Minnesota State Capitol
Predesign Study

Technology report submitted to LKPB and Miller Dunwiddie by
Elert & Associates

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Table of Contents

1 Executive Summary

1.1 Purpose and Scope of Work

Elert & Associates (E&A) was retained by LKPB, Inc. to assist that firm in its work with Miller Dunwiddie on the State Capitol Predesign Project. Elert & Associates' contractual role is to review and discuss technologies including networking, video/multimedia/sound, telephone system, infrastructure (cabling), and telecommuting.

Items and systems identified as outside of the scope of work were a) video at Senate and House Independent Systems[1], b) security systems – other than how those systems might need to interface to the covered technologies, and c) wireless systems.

1.2 Format

Our report is organized in sections by technology system type, beginning with Infrastructure Cabling systems, and ending with Multimedia/video/sound systems.

1.3 Summary of Technology Recommendations

In brief, Elert & Associates found that much has been done in the way of technology within the Capitol Building over the last several years, but that there are still a few areas that need improvement.

We recommend that in areas to be renovated, new **cabling** be installed. Due to a potential shortage of space for cabling "closets" and because of its high-bandwidth characteristics, we suggest the use of fiber optic cabling to each outlet where computers would connect. However this would require the replacement of network switches and if found not feasible for that reason, we have made alternate recommendations for a conventional copper cabling system.

The voice, data and video cabling system should be considered an integral part of the building, and thus should be managed by a single entity, which is not currently the case.

There are a number of additional cabling system recommendations to be found in the Infrastructure Cabling section.

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[1] This is understood to mean systems in the House Office Building, as well as video upgrades in the Capitol within the past two years.

For **voice** services (phones), we recommend the continued use of State InterTechnologies Group expertise.

We found a great deal of variety in the **data networking** systems of the tenants, with each having its own separate network, for data privacy reasons.

In preparation for the renovations, we suggest that each of the tenant's Information Systems departments more completely document its own network.

More specifically, the IS departments for groups that would have members moving (either to expansion space or to renovated spaces within the Capitol) should create a list of tasks to be accomplished when that occurs (i.e., an implementation plan). A single entity or person should coordinate these various plans to ensure smooth deployments/moves.

Video and multimedia systems are also a mixed bag in the current building, which has very few spaces well suited to video and audio needs. We recommend that many, if not all, of the hearing rooms move to an expansion space that could have rooms designed particularly as hearing rooms.

We also recommend the Senate TV studio (Room G4) be relocated to provide a proper environment for audio/video production.

A number of other recommendations for audio, video, presentation, and recording systems may be found in section 5.

1.4 Acknowledgements

Miller Dunwiddie coordinated and strove to provide E&A with contact information for those with whom we needed to speak. Special thanks to Mr. Jim Greenwalt, Director of Senate Information Systems, who was particularly helpful.

2 Infrastructure Cabling

Telecommunication cabling distribution at the State Capitol consists of many isolated networks serving the Senate, House, Supreme Court, Governor's office, Attorney General's Office, Minnesota Historical Society, External Media, Revisor of Statutes, Plant Management, and Security.

2.1 Summary of Cabling Recommendations

1. **After proper testing, remove all data, voice and video cabling no longer in use**. This will free up some space in cabling pathways, and eliminate a source of potential interference.
2. **Create and enforce standards for new cabling installations throughout the building** (all tenants) to include specified installation and testing criteria, and a consistent labeling scheme. This will greatly reduce the time it takes to make changes.
3. **Add conduit to the northeast tunnel where cabling is now exposed, then move cabling into that conduit.** This offers protection from both unintentional damage and deliberate sabotage.
4. **Secure Technology Closets** to reduce potential damage to expensive equipment. (See also Data Networking section.) May not be required if move to a fiber to the workstation system (see item 6.)

The next two recommendations would be an either-or choice – i.e., select one or the other, not both.

5. **Expand the current conventional cabling system**
    a. Add single mode fiber cabling to the backbone infrastructure.
    b. Add new copper unshielded twisted-pair (UTP) Category 5e cabling to workstations in renovated areas.
6. **Install centralized fiber optic horizontal cabling (fiber to the workstation) throughout the building** to add flexibility, reduce management costs, and increase bandwidth capability.

2.2 Cabling System Probable Costs

The first three items in the table are recommended without reservation.

For the remaining items, the two right-hand columns offer an **either-or** choice for a cabling system. Elert & Associates recommends the "fiber to the workstation" option.

Task	Fiber to the Workstation	Conventional cabling system
Identify and remove unused cables	$45 per cable	$45 per cable
Install metal conduits in the northeast tunnel	To be determined by EE	To be determined by EE
Pull out backbone cable from northeast tunnel and reinstall into new conduits	$25,000	$25,000
Install 12 single mode fiber optic to each TC	Not needed	$115,000
Cable changes as part of Telecommunication Closet enlargement	Not needed	$180,000
Install security locks at each TC (see also Data Networking section)	Not required, but still recommended if current systems remain in place	To be determined by Architect
Install fiber optic cable to each workstation	$320,000	N/A
New, divided main cross-connect space	To be determined by Architect	N/A
Additional electronics for use with horizontal fiber system	$100 - $150 per workstation (less in future)	N/A

2.3 Voice Backbone Cables

The existing voice backbone (between floors) cables originate from the MPOP that resides on the basement in room B6. The cables are terminated at this room on a cross-connect frame, which is in good condition and could be reused in the future. From the MPOP, the cables are run via the conduit system and free air to the multiple telecommunication closets located on east, west and north wings of the building. Backbone cables are terminated at the telecommunication closets on M-66 blocks. The majority of the cables viewed by Elert & Associates are in a good condition and can be reused in future for voice applications.

2.4 Data Backbone Cables

The existing data backbone for each tenant network was built using multimode 62.5μ fiber optic cable. At the time these cables were installed they were the best choice for the LAN transmission media. Even today, these cables can support Gigabit Ethernet (1,000 Megabits per second) for a distance of 220 meters, which is an optimum distance for building backbones.

However, these cables cannot be used for future applications that will require the transmission speeds of greater than 1,000 Mbps. Thus the installation of single mode fiber optic cable is strongly recommended to each telecommunication closet in addition to the existing multimode cable. Single mode fiber optic cable features almost unlimited bandwidth and will enable any future data and video applications.

During the site inspection, a large amount of old cables was noted to be occupying existing telecommunication pathways. Some of the cables are probably 30 - 40 years old and it is not certain whether the majority of the cables are still being used for telecommunication services. Thus, Elert & Associates recommends verifying which of these cables are in use and pulling out all abandoned cables prior to the installation of new cables to provide a clean, organized and traceable cabling infrastructure.

The backbone cables in the northeast tunnel are run without protection, leaving them open to accidental damage or vandalism, which can cost serious interruption of the telecommunication services. To protect these cables Elert & Associates recommends the exposed backbone cables be pulled out and then placed back in new 4" metal conduits to conceal and protect the cabling.

2.5 Wiring/Telecommunications Closets

A telecommunication closet is a space that supports the cable and equipment necessary for transmission between the building's backbone system and user (station) locations. There are telecommunication closets spread throughout the building on the basement, ground, first, second and third floors. Each tenant has a dedicated LAN run to a dedicated network telecommunications closet. All closets are placed at locations that assure that cable links will not exceed 295 feet (maximum cable length) from the closet to the farthest user station.

However, the actual floor space of the closets varies from closet to closet. The majority of the Telecommunication Closets in the building are of insufficient size to support an extensive list of voice, data, and video equipment. Some telecommunication closets share the space with janitorial supplies. Three closets are located behind bathrooms (one must go through the bathroom to get to the closet). These locations place delicate network electronic equipment too close to water sources. In addition, the locations behind bathrooms make access difficult for people of the opposite gender, and can prevent immediate access in an emergency if someone is using the restroom.

Elert & Associates has observed that none of the telecommunication closets have security locks, which should be installed, to allow access only by authorized personnel.

Although the closets were established in the areas dictated by the building structure and the location of the vertical riser chases, Elert & Associates strongly recommends enlarging the size of the existing telecommunication closets where possible, in areas to be renovated, as well as to dedicate these rooms only for IS use. (Note: this work would not be necessary if centralized horizontal fiber is installed). Proper clearance for telecommunication equipment, lighting and ventilation should also be considered if the closets are enlarged.

Square Foot Area: The size (square footage) of a Telecommunication Closet (TC) should be determined by the size of the area it serves. The following chart indicates industry standards:

Area Served	Closet Size
5000 square feet or less	10' x 7' closet
5000 to 8000 square feet	10' x 9' closet
8000 to 10,000 square feet	10' x 11' closet
10,000 and above	11' x 12'

2.5.1 Other Issues

In Room B6, the Main Point of Presence (MPOP) where the external phone lines and other circuits enter the building, there appears to be no lightning protection on the incoming cables. This is the responsibility of the company/ies (Qwest, etc.) providing those connections, and *should be corrected immediately.*

Further, throughout the building it was noted that firestopping (special material packed into sleeving to help keep fires from spreading) was not present in the cabling system installation. Elert & Associates understands that this is being addressed in all new work in the building, but *recommends an all-inclusive project to close all such openings throughout the building.*

2.6 Horizontal (station) Cabling

A universal building wiring/cabling system is one of the essential building blocks of the information "superhighway", and critical to the support of effective networks. Cabling infrastructure consists of the cables and means of connection to the various types of technology within a building. The capitol building has several existing Category 5 (Cat 5) networks installed from three to six years ago. A majority of the cables placed in the period between 1994 and 1998 are installed according to the industry standards. These cables will support data transmission up to 100 MHz and would be able to serve building needs for several years.

With network requirements changing constantly, it is important to employ a cabling system that can keep up with the demand. For users who currently have Cat 5 installed, the question of whether to deploy higher grade of twisted pair or fiber is pressing. Installed Cat 5 will support only the current generation of LAN speeds (100 Mbps). When the time has come to upgrade the LAN speeds, the cables need to be re-tested to see if they can support Gigabit Ethernet (GbE). If the existing cable will not support the needs, then the building should be re-cabled with higher grade copper cable (Category 6) or optical fiber cable. A Category 6 solution will support up to 1,000 Mbps (Gigabit) Ethernet.

Even though it is unlikely that users will need gigabit speeds to the desktop any time soon, Elert & Associates recommends that the State Capitol look for simple, straight-forward migration paths that will allow its tenants to upgrade their networks incrementally as needed. The days of re-cabling to adopt new networking technologies are past. Today's structured cabling system should provide seamless migration to tomorrow's network services. One media that provides utility-like service is optical fiber.

What value does fiber provide in the horizontal network? Fiber has the largest bandwidth of any available media. Fiber is immune to electromagnetic interference (EMI) and radio frequency interference (RFI). It cannot be tapped easily, so it's very secure. Fiber transmission systems are highly reliable. Network downtime is limited to catastrophic failures such as a cable cut. Soft failures such as loading problems do not affect it. Interference does not affect fiber traffic, and as a result, the number of retransmissions is reduced and network efficiency is increased. Optical fiber traditionally has been viewed as an inherently more expensive option than copper. Today, several factors are bringing the installed first costs of the two media closer together.

The cost of horizontal multimode fiber cable is now comparable to the cost of enhanced twisted pair (Cat 5e) and is lower than Category 6 twisted pair.

Pulling fiber cables now costs less than pulling copper because there are fewer regulatory restrictions regarding fiber cable placement. For example, special conduits or spacing considerations when running next to power lines are not as restrictive when installing fiber optic cabling. The introduction of a new generation of connectors, such as the MT-RJ (AMP), and the LC (Lucent) connectors, also make fiber connection quick and easy. These connectors are small (RJ45 footprint) and can be assembled in the same time as the RJ45.

Thus, we fully expect that fiber to the desktop/workstation will be a reality during the planned 10-year lifetime of this planning project. As such, it would make sense to pull fiber cabling wherever renovations take place.

2.6.1 Centralized Optical Fiber Cabling Design (Recommended)

Based on the proposed changes in the use of spaces at the State Capitol building, Elert & Associates recommends a centralized horizontal fiber cable system.

This centralized optical fiber design offers many benefits, including improved security, fewer points of failure, and reduced telecommunication closets renovation cost. Further, consolidating network electronics, servers, and power sources in a single communication closet greatly simplifies network management, and makes more efficient use of ports.

In this design, all data electronics would be housed in one area/room (the area can be securely divided among the various tenants: Senate, House. AG, Governor's Office, etc.) and fiber cables would provide direct connections to every workstation outlet in the network.

This would be in contrast to the traditional design, where active electronics are currently housed in undersized telecommunication closets all over the building.

The fiber optic centralized cabling is simplicity itself. The main cross-connect (room where the electronics housed) is linked to desktops in one of two ways.

1. Splice cabling to jumper cables in intermediate closets and then link to the desktop.
2. Terminate cabling on passive patch panels at intermediate closets and use jumpers and horizontal fiber cables to connect to the desktop.

Passive patch panels require little real estate. Also, unlike intermediate distribution frames containing active electronics, passive patch panels require no power, air-conditioning or grounding.

In areas not to be renovated, fiber would be installed alongside the existing copper cabling, which would not be removed and could continue to be used until the various tenants are ready to phase in the fiber system. This is also the case with current copper voice cabling. Eventually we foresee voice communications becoming part of the "data" network through a technology known as Voice Over Internet Protocol (VOIP), but until that is widely accepted, the tenants of the Capitol can continue to use the existing copper cabling.

The one drawback to this design is the additional cost for opto-electronic devices (switch ports and network interface cards with fiber connections.) In absolute terms, the end-user is likely to pay $100-$150 more per port. As volume rises, the price differential will decrease, thus one can expect a per-port premium of only $25-$50 for fiber in a few years.

3 Voice Services and Telecommuting

There are many different agencies represented within the State Capitol. The state InterTechnologies Group (InterTech) is the entity that supplies these different agencies with voice and data services, however they don't supply hardware to the agencies. InterTech supplies PBX-based phone service (lines and features) and also voicemail services under the State contract. It is important that any agency that needs service, contact InterTech for its needs. As the technology field is changing, InterTech is also changing to keep current, so it is able to offer the most effective and productive services available.

