TelePresence

It's about experience

Faisal Chaudhry

fchaudhr@cisco.com

Technical Leader

Cisco Advanced Services

TelePresence Network Design Overview
Agenda

- **What is Telepresence ?**

- **TelePresence Components Overview**

- **Connecting the TelePresence Endpoints**

- **TelePresence Network Deployment Models**

- **TelePresence QoS Design**

"It's all about the EXPERIENCE!"

Consider the Human Factor.

What does that mean?
How do you ensure it?
How do you consistently replicate it?

Are these Home Theaters?

Do they provide a Theater Experience?

Are these Home Theaters?

Do they provide a Theater Experience?

How do you create and ensure the Experience?

- Standards
- Validation

"It's all about the EXPERIENCE!"

The Human Factor.

What is the TelePresence Experience?

An In-Person Experience!

This is **NOT** the TelePresence experience.

This is **NOT** the TelePresence experience.

This is TelePresence.

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Cisco TelePresence
A New and Innovative Philosophy

| The Problem	Rules of Cisco TelePresence	Cisco Built from the Ground Up!
• 60% of communication is non-verbal • Current collaborative technology doesn't allow clarity, interaction of face-to-face • Scalability, productivity trade-off	• Experience the meeting, not the technology • Life size and high-resolution to discern body language • Guarantee everyone a seat at the table	• It's All About the Experience • Quality—Simplicity—Reliability
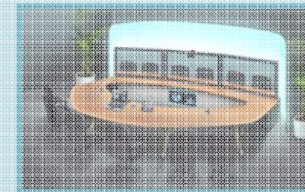
User Interface

- No remote control
- No on-screen menus to navigate
- As easy as making a phone call
- Cisco IP Phone 7970G - Touch screen

Cisco TelePresence System 1000
1:1 and Executive Applications

- Four seats at the virtual table – two seats per side

- 1 x 65" ultra high definition plasma display

- Furniture not included

- Mounts to existing wall space

- Streamlined design

- Data projector optional
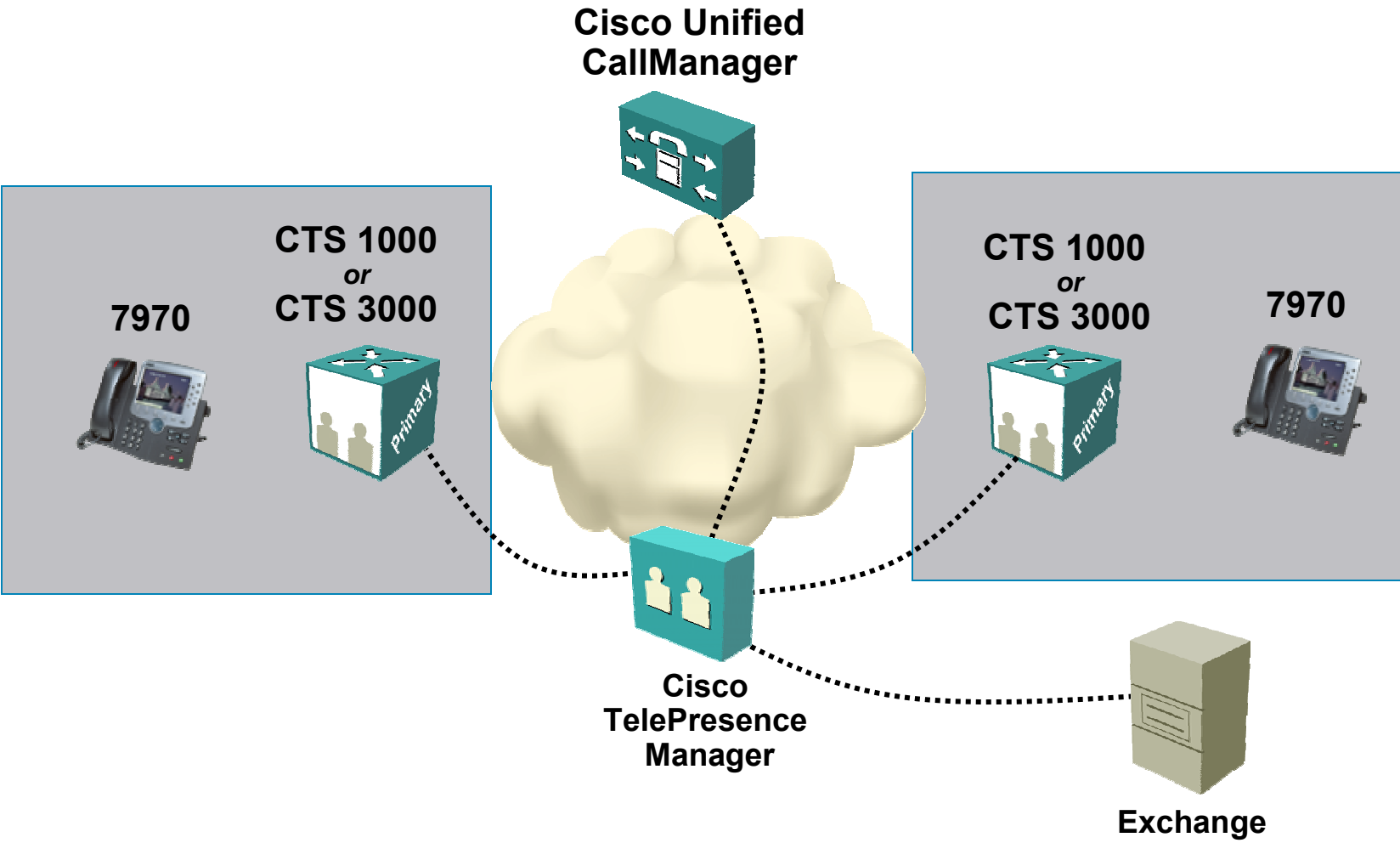
Cisco TelePresence System 3000
Large Team Meetings

- Twelve seats at the virtual table – six seats per side

- 3 x 65" ultra high definition plasma displays

- Furniture included (not including chairs or room adornments)

- Data projector, Ethernet & power connections provided for participants laptops

Cisco TelePresence Components
High Level Overview

Cisco Unified CallManager

CTS 1000
or
CTS 3000

7970

CTS 1000
or
CTS 3000

7970

Cisco TelePresence Manager

**Exchange**

Cisco CallManager
Version 5.x Overview

- **Cisco Unified CallManager Appliance Model**
  - Non windows version. Based on Cisco Linux Voice OS platform.
  - No direct access to the OS, no OS knowledge needed
  - Improved installation and upgrade (partitioning)

- **Access only via Cisco controlled tools and interfaces**
  - Platform command line interface (CLI) – via SSH or console
  - Web-based (GUI / HTTPs) interface for administration and monitoring
  - Disaster recovery (CLI and GUI)
  - Real Time Monitoring Tool (RTMT) for Performance, system logs etc

- **Native support of SIP endpoints**

- **Licensing**

- **Supported on Cisco MCS servers (7815, 7825, 7835 and 7845)**
  - Min. hardware: 2 GHz Processor, 72 GB Harddisk, 2 GB RAM

Cisco CallManager
Telepresence support

- **Requires Cisco Unified CallManager 5.0(4)a or greater**

  Cisco TelePresence device plugin

  5.1 recommended for production deployment

- **TelePresence system appears as a SIP endpoint to CallManager**

  Primary Codec and Cisco IP Phone 7970 in room share a line appearance

 Cisco IP Phone 7970 must be configured to use SIP (not SCCP)

Cisco Unified CallManager
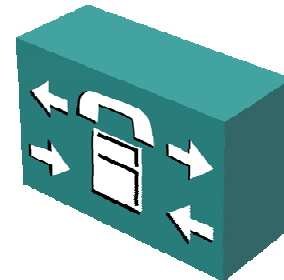
Cisco TelePresence Codec
Overview

- **Runs embedded Linux on an internal**

  Appliance model

- **Operates just like a Cisco IP Phone:**

  CDP and 802.1Q for VLAN assignment

  DHCP and TFTP for configuration and firmware

  SIP for signaling to Cisco Unified CallManager

  XML for making/terminating scheduled and ad hoc calls

- **802.3af Power over Ethernet (for cameras and IP Phone)**

- **Industry leading, extremely low-latency audio/video architecture**

  - Video = H.264 using 1080p & 1020p

 - Audio = AAC-LD (also support G.711)
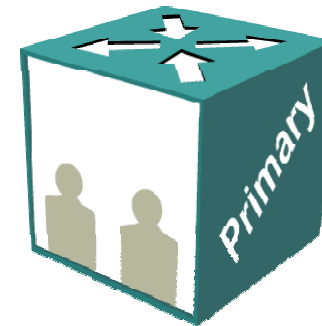
Cisco TelePresence Manager
Overview

- **Cisco TelePresence Manager provides management and scheduling of Cisco TelePresence rooms**
    - It is the "middle-ware" between the rooms, Cisco Unified CallManager and the customers calendaring application (Microsoft Exchange)

- **Provides "One Button to Push" call launch of scheduled meetings via the touch-screen user interface of the Cisco IP Phone 7970 within the TelePresence room**

- **Easy to administer: Same platform and administrative look and feel as Cisco Unified CallManager (version 5.x)**

    Runs on Cisco MCS 7835-H1/I1

    Based on Cisco Linux Voice OS platform.

