APPENDIX I
Traffic Management Video System Planner

CHAPTER I

OVERVIEW OF INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

GENERAL

The proliferation of Intelligent Transportation Systems (ITS) projects across the country indicates that this new approach to transportation management is the wave of the future. Transportation professionals are being called upon to evaluate, test, and embrace new technologies. What do they need to know and to do in order to ensure their successful application on today's roadways?

They must become better educated in ITS technology so they can make well founded decisions. Transportation professionals need to keep abreast of technological developments and to advocate safe and efficient transportation systems. Transportation professionals must also guide the public and elected officials in the development of ITS systems, helping them to avoid quick fixes while keeping an eye on long-term solutions.

The following material addresses ITS based technology that pertains to Advanced Traffic Management Systems (ATMS). This is most often identified with incident detection and congestion management.

STAGES OF INCIDENT MANAGEMENT

Before we can begin to understand the benefits of ATMS technology, we must first look at the stages of incident management. For the purpose of reviewing ITS opportunities, four stages of incident management are considered.

Incident Detection Stage - In this stage, a condition that is not normal for the time period or location is detected. The nature of the problem may or may not be confirmed, depending on the source of detection. This stage may take a few seconds or several minutes. The condition being reported may not be the result of an actual incident.

Incident Identification Stage - The actual occurrence of an unusual condition is determined and the nature of the occurrence is identified during this stage. This may occur concurrently with the detection stage or may take several additional minutes of time.

Incident Handling Stage - It is during this stage that corrective actions are being taken. Those actions may include simply pushing a vehicle to a safe area. The time required may be a few minutes or several hours.

Traveler Information Stage - Overlaying each of the stages is the need to inform travelers of the potential or actual incident condition. This stage may begin concurrently with the incident detection stage and continue for a period after the incident handling stage to assure travelers that the condition no longer exists.

Within an Advanced Traffic Management System (ATMS) there are several subsystems that perform various functions in the four stages of incident management. These systems consist of a Supervisory Control and Data Acquisition (SCADA) system, Video Surveillance and Control system, Fiber Optic Transmission system and Variable Message Sign system. (This architecture is shown in figure 1.1). Video surveillance technology will play a vital role in support of the Intelligent Vehicle-Highway Systems by providing assistance in the incident identification and incident management stages.

ADVANCED TRAFFIC MANAGEMENT SYSTEM ARCHITECTURE

The video surveillance system that exists within the Advanced Traffic Management System (ATMS) can be categorized into three separate equipment locations, interconnected to form a complete communications link. These locations can be identified as the Remote Camera Sites, Hub Sites, and the Traffic Operation Center. (This architecture is shown in figure I.1).

It is important to look at the video system architecture and allow for your system to grow as your requirements change, and doing so in the most economical way. Designing your backbone infrastructure and categorizing your areas to be monitored into subsystems will allow adding equipment in the future easier and cost effective.

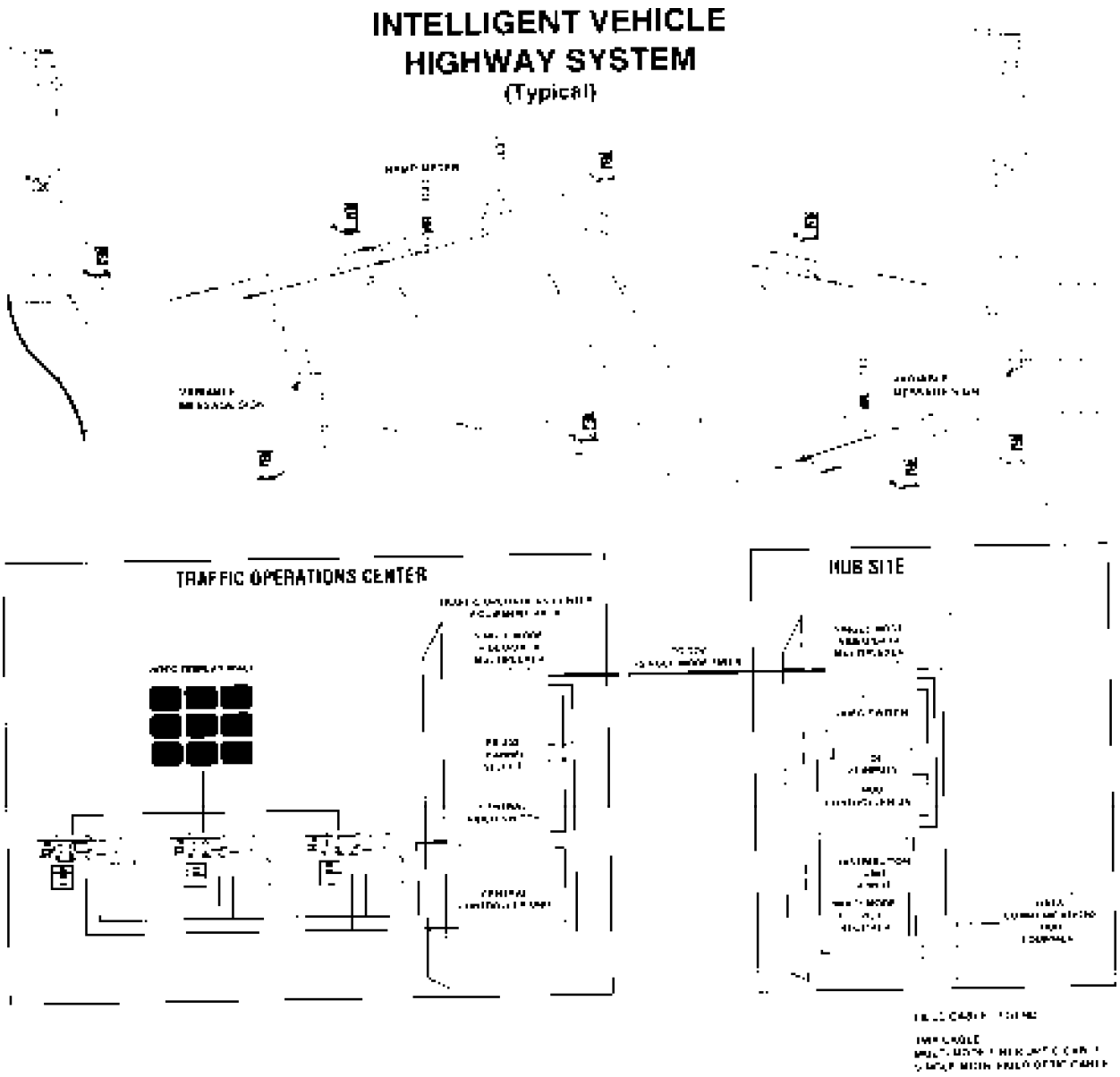

Figure I.1 Typical traffic surveillance components integrated into a traffic management system.

REMOTE CAMERA SITE

The remote camera site is that area required to be under surveillance. This may be an interchange, a rest stop, a congested ramp metering area, the display of a Variable Message Sign, or various traffic signal intersections. To allow a wide area of viewing, this camera usually has a pan/tilt unit.

The video and control signals are transmitted to a Hub site. There are various methods of transmitting video and control signals from the camera to the Hub site. The most common type of transmission used today is via a multimode fiber optic cable.

HUB SITE

A Hub site is necessary so that a group of cameras can be directed (or "hub") to a remote switching area. This is recommended to minimize the expense of transmitting video from the remote site to the traffic operations center down to a minimum. Transmitting all the remote camera sites back to the Traffic Operations Center is very costly and unnecessary. It is suggested that the number of cameras to be transmitted back to the Traffic Operations Center be kept to a minimum of three or four cameras per hub.

Hub sites can be added throughout an area and cameras can be added to the Hub sites as the demand increases. This type of open ended architecture allows growth for the future.

TRAFFIC OPERATIONS CENTER

This area is the command center and allows the viewing from various remote camera sites to be monitored, providing vital information for operators. There can be one to any number of workstations that can be provided, based on system size and demand. It is also possible to provide workstations for other agencies such as the Highway Patrol, City or County departments, or the Fire department.

The workstation equipment will very base on the extent of the Advance Traffic Management System (ATMS) and would reside in the operator control console. For the video requirements, a control keypad or computer would be provided to select the camera and control the pan/tilt/zoom functions of the selected camera. Also, large video display walls that can either be viewed as one large screen or many small screens are becoming very popular.

Other equipment used to fully integrate the Advanced Traffic Management System would also be available to the operator. A terminal for transmitting the variable message sign text, or for gathering data for the Supervisory Control and Data Acquisition (SCADA) system would all be available.

CHAPTER II

REMOTE CAMERA SITE

GENERAL

At a typical remote camera site, the various components consist of a video camera assembly, a pan and tilt unit, mounting flange, camera cable assembly, pan and tilt cable assembly, pole, MPC camera control receiver unit, and a multimode fiber optic transceiver. In addition, the MPC receiver unit and fiber optic transceiver fit neatly into a 330-type enclosure for easy access.

The reader may wish to list some objectives for, and physical characterization of, the proposed site. This will aid in selecting the camera that fits the need and environment.

