Effective videoconferencing system selection and deployment is a considerable challenge. This document was developed in an effort to provide some helpful guidelines to faculty and staff interested in integrating videoconferencing into the classroom.

A Comparison of Videoconference Systems

- Room System
  - Systems available at different levels. Price increases as quality and features increase.
  - Dedicated facilities designed for clear, high quality audio and video capture and transmission.
  - Multiple cameras and video displays depending on room size and type of application.
  - Multiple microphones (combination of wired and wireless) required for effective audience interaction in larger rooms.
  - Control panel (touch screen) required for sessions where user operates and switches between the various audio, video and multimedia sources.
  - Separate control room required for sessions where technician operates and switches between the various audio, video and multimedia sources.

- Portable/Roll-about System
  - Midrange system for individual and small groups.
  - Audio and video quality dependant on room environment.
  - Typically bundles codec, camera, monitor and microphone on portable cart, therefore flexible.
  - Controlled by wireless remote, touchpad or keyboard.
  - Portable system units can be adapted for use in dedicated rooms.

- Desktop Videoconferencing System
  - Lower cost.
  - Low quality audio and video.
  - Compact camera and single microphone hooked onto personal computer, with software based codec.
  - May include whiteboard, data and application sharing capabilities.

Guiding questions when selecting a Videoconference System

- Intended purpose – Type of application.
- System management – Who will manage the system?
- System usage and technical skill level of end user.
- Audio, video and multimedia requirements.
- Interoperability with chosen collaborators.
- Budget allocation and project timeline.
This document focuses mainly on designing a space for a room based videoconferencing system. Certain elements can be used to increase effectiveness when using portable systems as well.

**Room Considerations**

- **Selection** – Consult with University Registrar before room selection is finalized. Be open to sharing the space with non-videoconferencing classes.
  - Room size vs. available space – Although a room may accommodate a specific number of people, allowances must be made for any displays, furniture, whiteboards etc.
  - Room location – Videoconferencing spaces should be located away from noisy, high traffic areas.

- **Layout**
  - The videoconference is directionally oriented by the visual capabilities of the camera (maximum field of view).
  - All participants must have similar viewing capabilities.
  - Layout and room configuration are dependant on the type of application and amount of flexibility required.
  - Three typical layouts are provided below. Room configurations are not limited to these examples.

  E.g. Conference room layout
  (COPYRIGHT Video Development Initiative (ViDe) et al, 2004-5)
E.g. Large Auditorium Layout
(COPYRIGHT Video Development Initiative (ViDe) et al, 2004-5)

E.g. V-shaped classroom/conference room
(Layout provided by WSU Office of Global Learning)
• Furnishings – Meet with the Physical Plant once room selection and tentative layout has been determined. They will outline the changes that need to be. Layout can be finalized after the consult.
  o Multiple conduits, embedded in ceiling and walls for cabling purposes.
  o Adequate electrical (AC) outlets throughout the room, including in the ceiling space for projectors.
  o Sufficient storage space and/or mounting hardware for AV equipment.
  o Adequate measures for securing conferencing equipment if room is shared with regular classrooms (mics flush with desktop, lockbox for controls etc.)
  o Computerized room controls may be necessary. Controls for lights, VHS playback and record, access campus cable connection etc.
  o Smaller rooms should have flexible seating arrangements - U, V, or semi-circular configurations.
  o Movable tables and chairs, if flexible seating will be necessary.
  o Tables have neutral or dark surfaces to prevent light reflections.
  o Teaching station/podium if required.
  o Wall box for telephone. Speakerphone option would be beneficial.

Video Components
• Camera
  o Choice of camera - Most units include a built-in PTZ (pan, tilt, zoom) camera. If plugging in a different camera, use motorized PTZ cameras that output an NTSC signal. Make sure chosen camera fits into the intended use of the room. Depending on the size of the classroom and use of system additional cameras may be added.
  o Camera positioning - Camera should be positioned above or next to the remote site video display. This stimulates local audience to make eye contact into camera when viewing remote video.
  o Motion – Keep it natural, but minimize unnecessary movement in front of the camera. E.g. busy backgrounds, analog clocks, etc. This helps the Codec to reduce dropped frames, thereby improving video quality.

