

Technical Production Systems

To make sense of the various pieces of television equipment and how they interact in a multicamera or single-camera production, you should consider them part of a system. This way you can relate how they function together, even though they are presented here individually. This section gives an overview of the studio and field production systems and an introduction to the major equipment.

► BASIC TELEVISION SYSTEM

How a program host appears on the television receiver

► SINGLE-CAMERA SYSTEMS

Single-camera recording and transmission

► MULTICAMERA SYSTEMS

Multicamera studio system and instant replay system

► MAJOR EQUIPMENT

Camera, audio, lighting, switcher, video recorder, and postproduction editing

BASIC TELEVISION SYSTEM

A system is a collection of elements that work together to achieve a specific purpose. Each element depends on the proper functioning of the others, and none of the individual elements can do the job alone. The **television system** consists of equipment and people who operate that equipment for the production of specific programs.

How a Program Host Appears on the Television Receiver

Whether the production is simple or elaborate or originates in the studio or in the field—that is, on-location—the television system works on the same basic principle: the television camera converts whatever it “sees” (optical images) into electrical signals that can be temporarily

stored or directly reconverted by the television set into visible screen images. The microphone converts whatever it “hears” (actual sounds) into electrical signals that can be temporarily stored or directly reconverted into sounds by the loudspeaker. In general, the basic television system transduces (converts) one state of energy (optical image, actual sound) into another (electric energy). **SEE 1.5** The picture signals are called video signals, and the sound signals are called audio signals. Any small consumer camcorder, or even the video part of your cell phone, represents such a system. This basic system can be used in a variety of ways for single- and multicamera productions.

SINGLE-CAMERA SYSTEMS

Regardless of how simple or complex your production may be, the three basic **single-camera systems** are the same:

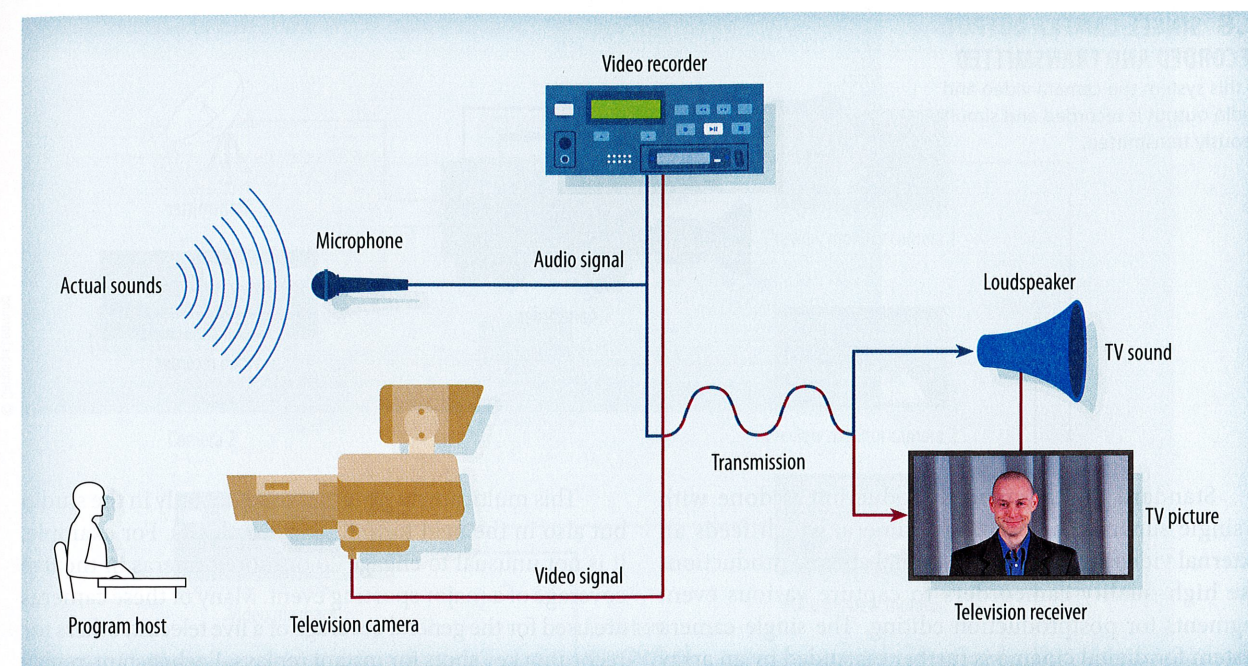
- The video and the audio of the camera output are recorded for later postproduction editing. **SEE 1.6**
- The camera output is transmitted to a specific destination. **SEE 1.7**
- The camera output is simultaneously recorded and transmitted. **SEE 1.8**

You are probably most familiar with the first system, from when you use your camcorder to capture footage of a birthday party or a blockbuster documentary.

