

# ST2110 for Theatres

**JATET 2023 IP Seminar**

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# Agenda

## Introduction – Cameron O'Neill

- Why use IP? Sydney Opera House Case Study
- Modern IP Protocols (ST2110, SDVOE)
- Advantages/Use Cases
- Design Considerations





# Introduction: Cameron O'Neill



- BSc in Physics, Masters in Arts Management
  - Harvard Business School CME
  - 2006-2011: Head of Theatre Technology, Sydney Opera House
  - 2011-2019: Director, APAC, Riedel Communications
  - 2020-2021: Director, Harman Professional
  - 2022-Present: Country Manager, NEP
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- Lived in Japan since 2015, but still learning Japanese, so my apologies for any mistakes!



# Introduction: NEP

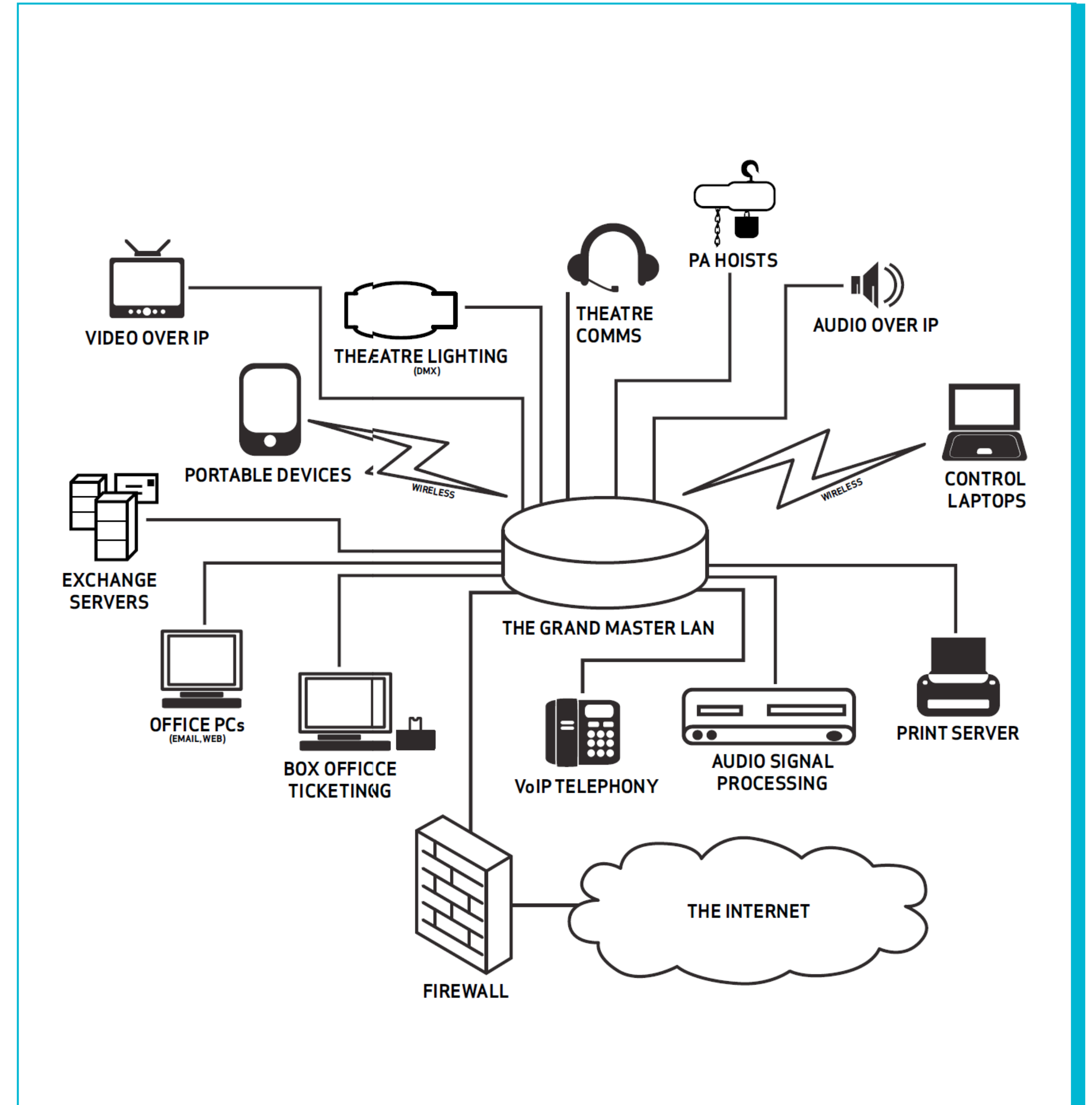
- World's largest Outside Broadcast company
- 200+ OB Trucks, 4000+ Employees
- Production company for Superbowl, Eurovision Song Contest, J-League, Academy Awards...
- World's first ST-2110 Broadcast Facility in Sydney, Australia, connecting 50+ venues (including 3,500km away in Perth)



