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PORTABLE NEWS MEDIA STUDIO

(CG4TV)

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PORTABLE NEWS MEDIA STUDIO

by

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Abstract

The Portable News Media Studio is a unit to be used in the future. This would serve as a temporary shelter during any type of emergency situation for a news team that is broadcasting on site. The unit would provide all the necessary elements for long term sustainability for the occupants. The unit would be able to broadcast from anywhere in the world as well as allowing the occupants to travel on any terrain in the world including land, sea, and snow. The power generated would all be self-provided and would be able to supply enough power for computers, a washing machine, lighting, broadcasting equipment, a waste treatment station, and any other utility in the unit that consumes electricity. Through research, various designs for the portable studio were developed. These designs encompass a range of necessities that would make the portable media studio feasible. Some of the necessities include portability, habitability, and sustainability, etc. This would be the best recommendation for any news station that wants to broadcast the world's most relevant news sources to a large audience.

Table of Contents

List of Figures

List of Tables

Acknowledgments

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Chapter 1 : IDEATION OF PORTABLE NEWS MEDIA STUDIO

1. Introduction

Natural disasters, wars, political campaigns, and national conflicts have become supreme influences as contributive sources for news coverage. In each circumstance, a news team travels to the destination in a company vehicle and is required to either reside in that vehicle or to expend payment for a temporary residence. In times of war or natural disaster, that temporary residence could become a dangerous or unstable dwelling for the crew delivering the breaking news. The proposed idea behind the portable news media studio would be a portable container that could withstand extreme environmental conditions while maintaining a constant stream of broadcasting quality to the public. The quality of broadcasting should not be influenced by the environmental surroundings by any means and the safety of the crew should always be high priority. The types of materials and components necessary for this endeavor are essential for the success of the portable news media studio.

Bulletproof materials might seem overkill for a news studio to contain in their facility, but in times of war where rampaging soldiers are firing sporadically near buildings, this could be a crucial factor of safety in the design. Another key element to the design of the portable news media studio, in order to maintain portability and comfort for the crew, is a portable wastewater treatment unit. This unit would be able to treat the waste from the personnel and convert it to a source for clean and reusable water. Along with personal comfort would be the private quarters that allow each member a place to relax during downtime. This portion of the container would need to guarantee that it would not occupy abundant space that would be

more suited toward the quality of the news production. The roles of shelter and water have been discussed which leaves the question of the supply of food to the crew. The food contained in the unit would have to be a type of ready to eat military ration because of the time span between uses of this building. The building may not be occupied for months at a time and therefore the food inside could be inactive for months as well. The need for ready to eat food is necessary for times where it is too dangerous for the crew to leave the building to gather other reserves.

When considering the three main necessities for the survival of the occupants for the portable news media studio, this could guarantee a successful new means of broadcasting global events from anywhere in the world. The studio would be able to reach the desired location by land, by sea, or by air due to the collapsibility and an approximate maximum weight of no more than 21,000 pounds intended for the design. From these task specifications, research was conducted on the types of materials needed to complete the project successfully. Chapter 2 of the report contains the research explaining the necessity for such an innovative idea. The information provides details on what types of technology is currently available and what technology was available in the past. Chapter 3 contains the equipment that would be implemented into the container and it also details the actual design of the container. The sections are broken down into features such as describing the living quarters, describing the gear found in the equipment bay, as well as many other components of the portable news container. Chapter 4 is the conclusion and describes the results expected from this project. The idea behind why this engineering design is necessary is discussed along with defending the ideas discussed in previous chapters.

Chapter 2 : RESEARCH

2. Introduction

In this chapter the research performed on the current broadcasting technology will be discussed in order to evaluate the need for a portable news studio. The current broadcasting technology can transmit media to many cellular phones, some personal digital assistants or PDAs, nearly all laptops with an internet connection, and a majority of television sets. The desire to constantly have breaking news transmitted to the community was another aspect in the ideation of the news media studio. The progression for how news was transmitted is discussed throughout this chapter.

2.1. Modern Progression of Streaming News

Considering other sources of news outside of the television news stations we can see that the need for information permeates everything we do. News websites like CNN, for example, can receive upwards of sixty seven million unique hits in a single day depending on the news (CNN). Similar statistics are also available for the other entire major broadcast news station websites across the board. In addition to these, mobile media is now generating a great deal of traffic with sites making specially designed sites to be viewed on smartphones so that people are constantly connected and constantly updated with the latest information. Currently, according to Internetusagestats.com there are almost two billion people connected to the internet and internet usage has grown an astounding 444% in the last ten years (Internet World Stats). Considering these statistics, it is clear that this type of mass media is going to be king in the near future and mass media studios are taking note. Visiting any of the major news

contributors' websites reveals that on a single page the user is able to view reports of a very large number of items at a single glance and these reports are updated frequently often faster than they are able to get on the air.

Mobile media is the latest trend which has to be considered when generating news. According to Admob.com, a leading company in advertising that uses its resources to generate statistics about mobile web stats, smartphone penetration is constantly growing and as such is a market that cannot be ignored when considering markets that have to be catered to when disseminating mass media (Admob.com). When considering the new mobile devices it is clear how important the media corporations take these devices. All of the large and many of the smaller news media companies have specific websites tailored to fit these mobile devices. The larger news corporations also have produced their own programs or "apps" for these mobile devices which link these devices to the media corporation directly and provide automatic updates for the user further showing how important the constant flow of information is to today's public.

While the dissemination of news has changed a great deal in recent history, generating the news has not. Reporters are still required to travel out to a hotspot and live in the residing conditions in order to be on the scene as soon as possible to generate the news that the public is so anxious to see. In cases like warzones, Iraq for instance, reporters are often staying in conditions that are dangerous and inhibit the reporter and crews attempt to be able to capture the news. Along with the people there is also all the equipment to consider. It is true that new technology is making it easier to broadcast from remote locations, but this technology is still in

its infancy as anyone who has seen a grainy video phone report from a remote location can attest to. By and large there is still a need for serious editing and mixing equipment in the form of computers to be able to make a legitimate broadcast that people will want to watch. This equipment requires power and a stable operating environment, neither of which is a guarantee in a lot of news generating hotspots. Take for example the recent earthquake in Haiti, with the city in ruins reporters flocked to the disaster scene to broadcast what had happened and the relief effort that was taking place. In the rush to get into Haiti the reporters were staying in unsafe locations subject to aftershocks and were constantly under increasing stress. This stress is often visible in the work done by the reporters as it is obvious when they are lacking sleep and feeling strained but are still required to present a news program that is going to grab the attention of the audience.

Reviewing the previously discussed topics shows that while our society strives for a constant flow of information even to the point of having access to such information at our fingertips, our ability to reliably produce and transmit data from such media hotpots has not kept pace. While new smartphones and better internet access are being introduced every day, news corporations are still dropping reporters into hotspots and having them stay in shanty shelters in a given area which in most cases lacks the necessary tools to reliably produce broadcast quality media.

2.2. Current Technology Used

Currently, there are two main types of vehicles that cover the capabilities that are needed for the portable news media studio. These vehicles are the mobile broadcast vehicles and off-road recreational vehicles. The mobile broadcast vehicles vary widely in their construction and use, depending on what type of news station they are working for and what news they are needed to cover. The mobile broadcast vans are all self-propelled vehicles and in some cases are towed behind a semi-truck. The mobile broadcasting vehicles, however, never have any accommodations for its crew leaving them to rely on local infrastructure for support. These vehicles are also not designed to deal with any sort of off-road terrain making accessing disaster sites nearly impossible.

The off road recreational vehicles have a form factor of a small box truck with large knobby tires and heavy duty suspension to allow them to cover extremely rough terrain while still offering the comforts of a recreational vehicle within the cargo box. These vehicles are specifically designed to go where most vehicles cannot and as such have a very robust construction and are often custom made units based off of a single chassis that has been extensively tested through years of actual sales and road use.

2.2.1. Mobile Broadcasting

Local news stations capitalize on the mobility of small broadcasting vehicles to cover relatively small distances and transmit the news back to their home station. These vehicles are generally limited in size to a full size van which is then filled with all the necessary video equipment to record and edit video and audio coming from a single reporter. These vans will generally carry support for a single camera and a single reporter with the possibility of one technician being brought along to mix and transmit their recordings. Inside this type of vehicle there would generally be two or three monitors attached to a mixing board with the appropriate input and output systems necessary to edit and mix the information incoming from the various sources. These vans do generally require that they have their own transmission systems in the form of a telescoping satellite dish seen in Figure 1. This is normally a requirement due to the fact that mobility is of primary concern for this broadcasting van and linking up with local infrastructure at every site they go to would not be a good use of time. Within a van of this nature are no facilities to support the crew for any length of time and the crew would be required to use local infrastructure for supply of food and lodging. The technology that the smaller mobile broadcasting vehicles make use of varies depending on the specific job it needs to deal with. Generally these vehicles have enough capability to service one crew and mix any video and audio that is necessary from a single source which can be seen in Figure 1.

Figure 1: Local News Broadcasting Van (Frontline Communications).

Larger scale news corporations have the ability to employ mobile broadcasting stations on a much larger scale. These much larger vehicles are sometimes housed in semi-trailers due to the amount of equipment held inside. These very sophisticated pieces of equipment are able to import, edit, and transmit just as well as a studio can but takes as many as 20 people to fully staff with reporters and technicians. The various equipment contained within this type of vehicle varies with the company, however they are all slightly similar. They all include a large number of displays to facilitate the editing of video as well as large mixing boards seen in Figure 2. These vehicles also carry their own on site digital storage so that they can save projects on site to be streamed out at a later time. Generally these vehicles do not carry their own satellite transmission systems rather this type of broadcasting vehicle tends to plug into local infrastructure for power and data transmission requirements. Although these trailers are much larger than their local news counterpart, they still are not meant to house the crew internally

for any length of time. The crew facilities inside a vehicle like this would be limited to sanitary facilities and that is all. The crew of this kind of vehicle is still completely dependent on the local infrastructure to support them. With this vehicle being towed behind a semi its usefulness for disaster deployment is very limited. This vehicle not only needs well maintained roads to travel on but roads and infrastructure capable of handling a semi-trailer which have a maximum government allowable weight of 80,000 pounds. This makes it impossible for this type of vehicle to travel over small bridges and on any sort of surface that is not paved adequately.

Figure 2: Broadcasting trailer interior (Gerling and Associates).

2.2.2. Large Scale Off-Road Vehicles

One of the main requirements of the portable news media studio is that it be able to reach environments that normal vehicles would not be able to get to. While there are no mobile broadcasting vehicles that fit this description there are however vehicles that are able to support people with adequate living facilities while at the same time being able to traverse very harsh environments. This type of off-road vehicle is generally built onto a modified box truck chassis with a proven reliable small diesel engine on it. In many cases inline four cylinder turbo charged diesel engines from manufacturers like Mercedes Benz or Cummins are used because of their proven durability (UNICAT). The portion of the vehicle designed for life support can vary widely from vehicle to vehicle due to the fact that these are mostly custom built units. There are however some similarities that can be seen from vehicle to vehicle and from those it is possible to get an idea of what is generally necessary. The Unicat off-road vehicle in Figure 3 can be seen traveling through a muddy river.

Figure 3: Unicat fording capabilities (UNICAT).

For life support within the large scale off-road vehicle there are a few items that are of high importance. These vehicles all share a common design for a kitchen. There is generally some sort of small ice box or very small refrigerator accompanied by a small butane or propane camping stove. All the other storage in this type of kitchen facility are arranged in such a way as to allow for minimum motion of loose items. All the necessary items must be able to be locked down so they do not become projectiles if the vehicle gets into a bad situation. This type of vehicle also contains a lavatory facility. These can be designed in many ways. Some may simply contain a porta-potty with a privacy curtain while some may contain actual self-contained units that are fully enclosed. These both offer their own advantages and disadvantages, one offers more privacy but requires an onboard tank, while the other offers minimum privacy but cleaning more often. The sleeping quarters of this type of vehicle are generally the easiest part

to design and are the most constant design from vehicle to vehicle seen in Figure 4 (UNICAT). In general these vehicles have beds that are elevated towards the roof of the unit or they have beds that are capable of folding up into the walls of the unit to conserve space.

Figure 4: Unicat interior (UNICAT).

The ability of these vehicles to pass over difficult terrain is the main purpose of the design of these vehicles. As such they are designed with robust drivetrain systems. Without exception they have four or six wheel drive allowing them the necessary grip to pass over loose terrain. The torque and horse power of the diesel engine makes sure they have the power necessary to move the bulk of the vehicle seen in Figure 5 traversing a rocky terrain (UNICAT). This type of vehicle is often outfitted with a snorkel attachment as well to make sure that it is capable of fording through streams and flooded roads without fear of flooding and ruining the engine. The large scale off-road vehicle also has storage space for the tools necessary to make all but the most severe repair jobs on site.

Figure 5: Unicat off-road capabilities (UNICAT).

