New Chinese UAVs Could Support Anti-Carrier Missile

Chinese UAVs complement missile capabilities

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Bill Sweetman

China's known in-service unmanned air vehicles (UAV) are conventional aircraft in the same class as the General Atomics Aeronautical Systems Inc. Predator. However, the People's Liberation Army Air Force is now testing examples of two much larger high-altitude, long-endurance (HALE) aircraft in the same size and weight class as the Northrop Grumman RQ-4 Global Hawk.

From different manufacturers, both feature different but unconventional configurations that point to different missions, targeting high-value air assets and supporting China's DF-21D anti-ship ballistic missile.

Neither Chengdu Aircraft's Guizhou Soar Dragon nor Shenyang Aircraft's Divine Eagle has yet been observed in flight, but what appear to be complete prototypes have been seen on Chinese websites. The Divine Eagle was photographed by a DigitalGlobe satellite earlier this year and has been located on Google Earth, while the Soar Dragon has been seen under tow by a standard Dongfeng 4 X 4 cargo truck. In both cases this makes it possible to calculate their dimensions (see table).

The Divine Eagle has a twin-body canard-wing shape, with the body centerlines about 20 ft. apart and the single engine in a conventional nacelle above the midpoint of the main wing. The forward wing surface is at the extreme front end of the two fuselages and does not extend outside them.

Divine Eagle UAV has a high-aspect-ratio main wing and a forward lifting surface. Credit: Via Google Earth

A Chinese technical paper describing a somewhat similar but much larger design dubbed the Space Fortress (with a 60,000-lb. gross weight and 180-ft. wingspan) notes that the dual fuselages can reduce wing weight by cutting the peak bending load, a principle used on Burt Rutan's around-the-world GlobalFlyer and Voyager aircraft. It also proposes the use of active laminar-flow (LF) control to achieve nearly 100% LF over the wing.

However, the Divine Eagle layout may not be as well optimized for efficiency. With the wing well aft of the center of gravity, much of the lift in cruising flight is provided by the relatively short-span forward wing, increasing drag due to lift. The vertical tails have a very short effective moment arm, and are both very large; together with the dual bodies, this increases wetted area and drag. "I wouldn't pick that layout for a surveillance vehicle unless it was tied into sensor performance or field of view," observes an aircraft designer with experience of HALE UAV configurations.

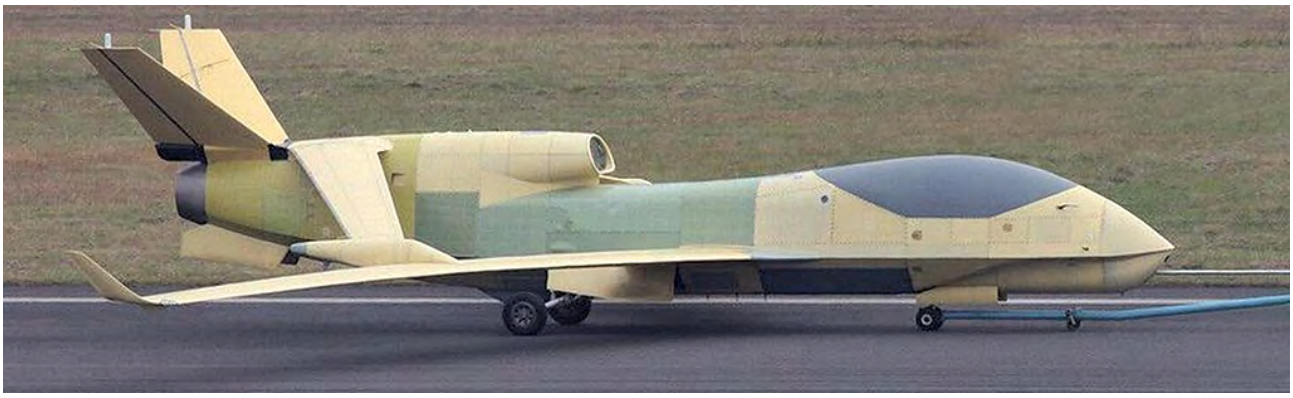
Divine Eagle in fact appears to be designed around its sensor suite. The twin body sections are asymmetrical ovoid-section bodies with the smaller-radius end outward. The outer body sections appear to be radomes, most likely covering active electronically steered array (AESA) radar antennas as much as 25 ft. long. Its unusual configuration could be an advantage: By using wing flaps and adjusting the fore-and-aft balance of lift, the UAV could trim itself with the fuselage level over a wide speed range and keep the radar's long axis horizontal.

The outer half of each of the Divine Eagle's twin bodies appears to be a radome. The total vertical tail area is strikingly large.