    CLI interface accessible via SSH or local keyboard/monitor/console ports

    Web-based (HTTPs) interface for administration and monitoring

    SNMP v3 and CDP support

Cisco TelePresence Manager
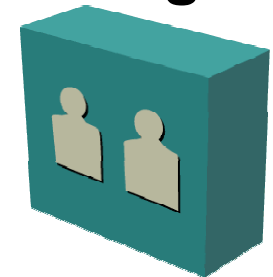
TelePresence Network Design Overview
Agenda

- **TelePresence Components Overview**

- **Connecting the TelePresence Endpoints**

- **TelePresence Network Deployment Models**

- **TelePresence QoS Design**

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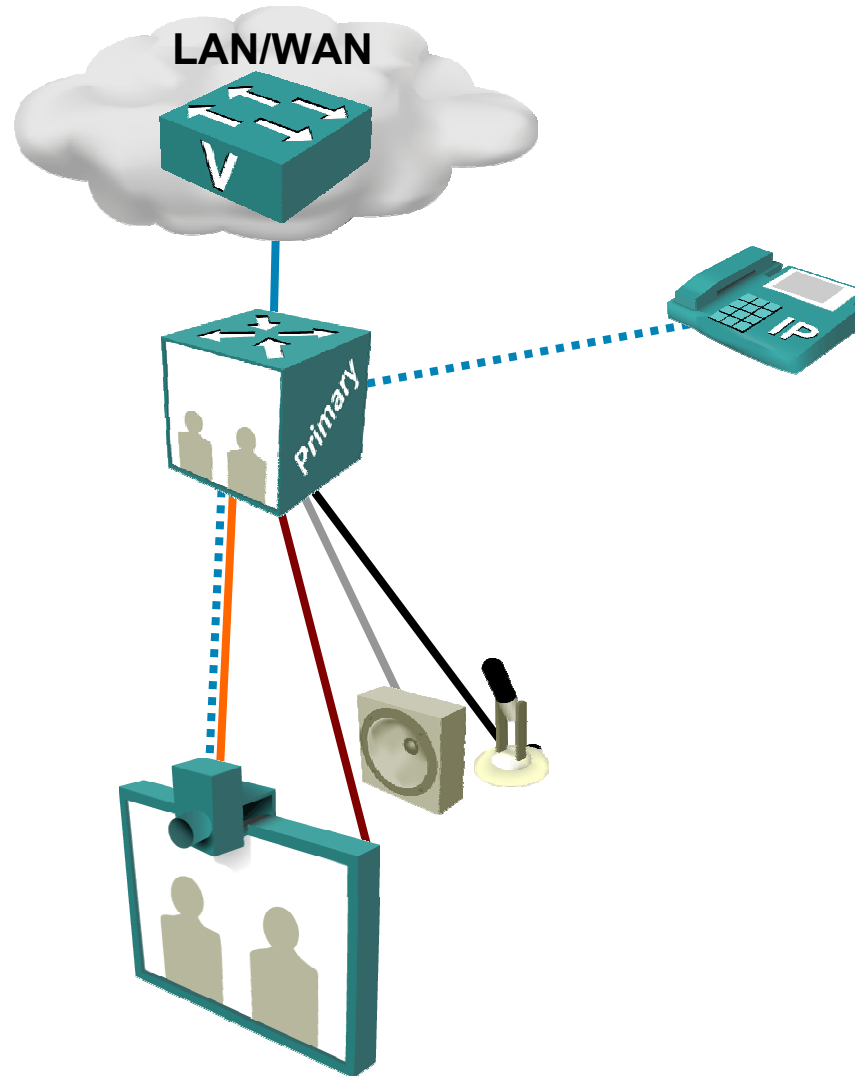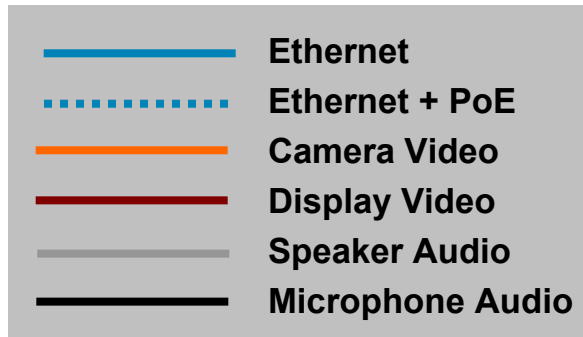
- **TelePresence QoS Design**

Connecting the Endpoints
CTS-1000
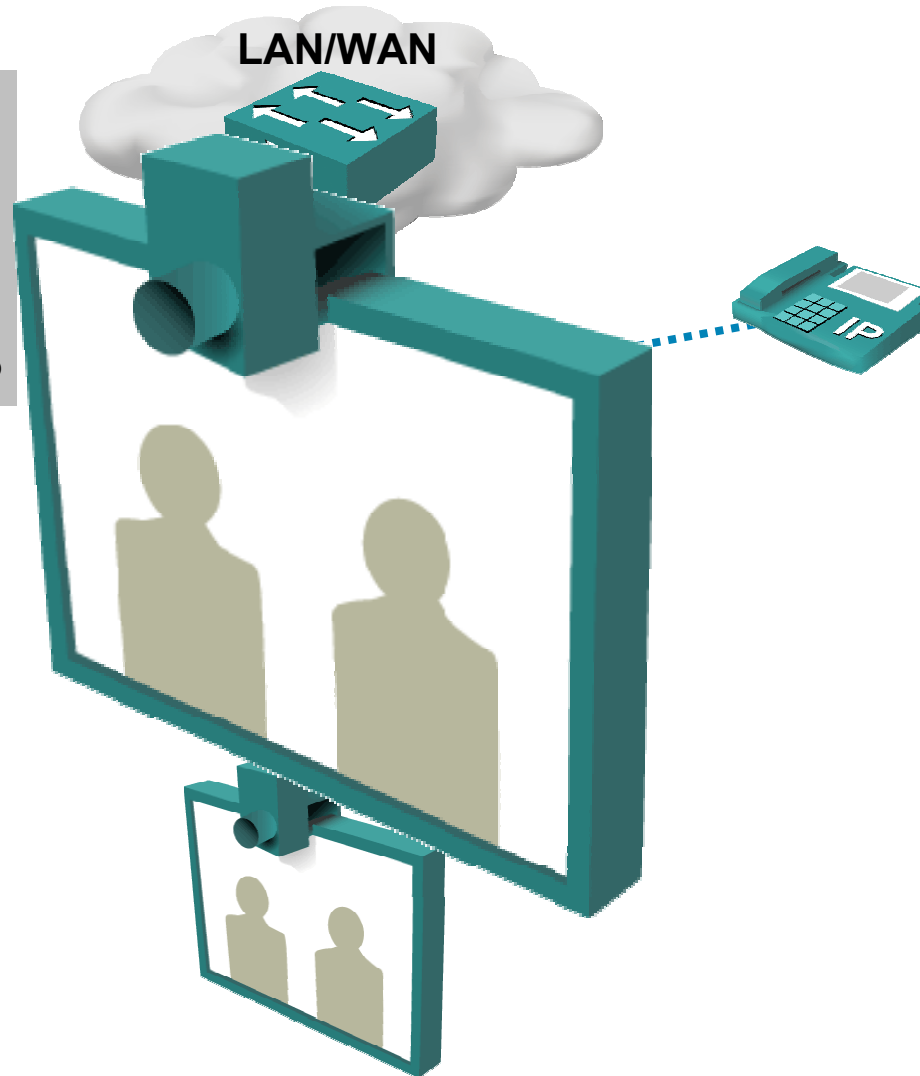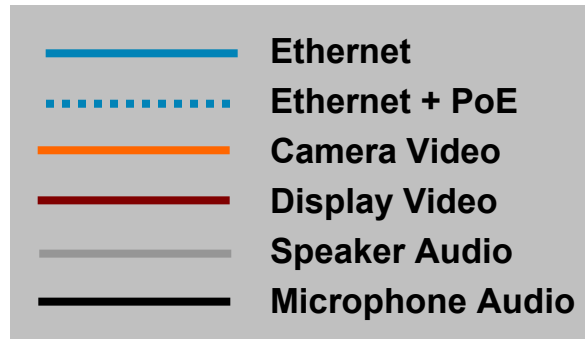
Legend:
- Ethernet
- Ethernet + PoE
- Camera Video
- Display Video
- Speaker Audio
- Microphone Audio

LAN/WAN

Primary

IP

Connecting the Endpoints
CTS-1000

LAN/WAN

————	Ethernet
··········	Ethernet + PoE
————	Camera Video
————	Display Video
————	Speaker Audio
————	Microphone Audio

Connecting the Endpoints
CTS-3000

LAN/WAN

——	Ethernet
·····	Ethernet + PoE
——	Camera Video
——	Display Video
——	Speaker Audio
——	Microphone Audio

