Chapter II Video Surveillance

A. Video cameras

1. Why video cameras?

The peace of mind of both students and faculty at a school can often be quickly enhanced by the installation of video cameras as part of a closed circuit television (CCTV) system. This change of attitude may result in even further-reaching effects on a campus than would be expected by the use of cameras alone. As mentioned in the introductory chapter of this guide, a sense of safety and authority will directly influence people's opinions and impressions, which will ultimately contribute to the overall order maintenance of a facility and how that facility is treated by occupants and outsiders.

To the school's security personnel who must handle day-to-day security issues, the best thing about cameras is the deterrence factor they introduce to outsiders who do not belong on campus and to students and employees who do. Information regarding security measures, such as cameras at the local school, will generally spread through a community. This type of reputation can make outsiders reconsider an unwelcome visit to the historically easy mark of the neighborhood—the school. It can be assumed that most kids are not going to step way out of bounds if they believe they will likely be caught, which is often possible through the appropriate application of cameras. In a school security system, the ideal goal should be to convince kids not to even attempt to do something that is unacceptable.

Addressing an incident after it occurs is good, but not as good as if it had never happened. Once a perpetrator is caught, there is a chain of events involving confrontation, denial, parental involvement, consequences, and perhaps even the involvement of law enforcement and the legal system. School administrators will be forced to spend a great deal of time on the matter, and all participants will find the process distasteful.

Another strength of cameras is the strong evidence they can preserve on tape. Even if law enforcement is not brought in regarding an incident, the recorded tape can be invaluable to a school administration. Many schools report that when students are brought into the school office after an incident and shown a tape of themselves in an illegal or unacceptable act—even if the tape might not have been of sufficient resolution and detail to use for prosecution purposes in a court of law—the student will usually admit to the incident.

The ultimate usability of a video recording is dependent on many variables. It is possible for a camera system to produce tapes on which individuals are unidentifiable or their actions are indiscernible. Be certain that a camera system provides the kind of information you need before you pay for it. These requirements should be clearly spelled out in the purchase agreement, along with a specified time period during which the school can adequately test it.

Video recordings are also beneficial for use with parents. Although nearly all parents want to believe their chil-

Exhibit 2.1. Examples of cameras and camera housings.

dren are innocent of wrongdoing, some parents will deny their child's guilt despite the credible testimony of others to the contrary. However, as many school administrators and teachers have discovered, parents quickly accept their child's role in an incident when shown a videotape of the incident. Most parents want to do the right thing, but hard evidence is often required for some to concede over a matter involving their own child.

From a cost standpoint, the use of CCTV in public areas on school grounds can free up manpower. If cameras are covering a large patio area where students congregate during breaks, adults who normally would be assigned to oversee that area can instead be made available to monitor other areas of concern.

Finally, the solid documentation that a video recording provides can be invaluable in situations involving liability claims. Although it is possible that this may occasionally work against a school, most schools welcome this concrete evidence so that testimony regarding an incident does not consist solely of hearsay.

2. Why NOT video cameras?

- CCTV systems are expensive. Installation can also be expensive, as well as logistically difficult.
- Choosing the correct camera equipment requires some technical knowledge (exhibit 2.2).
- A single camera can effectively view a smaller area than would be intuitively expected, hence many applications can require more cameras, equipment, and expense than was originally expected.
- Cameras can be stolen or vandalized.
- Ongoing maintenance and operational support are required.
- Some applications or areas do not warrant camera use.
- Some communities or individuals will challenge the legality of using cameras.
- Insiders with full knowledge of the installed video system's capabilities can possibly circumvent the system to their advantage.
- If it becomes well known where cameras are being used at a school, students may simply move their misbehaviors to a different part of campus.

3. Good applications versus poor applications

An effective use of cameras in schools is viewing the recorded tape after an incident has occurred. Examples of reasonable goals for a school video system are capturing scenes indicating who started a fight in the hallway, who is smoking marijuana in the parking lot, who stole all the blank computer disks out of the computer laboratory, or if a particular person did indeed try to run down someone with his or her truck in the school driveway. Less reasonable goals, or at least more difficult or manpower intensive, are trying to use camera scenes to stop a student fight in its early stages, prevent someone from bringing weapons into the facility, or catch a thief before he makes his escape.