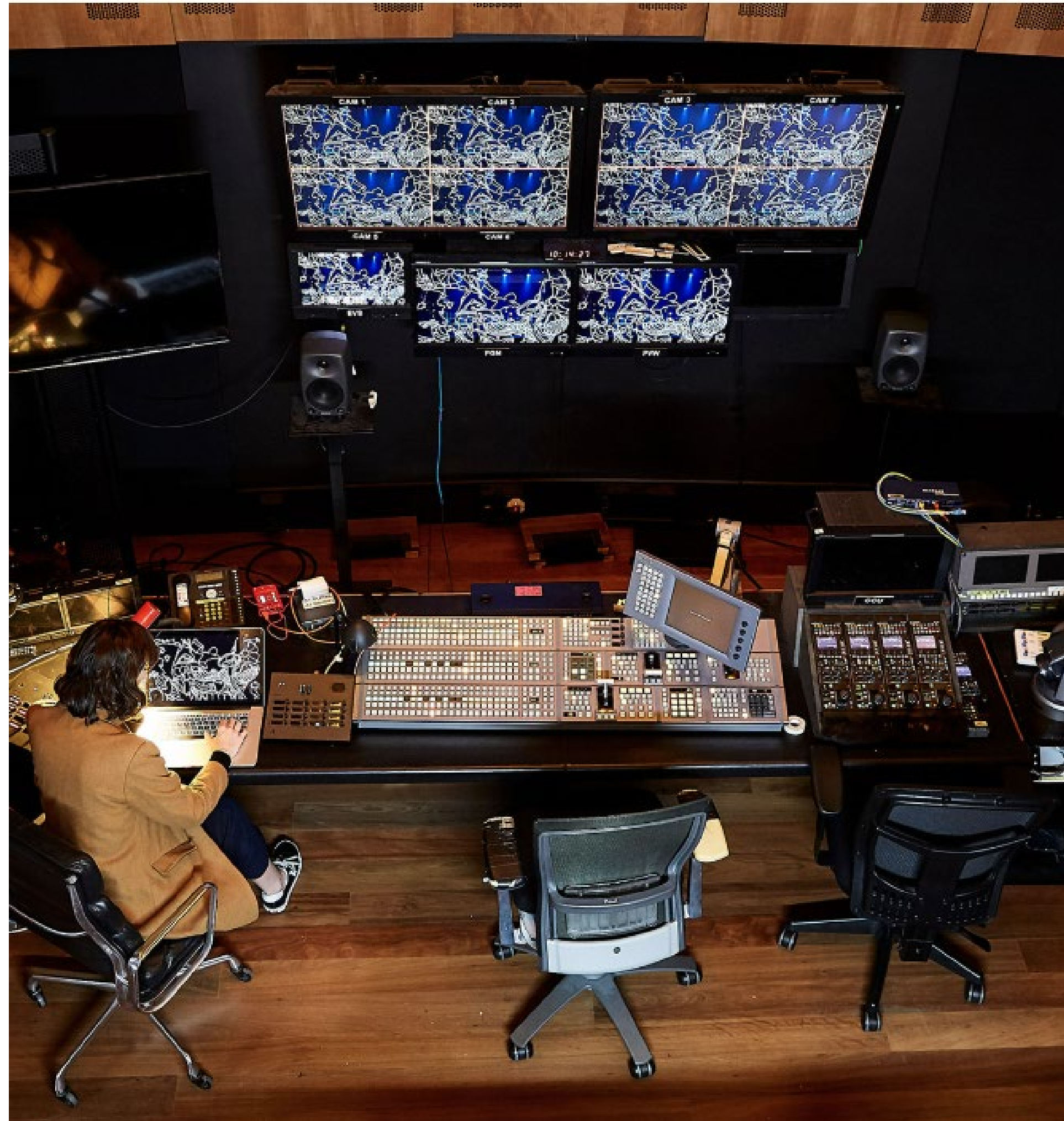
# Why Use IP?