Primary

Secondary

Secondary

Secondary

IP

Connecting the Endpoints
CTS-3000

LAN/WAN

Ethernet

PoE

IP
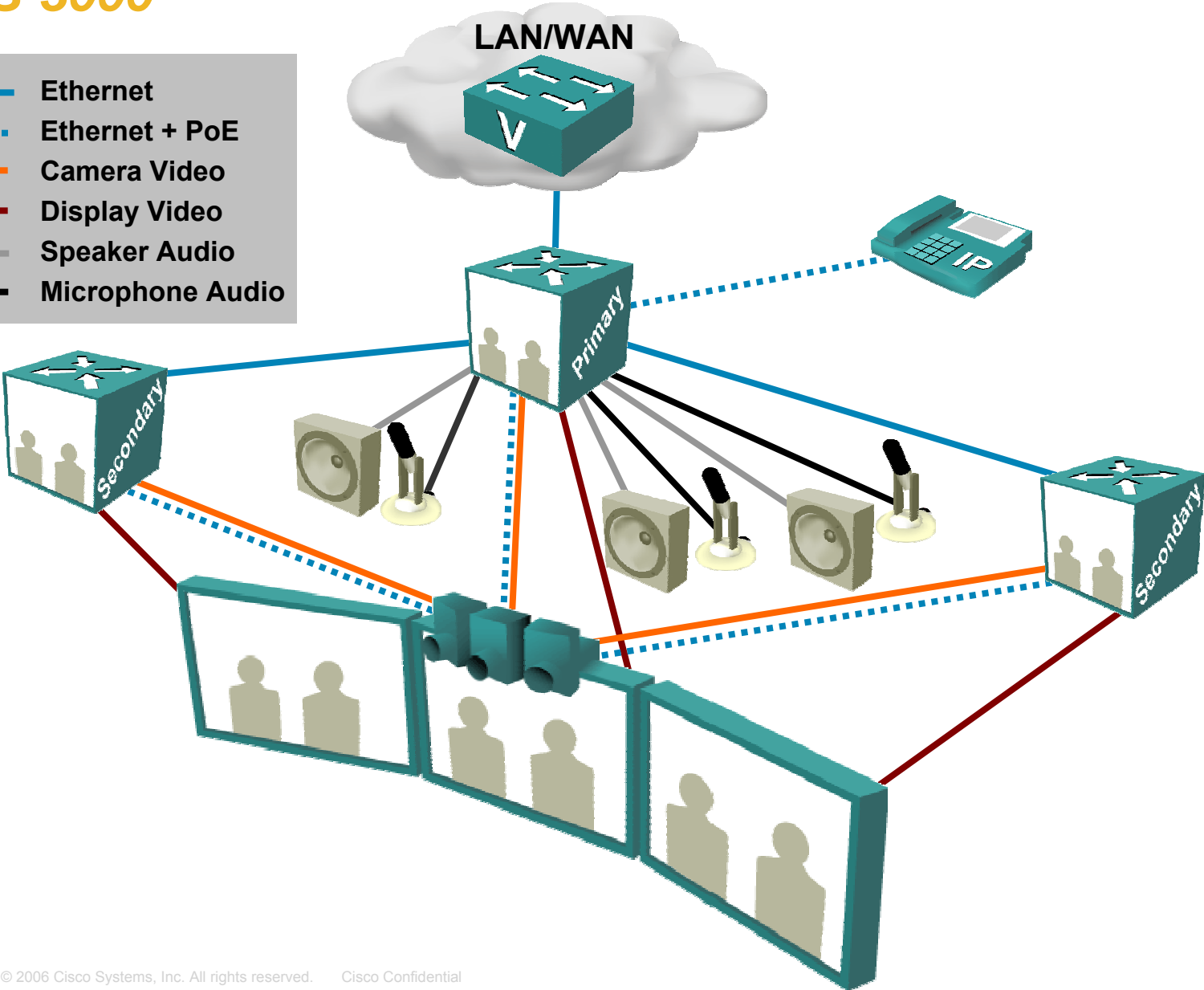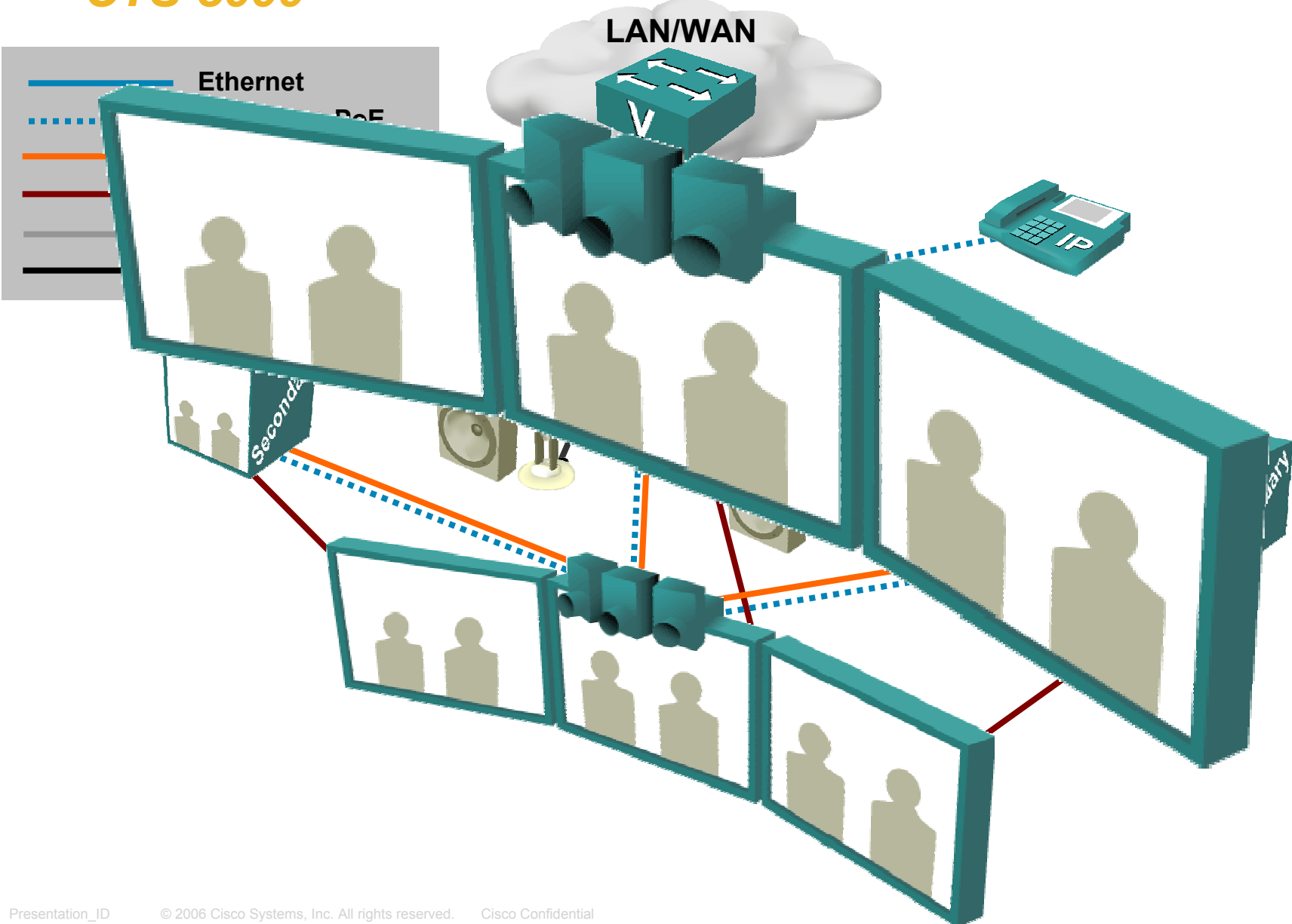
Secondary

Primary

Cisco TelePresence System 3000
From CallManager's Point of View

- **CallManager sees Primary Codec as a SIP endpoint**
- **Secondary Codecs are invisible to the network**
- **Cisco IP Phone 7970 runs SIP (not SCCP)**
- **Primary Codec and IP Phone share line appearance**

Ethernet

Ethernet + POE

SIP
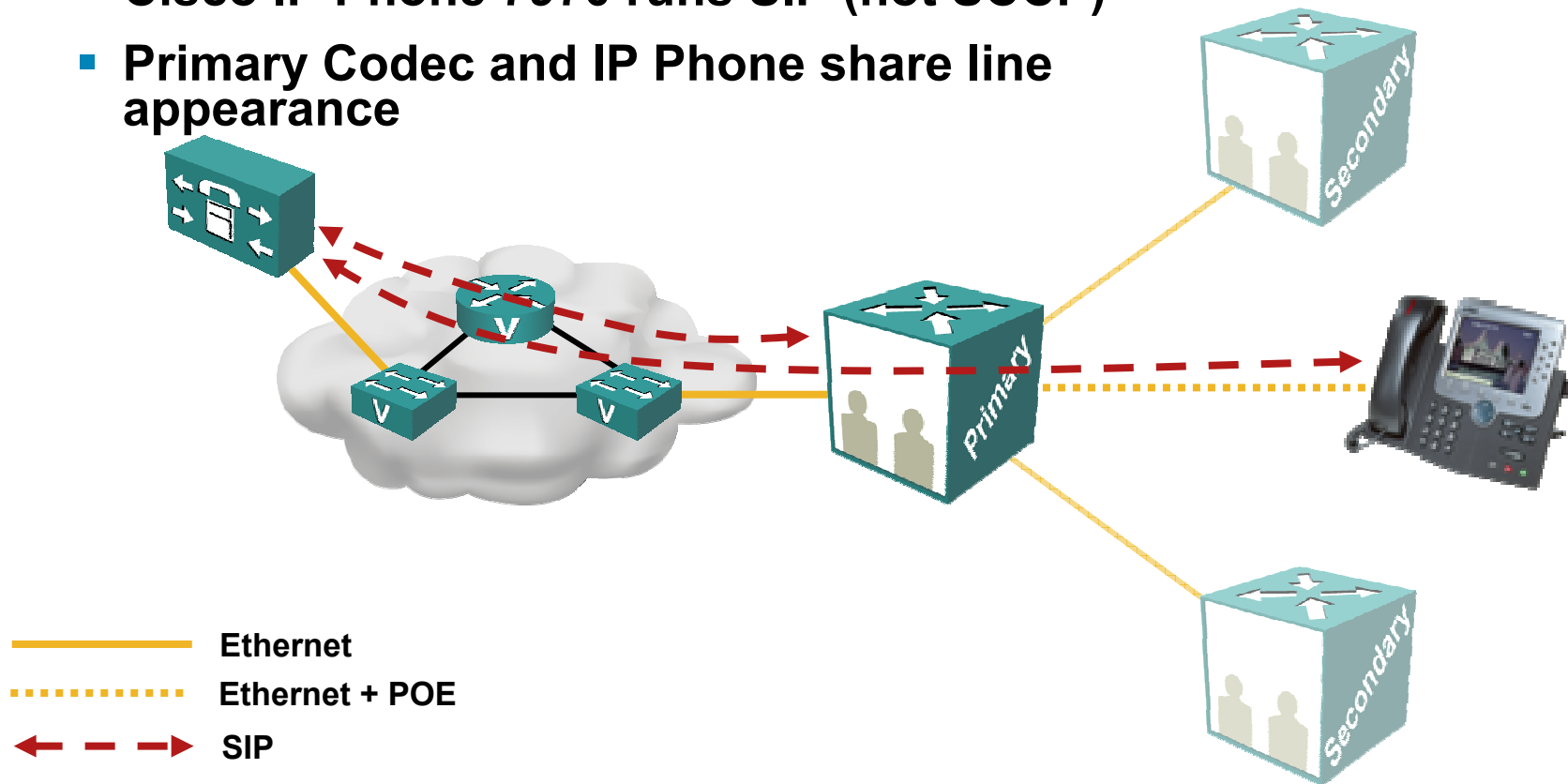
Connecting the Endpoints
CTS Network Protocol Interaction

