Figure 6.41 *Up until the late '70s, this is how graphics were usually created, by a graphic artist physically cutting and pasting the graphical elements together on an art card. It was then photographed and turned into a slide, or the art card was simply put on an easel and shot by a television camera. Often a camera was devoted to just shooting art cards on easels during a production.*

Graphics

The Winds of Change

Ten years ago, a remote truck would have included a character generator (CG), usually with a dedicated operator, and maybe a still store, usually operated by the technical director. In 1994, that started to change radically when FOX wrestled NFL away from CBS. In a few years, the graphics effort grew to include impressive graphic displays and animated moves – with sound effects. A decade ago, most of us would have never guessed that many CGs today would have audio channels. In that time, the graphics component of a remote production for at least two of the networks has expanded to require its own 53-foot trailer. At the start of each sports season, the mobile unit vendors review their contracts and reconfigure their production and support trucks for the upcoming season. Network and freelance crews, plus talent, often use the same set of trailers each week. The vendor will configure those units based on the job (A-game unit, B-game unit, etc.). Often, a stand-alone production truck will be reconfigured to become the graphics trailer in a particular unit (typically, three trailers comprise a unit). In the case of ESPN's *Sunday Night Football*, the truck vendor prior to the start of the season gathers the staff assigned to the graphics support units at the field shop, along with personnel from the network. Gear supplied by the truck vendor and rental houses is unpacked and installed. Monitors, router heads and communication gear are placed and wired in. This can be one or two items or, in the case of ESPN, over 100 cases of equipment. Once the gear is wired and in place, the two trucks are interconnected and all the connections, timing are verified and other signal integration concerns addressed. ESPN requires a three-trailer unit. The A trailer has production, VTRs and camera controls, along with routing, distribution and communications infrastructure. The B trailer carries audio effects (a Calrec C2 console), graphics (two Chyron Duets and an Aprisa), four super-slow-motion systems (two LDK/EVS and two Sony BVP-9500/MAV). Other equipment in this unit includes robo-cam operating positions and a Grass Valley Profile, which is used to edit feature pieces. The B trailer is a 53-foot expando. The C trailer carries the Sportvision first-and-ten yellow-line system, the tech manager's office, and two Chapman sideline camera cranes, along with all the extra equipment, such as lighting gear. The FOX A game has A and B units only. The B unit has a Chyron iNFiNiT! and an SGI O2, the first-and-ten line equipment, and carryall space for the sideline vehicles. Super "slo-mos" and Profiles are operated from the main truck. The CBS A game is similar to FOX's. Now let's look at the systems required for many network graphics packages.

The current workhorse CG for remotes is Chyron's iNFiNiT!, which

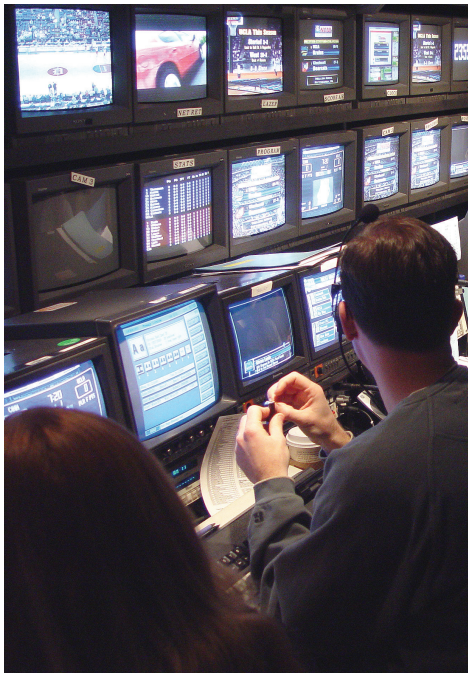
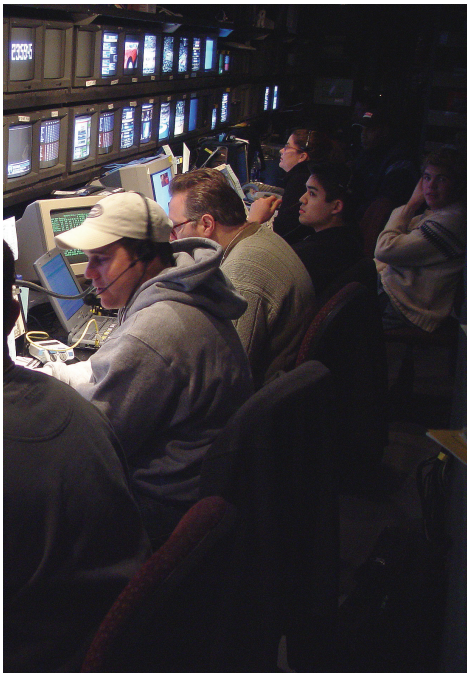