A visible camera may not help if a school's goal is to identify a nighttime thief in the band hall or computer lab if the thief simply covered his or her face or disguised

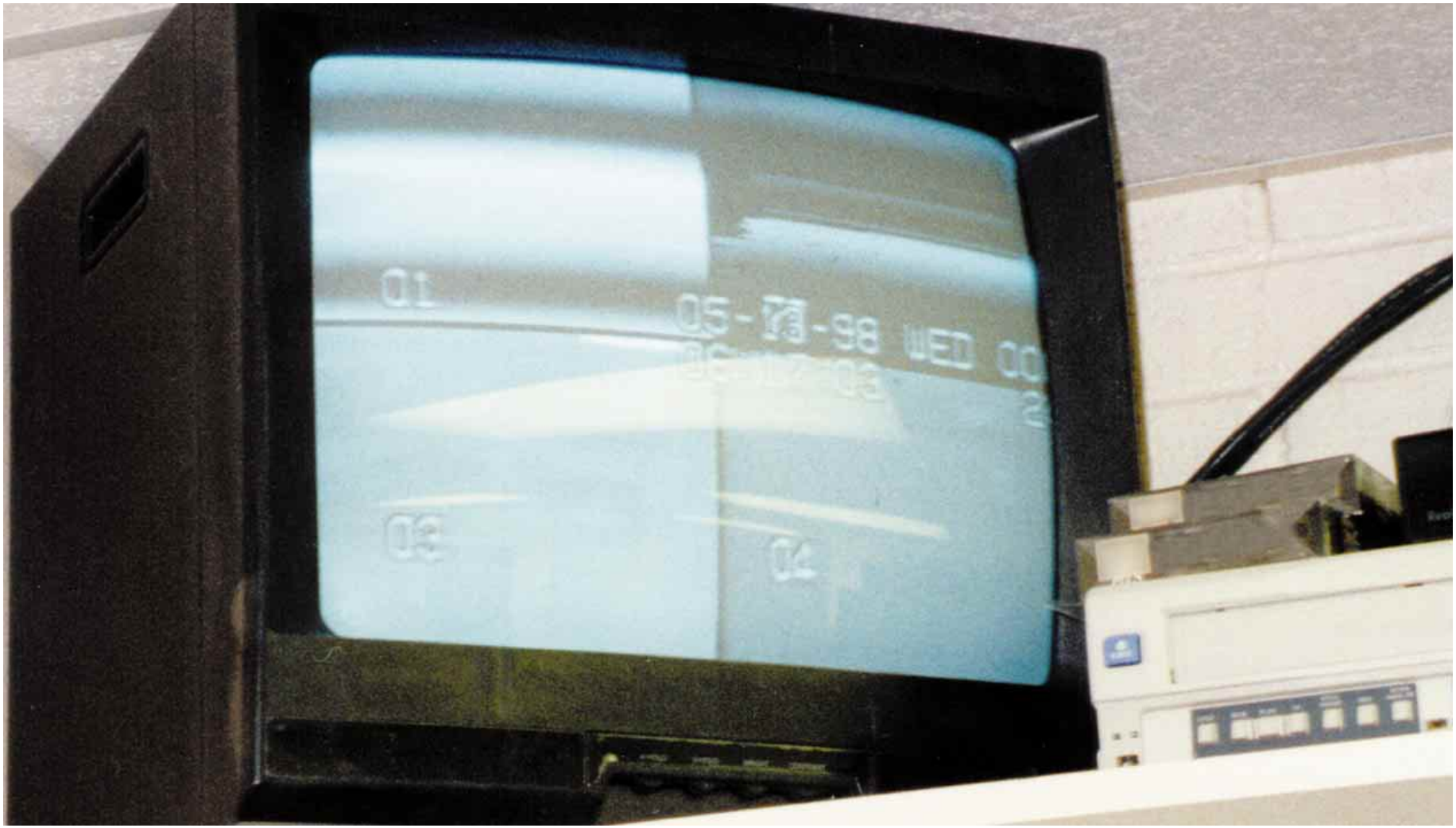

Exhibit 2.2. This photo shows the poor-quality images from a new camera system installed at a school. The installer had yet to debug the system 2 months after installation.

himself or herself. However, it may still add substantially to deterrence; a would-be thief may never be sure if there will be some type of immediate response to the video recording or exactly where all the cameras are located.