Cisco 7970G IP Phone

TelePresence Primary Codec

Access-Edge Switch

LAN / WAN

Cisco Unified CallManager

Cisco TelePresence Manager

802.3af

CDP

CDP

CDP

DHCP

DHCP

DHCP

TFTP

TFTP

TFTP

SIP

Shared Line

SIP

XML

XML, SNMP

→ No 802.1Q VLAN tag

⇠ ⇢ Tagged with 802.1Q ID of Voice VLAN
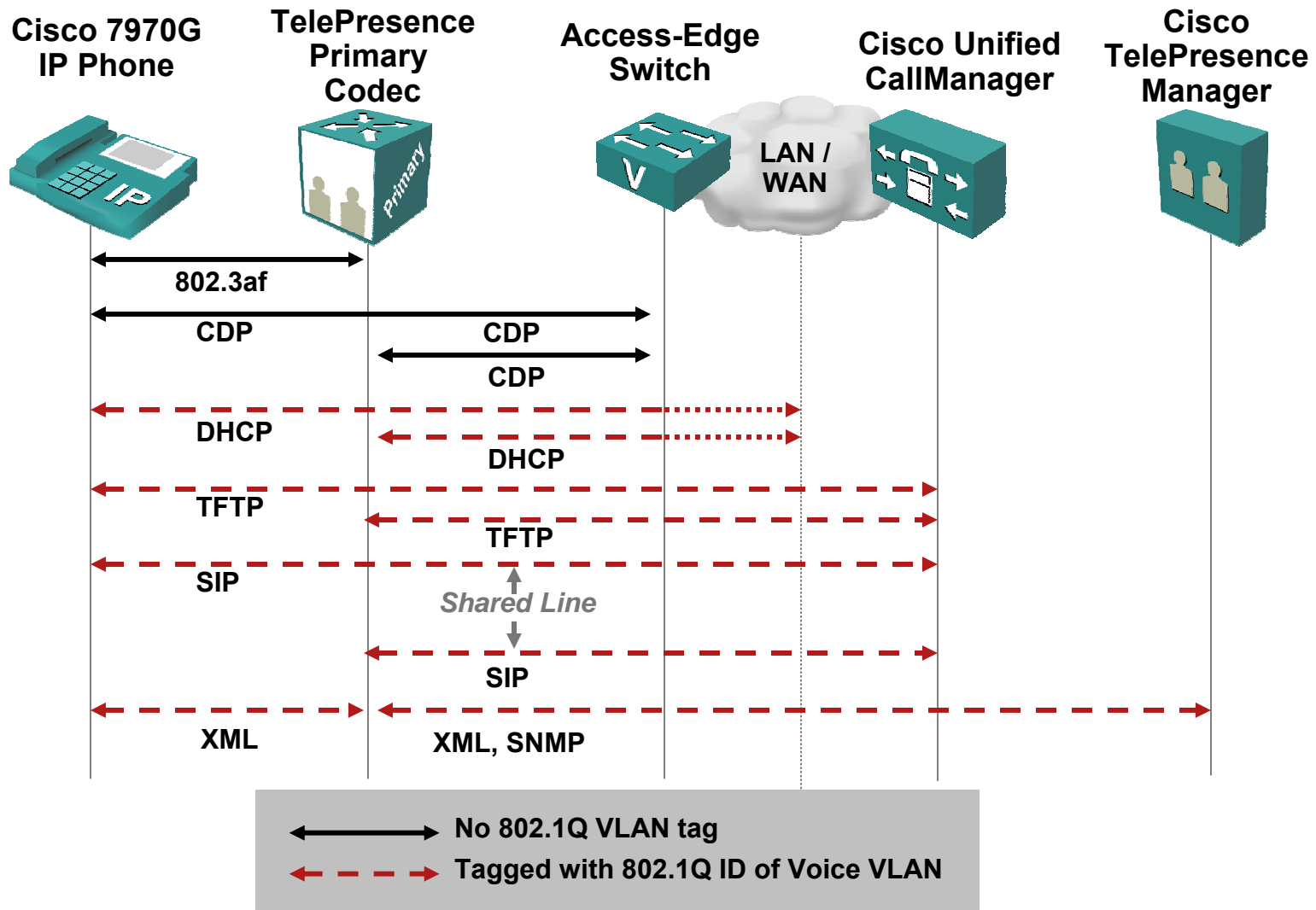
Cisco TelePresence
Call Processing
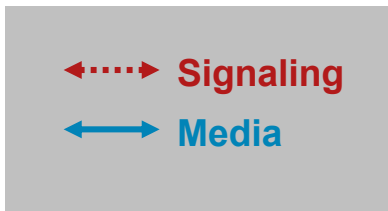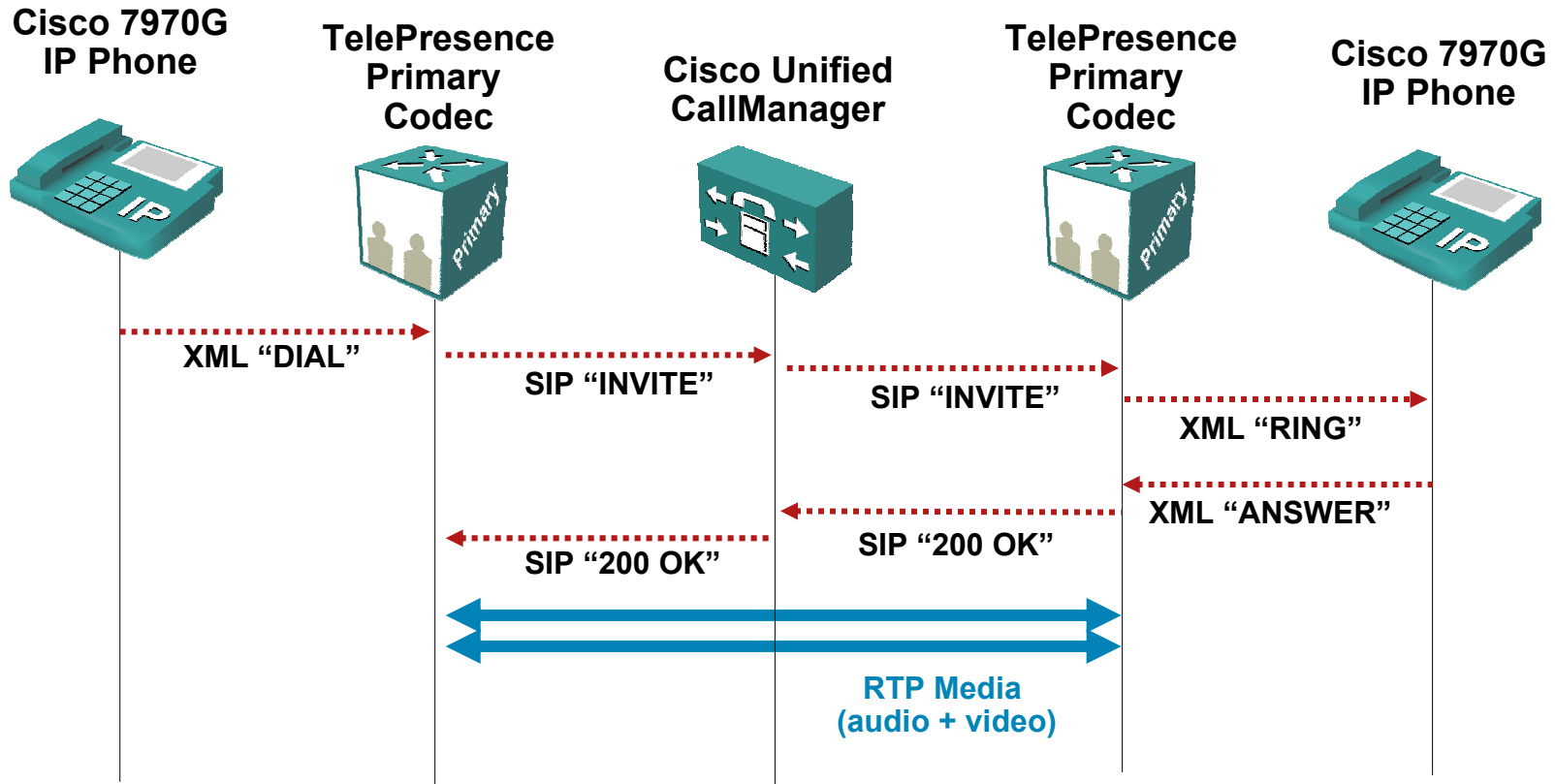
Note: Signaling has been simplified for the purpose of this figure. There are many other XML and SIP messages which are not shown.

Cisco TelePresence
Audio & Video Multiplexing

LAN/WAN

Primary

Secondary

← – – → **Audio Streams**

← – – → **Video Streams**
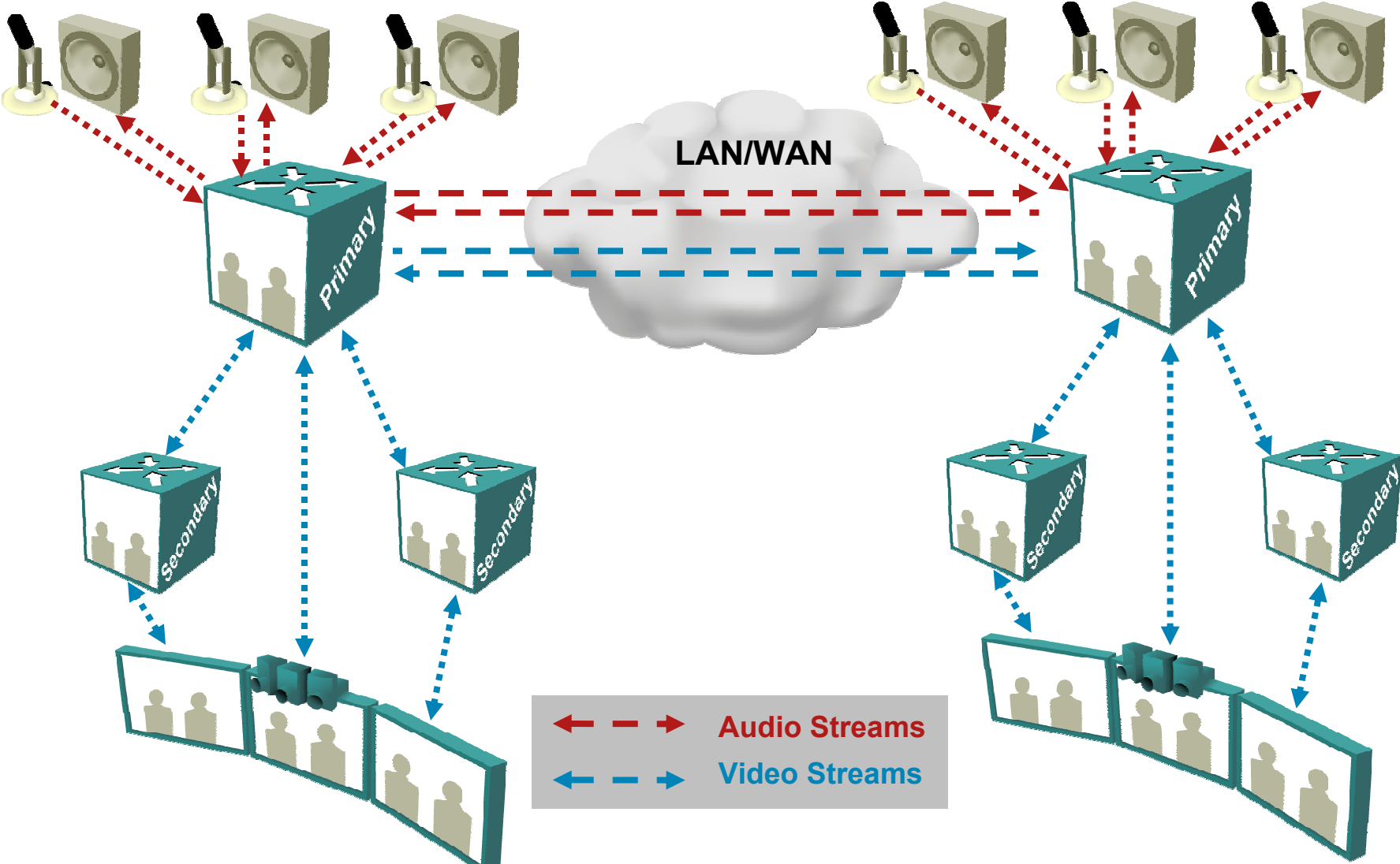
Cisco TelePresence Manager
CTM Example Protocol Flow
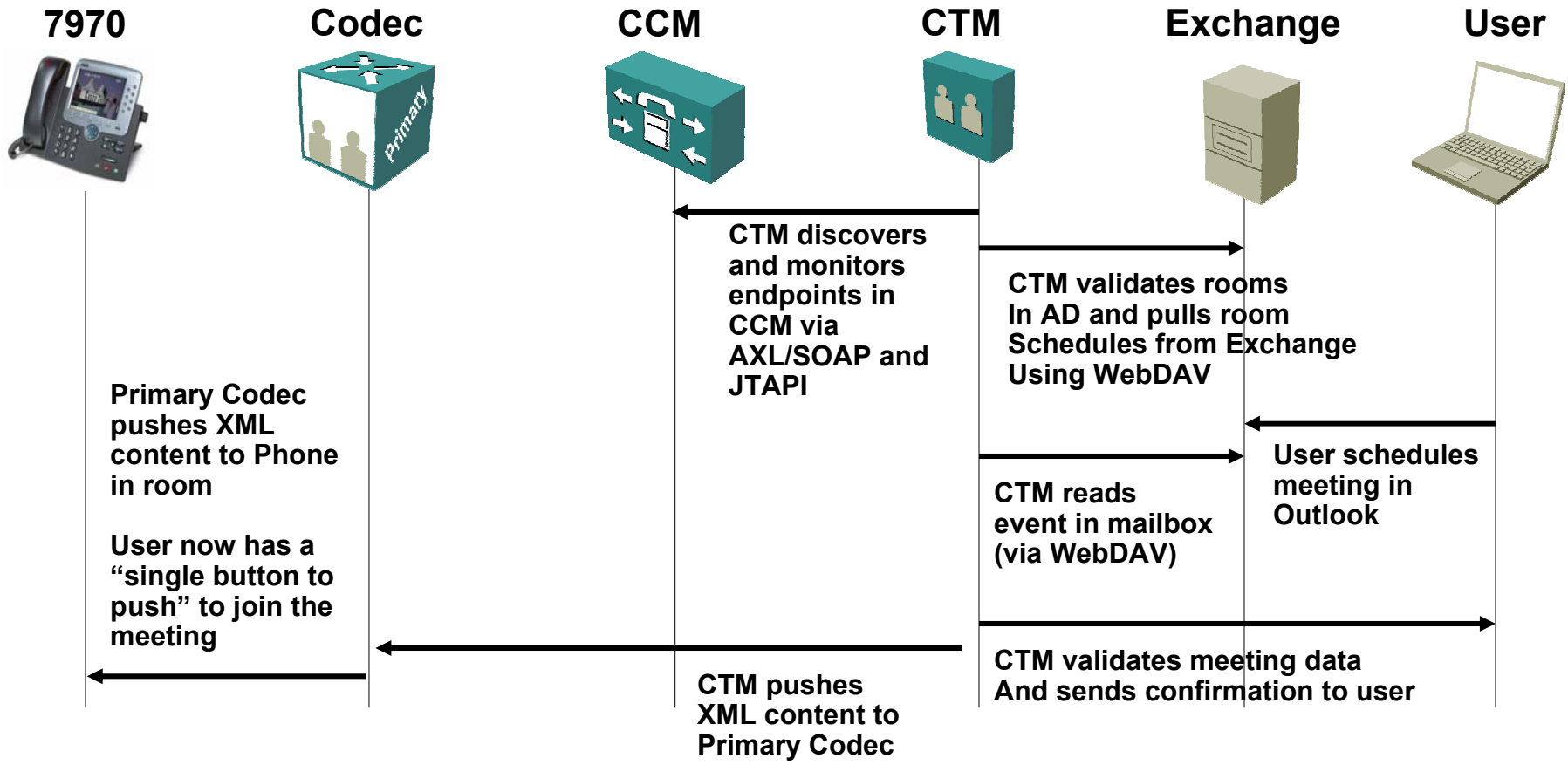
7970 **Codec** **CCM** **CTM** **Exchange** **User**