3.1 Guidelines

Each of the agencies within the State Capital has its own set of guidelines to follow for service. It is important that each agency follows those guidelines. InterTech is aware of the guidelines and provides the information needed to best provide service to the agencies. If an agency is requesting new service or hardware, there are vendors that can be contracted for hardware under the State contract. Their line service must be through InterTech.

3.2 Reduce Impact During Construction Phases

It is important to keep the service working during construction phases, and one of the biggest obstacles in construction is cabling. The State Capital's cable infrastructure is very difficult to route and locate. It is important to keep phone service and data networks functioning. In the State Capital the telephones can work because of the State Centrex system. This system allows the user to move within the building or outside of the building and still be able to retain the same number and continue the four-digit dialing.

3.3 Telecommuting

InterTech does provide the service for Telecommuters, but it is up to each agency to set up its own guidelines for telecommuting. Each agency will use the State Centrex according to the guideline they need to follow.

3.4 Future Services

Telecommunications and data networks are continually changing everyday, and InterTech is also continually enhancing its services to keep up with the way technology is moving. They continue to offer state of the art services and plan on doing so in the future. They are the driving force for the state agencies.

3.5 InterTech's Service Direction

The Technology Policy Bureau is the basis for the direction of technology for the future. This information is found in the "Master Plan for Information and Communications Technology in Minnesota". Being the service agency, InterTech's goals and strategies are intertwined with the "Master Plan". InterTech has taken its client's needs into consideration and is making a great effort in making sure it is offering the best services to meet its client's needs. Its network and service document includes information on the following services:

- Voice Services
- Data Services
- Video Services
- Network Management
- Support Services

For more information, InterTech's master plan is available at www.mainserver.state.mn.us/intertech/directions.html

3.6 Recommendation

It is the opinion of Elert & Associates that InterTech is now providing the best voice service to meet the needs of the various State agencies housed in the Capitol building, and that those groups should continue using InterTechnologies to provide quality voice services.

4 Data Networking Systems

Due to the number and variety of organizations that are housed (or partially housed) in the State Capitol Building, there are multiple separate data networks in place. Thus there is some duplication of equipment and systems.

However, from a network security standpoint, keeping networks separate is advantageous. Based on the variety of user groups in the Capitol building it makes sense to have distinct networks. This is comparable to a commercial office building where each tenant would have its own network.

The only two points where there is equipment for multiple tenants in the same location are the MPOP location (Room B6) and Room B18.

Each of the tenants has its own network run by internal personnel. All of these tenants do however utilize the services of the state InterTechnologies Group (also known as Inter Tech) to connect to the "outside world."

A router situated in Room G3 specifically handles all *legislative* traffic that leaves the building. The Senate Information Systems group maintains that router. Other tenants have similar arrangements, but may be connected by fiber to routers in different buildings.

4.1 Senate

Since the Senate occupies approximately 70% of the space within the building, we paid special attention to its network systems. Mr. Jim Greenwalt and his staff assisted in our inquiries.

4.1.1 Current Systems and Services

The Senate upgraded its infrastructure cabling for voice and data in 1998, and added or upgraded data network equipment at the same time.

The core or main device for the Senate network is a 3Com brand CoreBuilder 7000 switch that is located in the main computer equipment room G3. From here, fiber optic cabling connects to the MPOP and from there it is distributed to multiple Telecommunications Closets throughout the Senate areas of the building. 155 Mbps ATM traffic is sent over these cables to the TCs. Each of the TCs contains switches that take in the 155 Mbps signal and distribute it to the various users in the area served by that closet. End user ports are mostly 100 Mbps switched Ethernet, but there are also a few shared hubs in specific locations. All switches are 3Com brand; hubs are Hewlett-Packard brand. There are UPS systems in each closet housing Senate data equipment.

The CoreBuilder in G3 also connects to another CoreBuilder in the State Office Building. That switch serves the minority offices located there.

A fiber optic feed from the Senate video control room to InterTech, allows the distribution of unicast and multicast streaming video (video over the Internet) to be used when desired.

Video from within the building is sometimes multicast over the legislative network, but only within the Legislative Intranet. This means that multiple simultaneous Senate users can view live video on their computer screens.

A Citrix brand MetaFrame system with four dial-in lines is used to provide remote/telecommuting connectivity for Senators and authorized staff members.

With the exception of the payroll, financial and human resources applications, which run on an AS/400 in the Fiscal Analysis area, the applications used by the Senate are hosted on seven Intel-compatible servers located in six locked cabinets in Equipment Room G3.

4.1.2 Current Problems/Issues

1. The main equipment room (G3) is not a secured area, and in fact part of it is used as a hallway. While the Senate attempts to have a staff member at the Help Desk who can see those who enter, this person's main function is to respond to requests for help, not monitor the area. Although the cabinets are locked, it wouldn't take much effort for a determined intruder to enter those cabinets and potentially thoroughly decimate the servers.

   Recommendation: if G3 is to remain the main computer room for the Senate, it should be secured in some way, and not part of a traffic pathway.

2. Some of the technology closets in which network switches are housed are often left unlocked. Someone could very easily either inadvertently or purposely damage the cabling and switches, and/or attach a network analysis "sniffer" device to copy traffic sent over the network.

   Recommendation: We understand the building is to be re-keyed soon. At that time, the technology closets should be keyed alike (to each other), but differently than all other spaces. Then only specifically authorized staff members should be entrusted with keys.

   Another option to secure these rooms is the use of biometric (voice recognition, fingerprint or retinal scanner) devices.

   This implies that a single organization be responsible for the closets – logically this would be either Plant Management or Capitol Security. The chosen department could provide ongoing access to authorized IS personnel, and allow access to others only on an as-needed basis.

3. Some of the TCs are also used as storage for supplies and janitorial equipment. The potential for damage (from dust and liquids) to these expensive devices is high.

   Recommendation: A policy should be put in place stating that designated technology closets are not to be used for storage.

4. The electrical power to Room G3 is only partially conditioned. This means that systems in that room are more subject to power supply failure and that more expensive line-conditioning uninterruptible power supply (UPS) systems must be used. [We understand this issue will be resolved when the new electrical systems for the building are brought online.]

5. As a procedural matter, it appears as though all backup tapes for not only the Senate, but also the House and the Revisor of Statutes Office are stored in a single fire-resistant cabinet in Room G3.

   Recommendation: If they are not already doing so, we suggest these groups use off-site archival storage in addition to this.

4.1.3 Future Issues/Technologies

1. The Senate IS group is concerned about potentially higher future bandwidth needs. Streaming video is likely to become much more popular in the near future, and would place heavy demands on the network. Further, they are also aware that 3Com is no longer manufacturing higher end switches, and thus that the Senate may need something different to be able to provide Gigabit (1,000 Mbps) connectivity in the future.

   Recommendations: Use network management tools (such as 3Com Transcend) to monitor traffic levels and types.

   When streaming video and audio become more prevalent, replace the core switch with one that has a larger capacity, and add Gigabit modules to the TC switches. Current front-running brands are Cisco Systems, Foundry Networks, and Extreme Networks.

2. The Senate is currently exploring options for archiving audio-only or audio/video recordings to digital format. If this is implemented it implies the need for a means of long-term digital storage, and for a fast network connection to that system, because it will also need to be retrieved.

   Recommendation: continue investigating potential choices, with emphasis on hierarchical file storage (HFS) systems to ensure that data is readily retrievable.

3. Another potential initiative is the use of biometric authentication[2] for entry systems to certain areas and for secure access to laptop computers. At door/entry locations, this would require cabling.

   Recommendation: Systems such as this should always be part of an overall plan[3]. Therefore the first step is to identify where these systems are needed and/or would be used. Next wiring pathways should be designed. With that done, we then suggest retaining a security consulting firm to make specific recommendations for equipment and to project costs.

4.2 House

The House IS group supports 30 desktop computer systems at the Capitol building as well as 134 laptops carried by House members. Those laptops are frequently used in the House chamber (floor).

Three of the Technology Closets in the building contain the network equipment for the House. The backbone among these closets is 100 Mbps over fiber (100Base FX). Each of the closets houses at least one switch and from 3-12 hubs for end user ports, depending on end user needs (the 12 hub configuration serves the House Chamber and surrounding spaces.) Switches are new within the year, while the hubs are up to five years old. The IS group intends to replace all hubs as soon as possible.

There are no file/print servers at the Capitol building for the House. However, there are NT Servers in the House video control area. These are part of a new Internet-based video system (where web users can go to a specific web address and view live video from the House floor). This system is to be used throughout each session. Live video of House proceedings will be fed into a system (an Encoder) that translates it into a digital format. This signal is then sent via ISDN circuit to a provider who will make it available on the web.

This is in addition to the current multicast system that is for use only within the Capitol.

The House IS group would like to be able to provide screens/PC's embedded into the desks in the House Chamber. This would save House members the need to carry laptops back and forth to that room.

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2 Biometric authentication maps some part of the human body to use as a security validation. Some examples are fingerprint ID, retinal scanners and voice recognition. Fingerprint ID systems have become quite feasible and reliable recently. Systems to attach to laptop computers cost as little as $100 per unit, but installation takes some time and expertise.

3 Note: the Senate Information Systems department is currently re-writing its security policies and procedures, but any biometric initiative should be worked through in cooperation with Capitol Security, as well as the other tenants.

The House shares with the Senate and the Revisor of Statutes Office, an Internet link through InterTech.

There are no specific recommendations for the House data networking system.

4.3 Governor's Office

This office has a rather surprisingly large number of network ports – 96 – half of which are shared hubs, and the other half switches. Nearly all the ports are filled, but unless the Governor's office space were expanded physically, there would be little chance of growth in the port count, because of the current density.

Network cabling is sufficient to the current needs for the office areas. There is no cabling in the public areas due to a need to preserve the historic aspect. If networking were required in those spaces in the future, it may be possible to use an 802.11b wireless data system with the access point located in one of the adjacent office areas.

The connection to the outside world is a 384 Kbps channel out of a fiber connection to InterTech.

This office has three Windows NT-based servers running email, an advanced constituent database, and a web based front-end for that database.

This office used the InterTech connection to provide a streaming video version of last year's State of the State address.

There are no specific data networking recommendations for this area.

4.4 Attorney General's Office

This tenant has 24 workstations on its local network, plus several printers. These are attached to a newer 48-port Cisco System switch (model 3548.) One server here is a Windows NT backup domain controller (BDC).

All the data equipment for this area is located in a locked cabinet in a hallway of the area. This then constitutes the Attorney General's Office technology closet (TC) in this building.

There is now no fiber from the MPOP (B18) to this cabinet, but the AGO intends to add 12 multimode fibers in the near future.

New data (and voice) Category 5 cabling was just installed in 2000 and includes two data jacks to each outlet.

The AGO owns a firewall and router, which currently are located at the Capitol and attach to an InterTech router in B18. AGO intends to move these systems to its 525 Park office building, and connect via a new 24-strand fiber cable back to the State Capitol building (this fiber is planned, but not yet installed.) After the fiber is put in place, the Internet connection would be moved either to the DOT building or the Centennial Office building. Thus, the AGO TC at the Capitol would essentially be just another technology closet from the 525 Park building.

Future technology uses may include streaming video for training and/or orientation purposes, and Voice over IP (VoIP.) Based on the planned network, implementing either or both of these should be quite feasible.

4.5 Media (press)

This tenant is not one cohesive group as the others are, and is also somewhat outside the organization. There are also two subdivisions within this group - the metro area companies and those from greater Minnesota. The latter are not on-site throughout the year. These factors make it difficult to provision services.

Currently the media representatives who need data network connectivity use phone modems to connect either to the Internet or to their respective office/company networks. This ties up existing phone lines or requires additional lines.

For competitive reasons, it would be unlikely for the various media tenants to cooperate on a shared network infrastructure, thus an outsourced solution such as DSL is a good option.

For this reason, the Senate IS department recently informed media users of the cost and means to obtain Digital Subscriber Line (DSL) services for Internet connectivity. This would use existing phone wiring and thus not require new network cabling. The benefit is faster Internet access (from 128 Kbps to 1,540 Kbps, depending on cabling facilities and what the tenants are willing to pay.)

Please note however, that if the Media area were moved or renovated, we do recommend local (in-building) data cabling be installed, which could then be leased to the various tenants, as needed. Each tenant can then provide its own switch or hub for internal connectivity.

4.6 Capitol Security

Linc Starkey who is an employee of the Department of Administration, but is stationed in the Capitol Security area, oversees all of the computerized automation systems for the Capitol building. These include the automated fire management system, heating/ventilation/air conditioning (HVAC) system, and access control (door locks/security systems.)

These automated systems are set up as separate networks for reliability and security reasons. These systems do not require interfaces to other networks in the Capitol. Each runs mostly on fiber optic cabling. New proximity readers[4] are being installed for door access control – these same systems are used throughout the Capitol complex. Tenants' ID cards include programmed information as to which doors those users are allowed to open.

Mr. Starkey requested that in any renovation in the building, his group be consulted as to pathways for fiber cabling for automated systems.

With regard to Capitol Security/Public Safety as in internal building tenant, their group just moved to a newly renovated area. That space has network cabling that meets all current standards.

4.7 Revisor of Statutes

The Revisor's office has a network that was installed in 1997, based on Nortel Networks (formerly Bay Networks) equipment. This network uses a combination of two 155 Mbps ATM links to connect to the State Office Building, and multiple 100 Mbps Fast Ethernet to connect to Technology Closets within the Capitol building. It uses some of the multimode fiber in the backbone to connect switches in five different closets. All end user ports are 10/100 switched Ethernet.

This network should be usable for another two years or so, after which the electronic components will begin to require replacement. At that time, the likely needs will continue to be 100 Mbps at the desktop, but with greater bandwidth in the backbone. The probable technology to use at that point would be either Gigabit Ethernet or its upcoming big brother 10 Gigabit Ethernet. Current prices for Gigabit Ethernet run roughly $800 per port, but in two years that will likely be around $500. This is would be easily cost justifiable for the amount of bandwidth.

4.8 Minnesota Historical Society

Currently MHS has three networked users in the building. These are connected back the main MHS facility via an ISDN line from InterTech. To provide the best possible throughput, users have access to some internal applications via Citrix MetaFrame.

