STATEMENT OF OBJECTIVES FOR
Day and Night Heads-up-Display (DANHUD)

I. INTERNATIONAL **TRAFFIC AND ARMS REGULATION:** The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Vendors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with the solicitation.

II. **OVERALL OBJECTIVES**: In order to achieve the goals of enhancing operator capability and situational awareness while decreasing white-light self-illumination risk, a HUD system (including a Modular Smart Battery Pack) that is capable of working both 'stand-alone' in daylight conditions and also in conjunction with the currently issued NVGs (AN/PVS-31A) and future Advanced Night Vision Goggles (A-NVG) with integrated cameras/displays for night operation is required. In addition, the HUD system needs to be able to receive data from an EUD operating ATAK, and also be capable of powering and interfacing with helmet-mounted directional laser warning devices. The solutions provider shall create an Interface Control Document (ICD) that allows 'plug-and-play' upgrades to the DANHUD system in the future. The development of the technical requirements (listed in section V) could be proposed to be broken out into separate phases as the solutions provider sees fit. The solutions provider should expect to collaborate with USSOCOM operators to refine operator touchpoints and functionality throughout the development of the system.

III. **DELIVERABLES**:

A. **PROTOTYPE DELIVERABLES:**
   a. A total of 8 complete **TRL-6** DANHUD kits
   b. Complete ICD between DANHUD Display Module and DANHUD Modular Smart Battery Pack

B. **TRAVEL COSTS:** The solutions provider is responsible for any travel costs incurred to demonstrations/user feedback events.

C. **DOCUMENT DELIVERABLES:** The solutions provider shall provide the following documents
   1. Monthly Status Reports
   2. Preliminary Design Report (PDR)
   3. Interface Control Document (ICD) between the Display Unit and the Modular Smart Battery Pack.
   4. Critical Design Report (CDR)
   5. Final Report

IV. **TECHNICAL REQUIREMENTS**

It is expected that all prototypes delivered at the end of this effort will be **TRL-6.** A higher TRL is also acceptable.

a. DANHUD: Display Unit:

i. **Overview:** The DANHUD Display Unit (hereafter referred to as just "Display Unit") shall be a see-through display that provides information to at least one eye of the operator. It is desired that a single Display Unit can function both stand-alone during the day, and at night in conjunction with

the PVS-31A without degradation in capabilities. However, solutions that utilize separate Display Unit hardware for day and night will be considered.

ii. The Display Unit shall be interoperable with the Ops-Core FAST helmet without interfering with the ability for the operator to mount Night Vision Goggles (PVS-31A using the Wilcox L4 G24 mount) to the helmet. The Display Unit also shall not interfere with COMTAC hearing protection attached to the helmet. [If separate Display Unit hardware is proposed for day and night, it is acceptable that the day HUD would prevent the operator from mounting PVS-31A to the helmet at the same time as the day HUD].

iii. If not integrated into ballistic eyewear (or attached to the PVS-31A NVG):
    1. The Display Unit shall still allow the operator to wear ballistic eye protection.
    2. If not integrated into ballistic eyewear, the Display Unit shall be user-configurable for left or right eye usage.
    3. As an objective, the Display Unit should be able to be moved to a "stowed" position outside of the operator's field of view while minimizing snag hazards.

iv. The Display Unit shall be capable of displaying text, MILSTD-2525 symbols, maps, images, and full-motion video.

v. The Display Unit shall have user-adjustable brightness to allow use in both bright daylight and nighttime conditions. As an objective, the Display Unit should also have an 'automatic brightness' mode.

vi. The Display Unit shall integrate sensors that allow the DANHUD system to calculate the look vector of the Display Unit/head pose of the operator.

vii. The Display Unit shall be compatible with the AN/PVS-31A night vision goggles, allowing the operator to utilize both the Display Unit and the PVS-31A at night. Important aspects to consider that may or may not be relevant depending on proposed Display Unit technology:
    1. Reflections between PVS-31A eyepiece and Display Unit lens (if between operator's eye and NVG)
    2. Independent movement of the PVS-31A and the Display Unit.
    3. The PVS-31A has a 40° field of view and a 25mm eye relief.

viii. The Display Unit shall have controls for the DANHUD system, either on the display unit itself, or an easily accessed location on the operator's helmet. This shall include a dedicated "blank screen" button that removes all displayed items from the screen until the operator presses another button.

ix. The Display Unit shall have a wired connection (with connectors on either end of the cable) to the DANHUD Modular Smart Battery Pack. Wireless-

only connectivity between the Display Unit and Modular Smart Battery Pack is not permissible for this effort.

