Penn State
Pegula Arena
Small Arena, Big on Ammenities

Fans of the Penn State men's and women's ice hockey teams don't have to miss a second of the action even if they leave their seats, thanks to the video distribution to 95 televisions strategically located around the stadium.

With 6000 seats, the Pegula Ice Arena is the smallest of the arenas for the Big Ten conference men's ice hockey, but it boasts amenities such as a rich audiovisual experience and an immersive fan experience that rivals the National Hockey League arenas. This isn't much of a surprise since the arena was largely funded by Terrence Pegula, owner of the NHL's Buffalo Sabres, and his wife Kim Pegula.

The $102 million donation from the Pegula's was the largest private gift in Penn State history.

Challenge

In 2013, the arena hired Clair Solutions to install a television distribution system and other audiovisual components, according to design documents by Ian Wolfe, director of audiovisual designs at Henderson Engineers, Inc., out of Kansas City, Kansas. (For background, I'll note that Wolfe was previously a partner in Acoustical Design Group, Inc., which Henderson acquired in 2012.)

Clair Solutions started the installation with a tight deadline to install speakers in both, the main arena and community rink. They had two weeks until the ice would be laid in both arenas; Penn State needed to allow plenty of time to test the ice and make sure that the coolant was flowing correctly before the opening game against Army in October 2013. In accordance with the instructions of general contractor Mortenson Construction, they were required to use a lift weighing less than 3T. This made the process a bit more grueling than expected.

The Pegula Ice Arena is a 6,014-seat multi-purpose arena that opened on October 11, 2013

> *"The Fans have access to view the games and events anywhere and everywhere at the Pegula Arena, it is truly the Fan Experience"*
>
> Pegula Arena Facilities Manager

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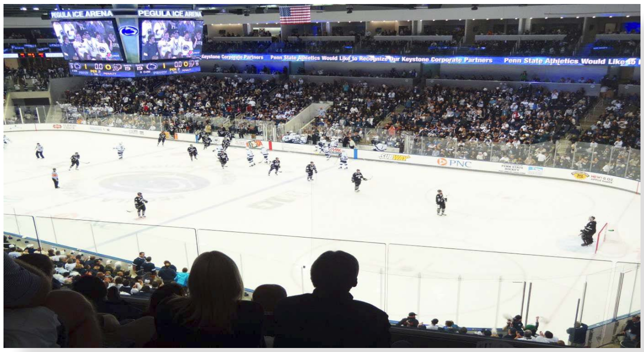
University of the South Continued...

Daktronics had months earlier installed the large scoreboard centered over the ice, before the seats were installed and before the concrete was poured for the ice. One thing to remember about arena installations is that everything is higher, heavier, and more precise, so planning is key! Unfortunately, with the score board already in place, it made for an interesting experience to hang the sub cluster, which was optimally placed directly adjacent to the motor winches in the center of the scoreboard. With a little planning, Clair Solutions was able to use a couple of motors to hoist the cabinets over the lowered scoreboard and swing them into their respective fixed location. Motors also had to be used to hoist all amp racks to their locations on the catwalk. The amps were loaded into a “custom” carrier, and sent up; they were then followed by the empty rack.

Success on any project takes a lot of coordination and cooperation. With the division of this contract, it also took a little patience by all. While Clair Solutions was responsible for almost all A/V components, they were not responsible for cable pulls (Bitter Electric), video production equipment (BECK Associates), replay (XOS Digital), and television installation (Mortenson and others). Claire’s responsibilities included termination and testing of all broadcast infrastructure, audio equipment, satellite TV distribution, and campus Comcast RF distribution which includes an in-house game day feed. With the amount of organizations involved and needs by all to achieve goals and deadlines, the next few months brought a growing list of needs versus priorities. This is where the communication became a necessity; the cooperation by all was top notch on this project which lead to the successful early completion.



Once Clair Solutions had all the audio equipment racks, broadcast racks, and satellite working, they had less than two weeks to start the distributed RF system. Television panels are located in the arena rink, community rink, press box, conference spaces, offices for the coaching staff, the recruiting lounge, hallways, and 14 suites. In addition, screens are located throughout the 5,000-square foot weight room, hydrotherapy training room, steam room, team lounge and locker room area.

