Sanswire and World Surveillance Group Inc. (WSGI) airships

Peter Lobner, 3 April 2021

1. Introduction

The US firm Sanswire Technologies was founded in 2002 with the goal of developing "Stratellites," which became a trademarked brand name of Sanswire for a future emissions-free, high-altitude stratospheric airship that serves as a stationary communications platform for various types of wireless signals traditionally carried by communications towers or satellites.

In 2002, Sanswire engaged Canadian airship maker 21st Century Airships and their licensee Techsphere Systems International LLC (TSI) to test a spherical airship as a potential Stratellite platform. Two years later, in 2004, Sanswire was acquired by GlobeTel Communications Corp. By this time, Sanswire's focus had shifted to developing a large Stratellite of their own design, the Sanswire One. The prototype was built, but it never flew. A smaller prototype, the Sanswire 2A, flew successfully in 2006.

GlobeTel Communications and German firm TAO Group GmbH entered into a business arrangement and formed Sanswire-TAO LLC in June 2008. Regarding this business arrangement, TAO Group provided this 2020 retrospective report on their website:

> "Starting in 2005 Sanswire, an American company, was interested to learn more about our technology and airship '*Lotte*', the high altitude platform '*SkyDragon*' and the autonomous parachute system 'ALF.' In 2008 a Joint Company was established by the name of 'Sanswire-TAO' in Florida. The American partners should cover the marketing part of the German products for the US, Mexico and Canada. In the year 2010 the cooperation was closed (ended). The rights of our technology still belong to our TAO-Group in Germany."

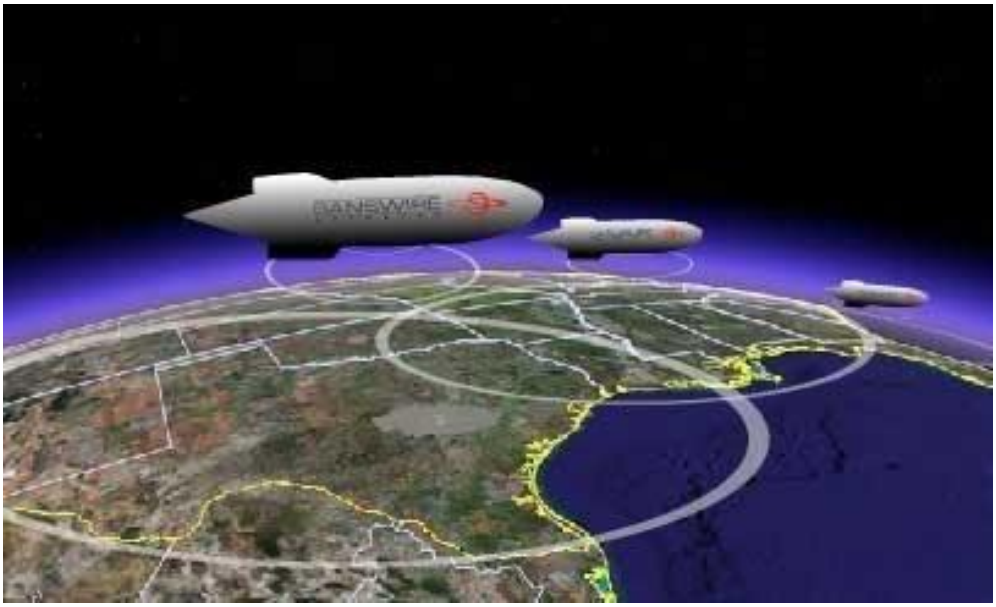
You can read the 22 March 2011 Securities and Exchange Commission (SEC) settlement report here: https://sec.report/Document/0001144204-11-017623/

Following the breakup of the joint company, Sanswire rebranded itself as World Surveillance Group Inc. (WSGI) in April 2011, after prior issues with the SEC had been settled through the payment of a significant civil penalty.

WSGI continued developing and demonstrating their low-to-medium altitude *Argus One* version of TAO Group's segmented STS-111 airship through 2014, and introduced a smaller Argus Hybrid aerostat / airship and a "Blimp-in-a-box" aerostat. Ultimately, WSGI failed and, on 23 June 2017, the SEC revoked its registered securities.