Depending upon each situation, video cameras can support security initiatives in the following applications:

- Parking lots and driveways.
- Cafeterias.
- Patio and entry areas.
- Hallways.
- Gymnasiums.
- Main administrative offices (exhibit 2.3).
- Band halls.
- School stores.
- Computer rooms.
- Science laboratories.
- Supply closets.

Schools may want to consider classroom installation of the cameras and recorder enclosures that are currently so popular for use on school buses. For buses, a camera is placed in the black box only when requested by a bus driver, thereby reducing the number of camera systems that must be purchased. Usually, the deterrence factor derived from students never knowing when a camera is actually present can discourage much of the misbehavior. (This is not to be confused with the use of a dummy camera, where a potential victim is under the illusion that he or she is being monitored and, therefore, help will be forthcoming in the event of an attack; this can create extensive liability concerns for a facility.)

In an application with a camera looking in an easterly or westerly direction, extreme glare may occur during sunrise or sunset. If this type of placement cannot be avoided, the camera should be mounted as high as possible and then angled downward to view below the horizon. If sunrise and/or sunset are not critical time periods for a particular application, then it may be acceptable to simply have an unusable picture during these times.

Similarly, vehicle headlights and other sources of glaring light, particularly during night operations, should be considered. A system that is designed with the potential problem sources recognized can be compensated for. After initial installation is complete, it is much more difficult to compensate for these problems. Oftentimes, funding is no longer available to make needed adjustments.

Viewing a scene such as a dark doorway that contains a significant shadow can be quite difficult (exhibit 2.4). Newer cameras with better electronics help compensate for these types of applications, but they are more expensive.

Seasonal problems should be anticipated and addressed before purchasing an exterior camera system. Conditions to be aware of are blowing snow, built-up ice on a camera housing, dust storms, trees that block the scene in summer, temperature extremes, or north sides of buildings with shadows that may affect scene assessment during winter months.

