Cisco TelePresence Application

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Agenda

- Cisco TelePresence
- Traffic Characteristics
- Inter-Company TelePresence
- Application for education and research community
Cisco TelePresence Portfolio
Integrated Architecture

Any to Any Interoperability

Endpoints
Complete Portfolio

Infrastructure
Scalable and Comprehensive

Cloud Services
Reliable, Secure and Global Reach

Architecture

Experiences | Solutions | Applications
Cisco TelePresence
Combined Infrastructure Portfolio

Call & Session Control
Comprehensive Cisco TelePresence session control via a complete set of capabilities for intra- and inter-company collaboration.

Management
Complete management with integrated scheduling, network and element management and reporting capabilities, including ROI tools.

Media Switching
Industry-leading switching capabilities for large and scalable multipoint meetings with security.

Media Services
Network-delivered media experiences such as multipoint, recording, streaming, transcoding, video analytics and tagging.

Any-to-any interoperability via multiple capabilities.

Architectural design for solutions and applications
Comprehensive integrated solutions
Cisco TelePresence Interoperability
Cisco TelePresence Server - HD Interop – User Experience
TelePresence Direction for the Future

Interoperability

Intercompany

Everyone, Everywhere

Quality

Simplicity

One Architecture
Combining the best of both worlds
• Full native interoperability with backwards compatibility
• Extensive B2B options in addition to leading exchange platform
• Integration with broader Cisco Medianet platform

Feature Parity
Integrating features across portfolio
• One Button to Push simplicity
• Adhoc flexibility
• Full support for industry-leading multipoint solutions with ActivePresence usability
• Webex and collaboration tools

Innovation
Leading the industry forward
• Next gen multipoint solutions with both switching and transcoding
• Simplified call control
• Absolute endpoint immersion
• Driving industry standards
• New collaboration devices and tools
Cisco TelePresence Traffic Characteristics

Resolution

- 1920 lines of Vertical Resolution (Widescreen Aspect Ratio is 16:9)
- 1080 lines of Horizontal Resolution

Compressed to 4 Mbps per screen

- 2,073,600 pixels per frame
- x 3 colors per pixel
- x 1 Byte (8 bits) per color
- x 30 frames per second

= 1.5 Gbps per screen uncompressed!
<table>
<thead>
<tr>
<th>Resolution</th>
<th>1080p</th>
<th>1080p</th>
<th>1080p</th>
<th>720p</th>
<th>720p</th>
<th>720p</th>
<th>720p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motion Handling</td>
<td>Best</td>
<td>Better</td>
<td>Good</td>
<td>Best</td>
<td>Better</td>
<td>Good</td>
<td>Lite</td>
</tr>
<tr>
<td>Video per Screen (kbps)</td>
<td>4000</td>
<td>3500</td>
<td>3000</td>
<td>2250</td>
<td>1500</td>
<td>1000</td>
<td>936</td>
</tr>
<tr>
<td>Audio per Microphone (kbps)</td>
<td>64</td>
<td>64</td>
<td>64</td>
<td>64</td>
<td>64</td>
<td>64</td>
<td>64</td>
</tr>
<tr>
<td>Auto Collaborate Video channel</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>100</td>
</tr>
<tr>
<td>Auto Collaborate Audio channel (kbps)</td>
<td>64</td>
<td>64</td>
<td>64</td>
<td>64</td>
<td>64</td>
<td>64</td>
<td>64</td>
</tr>
<tr>
<td>Single Screen Systems</td>
<td>4628</td>
<td>4128</td>
<td>3628</td>
<td>2878</td>
<td>2128</td>
<td>1628</td>
<td>1164</td>
</tr>
<tr>
<td>Total Audio and Video (kbps)</td>
<td>4756</td>
<td>4256</td>
<td>3756</td>
<td>3006</td>
<td>2256</td>
<td>1756</td>
<td>1292</td>
</tr>
<tr>
<td>Triple Screen Systems</td>
<td>12756</td>
<td>11256</td>
<td>9756</td>
<td>7506</td>
<td>5256</td>
<td>3756</td>
<td></td>
</tr>
<tr>
<td>Total Audio and Video (kbps)</td>
<td>+ 20% for Layer 2-4 overhead</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Single Screen Systems max bandwidth (kbps):