Most news coverage is done with a single camcorder that records the event on its built-in video recorder for later editing. **EFP** (electronic field production) normally uses a single camcorder or high-quality video camera with an external video recorder to capture the various event segments. These segments, called **clips**, are then edited into a story in the postproduction phase. Even the most elaborate digital cinema productions most often use this basic single-camera system, except that the single camera is a super-high-quality video camera with an equally specialized video recorder.

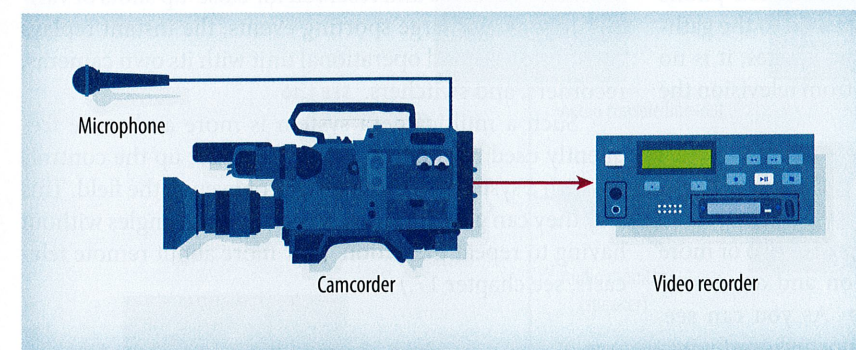
In **ENG** (electronic news gathering), you may occasionally be called on to transmit your developing story live to the station, directly to the station's transmitter or a satellite uplink. This process always requires that the camera be connected to a transmission device.

The third single-camera system is in use when you transmit your signal while simultaneously recording it for later postproduction. If you use a camcorder for the live transmission of an ENG event, you will most likely also record the signal output.



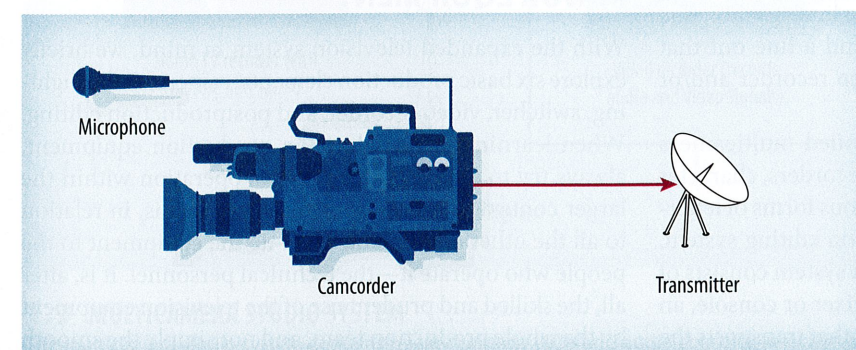
1.5 BASIC TELEVISION SYSTEM

The basic television system converts light and sounds into electrical video and audio signals that are transmitted (wirelessly or by cable) and reconverted by the television receiver and loudspeaker into television pictures and sound.



1.6 SINGLE-CAMERA OUTPUT RECORDED

In this system a single camera or camcorder is used to record electronic video and audio signals.