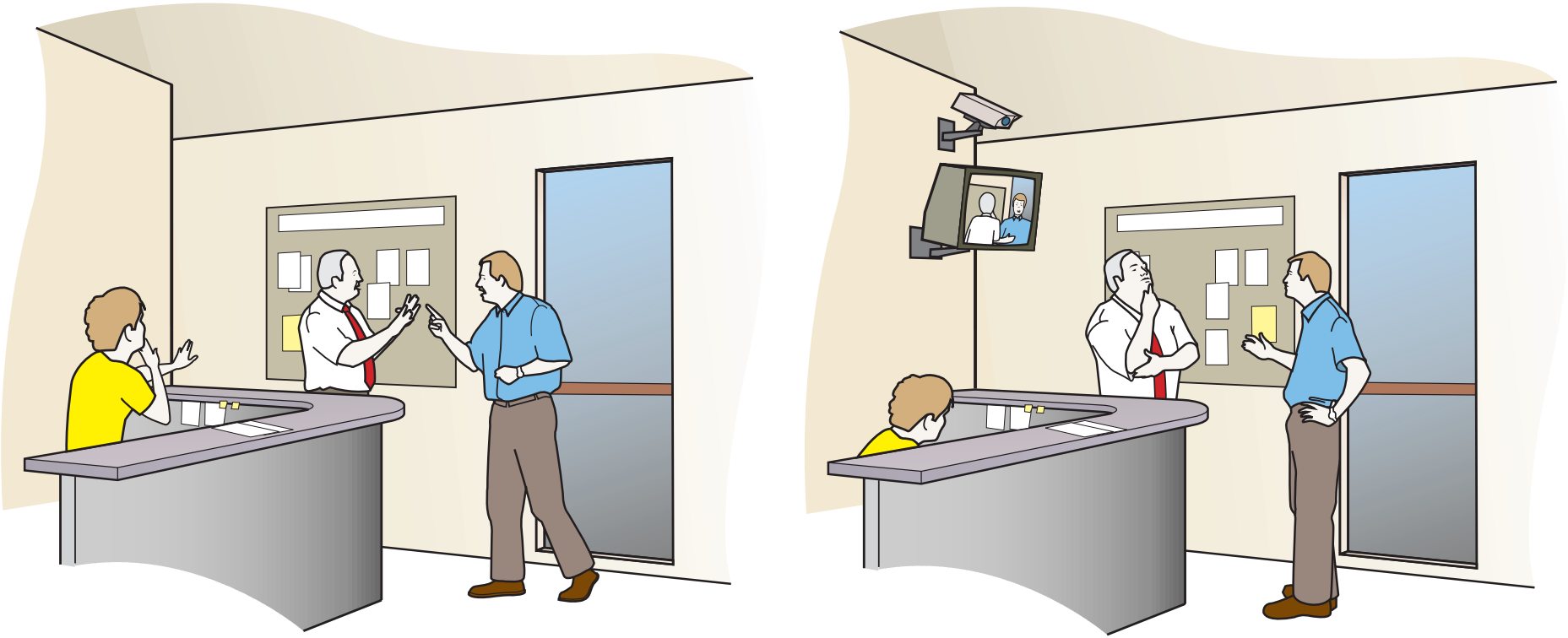

Exhibit 2.3. Occasionally, an irate parent may threaten a school employee, but this can be mitigated if the parent sees himself being recorded on a video monitor.

Exhibit 2.4. Dark spots caused by heavy shadows in a scene can be very difficult to assess with cameras.

4. To monitor or not to monitor

Each year, a great number of camera systems are bought in the United States with the objective of assigning a security person to constantly monitor the scenes from the video cameras in real time. The objective of such installations is that some sort of response may then be dispatched immediately and an undesirable incident prevented or stopped, basically using the live person watching the monitor as a detector. This is quite often an unrealistic approach to security, particularly in school applications.

Experiments were run at Sandia National Laboratories 20 years ago for the U.S. Department of Energy to test the effectiveness of an individual whose task was to sit in front of a video monitor(s) for several hours a day and watch for particular events. These studies demonstrated that such a task, even when assigned to a person who is dedicated and well-intentioned, will not support an effective security system. After only 20 minutes of watching and evaluating monitor screens, the attention of most individuals has degenerated to well below acceptable levels. Monitoring video screens is both boring and mesmerizing. There is no intellectually engaging stimuli, such as when watching a television program. This is particularly true if a staff member is asked to watch multiple monitors, with scenes of teenagers milling about in various hallways, in an attempt to watch for security incidents (exhibit 2.5).

A practical security application of real-time viewing of a video monitor might be the intent to actively allow or disallow individuals to enter a particular locked door. In this case, the security person at or near the video monitors receives an alarm or other announcement that a person desires entry into that facility or area. The security person would then focus his or her attention directly on the screen and make a decision (according to procedures) as to whether to release the remote lock on a door to allow the person access.

Most schools have a security staff, whether it be an assistant principal assigned security as one of his or her duties, a few security aides equipped with two-way radios, or an impressive number of sworn police officers. Few schools, however, find themselves with surplus security-staff time. Because of the ineffectiveness of people monitoring video scenes in real time, it would seem to be a very poor use of school security staff. One possible exception is when a certain incident is expected at a school during a finite time period. For example, if cars in a parking lot are frequently broken into during the noon hour, security staff may want to actively monitor their cameras' outputs during this period so that they may immediately assess an incident in progress and apprehend the suspect. This would be particularly appropriate if the suspect is not known and not a member of the school.

The use of cameras and a real-time display unit without the benefit of a recorder is not recommended. It is true that a video camera and monitor alone are much cheaper than a complete video system with recording and multiplexing capabilities. However, the hard evidence made available in the form of a video recording can more than make up for the cost of a recording system. Ease of prosecution and the likely prevention of future incidents by this individual are additional benefits.

Exhibit 2.5. Monitoring video output is a boring task and usually nonproductive in most security applications, even for the motivated employee.

