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DEPLOYABLE TRAINING TECHNOLOGIES

WRIGHT STATE APPLIED RESEARCH CORPORATION
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FINAL REPORT

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14. ABSTRACT

The Continuous Learning Branch, Warfighter Readiness Research Division of Air Force Research Laboratory's 711th Human Performance Wing (711HPW/RHAS), has sought to integrate live, virtual and constructive (LVC) simulation technologies with advanced, robust field training exercises, and to ultimately create a deployable LVC capability to be used for training and exercise control. The goal of the Deployable Training Technologies (DTT) project, intended as the next step in a continuing deployable LVC research effort, was to integrate training technologies into a ruggedized field platform that the Air Force Research Laboratory (AFRL) could deploy to training exercises in the U.S. and around the world.

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1.0 INTRODUCTION AND SCOPE

The Continuous Learning Branch, Warfighter Readiness Research Division of Air Force Research Laboratory's 711th Human Performance Wing (711HPW/RHAS), has sought to integrate live, virtual and constructive (LVC) simulation technologies with advanced, robust field training exercises, and to ultimately create a deployable LVC capability to be used for training and exercise control. The goal of the Deployable Training Technologies (DTT) project, intended as the next step in a continuing deployable LVC research effort, was to integrate training technologies into a ruggedized field platform that the Air Force Research Laboratory (AFRL) could deploy to training exercises in the U.S. and around the world. The effort included assimilating several pieces of AFRL-developed software that manages and supports training exercises into a deployable live, virtual and constructive (DLVC) platform. The DLVC platform is a simulation development and prototype production environment built for the State of Ohio by Cubic Corporation of San Diego and Dayton and SelectTech Geospatial Advanced Manufacturing of Springfield and operated by the Wright State Research Institute (WSRI).

As part of the DTT project, WSRI integrated existing software and hardware components and deployed the prototype system as part of the Angel Thunder 2017 exercise. Angel Thunder is the largest and most realistic joint service, multinational, interagency combat search and rescue exercise designed to provide training for personnel recovery assets using a variety of scenarios to simulate deployment conditions and contingencies. Personnel recovery forces train through the full spectrum of personnel recovery capabilities with ground recovery personnel, air assets, Special Forces teams and federal agents.

The DTT project goals were:

1. Analysis and disassembly of existing AFRL LVC software to create a modular LVC training system and bring all the components under configuration control.

2. Integration of the components, along with any new technologies identified by AFRL requirements analysis into the Deployable LVC (DLVC) trailer via the System Integration Lab.

3. Transportation of the DLVC trailer with the newly constituted training system to the USAF's Angel Thunder exercise in AZ and use the system to facilitate AFRL training research (May 2017).

This document is intended to be an initial requirements framework for a deployable LVC capability and uses lessons learned and observations from the DTT project as evidence and support for the capability requirements. This document also briefly describes the activities involved in preparation and integration of the hardware and software necessary for the system to be deployed, and the deployment and implementation of the system at Angel Thunder as background.

1.1. Identification

This document refers to the Deployable Live, Virtual, and Constructive (DLVC) capability being developed by the 711th Human Performance Wing's Warfighter Readiness Research Division, Continuous Learning Branch (711HPW/RHAS). The current version is a rough prototype capability that heavily leverages the hardware and software components of an After Action Review and Data Collection system originally developed by Ball Aerospace, Aptima, and Cubic Corporation under the Sensor Integration and Data Fusion for Operations and Training (SIDFOT) contract.

1.2. Intended Use

The system is intended to be used primarily for collecting data on and presenting data for USAF operational training exercises. In addition, it is intended to be used by operators and cadre to review the events of operational exercises for learning and by exercise control (EXCON) or white cell personnel for monitoring exercise execution and gaining situation awareness.

1.3. Background

In this project, the prototype system was incorporated into WSRI's DLVC platform and deployed to exercise Angel Thunder 2017.

The DTT project began in October 2016 and the technical effort was completed by the end of June 2017. DTT included the following accomplishments:

- Collected all software components affiliated with AFRL. These are all of the pieces of software that were developed for the SIDFOT and LVC contracts, including the software associated with the sensor grid, the software components of the AAR Tool, and the components of the SIDFOT android application.

- Created git server projects on the WSRI git server for each of these collections of source code and baselined them.

- Redesigned the research network at the National Center for Medical Readiness (NCMR) and DLVC. Redesign is based on lessons learned during TW 2016 and discussions with Mr. Ted Harmer (711HPW/RHAS).

- Installed and configured new backbone switch.

- Reconfigured other network devices to accommodate new network design, including Force 10 Switch, Cisco POE switch, Cisco Wireless Access Controller, Cisco Router, 2 servers.

- Researched Multicast configurations for the NCMR/DLVC equipment.

- Built S/W CM repository, using GIT, for DTT software components and sent out login information for git repository to team.

- Completed NCMR network changes.

- Installed and configured Cisco ASA Firewall device in the DLVC trailer.

- Configured permanent VPN tunnel between the WSRI main building (located at 4035 Colonel Glenn Hwy) and NCMR (located at 506 East Xenia Drive in Fairborn). This provided a dedicated connection between the software integration lab (SIL) located at the main building with the DLVC prototyping platform housed at NCMR.

- Configured client VPN capability to NCMR.

- Reconfigured the Ubiquiti wireless antennas and Tough switches to enable a more efficient and robust wireless network for supporting upcoming and future research, test, and evaluation events, such as Angel Thunder 17 and TechWarrior 17.

- Installed and configured new network devices for DLVC trailer.

- Reconfigured existing DLVC network devices and computing equipment.

- Configured and tested DLVC trailer backhaul capability.

- Completed configurations, downloaded the configuration from each device into individual text files and placed those in the sidfot GIT CM repository.

- Attended AT17 initial planning conference in Tucson, AZ, 12-16 DEC 2016

- Created first draft of LVC kit overview (OV-1)

- Documented list of radio frequencies used by the devices in the LVC kit and submitted those to AT17 planning staff on 17 JAN 2017.

- Uncovered a risk that the Milestone XProtect security camera software that was then a part of the AFRL kit was not provided with source code or installer applications. As a result (due to its hardware and software licensing policies) we could not install Milestone in the DLVC rack. Investigated Wowza and iSpy as interim solutions to overcome licensing and product lifecycle issues with Milestone Xprotect.

    - XProtect is the commercial-off-the-shelf (COTS) solution to recording video chosen by the SIDFOT project.

    - iSpy is an open-source project which could be upgraded to include certain kinds of software support with a paid subscription.

    - Wowza is commercial-off-the-shelf (COTS) software with an initial cost and a recurring yearly maintenance cost.

    - With AFRL concurrence, the team determined that the best value solution to this problem was to use open-source software.

- As a mitigation to the risk of not being able to get a new piece of software running integrated with the AFRL kit, DTT demonstrated the use of the existing AFRL rack in the DLVC with the upgraded networking.

- Unpacked and set up the AFRL Caesar human patient simulator inside the NCMR main building in anticipation of testing with the LVC network. Caesar seemed to run, but early on was neither addressable by the LVC network or addressable or operable by the instructor workstation tablet.

- Investigated whether GoPro video could be integrated into the prototype system.

  - Market research indicated VISLINK HEROCast Wireless Transmitter Kit for GoPro provided the ability to stream GoPro video over an IP addressable network. This solution was beyond the budget for the DTT project (~$7500 per camera/video feed).

  - Downloaded and installed latest firmware for each camera.

  - Testing live streaming from GoPro camera to VLC software was unsuccessful.

  - GoPro camera video streaming to a smartphone using the Capture app was successfully tested as a possible step to a more robust solution.

  - More details of GoPro integration challenges are available in Annex 1.

- Attended AT17 mid-planning conference in Tucson, AZ, 13-16 FEB 2017

- Confirmed the deployed locations were the Florence Military Range (FMR) in Florence, AZ, and Range 3 in the Barry M. Goldwater Range (BMGR) near Gila Bend, AZ.

- Regularly attended coordination meetings with the University of Nebraska Medical Center team to plan medical scenarios and discuss ways to accomplish human-patient simulator (HPS) interaction.