• Video Display
  o Choice of television monitor vs. projector is dependant on room size and maximum number of participants. All participants should have equal viewing capabilities regardless of what display type and size is used.
  o Number of video displays required will depend on type of application used. E.g. Display for data, display for audience view of remote video and display for instructor view of remote video requires a total of 3 displays)
  o Projection screen vs. wall – Screens have an optical coating that enhances reflective qualities that walls don’t.
  o Appropriately sized projections screen, bottom at least 4ft from floor.
  o Positioning of equipment will be influenced by ADA requirements.
• Projector - New projectors constantly flood the markets. Try out demo units before purchase if possible, to test out if the unit fits the intended application, room size and lighting conditions. Following are some factors to be considered when deciding on a projector.
  o Fixed vs. Portable – If ceiling mounted, unit must be capable of projecting image upside down. Use standard mounting hardware, in case projector needs to be replaced in future. Verify with Physical Plant if room is able to have a ceiling mounted unit.
  o Brightness – 2000 to 3000 lumens should be used in a room where lights cannot be turned off or dimmed. Avoid any direct source of light striking the projection screen.
  o Cost and availability of replacement lamps – Make sure 2-3 replacement lamps are kept on hand, as lamps for certain models can be on backorder and can take several months. If projector model is one used by Campus Media Services at MRC, departments may purchase replacement lamps from the CMS lamp inventory (Contact Jim Pearce listed in Appendix A).
  o Contrast ratio – Contrast ratio of 400:1 or higher provides the best video image or most legible computer and/or graphics image. If projector is used with lights turned on, higher contrast ratios are better.
  o Native resolution - XGA (1024x768) for good quality computer image. Ensure computer resolution matches projector resolution for best results.
  o Keystone correction – Unit should feature keystone correction capability, especially if projection surface is angled.
  o Video formats – Many projectors accept all three standard video formats NTSC, PAL, and SECAM. Ensure projector can accept PAL and SECAM video if needed.
  o Number of connections – Ensure projector has required number connectors for intended use. E.g. Multiple computer connectors, composite, component and S-Video connectors.
  o Data signal ports compatibility – Most projectors require an adaptor to connect to a Macintosh computer. Ensure that computer user is aware of the need and has an adaptor ready.
Audio Components

- Acoustics
  - Microphone must be placed away from speakers and other equipment to minimize feedback.
  - Volume on speakers should be set at midpoint. Avoid turning up volume too high as it will likely cause feedback problems.
  - Use soft furnishings like curtains, carpets, and upholstered panels to dampen the audio paths and minimize echo. Glass and tile surfaces cause particularly bad audio reflections.
  - Eliminate background noise as much as possible. Avoid paper shuffling and other unnecessary noise near microphone.
  - Mute all microphones when not in use (voice activated and voice activated gated mics described in Appendix B). Activate Push to Talk (PTT) microphones only when necessary (mics described in Appendix B).
  - Be aware of the affect of HVAC equipment noise in the room, especially if considering ceiling microphones.

- Audio equipment
  - Use a high quality omni-directional microphone for small groups. Large rooms require several smaller directional microphones placed throughout the room (One microphone for every two participants).
  - Use of multiple microphones requires an audio mixer. Mixers adjust gain and volume more accurately than the embedded adjustments of most videoconference systems.
  - Microphones should pick up speaker’s voice naturally, in terms of volume and physical positioning, without excessive background noise.
  - Small groups can use built-in speakers, or speakers from the television monitor. Larger rooms require a separate sound system (amplifier, optional equalizer and speakers).
  - Sound system for playback of multimedia (computer, VCR, DVD etc.).
  - Telephone with speakerphone capability (can be used as a backup).

Lighting

- Use lighting with proper color balance.
- Remove white backgrounds from the field of view of the camera.
- Use muted soft tones for walls if possible. Avoid colors that resemble skin tones.
- Participants faces need to be the lightest color in camera’s view.
- Arrange a simple, uncluttered, static background in neutral or darker solid colors.
- Install curtains or dark blinds to minimize and control amount of natural light coming in from windows.
- Tilt pictures, framed degrees, awards or any other glass-covered wall hanging downward to eliminate reflection and glare.
- Avoid seating configurations where windows are behind the participants.
Codec

- C0mpressor/DE-Compressor – Part of the videoconferencing unit that compresses and decompresses incoming and outgoing audio and video signals. Compression and decompression are also referred to as encoding and decoding respectively.

- Types of Codecs
  - Desktop/Laptop USB or PCI hardware codecs – Includes special hardware (web cam quality camera) to assist encoding, but decoding is done by computer. May offer option for external audio and video. Audio and video quality better than software based codecs. E.g. Polycom ViaVideo II
  - PC based integrated codecs – Combination of previous two types. Includes high performance computer with specialized hardware cards. Offers several connectivity options like set-top, but can run PC applications as well. Preferred choice for group videoconferencing with collaboration applications. E.g. Polycom iPower Suite, Polycom VS4000

- Limited to state contracted vendor (Polycom). Exception being if another vendor offers a product that contracted vendor does not provide.