2. Sanswire's Stratellite concept

In the early 2000s, Sanswire and GlobeTel Communications Corp. developed the concept for deploying a constellation of high altitude Stratellites over the US to compete with communications satellites and terrestrial communication systems for delivery of a wide range of services. In addition to voice and data cellular communications services, a Stratellite could support multichannel, multipoint distribution services (MMDS), paging, fixed wireless telephony, high definition digital TV broadcast, and real-time intelligence, surveillance and reconnaissance (ISR) with a variety of remote sensing technologies.



Example of coverage provided by a constellation of three Sanswire Stratellite airships along the US Gulf Coast. Source: Sanswire

Relative to orbiting satellites, Stratellites offer the following advantages:

- A Stratellite has much more electric power available than an orbiting satellite and can operate more powerful systems to deliver higher bandwidth service with less signal latency and greater transmission power.
- Service subscribers will be able to communicate in both directions using available wireless devices. This feature is not practical with communications satellites.
- From its operating altitude of about 65,000 feet (19,812 m), each Stratellite has a service area of about 300,000 square miles (777,000 square km). For many smaller countries, only two Stratellites would be required to provide nation-wide service.
- A similar quality of service is available throughout the coverage area, even in remote areas that are difficult to serve with terrestrial systems.
- Stratellites are designed to remain on station for 12 to 18 months and then can return to a ground station for maintenance and upgrades while another Stratellite takes its place. Orbiting communications satellites are not designed to return to Earth and in-orbit maintenance is problematic at best.
- An on-station Stratellite can be repositioned, or a new one launched, within 24 hours of notice to provide emergency communication services over a disaster area.

This Sanswire and GlobeTel Communications Corp. concept is very similar to the concept developed in the late 1970s by Michael Walden and the US firm Lighter Than Air Solar (LTAS) for a high altitude airship platform they called Sub-Orbital Solar Collection and Communications Station (S.O.S.C.S).

3. Sanswire experiments with spherical airships (2002 – 2004)

In 2002, Sanswire engaged 21st Century Airships and TSI to develop a spherical stratospheric airship that could operate at altitudes of 60,000 to 70,000 ft (18,300 to 21,336 m) to deliver a variety of telecommunications, environmental monitoring and surveillance

services over a wide service area. It appears that preliminary tests were conducted with the SPAS-70 spherical airship.

Stratellite test with a Techsphere Systems International (TSI) AeroSphere designed by Hokan Colting / 21st Century Airships, circa 2004. Source: Achmed Khammas, Buch der Synergie, Part C(4)

A full-size spherical Stratellite concept was developed with a diameter of 260 feet (79.2 m) and a capability of carrying 4,000 pounds (1,814 kg) of telecommunications gear to an altitude of 13 miles (68,640 ft, 20,922 m) in the stratosphere, well above commercial air traffic, turbulent weather patterns and the jet stream. From a geo-stationary position at this altitude, the Stratellite would provide a coverage area of about 300,000 square miles (770,000 square km).

However, by 2004, Sanswire redirected their Stratellite developments efforts to their own design for the larger Sanswire One prototype.

Artist's rendition of a spherical, solar-powered Stratellite operating in the stratosphere. Source: ZDNet, 19 July 2006

4. The Sanswire One prototype (2004 – 2007)

Sanswire One was a large prototype Stratellite airship, measuring 188 feet (57.3 m) long, 60 feet (18.3 m) wide and 42 feet (12.8 m) high. It was designed to demonstrate the feasibility of an airship serving as a high altitude communications relay station. The prototype was intended to operate at about 45,000 ft. (8.5 miles, 13.7 km), which is about 20,000 feet (3.8 miles, 6.1 km) lower than the altitude planned for the production Stratellites. The prototype had a payload capacity of about 4,000 pounds (1,814 kg).

The rigid, aluminum frame of Sanswire One was built in sub-sections in a factory in San Bernardino, CA. Sub-assembly construction began in November 2004 and continued through December. Sanswire reported that 10,000 parts and over 60,000 aircraft rivets were used to fabricate the interior structure of the prototype airship.