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Challenge

Henderson's design had specified Z-Band's RF video distribution system which relays signal over twisted pair cable, and the Z-Band technology made installation straightforward because as long as the quality of the video source is high, the signal at the set top boxes or televisions will be fine without a lot of tweaking. This is true for analog or digital including high definition signals.

With the Z-Band solution, the same device is used for the master or slave unit: the GigaBUD Video Hub 1000. BUD stands for Broadband Uniform Distribution. The GigaBUD unit that receives video input from the source designates itself as a master unit. Units that instead receive video through the Cascade In port designates themselves as satellite units. At each television panel is a GigaBOB, or breakout box, which delivers the signal to its final destination.

Results

While Penn State's campus distributes over fiber it is converted to coax at the headend to the master unit, and then from the master unit to the satellite unit. Category 5e twisted-pair cable carries the signal from the satellite unit to a standard patch panel, and from the panel to the balun. In other words, coax is used for the backbone and Cat 5e is used for the horizontals. Finally, coax carries the signal from the the balun to the television panel. A coax backbone made sense for this 200,000-square -foot arena although, for very large installations, single mode fiber might be preferred to allow for runs between units of 600 feet or more.

Many may wonder how the signal can go from coax which is an unbalanced transmission line to twisted-pair line which is a balanced line, and back to coax again. The coax is called unbalanced because it has a single signal working against ground. The twisted-pair cable is called balanced because it has two conductors carrying signals that work against each other and the ground is irrelevant. With twisted-pair, one conductor sends the signal in a positive direction; the other sends the signal in a negative direction, so if you wanted to send 10 volts, you can put plus five volts on one conductor and minus five on the other. Because both conductors meet exactly the same specifications, the signal arrives at the same time and the system sees a total of 10 volts. It's more efficient than trying to send a 10 volt signal through coax, which would generate significant radiation.

The GigaBUD satellite unit converts the unbalanced signal to a balanced signal, and the GigaBOB is a balun, a device used for balanced-to-unbalanced signal conversion.

That still doesn't explain how the Z-Band solution actively balances the signal.

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The Master GigaBUD transmits a 240 MHz pilot tone for a coax backbone and also sends 8 volts to power the GigaBOB. In both cases, some of this power is lost along the way. The Satellite GigaBUDS measure the loss in the pilot tone and the GigaBOBs measure the number of millivolts (one thousandth of a volt) of energy that were lost to calculate the length of coax in the backbone the twisted-pair horizontal cable and they automatically adjust their built-in amplifier, slopers, and attenuators to maintain signal quality.

As an active system, the Z-Band solution supports the addition or removal of receivers without manual adjustments, a full range of channels, and up to the full 100-meter run of twisted-pair cable between the patch panel in the closet and the balun, as specified in the TIA-568 standard. If twisted-pair cable was pre-installed for future use or for other purposes as if often the case for new construction or remodels, you can use an existing RJ45 jack for the balun and then connect the twisted pair to the GigaBUD in the closet. Z-Band says that a new receiver can be installed by a low voltage electrical contractor, but of course I think you would be well served by an audiovisual installer. Competitor solutions that use twisted-pair cable are, as far as I know, passive and so require manual signal balancing to counteract slope and support twisted-pair runs of perhaps 60 meters. Competitor solutions that use coax are also passive and require manual adjustments for each receiver to counteract slope, but can accommodate runs that are hundreds of feet long. The channels in the higher megahertz ranges are attenuated more than those in the lower range and therefore tend to become weak when a receiver is added to passive systems due to slope. Passive systems require audiovisual expertise to add receivers.

Because of active balancing, Z-Band recommends spending a little extra time early in the system install to ensure you have the best signal possible at the headend. If you have a good quality signal at the headend, you will have good reception at your receivers. With coax system, you often try to compensate for a poor headend signal quality by adjusting splitters and taps, so you tend to spend less time with the headend but significantly more time adjusting signal throughout your system.

Some situations naturally lend themselves to the Z-Band distributed video solution over twisted-pair cable. For instance:

- A client requests it again
- The facility already has twisted-pair cable and jacks installed
- A client plans to make frequent receiver adds or drops