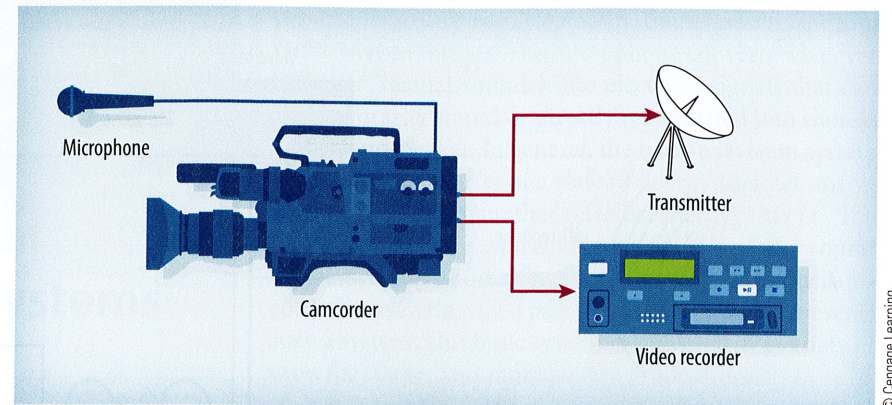


1.7 SINGLE-CAMERA OUTPUT TRANSMITTED

In this system the video and audio output of the camera or camcorder, such as news footage, is transmitted to a specific destination.

1.8 SINGLE-CAMERA OUTPUT RECORDED AND TRANSMITTED

In this system the camera video and audio output is recorded and simultaneously transmitted.



Standard digital cinema production is done with a single super-high-resolution camera, which feeds an external video recorder. Some digital cinema productions use high-quality camcorders to capture various event segments for postproduction editing. The single-camera system for digital cinema is further expanded by an array of additional equipment, such as various external filters, high-quality microphones and audio control accessories, and a great variety of lighting equipment. But, as you know, feature films have also been shot with small handheld digital single-lens reflex (DSLR) cameras or even cell-phone cameras. Because digital cinema has switched to the gathering and the manipulation of electronic images, it is no surprise to see that it has also borrowed from television the multicamera system.