The sub-assemblies were transported to a hanger for assembly of the complete rigid airframe, installation of the DuPont skin fabric (some sources say Tedlar, some say SPECTRA), and installation of the Mylar helium lift gas cells within the airframe. Final integration involved installation of the airship systems, including the electric motor driven propulsors, flight control and guidance systems, and the electric power storage and distribution system.

You can watch a short (1:03 minute) video of the partially assembled prototype here: https://www.youtube.com/watch?v=mb9aOvPP_sw

The rigid aluminum frame of the Sanswire One prototype during assembly, with some hull panels in place. Source: Sanswire.

An indoor launch (a float test inside the hanger) occurred in the first quarter of 2005. In May 2005, Sanswire reported: “We have done testing on the space frame and materials. The next plan is to go to an area near Edwards Air Force Base and, toward the end of summer, do a flight that will take the ship up to around 45,000 feet.” Sanswire moved its airship operations to Palmdale, CA in June 2005 to prepare for flight operations at Edwards AFB and install the mission-related communications equipment to be demonstrated during the flight tests.

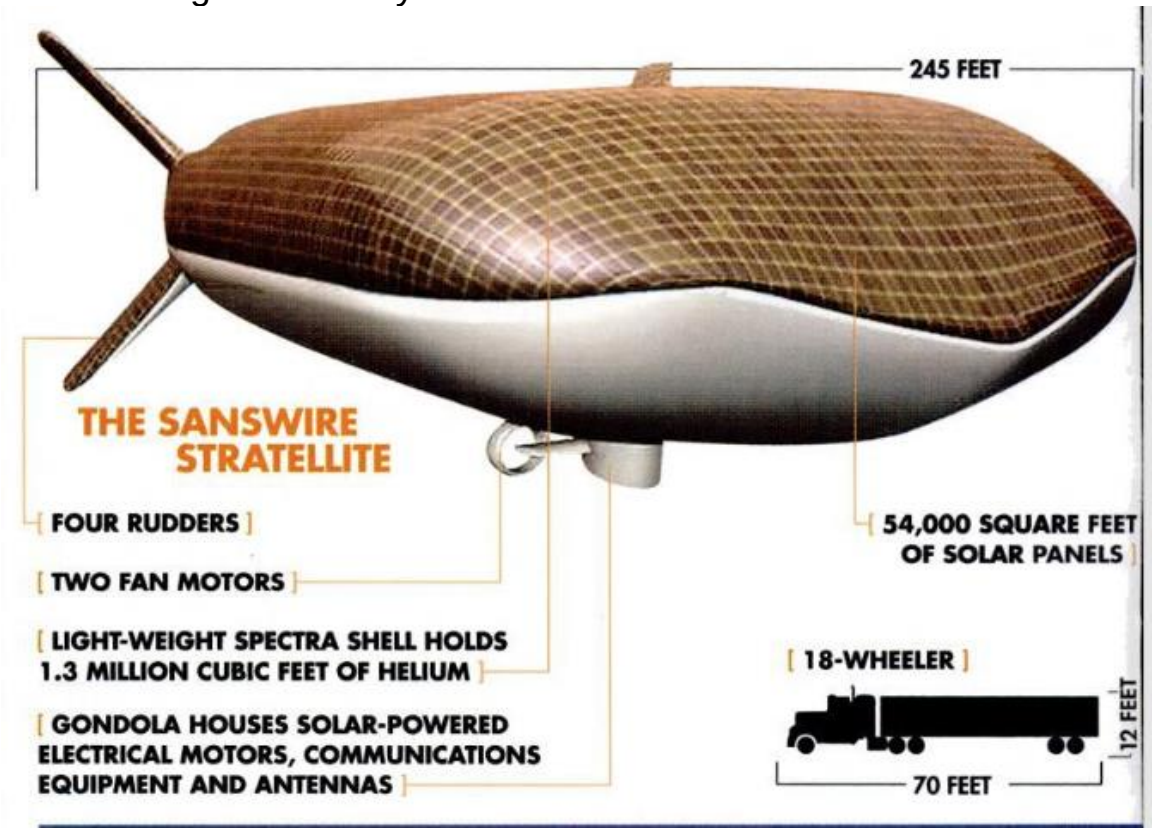
In-hanger float test of the Sanswire One prototype. Source: Sanswire

Helium retention was a problem for the Stratellite One, and Sanswire investigated new materials to help minimize helium loss. By 2007, no flight tests had occurred. Work on Stratellite One was abandoned at about this time. The prototype was dismantled and the aluminum frame was sold as scrap.

