WHITE PAPER

SMALL TACTICAL MULTI-PAYLOAD AEROSTAT SYSTEM (STMPAS)

A New Surveillance and Communications Capability For Post Disaster Communications

Low Cost

Long Mission Duration

Minimum Manpower

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STMPAS For Post Disaster Communications

1.0 BACKGROUND Natural disasters, industrial accidents, and terrorist acts often degrades essential emergency communications systems. With widespread power outages infrastructure such as cell towers will only operate as long as their battery backups last. Local, state and federal response agencies will need to cover very large areas. In the case of Hurricanes and blizzards the affected zone may spread over hundreds of miles. Short range communications provided by mobile communications towers are inadequate for the urgent requirements. Response agencies including the National Guard need low cost, responsive, and mobile equipment for wide area resilient and durable communications.

The most efficient means to meet these needs is an aerostat (Tethered helium balloon). Mobile towers are height limited, providing only short range coverage. Aircraft or UAS are expensive, have limited endurance and cannot operate in some restricted flight zones. Aerostats provide coverage of large area, comparable to aircraft or UAS, but with persistence of days and weeks instead of hours. However, traditional aerostats are large, manpower intensive and cannot operate in adverse weather conditions. They are expensive while their ground equipment has very limited mobility and lengthy set-up times, precluding their use in almost all Post Disaster situations.

To provide a system that removes the limitations of conventional aerostats Carolina Unmanned Vehicles (CUV) developed the **Small Tactical Multi-Payload Aerostat System (STMPAS)**, creating a mobile cost effective aerostat system. Originally developed under the name Lightweight Aerostat System (LAS), it was renamed STMPAS when it was deployed by the Army to Afghanistan. Earlier versions were built for the USAF, Sandia National Lab, and Lockheed Martin. STMPAS consists of a small specially designed tethered blimp, called a Helikite, mounted on a single HMMWV trailer Carrier, operated by a two person crew (Fig. 1). A STMPAS relay blimp at 4000 feet provides communication coverage out to 80 miles from its location 24 hours a day for a week or more without maintenance or downtime. Only a few systems can cover most of a state, without any dependence on electrical power or cell tower infrastructure. Cost is a fraction of using aircraft or multiple mobile communications towers.

STMPAS is very mobile and cost-effective through use of unique designs to reduce the need for ground crews to handle the blimp during launch and recovery. Operating and maintenance cost is a fraction of the cost of using aircraft or UAS to lift surveillance or relay payloads. It does not require the complicated flight clearances needed for UAS deconfliction with manned aircraft. In addition to communications use STMPAS equipped with camera turrets can provide 24/7 surveillance of large outdoor events such as a NASCAR race or political convention, or coverage of traffic and security for outdoor concerts and similar events. Surveillance versions up to 1,000 feet can cover a 20 mile radius, depending upon terrain.

2.0 MAJOR SUBSYSTEMS STMPAS consists of several unique components that, taken together, comprise a system far smaller and more versatile than any comparable unit. Each component emphasizes the strengths of the

Fig 1 **Small Tactical Multi-Payload Aerostat System (STMPAS)**

Missions:

Outdoor Event Surveillance / Security / Traffic Control

Post Disaster Wide Area and Remote Area Communication

Election Event / VIP Security

Attributes:

High Mobility On and Off-Road Trailer

Helikite Launched From Carrier For Safe Operation, Move While Inflated

Self-Contained With Rugged Diesel Generator, Electric Winch, Helium Racks and Inflation Manifold

Operable by 2 Persons

Low Fuel, Maintenance, Other Costs

others to produce a small, highly mobile capability unequalled by other aerostat systems. STMPAS consists of three major subsystems: The Helikite, Carrier, and Payloads.

2.1.1 Helikite Key to a small, mobile and cost effective aerostat system is to use of a Lifting Aerostat, which is an balloon with aerodynamic lifting surfaces. STMPAS uses the most mature and efficient lifting aerostat on the market, the Helikite. Helikites are lighter-than-air like a blimp but are not knocked down by wind. Wind forces on the kite wings generate lift to counteract the wind side force, so even very small sizes operate easily in high wind. This allows STMPAS to be designed with modern lightweight electronics and be a fraction of the cost and manpower of traditional lighter-than-air designs. The STMPAS Helikites are able to fly in winds up to 70 mph. Other aerostats must be considerably larger to withstand wind forces, so they cannot be designed for small payloads and mobile ground equipment. Helikite performance is the key that allows STMPAS to be very compact, use minimum helium and be operable by only two people.