- As part of the requirement discovery process and working with Angel Thunder staff to refine their expectations and requirements, the need for the AAR system to be able to provide simultaneous playback and recording capability has emerged. We have begun the redesign and reconfiguration of the networking to accommodate this approach.

- Discovered the main roadblocks to simultaneous playback and recording operation are the assumptions that guide how the existing SIDFOT software works, which preclude simultaneous record and playback. To minimize risk, we are segregating two separate sides of the DLVC network and will need to procure at least one additional 4G LTE router to enable a “day” system and a “night” system. Our computing architecture solution is assisted by the virtual machine approach, but this solution will also need to leverage the 711HPW computer rack in the DLVC to address the challenges.

- Chose the iSpy open-source camera control software as our solution to streaming and recording video. It provides the most ease-of-use, Windows platform native code, and significant customization, for no cost to the program.

- Examined the practicality of streaming GoPro video across the LVC wifi network. In the final analysis, to implement the most practical solution, it would cost ~$250 per camera and we would still be left with questions about how well this would work, as well as whether any of the PJs would be willing to strap on the camera pack.

- The BAO Kit does not provide an obvious answer as it only has usb 2.0 connections, likely not sufficient to transfer HD video/audio in real time.

- We have forwarded this information on to 711HPW and we have agreed to not pursue live streaming GoPro further.

- As part of the iSpy camera solution, our team developed a video playback capability (to be used with the AARTool) that will be synchronized with the AAR Tool. We expect to have the software completed by the end of March and tested soon after. It is a low-risk solution that leverages existing web-based solutions for video playback. A proof of concept has already been partially developed and successfully plays back video being externally synchronized.

- We have also spent a little time analyzing expected LTE coverage and expected wifi coverage based on currently understood locations. Based on a cursory terrain analysis and coverage maps published by Verizon, we have reasonable confidence that a 4G LTE router solution will work, provided that external antennas are pointed appropriately to maximize signal.

- April activities focused on testing the video playback capability. Initial testing was successful in that Axis video was synchronized during playback. But the software was modified to include the ability to playback GoPro video and a process to allow local playback (on the AAR computer) of GoPro video with remote playback of Axis video. That capability was successfully tested in walkthroughs during April.

- Logistics and preparation activities continued throughout April in preparation for deployment to Angel Thunder. The WINK-D trailer maintenance was completed and the trailer was ready for deployment.

- Final packing took place during the week of 24 April and both trailer were readied for deployment. (An issue emerged with the trucking company tasked with shipping the DLVC trailer, but WSRI was able to substitute other resources to get the trailer to Arizona.)

- The team departed for AZ on 29 April and left to return on 20 May.

- The DLVC was successfully deployed to Florence Military Range in Florence Arizona as part of the Angel Thunder exercise.

- The team successfully set up the DLVC and WINK-D kits on the Florence range as planned and set up the AAR equipment at Davis-Monthan AFB during Zero week.

- Also during Zero week, the team successfully integrated the HPS into the wink1r network and configured and deployed a solution for HPS familiarization training.

- The team successfully supported all required training vulnerability periods throughout the exercise.

- The DLVC and WINK-D kits worked as designed. However, the internet connection provided by the Verizon LTE routers proved to be far too bandwidth limited and essentially made remote AAR playback impossible.

- In addition to supporting day and night vulnerability periods on 9 and 11 May, the team successfully redeployed the kit to the BMGR Range 3 on Saturday, 13 May for the day VUL.

- The team then supported the final VUL on 18 May.

- The Hill camera continued to have issues and was eventually taken off line. It will need to be replaced in the future.

- The team helped troubleshoot an issue with several phones not joining the sensor grid and we successfully repaired that issue prior to the last VUL.

- The team packed up the kit on 19 May and departed for Dayton on 20 May.

1.4. System Overview

Wright State Research Institute integrated various hardware and software components into a deployable Live, Virtual, Constructive (DLVC) simulation system. The system currently includes three basic components: sensors, computing hardware and software, and networking hardware and software. The current system is designed to deploy a wifi network and associated computing resources to remote locations, enabling the collection and playback of ground-based training and simulation data on live ranges. Much of the software is the same software leveraged by the prior Sensor Integration and Data Fusion for Operations and Training (SIDFOT) project. This software has been repackaged into a deployable trailer capability with additional networking hardware and additional and enhanced video recording capability (in the form of GoPro cameras and a new, non-proprietary, open source video recording package.)

1.4.1. Sensors

The current sensors include android phones with custom applications primarily used for personnel tracking, GoPro cameras for first-person view video, and fixed pan, tilt, zoom cameras for broader video recording of live events.

1.4.2. Computing Hardware and Software

The current computing hardware and software includes three or more workstations running the Windows 7 operating system and all components of the SIDFOT software suite (see SIDFOT final report for more details). Most of the current workstations are rack mounted computers with some desktop computers added to provide more portability for after-action review (AAR) purposes.

1.4.3. Networking

The current system networking equipment is dominated by Cisco routers and switches configured to allow the sensors to communicate with the data collection computers and to allow any of the AAR computers to communicate with the data collection systems as well.

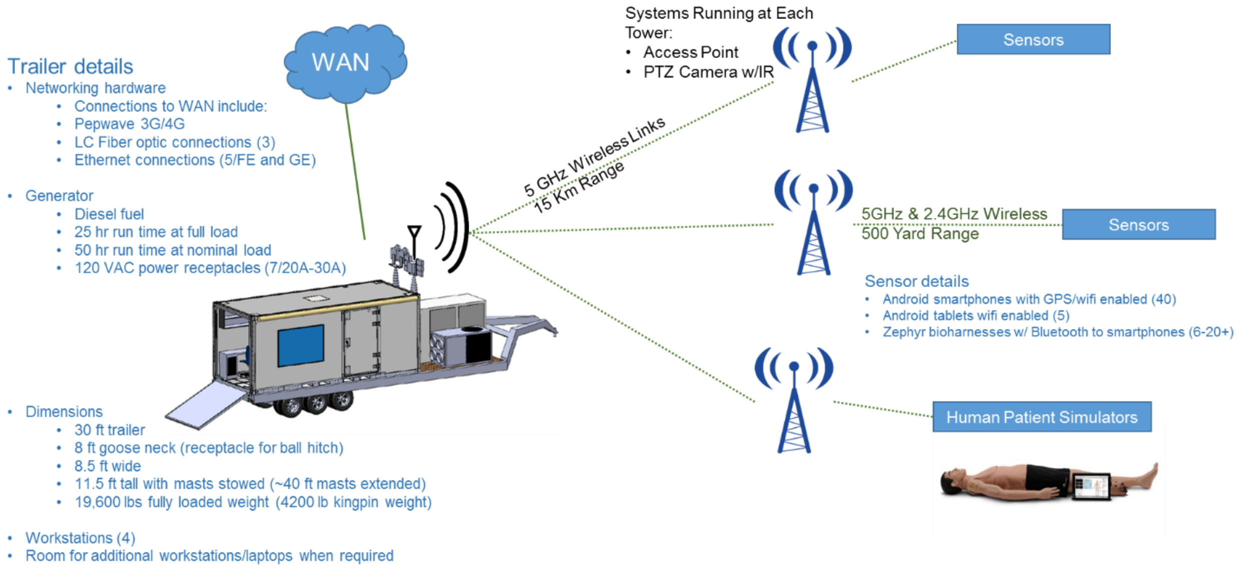

Figure 1. Deployable LVC System configured as of May 2017.

In the future, it is expected that the system will provide more interfaces to existing operational data sources rather and rely more on current operational systems to provide data. Therefore, the current wifi networks and sensors that the current system contains are to be considered prototype, proof-of-concept capabilities and not threshold or objective requirements.

1.5. Document Overview and Use

This document establishes an initial draft of Deployable LVC requirements with a description of a current prototype and lessons learned to support those requirements based on the system's most recent deployment (as of May 2017). The document should be used to collect additional requirements for a deployable LVC capability as more requirements are learned via demonstration or analysis.

2.0 APPLICABLE AND OTHER REFERENCED DOCUMENTS

Documents that may be applicable to defining, illustrating, or expanding these system requirements will appear here. As of now, this list is blank. But as the requirements are more fully understood and specified, those supporting documents will be listed here.