One of the small propulsors on the prototype. Source: Sanswire

5. The planned production Sanswire Stratellite

The production Stratellite was an advanced, rigid, composite, solar-powered lighter-than-air vehicle designed to operate either as an unmanned autonomous or remotely piloted system at stratospheric altitudes in geostationary locations.



Artist's concept of a production Stratellite based on the Stratellite One prototype. Source: Sanswire

Production Stratellites would have been about 30% larger than the prototype, with a length of 245 feet (74.6 m), width of 145 feet (44 m), and a height of 87 feet (26.5 m), yielding a total volume of 1.3 million ft^3 (420,000 m^3). The production Stratellite was designed to operate above the jet stream at a nominal altitude of 65,000 ft (12.3 miles, 19.8 km) with a payload of more than 20,000 pounds (9,072 kg).

Stratellite unit price was expected to be between $20 to 30 million, far less than the cost of a communications satellite, which at the time cost between $100 to $500 million. The full-scale Stratellite did not enter production.

6. The Sanswire 2A Technology Demonstrator (TD) Stratellite Airship (aka SkySat) (2006 – 2007)

The cigar-shaped Sanswire 2A Technology Demonstrator was a mid-altitude airship designed for communications and ISR missions performed at altitudes up to 45,000 ft. (8.5 miles, 13.7 km).

Sanswire 2A Technology Demonstrator inflated, but without the fin/rudder system installed. Source: AP via Tahoe Daily Tribune

On 20 October 2006 the Sanswire 2A completed its first outdoor, low altitude, tethered float test at the firm's facility in Palmdale, CA. For this test, the rigid hull/envelope structure was complete, with the fin/rudder system installed, but without propulsion or other airship systems installed. The test confirmed the structural integrity and overall balance of the airship.

In a subsequent tethered test on 15 December 2006, all airship and mission systems were installed. Using the airship as a communications platform, invited guests from government and industry were able to access the Internet, make VoIP telephone calls, and view a live video surveillance feed.

Sanswire 2A Technology Demonstrator tethered test.
Source: The Register

You can watch a short video of a December 2006 test flight in Palmdale, CA at the following link:
https://www.youtube.com/watch?v=LcZ_ARI9Ma0

Equipment pod and two propulsion propellers.
Source: Screenshot from Sanswire Dec 2006 YouTube video

7. The short-lived Sanswire-TAO joint company (2008 – 2011)

While the joint company Sanswire-TAO was in existence, TAO-developed technologies were rebranded for the US market:

- Starting in June 2008, TAO's small solar-powered airship *Lotte* was operated in the US by Sanswire-TAO and was renamed the Sanswire Autonomous Solar (SAS) airship, with the designation SAS-51.
- In early 2010 the STS-111 segmented airship was delivered to the US for demonstration flights, and was renamed *Argus One*.
- The ALF autonomous recovery system was rebranded for the US market as the Precision Air Drop Delivery System (PADDS).

A key business goal of the joint company was the development of a larger segmented airship based on the design of TAO's STS-111 and capable of operating in the stratosphere with larger payloads on long-duration missions.

SAS-51

The SAS-51 was well suited for operating at low altitude and low speed (or stationary) with a surveillance payload capable of providing real-time video and high-resolution still imagery to users on the ground. Applications for such surveillance capabilities include border control, pipeline monitoring, crop analysis, and geological surveying. The airship also could be configured to provide emergency communications capabilities.

SAS-51 could be rapidly deployed within hours, using a mobile hangar attached to a delivery vehicle to support local operations. It operated autonomously or by remote controlled from a ground station.

After the joint company Sanswire-TAO was dissolved in 2010, *Lotte* was returned to TAO Group.