Helikites are inherently safe, with only about ½ psi pressure and is a non-stretch material, so even if it develops multiple tears it does not "pop" and only slowly deflates over several hours. It remains operational during that time, and is easily repaired and returned to service. The non-flammable helium cannot burn. If the tether breaks it does not fall on people but floats upward. An automatic GPS based deflation device is carried to safely deflate the aerostat if it breaks from the Carrier, before it can drift into unsafe airspace. For safety to aircraft the aerostat can be equipped with standard lights visible to aircrew, or with IR lights visible only with night-vision goggles.

2.2 Carrier The Helikite allows even a small aerostat to withstand real world wind conditions, means STMPAS does not require the large, clumsy pivoting mooring system used by other aerostats. Until launch the uninflated STMPAS Helikite is contained in a mobile Carrier with helium tanks, electric generator, and a winch. Use of a single military HMMWV trailer provides good ground clearance for flood and off road capability, also ensuring maximum ruggedness and maintainability. Many comparable aerostat handling systems require multiple trucks for carriage. Carriers are off road capable, air transportable and can respond to any location accessible by a HMMWV and trailer. The Carrier can operate Helikites of varied sizes, optimized for the particular payloads and operating conditions. Tethers can be non-power for battery powered payloads, or powered with data / power wires and fiber-optic lines, for continuous 24 / 7 operation. A rugged diesel generator provides low fuel consumption and safe operation. All operations are done by a two person crew, minimizing operating cost.

The STMPAS Carrier provides a Launch Box atop the trailer, allowing Helikite launch directly from the trailer. This also allows stowage of the inflated Helikite on the trailer top when not aloft, so that it does not have to be deflated in the event of adverse weather. In areas without overhead obstructions the inflated Helikite can be moved while stowed atop the Carrier and quickly elevated after stopping, for a "quick look" at an area of interest. It can even be kept aloft during movement, for total surveillance and communications coverage.

2.3 Payloads STMPAS provides a unique and cost effective overhead capability for many electronic payloads. The main usage categories are communications and surveillance. STMPAS can act as a relay platform for voice communications, as a network bridge for interconnecting ground computers and networks, and as relay point for dissimilar communications systems, particularly in mountainous border terrain.

2.3.1 Relay Platform for Emergency Communications STMPAS can act as a communications relay platform for emergency response and law enforcement units, particularly in mountainous or urban terrain. It could be used to temporarily replace cellular towers damaged by hurricanes, earthquakes or tornadoes, providing emergency management communications to FEMA or other agencies at a critical time. In this role, the STMPAS payload could relay communications over a wide coverage area. Emergency responders would have seamless communications with remote personnel at extended ranges, with no dependence on (potentially) inoperative wired, cellular or point-to-point communications links.

Figure 2 shows potential coverage over the Eastern North Carolina area affected by Hurricane Floyd in 1999 as an example. A Helikite at even a few hundred feet altitude covers several counties. STMPAS to STMPAS relay allows communication to regional Command Centers.

2.3.2 Networked Bridge Communications Network Bridge Access to computer communications and emergency networks is critical for responders and emergency management. STMPAS can act as a "router in-the-sky", providing seamless connection of computer and network resources. Ground networks or individual computers would communicate to the bridge using inexpensive wireless network interface cards, bi-directional amplifier and antenna. This provides simultaneous "many-to-many" communications from one STMPAS.

2.3.3 Translation For Interoperability Communication interoperability between local, state and federal agencies has been a major problem in all natural disasters and terrorist incidents. In the translator role STMPAS would receive multiple signals from various agencies, translate them in a ground terminal on the Carrier and then rebroadcast the signals to users equipped with different equipment. Translator hardware is expensive, so STMPAS's broad area coverage enhances the utility of the translator system by eliminating the need for multiple vehicle mounted translator nodes. This maximizes communications interoperability between local, state and federal units with minimum investment.

2.3.4 Persistent Surveillance Payloads As noted STMPAS can also provide airborne surveillance is critical events and locations, both in normal operations and in post disaster situations. A short range surveillance payload may be a fairly simple remotely controlled camera. Long range, large area coverage would use a gryo-stabilized pan-tilt-zoom Electro-Optical (EO) and/or Infrared (IR) surveillance camera payload with day / night capability, with an included portable Ground Control System. These are adapted from those used on various military Unmanned Aerial Systems (UAS).