2.1. Applicable Documents

None

2.2. Other Referenced Documents

None

3.0 DEFINITIONS, ACRONYMS, AND ABBREVIATIONS

3.1. Definitions

Shall expresses a characteristic which is to be present in the item which is the subject of the specification, i.e. “shall” expresses a binding requirement.

Should expresses a target or goal to be pursued, but not necessarily achieved.

May expresses permissive guidance.

Will expresses a declaration of intent on the part of a party, usually the sponsoring or acquiring organization. “Will” does not express a binding requirement. “Will” may also be used in cases where the simple future tense is required, for example, “The operating system will be supplied by the government.” Any statement which employs the term “will”, if used in 4, should be present as a note so as to be clearly distinguishable from requirements. Will may also express simple futurity.

3.2. Acronyms

711HPW/RHAS	The Air Force Research Laboratory’s 711th Human Performance Wing, Warfighter Readiness Research Division, Continuous Learning Branch
AAR	After Action Review
AFRL	Air Force Research Laboratory
DIS	Distributed Interactive Simulation
DLVC	Deployable Live, Virtual, Constructive capability
EXCON	Exercise Control
JTEN	Joint Training and Experimentation Network
NCMR	National Center for Medical Readiness
SADL	Situational Awareness Data Link
SIDFOT	Sensor Integration and Data Fusion for Operations and Training

WINK-D	WiFi Network Kit-Deployable
WSRI	Wright State Research Institute

3.3. Abbreviations

F	Fahrenheit
gph	Gallons per hour
kW	Kilowatts of electrical power
mph	Miles per hour

4.0 REQUIREMENTS

4.1. Identification of External Interfaces

Link-16 (eventually via JRE/ACE IOS)

DIS

JTEN

Microwave

Internet

SADL (eventually via JRE/ACE IOS)

UHF (eventually ANW2, SRW, Voice)

4.2. System Function and Performance Requirements

The following system function requirements are those that are known at this time. For many of the currently understood requirements, standards of performance have not yet been defined. Where those standards are well enough understood, the performance requirements are defined.

4.2.1. Current Display Function

Current state of the exercise – near real-time data display. Data to be displayed include entity information (simulated and live) on a map (data that are geographically and temporally bound).

Supporting Data

The system currently displays the current state of entity information on a 2D map display leveraging Google Earth. The entity location and status is communicated via an icon with a number corresponding to the number assigned to that particular phone. (In its current configuration, the system relies on Android smartphones running a custom application designed to communicate with the system database. Each smartphone is assigned a number via the custom application and that number is then displayed in Google Earth when the smartphone is detected in the wifi network and the device is added to the database.) In addition, the system also provides real-time video data of the current exercise. An example of that information can be seen in Figure 2.

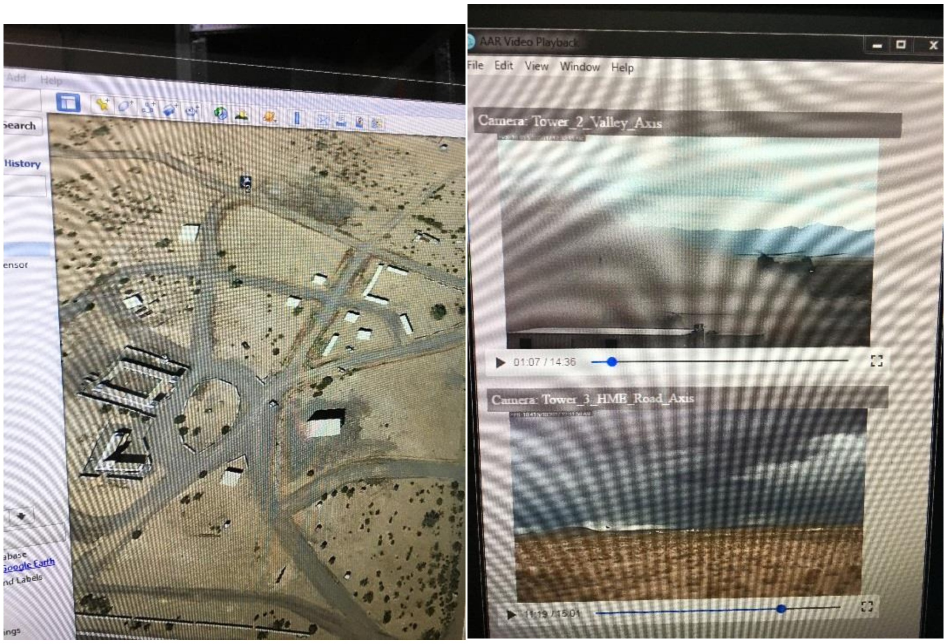

Figure 2. Current system Google Maps overlay and video data display.

4.2.2. Record Function

The system shall provide the capability to record entity state data, video data, audio data, and any other data required by exercise controllers, participants, or researchers.

Supporting Data

The current system records all exercise data that it captures, including entity position, event information added to the timeline, bio data, video data, and audio data in time synchronized data stores.

4.2.1. Playback Function

The system shall provide the capability to playback all recorded data as a time-synchronized data record. This record will be presented so that it can be used for situation assessment or after-action review.

Supporting Data

The system currently allows a user to pull up data on any recorded exercise for playback.

4.2.1. Timeline Function

The system shall provide the capability to display each recorded or live exercise as a function of time.

Supporting Data

The current system provides a timeline display capability. In addition, it allows the user to add events to the timeline with custom labeling (events can be seen in the timeline in Figure 3 below). The timeline tool also incorporates the plotting in time of rating events generated by other tools in the kit, such as the Performance Measurement Tool and the SPOTLITE tool.

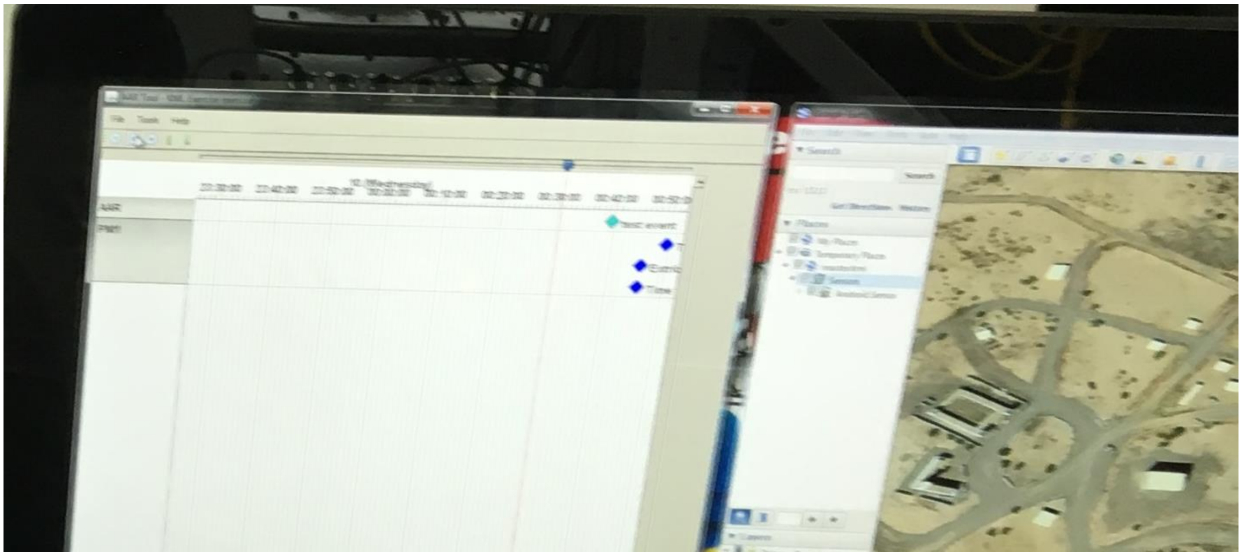

Figure 3. The system's Timeline Tool on the left and the Google Map overlay on the right.

4.2.1. Personnel Tracking Function

The system shall have the capability to display and record the location of any personnel of interest during an exercise.

Supporting Data

The current system relies on a smartphone application to enable this capability as briefly described in the "Current Display" function.

It is envisioned that this capability should be broadened to ingest data from DoD standard personnel tracking technologies already fielded, such as EPLGRS and others. In addition, it is expected that the data to be displayed could include attributes such as friendly (blue), enemy (red), other forces (gray), exercise control (white).

