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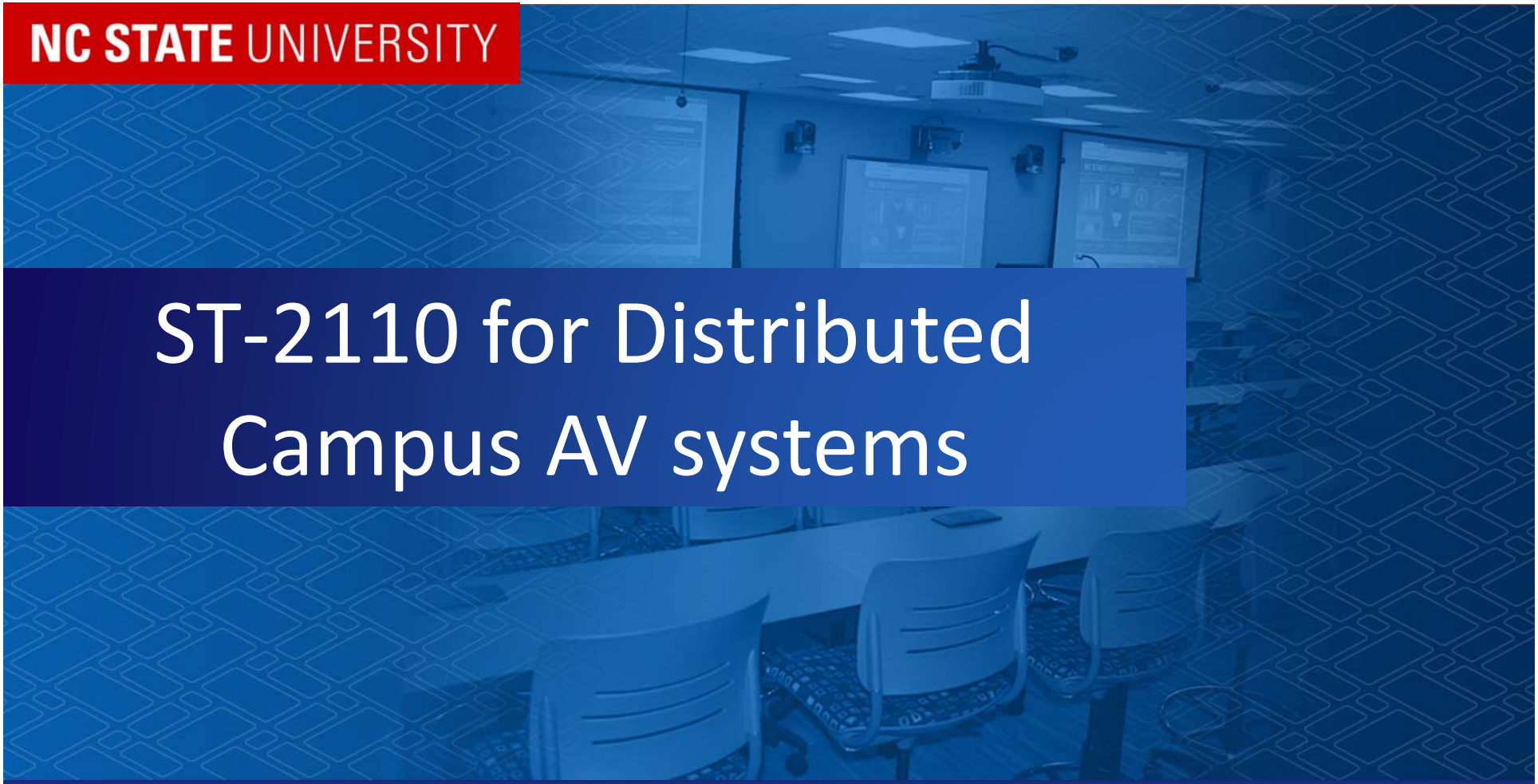

ST-2110 for Distributed Campus AV systems

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NC STATE UNIVERSITY Distance Education and Learning Technology Applications

INTRODUCTIONS & ROLES

- **Tony Pearson - Senior Associate Director**

  tpearso2@ncsu.edu

- **Shawn Colvin - Classroom Services Manager**

  secolvin@ncsu.edu

NC STATE UNIVERSITY Distance Education and Learning Technology Applications

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. We coordinate the funding and production of all distance-based credit programs and courses for the university.

NC STATE UNIVERSITY Distance Education and Learning Technology Applications

We promote high-quality education by extending the reach of the faculty and collaboratively applying expertise in technology and pedagogy in an efficient, effective and service-oriented environment.

NC STATE UNIVERSITY Distance Education and Learning Technology Applications

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.

