
TOMORROW
starts here.
CISCO
Cisco live!

Enabling Video For Every Workspace

BRKEVT-2665

Matt Lammi

Consulting Systems Engineer

#clmel

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Agenda

- Work environments & practices today
- Collaboration Endpoint Choices
- Designing the Workplace
- Room Remediation
- Network, Bandwidth & H265

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Work Environments and Practices Today

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The Employee Today

VS

The 21st Century Employee tethered to the 20th Century Cubicle

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The Most Disruptive Force in IT…
The End User

Workplace Resources - Major Impact on Organisations

- Sub-optimised Real Estate utilisation (40% average occupancy)
- Lack of Adequate Multi-party Collaborative Spaces
- Ability to attract/retain current and future talent
- Gaps in innovation/responsiveness

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A New Design Paradigm - Activity-based Working (ABW)

Creating a variety of workspace experiences
that are aligned to the activities being performed.

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Worker Roles and Styles – Cisco Examples

Workstation Anchored	Remote Collaborator	Campus Mobile	Neighbourhood Collaborator	Highly Mobile
				
Desk-bound, non-mobile employee who performs highly focused individual work; some team interaction	Non-mobile employee who works frequently with remote colleagues, and frequently works from home	Internally mobile; Interacts cross-functionally in face-to-face scheduled meetings; Often in leadership roles	Neighbourhood-based employee who is mobile within the group area; interacts with, coordinates and manages teams	Highly mobile; Travels extensively to customer and partner locations; frequently interacts with customers

Source: Cisco Work Profile Survey

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The Workforce Needs More Flexibility

40%

of the workforce will be mobile by 2016

40%

of video users use three or more devices for video calling

94%

of business leaders say cloud collaboration enables flexible work environments

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The Office is Now Anywhere…







Collaboration and Remote Access are key…

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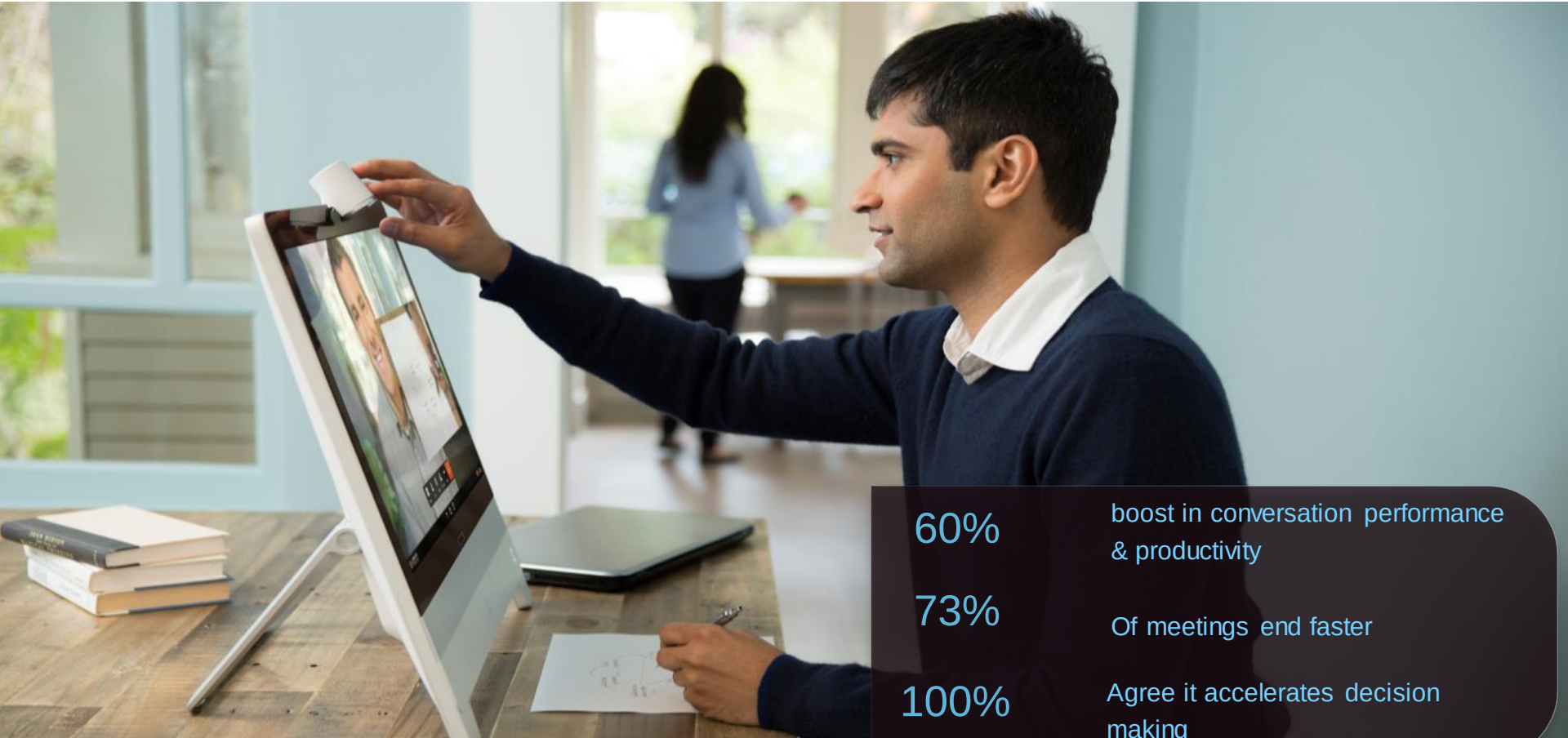
The Impact of Video Collaboration on Workplace Transformation



Connecting The Virtual Workforce

Conferencing providing Productivity through Connectivity

Driving Results

- Full Engagement drives spontaneous innovation.
- Secure B2B Video, Voice and Web collaboration

Work from anywhere like you're in the office!

Driving Results

- Empowered mobile workers
- Adaptive experiences anywhere; connected as if in the office
- Seamlessly escalate IM to video to a video conference
- Work anywhere: partner and customer sites

Collaboration Options Enhancing Workplace Transformation

Unified Communications

Connectivity and Federation

Multi-media Conferencing

Collaboration Endpoints and Clients

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Collaboration Endpoint Choices

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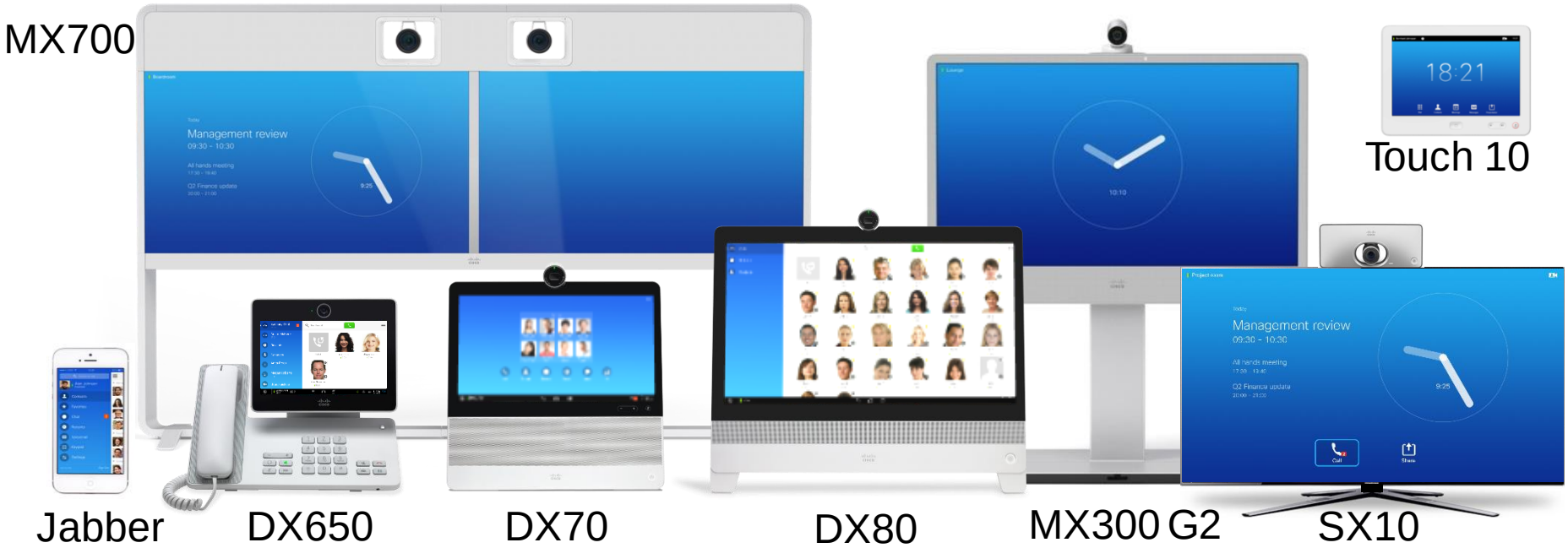
etrex 30
GARMIN
Simulating
Canon
CANON ZOOM LENS 6x IS
palmOne
TUNGSTEN T5
MENU


Upcoming meeting
Visual sync
18:30


Videosonic
Videosonic

Cisco's Biggest Endpoint Refresh Ever!

Ensuring Consistency Across Cisco Collaboration Product Portfolio



Get familiar with one product, know them all!

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Cisco Intelligent Proximity

Embracing Mobile Devices for Richer Collaboration Experiences

Auto-sync contacts and call log from your mobile phone to your desk phone

Experience quality audio for mobile devices at the desktop

View and share content wirelessly in the meeting room

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SX10

Compact purpose-built unit with built-in camera & mic

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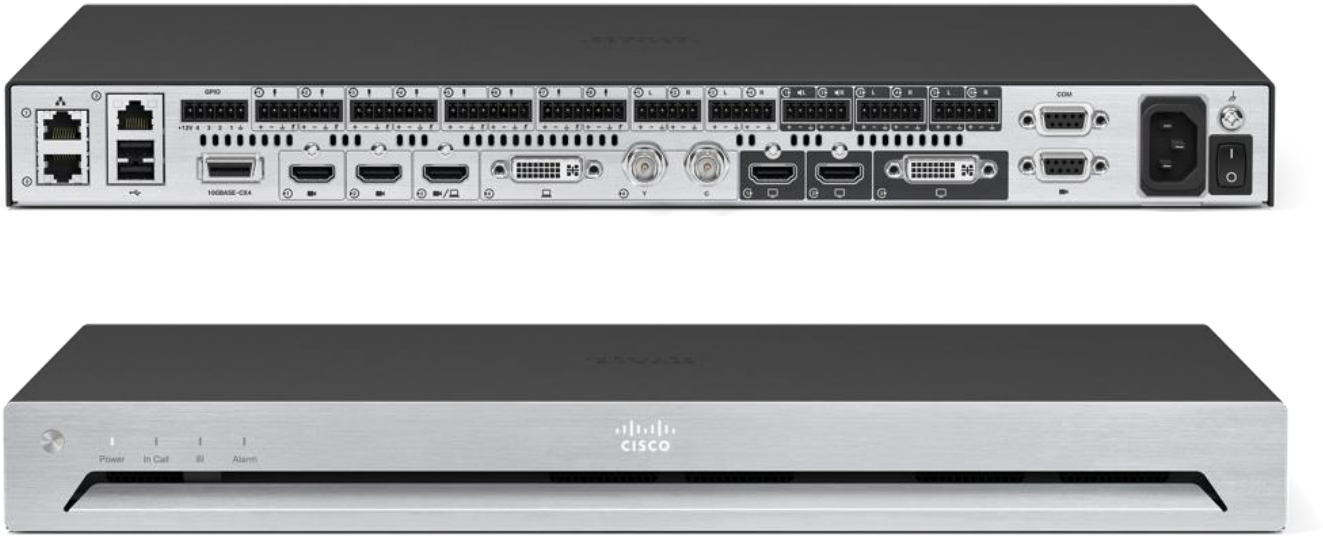
SX80

Flexibility for any demanding scenarios



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MX200 G2 & MX300 G2

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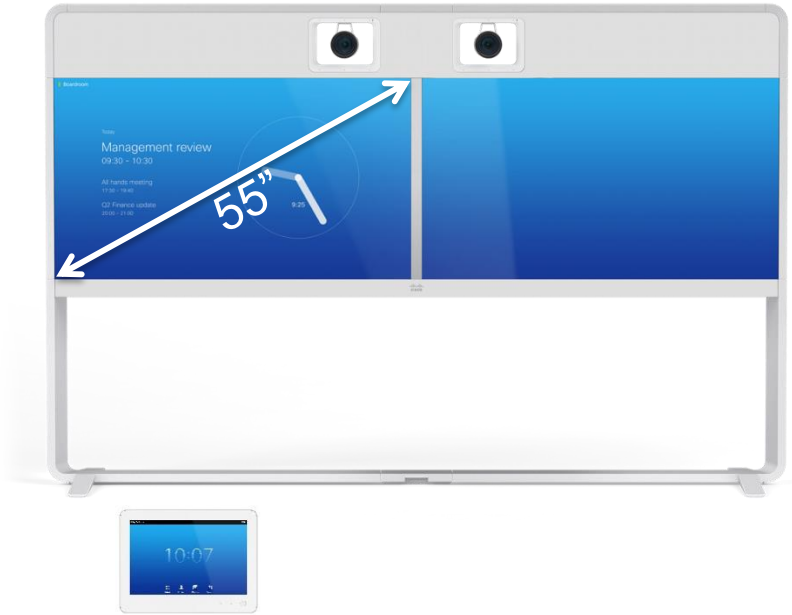
MX700 and MX800