4.2.1. Time-synchronized Video Function

The system shall have the capability to record and playback video that are time-synchronized to the exercise of interest.

Supporting Data

The current system has mechanisms to time-synchronize all video data. The stationary cameras that are part of the system are all IP-enabled cameras that are set up to feed data back to a central database where all video data are time-stamped. Currently however, some of these methods are highly manual. For example, the system is aware of the time data for GoPro video, but only if a series of currently manual steps are performed to prepare the files for ingestion by the system during playback mode. In addition, there is no current method of streaming GoPro video.

It is envisioned that the ultimate system should be able to ingest as many video feeds (of most commercially available and military system file/broadcast formats that hardware constraints (e.g., memory and file space) will allow. In addition, any and all of these feeds should be available for playback and all will be synchronized with the exercise data.

4.2.1. Accessible Participant State Data Function

The system should be able to collect and allow researchers and exercise controllers to monitor state data of exercise participants. These data may include bio data.

Supporting Data

The system currently collects and stores bio data via Zephyr bioharness devices worn by participants carrying cell phones within the system's data collection protocol. The harness data are streamed via Bluetooth to the smartphones running the custom application and these data are included in the Google Earth overlay.

It is envisioned that the system in the future should enable the monitoring and recording of types of exercise participant state data as required. In addition these data need to be stored in a way that allows researchers to secure the data and prevent the disclosure of sensitive data.

4.2.2. Integrate Human Patient Simulator Data

The system shall have the capability to ingest and monitor human patient simulator (HPS) data.

Supporting Data

The system currently can enable access to human patient simulator data in the form of web-based connectivity to CAE Caesar and Metiman HPSs that have been custom configured to be addressable on the system's wifi network. In the future, it is expected that the system and the HPSs themselves will evolve so that integrating their data into the system will be essentially plug and play, regardless of HPS manufacturer or model.

4.2.1. Integrate Other Entity Data

The system shall have the capability to ingest and monitor other data not previously mentioned, including aircraft information.

Supporting Data

The system is envisioned to be able to ingest aircraft data, especially that of HH-60 and HC-130 time-space-position information (TSPI) or similar data that will allow system users to locate and monitor aircraft within the exercise, their position and velocity information, and other state information.

4.3. Relationships Between States and Modes

The system should be able to simultaneously display, record, and playback data (for multiple users).

Currently, this is a challenge based on the design of the current prototype system software. The solution to this challenge during Angel Thunder 2017 was to instantiate two separate systems (a DAY system and a NIGHT system, each corresponding to the relative time of each exercise vulnerability period). This solution theoretically provided a mechanism for recording exercise activity while simultaneously playing back data from a different exercise period. The hardware in the DLVC, combined with the AFRL hardware provided enough computational power to enable this solution. However, the bandwidth required to push these data from the system to the remote after action review station exceeded the bandwidth available via the Verizon LTE system. (The recording hardware and software resided in the DLVC trailer, which was located at Florence Military Range in Florence, AZ, while the playback system was located at Davis-Monthan AFB, AZ. The only practical solution to moving data between these systems to enable playback at a location remote to the recording was the Verizon LTE network. Unfortunately, the network capability was not up to the task, often providing less than 1 Mbps at either location.

4.4. System External Interface Requirements

Network Connectivity

The system shall have sufficient network connectivity to enable all functions.

4.5. System Environmental Requirements

4.5.1. Temperature

The system shall be able to collect video and tracking data in environments with temperatures from 36 degrees to 104 degrees F. This is a threshold requirement. It is expected that the temperature extremes could be greater, to include below freezing temperatures through temperatures as high as 114 degrees as an objective requirement.

Supporting Data

Temperatures on the way to Angel Thunder and while at various sites in and around the Angel Thunder exercise varied between 36 deg and 104 deg (see Figure Figure 4). Temperatures near Flagstaff, AZ during Angel Thunder, even in June, dipped below freezing as snow was reported at upper elevations. Daytime temperatures in June near Gila Bend exceeded 100 deg regularly and temperatures in July of this year near Florence have been reported as high as 114 deg F.

Figure 4. Temperature extremes recorded during Angel Thunder 2017.

4.5.2. Precipitation

The system shall be able to collect data in light to moderate precipitation.

Supporting Data

During the exercise, there were a few days where the range experienced light to moderate precipitation.

4.5.3. Wind

The system should be able to collect data in winds of up to 20 mph.

Supporting Data

It is estimated that wind speeds at certain times during the exercise were as high as 20 mph, with gusts up to 25 mph.

4.5.4. Dirt/Dust

The system shall be capable of collecting data and operating in a highly dirty/dusty environment.

Supporting Data

Our setup location for the DLVC trailer during Angel Thunder 2017 was in a dirty and dusty area near a borrow pit on the Florence Military Range. In addition, the Military Operations in Urban Terrain (MOUT) site was also dirty and dusty, being located in desert-like conditions in Florence AZ. The Range 3 location, located south of Gila Bend, AZ, was also an extremely dusty location, being located in the Sonoran desert environment (see Figure 5).

Figure 5. Examples of dusty environments in which system can be deployed.

4.6. External Resource Utilization Requirements

4.6.1. Power

The system should be able to operate with either external electrical power or on power provided by a generator.

Supporting Data

The current DLVC trailer has an external power connection for 240 volt, 3-phase, 60 Hz power and a generator that provides an approximately 25 kW power output. It is, as yet, unknown exactly how much power is drawn by the DLVC trailer when operating all components including the HVAC component, but it is estimated that the total power draw currently could peak as high as 5 kW. How this would translate into additional power requirements is unknown.

4.6.2. Fuel

The system, when running on a generator, should be able to store and use up to 60 gallons of diesel fuel at a time. In addition, the fuel consumption rate should be no more than 1.5 gph.

Supporting Data

The generator on the DLVC trailer at the current time is requiring approximately 1.1 gph during normal operation.

4.7. System Physical Requirements

4.7.1. Portability

The system should be as portable as possible.

Supporting Data

It is expected that the ultimate system could be carried and deployed by a small number (four or fewer) of researchers and/or engineers. Therefore, the system is envisioned to be able to be run on just a few laptop/portable computers and have the smallest logistical footprint possible (perhaps all components fitting inside a standard – 8 foot-sized pickup truck bed.)

4.8. Personnel-Related Requirements

4.8.1. Manning

The objective manning requirement should be a small footprint, perhaps less than four people to be able to transport, set up, operate, maintain, take down, and return to home station. However the current manning requirement is 4-8 people depending on how the system is deployed.

Supporting Data

During Angel Thunder, the team successfully moved the WINK-D and DLVC trailers from FMR to BMGR, unpacked the system, set it up, operated it, repacked it, and transported it back to FMR, all in one day, with five people (Bell, Bridges, Harchick, Harmer, and Malek.) However, that move was highly planned and controlled, with plenty of preparation time available. In a more dynamic operation, it is likely that the manpower requirement would have been up to eight people.

4.8.2. Expertise

Unknown

Supporting Data

4.9. Training-Related Requirements

4.9.1. System Familiarization

Unknown

4.9.2. Operational Training

Unknown

4.10. Logistics-Related Requirements

4.10.1. Transport

The system will need to be transportable by a minimum of two qualified operators driving vehicles appropriate for the task.

Supporting Data

The current system, which includes the WINK-D trailer and the DLVC trailer (shown in Figure 6), requires vehicles and vehicle operators. The WINK-D trailer requires a ¾ ton pickup truck with a towing package for long distance moves. The DLVC trailer requires a large pickup truck, a 1 ½ to 2 ton pickup truck with a dual rear wheel and a goose neck hitch. The DLVC trailer's loaded weight for Angel Thunder 2017 was approximately 19,500 lbs. which technically requires that the driver have a commercial driver's license.

Figure 6. Both system trailers shown with their respectively required tow vehicles.

In the future, it is envisioned that the entire system (replicating or exceeding current capability) could fit in the bed of an 8 foot pickup truck bed.