NC STATE UNIVERSITY Distance Education and Learning Technology Applications

Programs Supported

1. Engineering Online Ranked 8th by US News & World Report For Graduate Engineering Programs
2. Online and Distance Education 100+ Programs
3. UNC Online Course Exchanges
   - Language Exchange
4. Geographic Information Systems (GIS)

NC STATE UNIVERSITY Distance Education and Learning Technology Applications

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**
- **Enrollments supported directly through ST 2110 infrastructure 4762**

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ST-2110 for Distributed Campus AV Systems

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

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Project Objectives

Create a distributive campus AV system that enables the following:

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- A transition to a standards-based, scalable, and future proof solution enabling a seamlessly transition from SDI to an all-IP platform for NC State University's Distance Education and Learning Technology Applications Learning Spaces support team.

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- Future expansion into additional locations throughout campus to connect, collaborate, and communicate utilizing the SMPTE ST-2110 standard.
- Centralized monitoring and control of all media sources from DELTA's nine media enhanced classrooms across eight different building.

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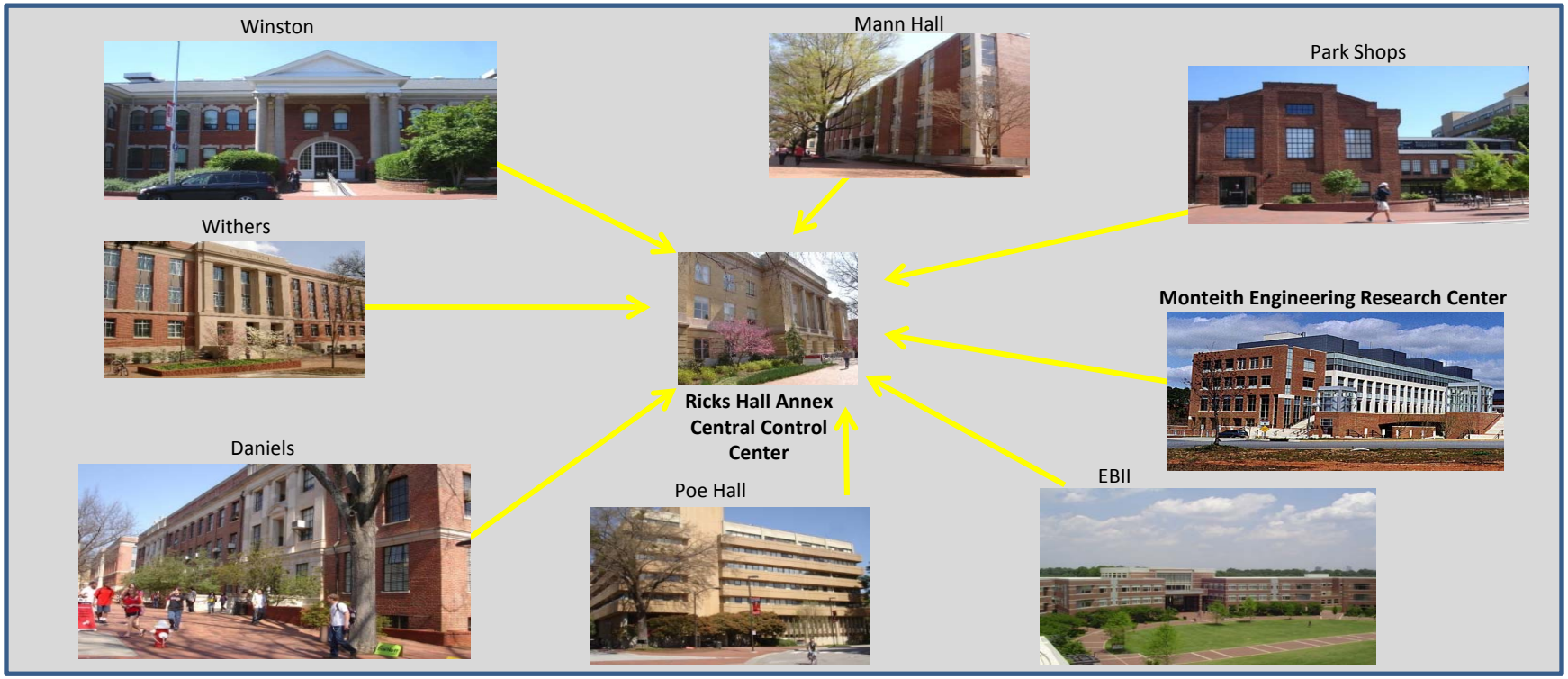
Supported Buildings



- Customized configurations and templates.
- 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.

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- Complete independent control over classroom resources and collaboration tools from a single point.
- Centralized recording of all course lectures, video and computer content.
- Real-time confidence monitoring of primary and secondary lecture captures.