Chapter 3 : PORTABLE NEWS MEDIA STUDIO

3. Introduction

The concept of the portable news media studio will need to include state-of-the-art equipment in order to properly accommodate the needs of the crew. The container would be separated into different sections including design studio, living quarters, and equipment bay/ garage. It would also include different types of vehicles depending on the type of environment that the reporting crew might be exposed to including heavy snow, flooding, mountainous, or desert conditions. The container should also be able to comfortably sustain up to seven crew members for multiple months. In order to create broadcast media of sufficient quality that will satisfy the global media, specific equipment is necessary. Most people that are familiar with news programs are familiar with the sweeping shots of the control rooms in broadcast stations which show all the people and equipment necessary to broadcast their program. The challenge here is identifying which pieces of equipment are necessities and which pieces of equipment that can be left out. Only the smallest and lightest pieces of equipment, that offer the highest quality digital operation are to be considered as weight is of the utmost importance for portability and for the integration of other systems.

3.1. Broadcasting Equipment

3.1.1. Cameras

Keeping in mind our need for light weight and portability, we can remove tapes from our list of necessary equipment. The technologies currently exist to record, edit, and transmit data all within the digital format. This will also have the effect of streamlining workflow and condensing the work area to a few computer stations. Broadcast quality cameras are available in abundance from large electronics corporations, for example Sony. For the requirements of the portable media studio a model like the Sony HDC1400R, shown in Figure 6 and Table 1 would work for several reasons. It is light weight, less than ten pounds, and it also records in 1080P high definition for the highest possible picture quality while having the output capabilities necessary to send video right to mixing stations without using tape (Sony). This camera will also run off AC or DC power giving the flexibility to work in a situation where the studio will be generating its own power. The camera would be used inside the studio for the most part and there would be a separate, smaller, portable camera that would be used out in the field.

Figure 6: Sony HDC1400R HDV Camcorder (Sony).

Table 1: HD1400R Spec Sheet (Sony).

Specifications

HDC-1000R/1400R/1450R/1500R/1550R Specifications

		HDC-1000R	HDC-1400R	HDC-1450R	HDC-1500R	HDC-1550R
General						
Power requirements		240 V AC, 1.7 A (max.), 180 V DC, 0.9 A (max.), 12 V DC, 10 A (max.)	240 V AC, 1.4 A (max.), 180 V DC, 1.0 A (max.), 12 V DC, 7 A (max.)	180 V DC, 1.0 A (max.), 12 V DC, 7 A (max.)	240 V AC, 1.4 A (max.), 180 V DC, 1.0 A (max.), 12 V DC, 7 A (max.)	180 V DC, 1.0 A (max.), 12 V DC, 7 A (max.)
Operating temperature		-4 °F to +113 °F (-20 °C to +45 °C)				
Storage temperature		-4 °F to +140 °F (-20 °C to +60 °C)				
Weight		46 lb 5 oz (21 kg)	9 lb 15 oz (4.5 kg)	10 lb 13 oz (4.9 kg)	9 lb 15 oz (4.5 kg)	10 lb 13 oz (4.9 kg)
Camera						
Pickup device		3-chip 2/3-inch type CCD				
Effective picture elements (H x V)		1920 x 1080				
Signal format		1080/50i, 59.94i, 23.98P, 24P, 25P, 29.97P 1080/50P*, 59.94P* 720/50P, 59.94P	1080/59.94i, 720/59.94P (for 60-Hz countries) 1080/50i, 720/50P (for 50-Hz countries)		1080/50i, 59.94i, 23.98P, 24P, 25P, 29.97P 1080/50P*, 59.94P* 720/50P, 59.94P	1080/50i, 59.94i, 23.98P, 24P, 25P, 29.97P 720/50P, 59.94P
Spectrum system		F1.4 prism system				
Lens mount		Sony bayonet mount	Sony bayonet mount			
Built-in filters	CC	A: CROSS, B: 3200K, C: 4300K, D: 6300K, E: 8000K	Electrical**		A: CROSS, B: 3200K, C: 4300K, D: 6300K, E: 8000K	
	ND	1: CLEAR, 2: 1/4ND, 3: 1/8ND, 4: 1/16ND, 5: 1/64ND	1: CLEAR, 2: 1/4ND, 3: 1/16ND, 4: 1/64ND, 5: CROSS		1: CLEAR, 2: 1/4ND, 3: 1/8ND, 4: 1/16ND, 5: 1/64ND	
Sensitivity (at 2000 lx, 3200K, 89.9% reflectance)		F10 (1080/59.94i), F11 (1080/50i)				
Signal-to-noise ratio (1080i, typical)		56 dB/64 dB (w/NS max.)				
Horizontal resolution (1080i)		1000 TV lines (at center)				
Shutter speed selection		1/100, 1/125, 1/250, 1/500, 1/1000, 1/2000 s (1080/59.94i) 1/60, 1/125, 1/250, 1/500, 1/1000, 1/2000 s (1080/50i)	1/100, 1/125, 1/250, 1/500, 1/1000, 1/2000 s (for 1080/59.94i, 60-Hz countries) 1/60, 1/125, 1/250, 1/500, 1/1000, 1/2000 s (for 1080/50i, 50-Hz countries)		1/100, 1/125, 1/250, 1/500, 1/1 000, 1/2000 s (1080/59.94i) 1/60, 1/125, 1/250, 1/500, 1/1000, 1/2000 s (1080/50i)	
Modulation depth (1080i, typical)		Y: 45% at 27.5 MHz (800 TV lines with typical lens), Pb/Pr: 80% at 12 MHz				
Input/output connectors						
Audio input (CH1)		XLR-3-pin (female) (1), mic or line selectable mic or line selectable				
Audio input (CH2)		XLR-3-pin (female) (1), AES/EBU or mic or line selectable		XLR-3-pin (female) (1), AES/EBU or mic or line selectable	XLR-3-pin (female) (1), mic or line selectable	
Mic 1 input		—	XLR-3-pin (female) (1)			
Return control input		6-pin (1)				
Prompter output/Genlock input/Return input		—	BNC type (1), 1.0 Vp-p, 75 Ω			
Prompter 1		BNC type (1), 1.0 Vp-p, 75 Ω	—			
Prompter 2		BNC type (1), 1.0 Vp-p, 75 Ω	—		BNC type (1), 1.0 Vp-p, 75 Ω	—
DC input		XLR-4-pin (1), 10.5 to 17 V DC				
DC output		4-pin (1), 10.5 to 17.5 V DC, 500 mA (max.)				
Test output		BNC type (1), 1.0 Vp-p, 75 Ω				
SDI 1 output (with embedded audio)		BNC type (1) HD-SDI	—		BNC type (1) HD-SDI	—
SDI 2 output (with embedded audio)		BNC type (1) HD-SDI or SD-SDI selectable	—		BNC type (1) HD-SDI or SD-SDI selectable	—
SDI output (with embedded audio)		—	BNC type (1) HD-SDI or SD-SDI selectable		—	BNC type (1) HD-SDI or SD-SDI selectable
Earphone output		—	Stereo minijack (1)			
CCU		Electro-optical connector (1)		—	Electro-optical connector (1)	—
HDCU/HDFX		—		Triax connector (1)	—	Triax connector (1)
Tracker		10-pin (1)				
Crane		12-pin (1)				
Intercom 1		XLR-5-pin (female) (1)				
Intercom 2		XLR-5-pin (female) (1)				
Remote		8-pin (1)				
Lens		36-pin (1)	12-pin (1)			
Viewfinder		D-sub 25-pin (1)	20-pin (1)			
Supplied accessories						
		Angle adjustment brackets (2), Front cover (1), Number plates for side panel (2 sets), Number plates for up-tally lamp (1 set), Cable clamp (2), Operation manual (1)	Operation manual (1), Switch label 1, 2 (1 each), Cable clamp belt (1 set)			

* 1080/59.94P and 1080/50P signals can be output only from the HDC-1000R/HDC-1500R camera head in a stand-alone configuration.
** CC optical filters are available with optional HKC-DF14

The portable camera used would possibly be a Sony HVRA1U HDV camcorder seen in Figure 7 and Table 2. This type of camera is extremely light weight and portable with a weight of less than two pounds. This camera would be able to record for up to 60 minutes of 1080P high definition video for the highest possible picture quality while having the output capabilities necessary to send video right to mixing stations only using a USB wire connection. This camera will also run off DC power or internal battery power giving the flexibility to record video in any news worthy location in the world (Sony). The camera would mainly be used outside the studio based on the ease of carrying the equipment.

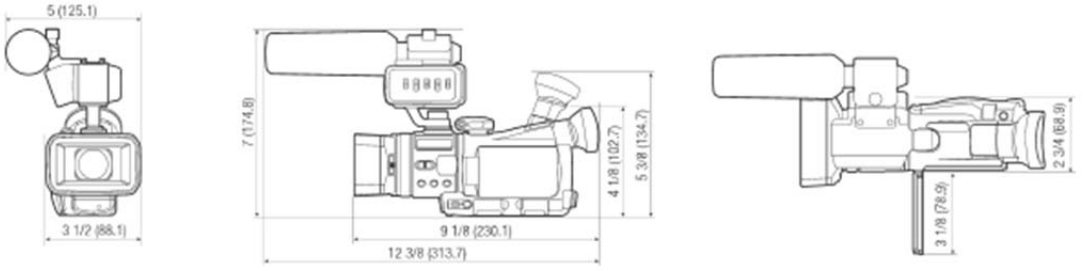
Figure 7: Sony HVRA1U Portable HDV Camcorder (Sony).

Table 2: HVRA1U Spec Sheet (Sony).

SPECIFICATIONS

Camera section		
Lens		Carl Zeiss Vario-Sonnar T* zoom lens, 10x (optical), f = 5.1 to 51 mm f = 40 to 400 mm in 16:9 mode and 49.3 to 493 mm in 4:3 mode (full scan mode on)* f = 41 to 480 mm in 16:9 mode and 50 to 590 mm in 4:3 mode (full scan mode off)* f = 40 to 400 mm in 16:9 mode and 37 to 370 mm in 4:3 mode (still picture mode)* f = 1.8 to 2.1, filter diameter: 37 mm
Focus		Auto, manual, spot focus (touch panel control)
Imaging device		1-chip, 1/3-inch type primary color CMOS sensor
Picture elements		Approx. 2,969,000 pixels (total)
Shutter speed		1/4, 1/8, 1/15, 1/30, 1/60, 1/90, 1/100, 1/125, 1/180, 1/250, 1/350, 1/500, 1/725, 1/1000, 1/1500, 1/2000, 1/3000, 1/4000, 1/6000, 1/10000 s
Minimum illumination		7 lx with F1.8
VTR section		
Recording format		1080i/50i, 480i/60i
Play out/Down conversion format		1080i/50i, 480i/60i, 480i/60P
Tape speed	HDV/DV SP	Max. 18.812 mm/s with PHDVM-63DM cassette
	DVCAM	Max. 28.218 mm/s with PHDVM-63DM cassette
Playback/Recording time	HDV/DV SP	Max. 63 min with PHDVM-63DM cassette
	DVCAM	Max. 41 min with PHDVM-63DM cassette
Fast forward/Rewind time		Approx. 2 min 40 s with PHDVM-63DM cassette (using a fully charged battery) Approx. 1 min 45 s with PHDVM-63DM cassette (using an AC adaptor)
Input/Output connectors		
Audio/Video output		A/V OUT jack, 10-pin connector Composite video: 1 Vp-p, 75 Ω unbalanced, sync negative Y: 1 Vp-p, 75 Ω unbalanced, sync negative C: 0.286 Vp-p, 75 Ω unbalanced Audio: 327 mV, input impedance more than 47 kΩ, output impedance less than 2.2 kΩ
Component video output		COMPONENT OUT jack Y: 1 Vp-p (0.3 V, sync negative), 75 Ω unbalanced Pr/Pb (Cr/Cb): 700 mVp-p (75% color bar)
HDV/DV input/output		i.LINK interface (IEEE 1394, 4-pin connector S100)
XLR audio input		XLR 3-pin female x 2, 327 mV, -60 dBu: 3 kΩ, +40 dBu: 10.8 kΩ, power supply: approx. 48 V
Headphone		Stereo minijack (Φ3.5 mm) x 1
MIC		Minijack x 1, 0.388 mV, low impedance with DC 2.5 to 3.0 V, output impedance 6.8 kΩ (Φ3.5 mm), stereo type
LANC		Stereo mini-minijack (Φ2.5 mm) x 1
USB		Mini-B x 1
Built-in input/output devices		
LCD viewfinder		0.44-inch type, approx. 252,000 (1120 x 225) pixels , hybrid type, 16:9 aspect ratio
LCD monitor		2.7-inch type, approx. 123,200 (560 x 220) pixels, hybrid type, 16:9 aspect ratio
Microphone		Stereo type, noise reduction on/off
Speaker		Φ16 mm
General		
Weight		Approx. 1 lb 7 oz (670 g) (camcorder only)
Power requirements		DC 7.2 V (battery pack), DC 8.4 V (AC adaptor)
Power consumption	HDV	Approx. 5.6 W (recording mode with LCD viewfinder on)
	DVCAM/DV	Approx. 5.1 W (recording mode with LCD viewfinder on)
Operating temperature		32 to 104 °F (0 to 40 °C)
Storage temperature		-4 to 140 °F (-20 to +60 °C)
Supplied accessories		AC-L15 AC adaptor, power code, NP-FM50 InfoLITHIUM rechargeable battery pack, lens hood with lens cover, RMT-831 wireless Remote Commander unit, A/V connecting cable with S video, component video cable, USB cable, Memory Stick Duo (16 MB), Memory Stick Duo adaptor, ECM-MV1 monaural electret condenser microphone, XLR audio adaptor, shoulder strap, operating instructions

* These values are calculated to be equivalent to the 35 mm film.



unit: inches (mm)

3.1.2. Microphones

The microphone, along with the video camera, is another piece of broadcasting equipment that is readily available from specific manufacturers. Just one example of a studio microphone that would fit the portable media studio would be the Sennheiser MD46, as seen in Figure 8 and Figure 9. Microphones of this type offer exceptional sound quality, minimum weight, and very little power usage (Sennheiser). Using a microphone of this type serves a dual purpose. They can be used in the portable media studio for media creation within the actual unit as well as being taken into the field. By using the same microphone for all aspects of the media studios operations some aspects of equipment usage and setup can be simplified.