MULTICAMERA SYSTEMS

The expanded *multicamera systems* consist of two or more cameras engaged in a single production and an assortment of associated equipment. **SEE 1.9** As you can see, the multicamera studio system in its normal configuration employs two or more cameras, camera control units (CCUs), preview monitors, a switcher, a line monitor, one or more servers or video recorders, and a line-out that transports the video signal to the video recorder and/or the transmission device.

Usually integrated into the expanded multicamera system are computer servers or video recorders, character or graphic generators that produce various forms of lettering or graphic art, and a postproduction editing system.

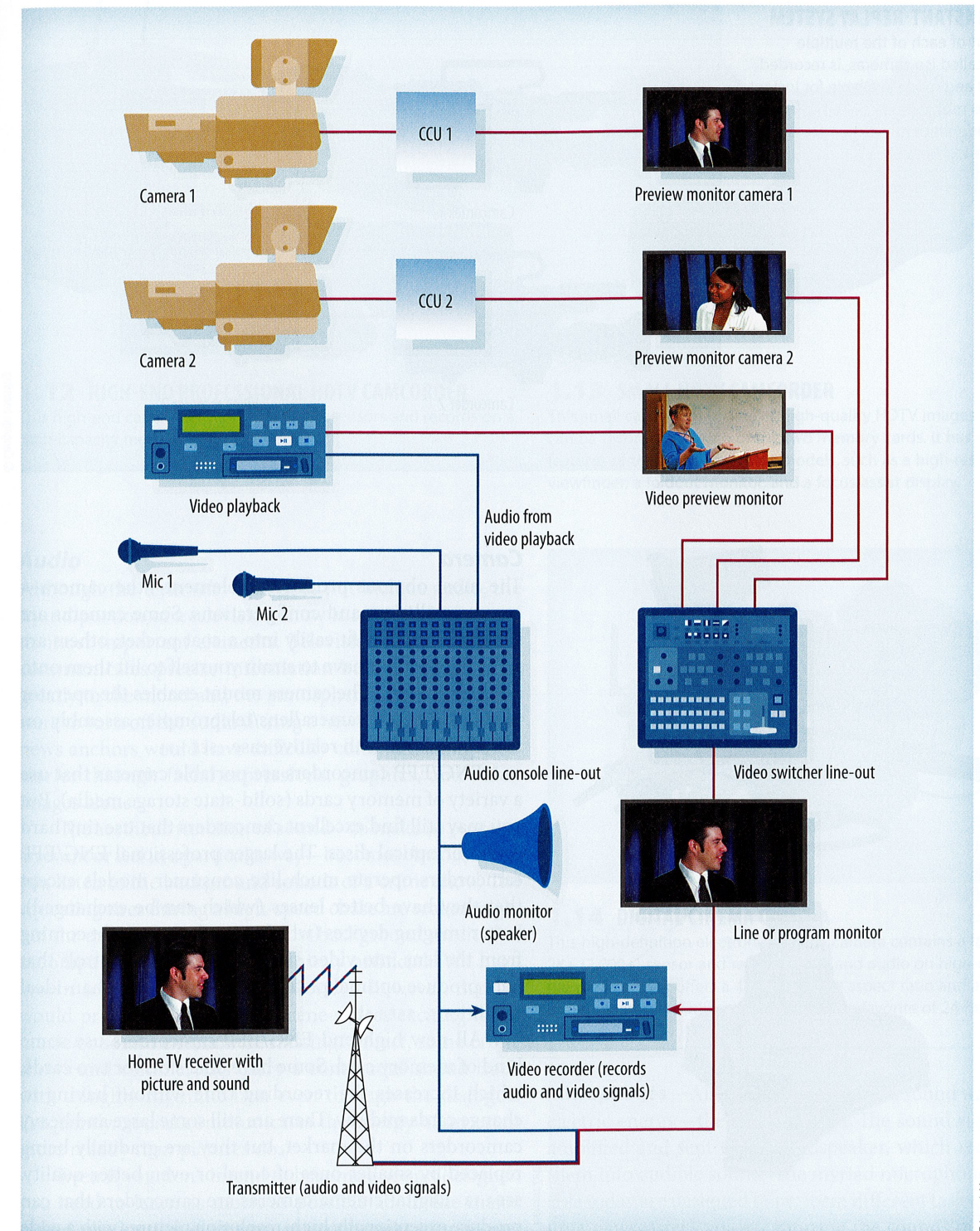
The audio portion of the expanded system consists of one or more microphones, an audio mixer or console, an audio monitor (speaker), and a line-out that transports the sound signal to the video recorder and/or the transmitter.

