Deploying SMPTE ST 2110 in a Distributed Campus System
Introductions & Roles
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DELTA’s role within the Office of the Provost is to foster the integration and support of learning technologies in NC State’s academic programs, both on the campus and at a distance.
Vision
We seek to improve the quality of education by harnessing technology to provide ready access for all learners. In this way we hope to meet the challenges of a changing society.
Mission

Transformative educational experiences benefit a complex, global society and are key to a quality future. DELTA collaboratively applies expertise in innovative technologies and pedagogies to solve instructional challenges in an efficient, effective and service-oriented environment, with the overarching goal of helping faculty build student success.
As we continue elevating and perfecting DELTA’s services, we make a difference at NC State and beyond. We are delivering on our promise to provide high-quality education to all learners — both on campus and at a distance.
Exploration in Excellence

As we continue elevating and perfecting DELTA’s services, we make a difference at NC State and beyond. We are delivering on our promise to provide high-quality education to all learners — both on campus and at a distance. We are driving innovation in course design, online and distance education programs, media and emerging technology production, faculty training, learning technologies and more. We are committed to supporting faculty as they guide students to a successful future.
Programs Supported

1. Online and Distance Education 100+ Programs
2. NC State Jenkins Online MBA Ranked 7th in the Country by The Princeton Review
3. Engineering Online Ranked 8th by US News & World Report For Graduate Engineering Programs
4. UNC Online Course Exchanges
   – Language Exchange
5. Geographic Information Systems (GIS)
Statistics
FY 2018/2019

• 131 Live Courses, Captured, Supported, and Monitored
• 1,708,017 Live Stream and Recording Views
• 7,055 Hours of Classroom Recordings
• 46,484 Enrollments in Online and DE Courses
Deploying SMPTE ST 2110 in a Distributed Campus System

Multi-Vendor, COTS-based, ST-2110 Live Production system
Project Objectives

Create a distributive campus AV system that enables the following:
Project Objectives

• Transition to a standards based, scalable, and future proof solution enabling a seamlessly transition from SDI to an all-IP.
Project Objectives

• Allows for the support of DELTA’s current locations plus expansion into additional locations throughout campus to connect, collaborate, and communicate utilizing the SMPTE ST-2110 standard.
Project Objectives

• Centralized monitoring and control of all media sources from DELTA’s nine media enhanced classrooms across eight different building.

• Customized configurations and templates.
Project Objectives

• Real-time audible and visual alarms with help desk notifications from each classroom.

• Collaborative cross connects between classrooms including interactive talkback between NOC and classrooms.
Project Objectives

• Complete independent control over classroom resources and collaboration tools from a single point.

• Centralized recording of all course lectures, video and computer content.
Project Objectives

• Real-time confidence monitoring of primary and secondary lecture captures.

• Connectivity to centralized video conferencing codecs.
Additional Goals

- Replace aging SDI routers and multiviewers.
- Maintain a hybrid SDI/IP infrastructure inside all Media Enhanced Classrooms.
- Repurpose current fiber infrastructure.
## Project Timeline

<table>
<thead>
<tr>
<th>Month</th>
<th>Event Description</th>
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<tbody>
<tr>
<td>December 2015</td>
<td>NC State begins researching next gen technologies to replace aging equipment</td>
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<tr>
<td>February 2016</td>
<td>DELTA engages vendors in talks for SDI MultiViewer</td>
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<tr>
<td>October 2018</td>
<td>ST-2110 + SDI demonstration at NC State DELTA</td>
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<tr>
<td>January 2019</td>
<td>DELTA requests SDI, Hybrid, and ST-2110 designs</td>
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<tr>
<td>April 2019</td>
<td>ST 2110 design, leveraging legacy SDI and existing fiber, are finalized.</td>
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<tr>
<td>May 2019</td>
<td>Wiring and deployment begins</td>
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<tr>
<td>August 2019</td>
<td>First classes are supported by new ST-2110 system</td>
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Key Challenges

- control of multiple manufacturer’s products
- cross campus control, monitoring and distribution
- transporting all classroom images to NOC
Key Challenges

• modification of signals for overall compatibility
• low-latency, seamless video switching
• tally system with advanced content-based alarming
Key Challenges

• long fiber runs
• compressed or uncompressed
• use of existing fiber infrastructure
Production Environment
Nine Media Enhanced Classroom
Production Environment

Seven Centralized Control Stations (PODS)
Production Environment

Dedicated Fiber Infrastructure Connecting Nine Buildings
Supported Buildings

- Winston Hall
- Mann Hall
- Park Shops
- Withers Hall
- Daniels Hall
- Ricks Hall Annex
- Central Control Center
- Poe Hall
- Monteith Engineering Research Center
- EBII
Fiber Runs

Main Campus

Ricks Hall
Withers Hall
Daniels Hall
Poe Hall
Mann Hall
Park Shops

to Centennial Campus

Winston Hall
Fiber Runs

- MRC - 10,460.7 meters, 6.5 miles
- EB II - 8,440 meters, 5.25 miles

Main Campus (within a mile)

Centennial Campus
Why was ST-2110 interesting for NC State DELTA?