Figure 8: Sennheiser MD46 Microphone (Sennheiser).

SENNHEISER

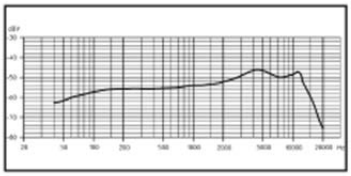
MD 46

MD 46 Handheld Dynamic ENG/EFP Microphone

Designed for audio journalists and field reporters, the Sennheiser MD 46 offers a host of advantages. Its extended frequency response provides clarity that exceeds any comparable mic in its class, and it's dimensions and weight ratio lend a completely comfortable feel. Add the fact that it's rugged enough to stand the strain of ENG/EFP, and you have a dynamic winner

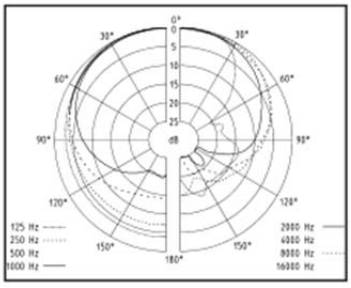
Features—Benefits

- Rugged all metal body
- Extremely low sensitivity to handling noise
- Very insensitive to pop and wind noise
- Uniform frequency response
- Excellent sound quality
- Integral microphone clamp thread



Technical Data

Acoustic principle	pressure gradient transducer
Frequency response	40–18,000 Hz
Pick-up pattern	cardioid
Rejection at 1 kHz at 180 degrees	>20dB
Sensitivity at 1kHz	2.0mV/Pa+-2.5dB (= - 54dB mit 0dB=1V/Pa)
	(= - 74dB mit 0dB=1V/ubar) (USA)
Nominal impedance at 1kHz	350 Ω
Min. terminating impedance	1000 Ω
Magnetic field at 50 Hz	<=1uV/uT
Dimensions in inches	1.92 x 9.84
Weight	12.7oz



Optional Accessories

Table stand	MZT 100
Microphone clamp	MZQ 800
Foam windsheild	MZW 65Pro (velour foam), MZW 4032 (w/ ID color bands) MZW 5000 (w/ ID color bands) MZW 1

Architect's Specifications

Cardioid reporter's microphone, frequency response 40–18,000 Hz, sensitivity (free field, no load) 1.8 mV/Pa ± 2.5 dB at 1 kHz, nominal impedance 200 Ω, min. terminating impedance 200 Ω, dimensions 11.92 x 9.84 inches, weight approx. 12.7oz.

Figure 9: MD46 Spec Sheet (Sennheiser).

3.1.3. Mixing Studio

One of the more difficult aspects of designing a portable media studio is making sure all the necessary input and output sources are connected in the appropriate order. Normally within a broadcast studio there are racks of audio and video mixing equipment connected to many arrays of monitors to facilitate quick and meaningful editing. For the portable media studio much of this equipment is not necessary. Considering the size and application of the studio there will only be need to mix two cameras from the internal studio source with possibly two more cameras attached to reporters in the field. With this in mind a mixer comparable to the NewTekTV Tricaster, as seen in Figure 10, Table 3, and Figure 11, fulfills the requirements of the studio almost perfectly. The unit is very small, 4U rack mount, and comes bundled with software necessary to mix multiple inputs on one screen (NewTek).

Figure 10: NewTek TriCaster Studio Portable Live Production (NewTek).

Table 3: TriCaster Spec Sheet (NewTek).

TRICASTER SPECIFICATIONS			
Price	$8,995 Multi-standard US$10,995	**Weight**	19 lbs.
Dimensions	17.5” D x 8.5” H x 10.4” W	**Recording Capacity**	20 Hours MPEG-2
Video Input	6 Y/C 6 Composite (BNC) 6 Component (BNC)	**Audio Input**	4 Balanced Mic/Line Inputs (XLR or phone)
Video Output	2 Y/C 2 Composite (BNC) 2 Component (BNC)	**Audio Output**	2 Balanced Line Outs (phone) 2 Unbalanced Line Outs (RCA) 1 Stereo Headphone Out
Video Ingest	1, 4-pin IEEE FireWire® 1, 6-pin IEEE FireWire®	**Tally**	6 Tally Light Connections
iVGA™ Network Import	Yes – 3 inputs	**iVGA™ Input**	Shift Between 3 iVGA Client Displays
Virtual Set Support	Yes; virtual sets included	**Integrated Character Generator**	Yes
On-screen ISO Preview Monitors	3-cam ISO previews or 6-cam shared preview	**16:9 Video Support**	Yes
Projector Output	Yes; 4:3 and 16:9 aspects	**Projector Resolutions**	XGA, SXGA, QSXGA and higher; DVI and analog outputs
Camera Auto-Calibration	Yes	**Live Web Casting**	Yes; push or pull Windows Media with VC-1 and Flash streaming support
16:9 streaming	Yes	**Recorder**	Simultaneous MPEG-2 + WMV records
DDR Playback	2 DDRs, with alpha channel assignable to downstream key	**Mic Inputs**	4 balanced (XLR or phone)
Line Inputs	4 XLR/phone[1]	**Line Outputs**	2 balanced phone; 2 RCA
Preview Out	No	**Vectorscope**	Yes
Waveform Monitor	Yes	**Phantom Power**	Yes
Nonlinear Editor	Yes	**Upstream Effects**	Yes
File Formats	AVI, DV, MPEG-2, QuickTime, HDV, JPG, PNG, and more ...	**Render Outputs**	AVI, DV, MPEG-2, DVD, QuickTime, MP4 (iPod and PSP)
Accessory Options	TriCaster™ LC-11, TimeWarp™, LiveText™	**Power Consumption**	90 watts / 307 BTUs per hour

System Configuration for Optical Fiber Operation

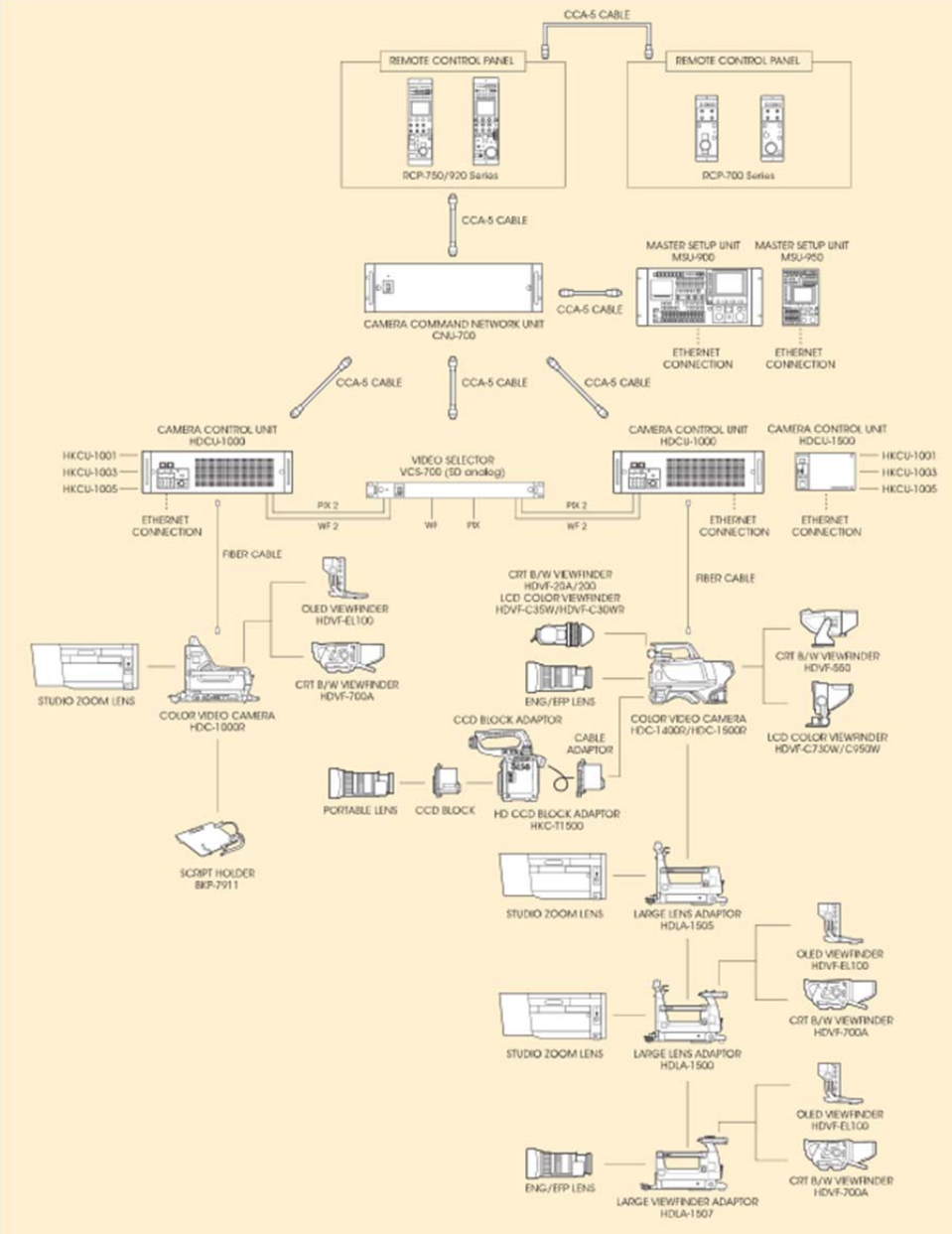


Figure 11: Wiring Layout (NewTek).

3.1.4. Computers

The computer setup for the portable media studio will be the backbone of its production potential. Due to the fact that the entire audio and video recording and editing process will be digital, raw computing power will be king for the media studio. With this in mind a single rack mounted server setup would be the best for this application. The rack will allow for any scalability that is necessary while providing the multiple CPU processing power that is needed to quickly edit high quality video, shown in Figure 12. With such a high power server virtualization becomes possible meaning that one user can be working on what are essentially four or five separate computers. This is advantageous because all the projects no longer take place in one single computer instead they each have their own resource allocation as directed by the server which will in turn be able to provide higher system resources to projects of a higher priority. The rack server's main drawback is that of power requirement. This will be the single largest power draw for the entire studio outside of life support capabilities and as such will employ the latest power conserving software and hardware utilities in order to maximize its power use while deployed. The other benefit to the rack mount system is that other equipment, such as the data transmission system, which will be shown next also fit into the rack unit form factor which aids in saving space in the media studio (TecLYNK).

Figure 12: Array of Computers Typically used in Studio (TecLYNK).

3.1.5. Data Transmission

The final, and possibly most important part of the portable media studio is the ability to keep in contact with the outside world. When the studio is deployed, the only way for it to contact the outside world is by satellite, seen in Figure 13. There is simply no other way to guarantee communication from remote operation zones. Communicating by satellite allows the portable media studio the ability to transmit large quantities of data at high speed to anywhere on Earth. In order to transmit the data generated by the studio certain special equipment will be necessary. Specifically, the portable media studio will need a dish to transmit and receive data and the electronic equipment to generate the signal necessary for satellite communication. For the purposes of the media studio the Integrated Multiple Antenna Terminal Electronics system or IMATE from Narda Satellite Networks or a similar system would be ideal, as seen in Figure 14 and Table 4. The system is small taking up only a few units of a rack mount server set. The rack would already be in place in the media studio because the computer system would be mounted within the same rack. The rack mount form factor allows for extremely easy integration into the portable media studios electronic system. The IMATE as a single unit allows for incoming data to be formatted and transmitted by satellite quickly and easily with a minimum of equipment. The system also includes a dish which for our purposes also works due to their portable, fold up design that would allow for easy deployment and packaging if quick movements were necessary.

Figure 13: Broadcasting Satellite Dish (Narda Satellite Networks).

Figure 14: IMATE System Broadcasting Controls (Narda Satellite Networks).

Table 4: IMATE Spec Sheet (Narda Satellite Networks).

Narda Satellite Networks

IMATE

INTEGRATED MULTIPLE ANTENNA TERMINAL ELECTRONICS

Environmental Conditions

Temperature:
- Operating: -30°C to +55°C
- Non-Operating: -40°C to +60°C

Wind – Antenna dependant:
- FTSAT: Steady-state 25 mph, 40 mph anchored
- HWA: 45 mph with gusts to 60 mph
- 3.9 LMAA: Steady- state 25 mph (un-anchored) with gusts up to 40 mph (anchored)

Shock:
MIL-STD-810F, Method 516.5

Vibration:
Normal rigors of loading, transport and unloading from vehicles, helicopter, military and commercial aircraft, rail and ship without damage.

