

VIDEO EQUIPMENT SELECTION

The Traffic Operations Center for the Colorado Department of Transportation has reviewed and tabulated specifications for a variety of cameras, and associated video matrix switching systems, to determine which manufacturers provide the best video equipment for our applications. Our camera requirements are basically those that you would encounter in any other video surveillance application. Therefore, all that is required is to define a basic set of minimum specifications, and then select the best products. Our matrix video switcher requirements are much more complex. First of all, the video switcher has to be 100% compatible with the camera that we procure. Because camera equipment / video switching equipment manufacturers use proprietary communication (control) protocols between their cameras and their switchers, you are locked into one supplier for both systems, so that you can take full advantage of all of the camera's functionality. Secondly, the selected video matrix switcher will become an integral part of our Statewide fiberoptic communication network. This video switching system is then required to be designed so that parts of the switcher can be physically distributed in a variety of locations around our State. Camera control in multiple Statewide locations is then required. However, there must be a means of defining the amount of camera control that is allowed at each location. Additionally, there must be a means of defining the amount of system access and control that is given to different individuals in these remote locations.

Initially we focused our attention on camera systems, and found that there were essentially two types of camera systems that would allow an operator to pan, tilt, and zoom the video image. The first type of system has been in use for many years. This system requires that a fixed camera with a zoom lens be mounted on a motorized pan / tilt mechanism. The electronics that are required for communications with the camera are installed in a separate enclosure. The major drawbacks of this system are:

- The system is bulky and heavy.
- The camera pan and tilt motion is very slow (usually less than 10 degrees per second).
- Camera motion is restricted by all of the interconnect cables, so the pan is less than 360 degrees, and you can't tilt the camera down past 90 degrees.
- Worst of all, these older systems cost approximately twice as much as the newer technology cameras.

The second type of camera systems employ newer, more sophisticated technology that has performance characteristics that are far superior to the older pan-tilt-zoom cameras. These new cameras are called 'dome cameras'. Dome cameras are small in size (approximately 5" by 7"), and all of the required control and communication electronics is included in these small devices. The weight of these units is usually less than 12 pounds, so they can be mounted almost anywhere. The pan / tilt speed at about 300 degrees per second is very fast. There are no interconnect cables, so the cameras can be continuously panned past 360 degrees without reversing direction. The cameras easily tilt past 90 degrees (straight down), so the operator has a totally unrestricted view of traffic in all directions. There are numerous camera manufacturers who provide products that have this basic functionality.

Effective traffic surveillance requires other camera features that, unfortunately, are not provided by the vast majority of suppliers. These additional important features are listed below:

- Camera Position Presets: Presets enable an operator to program camera positions. The operator can then view the scenes at these positions by pushing a button. No manual camera positioning is required, and you can move camera positions very quickly.
- Display Privacy Zone Masking: Privacy masking allows for the camera's video to be masked, so that the operator cannot view scenes at preprogrammed camera positions. This prevents viewing the windows of private homes, hotels, or other buildings in the vicinity of the camera.

- **Powerful Video Zoom Capability:** The cameras will frequently be used to view distant objects. The combination of camera optical zoom (by glass lenses) and electronic zoom (by electronic magnification) shall be as big as possible. At least 200X magnification should be adequate.
- **Alphanumeric Direction Display:** The camera video output needs to be capable of displaying the direction (north, south, east, or west) that the camera is pointing. This greatly reduces operator confusion when panning the camera from scene to scene.
- **Electronic Sensitivity Enhancement:** The camera needs to have the capability to clearly view poorly illuminated scenes. The camera's minimum required illumination shall be as low as possible. 1.0 lux or less should be sufficient for color video. For black and white video, the camera should be rated for 0.06 lux or less. Additionally, the camera should have the ability to further enhance the sensitivity using electronic circuits.
- **Automatic Backlight Compensation:** Most cameras have difficulty viewing scenes which contain both bright and dark areas. If you place a camera in a poorly illuminated room, and point the camera at a window and the brightly illuminated scene outside, the camera will either set its iris to view the room or the outdoor scene. This results in one part of the display appearing normal, while the other part is either too light or too dark. The same thing happens at night when viewing oncoming traffic with headlights turned on. Automatic backlight compensation enables the camera to clearly see both areas of the display. This feature also helps to reduce the flare of those oncoming headlights.
- **Motion Detection Alarm:** The camera should have the capability of sending an alarm to the operator if there is movement in a preprogrammed portion of the display. This capability is very useful when monitoring traffic lanes which are closed, such as our HOV lanes or construction zones.

Specifications were collected for dome style cameras from the following manufacturers: Sony (Pelco), American Dynamics, Panasonic, Burle, Phillips, Kalatel, Sensormatic, Vicon, and Hitachi. All data for these cameras was downloaded from the manufacturer's websites. A chart showing the results of this study is attached.