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SpeakerTrack 60

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DX70

Integrated Collaboration in a Compact Package

CUCM Registered

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DX80

Integrated Collaboration with One Screen on the Desk

CUCM Registered

ANDROID

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Cisco TelePresence IX5000 Series

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Cisco Jabber - The Power to Collaborate

Soft Clients: All-in-One Unified Communications Application

All-in-One Application

- Presence and IM
- Voice, video, voice messaging
- Desktop sharing, conferencing

Collaborate from Any Workspace

- PC, Mac, tablet, smartphone
- On premises and cloud
- Integration with Microsoft Office

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Jabber Guest
Revolutionise Consumer-to-Business Collaboration

Key Use Cases

- Enhance customer interactions
- Make experts easy to find
- Offer temporary guest access

Guest Video Access

- Simple, no registration required
- Click to video using Web URLs
- Desktop browsers
  Windows – IE, Firefox, Chrome
  Mac – Safari, Firefox, Chrome
- Mobile app for iOS (iPhone/iPad)

SDKs for Custom Experiences

- Web widget for easy desktop browser integration
- iOS native SDK for custom mobile app integration
- REST API on server VM for workflow integration

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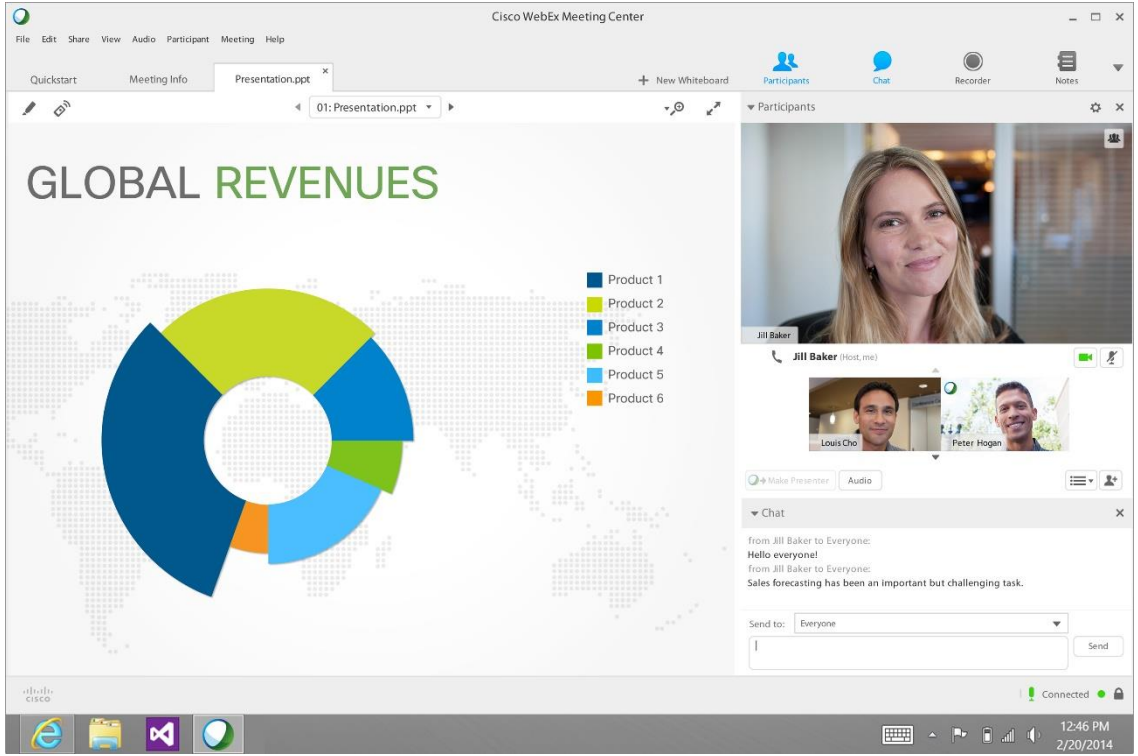
WebEx / CMR

Industry-Leading Web Conferencing and Video Conferencing



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Designing the Workplace

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Redesigning the Office Workspaces

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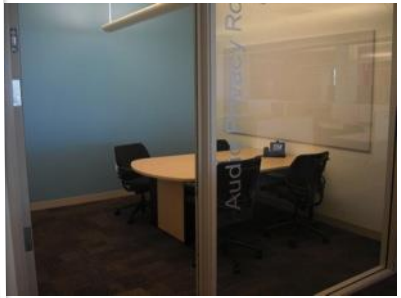
Workspace Types

Common Spaces

Personal Spaces



Collaboration Spaces

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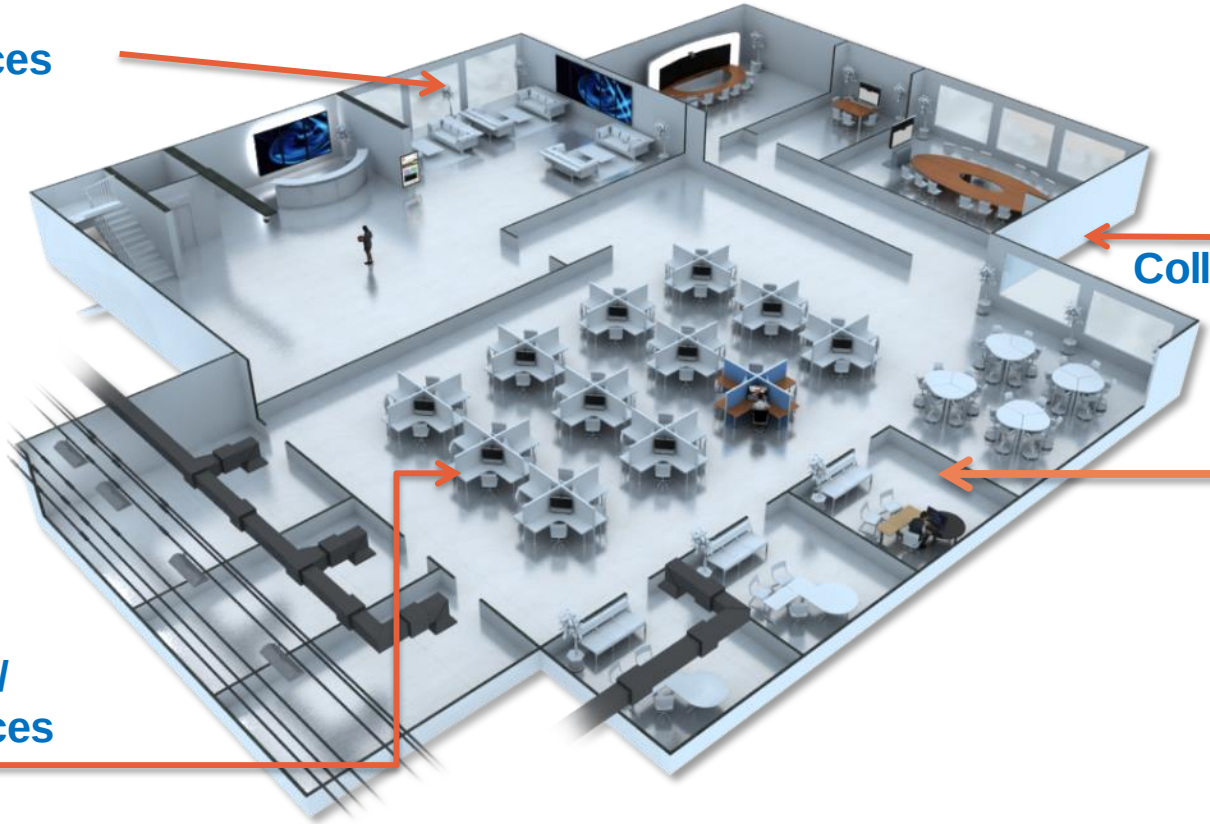
Redesigning the Office Workspaces



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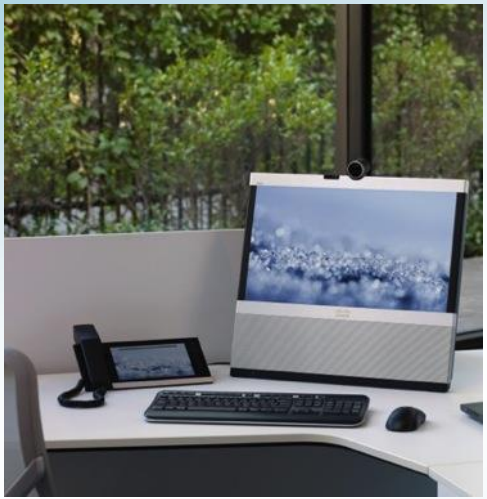
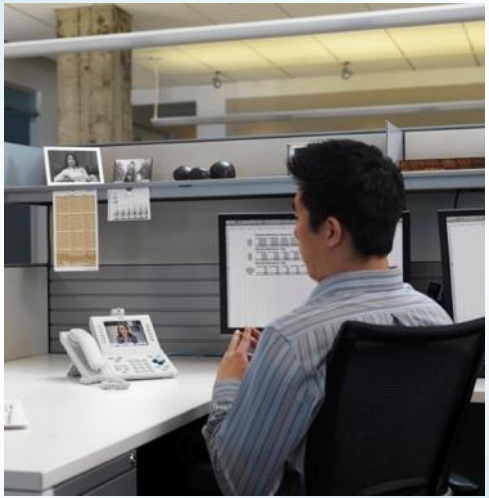
Focused Spaces

Employees reserve personal workspaces best suited to different tasks, seamlessly shifting from touchdown areas to video privacy rooms





Flexible working

- Simple reservation (in advance or adhoc) via multiple end points e.g. web, kiosk, smartphone app etc.
- Workspace personalisation
- Tools to search and navigate to people, desks , rooms, office spaces etc.
- Integration with Jabber enhances employee collaboration
- Integration with building management systems (e.g. lighting, heating etc.) for space control and energy savings

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Collaboration Spaces

Simplified with accelerated room scheduling and tighter integration with physical and virtual collaboration resources

Meeting room management

- Advance / Multi-Party / Ad-hoc room scheduling
- From multiple sources: web, kiosk, smartphone app, IP phone, Outlook
- Wayfinding enabled by signage, web, smartphone, app
- BMS integration for greater energy savings and in-room control
- AV integration for seamless Audio Visual element

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Collaboration Enabled Rooms

Collaboration Enabled Rooms

An endpoint to fit every workspace

MX200 G2 – 42’’

MX300 G2 – 55’’

MX700 – 55’’

MX800 – 70’’

TX9000 – 65’’

Quiet Room

Small Room

Medium Room

Large Room

Training-/Board Room/ Auditoriums

Immersive Room

SX10

SX20

SX80

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Touch Down Collaboration from the Desktop

