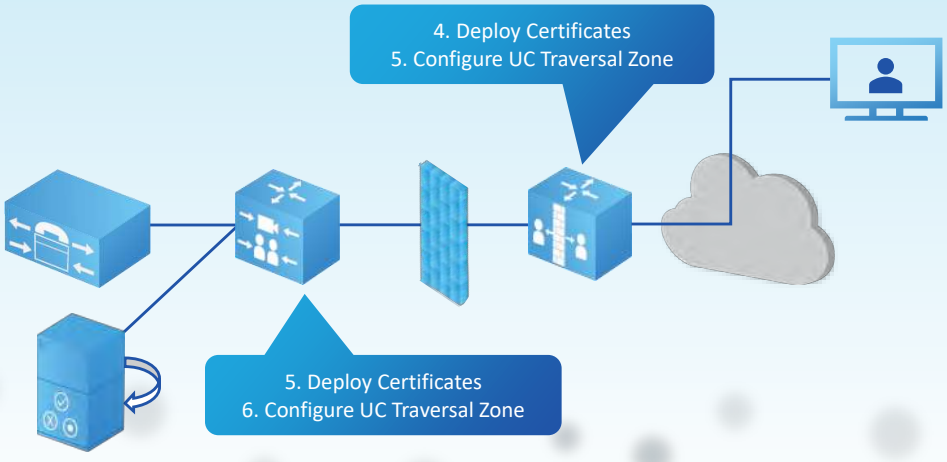


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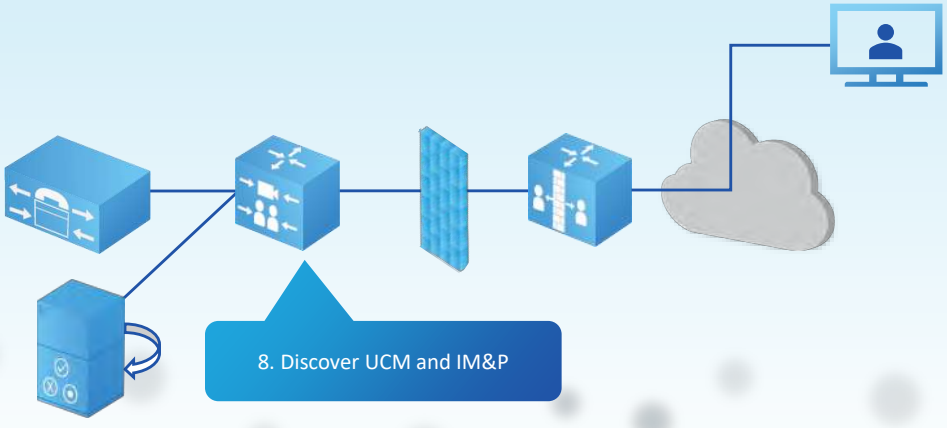
# Explore Expressway Settings for MRA

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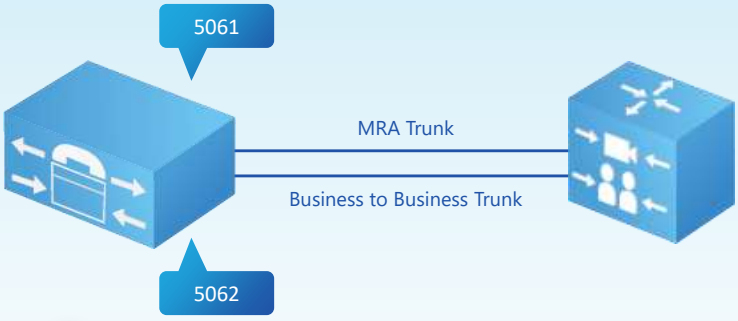
# Explore Expressway Settings for MRA

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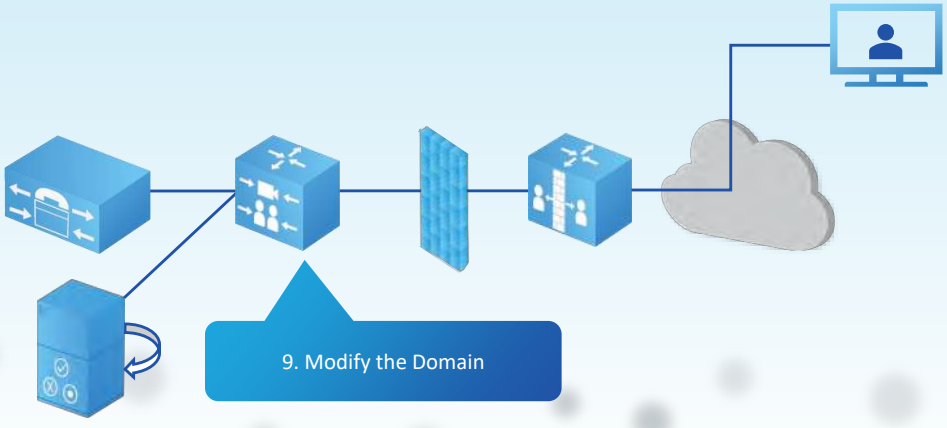


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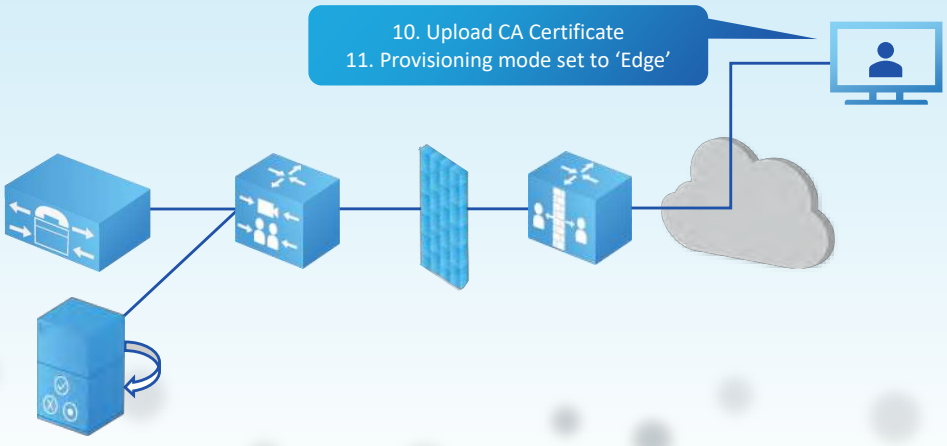


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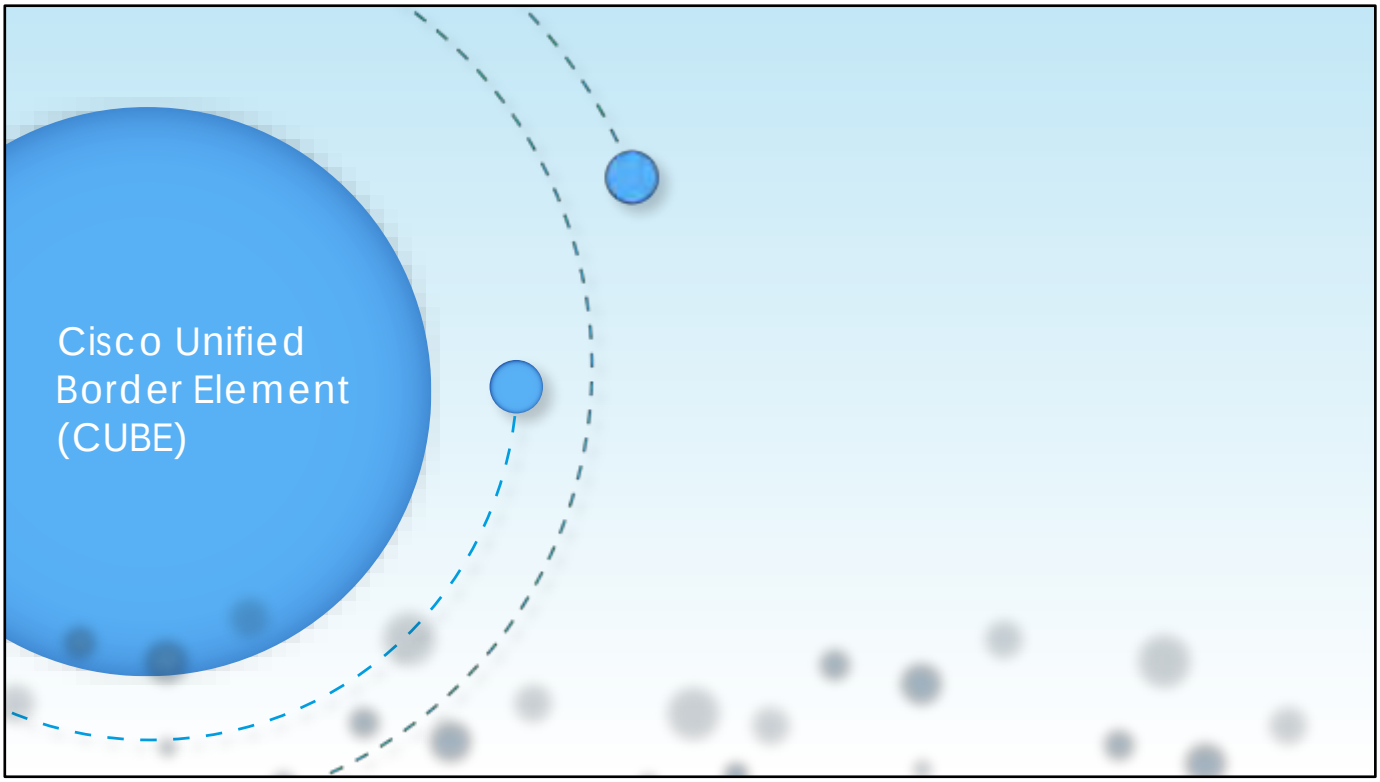


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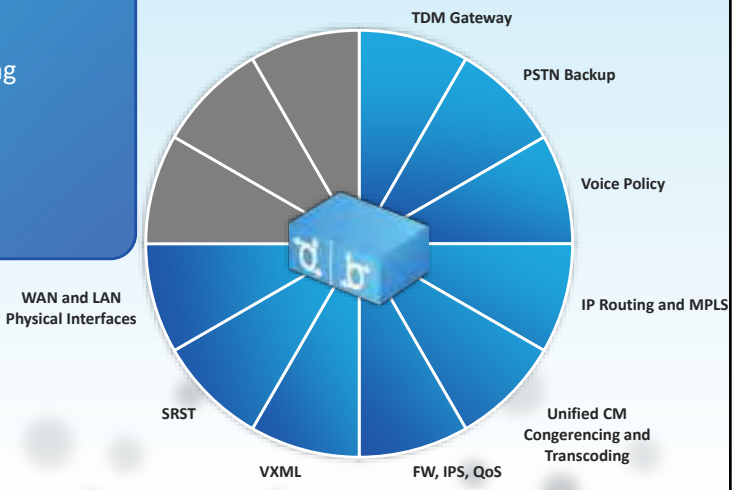
# Introduction

Cisco Unified Border Element

- Address hiding
- H.323 and SIP interworking
- DTMF interworking
- SIP security
- Transcoding

An SBC appliance has only these features.

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# Cisco Unified Border Element (CUBE) provides a Network-to-Network Interface point for the following:

**Signaling interworking:** H.323 and SIP

**Media interworking:** Dual-tone multifrequency (DTMF), fax, modem, and codec transcoding

**Address and port translations:** Privacy and topology hiding.

**Billing and call detail record (CDR) normalization**

**Quality-of-service (QoS) and bandwidth management:** QoS marking using Differentiated Services Code Point (DSCP) or Type of Service (ToS), bandwidth enforcement using Resource Reservation Protocol (RSVP), and codec filtering.

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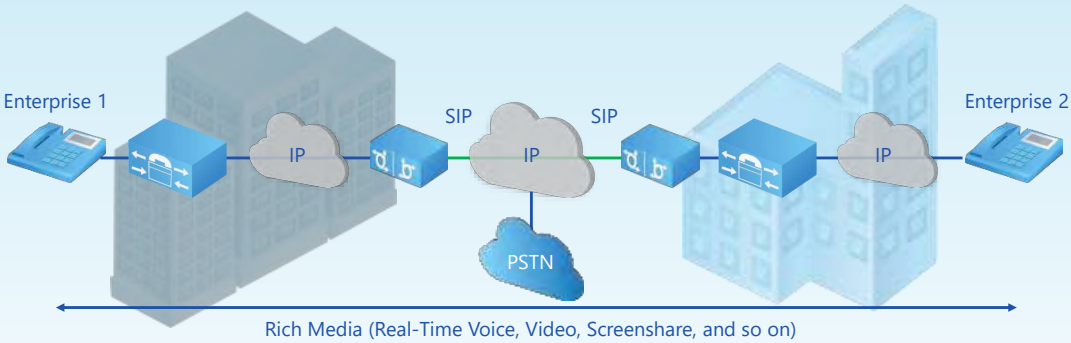
# Need for CUBE




Rich Media (Real-Time Voice, Video, Screenshare, and so on)

| Session Control | Security | Interworking | Demarcation |
|---|---|---|---|
| Call admission control<br>Ensuring QoS<br>Statistics and billing<br>Redundancy/scalability | Encryption<br>Authentication<br>Registration<br>SIP Protection<br>Firewall placement<br>Toll fraud | SIP-SIP<br>H.323-SIP<br>SIP normalization<br>DTMF interworking<br>Transcoding<br>Codec filtering | Fault isolation<br>Topology hiding<br>Network borders<br>L5/L7 protocol<br>Demarcation |

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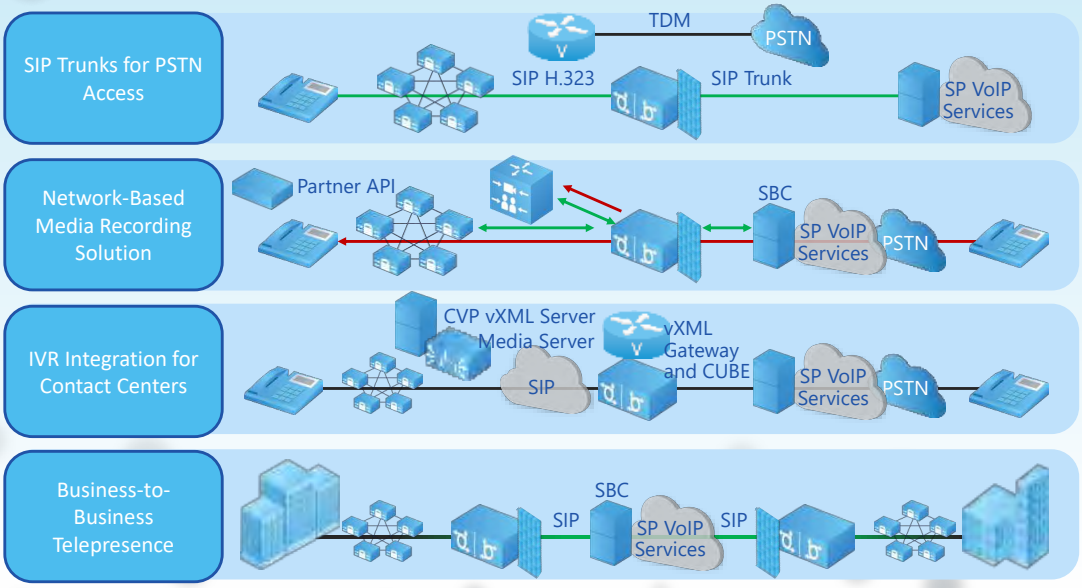
# Use Cases for CUBE

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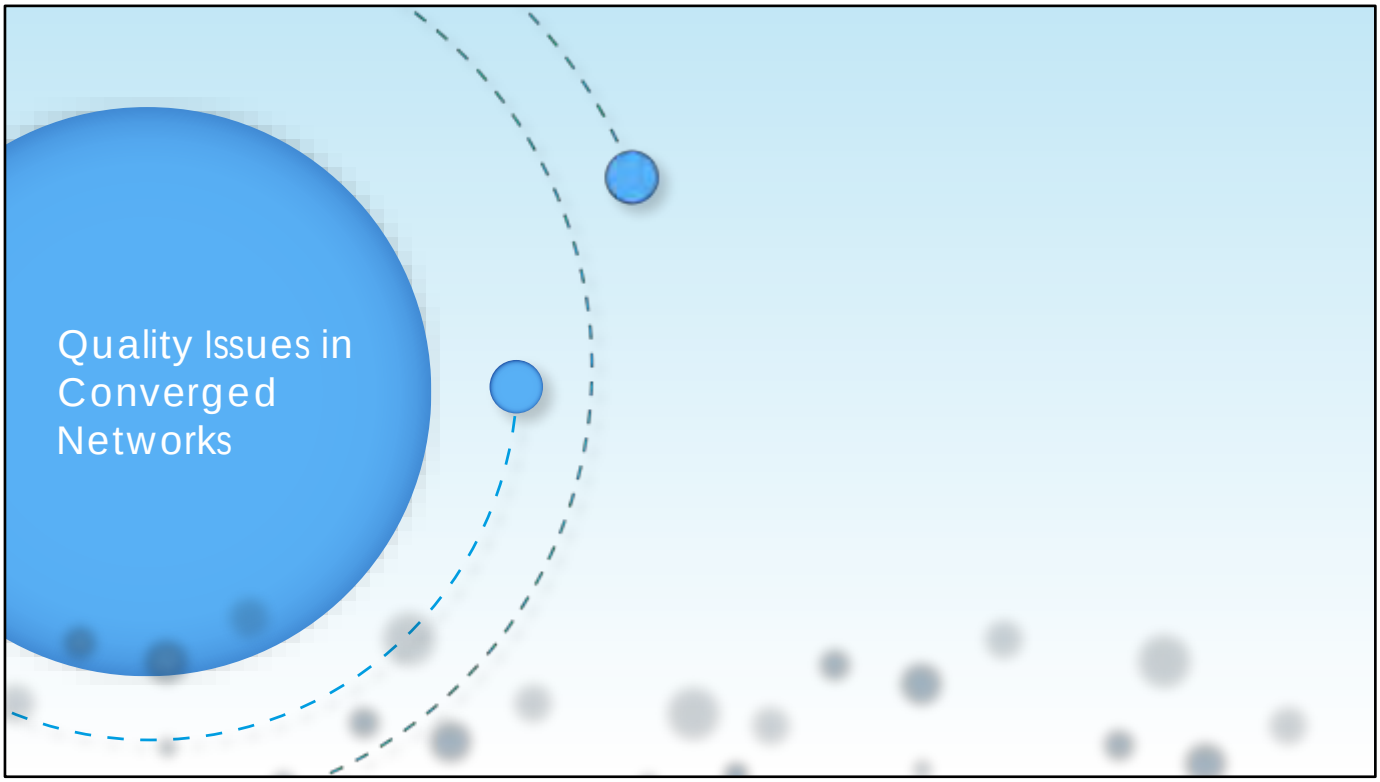


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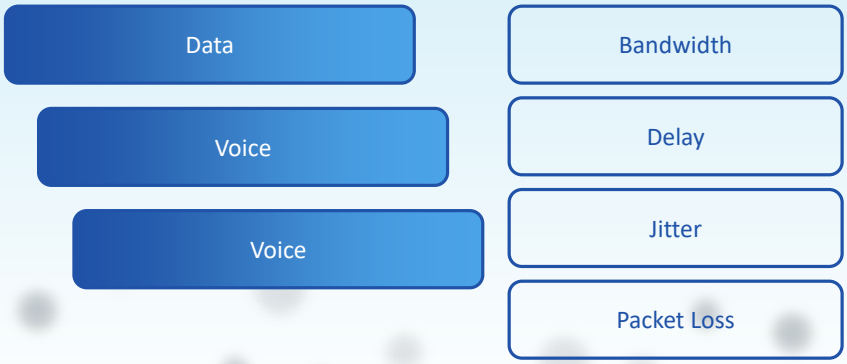
# Introduction

Traffic streams in the converged network

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# Explore Bandwidth Requirement

Explore bandwidth requirements

Examine the components of network delay

- Processing Delay
- Queuing Delay
- Serialization Delay
- Propagation Delay

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# Explore Bandwidth Requirement

Explore bandwidth requirements

Examine the components of network delay

Describe end-to-end delay

Examine Jitter

Describe packet loss

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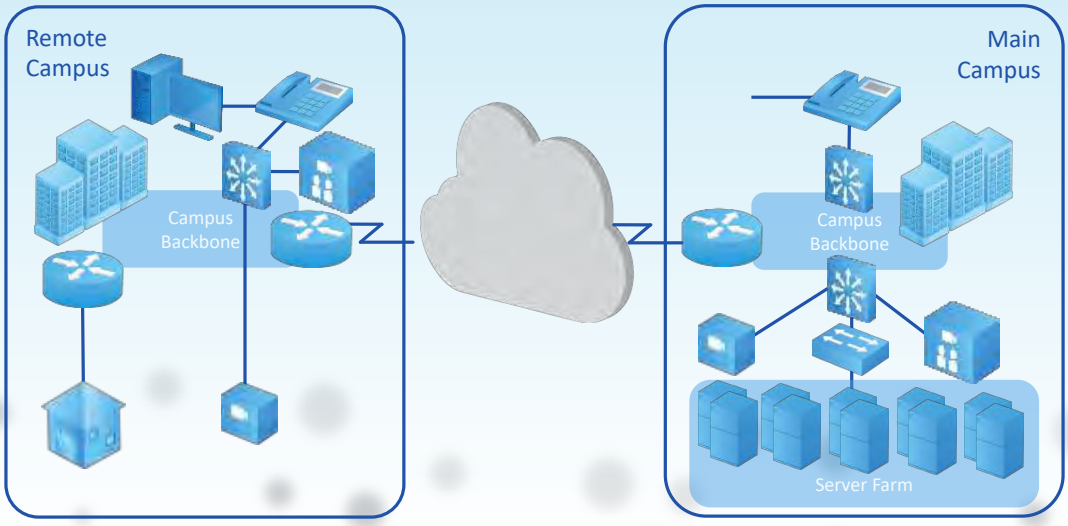
# Converged Networks Introduction

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# Four major problems affect quality on converged networks:

**Bandwidth capacity**

**Delay**

**Jitter**

**Packet loss**

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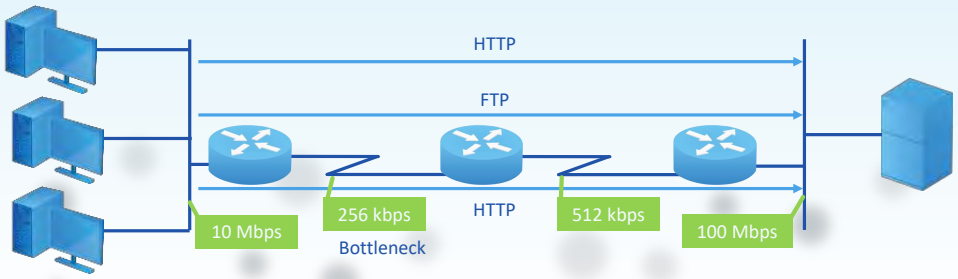
# Available Bandwidth

Available bandwidth across a network path is limited by the lowest-bandwidth circuit and the number and types of traffic flows competing for the bandwidth on the path

Bandwidth available = bandwidth maximum / number of flows

Bandwidth maximum = minimum (10 Mbps, 256 kbps, 512 kbps, 100 Mbps) = 256 kbps

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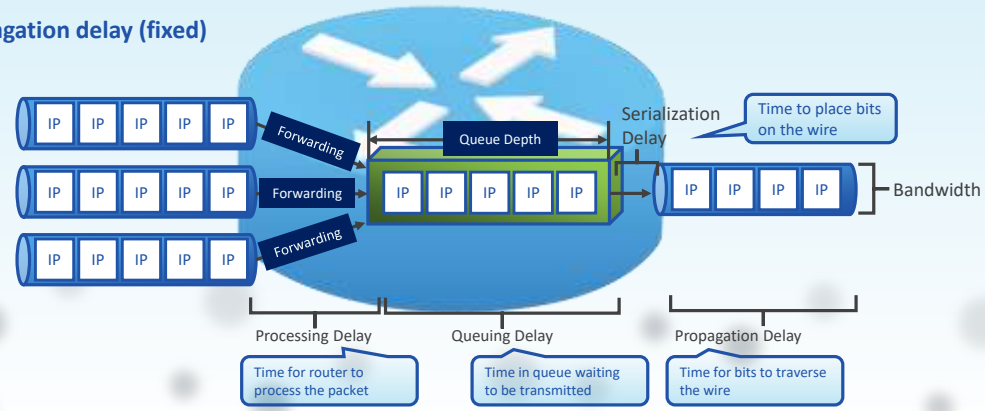
# 4 Types of Network Delay

**Processing delay (variable)**

**Queuing delay (variable)**

**Serialization delay (fixed)**

**Propagation delay (fixed)**

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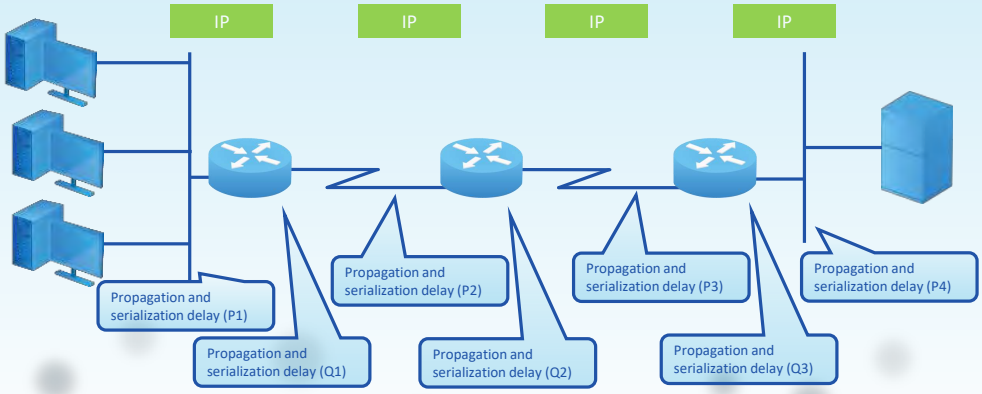
# End-to-End Delay Calculations

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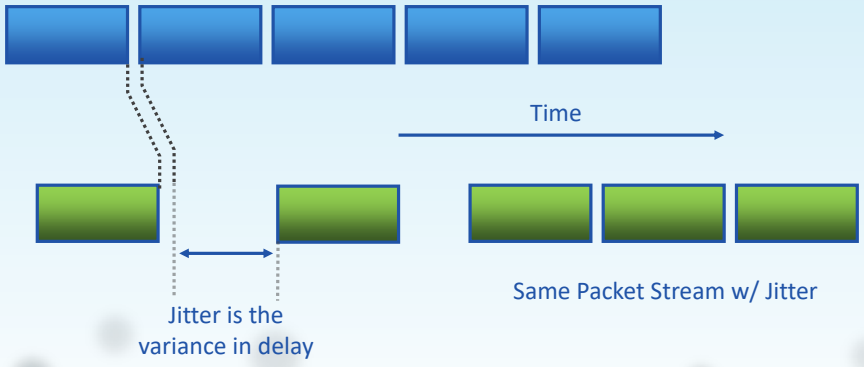
# Overview of Jitter

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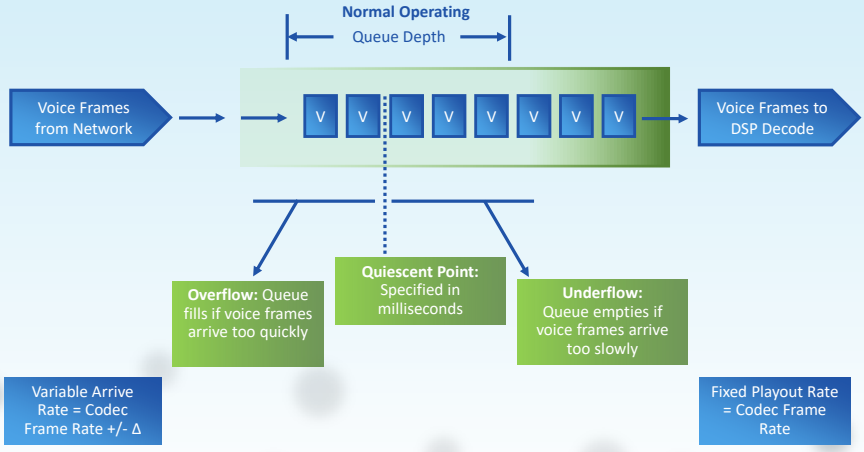
# De-jitter Buffer Operation

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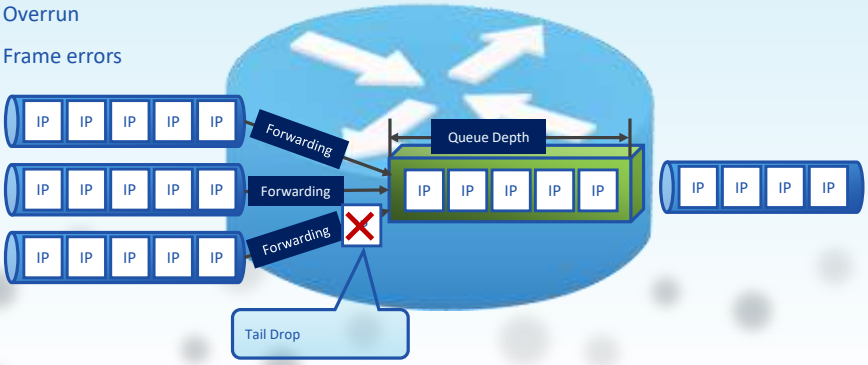
# Reason For Packet Loss

**Common Reason**

- Input queue drop
- Ignore
- Overrun
- Frame errors

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# Conclusions

- Bandwidth requirements
- Converged networks
  - Major problems
- Bandwidth
- Network delay
- Jitter
- Packet loss

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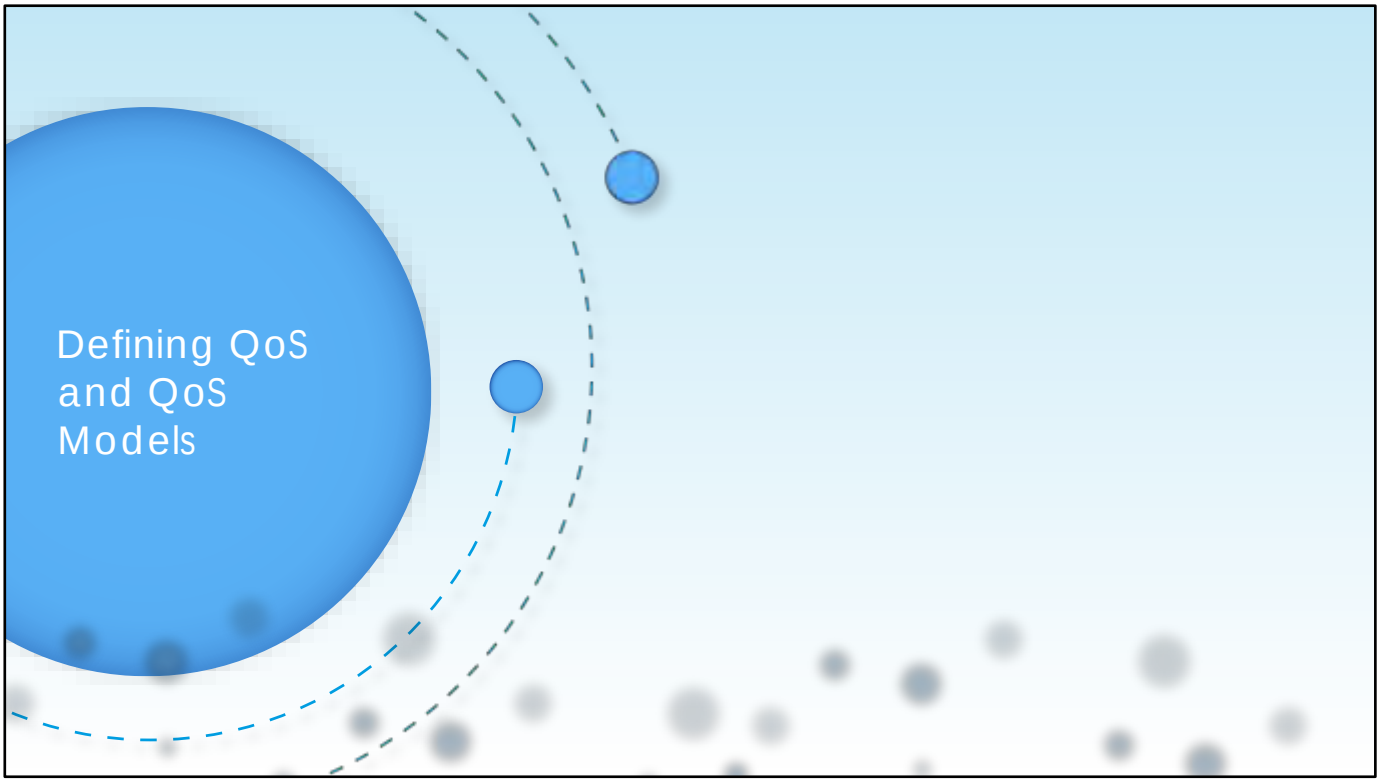


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# Introduction

QoS Needed To Handle different traffic at different rate

- Bandwidth
- Latency
- Jitter
- Delay
- Packet Loss

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# Introduction (cont.)

