Roadmap for NTS Video Services

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Introduction

As technology has matured, IT tools (from telephones and voice mail to networking and the varying applications) have naturally progressed from being spotty and expertise-intensive to becoming ubiquitous, robust, and easy to use parts of the common infrastructure. By taking advantage of standardized protocols over local and wide area networks, these tools provide enhanced productivity and more efficient communication as part of everyday life at the University.

At this juncture, the application that will move communication to the next level appears to be video. Knowing this, OIT and NTS are working towards a set of enterprise services that will expand the use of this important medium. The purpose of this document is to describe the existing video services that are in place at the University and to outline a strategy through which NTS intends to continue to introduce and robustly support the video-intensive applications enabled by the Gopher GigaNet.

Moving Forward

Currently, video applications are provided by a number of different groups: ADCS, VNS, NTS, and Classroom Technical Services. As these applications become more widely used throughout the University community, it will become necessary for NTS to consolidate the services that necessitate Enterprise support. This will allow NTS to prioritize the

various applications and determine how to best dedicate appropriate network resources to them.

Because different users have different needs for using video as well as diverse capabilities, it is our intention to experiment with as many different video technologies as possible. This will allow us a better chance of inspiring the entire University community to adopt video technologies. Some of these video applications are intended to meet or answer a specific need; others may be intended solely as a method of "showing off" a particular technology in the hopes that as these technologies become known, new uses for them at the University may be discovered. Furthermore, although video is rapidly maturing, it is still young enough that we will encounter dead-ends with technologies that initially seem promising but in actuality do not provide the types of features or benefits to our University that warrant enterprise support. Please keep this in mind while reading this document.

Types of Video Service

We need to make some distinctions between the two types of video services. Video can be either Real-Time/Near Real-Time, or it can be Video on Demand (VOD). Each of these has different requirements, including the type of hardware that is required to run it.

1. **Real-Time/Near Real-Time:** With this type of video, a video stream is supplied at a scheduled time and can only be viewed during that time. This delivery can either be multicast or unicast, and it would require some type of reserved bandwidth and very reliable wireless for adequate video performance. This type of application requires some sort of built-in or inherent resiliency to packet loss or latency.

2. **Video on Demand (VOD):** Also known as a "vodcast," Video on Demand simply refers to placing video on the internet where audiences can retrieve it and view it on demand. There are two main types of vodcasts. The first type of vodcast allows users to download content to a device and then play it again and again. The second type of VOD is unicast VOD, which is where the requested content is not downloaded, but simply viewed. This requires greater bandwidth for the wireless network, so in order to support this service, NTS would likely have to place some limit on the number of simultaneous users per wireless segment.

Video Applications and Services

NTS's current plan for the application of video centers around the following applications and technologies. Some of these technologies are already in place at the University; others of are planned for future release. In the description of each, we will also include NTS's plan for deploying and supporting these services. This is necessary not only to set

priorities but to allocate resources for development and testing of each application or technology.

Support Tools

Since many of these video applications are real-time services, they are extremely sensitive to network outages, latency, packet loss, jitter, and other network anomalies. As NTS rolls out video and other real-time services, they must also provide specialized tools that evaluate the network and the various applications in order to ensure reliable operation.

Several such tools are available, including our Network Management platform (Entuity), the NTS analysis network, future performance monitoring applications, physical tools (such as network scanners), and performance tools provided by the applications themselves. NTS will need to take care to always use these tools proactively and effectively; training its staff to use and react to information provided from these tools will be critical.

Quality of Service (QoS)

QoS refers to the pre-provisioning of the network in order to accommodate and prioritize the various video applications based on their requirements. Broadly speaking, video applications fall into several categories (such as interactive, non-interactive, high-bandwidth, moderate-bandwidth, etc.), and the video applications that fall into these different categories require different kinds of QoS treatment. NTS will design and implement QoS such that the different video applications will receive the appropriate priority treatment on the network.

Like Support Tools, proper design and implementation of network QoS is critical to support real-time applications such as video. This provisioning will ensure that the video experience is high quality and highly reliable. For specific details on QoS implementation, including how the various video applications are handled, see the QoS design document, "Gopher GigaNet QoS Framework."

Note: Desktop collaboration (example T.120, this is part of video conference) is difficult to classify, as it is difficult to identify. End and origination points are often different, as they are dependent on the individual user and the collaboration session. However, *listening* to the application itself in order to classify the traffic may pose problems, as classification may occur when the session is not University-mission related.