Figure 6.42 *Inside a network graphics truck. Most network productions have a separate trailer just for the graphics effort.*



was first shipped in 1989. Just about every remote unit on the road has one. Common configurations would find a 68060 processor with Transform II board and a three-channel mix buffer, a 230MB Zip, and/or 1GB Jazz drive. It is used for most sports productions. The notable exceptions are ESPN's *Sunday Night Football* and ABC's *Monday Night Football*, which use Chyron's newest CG and still store, the Duet and Aprisa. The iNFiNiT! is used to produce most of the lower-third graphics. It uses proprietary hardware, operating system and application software. Although not used in truck environments, Chyron did begin offering a Windows client (WiNFiNiT!) in 1997 that runs on a separate PC and controls the iNFiNiT! via Ethernet.

Most of the network productions call for an SGI Onyx2, or SGI's scaled-down O2 visual workstation running Vizrt (formally Peak Everest and RT-SET), Discreet or Sportvision software. These are real-time animation applications that run on IRIX, SGI's implementation of Unix. SGI developed and helped standardize a common set of application programming interfaces (APIs) known as Open Graphics Library (OpenGL).

These APIs are, in essence, applications that sit between the real-time applications that are OpenGL-aware and the OS. Calls to an OpenGL API result in calls to an IRIX API. This allows for a common way of creating and manipulating graphics independent of the underlying OS and hardware. The application's OS and hardware just described are used to produce the "Fox Box," a little upper-corner graphic showing score, downs and yards. No matter which network uses this type of graphic, its nickname has become the "Fox Box." FOX has actually reformatted the box to look like a ribbon across the top of the screen. The Onyx2/O2 is used for all those snappy little real-time animations, where flags, time-outs and first downs fly in and out. It also is used for scoreboards that fly together and then apart. It takes a lot of processing horsepower to perform these complex graphics in real time. The SGI hardware is based on 64-bit MIPS RISC processors. In the graphics display part of the O2 system, an integrated 32-bit, double-buffered (one buffer to air while the other buffer is filling with the next frame of video) OpenGL graphics engine renders high quality images for display at up to 1280x1024 pixels at 75Hz. The Onyx graphics engine consists of three subcomponents.

Figure 6.43 *Sophisticated graphics have become an integral part of visually covering the action.*

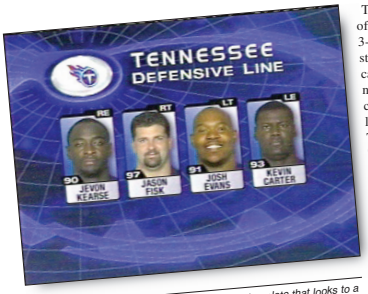
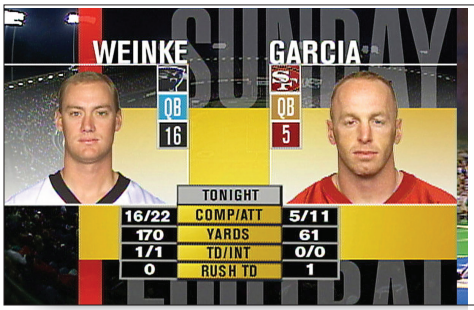


Figure 6.44 *Lineup out of SGI O2 based on a template that looks to a database for objects to comprise the display. Those objects include the moving background, and player positions, names and pictures. This graphic is only composited into a complete graphic when it is called up by the graphics operator.*