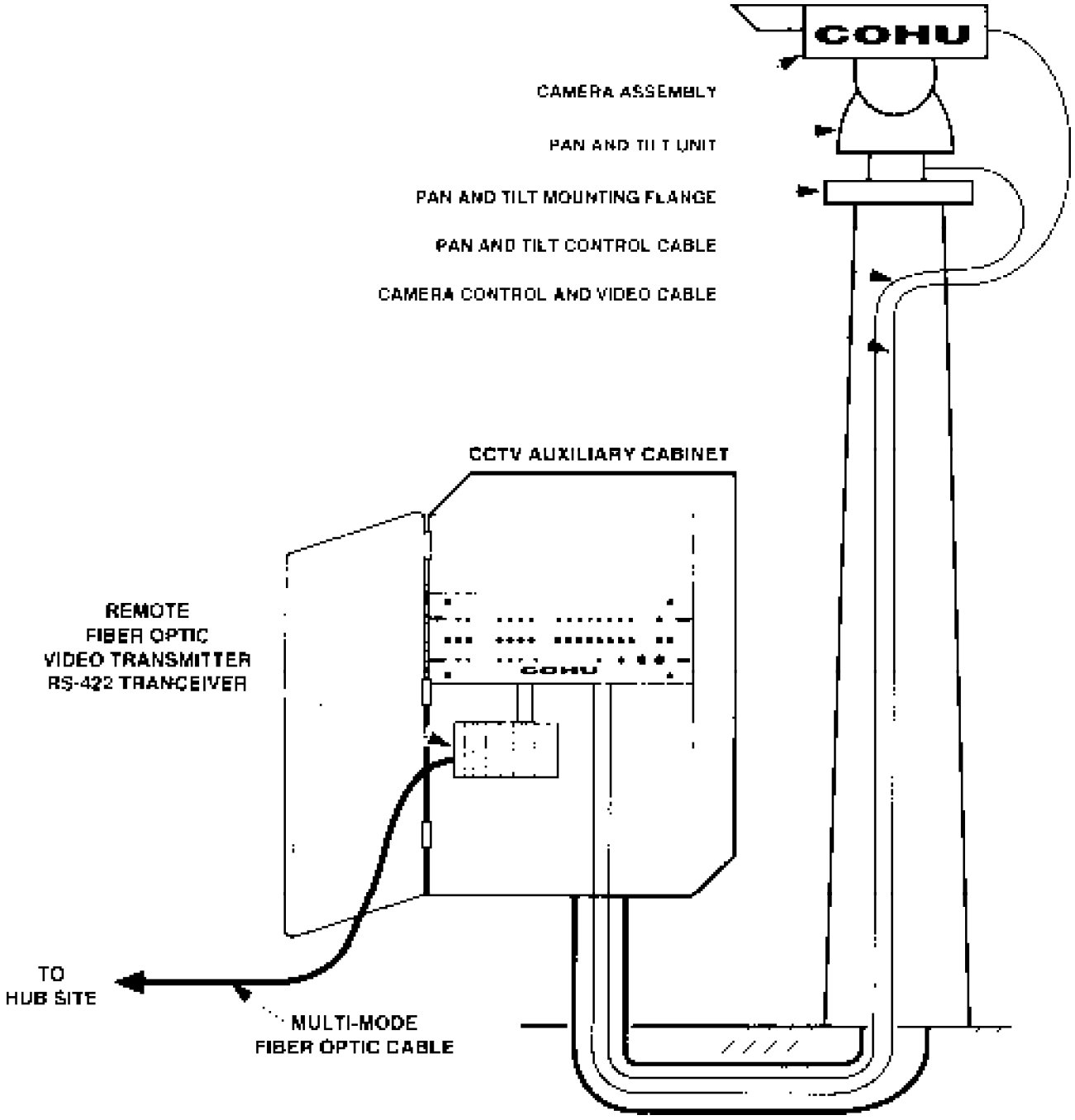

Figure I.2 Remote camera site configuration

CAMERA SELECTION

Once the camera site has been established, determine the type of camera that will best meet the objectives that have been established for the site.

Determining the type of camera to use with the existing lighting conditions isn't always a cut and dried situation. While color cameras provide important information needed to describe vehicles and identify license plates, color cameras require more light to produce a usable picture compared with a monochrome camera. The characteristics of a monochrome camera vs a color camera are:

MONOCHROME CAMERA	COLOR CAMERA
• High Sensitivity	• Requires 10 X More Light
• High Resolution	• Provides Valuable Color Information
• Any Type of Illumination	• Requires Full Spectrum Illumination

In daytime operations, either a color camera or a monochrome camera will perform well. Monochrome cameras can provide a higher resolution. Most people relate to color images and color information may be important. Therefore, the most common type of camera used for daytime operation today is the color camera.

For night time operation, lighting availability can come from various sources. The cars that are using the freeway and existing intersection lighting all have to be taken into consideration.

In most urban intersections where street lighting is available, a color camera will perform well. High pressure sodium and mercury vapor type of lighting will provide a full spectrum of light. It is not recommended that low pressure sodium lighting be used with a color camera. Low pressure sodium light does not provide the proper light spectrum to provide a true color image.

On freeways and interstates, the majority of light is provided from passing vehicles. In rural areas the absence of lighting dictates the use of a monochrome camera. (In extreme condition, an intensified camera may be required.)

With the advancement of color camera technology over the past five years, high performance, high sensitivity color cameras are being used in most traffic applications.

Video Color Camera

If a color camera is selected for the remote camera site, the camera should be a self-contained assembly capable of 24-hour per day unattended operation in specified environments. The following text describes the essential features of a color video camera. The glossary located in the appendix provides definitions to all technical terminology.

NTSC color CCTV cameras should have a blemish free, ½ inch, on-chip microlens, interline transfer charged coupled device (CCD) image sensor. The sensor should have a resolution of at least 768 horizontal and 494 vertical, active picture elements. All additional components should be of solid

state circuitry. The camera should have horizontal resolution of 460 TV Lines and have a standard C type or CS type lens mount. This will assure resolution and sensitivity.

The three most important specifications that determine the performance quality of a camera are:

1. sensitivity,

2. resolution, and

3. signal-to-noise ratio (SNR).

Other important considerations are the camera's ability to withstand shock and vibration, resistance to corrosion and the ability to handle hot and cold temperature extremes.

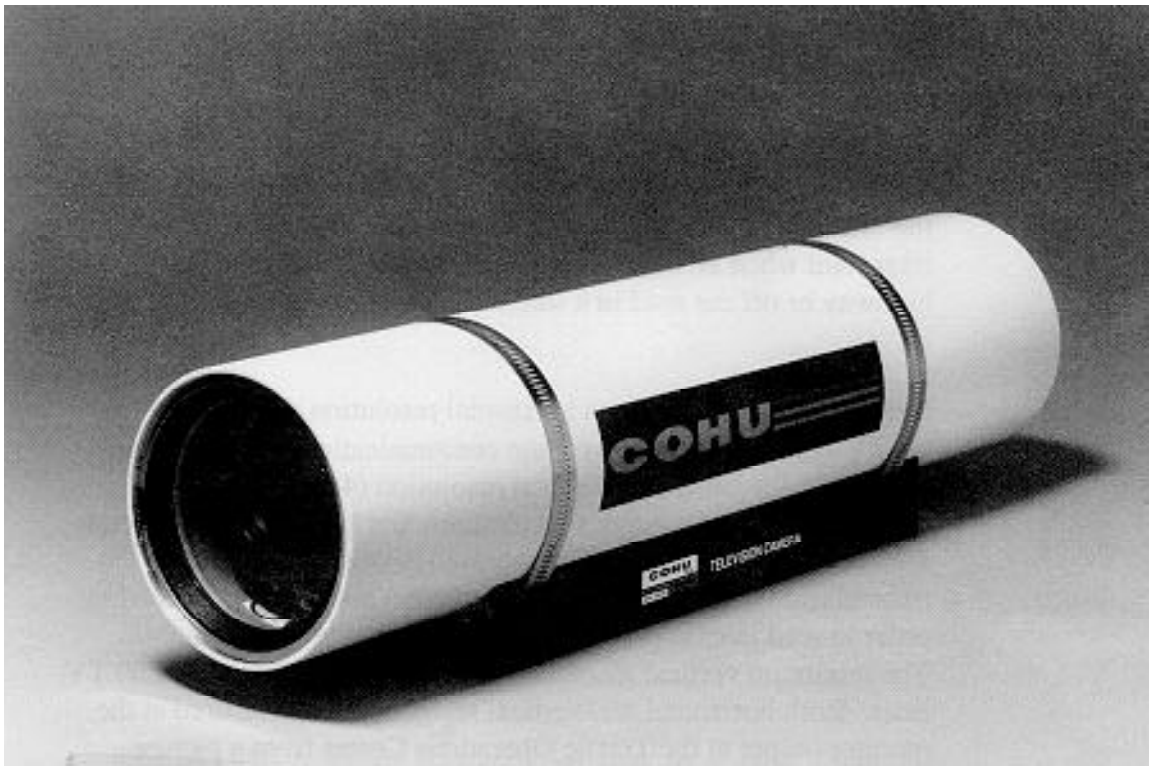

Figure I.3 The 8240 camera is recommended for traffic surveillance where color recognition is important. A sealed and pressurized enclosure provides maximum protection against rain, snow, dust, chemical pollutants, extreme temperatures, and other environmental hazards associated with traffic surveillance..

Camera Sensitivity: With Automatic Gain Control (AGC) off, the camera should achieve full video at 6.5 lux faceplate illumination. The camera should also provide a usable picture with only 0.55 lux faceplate illumination. (Usable picture is 80% of full video with AGC on). Extended sensitivity can be achieved by integrating the CCD sensor. More information on this is covered under the camera options section that follows.

Sensitivity is very important when using a color camera. The use of cameras in the winter months requires the best sensitivity during the 5:00 pm rush hour when little sunlight is available. This is also important when an incident is in a non-illuminated section of highway or off the road in a shadow area.

Resolution: The minimum horizontal resolution provided by the CCTV system operating over the communication system should be as close to the camera horizontal resolution (460 TV lines) as possible. This is a system specification that starts at the front-end with the video camera and is processed through the entire transmission medium. The best horizontal resolution is needed in order to read license plates, and identify the type of automobile. The minimum vertical resolution provided by the system is 350 TV lines. Both horizontal and vertical resolution are measured at the monitor output at the Traffic Operations Center from a picture generated by a CCTV camera or signal generator furthest from the Traffic Operations Center.

Signal to Noise Ratio: Signal-to-noise ratio for the CCTV system operating over the communication medium typically is no less than 40 dB. The system signal-to-nose ratio is measured at the monitor output at the Traffic Operations center for a picture generated by the CCTV camera installation furthest from the Traffic Operations Center. It is noteworthy to mention that signal-to-noise is accumulative starting with the camera, the transmission system, and the switching system. In order to achieve such a system signal to noise ratio the camera has to have the highest signal to noise possible, typically 45 dB.

Other Considerations: Sync is important when other components such as a video switcher, or a video tape recorder are being used in the system. The cameras need to be synchronized to the same reference point as the switcher or VCR to prevent any vertical roll or tear in the image when cameras are being sequenced or recorded.

Camera synchronization (sync) is available in two methods:

1. Phase-Adjust line lock, or

2. Genlock/Color lock.

The Phase-Adjust line lock sync method can achieve this, however this may effect color quality. By using a Time Base Corrector at the switching or recording site, vertical role or tear can be resolved.

Color camera sync signals and monochrome sync techniques are very different. The color signal is different, and has information such as color burst, and should be treated differently. Automatic gain control should have 0 - 20 dB range, with switch selectable on/off. Automatic Gain Control (AGC) is a process by which gain (the output signal level amplitude) is automatically adjusted as a function of

the input signal. Automatic White (Color) Balance is provided with through-the-lens sampling with remote control override capability to compensate for various amounts of illumination.

An 8-step switch-selectable electronic shutter can provide speeds from 1/60 to 1/10,000 second. This is recommended to capture a view of fast-moving objects.

The cable carrying the video signal from the camera to the control cabinet should be unspliced. The cable shall be of sufficient length to allow for the full range of pan and tilt movements and to provide a dip loop and a six-foot coil in the field equipment cabinet. These cable assemblies should have a potted connector so that no moisture can penetrate the cable.

This cable should be able to withstand the environment with or without being placed inside conduit or the equipment pole.

The camera will accept a variety of lenses in either C or CS mount format. The use a fixed focal length or variable focal length (zoom) lens can be incorporated into the camera housing. (Lens selection is covered later in this section.)

