

Internet2 Fall 2002 Performance Event Best Practices Guide (DRAFT)

Introduction

On 29 October 2002, in conjunction with the Internet2 Fall 2002 Member Meeting, Internet2 presented a music and dance performance event highlighting the capabilities of high performance networking-enabled collaborations and the talents of performers from our member institution campuses. *Cultivating Communities: Dance in the Digital Age* featured a showcase of regional dance and music around the country using low-latency interactive audio and video.

This *DRAFT* document is an attempt to describe the technical components involved in producing the event, which involved video streamed live from six remote sites to the Bing Theater on the University of Southern California (USC) campus. We will describe how we accomplished various tasks to make this performance event a reality and what we might do differently given what we learned.

In addition to Internet2, the Manhattan School of Music, and USC, many other Internet2 member institutions also provided production support for this performance event. Internet2 would also like to acknowledge [Sun Microsystems](#) and [Qwest Communications](#) for their support. A complete list of production staff and contributors can be found here: <http://arts.internet2.edu/fall2002-perfevent-credits.html>.

For more background information about this event, see <http://arts.internet2.edu/fall2002-perfevent.html>

The Goals for this Event

In hosting this performance event, Internet2 hoped to provide a proof-of-concept for a live dance performance—in a theater setting—that also integrated multiple live remote performances. Our goals for the performance event also included an educational component. Internet2's intention was to share the lessons learned in producing such events in a panel debrief discussion with all the event producers (held at the Fall Member Meeting), a best practices guide (which you are reading now), and share additional support documents including production scripts and technical diagrams (available on the Internet2 web site). Internet2 and our performance event collaborators hope that the lessons learned in producing *Cultivating Communities: Dance in the Digital Age* will assist our member institutions in producing similar events.

Projection/Cameras/Video

The performance event utilized a bank of MPEG-2 codecs and proprietary computer processing units that streamed video and audio signals between six remote campuses and the Bing Theater on the University of Southern California campus. Incoming signals from remote sites were fed into a Folsom 1603 Screen Pro Plus switcher connected to

three Christie Digital Roadie X10 DLP projectors for display in the Bing Theater. Two additional Panasonic MX 50 video switchers were used to send three local DV camera feeds (Sony DSR 300 and DSR 370) back to remote campuses as well as to feed both remote and local video signals to the live netcast. The cameras used for the event were record-capable DVCam cameras operated by USC students provided through Trojan Vision Television, a service of the University of Southern California Annenberg Center.

There are a number of considerations regarding selection of video projectors for an event including brightness and lumens, DLP vs. LCD, power requirements, keystoneing, and lenses. Factors affecting lumen requirements are level of ambient light in your performance venue, throw distance from projection position to stage, and size/placement of screens on stage. For example, the darker the theater, smaller the screen, and shorter the throw distance, the less lumens are required. At the Bing Theater, we had the ability to darken the theater, but had long throw distances of approximately 70' – 80' and screens varying in size from 9' x 12' to a large 17' x 30' screen. Thus, we selected a 10,000 lumen Christie Digital Roadie X10 projector to meet our requirements. Due to the fact that we used multiple screens in various stage positions, we had a variety of throw distances between projectors and screens, which therefore required the use of different lenses to accommodate changing focal lengths.

For an excellent summary of the advantages and disadvantages of LCD vs. DLP projectors, see http://www.projectorcentral.com/lcd_dlp.htm. The Christie Digital Roadie is a 3-chip DLP technology, which provided good contrast, minimal pixelation and accurate color reproduction optimal for the Bing event.

Keystoneing is a distortion of the projected image due to an ineffective angle of the projector to the screen. For instance, at the Bing Theater, the projection booth is at a steep angle relative to the stage causing a distortion of images where the top of the projected image appears wider than the bottom of the image. Some projectors are available with digital keystone correction, but this feature is not always entirely effective. Thus we placed the projectors at the back of the theater. An unanticipated challenge with this placement was the noise generated from the fans on the projectors. Also, each projector required its own 20-amp circuit (see section below on power distribution).

Audio

The audio system for the event used six mixing consoles to accomplish discreet routing of both remote and local audio: two Mackie 1604 mixers for local audio, one Mackie SR24/4 for remote audio, one Yamaha 01V for netcast, one Yamaha 03D for producer / MC communication, one Crest console for front of house (FOH) audio in the Bing Theatre. Remote audio from the Star Valley and VBrick codecs were fed to the Mackie SR console and split to the crest FOH console in the Bing. Local audio from the Bing theatre was fed to the two Mackie 1604 consoles and then sent to the Star Valley and VBrick codecs. The Netcast audio was routed from the Mackie SR (remote), and the Mackie 1604 (Local) and then fed to a VBrick codec.