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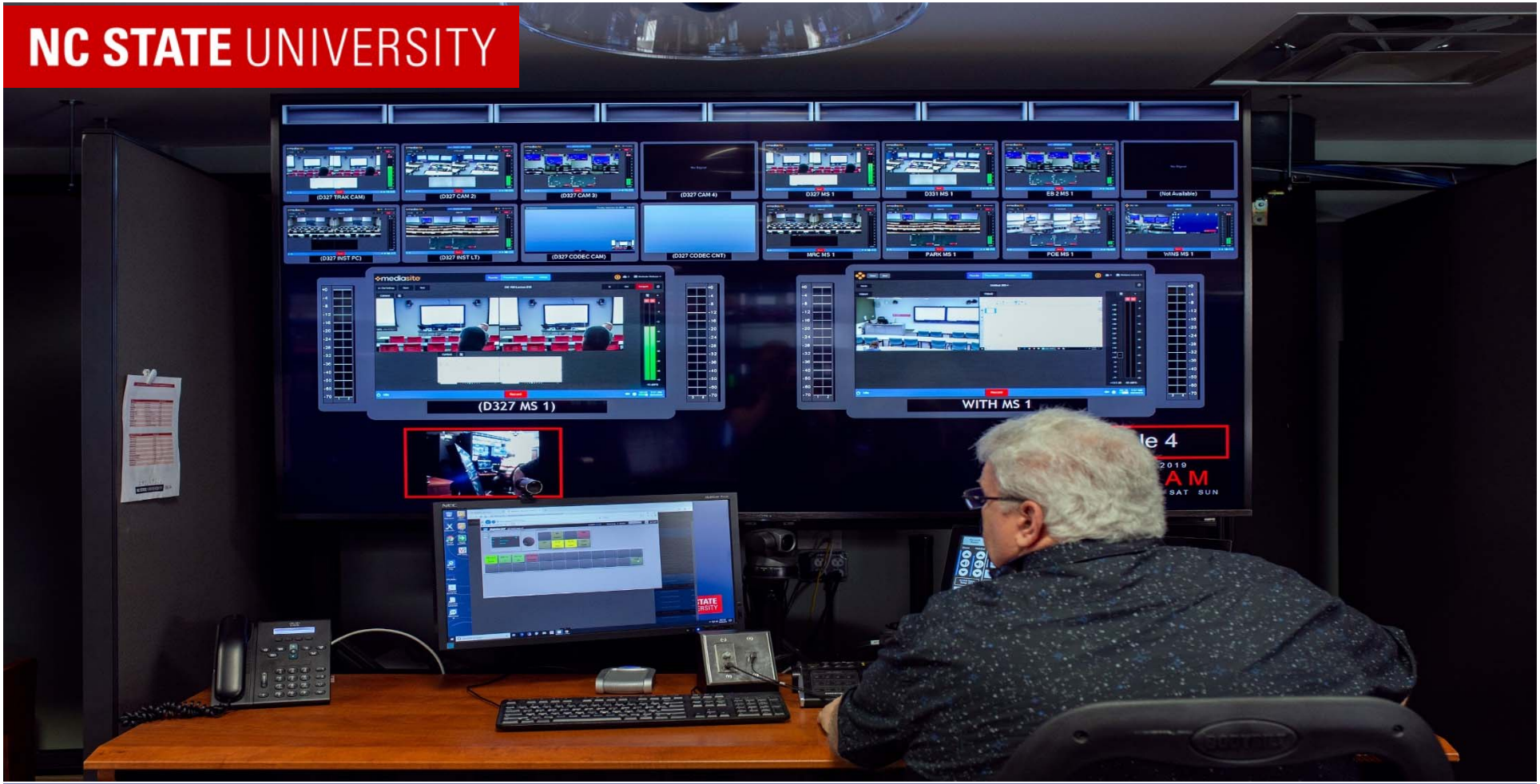

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- Connectivity to centralized video conferencing codecs

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Additional Goals

- Replace aging SDI routers and Multiviewer Systems
- Maintain a hybrid SDI/IP infrastructure inside all Media Enhanced Classrooms.

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Key Challenges

- control of multiple manufacturer's products
- cross-campus control, monitoring and distribution
- transporting all classroom images to Central Control Room
- modification of signals for overall compatibility
- low-latency, seamless video switching
- tally system with advanced content-based alarming