<table>
<thead>
<tr>
<th></th>
<th>Tx</th>
<th>Rx</th>
</tr>
</thead>
<tbody>
<tr>
<td>includes Layer 2-4 overhead</td>
<td>5,554</td>
<td>5,707</td>
</tr>
<tr>
<td>30fps Auto Collaborate Audio channel (kbps)</td>
<td>4,000</td>
<td>+ 20% for Layer 2-4 overhead</td>
</tr>
<tr>
<td>CTRS Recording in CIF Audio channel (kbps)</td>
<td>704</td>
<td>+ 20% for Layer 2-4 overhead</td>
</tr>
<tr>
<td>SD Interoperability Audio channel (kbps)</td>
<td>704</td>
<td>+ 20% for Layer 2-4 overhead</td>
</tr>
<tr>
<td>Video</td>
<td>64</td>
<td>+ 20% for Layer 2-4 overhead</td>
</tr>
<tr>
<td>WebEx OneTouch Audio channel (kbps)</td>
<td>304</td>
<td>+ 20% for Layer 2-4 overhead</td>
</tr>
<tr>
<td>Video</td>
<td>64</td>
<td>+ 20% for Layer 2-4 overhead</td>
</tr>
</tbody>
</table>
### Cisco TelePresence Traffic Characteristics

#### Average Call vs. Max Consumption

**Cisco TelePresence Traffic Characteristics**

**Average Call vs. Max Consumption**

<table>
<thead>
<tr>
<th>Resolution</th>
<th>1080p</th>
<th>1080p</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Motion Handling</td>
<td>Best</td>
<td>Better</td>
<td>Good</td>
<td>Best</td>
<td>Better</td>
<td>Good</td>
<td>Lite</td>
</tr>
<tr>
<td>CTS-500/1X00 average bandwidth (Mbps) includes Layer 2-4 overhead</td>
<td>4 Mbps</td>
<td>3.5 Mbps</td>
<td>3 Mbps</td>
<td>3 Mbps</td>
<td>2.5 Mbps</td>
<td>1.5 Mbps</td>
<td>1 Mbps</td>
</tr>
<tr>
<td>CTS-30X0/32X0 average bandwidth (Mbps) includes Layer 2-4 overhead</td>
<td>11 Mbps</td>
<td>10 Mbps</td>
<td>8 Mbps</td>
<td>8 Mbps</td>
<td>6 Mbps</td>
<td>3 Mbps</td>
<td>-</td>
</tr>
</tbody>
</table>

**CTS-3010 BW Consumption v.s Time Graph**

- VBR Traffic
- 15Mbps
- 11Mbps

---

**Table: “Average Call” Bandwidth Consumption Per Second**

- Resolution: 1080p, 1080p, 1080p, 720p, 720p, 720p, 720p
- Motion Handling: Best, Better, Good, Best, Better, Good, Lite
- CTS-500/1X00 average bandwidth (Mbps) includes Layer 2-4 overhead: 4 Mbps, 3.5 Mbps, 3 Mbps, 3 Mbps, 2.5 Mbps, 1.5 Mbps, 1 Mbps
- CTS-30X0/32X0 average bandwidth (Mbps) includes Layer 2-4 overhead: 11 Mbps, 10 Mbps, 8 Mbps, 8 Mbps, 6 Mbps, 3 Mbps, -
Cisco TelePresence Traffic Characteristics
Average Call vs. Max Consumption

### Average Call

- **Resolution:** 1080p
- **Motion Handling:** Best
- **Bandwidth Consumption Per Second:** 4 Mbps

**Total = 11 Megabits**

### Max Consumption

- **Resolution:** 720p
- **Motion Handling:** Lite
- **Bandwidth Consumption Per Second:** 11 Mbps

**Total = 15 Megabits**

---

**“Average Call” Bandwidth Consumption Per Second**

<table>
<thead>
<tr>
<th>Resolution</th>
<th>1080p</th>
<th>1080p</th>
<th>1080p</th>
<th>720p</th>
<th>720p</th>
<th>720p</th>
<th>720p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motion Handling</strong></td>
<td>Best</td>
<td>Better</td>
<td>Good</td>
<td>Best</td>
<td>Better</td>
<td>Good</td>
<td>Lite</td>
</tr>
<tr>
<td>CTS-500/1000 average bandwidth (Mbps) includes Layer 2-4 overhead</td>
<td>4 Mbps</td>
<td>3.5 Mbps</td>
<td>3 Mbps</td>
<td>3 Mbps</td>
<td>2.5 Mbps</td>
<td>1.5 Mbps</td>
<td>1 Mbps</td>
</tr>
<tr>
<td>CTS-3000/3200 average bandwidth (Mbps) includes Layer 2-4 overhead</td>
<td>11 Mbps</td>
<td>10 Mbps</td>
<td>8 Mbps</td>
<td>8 Mbps</td>
<td>6 Mbps</td>
<td>3 Mbps</td>
<td>-</td>
</tr>
</tbody>
</table>
Cisco TelePresence Traffic Characteristics
Relation of Video Frames to Bytes Per Millisecond