b. DANHUD: Modular Smart Battery Pack:

i. **Overview:** The DANHUD system shall have a helmet-mounted Modular Smart Battery Pack (MSBP) that provides power and computing capabilities for helmet mounted devices (such as the DANHUD Display Unit). The MSBP shall enable flexible operation of the DANHUD system in four distinct modalities:

1. Day Operation: Connected to the DANHUD Display Unit
2. Legacy Night Operation: Connected to the DANHUD Display Unit while also providing power to PVS-31A.
3. Next-Generation Night Operation: Connected to an Advanced-Night Vision Goggle (A-NVG) (including/such as the ENVG-B, F-BINO, and F-PANO), providing power and fused thermal/Augmented Reality (AR) to the A-NVG.
4. Night Vision Only: Providing power-only to the PVS-31A.

ii. **Hardware Processing:** The MSBP shall contain processing hardware capable of performing all AR-related calculations required by the DANHUD system – this is expected to include, but is not limited to:

1. Communicating with the operator's End User Device (EUD) to receive navigation points, points of interest, GPS data, photos, video feeds, and additional data.
2. Determining the head pose of the operator based on data from sensors in the Display Unit (or in the A-NVG).
3. Calculating the position of georeferenced AR data within the operator's Field of View.
4. Driving/communicating with the Display Unit or A-NVG to display AR data to the operator.
5. When utilized with A-NVG, fusing the sensor video feed of the A-NVG with the Augmented Reality overlay, then providing AR enhanced video feed back to the internal A-NVG display, with no user-perceivable latency.

iii. Mounting & Data Communication:

1. The MSBP shall mount on the rear of an Ops-Core FAST Helmet.
2. The MSBP shall be low profile, light weight, and designed to minimize 'snag' hazards.
3. The MSBP shall be capable of interfacing with ("plugging in to") both the Black Diamond Advanced Technology (BDAT) Apex Hub and the Glen Air Starpan Hub to pass data to/from the EUD/external devices & to receive power.

4. The MSBP shall be capable of outputting the feed of any attached camera sensor (such as the camera of an A-NVG) as a USB video class that does not require special drivers to utilize. This USB video class stream shall be accessible through the same cable that connects the MSBP to the body worn hub/EUD.
5. The MSBP shall have an internal GPS receiver and shall also be capable of receiving GPS data from an external device (such as the EUD/ATAK, or a separate GPS receiver).
6. All hardwired connections from the MSBP to the Display Unit shall have connectors on either end of the cable.
7. The MSBP shall have both Bluetooth and Wi-Fi transceivers to allow wireless connectivity. These transceivers shall also be capable of being entirely disabled to eliminate all radio emissions from the MSBP if required by the user.
8. The MSBP should be able to communicate with and provide power to helmet-mounted directional laser warning sensors.
9. An ICD (mechanical, electrical, and software) between the MSBP and Display Unit shall be created to allow for future independent upgrades/changes to either the MSBP or the Display Unit.

iv. Storage & Standalone Use:

1. The MSBP shall be able to store ATAK map data, DTED, navigation routes, check points, and other POIs/mission data locally on the MSBP, and shall be capable of operating without being connected to an EUD if desired by the user.
2. The DANHUD system shall be capable of functioning with the last known set of information if the connection between the EUD/ATAK and the MSBP is lost or interrupted. The MSBP shall notify/alert the user that the connection has been lost and historical data is being utilized.

v. Modular Smart Battery Pack: Power

1. The MSBP shall be capable of operating from (at the minimum) the below battery configurations:
    a. 6x L91 (Lithium AA)
    b. 8x CR-123
    c. 4x 18650 Rechargeable Lithium
2. The MSBP shall split the batteries into two separate compartments/bays and shall allow the user to ‘hot swap’ the batteries – allowing the user to change out the batteries within 45 seconds in one compartment/bay without the MSBP (or any devices powered by the MSBP) shutting off.

3. The MSBP shall not be damaged if different cell configurations are installed in each bay. As an objective, the MSBP should be able to function with different cell configurations in each bay.
4. The MSBP shall not be damaged if the batteries are inserted backwards (reverse polarity) into the battery bays.
5. The MSBP shall be capable of being powered via the connection to the body worn hub (BDAT or Glen Air).
6. The MSBP shall monitor battery life and alert the user as expected battery life drops beneath a user-configurable threshold. The MSBP shall also allow the user the ability to configure battery life threshold values where functionality 'gracefully decays':
    a. Battery life % where Augmented Reality-related processing hardware turns off & the DANHUD display unit shuts off (if both the DANHUD display unit and PVS-31A NVGs are connected)
    b. Battery life % where the thermal/digital sensor of any attached A-NVG shuts off, along with any other device being powered by the MSBP (such as a helmet worn laser detection device)