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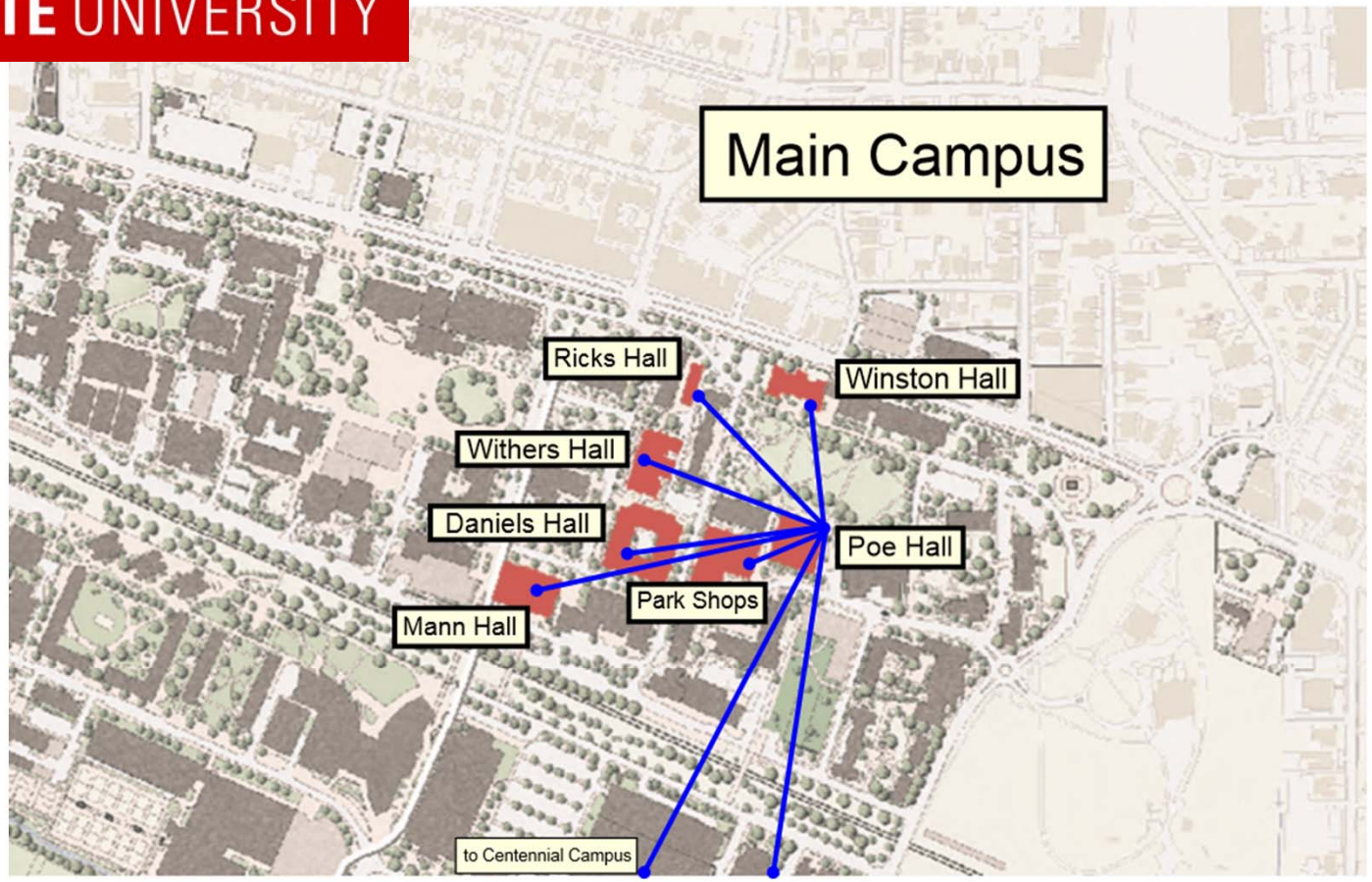
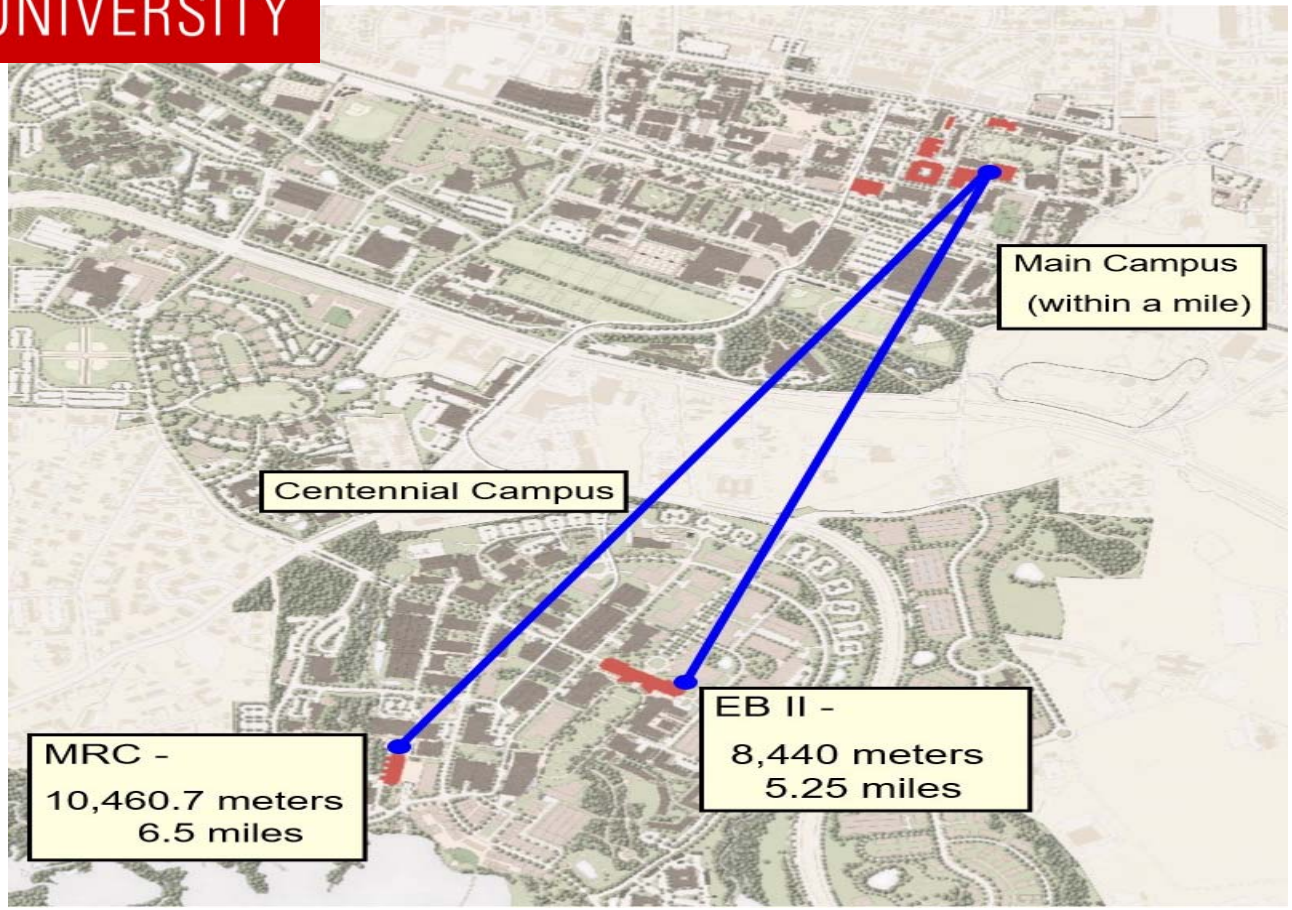
Key Challenges

