WEBCASTING: HOW TO FROM REMOTE LOCATIONS

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Abstract

This paper will discuss the issues associated with webcasting and will provide a "howto" for those interested in developing their own webcasts. Issues discussed will include the pros and cons of point-to-point versus multicasting, the use of commercial software versus freeware, the technical issues (network bandwidth requirements, chatroom and webpage configuration) and the challenges (technical, legal and health) involved in traveling to and webcasting from remote locations. The author has experience in setting up and conducting webcasts of astronomical events which have been broadcast from India, Panama, Spain and Turkey as part of the Sun Earth Moon system (SEMs) project - a public outreach and informal learning project under development at the University of North Dakota (UND).

Background

The Sun Earth Moon system project (SEMs) [1] is a public outreach project conceived by the author and Timothy Young (UND Physics Department) to bring live coverage of rare astronomical events to the public using the Internet. SEMs webcasts began with the June 8, 2004 Venus transit that was webcast from Delhi, India. The webcast was very successful (37,000 logins to the website during the six hour webcast) and, judging from the emails, well received. We were elated. The second SEMs webcast was the October 28, 2004 lunar eclipse that was webcast from Grand Forks. Unfortunately, it was cloudy. However, the website had over 159,000 logins in just two hours. The barrage of logins increased the workload on the server to the point where I could not login to place a notice on the website that it was cloudy and that there would be no webcast! We quickly realized that if we planned to continue webcasting astronomical events that we would have to develop a better understanding of webcasting methodologies, the current server and software environment and usage patterns.

For the first two webcasts, we were given accounts and disk space on the UND School of Medicine's [2] MacroMedia Breeze [3] server. While this software is very capable and easy to use, it limits the number of concurrent viewers (as determined by the site license) and this is what caused the barrage of login attempts during the October 28, 2004 lunar eclipse webcast as people would repeatedly login trying to get one of the 200 video feeds. At this point we also began to explore alternative webcast techniques/packages.

I should state up-front that the SEMs webcasts have some unique requirements and those requirements are what drove our decision making process. First and foremost is the tremendous number of logins that we expect over a short time period coupled with finite network bandwidth. The second is that we must be able to broadcast from remote locations – locations were we must make do with whatever Internet connection we can obtain and with whatever equipment we are allowed to bring (due to weight and customs restrictions). Therefore, it is highly desirable to be able to send a single stream from our remote site to a server located at UND and have that server provide the multitude of public streams. The third is that it is the goal of the SEMs project to give viewers the feeling of being there and to instill the excitement of being part of a global community witnessing a rare event. As a result, we have continuously experimented with the use of the media (video, audio and chatroom) to make the event as life-like as possible for the viewers. Unlike the other eclipse webcasts (each eclipse averages ten webcasts from various groups), the SEMs webcasts use streaming color video, audio and have a chatroom. We have also discovered that having viewers post questions on the chatroom and our answering via audio was very popular. However, such amenities require bandwidth and flexible software/systems.

The remainder of this paper will review the techniques and software that are available, provide a discussion of the techniques/software that we have adopted, issues associated with travel to remote locations and present a few of the highlights of our expeditions.

Webcasting Options

Webcasting options can be broken down into two categories: the network protocol and the software used. The network protocol options can be further divided into two sub-categories:

1. Point-to-point [4] – This is the most common protocol used by commercial webcast systems as it gives the software a mechanism to track/limit the number of viewers. Furthermore, point-to-point commonly uses HTTP [5] port 80 which is rarely blocked by Internet Service Providers (ISPs). Unfortunately, every viewer creates/requires a separate (and redundant in our case) connection to the server. Therefore, the number of viewers possible is also limited by the server site's bandwidth.

2. Multicast [6] - With multicast a single stream is broadcast by the server and is replicated by any and all network routers encountered and therefore sent to everyone on the network (whether they want it or not). As a result, multicast consumes a massive amount of network bandwidth and therefore, many ISPs block all multicast signals. Thus, multicast is akin to AM/FM radio where anyone knowing the channel can tune in (for free), thus multicast is not commonly supported by commercial webcast systems. Finally, to webcast over multicast, one needs to have possession of a multicast address [7] and must set the time-to-live on the packets such that the appropriate number of routers is crossed to reach the desired audience.

The software options can also be divided into two sub-categories:

1. Commercial Software – We have found that the commercial packages typically provide support for many cameras and microphones and provide useful features such as chatrooms, ability to show presentation slides, have remote feed capability and have web browser interfaces. The drawbacks to using commercial packages include the price, the rare support of multicast, license restrictions limiting the number of viewers and the need to install web browser plug-ins.

