



430 IACC Building – Fargo, ND 58105
Tel 701-231-8058 – Fax 701-231-1945
www.ugpti.org – www.atacenter.org

I-29/I94 Video-Based Surveillance and Traffic Detection System

Technical Memorandum

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Prepared for:
North Dakota Department of Transportation

Prepared by:
Advanced Traffic Analysis Center
Upper Great Plains Transportation Institute
North Dakota State University
Fargo, North Dakota

SPECIAL PROVISIONS

For

VIDEO-BASED TRAFFIC DETECTION AND SURVEILLANCE
ON THE FARGO I-29/I-94 INTERCHANGE

By:

North Dakota Department of Transportation
Bismarck, North Dakota

September 19, 2002

1.0 DESCRIPTION

The NDDOT is installing video detection and traffic monitoring system to replace existing cameras part of a WeatherScene[®], a wireless integrated road monitoring system which provides real-time imagery and current weather conditions on the I-29/I-94 Interchange in Fargo. The current system consists of four fixed cameras which provide limited video coverage but have no pan-tilt-zoom (PTZ) or traffic data collection capabilities. The NDDOT plans to move the cameras to a new location, but wants the weather station to remain in place to operate with the new video detection and surveillance cameras.

The new video-based traffic monitoring system is to enable the NDDOT Fargo District to collect real-time information about traffic conditions in the vicinity of the I-29/I-94 Interchange and provide live video of traffic conditions. The new system must also include provisions to carry data from the weather monitoring portion of the existing WeatherScene[®] which will remain on site back to the NDDOT Fargo District Office via fiber.

Specific functions for the new video-based traffic detection and monitoring system include:

1. Provide streaming video of traffic conditions on NB/SB I-29 and EB/WB I-94.
2. Provide traffic count/classification on NB/SB I-29 and EB/WB I-94.
3. Measure traffic speeds on NB/SB I-29 and EB/WB I-94.
4. Detect incidents on NB/SB I-29 and EB/WB I-94 when traffic speed falls below a pre-determined threshold (i.e., less than 40 MPH), wrong-way traffic, etc.

2.0 SCOPE

The Special Provisions (SP) consist of the following components to support the functions identified above:

1. Video detection system, installation hardware, and operating software.
2. Video monitoring and surveillance system, installation hardware, and operating software.
3. Remote devices at the NDDOT District in Fargo to operate the system and receive data.
4. Communications devices to support system operations using fiber optics, including required fiber termination points, but not the actual fiber.
5. Integrate the weather monitoring portion of the WeatherScene[®] with the new traffic detection and surveillance system to provide roadway weather information.
6. On-site training and technical support.

2.1. Video detection system (see Exhibit 1)

The video detection and monitoring system shall consist of the following components:

