MULTI-PURPOSE AUDITORIUM
SOUND REINFORCEMENT SYSTEM DESIGN
ECE 40020 – SPRING 2013
SPEAK EASEIES

Matt Carrol – EASE and couch enthusiast
John Sandvig – Master of cheese and EASE
Trevor Brown – Devourer of cookies and bad EASE models
Kent Seidel – Frustrated EASE user
OUTLINE

• Primary System Design Constraints
• Venue Illustration
• System Design Constraints
• EASE Simulation Results
• Mixing Console Requirements and Selection
• Microphone Requirements and Selection
• Loudspeaker Selection, Placement, and Rigging
• Power Amplifier Requirements and Selection
• Signal Processing Requirements and Selection
• Signal Path Wiring Diagram
• Rack Requirements and Design
• Cabling and Wiring Requirements
• System Component List and Street Price Estimate
• Summary and Recommendations
PRIMARY SYSTEM DESIGN CONSTRAINTS

- generic fan-shaped high school auditorium with seating for 3000 (approx. 2200 main floor, 800 balcony)
- minimum SPL of 105 dB at back row of seating
- no more than ±5 dB variation in SPL over the entire seating space for the 1 KHz, 2 KHz, 4 KHz, and 8 KHz frequency bands
- frequency response of 40 – 16,000 Hz ± 5 dB
- %ALCONS no greater than 10% over entire seating space
- minimum 48-channel mixing console
- minimum of 4 separate monitor mixes (and corresponding monitor loudspeaker systems)
- support for 20 compatible wireless microphone channels
- good assortment of general-purpose wired and wireless microphone systems
- digital media recording/playback capability
- all equipment mounted in rack cabinet(s)
- budget of $500,000
SYSTEM DESIGN CONSTRAINTS

- SPL of 105 dB in back row of seats led to second row of fills
- +- 5dB over 40-16000 Hz led to speaker selection
- Speaker delay and distance gave %ALCONS <10%
- Balcony angled steep enough to “catch” main speakers, smaller face on front of balcony
- Narrower seating areas with more balconies in back section
EASE SIMULATION RESULTS

1kHz

2kHz

4kHz

8kHz
MIXING CONSOLE REQUIREMENTS AND SELECTION (TREVOR)

- Original Alternatives
  - DiGiCo SD8
    - 60 channels, 24 busses
    - 15” touch screen
- Disadvantages
  - Expensive
  - Not CobraNet compatible
MIXING CONSOLE REQUIREMENTS AND SELECTION (TREVOR)

- **Original Alternatives**
  - Yamaha DM2000
    - 96 inputs, 22 busses
    - Built-in FX, EQ, scene memory
    - Relatively inexpensive
  - Disadvantages
    - Outdated
    - Navigation issues
MIXING CONSOLE REQUIREMENTS AND SELECTION (TREVOR)

• Final Decision
  • Midas Pro6
    • Max of 80 mix channels, 35 busses
    • 264 inputs and outputs
    • Built-in FX, graphic EQ
    • CobraNet compatible
• Disadvantages
  • Expensive
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<thead>
<tr>
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LOUDSPEAKER SELECTION, PLACEMENT, AND RIGGING (TREVOR)

- **Loudspeaker Requirements**
  - Minimum of 105 dB at rear seats
  - SPL variance less than +/- 5 dB

- **Alternatives**
  - Meyer Sound
    - M3D series
    - Reputable
    - Best suited for line arrays
LOUDSPEAKER SELECTION, PLACEMENT, AND RIGGING (TREVOR)

- **Final Selection**
  - Renkus-Heinz
    - Wide variety of options
    - RHAON with CobraNet
    - No external amplifiers
    - No line losses
LOUDSPEAKER SELECTION, PLACEMENT, AND RIGGING (TREVOR)
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<td><strong>CF121M</strong></td>
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<td>- Used for stage monitors</td>
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<td>- Integrated with on-stage Aviom in-ear mixes</td>
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| **PN61**                                            |
| - Powered front fills                               |
| - Rotatable complex conic horns                     |
| - Mountable                                         |

| **ST9**                                             |
| - 4 powered mains                                  |
| - 134 dB overall peak SPL                           |
| - 90X40 dispersion                                  |

| **PN82**                                            |
| - Balcony/under-balcony fills                       |
| - 125 dB peak SPL                                   |
| - 90X60 or 120X60 dispersion                        |
POWER AMPLIFIER REQUIREMENTS AND SELECTION

- Individual powered amplifiers in each speaker
  - Mains: PM-3R
  - Fills: PN-1R
  - Monitors: PF-R
- Class D digital amplifiers fed with digital CobraNet data
SIGNAL PROCESSING REQUIREMENTS AND SELECTION

- RHAON system provides DSP capabilities onboard each amplifier
- Provides:
  - 358ms Delay
  - Compressor
  - 9 band para. EQ
  - Level Control
RACK REQUIREMENTS AND DESIGN

• Allows for Accessibility, Aesthetics, Portability,

• House and organize:
  • Power Conditioning and Sequencing
  • Media Playback
  • CD and Digital Recording
  • Wireless Receiver and Antenna
RACK DESIGN

Signal Processing Rack

Wireless Receiver Rack

- Forman ASD-120
- System Power Sequencer (2U)
- ETA PD11SSP Power Sequencer (1U)
- Univox SLS-900 (2U)
- Aviom A-16D A-Net Distributor (2U)
- Aviom A-16D A-Net Distributor (2U)
- Drawer (3U)
- Midas DN9650 Network Bridge (1U)
- Midas DN9652 Network Bridge (1U)

- CobraNet Mesa
- Power Sequencer (1U)
- ETA PD11SSP
- Power Sequencer (1U)
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- Power Sequencer (1U)
- Tascam SS-CDR200
- Recorder (1U)
- Tascam CD-200iB
- Player (2U)
- Gear (2U)
- Senheiser EW112 G3
- (1U, etc.)
- Senheiser EW112 G3
- (1U, etc.)
- Senheiser EW112 G3
- Senheiser EW112 G3
- Senheiser ASA 1
- Antenna Splitter (1U)
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- Antenna Splitter (1U)
- Senheiser EW 365
- (1U, etc.)
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CABLING AND WIRING REQUIREMENTS

- Ethernet
- Whirlwind Mass I/O box
- Whirlwind Mass Multiline Cable – Mass box connection
- POWER
SYSTEM COMPONENT LIST AND STREET PRICE COST ESTIMATE

- Speakers and Monitor Support: $191,361
- Console: $69,999
- Microphones: $39,540
- CD/Record/Peripherals: $1,400
- Networking & Cables: $4,045
- Power: $33,263
- Rack Hardware: $1,976
- **TOTAL:** $341,584
SUMMARY AND RECOMMENDATIONS

• Point source mains
• Line source fills
• Digital speaker network
• Integrated RHAON amplifiers
• Extra $160K can be spent on alternative line array reinforcement system for pop, rock, metal, hip-hop, electronica, and alternative concerts