Questions for the Vendor

- Analyze the project
  - Project outline – Include type of project (instruction, collaboration etc.), goals to be achieved through videoconferencing, potential sites (single or multipoint) and timeline for deploying videoconferencing.
  - Obtain end user’s feedback whenever possible. Faculty input on teaching style and equipment use is crucial for successful implementation of videoconferencing. Potential technical staff must be involved throughout the process.
  - Budget – Include estimates for equipment installation and maintenance, possible room alterations, training and consulting services.

- Features of the videoconferencing unit.
  - Functional – Does the unit feature easy ways to dial and accept calls? Are phonebook and directory functions available? Can data rates be easily selected? Is the interface user friendly? Does it include basic troubleshooting and monitoring functions?
  - Application sharing and data collaboration features – Are they fully integrated into the application or require a separate application and/or adaptor (e.g. NetMeeting, Visual Concert etc.)?
- Interoperability – Does the unit support external audio and video devices and varying inputs and outputs (VCR in/out, document camera)? Can audio and video be controlled (e.g., volume, echo, color, brightness) through the application? Does the unit provide support for enhanced devices (e.g. far end camera control, dual monitors and picture-in-picture)?
- Does the system have built-in Multipoint Control Unit (MCU) capabilities or is additional software required?
- Can the system be configured to work through an external control unit?
- Can it be integrated into an existing touch panel control system?
- Compliancy – Is the system compliant with current industry standards? Is the system compatible with prospective connecting endpoints?

- Services and support questions
  - Onsite installation – Is onsite installation provided? Is there a fee?
  - Technical Documentation – Obtain paper based or CD ROM operating manuals, web based technical documentation and a list of compatible products that can be added.
  - Ongoing maintenance and troubleshooting help – Find out what options are available in case of technical trouble. E.g. toll free phone number, information for web based support, online chat and onsite services etc. What warranties are available and is there a cost? Is there additional fee based support available?
  - Training – Will on-site training provided at time of installation? Are there fee based training sessions? Will training manuals and interactive tutorials be provided? Is there separate training for technical staff and end users?
  - Upgrades and enhancements – Are both software and hardware upgrades provided? Are updates provided free or for a fee? How are future standards and directions handled?

Network Components
- Meet with University Telecommunications and Computing and outline your videoconferencing plans. They will advise you of any network issues that may affect the deployment of a videoconferencing unit in a particular building.
  - Network connections should be provided for the Codec and to the teaching station. Additional ports can be added if required.
  - Bandwidth – 100Mb switched port preferred; 10Mb switched port minimum. A 10Mb shared connection is likely to negatively impact or be impacted by other networked users in the same building.
  - Videoconferencing equipment should not be plugged into Ethernet hubs.
  - Be knowledgeable of firewall and network security measures within an individual building and departments as well as the campus network.
  - If videoconferencing via ISDN is required, contact Media Resources Center for availability and cost estimates. ISDN lines are not available to all campus buildings.
• Network concerns for IP based videoconferencing
  o Bandwidth - Measured in Hertz or bits per second. E.g. a regular Ethernet line has a bandwidth of 10Mbps (10 million bits per second.) It is sometimes measured in one direction and sometimes as a total in both directions. The connection speed of a call is limited by the total bandwidth available. Make allowances for call overheads (add minimum of 20% of call rate to actual connection rate) and any data that will be transmitted.
  o Packet loss - A packet is a unit of information sent across a packet-switched network. It generally contains the destination address as well as the data to be sent. Loss of packets through the network results in jerky audio and video.
  o Latency - The length of time it takes a packet to move from source to destination.
  o Jitter - The change in latency with time. This is a network problem that is very important to video quality. Significant jitter destroys video.
  o Policies – Be aware of internal policies of the campus network.

Internet Protocol (IP) vs. ISDN Protocols (H.323 vs. H.320)
• Advantages of Internet Protocol (H.323) Videoconferencing
  o Low usage cost – Typically a monthly charge, no per-minute long-distance call charges.
  o Easier to budget as cost does not vary according to usage.
  o Greater accessibility as connections are available in almost every desktop.
  o Easier to deploy. Can utilize existing IP infrastructure with standard IP drops. IT staff are already familiar and knowledgeable with IP.
  o Enables organizations to converge voice, video and data communication networks.
  o Facilitates rich-media integration and web collaboration more effectively. E.g. data and applications sharing, html presentations, multimedia etc.
  o Remote manageability reduces need for large number of support staff.
  o Can add levels of security (data encryption, Virtual Private Networks – VPN)
  o IP infrastructure is growing worldwide and is being widely adopted by vendors.