QoS Needed: Different Type of Traffic

Define a QoS Policy to handling business requirement

Examine Traffic and their needs

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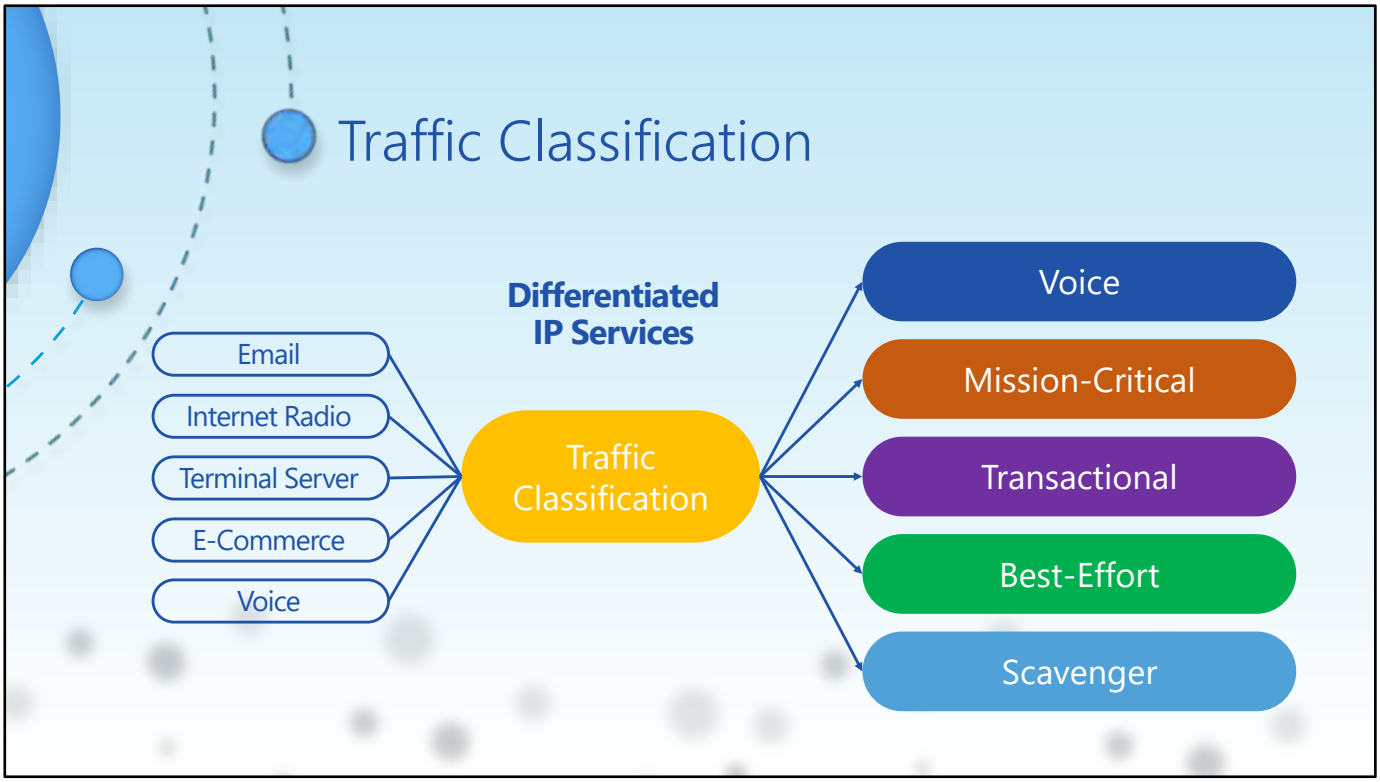


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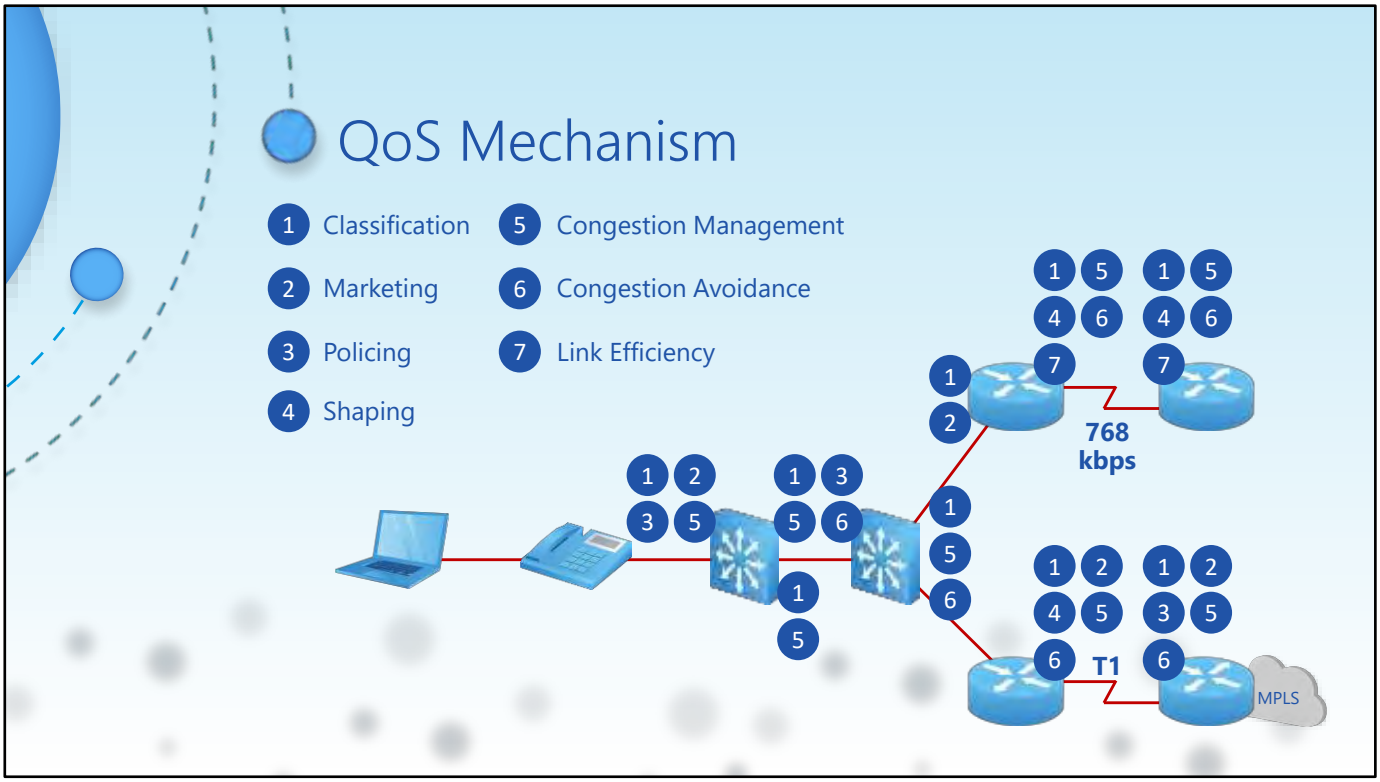


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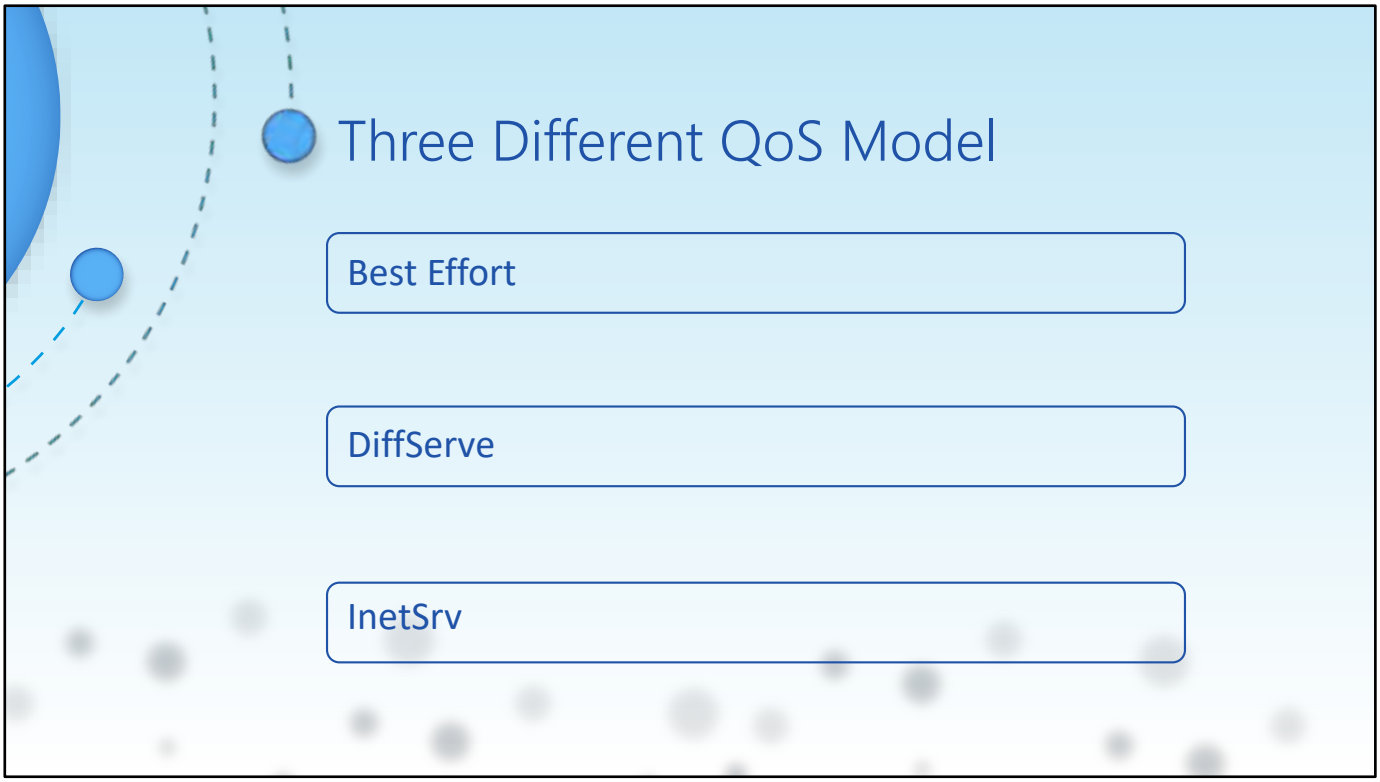


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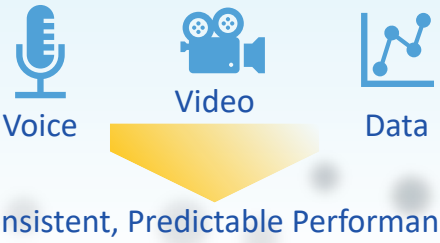
# QoS Defined

QoS is the ability of the network to predictably provide business applications with the service required for those applications to be successfully used on the network

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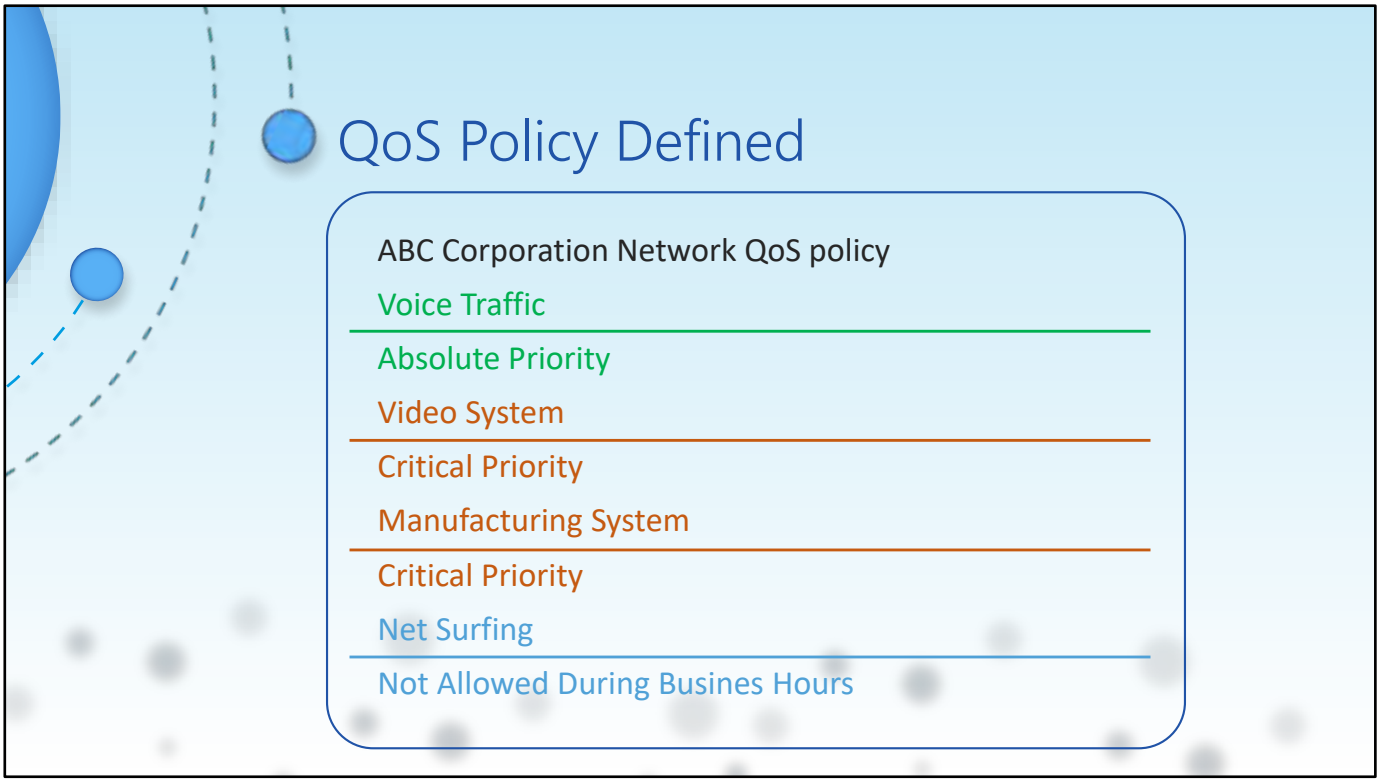


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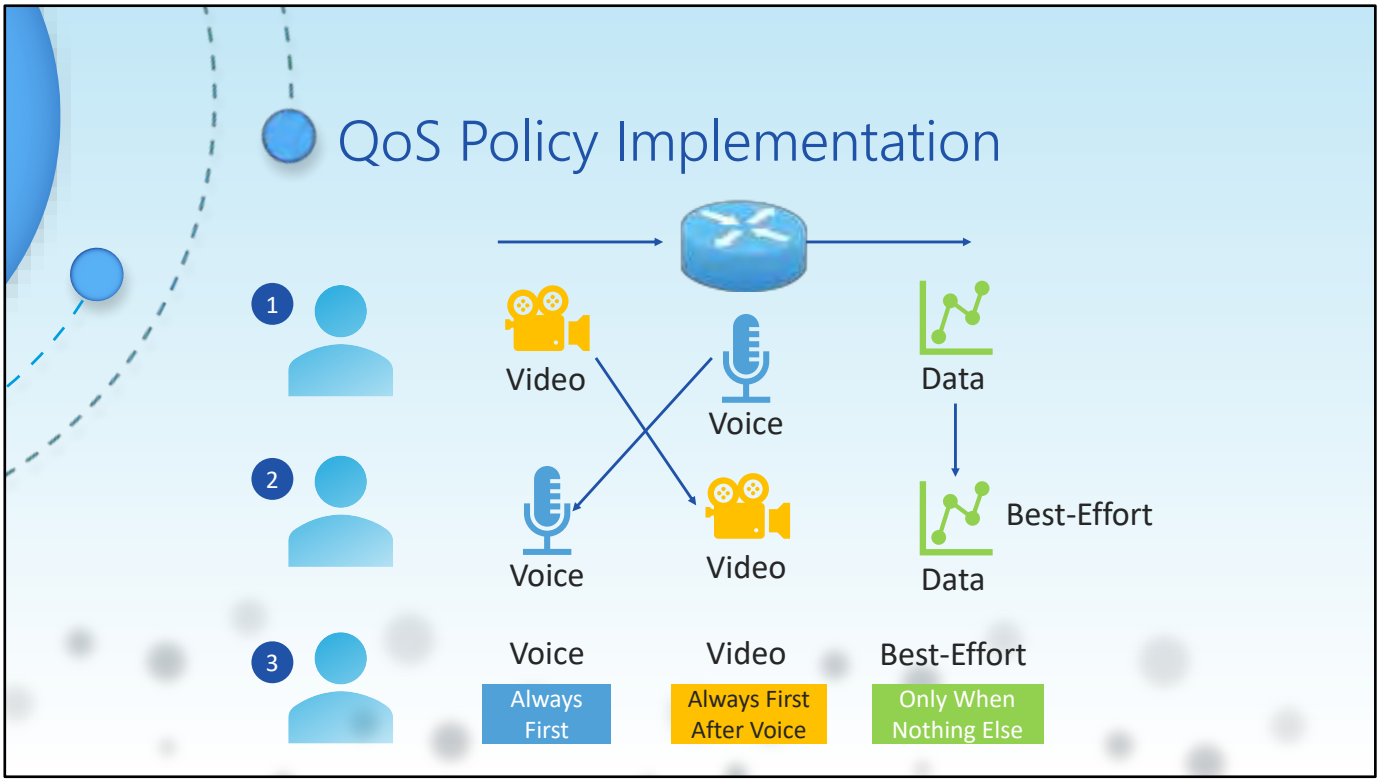


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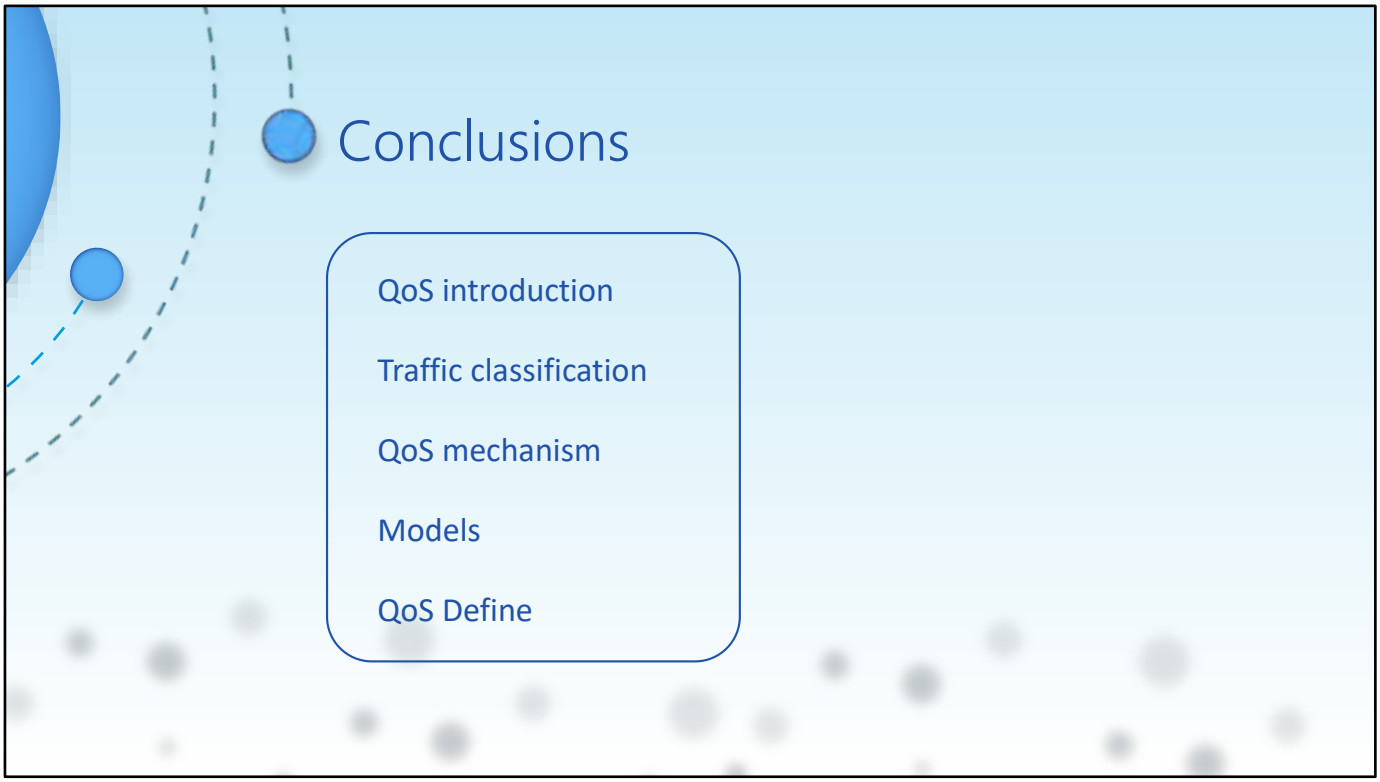


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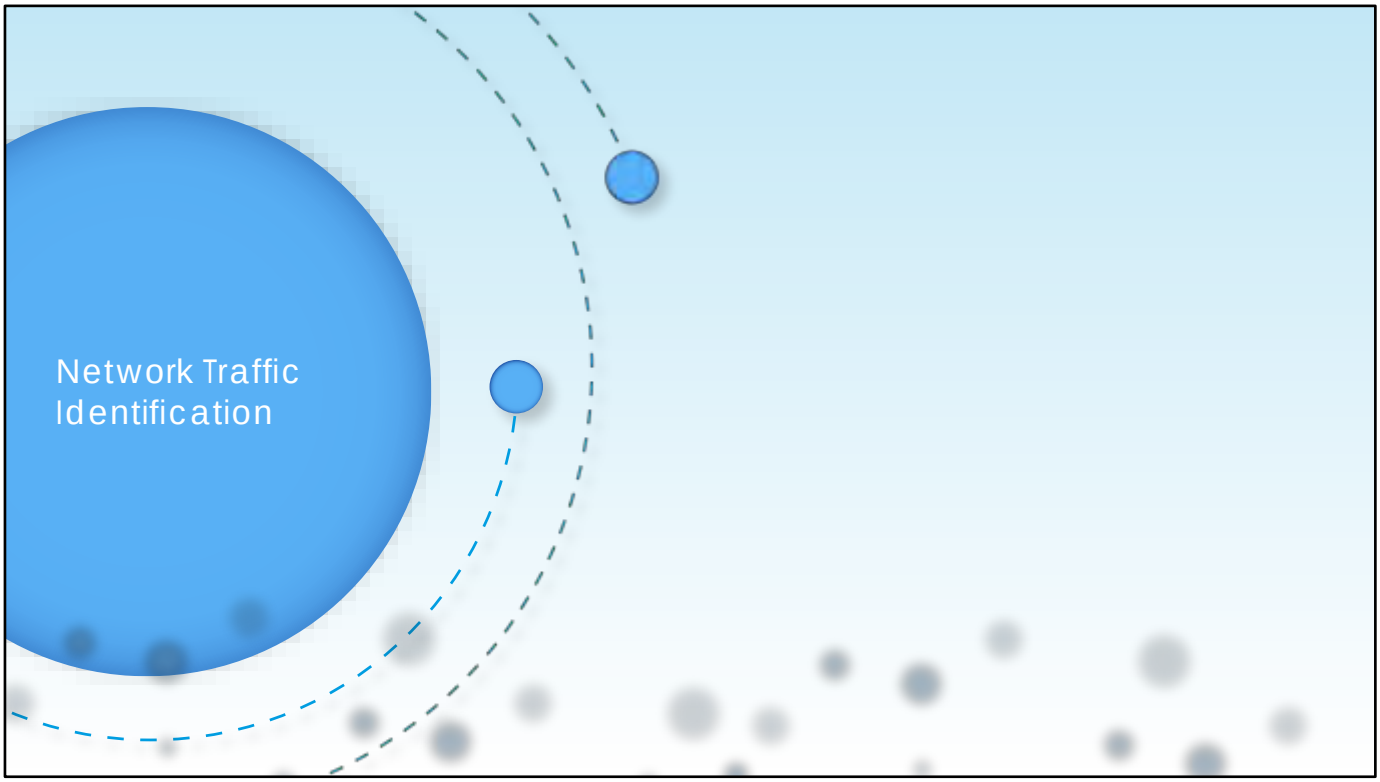


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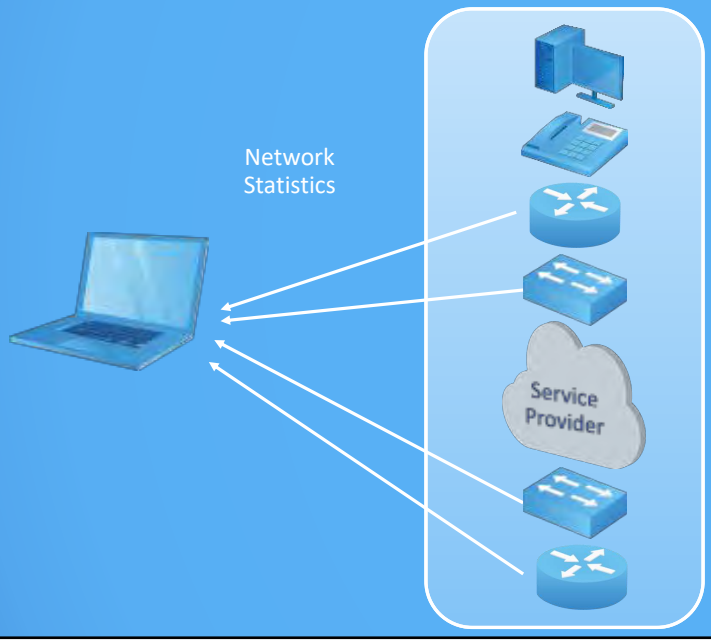
# Classified Network Traffic

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# Voice Traffic Profile

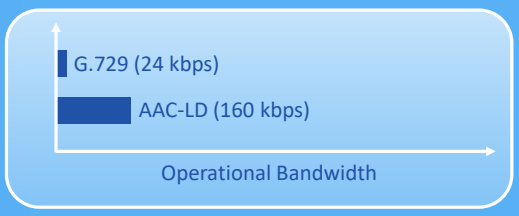
**Bandwidth:**

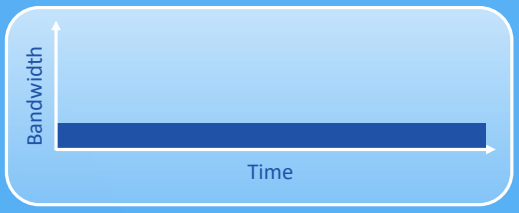
- Constant bitrate
- Small footprint

**Loss**-sensitive

**Delay**-sensitive

**Audio**

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# Video Traffic Profile

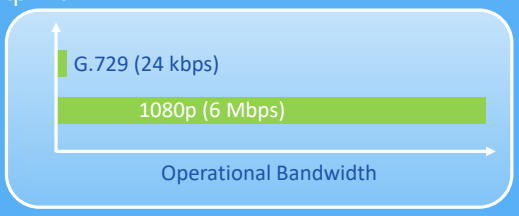
**Bandwidth:**

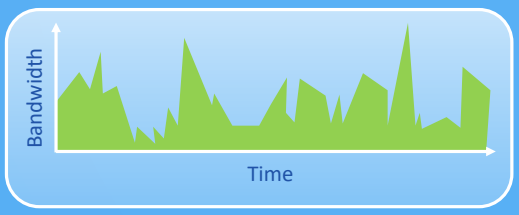
- Variable bitrate (bursty)
- Medium-to-large footprint

**Loss**-sensitive

**Delay**-sensitive

**Video**

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# Data Traffic Profile

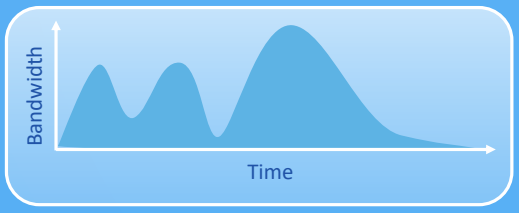
**Bandwidth:**

- Variable bitrate
- TCP

**Loss**-sensitive

**Delay**-sensitive

**Data**

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# Traffic Class

| Traffic Class | Application Traffic Properties |
|---|---|
| Mission-critical | These applications are the most significant for the success of the enterprise. Typically, applications technically fit within the transactional and interactive queue, but due to business requirements, they are given a higher level of preference. |
| Transactional and interactive | Transactional applications are typically client/server models that consist of user-initiated queries that are followed by server responses, while interactive applications have highly interactive traffic with strict user feedback requirements. |
| Bulk | TCP-based applications use large file transfers. |
| Best-effort | All noncritical traffic that has not been assigned to a specific data queue use this best-effort class. |

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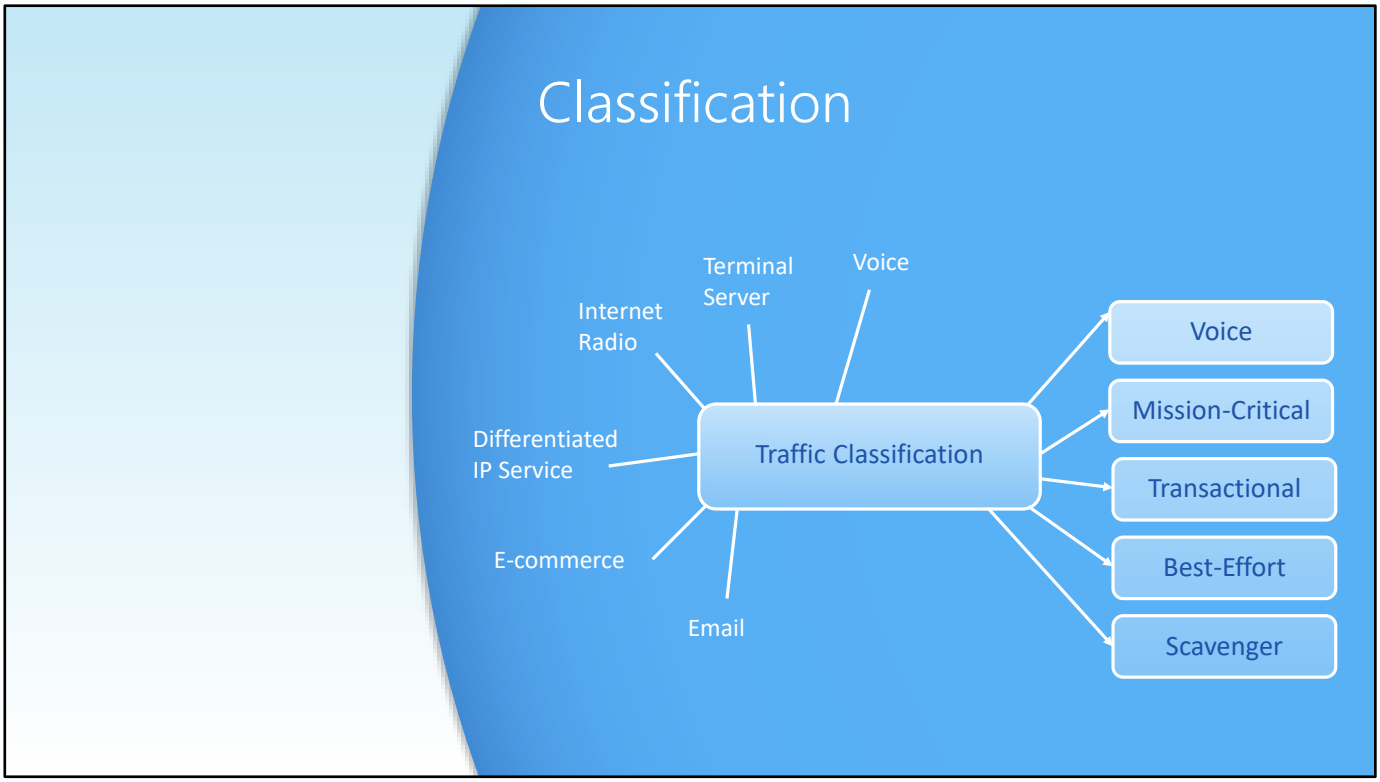


