

Figure 3.44 Every new remote truck must start somewhere — why not with a pair of axles? These two axles, along with leaf springs and shocks for suspension, will be fabricated into a trailer's running gear, also known as the "bogie."



Building the Truck

New Truck Considerations

Putting a new truck on the road can be an expensive and daunting process. Let's start with price. To produce a high-end production trailer would be about \$2 million on an analog truck, but few if any of those are built today. A standard-definition (SD) digital equivalent would come in at \$3 million to \$6 million. A high-definition (HD) example could easily be \$8 million. Financing a single high-end truck, let alone a fleet, is not for the financially faint of heart.

Most big trucks on the road today have trailers that range in length from 48 to 54 feet, and have expandable sides (expandos) to increase the interior "people" space. A ballpark figure of the weight for an empty trailer of this size is 40,000 lbs. Most trucks this size will end up approaching the bridge weight limit in the United States — 80,000 lbs. Generally, an analog truck could just make this weight, and still carry all its assigned equipment. SD digital trucks had a much harder time accomplishing the same feat. Many trucks today travel in tandem with utility trucks, or some of the operations or functions are off-loaded onto a secondary truck. Often this is graphics, or VTRs. Why? It just takes more stuff to do today's high-end remotes. Whereas a truck built 20 years ago might need 20 racks to house the needed equipment, an SD-SDI (serial digital interface — the official designation of a "digital" video signal) truck intended for network productions could need up to a dozen more racks. This obviously cuts into the people space, hence the single-, double- and even triple-expando trailers. The first expando sides came out the curb side of the trailer. Next, the second expandable segment of the trailer was the area where the monitor wall would be in a production compartment turned lengthwise. The third expando trailer area comes out the back of the truck.

Now comes the HD truck. An HD truck with similar capability to SD-SDI trucks could require 40 racks or more of equipment.

There are a number of other ways that this new excess in equipment makes itself known. Where your parents' trucks had rack-mounted equipment that would be in the 8000-pound range, today's truck might weight in at 10,000 lbs., and the HD-SDI truck could tip the scales at over 14,000 lbs. More equipment naturally requires more power. But digital SD and HD add an additional element. SD-SDI has a clock rate of 270MHz. HD-SDI has a clock rate of up to 1.458Gib/s. High clock rates tend to force equipment to run in high current conduction states a greater percentage of the time, which generally increases the power draw of that equipment. While an NTSC truck might consume 75 to 80kW of power under full operation, the comparable SD-SDI truck would require in excess of 90kW.

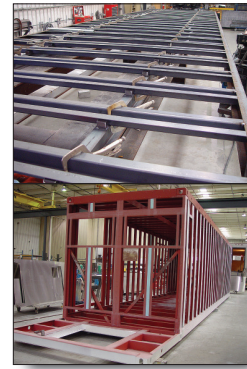


Figure 3.45 Large jigs hold cross members in place so that the top, bottom and sides of the trailer can be welded together into a complete frame. Once the walls are attached the electrical conduit is installed along with the expando drive unit, while the expando assembly is being fabricated separately. The trailer box is attached on top of the bogie assembly and a raised floor is installed throughout the trailer. After foam insulation is sprayed on the walls and roof, they have their lining installed.

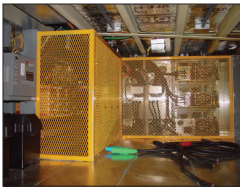


Figure 3.46 After the expando assembly is installed into the trailer and the belly storage bays are attached, construction of the power compartment assembly is started. Expando flip doors, and belly, personal and equipment access doors are built and installed.

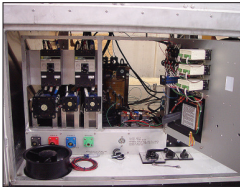


Figure 3.47 Breaker and power panel being assembled into the trailer.

The power requirements of the HD-SDI truck might be upwards of 130kW. Since an extremely small percentage of consumed power in any facility actually ends up as useful signals, the generated heat is considerably higher in SD-SDI and HD-SDI trucks. Whereas 10 tons of cooling capability would have sufficed for a truck 20 years ago, 15 tons would be prudent on the SD-SDI version, and 20 tons on the HD-SDI version. Environmental power, lights and air conditioning usually consume the bulk of the power. An HD truck's tech power would probably be around 50kW. The other +80kW would be to maintain the internal environment. These high current requirements mean that running the truck on single phase is no longer a viable option. Most new trucks will require three-phase service.