SAS-51 in flight.
Source. Achmed A. W. Khammas , Buch der Synergie, Teil C(4)

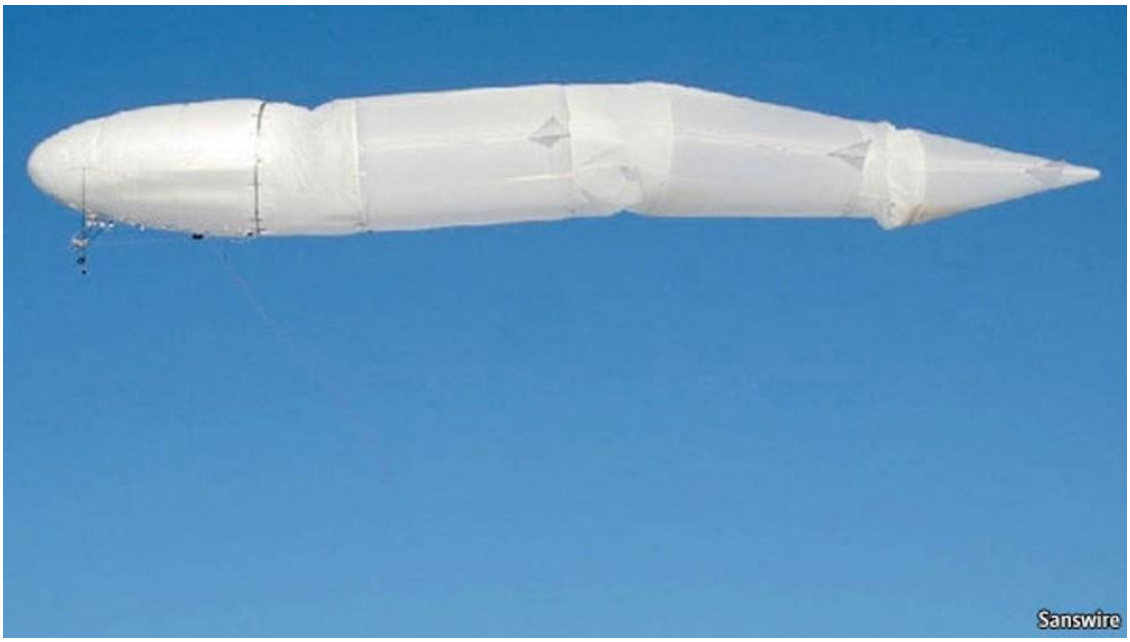
STS-111 / *Argus One* segmented airship

The TAO STS-111 was a 111-foot (33.8-meter) long, 11.2-foot (3.4-meter) diameter, non-rigid, four-segment airship. It was designed to operate as a surveillance platform at medium altitudes between 10,000 and 30,000 feet (1.9 to 5.7 miles, 3 to 9.1 km). From this operating altitude, an STS-111 could provide an operational line of sight of up to a 124 mile (200 km). Propulsion was provided by a small, one-cylinder, four-stroke engine mounted under the first segment of the airship. The engine had a 360° azimuthal thrust vectoring capability.

Only the first segment of the airship contains helium lift gas. The engine runs on fuel gas, which is a neutrally buoyant mixture of low density hydrocarbon gases (propane – ethane was used) stored in segments 2, 3 and 4. Since the fuel gas has the same density as atmospheric air, the airship's buoyancy remains the same as it burns off its fuel supply. The gas cells are surrounded by air cells within the flexible outer shell. As the fuel gas is consumed, the gas cells contract and the air cells expand to maintain the airship's mass and shape. The 1930s dirigible *Graf Zeppelin* also used fuel gas.

The STS-111 was designed to rapidly unfold from its standard-size crate and be prepared and tactically launched from virtually anywhere with minimal ground crew and no need for a large hangar or runway.

You can watch a short (4:09 minute) video of the18 December 2009 test flight of the STS-111 in Stuttgart, Germany here: https://www.youtube.com/watch?v=uMZvVcqmg1E



STS-111 segmented airship in flight.
Source: Sanswire-TAO, via The Economist, 6 May 2010

Artist's rendering of the STS-111, with carbon fiber winglets on all of the trailing segments to aid with lift, steering and overall stability.
Source: Sanswire-TAO Corp.