This multicamera system is used not only in the studio but also in the field for outdoor broadcasts. For example, it is not unusual to engage 20 or more cameras in the live coverage of a major sporting event. Many of these cameras are used for the general coverage of a live telecast, others for recording key shots for instant replays. Each instant-replay camera feeds its signal to a dedicated recorder or location on a large video server, but it is also available for the general coverage. These cameras are appropriately called “iso cameras,” which means they are generally isolated from the major coverage and reserved for close-up shots of various actions. For large sporting events, the instant replays constitute a second operational unit with its own cameras, recorders, and switchers. **SEE 1.10**

Such a multicamera system is more and more frequently used by movie directors, who set up the controls for such a system on a sound stage or even in the field. This way they can get shots from many different angles without having to repeat the action. (For more about remote telecasts, see chapter 17.)

MAJOR EQUIPMENT

With the expanded television system in mind, we briefly explore six basic production elements: camera, audio, lighting, switcher, video recorder, and postproduction editing. When learning about television production equipment, always try to see each piece and its operation within the larger context of the television system, that is, in relation to all the other equipment. Then tie the equipment to the people who operate it—the technical personnel. It is, after all, the skilled and prudent use of the television equipment by the whole production team, and not simply the smooth interaction of the machines, that gives the system its value.

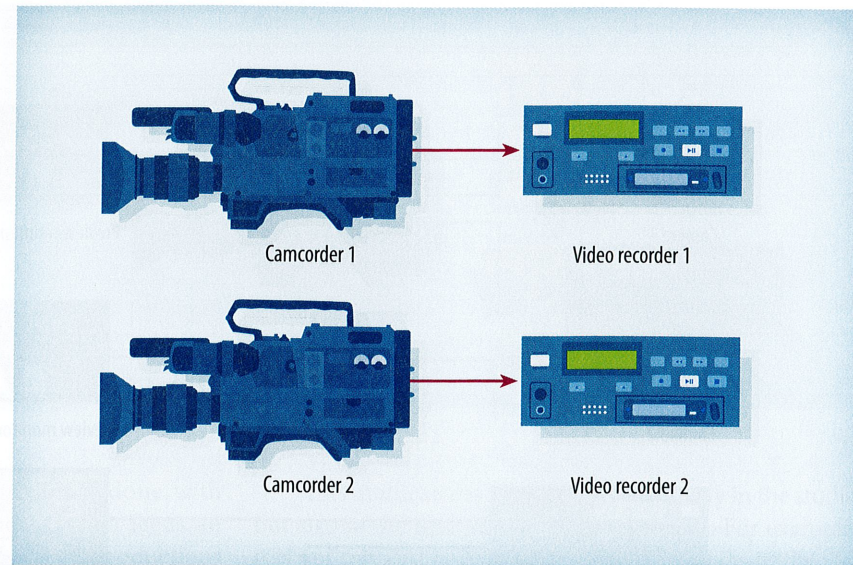


1.9 MULTICAMERA STUDIO SYSTEM

The multicamera studio system contains quality controls (CCU and audio console), selection controls (switcher and audio console), and monitors for previewing pictures and sound.

1.10 INSTANT-REPLAY SYSTEM

The output of each of the multiple cameras, called iso cameras, is recorded separately and made available for instant replay. This multicamera system can operate independently of the general multicamera coverage.



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1.11 STUDIO CAMERA WITH PEDESTAL

High-quality studio cameras are mounted on a studio pedestal for smooth and easy maneuverability.

Camera

The most obvious production element—the camera—comes in all sizes and configurations. Some cameras are so small that they fit easily into a coat pocket; others are so heavy that you have to strain yourself to lift them onto a camera mount. The camera mount enables the operator to move a heavy camera/lens/teleprompter assembly on the studio floor with relative ease. **SEE 1.11**

ENG/EFP camcorders are portable cameras that use a variety of memory cards (solid-state storage media). But you may still find excellent camcorders that use tiny hard drives or optical discs. The larger professional ENG/EFP camcorders operate much like consumer models except that they have better lenses (which can be exchanged), better imaging devices (which transduce the light coming from the lens into video signals), and more controls that help produce optimal pictures even under less-than-ideal conditions. **SEE 1.12**

All new high-end ENG/EFP camcorders use some kind of memory card. Some have dual slots for two cards, which increases the recording time without having to change cards midway. There are still some large and heavy camcorders on the market, but they are gradually being replaced by smaller ones of equal or even better quality.

SEE 1.13 Digital cinema cameras are camcorders that can produce exceptionally high-resolution pictures with a wide exposure range (many steps between white and black).

SEE 1.14 **ZVL7** CAMERA → Camera introduction **ZVL8** CAMERA → Camera moves



Sony Electronics

1.12 HIGH-END PROFESSIONAL HDTV CAMCORDER

This high-end camcorder has three CMOS sensors and records on a high-capacity memory card.



JVC

1.13 SMALL HDTV CAMCORDER

This small camcorder produces high-quality HDTV images that can be recorded on each of the two memory cards. It has several features of the more expensive models, such as a high-resolution viewfinder, a foldout monitor, and a focus-assist display.

Audio

Although the term *television* does not include audio, the sound portion of a television show is nevertheless one of its most important elements. Television audio not only communicates precise information but also contributes greatly to the mood and the atmosphere of a scene. If you were to turn off the audio during a newscast, even the best news anchors would have difficulty communicating their stories through facial expressions, graphics, and video images alone.

The aesthetic function of sound—to make us perceive an event or feel in a particular way—becomes obvious when you listen to the background sounds of a crime show. The squealing tires during a high-speed chase are real enough, but the exciting, rhythmically fast background music that accompanies the scene is definitely artificial. We have grown so accustomed to such devices, however, that we would probably perceive the scene as less exciting if the music or sound effects were missing. In fact, some crime shows and commercials carry a continuous sound track with a highly rhythmic beat even through the dialogue. Frequently, sound communicates the energy of an event more readily than pictures do.

Even if you don't intend to become a sound designer, you need to learn as much as possible about the major sound production elements: microphones, sound control equipment, and sound recording and playback devices. **ZVL9** AUDIO → Audio introduction



ARRI

1.14 DIGITAL CINEMA CAMERA

This high-definition electronic cinema camera contains a large 2K+ (2,000+) sensor and records video and audio on high-capacity memory cards. It offers a 4 × 3 or 16 × 9 aspect ratio and a variety of frame rates, including the digital movie favorite of 24 fps.