Video Services

NTS is committed to providing and enabling Video services. There are several applications that currently provide video to end-users. In addition, NTS is working to implement several new applications. This section will provide a brief overview of each known Video application, as well as a description of NTS's plan for deploying and supporting these services.

Video Conferencing

Video conferencing occurs when people connect two or more sites by video and audio, enabling them to interact as if they were at a single site. Video Conferencing is in use today in several forms: it can refer to the connection of two desktop computers with cameras, two rooms on campus, or several locations on and off campus. Users can employ both point-to-point and multipoint technologies. Below is a more thorough description of the various types of Video Conferencing that are currently supported at the U of M:

- **Peer to Peer (desktop) conferencing**: A Peer to Peer conference is a video conference that is run by two people using webcams to connect Windows or Macintosh computers. It is used for informal, ad hoc conferencing by University staff and students alike.

    - Benefits:
        - Users can transfer files to remote party.
        - Users can share documents with remote party.
        - Conference can be scheduled at any time.

    - Limitations:
        - Transmission may not be secured using latest encryption methods such as SSL (depending on the software used).
        - Hardware equipment may be difficult to initially configure or troubleshoot if it is not working properly.
        - Quality of conference service may be disrupted by busy network traffic.

- **Adobe Breeze-type Web Conferencing:** Adobe Breeze is an application that has been designed to facilitate real-time communication, collaboration, and teaching over the web. A Breeze Conference can also be run from a desktop, but unlike the standard desktop conferencing method described above, Breeze can be used to connect more than two locations and to web cast events to large audiences. This type of web conferencing is currently used to support classroom instruction, as well as for seminars.

    - Benefits:
        - Users may communicate by broadcasting audio and video or by chatting with text.

        - Communication is secured via SSL encryption software.
        - Users can display PowerPoint presentations and other video and graphics to audience.
        - Participants can share files with each other.
        - Users can use a whiteboard to collaborate with text or drawing.
        - Meetings can be recorded and viewed at a later time.
        - The only software requirement is a web browser with the Flash plug-in.

    - Limitations:
        - Users may need to configure and troubleshoot hardware such as webcams and audio if it is not working properly.
        - There can be potential issues with quality of service issues when off campus.

- **Set Top conferencing (Polycoms/Tandbergs/LifeSize)**: In a Set Top Conference, parties connect with one another by using codec (COmpressor/ DECompressor) units that sit on top of monitors. The CODEC takes analog signals, digitizes and converts them to IP packets, and transmits them over the IP network. Additionally, it receives data from the remote site and decodes it so that it can be seen and heard. Set Top Conferences are more structured than some of the other conference types already described, and they are often used in a business environment for groups of up to ten participants. Bandwidth to certified state locations can be reserved by using NTS Video Jack service.

    - Benefits:
        - The conference is secured over internal network.
        - Video quality is excellent.
        - Conference is compatible with auxiliary equipment such as VCRs, document cameras, etc.
        - The interface is user-friendly and easy to configure.
        - Conferences can be scheduled at any time.

    - Limitations:
        - Initial cost of the equipment is higher.
        - Some level of technical knowledge is generally required.
        - Quality of conference service may be disrupted by busy network traffic.

- **ITV (Interactive Television Classroom)**: ITV Classrooms are special classrooms that are equipped with cameras and microphones, allowing many participants to be seen and heard. Using an ITV Classroom is a good videoconferencing option for large groups of people who all need to be involved. There are currently approximately 20 ITV classrooms on campus, which are used for allowing instructors to teach classes to students in multiple locations (for example, an instructor can deliver a lecture live to a class in Minneapolis and

broadcast it to audiences in Rochester and Morris). Classes may also be recorded for future playback. Bandwidth for this service is reserved to certified state sites.

- Benefits:
  - This method is very secure; video connections go through the UM codecs.
  - There is no need for equipment setup. Users simply show up at time of conference.

- Limitations:
  - Conferences need to schedule with VNS for open times in designated locations.

- **Gopher Conferencing:** Gopher Conferencing is a telephone-based conference bridge that is equipped with features that facilitate collaboration (for example, it allows for the sharing of documents and presentations). We anticipate that a video conferencing component of this application will be released in the future. Users who dial into the conference bridge will have an option to activate a videoconference by using either a videophone or a combination of a soft phone (computer software), web cam, microphone, and headset.