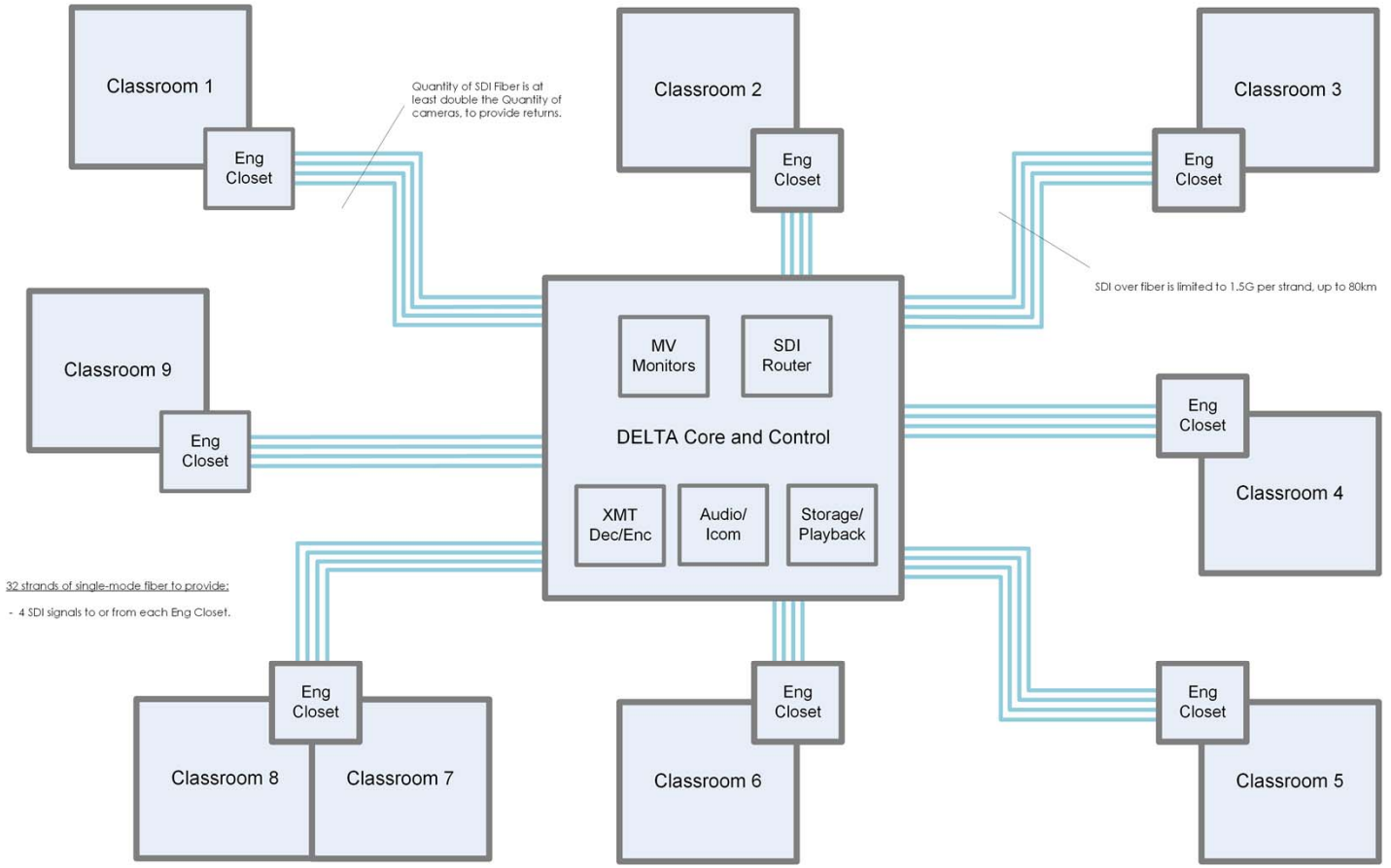
- Long fiber runs
- Compressed or uncompressed
- Use of existing fiber infrastructure

