ERRATA

To: Recipients of TR-234-A, *High-Altitude Airships for the Future Force Army*, by Lewis Jamison, Geoffrey Sommer, and Isaac R. Porche III, 2005

From: RAND Corporation Publications Department

Date: January 2008

Re: Corrected pages (pp. 2–3, 49)

On pages 2 and 3, three quotations that were attributed to a different source have been updated to reflect the correct source.

Under the section "Free-Floating Balloons":
"Free floaters are basically . . ." (p. 2)

Under the section "Steered Free-Floaters":
"Steered free-floaters also drift . . ." (p. 2)

Under the section "Maneuvering Airships":
"It is primarily maneuvering vehicles . . ." (p. 3)

The source for these quotations has been added to the document's bibiography (p. 49):

Tomme, Edward B., "The Paradigm Shift to Effects-Based Space: Near-Space as a Combat Space Effects Enabler," Maxwell AFB, AL: Airpower Research Institute, research paper 2005-01, 2005.

This has been corrected in the current pdf, which is available here for download.

We regret the inconvenience.

More vertical nodes (air and space) will be needed. According to an analysis of alternatives (AoA) done by AMSAA (2005), mobile subscribers can reliably communicate throughout the area of operations (assuming a Caspian Sea theater), only with vertical nodes. Military and commercial satellites are costly (Bonds, 2000) and require either expensive geosynchronous satellites or many low- or mid-earth-orbit satellites. Potential alternatives to satellites are solar-powered, high-altitude airships and airplanes flying at 65,000 feet or above. The AoA report determined that airborne line-of-sight resources reduce SATCOM use by more than a third, as compared to without it. Thus, there is strong motivation for using airborne line-of-sight relays like high-altitude airships. Airship proponents envision payloads that could support communications, surveillance suites, and/or weapon systems. The objective of this report is to inform the Army about the usefulness and limitations of airships in roles of supporting communications and surveillance functions in a theater "infosphere."

Background

While this report will center on lighter-than-air (LTA) maneuvering airships, other varieties of LTA craft that can carry payloads with different characteristics exist and may also be considered by the Army for some tasks. The following categories of LTA craft describe three different levels of maneuvering capabilities.

Free-Floating Balloons

"Free floaters are basically the simple weather balloons many people imagine when they think of lighter-than-air [craft]. They are very straightforward to construct and launch and very inexpensive but lack station-keeping capabilities. . . . Once launched, they are at the mercy of the existing winds. Limited steering is possible by variable ballasting, causing the balloon to float at different altitudes to take advantage of different wind directions and speeds. These balloons can take tens to thousands of pounds to over 100,000 feet, but more typical weather balloon payloads are on the order of tens of pounds. Free-floater systems have already demonstrated commercial viability as communications platforms" (Tomme, 2005, p. 18).

Steered Free-Floaters

"Steered free-floaters also drift on the wind, but they are able to exploit the wind much like sailing ships to maneuver almost at will. Sailing requires the vehicle to be immersed in two media moving at different speeds. . . . A large balloon at high altitude moves at a different speed through the air than a wing suspended below the balloon at a different altitude. The air around the wing is moving at a different speed than the air pushing the balloon. The entire platform is then steered when the differential wind between the two parts of the platform enables the wing to become aerodynamically effective. With the limited steering, these balloons can stay on station for short periods." A constellation of steered free-floater platforms would generally be necessary to maintain persistence (Tomme, 2005, p. 19).

Maneuvering Airships

The airship (synonymous with the term "dirigible") has a means of propulsion and a means of control. Propulsion can rely on fossil fuel, nuclear, or solar energy. Control can be attained through both aerodynamic and aerostatic means. These are maneuvering vehicles that do not require the continual replenishment of free-floaters or the large constellations of steered free-floaters to provide persistence. "It is primarily maneuvering vehicles that are the revolutionary technology behind the paradigm shift to effects-based space" (Tomme, 2005, p. 20).

Maneuvering airships have a long history of operations at lower altitudes. Germany developed long-range zeppelins and had made over 160 trans-Atlantic passenger-carrying flights until the Hindenburg, filled with flammable hydrogen, burned while mooring in 1937. The cause of the fire has been attributed not to the hydrogen but to electrostatic ignition of the flammable aluminum in the skin's silver paint. The U.S. Navy successfully operated patrol airships filled with helium for years before, during, and after World War II. Since World War II, commercial organizations such as Goodyear have successfully flown blimps for sightseeing, sports coverage, advertising, and other uses. The improvements in airship structures and operational procedures have progressed through the last century.

In the last few years, low-altitude transport airships have been examined by companies and organizations such as CargoLifter AG in Germany and Skycat Technologies in the United Kingdom. These airship concepts have been intended to lift heavy loads, up to 1,000 tons, and operate at altitudes below 10,000 feet mean sea level. None of these concepts have come close to fruition. The Center for Army Analysis (CAA) made an extensive study of transporting Army forces to overseas theaters using a CargoLifter CL 160 airship concept (CAA, 2001).

Aerostats

Another use of an airship-like concept is the aerostat, a tethered balloon-borne radar system that has been operational since 1980, used in an air defense and drug enforcement network with eight sites operated by the U.S. Air Force. The network uses two sizes of aerostats, 275,000 and 420,000 cubic feet, which carry two sizes of radars and operate at 15,000 feet. The radar products are fed to the U.S. Customs Service for anti-drug surveillance and to the North American Air Defense command (NORAD) for air defense (U.S. Air Force, 2003).

The use of aerostats for air defense has generated interest in the capabilities of high-altitude airships (HAAs) flying untethered but holding stationary positions to form a comprehensive surveillance net along U.S. coastlines. Furthermore, the Army Science Board in 1998–99 recommended that the Army "develop a surrogate satellite capability to augment/replenish space capabilities" (NORAD, USASMDC, 2003). Relatively speaking, aerostats are a mature concept. However, as noted by Bolkcom (2004), "the primary operational concern with employing aerostats appear to be vulnerability to weather and enemy ground fire." He notes that the latter is debatable: "Proponents argue that despite their large size, aerostats are survivable because of a low radar cross section and their ability to endure numerous punctures before gradually losing altitude. Low flying aircraft and UAVs are also vulnerable to enemy ground fire."

An Advanced Concept Technology Demonstration (ACTD) was initiated in 2003. Sponsored by the U.S. Missile Defense Agency (MDA), the goal of the effort is to design, build, and test an HAA prototype that is able to operate unmanned, maintain a geostationary position at 65,000 feet (21.33 kilometers (km)) for up to six months, generate its own power, and carry a variety of payloads. A study by the Massachusetts Institute of Technology (MIT) concluded that a line of ten HAAs could provide the needed air defense surveillance

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