5. Color versus black-and-white cameras

In a high-security application, when an alarm has been generated signaling a presence in an off-limits area, it is likely to be sufficient to be able to assess the alarm condition with a black-and-white camera. The objective here is merely to determine that it is a person intruding (any person) and that a response should be prepared or dispatched.

In a school application, the security objective of recording video scenes would generally be to determine who the perpetrator of an incident was. In this type of after-the-fact assessment, it is most important to identify, not just detect, the intruder. Because of this, color cameras are probably more helpful for most school applications than black-and-white cameras. Color recordings will contain much more information about the scene that was viewed, i.e., the boy who broke the window had red hair, a dark yellow jacket, and drove away in a light blue car. This can be critical for school applications; the school principal can match the characteristics of the recorded suspect with those of students or outsiders known to frequent the area. Quite often, when a suspected student is brought in and shown a recording of himself or herself in an incident, he or she will admit to a role in it, even though there may not have been quite enough detail on tape for a positive identification.

Color cameras usually have lower resolution than black-and-white cameras. However, for the school application, the ability to recognize the color of clothing, color of vehicle, and so forth is often more important than a more detailed image. The amount of information on a video recording that is required to prosecute a suspect in a court of law may be much greater in many instances than what a school video system will normally collect.

The cost of color cameras is slowly approaching the cost of black-and-white cameras. Currently, the cost of a color camera as compared to an equivalent black-and-white camera is anywhere from 30 percent to 70 percent greater. Most school applications will find the higher priced color cameras necessary for their goals. An exception to this would be a camera applied in a small interior room or area where any potential perpetrators will be close enough so that their faces will be easily identifiable in black and white.

When using either black-and-white or color cameras under low light level conditions (such as at night with artificial lighting) it is necessary to evaluate the effectiveness of the existing lighting. Generally, security applications of cameras require higher light levels and more evenly distributed lighting than is found in parking lots with typical safety lighting. Also, if school officials plan to use their cameras for nighttime applications, color cameras will require a higher lighting level than black and white cameras. (See the section on lighting requirements and nighttime applications.)

6. Fixed versus pan-tilt-zoom cameras

Two types of camera configurations are available on the market: the fixed camera and the pan-tilt-zoom camera. Fixed cameras are mounted in a stationary position (although what the camera is mounted on may actually move, such as on a police vehicle). These cameras will view the same scene until physically relocated. The scene is typically recorded and, less often, the scene is also viewed simultaneously on a monitor by security personnel.

Pan-tilt-zoom cameras can operate in either of two modes. The mode for which these cameras are most useful allows the scene that is viewed to be controlled by an operator sitting at a video monitor. This operator can control the direction and angle of the camera as necessary. These cameras typically have a zoom option that will allow the operator to focus on parts of a scene, such as zooming in on a suspected perpetrator. The second mode for pan-tilt-zoom cameras is an automatic mode, in which the camera automatically scans back and forth over a certain portion of its range. Normally a pan-tilt-zoom camera should be protected and shielded from view by an opaque enclosure (domes are quite common) so that it is difficult for a would-be perpetrator to tell where the camera is actually aimed.

Most applications in schools are better served by fixed cameras. One consideration is that the pan-tilt-zoom camera can cost around three to five times as much as an equal quality fixed camera. More important, though, is the fact that pan-tilt-zoom cameras, when run by an operator, consume the time of a security staff member. When run in automatic mode, the chance of the pan-tilt-zoom camera looking (and recording) in the direction where an incident is occurring is much less likely than the chance that it will be looking in the wrong direction (exhibit 2.6). Pan-tilt-zoom cameras also introduce a mechanical component to the system that will require more regular maintenance (e.g., oiling gears, replacing motors, and so forth) and that will be one of the more likely fail points.

Pan-tilt-zoom cameras may be employed during a fixed portion of the day, such as the lunch period, if an operator is available to watch and track suspects with this camera. Gateway High School in Denver, Colorado, has a dozen fixed cameras located throughout the campus but also successfully uses one pan-tilt-zoom camera overseeing the parking lot that allows an operator to watch suspected perpetrators before and after classes. Gateway's goal is to record a suspected individual while he or she is involved in a regularly occurring incident of which the school is already quite aware.