  - Benefits:
    - This type of conferencing is great for small-scale and ad hoc conferencing.

  - Limitations:
    - The user will need a video phone or another type of video application in order to take advantage of this service.

Deployment and Support of Service

The video conferencing services that are currently made available on campus through OIT generally function well, although widespread use is limited by departmental concentration of expertise.

The University provides video conference services using T1 links: dedicated ISDN lines and ethernet (IP). Within campus, coordinate campuses, the State of Minnesota, Higher Education, and even I2 SEGP (Sponsored Education Group Participant), IP services are well supported because of reserved bandwidth or overbuilt networks. As more wide area sites begin implementing bandwidth reservation services, IP can begin to supplant a dedicated facilities plant as the preferred technology.

With the Gopher GigaNet and the improvement of network-attached Video Conferencing technology, the time is right to build a video conferencing architecture that lowers the bar for using video conferencing. NTS intends to provide the University with several video conferencing solutions for both scheduled and ad hoc conferencing, with video quality ranging from standard definition (SD) to high definition (HD). The biggest challenge will

be providing departments on campus with the correct level or type of service (described above) to meet their needs.

Video Streaming/Web Casting

Webcasting (or Podcasting, as it is often called) means placing video on a remote computer and allowing users to access it on demand. This method is quite similar to a TV broadcast in that the source material can be pre-recorded (but may also be delivered live) and can then be accessed by thousands of users simultaneously. Once users receive (download) the content, they have the ability to store it and either play it back on their computer or load it onto a personal device such as an IPod.

Web casting currently has several different applications at the University. The Board of Regents meetings are webcast so that they can be viewed by the entire University community; instructors are webcasting content to their classes; and various departments are recording training sessions and webcasting them so that they can be accessed by employees on demand.

- Benefits:
  - Webcast content can be streamed in different types of media (QuickTime or Real).
  - Content can be secured by adding authentication to the video stream.
  - Content can be accessed by thousands of users concurrently, regardless of geographic location.

- Limitations:
  - The quality of video varies due to quality loss in compression.
  - When using unicast streams, bandwidth resources must be available for the maximum number of concurrent users.
  - When using multicast streams, streaming times generally need to be scheduled.

Deployment and Support of Service

Streams can be unicast (one unique stream per user) or multicast (many users sharing a single stream to the last common point). As usage of these video applications becomes more widespread, enterprise level servers and support will be needed. NTS will need to ensure adequate bandwidth is available for the anticipated users to maintain a high quality service. Some streams may require a higher level of security in order to ensure that only those users entitled to the content receive it.

IPTV (Internet Protocol TeleVision)

IPTV is a new real-time streaming video application that NTS is planning to introduce soon. This service will provide television channels or content in real-time over the network to either traditional televisions or computers. In addition, IPTV will have on-demand capability, allowing audiences to access content whenever they wish. IPTV may

be used as a replacement or augmentation for cable TV services in the Residence Halls and some campus buildings.

- Benefits:
  - IPTV provides a mechanism to easily "broadcast" campus events to all interested network users.
  - Students, departments, and university groups will have a wider campus audience for their work.
  - Students will gain experience in live TV production.

- Limitations:
  - It will be difficult to reach a level of quality with this service that can rival that provided by cable television.

This service involves three basic components.

1. **Content:** Providers offer many channels of education, entertainment, research, etc. Content will come from contracted, commercially available channels (similar to traditional cable TV channel line ups); local broadcast channels; and providers of educational content (such as University-affiliated groups and organizations).

2. **IPTV Servers:** IPTV servers will provide channel interfaces for a variety of feeds. Each channel of content will be converted to an Internet Protocol stream that is suitable for being sent across our network. Since the audience could be quite large, it is very important to use a multicast protocol method, which can send the same data to many locations without having to replicate each stream for each user. This method protects valuable network capacity as well as allows much smaller servers to be used for storing and delivering the content.

3. **End Points:** End points present the content to the viewer by accessing the IPTV server through a website that contains the channel selections. An end point could be either an application on any computer, laptop, PDA, or multimedia cell phone (such as QuickTime or Windows Media Player), or it could be a network-attached appliance that converts the video data stream to a television signal (such an appliances would be an IPTV set-top box, which resembles a Cable TV set-top channel box).