4.11. Other System Qualities

a. reliability (the ability to perform with correct, consistent results - such as mean-time-between-failure for equipment);

b. maintainability (the ability to be easily serviced and repaired - such as mean-time-to-repair for equipment);

c. availability (the ability to be accessed and operated when needed);

d. reuseability (the ability to be adapted for use in multiple applications);

e. testability (the ability to be easily and thoroughly tested);

f. useability (the ability to be easily learned to use, and easily used by its intended user population);

g. interchangeability of parts (the ability to have parts of the same part number interchanged without necessitating readjustment);

h. transportability (the ability to be transported from one location to another);

i. ease of set-up (the ability to be set up by one, or a given number of, persons);

j. expandability (the ability to be easily modified in response to potential areas of growth in requirements);

k. flexibility (the ability to be easily adapted to changes in mission, threat or technology);

l. interoperability (the ease of interfacing and/or interoperation with external systems in general.

4.12. Design and Construction Requirements

None as of yet.

4.13. General Design and Construction Requirements

None as of yet.

4.14. Characteristics of Subordinate Elements

None as of yet.

4.15. Requirements Traceability

N/A

4.16. Information Security Requirements

4.16.1. Multi-level Security

The system will need to have the ability to manage or deal with data and various levels of data classification.

Supporting Data

It is expected that future exercises will require data feeds that exist at multiple levels of security classification. There are some activities in current Angel Thunder exercises which are classified or sensitive.

5.0 VERIFICATION REQUIREMENTS

None as of yet.

6.0 NOTES

6.1. Operational Concept Description

7.0 ANNEXES

7.1. Annex 1: GoPro Streaming Progress Report

8 March 2017

Progress

This section documents available information and approaches to different streaming solutions, most of the info can probably be skimmed.

The initial idea to stream the GoPro video was to use a Raspberry Pi to interface between the camera and the WiFi network. This setup has already been moderately tested in previous work but it needs more development to streamline its usage. A WiFi hotspot is generated by the GoPro so that the GoPro app can connect to it. The fact that the camera creates its own hotspot instead of connecting to a network is very inconvenient. The GoPro does not natively support streaming. However, when using the GoPro app, a preview stream is sent to the phone so the user can control the GoPro. This preview stream can be accessed by connecting a laptop to the GoPro's wireless network, then opening the stream file that is stored in a web server that is ran on the camera. The URL to the stream is "http://10.5.5.9:8080/live/amba.m3u8".

Since the GoPro's WiFi hotspot has a very small range, and because having to connect to the cameras WiFi is inconvenient, a Raspberry Pi is used to interface with the GoPro. This is done by equipping the Pi with two wireless NIC's, one to connect to the GoPro WiFi, and another to connect to the main wireless network. Newer Raspberry Pi's have a built in WiFi chip which is nice so there is only one NIC plugged into a USB port instead of two. VLC is run on the Pi to handle the video stream. It opens the preview stream file, then creates a RTSP stream so that computers connected to the main network can access the stream.

One of the issues encountered with the Raspberry Pi streaming is that when it booted up, each NIC needs to connect to the right network. The issue is that if they don't connect to the right network, then they had to be manually changed. This required hooking up a mouse, keyboard, and monitor to the Pi which is cumbersome. A better way to do this is to look into the wireless config files, and startup scripts to make sure the NIC's connect to the right network. Another thing that needs to be done is to set up SSH so the Pi can be used remotely instead of hooking up peripherals. Finally, to stream with VLC, the stream needs to be set up by clicking through the menus. This can be automated by using VLC in the terminal instead of hooking up peripherals in order to use the GUI.

To power the Raspberry Pi, a LiPo battery pack was used. This battery has USB ports that can be used to recharge the pack and power devices. The Pi has a micro USB port used for connecting a power supply. The dimensions for the battery pack are 5.5 x 2.3 x 1 inches and weighs 0.625 lbs. Storage capacity for the battery is 10,000 mAh. At full load the Pi consumes about 750 mA, which means it would take 13.3 hours to drain this battery pack. Once the final GoPro solution is worked out, a smaller battery can be used to save weight.

Once the stream is setup with VLC running on the Pi, remote computers can access this stream. This is done by using VLC on the remote machine and inputting the IP of the Pi. Future implementation of this system will probably replace VLC on the remote computer with software called iSpy. iSpy is an open source security camera software that should be able to treat the Pi stream as any other IP camera.

The disadvantage of getting the preview stream from the GoPro through its WiFi hotspot is that enabling WiFi reduces the battery life of the GoPro significantly. According to the GoPro website, the battery should last approximately 2-3 hours, depending on the video resolution and frame rate. Tests were done to attempt to match GoPro's battery life claims. These results are shown in Table 1. According to GoPro's website, using the app and recording at 1080p 60 fps, the battery should last 1 hour and 30 minutes. During the test it only lasted 55 minutes. The best result achieved was using the app preview, but not recording, which yielded 1 hour and 24 minutes. It can be seen that during real world tests with the WiFi enabled, the GoPro's battery life is reduced by around 50%. Another disadvantage with the WiFi approach is that the connection between the GoPro and the Pi can drop out, it seems like this happens more often when the battery is getting low.

Table 1. GoPro Battery Life Test Results

Test Setup	Tested Duration
GoPro with app preview, no recording, 1080p60	1 Hour 24 Minutes
GoPro with app preview, recording, 1080p60	55 Minutes
GoPro streaming to laptop, recording, 1080p60	57 Minutes
GoPro streaming to laptop, recording, WVGA 60 fps	1 Hour 14 Minutes

An alternative to using the GoPro's WiFi to obtain the video stream is to use the micro HDMI port on the camera. This provides different challenges because the Raspberry Pi only has HDMI output, not input. A couple solutions exist to take HDMI input. One is to get an add on board for the Raspberry Pi, another is to replace the Pi with a specialized HDMI encoder that has wireless connectivity.

After doing some searching for Raspberry Pi HDMI capture cards, it appears there are two products that do this. The first is the Auvidea B101. This board receives HDMI and sends the signal through the Pi's CSI-2 port, which is what the Raspberry Pi camera uses. It seems that this product has been in development for several years and it is hard to tell if it would work sufficiently for this project. The website for the B101 says that it is on sale, however the sale was supposed to end in 2015 yet the webpage has not been updated. The other option is the Lintest PiCapture HD1. This board works in a similar way to the B101. If I understand correctly, the difference is that the B101 simply takes HDMI and converts it to a format that the CSI-2 bus can read, where the HD1 emulates the Raspberry Pi camera. An advantage of emulating the camera is that streaming can be done the same way as streaming with the official Raspberry Pi camera, a program called Raspivid easily sets up the stream. There was not a lot of reviews of the HD1, but some forum posts did indicate that it worked as claimed. I also emailed the developers of the HD1 describing the project and they said other people have streamed GoPro using it. The B101 is “on sale” for 70 Euros and ships from Germany, the HD1 is $170.

Auvidea does not specialize in Raspberry Pi boards, but it appears their main products are general HDMI encoder/decoder boards. One of their products, the E101 has HDMI input and WiFi connectivity. This board is an option instead of using the Raspberry Pi. The price of the board with a case is around $300-350, this is cheaper than most specialized HDMI boards that are upward of $1000. A potential issue is the power consumption, the website says it uses 5V at 3.5 W. This doesn’t necessarily mean it consumes this much but if it does then it would drain the battery pack quickly.

Path Moving Forward

Moving forward, the best solution for streaming the GoPro seems to be using the HDMI port. The PiCapture HD1 will take this HDMI signal and send it to the Raspberry Pi. The Pi will then send that stream over the WiFi network. Once a prototype system is built, battery consumption tests can be done to optimize the size of the battery needed for the completed system.