Enabling every focused desk

8800

DX650

DX70

DX80

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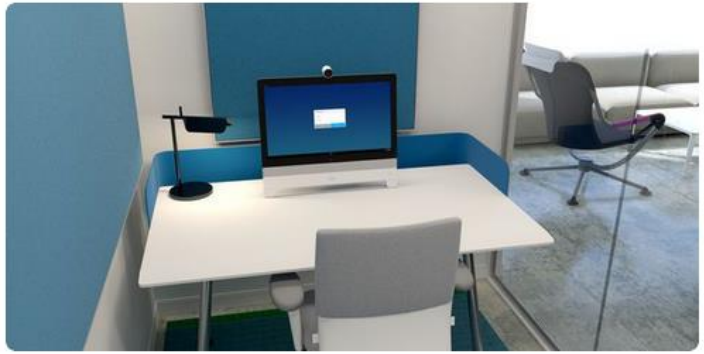
Project Workplace

cisco.com/go/project workplace



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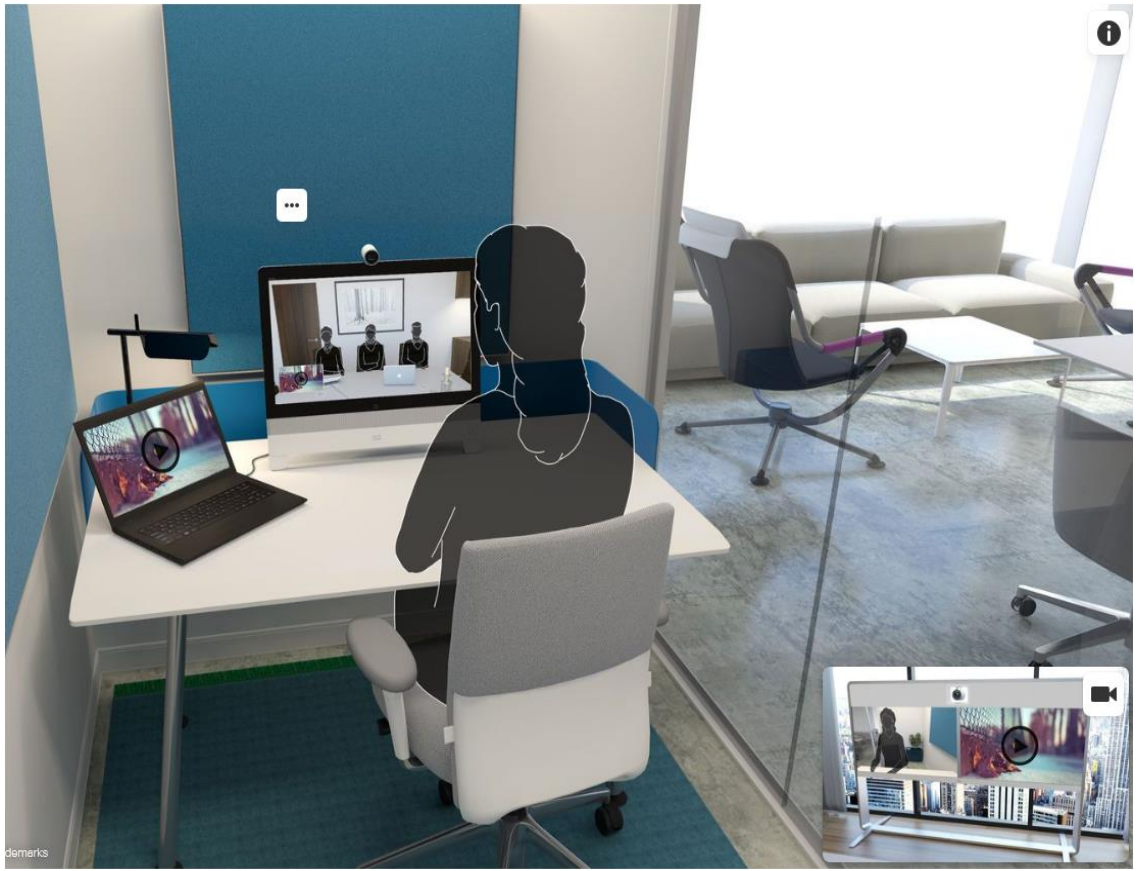
Optimising Space Design Through Simple Representations of User Scenarios



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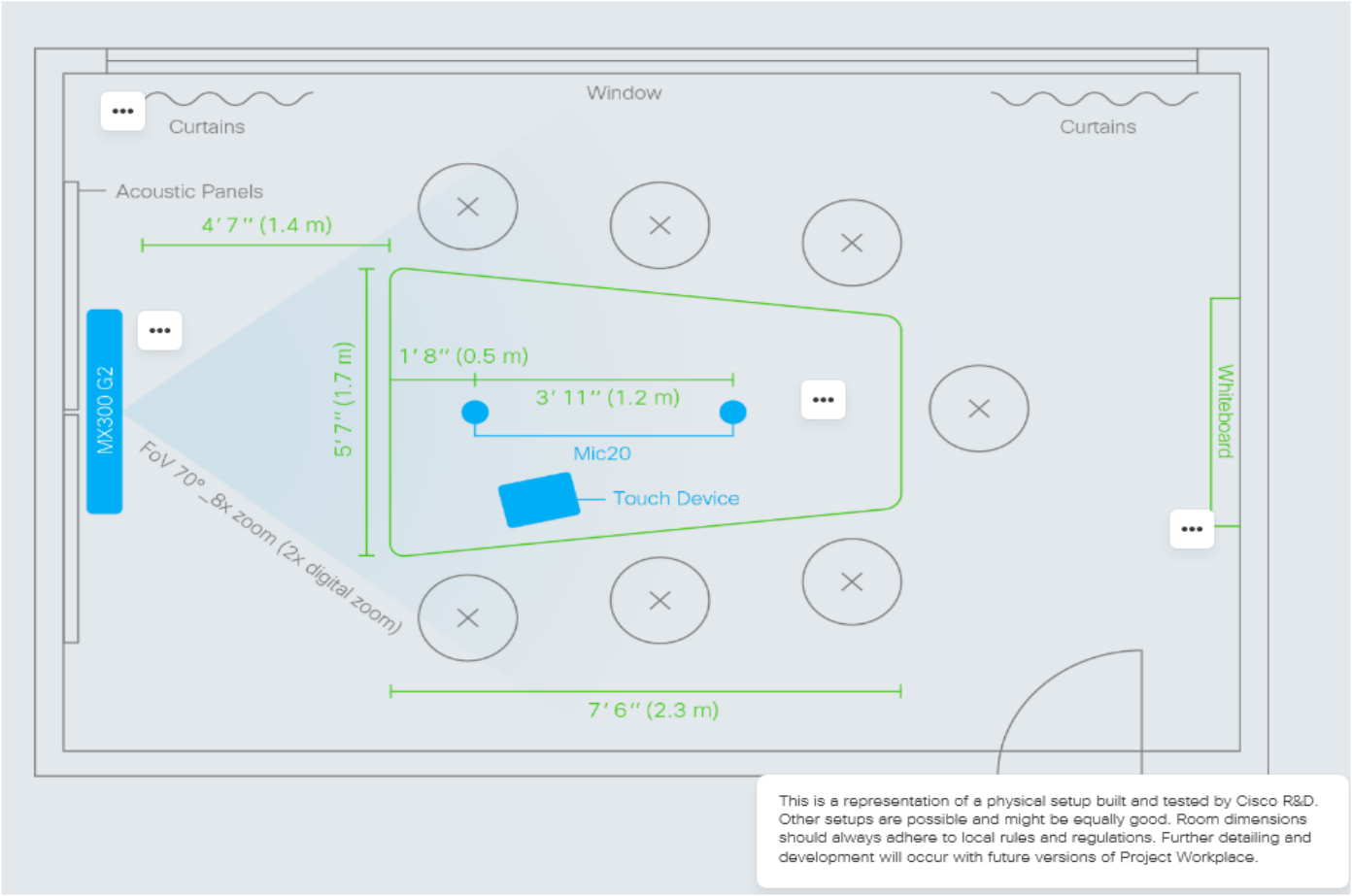
Includes Blueprints for Room Layout and Equipment Positioning



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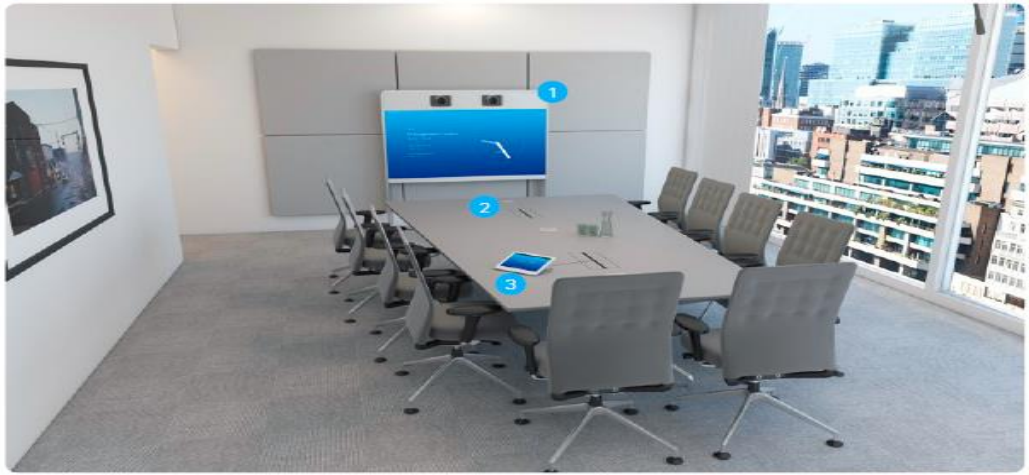
Showcases Collaboration in Use

Provides Best Practices Guidelines for Products, Acoustics and Whiteboard Use in a Collaboration Enabled Space

cisco

Products



1 **Cisco TelePresence MX800***
The Cisco TelePresence MX800 is a single 70-inch video system designed to provide medium to large meeting spaces with advanced collaboration capabilities. The most innovative and flexible all-in-one video collaboration device on the market, it can be installed and connected in less than an hour. With the dual-camera option and Cisco's SpeakerTrack technology, the active speaker can be shown in full view.

*The new MX800 will be generally available soon. Please check with your Cisco representative for updates.

2 **Cisco TelePresence Table Microphone 60***
This high-end tabletop microphone designed by Cisco offers a 360-degree pickup for scenarios where people may be situated around a table or throughout a meeting space.

*The new Microphone 60 will be generally available soon. Please check with your Cisco representative for updates.

3 **Cisco TelePresence Touch 10**
Cisco TelePresence Touch enables easy control of your meeting, from making a call to sharing content.

Products

Product ID	Product	Preview
CTS-MX800S-2CAM-K9	Cisco TelePresence MX800 (dual camera)	1
	2 Cisco TelePresence Table Microphone 60	2
	Cisco TelePresence Touch 10	3
CTS-MIC-TABL60	Cisco TelePresence Table Microphone 60	

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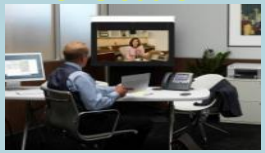
Room Remediation

Cisco TelePresence

Room Design Overview

CTS 500-37 CTS 500-32	CTS 1100	TX 1310-65	TX 9000	TX 9200
				
Recommendations			**Requirements**	
Multipurpose Environment			Dedicated Environment	
Recommended Range of Light Level			Specific Light Levels	Specific Light Levels & Layout
Standard Office Noise			Acoustic Paneling Recommended	Acoustic Paneling Required
Glass Walls and Windows (with Window Dressing)			Minimal Glass Walls or Large Windows	
Standard Office HVAC			Adequate Cooling & Management	
Room Size (Min. Max.) / Power / Network				

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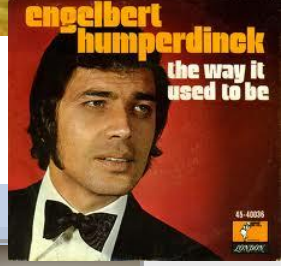
Cisco TelePresence System TX 9000



- Dedicated Environments
- 6 Person Capacity
- Group / Team Collaboration

Details:

Room Size **Minimum**	**Lighting**	**Acoustics**	**Power**	**HVAC**	**Design**
Width x Depth x Height 19’ x 14’4” x 8’ / 5.79m x 4.37m x 2.44m	200-400 lux Facial Light (vertical plane) Twice the facial light or less for Shoulder Light (work surface)	Ambient Noise 45dBA SPL NC30 Reverberation 150-700ms Acoustic Panel on Side walls	2.93kW Max 4 power receptacles Participant convenient ports consume additional power and receptacles	Independent Room Control Typical Cooling 9,500 BTU/Hr	Aesthetic Continuity highly desirable For best video quality: - Avoid high contrast elements such as very dark or bright colours - Avoid glossy finishes - Avoid clutter

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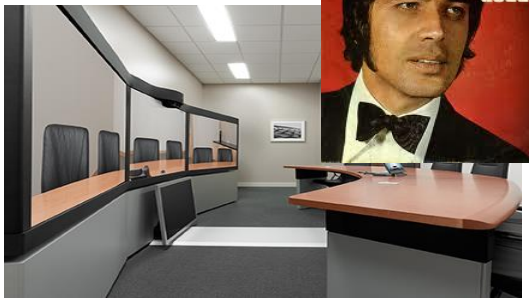
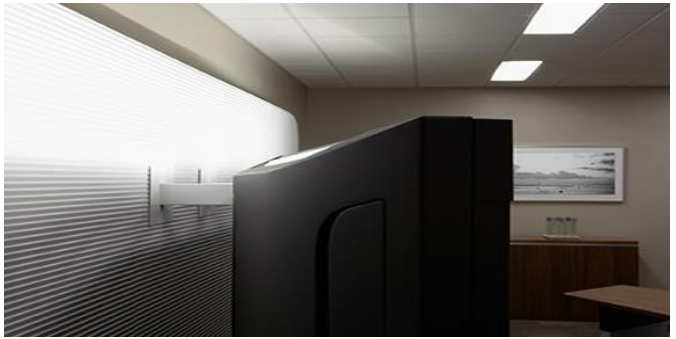
Lighting Design



- Dimmable Lighting Solution (Highly Recommended)
  - Variable lighting that enables precise intensity levels in specific areas
  - Efficiency and flexibility
  - Accurate and predictable lighting levels
  - Removes requirement to precisely calculate the overall lighting levels in advance
  - Ensures reproducible results with use of scene presets
- Indirect Linear Lighting Fixtures
  - Very common and readily available fixture type
  - Evenly distributed and diffused light
  - Comfortable for participants and well suited for video
- Asymmetric Fixtures
  - Provide the most efficient and predictable option
  - Efficient at distributing a greater amount of light in to one side of a room
  - Ability to light meeting participants without spilling light onto plasma



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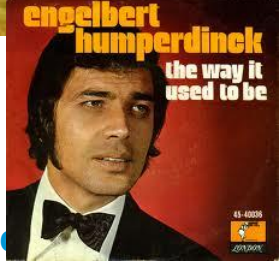
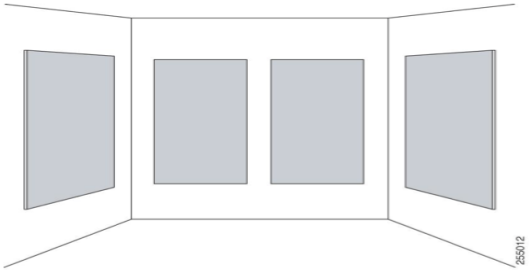
Acoustics - General Principles



Proper acoustics allow the environment to preserve and deliver sound with clarity and ac
the human ear and to the Cisco TelePresence microphones

- The acoustic characteristics of a room require attention during the room selection and design process.
  - Ambient Noise in the Room
  - Sound Isolation from External Noise Sources
  - Reverberation within the Room



- Factors that Affect the Acoustic Experience
  - Room Size & Orientation
  - Construction and finish of materials (Fabric, Plasterboard, Glass, Wood, etc.)
  - Objects in the environment

The larger the space or greater number of hard surfaces, the more issues can arise.

