![Cambium Networks logo] Cambium Networks™

Super Connectivity for Emergency Health Care at Super Bowl XLVIII

> "This event was highly successful for our entire team. The use of patient care information technology for Electronic Medical Records, radiology image transfer, and patient registration and tracking was exactly the same as in the hospital."

DR. HERMAN MORCHEL M.D., HACKENSACKUMC EMERGENCY TRAUMA DEPARTMENT

Challenge

MetLife Stadium, part of the Meadowlands Sports Complex in Northern New Jersey, several miles west of New York City recently hosted a major sports event, the National Football League Super Bowl XLVIII. Hackensack University Medical Center (HackensackUMC) in Hackensack, New Jersey, an "official medical services provider" of the Super Bowl, supplemented emergency medical care for event workers and spectators before, during, and after the game.

Mobile Satellite Emergency Department (MSED) in Pre-Game
(Monday to Friday) location outside MetLife Stadium

HackensackUMC (www.hackensackumc.org) is the leading academic medical institution and trauma center in close proximity to the stadium.

PROFILE

HackensackUMC needed connectivity between the main hospital and the New Jersey - Mobile Satellite Emergency Department (NJ-MSED) vehicle located at the stadium in the Meadowlands Sports Complex.

CHALLENGE

- High speed, low latency connectivity to support VoIP, video and data transfer

- Secure communications to transfer medical records and other private information

- High performance in an environment saturated with other RF communications

SOLUTION

- PTP 650 link from the medical center roof to a racetrack grandstand roof adjacent to the stadium

- PTP 650 link connecting the roof adjacent to the stadium to the MSED vehicles on the ground in the parking lot below

As part of its emergency services is the New Jersey - Mobile Satellite Emergency Departments (NJ-MSED's). The NJ-MSED vehicles are one of only a few mobile medical assets of their kind in the nation, funded through a unique partnership with the U.S. Department of Defense and the federal government's Urban Areas Security Initiative (UASI). The core of the NJ-MSED system consists of two 43-foot emergency department trailers and one 48-foot trauma operating suite trailer each with expandable sides. The vehicles are staffed by HackensackUMC emergency physicians, nurses, and operations personnel. The vehicles were used extensively during and after Superstorm Sandy in the New York / New Jersey metropolitan area. Medical capabilities of the two mobile emergency department vehicles include:

- Seven monitored critical care patient stretchers
- Portable digital X-ray
- Sonography (ultrasound)
- Pharmaceutical cache same as in hospital emergency department
- Arterial Blood Gas analyzer
- Oxygen and medical air generation
- Medical Suction
- Medical Procedure lighting
- Cardiac Arrest / Resuscitation supplies and equipment
- Respirators, intubation capability, nebulizers
- Suturing supplies and instruments for laceration closure
- Intravenous fluids and medications

Secure high speed connectivity to the main hospital computer network allows for:

• **Patient registration**
Critical for patient identification, discharge or transfer arrangements, billing, notification of regional authorities in event of mass causality incidents.

• **Use of existing electronic medical records (EMR)**
This enables the use of the EPIC EMR system the medical staff normally uses when on location in the hospital. This system provides access to documents regarding patient exams and condition, physicians' orders, and medical history.

• **Sending EKG results to cardiologists at the hospital**
For interpretation of unusual conditions and notifications if patient is being transferred for procedures such as cardiac catheterization or surgery in heart attacks.

• **Sending digital x-ray images to the hospital main campus**
For interpretation by board certified radiologists.

• **Use of secure drug distribution system (Omnicell) including biometric scanning**
Leverages the central drug distribution system used in the main campus hospital. This system communicates with hospital pharmacy via data link for tracking of drugs used so they can be re-supplied.

• **Telephone Communications**
Enables use of the normal hospital VoIP phone system.

• **Video Conferencing / Telemedicine**
Enables use of on board computers for video conferencing with specialist physicians if required.

Simulated patient, interior of Mobile Satellite Emergency Department (MSED)

HackensackUMC and PierCon chose Cambium Networks Solutions for the following reasons:

• **Fast deployment time** - HackensackUMC needed to establish requirements, design the links, procure the equipment, implement the solution, and test and commission the network in less than 8 weeks.

• **High throughput** - uploading large x-ray imaging files and conducting video conference for specialist physician consultations was deemed crucial for HUMC's success.

• **Low latency** - VoIP networks require low latency and low jitter to provide performance similar to picking up the phone as if you were in the office next door.

• **Information Assurance** - 256-bit AES secure data transmission of patient information compliant with HIPAA health care security requirements.

• **Easy Installation** - PTP 650 is a 'single cable solution' requiring one cable for both power and network data minimizing the installation foot-print and simplifying installation.