Purchase List

Lintest PiCapture HD1

https://lintestsystems.com/products/picapture-hd1

UPC/EAN Code:	706970455795
Model Number:	HD1

Raspberry Pi 3 Model B

https://www.amazon.com/Raspberry-Pi-RASPBERRYPI3-MODB-1GB-Model-Motherboard/dp/B01CD5VC92

Model Number:	RASPBERRYPI3-MODB-1GB

Micro HDMI Cable

GoPro Micro HDMI Cable, 6’ (only size they have) $19.99

http://shop.gopro.com/accessories-2/micro-hdmi-cable/AHDMC-301.html

ASIN:	B00A3MY7KE
Model Number:	AHDMC-301

Random Amazon brand, claims it supports 4k resolution so should be fast enough, didn't see any bad reviews, 6' at $6.99

https://www.amazon.com/Rankie-High-Speed-Supports-Ethernet-Return/dp/B00Z07JYLE/ref=sr_1_3?ie=UTF8&qid=1488990376&sr=8-3&keywords=micro+hdmi+cable

ASIN: B00Z07JYLE

Model Number: R-1108-HDMI-HDMI-6FT-BKx2

(Looks like 3' is the smallest cable size)

Battery Pack

Should probably wait until we see how much power the prototype consumes before buying a battery. This 10,000 mAh USB battery pack costs $12.99

http://www.mcmelectronics.com/product/29-7860?scode=GS401&utm_medium=cse&utm_source=google&utm_campaign=google&scid=scplp29-7860&sc_intid=29-7860&gclid=Cj0KEQiA9P7FBRCtoO33_LGUtPQBEiQAU_tBgKl4Ii44hPSy8IaEv1x77_F2qrV4wPcxyXFNRv9-x7IaAuyq8P8HAQ

Part Number: 29-7860

GoPro Alternatives

Two alternate solutions to using the GoPro are to use the official Raspberry Pi camera, or to use cell phones to stream the video. The Raspberry Pi camera is small, practically a breakout board with a ribbon cable. It costs about $30. It supports 1080p30, 720p60, and SD resolution. Streaming is easily done with the Raspivid program. The disadvantage is that the form factor of the camera would be fragile, so a suitable case for the Pi and camera would have to be obtained.

The second alternative is to use a cell phone to stream the video. The iSpy software can interact with an open source Android app called IP Camera. This app accesses the phone camera and streams this video as an IP camera. The disadvantage to this idea would be packaging of the phone on the soldier, and if the app works on the phones that we have.

7.2. Annex 2: DLVC/SIDFOT System Startup Instructions

Sensor Network

- For devices connecting to the 511 Vlan (10.50.11.x) use this config on the ToughSwitch Port: Vlan1-E, Vlan 511-U, Vlan 600-T
    - Devices would be AP's like loco's, 1st gen M2 Rockets, Camera's and AC AP
- For devices connecting to the 600 Vlan (10.50.100.x) use this config on the ToughSwitch Port: Vlan1-E, Vlan 511-T, Vlan 600-T
    - Devices would be: 2nd Gen Rockets, NanoBridge's, and 1st Gen Rocket M5 (backhaul devices)

Day System

- **Note:** All IP addresses can be addressed from any client workstation on that side (day/night) of the network.
- **Note:** Login to all workstations (desktops and VM's) with username password: LVCSIDFOT/LVCSIDFOT
- **Note:** Usernames and passwords for all ToughSwitch's: ubnt/ubnt
    - Usernames and passwords for all Network Gear (loco's, Access Point, all other Unifi and Ubiquity gear): ubnt/ubntWINK
- **Note:** To logout of a thin client machine to switch to another – Hit the front power button on the think client machine once. This will then bring up a small menu which will start a countdown to auto logoff the machine and bring up the menu to connect to another thin client. Another option is to login to 1 thin client and RDP into the others (10.50.2.10, 10.50.2.11, 10.50.2.12, 10.50.2.13)
- Turn on (assuming they are off after a full shutdown, some will come on automatically):
    - Turn on UPS – Largest device on the very bottom of the rack. Hold down the long rectangular button above the LCD display until you hear the power click on.
    - Day LTE Router – 192.168.60.5
    - DTECH Main Power Switch
    - Scorpion (10.50.20.10) – labeled on the DTECH Box
        - Runs DHCP, DNS, and NTP for the Day network

        - **Note:** Adjust the time of this server. It will come online with the time it was last turned off with. It is the NTP server and the rest of the network will readjust once it has been modified.
    - Built in cisco switch in DTECH Box with 8 cables connected
    - Day Router (Cisco 1921) – 192.168.60.9 (password – Cl3mc0rP)
    - Day Switch (Cisco 3750) – 192.168.50.3 – username/password (cisco/E=Mc2Man) via telnet (PuTTY session) where most of the cables are plugged into
        - Note: currently the Cisco firewall below this switch is not handling traffic, its power will not have an effect on the network
        -
    - Turn on the 4 Dell Servers
        - These servers Run the Virtual Machines
        - Each of these boxes have 3 IP addresses
            - Thin client login IP – 10.50.1.x
            - IP address of Windows 7 running native on the box – 10.50.2.x
            - IP address of Virtual Machine once it has been started manually – 10.100.11.x
    - Use a thin client workstation and login
        - The menu will prompt the user to select a machine to login into
            - These will be thin client IP address – 10.50.1.x
            - Note – These IP addresses are only addressable from the thin client login
        - IP address to choose from – select 1 at login
            - **Note:** It is not necessary to use a thin client to login to each machine. Once you have logged in to a machine via thin client – you can then Remote Desktop (RDP) to the other windows boxes (either 10.50.2.10, 10.50.2.11, 10.50.2.12, 10.50.2.13)
            - 10.50.1.10 – This login will login into the 10.50.2.10 Windows machine which is running the Day Cry/ARR Playback box – Use

        the VMWare Desktop icon to start the Cry/AAR Desktop Machine (10.100.11.69)

        - 10.50.1.11 - This login will login into the 10.50.2.11 Windows machine which is running the RackSGX box – Use the VMWare Desktop icon to start the RackSGX server (10.100.11.70)
        - 10.50.1.12 - This login will login into the 10.50.2.12 Windows machine which is running the RackAAR box – Use the VMWare Desktop icon to start the RackAAR server (10.100.11.72)
        - 10.50.1.13 – This login will login into the 10.50.2.11 Windows machine which is running the RackCryengine box – Use the VMWare Desktop icon to start the RackCryengine server (10.100.11.71)
            - VPN Server Resides on this box
                - Open Oracle VM Virtual Box
                    - Start “VPN server” (10.100.11.254)
                    - You must login to server for VPN services to begin
                        - On top menu bar – Input -> Keyboard -> Insert Ctrl-Alt-Del
                        - Login to Administrator – Password – LVCDEACON
                        - Minimize Virtual Box and continue running in background
                        - Note: If there are issues with the VPN connection the issue would reside in this machine. Make sure the “Routing and Remote Access” service is started. It should startup automatically though.
    - **Note:** If everything is up and running and the network connection says that it is not connected try these things:
        - Open a cmd prompt – ping 8.8.8.8
        - Check the time of the Scorpion server (10.50.20.10)

            - Make sure NTP, DNS and DHCP services are running
        - Open time and date settings. Click to do a manual update from time server.
        - Or open cmd prompt – type **net time**
            - This may take a few minutes to change the time on the task bar
    - **Note:** To “break out” of a VM session hit CTRL+ALT, this will then bring mouse and keyboard functions back to main computer and out of the VM.
    - The Ethernet cable from the TS Pro (10.50.100.9) should be plugged into port 1 on the cisco main day switch (this is labeled on the switch) and connected to port 1 on the TS Pro switch (also labeled)
    - Note: This system also contains the 40TB NAS (10.50.20.19). The E: drive is where most storage is contained. The drive can be located by entering \\10.50.20.19\e into a windows explorer window or creating a permanent mapping of the drive.
    - **The DAY system should now be up and running. Ready to run an exercise.**

Night System

- **Note:** Login to all workstations (desktops and VM’s) with username password: LVCSIDFOT/LVCSIDFOT
- Note: Just as with the Day system make sure the power, lower rack UPS and LTE router have been turned on
- Turn on the “NIGHT CRY\AAR DESKTOP” Workstation (10.100.11.60)
- Locate the VM Ware Application on the Desktop and start the Night Cry\AAR Virtual Machine (10.100.11.69)
    - There is a purple desktop sticky note indicating this server is the Night machine
- Power on the server blades:
    - RackSGX (10.100.11.70)
    - RackCryengine (10.100.11.71)
    - RackAAR (10.100.11.72)
        - DHCP & VPN Servers Resides on this box

        - Open Oracle VM Virtual Box
            - Start “DHCP” server (10.100.11.254)
            - You must login to server for the services to begin
                - On top menu bar – Input -> Keyboard -> Insert Ctrl-Alt-Del
                - Login to Administrator – Password – LVCDEACON
                - Minimize Virtual Box and continue running in background
                - Note: If there are issues with the DHCP server issuing addresses the issue would reside in this machine. Make sure the “DHCP Server” service is started. It should startup automatically though.
                - Note: If there are issues with the VPN connection the issue would reside in this machine. Make sure the “Routing and Remote Access” service is started. It should startup automatically though.