Zoom lenses and pan/tilt mechanisms should be capable of responding to remotely-generated preset positioning. Camera position and focus can be set to a desired configuration and stored into memory. A single button command will then automatically call up this position, thus reducing the chance of operator error. This is particularly useful when various scenes are covered by a single camera and at different time intervals, e.g.: three lanes of I-15 northbound between the hours of 7 - a.m., two lanes of SR-52 eastbound between the hours of 3 - 5 p.m..

Attempt to remain consistent in design of, and product acquisition for, each Site. Costs of maintenance, inventory, and training can be substantially reduced if all components at each Camera and Hub Site are identical.

Video Monochrome Cameras

If a monochrome camera is selected for the remote camera site, the camera should be a self-contained assembly capable of 24-hour per day unattended operation in specified environments. The following text describes the essential features of a monochrome video camera. The glossary located in the appendix provides definitions to all technical terminology.

RS-170 CCTV cameras should have a blemish free, ½ inch, on-chip microlens, interline transfer, charged coupled device (CCD) image sensor. The sensor should have a resolution of at least 768 horizontal and 494 vertical active picture elements. All additional components should be of solid state circuitry. Lens adapters must be standard C or CS mount.

Sensitivity: A 3200 K light source shall achieve full video at 2.5 lux faceplate illumination with the AGC off. The camera assembly will also provide a usable picture with only 0.015 lux faceplate illumination. (Usable picture is 30% of full video with AGC on)

Resolution: The minimum horizontal resolution is 580 TV lines and the vertical resolution is 350 TV lines.

Signal-to-Noise Ratio (SNR): The SNR ratio should be no less than 56 dB at gamma 1, gain 0 dB.

Automatic gain control should have 0 - 20 dB range, with switch selectable on/off. Automatic Gain Control (AGC) is a process by which gain (the output signal level amplitude) is automatically adjusted as a function of the input signal.

An 8-step switch-selectable electronic shutter can provide speeds from 1/60 to 1/10,000 second. This is recommended to capture a view of fast-moving objects.

The cable carrying the video signal from the camera to the control cabinet should be unspliced. The cable shall be of sufficient length to allow for the full range of pan and tilt movements and to provide a dip loop and a six-foot coil in the field equipment cabinet. These cable assemblies should have a potted connector so that no moisture can penetrate the cable.

This cable should be able to withstand the environment with or without being placed inside conduit or the equipment pole.

Auto iris, fixed focal length, or variable focal length CCTV lenses are recommended with standard C mount or CS mount adapters depending on the desired field of view. Camera should have auto- iris with the ability to have a manual override of the iris. Both color and monochrome cameras should accept and respond to remotely generated present positioning commands for lens functions such as zoom, focus positions. This makes viewing desired scene positions such as the north bound traffic in the morning and the southbound traffic in the evening quickly and easily. (Lens selection is covered in another section.)

It is recommended that the components provided at each field location should be identical to and interchangeable with all other field locations. This is so that a minimum inventory of spares need to be kept on hand. Also, maintenance training is reduced.

Figure I.4 A monochrome camera can be used at Sites where color identification is not considered important. It too provides the features and benefits of an environmental enclosure.

LENS SELECTION

When choosing a lens to perform at a remote camera site, there are several considerations that must be taken before an actual decision is to be made. Although choosing a lens is a fairly simple procedure, it is probably the second most important decision (the first being the camera).

To determine the size of the focal length of lenses needed, one must understand the basics of focal lengths. Focal lengths are measured in millimeters (mm). The millimeter number rating will get bigger for telephoto and smaller for wide angle. What this means is that the smaller the number, the wider the field of view, and the larger the number, the narrower the field of view.

Focal Length: Focal length is the distance between the surface of the lens and the sensor of the camera (known as the focal plane).

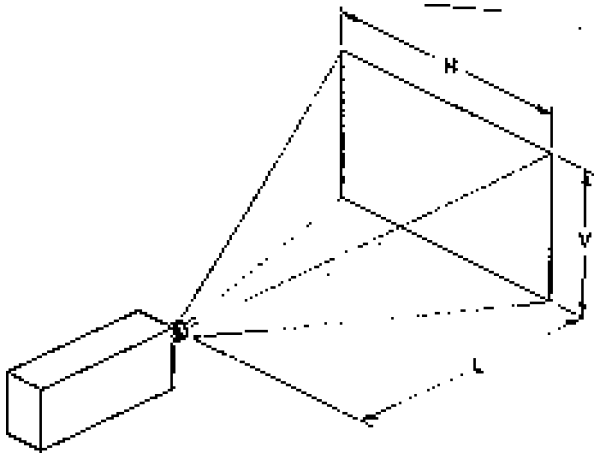

Figure I.5 Some of the elements that must be considered when selecting a lens are the field of view (height and width of a scene) and the depth of field (maximum and minimum distances from the lens at which the subject matter must be in sharp focus). This illustration helps explain the relationship between focal length and object area. With a 1/2" format imager:

H $\frac{6.4 \times L}{F}$ F = focal length of the lens in MM

V $\frac{4.8 \times L}{F}$ H = horizontal dimension of the object in mm

V = vertical dimension of the object in mm

L = distance from the lens to the object is measured in millimeters.

Fixed vs. Zoom Lenses

Determine if you need to view a wide area at short a distance. If so, a wide angle lens is needed. Secondly, does an average scene at medium distance need to be viewed? If so, use a standard angle lens. A telephoto lens is required to view a narrow area at long range If an area representing all three of the above requirements are necessary, a zoom lens would be required.

There are two basic types of lenses: fixed focal length lenses and motorized variable focal length lenses.

Fixed Lens: A fixed focal length lens provides one field of view. These type of lenses are available with either a fixed iris, used for indoor areas where the light is constant , or an auto-iris, used for outdoor applications were lighting conditions vary. This type of lens may be used for ramp metering or viewing inside a tunnel.

Motorized Zoom Lens: The term 'zoom lens' refers to the ability of the lens to physically alter its field of view from wide angle to narrow band. A zoom lens can make objects that are far away appear near and large, by increasing the viewing angle (field of view). This wide sweeping allows the operator a multitude of views at the touch of a button.

Automatic vs. Manual Iris

In an Incident Identification system when viewing traffic conditions on numerous lanes, a zoom lens is the most common type of lens. The zoom lens is motorized and remotely controlled. Functions under remote control include field of view, focus, and iris (light control into the lens).

The ability to select between automatic iris or manual override of the auto-iris operation is recommended. Manual override allows an operator to view scenes that might otherwise be unusable. For example: a vehicle accident where the automobile headlight is shining directly into the camera. An auto-iris lens would close down the iris, reducing the amount of light and affecting the cameras ability to produce a usable picture. By overriding the iris and manually opening the iris, the operator can now view the scene.

Preset positioning lenses are specially adapted lenses that provide zoom and focus information to the operator. This feature allows the operator to quickly adjust the zoom and focus of the lens automatically.

The three most common type of zoom lenses used on CCTV cameras are:

1. 8 - 80 MM 1/2" format
2. 10 - 100 MM 2/3" format
3. 16 - 160 MM 1" format.

Here are the approximate fields of view at 1 mile, 2 mile, and 3 mile distances for each type of lens zoomed to its narrowest angle with a 1/2" format imager.

WITH THIS ZOOM LENS FOCAL LENGTH:	AT THIS DISTANCE:	YOU WILL HAVE A HORIZONTAL FIELD OF VIEW OF:
8 MM - 80 MM	UP TO 1 MILE	420 FEET
10 MM - 100 MM	UP TO 2 MILES	675 FEET
16 MM - 160 MM	UP TO 3 MILES	630 FEET

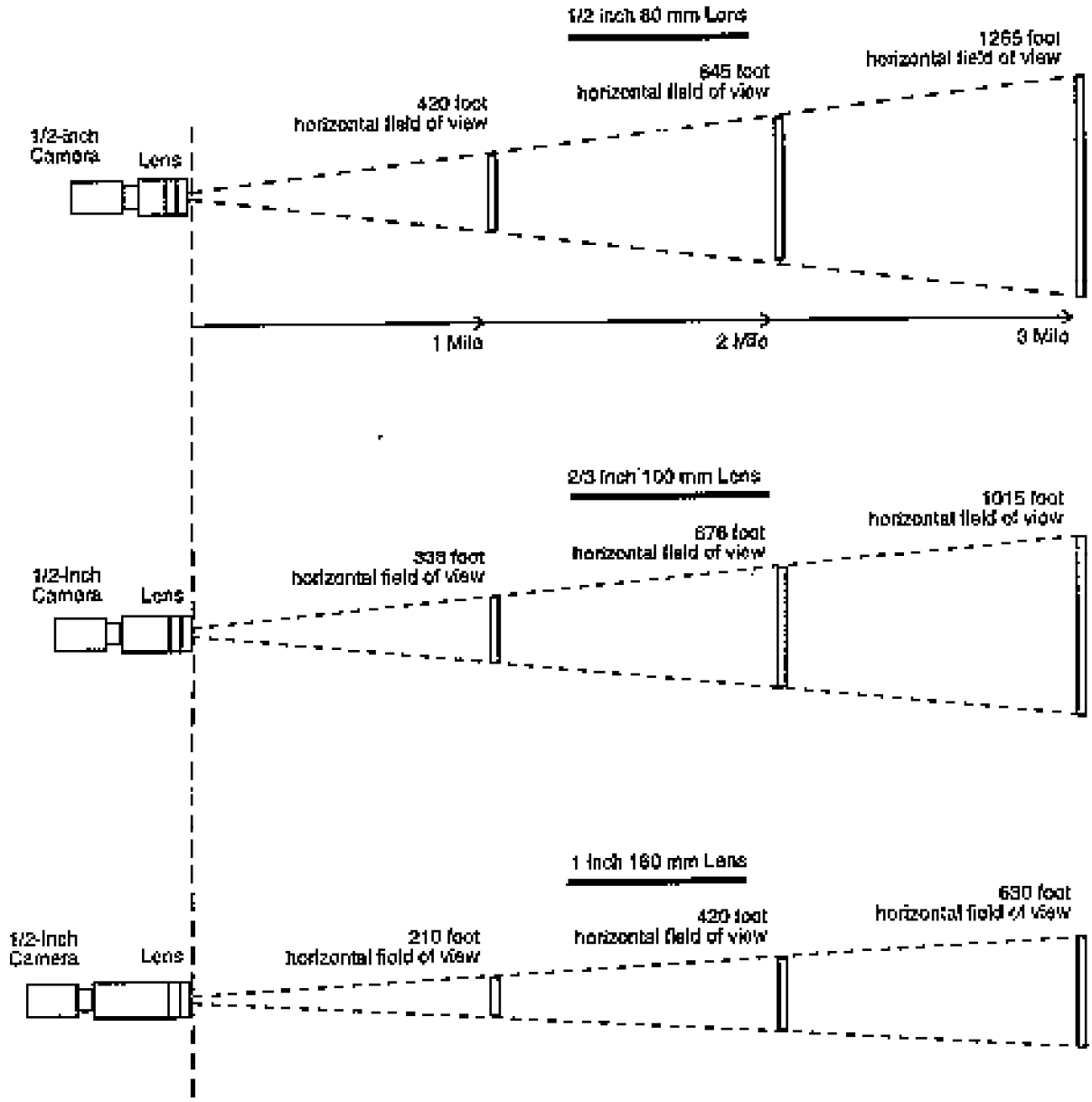

Figure I.6 = Field of View Comparisons Between Three Different Lenses

HOUSING

The effects of pollution, dirt, dust, and humidity associated with the highway environment can cause premature deterioration of electronic equipment. Typically, we recommend the use of a sealed and pressurized 4.5" (outer diameter) camera housing. The housing is pressurized with five psi of dry nitrogen, with desiccant bags and humidity indicator installed within the enclosure. This protects the camera, lens, and associated components from the damaging effects of the highway environment.