2. Freeware – We have found that the freeware packages range widely in capability and few support chatrooms, the ability to show presentation slides, remote feeds nor do they commonly have web browser interfaces. We have also found camera and microphone support spotty in these packages. However, free packages have no license restrictions and more likely to support multicast.

UND/SEMs Webcast System

Given the number of logins and the limited bandwidth, the SEMs team realized that any solution should include the possibility of multicast. Further investigation determined that the North Dakota Higher Education Computer Network (NDHECN) did possess a block of multicast addresses and that UND *had* the capability to become multicast enabled. With a lot of help from the Information Technology groups at UND and NDSU, UND's

network was made multicast capable. We also found a free package (VideoLan Client – VLC [8]) that provided both point-to-point and multicast protocols, was easy to install, supported remote feeds and had no license restrictions. Further investigation determined that VLC could be easily configured (via command line options or a startup script) to allow mirror sites. Unfortunately, VLC does not provide support for a chatroom, presentation slides, has relatively poor web browser support, spotty camera and microphone support and requires unique web browser plug-ins. However, due to its popularity, a lot of people not associated with the VLC project have developed components to extend its capability. For example, javascript applications have been written that allow VLC streams to be viewed on a web browser. Also, there are several chatroom packages freely available such as ircd-hybrid [9]. Therefore, with a little development, the SEMs team was able to create a website with nearly the same look and feel as a commercial package, but that provided the non-commercial features we required. The only remaining issue was that the user must download and install the VLC software. Figure 1 shows the Turkey expedition webcast page and Figure 2 shows the architecture of the SEMs webcast system.

Figure 1. SEMs Turkey expedition webcast page.

As Figure 1 shows, the Turkey expedition website supported two video streams (Camera #1 and Camera #2) and a chatroom implemented as frames. The Camera #1 frame provided a video stream of the Sun looking through a telescope equipped with an h-Alpha filter. The Camera #2 frame provided a video stream of the country side showing how dark it gets during a total eclipse. The chatroom frame contained the chatroom.

The decision to use frames was driven in part by the need (or convenience) of having multiple machines supporting the website. The core webpages are hosted using an Apache webserver [10] running on a RedHat Enterprise [11] Linux machine. The ircd-hybrid chatroom is also hosted on RedHat Enterprise Linux machine. While the two video streams are hosted on two Windows XP [12] machines using VLC. We would have preferred to use RedHat Enterprise Linux for all four servers however, VLC is rather challenging to install on a RedHat Enterprise Linux machine (many dependencies). In addition, VLC is more stable on the Windows XP platform. Finally, when serving N unique video streams, VLC requires N unique IP addresses to serve the stream from (and to send the original stream to). Hence, two video streams require two remote computers (each sending a unique stream) and two servers to receive and serve those streams. Even a dual processor machine with dual network interface cards has proven to be unstable when used for this purpose. A second reason for using multiple servers was the desire to reduce the workload at any one server to prevent a reoccurrence of the October 28, 2004 lunar eclipse fiasco. Therefore, using multiple frames should facilitate the distribution of the workload and active page user count among the 4 machines. However, we will not know how well this works until the March 29, 2006 eclipse as it is very difficult to generate 50,000 "test" logins.
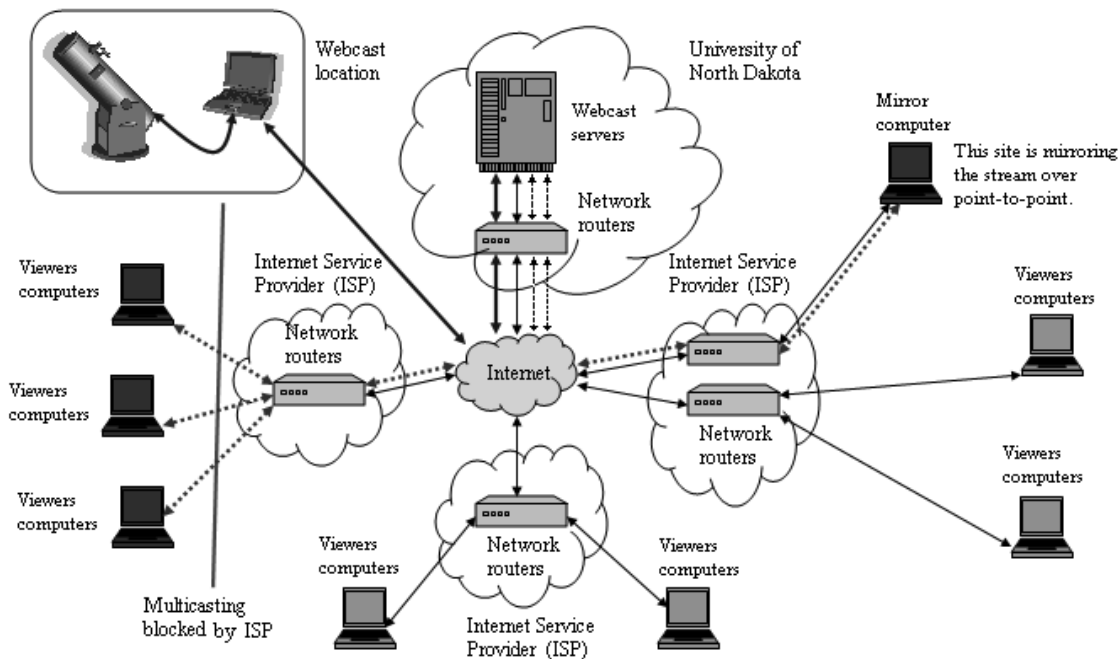