In early 2010 the STS-111 completed initial flight testing in Germany and was delivered to the US for demonstration flights. For the US market, the airship was renamed *Argus One*. Initial tethered flight testing of *Argus One* in the US was completed in April 2011, shortly after the formal breakup of the Sanswire / TAO joint venture.

The planned Sanswire-TAO 70-Meter segmented Stratellite

Sanswire-TAO planned to develop a 70-meter (230-foot) segmented Stratellite based on the design of STS-111 and capable of operating in the stratosphere with larger payloads. The operational airship could be controlled remotely from ground stations or operate autonomously for some segments of a mission, such as transiting from one GPS waypoint to another.

The operating altitude was to be in the 65,000 to 70,000 foot (12.3 to 13.3 miles, 19.8 to 21.3 km) range, which is above the jet stream and in a region where average wind speed is low. Operating in this altitude range helps a long-endurance unmanned airship to remain on station or transit about without having to burn much fuel. Propulsion was to be provided by a more powerful, supercharged Rotax engine driving a propeller mounted under the first segment of the airship.

Artist's rendering of a large segmented Stratellite operating in the stratosphere. Source: Sanswire-TAO Corp.

The airship will be able to drop its payload module at altitude and have it fly to a specified recovery site on the ground. The recovery system was based on TAO's autonomous safety parachute system "ALF," which was named the Precision Air Drop Delivery System (PADDS) for the US market. PADDS has a paraglider-type delivery system and a GPS-based autonomous flight control system that enables precision delivery even in poor weather.

ALF recovery system.
Source: TAO Group

At the end of a mission, the helium lift gas can be released from segment 1 and the airship envelope and propulsion system can be recovered by parachute. The helium lift gas will be lost.

After the breakup of the Sanswire / TAO joint venture, the TAO Group continued development of their *SkyDragon* version of the stratospheric segmented airship. In the US, development refocused on low-to-medium altitude applications of segmented airships.

8. World Surveillance Group Inc. (WSGI) segmented airships and more (2011 – 2017)

After the termination of the Sanswire-TAO joint venture in 2011 and rebranding itself as World Surveillance Group Inc. (WSGI) in April 2011, the firm continued developing Argus One and other concepts.

***Argus One*, continued**

After completing the initial tethered flight testing of *Argus One* in the US in April 2011, WSGI was invited by the Department of Defense (DoD) to conduct flight tests and demonstrations at the Army proving ground facility in Yuma, AZ. This test plan subsequently was revised and these tests were moved to the Department of Energy (DOE) Nevada Test Site (NTS).

Argus One in its hanger at Easton Airport in Easton, MD.
Source: https://www.intelligent-aerospace.com/, 30 August 2011

Argus One outside of Easton, MD hanger.
Source: https://www.nextbigfuture.com/, 1 March 2011

For the Nevada tests, the *Argus One* featured a “newly developed stabilization system that autonomously controls the level of rigidity” of the airship in flight and features an integrated payload bay that can carry high-tech sensors, cameras or electronics packages. It also featured automated control for individual body modules for improved flight stability and aerodynamic control. The new features for controlling the airship in flight are described in detail in WSGI patent WO2012/112913A1, “An airship and a method for controlling the airship,” filed 17 February 2012 by and published 23 August 2012.

Patent Figure 1 shows the general arrangement of the airship with an outer shell (110), four segments (102, 104a, 104b, 108) with air cells surrounding separate lift gas cells (112), and adjustable couplings / “closer straps” (113, 114) that are automatically controlled as part of the system that enables each segment to move separately from adjacent segments.