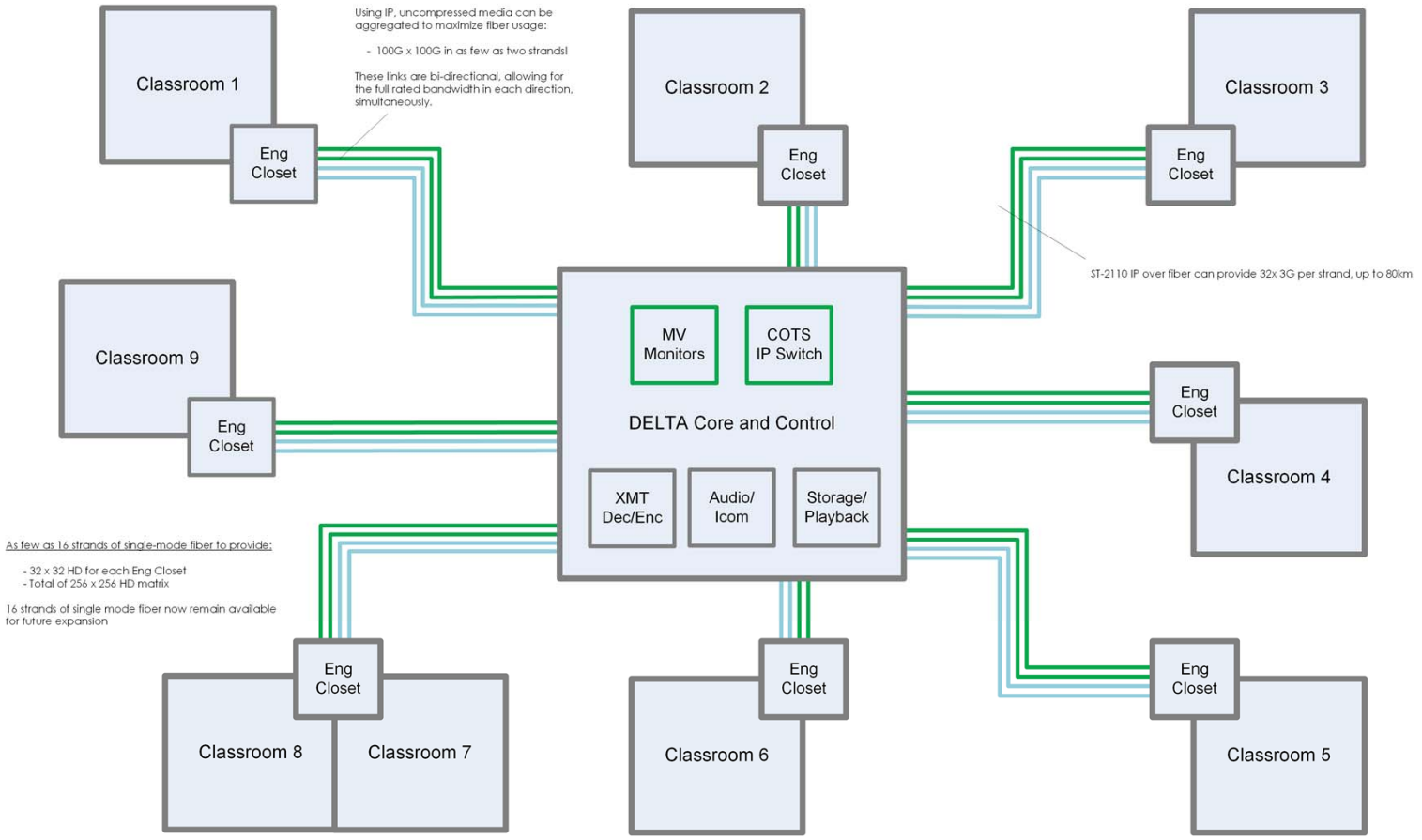
Fiber Runs


Main Campus
Ricks Hall
Winston Hall
Withers Hall
Daniels Hall
Poe Hall
Park Shops
Mann Hall
to Centennial Campus