The housing is manufactured from aluminum tubing. The length of the barrel, typically either 18 or 20 inches, is determined by the camera and lens desired.

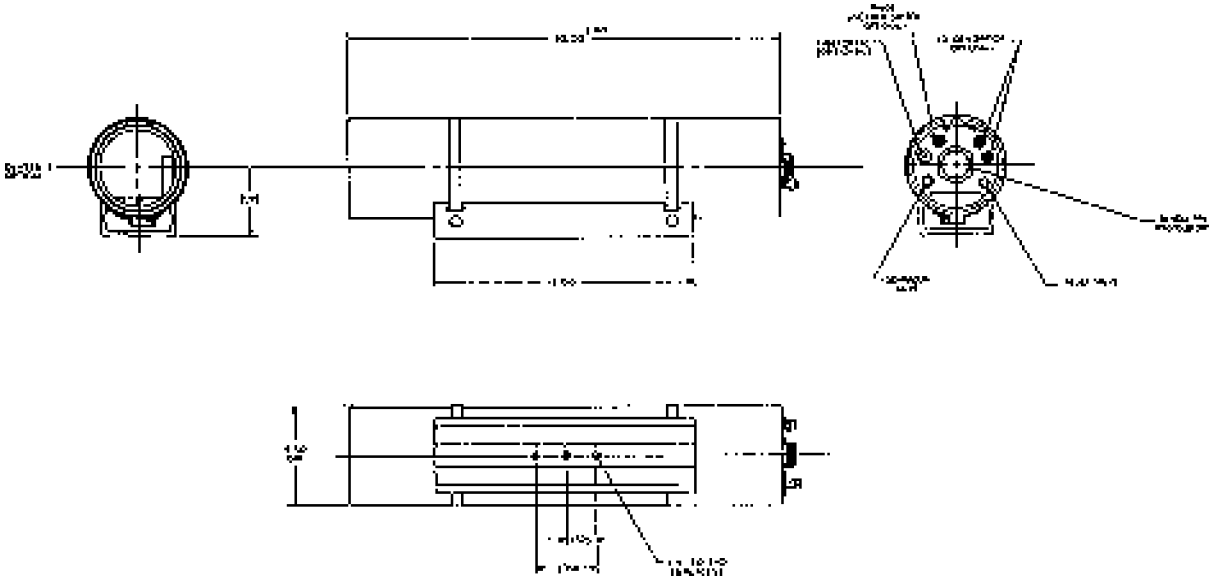

Figure I.7 The barrel attaches to the mounting base with two stainless steel circular clamps. The base has three tapped 1/4-20 holes for mounting to a pan-and-tilt unit, wall mount, or other type support.

OPTIONS AND ACCESSORIES

Programmable Alpha-Numeric ID Generator

This feature provides the capability to add an identification to the video output of the camera. This identification is 2 lines of 24 alpha-numeric characters each. The characters are white with a black border and are 28 TV lines in height. The two-line ID can be placed in either the top or bottom of the display. Left/right positioning is done by padding the message with spaces. A computer or ASCII terminal is used to enter the desired ID message into non-volatile RAM. This programming can also be done either at the remote camera site or downloaded from the Hubs or the Traffic Operations Center.

Low-Pressure Sensor

This feature notifies the operator when routine maintenance of the camera housing is required. The camera can be equipped with an optional low-pressure sensor consisting of a pressure switch set to create a contact closure. If the pressure in the camera housing drops to less than 2 psi, the closure will activate an alpha-numeric message stored in the programmable identification generator which reads "Low Camera Pressure." This message will be superimposed on the camera video output.

Fiber Optic Video Output

The fiber optic video output option allows the video signal to be transmitted over a fiber optic link to a compatible fiber optic receiver.

Heaters

This option provides a thermostatically controlled heater to keep the camera above its minimum operating temperature in cold environments. The thermostat turns the heater on at 40° F and off at 55° F. The heater circuit is protected by a 0.7 amp, slow-blow fuse.

Sunshield

The addition of a sunshield is recommended for use in hot, sunny areas to reduce internal temperatures and minimize glare caused by direct sunlight. The sunshield is mounted in such a fashion as to allow air to pass over the external surface while keeping direct sun off the housing. The sunshield is mounted so that the front portion of the shield protrudes approximately 4" over the housing viewing window.

Window Wiper Assembly

A window wiper assembly is available to keep the window of the environmental enclosure free from dust and dirt. The assembly includes a high pressure pump, motorized wiper, and refillable cleaner fluid with a capacity of approximately 120 applications.

While this option is extremely convenient in some installations, it adds greater maintenance responsibility and is generally not necessary.

Junction Box

At the top of the camera pole, a junction box is available where the camera and pan/tilt cables can be wired to a terminal strip. This is done to allow replacement of the cables quickly and easily if they become damaged.

PAN/TILT UNIT

The pan/tilt drive unit provides a means of remotely positioning the camera with commands from the control center. The camera, lens, and camera enclosure are mounted on the pan/tilt drive. The pan/tilt drive accept and respond to remotely generated preset positioning commands. The pan/tilt drive units should be weatherproof and dustproof.

The minimum range of horizontal movement is from 0º to 350º. The pan/tilt units have stops to prevent wrapping the cables around the pole. The minimum range of vertical movement typically is ±90º. The speed of movement is usually 6º/second in the horizontal plane (no wind load condition) and 3º/second in the vertical plane (no load condition).

Preset positioning follower pots are recommended on pan/tilt units to allow feedback to the camera control receiver to provide information relevant to horizontal and vertical positioning. This allows the operator to quickly adjust to a pre-selected scene automatically.

The pan/tilt drive should have a minimum allowable load capacity of 40 pounds including cable dress and potential wind loading, or the total weight of the camera, lens, and housing, whichever is greater.

Operation of the pan/tilt unit is in temperatures of -20º to -60º C. An optional heater for the pan/tilt is available to allow operation in cold extremes in excess of -20º C.

Figure I.8 Outdoor pan/tilt units are valuable because they allow the camera to look in more than one direction or position. Carefully weigh the cost and benefits of a pan/tilt versus additional cameras, because pan/tilts can be quite expensive.

SUPPORT STRUCTURE

The support structure positions the camera-lens assembly, pan/tilt drive, and housing at heights of various length, depending on desired views. The support structure is made from a single, tapered, tubular pole with a circular or octagonal cross-section. The height of the pole will vary but is typically no greater that 65 feet.

The support structure will have a maximum deflection in any direction of 1.5 inches in up to 30 mph wind speeds. This deflection can be measured at the top of the support structure at the point where the base of the pan/tilt drive is attached. The support structure shall not be subject to harmonic vibrations within the range of environmental conditions specified.

The support structure provides a means of routing the required conductors inside the structure from the base of the structure. These conductors should not be exposed between ground level and the base of the pan/tilt drive.

CAMERA CONTROL RECEIVER

The Camera Control Receiver (CCR) unit receives RS-232 or RS-422 command signals from the MPC Camera Control Transmitter unit located at the Hub site or from the Traffic Operations Center. The CCR unit generates all corresponding control signals for the camera, zoom lens and the pan/tilt drive, and provides camera position and control feedback information back to the Traffic Operations Center.

The Camera Control Receiver provides local control of the following functions:

Zoom in/zoom out

Pan up/pan down

Pan right/pan left

Focus near/focus far

Iris open/Iris close

Preset 1/Preset 2/Preset 3/Preset 4/Preset 5/Preset 6

Video out

Aux. on/off

Camera power on/camera power off

Main Power

The receiver unit can accept command signals via a multimode fiber optic cable, a twisted pair, microwave or any other compatible data medium. The fiber optic cable is the most common type of transmission medium for Traffic Management Systems.

The CCR has eight form “C” relays to activate auxiliary devices in the field. These relays are rated at 3 amps at 115 VAC or 5 amps at 30 VDC.

In addition, there are eight status inputs available to monitor conditions in the field such as cabinet entry, loss of housing pressure alarm, etc.

The CCR has two RS-232 connectors, one RS-422 connector, a camera control connector, and a pan/tilt control connector. BNC video connectors are supplied.

Electrical connectors do not require special tools for installation or removal. All connectors are screw type and are unique in design to prevent incorrect installation of cables.

The power input to the Camera Control Receiver is 120 VAC/60 Hz.

The CCR accepts and responds to a minimum of 10 remotely generated preset positioning commands.

The CCR is a 19" rack mount for use in 330-type cabinets.

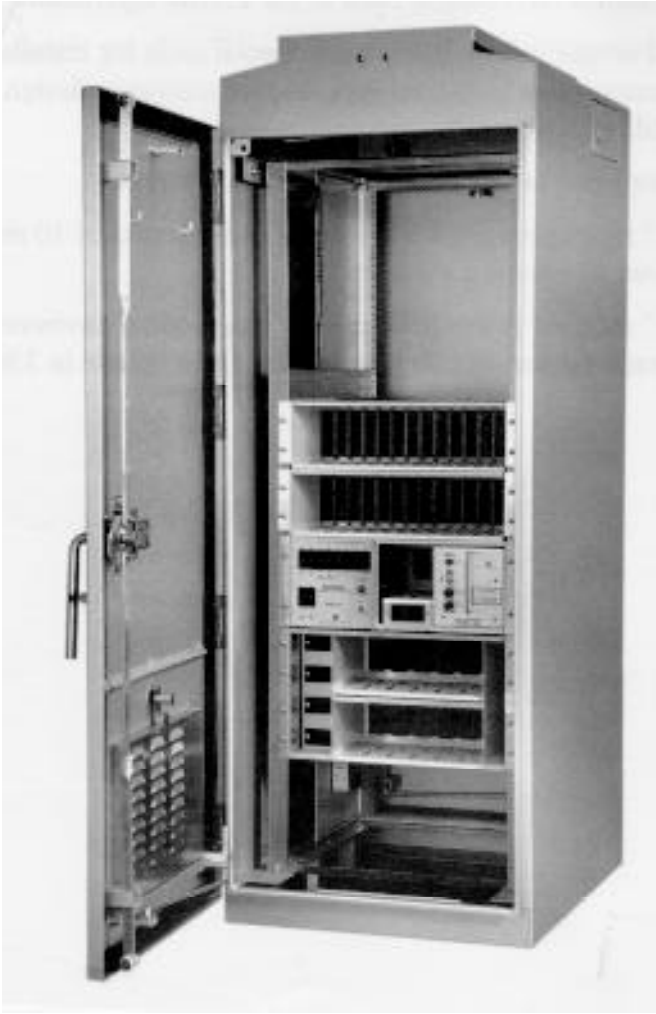

Figure I.9 Typical 330-type enclosure showing space for traffic control and camera surveillance control equipment.