CTM discovers and monitors endpoints in CCM via AXL/SOAP and JTAPI

CTM validates rooms In AD and pulls room Schedules from Exchange Using WebDAV

Primary Codec pushes XML content to Phone in room

User now has a "single button to push" to join the meeting

CTM reads event in mailbox (via WebDAV)

User schedules meeting in Outlook

CTM pushes XML content to Primary Codec

CTM validates meeting data And sends confirmation to user

TelePresence Network Design Overview
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- **TelePresence Network Deployment Models**

- **TelePresence QoS Design**

TelePresence Network Deployment Models
1) Intra-Campus

Campus Building A

Campus Building B

Campus Core

CTS-3000

CTS-3000

Campus Access

Campus Distribution

Campus Access

TelePresence Network Deployment Models
2) Intra-Enterprise

Campus A

CTS-3000

Campus

WAN/MAN Block

Campus B

Private WAN

MPLS VPN

Metro Ethernet

CTS-3000

Branch C
CTS-1000

TelePresence Network Deployment Models
3) Intra-Enterprise Multipoint Switch
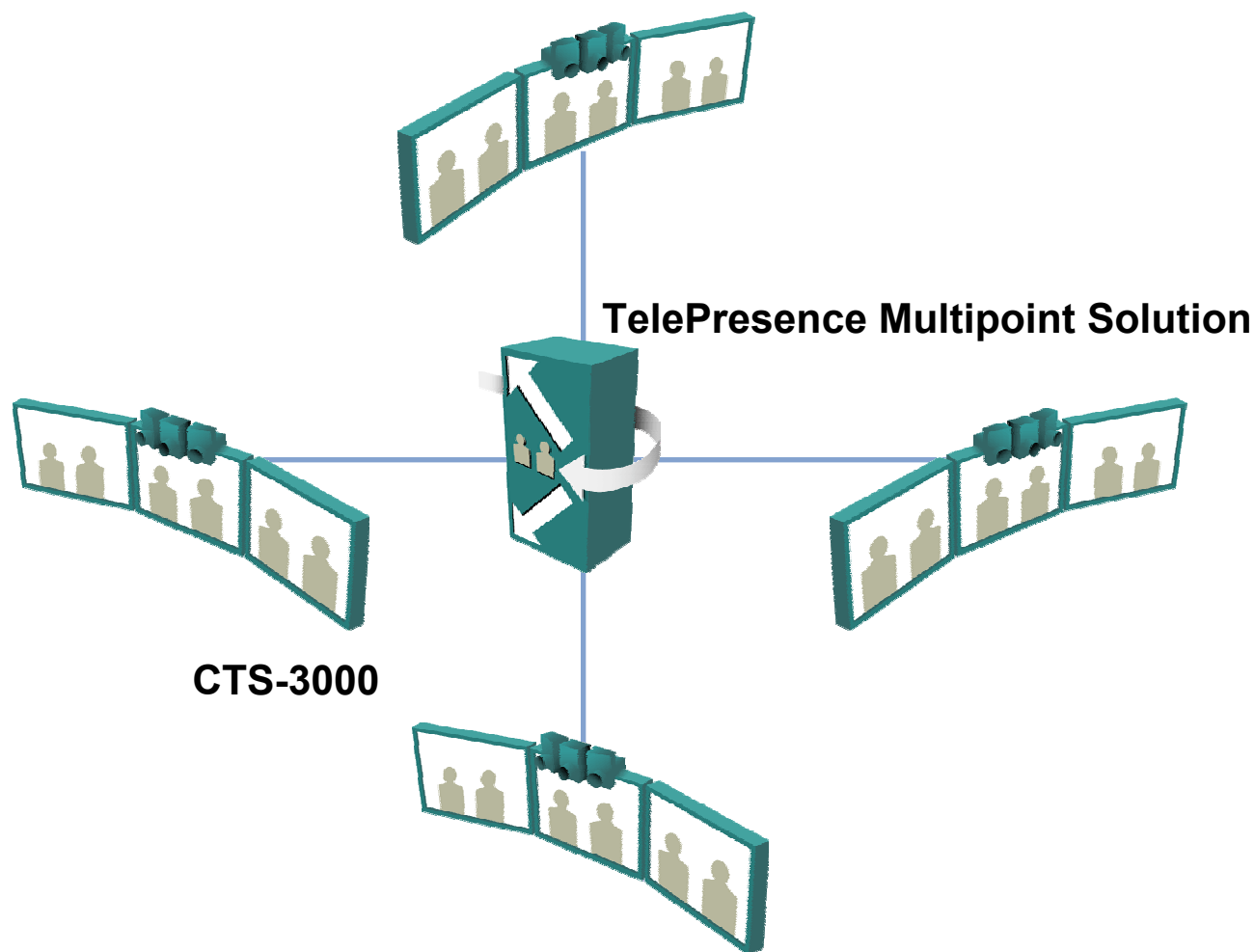
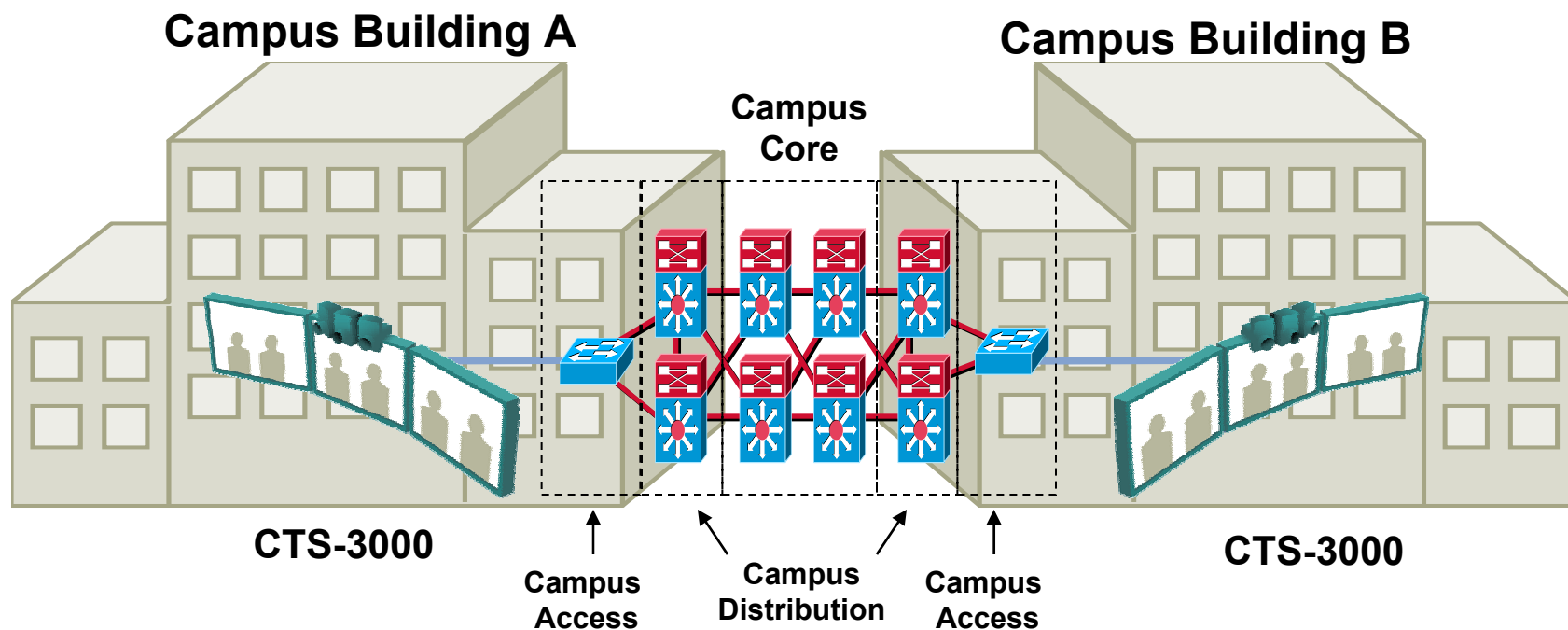**TelePresence Multipoint Solution**

