Wisconsin Department of Transportation

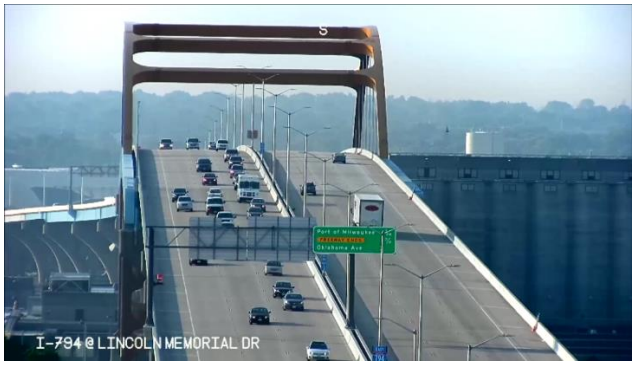
High Definition Video System Upgrade

ITS Wisconsin Project of the Year 2017

WisDOT HD Video Upgrade Project

Upgrading the Wisconsin Department of Transportation (WisDOT) traffic camera video system to support High Definition (HD) video has been a multi-year project spanning several technological and logistical disciplines. The stated mission of the Wisconsin Department of Transportation is to “Provide leadership in the development and operation of a safe and efficient transportation system”. The HD video system upgrade project fulfills this mission by enhancing the mobility, accountability, preservation, safety, and service (MAPSS) of the state highway system.

Standard Definition



High Definition

Network Upgrades

Beginning in 2013 the groundwork for the HD video system was laid when the statewide ITS network was upgraded to support up to 20 Gbps of network throughput. This network upgrade was designed and implemented by Jeremy Sarauer of INOC under the direction of Project Manager Don Schell. This increase from the previous 1.2 Gbps network core provides the network capacity needed to transport 450+ HD video streams from cameras throughout the state. These network streams are viewed by numerous public safety and law enforcement agencies including:

- Control room operators at the STOC
- State Patrol dispatch
- Local and county law enforcement dispatch centers
- WisDOT traffic engineers
- Fire and EMS
- Statewide Emergency Operations Center
- Interstate highway rest areas
- Safety and Weight Enforcement Facilities (SWEFs)
- Private towing companies
- Radio and television media outlets
- Public television channel 36-6 (Milwaukee)
- University of Wisconsin TOPS lab

Without this prerequisite upgrade to the core fiber optic network, this HD video transmission would not have been possible.

Camera Upgrades

The first HD camera was installed by TAPCO on a test basis in 2015. Located in the city of Brookfield on US 18 at Brookfield Road, this camera provided the proof of concept that HD cameras could be integrated into the WisDOT video system. It also demonstrated the incredible visual difference between the HALFD1 resolution (704 x 288) of the SD system and the 1080p (1,920 x 1,080) resolution capable under the HD system.

The COHU Helios 3960HD camera installed at this intersection signaled a move away from the Pelco Spectra cameras of the past. In the two years since replacements began, a new model of COHU HD camera has been adopted. The COHU RISE 4260HD camera offers the same HD capabilities and rugged design as the Helios 3960 but at about 50% of the cost. WisDOT adopted this camera model in 2016 to enact cost savings while continuing to provide the benefits provided through camera upgrades.

As of the writing of this report, over 120 standard definition Pelco cameras have now been replaced with COHU HD cameras.

Video Server Upgrades

Integration of these new HD video streams also required an upgrade to the core video management system. The S-VMX system provided by Teleste manages all user interaction with the video streams, controls the pan, tilt and zoom (PTZ) functions of the cameras, records the video streams on specialized network video recorders (NVRs) and allows playback and archiving of video. In July of 2017 the software on all core components of the video management system was upgraded. This upgrade was performed by Andy Plamann and Teleste support staff under the direction of Don Schell. Significant network support was provided by Jeremy Sarauer (INOC).

This upgrade marked a transition from the old Linux based Teleste VMS to a new Windows server based model. This new model provides greater support for HD camera operations included increased web client functionality. Teleste now touts the WisDOT video installation as a case study in successful video system installations on their customer website.

Video Decoder Upgrades

In order to display this HD video to the world, new HD video decoders are also needed. These decoders transform the multicast network video streams into camera tours that can be displayed on televisions and monitors at the video recipient locations. Statewide there are 73 disparate video tours being decoded. Each decoder must be upgraded to support the new H.264 encoding protocol used by the HD cameras to compress and transmit the HD video. These new decoders are software based which will allow for greater flexibility as video compression protocols are rapidly evolving. They also support native

HDMI output making them compatible with most current production display monitors. The replacement of these decoders is underway with the goal of 100% replacement by early 2018.

Safety Improvements

The benefits of HD video in improving the safety of the roadways are clear. Traffic video allows first responders to more precisely and efficiently assess the scene of a traffic incident and provide an appropriate response. Recorded video is analyzed by the Traffic Incident Management Enhancement (TIME) program and utilized to provide training and after action review of incidents. Work zones can be analyzed from above both in real time and after the fact to provide greater safety to travelers as well as construction and maintenance crews. All safety benefits provided by traffic video are enhanced by the greater clarity and definition of HD video.