MPC RECEIVER

If local control is not desired, the microprocessor receiver unit is available. This unit receives RS-422 or RS-232 command signals from the MPC Control unit located at the Hub site or from the Traffic Operations Center.

The MPC receiver unit generates all corresponding control signals for the camera, zoom lens and pan/tilt drive, and provides camera power, and position and control information back to the Traffic Operations Center.

Electrical connectors do not require special tools for installation or removal. All connectors are screw type and are unique in design to prevent incorrect installation of cables.

The power input to the receiver is 120 VAC/60 Hz.

The MPC receivers accept and respond a minimum of 10 remotely generated preset positioning commands.

The MPC receiver is available in either an outdoor environmental housing or a rack mount version with local control for use in 330-type cabinets.

TRANSMISSION SYSTEMS

Fiber Optic Transmission Systems

The most common fiber optic signal transmission method between the Remote Camera Sites and the Hub is multimode fiber optic cable. RS-232 data signals originate from the Traffic Operations Center and travel to and from the MPC Satellite Master Control Unit located at each Hub Site. The Satellite Control Panel receives the encoded control signals, converts this data to RS-422 and transmits this data to the MPC Receiver unit. The receiver decodes the signal and provides the drive voltages to the camera, zoom lens, and pan tilt.

The video signal received at the Traffic Operations Center via the fiber optic cable is demodulated to standard RS-170 composite video and processed through a standard CCTV video switching network. This signal can be viewed on standard CCTV monitors.

Comparing Fiber Optic to Coaxial Cable

Poor picture quality can result from outside interference, attenuation of the video signal, and poor video connections. RG-59 coaxial cable is limited to a transmission distance of 500-750 feet. Longer cable lengths may be achieved with different coax cables. As an example, RG-11 foam coax cables can be used for distances up to 3000 feet. To insure proper system operation, video equalizers and power amplifiers often are required before the maximum cable transmission distance is reached. The additional expenditures, along with the maintenance needed to maintain such equipment will often offset the initial higher cost of a fiber optic system.

Fiber Optic System Description

The primary design criteria for fiber optic transmission systems are the transmission type, transmission distance and the transmission environment.

Transmission Type

To compensate for longer cable lengths, different types of transceivers are used. These fiber optic transceivers differ in type of light source, method of modulation, wavelengths of light transmitted and the size of the fiber optic cable.

There are several methods which can be employed to transmit video and control over a single fiber. The frequency modulation (FM) configuration is one popular method.

Frequency Modulation (FM): Several manufacturers of fiber optic equipment offer a standard product which accepts RS-170 composite video inputs and control signals and converts them to frequency modulated (FM) lightwaves. The lightwaves are transmitted over a single fiber.

Amplitude Modulation (AM): Amplitude Modulation also carries video and control signals over a single fiber. The overall performance specifications of this system is not as high as the FM system. However, the difference has little consequence in normal traffic monitoring applications. AM systems do offer greater flexibility in the system designs.

The fiber optic transceivers are designed to be used with specific types of fiber cable. The two most common types of cable are 50/125 and 62.5/125 micron. The 50 and 62.5 refer to the inside diameter of the glass tube. The 62.5 is quickly becoming the industry standard as it is more efficient than the smaller 50 micron cable. The 125 figure refers to the thickness of the jacket (cladding) which surrounds the glass tube. The type and thickness of the cladding affects the strength and reflection of the light within the tube.

Transmission Distance

The most common type of fiber optic transmission found in a traffic management system from the Camera Site to the Hub Site is multimode fiber. Multimode fiber optic transceivers use a light emitting diode (LED) to transmit video and control signals to the Hub Site. Multimode fiber transceivers are primarily used for distances ranging up to six miles.

The single-mode cable design is used from the Remote Camera Site to the Hub Site when the distances become greater than six miles, and from the Hub Site to the Traffic Operations Center. Single-mode fiber optic transceivers also use an LED. Single-mode is the most expensive of all of the direct line fiber optic options.

It is critical to select the proper fiber optic transceiver for each application. The longer the transmission distance, the greater the amount of light that needs to be generated at the transmitter. The amount of light which is available at the receiver is affected by the transmission distance, type of transmitters, type of cable, and the quantity and quality of cable connections and splices.

Transmission Environment

The primary benefit of a fiber optic system is the elimination of voltage transient spikes found in the transmission lines that can cause equipment failure, cable interference caused by ground loops, and inductance and resistance. The use of fiber optics is always recommended when high levels of electronic noise is present.

The other major factor affecting a fiber optic transmission system is the number of cable connectors and splices. Each connection and splice reduces the amount of light available at the receiving end.

Other Factors

All these factors are taken into consideration when determining the Optical Loss Budget. The Optical Loss Budget is a measurement of how much light is lost due to transmission distance, cable type and the number of splices and connectors. The objective of the measurement is to assure sufficient signal strength (light) at the receiver to produce a usable video signal.

Fiber optic transmission systems can be complicated to design and specify.

CHAPTER III

REMOTE HUB SITES

GENERAL

The Remote Hub Sites begin with a multimode fiber optic video receiver card cage assembly. This is where the video from the multimode fiber is received and converted back to base band video. After processing the video signal through a video switcher, the base band video is directed to a single-mode fiber optic modulator. The single-mode fiber optic modulators are used to transmit from the Hub sites to the Traffic Operations Center.

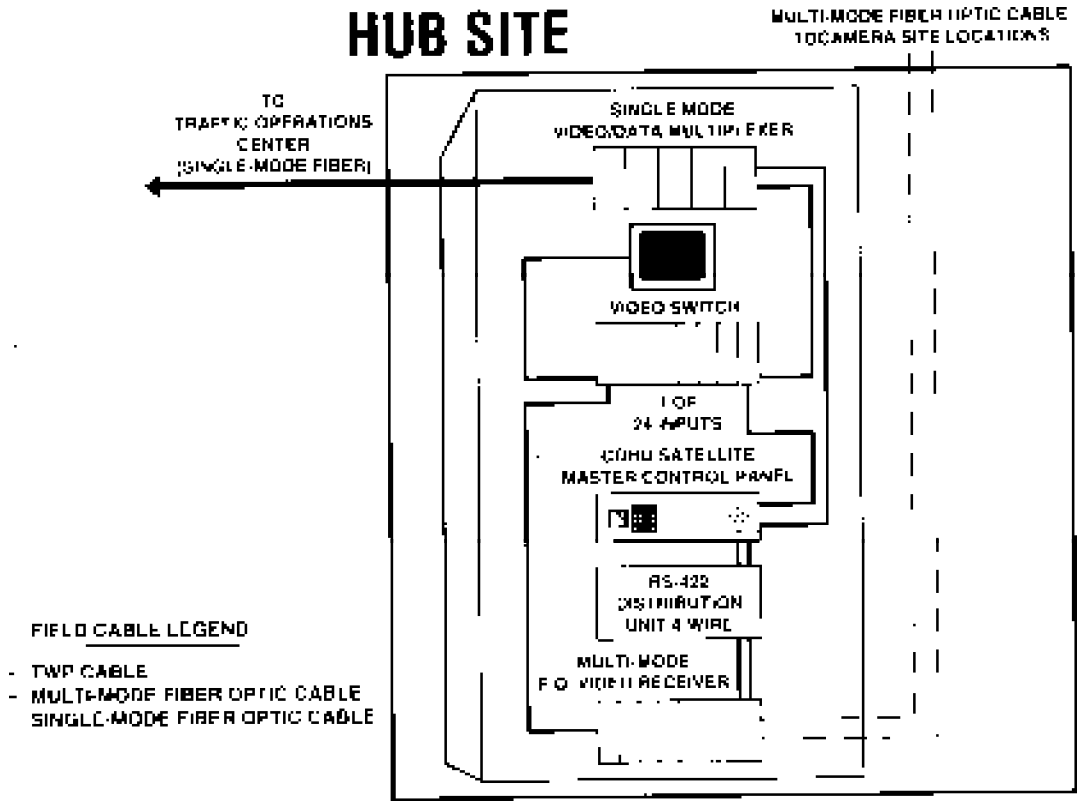

Figure I.10 Typical hub site

MULTIMODE FIBER OPTIC TRANSCEIVER

The multimode fiber optic cable from each camera site is terminated to a multimode fiber optic transceiver. Typically, these transceivers are supplied in a 19" rack frame with power supply. One transceiver is required for each camera site. The fiber optic transceiver breaks out both video and control signals. The video signal is routed to a video switcher and the control signal is routed to a RS-422 distribution unit.

SATELLITE HUB CONTROL PANEL

The Satellite Hub Control Panel is provided so that each Hub can operate as an independent subsystem. In the event of a break in the fiber optic single-mode cable or hardware problems, communications failure to the Traffic Operations Center may occur. An operator can operate each camera that is assigned to the Hub from the Remote Hub Site until the communication to the Traffic Operations Center is restored.

The Satellite Hub Control Panel has the following operator control features:

- Numeric Display
- Numeric Keypad
- Camera Power Switch and LED Status Indicator
- Auto/Manual Color Balance and LED Status Indicator
- Lens Speed Switch and LED Status Indicator
- Peak/Average Blue Adjustment Switches
- Manual/Auto Iris Switch and LED Status indicator
- Peak/Average Red Adjustment Switches
- Iris Open/Close Toggle Switch
- Focus Near/Far Toggle Switch
- Communications Error Status Indicator
- Reset Switch
- Zoom In/Out Toggle Switch
- Power Status Indicator
- Pan and Tilt Joystick Control

Satellite Hub Control Panel provides the following capabilities:

- Control and distribute command signals to and from 223 camera locations.

- Select and control a minimum of 10 pan & tilt and zoom lens (PTZ) preset positions for each camera location with the preset control panel. This is an option, and is not absolutely necessary, but nice to have when operating from this location.

- Communicate with the control receivers via bi-directional RS-422 over fiber optic data trans mission system.

- Display of camera and monitor identification. The display gives a busy indication when ever the camera/monitor being selected is under the control of another control panel.

- Program system configuration pertaining to the number of cameras, monitors, remote control stations and the communication type and baud rate.