Sand and Dust:
Dust particles up to 149 µm @ 0.3 g/ft3 at 10 mph, sand particles from 150 µm to 850 µm @ 0.033 g/ft3 up to 40 mph

Humidity:
10% to 90% non-condensing

Rain (operating): 2 inches per hour with 25 mph wind

Altitude (Feet):
- Operating: 8,000 ft
- Non-Operating: 40,000 ft

Physical Characteristics:
- Configuration: one 9U transit case (not including antenna interface kit)
- Weight: (total) approx. 205 lbs
- Storage Space: 22.17" W x 41.50" L x19.84"H

Options:
- Data Collection Unit and Laptop (CMA)
- Trak Microwave Modular Time/Code Processor (Stratum-1)
- FDMA and TDMA modems
- L-Band Spectrum Analyzer
- Test translator

Electrical Specifications

IMATE 3.9M LMAA

Parameter	C-BAND	X-BAND	KU-BAND	KA-BAND	UNITS
Transmit Frequencies	5.850 to 6.650	7.900 to 8.400	13.750 to 14.500	30.000 to 31.000	GHz
Receive Frequencies	3.400 to 4.200	7.250 to 7.750	10.950 to 12.750	20.000 to 21.200	GHz
G/T	21.3	25.5	29.0	31.5	dB/°K
EIRP	67.5	71.0	74.5	75.5	dBW

IMATE 2.4M HWA

Parameter	C-BAND	X-BAND	KU-BAND	KA-BAND	UNITS
Transmit Frequencies	5.850 to 6.650	7.90 to 8.40	13.75 to 14.50	30.00 to 31.0	GHz
Receive Frequencies	3.400 to 4.200	7.25 to 7.75	10.95 to 12.75	20.2 to 21.2	GHz
G/T	18.5	22.00	25.0	27.0	dB/°K
EIRP (Linear)	61.5	67.0	66.5	68.0	dBW

IMATE AN/USC-60A 2.4M Antenna

Parameter	C-BAND	X-BAND	KU-BAND	KA-BAND	UNITS
Transmit Frequencies	5.850 to 6.425	7.90 to 8.40	14.0 to 14.50	N/A	GHz
Receive Frequencies	3.625 to 4.200	7.25 to 7.75	10.95 to 12.75	N/A	GHz
G/T	18.8	21.7	26.0	N/A	dB/°K
EIRP (Linear)	61.5	67.0	66.5	N/A	dBW

3.2. Design Studio

One of the hallmarks of today's broadcast news is the professional manner in which the new is presented. For news to be credible in the eyes of the viewers it must be presented in a believable fashion. Part of this requires that the set where the news is being broadcast from gives the viewer that air of professionalism which they desire to see from respectable news sources. This also pertains to the mixing of the video and audio effects present during the broadcast. Whether it be background music or fade effects from story to story all must be carried out in a professional crowd pleasing way. To that end, using the computing power that will already be in place in the portable media studio, here are some solutions to the problem of creating professional work on site.

3.2.1. Virtual Set

The first thing most viewers see as they turn on the new broadcast is the set at which the anchor sits. The portable media studio simply does not have the space or extra weight capacity available to add in a professional looking studio from which they can broadcast their stories. In order to overcome this we will be looking to virtual sets like those from CG4TV Animation studios shown in Figure 15. This company specializes in virtual sets that can be added in to the news broadcast on the fly or during post production (CG4TV). This allows for the news anchor to be sitting in what will essentially be a small room with lights and cameras to appear as though they were in a large studio. This will add the extra professionalism and realism to the stories that are broadcast from the portable media studio.

Figure 15: Concept of Virtual Studio (CG4TV.COM)

3.2.2. Mixing, Editing, and Sound Room

In addition to providing a presentable appearance the studio must also be able to provide clear audio and video that could be mixed to studio quality standards. To do this the portable media studio must have its own editing room for audio and video. This will be the same room where the computer rack is located in order to save space in the whole unit. Within the room there will be two workstations that are linked to the server to provide for the necessary computing power and there will be as many screens as necessary to complete the appropriate work. To facilitate the editing process without the need of the large editing rooms that studios have, the portable media studio will make use of the software that comes with Tricaster Studio as described above. This software, seen in Figure 16, allows for a complete suite of editing and mixing tools to be made available to the engineer on one computer screen so that mixing and editing can be performed quickly, onsite, with a minimal need of extra equipment.

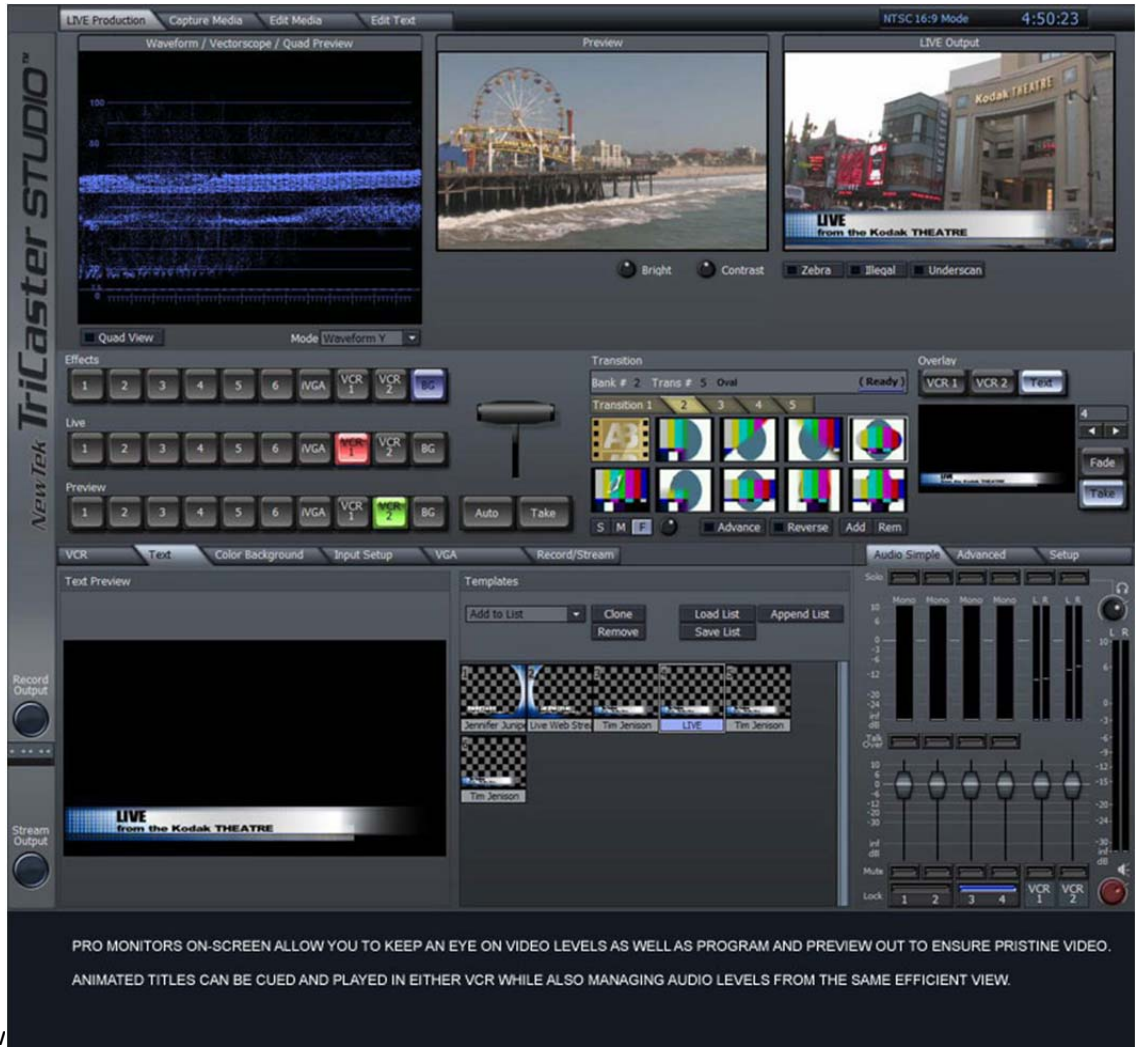


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Figure 16: TriCaster Studio User Interface (NewTek).

3.3. Living Quarters

One of the main functions of the portable news media studio is to serve as a shelter to the residing news crew. The unit should be capable of housing the crew comfortably and also still serve as a functional broadcasting environment. The sectioning of the unit would be divided into four sections being the editing room, broadcasting room, the living quarters, and the equipment bay, which would be the largest of the three sections. The reason for the equipment bay/ garage being the largest of the three sections in the unit is because it needs to be able to house a water treatment system, all the vehicles required, the engine and generator, and the water supply piping.

3.3.1. Sleeping Arrangements

The sleeping arrangements for the portable news media studio would need to include enough space to comfortably fit a maximum of two camera operators, two news reporters, two video/ sound engineers, and possibly a supervisor or managerial personnel. The maximum number of occupants at any time would be seven and the minimum number would be three because the minimum required personnel to create a news report is one reporter, one camera person, and a video/ sound engineer for mixing and editing. The sleeping quarters would have to contain bunk beds that are either bolted to the floor or walls, or bunk beds that are collapsible since the portable unit should have interior objects secured making it safe for travel. The collapsible bunk beds, one is shown in Figure 17 and the closed position is shown in Figure 18, could easily be folded and strapped to the wall as well as the mattresses when the unit is in transit to the next location (LiftCo). The width of the portable media studio unit is about ten

feet wide so four bunk beds could be arranged and fit in the unit for the maximum of seven crew members.

Figure 17: A Collapsible Bunk Bed Rack (LiftCo).

Figure 18: Collapsible Bunk Bed Closed Position (LiftCo).

3.3.2. Washroom

The washroom where the crew can get cleaned up would be directly beside the sleeping arrangements. This area would contain one to two showers and one to two toilets which should be a sufficient capacity. The privacy of the restroom would be much like the privacy in a public restroom. There would not be a maid or janitor available to clean up any area inside the unit and so would rely fully on the crew to keep it sanitary. The water would be piped in from the treated water filtration system located in the equipment bay which produces water acceptable by EPA standards (Clark). Figure 19 shows an approximate view of the bathroom stalls with the doors removed so that the concept could be viewed easier. The figure also depicts only one of the stalls not all of the stalls positioned as they would finally stand in the portable unit. The idea is that the washroom would take up as little space as possible because it is also to house the laundry room.

Figure 19: Conceptual Layout of Washroom (UNICAT).

3.3.3. Laundry Room

The laundry room would be located inside the washroom and would include only one washing unit. This unit is very compact and would be able to handle small loads of laundry at a time. The necessity for the laundry machine is again to keep the news crew comfortable and clean at all times. The crew could possibly spend many months inside this unit and not only does hygiene affect the health of the news crew but it could start to affect the quality of the broadcasts. Keeping this in mind, the washroom and laundry room were deemed a necessity for this portable news media studio concept. The Wonder Wash mini washing machine shown in Figure 20 is hand operated and is capable of washing a 5lb load in 1.5 minutes, using only water and detergent (Laundry Alternative). This would be adequate due to the number of occupants that the unit could house. The countertop spin dryer made by the same company seen in Figure 21, Laundry Alternatives does use a small amount of power to spin the cloth at 1600 rpm to remove excess water and the total load weight is only 2.2lbs, so multiple units will need to be added to the studio to meet supply (Laundry Alternative). The countertop spin dryer does not remove all the water like a tumble style dryer but it removes most of the water which could later be air dried.

Figure 20: Mini Washing Machine (Laundry Alternative).

Figure 21: Mini Countertop Spin Dryer (Laundry Alternative).

3.3.4. Food Locker

The food locker would be the equivalent to a kitchen since the unit has no use of a full kitchen. The locker would be able to hold four to six packs of ready-to-eat meals or any other snack that the crew may want. The food would be supplied by Epicenter Supplies who make a ready to eat meal pack. The packs are called a SURE-PAK 12 pack of fully prepared meals displayed in Figure 22 which are designed with the intent of being an emergency food reserve system. These packs would be stored in a food locker that would be rigidly secured to the unit. The food packages also do not require any refrigeration whatsoever. These packs have the nickname M.R.E. which stands for Meal-Ready-To-Eat. The pack depicted on Figure 22 includes 12 main courses, 12 sides, 12 dessert packs, 12 crackers, 12 spreads, 12 beverages, and 12 coffees. The food in these packs are rated to be able to last 5-7 years at room temperature which is more than enough time to store in this portable studio unit (Epicenter Supplies LLC). The reason for the long life is because the food is cooked in a flexible triple-layered, sealed foil pouch, which locks the foods natural flavors and nutrients in for at least 3 years. The military has been using this type of ready meal for over 30 years and they have a reputation for being a reliable product (Epicenter Supplies LLC). The food locker would be stored in the equipment bay because of the restrictions on the space available in the unit. The equipment bay/ garage would have the most space available for storage and would be able to perfectly fit a food locker in one of the unused corners preferably adjacent to the entrance so the crew would not have to walk far into the equipment bay.