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# Define Policies for Traffic Classes

**Four-class Policy**

- Voice
- Mission-Critical
- Best-Effort
- Scavenger

The following parameter must be defined for each traffic class:

- Min or max bandwidth
- Priorities
- Congestion management technique

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# Conclusions

- Classified network traffic
- Traffic Profiles
  - Voice
  - Video
  - Data
- Traffic class

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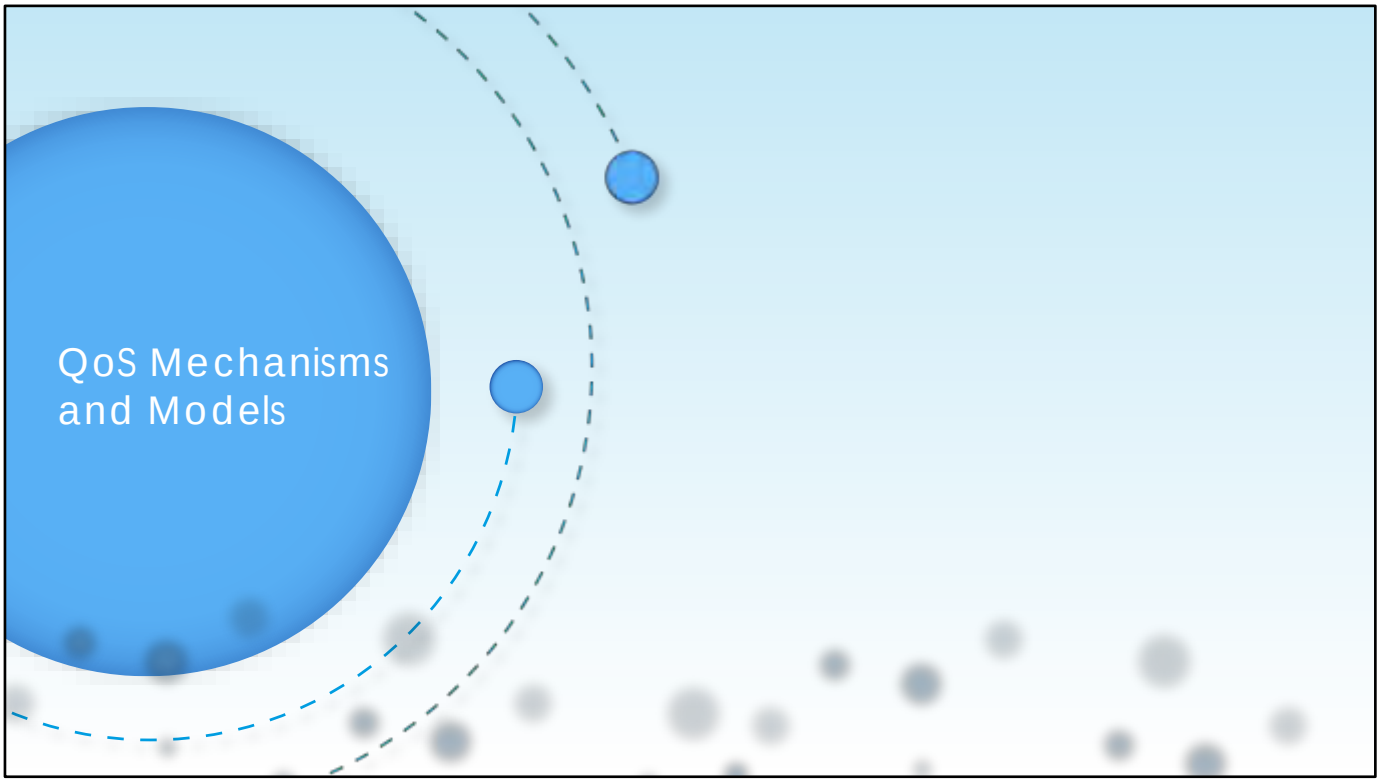


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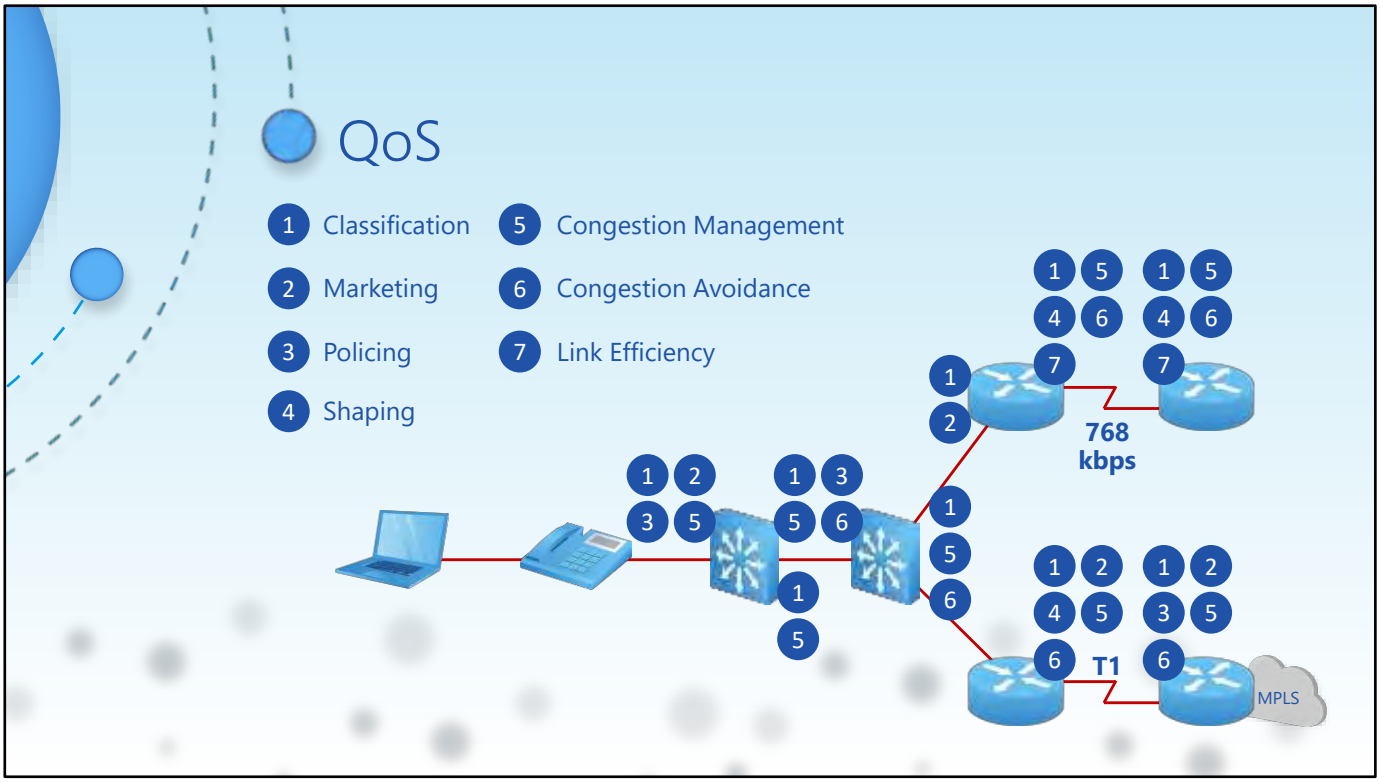


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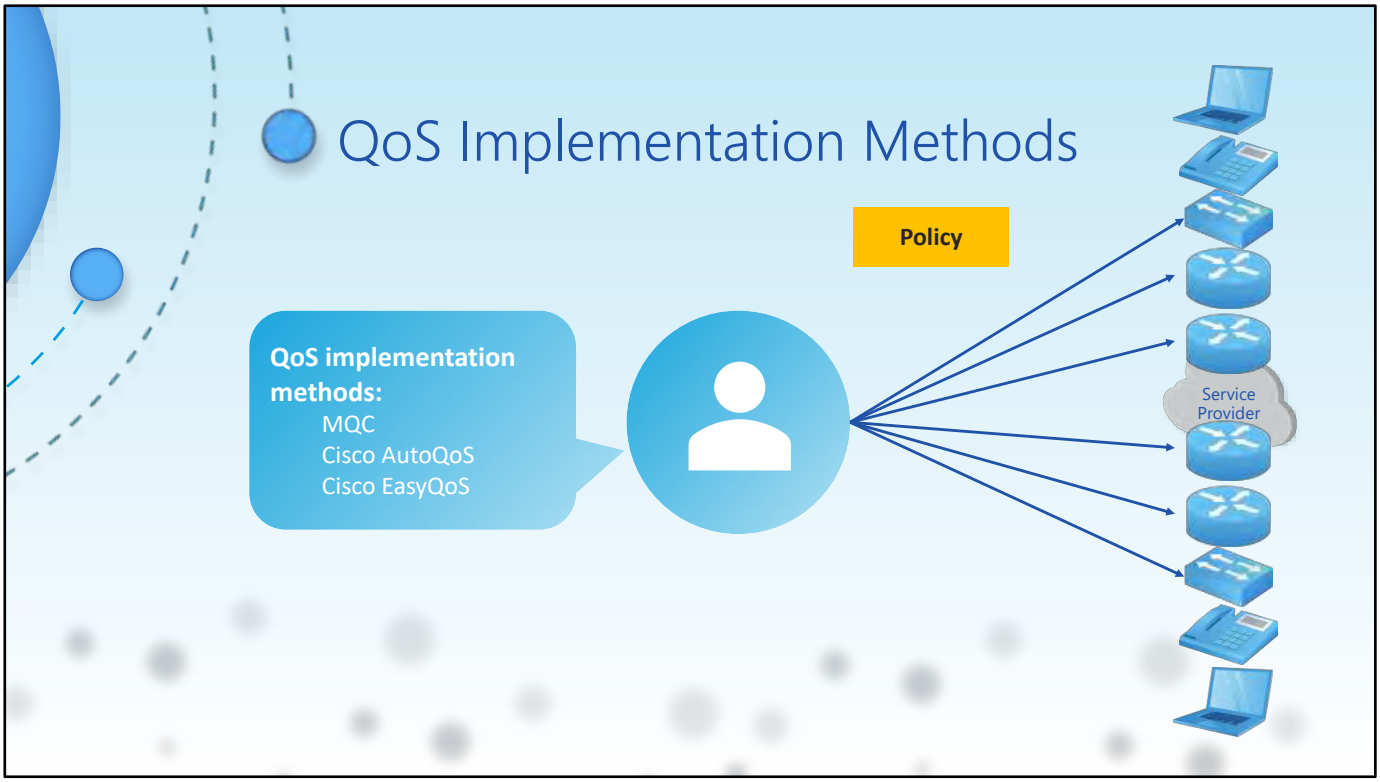


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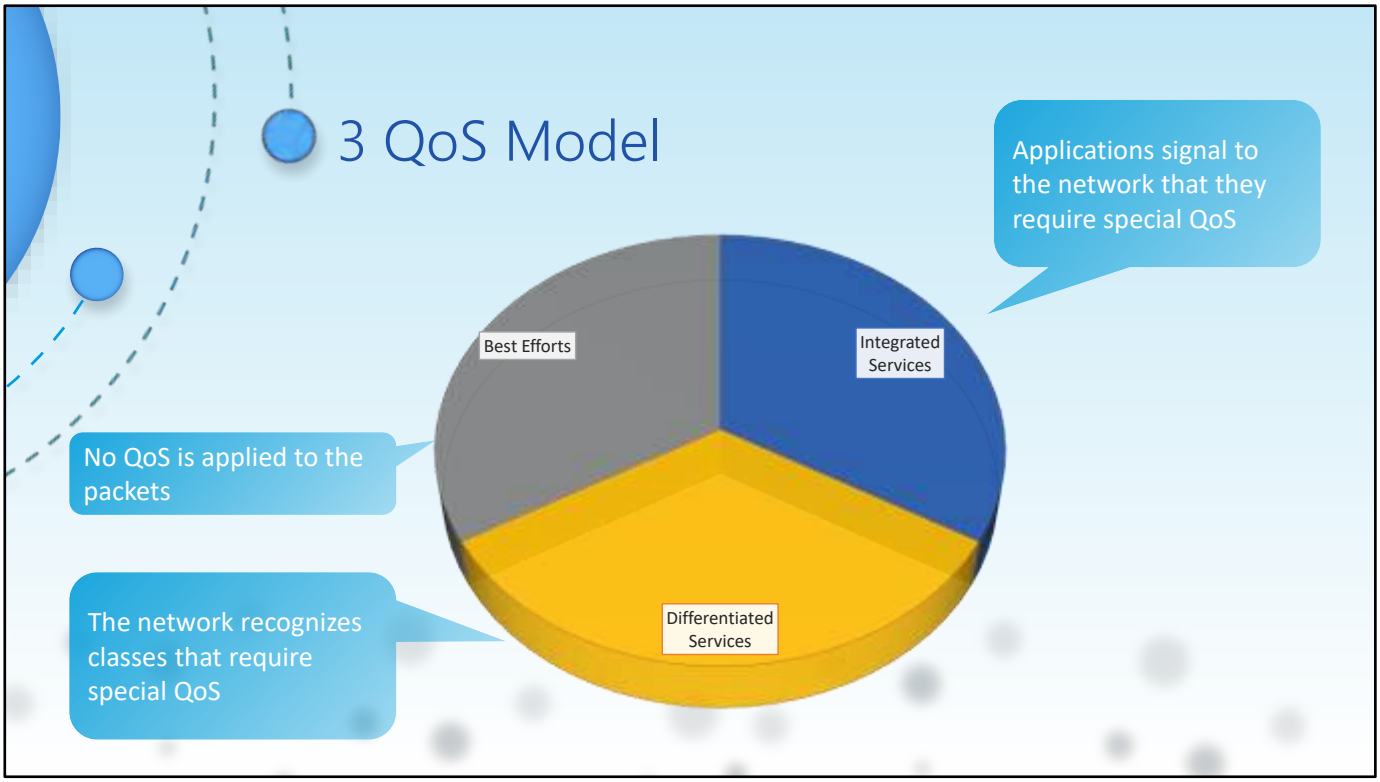


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# Best-Effort QoS Model

The best-effort model is similar to standard mail service.

It is the default mode for all traffic.

There is no differentiation between types of traffic.

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# IntServ Model

IntServ is similar to a private courier service

Some applications have special bandwidth or delay requirements

IntServ guarantees predictable network behavior

No other traffic can use the reserved bandwidth

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# Benefits of IntServ and RSVP

RSVP informs network devices of the flow parameters (IP addresses and port numbers)

RSVP signals QoS requests per individual flow

IntServ supports admission control

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# Drawbacks of IntServ and RSVP

There is continuous signaling because of the stateful RSVP operation

RSVP is not scalable in large networks where per-flow guarantees would have to be made to thousands of concurrent RSVP flows

End-to-end guaranteed service requires that all network devices are RSVP-capable

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# DiffServ Model

DiffServ is similar to a package delivery service

The network traffic is identified by class

The network QoS policy enforces differentiated treatment of traffic classes

You choose the level of service for each traffic class

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# DiffServ Benefits & Drawbacks

DiffServ has these major benefits:

- It is highly scalable
- It provides many different levels of quality

DiffServ also has these drawbacks:

- No absolute guarantee of service quality can be made.
- It requires a set of complex mechanisms to work together throughout the network.

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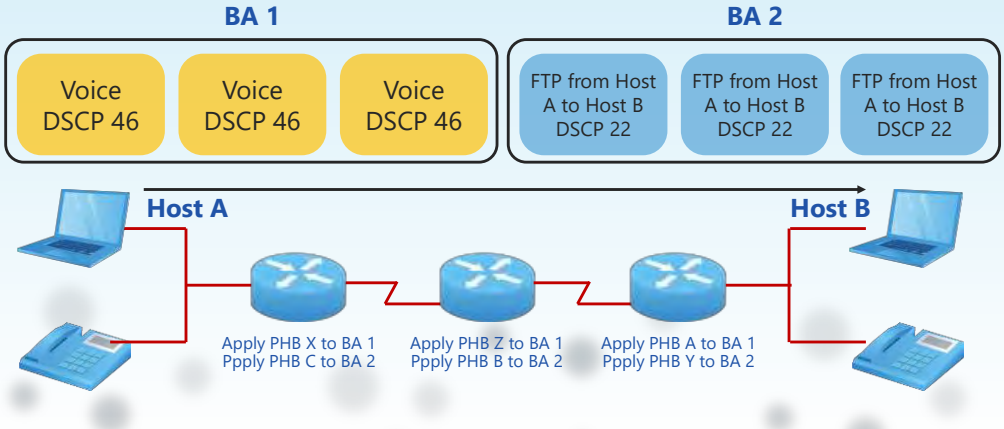
# DiffServ Terminology

- Behavior Aggregate (BA)
- DSCP
- Per Hop Behavior (PHB)

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# Conclusions

- Mechanisms
- Implementation methods
- 3 QoS model
  - Best effort
  - IntServ
  - DiffServ

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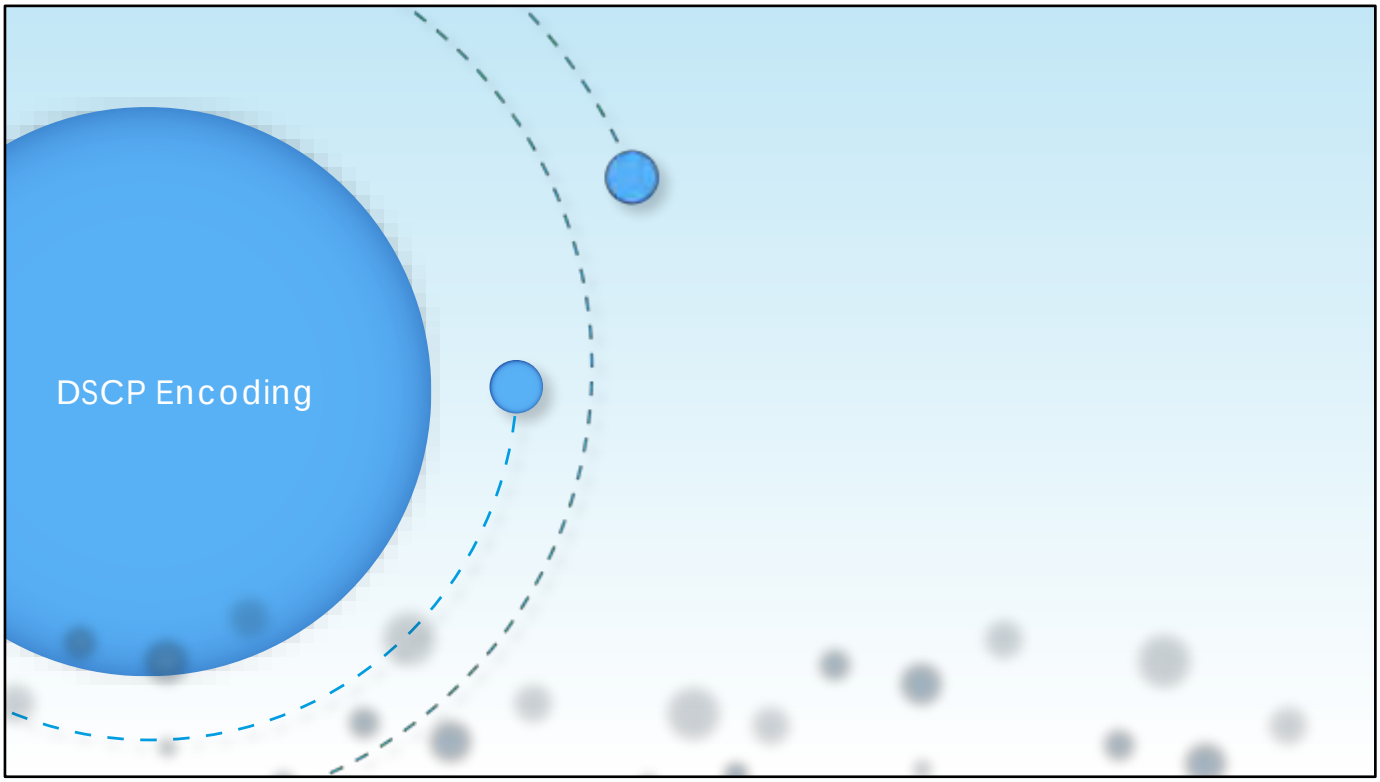


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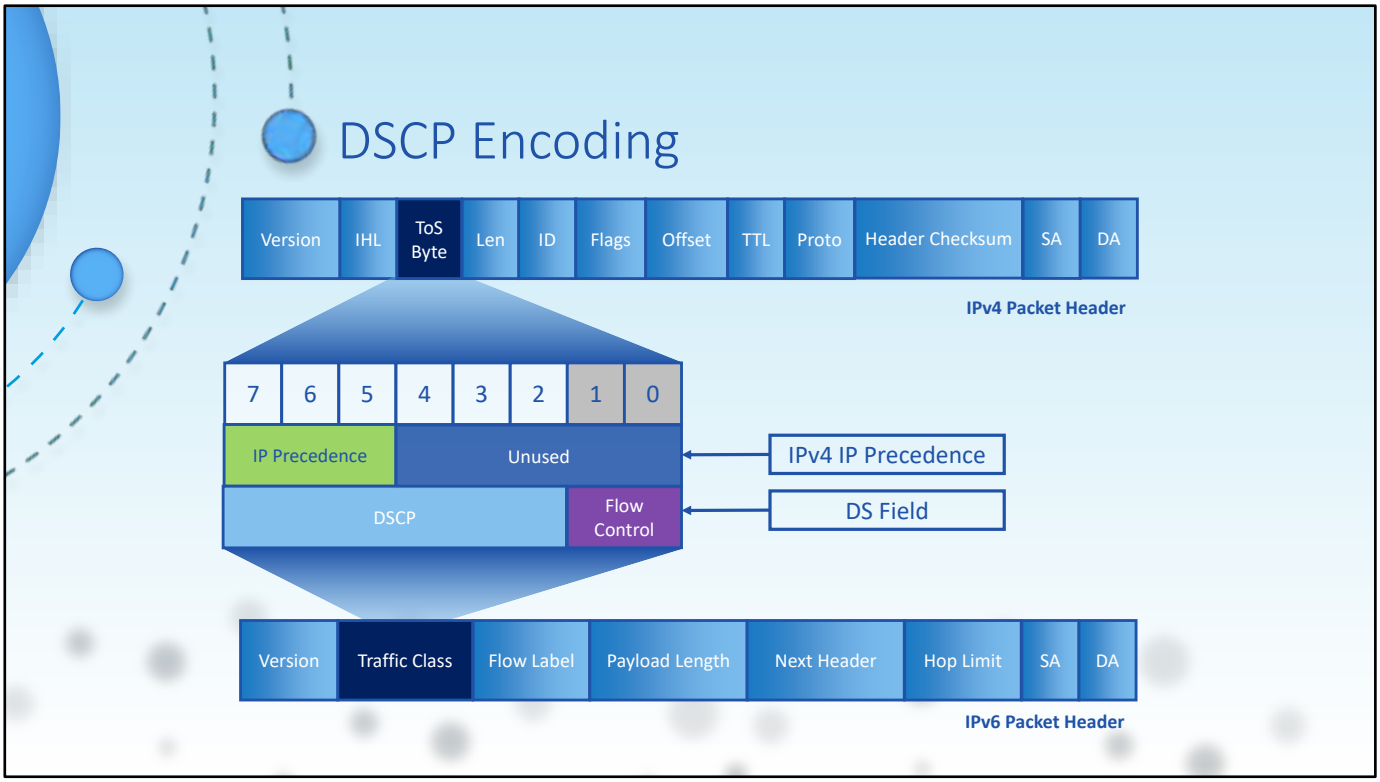


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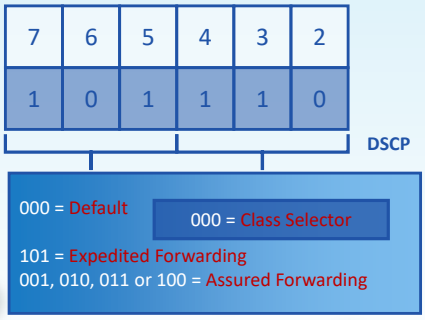
# Per-Hop Behaviors

| PHB | Use | DSCP Bit Settings |
|---|---|---|
| Default | Used for best-effort service | Bits 5 to 7 of DSCP = 000 |
| EF | Used for low-delay service | Bits 5 to 7 of DSCP = 101 |
| AF | Used for guaranteed bandwidth service | Bits 5 to 7 of DSCP = 001, 010, 011, or 100 |
| Class selector | Used for backward compatibility with non-DiffServ-compliant devices (RFC 1812 devices) | Bits 2 to 4 of DSCP = 000 |

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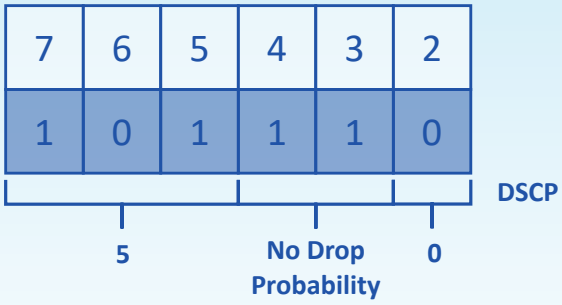
# Expedited Forwarding and Assured Forwarding

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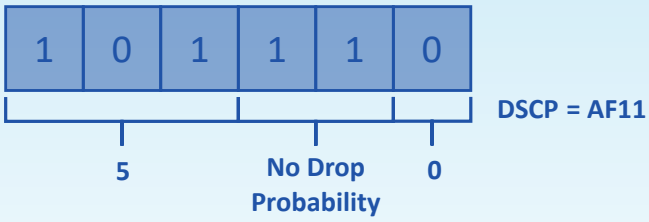
# AF Drop Probability




| Class | Value | | |
|---|---|---|---|
| AF1 | 001 | dd | 0 |
| AF2 | 010 | dd | 0 |
| AF3 | 011 | dd | 0 |
| AF4 | 100 | dd | 0 |

| Drop Probability (dd) | Value | AF Value |
|---|---|---|
| Low | 01 | AF11 |
| Medium | 10 | AF12 |
| High | 11 | AF13 |

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# AF Class with the Drop Probability

| Drop | AF1x | AF2x | AF3x | AF4x |
|---|---|---|---|---|
| Low | AF11 = DSCP 10 or 001010 | AF21 = DSCP 18 or 010010 | AF31 = DSCP 26 or 011010 | AF41 = DSCP 34 or 100010 |
| Medium | AF12 = DSCP 12 or 001100 | AF22 = DSCP 20 or 010100 | AF32 = DSCP 28 or 011100 | AF42 = DSCP 36 or 100100 |
| High | AF13 = DSCP 14 or 001110 | AF23 = DSCP 22 or 010110 | AF33 = DSCP 30 or 011110 | AF43 = DSCP 38 or 100110 |

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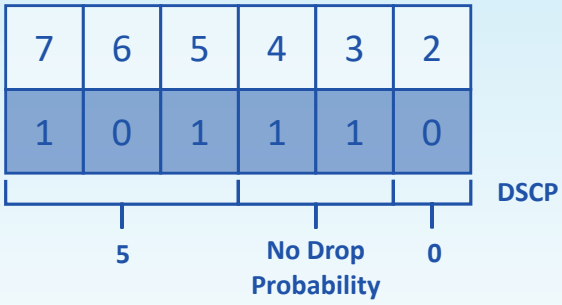
# Expedited Forwarding and Assured Forwarding

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# Expedited Forwarding and Assured Forwarding

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# AF Class with the Drop Probability

| Drop | AF1x | AF2x | AF3x | AF4x |
|---|---|---|---|---|
| Low | AF11 = DSCP 10 or 001010 | AF21 = DSCP 18 or 010010 | AF31 = DSCP 26 or 011010 | AF41 = DSCP 34 or 100010 |
| Medium | AF12 = DSCP 12 or 001100 | AF22 = DSCP 20 or 010100 | AF32 = DSCP 28 or 011100 | AF42 = DSCP 36 or 100100 |
| High | AF13 = DSCP 14 or 001110 | AF23 = DSCP 22 or 010110 | AF33 = DSCP 30 or 011110 | AF43 = DSCP 38 or 100110 |

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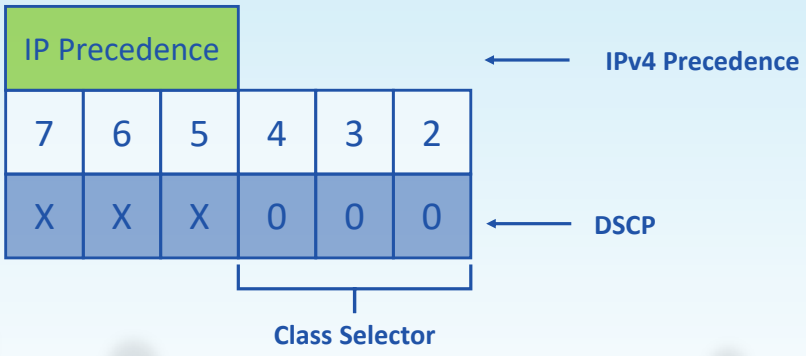
# Class Selector

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# DSCP Summary

| PHB | | | | DSCP | | | Maps to IP Precedence |
|---|---|---|---|---|---|---|---|
| Default (Best Effort) | | | | 0<br>000000 | | | 0 |
| Scavenger (Less-than-Best-Effort) | | | | 8<br>001000 | | | 1 |
| | Low | Med | High | | | | |
| Assured Forwarding Class 1 | AF11 | AF12 | AF13 | 10<br>001010 | 12<br>001100 | 14<br>001110 | 1 |
| Class 1 | AF11 | AF12 | AF13 | 18<br>010010 | 20<br>010100 | 22<br>010110 | 2 |
| Class 1 | AF11 | AF12 | AF13 | 26<br>011010 | 28<br>001100 | 30<br>011110 | 3 |
| Class 1 | AF11 | AF12 | AF13 | 34<br>100010 | 36<br>100100 | 38<br>100110 | 4 |
| Expedited Forwarding | EF | | | 46<br>101110 | | | 5 |