The Hub Control Panel video switch interface, when utilized, will communicate with a video switcher via a parallel communications system. The numeric keyboard is be used to program these additional functions:

- Camera selection

- Monitor selection

- Sequence programming

- Sequence/Hold control

- Sequence order

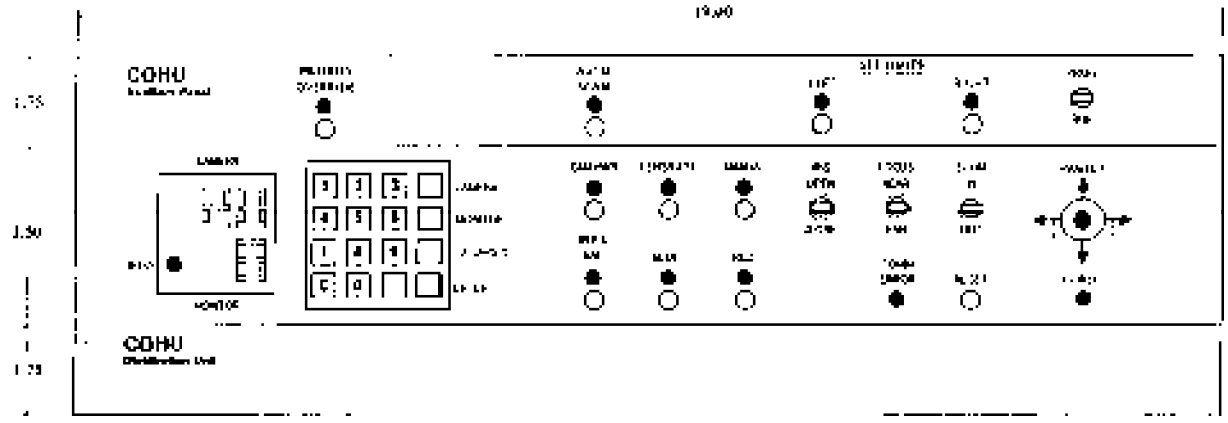

Figure I. 11 Typical Satellite Hub Control Panel and functions, with optional auxiliary control panel.

RS-422 Distribution Unit

The RS-422 distribution unit provides for 10 four-wire connections for MPC system data communications to control receivers located at each Remote Camera Site. This unit is used to communicate to each camera location in a star or parallel data bus configuration. In a serial or daisy chain configuration, if one communications path fails, you lose all other control of the cameras connected to this data bus. The benefits of using a star or a parallel data bus is that you have multiple communications paths instead of just a single path.

VIDEO SWITCHER

Video switching allows an operator to route a signal from one source to a destination. The equipment size is determined by the number of inputs (cameras, for example) and outputs (monitors, for example). In traffic surveillance, video switching normally occurs at the Hub Site, and is controlled from the Traffic Operations Center. This is done to reduce costs of the switcher and additional cables.

Distributed switching vs. centralized switching

One important factor in designing the operation of the video switch is to have the ability to control the video switch at the Hub Site from the Traffic Operations Center. This can be defined as distributed switching. This way, an operator sitting in the Traffic Control Center is able to select a video camera and route its signal from the Hub back to the Traffic Operations Center, or any other location on the video network.

In centralized switching, one master switch is located at the Traffic Operations Center and performs all the camera selections from a centralized switch. This method is costly due to the fact that now all of the video signals have to be brought into the Traffic Operations Center. The cost of single-mode transmitters and cable makes this alternative cost prohibitive.

A distributed switching system performed at the Hub Site is recommended, with two or three cameras per Hub Site.

Matrix Switching System

The switching system used most frequently is a microprocessor-based crosspoint matrix switcher capable of automatically routing video signals from a requested camera position to a specified monitor. Control of the system is provided by the Satellite Hub Controller. The switcher cage includes a power supply, an output amplifier, and a mother board. The switcher card cage also accommodates removable printed circuit boards, featuring plug-in connectors.

One switcher card cage can accommodate 128 cameras and 8 monitors. Multiple cages may be cascaded to create larger switching systems. Video inputs can be cascaded in increments of eight, in the form of video switcher cards with individual capacity of eight inputs per card. The card cage can accommodate up to 16 switcher cards. Outputs to monitors are eight per card cage.

The card cage is constructed of a steel chassis with aluminum side plates. The cage is designed to fit into a standard 19-inch-wide instrument rack.

SINGLE MODE MULTICHANNEL FIBER OPTIC MODULATOR/TRANSMITTER

The video signal transmitted from each Hub Site is transmitted by a single-mode multi-channel frequency modulated fiber optic transmitter modulator circuit that converts incoming baseband video to a Radio Frequency (RF) signal. The typical capacity of a single-mode multi-channel system can be anywhere from 12 channels to 20 channels, depending on the manufacturer. This video signal is then routed to the Traffic Operations Center.

REMOTE MONITOR

A monitor should be provided at each hub. This allows a complete subsystem in the event of a communications failure. All color monitors should have a horizontal resolution of no less than 460 lines, and monochrome monitors should have no less that 800 TV lines , and a vertical resolution of no less than 350 lines.

.

CHAPTER IV

TRAFFIC OPERATIONS CENTER

GENERAL

The Traffic Operations Center (TOC) generally consists of an equipment room and workstation consoles.

In the Equipment Room is:

- Single mode multichannel fiber optic demodulator/receiver
- Matrix switching System

At each workstation is:

- CCTV console
- Computer operated CCTV control system.

A well-equipped Traffic Operations Center will also have a video wall that allows all persons in the room to view various television monitors at one time.

An Equipment Room, or a similar area would provide a 19" equipment rack or cabinet used to house the single-mode fiber optic demodulators, a matrix switcher, a central Master MPC Control unit, and a RS-232 Code Operated Switch. The workstation console, located at the Traffic Operations Center (TOC) surveillance area, typically consists of one or a number of separate monitor console workstations. For each workstation console, a 13" monitor and one control panel would be provided.

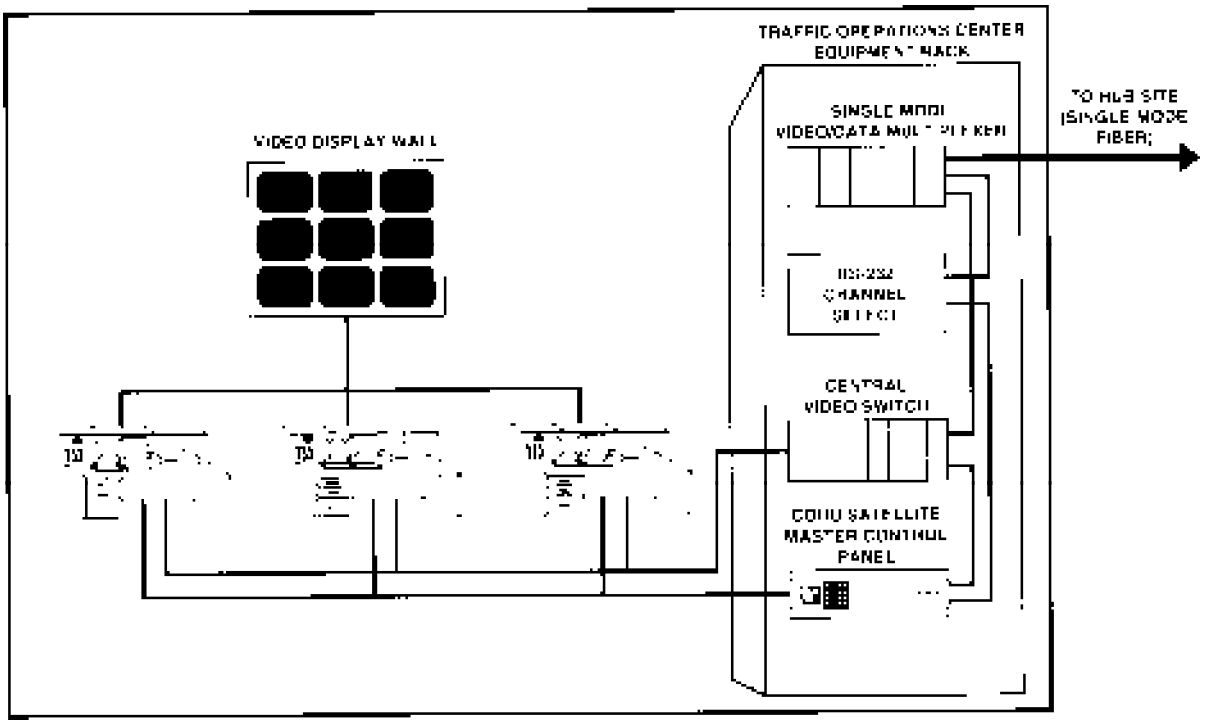

Figure I.12 Typical Traffic Operations Center

SINGLE-MODE MULTICHANNEL FIBER OPTIC DEMODULATOR/RECEIVERS

The video signal transmitted from each Hub Site is received by a single-mode multi-channel, frequency modulated, fiber optic receiver/demodulator circuit that converts incoming modulated lightwave signals to a Radio Frequency (RF) signal, then converted to baseband video. The typical capacity of a single-mode multi-channel system can be anywhere from 12 channels to 20 channels, depending on the manufacturer. This video signal is then routed to a matrix video switcher.

MATRIX SWITCHING SYSTEM

The switching system used at the Traffic Operations Center can be very similar to the switch at the Hub Site. The difference is that of inputs and outputs. The microprocessor-based crosspoint matrix switcher is capable of automatically routing video signals from a requested camera position to a specified monitor at a workstation or interface to a video display wall. Control of the system is provided by the MPC Control Panel located at the workstations. The switcher cage includes a power supply, an output amplifier, and a mother board. The switcher card cage also accommodate removable printed circuit boards, featuring plug-in connectors.

One switcher card cage can accommodate 128 cameras and 8 monitors. Multiple cages may be cascaded to create larger switching systems. Video inputs can be cascaded in increments of eight, in the form of video switcher cards with individual capacity of eight inputs per card. The card cage can accommodate up to 16 switcher cards. Outputs to monitors are eight per card cage.

The card cage is constructed of a steel chassis with aluminum side plates. The cage is designed to fit into a standard 19-inch-wide instrument rack, no more than 7.0 inches (17.8 cm) in height (H) and 12.3 inches (31.2 cm) in depth (D).

CCTV CONTROL CONSOLE

Each user will have different requirements for the workstation console, depending on the capability of the Advanced Traffic Management System. The console may provide a master computer terminal that would provide data on the traffic signal status, SCADA information to monitor loop detectors throughout the system and provide flow rate data, computer aided control of the CCTV system, and possibly a terminal for sending messages to the changeable message signs.

Let's take a look at how the CCTV system components fit together and the capabilities that can be provided.

The Control Console provides operator control features identical to those discussed at the Hub Site:

- Numeric display
- Numeric keypad
- Camera power switch and LED indicator
- Lens Speed switch and LED indicator

- Manual/Auto color balance and LED indicator
- Manual/Auto iris switch and LED indicator
- Iris control
- Zoom control
- Focus control
- Reset control
- Pan/Tilt joystick control

A control panel is one way to control the desired camera and select the proper monitor to view the scene. Refer to the control section at the Hub Site for a review of the capabilities. Another way to control cameras and select monitors is via a computer operated CCTV control system.