On the whole, the cameras manufactured by Pelco, American Dynamics, and Panasonic appeared to be the best. However, the camera with the best specifications, and the only camera which offers all of the important features listed above, is the Panasonic Model WV-CS854. No other camera even comes close to the Panasonic camera's features and capabilities. For this reason, the Panasonic WV-CS854 camera is our preferred choice.

Even though the Panasonic dome camera appears to be perfect for our traffic surveillance applications, it still has to interface to a video matrix switcher that has all of the capabilities required by a large Statewide video system. The switcher also has to be able to take advantage of the camera's wide ranging capabilities, and be able to control every one of its important features. Because the Panasonic camera has features that no other cctv dome camera has, it would be very unlikely to find a matrix switcher, made by a third party, which would be capable of controlling these features. If Panasonic manufactured a switcher that met all of our requirements, then this system would be our preferred choice. If Panasonic did not offer such a system, then we would have to drastically downgrade our camera specifications, and seek out another source.

The basic requirements for our video matrix switcher are outlined below:

- **Camera Inputs:** At the present time, there are very few cameras (approximately 20) which are viewed and / or controlled at the Traffic Operations Center. This will soon change as we begin to share video with other cities and other regions. Our matrix video switcher must be capable of growing with our expanding system. As a place of beginning, we anticipate a short term need for approximately 100 camera inputs. However, the switcher should be capable of handling thousands of video inputs, so that

we know that we will never outgrow its capabilities. Therefore, the minimum system specification for video inputs is set at 8000.

- Video Outputs: These outputs are typically connected to cctv monitors so that the cameras' video outputs can be viewed on television screens. These outputs could also be feeds to video tape recorders, or even video feeds to other traffic control centers, or feeds to external users such as television stations. As a place of beginning, we will configure our system for approximately 64 outputs. However, the switcher shall be capable of at least 1000 outputs.
- Control Ports: Initially the system will be configured for 16 control ports. This will enable full control of camera inputs, camera outputs, and system programming functions at the Traffic Operations Center, with additional selected control functions from other locations such as the City of Lakewood, City of Denver, RTD, CDOT Region 6, Park Meadows Mall, City of Colorado Springs, City of Grand Junction, and City of Pueblo. The minimum number of possible system control points shall be set at 128.
- System Access Control: When you have a video system which can be controlled from multiple locations by many different people, it is very important that there are controls which define what features can be programmed or controlled by every operator. At a minimum, the following control features shall be in place:
 - (1) Operators shall have passwords that allow access to the system.
 - (2) The system shall have the capability to limit the number of system controllers (keyboards, etc) where a given operator can log-on.
 - (3) The system shall have the capability to limit the number of cameras that can be selected by any given operator.
 - (4) The system shall have the ability to limit the cameras that can be selected or controlled from any control location.
 - (5) The system shall have the ability to limit the monitors that can be viewed from any control location.
 - (6) The system shall have the ability to limit the cameras that can be shown on any particular monitor.
- Basic Operator Functions: When given access to the system, the operator shall be able to perform the following basic functions:
 - (1) Switch camera video signals to monitors.
 - (2) Operate camera functions such as pan, tilt, zoom, and focus.
 - (3) Activate preprogrammed group presets. (Set camera positions to previously selected positions.)
 - (4) Activate previously established camera tour sequences.
 - (5) Acknowledge and reset alarms. (Such as motion detector alarms.)
 - (6) Activate auxiliary contacts.
 - (7) Activate camera specific features by camera menu.
- Advanced Operator Functions: Selected operators shall have the ability to program automated camera sequences as described below:
 - (1) Establish Group Presets: Set up to 16 camera preset positions including camera to monitor selections.
 - (2) Establish Tour Sequences: Set preprogrammed camera display sequences in both forward and backward directions.
 - (3) Establish Group Tour Sequences: Link together multiple group camera presets and set a dwell time for viewing each camera.
 - (4) Program Alarm Events: Determine what actions the system will take when alarms are received due to such occurrences as video loss or motion detection.

- System Module Interconnect: It is very important that this system be modular in design. The basic video switching assemblies shall be configured as a series of electronic card cages into which input cards, output cards, and switching electronics can be assembled. As the system is expanded, more card cages will be installed. These card cages may be located at the Traffic Operations Center (TOC), or they may be located in remote locations such as Colorado Springs. The communication link between these subassemblies shall be accomplished using an Ethernet data link. This Ethernet link can be established using simple cables if the cages are in close proximity to one another, or this link can be established via the fiberoptic network if the cages are miles apart. The video system controller located in the TOC will not be concerned with the physical location of this equipment, it will communicate with the system over these Ethernet links no matter where the individual piece parts are located.

Panasonic offers a 'System 850' video matrix switcher which meets or exceeds all of our system requirements. No other manufacturer's system meets our system requirements. For this reason, we have selected the Panasonic 'System 850' video matrix switcher as the preferred video control system. For your reference, sample specifications for both the pan-tilt-zoom cameras, and the video matrix switcher are attached.