• The NC State DELTA system is distributed across great distances
• Fiber runs can be >10 kilometers
• The existing SDI classroom cameras remain in use
Why was ST-2110 interesting for NC State DELTA?

• Flexibility to expand the system with additional cameras, equipment
• The existing AES67 Audio system can interoperate with ST-2110
• Integration across the campus
Why was ST-2110 interesting for NC State DELTA?

• The ST-2110 standards are designed with future-proofing, to support horizontal and vertical changes in media requirements
Benefits of IP/2110: Physical-Scale

• 10G/25G/40G/100G fiber infrastructure
  • Up to 32x 1080p HD (3G) signals per Single Mode fiber
  • Where we were doing 4 HD signals, we can now do 32x32 HD signals!
SDI to IP... IP to IP... IP to SDI
Benefits of IP/2110: Physical-Scale

• Can mix AOC-direct-attach, OM4, and Single-Mode for optimized economics

• Uses less space and a lot fewer cables
Benefits of IP/2110: Physical-Scale

• Redundancy can be easily added using ST-2022-7 model
Benefits of IP/2110: Physical-Scale

- Going IP means never having to say that you can’t make it bigger
  - UHD-capability can be built into the infrastructure
  - Network Switches can be as big as you want
Benefits of IP/2110: Audio

• SDI is limited to 16 ch of audio per video
  – Requires embedding and de-embedding at every touch-point

• In ST2110, the audio is sent on separate IP streams
  – Audio console can subscribe to every stream it needs
  – Audio console generates new streams for its outputs
Benefits of IP/2110: Audio

• Separate Audio = Total Flexibility

• The Control System ties it all together
  – Every user gets the audio and video (and ANC data) they need for their job
  – Every production can be easily configured
Benefits of IP/2110: Timing

- PTP Timing on the Media Network
  - Uses the same cables and switches as the media
  - No black-burst DA tree to design, build & maintain
  - No timecode DA tree to design, build, & maintain
  - No crazy mix of black-burst, tri-level, World Clock, DARS, ...
Benefits of IP/2110: Timing

• PTP is format-flexible across SD, HD, 3G, UHD
• PTP = timestamps on every packet of video and audio
  – The tools are there in the standards to help with sync
  – Allows equipment to synchronize audio and video anyplace in the system
Benefits of IP/2110: Choices

• Every Major Vendor is building ST-2110 interfaces now

• NC State DELTA can choose Cameras, Switchers, Replay, Multiviewers, and other equipment based on operational criteria – not technical limitations
Benefits of IP/2110: Choices

• 2110 provides the level playing field for best-of-breed systems
COTS-Based IP Core

• 9K 9336 Switch
• 7 Terabytes per second
• Could support a 1,200 x 1,200 1080p HD matrix today
• Each COTS IP Core is 1 rack unit
COTS-Based IP Core

• The same system would require full racks of additional equipment in pure SDI
• AES67 can be introduced into the switch and ST-2110 Media Network
• Allowing mix-and-match of any Audio and Video streams in the network
Multi-Viewer system leverages COTS Servers
NC State DELTA Before...

And After...
IP/2110 and Distributed Campus: Perfect Together

• ST-2110 provides a level playing field for best-of-breed systems
• Fiber optimization like never before
  —Up to 32x uncompressed HD per strand
IP/2110 and Distributed Campus: Perfect Together

• Flexibility to move everything - From audio, ancillary data and HD video to UHD and beyond
• No more tie-lines! –distributed system can perform as “one big router”
• The right gateways can extend the life of functioning SDI devices for years to come
Questions ?
Lessons Learned

• Make good manufacturer contacts, get emails and #'s, and reach out when needed
• Keep your testing organized, use shared documents and spreadsheets so the team stays on same page
• This AVoIP is more flexible than analog and takes getting used to, so be open to trying different approaches along the way.
Lessons Learned

• Be flexible when considering new workflows and SOPs. New system means things will need to change.
• And be Patient! This is a long process, it takes time and can get overwhelming, so patience is important.

Brandon Joyner, CTS
Classroom Support Technician
Lessons Learned

• Collaboration is a key component to a successful project
THANK YOU!
delta.ncsu.edu
Supplemental Materials
Why SMPTE ST-2110

The SMPTE ST 2110 standards suite specifies

• the transport, synchronization and description of separate elementary essence streams (video, audio, ancillary data) over managed IP networks (at any speed, from 1GbE to 100 GbE and beyond) for real-time production, playout and other professional media applications.
Google Link UCIP config
https://drive.google.com/file/d/0B7uJV_5eEmmsaGJpdGYyNllHNVFnV2pHUFRrcmRW
MVFVREww/view?ts=5dd83e8e