• **Plug and Play** - Information technology staff are not required to configure or optimize the links. Connectivity is transparent and acts as if the equipment was simply in the next room. There are no issues with VPNs or other critical communica -tion system. The connection was essentially an Ethernet Bridge invisible to the hospital computer network.
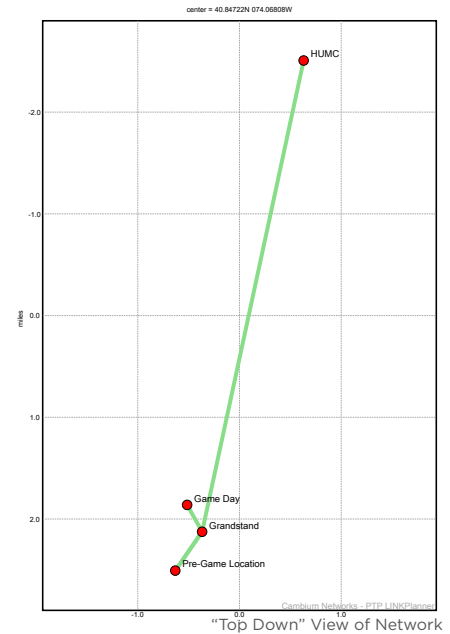
Solution

HackensackUMC contacted PierCon Solutions LLC (www.piercon.net) to assist in designing and implementing a connectivity solution for the Super Bowl deployment to enable the NJ-MSED to link with the HackensackUMC main campus computer network. PierCon Solutions is an experienced communications networks provider. In 2012 during the aftermath of Superstorm Sandy, HackensackUMC worked with PierCon to provide connectivity between the NJ-MSED's and the data center of a hospital that had been taken out of service by the storm. The NJ-MSED replaced hospital emergency departments. The best solution was to deploy secure Point to Point (PTP) microwave radio backhaul links from Cambium Networks (PTP-600 series) that operated independent of any other communication system.

For the Super Bowl, PierCon and HackensackUMC once again chose Cambium PTP backhaul to create a temporary stand-alone link that would perform when other networks could be over capacity and unreliable. Specifically, the Cambium Networks PTP 650 frequency agile radios would be used in a 'two-hop' deployment to deliver a secure high speed data link from the hospital main campus to the MSED vehicle at the stadium, a distance of 4.7 miles.

Inside the NJ-MSED a Cisco 3750 switch connected to the PTP 650 and then to 3 desktop PC computers, 3 Cisco VoIP phones, an Omnicell drug distribution system, a Siemens digital x-ray system, and an EKG recorder. Additional ports were available for other devices such as IP cameras, and other equipment.

"Top Down" View of Network

Plan for Performance

To plan the network, HackensackUMC and PierCon Solutions used Cambium Networks' LINKPlanner diagnostic tool to develop a detailed prediction of broadband performance. The planning and design tool provided a top down view of the network showing the connections between the locations at the stadium and the HUMC main campus. LINKPlanner also provides a detailed tabular report that describes the products and antennas used at each location and an estimate of the maximum aggregate usable throughput between each of the sites.

LINKPlanner provided a path profile view of each link. The side view of each link indicates whether the link is Line of Sight (LOS), near Line of Sight (nLOS) or Non Line of Sight (NLOS), the obstructions, link distance and free space path loss. With this information at their fingertips, PierCon and Hackensack-UMC were able to test alternative models and select the equipment that best suited their needs.

Link name	Product	Local antenna	Remote antenna	Max aggregate IP throughput (Mbps)
HUMC to Grandstand	PTP650	Radio Waves 2ft High Performance Dual-Polar Parabolic HPD2-5.2NS	Radio Waves 2ft High Performance Dual-Polar Parabolic HPD2-4.7	197.11
Grandstand to Game Day	PTP650	Cambium Networks Integrated Dual Polar Antenna	Cambium Networks Integrated Dual Polar Antenna	200.09
Grandstand to Pre-Game Location	PTP650	Cambium Networks Integrated Dual Polar Antenna	Cambium Networks Integrated Dual Polar Antenna	200.09

| Summary	
Link Name	HUMC to Grandstand
Customer Company Name	Hackensack University Medical Center
Link Type	Line-of-Sight
Equipment Type	PTP650
Maximum Obstruction	0 feet
Link Distance	4.723 miles
Free Space Path Loss	123.98 dB
Excess Path Loss	0.00 dB
User IP Throughput Expectation Aggregate	Aggregate 197.11 Mbps assuming PTP-650 Series running the 650-01-01 software
RF Frequency Band	4.9 GHz (4940 to 4990 MHz)
RF Channel Bandwidth	20 MHz
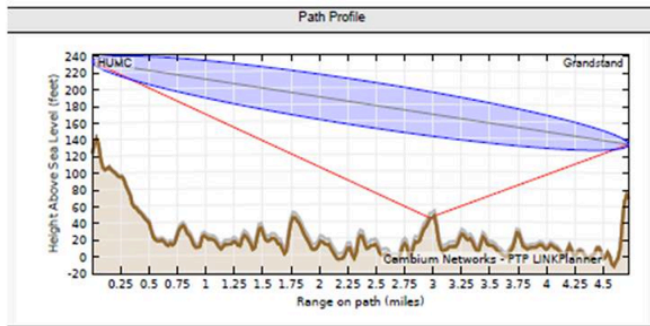
Image of PTP 650 Link, ballast weight temporary mount, roof of HackensackUMC