Microphones All microphones convert sound waves into electric energy—the audio signals. The sound signals are amplified and sent to the loudspeaker, which reconverts them into audible sound. The myriad microphones available today are designed to perform different tasks. Picking up a newscaster's voice, capturing the sounds of a tennis match, and recording a rock concert—all may require different microphones or microphone sets.

1.15 FISHPOLE MICROPHONE

This highly directional shotgun mic is suspended from a fishpole by the boom operator.



Edward Atona

Some microphones, such as lavalier mics (pronounced "mikes"), are quite small and are clipped to the performer's clothing. Hand mics are larger and carried by the performer or attached to a mic stand. Boom, or long-distance, mics are either suspended from a small boom (called a fishpole, which is carried by the operator) or from a large boom, whose operator sits on a movable platform.

SEE 1.15 ZVL10 AUDIO → Microphones → mic types

Sound control equipment In studio productions the most important piece of sound control equipment is the

audio console. At the audio console, you can select a specific microphone or other sound input, amplify a weak signal from a mic or other audio source for further processing, control the volume and the quality of the sound, and mix (combine) two or more incoming sound sources. In relatively simple productions, such as a newscast or an interview, you are mostly concerned with keeping the audio within a certain volume level. If it is too low, the viewer-listener can't hear the sound very well; if it is too high, the sound is not only hard on the ears but distorts so much that it may be impossible to fix in postproduction. SEE 1.16

1.16 AUDIO CONSOLE

Even a relatively simple audio console has many controls to adjust the volume and the quality of incoming sound signals and to mix them in various ways.



Loud Technologies, Inc.

1.17 AUDIO MIXER

The portable mixer has a limited number of inputs and volume controls.



Shure, Inc.

In ENG and EFP, the sound is normally controlled by the camera operator, who wears a small earphone that carries the incoming sound. Because the camera operator is busy running the camera, the sound controls on the camcorder are often switched to the automatic setting. In the more critical EFP, the volume of incoming sounds is often controlled by a portable mixer. SEE 1.17 ZVL11 AUDIO → Consoles and mixers

Sound recording and playback devices When an event is recorded for postproduction, most of the dialogue and environmental sounds are recorded simultaneously with the picture.

In large and complex studio productions in which a single camera shoots a scene piecemeal, much in the way films are made, the audio track is subjected to much manipulation in postproduction. The sounds of explosions, sirens, and car crashes, for example, are normally dubbed in (added) during the postproduction sessions. Even parts of the original dialogue are occasionally recreated in the studio, especially when the dialogue occurs outdoors. As you undoubtedly know and have probably experienced, wind is a constant hazard to clean sound pickup. ZVL12 AUDIO → Systems

Lighting

Like the human eye, the camera cannot see well without a certain amount of light. Because it is actually not objects

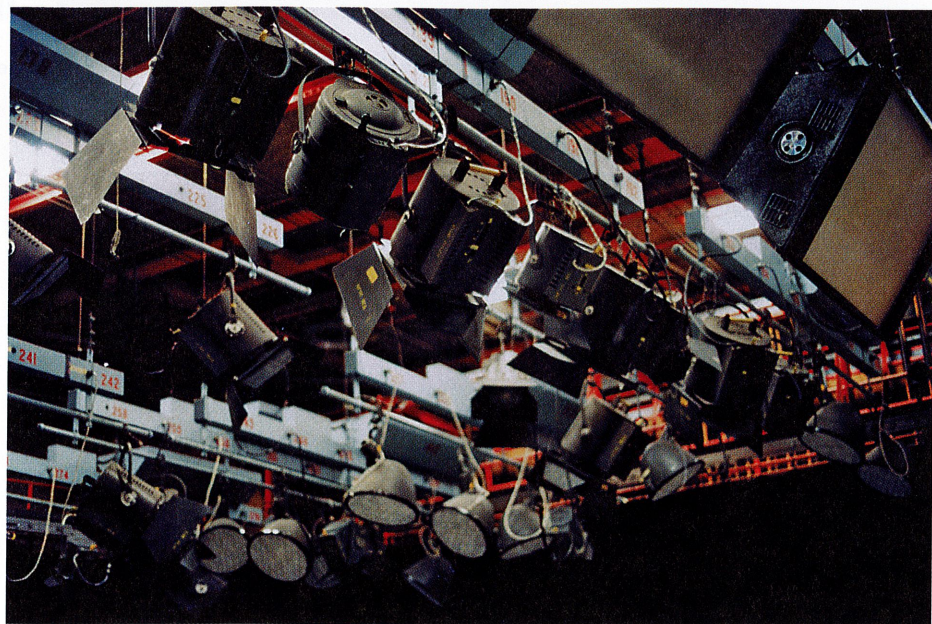
we see but the light that is reflected off the objects, manipulating the light falling on objects influences the way we perceive them on-screen. The purposeful control of light and shadows is called lighting.