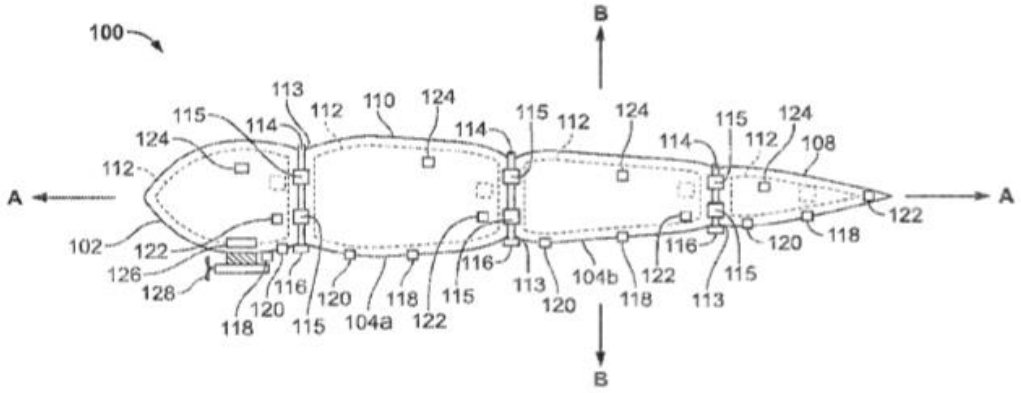
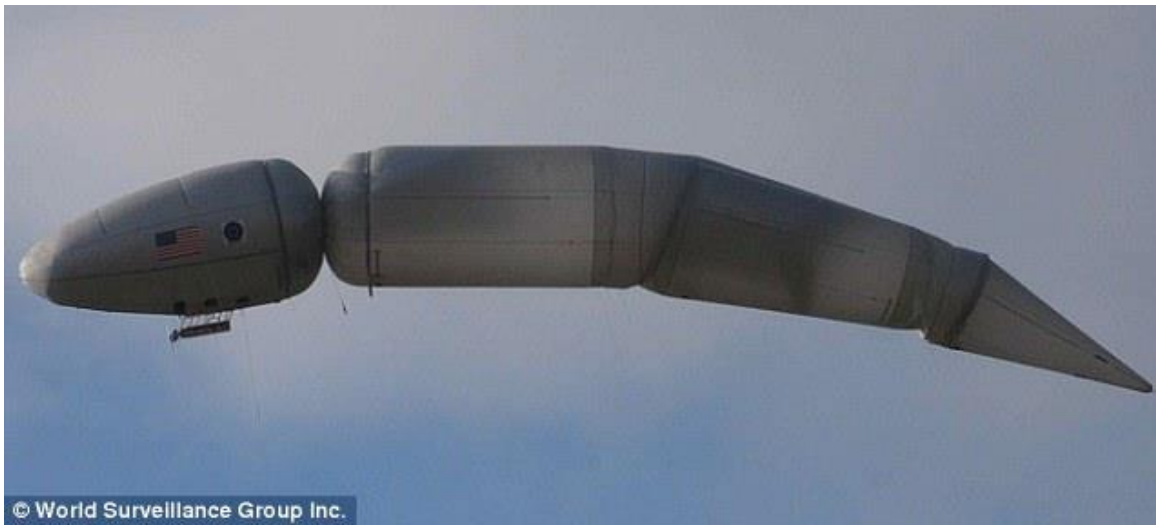


FIG. 1

The patent claims, “In high wind and/or turbulent air environments, such flexibility allows each segment … of the airship … to drift into a position that reduces the gradient of the wind with respect to such segment (that is, such segment presents a minimized cross-section to the wind). In this fashion, the airship … is able to remain airborne even in high wind and or turbulent air conditions without being at risk of damage from crosswinds.”

You can read this patent here:
https://patents.google.com/patent/WO2012112913A1/en



Argus One in flight. Source: WSGI

Argus One, segment 1 with propulsion unit.
Source: https://www.blimpinfo.com/, 19 November 2011

Close-up of Argus One, segment 1, propulsion module.
Source: https://www.blimpinfo.com/, 11 June 2012

The flight tests at NTS originally were scheduled to start in early December 2011. Integration of the government-provided, classified payload was accomplished during the first quarter of 2012 and the initial set of payload and tethered flight tests of the *Argus One* were completed later in the spring of 2012. WSGI reported that their airship demonstrated the following capabilities:

- Can be assembled and launched in hours from virtually anywhere, including remote, mountainous terrain
- Can carry a 30 pound (13.6 kg) payload
- Can hover over remote locations between 10,000 and 20,000 feet (3,048 and 6,096 m), even in rough weather
- Has low radar cross-section
- Can wirelessly transmit live video and other information directly to a ground control station or system
- Can execute GPS-based autonomous navigation

In May 2014, WSGI president Glenn Estrella reported in a letter to shareholders, “Unfortunately due to a lack of resources, the Company was not able to continue the development and commercialization of the Argus One on its own…… Argus One was relocated to Ohio. Under the newly formed Consortium, it is currently undergoing design and system improvements that we believe will lead to future test flights and demonstrations to potential customers.”