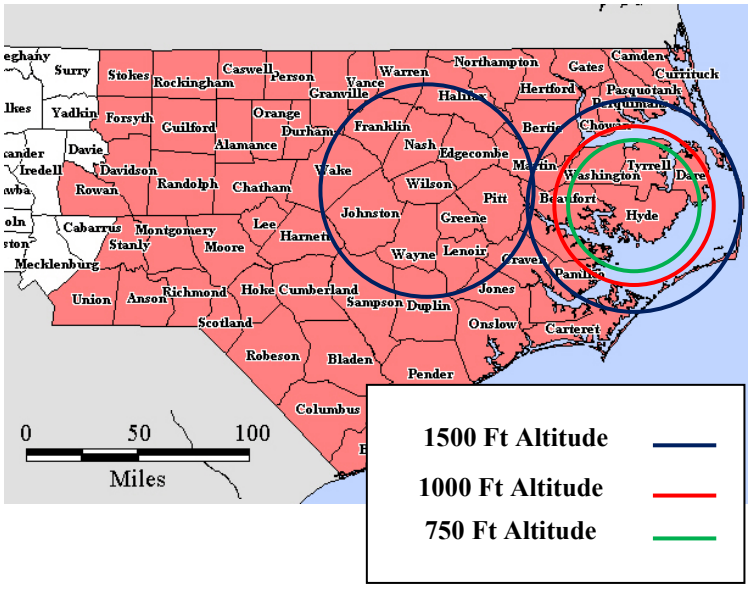
2.4 Field Operations Basic operation is versatile since STMPAS is completely self-contained, with electrical power and all essential equipment on one trailer. The Carrier is towed to an operating location by a HMMWV or pickup truck. A typical operating site is a clear area approximately 90 feet across without trees, power lines or other overhead obstructions. Once on site the two person crew inflates and launches the Helikite. The primary crew tasks during while the Helikite is aloft are operating the surveillance payloads and periodically refueling the generator or running the winch. It carries helium for one inflation and several weeks of helium to "top-off" every 3 to 5 days. It can remain aloft for a week or more if using a power tether, or brought down about once every 12 to 24 hours to change batteries if using a non-power tether.

STMPAS requires a much lower level of skilled personnel than UAS or manned aircraft systems, and requires fewer of the skilled personnel. This makes it ideal to provide to smaller agencies with fewer personnel. For many

Fig. 2 **STMPAS Coverage Example (North Carolina Hurricane Response)**

STMPAS communications relays can cover large disaster areas, such as the Eastern NC counties area affected by Hurricane Floyd in 1999, with a STMPAS to STMPAS relay to the State Command Center in Raleigh.

STMPAS is mobile and air transportable to get to the disaster quickly, providing one-to-one Communication Relay, multiple user Network In The Sky, and a Translation Bridge for enhanced multi-agency interoperability.



applications such as disaster response STMPAS could be operated by part time National Guard or contractor personnel. As a ground based system it presents fewer deconfliction problems than UAS.

1.2 STMPAS Operational Advantages Compared to towers, UAS and aircraft STMPAS has significant operational advantages for mobile surveillance and communications relay:

Mission Duration	Duration of weeks or more, requiring only a helium "top-off" about once a week
Acquisition Cost	Considerably less than aircraft or multiple mobile towers.
Operating Cost	Low cost per operating hour. No pilot proficiency flying, etc.
Manpower	Very low, requiring only two persons to launch and retrieve the system. These can be the same people as the communications / sensor operators.
Deployment	Road and off-road mobile, no fixed infrastructure
Operating Restrictions	Minimal FAA restrictions, No noise, unobtrusive, no danger of falling on civilians
Coverage Area and Capabilities	Up to 80 miles radius for communications relay. Can function as a translator node and a network-bridge-in-the-sky, providing seamless multi-agency interoperability and connection of computer / networks across a wide area. Several miles radius for surveillance, limited by camera resolution.

5.0 SUMMARY STMPAS an excellent platform for post disaster communications relay concepts and other missions. It can provide low cost, highly mobile platform with a mission duration of a week or more. It can operate in weather conditions too severe for many UAS or aircraft, or other aerostats, and does so without endangering an aircrew. It is a cost effective solution to many missions.

For further information, or to discuss technical, cost or other issues, please contact us.

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