CTS-3000

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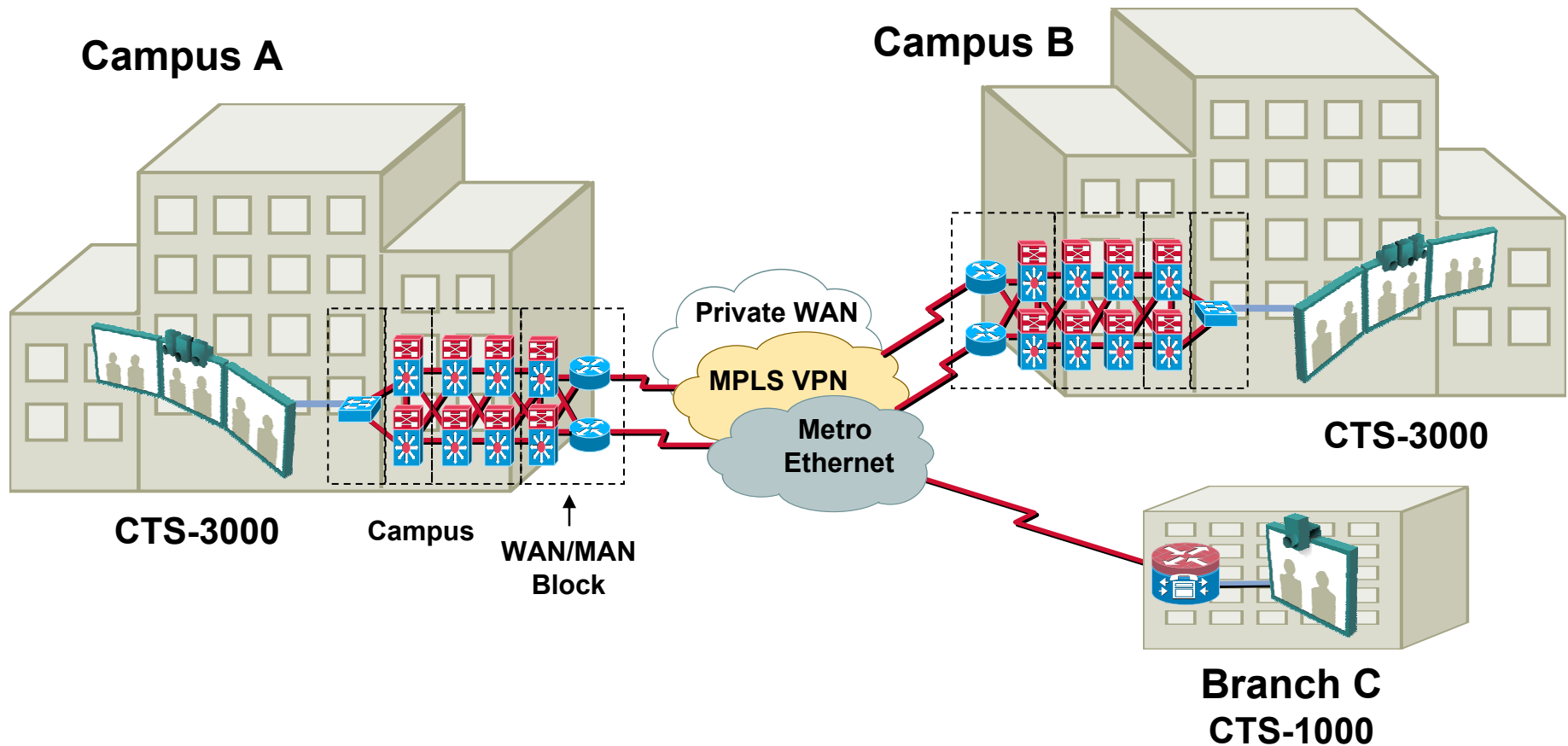
- **TelePresence QoS Design**

TelePresence BW Requirements Breakdown:
CTS-1000 at 1080p-Best

- 1 primary video streams (4 Mbps each):   4 Mbps

- 1 primary audio streams (64 Kbps each):   64 Kbps

- 1 auxiliary audio stream: 64 Kbps

- 1 auxiliary video stream: <u>400 Kbps</u>

- TOTAL :   4,528 Kbps

- + burst and L2-4 overhead: ≈ 5.1 Mbps

TelePresence BW Requirements Breakdown:
CTS-3000 at 1080p-Best

- **3 primary video streams (4 Mbps each):   12 Mbps**

- **3 primary audio streams (64 Kbps each): 192 Kbps**

- **1 auxiliary audio stream: 64 Kbps**

- **1 auxiliary video stream: 400 Kbps**

- **TOTAL :   12,656 Kbps**

- **+ burst and L2-4 overhead: ≈ 14.3 Mbps**

TelePresence Service Level Requirements
Latency Targets

CODEC	Queuing	Serialization	Propagation	Jitter Buffer + CODEC
≈70 ms	Variable	Fixed	Fixed (6.3 μs/Km)	≈80 ms
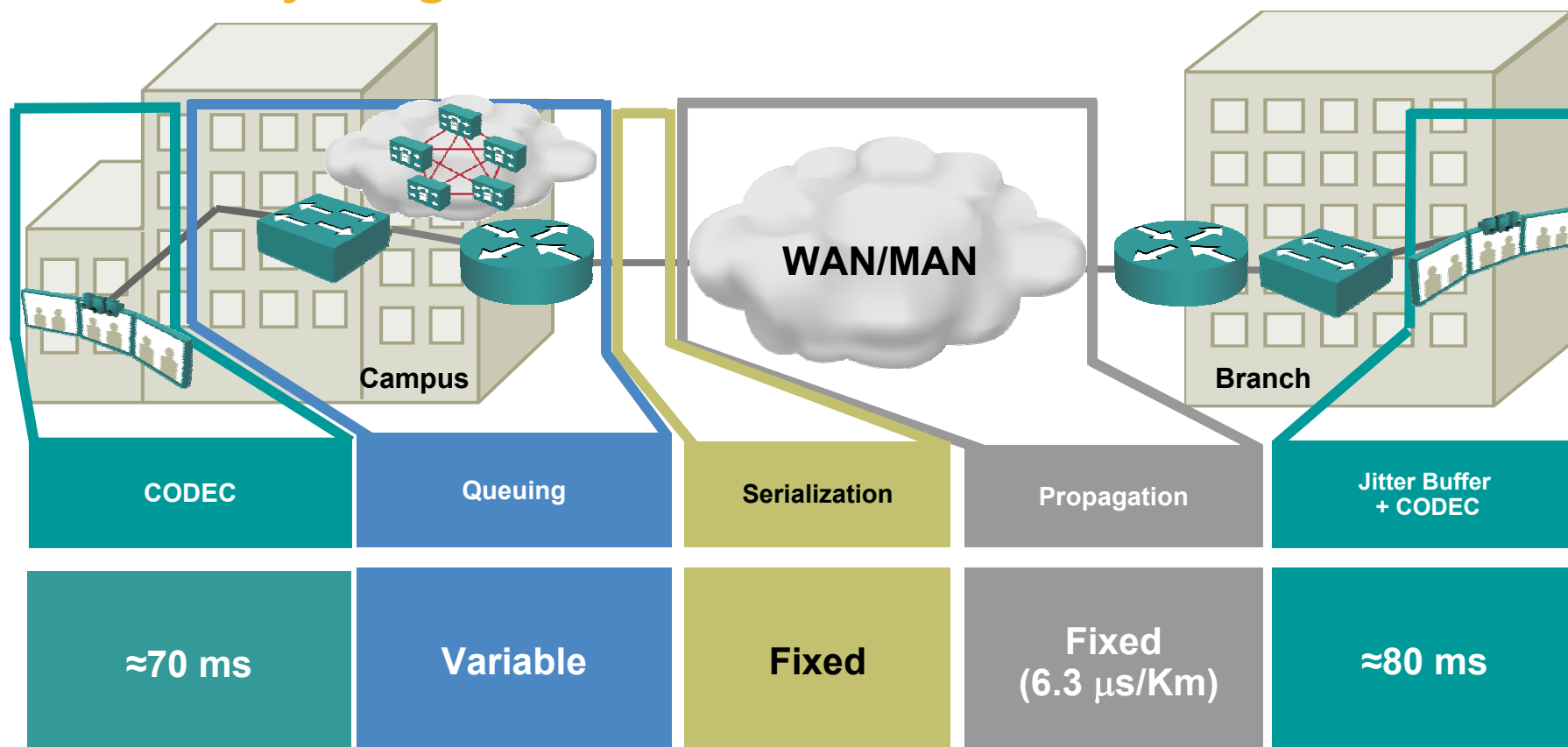
Metric	Target	Threshold 1 (Warning)	Threshold 2 (Call Drop)	Enterprise Component	Service Provider Component
Latency	150 ms	200 ms	400 ms	20%	80%
Jitter	10 ms	20 ms	40 ms	50%	50%
Loss	0.05%	0.10%	0.20%	50%	50%

TelePresence Loss Service Level Requirement
Why is TelePresence So Sensitive to Packet Loss?

Cisco TelePresence Codecs use 1080p30 Resolution

1920 lines of Vertical Resolution (Widescreen Aspect Ratio is 16:9)

1080 lines of Horizontal Resolution

1080 x 1920 lines =

2,073,600 pixels per frame

x 3 colors per pixel

x 1 Byte (8 bits) per color

x 30 frames per second

= 1,492,992,000 bps

or **1.5 Gbps Uncompressed**

Cisco TelePresence Codecs transmit 3-5 Mbps per 1080p screen,
which represents *over 99% compression*.
Therefore packet loss is proportionally magnified in overall video quality.