The first is a geometry engine, which has a model of the graphic in 2-D or 3-D. An object modeled in 3-D can be made to spin, tumble or appear to be stationary as the viewpoint moves. Objects, which can be text, pictures or banners, are stored and manipulated separately. They are brought together, or composited, only when needed for output. This allows graphics to be constructed only as templates. The template is a framework to hold pointers. These pointers point to one or more Oracle-type databases that contain the actual objects. Thus the player lineup graphic, which doesn't change format from game to game as the players do, stays essentially the same. The template for that graphic might hold only pointers such as quarterback and halfback, which point to a database record that contains additional pointers to such fields as QB_picture, QB_name, QB-stats, etc. This second set of pointers would be the variables that change every week, or even at the last minute. The operator would sit at a PC or a laptop, running a thin client that would be used to input changes such as distance or down, and send the command via LAN to the SGI system. The system would then perform the transitions from old info to new. In addition, data streams such as game clock, which are often wrapped in TCP/IP, can also arrive into the same box. Thus the graphics box would have separate sockets open to both the operator's PC and the device providing the clock data.



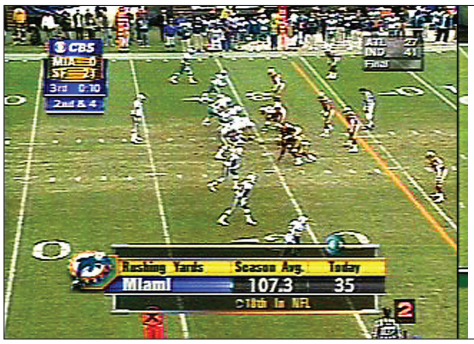


Figure 6.45 *Above, here and on the opposite page: CGs today can perform linear keys as demonstrated here. A linear key produces a key signal, or the whole cut pattern, that is "linear," with shades of key intensity. When combined with a switcher that understands that the key is not only on or off, but is to be mixed with the video it is overlaying, the key can be semitransparent in varying degrees. In the last section we mentioned that the video switcher performs two basic operations, switching and mixing (or dissolving). Up until the linear key, the keying process was a switching process based on the key whole cut signal used as a switching pattern. With the advent of the linear key, the key is a used as a mixing (or dissolving) pattern based on the value of the key signal at any given point. (Source: Chyron/ESPN)*

Sockets

Sockets are a method for communication between a client program (such as the operator's control application) and a server program (the graphics applications running on the graphics box) in a network. A socket is defined as "the endpoint in a connection." Most OSs today have API calls that support sockets. Calls to these APIs prompt the OS to open threads (separate processes that wrap outgoing data or unwrap incoming data in the necessary protocol to send the data to the appropriate recipient). Often, this wrapping is a few layers thick. The most common way to initially wrap the data is Transport Control Protocol (TCP), which is a service that lets the receiver put the data back in order (because some packets might take longer paths than others from point A to B), and makes the recipient return a receipt verifying that the data arrived intact. The next layer would be Internet Protocol (IP). It provides the addressing that allows routers on the network to push the data toward the receiver (small networks would not need routers). The third wrap or layer would be the information necessary to traverse the local Ethernet, either to a router for travel onto another LAN or out to the Internet or, if the receiving device is on the same LAN, straight to the device.

Figure 6.46 *Below and on the opposite page is CBS's version of the Fox box in the upper left corner, generated by SGI O2, lower banner Chyron iNFiNiT!, and first-and-ten PVI. The score in the upper right is a linear key that is usually provided by a Digital PC Codi. In most cases today, the stats in the lower banner are automatically provided by a third-party statistic vendor via a database, which the CG automatically loads into a template. The right shows FOX's latest version of the Fox box, which now is more of a ribbon than a box.*

The second SGI graphics component is the raster manager, which takes the calculations from the 3-D geometry engine and creates a 2-D raster. This block does all the pixel operations, color and transparency blending, texture mapping and multisample anti-aliasing. It must perform these operations at real-time rates.