Early on during the setup the proximity of the codecs in relation to the audio location became an issue, due to the length of unbalanced runs. Balancing boxes were placed

between the codec and backstage mixers to balance the lines in an effort reduce hum. This proved to be somewhat successful. A ground loop occurred when audio was routed from the backstage position to the front of house console even though there was isolated power for both FOH and backstage audio positions. Therefore, a splitter, which utilized a transformer in its path to the front of house position, was introduced to reduce the ground problem. A great deal of audio issues could have been eliminated if the audio station was located directly beside the networking codecs thus eliminating the need to use long runs to and from the audio and networking position. The Mackie console proved to be unreliable for this event. In the future a better mixing console with matrixing (routing) should be used to mix and route remote and local audio.

The wireless microphone from the producer was discreetly routed to a wireless in-ear monitor for the Master of Ceremonies (MC). This system worked well and gave immediate communication regarding backstage concerns from the producer to the MC.

Power/Distribution Amp

Productions prior to the Bing event have demonstrated that sharing electrical circuits for various components in a theater set up can lead to audio buzzes that are hard to debug. Also the amount of power required to run all of the equipment can blow circuits in many older theaters. For these reasons, we rented a 200 Amp power distribution amplifier with 200 feet of feeder. This allowed us to tie in to a 200 Amp disconnect backstage and run cable through the catwalk to back of house where the projectors were located. There are two types of tie-ins for distribution amps, camlock or tails. The tie-in used at the Bing was tails.

Monitors

Approximately 25 production video monitors were used back stage by networking and video production staff. In the future, additional monitoring of a “live” remote site for audio production staff should be included for confidence monitoring purposes. Initially, we planned to have video monitors displaying remote sites on stage for performers, however, we assessed that this was not a necessary expense as on-stage performers were interacting with large projection screens and therefore didn’t require these monitors.

It should be noted, that musical events differ from dance events in that musicians require a series of video monitors of remote locations on stage, because looking up at projection screens is not practical or tenable. Whereas dance events can use the large projection screens to interact with partner sites.

In-House Communication System

There are two technologies most likely to be found in theaters for in-house communication systems: ClearCom and Telex RTS systems. The Bing Theater has a ClearCom system, which is a headset-based, party-line system allowing all people on a

given channel to talk and listen to each other. In some ClearCom systems, multiple channels may be used to separate technical staff by function, for example, all networking staff can use one channel, and all theater production staff (i.e.; lighting, flyrail, house audio, etc.) a separate channel. The Bing Theater had nine installation points, each requiring its own power supply.

Unfortunately, the Bing Theater ClearCom system had only one channel of communication available; thus, two more intercom systems were integrated into the in-house communication system in order to allow for additional stations required throughout the theatre and to enable certain specific production groups to communicate discreetly on secondary channels. For example, an RTS system owned by Trojan Vision was integrated so that the Technical Director (i.e., camera switch operator) could communicate with the three camera operators in the theatre while remaining in contact with the Line Producer. In addition, a secondary party line intercom system owned by the Bing Theatre was integrated so that the audio lead could communicate separately with the Front of House (“FOH”) audio engineer as well as maintain communication with the Line Producer on a separate channel. Ultimately, 16 production staff members were connected via in-house communication systems throughout the duration of the dress rehearsal and performance. Here is more information about the ClearCom RTS system: <http://arts.internet2.edu/files/Clearcom-RTS-System.pdf>.

Remote Site Communication Systems

For communication with the staff at the six remote campuses, we set up three audio conference calls that were live throughout the duration of the tech and dress rehearsals and the live show. The calls were divided into three subgroups: networking, audio, and stage management.

As there were no available POTS lines backstage at the Bing, the production staff relied on cell phones to access conference calls with remote sites and headsets for in-house communications. In addition to the intermittency of cell phone service, the combination of headsets and cell phones proved to be impractical. Production staff needed a “hands-free” system so that they could communicate with remote sites while simultaneously operating codecs, switchers, and mixing consoles. In other Internet2 performance events, a set up that has worked well was an RTS phone bridge to an audio conference call with remote performers. This worked much better because the remote sites were then just "on headset" like everyone else. In the future, a telex matrix could be introduced to route ClearCom/RTS communication systems between remote and local sites. Utilizing only RTS/ClearCom devices for communication for backstage and between local and remote sites would greatly improve communication audio quality and reduce confusion.

Netcast

Two Panasonic MX-50 switchers were used to route content to the netcast. The first MX-50 was used to route house cameras plus an input from the graphic imaging system deployed backstage by University of California, Irvine. Through this switcher, video

signals were sent back to the remote sites and also fed to the second MX-50 used to select netcast content. This second switcher also had inputs from two of the three video projector sources and a VCR for playback of an alternate version of the New World Symphony performance. This version was recorded in stereo since the immersive sound system in the house was unable to be dumbered-down to stereo for the netcast feed.

The netcast feed was then sent via a VBrick MPEG-2 codec to the Internet2 offices in Ann Arbor, MI. The signal was decoded and then re-encoded into a variety of formats allowing the event to be viewed via IP/TV, NCast MPEG-1 stream, VBrick MPEG-2 stream, Windows Media, or a Real Stream.

Some engineers find that the MX-50 is more suitable as a post-production mixer than for live events. However, this unit is a cost-effective rental option compared to the price of a live broadcast unit.