Building a truck indeed involves coping with a long list of engineering trade-offs. Many trade-offs are fairly clear, and will be dictated by the truck's intended use. But a number are not, as we saw in the section on powering the truck – for instance, to ground or not to ground. Subjective decisions that have to be grappled with include which way to orient the production compartment, and what the general layout of the truck should be. Often the intended customer(s) will express their desires and concerns early on, and these may not align with a truck that is suitable for general use.

Like many things, deciding where to begin can be a confusing part of the truck-building process. The television station, production company or truck vendor may wish to start with an engineering consultant — either someone on their staff or an outside expert. A good analogy would be consulting an architect before you hire a building contractor for your house.

Step 1 – Why a truck?

The first step in this process is to have a clearly defined purpose in mind before you begin talking to outside contractors. Will the truck be used mostly for sports, news, entertainment, post production, or all of these? In other words, does it have a primary purpose, such as in-house production needs? A TV station needing to cover all the home NBA games is a good example of this. Or is this a generic truck that will be marketed to outside program suppliers?

Step 2 — What do we need to put in the truck?

A large question that must be addressed before spending time and money on engineering is what equipment will this truck need. This simple question is, in fact, far more complex than it may appear at first. Part of the question relates to issues such as how many cameras, tape decks and monitors are needed. A parallel question is what format to use. Will this be an analog truck, an SD truck, an HD truck, or some sort of hybrid. The last options is most likely and perhaps necessary in the transitional world of today's broadcaster. The engineering contractor assists with these is-





Figure 3.48 As walls and ceilings are completed, electrical distribution is being wrapped up.

sues, but there will have to be a general idea of what direction the project is headed in before a consultant can be of much real assistance. Additionally, is the truck to be used only by a television station's crew or some other fixed crew, or mainly by freelance crews? If the latter, that may limit the equipment selection as freelancers live and die by their operation of the equipment. Equipment that is generally not found on trucks and not similar in operation to what the crew is used to might pose operational issues that usually end up giving the truck a bad reputation.

Step 3 – How big?

Next, the size of the truck will have to be determined. At this stage the equipment needed — number of cameras, VTRs, etc — to serve the truck's intended market is determined. A three-camera truck is not going to get much network sports work, and a 12-camera high-end trailer will have a hard time competing financially for local high school sports shoots. So is a 24-foot or 32-foot straight truck big enough for the need? Or will a rig of 42, 48, or 53 feet be needed? Is an expando desired or required? If so, how much of the truck will need to expand? Is a dual expando needed? The size and layout of the truck will depend not only on the amount of equipment in the truck, but also on the operational philosophy of the truck's owner and customers. It is not unheard of for a director to also do the video switching, maybe even run audio at the same time. That calls for a production compartment, or space laid out much differently than one where a TD, director, producer and a slew of production assistants are used during the show.

Step 4 – How much?

And finally: costs. Rough initial budget guidelines must be set before any contractor can provide meaningful help. It is important to match the needs with the budget in the early planning stages. There are huge differences in the costs of, say, a straight 32-foot truck and a 53-foot expando, even if you were to install exactly the same equipment in each. And those additional costs go far beyond the difference in price of the basic "box." Also worthy of consideration are the operating costs of the unit. Whereas the expando requires a tractor and CDL driver, the small straight truck needs no tractor, and may or may not need a CDL driver, depending on several factors.

So one of the uninitiated, who simply asks how much it costs to build a truck, is likely to get a response such as "Just how much does it cost to build 'a house'?" Of course, you need to know how many stories, how many rooms, carpet or hardwood, shades or drapes, brick or aluminum, and on and on.

Step 5 – Repeat steps 1 through 4

All the above factors are heavily interdependent. Several iterations of the above steps are required before you can build a truck within budget



that will serve its intended use. Vehicle type, size, equipment complement, layout, cost and schedule all have a major impact on each step in the process.

Step 6 — Determining the truck-building food chain

If the project has survived the first five steps, and many don't, it's time to begin looking at the contractor or contractors necessary to get the truck on the road. In the mobile world, there are four major "building blocks" to consider. These are ENGINEERING, MECHANICAL construction (which includes the body and all within), TECHNICAL construction and EQUIPMENT suppliers. There are companies or contractors that specialize in one, several or all of these building blocks. Now a decision is made as how to proceed. Many truck owners go the "turn-key" approach — that is, hire just one company to provide all services including financing. Others wish to control the individual portions of the project more closely. At least one mobile unit company manufactures their own units, other than the base trailer and HVAC unit. This decision is obviously based in large part on the level of expertise of the truck owner and whether they have the personnel willing and able to be involved with some or all of the four major areas. If so, another important question is, do they have the time available to devote to this project?