## Sydney Opera House

- Sydney Opera House (SOH) has 6 stages, 15 rehearsal rooms and 2 outdoor venues
- Patching for a major event would take 2-3 technicians about 1 week to complete
- Venues worked as “islands” - there was no connection between different halls
- Multiple systems with unique cabling meant that installation and maintenance was expensive
- When broadcasts took place, it required an OB Truck



# SOH Now



- Fully Integrated Recording and Broadcast studio allows for internal production
- All venues connected, allowing for seamless coordination
- Shorter changeover times means more shows per year – peaking at 1,800 events per year
- 22km of fibre installed over 3 years
- ~50 network switches
- Networked intercom to local police, government agencies

# Video over IP (VoIP) Standards



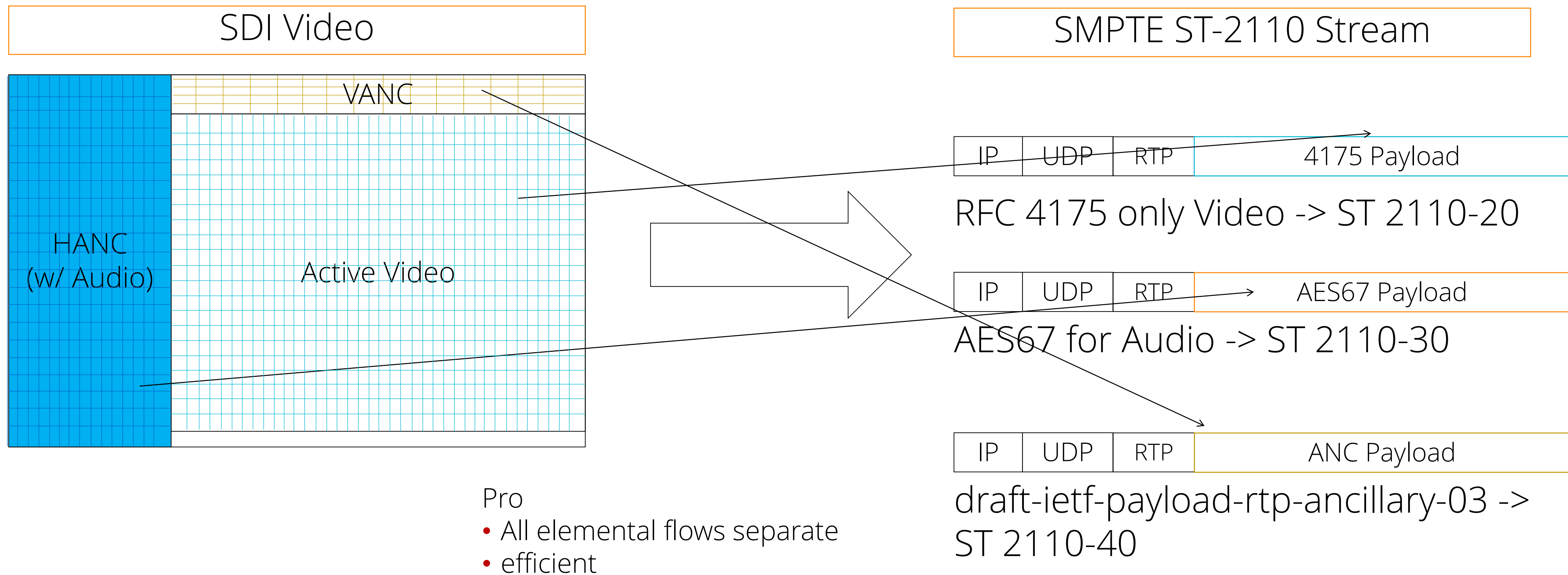


# Key Concepts

- **Compressed vs Uncompressed**
  - Compressed video trades latency and quality for bandwidth
  - 1080p Uncompressed takes 3Gbps per video. JPEGXS takes 0.3Gbps per video; h.264 can be as little as 6Mbps!
- **Encapsulation**
  - Encapsulation is taking a video source and “encapsulating” it in a data packet for IP transfer
- **Latency**
  - The time between an input and an output
  - Has multiple causes:
    - Compression
    - Encapsulation
    - Transport
- **Synchronisation**
  - The receiving of all signals at the same time (Genlock or Word Clock)
  - Allows switching between different cameras without any “jerk”



# SMPTE 2110



- Pro
- All elemental flows separate
  - efficient
- Con
- Timing sensitive



# SMPTE-2110 (ST-2110)

## Pros

- One-to-one bit mapping of an SDI stream
- Very low latency (uncompressed)
- Able to separate Video, Audio and Data into separate components
- Widely available standard, compatible with AES-67 equipment
- Commonly used in broadcast

## Cons

- High Bandwidth requirement
- Needs synchronisation across whole network (PTP)