Figure 2. SEMs webcast system.

Figure 2 shows the overall architecture of the SEMs webcast system. The thin solid arrows indicate the multicast stream, while the dotted arrows indicate the point-to-point stream. Note that some of the home computers (on left) have the multicast stream blocked by their ISP, yet these participants are able to receive the stream via other home computers (upper right) who are receiving the stream (via point-to-point or multicast) and rebroadcasting (mirroring) the stream over point-to-point. This scheme has been used by

the SEMs team to reduce the bandwidth requirements out of UND. To date our webcasts have been mirrored by Penn State Wilkes-Barre Campus, Lawrence Berkley National Lab (High Performance Computing Research Department), Universidad de Sonora in Mexico, University of Barcelona in Spain, Williston North Dakota School District and www.ParsSky.net in Iran. Also note that the UND servers also provide point-to-point streams, however the intent for these streams is to feed mirror sites that are not multicast enabled (common with foreign mirror sites). Finally, UND only multicasts on the Internet 2 network.

Travel to the site - Issues

Other issues the traveling webcaster will encounter include legal and health issues. Beware of the airline luggage weight limits and customs restrictions as many countries limit the type and amount of equipment allowed (a one laptop computer per person limit is common). We discovered this the hard way in India by having *all* of our equipment confiscated – It took the U.S. embassy 1 full day to get our equipment released (I recommend having a letter from your agency/university documenting all of the equipment that you are bringing.). We discovered that some countries (Panama, for example) require webcasters to have a commercial "filming" permit. Also, note that some countries have several types of visas.

Be aware of the many health issues, specifically when traveling to third world countries. Make sure to get all of the recommended vaccinations and do *NOT* forget about malaria medication! Remember, in some countries, "It's not if you get sick, it's when you get sick." so plan for it (antiseptic hand cleanser and Pepto Bismal® are recommended by physicians who specialize in travel related health issues). This also includes having international health insurance that will pay the *cash* fee required to airlift you out of the country, if need be. It is also recommended that you review the State Department's [13] website for travel alerts and the CIA's World Factbook [14] to review health and crime statistics.

Our experience has also shown that it is very unlikely that you will arrive in a foreign country and simply "setup shop." Luggage weight and customs restrictions limit the amount and type of equipment you can bring and something may get broken or lost in transit, breaks on-site or will not interface with the local infrastructure. Even in a major city in a modern country such as Madrid, Spain, a person can spend several days trying to find something as simple as an Ethernet cable. Do not forget that things are not always as advertised. Until you have been there, don't count on anything being as advertised. Our experience has shown that it is best to arrive a week early if possible and having a local contact is invaluable.

The webcast - Issues

Once you have arrived and successfully "setup shop" you have to determine how much bandwidth you have. Or more importantly, what is the bandwidth back to the server. While local bandwidth may be very high, there may be a low bandwidth link somewhere between you and your servers. The only way to verify what you have is to test the stream and to adjust the video and audio data rates (VLC provides this capability) to obtain the best quality of service possible. It helps to have someone monitoring the stream from a location at or near the server and to have them communicate to you regarding the stream quality (the chat room works nicely for this). Unfortunately, there is no obvious formula for determining the best combination of frame rates and bit rates – other than the heuristic that audio requires a lower data rate than video and the solar view requires a lower frame and bit rate than the countryside view. Given the many variables, trial and error is the only real solution.