[4] A card-based system where the card needs only to be near the reader to operate. Cards can be kept in clothing, wallet or purse and still activate the mechanism.

The network needs for MHS would increase greatly if more of the building were to be used for ceremonial and exhibit areas. Potential FTEs would increase from 4.3 (plus 21 site guides) to 10.75, plus additional resale clerks, volunteers (15) and site guides (30 – currently 15.) It is difficult to predict all the new data needs for this organization due to the unknowns about space. Certainly some cabling and network ports would be needed for any new cash register (point of sale) systems, as well as to any additional stationary desk/office areas.

We are unable to estimate technology systems and costs for potential new exhibit areas since that can vary so widely[5]. It would be possible to provide recommendations and estimates after MHS has generated tentative plans for exhibit areas.

4.9 Judicial

The Supreme Court areas in the Capitol do not currently include any data networking capabilities.

There is a desire in the fairly near future to be able to allow presentation of evidence via PowerPoint presentations and similar technologies. This would not typically require a network connection, but can be done as a stand-alone system.

However, another future request is for network connections at the Bench, the Counsel tables, and the center lectern. Due to the physical nature of the room, the only viable option for this space is wireless networking. If this were done in the near future, the technology to use is 802.11b (11 Mbps maximum.) The room would likely require two access points, plus each laptop or computer to be connected would need a special wireless interface card.

Cost per computer is approximately $250, while the access points should cost ~$1,200 each. For a potential 20 simultaneous users, this would *total $7,400*. The *useful lifetime of this technology is approximately three years*, after which it should be reviewed for potential upgrade or replacement.

Should the justices wish to communicate with their offices, this network should be tied to the Judiciary building's network. This could be accomplished either via a routed connection provided by the InterTechnologies Group, or via installation of a direct fiber connection through the tunnels between the buildings. This could be part of or follow the same path as the fiber currently used for video/audio feeds between the buildings.

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5 As we have seen in our experience at the Science Museum of Minnesota and the new (under construction) St. Anthony Falls Heritage Center, which is also part of the Minnesota Historical Society.

5 Video/Multimedia/Sound Systems

5.1 *Senate Video/Television*

Facilities currently set up for providing content over the dedicated internal Radio Frequency (RF) channels and to remote feeds such as Twin Cities Public Television (TPT) and the Department of Administration for web streaming.

5.1.1 B29 – Control system for 16 cameras located in four rooms (Senate Chamber, 107, 112, 15).

The system is in the midst of transition from analog to digital television technology. Besides equipment issues (future procurement of additional digital signal routing, switching, processing and monitoring), the major architectural technology issue is one of cabling. While all of the cameras are digital-ready, much of the cabling between the hearing rooms and the control room is not. There is some discussion in the industry of whether the particular cable (Belden 8281) may be functional with digital at some level, but *replacement of non-digital-capable cabling should be a priority* and should be coordinated with the larger re-cabling efforts, as well as with a view towards wider video interconnection between spaces. Most of the cabling within B29 is already digital-ready.

5.1.2 Room G4

The Senate studio has significant architectural technology issues. The entire system is currently wired with non-digital-ready cable. The acoustical treatment of the room consists of acoustical foam squares haphazardly stuck to the walls. The overall effect (acoustically and aesthetically) is less than what is normally desired for a room of this type. There is a significant amount of mechanical noise, which impairs the production quality in the room. The lighting system creates a great deal of heat, which is insufficiently handled by the HVAC system. The current high-volume system causes "rushing" air sounds, which necessitates turning the system down during production, when it is needed most due to the lights.

Solutions for this space could include:

- Relocating the Studio function to a space with less mechanical noise
- Relocating the nearby equipment that is causing the mechanical noise
- Providing proper acoustical treatments to the walls
- Replacing the current incandescent lighting with studio florescent lighting for greater energy and thermal efficiency

- Exploring whether the ceiling can be raised to allow more space for the grid, which hangs lower than normal for a room of this type.
- Replace failing HVAC system with one that operates with less noise and can be run during normal studio operations.

The equipment in the Studio and adjacent control room is analog and will likely need to be replaced in the next 10 years. The longer the wait, the greater the costs associated with equipment maintenance and downtime. All of the existing components are analog and most will need to be replaced by digital components.

The existing furniture console in the studio control room should be replaced to accommodate the different configurations of digital equipment and to provide better ergonomics for the users.

The Sound Booth in the space also has serious mechanical noise issues. Part of these could be addressed by relocating the flag pole, which is taller than the ceiling and has caused a ceiling tile to be removed to accommodate its full height and therefore has compromised the noise blocking function of the drop ceiling.

The Editing Suite in this space is currently used for equipment and box storage. This space could be put to better use. The Senate Media Services staff expressed the need for having a space where they could receive, store, and service their equipment. This proposed space would have a workbench area with tool/instrument storage and proper shelving for safely storing equipment that has been received or waiting for service. The Editing Suite might be good site for this function.

5.2 Hearing Rooms

5.2.1 Room 15

This Hearing Room has needs in the area of sound reinforcement and presentation technology. The current sound system needs to be made more reliable, according to Senate Media Services. While the existing Shure AMS system has proven to be effective in meeting the needs of the Senate, newer systems may provide additional benefits while meeting the high performance expectations established by the AMS system.

From an architectural technology standpoint, the main area of interest is in visual presentation. Currently, the witness/presenter(s) sits at a wide, deep desk, upon which two microphones sit. These are connected to floor pocket jacks underneath the desk. There is no provided technology to facilitate visual presentations (computers, media players, etc.), nor is there any permanent display technology that allows Senators or audience members to see what is being presented. Currently, a portable screen and projector is set up beside the presenter's desk to enable the Senators to see the presentation. The Senate TV system is then forced to try to focus a camera on the screen to get the image to the viewers (highly unsatisfactory).

One approach to the presenter location would be to either supplement or replace the existing desk with a technology-friendly and suitably attractive furniture piece that would accommodate equipment such as a document camera, dedicated presentation PC, Laptop interface connection (network, graphics, video, audio), and other devices to accommodate transportable media. The cabling requirements for this presentation station would require the addition of floor pockets or boxes, with space to accommodate at least a two-gang plate of A/V connectors and preferably up to a four-gang plate. The cable pathways would need to extend to the sound system, to the Senate Media control room (B29), to the nearest TC, and to the location of the local room displays. All of the video cable provision should be digital-ready.

There are many ways to display the information to the Senators in attendance. The common requirement for these methods is that the size of the image must be in correct proportion to the distance from the image to the viewer to allow the detail of the image to be perceived by the viewer. If the image is small, the distance must be also small. If the distance is large, then the image must also be large.

Looking at the room from a functional perspective, using a large-screen projected image has several disadvantages; the largest being that the lights must be turned down to avoid washing out the color on the screen. A large screen can also block the view of cameras and/or members of the audience. The screen must be large in order to clearly show detail to the Senators seated furthest from the screen.

Medium-sized monitors are often used in legislative and deliberative spaces. They are often mounted from the ceiling or close to the floor to prevent interrupting sightlines of cameras or the audience, as a large projection screen would do. In this room, flat-panel monitors could be hung underneath the air vents between the columns around the room. This would not block sightlines, but might require the use of flat-panel monitors, which in their present state of technological development offer some challenges that will be addressed later in this report. Mounting monitors on moveable carts near the floor is an option, but this tends to cause visual and physical clutter in the room, and would restrict wheel chair access both due to the physical size of the monitors and the cables that would be stretched across the floor.

Small sized displays are an excellent option for a number of reasons. They typically do not cause sightline issues, they can be concealed within furniture or casework, they are close enough to the viewer that all of the relevant detail can be easily seen, even by those without a current prescription. The disadvantages to deploying small monitors up-close include forcing viewer to look down to see their displays, which can appear on a camera mounted above the view as looking inattentive or drowsy, and that the monitors compete for space with papers, books, folders, and other materials brought in by the Senator.

An option that is currently not quite practicable but may be so in a few years is using the laptop screen displays of the Senators as a tool to view presentations. Video and graphics that are streamed through Internet, WAN or LAN will likely replace direct analog connections within the next 10 years. *This means may prove to be the most efficient way of getting a viewable presentation in front of each Senator without adding clutter, cables, or cost.*

To provide the connectivity, some sort of wired interface would likely be necessary for two reasons. First, streaming video consumes more bandwidth than envisioned wireless systems can support, especially considering the number of users that would be operating simultaneously in the space. Second, the laptops would likely a need power source and therefore some sort of cabling must be brought to the top of the desk. One solution could be a "pop-up" interface that is flush with the tabletop until activated by a light press or touch. The interface would then rise to two or three inches above the desk (itself only a few inches wide and deep) and expose network, power, audio and video connectivity.

The presented images would need to be provided to the Senate television system for broadcast. This could be done either through direct analog connection using scan converter technology where appropriate or through the same future streaming technology used to supply images to the Senator's portable computers.

Thought would still need to be given for how the audience would see the presented images. In Room 15, based on the seating patterns, it would be difficult to provide adequately sized images to each audience member. The most efficient strategy may be to use a combination of technologies, commensurate to the importance to the Senate of providing the presentation visuals to the audience.

The lighting in Room 15 is low and warm from a video perspective, but within the specifications for the cameras that are currently installed. More lighting would be better from the video production perspective, but that would need to be part of a major reworking of the ceiling to be effective.

5.2.2 Room 112

This hearing room shares many of the same issues of sound reinforcement and visual presentation as Room 15. The primary difference from the visual presentation perspective is that the Senators seated along the table face each other and look down the table in a perpendicular fashion towards the presenter(s), unlike in 15 where each Senator faces the presenter(s) more directly due to the curve of the table.

This seating difference is important when consideration is given to where Senators are looking during a presentation. It can be expected that in Room15, if the laptops are used as a display device, that Senators would look at the presenter directly (straight ahead) and at their laptop (straight ahead and down). In 112, there is very limited space between the pillar and the presenter's desk. Hanging a screen from the ceiling over the presenter's desk would be inadvisable due to aesthetic and lighting factors. Other options would include hanging flat panel monitors from the pillars, but this would have Senators looking up at the monitors high above them on the pillars on the other side of the table from them, while turning nearly ninety degrees to their left or right to see the presenter. Not all of the Senators at the table would have a monitor in their field of view that would provide an adequate image. Also, Senate Media Services has expressed concern that this approach might interfere with sightlines of the cameras.

Once again, the small, close monitor would seem to be the best approach, given the sightline issues. The alternatives would be to build monitors into the table (requiring extensive casework to be done on a very exquisite piece) or relying on future streaming technologies to connect with the Senator's laptops. This last approach would seem to provide the best viewing angles, as Senators could adjust the position and angle of their laptops to be slightly "down-table" and reduce the amount of craning of necks necessary to see both the presenter and the presented images.

The physical changes necessary for these types of systems would be a connection point in the floor underneath the presenter's desk for the medias that are being presented, and provision in the hearing room table for network connectivity (power and network).

The video production element most needing change in Room 112 is the windows. Direct sunlight in the mornings can make certain camera shots of Senators highly undesirable due to the significant difference in brightness and color temperature between room lighting and natural sunlight.

This could be corrected using blinds that would eliminate or reduce the direct and indirect sunlight to levels that can be adequately compensated for by the cameras.

5.2.3 Room 107

The layout and challenges of the room mirror those of Room 112. The main difference is that the afternoon sun causes problems for certain camera shots.

5.2.4 Room 125

This conference room would require extensive technology work to bring it up to a usable level for broadcast and presentation purposes. In particular, the audio system needs to be redone, as the current system shows frayed, ragged bare wires sticking through pieces of carpet. In conjunction with adding cameras, extensive window treatments would be necessary to ensure proper camera function. This room has been identified by Senate Media Services as having cabling for video but has no cameras at this time.

Presentation technology would have many of the same issues and solutions as the previous conference rooms, but the sightlines are better for a large-screen projection type display than 15, 107, and 112, should a large projection screen be desired.

5.2.5 Room 123

This conference room would require both extensive architectural and technology work to become a usable space for broadcast and presentation purposes. The existing lighting grid is completely unusable for video broadcasts and would need to be replaced. The existing screen is also unusable. This room has been identified by Senate Media Services as not having cable installed for cameras.

Presentation technology would have many of the same issues and solutions as the previous conference rooms, but the sightlines are better for a large-screen projection type display than 15, 107, and 112, should a large projection screen be desired.

5.3 Senate Chamber

The single biggest problem in the Senate chamber is that some members cannot hear each other when speaking from their desks. The reason for this is that while each Senator has their own microphone, the speakers are in the ceiling along the base of the dome. This arrangement causes the audio to have a strong echo factor and can be unintelligible to listeners.

The system in the House chambers has successfully addressed this problem by adopting a distributed-delay mix-minus system wherein the speakers are located at each individual desk. This arrangement greatly increases intelligibility, which along with gain-before-feedback are the benchmarks by which sounds systems of this type are measured. An adoption of a similar system would solve the intelligibility issues associated with having the speakers so far away from and above the intended audience. Advances in digital signal processing technology have made the integration of this type of system much simpler than when the House system was designed.

Note: a study was commissioned in January 2001 to review audio issues, including sound reinforcement, in the Senate Chamber. This study is to be completed in Spring 2001.

The lighting in the Senate chamber is insufficient for optimal video camera performance. Careful study should be given to how (and if) additional base lighting that is not objectionable could be integrated into the room. This could be as straightforward as increasing the wattage of the existing fixtures or adding additional ones. More lighting would make the Senators look better on camera.

5.4 Minnesota Supreme Court

Two primary multimedia technology needs have been identified for the Supreme Court's Capitol spaces. These needs are the Supreme Court Courtroom Chamber and the Video Broadcast System.

5.4.1 Supreme Court Courtroom/Chamber

The courtroom **audio system** needs to be upgraded to provide better quality sound and more reliable performance. Modern courtroom audio design includes such features as active sound masking for bench conferences, dual language translation systems and distributed speakers built into the furniture in the courtroom. The format of cases heard before the court and the historical nature of the room may make these features unnecessary and the extensive cabling burdensome to provide. The sound system might be better modeled on those of a top-quality deliberative hearing room rather than a modern high-technology criminal or civil court.