• Disadvantages of IP based Videoconferencing
  o Compatibility and interoperability concerns still exist.
  o Requires dedicated, high-bandwidth networks, such as WAN.
  o Transmissions can be bogged down with heavy network traffic.
  o Quality-of-service is not guaranteed.
  o Audio and data skip more commonly than on ISDN.
  o Firewalls can limit video access (must be configured prior to making calls).
  o Less secure than leased ISDN lines.
  o Industry still in its infancy.
Advantages of ISDN (H.320) Videoconferencing
- The system offers wide compatibility.
- Technology and protocols are already well established.
- Handles time-sensitive data better than IP. E.g. synced video and audio.
- Better QoS when compared to IP.
- The networks follow the existing telecommunication infrastructure.
- Communication lines are well-established in the United States and Europe.

Disadvantages of ISDN based Videoconferencing
- High usage cost – Monthly charges as well as per-minute long-distance charges are incurred.
- Difficult to budget as costs vary according to usage.
- Rich-media integration and Web collaboration are difficult.
- Difficult and expensive to deploy due to high line costs. The system is too expensive to put on every desktop.
- Limited remote management capabilities. Therefore requires larger support staff.
- Organizations must maintain a network solely for videoconferencing.

Basic Cost Comparison
A WSU faculty member schedules a 1hr videoconference with a collaborator in Australia through the MRC. If the call is made via IP, there would be no transmission charges, regardless of the connection rate. If the call is made utilizing the campus ISDN lines at the connection rate of 384 Kbps, the charge to the client would be $360 ($1/minute per line or $6/minute for 6 lines).
Global Learning Resources
http://www.gl.wichita.edu/

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Note: Contact Jim Pearce for detailed information on projector models used in master classrooms and lamps available in the CMS lamp inventory.
Physical Plant
http://www.pp.twsu.edu/

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Director, Facility Maintenance  
Phone: 316-978-3444  
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Note: The Physical Plant prefers a "Request an Estimate" for any projects. This helps them schedule man power and be aware of upcoming projects.

Project Planning Resources  
‘Microsoft Project’ software helps planning and can provide realistic estimates of deadlines and costs.

University Computing and Telecommunication Services (UCATS)
http://webs.wichita.edu/?u=UCATS&p=index

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Note: Contact WSU Telecommunications for all Ethernet, telephone, facsimile and audio conferencing device needs.
University Registrar’s Office
http://webs.wichita.edu/?u=registrar

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Note: Please contact WSU Registrar’s Office for information on room scheduling.
Appendix B

**Glossary**

**Auto Tracking**
Feature of a Pan Tilt Zoom (PTZ) camera that enables it to follow the speaker by voice detection.

**Bandwidth**
Measurement of data that can fit on a network. Measured is Hertz or bits per second.

**BRI (Basic Rate Interface)**
An ISDN connection utilizing 2 64Kbps B channels (bearer) and a single 16Kbps D Channel (Delta).

**Codec**
Coder/decoder is a piece of hardware that compresses and decompresses digital audio and video.

**Component Video**
Method of delivering quality video in a format that contains all the components of the original image. These components are referred to as luminance and chroma. Component video is available on some DVD players and projectors.

**Composite Video**
The combined picture signal, including vertical and horizontal blanking and synchronizing signals.

**Contrast Ratio**
The ratio between white and black. The larger the contrast ratio the greater the ability of a projector to show subtle color details and tolerate extraneous room light.

**Echo suppression**
Echo suppression is crucial for all videoconferencing systems. If the echo is not suppressed, the speaker will hear his own audio coming back through the system, after a small delay. It is important to mute mics when not in use to minimize echo and feedback.

**Firewall**
A hardware or software based system that monitors and filters network traffic based on a predetermined set of rules. Firewalls can block ports utilized by videoconferencing units. Therefore it is recommended that these units be placed outside of firewalls.

**Full Duplex**
Sending data in both directions simultaneously. Typically higher quality, but requires more bandwidth. Full duplex connections are more natural.