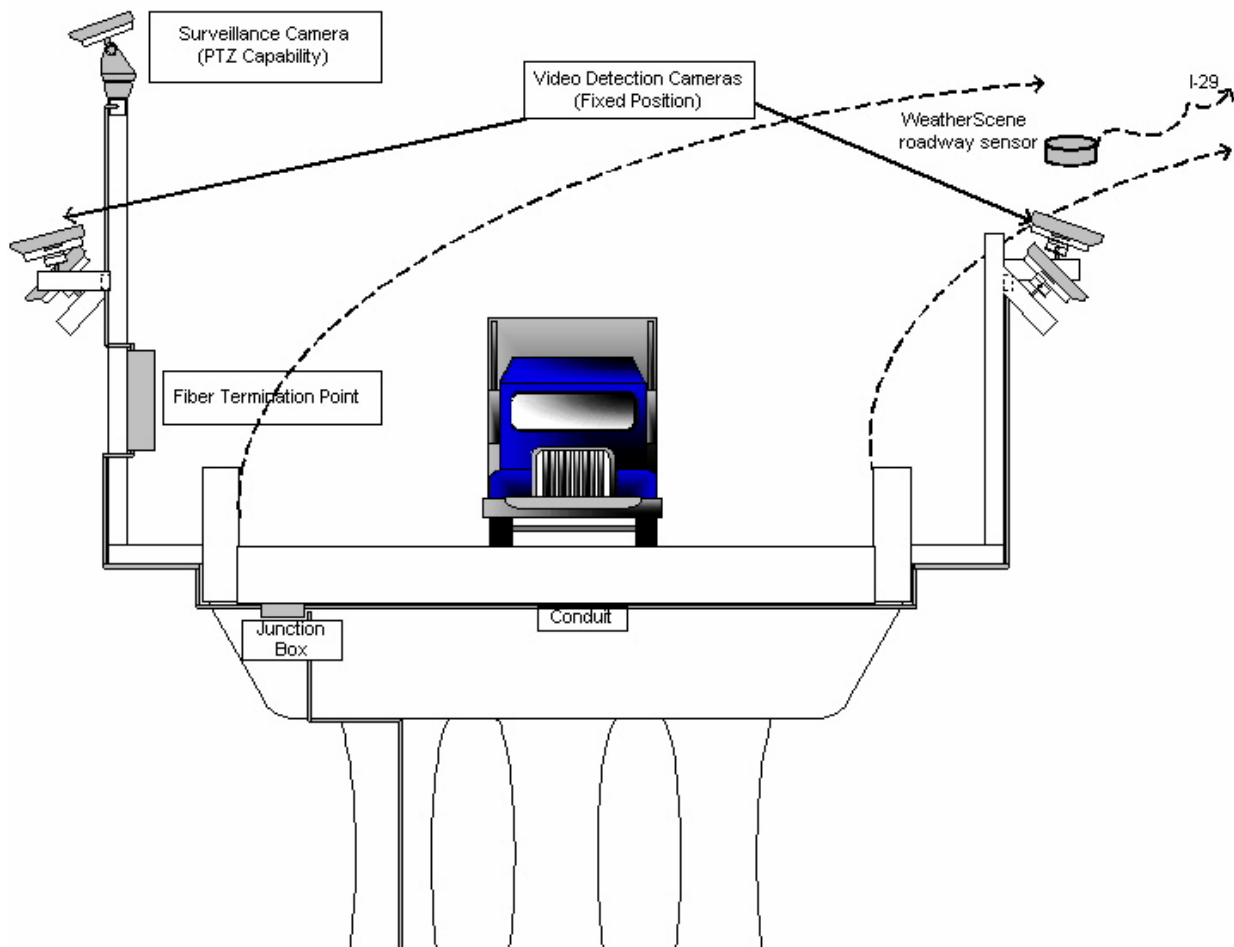
5. Four video cameras with capability to detect traffic to provide traffic counts, traffic classification, and measure traffic speeds.
6. Supervisor computer with Windows NT/2000, capable of supporting system functionality, including viewing full-motion video.
7. Supervisor software in Windows NT/2000 environment to set up and manage the system configuration, including detection zones, monitoring of detector operations, and collecting of traffic data.
8. Power supply.

9. Additional equipment and supplies required to have a ready-to-operate system.

2.2. Video surveillance and monitoring system (see Exhibit 1)

The video surveillance system shall consist of the following components:

1. One video surveillance camera with PTZ capability, preferably through a built-in PTZ, capable of 360° rotation and minimum of 12X zoom.
2. Supervisor software in Windows NT/2000 capable of supporting system operations.



I-29/I-94 Tri-level Bridge (Conceptual Illustration)
CCTV Surveillance System with Video Detection

3. Power supply

4. Additional equipment and supplies required to have a ready-to-operate system.

2.3. Remote Video Viewing Field Traffic Data. Receiving (Exhibit 2)

The NDDOT District Office shall be equipped with the necessary devices and software to allow viewing full-motion video from any video detection or surveillance camera as well as weather and traffic data collected in the field, including the following:

1. Software/hardware needed to receive full-motion video from the four video detection cameras and the surveillance camera, as well as video detection cameras that will be installed on 13th Avenue South in Fargo in Fall 2002. Specifically, the following items are included:
 - i. One video monitor dedicated to the surveillance camera.
 - ii. Two video monitors for viewing any of the video detection cameras.
 - iii. One field supervisor monitor for testing and configuring video cameras in the field.
 - iv. One video switching system capable of switching at least 16 inputs to 8 outputs.
 - v. Computer hardware and software to support viewing full-motion video on the supervisor computer at the NDDOT Fargo District Office.
2. Communications devices for supporting full two-way communications between the NDDOT Fargo District Office and field devices to properly operate the system.

2.4. Communications

The NDDOT requests the contractor to provide all necessary communications devices to support a fully-operational system compatible with NDDOT fiber optics network, including:

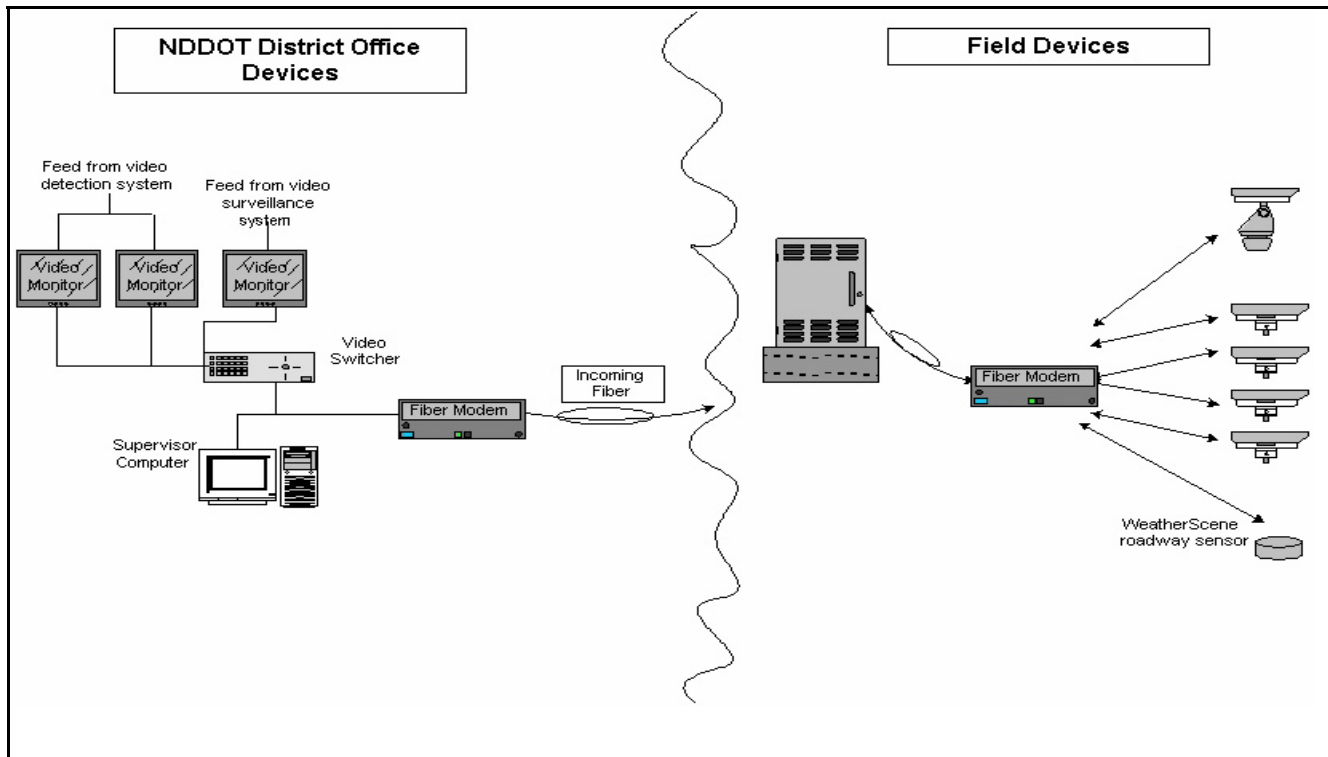
- i. Communications interfaces for connecting all field devices to fiber optics network.
- ii. Communications interfaces for delivering full-motion video, traffic data, and roadway weather data from the weather sensing equipment to the NDDOT District Office in Fargo.
- iii. All necessary connectors from the field to existing fiber optics (see Exhibit 2)

3.0 SYSTEM REQUIREMENTS

3.1 Video Detection System

The video detection system shall provide full-motion video and detect vehicles through processing video images. The system shall have the capacity to detect a minimum of four approaches-each camera fully detecting one approach with multiple detection zones to cover 6 lanes simultaneously.

The video detection cameras shall be 1/3-inch color CCD that outputs NTSC video, with a resolution no less than 350 TV lines (horizontal) and 350 TV line (vertical).



The video detection cameras lenses shall be pre-focused at the factory and shall not require field adjustments. The zoom optics shall maintain focus throughout the operating range from 7 to 74 degrees horizontal field of view (5 to 58 degrees vertical field of view).

3.2 Video Surveillance System

The video surveillance camera shall provide full-motion video and work with a PTZ unit to allow remote control of camera operations, including pan, tilt, and zoom.

The surveillance camera lens shall be pre-focused at the factory and shall not require field adjustments. The zoom optics shall maintain focus throughout the operating range from 7 to 74 degrees horizontal field of view (5 to 58 degrees vertical field of view).

The surveillance camera zoom optics shall provide a minimum of 12X optical zoom.

3.3 PTZ Unit for Surveillance Camera

The PTZ unit shall have 360° continuous pan rotation at a minimum variable rate of 0.1° to 40°/sec and tilt capabilities at a minimum variable rate of 0.1° to 20°/sec. Preset functions will be built into the PTZ enabling the unit to have 30 programmable stopping points. The PTZ shall be capable of remote control operations via serial connection (RS232 or RS485).