The existing **recording system** is in need of replacement. This new recording system may require multiple channels of inputs for recording, which may affect the design of the overall audio system based on the need to have separate channels for different groups of microphones. Whether this is necessary must be determined by the specific recording needs of the court. The recording signal(s) would exclude any sound masking and include all aspects of the proceedings, ideally even where participants have inadvertently moved away from their microphones when speaking. The format of the recording input must be compatible with the selected recording equipment (analog versus digital).

PowerPoint and video **presentations** are likely best presented with portable equipment rather than building this technology into the architecture in this room, based on the amount of use and the multiple purposes that the room is used for. There are portable systems designed specifically for courtroom use that are self-contained and simple to use. The only required permanent provisions for these cart-based units are computer network jack(s) and electrical power.

A request from Supreme Court staff was made for a replacement **timing system**. The timer system alerts the presenter that their time has expired. This could be designed as part of an integrated control system or done as a separate stand-alone system using any of a range of products designed for this purpose.

Another request is with regards to a "**panic button**" which is installed at the front of the courtroom. The request is that an additional or parallel-wired switch or button be added to the Marshall's table, along with a telephone jack connection. This would enhance the security of the proceedings.

5.4.2 Supreme Court Video Broadcast System

The type of feed that comes out of the Supreme Court area should be compatible in type with those provided from the other areas within the Capitol. This means that the systems in this area need to migrate from analog to digital as the other systems are upgraded.

A request was made to add three voice-activated/tracking cameras to the courtroom for use in broadcasts. Camera housings should be designed with a specific camera technology in mind, be it cameras similar in quality to those in the House and Senate Hearing rooms or something different. The question of whether to execute manual camera operations, such as done by the House and Senate, or automatic or voice-tracking is largely a function of staffing and budgets.

The PowerPoint and video presentations made in the Supreme Court Courtroom Chamber also need to be provided in a high-quality format to the video broadcast system. This will ensure that viewers would be able to see the visuals accompanying the presentation, not just the presenter and the reactions of the audience.

Lighting levels and color temperatures might need adjustment to optimize camera performance.

The video feed from the Supreme Court to the Judicial Center runs through the Senate Media control room, where the interface equipment is exposed to accidental contact (kicking) and has experienced several disconnections as a result of this arrangement. It has been requested that this equipment be relocated and made secure from accidental contact or damage.

5.4.3 Attorney General

If multimedia presentations are to be integrated with press conferences and other functions where video is being broadcast, then the optimal technology solution would be to have the presentation elements integrated with the lighting and video systems under a single control interface, such as the touch panels used in the House hearing rooms. Equipment should be similar in function and operation to equipment used by the AG office in other locations to minimize operator training needs.

5.5 House Television Services

There are some infrastructure issues with the existing facilities that merit attention. These were addressed in the survey submitted to Miller Dunwiddie by House Television Services.

A long-term need has been expressed by House Television Services for a production studio, possibly to be located in Room 317B. Converting this room into a proper video production studio facility would require lighting, HVAC, wall treatments/curtains, staffing and equipment changes. It is the intention of House Television Services to use this studio to produce programming that is in addition to the committee coverage that is currently produced.

Please also see "Expansion space Considerations - Television/Media Production Spaces".

5.6 Wireless Audio Systems

Two types of wireless audio systems are used in the Capitol's hearing rooms. The first type is **wireless microphones**. While the use of wireless microphones is commonplace in presentation and video production environments, there are two issues that need to be addressed from a technology perspective as systems are maintained or modified.

The first issue with wireless microphones is interference from other wireless microphones. This happens when a single receiver picks up two or more transmitters operating on the same frequency. With the number of groups using the Capitol building potentially growing and the separate media departments making individual purchasing decisions, *an overall plan for allocating frequencies is essential* to prevent interference and unintended (and potentially embarrassing) pickup and amplification in the wrong spaces and to the wrong audiences.

The second issue with wireless microphones is interference with other sources. A transmitting source does not need to be on the same frequency to cause interference problems. An 800-MHz receiver can be sensitive to interference from transmissions at 1600 MHz, 400 MHz, 200 MHz, 100 MHz, and so on. This means that other transmission sources such as security radios, radio dispatch centers, cell phones, walkie-talkies used by maintenance or construction crews, taxi radios, and other RF traffic can cause potential problems. In addition, some new DTV broadcast frequencies may cause interference with existing wireless frequencies, causing problems with systems that have worked satisfactorily until the DTV broadcasts begin.

The second type of wireless audio system used in the Capitol is **assistive listening systems**. These allow people with hearing impairment to be able to clearly hear the proceedings by having their own volume adjustment that does not affect the people next to them. They also can be used for tour groups. These systems fall into two general categories: RF and IR.

RF, or radio frequency system, rely on broadcasting on a frequency that can have interference problems caused by the factors listed above. The main strength of RF systems is that they work even when the user is seated behind a pillar or behind several rows of standing or seated audience members. RF systems are also susceptible to "snooping" by anyone with a handheld radio scanner. This is significant if a deliberative body is meeting in closed session and one of the members is using an RF assistive listening system, or the system is left on when nobody is listening. The entire proceedings are being broadcast up to a quarter mile away over the open airwaves for anyone to intercept.

IR systems, or infrared, rely on using invisible light to transmit the audio signal to the system user. The main difficulty with this type of system is that it operates on a line-of-sight basis from the emitter to the receiver. The spaces in the Capitol that have pillars or other obstructions make using IR a dicey proposition. Exterior windows and certain florescent light fixtures can also create problems with IR systems.

> *Recommendation*: The use of RF wireless microphones and assistive listening devices makes frequency spectrum allocation a critical part of any technology plans. All of the users of these systems within the building need to coordinate their equipment with those of Capitol Security, the IT departments of the various groups using the building, and any other group, organization, company, contractor, or entity that is broadcasting in the RF spectrum.

5.7 House Hearing Room Technology

It has been suggested that the newly renovated House hearing rooms in the State Office Building serve as models for deploying high-quality audio and video presentation technology for the Senate. In evaluating the design of any audio/visual system, several key questions need to be asked.

1. Can everyone hear each other?
2. Can everyone see each other?
3. Can everyone see the visual presentations?
4. Will the system be simple to operate?
5. Will the system be functional for an extended period of time?

My evaluation of these systems is based on examining the original plans and RFP, as well as a walkthrough with the Director of House Television Services.

Question One: "Can everyone hear each other?" There was no meeting in progress during my visits so this could not be judged. The provision and location of microphones indicates that thought has been given to picking up House members seated in the center of the horseshoe tables even when they are turned around in their seats. This is intended to be accomplished by using hanging microphones. While this does not greatly affect the ability of the people in the room to hear, this provision ensures that the television broadcast feed includes those members that have turned in their seats.

In reality, this approach has proven to be unsatisfactory and is not recommended for future installations. In addition, the moveable gooseneck microphones have proven to be problematic by introducing a great deal of movement and handling noise into the broadcast signal. The problem is serious enough that House Television Services is investigating the option of reverting to the old "iron mounts", which consist of an immobile L-shaped bracket that hold the microphone in the face of the speaker.

Question Two: "Can everyone see each other?" The room layout of the House Hearing rooms, with the audience seated either in sloped seating on either side of the Representatives or in sloped seating in front of the members ensures excellent sightlines of the entire body. There are no substantial pillars or other obstructions such as are found in the current Senate hearing rooms. This is more of an architectural and room layout question than a technology one, although the installation of large projection screens can easily hinder sightlines in a large room.

Question Three: "Can everyone see the visual presentations?" The answer here is unequivocally "No". The primary means of image display in all but one of the rooms is via gas plasma monitors. These 42" diagonal monitors are less than 6" thick and have the wide screen 16:9 aspect, which gives them a futuristic appearance. This wide screen aspect, together with the "native" resolution of the displays, limits their ability to serve the function for which they were intended.

A 42" diagonal image in a 16:9 aspect ratio (width to height) is only 21" high. Since image height is the dimension most often correlated with calculating the effective distance between the screen and the viewer, this 21" dimension is extremely critical. It yields an effective viewing distance for meeting participants of average eyesight looking at PowerPoint-type graphics of approximately 10.5'. For extremely detailed images, such as spreadsheet information, this effective distance drops to 7'. In this space, the monitors are serving House members seated up to 20' or more away from the screens. Those who design future Senate Hearing room systems should strive to ensure that all of the displays are suitably sized and placed such that all Senators can clearly see the information being presented.

The second limitation of this display technology is the "native" resolution, or the actual number of pixels (picture elements) in the display. The monitors used by the House have a native resolution of 852x480. Most of the computers that will be used with this system have a native resolution of 800x600 (and in the future will increase to 1024x768 and higher). Because the computer input signal has a larger number of vertical pixels than can be displayed on the monitor, the monitor compresses the image by eliminating pixels. The eliminated pixels make the image less readable; for example, imagine a spreadsheet where a decimal point disappears, or an 8 becomes a 0. As computer display resolutions increase, the problems associated with image compression will grow. The distances over which the viewers are trying to see the monitors also exacerbates this problem.

It is also important to note that there are monitors provided for the audience to see the presentations in only one of the House hearing rooms. Serious thought should be given to allowing the audience and press to see the same images as the Senators, albeit perhaps on a more limited scale or size.

Question Four: "Will the system be easy to operate?" The House hearing room systems utilize an integrated control system that is operated by the presenter via a touch panel. This touch panel can simply command features and allow a single button press of an icon-labeled button to execute a multitude of commands to configure or reconfigure the audio and video system. Any system upgrades in the area of visual presentation undertaken by the Senate should have a similar integrated control system to that used by the House.

Question Five: "Will the system be functional for an extended period of time?" The particular choice of display technology in the House hearing rooms virtually guarantees that there will be problems with the gas plasma monitors within a year or two. Gas plasma technology is highly susceptible to a problem known as "burn-in", where a fixed image if left for a period of time (even as short as a weekend) will remain visible on the monitor, even when it is showing something else (or even turned off).

The red, green, causes burn-in and blue phosphors that create the image on a plasma monitor being activated in unequal amounts for extended periods of time. However, without proper equipment provision, training, and safeguards in place, burn-in will likely become noticeable within months and will become progressively worse throughout the life of the system.

House Television Services was made aware of this issue during the writing of this report and systems are shut down after every committee meeting. Another issue that has arisen is the lamp life of projection systems. Projection lamps typically last 1000-2000 hours before requiring replacement. Since replacement lamps are $400-$600 each, they should be budgeted for each year. In addition, because projection technology and models change so quickly from year-to-year, careful consideration should be given to purchasing a supply sufficient to last the estimated life of the projector, rather than hoping that lamps for a particular model are still available and affordable in 3-4 years (unlikely).

5.8 Multimedia Technology Infrastructure Checklist for Renovated or New Hearing Rooms:

1. All desks for meeting participants should have provision for microphone, data network, and power cables to the top of the desk.

2. Any large-screen projection systems should be rear-projection if possible. All projectors should have a data network connection to the nearest TC, in addition to the direct analog cables to the signal source equipment. Also, fiber and UTP cable should be provided alongside the analog cables for future digital signal transmission.

3. Sightlines to meeting participants for mounted cameras must be carefully considered when laying out rooms and furniture.

4. Lighting should be designed with a consistent color temperature of around 3200 degrees Kelvin. This will ensure optimal video camera performance.

5. All image displays should be sized according to the distance over which they are viewed and level of detail of the content contained therein.

6. Integrated control systems automate and simplify control functions, allowing presenters and meeting participants to focus on the issues at hand and not on running the technology.

7. Future digital technology must be anticipated when installing any permanent cabling.

8. Rooms with large display capabilities should be wired into the buildings broadband video system to serve as overflow seating for any of the other rooms or spaces.

9. ADA accessibility and provision for hearing-impaired and vision-impaired must be considered. This includes being able to reach and operate all of the technology equipment.

10. The sound system must achieve two goals: to amplify speaker's voices without loss of intelligibility or feedback while gathering the needed sound sources for broadcast and archival purposes.

5.9 Probable Costs for Hearing Rooms

5.9.1 Sound System

A properly engineered sound system of good quality for a hearing room should be budgeted for a **range of $20,000 to $40,000 per room**. The range is dependent on the installation conditions (new construction is less expensive to install than upgrade of existing) and the size of the room and the numbers of necessary microphones, speaker zones, and the amount of digital processing/mixing required.

5.9.2 Video Presentation System

The cost estimates for this type of system vary widely, as they are largely dependent on the type and number of displays (projectors and/or monitors) that are necessary, and whether these displays are only for the meeting participants or also for the audience. A basic video presentation system for participants-only should be budgeted for a range of $40,000-$60,000. Additional monitors/projectors for audience coverage (depending on seating patterns) should be budgeted for $10,000 each, installed.

5.9.3 Integrated Control System

This is the equipment that allows operation of the sound and video systems to be made simple and intuitive through a graphical interface that automates room functions and equipment. A base system that operates all of the audio and video equipment should be budgeted for $20,000 to $30,000, including installation and programming. Options such as integrated lighting controls and motorized blinds for drapes would add to the costs of such as system.

5.9.4 Presentation Furniture

Presentation desks and mobile presentation technology carts should be budgeted to match the existing or planned furniture in the space. Between $5,000 and $20,000 should be budgeted for this purpose.

5.9.5 Hearing Room Probable Cost Summary

The total probable costs for audio and video technology for a single hearing room are between $85,000 and $150,000 or more, depending on the factors listed above.

5.10 Expansion Space Considerations

If a different space is designed to accommodate the hearing room functions for the Senate, there is some impact on the multimedia and video recommendations in this report.

5.10.1 Hearing Room Systems

The need has been expressed for a hearing room that would seat up to 600 people for meetings. The room would be dividable to accommodate two separate meetings, each with up to 300 people. Meetings would have up to 40 active participants (committee members and staff). Here are some of the technical considerations in designing a room of this scope:

1. **Sightlines**. To allow audience members to see the meeting participants, the meeting would have to be held on a dais, or the audience would have to be seated on a slope or stepped floor, or both.

