Backpack Multi-Camera Teleconferencing System

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INTRODUCTION:

This paper describes a portable, multi-camera, “Zoom” teleconferencing system that fits inside a backpack. It’s designed to use a cellular connection or a Starlink (satellite) connection for live, multi-camera presentations, anywhere. Most Zoom conferences utilize a laptop with a built-in camera. This system, by contrast, is designed to switch between 4 different video sources including; (1) Talking head, (2) Wide Shot, (3) Powerpoint, Maps & Photos, (4) Prerecorded video. This system is NOT based on extensive Zoom experience, so feedback is encouraged.

OVERVIEW:

The NW wildfires brought home the need for a mobile video conferencing system. Zoom teleconferences are easy to run, but lack switching between multiple local sources. The presenter is often restricted to a single, head and shoulders shot. Live television news has made everyone accustomed to combining a live talking head, with a pre-recorded press conference, maps and photos. This paper attempts to define the elements on a portable video conferencing system that can do just that for under $5,000

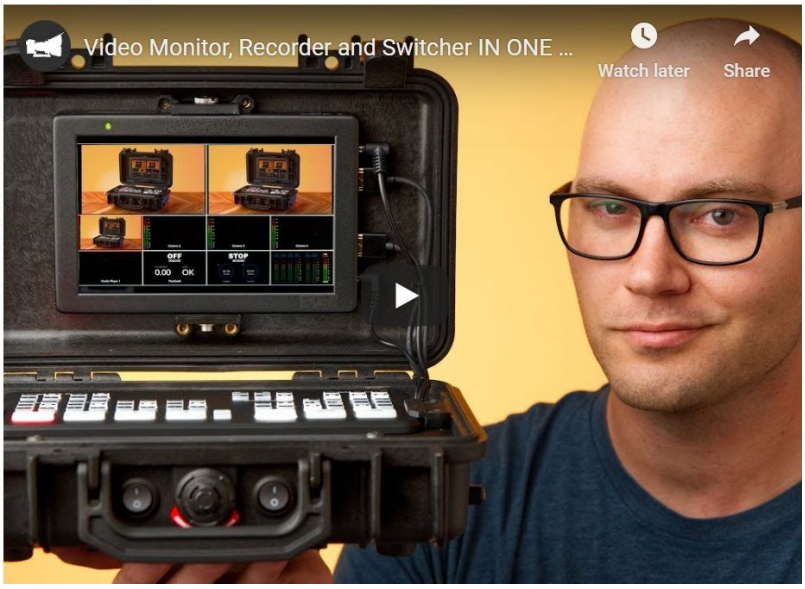
SYSTEM DESCRIPTION:
Zoom teleconferences have become popular because they are generally free and easy to manage. But the talking head cannot cut to a wide shot, a powerpoint presentation or a pre-recorded video.