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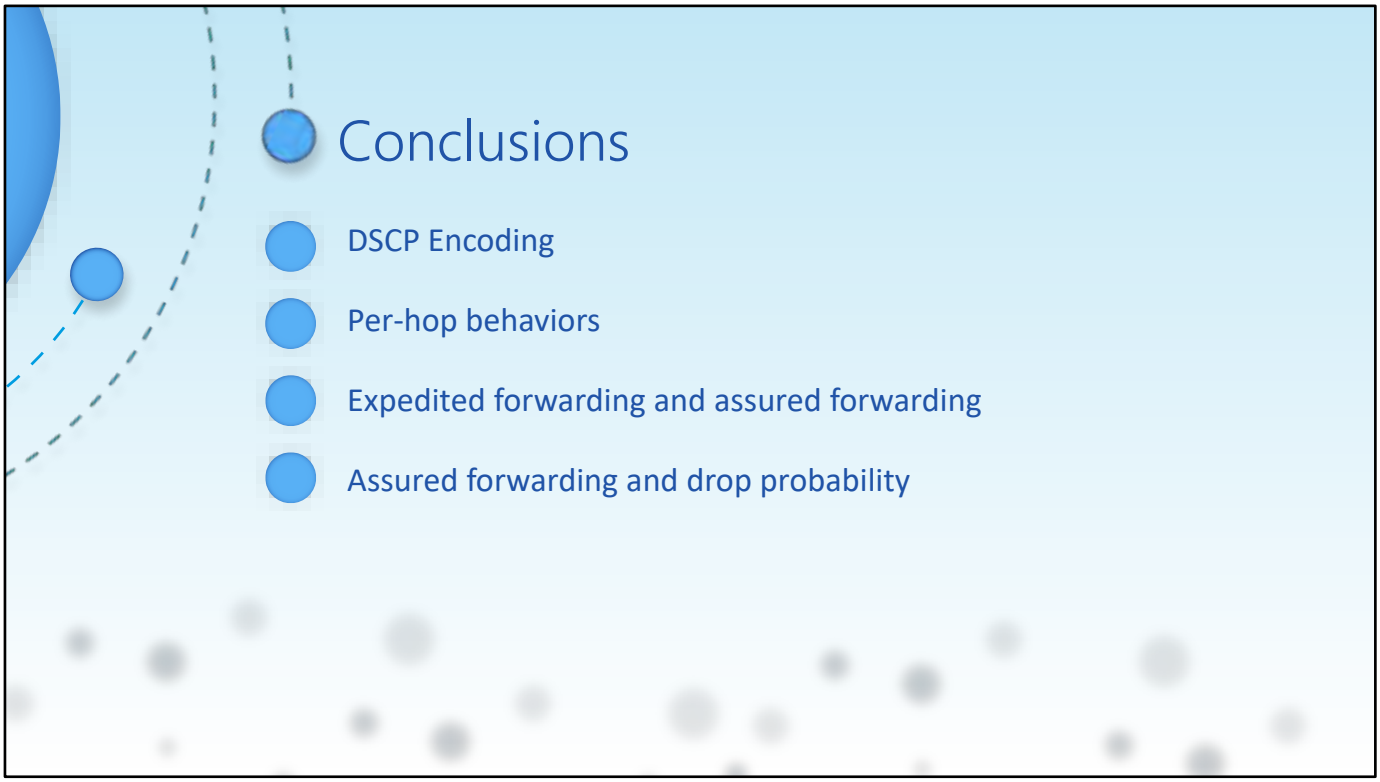


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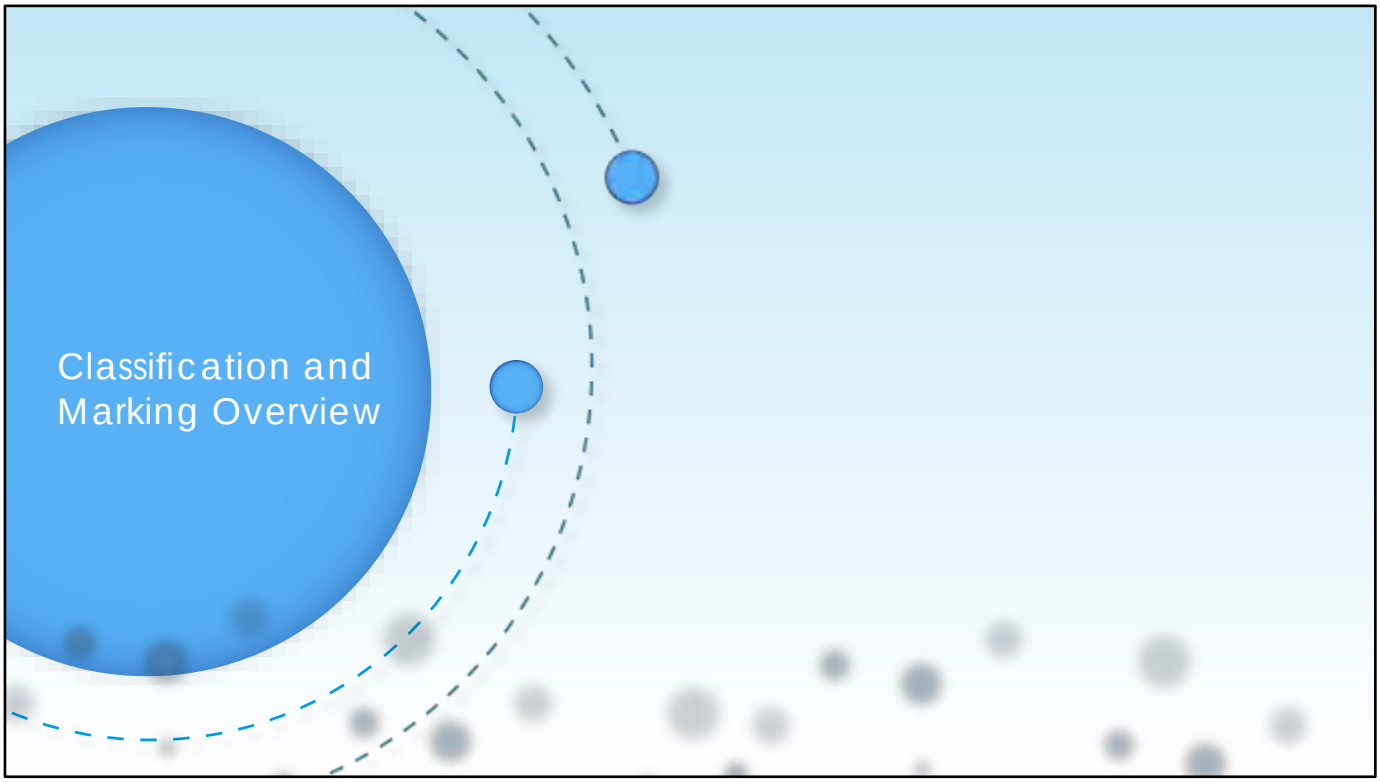


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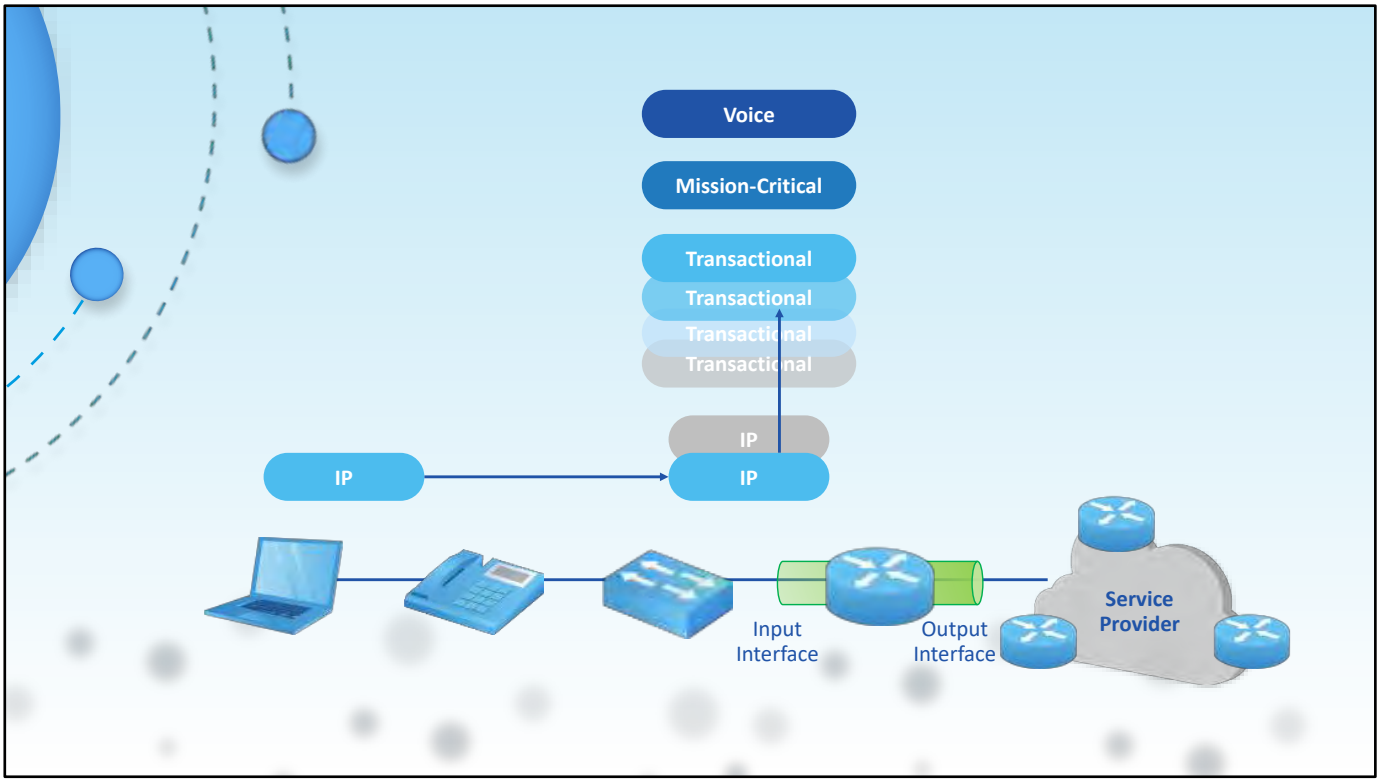


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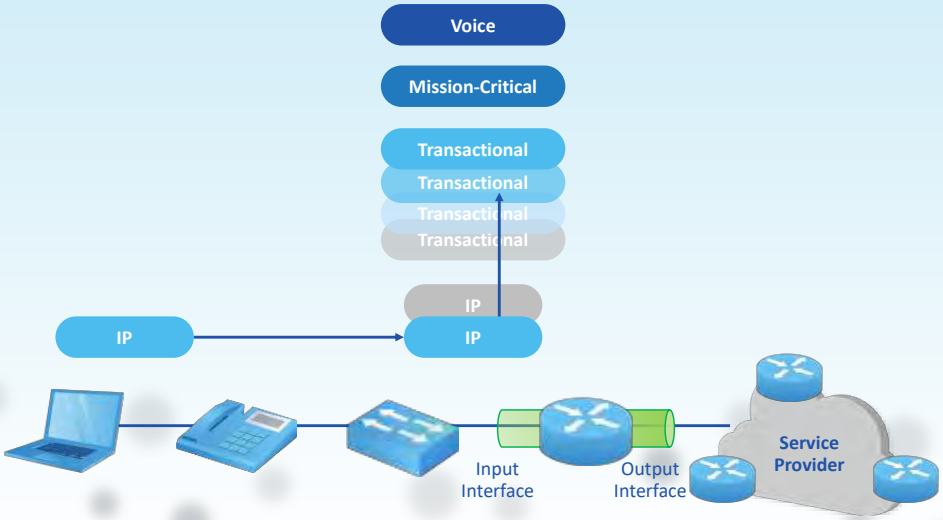
# Classification and Marking Overview

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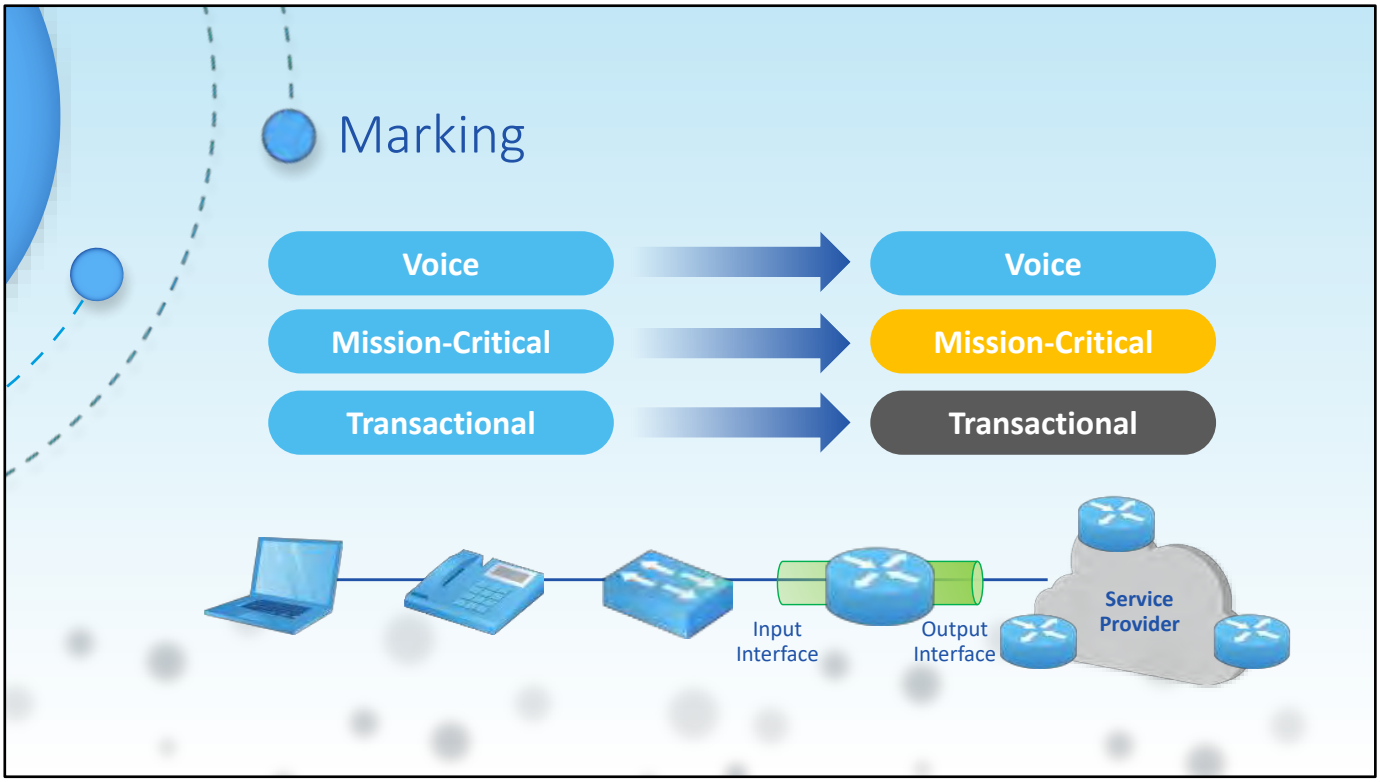


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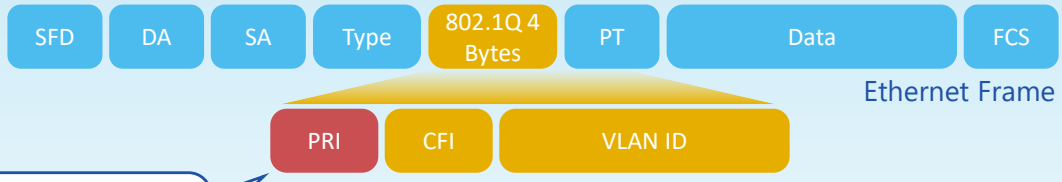
# Classification and Marking at the Network and Data Link Layers




Ethernet Frame




3 Bits Used for CoS (IEEE 802.1p CoS

802.1p User Priority field is also called Class of Service (CoS).

Different types of traffic are assigned different CoS values.

CoS 6 and 7 are reserved for network use.

IEEE 802.1Q

| Cos | Acronym | Traffic Characteristics |
|---|---|---|
| 0 | BE | Best Effort |
| 1 | BK | Background |
| 2 | EE | Excellent Effort |
| 3 | CA | Critical Applications |
| 4 | VI | Video, < 100 ms Latency |
| 6 | IC | Internetwork Control |
| 7 | NC | Network Control |

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# The TCI field is composed of three field

**User priority bits (3 bits):**

IEEE 802.1p standard defines the specifications of this 3-bit field

CoS markings use the three 802.1p user priority bits

The 3 bits allow a direct correspondence with IPv4 (IP precedence) ToS values

**CFI (1 bit)**

This bit indicates whether the bit order is canonical or noncanonical

**VLAN identifier, or VLAN ID (12 bits)**

VLAN ID field is a 12-bit field that defines the VLAN that is used by 802.1Q

| Cos | Acronym | Traffic Characteristics |
|---|---|---|
| 0 | BE | Best Effort |
| 1 | BK | Background |
| 2 | EE | Excellent Effort |
| 3 | CA | Critical Applications |
| 4 | VI | Video, < 100 ms Latency |
| 6 | IC | Internetwork Control |
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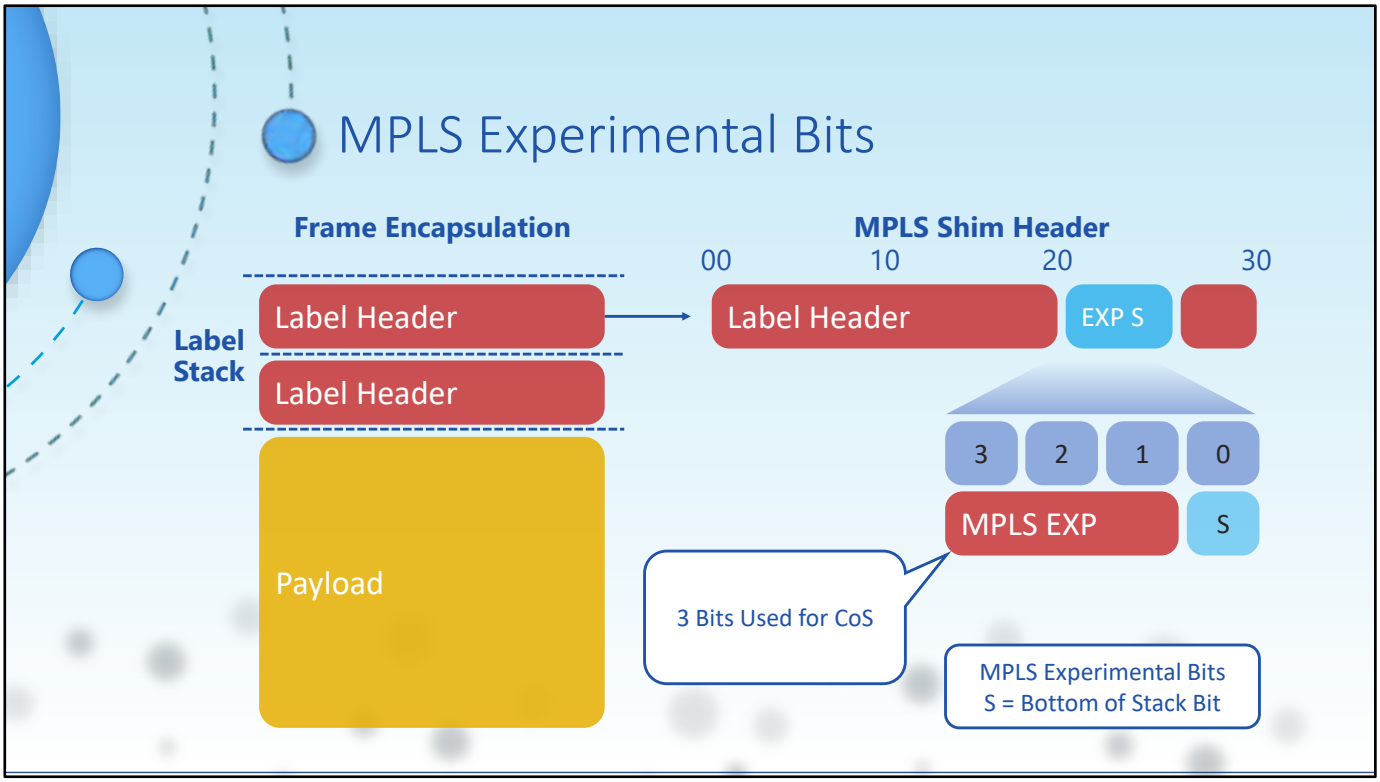


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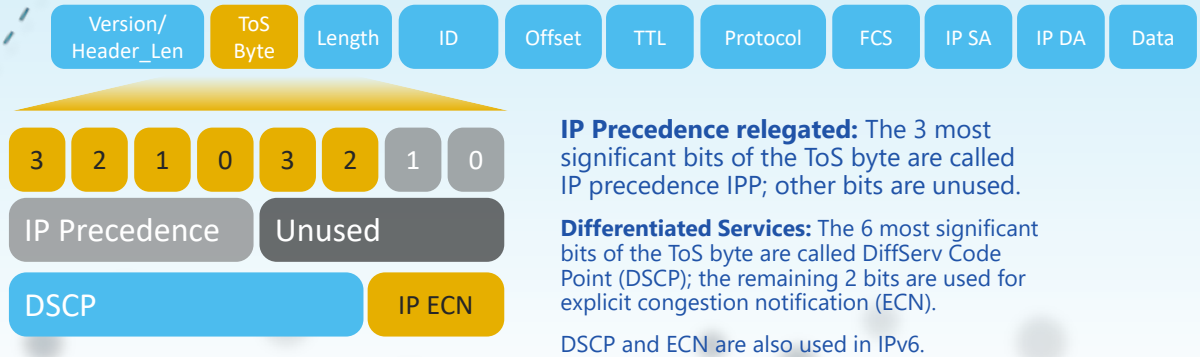
# Classification and Marking at the Network Layer




**IP Precedence relegated:** The 3 most significant bits of the ToS byte are called IP precedence IPP; other bits are unused.

**Differentiated Services:** The 6 most significant bits of the ToS byte are called DiffServ Code Point (DSCP); the remaining 2 bits are used for explicit congestion notification (ECN).

DSCP and ECN are also used in IPv6.

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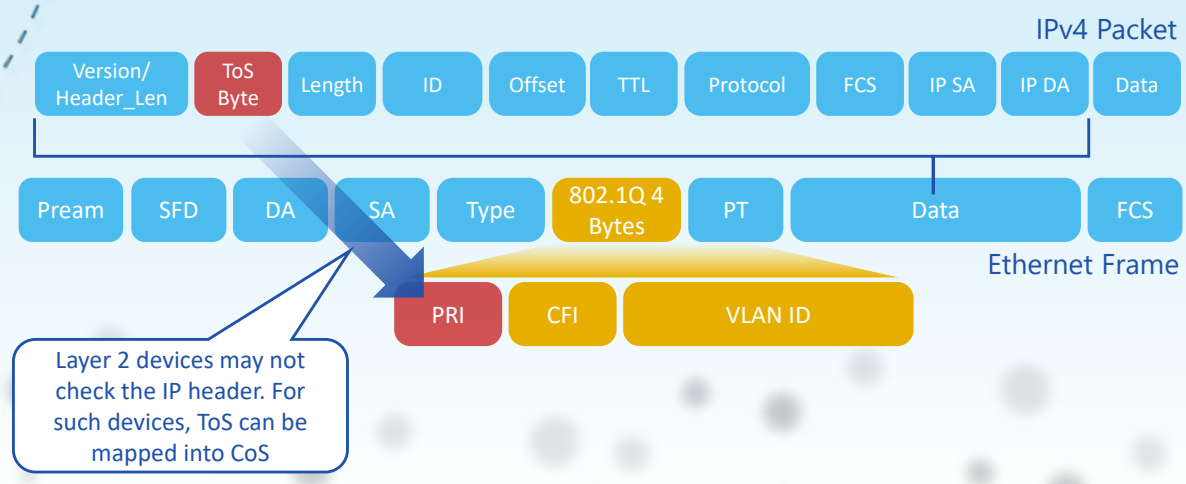
# Mapping QoS Markings Between OSI Layers

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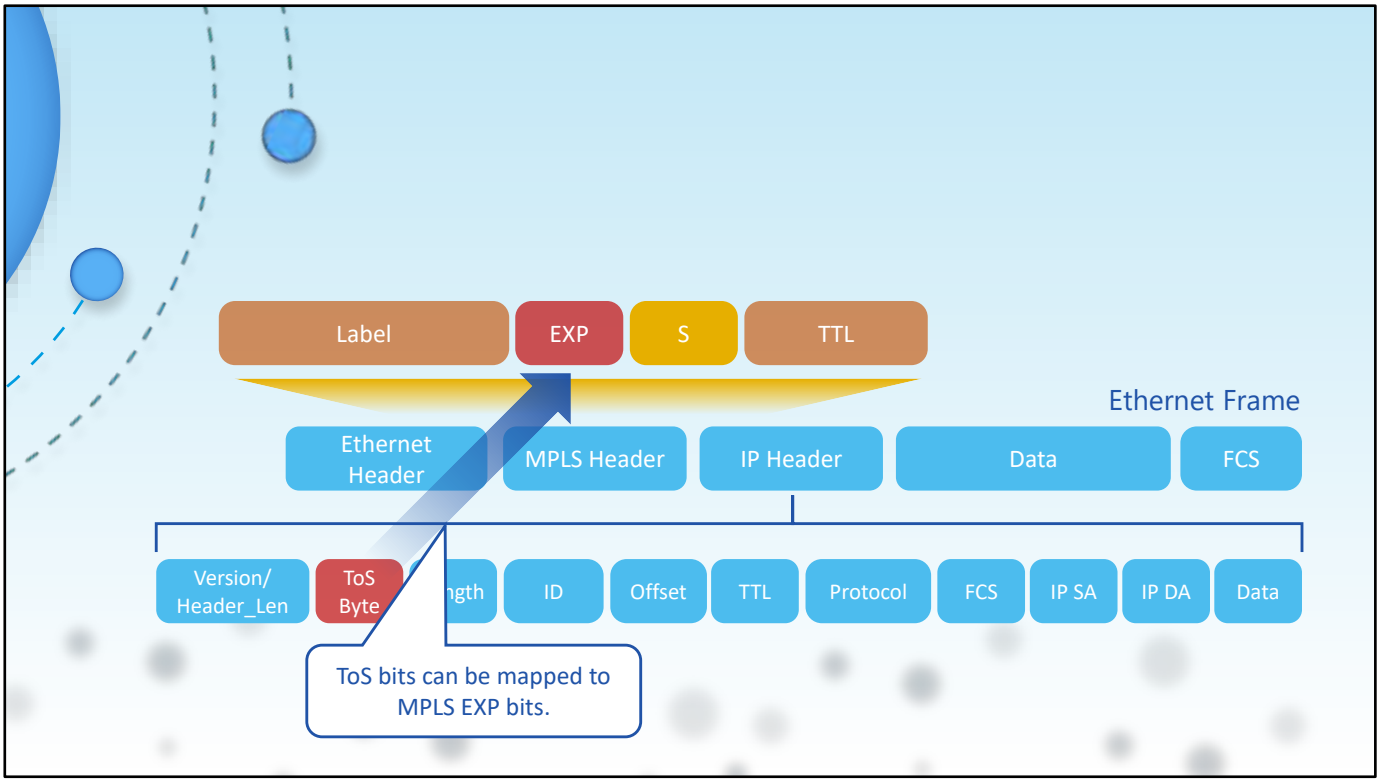


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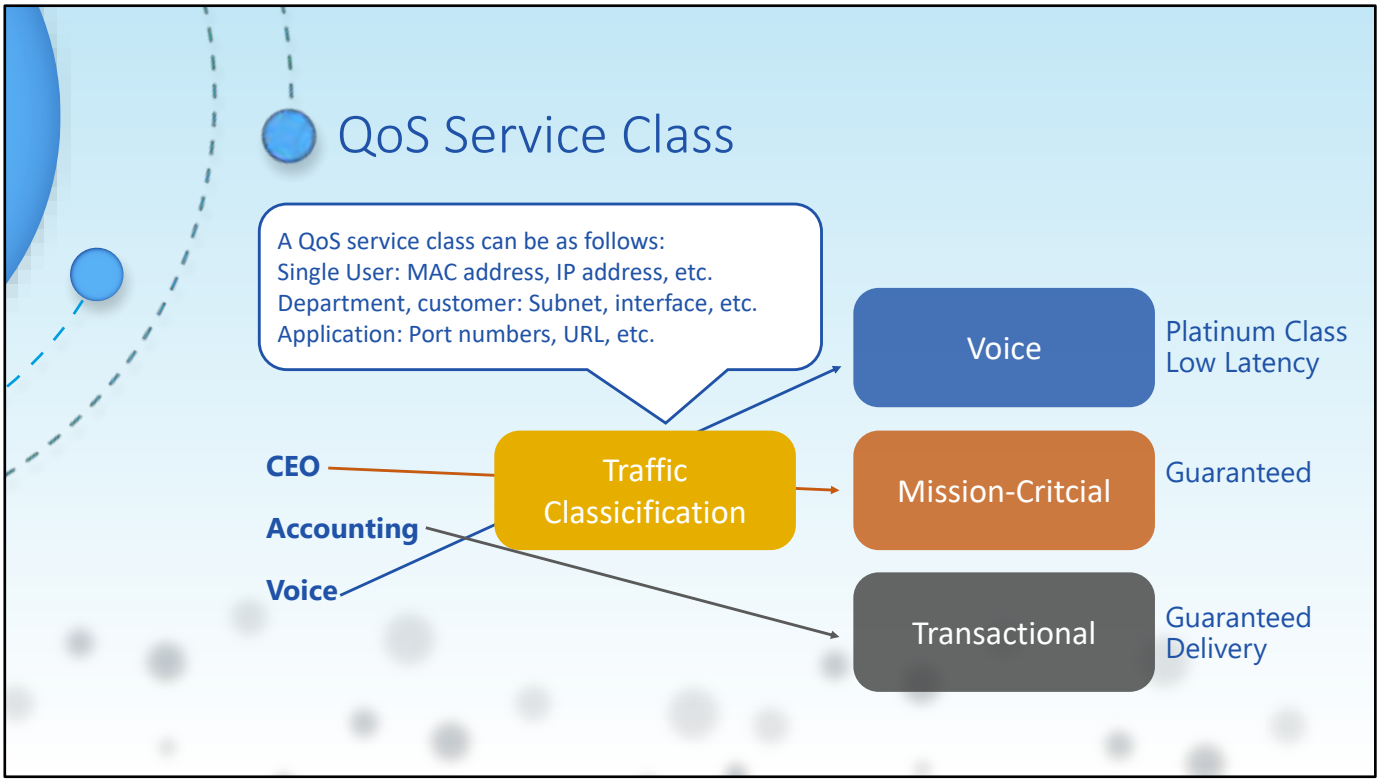