COMPUTER OPERATED CCTV CONTROL SYSTEM

Graphical user software is available on a DOS™-based software program that provides color graphic displays of the locations of CCTV Cameras on city maps for use as a traffic management system. These type of software systems are available from a number of suppliers with different applications.

This system is an extension to the Cohu MPC control system and simplifies the operator selection and control of cameras. It allows the display of traffic conditions quickly and easily.

Among its many features for traffic surveillance:

- Shows the position of television surveillance cameras on computer generated geographical maps and allows instant selection of any camera with the mouse.
- Automatically sequences through selected TV surveillance cameras on command, eliminating the need for a sequencing video switcher. The cameras in the sequence are selected by simply pointing and clicking the mouse. (The mouse can also be clicked to adjust the switching dwell time over a range from one to 45 seconds.)
- Allows video signals from the TV surveillance cameras to be routed to up to ten different television monitor circuits by simply pointing to the desired circuit on the screen and clicking the mouse.
- Allows mouse control of a video printer from the computer screen, allowing hard-copy "video snapshots" to be captured instantly in emergencies.
- Provide instantaneous mouse control of a video recorder (VCR) from the computer screen.
- Allows the operator to select from of a wide range of geographical maps of different areas and with varying degrees of detail. (Graphical images can include both two and three

dimensional drawings, photographs and video snapshots of terrain, building, tunnel or bridges.)

- Graphically show the location of remotely controllable devices such as gates, lights, variable message signs, etc., and allow those devices to be switched on or off from the computer screen with a simple click of a computer mouse.

- Event logging.

- Provides an easy-to-use, pop-up computerized ten-page "Notebook" for emergency procedures and notes between operators.

- Speed-dial emergency telephone numbers from the computerized "notebook".

Should you wish to purchase a Graphic Link, the following equipment is required:

1 An 80486DX computer with a 66 MHz minimum clock speed. Computers operating at higher clock speed will provide better performance.

2 100 MB hard disk

3 MS-DOS 5.1 or higher operating system.

4 8 MB of RAM is recommended.

5 Compatible bus mouse

6 VGA (video graphics array) video adapter

7 VGA color monitor. Analog interfacing between the VGA adapter and the video monitor will provide superior image quality. NEC multisync II monitors are ideal. Many other makes and models are equally acceptable.

8 9600 baud modem

MONITOR SELECTION

All color monitors should have a horizontal resolution of no less than 460 lines. Monochrome monitors should have a horizontal resolution of no less that 800 TV lines, and a vertical resolution of no less than 350 lines.

VIDEO DISPLAY WALL

Video displays walls are becoming increasingly common in Traffic Management Systems. A video wall typically consists of a bank of six to 12 monitors stacked in a pattern most suited to the room or viewing conditions. These monitors can be configured to be independent from each other or operate as one. Computer graphics can also be displayed on the Video display wall giving operators graphic displays of events.

GLOSSARY

This glossary contains definitions of terms used in this publication.

AGC	Automatic Gain Control. A circuit for automatically controlling amplifier gain in order to maintain a constant output voltage with a varying input voltage within a predetermined range of input-to-output variation.
Aperture	In television optics, it is the effective diameter of the lens that controls the amount of light reaching the photoconductive or photoemitting image pickup sensor.
Aperture Correction	Compensation for the loss in sharpness of detail because of the finite dimen sions of the image elements or the dot-pitch of the monitor.
Aspect Ratio	The ratio of width to height for the frame of the televised picture; four units wide by three units high in standard systems.
Attenuation	In general terms, a reduction in signal strength.
Auto Balance	A system for detecting errors in color balance in white and black areas of the picture and automatically adjusting the white and black levels of both the red and blue signals as needed for correction.
Auto Light Range	The range of light, e.g., sunlight to moonlight, over which a TV camera is capable of automatically operating at specified output.
Automatic Brightness Control	In display devices, the self-acting mechanism which controls brightness of the device as a function of ambient light.
Automatic Frequency	An arrangement whereby the frequency of an oscillator is automatically maintained within specified limits.
Automatic Gain Control	A process by which gain is automatically adjusted as a function of input or other specified parameter.
Automatic Light Control	The process by which the illumination incident upon the face of a pickup device is automatically adjusted as a function of scene brightness.
Back Porch	That portion of the composite picture signal which lies between the trailing edge of the horizontal sync pulse and the trailing edge of the corresponding blanking pulse.
Bandwidth	The number of cycles per second (Hertz) expressing the difference between the lower and upper limiting frequencies of a frequency band; also, the width of a band of frequencies.

Bar Test Pattern	Special test pattern for adjusting color TV receivers or color encoders. The upper portion consists of vertical bars of saturated colors and white. The power horizontal bars have black and white areas and I and Q signals.
Blooming	The defocusing of regions of the picture where the brightness is at an exces sive level, due to enlargement of spot size and halation of the fluorescent screen of the cathode-ray picture tube. In a camera, sensor element satura tion and excess which causes widening of the spatial representation of a spot light source.
Bounce	Sudden variations in picture presentation (brightness, size, etc.,) independent of scene illumination.
Brightness	The attribute of visual perception in accordance with which an area appear to emit more of less light. (Luminance is the recommended name for the photo-electric quantity which has also been called brightness.)
Broadband	In television system use, a device having a bandpass greater than the band of a single VHF television channel.
Burned-In-Image	Also called burn. An image which persists in a fixed position in the output signal of a camera tube after the camera has been turned to a different scene or, on a monitor screen.
CCD	See Charge Coupled Device
"C" Mount	A television camera lens mount of the 16 mm format, 1 inch in diameter with 32 threads per inch.
CCTV	Common abbreviation for Closed-Circuit Television.
Charge-Coupled Device	CCD. For imaging devices, a self-scanning semiconductor array that utilizes MOS technology, surface storage, and information transfer by shift register techniques.
Chroma	That quality of color which embraces both hue and saturation. White, black, and grays have no chroma.
Chroma Control	A control of color television receiver that regulates the saturation (vividness) of colors in a color picture.
Chroma Detector	Detects the absence of chrominance information in a color encoder input. The chroma detector automatically deletes the color burst from the color encoder output when the absence of chrominance is detected.

Chromatic Aberration	An optical defect of a lens which causes different colors or wave lengths of light to be focused at different distances from the lens. It is seen as color fringes or halos along edges and around every point in the image.
Chromaticity	The color quality of light which is defined by the wavelength (hue) and satura tion. Chromaticity defines all the qualities of color except its brightness.
Chrominance	A color term defining the hue and saturation of a color. Does not refer to brightness.
Chrominance Signal	That portion of the NTSC color television signal which contains the color information.
Clamp	A device which functions during the horizontal blanking or synchronizing interval to fix the level of the picture signal at some predetermined reference level at the beginning of each scanning line.
Clamping	The process that established a fixed level for the picture level at the beginning of each scanning line.
Clipping	The shearing off of the peaks of a signal. For a picture signal. This effects the positive (white).
Coaxial Cable	A particular type of cable capable of passing a wide range of frequencies with very low signal loss. Such a cable in its simplest form, consists of a hollow metallic shield with a single wire accurately placed along the center of the shield and isolated from the shield.
Color Burst	That portion of the composite color signal, comprising a few cycles of a sine wave of chrominance subcarrier frequency, which is used to establish a reference for demodulating the chrominance signal. Normally approximately 9 cycles of 3.579545 MHz.
Color Edging	Extraneous colors appearing at the edges of colored objects, and differing from the true colors in the object.
Color Encoder	A device which produces an NTSC color signal from separate R, G, and B video inputs.
Color Fringing	Spurious colors introduced into the picture by the change in position of the televised object from field to field.
Color Purity	The degree to which a color is free of white or any other color. In reference to the operation of a tri-color picture tube it refers to the production of pure red, green or blue illumination of the phosphor dot face plate.
Color Saturation	The degree to which a color is free of white light.

Color Sync Signal	A signal used to establish and to maintain the same color relationships that are transmitted.
Color Transmission	The transmission of a signal which represents both the brightness values and the color values in a picture.
Composite Video Signal	The combined picture signal, including vertical and horizontal blanking and synchronizing signals.
Compression	The reduction in gain at one level of a picture signal with respect to the gain at another level of the same signal.
Contrast	The range of light to dark values in a picture or the ratio between the maxi mum and minimum brightness values.
Contrast Range	The ratio between the whitest and blackest portions of television image.
Convergence	The crossover of the three electron beams of a three-gun tri-color picture tube. This normally occurs at the plane of the aperture mask.
Crosstalk	An undesired signal from a different channel interfering with the desired signal.
dB	Basically, a measure of the power ratio of two signals. In system use, a measure of the voltage ratio of two signals, provided they are measured across a common impedance.
Decoder	The circuitry in a color TV receiver which transforms the detected color signals into a form suitable to operate the color tube.
Definition	The fidelity of a television system to the original scene.
Depth of Field	The in-focus range of a lens or optical system. It is measured from the distance behind an object to the distance in front of the object when the viewing lens shows the object to be in focus.
Depth of Focus	The range of sensor-to-lens distance for which the image formed by the lens is clearly focused.
Distortion	The deviation of the received signal waveform from that of the original trans mitted waveform.
Distribution Amplifier	A device that provides several isolated outputs from one looping or bridging input, and has a sufficiently high input impedance and input-to-output isola tion to prevent loading of the input source.
Dynamic Range	The difference between the maximum acceptable signal level and the mini mum acceptable signal level.

EIA Sync	The signal used for the synchronizing of scanning specified in EIA Standards RS-170, RS-330, RS-343, or subsequent issues.
Equalizer	An electronic circuit that introduces compensation for frequency discriminative effects of elements within the television system, particularly long coaxial transmission systems.
Fiber Optics	Also called optical fibers or optical fiber bundles. An assemblage of transpar ent glass fibers all bundled together parallel to one another. The length of each fiber is much greater than its diameter. This bundle of fibers has the ability to transmit a picture from one of its surfaces to the other around curves and into otherwise inaccessible places with an extremely low loss of definition and light, by a process of total reflection.
Field	One of the two equal but vertically separated parts into which a television frame is divided in an interlaced system of scanning. A period of 1/60 second separates each field start time.
Field of View	The maximum angle of view that can be seen through a lens or optical instrument.
Focal Length	Of a lens, the distance from the focal point to the principal point of the lens.
Focal Plane	A plane (through the focal point) at right angles to the principal point of the lens.
Focal Point	The point at which a lens or mirror will focus parallel incident radiation.
Footcandle	See lumen/ft 2.
Footlambert (FL)	A unit of luminance equal to 1/candela per square foot or to the uniform luminance at a perfectly diffusing surface emitting or reflecting light at the rate of one lumen per square foot. A lumen per square foot is a unit of incident light and a footlambert is a unit of emitted or reflected light. For a perfectly reflecting and perfectly diffusing surface, the number of lumens per square foot is equal to the number of footlamberts.
Frame	The total area, occupied by the television picture, which is scanned while the picture signal is not blanked.
Frame Frequency	The number of times per second that the frame is scanned. The U.S. standard is 30 frames per second.
Frequency Interlace	The method by which color and black and white sideband signals are interwo ven within the same channel bandwidth.