2. **Sound System**. Each meeting participant would need to have a microphone that would provide adequate pickup. This is largely a function of microphone positioning (mount type, adjustability, user-control). The less the user can do

to move the microphone away, the better the pickup will be. Meeting participants will need sound reinforcement in order to clearly hear each other in a room of this size. Loudspeakers could be mounted in the desk or table to facilitate good sound for each participant. The overall room system would need to be carefully designed and configured to allow each side of the room to function independently or together as one integrated system.

3. **Visual Presentation System**. Due to the size of the image that would be required in a room of this size, rear-projection technology should be utilized for cost-effective coverage of the majority of seats. Other technologies, such as personal or group monitors might be used to cover specific groups of participants.

4. **Acoustical Separation**. Most moveable walls do a poor job of blocking sound. If a moveable wall were used between these two large spaces, it would itself be large. If this wall does not do an excellent job of blocking sound, only one side of the room will be usable at a time. All new hearing rooms should have significant attention paid to reducing the acoustical noise created by HVAC and adjacent spaces.

5. **Flexible Setup**. If the room will be configured in different ways, depending on the number of participants or audience members, then the wiring scheme for audio, video, multimedia, network, and power needs to be provided in flexible, easy-to-configure ways. This could be via floor boxes or accessible pathway under a raised dais. The interface between the structured cabling backbone and the user devices (microphones, video devices, etc) must be robust. This feature is often overlooked in designs of this type.

6. **Probable Costs**. Audio, Video, and Multimedia systems for a room of this type could exceed $500,000.00, depending on the sophistication, quality and quantity of the systems selected.

5.10.2 Television/Media Production Spaces

An expansion space in a different building would give House Television Services and Senate Media Services the space that they desperately need to design and build adequate production studio facilities for which each group has expressed need. All camera locations in the State Office building and Capitol would then be routed to these new production spaces, which would include control rooms, studios, workshop areas, editing/production, and storage/receiving areas.

While the infrastructure (HVAC, lighting, space) needs for each group would be similar, each group uses different equipment standards for video acquisition and storage. While the two groups could be physically close in the expansion space to allow for efficient cabling from the other buildings, they would each need their own spaces barring a significant change in the structure and operations of the video services groups.

Appendix A - List of State Personnel Interviewed

For the most part, interviews were conducted by telephone; however, four of the five consultants on this project did visit the Capitol building to view status of the technology systems.

This list is in no particular order and not all name spellings were verified.

Mr. Jim Greenwalt, Director Senate IS

Mr. Dale Good, IS Director, Supreme Court

Mr. Fred Gritner, Clerk of Appellate Courts

Mr. Michael Speiker, House IS staff

Mr. Dennis Kerns, Director of House IS

Mr. Jon Brimacomb, Governor's Office

Mr. Linc Starkey, automated systems, Department of Administration

Mr. Richard Finch, Attorney General's Office

Ms. Barb Neuman, InterTechnologies Group (DoA)

Mr. Don Davis, Rochester Post Bulletin newspaper

Ms. Kate Piva and Ms. Rose Sherman, Minnesota Historical Society

Mr. Brad Hofman (and Ms. Julie Talbot?), Plant Management

Mr. Steve Senyk, Director Senate Media Services

Mr. Philip Mednick, Senate Media Services

Mr. Barry LaGrave, House Television Services

Appendix B – Glossary

6 Glossary of Terms

Major Source: Newton's Telecom Dictionary, 8th Edition

ADSL (Asymmetrical Digital Subscriber Line): Term for a higher-bandwidth link to the business or home over twisted pair wiring already going to the location. The word asymmetric refers to the fact that this technology offers greater bandwidth from provider to user (downstream) and a smaller amount in the reverse direction (upstream).

Analog: Analog refers to the natural structure of information, specifically audio and video. Analog communications transmits voice and video at the different frequencies they are produced. Also - transmission of information through a continuously variable signal. Compare with digital.

Authentication: A process used to verify the identity of a user.

Automated Attendant: A device connected to a PBX. When a call comes in, this device answers it and says something like "Thanks for calling the ABC Company. If you know the extension number you'd like, push-button that extension now and you'll be transferred. If you don't know it, pushbutton "0" (zero) and wait a few seconds and the operator will come on. Or, wait and the operator will come on anyway." Sometimes the automated attendant might give you other options, such as, "dial 2" for a directory. Auto attendants are connected/integrated also to voice mail systems.

Automatic Call Distributor (ACD): A specialized phone system used for handling many incoming calls. An ACD performs four functions: (1) it will recognize and answer an incoming call; (2) it will look in its database for instructions on what to do with that call; (3) based on these instructions, it will send the call to a recording that "somebody will be with you soon, please don't hang up!" or to a voice response unit (VRU); and (4) it will send the call to an agent as soon as that operator has completed his/her previous call, and/or the caller has heard the message. The term Automatic Call Distributor comes from distributing the incoming calls in some logical pattern to a group of operators.

Backbone: The term backbone in the context of networking refers to the highest speed and widest bandwidth point of a communications circuit or path. In most cases all information central to the users is connected to the backbone such as shared databases or servers, with lower bandwidth circuits extending to user stations.

Bandwidth: The amount of data that can be carried by a circuit between two points of a network. Bandwidth is typically measured in Hertz (cycles per second) or kilobits per second or Megabits per second (shortened to Kbps and Mbps). The top speed of today's modems operates at 33.6 Kbps. One strand of fiber optics can carry 20,000,000,000 (20 Gigabits) or more (via wave division multiplexing). That 20 Gbps fiber optic strand can interconnect 357,000 telephone calls or carry 222 television channels. As examples of bandwidth, the following chart compares analog to digital bandwidth:

Device	Analog	Digital
Telephone	300-3,000 Hertz	56,000 Bits/Second
Television (broadcast)	30-3,500,000 Hertz	90,000,000 Bits/Second
Compressed Video	30-3,500,000 Hertz	56,000 - 1,544,000 Bits/Second

bit: Fundamental unit of information, occupying two discrete states (e.g., 0 or 1).

Bluetooth: A cable-replacement radio protocol for short distance (5-100 meter) networking at moderate speeds (1 Mbps raw bandwidth). Developed by the Bluetooth Consortium.

Bonding: Allows inverse multiplexers from different manufacturers to subdivide a wideband signal into multiple 56 or 64 Kbps channels, pass these individual channels over a switched digital network, and recombine them into a single high-speed signal at the receiving end.
bps: Bits per second. A measure of the speed of a transmission link.

Broadband Video: This term as used defines the capability of the network to carry numerous channels of television via one media, coax or fiber optics. Fiber optics can carry up to 110 television channels 20 miles while much lesser distances are possible with coax. Citywide cable systems carry broadband video.

byte: An 8 bit unit of data storage.

Cable: A collection of metallic wires or fibers surrounded by an insulator used to transmit information or carry power.

Call Accounting (also Call Detail Recording, Station Message Detail Recording): A device generally consisting of a computer, storage device and a means of attachment to the phone system to record and report information and statistics regarding call activity on the phone system. Generally used to provide information about call origination and reception within the telephone system.

Category 3 Cable: Rated 10 Mbps, medium speed LAN connectivity.

Category 5 Cable: Rated to 100 Mbps. A type of unshielded twisted pair (UTP) copper cabling that meets industry standards for use with voice and data installations. The cable must produce test results that will provide data transmission rates of up to 100 Mbps.

CATV - Community Antenna Television or Cable Television: CATV is a broadband transmission facility. It generally uses a 75-ohm coaxial cable and simultaneously carries many frequency-divided TV channels.

CDMA (Code Division Multiple Access): A spread-spectrum approach to digital transmission. With CDMA, each conversation is digitized and then tagged with a code. The process can be compared in some ways to an English-speaking person picking out in a crowded room of French speakers the only other person who is speaking English. See also Digital Modulation.

Central Office (CO): A term used by common carriers when referring to switching points. May also be called local exchange or telephone exchange. Contrast PBX.

Centrex Service: Central exchange service offered by a telephone company supplier. The switching between "in premises" communications is performed by a telephone company-owned remote switch.

Channel: A data communications path such as a wire, fiber-optic conductor, or broadcast frequency.

Channel Service Unit (CSU): The device used by customer premises equipment to terminate a telephone company-supplied digital transmission line.

CHAP: Challenge Handshake Authentication Protocol. A security measure used mostly in dial-up networks.

Character Generator (CG): This device offers a means of presenting graphical information (text and pictures) via a presentation device (monitor or projector) to the viewer. Many times the CG is used as a bulletin board for information.

CLEC: Competitive Local Exchange Carrier. A new entrant in a market previously limited to one carrier.

Client-Server: A computer network system in which programs and information reside on the server and clients connect to the server for network access.

Coaxial Cable: A cable composed of an insulated central conducting wire wrapped in another cylindrical conducting wire. It is usually wrapped in another layer and an outer protective layer and has the capacity to carry great quantities of information.

CODEC (Coder/Decoder): A CODEC is the device that converts analog based audio and video as produced by a microphone or camera to a digital signal from 56 Kbps to 90 Mbps that can be sent via digital signals across the street or around the world. A CODEC is then required to return the digital signal to analog for speaker and or a display device. Digital rates must match on each end of a connection.

Co-Location: The siting of two or more separate companies' (or departments') equipment in or on the same structure.

Compressed Video: Full motion video such as provided via broadcast television requires 90 Mbps of information to establish the detail and motion elements of a picture. Video can be transferred via lower bandwidth circuits if the number of bit is reduced via a compression device such as a CODEC. Rates of 36 Mbps, 1.5 Mbps, 384 Kbps, 128 Kbps and 56 Kbps are typical.

Compression: Reducing the size of data to be stored or transmitted in order to save transmission time, capacity, or storage space.

Connector: [1.] An attachment at the end of a wire or set of wires that facilitates their connection to a device. [2.] In a general sense, any attachment that facilitates connection.

C.O. Trunks: Also called CO Lines - These are the lines connecting the office to a local telephone company's Central Office which in turn connects to the nationwide telephone system.

CPE: Customer Premises Equipment. CPE is a term that has carried over from ordinary telephone service to refer to any equipment that is located past the point of demarcation. CPE may be a PBX, router, or other communications equipment.

CPU: The Central Processing Unit - The computing part of a computer. The "brain" of the computer. It manipulates data and processes instructions coming from software or a human operator.

CSU: Channel Service Unit. (See also DSU/CSU.)

dB: Decibel. 10 times the logarithm of the value in base 10. A measurement of either loudness or signal strength depending on the application.

Dial Up (or dial-up): The technique used to initiate a communications session over a common carrier switched transmission line. More commonly, the use of a standard telephone to create a telephone or data call.

DID: Direct Inward Dial - Offers the ability to from outside an enterprise to a distinct telephone station within the enterprise, without going through the telephone attendant.

digital: Transmission of information through a signal that can take on only certain discrete values (e.g., bits with values 0 or 1). Compare with analog.

Digital Video: Unlike analog video, digital video assigns a finite set of transmission levels.

Display Telephone: A telephone that incorporates a display, either and LED screen of LCD (liquid crystal display) that will show items like time and date and if subscribed, caller ID. On internal phone systems the display may show who is calling if it an internal call or if you have any messages waiting in voice mail.

DNS: Domain Name Server or Domain Name System - A distributed database system for translating computer names. DNS allows one to use the Internet without remembering long lists of numbers.

Drop Cable: In local area networks, the cable used to connect a device interface to the backbone network.

DS-0: Digital Signal, Level 0. DS-0 is the bandwidth required for one voice conversation. It is 64 Kbps and is one of 24 channels in a DS-1, or T1. (see also 56 Kbps)

DS-1: Digital Signal, Level 1. 24 DS-0's are required to make up one DS-1. (see also T-1)

DS-3 (Digital Signal, Level 3): A 44.736 Mbps carrier facility, (also referred to as a T3, and generally thought of as 45 Mbps), which is the equivalent of 28-T1 connections.

DSL: Digital Subscriber Line. See ADSL and HDSL.

DSLAM: DSL Access Multiplexer. Used to aggregate many DSL connections onto a single higher-bandwidth connection/link.

DSU/CSU (Digital Service Unit -Channel Service Unit): A DSU/CSU is used at both ends of a digital signal to filter, decode and equalize the digital signal to make it usable to the end user. Routers can be and are often used in place of a DSU/CSU at the customer location.

DTV (Digital TV): Many times DTV is referred to as HDTV or SDTV, although all of these terms define the change from analog television (as we now use) to digital.

DWDM: Dense Wavelength Division Multiplexing. A way of increasing the capacity of an optical fiber by simultaneously operating at more than one wavelength. With WDM you can multiplex signals by transmitting them at different wavelengths through the same fiber. See also WDM.

Dynamic Bandwidth Allocation: A technique used to allocate transmission channels only to devices that are transmitting. This helps makes the best use of the available bandwidth.

EIA: Electronics Industry Association. A Washington DC trade organization of manufacturers that sets standards for use by its member companies, conducts educational programs and lobbies in Washington for its members' collective prosperity. See also TIA.

EMC (Electromagnetic Compatibility): The ability of equipment or systems to be used in their intended environment within designed efficiency levels without causing or receiving degradation due to unintentional electromagnetic interference. Proper shielding of devices reduces interference.

EMI: Electromagnetic Interference.

Encryption: The transformation of data, for the purpose of privacy, into an unreadable format until reformatted with a decryption key.

Ethernet: A local area network (LAN) protocol using collision detection to resolve access contention.

Far-end Crosstalk (FEXT): The transfer of signals between conductors that then travel in the same direction as the signals, causing problems at the far end.

Fast Ethernet: A successor to the popular Ethernet LAN topology. Fast Ethernet is designed to run at 100 Million bits per second over the same Unshielded Twisted Pair cable as 10Mbps Ethernet. Fast Ethernet uses the same CSMA/CD as Ethernet.

FCC (Federal Communications Commission): The government agency responsible for regulating telecommunications in the United States.

FHSS (Frequency Hopping Spread Spectrum): A technique used in spread spectrum radio transmission systems, such as wireless LANs and some PCS cellular systems, that involves the conversion of a datastream into a stream of packets.

Fiber Loss: The energy loss in a light signal caused by its transmission through a fiber-optic medium.