Resolution | 1080p | 720p
---|---|---
**Motion Handling**
CTS-1000 *max bandwidth over one second (Mbps)* | Best | Better | Good | Best | Better | Good | Lite
5,553 TX 5,707 RX | 4,953 TX 4,507 RX | 4,353 TX 4,507 RX | 4,353 TX 4,507 RX | 3,153 TX 3,307 RX | 1,953 TX 2,107 RX | 1,397 TX 1,550 RX
CTS-3000 *max bandwidth over one second (Mbps)* | 15,307 | 13,507 | 11,707 | 11,707 | 8,107 | 4,507 |

**CTS-1000 mean rate per millisecond the router expects (Bytes)**
688 TX 713 RX | 613 TX 638 RX | 538 TX 563 RX | 538 TX 563 RX | 388 TX 413 RX | 250 TX 263 RX | 250 TX 263 RX

**CTS-3000 mean rate per millisecond the router expects (Bytes)**
1,913 | 1,688 | 1,463 | 1,463 | 1,013 | 563 |

* Audio Traffic Not Included for Simplicity
Cisco TelePresence Traffic Characteristics
Relation of Video Frames to Packets

**Application Layer**

<table>
<thead>
<tr>
<th>Resolution</th>
<th>1080p</th>
<th>720p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motion Handling</td>
<td>Best</td>
<td>Better</td>
</tr>
<tr>
<td>Average video frame size <strong>includes Layer 3-4 overhead</strong></td>
<td>16KB</td>
<td>14KB</td>
</tr>
<tr>
<td>Average bytes per video packet <strong>includes Layer 3-4 overhead</strong></td>
<td>1,100 Bytes</td>
<td></td>
</tr>
</tbody>
</table>

**Network Layer**

| CTS-1000 **average** video packets per second (2 video channels) | 873 pps | 792 pps | 682 pps | 553 pps | 373 pps | 272 pps | 262 pps |
| CTS-3000 **average** video packets per second (4 video channels) | 1745 pps | 1584 pps | 1364 pps | 1106 pps | 747 pps | 545 pps |
Cisco TelePresence Traffic Characteristics
One-Way Latency, Jitter and Loss Targets & Thresholds

<table>
<thead>
<tr>
<th>Metric</th>
<th>Target</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
<th>1st</th>
<th>2nd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latency</td>
<td>150 ms</td>
<td>250 ms</td>
<td>400 ms</td>
<td></td>
<td></td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Jitter</td>
<td>50 ms</td>
<td>85 ms</td>
<td>125 ms</td>
<td>165 ms</td>
<td>245 ms</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Loss</td>
<td>0.05%</td>
<td>1%</td>
<td>10%</td>
<td></td>
<td></td>
<td>Network Bar Change</td>
<td>1. Reduce Quality 2. Drop Call</td>
</tr>
</tbody>
</table>