- Treatments for such issues:
  - Acoustic Paneling | Ceiling Panels | Insulation | Carpeting

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Room Design Palettes

LIGHT & AIRY (WALNUT)
FIELD
COMPLEMENT
DETAILS
FABRIC
CARPET

MODERN WARMTH (WALNUT)
FIELD
COMPLEMENT
DETAILS
FABRIC
CARPET

RICH & BRIGHT (WALNUT)
FIELD
COMPLEMENT
DETAILS
FABRIC
CARPET

STARK CONTRAST (WALNUT)
FIELD
COMPLEMENT
DETAILS
FABRIC
CARPET 1
CARPET 2

WALNUT

MAPLE

LUXURIOUS & CALM (WALNUT/MAPLE)
FIELD
COMPLEMENT
DETAILS
FABRIC
CARPET

ELEGANT & EARTHY (WALNUT/MAPLE)
FIELD
COMPLEMENT
DETAILS
FABRIC
CARPET

TRADITIONAL WARMTH (WALNUT/MAPLE)
FIELD
COMPLEMENT
DETAILS
FABRIC
CARPET

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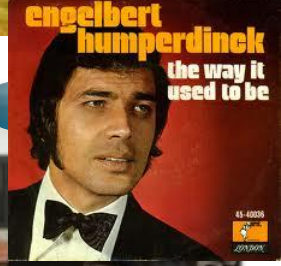
Room Design Levels

Design levels address incremental improvements in room elements

Classic level is the baseline model for RRA

Build upon the Classic model with aesthetic and technical room elements to achieve Professional and Executive models



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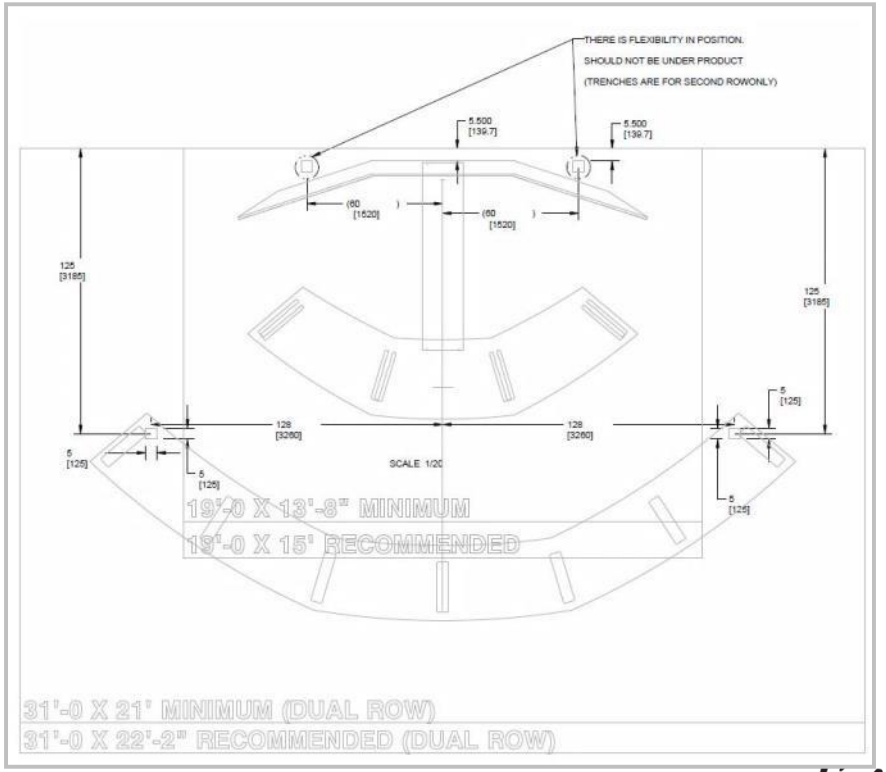
IX5000 Series Room Specs

6-Seat	18-seat
Recommended: 19 x 15 x 8 feet	Recommended: 31 ft. x 22 ft. 2 in. x 8 ft.
Minimum: 19 ft. x 13 ft. 8 in. x 8 ft.	Minimum: 31 x 21 x 8 feet
*Power: 950 Watts	*Power: 1000 watts; additional microphones

*Power is for system power only. It does not include additional power for participants, auxiliary displays, etc.



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Cisco TelePresence IX5000 Series Room Remediation

The Cisco TelePresence® IX5000 Series requires no room remediation for standard meeting rooms.

Minimum Room Requirements:

- 19’x15’x8’ size
- 1000Watts of electricity with two plugs
- 1-2 100Meg/1Gig Ethernet port
- standard office lighting

* It is very important to review the room and discuss optimisation details with your partner.
* Room requirements: 19 x 15 x 8 feet, 1000 Watts of electricity with two plugs, one to two 100 Mb ports or 1 Gigabit Ethernet port

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Cisco TelePresence IX5000 Series Lighting Façade

New integrated LED facial lighting

Previous reflected panel system

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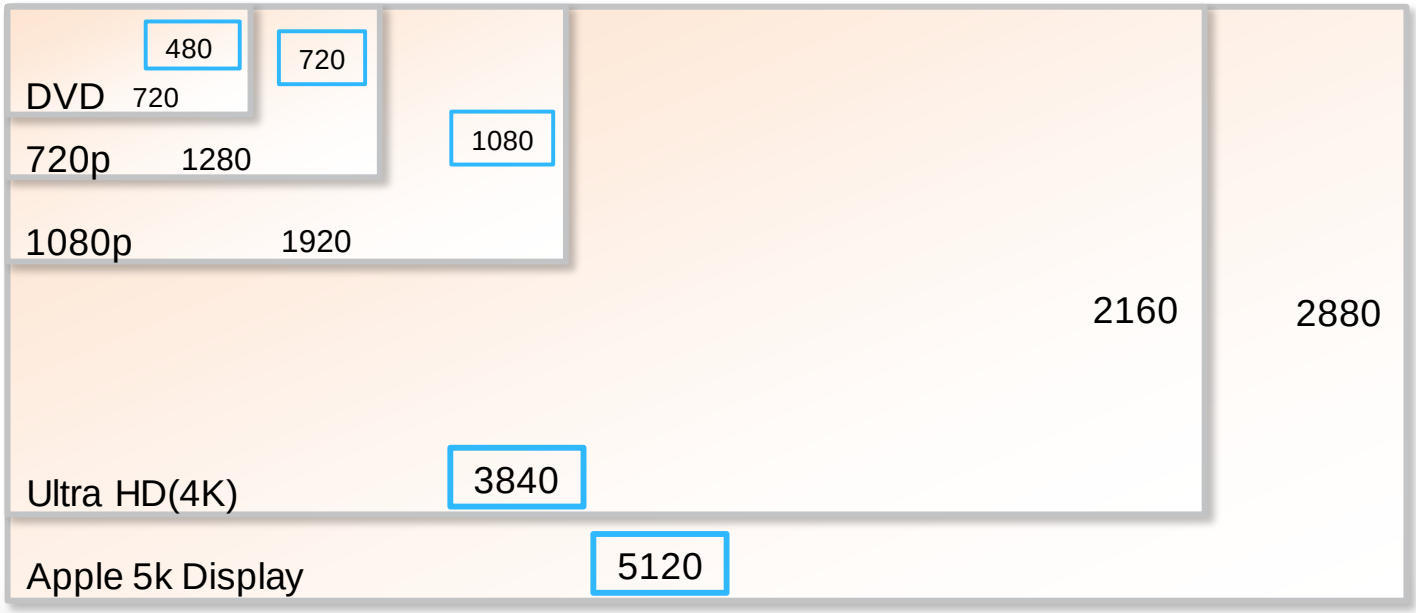
Some 4K Basics – Resolution and the Name



1920x1080 = 2,073,600 pixels
3840x2160 = 8,294,400 pixels

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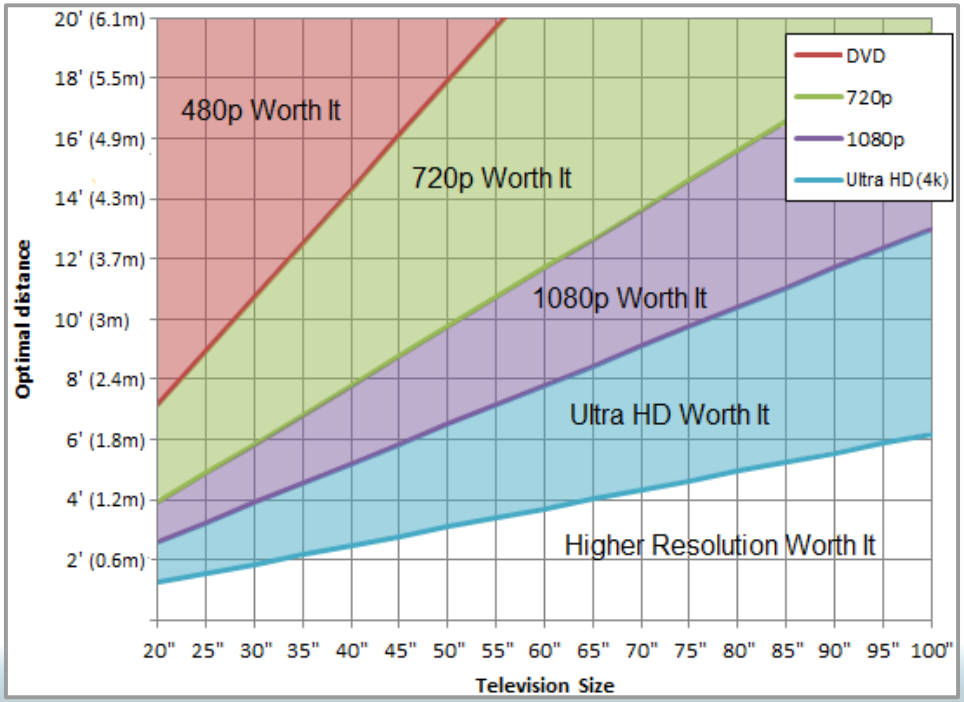
Optimal Distances – Display Size and Resolution



How many of your customers are asking for 4k?