Two subsidiaries of China Electronics Technology (Group) Corp. (CETC)—East China Research Institute of Electronic Engineering and Nanjing Research Institute of Electronics Technology—have developed ultra-high-frequency AESA technology for surface-based air-surveillance radars that have entered service with the Chinese military. CTEC has also developed a slightly larger airborne AESA, resembling the Saab Erieye, for the Shaanxi KJ-200 airborne early warning (AEW) aircraft. The Divine Eagle also has a satellite communications radome above the forward section of the right-hand fuselage and a similar aerodynamic bulge on the left.

Divine Eagle's most likely role is for AEW. Using satcoms, part of one radar array or a dedicated line-of-sight data link, it could act as a forward radar picket and transmit radar data to a ground station, airborne relay or airborne control system orbiting in a safe area. While being far from an expendable asset, it would not require fighter cover, as manned AEW aircraft often do.

The joined-wing configuration of the Chengdu Soar Dragon was designed and evolved in the West but never tested on this scale. Joined wings—a subset of closed-wing systems—comprise a swept-back forward wing and a forward-swept aft wing. In the new Chinese design, the rear wing is higher than the forward wing, to reduce the impact of the forward wing's downwash on the rear wing's lifting properties. The rear wing has a shorter span than the front wing and its downturned tips meet the front wing at a part-span point.



Joined-wing Soar Dragon could be capable of high subsonic speeds. Credit: Chinese Internet

The joined wing's claimed advantages derive from the front and rear wings being structurally cross-braced. This allows higher aspect ratio while keeping down weight and staying within flutter limits—important for swept wings. Higher aspect ratio reduces drag due to lift, and because the wings are both slender and short-span (relative to a single wing with equivalent lift) the wing chords are short, which makes it easier to achieve laminar flow. The joined wing can also reduce trim drag.

Another advantage of the joined wing, for a UAV, is that it can accommodate a large payload bay, on the center of gravity and clear of the wing carry-through structure. This is convenient because payloads can vary widely in weight (radars are heavy, passive electronics are lighter) and it allows payloads to be traded for larger fuel cells.

The Soar Dragon appears to be designed for a lower radar cross section than the Divine Eagle, with a chined fuselage section, an S-duct to the engine and V-tails. It may also be faster, with its swept wing. However, it is not an all-aspect, wideband stealth design.

China's UAVs Compared to Global Hawk

	Divine Eagle	Soar Dragon	Global Hawk
Wing span (ft.)	132	94	132
Length (ft.)	50	49	47.5
Wing area (sq. ft.)	700	Unknown	685
Engine	WP-13 or Minshan	AE3007H	
Thrust (lb.)	9,900 (WP-13); 7,000 (Minshan)	7,000	
Bypass ratio	0 (WP-13); 0.4 (Minshan)	5	
Takeoff weight (lb.)	30,000-35,000	32,250	

Sources: Northrop Grumman, Rolls-Royce, AW&ST estimates

The two aircraft are similar in size and may have similar engines—either Guizhou's WP-13, a version of the MiG-21 turbojet engine, or possibly a nonafterburning version of Shenyang's all-new Minshan turbofan. Both should have range and time-on-station performance to provide double-digit-hours endurance at any point within the first island chain that bounds the China

Sea. However, they have one fundamental difference: Divine Eagle is designed around its very large radar, and Soar Dragon is intended to carry a variety of different payloads.

It is not clear how close either type is to operational capability, but with only single prototypes seen so far, it is certainly closer to 2020 than to the present day. However, both could be important to China's military capability for a number of reasons.

China does not have a large selection of intelligence, surveillance and reconnaissance (ISR) platforms available. Western militaries use commercial aircraft, including regional and corporate jets, as ISR platforms, and although not designed to survive combat, they are much faster and higher-flying than the Shaanxi Y-8—China's equivalent of the C-130—which is China's most-used ISR platform. China's only long-range military jet aircraft is the Xian H-6 bomber, which is used primarily for strike capability. CETC videos show UAVs operating in conjunction with Y-8s for maritime surveillance.

On the other hand, China has invested heavily in anti-ship and land-attack weapons with over-the-horizon range, of both ballistic and cruise types. The 2014 Zhuhai air show saw the debut of several such weapons, and some were shown using UAVs for targeting. This demands greater performance—speed, range and payload—than Chinese UAVs operating today, and would be the Soar Dragon's operational niche as part of a new reconnaissance-strike complex. With its long range, it could provide ISR and targeting support to the DF-21D.

A forward-based AEW sensor, meanwhile, could be used to detect and track both combat aircraft and larger aircraft—tankers and transport-based ISR assets—to give early warning of inbound airstrikes, even if the combat aircraft themselves were stealthy.