Frequency Response	The range of band of frequencies to which a unit of electronic equipment will offer essentially the same characteristics.
Front Porch	The portion of a composite picture signal which lies between the leading edge of the horizontal blanking pulse and the leading edge of the corresponding sync pulse.
f/Stop	Also called F Number and F System. Refers to the speed or ability of a lens to pass light. It is calculated by dividing the focal length of the lens by its diam eter.
Gain	An increase in voltage or power, usually expressed in dB.
Gamma	A numerical value, or the degree of contrast in a television picture, which is the exponent of that power law which is used to approximate the curve of output magnitude versus input magnitude over the region of interest.
Gamma Correction	To provide for a linear transfer characteristic from input to output device.
Genlock	A device used to lock the frequency of an internal sync generator to an external source.
Ghost	A spurious image resulting from an echo.
Gray Scale	Variations in value from white, through shades of gray, to black on a television screen. The gradations approximate the tonal values of the original image picked up by the TV camera.
Hue	Corresponds to colors such as red, blue, etcetera.
Hum	Electrical disturbance at the power supply frequency or harmonics thereof.
Image Intensifier	A device coupled by fiber optics to a TV image pickup sensor to increase sensitivity. Can be single or multi stage.
Image Plane	The plane at right angles to the optical axis at the image point.
Impedance (input or output)	The input or output characteristic of a system component that determines the type of transmission cable to be used. The cable used must have the same characteristic impedance as the component. Expressed in ohms. Video distribution has standardized on 75-ohm coaxial and 124-ohm balanced cable.
Incident Light	The light that falls directly on an object.
Insertion Loss	The signal strength loss when a piece of equipment is inserted into a line.

Interference	Extraneous energy which tends to interfere with the reception of the desired signals.
Interline Transfer	A technology of pixel design, transfer, and readout of video information. The sensor's active pixel area and storage register are both contained within the active image area. This differs from "frame transfer" cameras that move all active pixels to a storage register outside of the active area.
Interlaced Scanning	A scanning process for reducing image flicker in which the distance from center to center of successively scanned lines is two or more times the nominal line width, and in which the adjacent lines belong to different fields.
Iris	An adjustable aperture built into a camera lens to permit control of the amount of light passing through the lens.
Isolation Amplifier	An amplifier with input circuitry and output circuitry designed to eliminate the effects of changes made at either upon the other.
Jitter	Small, rapid variations in a waveform due to mechanical disturbances or to changes in the characteristic of components. Supply voltages, imperfect synchronizing signals, circuits, etc.
Lens	A transparent optical component consisting of one or more pieces of optical glass with surfaces so curved (usually Spherical), that they serve to converge or diverge the transmitted rays of an object, thus forming a real or virtual image of that object.
Lens Preset Positioning	Follower Pots are installed on lens that allows feedback to the controller information relevant to zoom and focus positioning allowing the controller to quickly adjust to a preselected scene and arrive in focus at the proper focal length automatically.
Lens Speed	Refers to the ability of a lens to transmit light, represented as the ratio of the focal length to the diameter of the lens. A fast lens would be rated < f/1.4; a much slower lens might be designated as > f/8. The larger the f number, the slower the lens.
Light	Electromagnetic radiation detectable by the eye, ranging in wavelength from about 400 to 750 nm.
Line Amplifier	An amplifier for audio or video signals that feeds a transmission line; also called program amplifier.
Loop Through	Also called looping. The method of feeding a series of high impedance circuits (such as multiple monitor/displays in parallel) from a pulse or video source with a coax transmission line in such a manner that the line is bridged (with minimum length stubs) and that the last unit properly terminates the line

in its characteristic impedance. This minimizes discontinuities or reflections on the transmission line.

Loss	A reduction in signal level or strength, usually expressed in dB. Power dissipation serving no useful purpose.
Low-Frequency Distortion	Distortion effects which occur at low frequencies. In television, generally considered as any frequency below the 15.75-kHz line frequency.
Lumen (LM)	The unit of luminous flux. It is equal to the flux through a unit solid angle (steradian) from a uniform point source of one candela or to the flux on a unit surface of which all points are at a unit distance from a uniform point source of one candela.
Lumen/FT2	A unit of incident light. It is the illumination on a surface one square foot in area on which a flux of one lumen is uniformly distributed, or the illumination at a surface all points of which are at a distance of one foot from a uniform source of one candela.
Luminance	Luminous intensity (photometric brightness) of any surface in a given direction per unit of projected area of the surface as viewed from that direction, measured in footlamberts (fl).
Luminance Signal	That portion of the NTSC color television signal which contains the luminance or brightness information.
Lux	International System (SI) unit of illumination in which the meter is the unit of length. One lux equals one lumen per square meter.
Matrix Switcher	A combination or array of electromechanical or electronic switches which route a number of signal sources to one or more designations.
Modulation	The process, or results of the process, whereby some characteristic of one signal is varied in accordance with another signal. The modulated signal is called the carrier. The carrier may be modulated in three fundamental ways: by varying the amplitude, called amplitude modulation; by varying the frequency, called frequency modulation; by varying the phase, called phase modulation.
Monitor	A unit of equipment that displays on the face of a picture tube the images detected and transmitted by a television camera.
Monochrome	Black and white with all shades of gray.
Monochrome Signal	In monochrome television, a signal wave for controlling the brightness values in the picture. In color television, that part of the signal wave which has major control of the brightness values of the picture, whether displayed in color or in monochrome.

Monochrome Transmission	The transmission of a signal wave which represents the brightness values in the picture, but not the color (chrominance) values.
Noise	The word “noise” originated in audio practice and refers to random spurts of electrical energy or interference. In some cases, it will produce a “salt-and-pepper” pattern over the televised picture. Heavy noise is sometimes referred to as “snow”.
Non-Composite Video	A video signal containing all information except sync.
NTSC	Abbreviation for National Television Systems Committee. A committee that worked with the FCC in formulating standards for the present day United States color television system.
Output	The signal level at the output of an amplifier or other device.
Pan and Tilt	A device upon which a camera can be mounted that allows movement in both the azimuth (pan) and in the vertical plane (tilt).
Pan/Tilt Preset Positioning	Follower pots are installed on pan/tilt unit to allow feedback to the controller and provides information relevant to horizontal and vertical positioning, allowing the controller to quickly adjust to a pre-selected scene automatically.
Patch Panel	A panel where circuits are terminated and facilities provided for interconnect ing between circuits by means of jacks and plugs.
Peak Pulse Amplitude	The maximum absolute peak value of a pulse, excluding those portions considered to be unwanted, such as spikes.
Peak-to-Peak	The amplitude (voltage) difference between the most positive and the most negative excursions (peaks) of an electrical signal.
Picture Element	See Pixel
Pixel	Short for Picture Element. A pixel is the smallest area of a television picture capable of being delineated by an electrical signal passed through the system of part thereof. The number of picture elements (pixels) in a complete picture, and their geometric characteristics of vertical height and horzontal width, provide information on the total amount of detail which the raster can display and on the sharpness of the detail, respectively.
Primary Colors	Three colors wherein no mixture of any two can produce the third. In color television these are the additive primary colors red, blue and green.
Resolution (horizontal)	The amount of resolvable detail in the horizontal direction in a picture. It is usually expressed as the number of distinct vertical lines, alternately black and white, which can be seen in a distance equal to picture height.

Resolution, Limiting	The details that can be distinguished on the television screen. Vertical resolu tion refers to the number of horizontal black and white lines that can be resolved in the picture height. Horizontal resolution refers to the black and white lines resolved in a dimension equal to the vertical height and may be limited by the video amplifier bandwidth.
Resolution (vertical)	The amount of resolvable detail in the vertical direction in a picture. It is usually expressed as the number of distinct horizontal lines, alternately black and white, which can theoretically be seen in a picture.
Retained Image	Also called image burn. A change produced in or on the target which re mains for a large number of frames after the removal of a previously station ary light image and which yields a spurious electrical signal corresponding to that light image.
RF (Radio Frequency)	A frequency at which coherent electromagnetic radiation of energy is useful for communication purposes. Also, the entire range of such frequencies.
Ripple	Amplitude variations in the output voltage of a power supply caused by insufficient filtering.
Roll	A loss of vertical synchronization which causes the picture to move up or down on a receiver or monitor.
Saturation	In color, the degree to which a color is diluted with white light or is pure. The vividness of a color, described by such terms as bright, deep, pastel, pale, etc. Saturation is directly related to the amplitude of the chrominance signal.
Scanning	The process of moving the electron beam of a pickup tube or a picture tube across the target or screen area of a tube.
Sensitivity	In television, a factor expressing the incident illumination upon a specified scene required to produce a specified picture signal at the output terminals of a television camera.
Shutter	Ability to control the integration (of light) time to the sensor to less than 1/60 second; e.g: stop motion of moving traffic.
Signal-to-Noise Ratio	The ratio between useful television signal and disturbing noise or snow.
Snow	Heavy random noise.
Spike	A transient of short duration, comprising part of a pulse, during which the amplitude considerably exceeds the average amplitude of the pulse.
Standard Minimum Signal	1000 microvolts at 75 ohms (0dB mV) in RF systems; 0.7-VPP non-compos ite, 1-VPP composite in video systems.

Sync	A contraction of “synchronous” or “synchronize”.
Sync Generator	A device for generating a synchronizing signal.
Sync Level	The level of the peaks of the synchronizing signal.
Sync Signal	The signal employed for the synchronizing of scanning.
Synchronizing	Maintaining two or more scanning processes in phase.
Tearing	A term used to describe a picture condition in which groups of horizontal lines are displaced in an irregular manner.
Test Pattern	A chart especially prepared for checking overall performance of a television system. It contains various combinations of lines and geometric shapes. The camera is focused on the chart, and the pattern is viewed at the monitor for fidelity.
Transients	Signals which exist for a brief period of time prior to the attainment of a steady-state condition. These may include overshoots, damped sinusoidal waves, etc.
Vertical Resolution	The number of horizontal lines that can be seen in the reproduced image of a television pattern.
Video Amplifier	A wideband amplifier used for passing picture signals.
Video Band	The frequency band width utilized to transmit a composite video signal.
Video Signal (Non-Composite)	The picture signal. A signal containing visual information and horizontal and vertical blanking (see also Composite Video Signal) but not sync.
“Y’ Signal	A signal transmitted in color television containing brightness information. This signal produces a black and white picture on a standard monochrome receiver. In a color picture it supplies fine detail and brightness information.
Zoom	To enlarge or reduce, on a continuously variable basis, the size of a televised image primarily by varying lens focal length.
Zoom Lens	An optical system of continuously variable focal length, the focal plane re maining in a fixed position.

Adapted from Traffic Management Video System Planner by Cohu, Inc.

Return to Table of Contents