Figure 22: A 12 Pack of MRE (Epicenter Supplies LLC).

3.4. Equipment Bay/ Garage

The equipment bay/ garage is the foundation for housing the important and expensive mechanical equipment. The specific equipment that would be placed inside this designated area is the IMATE control system, the food locker, the waste treatment and water supply systems, a Polaris ranger four seater or a set of snowmobiles depending on the terrain, and an inflatable boat. All of this equipment will be necessary for the complete and proper broadcasting during any emergency or warfare. Each system is required for the safety and health of the occupants and should not be regarded as a luxury item.

3.4.1. Waste Treatment/ Water Supply

The waste treatment system is one of the most important aspects of the portable unit. This instrument was developed by the Texas Research Institute for Environmental Studies (TRIES) at Sam Houston State University. The system developed is highly portable and is able to convert wastewater into acceptable EPA standards within a 24-48 hour period. The full scale unit is able to treat wastewater from up to 600 people per day (Clark). Since there will only be roughly three to four occupants at a time, a smaller scaled model could be used. This unit is originally forty feet long which is undesirable, but if TRIES were contacted about miniaturizing the product it is assumed that it would be possible. The unit is completely autonomous and can be diagnosed, monitored, and controlled from the Internet which would be perfect for this type of project since the crew is surrounded by computers (Clark). The unit would serve as the wastewater treatment plant and be able to supply the clean water back to the crew. The average American is said to use roughly one hundred gallons of water per day in their home. The portable waste treatment system would be able to handle this amount of water

consumption with ease. An illustration of the waste treatment system is shown in Figure 23 and should be remembered that this is a full size, 40 foot long unit that would not be imbedded into the portable news media studio as seen. The final waste treatment would have to be scaled so that it still functions properly but that it does not use up all the available space since this news studio is required to be moved by the use of a flatbed truck, or Chinook, or cargo ship, etc.

Figure 23: The Waste Treatment Plant (Clark).

3.4.2. Personal Transportation

Personal transportation for the crew will also serve an important role in the portability of the news media studio. Since the crew will be residing inside the unit at all times and will be moved around the world, they will need a way to reach the destination to film the news source. The climate and environmental conditions could range from being in a desert one month to a mountainous region the next month. Keeping this in mind, a broad range of vehicles was considered to be included in the portable news media studio. All of the vehicles will be stored in the equipment bay and will be considered the garage even though these are the same regions of the unit.

3.4.2.1. Polaris Ranger Four Seater

The Polaris Ranger 800 Crew is a utility vehicle that would serve as the main vehicle for transporting the news crew to any land based destination. This piece of equipment is equipped with an 800 Twin EFI engine providing 40 HP with a top speed of 46 mph. It can also automatically account and adjust for different altitudes which would be beneficial for traveling around the world. The suspension system is an adjustable front and rear dual A-arm providing a ground clearance of 11.5 inches which allows this vehicle to cross any terrain imaginable. The Polaris Ranger 800 Crew is also capable of seating 6 and is designed to handle a payload of 1,750 pounds, and a towing capacity of 2,000 pounds (Polaris). Most importantly, this vehicle is equipped with on-demand true all-wheel drive and can revert back to 2-wheel drive when the vehicle needs to. The Polaris Ranger 800 Crew seen in Figure 24 would serve perfectly as the main utility vehicle for arriving at any news worthy location while also allowing for a speedy retreat from a hostile environment. The Polaris Ranger 800 Crew can also be equipped with a

relay station and a small generator. The relay station would transmit the live video feeds back to the portable studio reducing the reliance on memory cards, unless there is a transmission problem, either due to weather or equipment which then the memory cards could be utilized again. The generator would ensure that the equipment transported to the location will ways have a power source whether the batteries are full or not.

Figure 24: The Polaris Ranger 800 Crew AWD Vehicle (Polaris).

3.4.2.2. Snowmobiles

Snowmobiles might sound like a vehicle for fun and games when the crew is not reporting news, but this vehicle is in fact essential for mountainous terrain or snowy conditions. The Polaris 600 IQ WideTrak Snowmobile features durable steel construction that can also comfortably carry two occupants on a single vehicle. This snowmobile also contains under seat storage which could allow the camera crew to either shoot video while riding on the back or be able to house the camcorders below. Two snowmobiles would need to be purchased so that if both news casters have to head toward the source then both camera men could follow as well. The snowmobile, shown in Figure 25 could be driven in a blizzard instead of driving the Polaris Ranger, although the Ranger could also be used if necessary. The mountainous terrain would be a lot safer if the crew had a snowmobile that could handle deep snow and windy tree covered paths. The Polaris brand snowmobile is able to hold 14.3 gallons and has a cleanfire injection fuel system which allows for higher mileage (Polaris).

Figure 25: Polaris 600 IQ WideTrak Snowmobile (Polaris).

3.4.2.3. Inflatable Boat

An inflatable boat would be necessary for any kind of situation where a large body of water or some flooding is involved. The inflatable boat would be best because it would be able to be folded up when not in use. The boat could also have an electric motor attached to the back as seen in Figure 26. The boat is large enough to fit all of the crew members if necessary. The largest motor that this inflatable boat could handle is a 3.5 HP (Quality Adventure LLC). The boat seen in Figure 27 is composed of a polyvinyl chlorine plastic that is resistant to gasoline, oil, and salt water making it perfect in any hazardous situation. The material thickness is 30 gauge and an air pump and aluminum oars are included. This boat could easily be deflated when the scouting and reporting has concluded and then inflated again when needed. The boat also has a high resistance to abrasive damage, impact damage, and damage from sunlight (Quality Adventure LLC).

Figure 26: Detachable Outboard Motor (Quality Adventure LLC).

Figure 27: Inflatable Excursion Boat (Quality Adventure LLC).

3.5. Hazardous Environmental Materials

Due to the nature of the work the portable media studio will be deployed to cover, there will be a need for it to withstand very harsh environments. The whole idea behind the media studio is the ability to be placed in situations that are normally very difficult for the normal reporter and crew team and to make that experience easier while they relay the important information. With that in mind if the unit is to be placed into a warzone it will need to be able to provide adequate protection to the occupants inside. It is not necessary for the unit to be armed as this is not a military installation, however seeing as warzones are unpredictable the unit should be able to provide the crew protection from small arms fire and possible small explosions. In addition to the hazards of warzones we must also consider the hazards of weather in the construction of the portable media studio. The main concern here is extreme cold. In order to be able to deploy the unit to those places where the extreme cold is an issue an insulation scheme will be necessary to provide those inside as well as the equipment protection from arctic temperatures.

3.5.1. Bulletproof Glass and Walls

Keeping the crew of the portable media studio safe is of paramount importance wherever the unit may be deployed. To that end, in certain situations, bulletproofing may be necessary. It is all too common in today's headlines to see news coming from areas of intense hostility. If the portable media studio were to be deployed to such an area it would be expected that it would be able to provide adequate protection to those inside. With this in mind there would need to be some sort of bulletproofing added to the media studio in order to provide this protection. Total Security Solutions provides a line of bulletproof fiberglass seen in Figure 28 that would provide the necessary protection while also being light weight and easy to implement. The fiberglass comes in four by eight sheets which makes it easy to insert into walls in addition to being approximately three pounds per square foot it is light enough for the unit to maintain portability (Total Security Solutions, Inc.).

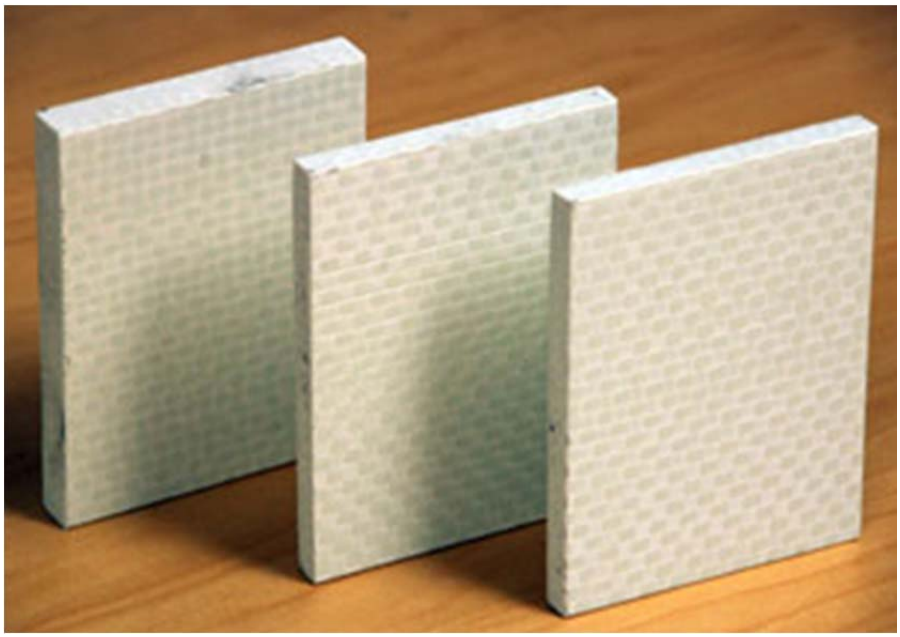

Figure 28: Bulletproof Material (Total Security Solutions, Inc.).

3.5.2. Insulation

Being able to keep the unit safe from extreme heat and cold is also of high importance. Portability being the hallmark of the portable media studio implies that the unit will be able to be deployed to any environment. With that in mind an insulation strategy has to be in place so that the unit can cope with whatever the current temperatures are in the current deployment zone. Adding insulation to the walls of a unit like this, as is commonly done to houses, is not an option. The walls of the unit are not thick as a common house and any additional space will be reserved for bulletproofing as mentioned above. Keeping these restrictions in mind the only other feasible way to adequately insulate the entire unit is to encapsulate it in an inflatable building. Inflatable buildings, like the one unveiled by NASA, National Science Foundation and ILC Dover shown in Figure 29 would be able to be attached to the top of the portable media studio and, when inflated, encapsulate the entire unit. This will give a buffer between the hazardous outside conditions and the unit (NASA). This buffer would pick up the ambient heat being produced by the portable media studios own heating devices allowing for what is essentially a giant insulation buffer that will shield the unit from any hazardous outside conditions while still allowing enough space for a prep area where they can setup any equipment they need outside without being totally exposed to the elements. The generator or any other equipment that emits CO_2 as a byproduct will need to have the exhaust ports piped directly outside, similar to what is currently done in garages.

Figure 29: The Inflatable Insulation (NASA).

3.6. Power Supply

3.6.1. Power Usage Estimate

One of the main design considerations as well as a bottleneck with anything portable idea is generating power. Power consumption from portable devices whether it is an mp3 player, computer, or media studio needs to be addressed as well as minimized since it is a limited resource. The power requirements can be estimated very similarly to a mobile home. Looking at the mobile media studio as a mobile home, the power consumption was estimated to be around 10kW assuming that everything is running at the same time shown in

Table 5 (Energy Information Administration). Producing such an output of power for long durations will require a large generator and large quantity of fuel, which in turn means more weight will be added to the studio. In order to reduce the weight of the studio's power plant, the energy consumption first needs to be reduced. One easy and efficient way is to use LED light bulbs rather than incandescent bulbs. C. Crane Company provides such a bulb which uses only 7 watts rather than the 60 watts required by conventional bulbs (Wikipedia). One other method to reducing the power consumption is to install appliances with an Energy Star rating. In general products with the Energy Star label save 20% to 30% in energy (Wikipedia). One other method of significantly reducing power consumption is to reduce the use of an electrical water heater. Using a closed loop solar water heater as depicted on Figure 30, the time in which the water heater is on is significantly reduced (U.S. Department of Energy).

Table 5: Power Consumption Estimate (Energy Information Administration).