Deployment and Support of Service

By taking advantage of bandwidth improvements and newer encoding technologies, NTS can provide video services that are similar to cable television. The difficulty is making sure the users' "experience" or the quality of service is on par with their current cable service. This can be difficult to achieve, as this is an area where technology is still changing and maturing. The systems work, and they generally provide an acceptable

customer experience; the trick is to find one which works seamlessly across as many devices as possible.

As mentioned above, IPTV will be multicast and is not currently provisioned on wireless service. Providing IPTV content via wireless will be challenging even after the campus wireless upgrade is complete because wireless is a shared rather than switched media network, which implies a need for very careful management of bandwidth. A few high bandwidth streams or a less-than-ideal signal can have a severe impact on throughput. Since multicast rarely uses reliable protocols, wireless multicast is probably not practical in the near future. Support for video over wireless will almost certainly require using reliable unicast streams—and the servers capable of supplying them.

Access Grid

Another real-time video technology that is currently becoming available is the Video Access Grid (AG). AG offers many of the same features that are offered by the other methods of videoconferencing, but it allows the conference to be controlled differently. Although it is very new and still somewhat experimental, this emerging technology is extremely flexible, and it uses a connection-immersion type of environment. Therefore, AG provides users a more real-life video conference experience.

- Benefits:
  - AG makes it easier to run a conference for a large group of participants.

- Limitations:
  - An experienced operator is required to coordinate the conference.
  - All users will need to have the appropriate software.

Deployment and Support of Service

AG may be use the same equipment as other typical forms of video technology (such as webcams, Polycoms, set tops etc.), but it is all coordinated through desktop software. AG software is becoming more user friendly, but it still requires a level of knowledge beyond many video conference users. For this reason, AG may not become widely utilized until it is an easier platform to use.

Classroom Education

Distance Education for instructional purposes has been in place for many years in the form of ITV classrooms (described above). But as ITV rooms can be very expensive, NTS is looking for new ways to build upon this service and affordably implement video technology in non-ITV classrooms. Classroom Education can do just this: provide the same sorts of service as ITV classrooms, but much more affordably (and at a lower level of service).

In addition, Classroom Education will introduce many new features into the video classroom. For example, instructors will be able to manage class sessions with controls that allow them to listen to questions, poll students, and mute classes. Students will be able to raise their hands electronically to ask questions, and the instructor will be able to direct the attention of the entire class to a particular student. It will even be possible for students to attend these classes from their computers or perhaps even a handheld device such as a PDA or video cell phone. There will always be a need to have a variety of ways to transmit/view the classroom experience. Some instructors may want the video to be real-time; others may prefer it to be delayed; and others may just want parts of the material available to students.

- Benefits:
  - This type of classroom video service will be much more available to instructors than the current classroom video technologies (Interactive Television Classrooms), which are quite limited.
  - This type of classroom video service will also be much more affordable than Interactive television Classrooms.

- Limitations:
  - An operator may be required.
  - The quality of service may vary, depending on classroom setup and the expertise of the operator.

Deployment and Support of Service
Some of such classes are transmitted via dialup ISDN circuits or T1 circuits, but due to locations and end users' equipment, this may not change for a while. However, OIT is looking to implement an IP solution in new classrooms and to replace a fiber infrastructure wherever it is possible from specially designed classrooms to a central IP switcher. This would allow new classrooms to come on-line without significant fiber expense (although these classrooms may still require an audio/video operator for the equipment).

New systems have emerged that leverage the data network, allowing it to operate as the switching mechanism. Being connected to the network infrastructure provides much more flexibility. Classrooms will still need to be architecturally designed for high quality audio/video capabilities, but even lower quality rooms would be able to connect to any instructor similar to the way the ITV classrooms are managed now.

Campus Video Cameras

Several departments currently use cameras to capture and share projects or campus life. For example, OneStop Student Services currently broadcasts a webcam on their website, which shows the activity at the OneStop office in Fraser Hall (East Bank).

NTS is in the process of building on exactly this type of service to create a virtual campus; NTS staff is currently installing other such cameras all over campus. In addition, NTS will also attempt to assemble traffic cameras from the Department of Transportation

(DOT) and other freely available entities. All of this will allow prospective students to tour the campus online without ever physically coming to campus, and it will provide current students, staff, and faculty the ability to see what is happening on campus so that they may more effectively plan their activities. These views will be available on the Gopher TV web site and the NTS website.