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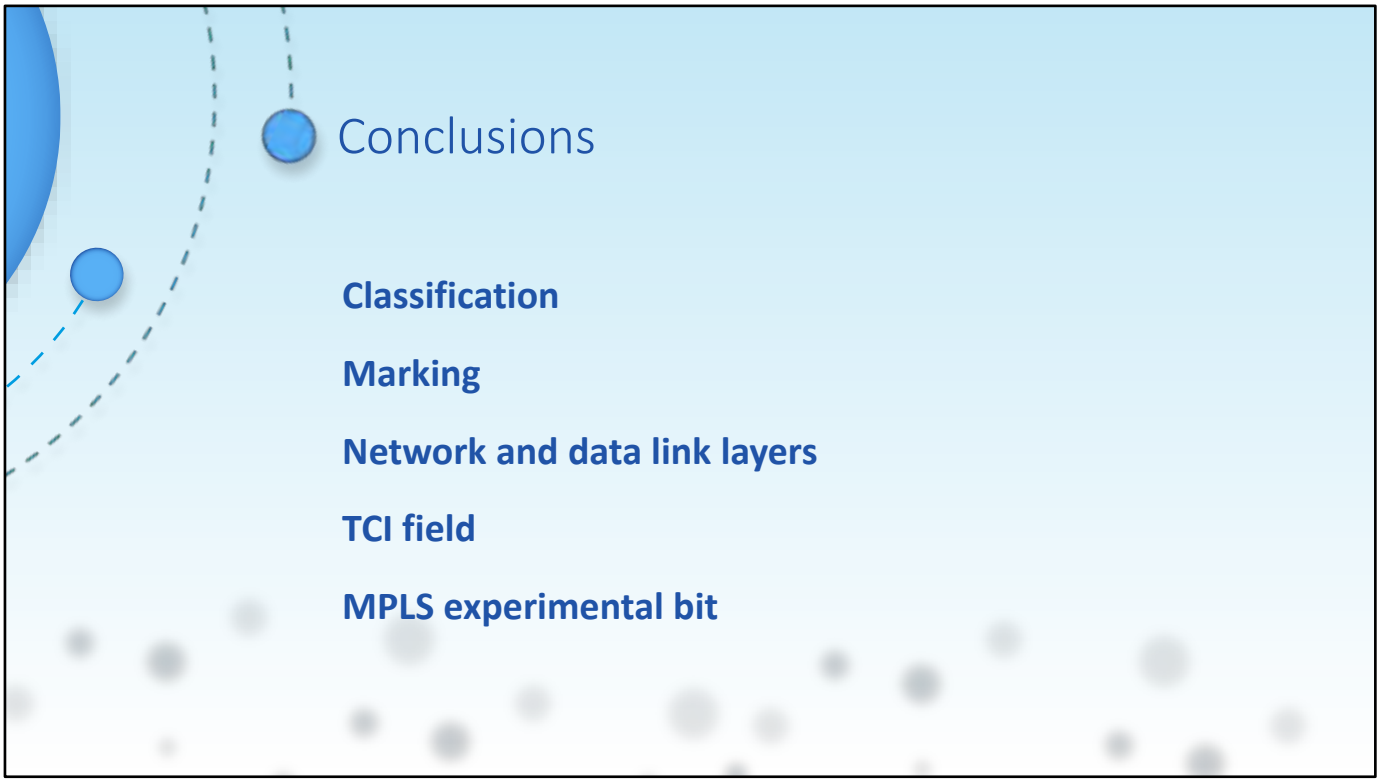


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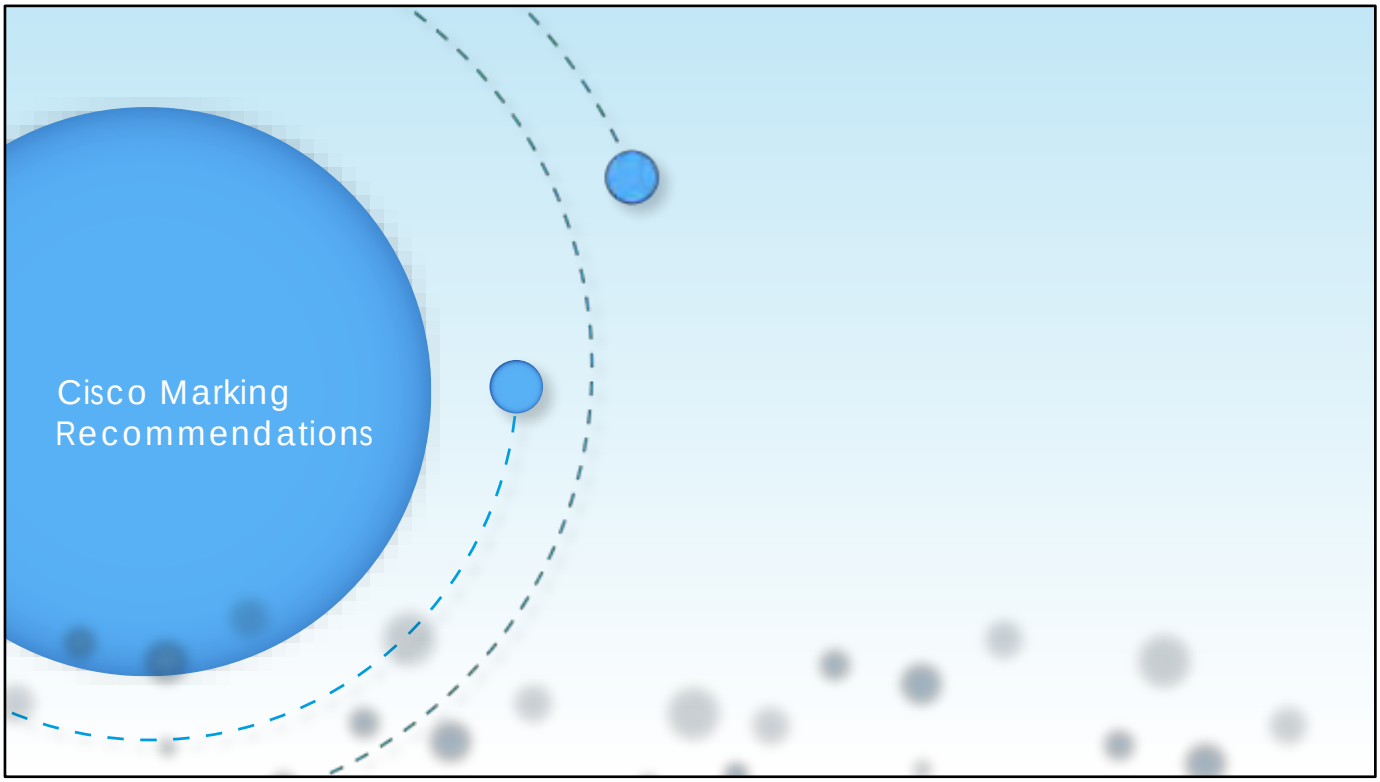


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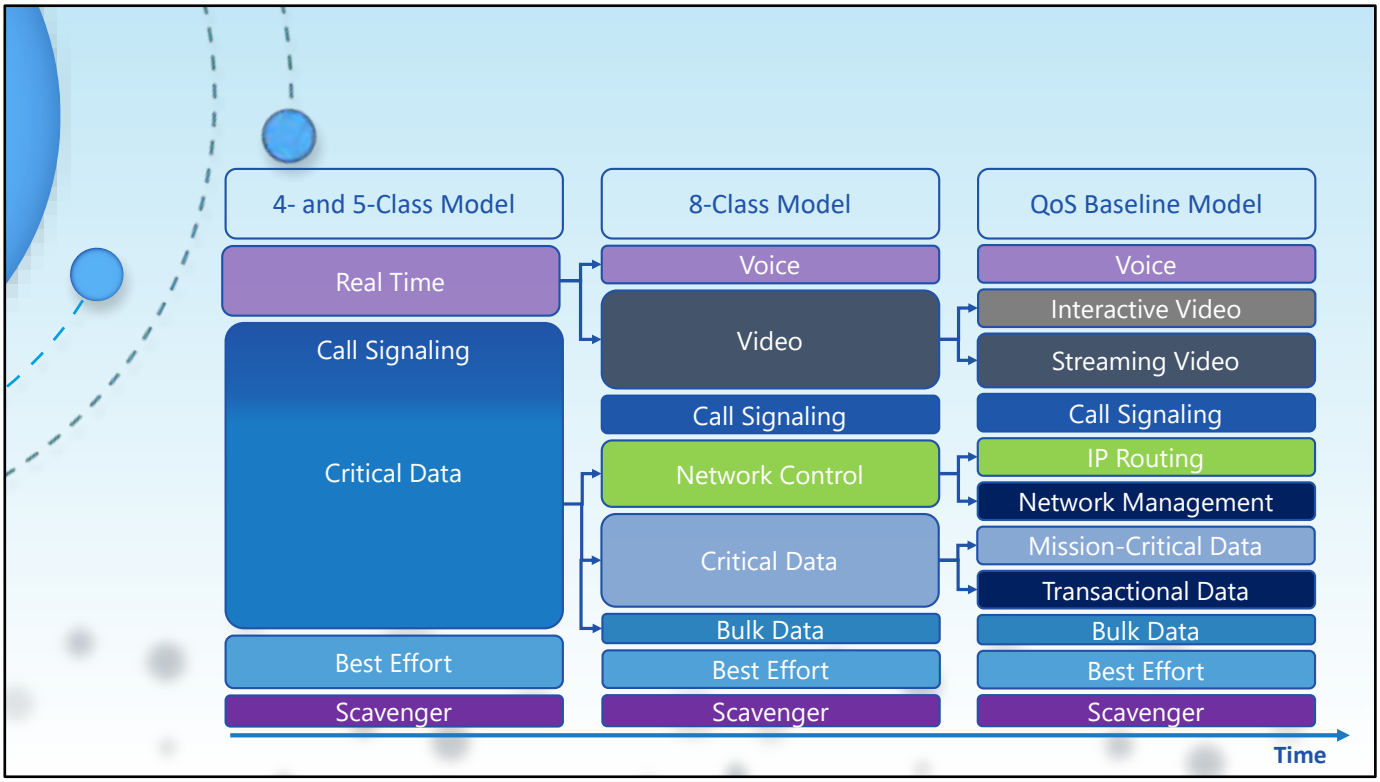


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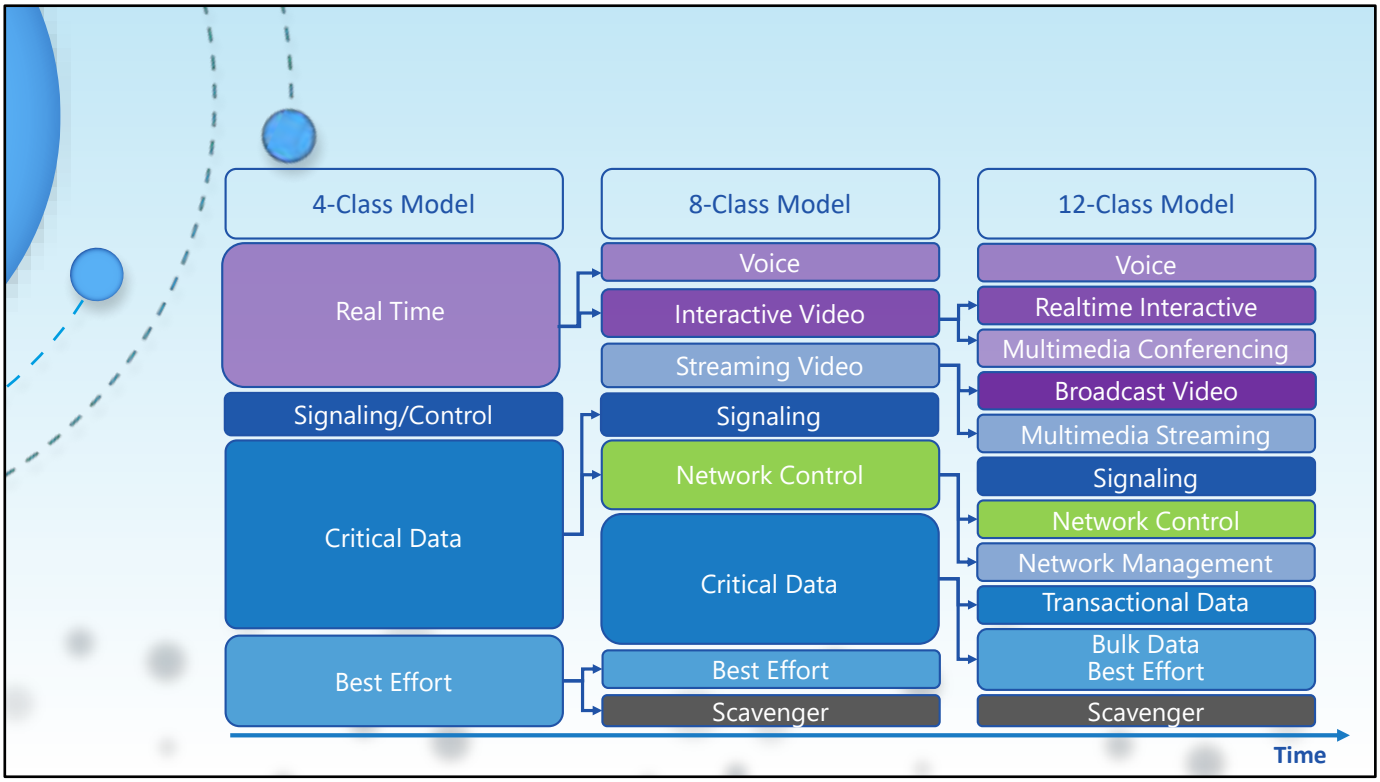


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| Application | Layer 3 Classification | | Layer 2 CoS/MPLS EXP |
|---|---|---|---|
| | PHB | DSCP | |
| VoIP Telephony | EF | 46 | 5 |
| Real-time Interactive | CS4 | 32 | 4 |
| Multimedia Conferencing | AF41 | 34 | 4 |
| Broadcast Video | CS5 | 40 | 5 |
| Multimedia Streaming | AF31 | 26 | 3 |
| Call Signaling | CS3 | 24 | 3 |

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| Application | Layer 3 Classification | | Layer 2 CoS/MPLS EXP |
|---|---|---|---|
| | PHB | DSCP | |
| Network Control | CS6 | 48 | 6 |
| Network Management | CS2 | 16 | 2 |
| Transactional Data | AF21 | 18 | 2 |
| Bulk Data | AF11 | 10 | 1 |
| Scavenger | CS1 | 8 | 1 |
| Best Effort | 0 | 0 | 0 |

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# QoS Markings in a SIP Call Flow

| Endpoint | Cisco TelePresence Endpoint | Unified Communications Video Endpoint |
|---|---|---|
| Cisco IP Phone 8800 Series | | X |
| Cisco Jabber | | X |
| DX650, DX70 and DX80 with non-CE Software | | X |
| Cisco DX70 and DX80 (Cisco TelePresence CE Software) | X | |
| Cisco TelePresence MX Series | X | |
| Cisco TelePresence SX Series | X | |
| Cisco TelePresence IX Series | X | |

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# QoS Markings in a SIP Call Flow

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| Cisco TelePresence MX Series | X | |
| Cisco TelePresence SX Series | X | |
| Cisco TelePresence IX Series | X | |

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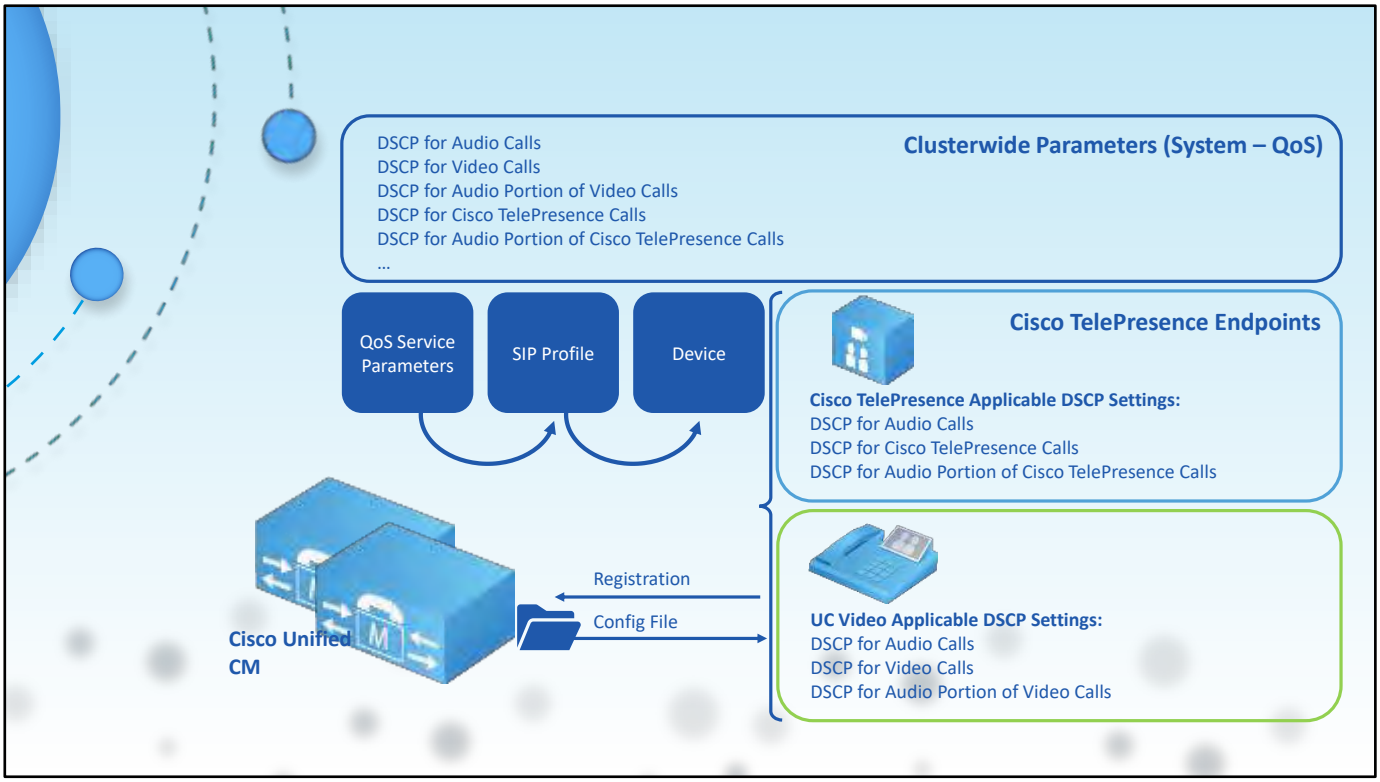


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| DSCP Parameter | Cisco TelePresence Endpoint | UC Video Endpoint | Call Flow |
|---|---|---|---|
| DSCP for Audio Calls | X | X | Voice only |
| DSCP for Video Calls | | X | Video: Audio and video stream of a video call, unless the endpoint supports the DSCP for Audio Portion of Video Calls parameter (Cisco IP Phone 8845 and 8865) |
| DSCP for Audio Portion of Video Calls | | X | Audio stream of a video call: Applicable only to endpoints that support the parameter. |
| DSCP for TelePresence Calls | X | | Immersive video: Audio and video stream of an immersive video call, unless the endpoint supports the DSCP for Audio Portion of TelePresence Calls parameter (Cisco DX70 and DX80, Cisco TelePresence IX, SX, and MX Series) |
| DSCP for Audio Portion of TelePresence Calls | X | | Audio stream of a video call: Applicable only to endpoints that support the parameter. |

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| Cisco Unified Communications Manager Services Parameters or SIP Profile QoS Parameters | Default Values | | Recommended Values for Desktop and Telepresence Endpoints | | Recommended Values for Jabber Endpoints | |
|---|---|---|---|---|---|---|
| | **DSCP** | **PHB** | **DSCP** | **PHB** | **DSCP** | **PHB** |
| DSCP for Audio Calls | 46 | EF | 46 | EF | 46 | EF |
| DSCP for Video Calls | 34 | AF41 | 34 | AF41 | 36 | AF42 |
| DSCP for Audio Portion of Video Calls | 34 | AF41 | 46 | EF | 46 | EF |
| DSCP for Telepresence Calls | 32 | CS4 | 34 | AF41 | 34 | AF41 |
| DSCP for Audio Portion of Telepresence Calls | 32 | CS4 | 46 | EF | 46 | EF |

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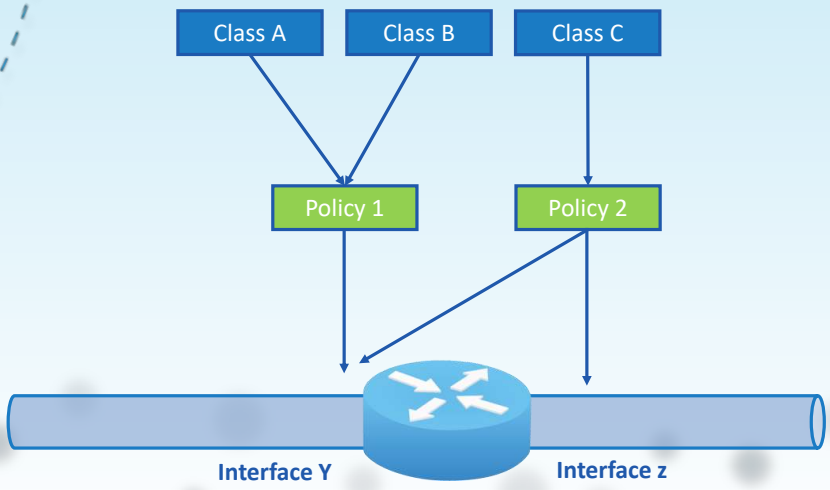
# MQC Classification and Marking Options

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# MQC Components

| Define Classes or Traffic | Define QoS Policies for Classes | Apply a Service Policy |
|---|---|---|
| " What traffic do we care about?" | "What will be done to this traffic?" | "Where will this policy be implemented?" |
| Defines each class of traffic, using a class map | Defines a policy map, which configures the QoS features that are associated with traffic classes that were previously identified using class maps | Attaches a service policy that is configured with a policy map to an interface |

**Define Overall QoS Policy**

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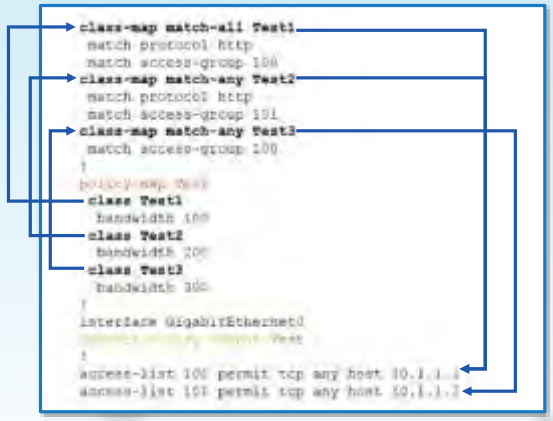
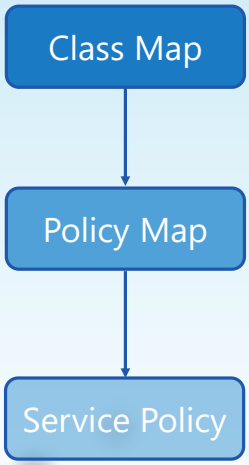
# Example: MQC Policy Configuration

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# Class Maps

Each class map contains three major elements:

1. A case-sensitive name
2. Instructions on the mode in which to operate:
   - **-match-all (default mode):** All conditions must succeed
   - **-match-any:** At least one condition must succeed
3. A series of match commands

```
class-map match-all Test1
 match protocol http
 match access-group 100
class-map match-any Test2
 match protocol http
 match access-group 101
class-map match-any Test3
 match access-group 100
```

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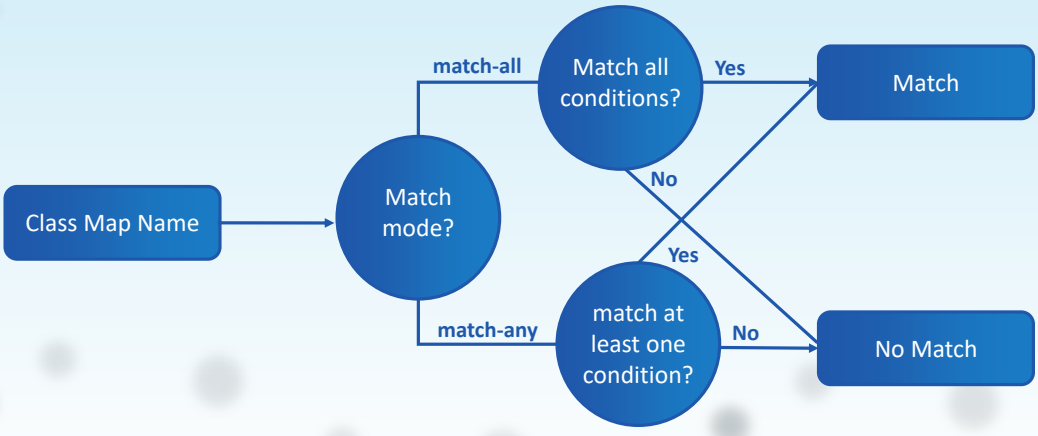
# Match Operation in Class Maps

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# Policy Maps

Each policy map contains three major elements:

1. A case-sensitive name
2. A traffic class or classes
3. The QoS policy that is associated with that traffic class

```
policy-map Test
 class Test1
  priority 100
 class Test2
  bandwidth 200
 class Test3
  shape average 384000
```

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# Service Policy

The **service policy** command is used to apply a QoS policy

The service-policy command can be applied at the following levels:
- At the interface level, inbound or outbound
- At the class level, within a policy map

```
interface GigabitEthernet 0/0
service-policy output Test
```

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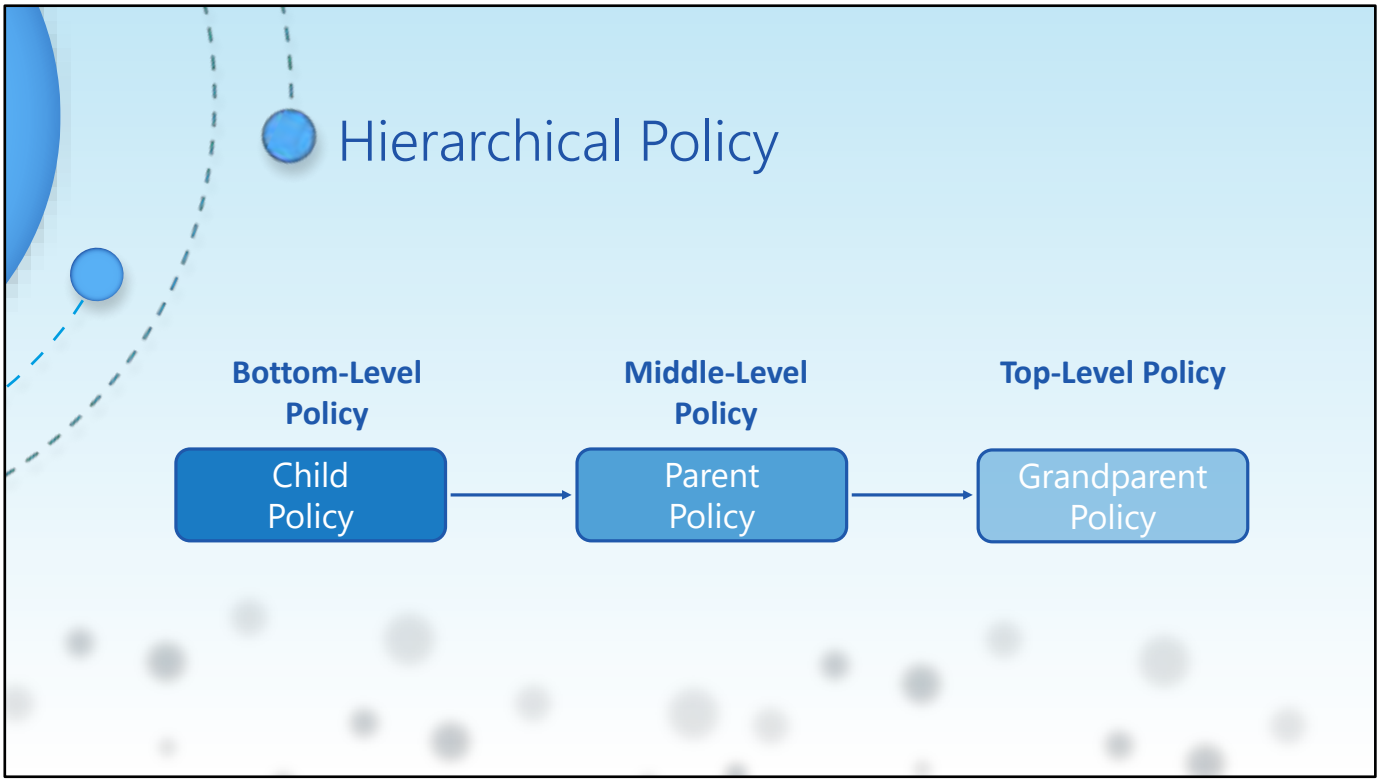


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# Example: Hierarchical QoS Policy

```
class-map HTTP
 match protocol http
!
policy-map QueueAll
 class HTTP
  bandwidth 1000
!
class-map AllTraffic
 match any
!
policy-map ShapeAll
 class AllTraffic
  shape 2000000
  service-policy QueueAll
!
interface FastEthernet/0
 service-policy output ShapeAll
```

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# Conclusions

- Marking recommendations
- QoS Marking in a SIP call flow

- MQC Classification and marking options
- MQC components
- MQC policy configuration

- Class maps
- Policy maps
- Service and hierarchical policy

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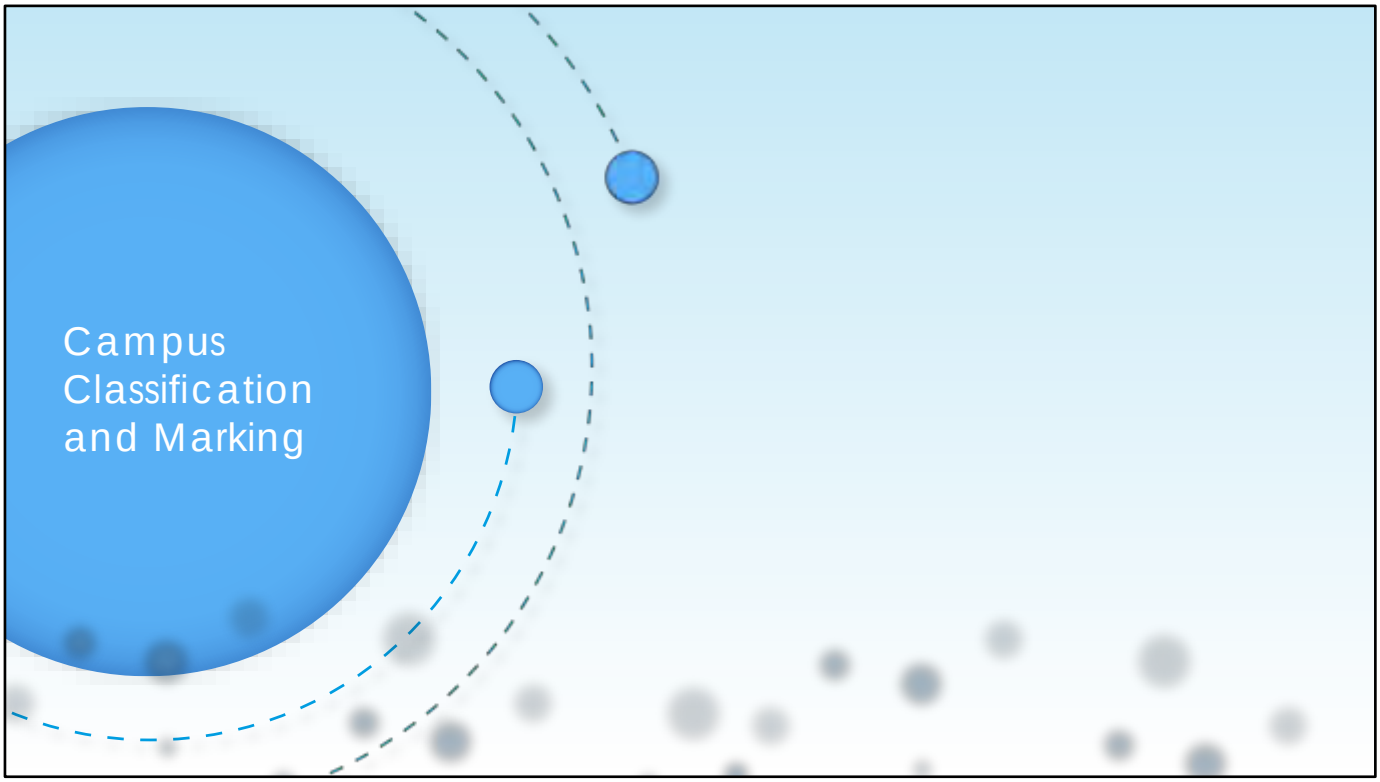