SLAs Only Relate to Network Flight Time
## Cisco TelePresence Network Design

### RFC 4594 Configuration Guidelines for DiffServ Classes

<table>
<thead>
<tr>
<th>Application</th>
<th>L3 Classification</th>
<th>DSCP</th>
<th>IETF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Control</td>
<td>CS6</td>
<td>48</td>
<td>RFC 2474</td>
</tr>
<tr>
<td>VoIP Telephony</td>
<td>EF</td>
<td>46</td>
<td>RFC 3246</td>
</tr>
<tr>
<td>Call-Signaling</td>
<td>CS5</td>
<td>40</td>
<td>RFC 2474</td>
</tr>
<tr>
<td>Multimedia Conferencing</td>
<td>AF41</td>
<td>34</td>
<td>RFC 2597</td>
</tr>
<tr>
<td>Real-Time Interactive / TelePresence</td>
<td>CS4</td>
<td>32</td>
<td>RFC 2474</td>
</tr>
<tr>
<td>Multimedia Streaming</td>
<td>AF31</td>
<td>26</td>
<td>RFC 2597</td>
</tr>
<tr>
<td>Broadcast Video</td>
<td>CS3</td>
<td>24</td>
<td>RFC 2474</td>
</tr>
<tr>
<td>Low-Latency / Transactional Data</td>
<td>AF21</td>
<td>18</td>
<td>RFC 2597</td>
</tr>
<tr>
<td>Operations / Administration / Management</td>
<td>CS2</td>
<td>16</td>
<td>RFC 2474</td>
</tr>
<tr>
<td>High-Throughput / Bulk Data</td>
<td>AF11</td>
<td>10</td>
<td>RFC 2597</td>
</tr>
<tr>
<td>Best Effort</td>
<td>DF</td>
<td>0</td>
<td>RFC 2474</td>
</tr>
<tr>
<td>Low-Priority / Scavenger Data</td>
<td>CS1</td>
<td>8</td>
<td>RFC 3662</td>
</tr>
</tbody>
</table>
## Cisco TelePresence Traffic Characteristics

### Summary

<table>
<thead>
<tr>
<th>Traffic Characteristics</th>
<th>Network Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Multiple channels of 1080p (or 720p) resolution video and wide-band audio @ 30 frames/sec</td>
<td>▪ Ultra-high bandwidth</td>
</tr>
<tr>
<td>▪ Variable video frame sizes</td>
<td>▪ Very low latency, jitter and loss SLA targets and thresholds</td>
</tr>
<tr>
<td>▪ Large packets, high packets/sec</td>
<td>▪ Highly-reliable, redundant</td>
</tr>
<tr>
<td>▪ Very low latency, jitter and loss targets and thresholds</td>
<td>▪ Latest generation switching and routing platforms and IOS queuing and shaping policies</td>
</tr>
<tr>
<td>▪ Very low latency, jitter and loss targets and thresholds</td>
<td>▪ End-to-end Quality of Service</td>
</tr>
</tbody>
</table>
Inter-Company TelePresence
Basic Intra-Enterprise Model
Preview The ICT Goal

Call Setup to external numbers

Medial Flow Across Multiple VPN

Ability to reach external CTS Endpoints
Integration to ICT

Connecting Businesses via Service Provider(s)

External Number Dialing

Secure Transport over Service Provider(s)

Maintain Intra-Enterprise User Experience

End to End Signaling & Media over IP
TelePresence ICT Enablement

User Experience

Scheduling | External Number Dialing | E2E Secured IP Connectivity

**Application Layer**

- **Off-net Signaling**
  - Avoid peering between enterprises

- **Address Resolution**
  - SP Managed Phone # to IP mapping

- **OAM**

**DL/Network/Transport Layers**

- **End2End QoS Assurance**
  - Internal QoS plus SLA from SP

- **Signaling & Media Security**

- **TelePresence Endpoint Encryption**
  - Inter-VPN Connectivity
  - NAT/Firewall Traversal

- **TelePresence Aware Network Monitoring & Troubleshooting tools**
Address Resolution Function

- Phone number to IP Address/Domain Lookup
- Provided by SBC
- Expands as the number of media endpoints grow
- Impractical for an enterprise to maintain
- Best managed by SP

SP Managed Phone # to IP mapping

Session Border Controller
Session Border Services

- Usually a Service Provider Function
- VPN Aware
- Terminates Signaling/Media path
- NAT/Firewall Traversal
- Topology/Address Hiding
- Encrypted Signaling/Media Passing
- Address Resolution

Off-net Signaling

Avoid peering between enterprises

Signaling & Media Security

TelePresence Endpoint Encryption
Inter-VPN Connectivity
NAT/Firewall Traversal

Session Border Controller
Topology Hiding Solution

- Insertion of SBC in SP
- SBC as a B2BUA terminating both Media & Signaling
- No direct signaling exchange between enterprises
- All topology & identities shown belong to SBC
Through SBC Signaling Intelligence, endpoints have been previously told the destination is the routable respective IP address within the VPN.
SBC – Media Flow

- **B2BUA**

- **Firewall Traversal**
  Symmetrical Media RTP Connections
  Accepts one Rx connection from each endpoint – UDP port opened on firewall
  Establishes one Tx connection with each endpoint using the same UDP port as Rx