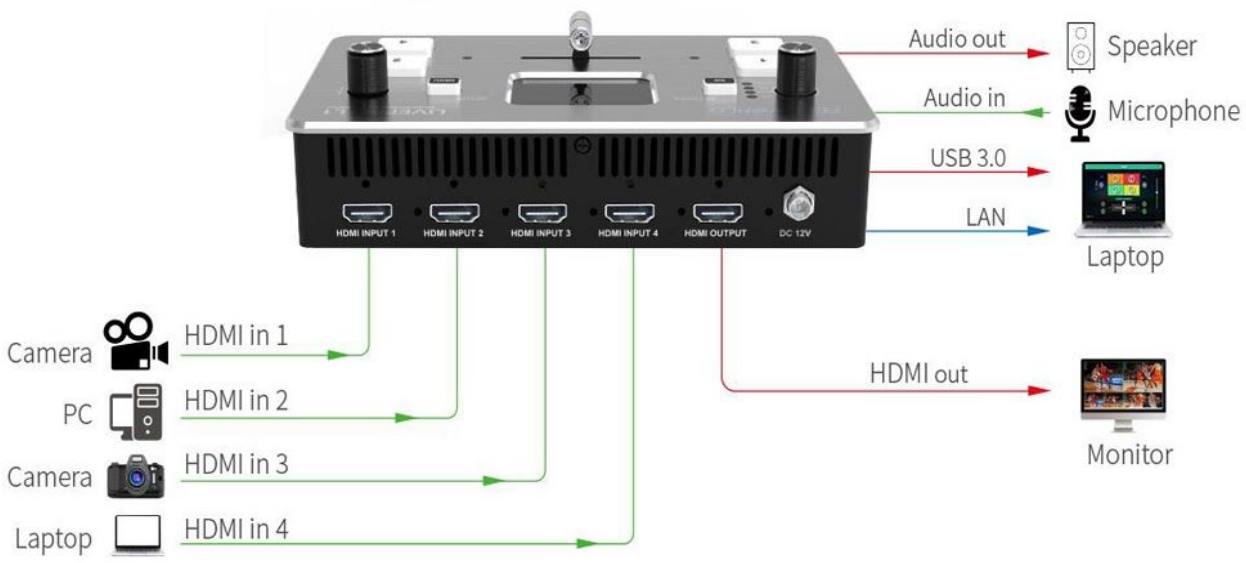
This system would do just that using the current Zoom teleconferencing system. A small video switcher, instead of a single external camera, allows switching between four HDMI sources, enabling the presenter to cut from their own head to (1) a wide shot (2) a pre-recorded video (3) powerpoints, photos and maps. It requires a laptop ($650), a switcher ($300), 2 smartphones ($600 each), two Samsung tablets ($450 each) and a mobile hotspot ($250). Optionally, a Starlink satellite terminal ($1000) and a small generator ($800) enables live operation most anywhere in the Northwest. Total cost is ~$5,000.

SYSTEM COMPONENTS:
The main difference is the addition of a camera switcher. It lets you switch between four HDMI inputs and outputs USB-3, direct into a laptop running zoom.

SMALL, INEXPENSIVE PRODUCTION SWITCHER

The LIVEPRO L1 ($300) with 4 CH HDMI inputs and 1 HDMI output (for a monitor), supports 1080p. For live streaming, there is a USB3.0 interface. Audio has 2 interfaces, one 3.5mm for input, and one for output. It can stream any one (or a split-screen) of the 4 HDMI inputs to any live broadcasting software, such as OBS or Zoom directly. Simply connect LIVEPRO L1 and you can switch live between any 4 inputs, including live cameras or a computer/smartphone running PowerPoint slides or pre-recorded videos.





USE SMARTPHONES AND TABLETS AS CAMERAS:

Smartphones now shoot pictures and video as good as dedicated digital cameras. They can make phone calls and enable live teleconferencing. The Samsung S-20FE (below, left), and Samsung S5e tablet (right) feature live HDMI output. They can plug into a large television or a small video switcher (such as the LIVEPRO L1, above).

The Samsung phones feature a 3x optical zoom, removable microSD cards, and a 4500ma battery, for 15 hour life. The Samsung phones can provide 2 live cameras while the two Samsung S5e tablets can provide pre-recorded video, powerpoints or chat comments. All four devices provide HDMI outputs for the video switcher.

A USB-3 to HDMI cable (above) provides live HDMI video output to the switcher.

The S-20fe smartphone is compact, runs 15 hrs, and is more quickly charged than any digital camera (left). Samsung's 10" tablet screen makes pre-recorded presentations easy to cue up and play when needed.

The Samsung devices also enable video bokeh as well as playback of stored photos, videos, powerpoints and live text feedback.

LAPTOP

Virtually any modern laptop can be used, but one that doesn't use much power, is compact and has modern USB-3 and HDMI ports, M.2 SSD storage, and WiFi 6 (802.11ax) might be advisable. The Acer Swift 3 laptop ($650) with a Ryzen 7 processor and Radeon graphics is small, powerful, and well reviewed. I've been using one for 6 months without issues.