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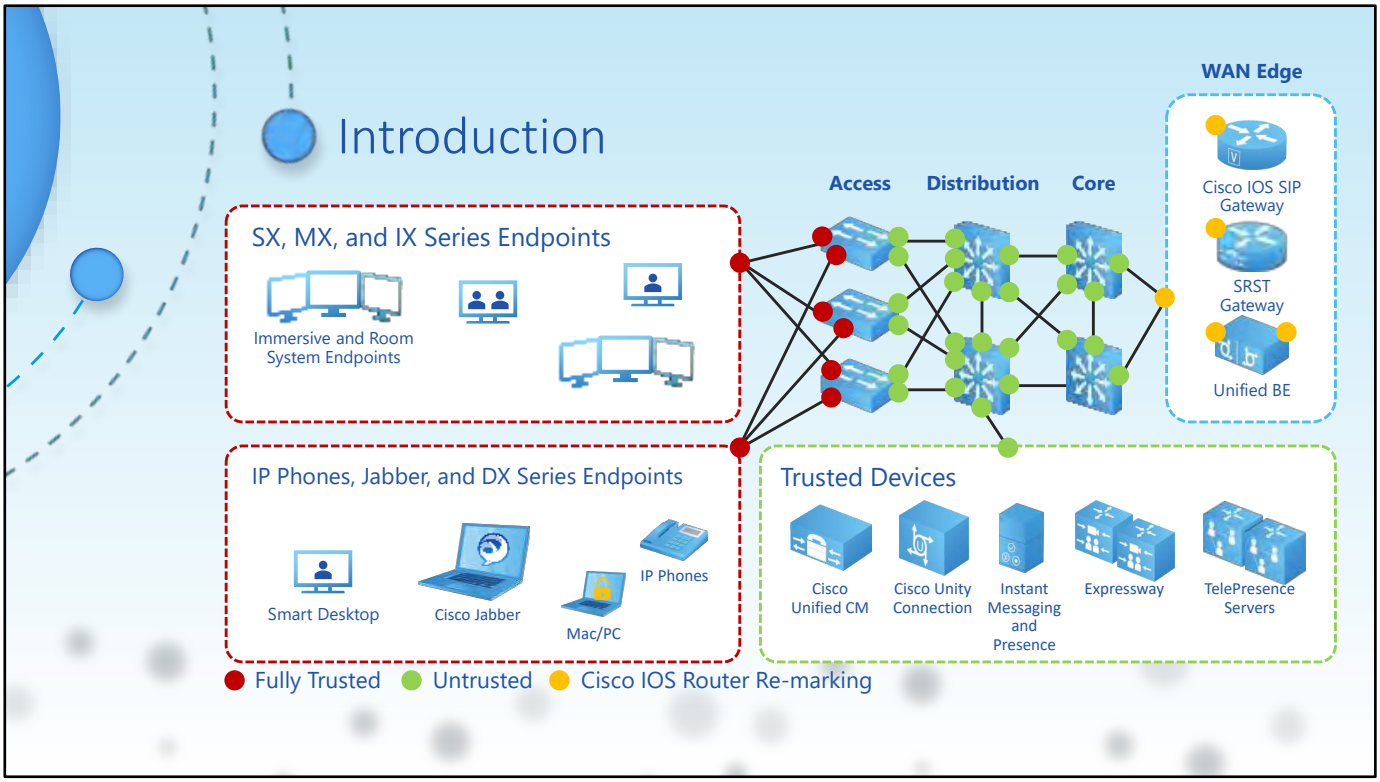


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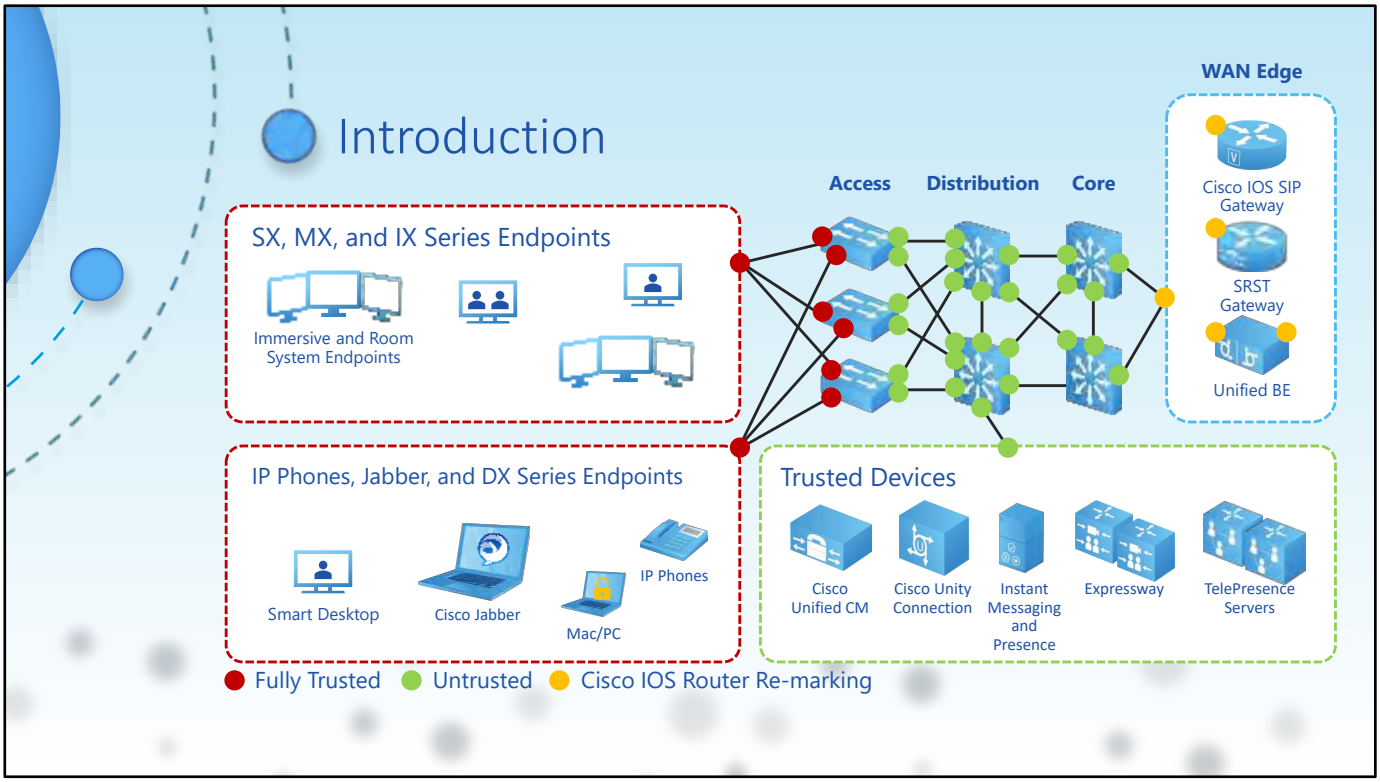


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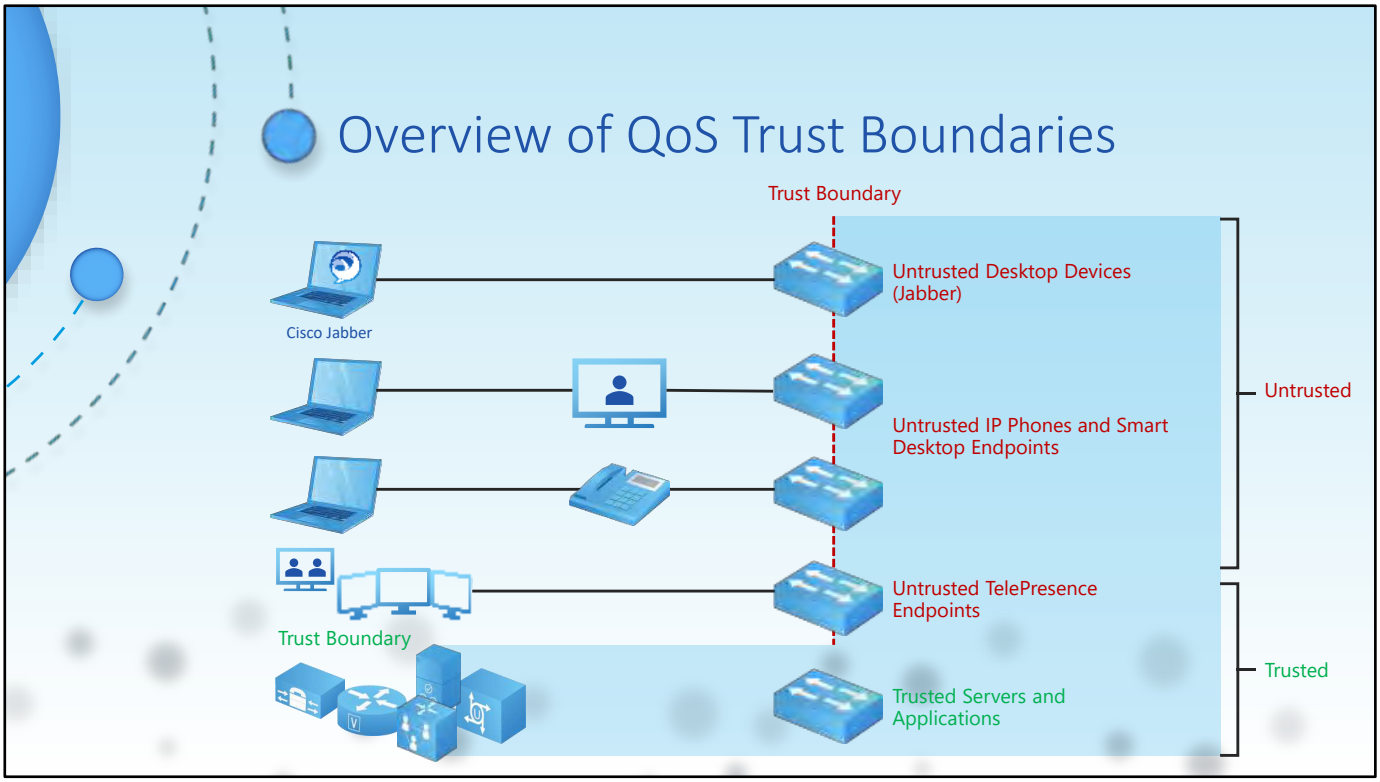


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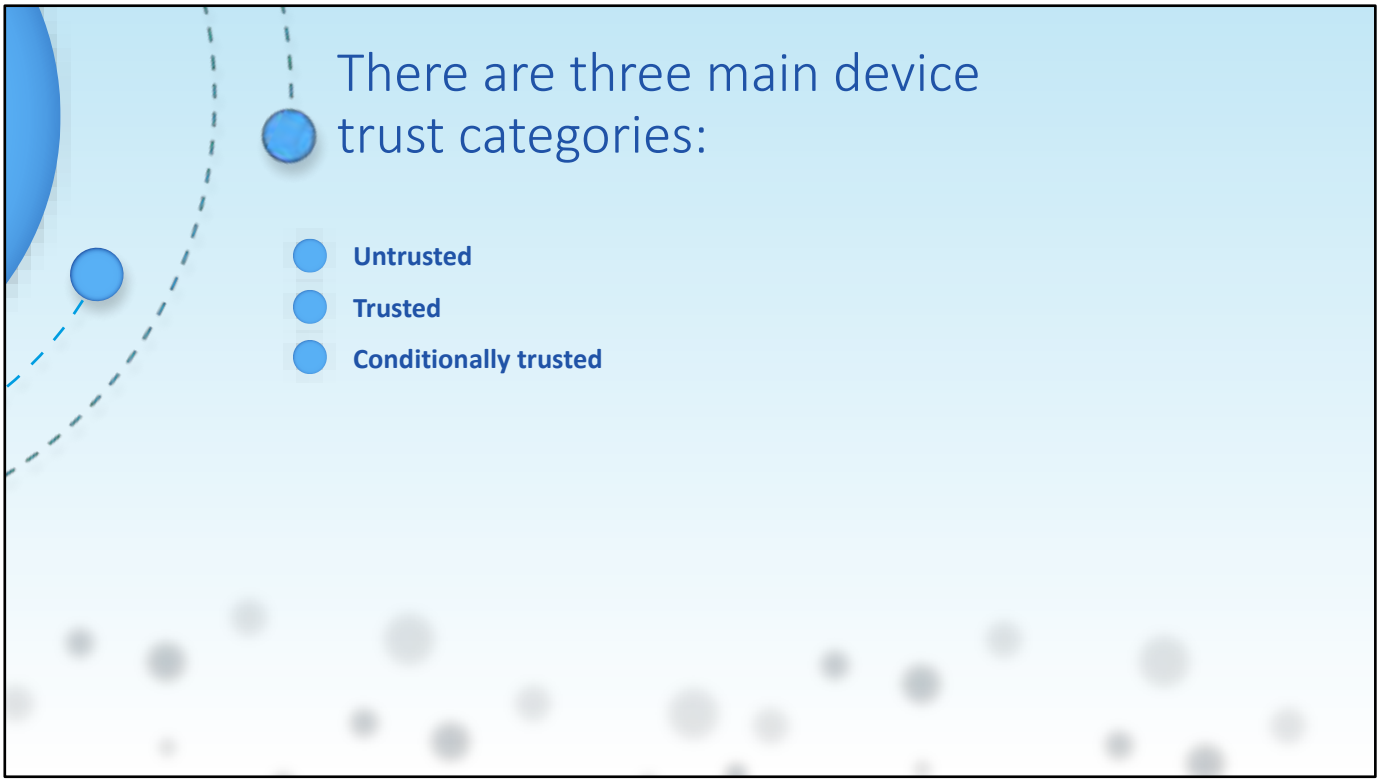


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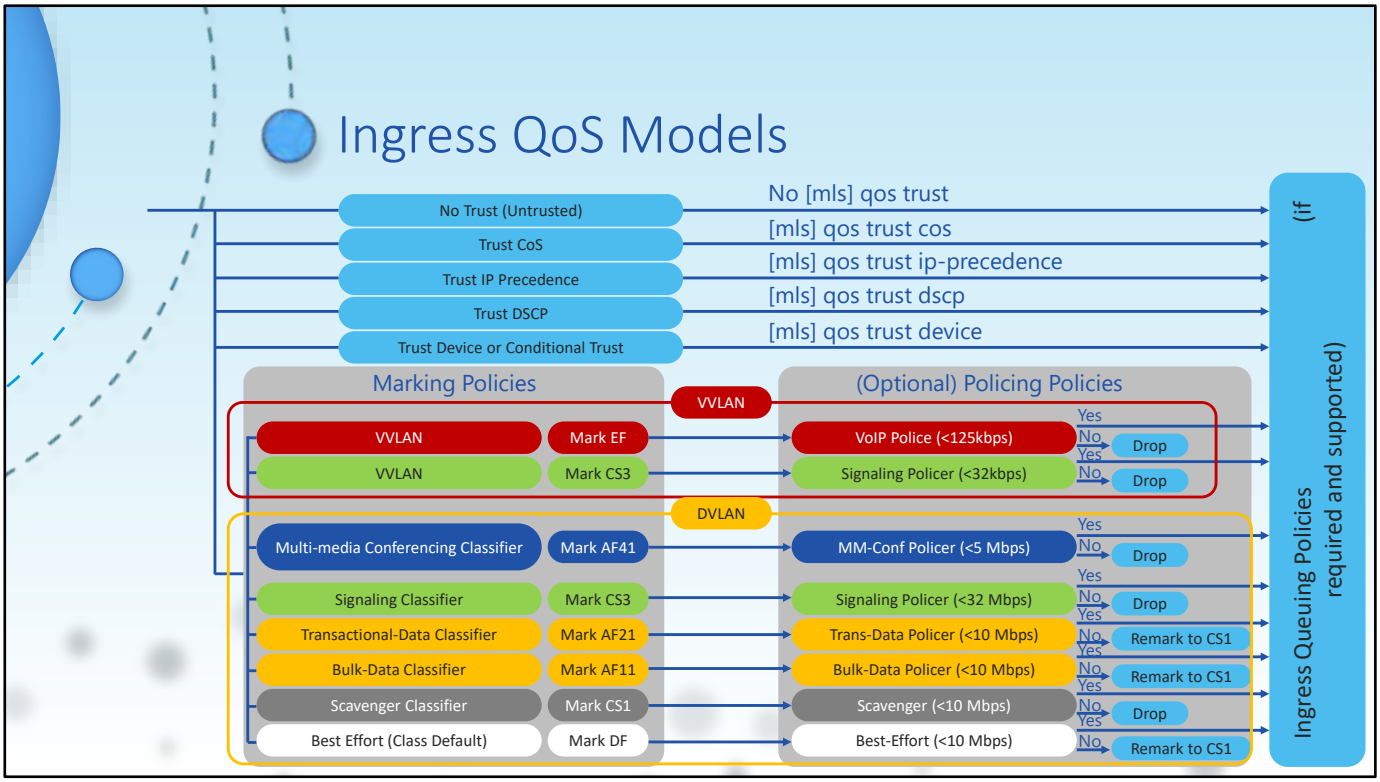
# Ingress QoS Models

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# QoS Marking and Table Maps

The CoS-to-DSCP map is used on ingress to determine the internal DSCP, based on the CoS

| CoS value | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| DSCP value | 0 | 8 | 16 | 24 | 32 | 40 | 48 | 56 |

The DSCP-to-CoS map is used on egress to set the CoS, based on the final DSCP value.

| DSCP value | 0-7 | 8-15 | 16-23 | 24-31 | 32-39 | 40-47 | 48-55 | 56-63 |
|---|---|---|---|---|---|---|---|---|
| CoS value | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

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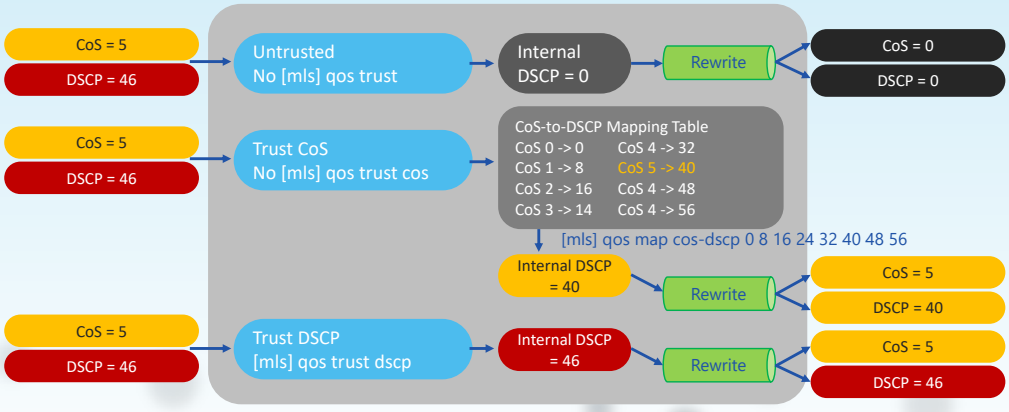
# Internal DSCP

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# Trust States

| Trust State | Internal DSCP | Re-marking Behavior |
|---|---|---|
| Untrusted | The internal DSCP value is set to 0 | Sets CoS and DSCP to 0 |
| Trust CoS | The CoS-to-DSCP mapping table determines the internal DSCP. If CoS is not marked, the default port CoS is used | CoS is preserved, and the DSCP is rewritten to the internal DSCP value |
| Trust IP precedence | The IP precedence-to-DSCP-mapping table determines the internal DSCP | The DSCP-to-CoS table determines the CoS, and the DSCP is rewritten to the internal DSCP value |
| Trust DSCP | The internal DSCP value is equal to the DSCP in the packet. | The DSCP-to-CoS table determines the CoS, and the DSCP is preserved. |

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# Conclusions

- Classification and Marking on Cisco Catalyst Switches
- Campus Classification and Marking
- Overview of QoS Trust Boundaries
- Ingress QoS Models
- Ingress QoS Model
- QoS Marking and Table Maps

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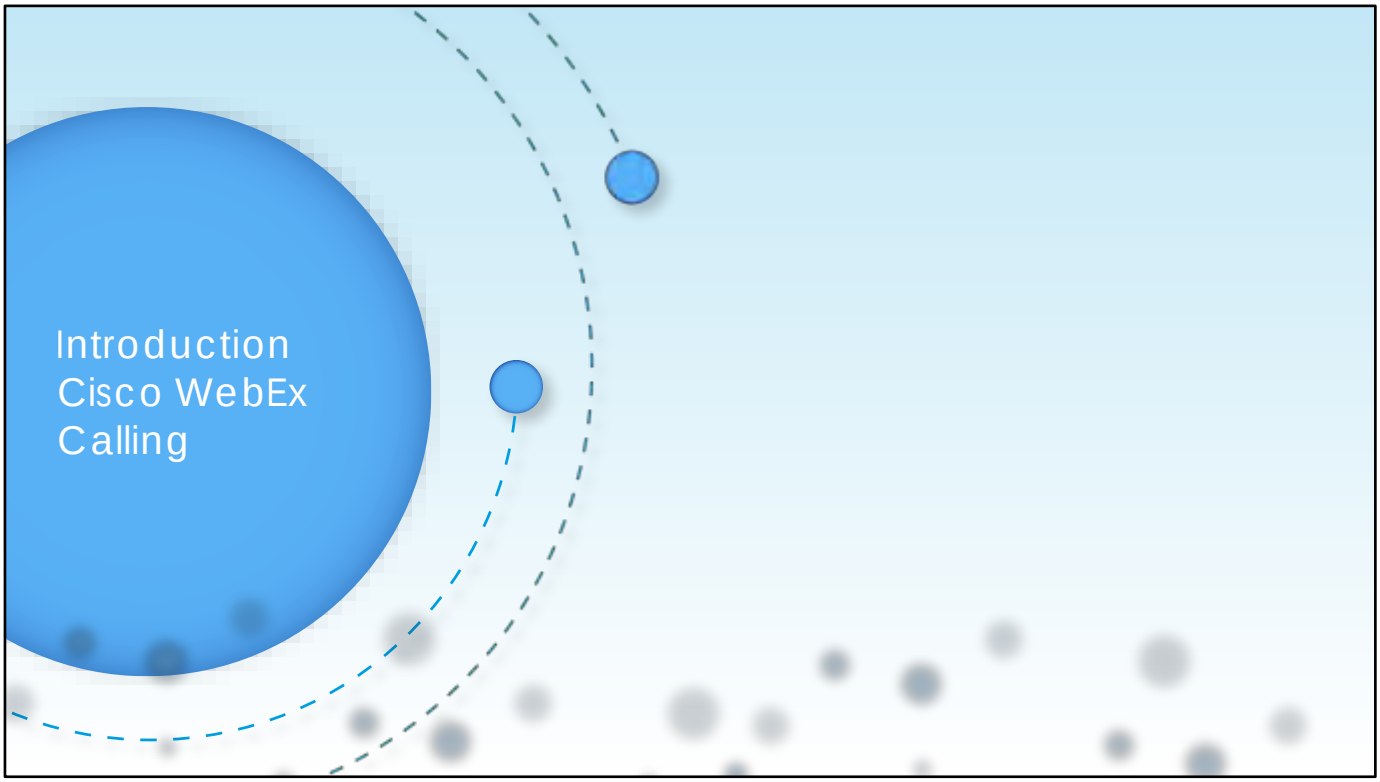


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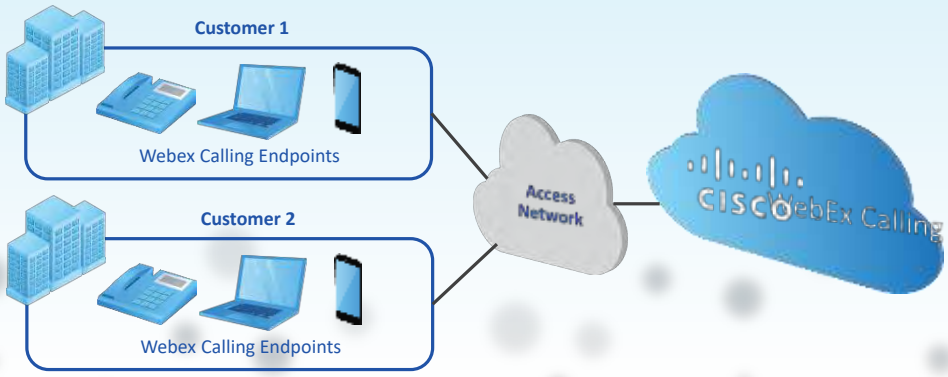
# The Cisco Webex Calling Platform

Fully-featured cloud PBX powered by proven technology
Deployed in Geo-redundant Cisco Data Centers
Partner sells the service, owns customer relationship
Cisco owns and supports platform and service, can bring opportunities

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# Webex Calling Offers in the Collaboration Flex Plan

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# Cisco MPP Portfolio

| Basic | Conference | Advanced | Video | Accessories |
|---|---|---|---|---|
| Cisco® IP Phone 6800 Series<br>Cisco IP Phone 7800 Series<br>Telephony adapters<br>Cisco ATA 190 series | Cisco IP Conference Phone 7832 and 8832 | Cisco IP Phone 8800 Series<br>MPP 6800 DECT | Cisco 88x5 Series Video Phone | Key Expansion Modules<br>Headsets |
| | | | | |
| Basic product line | Conference room | Advanced product line | Video | Accessories |

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# Soft Clients

**Webex Teams** with Integrated Calling

OR

Standalone **Cisco Webex Calling app**

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# Webex Calling Architecture

## Regions and Datacenters

Webex Calling operates four regional platforms:

**North America, EMEAR, APJC(Japan** and **APJC(Australia).**

Each region contains localizations for all supported countries. This ensures that from a single location, the Partner can provide services globally to their Enterprise Customers.

Data and traffic are stored and processed within the regional platform.

### Regional Data Center Locations

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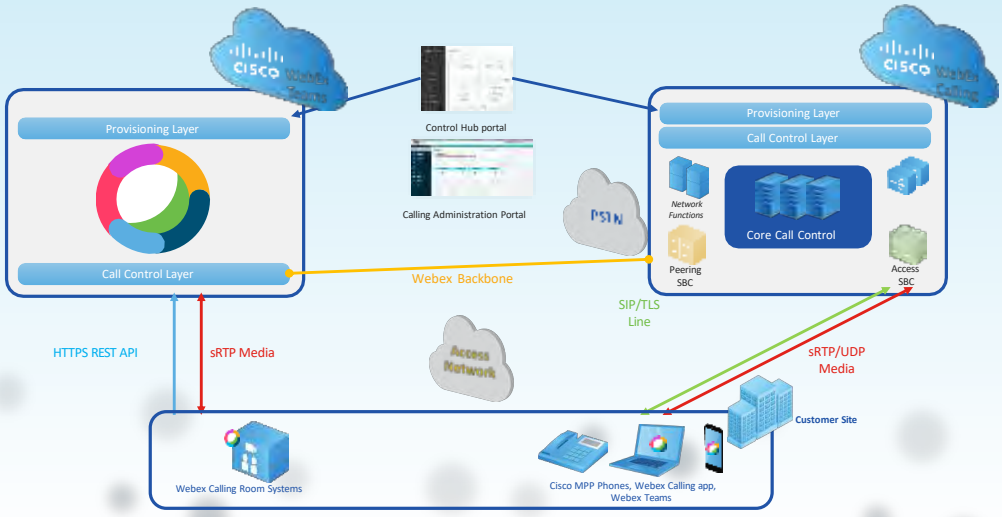
# Webex Calling Architecture

## Connectivity with SP/CCP PSTN

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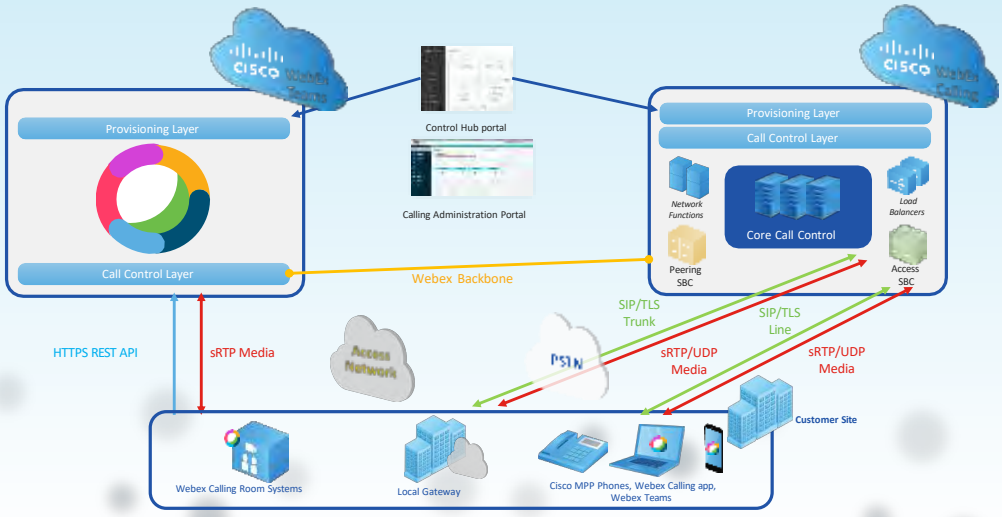
# Webex Calling Architecture

## Connectivity with Local Gateway PSTN

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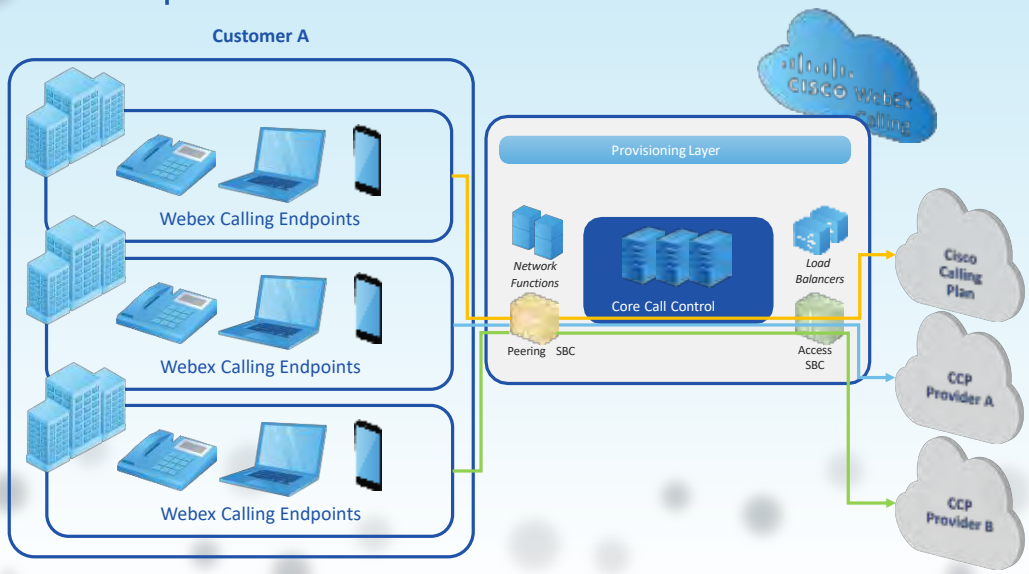
# Multiple PSTN Providers