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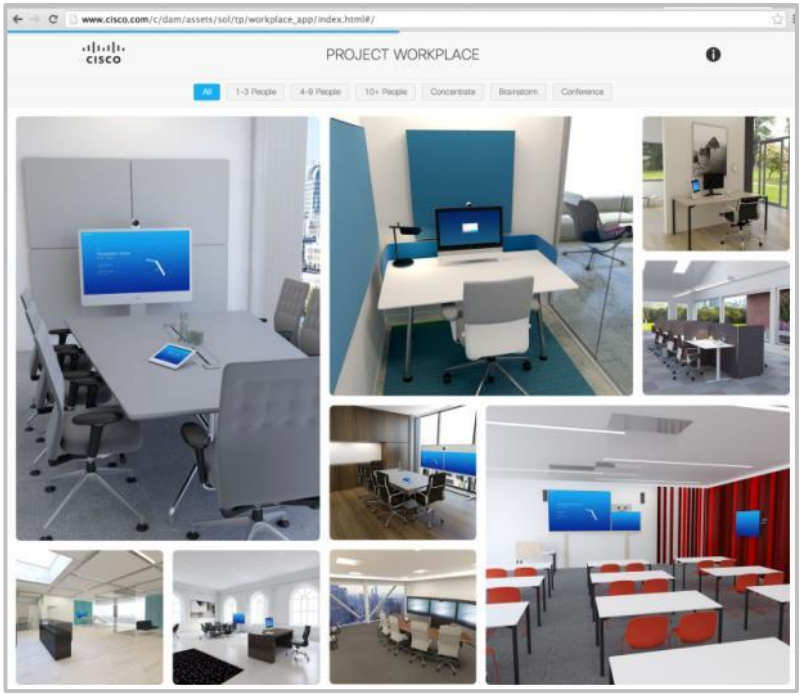
How to Optimise Your Telepresence Room

Any telepresence room can benefit from proper room design

We offer guidance and recommendations for designing the optimal telepresence room

Cisco® Project Workplace offers high-level or details-remediation examples
http://www.cisco.com/go/projectworkplace

Read the Cisco TelePresence® Room Design Guide located on Cisco.com



http://www.cisco.com/c/en/us/solutions/telepresence/networking_solutions_products_genericcontent0900aecd80554cb2.html

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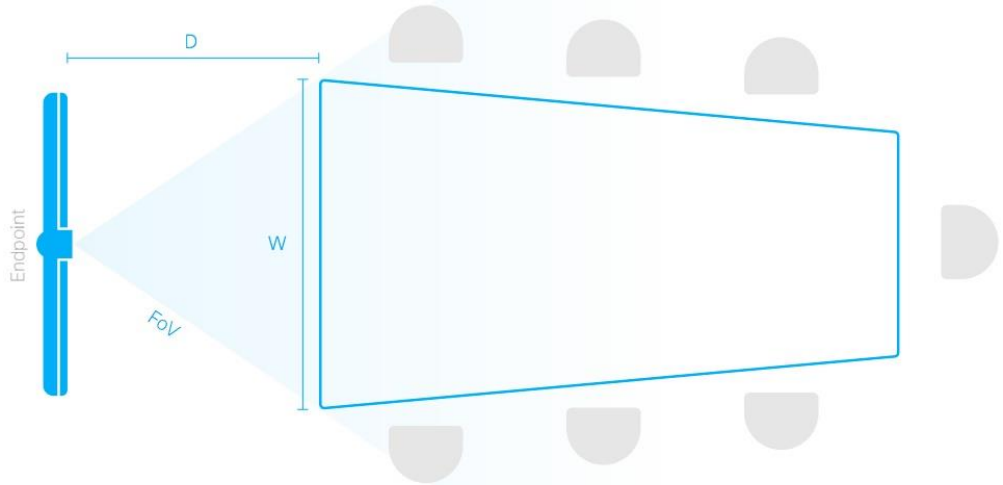

Table

- To enable everyone at the table to see the screen, the table width should be slightly wider than the system/ screen(s).
- The Field of View (FoV) of the cameras dictates that the distance (D) between table and system should not be less than 0.7 times the width (W) of the table front.
- We recommend using a slightly slanted table when there are three or more participants seated on the long side of a table. It should be wider on the end closest to the system so that everyone can see the screen and be seen on camera.

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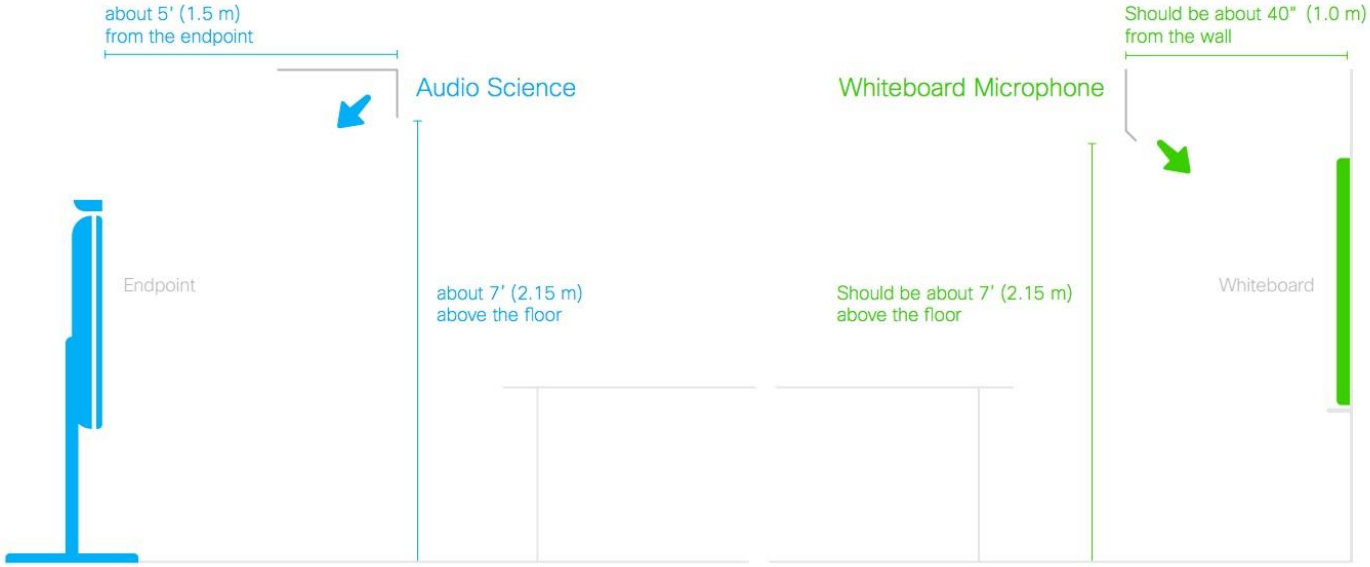
Presenter and Whiteboard Microphones



Addtitional Microphones

In scenarios with an active presenter who could be moving around, an additional ceiling microphone can be used to capture the speaker's voice.

Presenter Microphones

- To capture the voice of the presenter, it is recommended to use an Audio Science microphone.
- The microphone must face where the presenter will be.
- It should be mounted well above the floor, about 7 ft (2.15 m) Distance to the endpoint should be about 5 ft (1.5 m).

Whiteboard Microphones

- As an alternative to Audio Science, a directional microphone suspended from the ceiling could be used.
- It should be mounted about 7 ft (2.15 m) above the floor and 40 in (1.0 m) from the wall.

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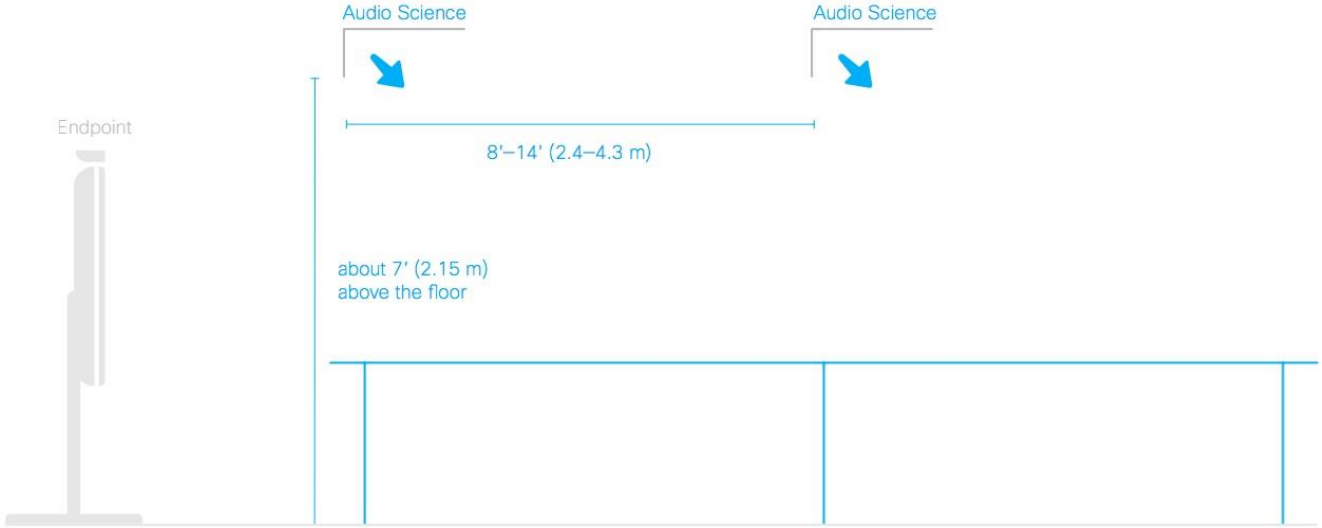
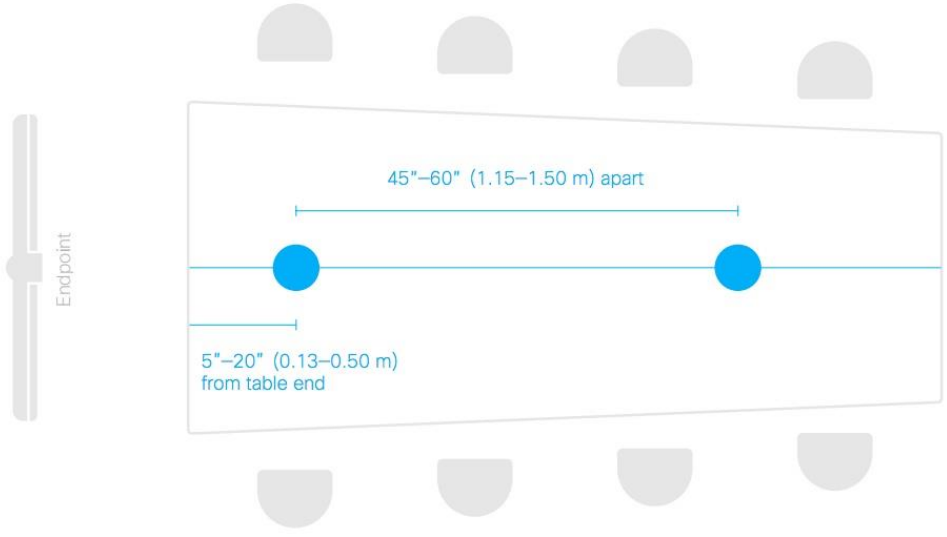


Ceiling Microphones

In some situations you might want to keep the table free of microphones. Cisco provides the ceiling microphone, Audio Science, which can be used in these scenarios.

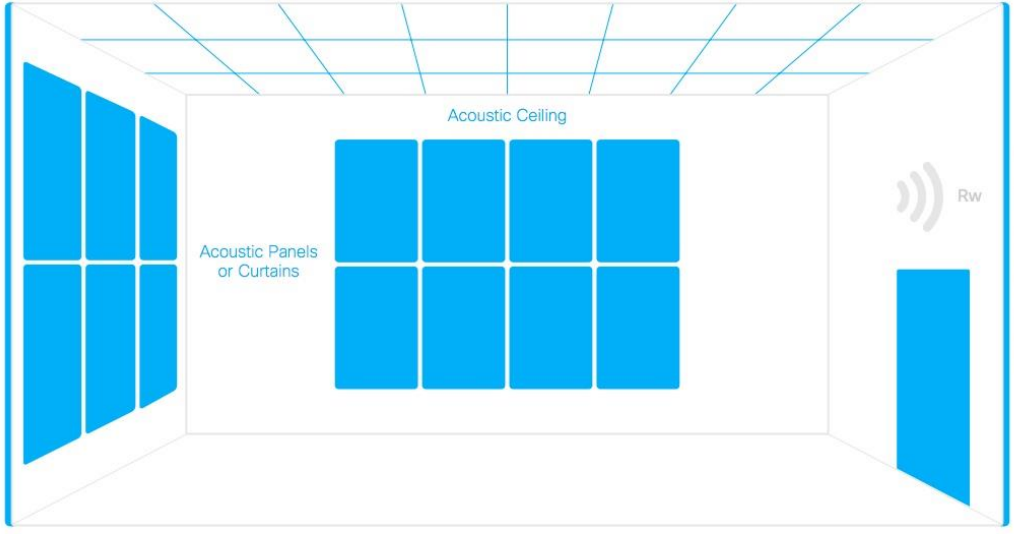
Following are some guidelines on positioning the microphone correctly:

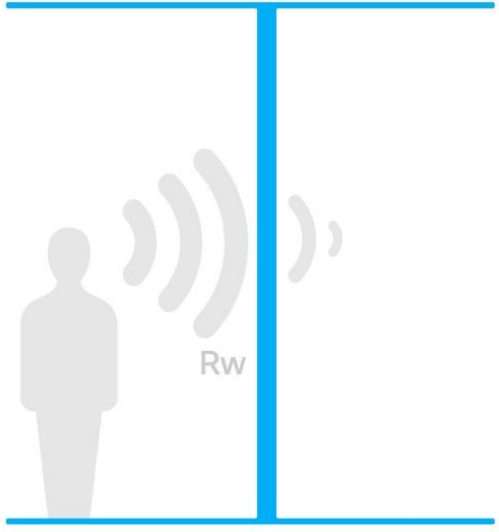
- It can be used with tables seating 8–14 people.
- Align the Audio Science microphone with the table edge closest to the system. Mount it about 7 ft (2.15 m). above the floor.
- The microphone must face away from the endpoint.
- For longer tables, mount the Audio Science microphones with a spacing of 8–14 ft (2.4–4.3 m).
- The maximum spacing should only be used in acoustically dampened rooms. In less-dampened rooms, the spacing should be decreased.