- Remove the cable from the TS Pro to the Day Switch located in the Cisco 3570 Port 1, and move it Port 8 labeled on the Cisco SG500

- **The NIGHT system should now be up and running. Ready to run an exercise.**

Shutdown Procedure

Day System

- Login to each workstation (username/password: LVCSIDFOT/LVCSIDFOT) and push shutdown. If shutdown is not an option in a remote desktop session open a cmd prompt window and type: **shutdown –s –t 0**

- The systems are:
    - 10.50.2.10
    - 10.50.2.11
    - 10.50.2.12

    - 10.50.2.13
    - 10.50.20.19 - NAS
    - 10.50.20.20 – Discovery (might or might not be on. Used primarily as a backup server and is used to PuTTY into network gear)
    - 10.50.20.10 – Scorpion
- Do not need to worry about network gear. It will shut down fine when the power is turned off.
- Manually turn off the DTECH UPS switch
- Manually turn off the main server UPS in the rack
- Turn off the main breaker in the DLVC panel

Night System

- Login to each workstation (username/password: LVCSIDFOT/LVCSIDFOT) and push shutdown. If shutdown is not an option in a remote desktop session open a cmd prompt window and type: **shutdown –s –t 0**
    - The systems are:
        - 10.100.11.60 – The workstation running the Night Cry/AAR Box
        - 10.100.11.70
        - 10.100.11.71
        - 10.100.11.72
- Do not need to worry about network gear. It will shut down fine when the power is turned off.
- Manually turn off the main server UPS in the rack
- Turn off the main breaker in the DLVC panel

VPN Instructions

- In windows “Setup a new Network Connection” from the Network and Sharing Center

- Connect to a workplace
- Create a new connection, assuming the connection hasn't already been connected
- Use My Internet Connection (VPN)
- Internet Address (this will depend as to which system you are connecting to, Day or Night)
  - 166.246.55.173 – Night
  - 166.246.55.174 – Day
- Destination Name – Name does not matter, can be DLVC Day or DLVC Night. Just a reminder to the user as to which connection it is.
- Username: Administrator Password: LVCDEACON (No Domain)
- Finish
- Repeat for both Networks

- To connect click on the network icon in the taskbar
  - Select the connection you wish to connect to and connect.

<table>
<tr><td colspan="4">Time Checklist</td></tr>
<tr><td colspan="4">Is the time of this machine accurate?
Login with LVCSIDFOT/LVCSIDFOT for all machines (*expect for the two 10.100.11.254, Virtual Box machines, use Administrator/LVCDEACON)</td></tr>
<tr><td colspan="4">Day System Computer</td></tr>
<tr><td>Computer</td><td colspan="2">VM</td><td>Y/N</td></tr>
<tr><td>10.50.20.10 - Scorpion</td><td colspan="2">N/A</td><td></td></tr>
<tr><td>10.50.2.10 - Workstation</td><td colspan="2">10.100.11.69 – Day CRY/AAR Desktop</td><td></td></tr>
<tr><td>10.50.2.11 - Workstation</td><td colspan="2">10.100.11.70 - RackSGX</td><td></td></tr>
<tr><td>10.50.2.12 - Workstation</td><td colspan="2">10.100.11.72 – RackAAR</td><td></td></tr>
<tr><td>10.50.2.13 - Workstation</td><td>10.100.11.71 – RackCryEngine</td><td>10.100.11.254* – VPN Server (Oracle Virtual Box Server on Desktop)</td><td></td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4">Night System Computer</td></tr>
<tr><td>10.100.11.60 – Workstation with label</td><td colspan="2">10.100.11.69 - Night CRY/AAR Desktop (VMWare shortcut on desktop)</td><td></td></tr>
<tr><td colspan="3">10.100.11.70 - RackSGX</td><td></td></tr>
<tr><td colspan="3">10.100.11.71 - RackCryEngine</td><td></td></tr>
<tr><td>10.100.11.72 – RackAAR</td><td colspan="2">10.100.11.254* (Oracle Virtual Box Server on Desktop)</td><td></td></tr>
</table>

Network Flow

Day System	
Device	**IP Addresses**
WWW to LTE WAN	**166.246.55.174**
LTE LAN to Cisco 1921	**192.168.60.5**
Cisco 1921 from LTE	**192.168.60.9**
Cisco 1921 to Cisco 3570 (Day Switch)	**192.168.50.254**
Cisco 3570 from Cisco 1921	**192.168.50.3**
Cisco 3570 to TS Pro	**10.50.100.1**
TS Pro from Cisco 3570	**10.50.100.9**
TS Pro to Network	**10.50.100.x**

Night System	
Device	**IP Addresses**
WWW to LTE router	**166.246.55.173**
LTE LAN to Asus RTR WAN	**192.168.60.5**
Asus RTR LAN from to Asus RTR WAN	**192.168.60.9**
Asus RTR LAN to Cisco SG500	**192.168.1.253**
Cisco SG500 from Asus RTR LAN	**192.168.1.2**
Cisco SG500 to TS Pro	**10.50.100.1**
TS Pro From Cisco SG500	**10.50.100.9**
TS Pro to Network	**10.50.100.x**

IP Addresses of Interest

Device	IP Addresses
CAE Caesar	**10.50.11.**
CAE Apollo **SSH- Username: root Password: metiadmin**	**10.50.11.196**

Siris Streaming Instructions

- Open instance of VLC
    - It does not matter which machine this is done from. VLC is currently installed on most machines. Using the Cry/AAR desktop Machine (Day or Night – 10.100.11.69) will work.
- Click Media
    - Stream
    - Enter this string in the source line (all one line) depending on the camera:
        - Note: The stream profile for the cameras should take care of the username and password. If VLC does prompt for them use: root/admin
        - rtsp:// root:admin@10.50.11.143/onvif-media/media.amp?profile=quality_h264&sessiontimeout=60&streamtype=unicast
        - rtsp://root:admin@10.50.11.145/onvif-media/media.amp?profile=quality_h264&sessiontimeout=60&streamtype=unicast
    - Click Next to go to the "Destination Setup" screen
        - In this select "UDP (legacy)" from the drop down, also select "Display Locally"
        - Click Add next to UDP
        - Next
    - On the "Destination Setup" screen on the "UDP" tab
        - Add the Siris Address: 172.97.98.146
        - Port – We have been given a block of ports starting at 5000-5009
            - Select a port and record it so that the next camera can have a different port than was already used with this setup.
        - Click Next
        - Transcoding Options
            - Turn off "Active Transcoding" – If this is left checked it will crash VLC

            - In the “Profile” Drop Down select the first option “Video – H.264 + MP3 (MP4)”
            - Click Next
            - Clicking “Stream all elementary streams”
            - Click “Stream”
            - Enter Username and Password: root admin
        - The data stream should now be up and running. Repeat for each additional camera by changing the IP address in the RTSP stream declaration
    - Note: Multiple camera streams can be setup from the same computer. When one stream has started just click VLC again on the desktop and refollow the steps.
    - **Note: With the distance from the DLVC to the tower, running VLC streaming, even in UDP, bottlenecks the network and won’t allow other traffic out of the network. This was repeatable, where a data stream via VLC was setup and outside internet connectivity then would fail. Once the VLC stream was cancelled, the ability to access the internet returned.**

7.3. Annex 3: AAR Instructions

This document provides instructions for operating the 711HPW/RHAS After-Action Review (AAR) System when deployed as part of the overall deployable LVC kit.

These instructions include the following assumptions:

A KML exercise has been run.

The AARTool (in the deployed kit) was running during the exercise.

Video was captured (either GoPro or Axis camera video).

At least one sensor (phone or tablet) was turned on, running the SIDFOT application, and connected to SGX during the exercise.