TelePresence Service Level Requirements
Summary

- **Latency ≤ 250 ms**

- **Jitter ≤ 10 ms**

- **Loss ≤ 0.05%**

One-Way Requirements

- **Bandwidth** (4 Mbps per screen @ 1080p-Best)

  + **voice** (64 kbps streams)

  + **auxiliary audio and/or video streams**

  + **burst allowance**

  + **L2-4 overhead**

- **Call Admission Control must be enabled (Cisco CallManager)**

Cisco TelePresence

- Bursty
- Drop sensitive
- Delay sensitive
- Jitter sensitive
- UDP priority

RFC 4594: Config Guidelines for DiffServ Classes
Real-Time Interactive Class for TelePresence

Application	L3 Classification		IETF
	PHB	DSCP	RFC
Network Control	CS6	48	RFC 2474
VoIP Telephony	EF	46	RFC 3246
Call Signaling	CS5	40	RFC 2474
Multimedia Conferencing	AF41	34	RFC 2597
Real-Time Interactive	CS4	32	RFC 2474
Multimedia Streaming	AF31	26	RFC 2597
Broadcast Video	CS3	24	RFC 2474
Low-Latency Data	AF21	18	RFC 2597
OAM	CS2	16	RFC 2474
High-Throughput Data	AF11	10	RFC 2597
Best Effort	DF	0	RFC 2474
Low-Priority Data	CS1	8	RFC 3662

Establishing the Trust Boundary for TelePresence
Conditional Trust Extended to Cisco 7970G IP Phone

Trust Boundary

Successful "Condition" Met (i.e. CDP negotiation successful)

1

Trust is Dynamically Extended to Cisco 7970G IP Phone

2

Cisco 7979G: Voice ➜ CoS 5 & DSCP 46
Call-Signaling ➜ CoS 3 & DSCP CS3

3

Primary Codec: Voice + Video ➜ CoS 4 & DSCP CS4

Call-Signaling ➜ CoS 3 & DSCP CS3

4

CoS-to-DSCP Map:
CoS 5 ➜ DSCP EF (46)
CoS 4 ➜ DSCP CS4 (32)
CoS 3 ➜ DSCP CS3 (24)
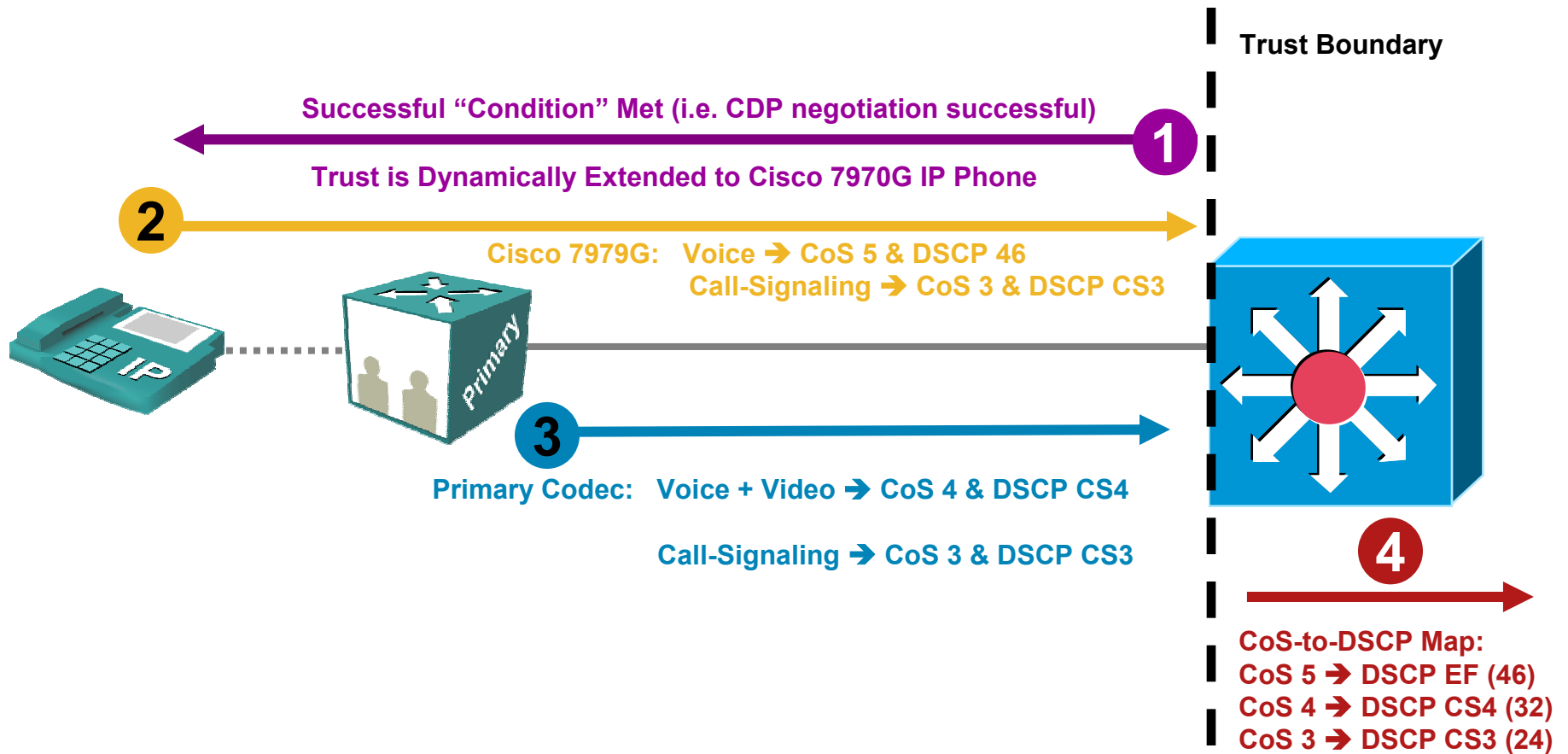
Note: **As 2-6 data ports are available for PC connections (as part of the TelePresence tables),
it is recommended to disable the PC port in the back of the Cisco Unified 7970G IP Phone
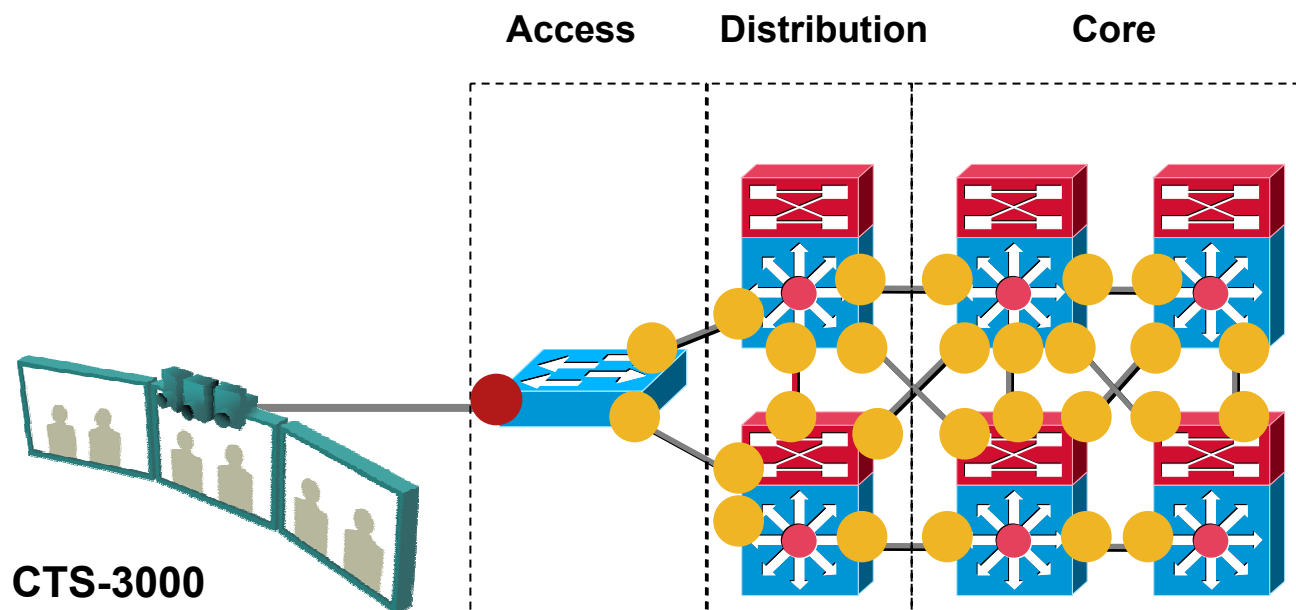(from within CallManager)**

Campus Queuing Design for TelePresence
1P3Q8T Queuing Model Example

Application	PHB	CoS
Network Control	–	CoS 7
Internetwork Control	CS6	CoS 6
Voice	EF	CoS 5
TelePresence	CS4	CoS 4
Call Signaling	CS3	CoS 3
Network Management	CS2	CoS 2
Scavenger	CS1	CoS 1
Best Effort	0	0