The Argus One did not enter production.

Argus Hybrid aerostat / UAV

On 27 June 2012, WSGI filed a provisional patent application for its Argus Hybrid aerostat/airship, which built on Argus One segmented airship technology in the form of a smaller, more cost effective ISR and communications package that can function as a long-duration tethered aerostat and also serve as a stealthy, free-flying UAV when needed.

The Argus Hybrid is designed to be packaged in a standard size crate that fits in the back of a full size truck or HUMVEE and is rapidly deployable within hours by a small crew. Once inflated and prepared

for launch, the Argus Hybrid is designed to be released on a tether to ascend and stay on station providing 24/7 ISR data from a sensor payload that streams data through fiber optics in the tether.

To make the transition from aerostat to UAV, the propulsion unit on the Argus Hybrid is remotely started, the tether is released, and the Argus Hybrid flies away as a UAV on a mission that can cover hundreds of miles. WSGI reported, “During free flight, the Argus Hybrid and the sensor package are commanded via wireless capabilities and satellite communications. Upon returning back to the landing destination, the Argus Hybrid can be refueled and launched again as an aerostat awaiting the next opportunity to be released for free flight.”

The Argus Hybrid did not enter production.

Blimp in a Box™ (“BIB”) aerostat

Even smaller and simpler than the Argus Hybrid, BIB, is an ISR aerostat that fits in the back of a full size truck or HUMVEE and is rapidly deployable. It is retrieved by reeling in the tether. The first BIB unit was delivered to DoD for testing in April 2013.

A deployed Blimp in a Box. Source: WSGI

9. For more information

Sanswire One

- T. Tozer & D. Grace, "USE-HAAS, WP2, 1st Deliverable - Analysis of works and underway programmes," Creative Technologies Israel Ltd., 27 July 2005: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.607.291&rep=rep1&type=pdf

STS-111 / Argus One

- Michael Klesius, "Sky Snake – Flexible blimps are bending the rules on UAV design," Air & Space, 18 December 2009: https://www.airspacemag.com/flight-today/sky-snake-2630679/
- "'Stratellite': Unmanned Lighter-Than-Air Flexible Blimp," ImpactLab, 20 August 2009: http://www.impactlab.net/2009/08/20/stratellite-unmanned-lighter-than-air-flexible-blimp/
- "Sanswire Invites Public to US Debut of Its STS-111 Unmanned Aerial Vehicle," Defense News, 29 December 2009: https://defensenews-updates.blogspot.com/2009/12/fort-lauderdale-fl-marketwire-122909.html?m=0
- Clay Dillow, "The German-American Tadpole Blimp Re-Emerges on the Way to Army Flight Testing, Popular Science, 20 April 2011: https://www.popsci.com/technology/article/2011-04/german-american-tadpole-blimp-re-emerges-way-army-flight-testing/
- Lewis Page, "Spyeye sperm-blimp in US flight trials - Owning company changes name for third time," The Register, 20 April 2011: https://www.theregister.com/2011/04/20/wsgi_sanswire_tao_blimp_flight_tests/
- "Sanswire's Compelling, Clouded Vision," Robotics Business Review, 14 May 2010: https://www.roboticsbusinessreview.com/rbr/sanswires-compelling-clouded-vision/
- "World Surveillance : Issues Letter to Shareholders," MarketScreener, 12 June 2014: https://www.marketscreener.com/quote/stock/WORLD-

SURVEILLANCE-GROUP-9730899/news/World-Surveillance-Issues-Letter-to-Shareholders-18583797/

- "World Surveillance : Issues Letter to Shareholders," MarketScreener, 5 May 2014: https://www.marketscreener.com/quote/stock/WORLD-SURVEILLANCE-GROUP-9730899/news/World-Surveillance-Letter-to-Shareholders-18408427/
- "World Surveillance Group Files Provisional Patent Application on Argus Hybrid Design," EINnews, 27 June 2012: http://pages.citebite.com/t2v5x7c1vctr