    The intent is that the I^2 channel of any NVG being powered by the MSBP is the last thing to turn off/lose power.

c. DANHUD: Display Software/ATAK Integration:

Overview: The DANHUD Display Software shall take in data from sensors [expected to be a MEMS-based Inertial Measurement Unit (IMU)] in the DANHUD display unit or connected A-NVG, and combines this with position data from an external device (such as GPS from ATAK) to calculate the user's 'head pose' to estimate where the user is looking in the 3D space of the real-world. This calculated head pose is then utilized to calculate where to display/anchor Augmented Reality information in the user's field of view. Additionally, the display software handles communication with ATAK running on the user's EUD to pull updated information/points of interest/new navigation routes/etc.

i. **Overarching modes:** The DANHUD Display Software shall have at least two display modalities:
    1. 'Light Augmented Reality' (L-AR) that displays information in a "2D" manner, such as (but not limited to) showing points of interest & map data on a radar plot, compass heading/ring, imagery and video, etc.
    2. 'Full Augmented Reality' (F-AR), which includes all items of L-AR with the addition of georeferenced iconography (navigation

points, target locations, friendly/enemy locations, etc.) overlaid/anchored to their respective real-world locations in the DANHUD system field of view.

a. Displayed georeferenced icons shall be within a 2-degree radius of the object's 'true' (as provided to DANHUD via ATAK) position in the operator's field of view.

ii. Communication with External Devices:

1. The DANHUD software shall allow the user to select and import (from the EUD) different ATAK map data layers for display in the DANHUD system – such as GRG, routes, points-of-interest (POI) etc.
2. The DANHUD software shall utilize position information from external sources (such as ATAK or an external GPS unit) and shall notify the user when position is no longer being received (i.e., loss of GPS signal) – in this case, the DANHUD software shall utilize the last reported position.
3. The DANHUD software shall have provisions to take input from a user-carried Directional Laser Warning System and display both a warning to the user and the direction of the incident laser.
4. The DANHUD system should require minimal user (and should guide the operator) to configuration/setup to function with ATAK running on the Operator's EUD. This includes (but is not limited to):
    a. Minimizing effort required to load/pass DTED data & map data to DANHUD.
    b. Minimizing user input during the initial network configuration between the DANHUD and EUD. Operators should not be required to manually enter IP addresses of any DANHUD components in order to link the EUD to DANHUD.

   It is envisioned this will be accomplished by a DANHUD plugin for ATAK that handles setup, configuration and management of the DANHUD system.
5. The DANHUD system shall allow the operator to configure different 'mission profiles' via an ATAK plugin or application running on the EUD. These profiles shall have the ability to have different display items (such as, but not limited to a radar plot of points of interest, compass ring, alphanumeric data, jump master data, imagery) arranged in an arbitrary, user-selected manner in the DANHUD system Field of View.

iii. The DANHUD system shall allow the operator to easily move/scroll through different pre-configured mission profiles via a hardware button

press/action. The DANHUD software shall also have a provision for a 'blank all' button to remove all AR items from the user's view.

d. DANHUD: Environmental & EMI:

i. **Overview:** The DANHUD system shall be ruggedized and environmentally hardened to be able to survive and operate in SOF environments:

1. Temperature: In accordance with MIL-STD-810G, Method 501.5 High Temperature and Method 502.5 Low Temperature, the DANHUD System shall withstand storage and transit temperatures ranging from -37°C to +52°C and operate without degradation at temperatures ranging from -37°C to + 52°C.The DANHUD System shall display no degradation and allow immediate operation when removed from a hot or cold vehicle or storage area.
2. Waterproofing: In accordance with MIL-STD-810G, Method 512.5 Immersion, the DANHUD system shall not be damaged or experience any degradation in performance after being immersed in salt water or fresh water for a period of 2 hours without the aid of a dive bag to a depth of 1 meter.
3. Pressures: In accordance with MIL-STD-810G, Method 500.5 Low Pressure (Altitude), the DANHUD system shall be transportable and function effectively without degradation at altitudes up to 30,000 feet above sea level.
4. Salt/Fog: In accordance with MIL-STD-810G, Method 509.5 Salt/Fog, all external surface finishes of the DANHUD system shall be rust and saltwater corrosion resistant and shall not be degraded or damaged when exposed to an environment with 95% humidity and 35°C for a period of 48 hours.
5. Sand and Dust: In accordance with MIL-STD-810G, Method 510.5 Sand and Dust, the DANHUD, with all lenses covered, shall not be damaged and shall operate without degradation after exposure to fine sand and dust particles for 90 minutes on each side.

ii. The DANHUD system shall not be susceptible to nearby electromagnetic interference from body worn equipment.