1P3Q8T

CoS 5 CoS 4	Q4 Priority Queue	
CoS 7		Q3T4
CoS 6		Q3T3
CoS 3		Q3T2
CoS 2	Queue 3	Q3T1
CoS 0	Queue 2	Q2T1
CoS 1	Queue 1	Q1T1
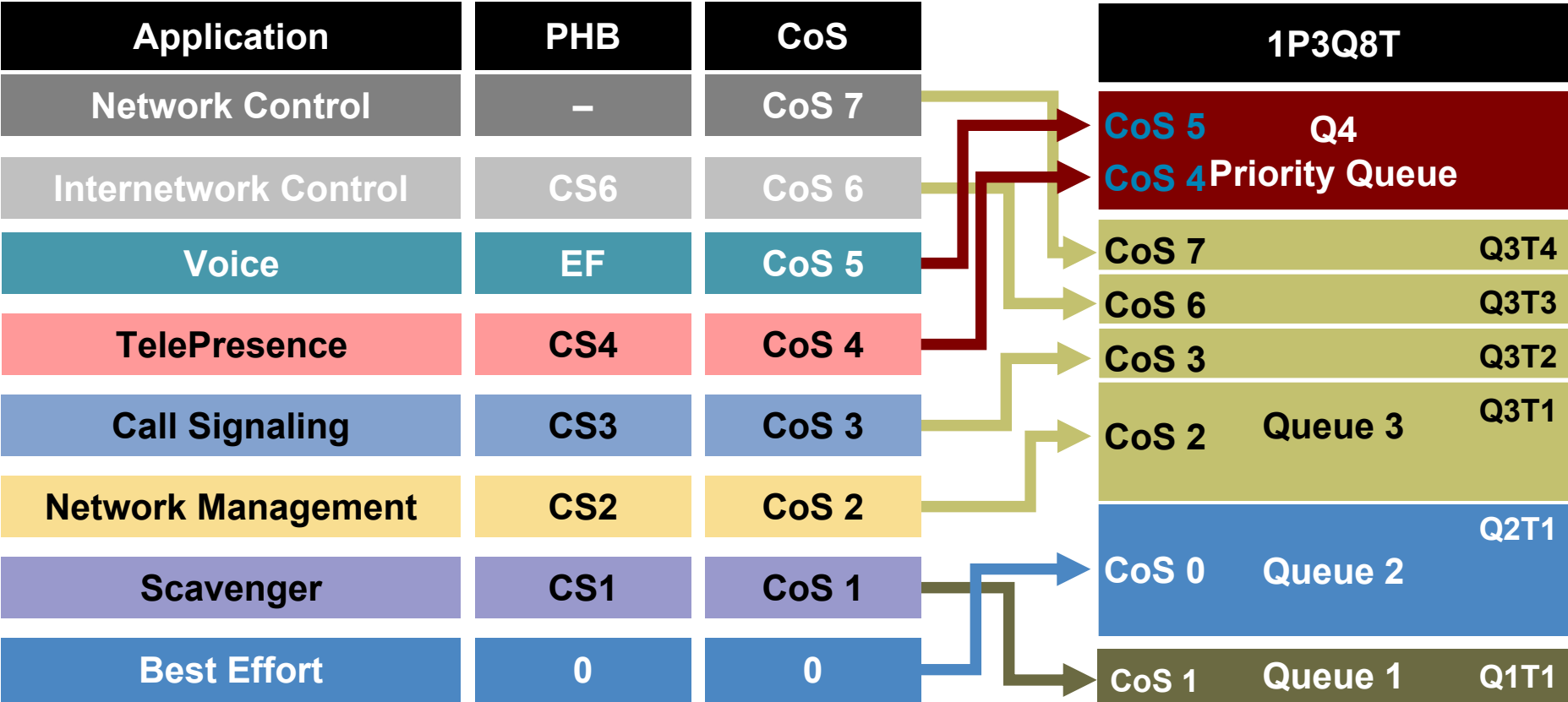
TelePresence Campus QoS Design
Access-Edge and Interswitch Link QoS Policies

Access   **Distribution**   **Core**

CTS-3000

🔴 **Trust CoS**
+ Map CoS 4 ➔ DSCP CS4 (32)
+ (Optional Policing)
+ Queuing (CoS 4 & 5 ➔ PQ)
+ Queuing (CoS 3 ➔ Non-PQ)

🟠 **Trust DSCP**
+ Queuing (CoS 4 & 5 ➔ PQ)
+ Queuing (CoS 3 ➔ Non-PQ)

TelePresence WAN QoS Design
LLQ/CBWFQ Queuing Subsystems

Low Latency Queueing

VoIP Policer

TP Policer

PQ

Packets In

Call-Signaling
Transactional
Bulk Data
Mgmt
Default

FQ

CBWFQ

Link Fragmentation and Interleave

Interleave

TX Ring

Fragment

Packets Out

Layer 3 Queuing Subsystem   **Layer 2 Queuing Subsystem**
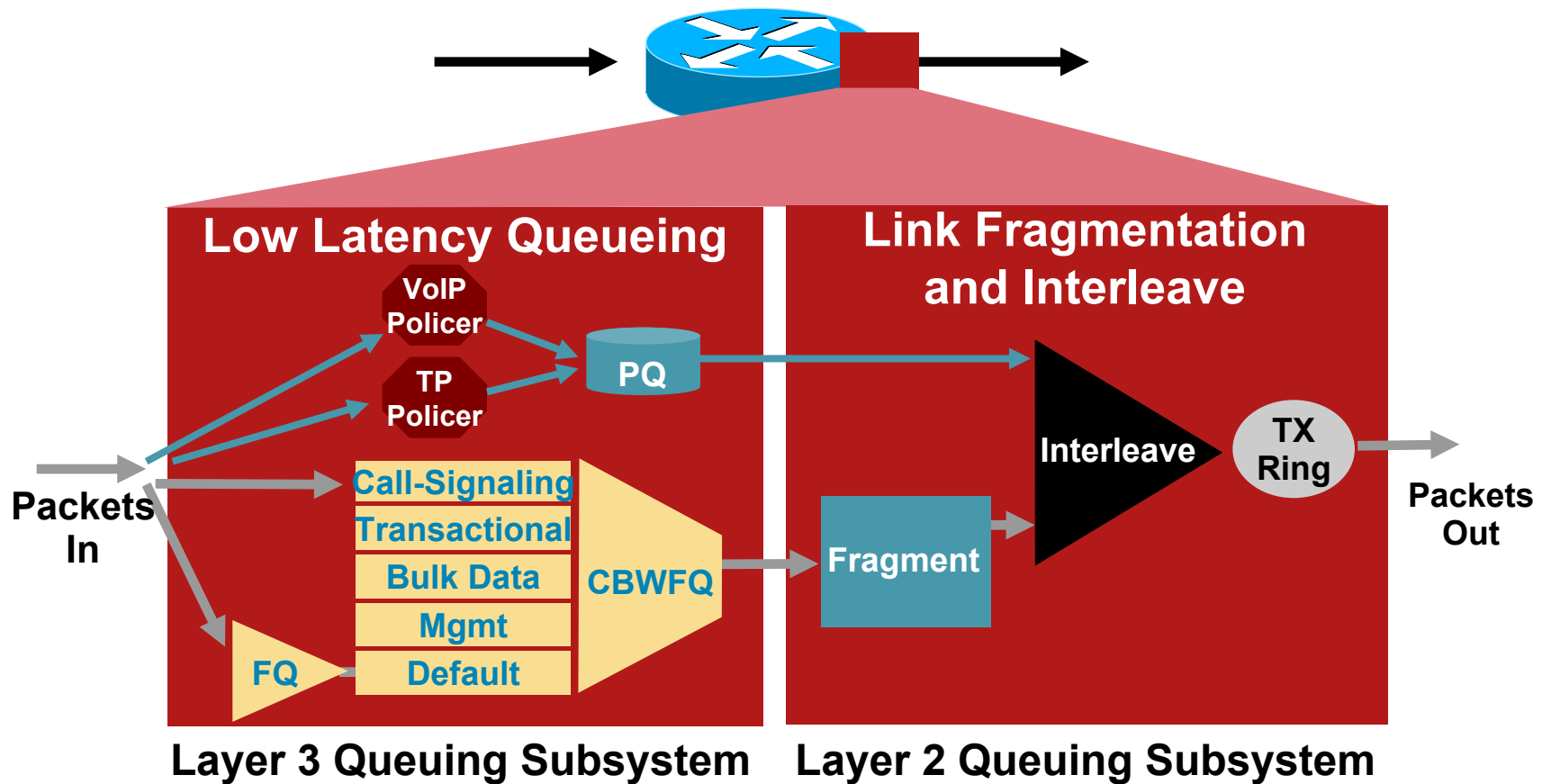
TelePresence WAN QoS Design
WAN Block and WAN Edge QoS Design

WAN Block

Private (L2) WAN
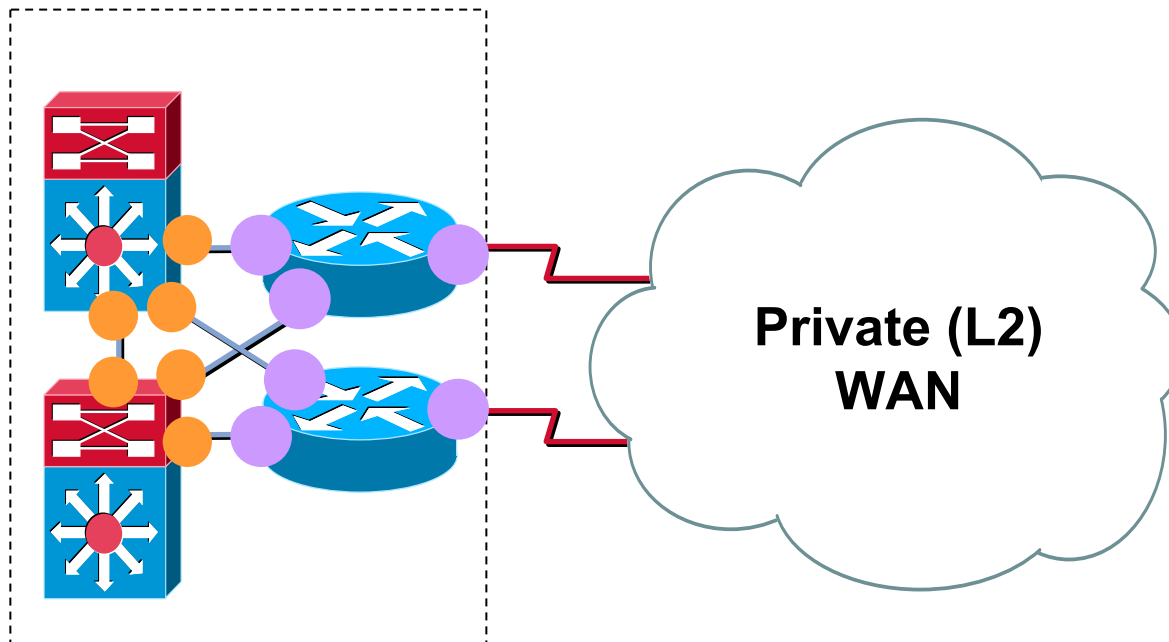
🟠 **Trust DSCP**
+ Queuing (CoS 4 & 5 ➔ PQ)
+ Queuing (CoS 3 ➔ Non-PQ)

🟣 **Trust DSCP**
+ LLQ for VoIP (EF)
+ LLQ for TelePresence (CS4)
+ CBWFQ for Call-Signaling (CS3)

≤ 33% of BW

TelePresence Network Design
Key Takeaways

The Key Takeaways of this presentation are:

- Cisco TelePresence (TP) is *not* simply better video-conferencing; it is an entirely new application developed in-house, featuring a proprietary codec, a 7970G IP Phone, 65" Plasma displays, speakers, mics, etc.

- CTS-1000 systems have 1 screen; CTS-3000 systems have 3 screens; the TelePresence primary codec is the heart of the system, to which all other components connect to; TP systems connect to the network via a 10/100/1000 Base-T Ethernet connection from the primary codec

- TelePresence SLA targets are (currently) set as:

  - 2 Mbps (CTS-1000 @ 720p-Good) to 15 Mbps (CTS-3000 @ 1080p-Best)

  - ≤ 250 ms camera-to-glass latency (100 ms network flight time)

  - ≤ 10 ms jitter

  - ≤ 0.05% packet loss

- Per RFC 4594, TelePresence should be marked CS4 and assigned priority queuing throughout the network ("a second EF PHB")