**G.7xx**
A family of ITU standards for audio compression.
**Gatekeepers**
Network management devices designed to maintain control and assign accessibility to various videoconferencing endpoints. They control access to the network, controlling the bandwidth of a call. It helps with address resolution, by converting email type names of end users into appropriate network addresses. They handle call tracking and billing, call signaling, and management of gateways.

**Gateways**
Network device used to interconnect or translate between two main videoconferencing protocols. They provide a link between the H.323 world and other videoconferencing systems.

**H.320**
Integrated Switched Digital Network (ISDN) based videoconferencing standard determined by the ITU. The standard utilizes the existing Public Switched Telephone System (PSTN) to send video, voice and data. It is also sometimes referred to as Legacy products within the industry.

**H.323**
Internet Protocol (IP) based videoconferencing standard determined by the International Telecommunications Union (ITU).

**Half Duplex**
A system where data can only flow in one direction at a time.

**ITU**
International Telecommunications Union, an intergovernmental organization through which public and private organizations develop telecommunication standards. It is a branch of the United Nations that addresses global telecommunications.

**Keystone**
Keystoning occurs when the projector is not perpendicular to the screen, thereby creating an image that is not rectangular.

**Keystone Correction**
Since not all projectors can be positioned perpendicular to the screen, most are equipped with keystone correction. This allows the image to be keystone corrected (made rectangular) by making mechanical adjustments, adjusting optics or applying digital correction to the image. Keystone correction can be one or two dimensional and manual or automatic depending on the projector and the manufacturer.

**Lumens**
Lumens are a measurement of the overall brightness of a projector. Brightness is measured in ANSI (American National Standards Institute) lumens: the brighter the projector, the higher the ANSI lumen rating.
**Maximum Resolution**
Refers to the highest resolution that a given projector can display. If the maximum resolution exceeds the native resolution, the image is usually scaled to match or approximate the native resolution of the projector. Scaling reduces the image resolution and produces some artifacts in the image that are more apparent when viewing text than graphics or video.

**MCU (Multipoint Control Unit)**
A video switching device (bridge) that serves as a hub so more than two sites can participate in a videoconference. It is standards based and can connect all standards based Codecs. Commonly supports voice activated switching, where whoever is talking is broadcast to all users. Some systems support "Hollywood squares", where multiple windows show each participant.

**Multipoint Connection**
A videoconference that connects three or more sites. If none of the codecs have a built-in MCU, bridging services must be utilized.

**Native Resolution**
This refers to the number of physical pixels in a display device. E.g. XGA projector has 1024 physical pixels of resolution horizontally and 768 pixels vertically. Units can project greater or smaller resolution images into the same physical resolution through scaling, which reduces the resolution of larger images and increases the resolution of smaller images to fit the native resolution.

**NTSC (National Television System Committee)**
The U.S. standard for video and broadcasting. Also used in the western hemisphere, Japan, and other Asian countries. NTSC is incompatible with most computer video standards, which generally use RGB video signals. Special video adapters can be inserted to convert NTSC signals into computer video signals and vice versa.

**PAL**
The European and international broadcast standard for video and broadcasting. Higher resolution than NTSC.

**Point-to-Point Connection**
A two-site videoconference where one party dials another and no MCU is involved.

**Push To Talk (PTT) Microphones**
Microphones where circuit is always open. The mic is activated when the push to talk button is held down and circuit is closed. The mic shuts off when the button is let go.

**Quality of Service (QoS)**
Measurement of the performance of a transmission system. It reflects the quality of the transmission and availability of the service for applications. H.323 cannot guarantee QoS.
S-Video
A transmission standard that sends video information on two signal wires called luminance (brightness, Y) and chrominance (color, C). A composite signal, typically found coming out of an RCA jack on the back of most VCRs has the Y and C information combined into one signal.

SECAM
A French and international broadcast standard for video and broadcasting. Higher resolution than NTSC.

T-120
The ITU standard for application and data sharing.

Voice Activated Microphone
Mics designed to activate when someone talks. They can be activated by random noises such as paper shuffling, sound of a bag being zipped and whispering causing unnecessary noise.

Voice Activated Gated Microphones
Microphones designed to turn off when sounds entering are below a predetermined threshold. The mic will turn itself on when the audio entering is above the threshold level. If extraneous noise is above the predetermined level, the microphone will be activated when not needed and can cause erroneous switching of video. In rooms with good acoustics, incoming audio can sometimes turn the mics on.

Voice activated Switching
Automatically switching the video feed to the site that is speaking in a multipoint conference. The switching is handled by the MCU.