Fiber Runs


Main Campus
(within a mile)
Centennial Campus
EB II -
8,440 meters
5.25 miles
MRC -
10,460.7 meters
6.5 miles


Classroom 1
Eng Closet
Quantity of SDI Fiber is at least double the Quantity of cameras, to provide returns.
Classroom 2
Eng Closet
Classroom 3
Eng Closet
SDI over fiber is limited to 1.5G per strand, up to 80km
Classroom 9
Eng Closet
MV Monitors
SDI Router
DELTA Core and Control
XMT Dec/Enc
Audio/ Icom
Storage/ Playback
Eng Closet
Classroom 4
32 strands of single-mode fiber to provide:
- 4 SDI signals to or from each Eng Closet.
Eng Closet
Classroom 8
Classroom 7
Eng Closet
Classroom 6
Eng Closet
Classroom 5


Using IP, uncompressed media can be aggregated to maximize fiber usage:
- 100G x 100G in as few as two strands!
These links are bi-directional, allowing for the full rated bandwidth in each direction, simultaneously.
Classroom 1
Eng Closet
Classroom 2
Eng Closet
Classroom 3
Eng Closet
ST-2110 IP over fiber can provide 32x 3G per strand, up to 80km
Classroom 9
Eng Closet
MV Monitors
COTS IP Switch
DELTA Core and Control
XMT Dec/Enc
Audio/ Icom
Storage/ Playback
Eng Closet
Classroom 4
As few as 16 strands of single-mode fiber to provide:
- 32 x 32 HD for each Eng Closet
- Total of 256 x 256 HD matrix
16 strands of single mode fiber now remain available for future expansion
Eng Closet
Classroom 8
Classroom 7
Eng Closet
Classroom 6
Eng Closet
Classroom 5

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Why 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.

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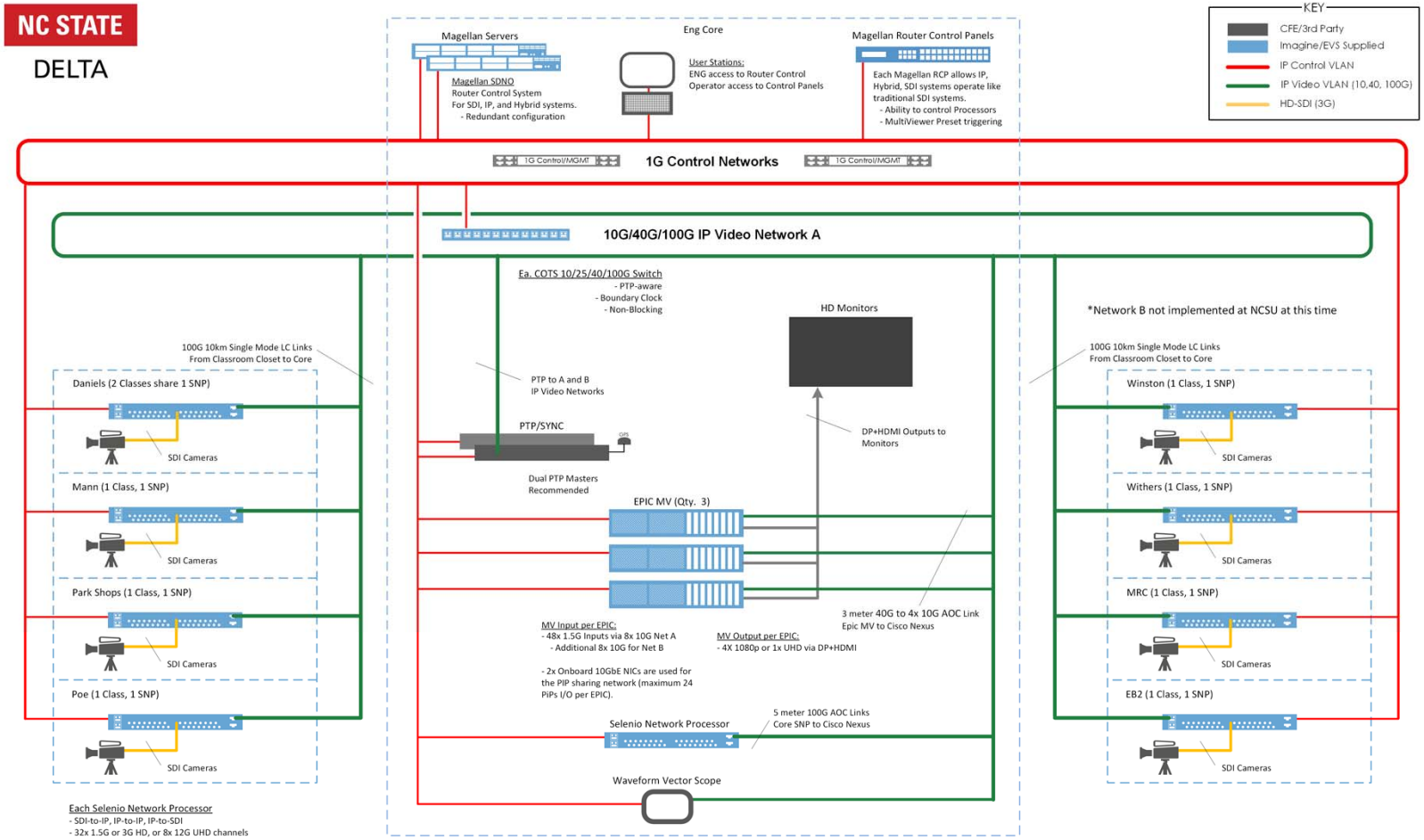
DELTA