CELLULAR CONNECTION:

A solid broadband wireless connection is required for video conferencing. While FirstNet may be the preferred choice of many first responders, combining Band 12 and 14 of AT&T's 700 MHz spectrum. But, for more routine use in the city, the Sprint/T-Mobile InseeGo 8000 has advantages. It can combine both 600 MHz (for better range) and 2.5 GHz (for more speed) as well as a USB-3 connection (for power and tethering) and external antenna jacks. It also works with 3.5 GHz.

SATELLITE CONNECTION:

When NO internet connection exists, there really is only one option - satellite. But current residential satellite services, provided by ViaSat and HughesNet, are slow, bulky, expensive and problematic.

In addition, the spot beams provided by the newest generation of ViaSat and HughesNet cover only a limited area, perhaps 50-100 miles in diameter. Move beyond your “home” range and it requires a new service arrangement. Not ideal for RVers or other mobile rigs. In addition, satellite internet using geosynchronous satellites are difficult to setup, need a clear shot of the southern sky, and require a fair amount of power.

The new SpaceX Starlink service, which is beta testing now in the Northwest, promises a much better solution. SpaceX recently gave Starlink internet service to Washington State’s Emergency Management department, to help fight forest fires as well as the state’s Native American Hoh Tribe.

Starlink is similar to ViaSat and HughesNet in that it is not designed for urban users. However, Starlink is expected to provide much faster internet speeds, easier to setup, more compact and cheaper.

Starlink looks like a good match for this mobile teleconferencing system. The entire video conferencing system, including cameras, laptop, satellite terminal, and generator could be placed in the trunk of a car.

While the cost of the terminal and monthly service has yet to be released, we are budgeting $1000 for the satellite terminal and $50-$100/month for 25 Mbps satellite service.

BUDGET:
We would like to bring this under $5,000. Petty cash. Here's the basic system:

1. One, Acer Swift 3 laptop with 8 Megs RAM & 512 SSD storage - $650
2. Four, Samsung S-20fe smartphones ($600) with USB3 to HDMI - 1200
3. Two, Samsung S5e tablets ($400) with 10" screen and HDMI out - 800
4. One, Livepro L1 switcher with 4 HDMIs, audio & video screen - 300
5. One, InseeGo mobile hotspot with external LTE antenna - 250
6. Misc, Pelican case for switcher, phones and laptop, misc items - 300
7. TOTAL - less satellite terminal - $3,500
8. TOTAL - including Starlink terminal & 6 months service - $5,000

SUMMARY:
This paper describes a mobile 2-way video studio that may be used for first responders or community events such as concerts. Four Samsung devices provide video sources. Samsung S20fe phones have a 3X optical zoom and a long life 4,500 ma/h battery. The Samsung tablets have quality cameras front and back as well as a 10" screen for previewing and playing presentations. The phones and tablets feature HDMI output using a simple USB-3 to HDMI cable and Samsungs DEX. The tiny switcher features a video monitor, enabling one person to produce a live Zoom broadcast with 4 different video sources.

Two live cameras might be supplemented by two pre-recorded segments on the tablets. In this way, multi-camera steamcasts might also include videos, powerpoints, slide shows or text feedback. A mobile hotspot provides upstream capability at any location in the city. For truly remote streamcasts, a Starlink terminal ($1500) provides a 25 Mbps connection most anywhere. The complete system, including satellite terminal, costs under $5,000 and could fit in the trunk of a car.

LINKS:
Acer Swift 3 laptop with 8 GB Ram and 512 GB SSD, USB-3 and HDMI

Livepro L1 switcher with 4 CH HDMI inputs, 1 HDMI monitor out & USB-3 out

Samsung S-20fe smartphones

InSeeGo mobile hotspot

Starlink terminal

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