Standard Microphones

- Use Cisco Telepresence omnidirectional microphones along the center line of the table.
- One microphone generally covers four people.
- The microphone closest to the system should be placed approximately 5–20 in (0.13–0.50 m) from the table end.
- Spacing between microphones should be about 45–60 in (1.15–1.50 m), and a maximum of 45 in (1.15 m) from participants.
- The maximum spacing should only be used in acoustically dampened rooms. In less-dampened rooms, the spacing should be decreased.





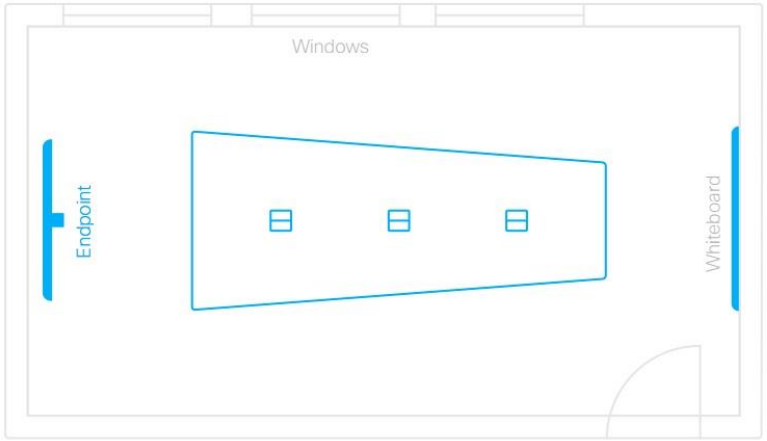
Acoustic Essentials

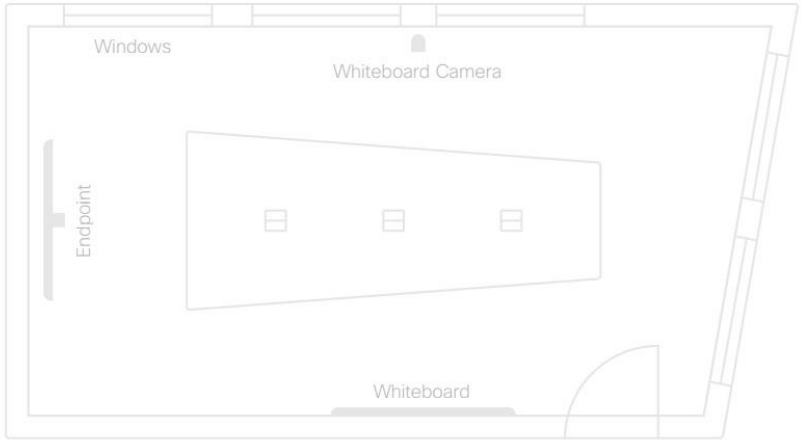
Video systems usually work fairly well with most types of acoustics, but the experience can be a lot better with a little well-aimed treatment.

For the optimal experience aim for a reverberation time (RT60) of 0.3 to 0.4 seconds, and ensure that sound absorption is distributed evenly on the walls to avoid flutter echo from parallel walls. Follow these guidelines:

- Use an acoustic ceiling consisting of tiles with an absorption class A or NRC of 0.9 or greater.
- Put acoustic absorption on walls.
  - A good amount to use is approximately 0.5 times the ceiling area (Textile curtains also count as absorption).
  - Place absorption on at least two walls, preferably adjacent walls. Avoid placing it on opposing walls.
  - In order to increase the low frequency absorption, acoustic wall panels should be mounted so that they protrude at least 2 in. (5 cm).
- To avoid eavesdropping as well as disturbance of people located outside the room, we recommend that walls and doors have appropriate sound insulation. The walls should hold a Sound Reduction Index (Rw) of about 48 dB. Doors in the meeting room are recommended to hold an Rw of about 35 dB. For more information on how Rw is defined, see the international standard ISO 717-1.
- For quality microphone pick-up and comfort in the room, the ambient noise level should not exceed 30 dB (A-weighted sound pressure level).

Whiteboard Placement





Whiteboard Essentials

It is best to have the whiteboard visible in the camera overview. An additional camera allows for greater flexibility, such as focusing on the whiteboard.

- If the room allows for it, place the whiteboard on the wall opposite the endpoint.
- If the whiteboard is on a side wall, place it so that it is visible in the overview and use an additional camera to focus on the whiteboard.
- Point the additional camera directly at and centered on the whiteboard.
- Place the additional camera at least 5 ft (1.5 m) above the floor.

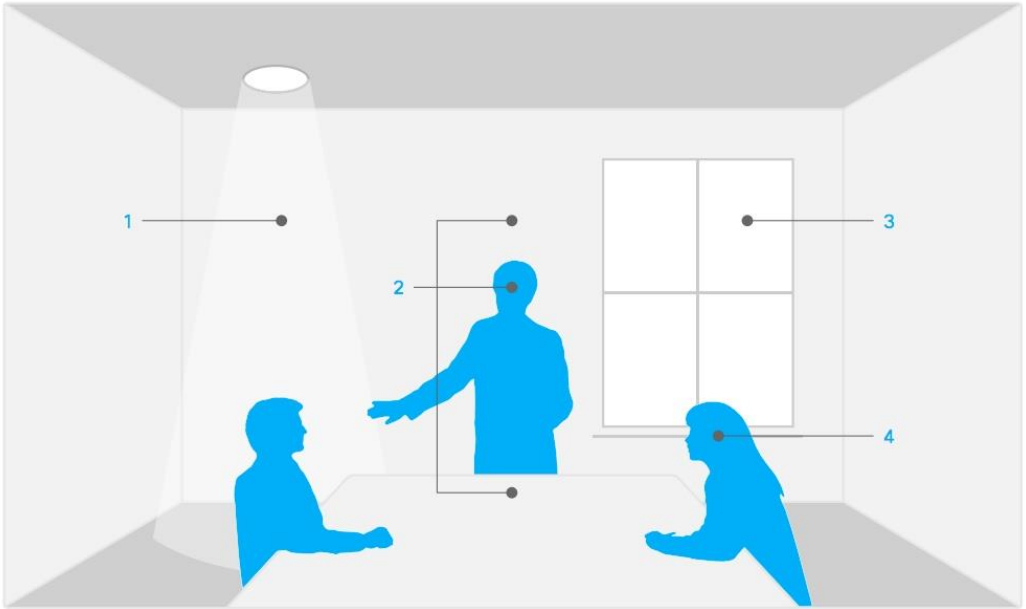
Tips

Generally a good light color temperature is 4000 kelvin, but consider increasing this number if you depend mostly on daylight as your light source. A color-rendering index (CRI) of 80 or better is important. Avoid mixing technologies such as fluorescents and LED because their color profiles differ.

Tips

Neutral gray colors on walls and tables improve color appearance.

Avoid completely white walls or tables, a color with reflection value (LRV) of 50 percent is recommended.



Light Essentials

Be aware that video is sensitive to high contrast levels in the room. Most luminaries are made to avoid glare thus focusing the effect on the work area rather than people's faces.

A common problem is insufficient light on people's faces. A glare-free luminary producing directive light at an angle of 45 degrees is optimal for video, but may be challenging to achieve. Following are some tips on how to improve the lighting situation within a room.

1 Avoid illuminating the surrounding walls too much. This only makes the faces appear darker.

2 Try to keep the contrast less than 1:1.5. For example, 500 lux on faces implicates maximum 750 lux on the table and surroundings.

3 Make sure you can reduce sunlight to a comfortable level.

4 Recommended light intensity is 400 to 500 lux on faces.

Network, Bandwidth and H265

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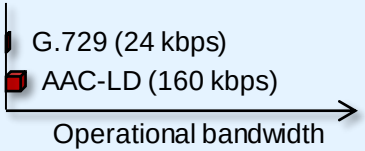
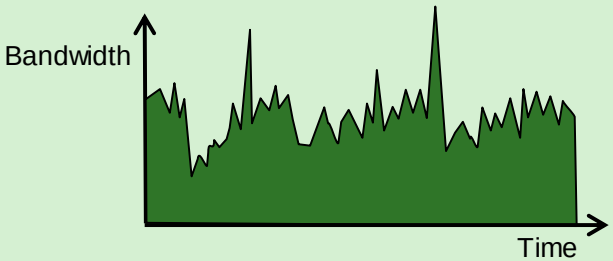
Video Traffic: Requirements and Profiles

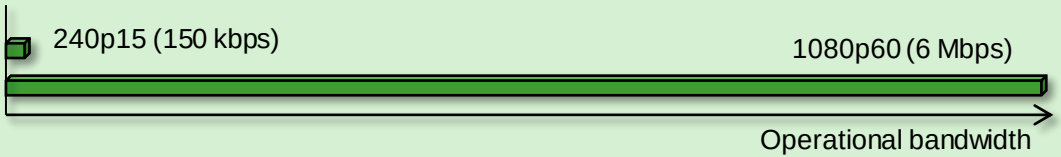
AUDIO



- **Bandwidth**:
  - Constant bitrate (smooth)
  - Small footprint
  - Narrow operational range (1:6)
- **Loss**-sensitive
- **Delay**-sensitive

VIDEO





- **Bandwidth**:
  - Variable bitrate (bursty)
  - Medium/large footprint
  - Wide operational range (1:40)
- **Loss**-sensitive
- **Delay**-sensitive

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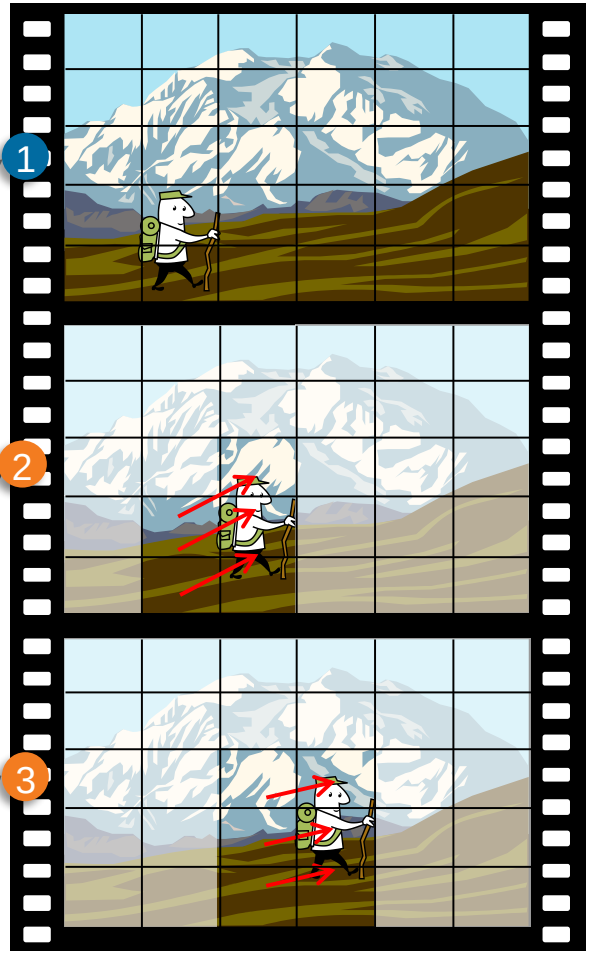
Video Traffic

Video Encoding Basics



1 I-Frame

"Intra-coded" picture

- Entire picture encoded as a static image
- No reference to other frames

2 P-Frame

"Predicted" picture

- Based on a previously encoded frame (1)
- Only the differences from that frame are encoded

3 P-Frame

"Predicted" picture

- Reference for prediction can be another P-Frame (2)

For more, see **BRKCOL-2777**: "Emerging Video Technologies: H.265, SVC, WebRTC / HTML5"