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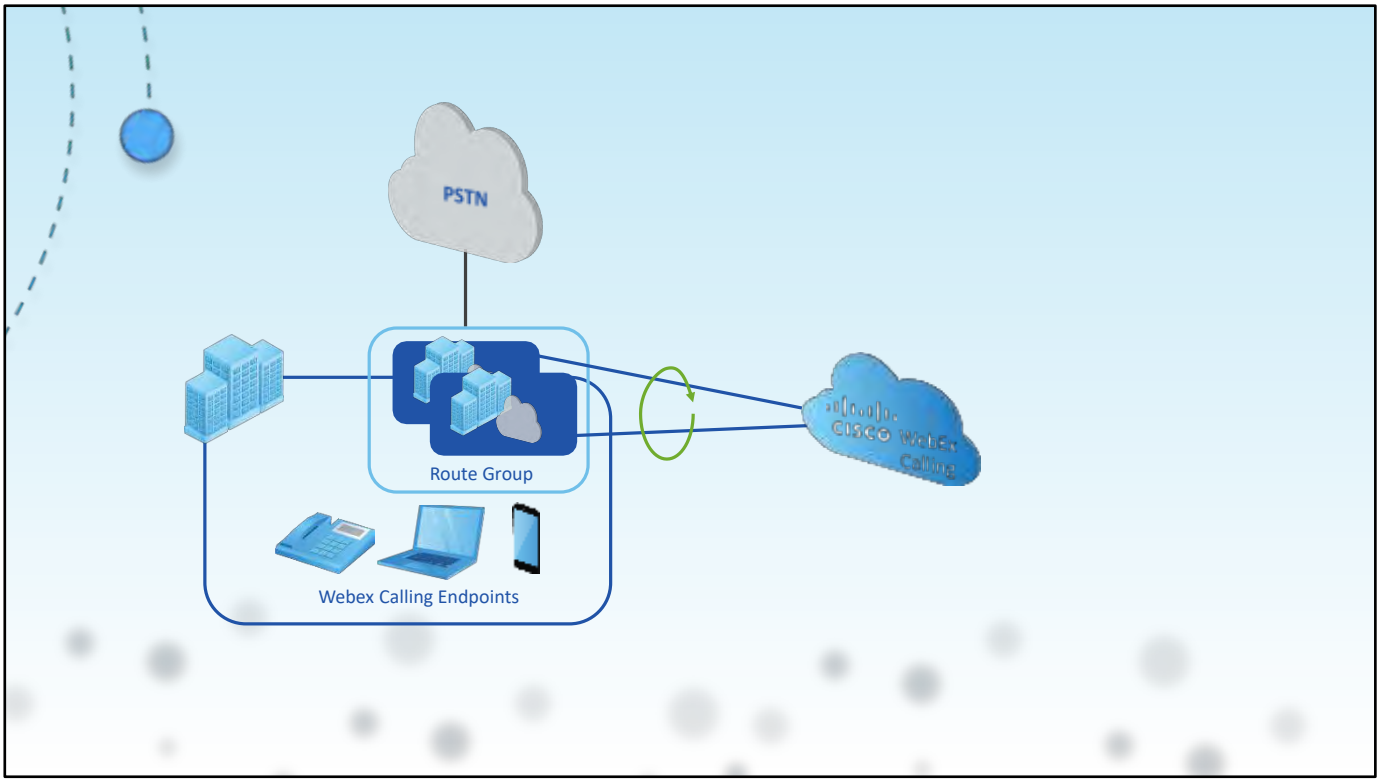


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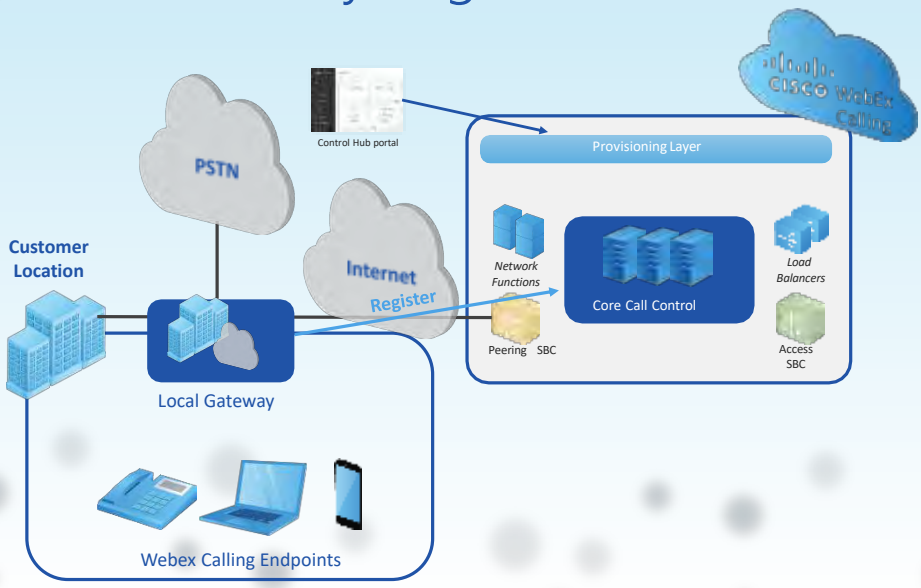
# Local Gateway Registration

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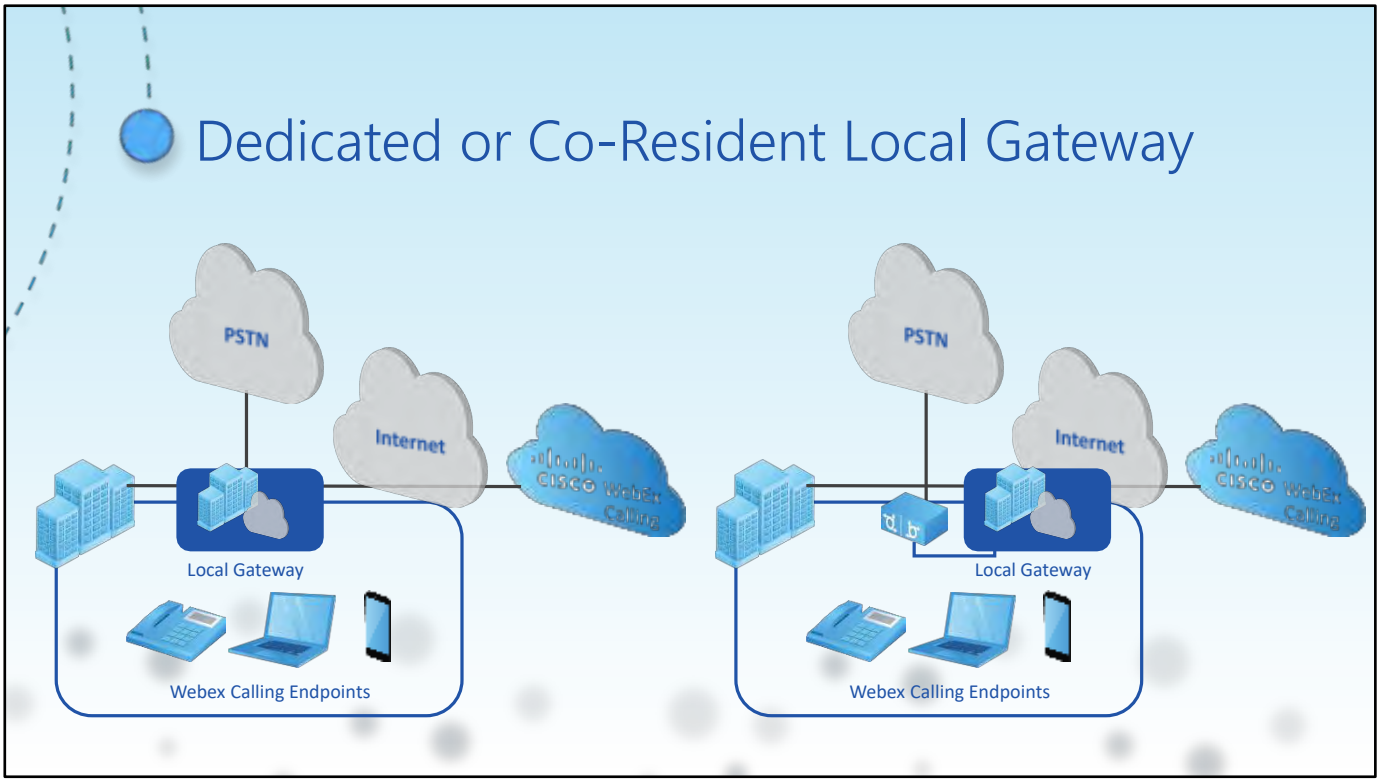


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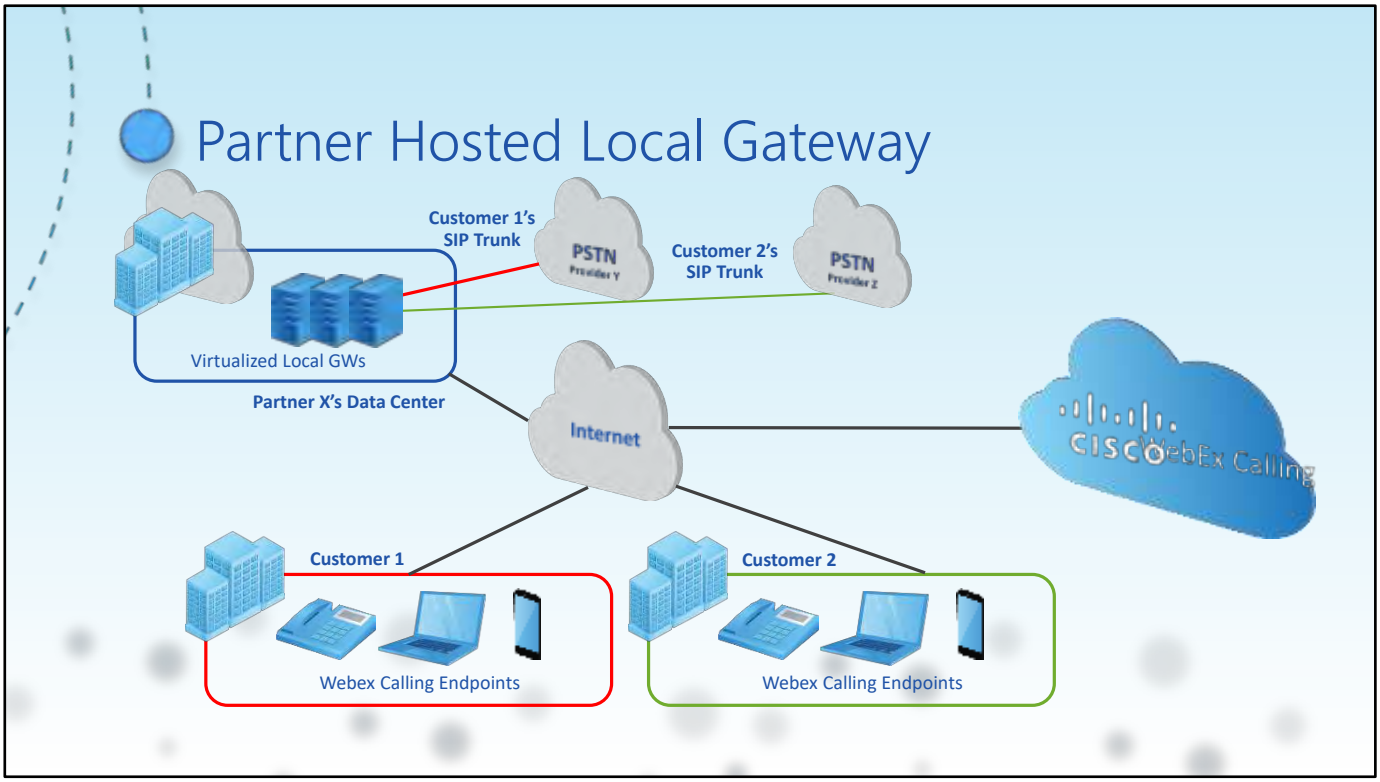


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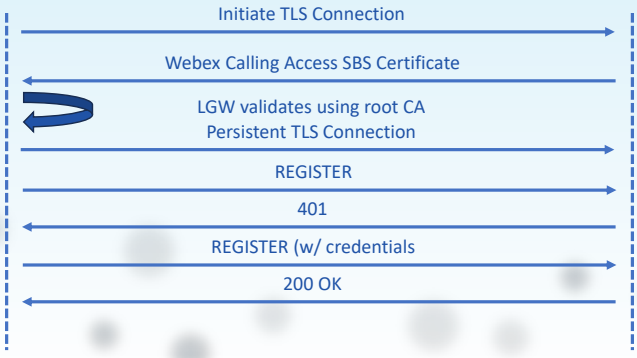
# Local Gateway Call Setup

Local Gateway

Import Webex Calling Root CA Certificate

Setup the credentials and trust point

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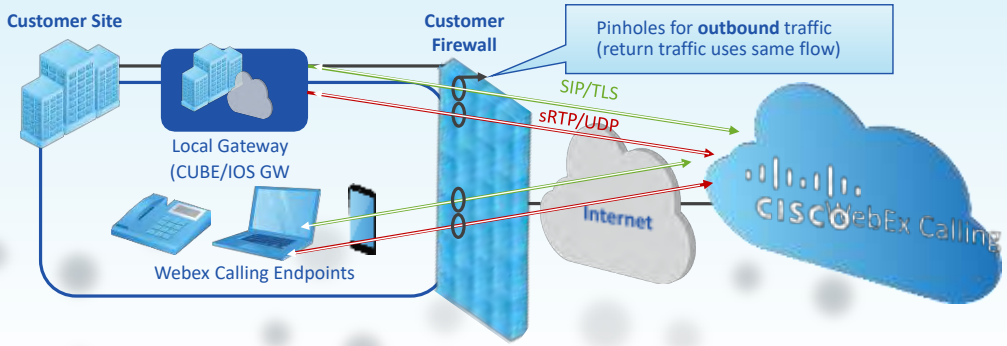
# Webex Calling Architecture

## Firewall and NAT Traversal(LGW,MPP Phones, apps)

In most cases, Local Gateway and endpoints can sit on **internal** customer network using private IP addresses with NAT (*media latching in Webex Calling SBC*)

Firewall needs to allow **outbound** traffic (SIP, RTP/UDP, HTTP) to specific IP addresses/ports (*see firewall and network configuration guide*)

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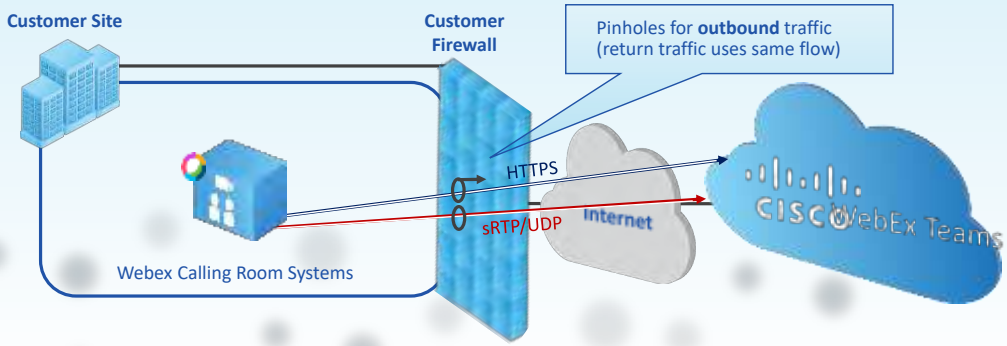
# Webex Calling Architecture

## Firewall and NAT Traversal(Webex Room Systems)

In most cases, Room Systems can sit on **internal** customer network using private IP addresses with NAT (*ICE/STUN Bindings used by Webex Teams*)

Firewall needs to allow outbound traffic (HTTP, RTP/UDP) to many destinations (*see firewall and network configuration guide*)

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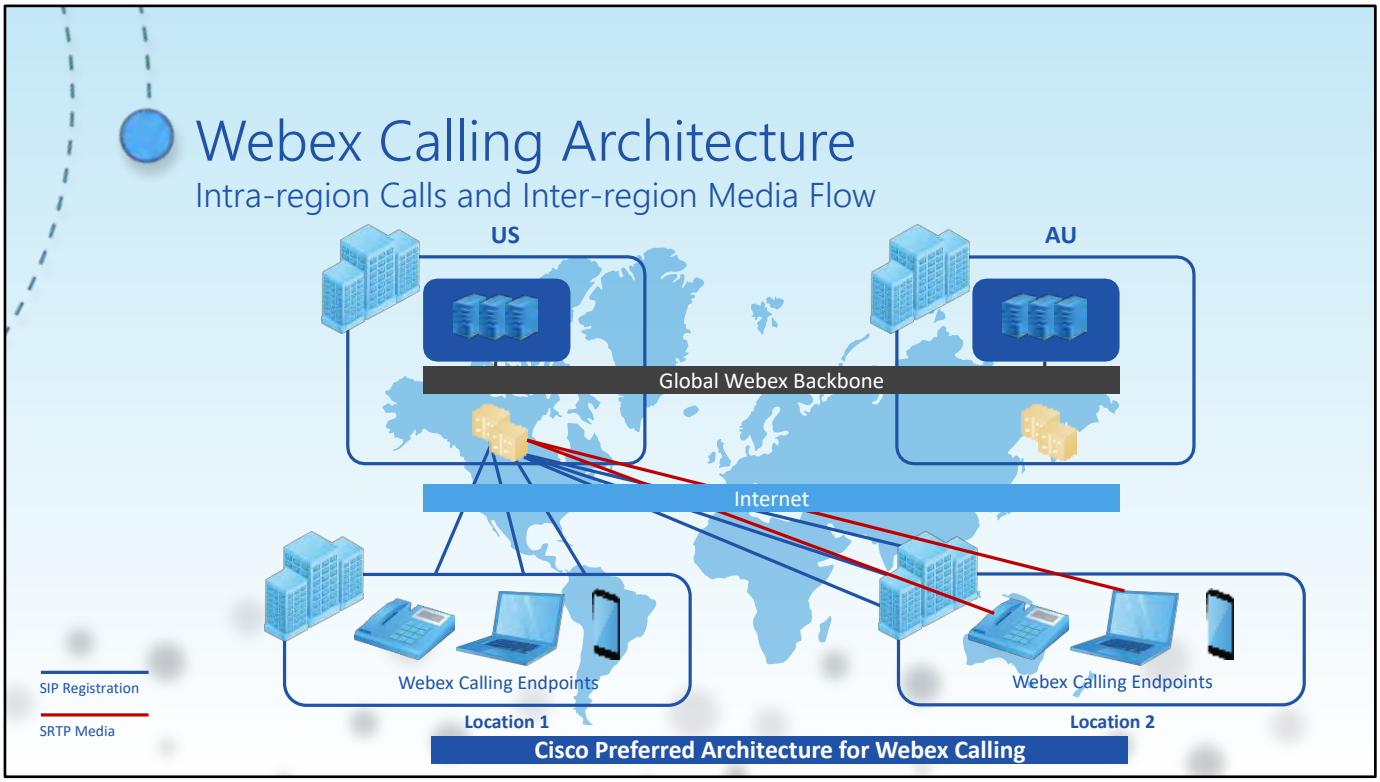


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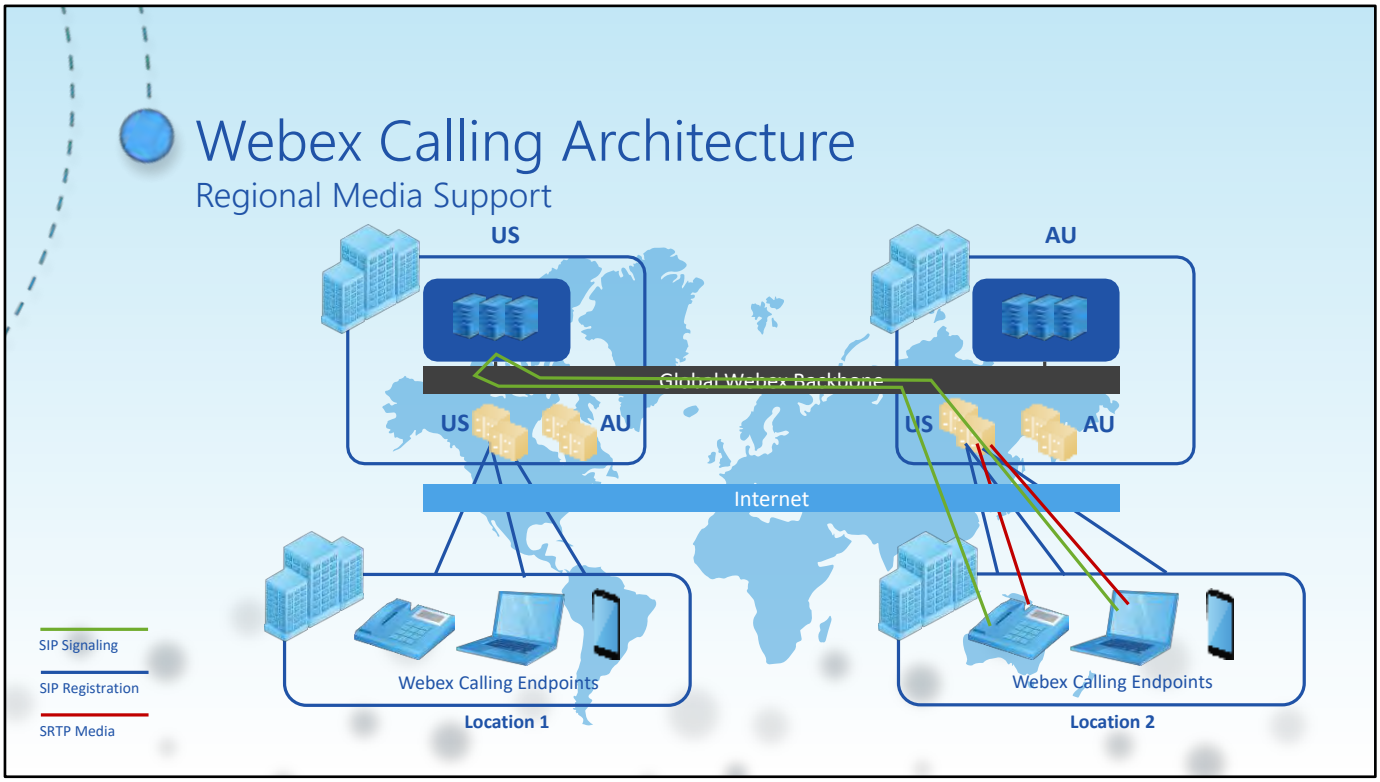


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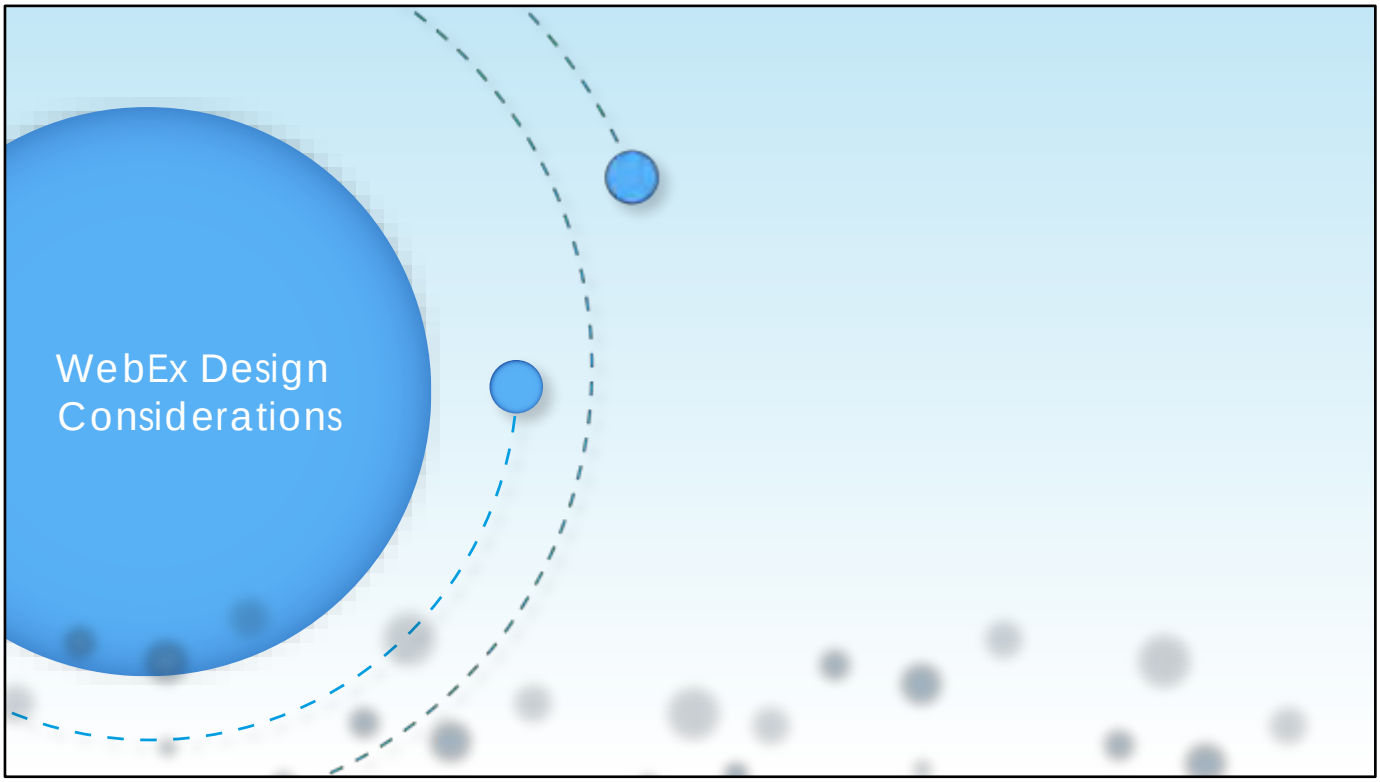


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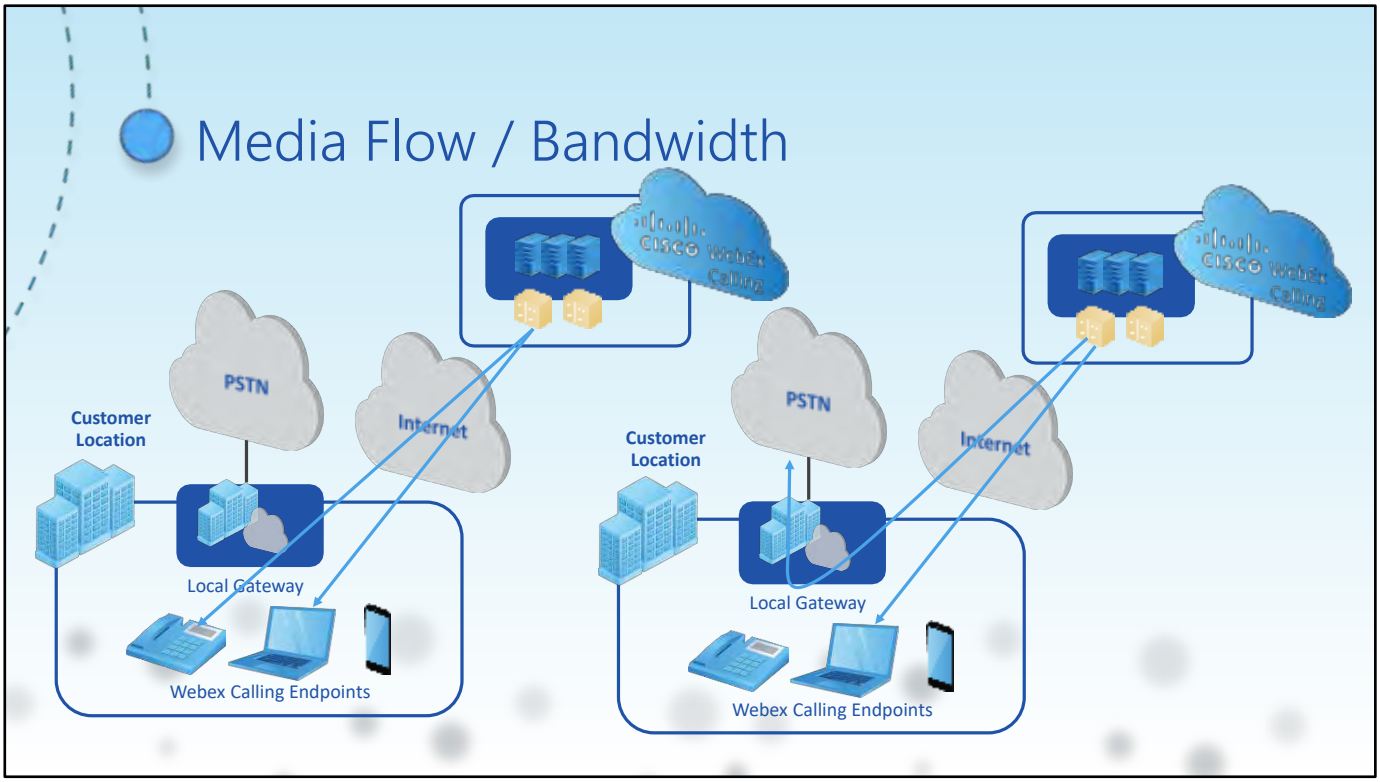


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# Codec Selection

Webex Calling codec preference: G.722, **G.729**, G.711u, G.711a

Unified CM codec preference: G.722, G.711u, G.711a, **G.729**

UCM prefers G.711 over G.729

Webex Calling prefers G.729 over G.711

Leads to asymmetric codec negotiation based in offer/answer model

- Call from Unified CM: Webex Calling picks G.729
- Call from Webex Calling: Unified CM picks G.711

Solution: don't offer G.729 to Webex Calling; configuration on CUBE

Bandwidth: 87.2 kbps (G.711, G.722) or 31.2 kpbs

… full-duplex **per call leg!**

https://www.cisco.com/c/en/us/support/docs/voice/voice-quality/7934-bwidth-consume.html

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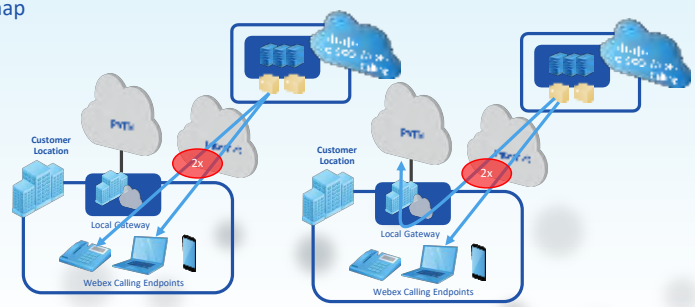
# Media Flow

- All media flows are always anchored on Webex Calling access SBCs
  - Between Webex Calling endpoints
  - Between Local Gateway and Webex Calling endpoints
- Needs to be factored into bandwidth requirements calculation
  - 2 x 87.2kbps full-duplex per G.711 intra-site call
- No hair-pinning of PSTN calls when using Cloud Connected PSTN (CCP)
  - Conditional media release (ICE): roadmap
- Media path optimization based on

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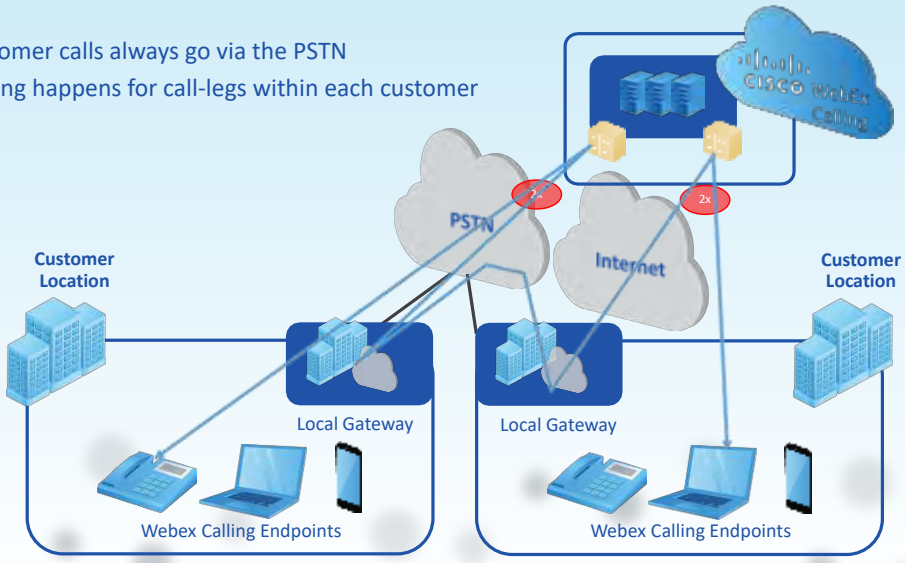
# Inter-Customer Media Flow