- **Media Relay Flow Through**
  Relays media traffic received to the destination
  Reconstructs RTP header with new source IP address
  Payload untouched

- **Topology Hiding**
  Endpoints do not communicate with each other directly
  Each RTP connection is terminated on the SBC
  RTP header reconstruction enables topology hiding
SBC – VPN Awareness

- VRF aware

- Resides within each VPN
  
  One routable IP address for each VPN
  Allow private IP address overlapping
  Signaling/Media connections from multiple MPLS/VPN

- Direct communication only with the SP owned SBC
  
  Topology Hiding
  SBC enables inter-VPN flow
CUBE Protection Function

- Resides within the Enterprise DMZ
- Relays SIP messages between Enterprise and SP
- Single point of contact for external Signaling
- Accepts external call requests from the SP
- Prevents direct port opening to CUCM
ICT Architecture Illustration

- Customer Choice of ICT Capable SP
- Static Signaling Link to the SP
- Simple Dial Plan
- Dynamic Media Ports through NAT/FW

Future Extendable NNI link for Multi-SP Inter-Company TelePresence
Cisco TelePresence Exchange System
High Level Architecture Overview

Scheduling Portal

Hosted Controller
- VCS
- CUCM
- CTS-Man

Admin Portal
- CTMS
- Scheduling Middleware

CTX Deployment

East Coast
- CTMS Pool
- SBC
- Session Border

Routing / Switching
- IVR Pool
- MSE Pool

West Coast
- CTMS Pool
- SBC
- Session Border

Media Sub-System
- MSE Pool
- IVR Pool
- CTMS Pool

Media Plane

Customer Access

Customer A
- TMS
- VCS

Customer B

Customer C

Customer ...

Application Plane

Control Plane

SIP Line
- SIP Trunk
- Physical Access

Cisco Confidential
CTS Security Overview

Application Requirements –
- Secure Signaling & Media
- Authentication
- Platform Security

Enterprise Campus –
- Topology Hiding
- DoS Prevention
- NAT/Firewall Traversal

VPN/WAN Provider –
- Topology Hiding
- NAT/Firewall Traversal
- Secure Connection
- Inter-VPN Reachability

Signaling
Media

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CTS – Application Requirements

- **Secure Signaling & Media**
  - Content Encryption

- **Authentication**
  - Between CTS and Signaling devices (ie., CUCM)
  - Hub by hub media path authentication

- **Platform Security**
  - Access to the device (ie., Web Interface/CLI)
  - Configuration Encryption
CTS Secure Signaling & Media Overview

- **Hop by Hop Layer 4 & Layer 5 Connection Encryption**
  Required between each layer 4 hops
  No end to end security if the chain is broken

### Signaling Encryption

- Already Handled on Transport Layer

### Media Encryption

#### Application Layer Security
- Audio/Video Packets over SRTP
- SRTP = Authenticated + Encrypted RTP
- S-Description in SDP *(Key Exchange)*

#### Transport Layer Security
- Transport Layer Security (TLS)
  - Authenticated + Encrypted TCP
  - RFC 4346
- Datagram TLS (DTLS)
  - Purely for Key Exchange
  - RFC 4347
CTS – Enterprise Campus Security

- **Topology Hiding** *(Protection)*
  Identity & Topology should not be visible/detectable from outside
  Allows private IP addresses

- **DoS Prevention** *(Protection)*
  Servers accept requests on wide open ports
  CUCM, CTMS and other servers should be protected from attacks
  Prevention provided by Firewall and DMZ

- **NAT / Firewall Traversal** *(Enablement)*
  Retain CTS Application Requirements while using NAT / Firewall
NAT Traversal for ICT

- **Nature of NAT**
  - Modifies Source/Destination IP addresses
  - Modifies Source/Destination Port numbers

- **SIP Signaling with external device**
  - SBC only needs reachability to the DMZ without concerning NAT

- **Media Flow with external endpoints**
  - Actual IP address/port number used are different from SDP offer
  - **NAT device can’t read encrypted SDP offers**
  - NAT device might not correct the SDP offer

- **NAT Traversal enabled on SBC**
  - SDP offer is ignored
  - NAT’d IP address & port number learned from RTP packets received
NAT Traversal Illustration