ITEM	WATT	QTY	ITEM	WATT	QTY
Coffee Maker	800.0	1.0	Satellite Dish	30.0	1.0
Microwave	1000.0	1.0	Light Bulbs CFL	25.0	5.0
Gbg. Disposal	450.0	1.0	Fridge	2000.0	1.0
Desktop	150.0	4.0	Large Heating / Cooling	1440.0	1.0
Printer	100.0	1.0	TriCaster Studio	90.0	2.0
Laptop	50.0	4.0	Stereo	80.3	1.0
TV 19"	70.0	2.0	Water Heater	2552.0	1.0
TV 32"	150.0	1.0	Misc. Items	200.0	1.0
VCR	40.0	1.0			
CB Radio	5.0	1.0			
TOTAL:			9232 WATTS		

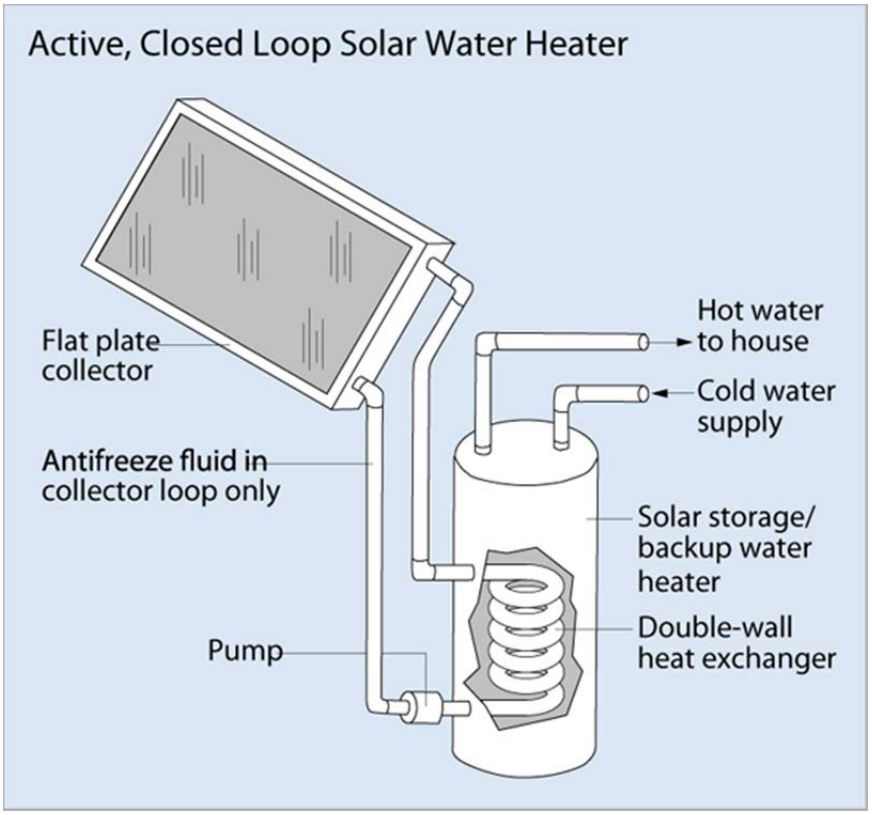

Figure 30: Closed Loop Solar Water Heater (U.S. Department of Energy).

An even better way to save energy and still have hot water is to have an instant or tank-less water system as shown in Figure 31. This system heats the water on demand. Some draw backs to this is that there is a flow limit of about 2-5 gallons per minute. This flow limit can be seen as a good thing when water supplied is limited in remote locations (U.S. Department of Energy).

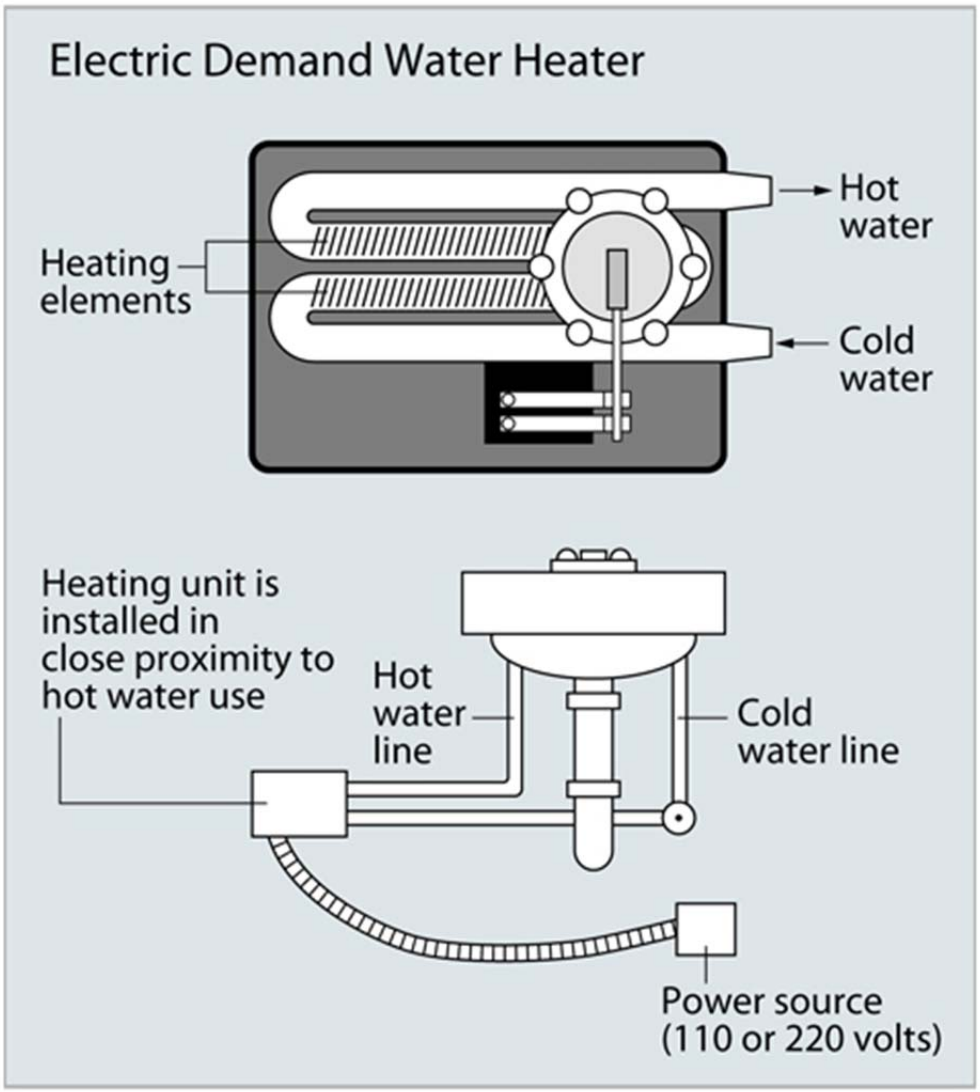

Figure 31: Tank-less Water Heater (U.S. Department of Energy).

3.6.2. Power Source

Providing energy to power the appliances in the mobile studio is a big concern. It needs to be reliable and efficient since gas and other fuels will be very limited. One solution is to make the mobile studio a hybrid. Like many cars on the market, two different types of fuel will power the studio. A conventional gas generator and solar panels will be sufficient to power the studio. The solar panels will reduce the use of the gas generator during the day where consumption of energy is expected to be high. The generator needs to provide at least 10kW of power while being small and quiet. An example of such a generator is the Generac 5871 Guardian Series seen in Figure 32 (CPO Generac). It is small enough that it fits atop of the studio and with a foam-lined housing it considerably reduces the noise inside.

Figure 32: Generac 10kW Generator (CPO Generac).

The solar panels do not need to produce as much power as the generator itself, it is mostly used to reduce the use of the generator. Evergreensolar has a variety of models that produce 220W per panel. The ES-E series panel shown in Figure 33 is about 5.5 feet by 3 feet by 2 inches thick and only weighs 43 pounds (Evergreensolar). The solar panels can also be used in junction with the vehicle that it uses for transportation.

Figure 33: Evergreensolar ES-E Series Solar Panel (Evergreensolar)

One other source that would be a great benefit to the media studio is the cyclone engine. This engine uses any type of fuel from conventional gas, diesel, and ethanol to the less conventional fuels like trash. The heat from combustion creates steam which then drives a radial set of pistons. The steam is used not only to drive the piston but also lubricate the system, eliminating a lot of the maintenance. The system is a closed loop system seen in Figure 34 which means that the liquid does not need to be topped off or replaced. This engine can be used to perform very important functions. The first function is that it can be used to drive a generator thus supply power for the studio and the second function is that it can be used as a trash incinerator reducing the size of storage for trash. The engine comes in many power ranges from 5kW to 1MW (Cyclone Power Technologies).

Figure 34: Cyclone Engine (Cyclone Power Technologies).

3.7. Transportation/ Moving

3.7.1. Air

Reaching the desired location for the news is vital. If the location cannot be reached, the news cannot be produced. On some occasion the location cannot be reached due to adverse weather and terrain or hostiles in the area. The only method of reaching the desired location is by air. Only a few aircraft have the capability of lifting such a heavy load. For long distances the studio can be airlifted to a nearby airport or remote runway. This can be achieved by using a C-130 Hercules seen in Figure 35 manufactured by Lockheed Martin Aeronautical Company. The C-130 has been in production since 1956. One of the reasons this is a great aircraft for long hauls is that its maximum cargo weight is 42,000 pounds since we estimate that the studio will only weigh half that. The aircraft also contains a loading ramp located in the aft of the aircraft, making loading and unloading an ease. The C130J-30 maximum cargo length is 55 feet, allowing the studio to fit properly inside (U.S. Air Force).

Figure 35: U.S.A.F. C-130 Hercules (U.S. Air Force)

For short range transportation or transportation to remote locations where the terrain makes it impossible for a landing strip or roads the CH-47, or Chinook, is the best candidate to get the job done. The CH-47 seen in Figure 36 was first introduced in 1962 by Boeing Rotorcraft Systems. The CH-47 is capable of lifting 26,000 pounds, externally mounted to its underbelly, allowing plenty of space inside for the crew (United States Army). The CH-47 was originally designed for military use but civilian models have now emerged.

Figure 36: Chinook CH-47 (United States Army).

3.7.2. Land and Sea

Negotiating over land or water will be the most common method of transportation. Portability is a key part in order to make the mobile media studio useful, for that reason the studio was chosen to be something that can be transported easily without any special equipment. The portable news media studio will be built into a standard shipping container, making it very easy to transport from one point to another using a standard truck. An example of such a truck is the Peterbuilt 388 shown in Figure 37. It is capable of hauling a load far heavier than the estimated weight of the studio with a maximum load capacity of over 50,000 lbs., depending on the wheel configuration. It also contains a bed and other accommodations in the back of the cab, further increasing the capacity for the crew. Transporting the studio would be just as easy as transporting a common trailer due to its commonly used frame and attachment points (Peterbuilt Motor Company).

Figure 37: Peterbuilt 388 (Peterbuilt Motor Company).

Due to the construction of the studio, which is based on a common shipping container, the studio can be easily placed on a barge or for long journeys the trailer can be placed on a cargo ship. This method is not the fastest way to do trans-Atlantic journeys but if a studio needs to be placed prior to the event such as the Olympics or some other international occurrences, the cargo ship should be a cheap alternative to air travel. An example of such a cargo ship, shown in Figure 38, would be a Panamax ship used to deliver hundreds of thousands of tons across the world.

Figure 38: Panamax Cargo Ships (NOAA)

3.8. Internal Layout

The internal design of the Portable News Media Studio will be compartmentalized to keep certain sections of the unit separate from others. This is done to increase crew comfort while allowing work to be done in other parts of the unit unimpeded. The unit itself, being based off of a 48 ft. standard shipping container, is large enough to have separate spaces for working and living for long duration missions. The four main compartments are the editing space, the recording space, living space, and engineering space seen in Figure 39. These four compartments being completely separate from one another allow the unit to be in operation 24 hours a day. The crew can be sleeping in one area while there are recordings being done in another or there can be editing and transmitting done at the same time as recording.

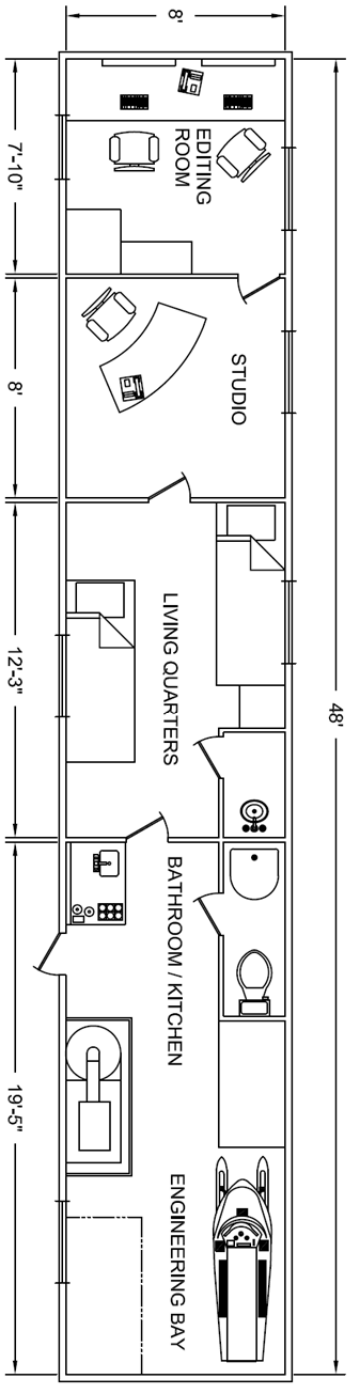

Figure 39: Interior Layout.

3.8.1. Editing Room

The editing room, as the name would suggest, is where all the video and audio editing is handled for any media that is brought into the unit. This area is located at the forward end of the unit and is large enough to allow for two people to work simultaneously as seen in Figure 40. This space is also where data transmission is handled so once created, the media can be quickly transmitted off to the home station. This work space is also home to the computer systems that power the entire media studio. Having the computer system in the same area as the technicians working on the media or transmissions allows them easier access in case they require direct contact with the hardware. In addition the broadcasting equipment will be in the same room which will allow the crew to link up with their home network and transmit any necessary data.