With these considerations, it would usually be more cost-effective and more reliable to capture incidents using multiple fixed cameras looking in different areas from a single point than to use a single pan-tilt-zoom camera. (This does not take into account installation costs.)

7. Hardwired versus wireless systems

Traditionally, camera systems have cabling that runs directly between the camera and the recording mechanism (or viewing monitor). These hardwired runs are usually recommended by manufacturers to not exceed 500–1,000 feet, using RG–59 coaxial cable. Signal equalizers/amplifiers will be required to compensate for signal loss if distances become much greater than 1,000 feet. See exhibit 2.7 for typical transmitting distances.

For exterior applications, cabling for camera systems should be placed within a watertight conduit. Underground cabling should be buried below the frostline or a minimum of 24 inches deep. Direct buried cables (without conduit) are subject to damage by rodents (if no rodent shield is provided), accidental digging, and intentional tampering. Above-ground cabling that is not in a conduit is very susceptible to tampering, as well as environmental degradation. With coaxial cable runs, ground loops (in video applications, this is a current flowing along

Exhibit 2.6. A pan-tilt-zoom camera that is set to automatically pan an area may completely miss capturing incidents of concern.

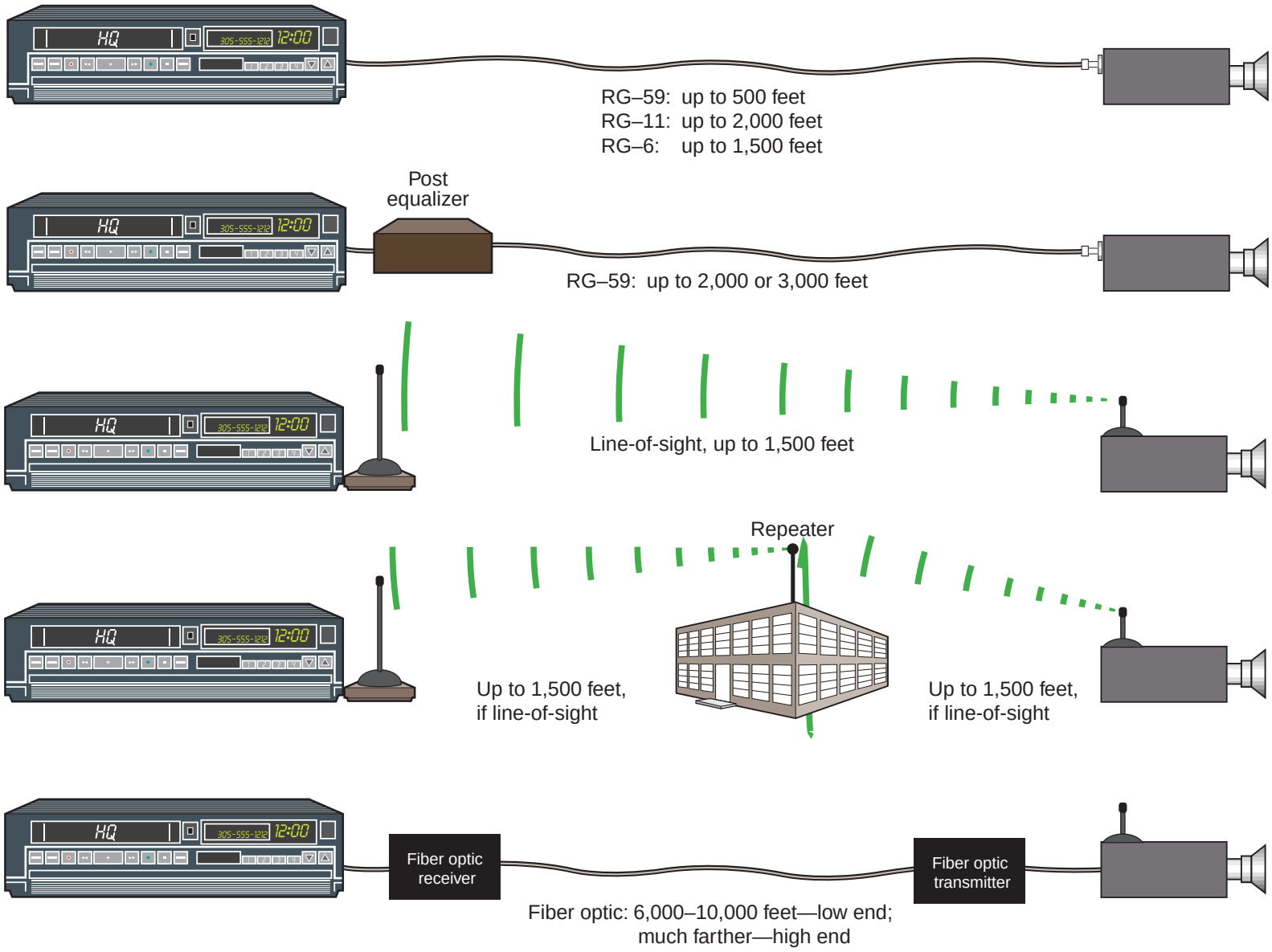

Exhibit 2.7. This diagram illustrates typical maximum transmitting distances for hardwired and wireless camera systems. (Note: Some cameras have "pre-equalization" that will allow signals to go 1,000 feet farther than typical RG–59 signals.)

the shield of the coaxial cable due to a voltage difference in the ground between the ends of the cable) and interference from radio frequencies (RF) or other signals must be considered. Coaxial cables should not be run next to, or parallel with, power lines over long distances. Equipment, such as hum transformers and electronic video clamps, is available in instances where interference is a problem.

With exterior coaxial cable runs, close lightning strikes can induce voltage surges on the cable that can damage equipment on both ends. To protect equipment, surge protectors are installed at both ends of the cable run.

Fiber optic cabling is an excellent alternative to coaxial cable. With fiber optics, there are no concerns with noise, RF interference, ground loops, or voltage surges. Fiber optic systems require a transmitter at the camera end and a receiver at the monitoring end. Fiber optic systems are more costly than coaxial cable systems for short runs but become more cost effective with longer cable runs (greater than 3,000 feet). Installation of fiber optics is also more expensive, requiring trained and experienced installers and specialized tools for handling and connecting.

