Boeing is studying a scaled-up UCAV version of its X-36 remotely piloted tailless research aircraft

set a unit flyaway price target, but is treating life-cycle cost as a technical requirement. This reflects the fact that most savings are expected to accrue from how the UCAV is operated.

It is being left to contractors, for example, to decide how many systems are needed – a large number of cheap vehicles or a smaller number of more expensive aircraft. This determines, among other things, the level of air vehicle survivability required. Deciding what rate of attrition is acceptable is a key element of the UCAV operational system design process.

Lockheed Martin has produced cost comparison which attempt to quantify what would be an acceptable attrition rate for UCAVs. To be cost-competitive with a $20 million fighter having an attrition rate of 40,000h/mishap, a $5 million UCAV could be designed for 2,000h/-mishap, but a $20 million vehicle would have to be designed for 8,000h/mishap. As a typical attrition rate for today's unmanned air vehicles is around 500h/mishap, the challenge facing UCAV designers is obvious.

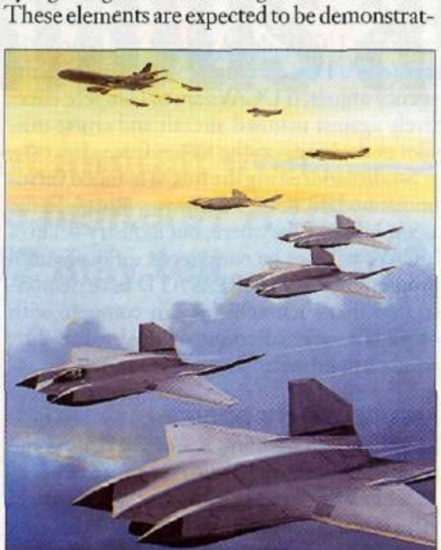
Among issues to be addressed is the degree to while the UCAV itself will be vulnerable to attack. At least in the near term, Lockheed Martin says, UCAVs "…probably will be vulnerable to manned fighters within visual range. Beyond visual range there is not technical reason to believe that a UCAV could not hold its own against a manned fighter. In the longer term, it is conceivable that technology could even make it formidable within visual range".

The SEAD/strike UCAV will be a stealthy vehicle, one reason why DARPA restricted the ATD competition to four prime contractors, three of which have known stealth experience. While survivability analysis will be a critical aspect of the UCAV operational system design phase, demonstration of low-observable and self-defence technologies is not a primary objective of the programme, DARPA says.

Instead, the UCAV demonstrators are required to be compatible with the survivability features described in the UOS. Structural layout and surface characteristics must allow for the later addition of reduced-signature materials and treatments. As now planned, one of the two UCAV demonstrators will be modified, or a third vehicle built, to incorporate the low-observable and self-defence features for flight testing during the follow-on risk reduction and operational evaluation phase.

NOTIONAL CONCEPT

While design of the SEAD/strike UCAV system is being left to the contractors, DARPA has offered a notional concept for both the operational and demonstrator air vehicles. The UOS vehicle described is a two-axis-unstable aircraft with no vertical tail, thrust-vectoring and fly-by-light flight controls using electric actuators. These elements are expected to be demonstrated in the UDS vehicle, which is required to have the same aerodynamic/propulsion integration, payload/range characteristics, sensors and weapons as the UOS aircraft.



This Lockheed Martin concept includes a manned version for airborne mission management

According to DARPA, a SEAD/strike UCAV is likely to have an empty weight of 3,600kg or less and a payload of 900kg or less – typically two 450kg Joint Direct Attack Munitions or eight 110kg Small Smart Bombs, both using global positioning/internal navigation precision guidance. This is equivalent to the design air-to-ground payload for the US Air Force variant of the Joint Strike Fighter, but DARPA is looking for "radically reduced" production and support costs relative to the JSF.

Notionally, DARPA sees the UCAV system being deployed and operational anywhere in the world within 24h. The vehicle would be operated from NATO-standard 2,400m (8,000ft) runways, alongside manned aircraft. The mission control station could be land-, sea- or air-based and allow simultaneous management of more than one vehicle.

To keep costs down, on-board avionics will be minimised and will be designed to be tested, replaced and upgraded even when the vehicle is dormant. DARPA expects the UCAV to be maintained in flight-ready storage for up to a year between operations. On-board avionics will provide autonomous functions such as collision avoidance, self-defence and attack manoeuvring, plus the ability to self-diagnose problems and determine autonomously whether to return to base or terminate the flight.

To provide the mission control station with the situational awareness required to permit lethal operations, but without making the air vehicle too expensive, DARPA says on-board and off-board sensor information will be combined to enable precise location and identification of targets. The aim is to provide the range and accuracy required to cue and release weapons in adverse weather, day or night.

Such a concept requires a robust communications link between the control station and the air vehicle, and DARPA envisages the use of wide-area and local-area, line-of-sight and over-the-horizon, networks. While a wide area network would connect the air vehicle with stand-off sensor platforms as well as the mission control station, a local area network would link the UCAV with accompanying manned strike aircraft. Such networks must be "bullet-proof", DARPA stresses.

The communications bandwidth required will be determined by the degree of real-time control to be exercised over the air vehicle. The concept is for the control station to manage the mission by modifying a preprogrammed plan stored on-board the UCAV, rather than by remotely piloting the aircraft. The degree of autonomy permitted to the vehicle is expected to vary throughout the mission, and lethal operations will require human authorisation, but DARPA expects the UCAV to be capable of autonomously engaging pop-up threats. ❑