Types of illumination All television lighting basically involves two types of illumination: directional and diffused. Directional light has a sharp beam and produces harsh shadows. A flashlight and car headlights produce directional light. You can aim a light beam to illuminate a precise area. In television and motion pictures, such lights are called spotlights. Diffused light has a wide, indistinct beam that illuminates a relatively large area and produces soft, translucent shadows. The fluorescent lamps in a department store produce diffused lighting. Television and motion pictures use floodlights to achieve such general nondirectional lighting and to control the density of shadows. ZVL13 LIGHTS → Light introduction

Lighting instruments In the television studio, the various types of spotlights and floodlights are usually suspended on battens that can be raised close to the ceiling and lowered close to the floor. This enables the lighting crew to place the instruments in the desired positions on the battens. When the battens are raised, the cameras and the crewmembers can move freely about the studio floor without interfering with the lighting. SEE 1.18

1.18 STUDIO LIGHTS SUSPENDED FROM MOVABLE BATTENS

Typical studio lighting uses spotlights and floodlights. All instruments are suspended from battens that can be lowered close to the studio floor and raised well above the scenery.



Herbert Zatti

ENG and EFP use much smaller, portable instruments that can be set up quickly and plugged into ordinary household outlets. [ZVL14 LIGHTS](#) → [Instruments](#) → [studio](#) | [field](#)

Lighting techniques As mentioned, lighting is the manipulation of light and shadows that influences the way we perceive how things on-screen look and feel. All television lighting is based on a simple principle: to illuminate specific areas, mold shadows, and bring the overall light on a scene to an intensity level at which the cameras can produce optimal pictures and create a certain mood. Optimal pictures means that the colors are faithfully reproduced even in the shadow areas, that there is a certain number of brightness steps between the darkest and the brightest spots in the scene, and that you can still see some detail in the brightest and darkest areas.

For some shows the lighting is deliberately flat, which means that there is little contrast between light and shadows. Flat (diffused) lighting is frequently used on news and interview sets, for game shows and situation comedies, and in many field productions. Crime and mystery shows normally use high-contrast lighting. This creates dense shadows and intensifies the dramatic tension. [ZVL15 LIGHTS](#) → [Falloff](#) → [fast](#) | [slow](#) | [none](#)

Switcher

The switcher works on a principle similar to that of push-buttons on a car radio that allow you to choose different radio stations. The switcher lets you select various video inputs, such as cameras, video recorders, and titles or other special effects, and join them through a great variety of transitions while the event is in progress. In effect, the switcher allows you to do instantaneous editing.

Any switcher, simple or complex, can perform three basic functions: select an appropriate video source from several inputs, perform basic transitions between two video sources, and create or retrieve special effects, such as split screens. [SEE 1.19](#)

If you now look back at figure 1.9, you can see that three video inputs—camera 1, camera 2, and a video recorder—are routed to the switcher. From these three inputs, camera 1 is selected to go on the air. [ZVL16 SWITCHING](#) → [Switching introduction](#)

Video Recorder

One of the unique features of television is its ability to transmit a telecast live, which means capturing the pictures and the sounds of an ongoing event and distributing them instantly to a worldwide audience. Most television

1.19 VIDEO PRODUCTION SWITCHER

The production switcher has rows of buttons and other controls for selecting and mixing various video inputs and creating transitions and special effects. It then sends the selected video to the line-out.



FOR-A Company Limited

programs, however, originate from playback of previously recorded material.

Recording media Almost all video-recording is done on some kind of computer-like high-capacity hard drive or solid-state storage media. An assembly of hard drives with a very large storage capacity in the multi-terabyte range (a terabyte equals 1,000 gigabytes) is called a server. Some servers do not use spinning hard disks (like what you have in your computer) but rather solid-state drives (SSDs), which are basically large memory cards. For archival storage, programs are also recorded on digital videodiscs (DVDs).