Fiber Optics (FO): Optical fiber cable consists of multiple individual strands of glass fiber capable of carrying high-speed light pulses from one point to another. This cable comes in two types, single mode and multimode, each with its own unique place in communications. Single mode FO cable is typically used where long distances and very high speeds are required, while multimode is used for intra-building communications and places where low speeds are required. Secondly, the bandwidth of single mode fiber is considerably larger than multimode.

Fishable walls: Walls with hollow cores that allow one to run cables inside them.

Fractional T-1: A T1 service whereby the customer leases a 128-, 256-, 384- or 512-Kbps channel that is part of a T1 transmission system owned by the telephone company.
Frequency: A measure of the energy, as one or more waves per second, in an electrical or light-wave information signal. A signal's frequency is stated in either cycles-per-second or Hertz (Hz). See also Hertz.

FTE: Full Time Equivalent. An FTE is equal to a full-time position, even though the hours may actually be filled by part-time employees.

FTP: File Transfer Protocol. In local area networking technology, file-sharing protocol that operates at layers 5 through 7 of the Open Systems Interconnection (OSI) model.

Gateway: The hardware or software product that allows access from one networked system environment to another. (This term is often used to describe a device that interconnects networks at any level.)

Gigabit: One thousand million bits. One billion bits. Or more precisely 1,073,741,824 bits.

Gigabit Ethernet (GigE): a variation on Ethernet wherein the maximum data transfer per link is 1,000 Mbps. Gigabit Ethernet requires a high-performing cabling system, such as Category 6 or fiber optic media. One can run GigE on certified Category 5e cabling for very short distances – within a room.

Guest voice mailbox: A mailbox that is not assigned to a telephone instrument.

GUI (Graphical User Interface): A name for any computer interface that substitutes graphics for characters. GUIs use pull-down menus and icons (representative pictures) to help the user accomplish specific tasks.

HDSL – High bit rate Digital Subscriber Line: A technology to put two-way, symmetric 1.5 Mbps on a normal unshielded, bridged (but not loaded) twisted pair without using repeaters.

HFC (Hybrid Fiber Coax): A wide area transport system consisting of a mixture of fiber optic and coaxial cabling. The fiber is used for longer runs and coax is used for the final connection to a house or business site.

Headend Room: This is a video term for the main distribution point for video.

Hertz: A measurement of electromagnetic energy, equivalent to one 'wave' or cycle per second. See also KHz, MHz, GHz.

Home run: Technology cabling installed in such a way that the individual cables run from each telephone, computer or video station directly back to the central equipment or switching location. Also known as "star" topology.

HTML (HyperText Markup Language): An authoring software language used on the Web. HTML is used to create Web pages and hyperlinks.

HTTP (HyperText Transfer Protocol): The protocol used by the Web server and the client browser to communicate and move documents around the Internet.

Hub: The electronic device through which data station connections are made to the network. The term hub has come to mean a shared media Ethernet device. Today most hubs have been or are being replaced by switches.

HVAC: Heating, Ventilating, and Air Conditioning systems. Due to high voltage and electromagnetic interference, telecommunication cables must be kept away from the motors in HVAC systems.

Hz: Cycles per second. A measure of radio frequency. See Hertz.

ICMP: Internet Control Message Protocol. Method for reporting errors and performing loopback testing on the Internet.

IEEE: Institute of Electrical and Electronic Engineers - a publishing and standards setting body responsible for many telecom and computing standards, including those standards used in LANs.

IETF: Internet Engineering Task Force. Standards setting body for the Internet.

ILEC: Incumbent Local Exchange Carrier. The former monopoly local telephone carrier. Contrast with CLEC.

Infrared: A band of the electromagnetic spectrum used for airwave communications and some fiber-optic transmission systems. Infrared is commonly used for short-range (up to 20 feet) through-the-air data transmission. Many PC devices have infrared ports, called Infrared Serial Data Link (IRDA), to synchronize with other devices. IRDA supports speeds up to 1.5 Mbps.

Inside Wiring: A term often used in place of customer premises wiring. It refers to cabling placed within a building.

Intercom: Part of the function of some PBX systems that provides station-to-station communications using the telephone speaker.

Interface: A connection between two network elements. Compare with Protocol.

Internet Protocol (IP): A network layer protocol developed in conjunction with the Transmission Control Protocol (operating at the transport layer). See TCP/IP.

Interoperability: The process whereby computers can operate interactively with each other across a network without data conversion or human intervention.

Intranet: An internal network, which is private or employs a firewall to secure it from outside access, that supports Internet technology. The Intranet is used for inter-company communications and can be accessed only by authorized users.

IP (Internet Protocol): See TCP/IP.

IP Address: The IP address is a 32-bit address used in IP routing, which includes a network address identifier assigned by a central authority and a Host ID (an end station identifier assigned by the LAN administrator).

IPSec: Encryption protocol for tunneling IP communications over the Internet.

IPX: Internetwork Packet Exchange protocol. Novell NetWare's native LAN communications protocol. Has fallen out of favor due to its "chatty" nature, wherein devices report their availability on a periodic basis.

ISDN: **I**ntegrated Services **D**igital **N**etwork (ISDN). A type of network that transfers all information from source to destination in a digital form. ISDN comes in two different capacities: BRI - Basic Rate Interface - which is 144,000 bps and PRI - Primary Rate Interface - equivalent to a T1 (1.5436 Mbps). ISDN is divided into bearer or B-channels and data or D-channels. In BRI ISDN is composed of 2B+D, the two bearer channels are 64 Kbps used to carrier user data or one voice conversation and one 16 Kbps for control and signaling information, it also can be used to carry user data up to 9600 bps.

ISM Band (Industrial Scientific Medical Band): Frequency bands in the radio spectrum that are unlicensed, meaning they can be used for a variety of applications without the requirement for FCC permission. The bands are used traditionally for in-building and system applications such as bar code scanners and wireless LANs. Because there is no licensing requirement, there exists the potential for interference. Therefore, spread spectrum technology is often used to protect the integrity of data transmission.

ISO: International Organization for Standardization; an international standards-setting organization.

ISP: Internet Service Provider

ITU – International Telecommunications Union: An organization established by the United Nations. The ITU's objective is to set telecommunications standards, allocate frequencies to various users and hold trade shows every four years. ITU-T has replaced the CCITT as the world's telecommunications standards organization.

IXC (Interexchange Carrier): A long-distance phone company.

JPEG: Joint Photographic Experts Group.

Kbps: Kilobits per second. See bps.

Key System (Key Telephone System): Telephone system where users only have to push one of the multiple buttons on the telephone to access a central office phone line. With this system you don't have to dial 9 to access a line as is common in PBX systems. A drawback is fewer features and a larger phone on the user's desk.

KHz (KiloHertz - Thousands of Hertz): See also Hertz, MHz, GHz.

LAN (Local Area Network): A data communications network, typically within a building or campus, to link computers and peripheral devices under some form of standard control.

LCD – Liquid Crystal Display: An alphanumeric display using liquid crystal sealed between two pieces of glass. LCD displays provide information to the user of a telephone instrument or to the screen of a laptop computer.
LEC (Local Exchange Carrier): Wireline carrier for local calls. Also see ILEC and CLEC.

Leased Line Services: These are typically voice, video or data communications circuits provide by a telephone company or cable company and leased for a cost per month to a customer such as a city or school district. Typical lease lines include 56 Kbps, ISDN, T-1, and DS-3.

Line-of-Sight Transmission: Transmission limited to straight lines. Examples are microwave and laser.

Link Redundancy: The ratio of the actual number of links between nodes in a network and the minimum number that would be required to ensure that any node could transmit to any other node. This ratio is a measure of alternate routing availability.

Load Balancing: The process whereby multiple service units are used equally. For example, if two communications lines are available between two points, each carries half of the traffic load.

Loss: The reduction of transmission signal strength.

MAC: Medium Access Control.

MAC address: In Ethernet the MAC address is a specific alphanumeric sequence that is unique to each device, and is "burned on" when that device or interface is manufactured. For example, every Ethernet network interface card (NIC) has a unique MAC address. The initial characters identify the manufacturer.

MAN (Metropolitan Area Network): A network covering a larger area than a Local Area Network (LAN) and less than a Wide Area Network (WAN). Typically, a MAN connects two or more LANs. In addition to data, a MAN may also carry voice, video, image and multimedia. This is generally a higher speed connection than a WAN and can use various access methods, although fiber is the most common transport medium.

Mbps: MegaBits Per Second - Million bits per second.

MC (Main Cross-Connect or Main Closet): The central location in a building out from which voice, video and/or data cabling is run. This term is most commonly used in data networks. This room/space may also house electronics. May or may not be collocated with the Main Distribution Frame (MDF).

MCU (Multichannel Control Unit): The MCU is a device used to support the interconnection of multiple compressed video CODEC input/output lines. The MCU establishes an automatic switcher device that sends the active video from the send unit to all other connected devices. Audio is handled as a bridge with the video following the audio as the switching source. An MCU can handle multiple inputs and can typically be cross connected with other MCUs to increase the number of video conference sites.

MDF: Main Distribution Frame - This is a Telco term usually where the PBX is located and is the central wire distribution for the voice system. Efforts should be given to be able to locate wiring closet in this room as well as the video headend equipment.

Media: This term is used specifically to describe the various methods of transporting communications signals, including fiber optics, copper cable, coaxial cable and/or radio systems such as spread spectrum or microwave.

Megabyte: One million eight-bit bytes.

MEGACO: Media Gateway Control – IETF Working Group.

Message Alert: A light or other indicator on a wireless phone that notifies a user that a call has come in. A useful feature especially if the wireless subscriber has voice mail. Also called a 'call-in-absence' indicator.

Messaging Waiting Indicators: An indicator on a telephone to let user know that there is a message waiting with either an operator or voice mail system for them. Commonly the indicator is a light as in hotels or it could be a text message on a display phone.

MHz (MegaHertz): Millions of Hertz. See also Hertz, KHz, GHz.

Microsoft NT: Also known as Windows NT. It is a computer operating system.

MMF: Multimode fiber optic cable.

Modem: Modem, which is short for Modulator/Demodulator is a device that is used to convert the digital signal which the computer requires to an analog signal that can be transmitted over the voice phone line (analog line) and vice-versa.

Modulation: The process of varying some characteristic of the electrical carrier wave.

MPEG: Motion Picture Experts Group. This organization has created several industry standards for compression used for audio and video.

MTSO (Mobile Telephone Switching Office): The central computer that connects a wireless phone call to the public telephone network. The MTSO controls the entire system's operations, including call monitoring, billing, and hand-offs.

Multi-line Telephone: A telephone set used to access the Key Telephone System. It will have buttons on the face to access the outside lines.

Multimedia: This word refers to the use of audio and video as interfaced with digital technology for sending-receiving or storing-retrieving of images, moving pictures or sound.

Multi-mode (or multimode) fiber: An optical fiber that will allow nonaxial rays or modes to be carried through the fiber core. Multi-mode optical fibers have a much larger core diameter than single-mode fiber, and consequently a lower bandwidth capacity.

Multiplexing: 1. A process whereby more than one low-speed communications device uses one high-speed transmission line. 2. A process whereby any number of entities can be made to use a single entity.

MUX: Multiplexer.

Network Interface: The interface between a network and a computational device. An example is an Ethernet or IEEE 802.3 controller, which interfaces a specific computer or other device to an Ethernet or IEEE 802.3 local area network.

Network Layer: This layer of network architecture is responsible for choosing routes or circuits for transmission and packet-switching decisions. Also known as Layer 3 in the OSI model.

Network Management Software (or System): The software that manages and controls network functions within a network. It can sometimes facilitate problem determination.

Network Operations Center: The physical location from which the operational functions of a network are controlled. May also be called network control center.

Network (Protocol) Analyzer: A device designed to monitor the functions of individual protocols or multiple protocols in complete networks and provide performance and maintenance data.

Network Redundancy: In a network, the state of having more connecting links than the minimum required to provide a connecting path between all nodes.

Network Topology: The physical relationships between devices in a network. An example is the ring topology, in which all devices are connected in a physical ring.

Network Traffic: The total amount of data transferred over a network at some period of time.

NIST: US National Institute of Standards and Technology.

NOS: Network Operating System - The software side of a LAN. The program that controls the operation of a network.

NTSC – National Television Standards Committee: Committee of Electronic Industries Association (EIA) that prepares the standard specifications approved by the Federal Communications Commission for commercial broadcasting.

OC-3: SONET service at 155 Mbit/sec.

OC-12: SONET service at 622 Mbit/sec.

OC-48: SONET service at 2,488 Mbit/sec.

OC-192: SONET service at 9,953 Mbit/sec.

Operating System: A software program that manages the basic operations of a computer system. These operations include memory apportionment, the order and method of handling tasks, flow of information into and out of the main processor and to peripherals, etc.

OPX (Off Premise Extension): OPX is often a feature of a PBX to allow a person to have an extension away from the location where the PBX is. An outgoing line is used to give someone at a remote site or home access to the features of a PBX.

OSI: Open Systems Interconnection. The OSI model created by the International Standards Organization describes a set of seven layers for networking.

Overhead Paging: A system sometimes used as an adjunct to a telephone system. Provides broadcast or announcement through wired ceiling-mounted speakers and wall-mounted horns, powered by a paging amplifier.

Packet: A bundle of data organized in a specific way for transmission. The three principal elements of a packet include the header, the text, and the trailer (error detection and correction bits).

Packet switching: Sending data in packets through a network to some remote location. The data to be sent is subdivided into individual packets of data, each packet having a unique identification and each carrying its own destination address.

Paging: The function of transmitting a message to someone whom is at an unknown location, using one of several methods.

PAP: Password Authentication Protocol. A method of ensuring the end user is genuine. See also CHAP.

Path: Any possible route within a network.

PBX (Private Branch Exchange): A PBX is a CPE device that the customer more than likely owns, although some are leased. This allows service to many internal phone lines with relatively few outside phone lines. PBX owners can choose options they would like on their system, like ring again or call park/forward rather than ordering them through the local exchange carrier as in a Centrex system.

PC Card: The new name for PCMCIA cards (see definition). A small, credit-card sized device, compatible with the PCMCIA PC Card Standard, that packages for memory and input/output.

PCMCIA (Personal Computer Memory Card International Association): A standards body that sets the standards for PC cards.