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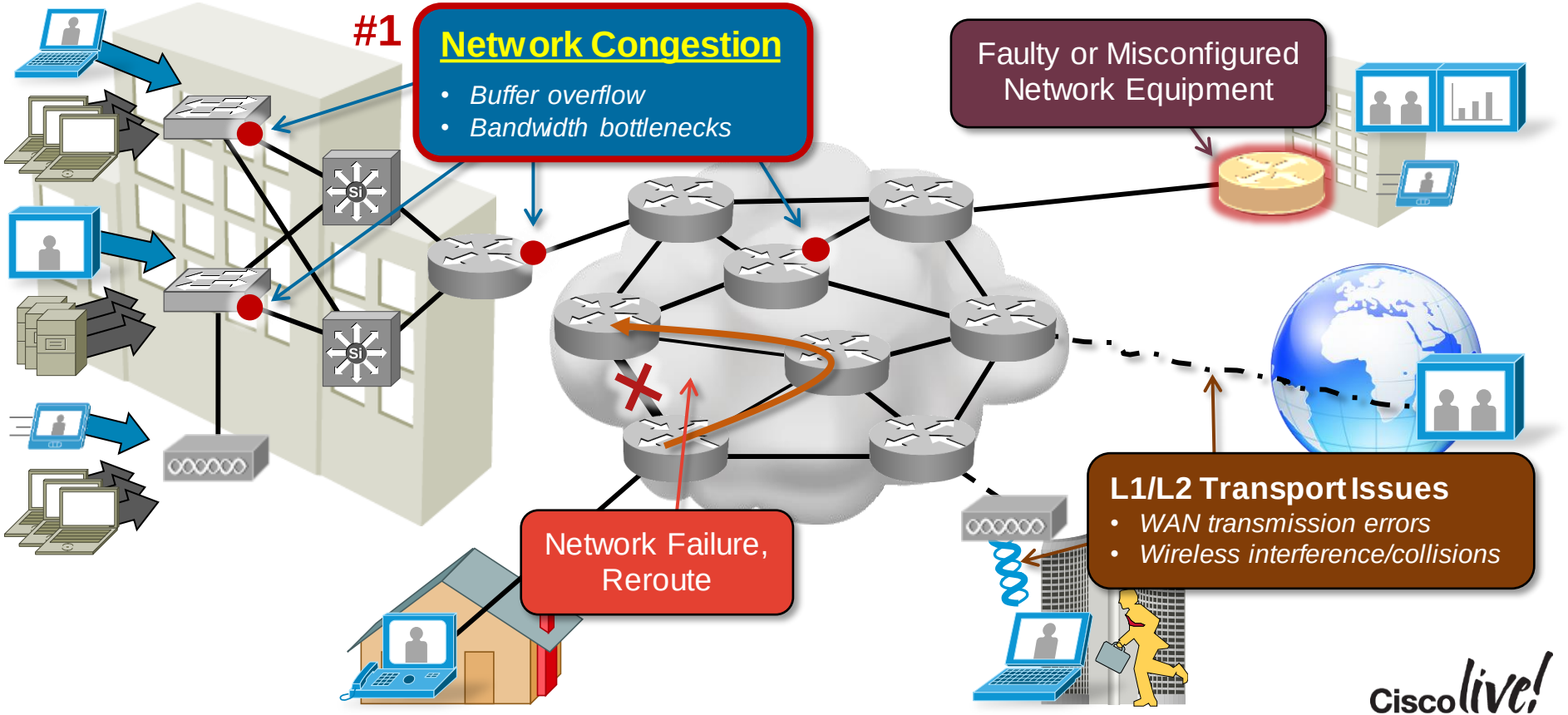
Video Traffic

Causes of Packet Loss



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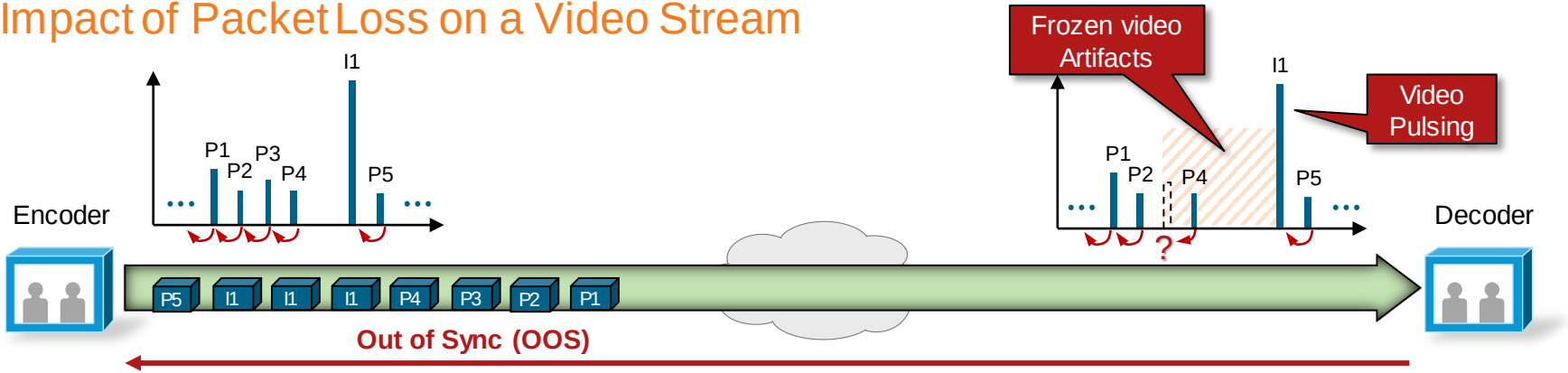
Video Traffic

Impact of Packet Loss on a Video Stream



- Loss of a P-frame triggers request for a new I-frame
  - Encoding and transmitting large I-frame takes time
  - If any of the I-frame packets get lost, the process needs to restart
  - I-frame creates burst that risks exacerbating network congestion (more packet loss!)
- Flickering/pulsing of video when new I-frame arrives
  - Video freeze or artifacts when multiple packets are lost

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QoS Recommendations (RFC 4594-Based)

Application Class	Per-Hop Behaviour	DSCP	Queuing & Dropping	Application Examples
VoIP Telephony	EF	46	Priority Queue (PQ)	Cisco IP Phones (G.711, G.729)
Broadcast Video	CS5	40	BW Queue	Cisco IP Video Surveillance / Cisco Enterprise TV
Realtime Interactive	CS4	32	BW Queue + DSCP WRED	Cisco TelePresence
Multimedia Conferencing	AF4	34/36/38	BW Queue + DSCP WRED	Cisco Unified Personal Communicator, WebEx
Multimedia Streaming	AF3	26/28/30	BW Queue + DSCP WRED	Cisco Digital Media System (VoDs)
Network Control	CS6	48	BW Queue	EIGRP, OSPF, BGP, HSRP, IKE
Call-Signalling	CS3	24	BW Queue	SCCP, SIP, H.323
Ops / Admin / Mgmt (OAM)	CS2	16	BW Queue	SNMP, SSH, Syslog
Transactional Data	AF2	18/20/22	BW Queue + DSCP WRED	ERP Apps, CRM Apps, Database Apps
Bulk Data	AF1	10/12/14	BW Queue + DSCP WRED	E-mail, FTP, Backup Apps, Content Distribution
Best Effort	DF	0	Default Queue + RED	Default Class
Scavenger	CS1	8	Min BW Queue (Deferential)	YouTube, iTunes, BitTorent, Xbox Live

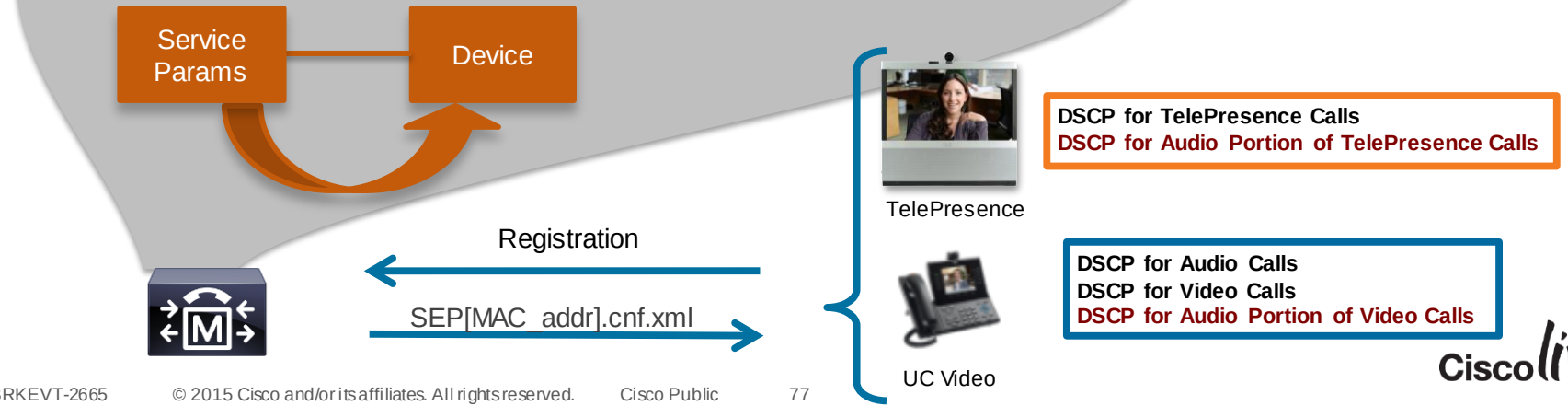
Quality of Service

DiffServ Configuration on Cisco Endpoints

UCM Provides DSCP values via the service parameters to endpoints for media marking:

Clusterwide Parameters (System - QOS)

Priority Class *	Normal Priority	Normal Priority
DSCP for Audio Calls *	46 (101110)	46 (101110)
DSCP for Video Calls *	34 (100010)	34 (100010)
DSCP for Audio Portion of Video Calls *	34 (100010)	34 (100010)
DSCP for TelePresence Calls *	32 (100000)	32 (100000)
DSCP for Audio Portion of TelePresence Calls *	32 (100000)	32 (100000)



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Jabber Client Summary / Best Practices

- Use the SIP Profile to configure media port range (default 16384-32766)
- Use the Sip Security Profile to configure the signalling port range (default 5060 or 5061 for secure signalling)
- If you have SCCP devices in the same network use a port range outside of 16384-32766 to avoid overlap and incorrect remarking
  - **Unified CM 9.1 expands SIP media port range to 2048-65535**
- Video Enablement:
  - Disable video if you do not want device to send or receive video
  - Video capable devices ALWAYS divide the port ranges (even if video is disabled)
  - Devices that do NOT support video (version dependent) use the entire port range for audio-only.

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Summary / Best Practice Recommendations

Trusted / Native Marking

- Windows Vista, 7 and 8 require GPOs set QoS
  - GPOs use TCP and UDP port ranges to set QoS
  - Cannot differentiate audio-only from audio of a video call
- Previous Windows versions allow the application to set QoS natively
- All other Jabber clients (latest versions) mark EF for audio-only, AF41 for audio and video of a video call.

Mapping Identifiable Media and Signalling Streams (Network ACLs)

- QoS Strategies
  - Mark audio EF and Video AF41
  - Mark audio AF41 and Video AF42
  - Mark audio and video AF42
- Recommended Remarking Policy
  - Remark using UDP/TCP Port ranges

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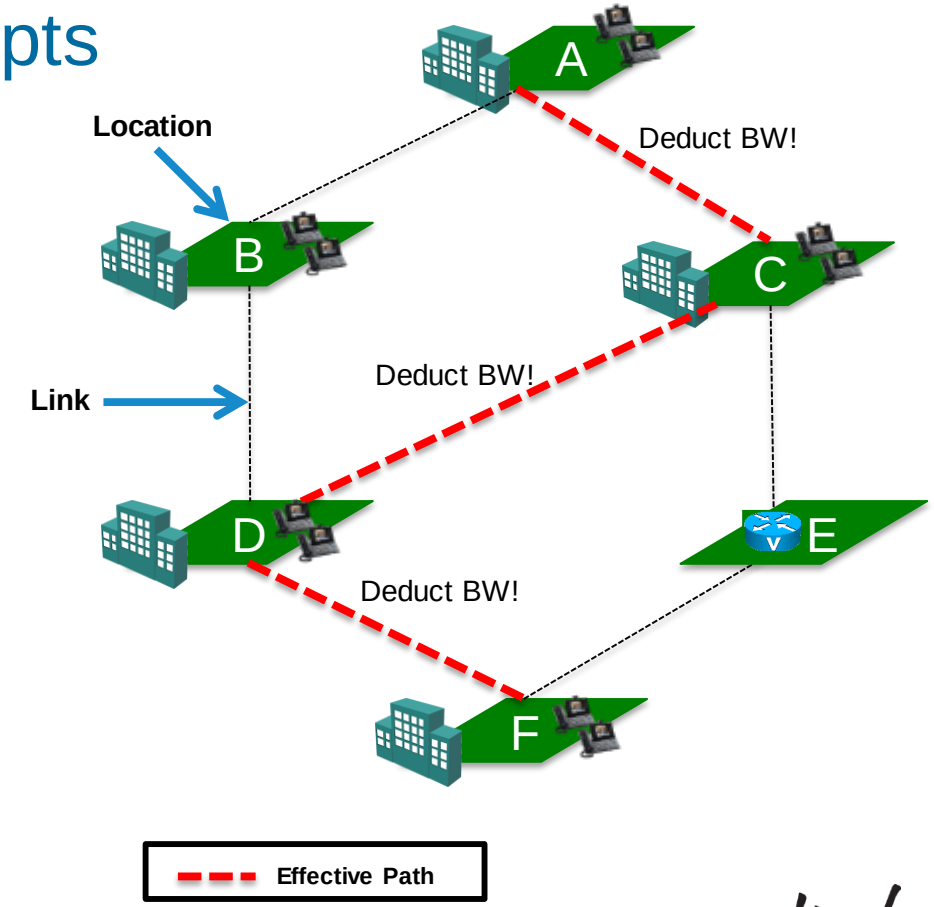
Network Modelling - Concepts

- Administrator builds a Network Model using locations and links
- A **Location** represents a LAN. It could contain endpoints or simply serve as a transit location between links for WAN network modelling
- **Links** interconnect locations and are used to define bandwidth available **between** locations. Links logically represent the WAN link
- **Weights** are used on links to provide a "cost" to the "effective path". Weights are pertinent only when there is more than 1 path between any 2 locations
- UCM calculates shortest paths (least cost) from all locations to all locations and builds the effective paths
- The **Effective paths** are the paths with the "least cumulative weight"
- UCM tracks bandwidth across any link that the network model indicates from originating Location to terminating location.