The raster manager hands its output to the third graphics component, the display generator, which converts the digital data into the desired analog or digital format. The internal bandwidth of the Onyx2/02 is greater than 6GB/s, so the box can handle SD or HD video.

The line between graphics and storage continues to blur. Pinnacle Systems is the main graphics package that was used by NBC at the 2002 Winter Olympics, by CBS at the U.S. Open Tennis and their NFL A game, and by TNT at the Goodwill games. Pinnacle products use Microsoft NT as their OS. Pinnacle has a family of products that treats graphics as a collection of objects. A composite graphic is made up of objects. These objects are stored separately but related to other objects that come together to form a composite or complete video signal only when desired. An object, which could be a block of text, a picture (animated or still) or a background, can be modified individually. Templates are created that bring the required objects together to create a composite output. What is interesting about this approach is that the objects such as the network's "bug," a banner or an animated background can be created on one graphics machine and be made available to other machines via an Ethernet LAN. Two machines simply open a socket connection between each other.

CGs are not the only devices that deal in objects. Pinnacle's DVEs, still stores and even their servers deal in these objects as well. This means that stills or video clips can be modified remotely by changing a centrally controlled object. In this way, the whole still or clip doesn't need to be replaced, just the changed object. This concept allows objects to be created and edited on laptops, perhaps by a graphics person sitting at the airport waiting for a flight. But, more likely, the changes will be made on desktops back at the network and downloaded over the Internet by the truck crew once on site.

Chyron, which introduced the broadcast character generator, is still a major player in graphics. ESPN and ABC use the Chyron Duet, the replacement for the iNFiNiT!, for NFL games. The Duet (and its family of surrounding products like the Aprisa) also treats composite graphics as an associated group of objects. The Chyron application running on the Duet is Lyric. Lyric is a text, animation and graphics authoring software that contains features such as the animation tool and clip playback device used for creating *Monday Night Football*'s promos, lineups and animated 3-D bar charts. The Duet can even have a digital disk recorder installed in it. This allows for a single-channel clip player in the CG with its storage via a SCSI drive. While the user interface application on a Duet rides on top of NT, the Chyron graphic engine uses VXWorks, which is a real-

Figure 6.47 *Graphics and the production switcher work in concert to produce this transition from game to replay. Two channels of GVG Profile video server is used to produce the ring's key signal and video fill. At the same time, the production switcher is performing a circle wipe in step with the moving graphic.*

time operating system. NT passes the OpenGL-requested tasks off to VXWorks. OpenGL is a part of Lyric.

ESPN and ABC also use Chyron Aprisa for the NFL. The Duet controls the Aprisa 300 systems, which provide *Sunday/Monday Night Football* directors the flexibility to include animated clips for the Aprisa. During the game, the stand-alone Aprisa 300 systems are used to play back network promotion material as well as full-screen, rendered graphic elements. The Aprisa can also run a scaled-back version of Lyric, which allows editing of objects residing on it. The Aprisa comes in a number of variations. The 100 is like the still stores we have known. The difference is an integrated content and asset management database that can

manage content across the other Chyron still stores, CGs and servers. The 200 adds a DDR to the 100's capabilities. The 250 is a 200 that has two channels, which can be any combination of clip player, still store or one of each. The 300 adds internal transition effects.

Some B games and local college games use a Chyron Maxine, which produces a basic Fox Box without animations.

Another item in the graphics racks is the Chyron Codi Telestrator, with a 15-inch flat-panel touch screen located up in the announce booth that lets the color announcers (John Madden being the most well known) doodle on the screen. Companies such as Sportvision and PVI are now offering systems that use chroma inclusion/exclusion techniques developed for their first-down line to key the drawing in such a way that it appears to be under the players and officials.

We have seen how on-screen graphics have grown from cameras pointed at art cards to sophisticated electronic character generators. In the next section we will look at the marriage of the high-power computer and character generators, which is creating a dramatic increase in information avail able to the viewer through those on-screen graphics. ■

Figure 6.48 *Color announcer draws on stylus touch pad overlaid on a monitor. This used to be performed with a light pen. The key is generally performed with a Chyron Codi.*