PDA (Personal Digital Assistant): Portable computing devices capable of transmitting data. These devices make possible services such as paging, data messaging, electronic mail, stock quotations, handwriting recognition, personal computing, facsimile, date book, and other information-handling capabilities.

PHY: Physical Layer. Layer 1 of the OSI model.

Physical Layer: The layer in a layered network architecture, such as the International Standards Organization's Open System Interconnect (OSI) seven-layer model, that is responsible for the transmission of bits across the medium.

PIM (Personal Information Manager): Also known as a 'contact manager,' is a form of software that logs personal and business information, such as contacts, appointments, lists, notes, occasions, etc.

PIN: Personal Identification Number. Used to restrict access to personal services or capabilities.

PKE: Public Key Encryption. A security method whereby information is encrypted (scrambled) before it is sent.

Plenum cable: Cable specifically designed for use in a plenum (the space above a suspended ceiling used to circulate air back to the general living or work space via the building heating or cooling system). Plenum rated cable is far more fire-retardant than PVC cable.

POP: Point of Presence. This is where the main service of a telephone provider or video cable (CATV) comes from. See also MPOP.
POTS (Plain Old Telephone System): This refers to an unenhanced telephone service, where the only features are being able to send and receive phone calls. Features like call waiting and call forward are present on this system.

PRI: Primary Rate Interface (1.544 Mbps). See also ISDN.

Proprietary: Something that will only work with one vendor's equipment or software. Many telephones are proprietary to one telephone system or one manufacturer.

Protocol: A procedure for adding order to the exchange of data. It is a specific set of rules, procedures or conventions relating to format and timing of data transmission between two devices.

PSTN: Public Switched Telephone Network (utilizing R1 MF tone interfaces).

PVC: Permanent Virtual Circuit. Used in Frame Relay networks.

PVC: Polyvinyl chloride. Material used as a sheath in the manufacture of technology cabling.

QOS/QoS: Quality of Service. Refers to attempting to ensure that high-priority information or transmissions are sent and arrive before low-priority transmissions. Or that traffic that needs to arrive in real-time does so with as little interruption as possible.

Raceway: Metal or plastic channel used for loosely holding electrical and telephone wires in buildings. It is usually located in the floor and is encased on three or four sides by concrete.

RADIUS: Remote Authentication Dial-In User Service. Used to authenticate (or validate the identity of) users. May be used on LANs and WANs as well as dial-up networks.

RAM: Random Access Memory - The primary memory in a computer.

Response Time: [1.] In computer systems, the time required for a computer to provide output after receiving input. [2.] In network applications, response time may refer to the time required for a network to respond to a request for service.

RF: Radio frequency. Electromagnetic waves operating between 10 kHz and 3 MHz propagated without guide (wire or cable) in free space.

RGB Video: A color model based on the mixing of red, green, and blue – the primary additive colors used by color monitor displays and TVs. Typically these colors are merged together as a composite signal, but for maximum quality and for computer applications the signals are segregated.
Roaming: The ability to use a wireless phone to make and receive calls in places outside one's home calling area.

Router: A device that performs routing functions - possibly altering physical data link and network layer protocols - within a network or between dissimilar networks.

66-Blocks: Punchdown blocks most commonly used to terminate 25-pair cables.

S-Video: Type of video signal used in Hi8, S-VHS, and some laserdisc formats. It transmits luminous and color portions separately using multiple wires. S-video avoids composite video encoding, such as NTSC and the resulting loss of picture quality.
SDSL: Symmetric DSL.

Single-mode (or single mode) fiber: Fiber optic cable designed to carry only the single wavelength selected for transmission. Most commonly 9 microns in diameter.

Smart Card: A credit card-sized card with a microprocessor and memory.

SMF: Single Mode Fiber.

SNMP: Simple Network Management Protocol. A standards-based approach to managing network devices such as switches.
SONET (Synchronous Optical NETwork): SONET is an optical network used to transport many unique digital signals (ATM, T1, etc.) over the same optical carrier. Its physical interface is the OC, (Optical Carrier) which has a base rate of OC-1, or 51.84 Mbps and continues to as high as the theoretical limit of 13 Gbps.

Spread Spectrum: A modulation technique in which the information content is spread over a wider bandwidth than the frequency range of the original signal.

SSL: Secure Socket Layer. One method used to secure web-based transactions.

Standalone: Any device that can perform independently of something else.

Switched Ethernet: An Ethernet environment that utilizes switches to segment the network. Switches function similar to that of a bridge. Fully switched networks have no collision problems; this increases the performance of the network.

Synchronization: Also known as 'replication,' it is the process of uploading and downloading information from two or more data sources, so that each is identical.

Synchronous: Data that is transmitted as a regular, precisely clocked, stream of bits. A pattern of bits is used as a filler for times when there is no data to transmit. Compare with Asynchronous.

10Base-T: A transmission medium specified by IEEE 802.3 that carries information at 10 Mbps in baseband form using twisted-pair conductors.

T1 (DS1): In the United States this T1 standard has a speed of 1.544 Mbps. The T1 standard has carried over to data networking from the voice arena where it was used to describe a carrier that could carry 24 voice conversations over a clear channel (64 Kbps, DS0).

TC - Telecommunications (or Technology) Closet: a physical space where voice, data and/or video cabling is aggregated. May also contain equipment such as telephone switch equipment or data network electronics. The TIA/EIA provides guidelines for TC design.

TCP/IP (Transmission Control Protocol/Internet Protocol): The standard set of protocols used by the Internet for transferring information between computers, handsets, and other devices across many kinds of networks, including unreliable ones and connected to dissimilar LANs.

Telephone paging: Part of the function of some telephone systems. Enables broadcasting/announcements over several or all telephone speakers.

TIA: Telecommunications Industry Association.

TIA/EIA: A prefix for a standard produced by the TIA in association with the EIA.

Transceiver: 1. In IEEE 802.3 networks, the attachment hardware connecting the controller interface to the transmission cable. The transceiver contains the carrier-sense logic, the transmit/receive logic and the collision-detect logic. 2. Any device that both transmits and receives.

Trunk: A communication line between two switching systems. The term switching system typically includes equipment in a central office (the telephone company) and PBXs.

TTY: A device used by the deaf or hearing-impaired to communicate text messages over telephone systems. It runs at 45.45 bps.

Tunneling: Sending data transparently through a foreign network. Usually implies the use of a larger than optimal number of protocol layers.

UDP: User Datagram Protocol. An Internet protocol providing basic services only. Compare with TCP.

Unified Messaging: *Generally, a system or group of systems that bring the various forms of messaging (voice mail, facsimile, e-mail) to one point of retrieval for the end user.*

UTP: Unshielded Twisted Pair cable.

UPS: Uninterruptible Power Supply - A device providing a steady source of electric energy to a piece of equipment, enabling electronic systems to function despite periodic commercial power spikes, brownouts or failures.

Upstream: From the user back to the provider.

Video Headend: The originating point of a signal in TV cable distribution systems. Video editing and other electronic equipment is generally found at the headend.

Video Streaming: Video streaming allows high quality video and audio to be transported efficiently over broadband networks, optimizing bandwidth and enabling video services and applications via an organization-wide computer network.

Voice Mail: A computerized answering service that answers a call, plays a greeting, and records a message. Depending on the sophistication of the service, it also can notify the subscriber, via pager, that he or she has received a call. Also called voice messaging.

Voice Messaging: A generic term that can typically be divided in four major ways: (1) Voice Mail, where messages can be retrieved and played back at any time from a user's "voice mailbox"; (2) Call Answering, which routes calls made to a busy/no answer extension into a voice mailbox; (3) Call Processing, which lets callers route themselves among destinations via their touch-tone phones; and (4) Information Mailbox, which stores general recorded information for callers to hear.

Voice Response Unit (VRU)--also referred to as Interactive Voice Response (IVR): Think of a Voice Response Unit as a voice computer. Where a computer has a keyboard for entering information, a VRU uses remote touch-tone telephones. Where a computer has a screen for showing the results, a VRU uses a digitized synthesized voice to "read" the screen to the distant caller. A VRU can do whatever a computer can, from looking up timetables to moving calls around an automated call distributor (ACD). The only limitation on a VRU is that you can't present as many alternatives on a phone as you can on a screen.

VOIP (Voice Over IP): Voice traffic is digitized and compressed so it may be transmitted over an IP network. Requires a network with low latency (delay.)

VPN: Virtual Private Network.

WAN (Wide Area Network): A Wide Area Network is used to extend LAN connectivity beyond a building or campus, usually through common carrier facilities at either 1.544-Mbps or 56-Kbps. See LAN and MAN.

WDM: Optical Wavelength Division Multiplexing. Divides the signal over fiber optic cabling into multiple colors of light to allow more than one signal to be sent simultaneously over the same single fiber.

Wireless: Describing radio-based systems that allow transmission of telephone and/or data signals through the air without a physical connection, such as a metal wire or fiber optic cable.

Wiring Closet: This is a data distribution point for cabling systems. Network equipment is often also located here. See also MC and TC.

XDSL: Refers to all the DSL variants, e.g. ADSL, SDSL.

Information Technology Plan

For

Capital Building/Relocation Funding Request

Minnesota State Capitol
Predesign Study

Date Prepared: June 13, 2001

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Table of Contents

(This Table of Contents can be generate automatically or keyed manually. The page numbers will be different for your document. Delete this note from your document.)

INFORMATION TECHNOLOGY PLAN REQUIREMENTS

The Minnesota Office of Technology (OT) is required to review and approve state agency information technology plans before agency requests for office space are submitted to the legislature.

This information technology plan is being submitted to the Office of Technology to fulfill those requirements. **A copy of the OT approval memo will be included in the predesign package or the relocation request document when the OT review is complete and an approval memo is received from OT.**

Introductory Remarks

Components of the Information Technology Plan

The following six requirements are addressed within this information technology plan:

1. One-page building or relocation summary
2. Description of executive leadership
3. Description of the telecommunications network
4. Description of information resource technologies
5. Implementation plan
6. High-level technology model

1. One-page building or relocation summary

In 1984, Miller-Dunwiddie-Associates was retained by the Capitol Area Architectural and Planning Board (CAAPB) to prepare a study of the public and ceremonial spaces of the Minnesota State Capitol Building. This report, *Minnesota State Capitol: a Preservation and Planning Study for Public and Ceremonial Areas*, was the first step toward an inventory the historic characteristics of the building and the first step toward a comprehensive preservation plan.

In 1988, Miller-Dunwiddie-Associates, again under the direction of the CAAPB, prepared the report: *Minnesota State Capitol: A Comprehensive Preservation Plan and Implementation Strategy*. This report provided a complete inventory of the historic materials in the building, reviewed the architectural, structural, mechanical and electrical systems, and laid out a strategy for implementation and completion of the restoration work by 1994. This plan has been the basis for the work that has been completed at the Capitol between then and now, however, a large portion of the restoration work has yet to be completed.

It, therefore, became clear that the restoration and renovation schedule and master plan needed to be reviewed. The previous studies carefully reviewed the historic, structural, mechanical and electrical issues in the building. They did not attempt to review the needs of the building users.

The primary reason for this predesign study is to propose a plan for the "restoration of the remaining areas of the Capitol", as stated in the budget appropriation. In order to do this, it was necessary to first understand how the building is used by the public and the tenants. This predesign is really a predesign for a master plan, not a specific detailed project. Therefore, we were not able to review and include as much detail as most predesign studies would.

After reviewing the tenant and public needs information, it became apparent that the Capitol cannot meet the needs for public hearing spaces. Large hearing rooms are needed to accommodate the public, but there is not a practical, feasible way to provide these large rooms in the Capitol. This is due to the short beam spans and the large number of columns in the building. There is also a need for additional office space and small meeting rooms within the office areas. There is not adequate expansion space in the Capitol to provide these office and meeting spaces. Also, east wing ground floor public corridor is currently being used as office space. For fire safety and historic reasons, this space needs to be returned to a public corridor.

Because there is not enough space in the Capitol to meet the tenant needs, additional space needs to be found for some of the tenants outside of the Capitol. There are two possibilities for this space. The first alternate is to find existing space on the Capitol Complex. Because there is very little vacant space on the Capitol Complex, this will probably require the relocation of some other Capitol Complex tenants into other space off of the Complex. Additional lease space would need to be found for them.

The second alternate is to build a new building on the Capitol Complex. *The Comprehensive Plan for the Minnesota State Capitol Area* identifies Capitol complex potential development sites. The site closest to the Capitol, and therefore the most desirable to current Capitol tenants, is the block to the northeast of the Capitol, which is now parking lot "B".

It is beyond the scope of this predesign to determine which of these alternates will be the best route. A separate predesign, which reviews the other needs for space on the Capitol Complex, is needed.

2. Description of Executive Leadership

Because of the complexity and diversity of this project, three groups were set up to review, guide and facilitate the predesign process.

A **steering group** guided the procedure of the predesign process and was made up of:

- Department of Administration – Kath Ouska
- Division of State Building Construction - Richard Cottle, Wes Chapman, Gordon Christofferson
- Capitol Area Architectural and Planning Board - Nancy Stark , Paul Mandell

An **advisory group** reviewed and verified the predesign findings and recommendations, including prioritizing the work and helping define the needs for the public spaces. It was made up of:

- Governor's Office – Paula Brown
- Senate – Senator Dennis Fredrickson, Senator Len Price, Senator Deanna Weiner, Patrick Flahaven, Jim Greenwalt, Sven Lindquist, Peter Wattson, Kathleen Lonergan, Kevin Lundeen
- House of Representatives – Gail Romanowski, Don Crosby, Matt Hughes, Barbara Thomas
- Minnesota Historical Society – Charles Nelson, Carolyn Kompelien, David Kelliher
- Capitol Area Architectural and Planning Board – Nancy Stark, Paul Mandell
- Department of Administration – Kath Ouska

    - Division of State Building Construction – Richard Cottle, Wes Chapman
    - Plant Management Division – Gordon Specht, Brad Hoffman
- Department of Finance – Lorna Smith

A **tenants' group** was asked to serve as the contacts for gathering information from the tenant groups and was made up of:

- Attorney General's Executive Office – Rebecca Spartz
- Capitol Café – Chaz LeGreca
- Capitol Security – Lt. Alesia Metry
- Council on Disability – Margot Imdieke
- Governor's Office – Paula Brown, Andy Lokken
- House of Representatives – Gail Romanowski, Don Crosby
- Minnesota Historical Society – Carolyn Kompelien
- Plant Management Division – Gordon Specht
- Press Corps – Don Davis (Rochester Post-Bulletin)
- Senate – Sven Lindquist, Peter Wattson, Dan Wolf, Jim Greenwalt
- State Services for the Blind – Steve Adair
- Supreme Court – Judy Rehak
- Real Estate Management Division – Nancy Freeman
- Capitol Area Architectural and Planning Board – Nancy Stark, Paul Mandell

3. Description of the Telecommunications Network

Current and future business communications needs

We've included information about the various tenants' current uses and needs for technology:

Senate - The Senate upgraded its infrastructure cabling for voice and data in 1998, and added or upgraded data network equipment at the same time. The core device for the Senate network is located in the main computer equipment room G3. From there, fiber optic cabling connects to the MPOP, and from there it is distributed via fiber to multiple Telecommunications Closets throughout the Senate areas of the building. End user ports are mostly 100 Mbps switched Ethernet, but there are also a few shared hubs in specific locations. There are UPS systems in each closet that houses Senate data equipment.