Stage Design

Prior to setting up the Bing Theater, each remote site engaged in a series of teleconferences, e-mail exchanges and, where possible, meetings to assess their needs for stage setup. We defined requirements for physical placement on the stage, audio, projection and screens, dance floor, monitors and video processing, and basic lighting. Through these conversations we determined that a variety of screens would be required, and that some screens would need to be custom designed in order to serve the multiple needs of the show. We built three 9' x 12' screens that allowed for both front and rear projection, using a semi-transparent scrim material so that a lit local dancer behind the screen could be seen through the projected image of a remote dancer. This special material is called silver sharktooth scrim, made with 66% silver fiber and 33% gray cotton thread. These three screens also had an optional opaque backing (attachable with velcro) to allow for optimal front projection without semi-transparency. Each screen frame had hanging hardware and loose pin hinge hardware attached to two sides, allowing for quick change hanging or stage jack assembly, set up as either 9' x 12' or as 12' x 9'.

Additionally, the Integrated Media Systems Center at USC built a screen with a 30' width and 17' height to accommodate the HD 16:9 aspect ratio for the New World Symphony portion of the evening.

Key to creating the screen configuration was an understanding of the equation for projection dynamics: $\text{Distance from Projector to Screen} / \text{Lens Focal Length} = \text{Projected Image Width}$. This formula dictated the screen configurations and placement of the screens on the stage, which determined the area of dancers' movement in the stage space and affected stage lighting positions to guard against light spill on the screens.

For lighting, we used the Bing Theater house plot, which provided an attractive base setup and also provided flexibility if performances required customization. Most of the light for the local live dancers was supplied by special Shin Busters – which are standing light booms set up in several positions both off stage left and right, to cast side shuttered,

focused beams of light onto the dancers without washing out the screens. A lesson learned is that lighting is integral to the dance medium, as the performers and audience both expect the lighting to add to the dance, much more so than, for example, lighting musicians as in previous Internet2 productions. In future dance productions, appropriate time and planning will be required in order to integrate the needs of several sites, as well as the needs for lighting for video and masking for projection into an overall unified lighting plan.

The Bing Theater owned a marley dance floor that we had installed for use during the event. A marley floor provides a smooth surface ensuring that dancers are protected from flaws, nails etc. in the floor of a multipurpose theater.

Several theater crew members were needed to assist with the production of the show, including theater manager, audio assistant, lighting assistant, fly rail operator, follow spot operator, and running crew to assist in shifting scenery and equipment, and to help with fly rigging.

Media Coverage

Media coverage was arranged through the Internet2 Director of Communications and the University of Southern California News and Media Services Department who provided an interface to Los Angeles media sources. Reporters from the Los Angeles Times were present both during dress rehearsal and the performance and conducted follow up interviews after the show. Media coverage from the performance event can be found here: <http://arts.internet2.edu/fall2002-perfevent.html#press>.

Production Scheduling

For the Bing performance event, we used the following production schedule:

Tech Load in and Set-Up — 2 days

Technical Rehearsal — 1 day; 1 ½ hours per site

Dress Rehearsal — ½ day

Performance event — ½ day

For future events, the production schedule will need to be refined in terms of technical and dress rehearsal time allocation. Defining the terms of a technical rehearsal needs to be laid out in greater detail so that partner sites and in-house production staff clearly understand the goals of this rehearsal. For example, the technical rehearsal needs to cover the basic elements required for the virtual environment: codecs and networking, audio and video signals. Live performance stage elements such as blocking, lighting, and segment transitions need to get covered in a more thorough and extended dress rehearsal.

Additionally, partner sites must make performance venue available for technical and dress rehearsal sessions so that environmental conditions are constant throughout. Using a networking server room for the technical rehearsal and then moving to a performance

venue for the dress rehearsal/performance is not useful from networking, audio or video standpoints. In addition to a dress rehearsal, a performance run-through is advised to bring together all the elements in a time-sensitive simulation.

Backstage/Tech Center Set Up

Prior to arriving at the theater for equipment load in, the production director diagrammed where all equipment and staff were to be placed. Thought was given to placement of staff for optimal communication, direct line of sight to stage, location of electrical outlets, fire code, noise reduction, tables to place equipment, chairs for staffing etc.

Production Staffing

A complete list of production staff and contributors can be found here: <http://arts.internet2.edu/fall2002-perfevent-credits.html>.

Scripting

Here is the production script used for the performance event: <http://arts.internet2.edu/files/BING-PRODUCTION-SCRIPT.pdf>.

Technical Diagrams

Here are diagrams of the video and audio set-up used for the performance event:
<http://arts.internet2.edu/images/BingVideoDiagram.gif>
<http://arts.internet2.edu/images/BingAudioDiagram.gif>

For More Information

For more information about the Fall 2002 Internet2 Performance Event, or about other arts initiatives taking place throughout the Internet2 community, please contact Ann Doyle, Internet2 Manager for Arts & Humanities Initiatives at adoyle@internet2.edu or call (734) 352-7011.

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