Implementation

Based on LINKPlanner estimations, Cambium Networks PTP 650 radios with 2 foot dual polarized dish antennas were selected to make the longest 4.7 mile (7.5 km) line of sight connection from the Medical Center main campus to the racetrack grandstand roof at the Meadowlands Sports Complex, adjacent to MetLife Stadium.

A second link was established from the roof of the Meadowlands Racetrack to the NJ-MSED vehicle at a distance of 0.25 miles (0.4 km) with a pair of PTP 650's with integrated antennas. The two PTP 650 links at the relay point on the racetrack grandstand roof were interconnected with a small Gigabit switch. Temporary ballast weight type antenna installations were utilized on the rooftops.

The entire network was installed in one day, and the system performed exactly as predicted in the LINKPlanner design tool. The pre-game location was setup and operated the week prior to the game with the MSED vehicle supporting work related injuries and illnesses all week long.

Rich Conroy, President, PierCon Solutions describes the use of spectrum. "We utilized 4.9 GHz on a 20 MHz channel between HackensackUMC and the Meadowland Racetrack rooftop, located adjacent to the stadium. From there, we then utilized 5.8 GHz PTP 650 link using a 10 MHz channel between the Racetrack Rooftop and the NJ-MSED vehicle locations. The narrow channels helped mitigate interference and provide a more robust RF path. We tested the links for maximum throughput just prior to game-day and we were consistently seeing 201 Mbps of usable aggregate through-put."

One significant factor at the event was the high concentration of radio frequency emissions. Kareem Elhawary, technical manager from Cambium Networks said, "From the moment we first turned up the equipment it performed admirably. Even in a radio frequency environment heavily saturated with interference from other wireless networks, land-mobile radio, and satellite links employed by multiple public safety agencies and broadcast television / radio stations, the PTP 650 link was solid and reliable during the entire event. Once optimized, the system performed with 100% availability at full 256 QAM modulation producing 10 bits per Hertz of spectrally efficient throughput."

All frequency usage was approved by and coordinated with the National Football League event frequency coordinator and covered by FCC licenses held by HackensackUMC.

Results

The system performed flawlessly through the entire week, and for the doctors and staff, it was as if they were in the main hospital facility.

"Without the Cambium Networks data link, we would have had to use paper charts," says Dr. Morchel. "Because of the connectivity, we were able to immediately transfer x-ray images and other diagnostic test results. We demonstrated tremendous new capability which had a very positive effect on patient care."

During the game the trauma vehicle was simultaneously streaming HD video on two different computers and video screens, accessing the computer network at Hackensack-UMC and operating the VoIP phone system. While other public networks were dropping out due to noise and congestion, HUMC's Cambium PTP 650 connection was rock solid.

In decades of creating connectivity, Rich Conroy, President, PierCon Solutions has seen it all. "This project was successful because we knew exactly what to expect thanks to the LINKPlanner. The ease of installation ensured portability during MSED repositioning, and the use of AES encryption ensured the customer was able to meet all federal information assurance regulations. The system delivered according to plan."

Next Steps

HackensackUMC, Cambium Networks and PierCon Solutions are currently investigating additional applications for supporting health care with wireless broadband connectivity. High-definition video conferencing and remotely accessed medical devices can expand diagnostic and treatment capabilities in underserved areas.

Additional areas for consideration are interfacing with existing point to point microwave links and other wireless networks. Since the PTP series device functions as an Ethernet Bridge, essentially invisible to the network it is   serving, computers on the NJ-MSED could function as if they were in any hospital. This would be especially useful if the NJ-MSED were deployed to an area where it was being staffed by medical personnel other than those of HackensackUMC.

Interior of Mobile Satellite Emergency Department (MSED)

"The fact that the link functioned as an Ethernet Bridge with inherent AES 256 encryption made integration with our existing infrastructure very straightforward. It was as if the ETD was here locally at our main campus. This seamless integration allows flow of the right information for the right person at the right time in the right format every time securely for appropriate action in the best interest of the patient."

- Dr. Shafiq Rab, Chief Information Officer, HackensackUMC

"Seamless access to the same electronic medical record system used on campus made patient care in the mobile unit much more efficient. Patients at the Super Bowl came from a wide geographic area, both nationally and internationally. Having their diagnosis and treatment information stored in our normal electronic medical record system makes it easily available to their home physicians if needed."

- Dr. Joseph Feldman, Chairman Emergency Services, HackensackUMC