House - The House IS group supports 30 desktop computer systems at the Capitol building as well as 134 laptops carried by House members. Those laptops are frequently used in the House chamber (floor). Three of the Technology Closets in the building contain the network equipment for the House. The backbone among these closets is 100 Mbps over fiber. Each of the closets houses at least one switch and from 3-12 hubs for end user ports, depending on end user needs (the 12 hub configuration serves the House Chamber and surrounding spaces.) Switches are new within the year, while the hubs are up to five years old. The IS group intends to replace all hubs as soon as possible.

Legislative video technologies – both analog ("normal") and network-based (streaming) are important to both the House and the Senate. Video/audio is broadcast (or multicast as the case may be) within the building and to adjacent office buildings so legislators can follow what is going on in various hearing rooms, etc. without being physically present. This helps reduce the need for space in the Capitol building itself.

A fiber optic feed from the Senate video control room to InterTech, allows the distribution of unicast and multicast streaming video (video over the Internet) to be used when desired.

Note: increasing use of streaming video would place heavy demands on the current data networks.

Revisor of Statutes - The Revisor's office has a network that uses a combination of two 155 Mbps ATM links to connect to the State Office Building, and multiple 100 Mbps Fast Ethernet to connect to Technology Closets within the Capitol building. It uses some of the multimode fiber in the backbone to connect switches in five different closets. All end-user ports are 10/100 switched Ethernet.

This network should be usable for another two years or so, after which the electronic components will begin to require replacement. At that time, the likely needs will continue to be 100 Mbps at the desktop, but with greater bandwidth in the backbone. The probable technology to use at that point would be either Gigabit Ethernet or its upcoming big brother 10 Gigabit Ethernet.

The House, Senate and Revisor of Statutes Offices share an Internet link via InterTech.

Governor's Office - This office has a rather surprisingly large number of network ports – 96. Network cabling is sufficient to the current needs for the office areas. There is no cabling in the public areas due to a need to preserve the historic aspect. If networking were required in those spaces in the future, it may be possible to use an 802.11 wireless data system with the access point located in one of the adjacent office areas.

The connection to the outside world is a 384 Kbps channel out of a fiber connection to InterTech.

This office has three Windows NT-based servers running email, an advanced constituent database, and a web based front-end for that database.

This office used the InterTech connection to provide a streaming video version of last year's State of the State address.

Attorney General's Office – This office needs to connect to the 525 Park Building where most of the rest of its staff reside. The AGO owns a firewall and router, which currently are located at the Capitol and attach to an InterTech router in B18. AGO intends to move these systems to its 525 Park office building, and connect via a new 24-strand fiber cable back to the State Capitol building (this fiber is planned, but not yet installed.) After the fiber is put in place, the Internet connection would be moved either to the DOT building or the Centennial Office building. Thus, the AGO TC at the Capitol would essentially be just another technology closet from the 525 Park building.

Future AGO technology uses may include streaming video for training and/or orientation purposes, and Voice over IP (VoIP.) Based on the planned network, implementing either or both of these should be quite feasible.

Media - For competitive reasons, it would be unlikely for the various media tenants to cooperate on a shared network infrastructure, thus an outsourced solution such as DSL is a good option.

For this reason, the Senate IS department recently informed media users of the cost and means to obtain Digital Subscriber Line (DSL) services for Internet connectivity. This would use existing phone wiring and thus not require new network cabling. The benefit is faster Internet access (from 128 Kbps to 1,540 Kbps, depending on cabling facilities and what the tenants are willing to pay.)

Please note however, that if the Media area were moved or renovated, we do recommend local (in-building) data cabling be installed, which could then be leased to the various tenants, as needed. Each media tenant could then provide its own switch or hub for internal connectivity.

Capitol Security/Department of Administration - Linc Starkey who is an employee of the Department of Administration, but is stationed in the Capitol Security area, oversees all of the computerized automation systems for the Capitol building. These include the automated fire management system, heating/ventilation/air conditioning (HVAC) system, and access control (door locks/security systems.)

These automated systems are set up as separate networks for reliability and security reasons. These systems do not require interfaces to other networks in the Capitol. Each runs mostly on fiber optic cabling. New proximity readers are being installed for door access control – these same systems are used throughout the Capitol complex. Tenants' ID cards include programmed information as to which doors those users are allowed to open.

Mr. Starkey requested that in any renovation in the building, his group be consulted as to pathways for fiber cabling for automated systems.

With regard to Capitol Security/Public Safety as in internal building tenant, that group just moved to a newly renovated area. That space has network cabling that meets all current standards.

Minnesota Historical Society - Currently MHS has three networked users in the building. These are connected back the main MHS facility via an ISDN line from InterTech. To provide the best possible throughput, users have access to some internal applications via Citrix MetaFrame.

The network needs for MHS would increase greatly if more of the building were to be used for ceremonial and exhibit areas. Potential FTEs would increase from 4.3 (plus 21 site guides) to 10.75, plus additional resale clerks, volunteers (15) and site guides (30 – currently 15.) It is difficult to predict all the new data needs for this organization due to the unknowns about space. Certainly some cabling and network ports would be needed for any new cash register (point of sale) systems, as well as to any additional stationary desk/office areas.

Judicial - The Supreme Court area in the Capitol does not currently include any data networking capabilities. However, a future request is for network connections at the Bench, the Counsel tables, and the center lectern. Due to the physical nature of the room, the only viable option for this space is wireless networking.

There is a desire in the fairly near future to be able to allow presentation of evidence via PowerPoint presentations and similar technologies. This would not typically require a network connection, but can be done as a stand-alone system.

Telecommunications Network

While each of the building tenants do have some differing needs, their overall needs for networking are very similar. Each requires fast internal links within their departments as well as quick, reliable access to areas outside the building.

Based on the tenants' needs, we recommend a fiber optic based backbone of both multimode and single mode fiber throughout the building linking the various secondary technology closets to a main closet. End user physical links would be either Category 5e or fiber (see section below.)

The voice, data and video cabling system should be considered an integral part of the building, and thus should be managed by a single entity, which is not now the case.

We recommend that network electronics consist of 10/100 Ethernet at the user desktop, with backbone links of at least 100 Mbps, but better at 1 Gigabit.

To ensure the necessary quality of service (QoS) on the network to carry streaming video, videoconferencing, and voice/audio over the network, we suggest a careful review of the available QoS technologies about a year prior to the necessary installations.

In preparation for the renovations, we suggest that each of the tenant's Information Systems departments more thoroughly document its own network.

4. Description of Information Resource Technologies

Due to the preliminary nature of this study and the large number of tenant groups, we were unable to speak to each in depth about technologies such as electronic commerce, business applications, or scheduling/calendaring software.

Here are a few instances uncovered during the study.

Storage technology - The Senate IS group is currently exploring options for archiving audio-only or audio/video recordings to digital format. If this is implemented, it implies the need for a means of long-term digital storage, and for a fast network connection to that system, because it will also need to be retrieved.

Remote work - A Citrix brand MetaFrame system with four dial-in lines is used to provide remote/telecommuting connectivity for Senators and authorized Senate staff members.

Connectivity/local area networking - the Capitol building has some areas that need improvement in the area of voice/video and data cabling. Following are recommendations for the cabling infrastructure in the Capitol Building. If these were implemented, the result would be *improved efficiency and security in the electronic delivery of services.*

1. After proper testing, remove all data, voice and video cabling no longer in use. This will free up some space in cabling pathways, and eliminate a source of potential interference.

2. Create and enforce standards for new cabling installations throughout the building (all tenants) to include specified installation and testing criteria, and a consistent labeling scheme. This will greatly reduce the time it takes to make changes.

3. Add conduit to the northeast tunnel where cabling is now exposed, then move cabling into that conduit. This offers protection from both unintentional damage and deliberate sabotage.

4. Secure Technology Closets to reduce potential damage to expensive equipment. May not be required if move to a fiber to the workstation system (see item 6.)

   The next two recommendations would be an either-or choice – i.e., select one or the other, not both.

5. Expand the current conventional cabling system

   a. Add single mode fiber cabling to the backbone infrastructure.

   b. Add new copper unshielded twisted-pair (UTP) Category 5e cabling to workstations in renovated areas.

6. Install centralized fiber optic horizontal cabling (fiber to the workstation) throughout the building to add flexibility, reduce management costs, and increase bandwidth capability.

Audio and video teleconferencing - these technologies are already used rather extensively at the Capitol building, especially by the Legislative offices.

Much of the burden of supporting these technologies falls on InterTech since that agency supports both voice and data systems for many of the building's tenants. Thus the main prerequisites for the building as a whole would be to ensure a sufficient amount of fiber and copper connectivity from the outside world into the main closet/POP in the basement.

Otherwise, we believe that more and more of the videoconferencing to be done in the future will run over the "data" network, requiring a solid cabling infrastructure, switched 10/100 end-user connections, and a high-capacity backbone such as Gigabit Ethernet.

5. Implementation Plan

Due to the very preliminary nature of this project, it is not yet possible to provide a detailed plan with associated resources and dates.

The first step of this project will be providing the expansion space. New networking will be provided in this space and the systems should be up and running before the move.

Since the remodeling and restoration of the Capitol will require the vacating of one wing at a time, temporary (swing) space will need to be found for the other Capitol tenants. Temporary networking for the swing space should be but in place before the tenant moves, to minimize any disruptions. Between each phase, the network systems will need to be adjusted to meet the needs of the temporary tenants for the next phase.

There are many abandoned cables in the Capitol building. The abandoned cables and wiring should be removed during the phased restoration. All new wiring should be carefully labeled and the locations documented.

Network closets are located throughout the Capitol building. Some of these network closets will be affected with each phase of construction. Care will need to be taken to upgrade (and in some cases move) these closets without disrupting the network service to other areas of the Capitol.

A. Relocation to Expansion Space

The following public and shared spaces will be moved to the expansion space: shared Legislative hearing rooms, press conference room, press corps offices, and lobbyist space. The following office spaces will be moved to the expansion space: Senate Information Systems, Senate Sergeant at Arms, Senate Media Services, Senate Index, Senate Fiscal Services, Senate Publications, Senate Counsel and Research, Senate Fiscal Analysis, Senate Majority Research, Senate Minority Research, House TV, and House Sergeant at Arms. All of the systems for the expansion space should be up and running before the move. This will also involve connecting these networks with those in the Capitol building.

B. Capitol Construction Phase One - East Wing

The work in the east wing will affect the House Chief Clerk's Office Information Systems, some House temporary offices, House meeting rooms, several Senate offices, the Supreme Court and the Minnesota Historical Society offices and some of the Governor's offices (including the IS staff). The House Chief Clerk's Is office and the Governor's IS staff will require the most coordination for moving systems.

C. Capitol Construction Phase Two - West Wing

Work on the west wing would affect several tenants including the Governor's Office, the Attorney General's office, and some Senate offices. The Governor's Office and Attorney General's office should be minimally affected since each has a relatively small network, the switches for which can be moved as personnel are moved. This phase also affects the Senate Chamber.

D. North Wing and Rotunda

These areas have the smallest amount of space to be remodeled and the fewest number of tenants. This phase affects some Senate offices, most of the House offices in the Capitol, and the House chamber. This phase also involves the information desk, which will need to be connected to the MHS.

6. High-Level Technology Model

Due to the multiplicity of tenants and the preliminary nature of the project, this description will be tentative. Some of the smaller tenants of this building have little or no documentation about their network resources, which limits the information we are able to provide.

Each of the tenants has standards for and maintains its own desktop and laptop PCs. We don't foresee a need to make changes to the current acquisition or support of these systems.

Most of the shared systems/servers that provide services within the Capitol Building are either already outside the building (provided via other office buildings in which the various tenants are located, or provided by InterTech) or will be moved outside the building during the project. This would include the AS/400 in the Senate Fiscal Analysis area, and the seven Intel-compatible servers currently located in six locked cabinets in the Senate IS equipment room.

Nearly all the routers used by building tenants are managed by InterTech, and located in a room that would be affected minimally by the remodeling project. Thus those links should remain intact and stable. The Senate IS group maintains the router for the Legislature, but this, too, would be little affected.

For voice services (phones), we recommend the continued use of InterTech expertise.

Many of the links to the outside world are via fiber among Capitol complex buildings. Others are leased copper circuits, which might need to be re-provisioned during the moving.

We anticipate that the new/renovated space in another building will be linked via fiber optic cabling, with sufficient strand count to provide services for all of the tenants who have offices/spaces in both the Capitol Building and the other/new building. These fiber links could in effect create an extended LAN, providing high bandwidth connectivity when combined with up-to-date electronics.

Concluding Remarks

Most of the technology intensive groups are moving form the Capitol to the expansion space. This will allow the new systems to be up and running before they are moved over.

A new predesign study will be needed for the new expansion space. This predesign study will also require a separate Office of Technology review. At that time, more details will be available.

List of Attachments

Minnesota State Capitol Predesign Study Technology Report, submitted by to LKPB and Miller Dunwiddie by Elert & Associates, Revised 6-12-01