Deployment and Support of Service
The video cameras currently found around campus are not managed at an enterprise level. Instead, the cameras that may be viewed over the web are all managed in small isolated pockets by the separate departments that provide them. As this technology becomes more widespread and is supported at an enterprise level, NTS will need to be careful in how they support a center stage for it: there are a number of issues, including bandwidth constraints, ease of access, and privacy and security issues that we need to consider as we roll out this service.

Central Security monitors hundreds of security cameras. NTS will continue to support Central Security for these life-critical campus video cameras and is working to create an appropriate level of quality of service for these applications.

Digital Signage

Digital signs are currently used in many applications such as displaying conference facility information and marketing information in public spaces. The two basic components needed to provide this service are:

- A server to store the content
- A display unit (basically a monitor), which can access and display the content.

Digital signage technology has advanced considerably, and there are now solutions that take advantage of the improved network. A possible new application for digital signage technology would be to provide some type of ‘touch screen’ technology that users could interact with to get the content that they want. Users could see a menu of information and select the item that they would like additional information for, such as "conference room information" or "directions." In this case, a kiosk may contain the content, and customers could also be able to review a listing of media clips or videos that the user would be able to select and play.

Deployment and Support of Service
As this technology becomes more widespread, it will become necessary for NTS to support digital signage at an enterprise level. One method of doing so might be to connect the displays to the network and allow customers to remotely manage the display content themselves on a secure website. This service would be similar to the voicemail service, where NTS maintains the infrastructure and users maintain their own content (they serve as the administrators).

NTS Initiatives

How will NTS pull this together? Where are we at now and when will it all be done? NTS needs to prioritize each of the services, prototype solutions, and determine which services match the University's goals. Some of this is underway, and we will always be looking to adjust services to find solutions for customer needs.

- For QOS, deployment work is being done to evaluate the best roll out method. This has already started and is of a higher priority for completion than the other services. A design plan is to be completed by March/April 2007. Once the roll out plan is developed, implementation could be completed during summer 2007. In the mean time, most of our network has the capacity to run prototypes and some production services.

- IPTV is in progress. An RFP was sent out, and we have 12 responses (8 for equipment and 5 for content—some had both). We requested additional clarifying questions on both parts; the responses will be back the first week of April. At that point, the RFP will be scored, evaluation completed, and a solution chosen by late April 2007. Implementation will begin as soon as the contracts are completed and approved by the Regents and the products are delivered. We are targeting March for the start of implementation and rolling out of services to end-users over the summer of 2007. A lot of work will need to be completed for advertising and releasing this service. Housing and Campus Life are anxious for a new service like this.

- We are in process of completing an RFP or bid for video switching spare equipment for VNS. This will be out by May 2007. We anticipate that this equipment will arrive at the end of April 2007. It is important to allow VNS enough time to install and test equipment for classroom operation. It is important to note that the purpose of this equipment is to keep the current type of service operational and avoid potential outages. During the same time frame, we will be generating another RFP to provide IP-based video transport switching capability to VNS. Once this is in place, we will gradually migrate VNS from dedicated fiber for transport and dedicated video switchers to IP based transport and switching.

Mobile Applications

Video is currently being deployed commercially in many mobile applications: cellular providers are delivering video content via cell phones, and PDA's have become mature enough to perform video functions over the network. NTS is investigating many of the video applications that are currently used in mobile devices in order to determine how they can be implemented at the U of M. As listed under the IPTV section, mobile (wireless) video does have some quality limitations.

Video Conferencing

We are looking at a variety of new types of Video Conferencing. As stated earlier, this will encompass both single user point-to-point and multi-site HD equipment. NTS will

work with other areas in and out of OIT to develop appropriate solutions to meet or answer customer needs:

- Campus view cameras are being evaluated as well as streaming server configurations and methods. Once these have been identified, crews can begin work across campus to install cameras in strategic locations and service them from a University web page. Cameras already in place need to be found and linked from the NTS site. A suite of cameras and locations will be defined by January 2007. The method of serving those cameras will also be identified during the same timeframe. We anticipate being able to broadly roll out beginning in spring 2007.

- NTS is evaluating a Voice Over IP solution that includes a video conferencing capability through a client application as well as a physical phone. These are the same devices that would be used with the Gopher Conferencing service.

- The Gopher conferencing video application is being evaluated as test components arrive. If the feature is determined to be useful, we will deploy it as an add-on to the teleconferencing feature in the summer of 2007.

- NTS has completed a Podcast prototype project in September and is in process of developing a Podcasting service to deploy information such as system status, statistics, instructional content, and FAQs.