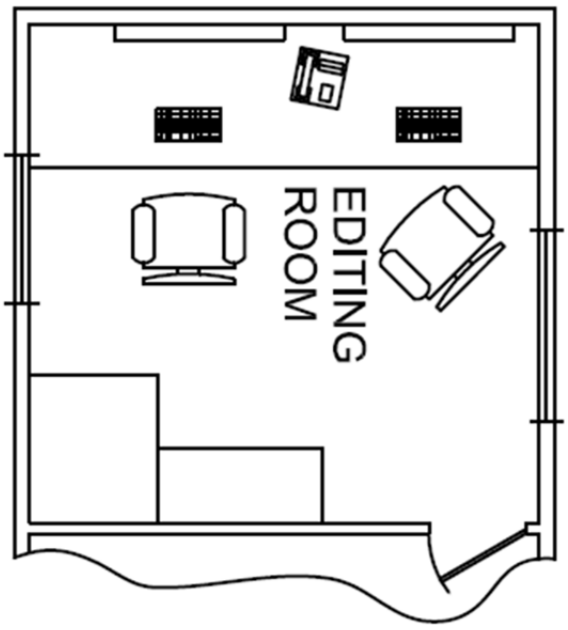

Figure 40: Portable Studio - Editing Room.

3.8.2. Recording Room

The recording room is the area of the unit designed to handle all in studio recordings of media. This section is fully wired for sound and video and will make use of the virtual set to enhance the physical appearance of the room. The physical location of the recording room is between the editing space and the living space in the forward half of the vehicle. This area will also have the greatest sound insulation capabilities of any space in the container so that the recording done here will not have any background noise from a given location where the portable media studio may be located. Within the recording room will be a desk or table for the reporters to sit at as well as camera equipment for the technicians to use seen in Figure 41. The recording room will also have sets of track lighting in order to allow for the appropriate lighting setup when recording news or other types of media. The recording room will have a direct wired link to the editing room so that any recordings being done will be sent right to the main server for the portable news media studio and from there they can be either broadcast out immediately for live broadcasting, or stored and edited later. There will also be space for another person to sit in case the crew would like to interview someone in a more professional setting instead of out in the field.

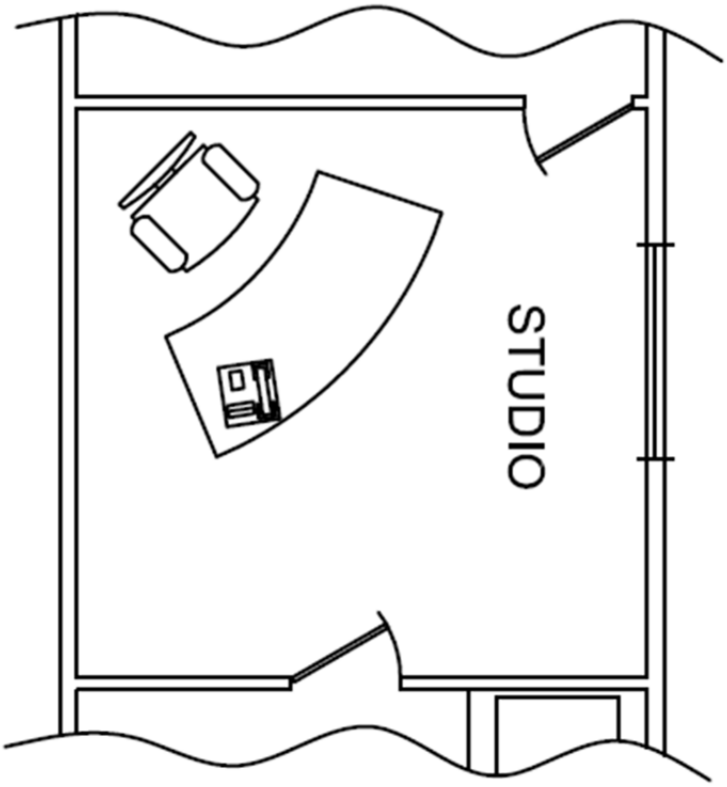

Figure 41: Portable Studio - Recording Studio.

3.8.3. Living Space

The living space of the portable news media studio will hold all of the necessary implements for sleeping, eating, sanitation and personal storage in the unit. In this space all sleeping equipment will be in the form of bunk beds to utilize the limited space. Personal storage in the floor will be available here as well as lockers for easier access on the other side of the room. This section will have the greatest need in the way of HVAC and water and in order to fit the necessary infrastructure the actual internal volume will be lower than the other rooms. Within the superstructure of this section of the unit there will also be significant insulation as to protect the crew from any environmental hazards that may be present. This area also contains the sanitary facilities for the crew which consists of a marine style toilet and shower system as explained earlier. In terms of physical location this space will be located between the recording room and the engineering space which puts it basically in the middle of the unit seen in Figure 42.

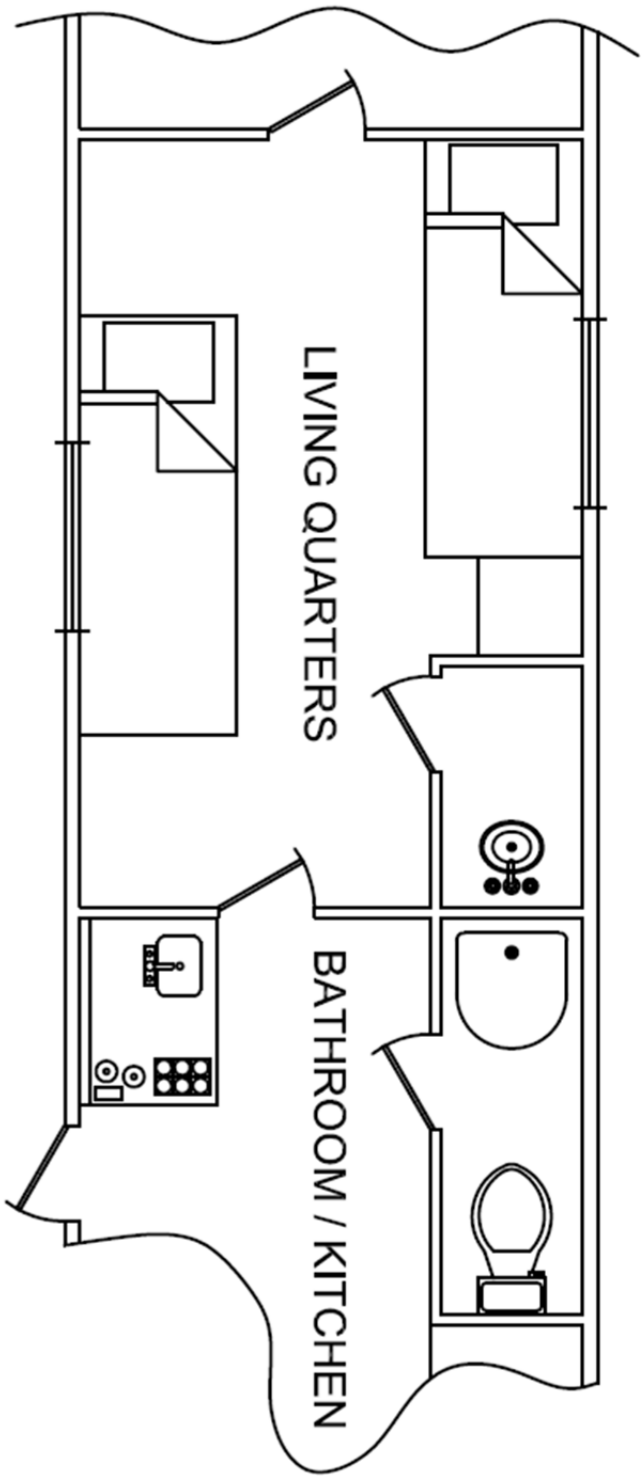

Figure 42: Portable Studio - Living Arrangements.

3.8.4. Engineering Space

The engineering space, also known as the equipment bay/ garage, is the heart of the portable news media studio. It is the equipment held in this space that allows the unit to stay out for extended periods of time. In the engineering space all tanks for potable water and fuel as well as necessary pumping equipment for these tanks are stored. A section of this area is also devoted to tools with its own work bench in case specific pieces of the unit need to be worked on. This is of particular importance as the unit will need to be self-sufficient and be able to fix as many of its own problems as possible without outside intervention. Also contained within this section is the personal transportation vehicles which will allow the crew to cover a much larger area than they would normally be able to if they were only on foot, or in case of emergency allow them to evacuate the area. In this section of the portable news media also resides the HVAC system which is responsible for heating or cooling the entire unit. One of the main reasons for separating this section the way it is was for safety purposes. In case the unit is placed in a hostile environment, all combustible fluids will be stored in this part of the vehicle with the wall between the crew living space and the engineering space being heavily reinforced and insulated to guard against possible fire hazards or explosions. This section, due to the equipment held within is also the largest section of the entire unit and takes up the entire back end seen in Figure 43.

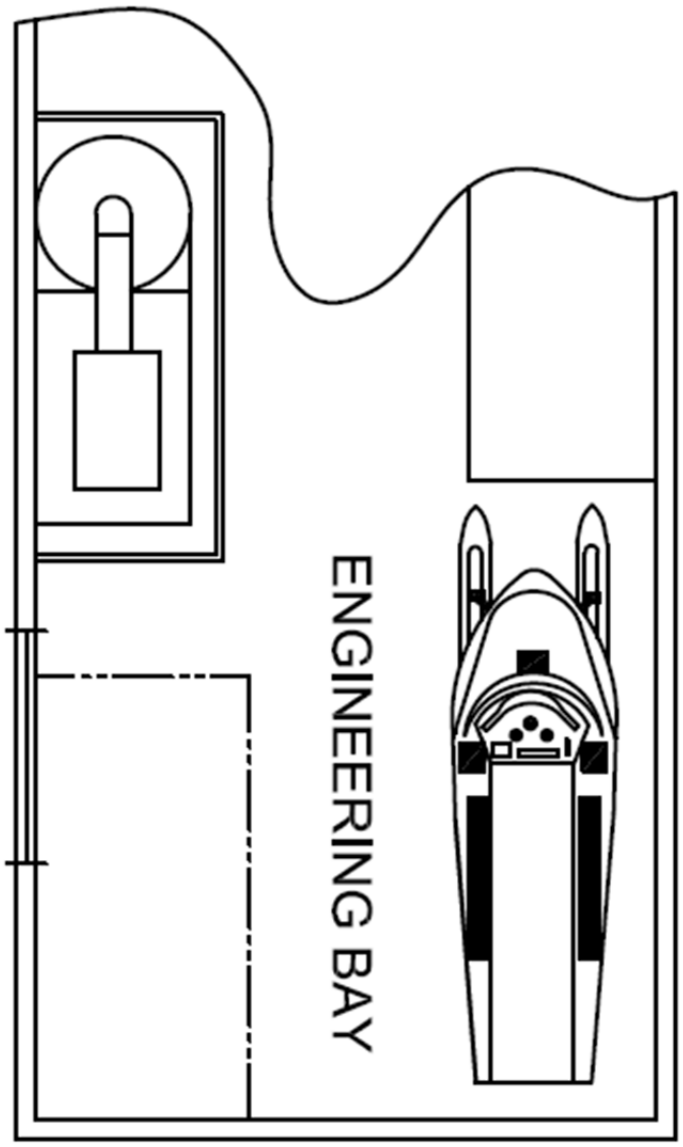

Figure 43: Portable Studio - Engineering Bay.

3.9. Alternative Layout

The current design of the Portable News Media Studio is setup in such a way that allows for extended deployments. In light of this fact it has to be large enough to supports the crew for long periods of time without external support. This however is not the only way that the Portable News Media Studio can be designed. In the interest of portability it could be redesigned so that it is slightly less self-sufficient while being a lot smaller and easier to transport. By taking the equipment out of the engineering space and building it into the floor and walls of the unit it is possible to shrink the physical profile to less than 30 feet long.