The big advantage of a server over other storage media is that it can multitask. For example, it can record incoming program material while providing a newscast in progress with various news clips and, at the same time, feed some news footage to the editing room for the subsequent newscast.

You will find that videotape has not entirely left the planet; it is occasionally still used as a relatively inexpensive storage media for archival purposes. The problem, of course, is finding a working high-quality videotape recorder (VTR) and maintaining it over the years.

Postproduction Editing

In principle *postproduction editing* is relatively simple: you select the most effective shots from the original source material and join them with transitions in a specific sequence. In practice, however, postproduction editing can be quite complicated and time-consuming, especially if it also involves extensive audio manipulation. [ZVL17 EDITING](#) → [Editing introduction](#)

In the very early stages of video editing, videotape was literally cut and spliced together again, very much like optical film. Later the splices were done electronically. All tape editing was linear, which means you had to roll through shots 1, 2, and 3 before you could get to shot 4. With the advent of computer editing, all clips—in fact, all frames—are placed into individual digital files, which you can access randomly. This means that if you wanted to call up clip 4 directly, you could do so without having to go through the previous three. Once all video and audio clips are transferred to the hard drive of your editing system (your laptop computer or a dedicated system), you can manipulate them pretty much as you would edit text with a word-processing program. You can call up, move, cut, paste, and join the various video or audio clips much like words, sentences, and paragraphs when editing a document. This method is

still frequently called “nonlinear editing” because you can call up any clip or frame regardless of the sequence in which it was captured or ingested by the editing system. With the demise of videotape, however, the division of video editing into linear and nonlinear no longer makes sense. We will simply refer to the process of selecting and sequencing clips as postproduction editing. **SEE 1.20 ZVL18 EDITING→**

Nonlinear editing→ system

Regardless of the editing system you use, it cannot make the creative decisions for you. Thinking about postproduction as early as the preproduction stage facilitates considerably your editing chores. Always consider postproduction an extension of the creative process, not a salvage operation.



1.20 POSTPRODUCTION EDITING COMPUTER INTERFACE

The interface of most postproduction editing systems shows a list of available clips, a preview monitor of the upcoming shot that is to be edited to the shot shown on the program monitor, a video track (blue track with thumbnail images), two or more audio tracks (green tracks), and other information such as available transitions.

MAIN POINTS

- ▶ The basic television system consists of the equipment and the people who operate the equipment to produce specific programs. In its simplest form, the system comprises a television camera that converts what it sees into a video signal, a microphone that converts what it hears into an audio signal, and a television set and a loudspeaker that reconvert the two signals into pictures and sound.
- ▶ Single-camera systems use the camera for ENG (electronic new gathering), EFP (electronic field production), and digital cinema.
- ▶ The expanded multicamera systems use two or more cameras for the simultaneous capture of events or event details and for instant replays.
- ▶ The major production elements are the camera, audio, lighting, switcher, videotape recorder, and postproduction editing.
- ▶ There are several types of video cameras: large studio cameras that need a pedestal to be moved about the studio floor; ENG/EFP cameras that are small enough to be carried by the operator; and camcorders, which have the recording device built into the camera.
- ▶ Audio, the sound portion of a television show, is necessary to give specific information about what is said and to set the mood of a scene.
- ▶ Audio production elements include microphones, sound control equipment, and sound recording and playback devices.
- ▶ Lighting is the manipulation of light and shadows that influences the way we perceive objects on-screen and how we feel about the screen event.
- ▶ The two types of illumination are directional light, produced by spotlights, and diffused light, produced by floodlights.
- ▶ The switcher enables you to do instantaneous editing by selecting a specific picture from several inputs and performing basic transitions between two video sources.
- ▶ Almost all video-recording uses large-capacity hard drives, or servers, and large-capacity memory cards, called solid-state drives (SSDs).
- ▶ Postproduction editing consists of selecting various clips (shots) from the source material and arranging them in a specific sequence. The digital video and audio material is recorded onto the editing hard drive as files and manipulated during the actual editing using computer software.

ZETTL'S VIDEO LAB



For your reference or to track your work, the Zettl's VideoLab program cues in this chapter are listed here with their corresponding page numbers.

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