For interior applications, cabling for hardwired camera systems should be placed within a metal conduit if it is exposed or accessible by building occupants, including maintenance staff. A good example of this is cabling run above loose/replaceable ceiling tiles.

Short-distance, low-power RF wireless camera systems for video signal transmission are becoming more popular. (Wiring is still required for power.) A transmitter is required at the camera, as well as a receiver at the recording end. This will add an estimated $1,000 or more to the price of the system for each distinct camera location (multiple cameras can be at one location, as in exhibit 2.8). In many cases, however, wireless may be cheaper (and certainly easier) than running cabling.

Acceptable distances between a transmitter and receiver may range up to about 1,500 feet if the camera transmitter is in direct line-of-sight of the receiver. If equipment is located such that data transmissions must go through walls, fences, and so forth, the detail of the transmission can quickly degrade if the transmitter/receiver distance is already close to the manufacturer's recommended maximum distance. Installation distances to be implemented for camera transmissions should be much less than manufacturer recommendations if the transmitter and receiver are not within each other's line of sight.

The advantage of wireless camera systems is, of course, that cabling does not have to be run underground, through the air, or behind walls and ceilings. Therefore, the chance of tampering is much less. However, wireless applications where distances are close to manufacturer limitations may experience interference from very unusual sources, e.g., a nearby parked truck. Previous installation experience is usually required to set up such a system, due to the different antennas available that can perform differently in unique setups.

Short-distance, low-power RF transmission systems, such as a school's wireless camera system, usually do not require licensing by the Federal Communications Commission (FCC). Higher power systems will require an FCC license.

Exhibit 2.8. These bullet-resistant cameras on the light pole of a school parking lot were installed using wireless technology for data transmission. This configuration, which required line of sight between the transmitter and receiver, greatly reduced the expense and difficulty in running protected cabling back to the recording equipment. Note the protective shielding for the power cables that serve each camera.