Technical Innovation in Installation

Replacing an SD camera with an HD camera at the top of a 50-foot (or taller) camera pole on the side of the highway requires a good deal of ingenuity. As the ITS integrator TAPCO has achieved replacement of all cameras to date without needing to replace any significant portions of the roadside equipment. Camera poles, cables, and camera mounts have all been repurposed. Perhaps the most significant innovation is the use of IP over coax adapters which are used to extend IP connectivity to the top of the camera pole. The use of these adapters eliminated the need to install new Ethernet cabling in every camera pole. Significant time and expense is saved through this innovation.

Technical Innovation in Multicast Video Distribution

WisDOT now maintains one of the largest high definition multicast video distribution systems in the nation. The use of multicast video technology over the statewide fiber optic network allows for the recording of all network streams while minimizing network bandwidth consumption. WisDOT and consultant staff have been significant contributors in driving the development of the products that deliver this video. Partnerships with Cisco, Teleste, COHU, and other manufacturers driving the development of video distribution technology have been strengthened and leveraged throughout this project.

Cost Reduction

One of the less obvious benefits of the HD camera upgrades is a reduction in maintenance cost. With IP connectivity now extended to the top of the camera pole many camera maintenance tasks can be performed remotely. Remote maintenance of cameras reduces the number of billable field responses by maintenance staff while increasing the uptime of each individual camera.

Replacement cost of cameras also becomes more efficient under the new HD system. As the industry moves away from SD cameras and analog installations the purchase price of HD cameras is decreasing dramatically. As the manufacture of the older model SD cameras comes to an end, the cost of that old technology will increase significantly. Being on the mainstream development path of the video industry will insure that competitive and cost effective replacement products will be available to WisDOT for years to come.

Customer Satisfaction

Our customers have been very receptive and excited to have increased access to HD quality video. Here are just a few of the things they have had to say.

"*From a training standpoint, the better quality video permits the viewer to see much in better detail at an incident scene. It also aids the instructor/presenter by showing in great detail what the incident scene looked like before, during and after the incident." – TIME Program*

"The HD cameras are much better in the dark. The picture is more clear which allows us to determine what we are looking at more effectively and faster." – Control Room Supervisor

"We can see details that an SD camera cannot - a damaged crash cushion after a crash (if the cushion is depressed greater than 50% it requires immediate repair). This eliminates the need to wait for someone to respond onsite and expedites repair if necessary." – Zoo Interchange Project

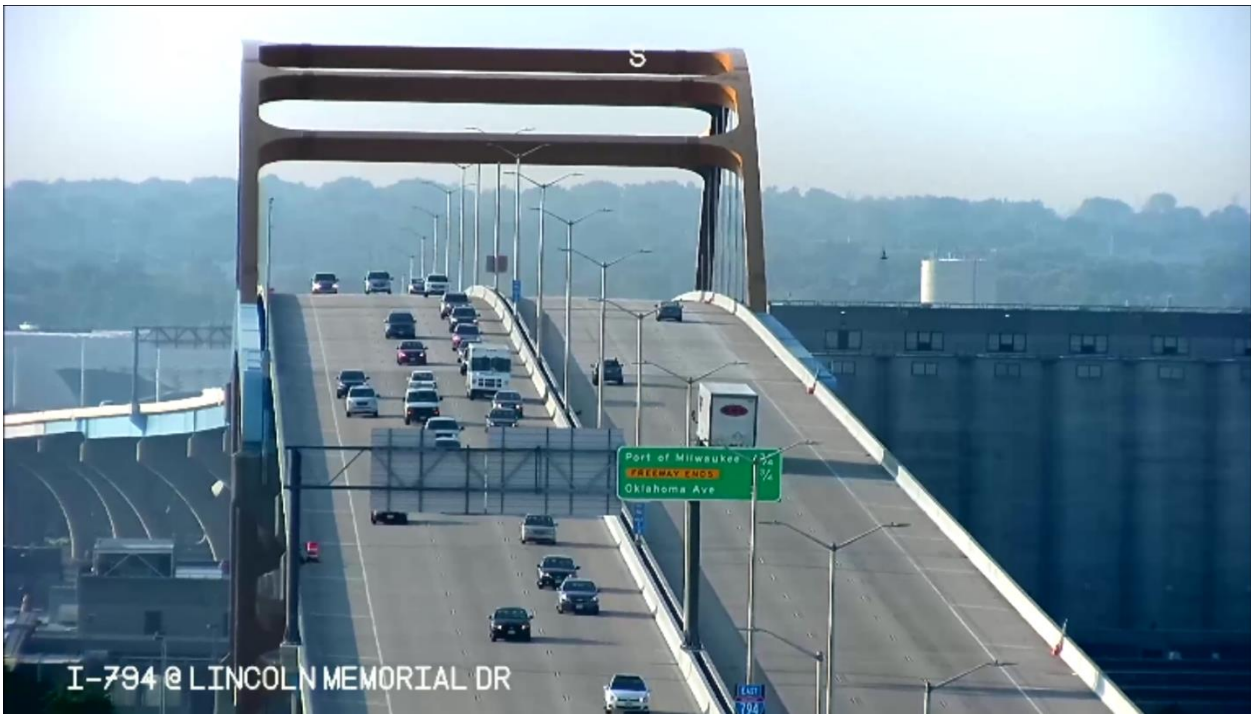
"It can aid law enforcement in possibly identifying the first hazardous event that led to the incident. This is sometimes very difficult with standard video. It is also extremely beneficial to fire department personnel when viewing an incident. Based on the quality of the video, I trust they can use the video to assist in identifying the origin of the fire and based on the color of the smoke, the type of material that is burning." – TIME Program