3.4 Video Monitors

The video monitors used for viewing video feed from the video detection cameras and video surveillance camera shall be in color and of high resolution(450 horizontal lines). Each video monitor shall contain BNC type connectors and support the NTSC television format. Monitors shall have face mounted controls in addition to fully functional remote controls. The video monitor size shall be a minimum of 19 inches, each.

3.5 Environmental Requirements

The video cameras shall operate from -40 to 140 degrees F (-40 to 60 degrees C) and a humidity level of up to 95% relative humidity. The camera enclosure shall be waterproof and dust-tight to NEMA-4 specifications.

The video cameras shall be equipped with faceplate heaters to prevent fogging.

The video cameras shall meet FCC class B and CE requirements for electromagnetic interference emissions.

The communication panel shall operate under a temperature range of -30 to 166 degrees F (-34 to 74 degrees C) and up to 95% relative humidity, non-condensing.

3.6 Power supply

The cameras, heater, and PTZ unit shall operate on 24 VAC at 50/60 Hz or 120 VAC nominal 60 Hz and conform to NEMA 2.1.2 Standard TS2 specifications.

The video output, communication, and power stages of the sensor shall include transient protection to prevent damage to the camera due to voltage transient occurring on the cable leading from the sensor to other field terminations.

3.7 Video Switching System

The video switcher shall consist of a matrix switch capable of switching at least 16 inputs to 8 outputs. The switch shall have a manual control panel, to allow the switching of signals as well as remote switching ability. It shall have BNC type connectors and comply with the NTSC format.

4. SYSTEM FUNCTIONAL REQUIREMENTS

The system shall provide full-motion video, remote access to modify detector attributes, and real-time and stored traffic data. When optimally mounted, the video detection camera shall be able to monitor at least six (6) traffic lanes simultaneously.

4.1 Video Data

Each video camera shall provide NTSC output at no less than 30 frames per second and shall process a minimum of twenty detector zones anywhere in the field of view of the camera.

The video shall be transmitted over a coaxial cable to the communications interface. The operator shall select the desired video quality of the desired frame rate, and the compression shall automatically adapt to provide either the highest frame rate at the

requested video quality or the best quality at the requested frame rate, based on the effective communications system data throughput rate.

4.2 Video Detection System Traffic Data

The video detection system shall be able to provide real-time polling, dial out, or stored traffic data including volume, occupancy, speed, density, headway, incident detection and five vehicle classifications either by phase or in a user-specified time interval as short as 10 seconds and as long as 60 minutes. The system shall provide status indications and an operations log for a history of events. The system shall allow users to add/modify detection zones remotely.

5. SYSTEM PERFORMANCE

The followings are minimum requirement for the system.

5.1 Count Detection Performance

The system shall be able to count vehicles with at least 96% accuracy under normal operation conditions (day and night), and at least 93% during artifact conditions (lighting conditions caused by shadows, fog, rain, snow, etc).

5.2 Demand/Presence Detection Performance

The demand presence detection shall be based on the ability to enable a protected turning moment on an intersection stop line, when a demand exists. The probability of not detecting a vehicle for demand presence shall be less than 1-percent error under normal operating conditions. During adverse conditions, the system shall minimize false protected movement calls to less than 7%.

5.3 Speed Detection Performance

The system shall accurately measure average speed of vehicles.

5.4 Traffic Signal Control

The system shall detect vehicles through processing video images and providing detector outputs to a traffic signal controller (TS-1, TS-2, 170 and 2070). The system shall provide remote access to modify detector attributes and receive real-time and stored traffic data.

5.6 Detection Zones

Each camera shall accurately detect a minimum of 20 zones.

6. ADDITIONAL EQUIPMENT

In addition to the equipment identified in the SP, the contractor must provide all additional equipment and software for a fully-functional traffic detection and surveillance system. However, it is the intent of the NDDOT to keep all field hardware/devices to a minimum due to site limitations.

7. TRAINING

The supplier of the system shall provide on-site training to representatives of the NDDOT,

the Advanced Traffic Analysis Center of NDSU, and anyone on invitation from NDDOT. The training shall include all aspects of the detector system reasonable for full operation of the system by Owner. The exact amount of time for the training is to be determined by the Owner.

8. WARRANTY, MAINTENANCE, AND SUPPORT

The video detection system shall be warranted by its supplier for a minimum of two years.

Ongoing software support by the supplier shall include updates of the camera and application software. These updates shall be provided free of charge for one year.

9. BASIS OF PAYMENT

| Pay Item | Pay Unit |
|-----------|----------|
| IT System | Each |