Highlights

As previously stated our expeditions have taken the SEMs team to India, Panama, Spain and Turkey. In all cases we have found the local population very interested in what we are doing and very helpful. Yet, due to infrastructure limitations we have had to "setup shop" in some rather interesting places. Figure 3 shows the June 8, 2004 Venus transit webcast site in the residential compound at the U.S. Embassy in Delhi, India (after a dust storm knocked things over). Figure 4 shows the April 8, 2005 hybrid eclipse website at an equestrian center outside of San Carlos, Panama. About 100 people stopped to see what we were doing and to watch the eclipse. Finally, Figure 5 shows the October 3, 2005 annular eclipse website on the roof of an observatory at the Universidad Autonoma, Madrid, Spain.
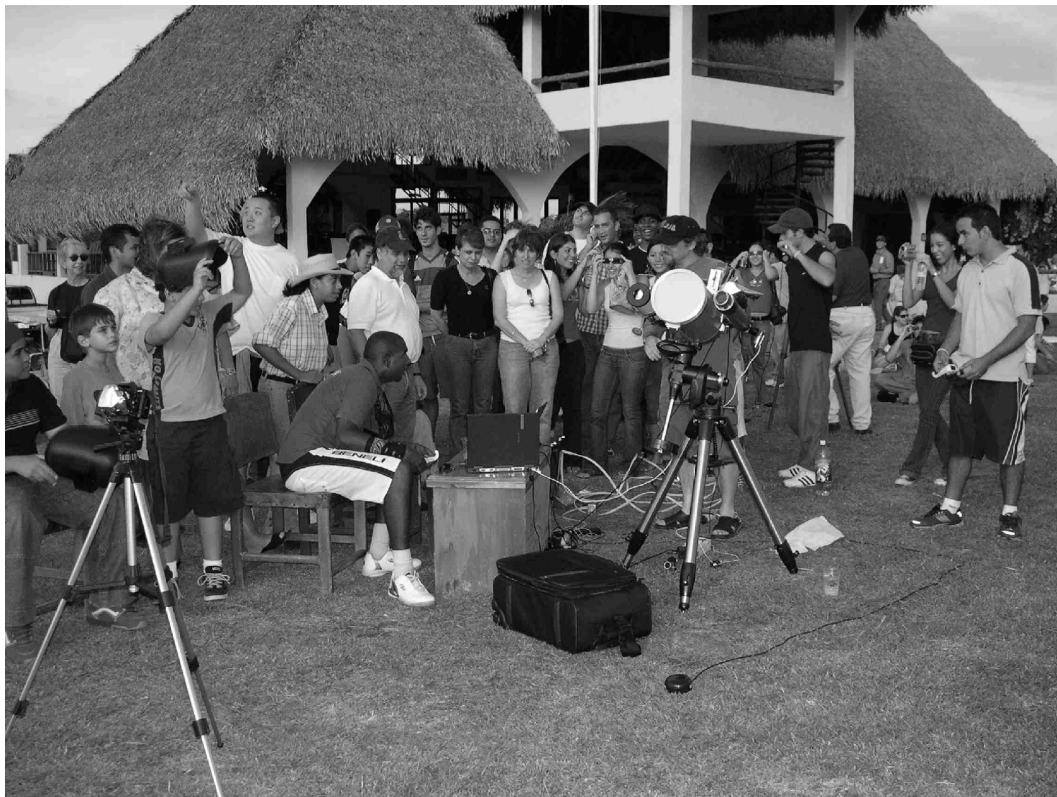
Figure 3. India.

Figure 4. Panama.

Figure 5. Spain.

Conclusion

To conclude, we have developed a webcasting system that uses no commercial software and yet, allows the SEMs team to travel the world to bring to the world the wonders of rare astronomical events. Our system allows the SEMs team to webcast streaming color video and allows the team to interact with viewers around the world via a chatroom and interactive audio. A similar webcast system could easily be developed by anyone else wanting to produce such live events.

Lastly, our webcasts have garnered international media attention for SEMs and UND. While in India, several South Asian newspapers ran stories about our expedition. During the lunar eclipse the BBC called Tim Young for a live interview on the BBC radio program "World News." While in Panama, La Prensa (the national newspaper) and MSNBC carried stories about our expedition. Finally, while in Spain, Tim Young was interviewed by an Associated Press reporter for an article on the eclipse. The article was carried by several major online outlets including USA Today, ABC and CBS.

References

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