Let's take a moment and explore the four major contractor groups a little more closely from these two different perspectives: the turnkey approach and the individual contractor approach.

Turnkey Approach

In the turnkey approach, a full-service company is contacted, probably a fairly sizable corporation, and initial conversations are conducted between this firm and the client's in-house financiers, engineers and other tradespeople. Simple. The rest of the decisions that the truck owner will need to make will be brought to their attention by the turnkey contractor. Remember the BIG 4? Engineering, mechanical, technical and equipment will ALL be supplied by this one turnkey contractor. It's a fairly uncluttered way to go.

Non-Turnkey Approach

Engineering up front is the glue that binds a vehicle and a list of equipment into a useful production facility. In the individual contractor approach, the engineer or consultant is probably going to be the initial and primary contact for the project. Regardless of who builds the truck, or how, the importance of sound engineering cannot be overstated. In the end, the engineer — be it one of the staff or an outside contractor — will ultimately be responsible for the truck's proper operation. That person is the architect of the truck, and it is the engineer's job to make sure all the pieces fit together properly. The engineer(s) will have to individually select each of the contractors or suppliers. Even in the non-turnkey ap-



Figure 3.49 Images in the left hand column: Racks are installed and the necessary power to them is pulled. Some racks, as the second photo down demonstrates, will be on rails in the floor, so they can slide out of the way when the expando sections are slid back in for traveling. After the racks are installed, the air conditioning will be installed and wired in.



Figure 3.50 The truck or trailer is then primed and painted. Some manufacturers will paint the vehicle before the racks and inside finish is completed. Then any livery identifying the truck's owner, and often a major customer, is added.

proach, one contractor will often handle a couple of the areas, such as mechanical and technical construction, or engineering and technical construction, etc.

Step 7 — Building the box or trailer

The mechanical contractor is responsible for the trailer body and running gear, the environmental systems, power systems, racks, consoles, lighting, walls and floors — in short, the empty house. The engineering usually has begun and at least a rough floor plan has been developed before the mechanical contractor is brought in. The truck owner and engineers will need to go over every detail of the physical truck with this company. The idea is to make sure that equipment and the associated wiring are installed and that everything fits. Lighting needs to be over the consoles where it belongs. Switches should not end up inside racks. There needs to be enough power and cooling in the proper racks depending on what's in them. The power system needs to be large enough for the truck as presently conceived, and for the future. The racks need to be tall enough for what you plan to install. Raceways and conduits need to be installed where needed before walls and ceilings are closed up. These are all inputs that the mechanical contractor needs from engineering.

Step 8 — Turning that box or trailer into a production facility

The technical systems contractor will take the empty physical rack-ready truck and turn it into a television production truck by following the plans drawn up by the engineer(s). This contractor will begin by studying the engineering drawings and discussing the project with the engineers. This contractor actually makes the cables and cable harnesses, wires the patch panels, puts connectors on all the wiring, installs the wiring and equipment, and coordinates the entire installation process to get the truck out the door on time. This will also include what's known as 'commissioning' — making each piece of equipment and the entire unit as a whole work properly. This includes programming the routers, intercom, switchers, setting up distribution amplifier (DA) levels, etc. Testing on each and every wire and system will also be performed before the truck rolls out. There is usually a great deal of pressure on this contractor since, as the last link in the chain, he is expected to somehow make up all the delays to date from earlier steps. Allowing enough time up front in the project can make this contractor's job easier, and will usually end up providing a better built truck.

Any installation contractor will have stories about the 12-week project that had to be done in six because of accumulated delays, since opening



Figure 3.51 State of the art production trailer under construction. Foreground is tape compartment; in the distance is the production compartment's monitor wall.



Figure 3.52 To maximize operational space, equipment racks are often located along the trailer walls as much as possible. To access the rear of these racks, outside access panels are usually an integral part of trailer construction. As the close-up photos illustrate, cable installation and management can be an art in itself.

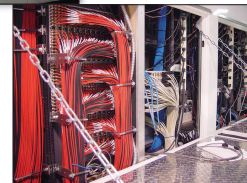




Figure 3.53 Equipment is installed and wired into a complete system. (Source: Core Digital Technologies/SWTV and Bennett Systems)

day at the ballpark won't wait. While the truck will probably get to the field for the first pitch, and not much before, the installation will be lower quality than the full 12-week build would have allowed. Often the "shakedown" crew won't know what was left out until they try to use it and find it's not there! Engineers like to point out that projects have three aspects that can be viewed as a triangle. These three sides are quality, cheap and quick. The mantra is that you can only have two, and often they are handed projects where one or two aspects have already been decided. ■