Inter-customer calls always go via the PSTN

Hair-pinning happens for call-legs within each customer

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# Multi-Region Customer

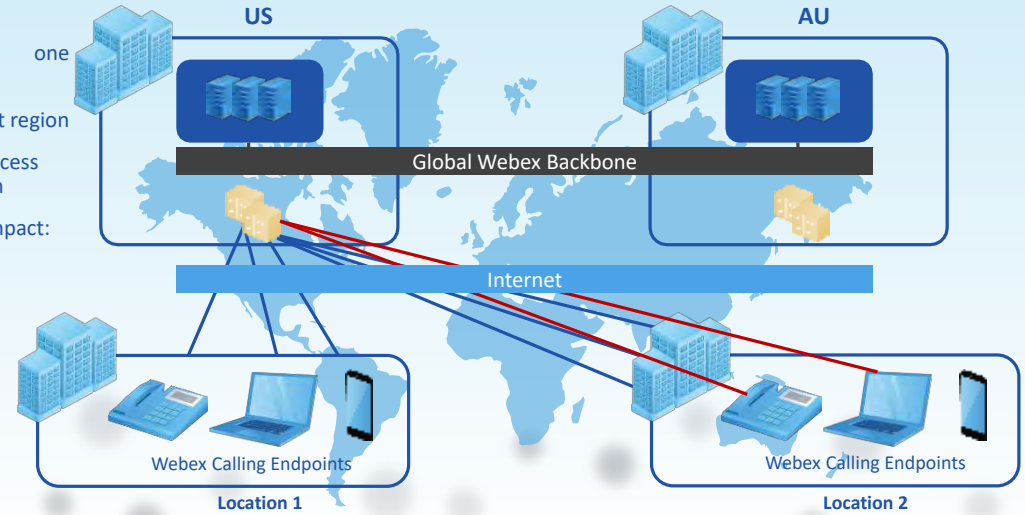
Customers are tied to one region

All registrations to that region

Media anchored on access SBCs of "home" region

Potentially negative impact:

- Cut-through delay
- Media RTT impact




Cisco Preferred Architecture for Webex Calling

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# Multi-Region Customer: Regional Media

Access SBC presence in other regions

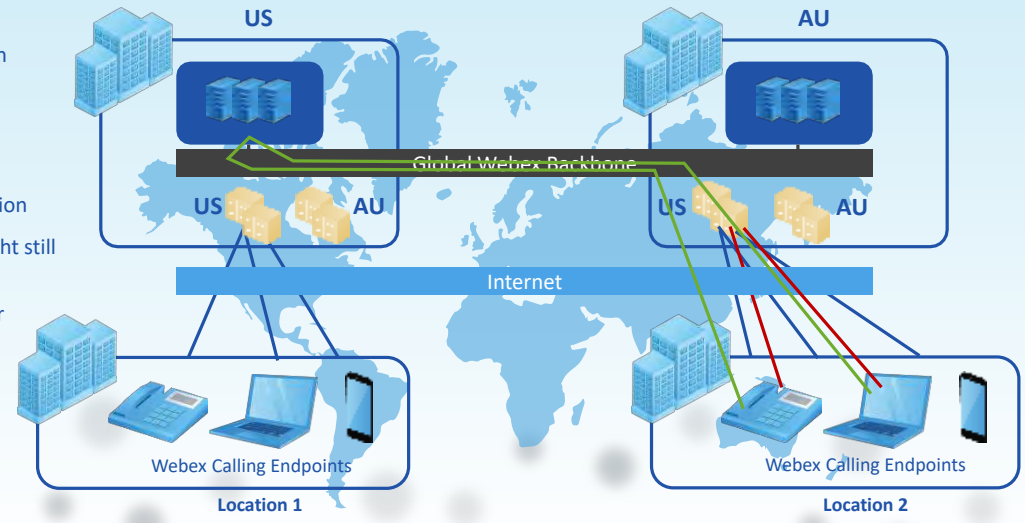
In-region registration

In-region media

Signaling still inter-region

Cut-through delay might still occur

Media RTT not a factor




SIP Signaling

SIP Registration

SRTP Media

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# Conclusions

- WebEx design considerations
  - Media Flow / Bandwidth
  - Codecs
  - Mutli-region Customer

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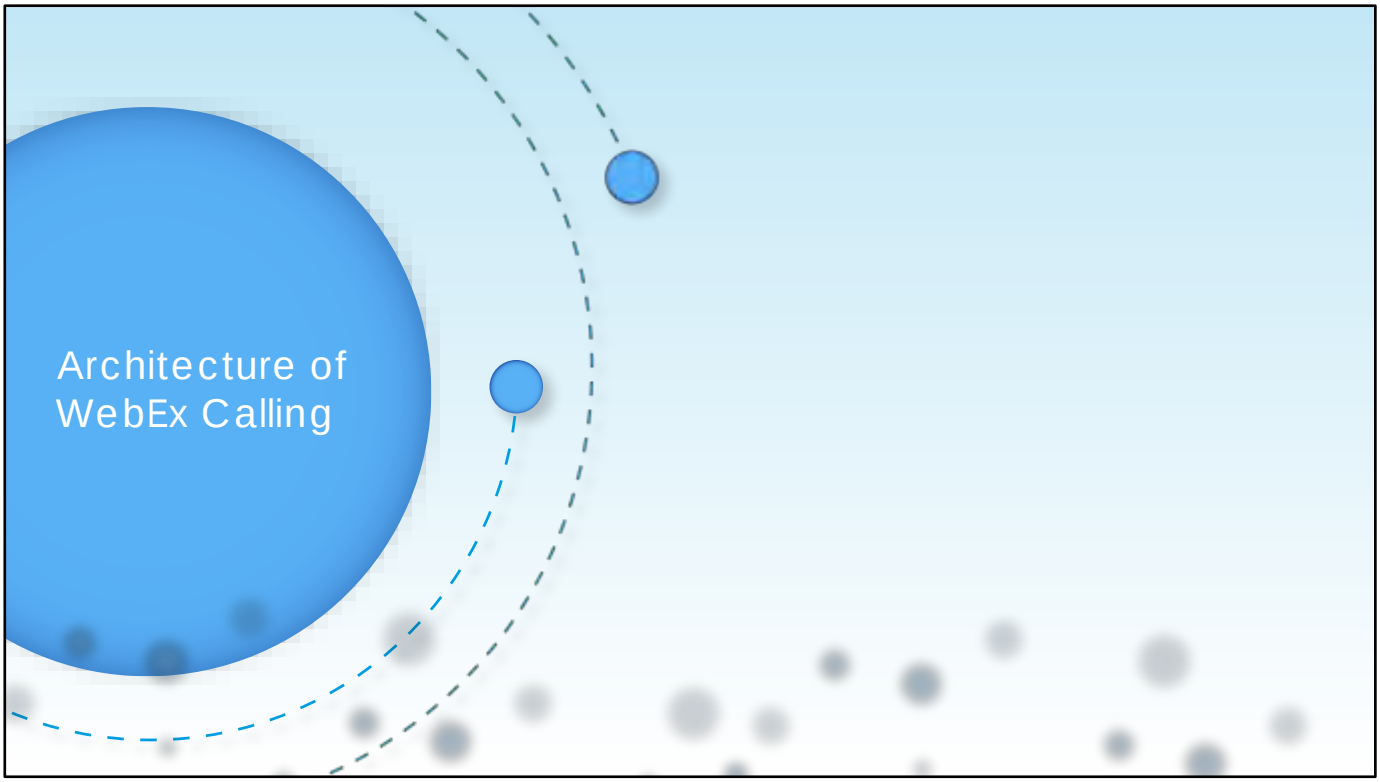


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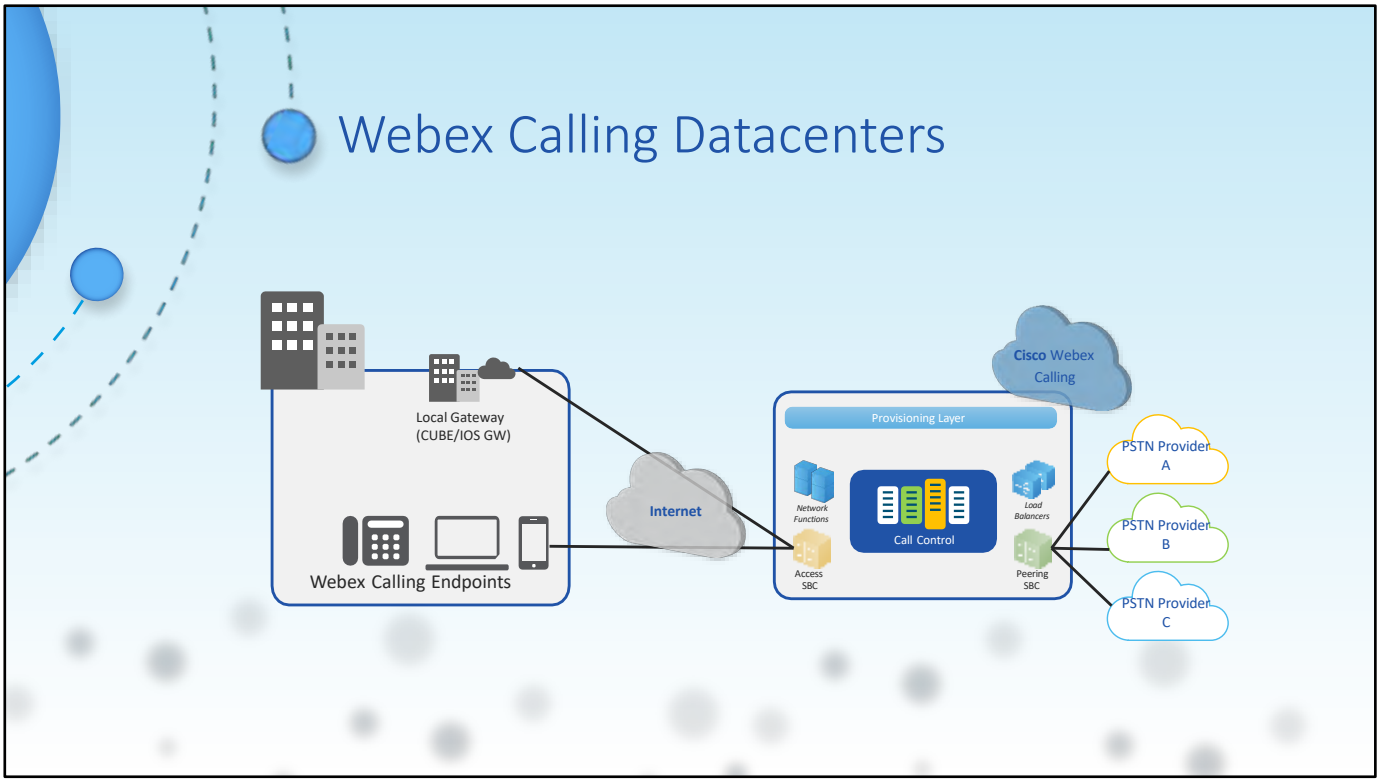


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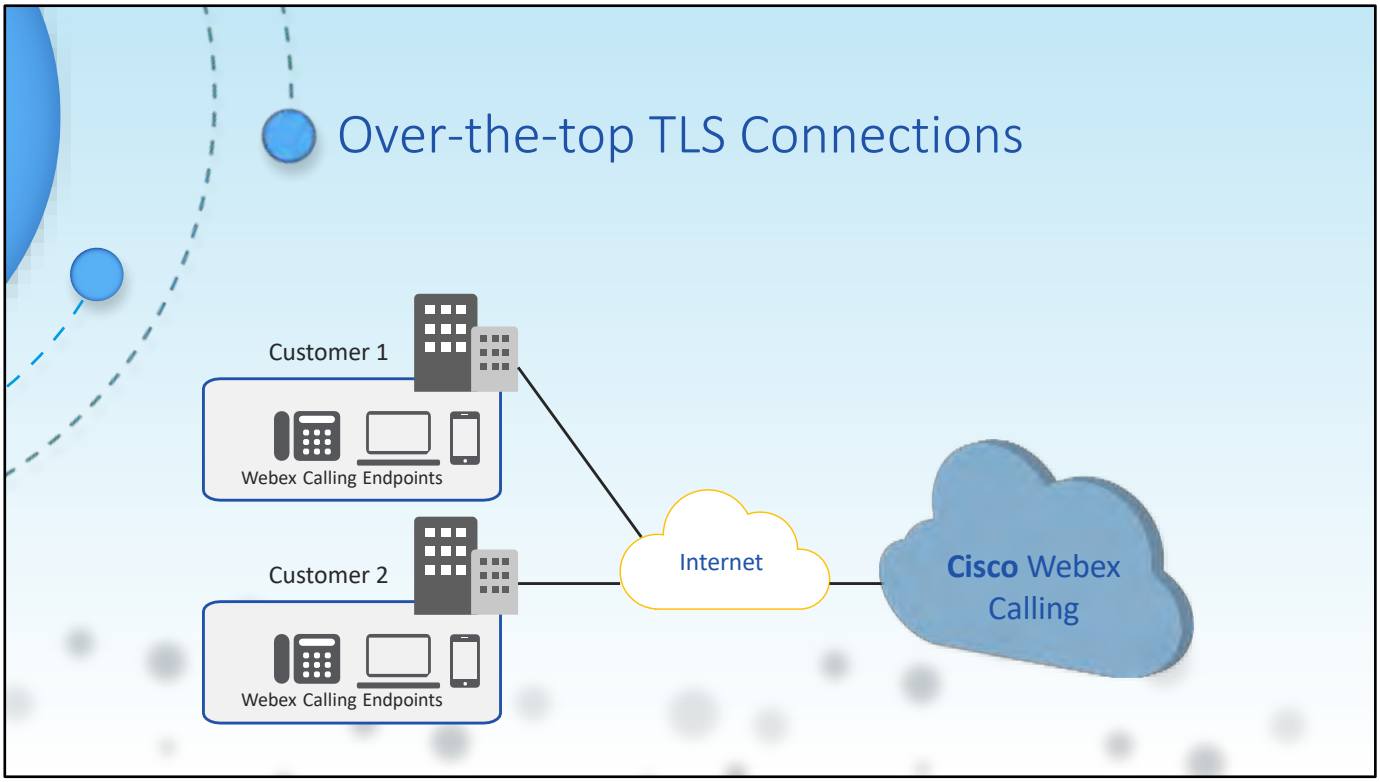


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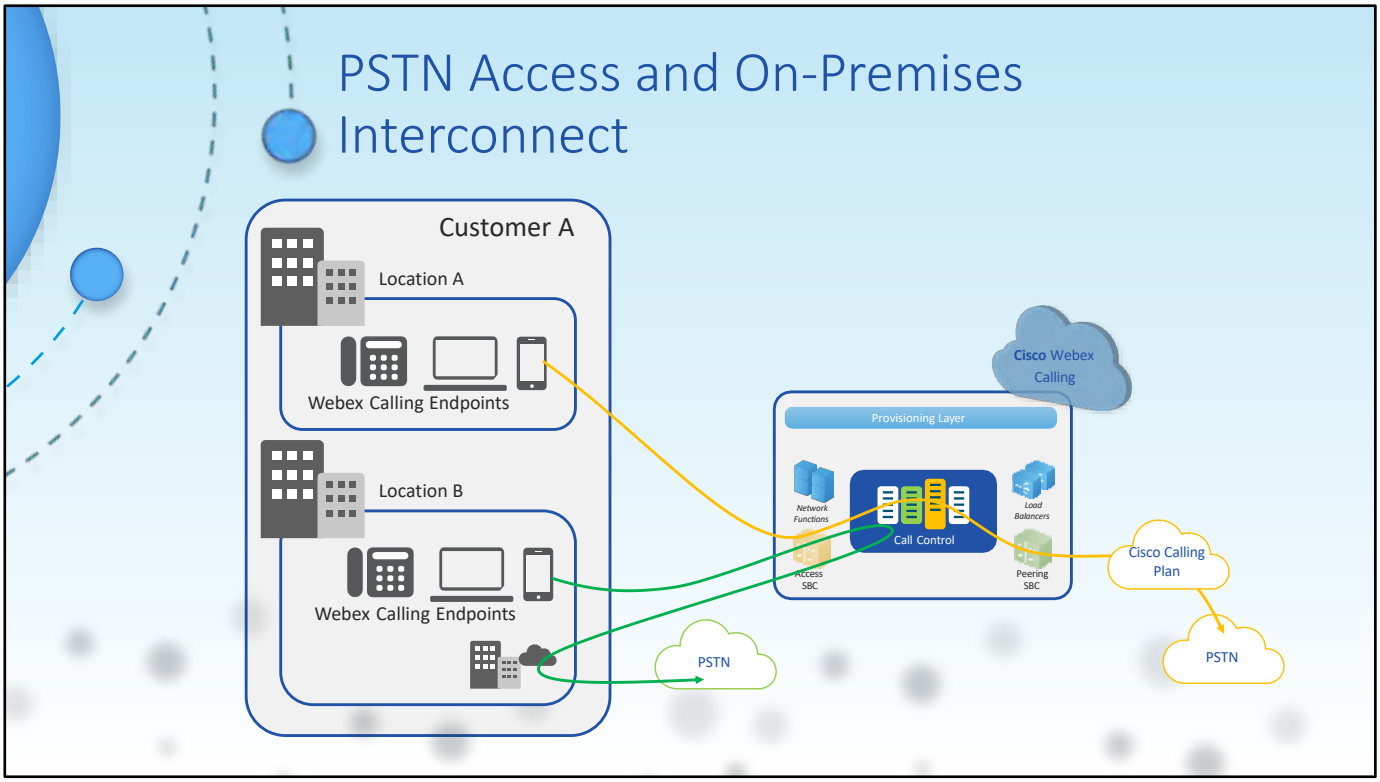


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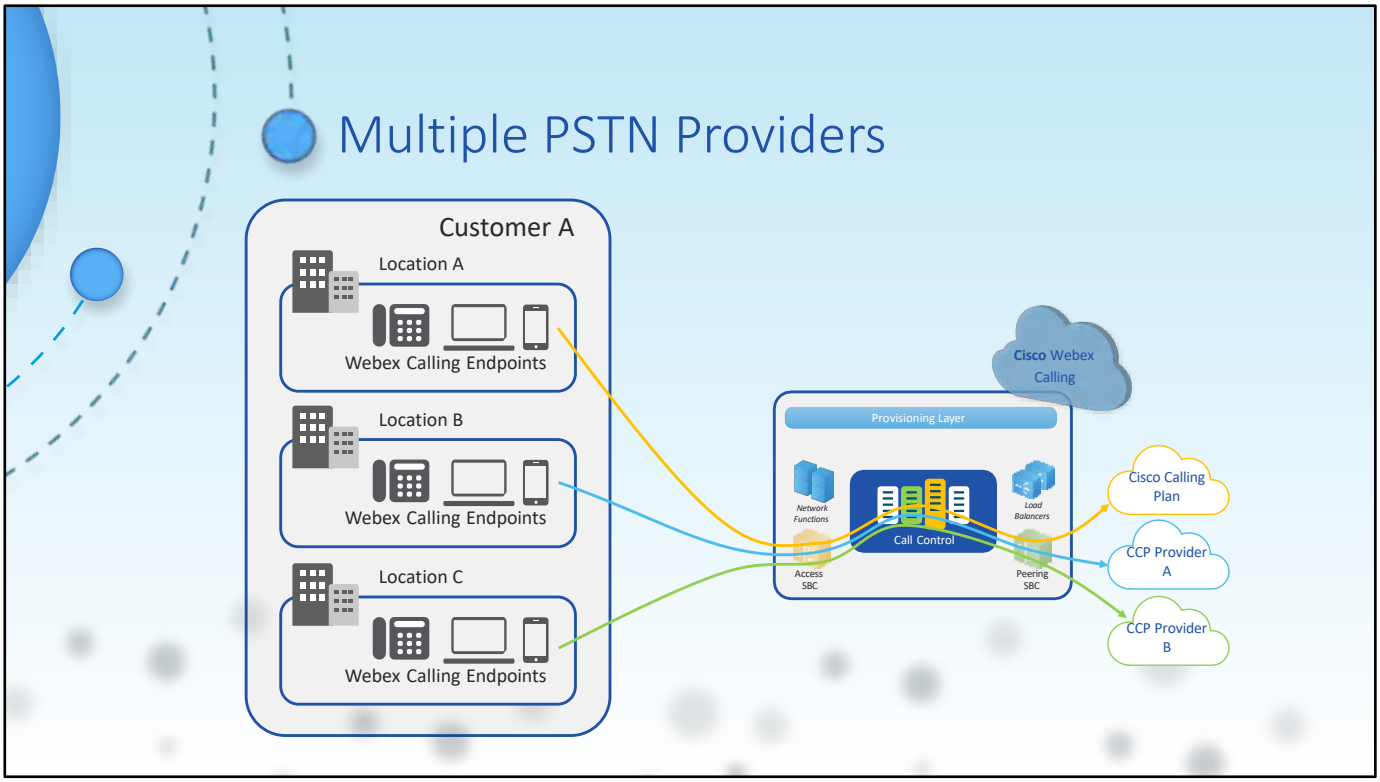


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# Trunks and Route Groups

Trunks connect Webex Calling with Local Gateways

Each trunk in Control Hub represents a trunk to one Local Gateway instance configured on a CUBE

Using route groups for redundancy

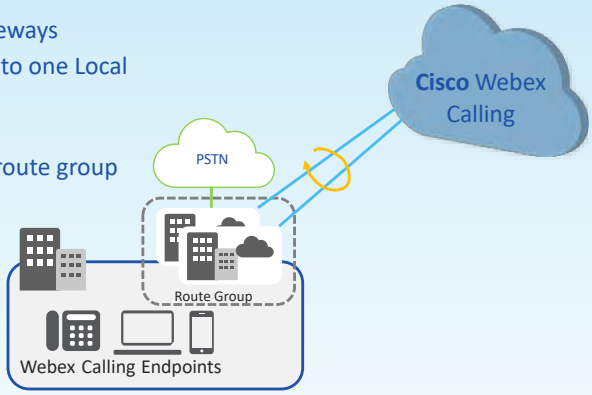
A priority is assigned for each trunk within a route group

**Rerouting is triggered by:**

- SIP Response 401, 470, 480
- 4xx SIP Response except for 403, 404..
- All 5xx SIP Response
- A SIP Timeout (12 seconds)

**Limitation**

- Maximum of 100 trunks is allowed per location
- Route group can have a maximum of 10 trunks
- A maximum of 10,000 route groups can be configured for a Webex Calling customer

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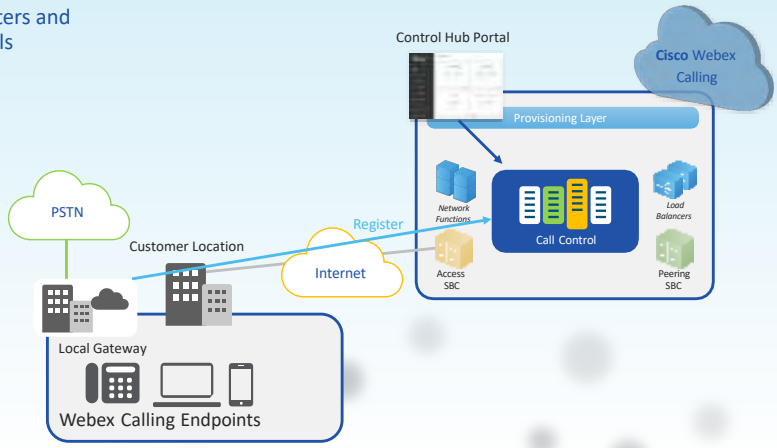
# Local Gateway Registration

- Use authenticated and registered SIP trunks to WebEx Calling
- Manage by WebEx Control Hub
  - Provide Connection parameters and SIP authentication credentials
  - SIP/TLS
- Only Initiated from Customer
- No Firewall entries required

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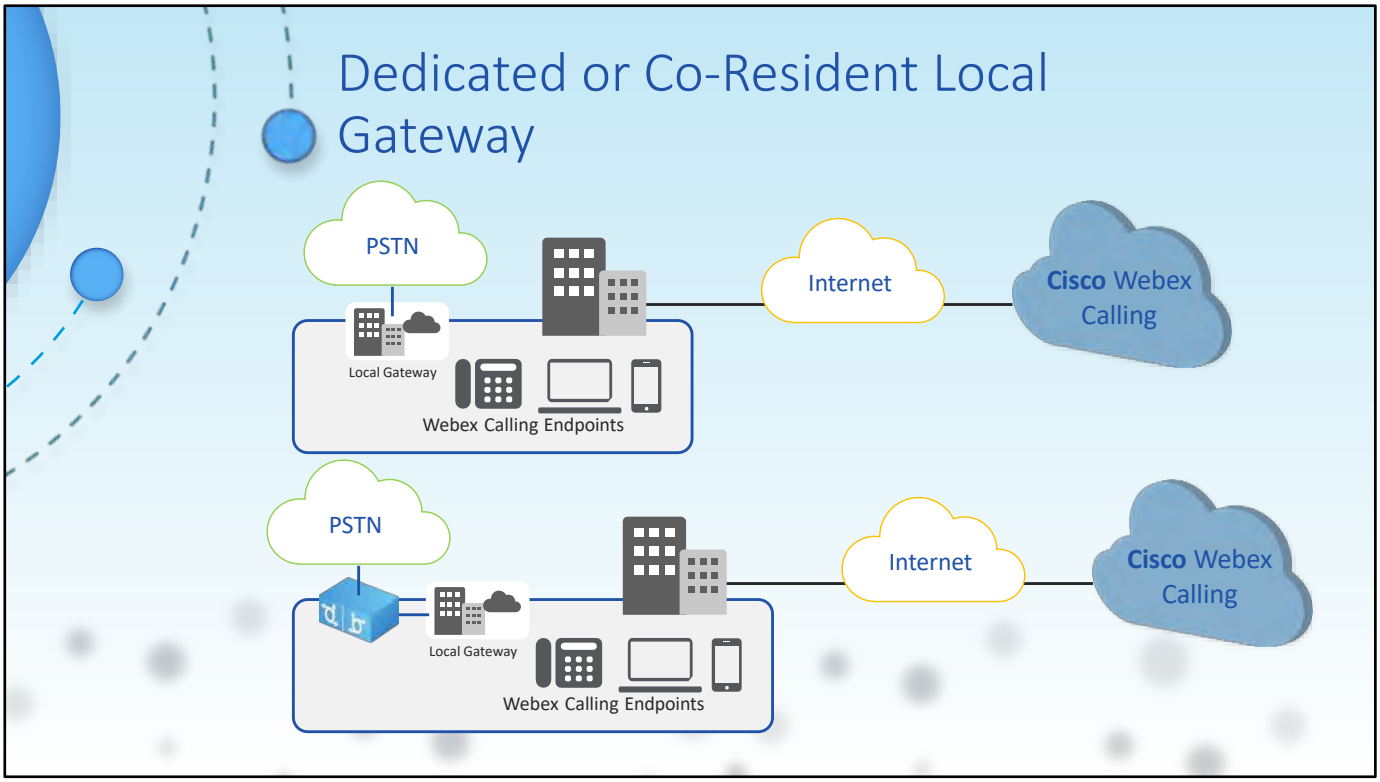


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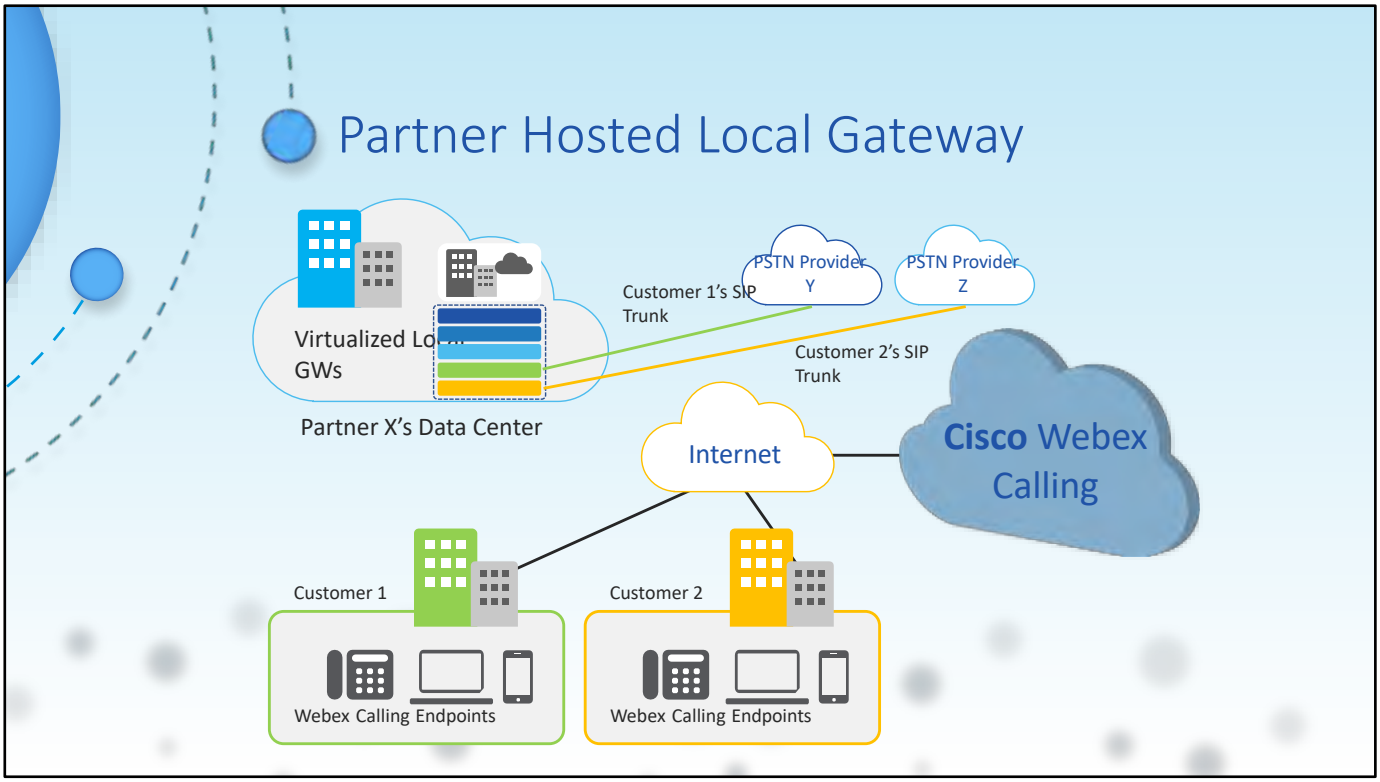


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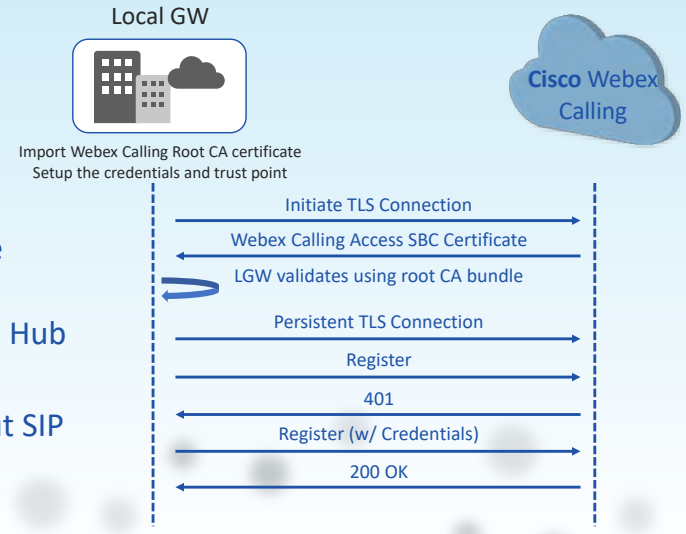
# Local Gateway Call Setup

- Cisco Trusted Core Root Bundle
  - Set of Public CA trust anchors
- Digest credentials from Control Hub
- Follow RFC3261
- First REGISTER message without SIP Digest Credentials

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# Conclusions

- Webex Calling Datacenters
- PSTN Access and On-Premises Interconnect
- Dial Plans
- Media Flows
- Webex Calling Regions

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