"I can't wait until all cameras in the state are being recorded in HD." – TIME Program

SD vs. HD Visual Comparison - US 18 in Brookfield

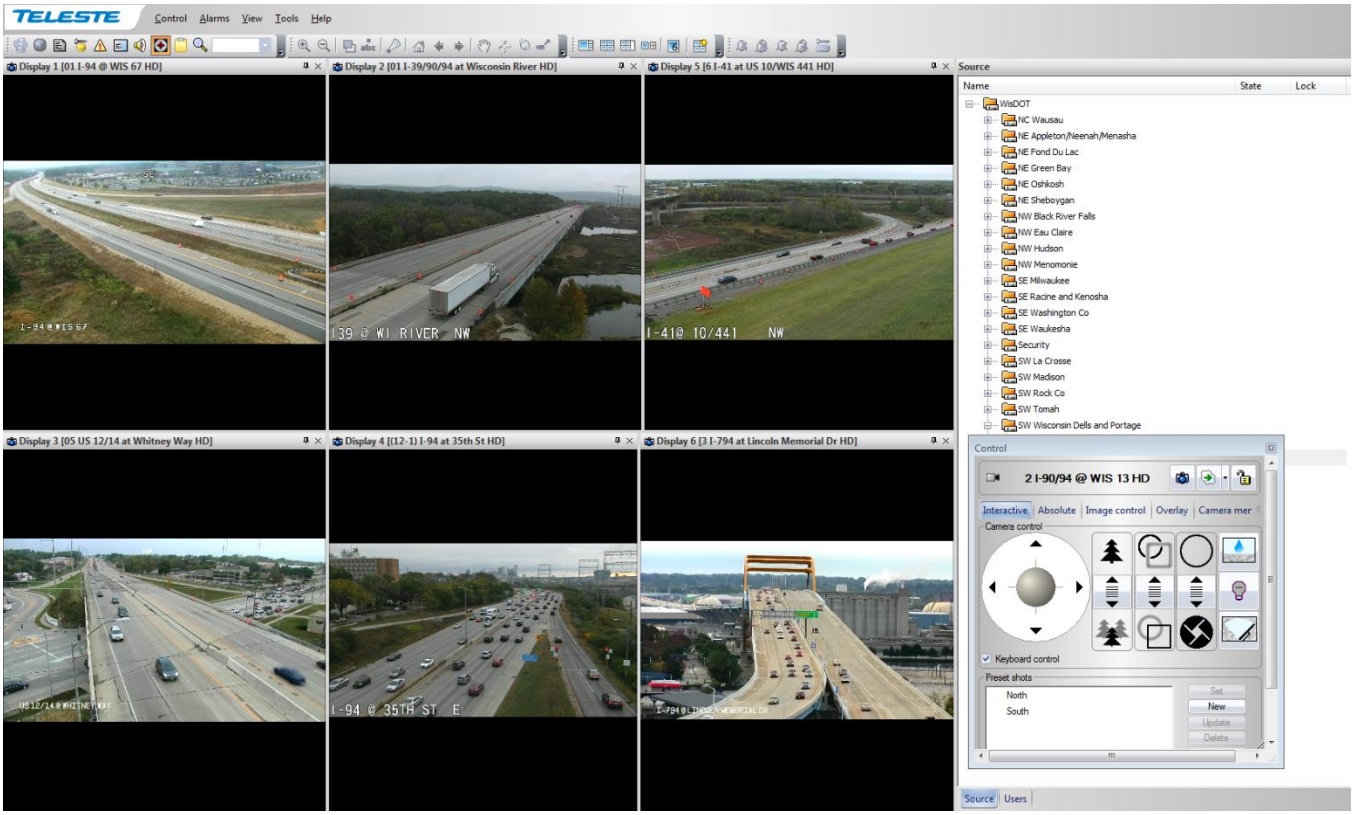
SD vs. HD Visual Comparison – I-43 in Milwaukee

SD vs. HD Visual Comparison – I-794 in Milwaukee



SD vs. HD Visual Comparison – I-90/94 in SW Region

Teleste VMX User Interface with PTZ Controls



Project Name: High Definition Video System Upgrade
Project Address: STOC, 433 W. St Paul Ave., Milwaukee, WI 53213
Date Completed: July 2017
Project Budget: Multiple Years / Various

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