AAR Video Playback Instructions

1. Playback
2. Load GoPro videos
3. Take card out of GoPro. Insert into card reader. Put card reader in computer.
4. Copy MP4 files from the SD card. Paste them into the appropriate GoPro folder, under the parent aar_videos folder
5. Run script to get MP4 in proper format.
6. VPN into the field network
   a. Go to Day or Night drive.
7. Go to iSpy Files. Choose date. Choose video folder.
8. Go into appropriate Field camera (eg, AXIS) video folders.
9. Select all relevant MP4 files. Right click. Click “Create Shortcut”
10. Move all Shortcut links to the appropriate local folder; My Documents/aar_videos

11. In each local folder for each field camera (eg, AXIS)- Run the create_data_xml_from_shortcut script

12. Remote desktop to the SGX

13. SGX - Run Playback Tomcat batch file

14. Desktop - Open eclipse. Run AAR Tool. Open KML Exercise file.

15. Desktop – Open AAR Video Playback

16. Desktop – StartPlayback

17. When done, close everything on desktop. On SGX, run the killer batch file

18. In the My Documents/AAR Playback/aar-video-playback folder, there is the config.js script

19. The AAR Video Playback utility folder (also referred to as the project root directory) can be located at the following path:

C:\Users\LVCSIDFOT\Documents\AAR Playback\aar-video-playback

20. Once the recordings are done, copy the GoPro videos in to appropriate folders in the AAR video repository folder (video directory) at the following path:

C:\Users\LVCSIDFOT\Documents\aar_videos

Make sure to create one folder per device/camera (if one doesn't already exist) and enter those folder names in to the config.js file located in the project root directory.

More on the config.js file later

(This file defines the top level directory where the video files you need are located. Only the folders named in the config.js will be traversed by the software. Another important feature of this file is that the order of the video playback windows in the tool is determined by the order of the folder names in this file. Video sources listed top to bottom in this file appear left to right and top to bottom in the video playback tool. If you want to change where a video appears in relation to other video streams in the tool, simply cut and paste folder names appropriately.

ENSURE that folder names listed in the config.js file appear exactly as they do in the file directory structure, are contained completely within single quotes ('), and are separated by commas after every line except the last entry before the braces.

21. Create folders for all the axis cameras in the video directory with the appropriate names and also enter those names in the config.js file.

22. Create shortcuts of the axis camera videos and copy the shortcuts to the respective folders in the video directory.

Creating data_1.xml files:

23. The AAR video playback tool uses xml files to know which files to load

24. Once all the GoPro video files and Axis camera video shortcuts have been copied to their respective folders in the video directory, open a terminal and traverse to the video directory at C:\Users\LVCSIDFOT\Documents\aar_videos

25. To generate the data files for the GoPro videos, cd in to each GoPro video folder in a terminal, and run the following command:

   ```
   node 'C:\Users\LVCSIDFOT\Documents\AAR Playback\aar-video-playback\create_data_xml_goPro.js' .
   ```

Note the '.' at the end of the command (preceded by a space)

26. To generate the data files for the Axis camera video shortcuts, cd in to Axis camera folder in a terminal and run the following command:

   ```
   node 'C:\Users\LVCSIDFOT\Documents\AAR Playback\aar-video-playback\create_data_xml_from_shortcut.js' .
   ```

Note the '.' at the end of the command (preceded by a space)

Running the AAR Video utility:

27. To run the video playback utility, cd in to the project root directory at C:\Users\LVCSIDFOT\Documents\AAR Playback\aar-video-playback and run the following command:

    - ➢ *npm start*

(Note: this can also be accomplished using the shortcut on the desktop.)

Run shortcut script from trailer. Then copy the data.xml and the shortcuts

7.4. Annex 3: DTT AAR Notes/Lessons Learned

- Timeline
    - Prior to travel
        - It was determined that the AFRL DWINK towers must be in a secure location due to potential theft and vandalism
        - It was discussed the DLVC/AFRL capability would have to provide its own internet connectivity and power (diesel generator).
            - In the future having a more robust internet connection, at both the collection site, as well as the debrief site would increase success greatly
            - Future logistical support from AT staff when it came to fuel and logistical equipment relocation during the exercise would be beneficial.
        - LIMFAC – receiving Verizon LTE routers 4 days prior to travel to then configure both day/night networks to work with them
            - 1 day delay while Verizon worked to get all 3 routers to address one another
            - Configure day/night networks to route traffic through the LTE routers
            - Establish VPN connection from 3rd LTE router slated for Davis-Monthan, AAR capability, back to the day and night networks
        - Packing the trailer and towers for transport took approximately 8 hours with 3-4 people.
            - Future – integrate a master packing list.
        - HPS's sent directly to AZ
            - Did not have time to do pre-integration work for the CAE medical mannequins
    - Travel to AT17
        - Logistics Company for movement of DLVC trailer was unable to perform last minute. An additional WSRI team member was recruited last minute, who had access to a vehicle capable of towing the DLVC, to tow the DLVC trailer to Florence, AZ from Fairborn, OH.

        - 3 Days of travel at 10 hours, approx. /day.
            - Day 1 – Dayton to Joplin, MO
            - Day 1 – Joplin, MO to Santa Rosa, NM
            - Day 3 – Santa Rose, NM to Florence, AZ
        - Flat tire on F550 in San Jon, NM
            - Tire replacement in Albuquerque, NM
    - Arrival at Florence, AZ
    - Zero Week
        - Unpack and unload
        - Range safety training
        - Boot system and locate nearest cell tower
        - Reconfigure all system components to UCT time
            - System was up and running and deployed on day 2
        - Drive to DM and pickup medical mannequins
            - Test their connectivity in the network
            - Create an ad-hoc network using a network switch and Wi-Fi Access Point for the familiarization training at DM
            - Transport mannequins back to DM for FAM training with Wi-Fi
    - Start of Exercise
        - Exercise Day 1
            - When powered on, 2 of the Virtual Machines running AFRL servers, were unable to obtain proper IP addresses.
                - The issue through troubleshooting ended up being a setting which was automatically reset in the host's network card settings for virtual network adapter in VMWare.
            - During the night exercise, the SGX server installed auto updates.

    - This prompted a recheck of all machines the next morning to ensure the windows update service was disabled.
  - Coordination of time of events was unknown.
    - Event started 4 hours after expected time
  - Mannequins were not used during this exercise
- Exercise Day 2
  - Last minute change of schedule and a struggle with communication, lead to a scramble to prep and deploy medical mannequins in time for start of exercise
  - Not all phones which were “kitted up” showed up in the Sensor Grid
- Down day
  - Received all phones from DM
    - Took phones to field and verified their connectivity to the wink1R network in an attempt to troubleshoot the issues with phones entering the network in Exercise Day 2
- Exercise Day 3 (BMGR)
  - Due to conducting an advanced visit to the range the week prior the exercise went very smooth.
  - Increased support from AFRL allowed for rapid deployment of the system.
  - Prior determination of what were the minimum, yet required components for a rapid deployment, greatly decreased setup and teardown timeframes
- Down Day
  - Received all phones from DM with AFRL assistance throughout the day to troubleshoot phones entering the sensor grid once more
    - It was determined that the SIDFOT application varied on the Android phones.
    - The phones were then standardized on the version of the application

      - Retested the phones connecting to the network as well as ran a practice exercise
  - Exercise Day 4
    - Mannequins were successfully deployed to the field
      - Mobile Wi-Fi solution (AP, switch, battery) was able to successfully allow control of the medical mannequins in the field and beyond the Wi-Fi network coverage
      - A higher fidelity of phones populated the network due to the testing and application standardization on the prior down day.
- End Exercise
- Prep for Travel Back to Dayton
  - 2 individuals fulltime doing teardown, packing and tower retrieval and a 3rd running equipment to and from DM
- Travel Back to Dayton
  - Logistics of the travel back was handled by 2 individuals. In the future 2 additional individuals (2 per vehicle) would be advised.
  - 3 Days of travel at 10 hours, approx. /day.
    - Day 1 – Florence, AZ to Santa Rosa, NM
    - Day 1 – Santa Rosa, NM to Joplin, MO
    - Day 3 – Joplin, MO to Fairborn, OH

Key Lessons Learned

- More manning the better
  - 2 WSRI reps during the entire exercise and transport is not enough to handle the load of responsibilities and logistics
- Increase communication at all levels
- More prep work with the technology
  - Time standardization
  - Phone application standardization