Cable Size and Weight

An interesting corollary is racked equipment weight vs. overall cable weight. They usually are very close to each other. On a truck it is imperative to eliminate any unnecessary weight. One way to do this is to use the lightest, and therefore usually the thinnest, cable possible. The trade-off is that thinner cable tends to have greater losses as a function of frequency. Thin coax for NTSC tended not to work, as it rolled the chroma off. It seemed to hit its stride with SD-SDI. It still tended to roll off higher frequencies much faster than lower frequencies, but the lengths used on trucks didn't cause the third harmonic in SD-SDI signals to attenuate to anywhere near problem levels. This is not so with HD-SDI. Whereas SD-SDI might travel 600 feet down minicoax with no problem, HD-SDI would be limited to 200 feet down the same coax. So, as far as trucks are concerned, the renaissance of minicable seems to be in the SD-SDI domain. As alluded to at the beginning of this paragraph, cable weights for NTSC, SD-SDI and HD-SDI trucks should be in the eight-, 10- and 14,000-pound ranges, in association with the weight of the racked equipment. Cable weight on an SD-SDI truck might break this rule due to the use of minicable.

Cable size found on the truck is not only dictated by the flavor of video coursing through it. Audio has similar problems. If AES-3 audio is used over twisted pair, it requires true 110-ohm cable. This is because AES audio pumps energy into its cables, comparable to NTSC video. Reflections at these frequencies become important. 110-ohm cable tends to be larger than 600-ohm cable. With analog audio, the upper frequency limit is typically 20kHz. Even if cable with the wrong impedance is used, the reflections are such a small percentage of the overall path length that they are not noticeable. But at AES frequencies they would cause problems. This means that AES requires the right impedance, and the use of larger-diameter cables. Therefore, AES audio adds to the cable weight and space used on the truck.



Figure 3.54 Video compartment of a truck under construction. Each large black knob represents iris and black level control of a camera. The panel between the controls for the eighth and ninth cameras allows for more detailed control and setup of any of the cameras.



Figure 3.55 Tape compartment of the truck in Figure 3.54 as it approaches the testing phase. The controllers on the desk control digital VTRs above. Why all the monitors? So operators can see the video inot each VTR, along with what each is feeding back out, plus all the sources available that can be selected to be fed into the VTRs.

Many Layers of Signals

Trucks can contain a number of layers of video and audio. Most trucks being built today, at least at the high end, are either SD or HD. But most digital trucks still have analog video running through them. Let's start by looking at the types of video in an HD truck. Although most sources will have an HD path through the truck, not all sources have HD outputs yet. Almost all have SD-SDI, so some sources will also need paths to an HD upconverter. Additionally, just because you have an HD truck, doesn't mean you won't still have SD customers. Therefore, many outputs of the truck will have to be downconverted back to SD. Converters are not cheap — they currently top out at over \$100K. Therefore you will find a limited number of these on a truck. This means that an SD digital router will be needed along with the HD router. A remote truck today can contain upwards of 150 monitors. Few of these usually need to be high quality evaluation monitors. So it often makes economic sense to use lower-priced monitors, often with analog inputs, for less critical applications. Since most HD and SD gear also has NTSC analog outputs, this infrastructure, complete with its own router, is usually desired. Surprisingly, the HD router matrix may be the smallest, and the NTSC router matrix may be the largest.

In some cases, NTSC waveform monitoring still makes sense. Many video operators still find that camera balance and matching are easier to perform using NTSC test equipment than either SD or HD digital component test equipment because baselines are easier to quantize. Plus, the NTSC test equipment is much cheaper. Generally, the only paths that are solely in the HD layer are those tangential to the production switcher, and DME/DVE.

The audio side of the truck undergoes a similar stratification. The main audio layer today is AES. But often a sizable analog audio layer is present. The two audio layers will generally each have their own routing matrices. A third level will probably evolve over time, as 5.1 surround sound (which requires six channels of audio) might have to be encoded into one, or two AES channels. Most VTRs today still accept only four separate audio feeds.

This leads us back to the video. If a network-distribution standard (network-to-affiliate feed) becomes dominant, this might extend back to the origination truck or the contribution feed, known as the "backhaul." This would mean an ATSC signal might need to emanate from and be processed on the truck. Add a machine control layer to the truck, and we have eight layers of signals, each probably requiring routing capability.



Figure 3.56 Equipment and cable are staged outside this trailer under construction awaiting installation. Also seen here are the trailer's complement of cameras, which will be tested as part of the overall system checkout. The closest camera facing away from the truck does not have a lens mounted on it yet.