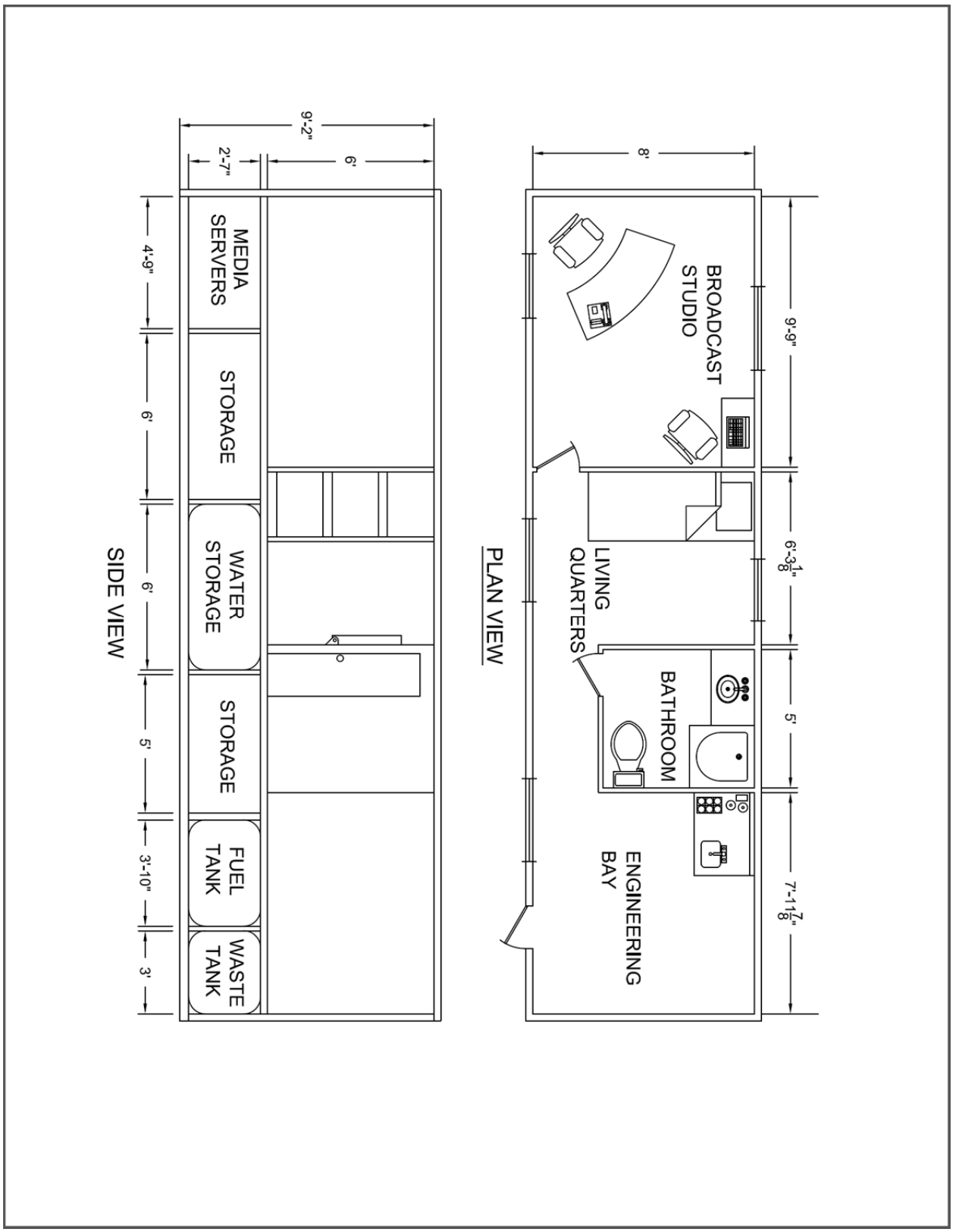

Figure 44: Smaller Version of Portable Studio.

3.9.1. Physical Specifications

The dimensions of the smaller Portable News Media Studio will be approximately 29.5 feet long, 8 feet wide, and 9 feet high as shown in the above image. This is considerably smaller than the original design and also will save a considerable amount of overall weight on the entire unit. This reduction in weight and overall dimensions will make the unit considerably easier to transport by both land based vehicle and airborne transportation systems. This makes the whole system more plausible especially when considering the system will be expected to be deployed to remote and dangerous areas. All of the major sources of weight for this unit will also be distributed throughout the floor of the unit, distributing the weight much more evenly than the larger unit which also adds to the ease of transportation.

3.9.2. Internal Layout

The internal layout of the smaller Portable News Media Studio is considerably different from the larger model. The separate editing space from the original unit has been removed completely in favor of the use of laptops that can link with the built-in server system that now resides in the floor. The engineering space of the larger model has also been reduced drastically. This has been done by removing all storage and fluid tanks and placing them into the floor of the unit which has been raised up approximately three feet in order to accommodate the extra space. The result of the raised floor is considerably less internal volume which could make life in the unit slightly less comfortable for individuals that are of considerable height. However, this reduction in volume is necessary when considering the overall advantage of the smaller size that was achieved.

The living quarters of the smaller media studio have also been reduced drastically. This is partly due to the fact that with the smaller unit we would expect to be carrying a crew that is reduced by two people. This reduces the necessary sleeping and storage space that is needed to support the crew, as well as reducing necessary potable water storage and waste water storage as well. The living space also makes use of the new storage spaces contained within the flooring in order store the necessary food and supplies needed by the crew that was previously stored in more accessible overhead compartments.

3.9.3. Systems Integration

The reason the unit can be downsized in such a manner is through systems integration. Where the larger unit used separate spaces for all the major systems the smaller unit will integrate these systems into the walls and superstructure of the housing. This will allow entire rooms to be eliminated at the cost of shrinking the internal volume that the larger unit has to work with. By thickening the walls and floor it is possible to run more systems through them. For example all of the fluid holding tanks will now be installed in the floors as well as all necessary piping and pumping equipment. This removes a huge volume of material from what would have been the engineering space and at the same time improves weight distribution of the entire system by spreading the fluid tanks through the bottom of the container. This same idea can be applied to the computer system. Where as in the larger unit the computer systems were setup for easy access and upgradeability, now they will be installed into the floors and walls of the unit. While this limits the access to the computer systems it basically eliminates the need for an editing room. Instead of traditional work stations the crew can use a laptop from anywhere in the unit and link with the main server to handle any large editing needs. Power and HVAC needs will be moved to the roof of the unit with all necessary plumbing going through the walls that have been thickened to handle the extra hardware. With the engineering space and editing space gone from the original unit the overall length has been dropped by almost 18.5 feet going from a large 48 feet to a more manageable 29.5 feet. This reduction in length has been achieved with a minimal operational impact.

3.9.4. News Media Uplink

One of the main concerns of today's news media is connectivity. Today, all major news branches end up feeding off each other as they fight to break stories first and get on scene faster than the next. With this in mind the Portable News Media Studio can be set up to act as a distribution hub of sorts so that all the major news corporations can access the material that it is recording. If for instance, the Portable News Media Studio is owned by one news corporation it can setup the built in server to allow pay-per-transfer access to the information contained within it. Each of the major news corporations can have their own login information as well as account access information so login and data transfer can be tracked from the owning corporation. It can also be locked down if the owning news corporation wishes to have the news exclusively. This can also be handled in a similar way if the Portable News Media Studio was owned by a separate entity. If the goal of the owning corporation is just to sell information then this type of system would work well do to its automation and the ease of which account access can be tracked. In the same way these units can be setup to be leased to a given corporation and have the account access turned on for a given corporation and turned off for all others so that the owning corporation's sole responsibility is setup and transit and the rest falls to the news corporation that wishes to rent the unit.

Chapter 4 : CONCLUSION

The Portable News Media Studio is truly a unit that should be integrated in the future. It would provide shelter, food, sanitation, and water for a crew sent in to cover a given event. It would treat the wastewater created by the crew and be able to recycle the water back into the unit meeting the EPA standard for drinking which is highly desirable. The unit would be able to broadcast from anywhere in the world as well as allowing the occupants to travel on any possible terrain in the world. The power generation would be done onsite by systems inside the unit and would be able to supply enough power to maintain computers, lighting, broadcasting equipment, waste treatment station, and any other utility in the unit that consumes electricity. For concerns regarding the overall size of the unit an alternative design has also been presented that has a smaller overall footprint. This would be the best recommendation for any news station that wants to broadcast the world's most relevant news sources to a large audience. It would be able to comfortably accommodate the crew as well as produce a broadcast that appears to be at the highest professional standards.

REFERENCES

Admob.com. Admob Mobile Metrics Report. February 2010. 23 April 2011 <http://metrics.admob.com/wp-content/uploads/2010/03/AdMob-Mobile-Metrics-Feb-10.pdf>.

CG4TV. Custom Design 3D Virtual Sets in Standard and Hi Def Resolution . 2011. 16 03 2011 <http://3danimation.e-spaces.com/virtualsets.html>.

—. Royalty Free Virtual Set Library. 2011. 16 03 2011 <http://www.cg4tv.com/virtual-set>.

Clark, Emily. Gizmag. 16 11 2008. 16 03 2011 <http://www.gizmag.com/new-technology-for-portable-wastewater-treatment-unveiled/10364/>.

CNN. CNN Press Room. 04 April 2011. 23 04 2011 <http://cnnpressroom.blogs.cnn.com/2011/04/04/cnn-com-sets-global-records-for-japan-coverage/>.

CPO Generac. Generac 5871 Guardian Series. n.d. 11 03 2011 <http://www.cpogenerac.com/generac-5871-guardian-series-air-cooled-10kw-120-240-volt-single-phase-steel-residential-generator-with-ez-transfer-switch/grcn5871,default,pd.html?start=5&cgid=generac-guardian-standby-generators>.

Cyclone Power Technologies. Technical FAQ. 2009. 16 03 2011 <http://www.cyclonepower.com/faq.html>.

Energy Information Administration. Electricity Consumption by End Use in U.S. Households, 2001 . n.d. <http://www.eia.doe.gov/emeu/reps/enduse/er01_us_tab1.html>.

Epicenter Supplies LLC. MRE's, MREs, Military Meals Ready to Eat and Other Shelf-Stable Emergency Food Supplies. n.d. 16 03 2011 <http://theepicenter.com/mre_military_meal_ready_to_eat.html>.

Evergreensolar. n.d. 10 03 2011 <http://evergreensolar.com/en/view-panels/>.

Frontline Communications. Broadcast. 2011. 23 April 2011 <http://www.frontlinecomm.com/broadcast.cfm>.

Gerling and Associates. Production Trailers. n.d. 23 April 2011 <http://www.gerlinggroup.com/index.php/products/broadcast-tv/television-production/emperor-expanding>.

Internet World Stats. INTERNET USAGE STATISTICS. 2010. 16 03 2011 <http://www.internetworldstats.com/stats.htm>.

Laundry Alternative. Portable, Mini Washing Machine. 2009. 23 April 2011 <http://www.laundry-alternative.com/categories.htm>.

LiftCo. Bed Systems. 2005. 23 April 2011 <http://www.liftcoinc.com/?page=beds&title=Beds&level=2>.

Narda Satellite Networks. IMATE. n.d. 16 03 2011 <http://www.nardamicrowave.com/satellite/pdf/IMATE-OSR_1-21-10.pdf>.

NASA. Partnership News. 2008. 8 March 2011 <http://www.sti.nasa.gov/tto/Spinoff2008/partnership_1.html>.

NewTek. TriCaster Studio. 2011. 16 03 2011 <http://www.newtek.com/tricaster/tricaster_studio.php>.

NOAA. The National Oceanic and Atmospheric Administration Photo Library - America's Coastlines/West Coast. 30 September 2009. 13 March 2011 <http://www.photolib.noaa.gov/htmls/line0534.htm>.

Peterbuilt Motor Company. Model 388. n.d. 14 March 2011 <http://www.peterbilt.com/trad388.1.aspx>.

Polaris. 600 IQ WideTrak. 2011. 16 03 2011 <http://www.polarisindustries.com/en-us/snowmobiles/2012/utility/600-iq-widetrak/pages/features.aspx>.

—. Ranger 800 Crew. 2011. 16 03 2011 <http://www.polarisindustries.com/en-us/ATV-RANGER/2010/Multi-Passenger-Utility-Vehicles/RANGER-800-CREW/Pages/features.aspx>.

—. Ranger RZR Specifications. 2011. 16 03 2011 <http://www.polarisindustries.com/en-us/atv-ranger/2011/side-by-side-vehicles/ranger-rzr-4-800-eps-robby-gordon/pages/specifications.aspx>.

Quality Adventure LLC. Intex Inflatable Excursion Boats. 2010. 16 03 2011 <http://www.qualityadventure.com/boatsexcursion.html>.

—. Intex New Style Boat Motor Mount Kit. 2010. 16 03 2011 <http://www.qualityadventure.com/68624.html>.

Sennheiser. MD 46. 2010. 16 03 2011 <http://www.sennheiserusa.com/professional-dynamic-vocal-microphone-omni-reporter_005172>.

Sony. HDC1400R. 2011. 16 03 2011 <http://pro.sony.com/bbsc/ssr/cat-broadcastcameras/cat-hdstudio/product-HDC1400R/?XID=O:BPSEG_hdc1400r:Google_ConCre_Mod_bpd1400r_p_ad1>.

—. HVRA1U. 2011. 16 03 2011 <http://pro.sony.com/bbsc/ssr/cat-broadcastcameras/cat-hdv/product-HVRA1U/>.

TecLYNK. Website Design Hosting. 2011. 23 April 2011 <http://www.teclynk.com/page.htm?pid=5>.

Total Security Solutions, Inc. Bullet Resistant Products. 2010. 16 03 2011 <http://www.tssbulletproof.com/bullet-proof-security-products>.

U.S. Air Force. Factsheets : C-130 Hercules. 10 October 2009. 2011 March 5 <http://www.af.mil/information/factsheets/factsheet.asp?id=92>.

U.S. Department of Energy. Solar Water heaters. 09 February 2011. 10 March 2011 <http://www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=12850>.

—. Tankless Water Heaters. 09 February 2011. 11 March 2011 <http://www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=12820>.

UNICAT. Vehicles. 2007. 27 March 2011 <http://www.unicatamericas.com/>.

United States Army. Chinook Fact File . n.d. 05 March 2011 <http://www.army.mil/factfiles/equipment/aircraft/chinook.html>.

Wikipedia. Enery Star. 06 03 2011. 11 03 2011 <http://en.wikipedia.org/wiki/Energy_Star>.

—. LED Lamp. 10 March 2011. 01 March 2011 <http://en.wikipedia.org/wiki/LED_lamp>.