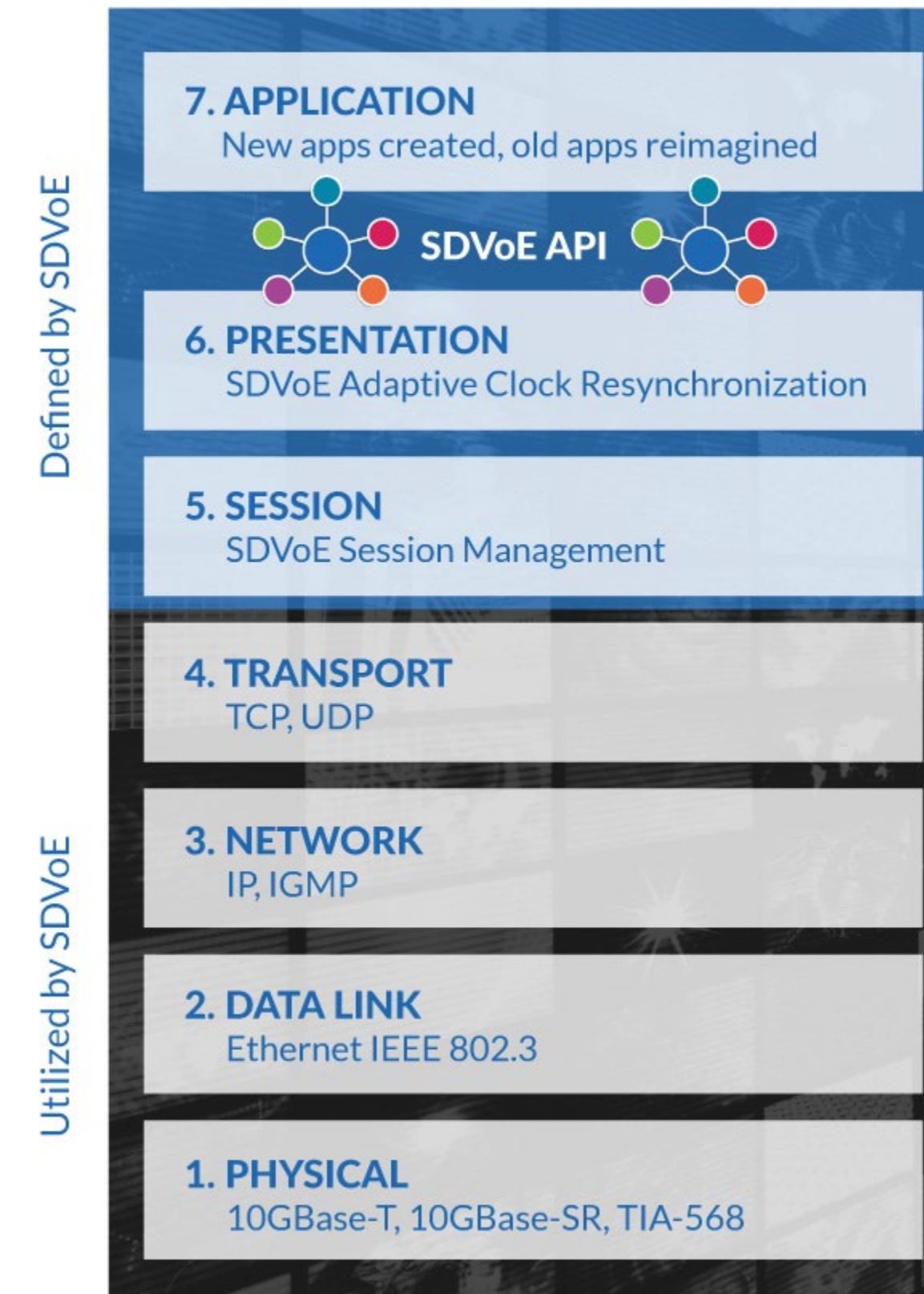
# Software Defined Video over Ethernet

## Pros

- High, Modern compression uses low bandwidth with acceptable latency
- Software-defined means that almost all switches are compatible
- Very common in AV equipment
- Can also be fully software – i.e. an App on a Smart TV

## Cons

- Latency higher than ST-2110
- Not fully synchronised





# Advantages of VoIP

- Synchronisation is built-in to protocols like ST-2110 – can have one clock sync all venues
- Distance is no longer a concern – NEP has produced live TV from Japan in our Sydney facility with ~ 100ms latency
- Cable capacity is greatly increased, reducing installation costs
- Expansion is much easier – only adding a new switch instead of a whole new router
- Theatres can install cameras/network but the production can be centralised (e.g. the Andrews Hub in Sydney)





# Use Case #1: Multi-Venue Facility



- Multi-Venue facilities (e.g. Main Hall, Small Hall, Rehearsal Facility) can use IP to centralise equipment (e.g. Audio Routers, Video Playback servers)
- Connecting Venues allows for larger events (e.g. TED Talks, Conferences)
- Easy to add an internal broadcast/streaming facility, or to connect to OB trucks for larger events
- Reduce turn-around time, increasing revenue potential
- Single synchronisation can reduce the need for multiple clock converters and different time domains (e.g. Black Burst to Word Clock converters)



# Use Case #2: Centralised Broadcast

- An ST-2110 system could be extended to another broadcaster
- All Events could be made available as a stream or broadcast-grade event
- Theatre side can remain under control of theatre technical staff and broadcast can focus on transmission (because the needs are so wildly different)
- No need for embedders, de-embedders, frame syncs or other “glue” ware





# Design Considerations



Standard Equipment and good training



Plan your network in a Spine and Leaf Topology



IP Theatres are well-proven

- Systems can be mixed and matched. Use ST-2110 when low latency is required (e.g. conductor monitors) or when synchronisation is required (e.g. Multicam systems)
- Calculate bandwidth carefully. A “Spine and Leaf” topology is suggested – big, expensive “Spine” switches connecting smaller, cheaper “Leaves”
  - A large facility might only need 1-2 spine switches but may have 20-30 leaves
- Standards (such as ST-2110) are open to all manufacturers, so there is the ability to make a “fit for purpose” system
- IP Networks will break “Silos” – Video, Audio and Lighting data will all be on the same network, so it will require people to talk to each other!
- Some venues (like the SOH) have been IP for more than 10 years - It’s not new but it does need planning



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