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Production Environment

1. Dedicated Fiber Infrastructure Connecting Nine Buildings
2. Nine Media-Enhanced Classrooms
3. Seven Centralized Control Stations (PODS)
4. Eight Equipment Closets
5. Two Mini Studios
6. One Collaboration Room
7. One Centralized Server Room
8. Privet Fiber Media Production Network


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Extron
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Project Timeline

December 2015

NC State begins researching next gen technologies to replace aging equipment

February 2016

DELTA engages vendors in talks for SDI MultiViewer

October 2018

ST-2110 + SDI demonstration at NC State DELTA

January 2019

DELTA requests SDI, Hybrid, and ST-2110 designs

April 2019

ST 2110 design, leveraging legacy SDI and existing fiber, are finalized.

May 2019

Wiring and deployment begins

August 2019

First classes are supported by new ST-2110 system

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
- Flexibility to expand the system with additional cameras, equipment
- The existing AES67 Audio system can interoperate with ST-2110
- Integration across the campus
- 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!
  - Can mix AOC-direct-attach, OM4, and Single-Mode for optimized economics

Benefits of IP/2110: Physical-Scale

- Uses less space and a lot fewer cables
- Redundancy can be easily added using ST-2022-7 model
- 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 16ch 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
- 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, Word Clock, DARS, …
- 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

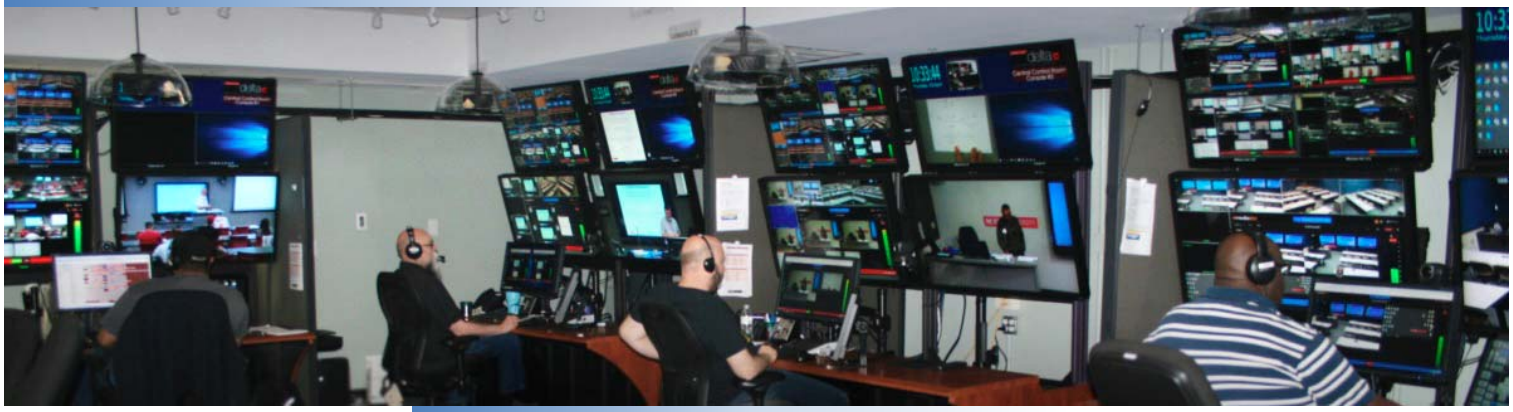
- Every Major Vendor is building ST-2110 interfaces now
- NC State DELTA can choose Cameras, Switchers, Replay, Multiviewer Systems, and other equipment based on operational criteria – not technical limitations
- 2110 provides the level playing field for best-of-breed systems

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
  - 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
- 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

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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
- AVoIP is more flexible than analog and takes getting used to, so be open to trying different approaches along the way.
- 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, Classroom Support Technician

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Supplemental Materials

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Google Link UCIP config

https://drive.google.com/file/d/0B7uJV_5eEmmsaGJpdGYyNllHNVFnV2pHUFRrcmRWMVFVREww/view?ts=5dd83e8e

NC STATE UNIVERSITY Distance Education and Learning Technology Applications

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.

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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.