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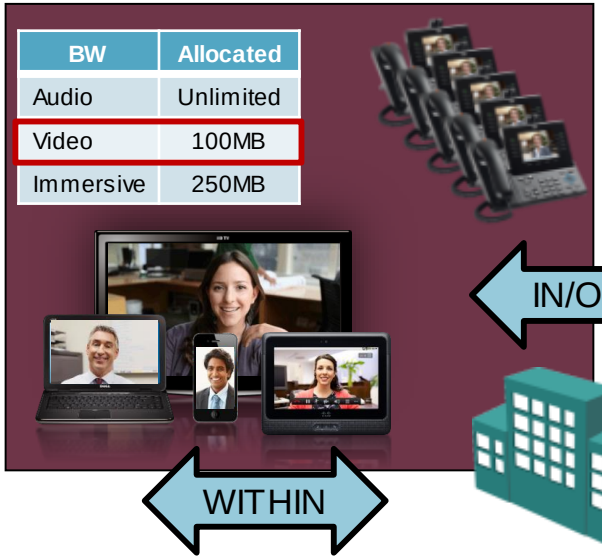
Network Modelling – Locations and Links

Location A

BW	Allocated
Audio	Unlimited
Video	100MB
Immersive	250MB



IN/OUT

WITHIN

Locations Provide Bandwidth Accounting WITHIN the Location as well as IN or OUT of the Location

BETWEEN

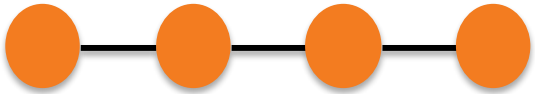
Link A < > B

BW	Allocated
Audio	1500k
Video	3000k
Immersive	5000k

Links Provide Bandwidth Accounting Between Locations

And Interconnect Locations

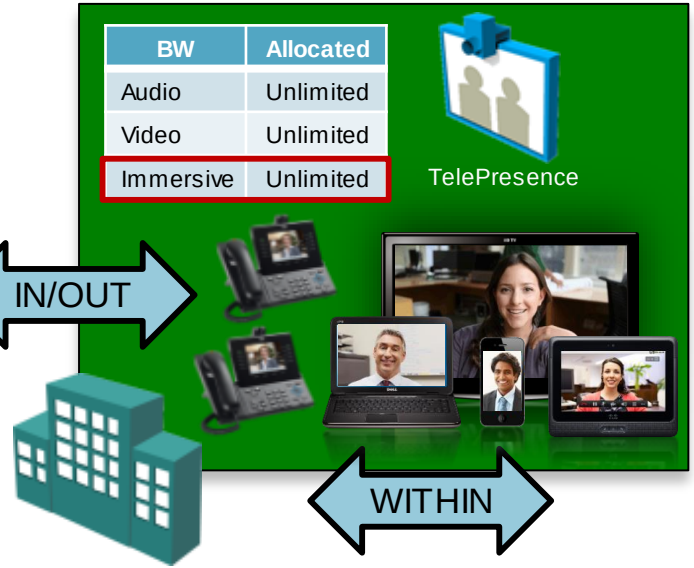
Linking Locations



Location B

BW	Allocated
Audio	Unlimited
Video	Unlimited
Immersive	Unlimited

TelePresence



IN/OUT

WITHIN

TelePresence and UC Video Endpoints Can Reside in the Same Location*

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Network Modelling

Key Takeaways

- Enhanced Locations CAC is a Static Model-Based CAC Mechanism
- E-LCAC is a Model of the “Routed Network” Attempting to Represent How The WAN Network Topology Routes Media
- Network Modelling is NOT Dynamic like RSVP
- The Model Needs to be Updated When the Network Topology Changes
- E-LAC is Call-Based (No Asymmetric or Unidirectional Bandwidth Deductions)
- Intra-location bandwidth assignment and deduction. The default is set to unlimited.

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Cisco TelePresence Traffic Characteristics

IX5000 Series Bandwidth Requirements – Three Screens

Best video quality for all three screens

Resolution	H.264	H.265 (HEVC)
1080p60	18 Mbps	10.8 Mbps
1080p30	10.3 Mbps	6 Mbps
720p60	10 Mbps	6 Mbps
720p30 (Good)	3 Mbps	1.8 Mbps

* Does not include content or overhead beyond Ethernet

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Cisco TelePresence Traffic Characteristics

Recommended Endpoint Bandwidth

Average Bandwidth Consumption - Tested					
Endpoint	Resolution	30 Frames Per Second (30fps)			60fps
		Good	Better	Best	Supreme
TX Triple	1080p	8.8 Mbps	10.1 Mbps	11.9 Mbps	19.2 Mbps
	720p	3.1 Mbps	4.5 Mbps	6.4 Mbps	10.1 Mbps
CTS/TX/Single	1080p	3.1 Mbps	3.6 Mbps	3.9 Mbps	6.3 Mbps
	720p	1.1 Mbps	1.5 Mbps	2.3 Mbps	3.6 Mbps
MX/EX/C Single	1080p	2.5 Mbps		6 Mbps	8.0 Mbps*
	720p	0.8 Mbps		1.2 Mbps	2.4 Mbps*

- Includes ~3% Ethernet Overhead
- CTS/TX add 500k for 5fps content, 2Mbps for 30fps content
- MX/EX/C Use same bandwidth but lose video quality when sharing content

** has not been tested, calculated 50% addition*

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Cisco TelePresence Traffic Characteristics

How Are Latency, Jitter and Loss Measured?

- Latency, jitter and loss are measured:
  - End-to-end (codec Ethernet port to codec Ethernet port)
  - Uni-directionally (One way measurement)
  - Latency and loss are measured at a packet level – based on RTP header sequence numbers and timestamps
  - Jitter is measured at a video frame level, not at a packet level, by measuring the arrival time of the entire video frame vs. the expected arrival time of that frame based on the 33ms clock rate of video frame intervals

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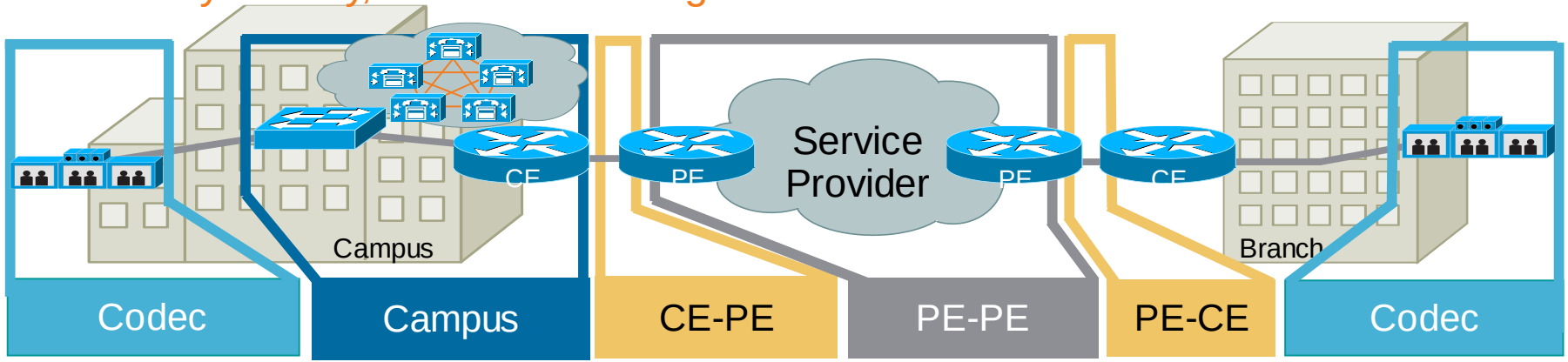
Cisco TelePresence Traffic Characteristics

One-Way Latency, Jitter and Loss Targets & Thresholds



Metric	Target	Thresholds				Triggered Action on Threshold	
		1st	2nd	3rd	4th	1st	2nd
Latency	150 ms	250 ms	400 ms			None	None
Video Jitter	50 ms	85 ms	125 ms	165 ms	245 ms	None	None
Loss	0.05%	1%	10%			Network Bar Change	1. Reduce Quality 2. Drop Call

Key Benefits of H.265

- Higher compression efficiency
  - Half the bandwidth for the same quality, compared to H.264
  - HD for everyone, everywhere: 720p30 < 500kbps
- Higher resolutions: UHD 8k, 4k, 120 Hz
  - H.264 Level 5.2: 4k (2160p) 60 Hz, 0.5 Gpixels/s
  - H.265 Level 6.2: 8k (4320p) 120 Hz, 4.2 Gpixels/s (8x pixel rate)
- Low complexity options
  - Enables simpler decoders (mobiles)
  - Tiles for memory bandwidth reduction

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Key Benefits of H.265 Cont

- Backward compatibility
  - H.264 base layer with H.265 enhancement layers
- Better interoperability
  - Main Profile vs. many profiles
  - Non-Interleaved Packetization vs. multiple packetizations
- New target applications
  - Screen content (Class F test streams)
  - Still pictures (half the size of JPEG)
- Parallel processing
  - Exploit multi-core hardware and reduce latency
  - 2D Tiles vs. 1D Slices, Dependent Slices, and Wavefronts
  - Deblocking filter and CABAC entropy coding are parallel-friendly

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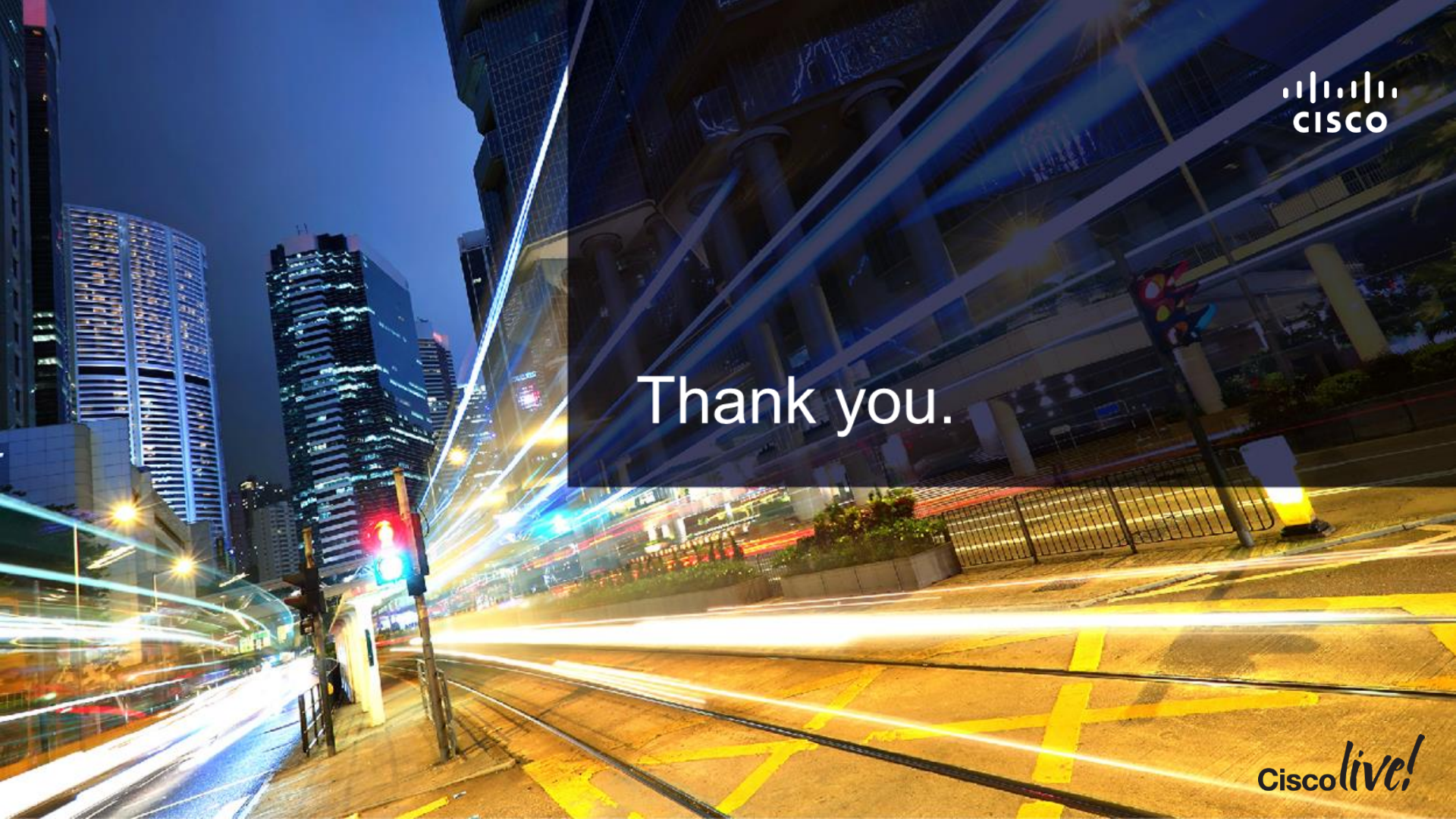
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