Green Customer

10.10.10.10
CE+NAT
1.1.1.10

2.2.2.10
CE+NAT

3.3.3.20

Red Customer

5.5.5.20

CE+NAT

10.10.10.20

Signaling SIP SDP Exchange

SDP
+ My IP = 10.10.10.10
+ My UDP port = 16384

SDP
+ My IP = 10.10.10.20
+ My UDP port = 16384

Media UDP Packet Flow

First Packet
SRC: 10.10.10.10/16384

First Packet
SRC: 1.1.1.10/1000

First Packet
SRC: 3.3.3.20/3000

Payload Switched
DST: 1.1.1.10/1000

DST: 3.3.3.20/3000

First Packet
SRC: 10.10.10.20/16384

DST: 10.10.10.10/16384

DST: 10.10.10.20/16384
Firewall support

- **Signaling for ICT**
  Only between CUCM and SBC
  Sever ports are static

- **Media for ICT**
  Between endpoints and/or CTMS
  Range of dynamic ports allowed (a CUCM configuration)
  Specified in SDP/SIP exchange

- **Solution**
  Signaling – Static configuration
  Media – Bidirectional dynamic port opening
Firewall Traversal – Media Flow

First Packet
DST: 2.2.2.10/16384
1.1.1.10 ↔ 2.2.2.10
Port 16384 opened

Payload
Switched

Second Packet
SRC: 2.2.2.10
DST: 1.1.1.10/16384

5.5.5.10 ↔ 3.3.3.20
Port 34567 opened

Unknown source
Rejected

First Packet
DST: 5.5.5.10/34567

5.5.5.10 ↔ 3.3.3.20
Port 34567 opened

SRC: 5.5.5.10
DST: 3.3.3.20/34567
Application for education and research community
Active Collaboration Room Overview
An Interactive Experience for Team Brainstorming

- A new Telepresence Experience
- Up to 15 participants per room (depending on café table configuration) can participate freely in brainstorming, design work and other collaboration exercises
- Collaborate globally with colleagues anywhere, anytime

*Interoperable with all other Cisco TelePresence rooms, video conferencing and Cisco WebEx participants*
Active Collaboration Room Design

Cisco Telepresence CTS 1300 captures entire room with one video stream. Voice-activated switching automatically captures whoever is speaking.

Electronic Whiteboard shared with remote participants through WebEx.

Cisco WebEx combined with video conferencing enables maximum participation from remote participants.

Interoperability allows remote users to effectively participate using any Cisco Telepresence System, standards-based video conferencing systems, or Cisco Webex.

Steelcase café-height seating allows participants to move freely and change postures while still remaining on camera.

Flexible: 0 or 3 café-height tables provides for 6 or 15 participants per room.

Steelcase Media:scape furniture enables rapid transition from presenter to presenter.

Ceiling-mounted video projector allows for extremely large content display.

Cisco 40” or 52” LCD displays may be used for smaller rooms.
Solution Components

Standard Template Configuration

Cisco Components

- **CTS-1300**
  - CTS-3200 camera lenses for additional depth of field
  - Cisco 52” LCD display (for small room configurations)

Steelcase Furniture

- **Media:scape table**
  - Integrated VGA matrix switch
  - Dimensions: 60”D x 84”W x 38”H
- **Café height tables**
  - 36” Diameters
  - Café Height
- **VGA, USB and power cabling**

3rd-party AV Components

- **Projection**
  - Projector(s)
- **Smartboard**
  - Smart Technologies
  - Gowire USB sharing cable
- **Ceiling Audio**
  - Clock Audio microphones
  - ClearOne Mixer
  - JBL Speakers

Value Add Options

Cisco Components

- **WebEx**
  - Adds multi-party interactivity for smartboard and remote participants
- **HFR codec**
  - Adds 30fps graphics
- **Interoperability and Recording**
  - Cisco Telepresence Server
  - Cisco Telepresence Content Server
- **Digital Signage**
  - Cisco DMS Player and LCD displays

3rd-party AV Components

- **Document Camera**
  - Wolfvision VZ-32 Visualizer
Classroom of the Future
Making Borderless Education a Reality

- Brings together teachers and students in any location
- Immersive experience for comprehension and interactivity
- Deliver material with maximum flexibility and recording capabilities
- Ability to scale educational organizations globally
- Custom installation of Cisco TelePresence with multimedia technologies for classrooms of any size
- Available now
Cisco TelePresence Recording Studio
Simple, High Quality Video Recording

- Simple: One-button-to-push
- High-quality: Recording at 1080p
- Medianet application integration
- User-driven creation and distribution
- Any to Any: Streaming to Web