

# Archangel: Crop Duster to Tank Buster



This shot shows an Archangel configured with a heavy payload comprising two pods carrying missile and radar warning sensors (outer pylons); a Rocketsan CIRIT quad pack launcher; three GBU-12s; an IOMAX mission pod fitted with an MX-15Di imaging sensor; and two AGM-114 Hellfire missiles. *All photos IOMAX USA Inc unless noted*

**Mark Ayton profiles  
the American  
Archangel aircraft,  
born and raised in  
the south**



Looking at the Archangel aircraft you might think it's the grandson aeroplane of the Piper Pawnee crop duster. Close. The Archangel does have crop duster roots. It's a S2R-660 built by Thrush in Albany, Georgia and heavily modified by IOMAX

USA Inc at its facility at Lake Norman Airpark, North Carolina.

The baseline S2R-660 was originally designed by a team led by the late Leland Snow who formed the Snow Aeronautical Company in Olney, Texas in 1958. Snow sold his company to Rockwell-Standard in 1965. During his career with Rockwell-Standard, the S2R model was developed and named the Thrush. Snow resigned from Rockwell in 1970 and the company moved production of the Thrush to Albany in 1970. Seven years later, the Ayres Corporation bought the production rights for Rockwell's agricultural aircraft and continued production at the Albany facility. In June 2003, Ayres in turn sold its production rights to Thrush Aircraft Inc: the current producer.

### ARCHANGEL CHARACTERISTICS

**Length:** 36ft (10.97m)

**Wingspan:** 57ft (17.37m)

**Height:** 12.5ft (3.81m)

**Max take-off weight:** 14,800lb (6,710kg)

**Payload (external):** 6,600lb (2,990kg)

**Fuel payload:** 648 gallons (2,417 litres)

**Max level speed (clean):** 210kts (389km/h)

**Cruise speed (with external stores):** 180kts (333km/h)

**Ceiling:** 25,000ft (7,620m)

**Endurance:** 10.4 hours

**Range (at 175kts):** 1,350nm (2,500km)

**Engine:** Pratt & Whitney PT6A-67F rated at 1,600shp (1,193kW)

So what's this all to do with IOMAX? Not so much at first glance. However, before IOMAX started production of the S2R-based Archangel in mid-2014, the North Carolina company had previously completed 24 similar aircraft for the border patrol mission. Those aircraft were all modified from baseline Air Tractor AT-802 models designed for crop dusting, not the AT-802U as widely reported elsewhere, and supplied to the United Arab Emirates Special

Operations Command (UAE SOC). They are designated as Border Patrol Aircraft (BPA).

IOMAX Chief Executive Officer Ron Howard reckons that set the course for the Archangel programme: "Many people have confused the Thrush aircraft we now use with the Air Tractor AT-802U."

Changing to the Thrush aircraft came about in 2012 when IOMAX was trying to meet the requirements of the Libyan Government at the time, which was trying to rebuild its military forces after the fall of Gaddafi. Two things happened. One, IOMAX was having to buy Air Tractor aircraft through a different company, a so-called middle man. Two, Air Tractor was not willing to modify its aircraft to affect structural and armament changes to meet Libyan requirements, although the company did agree to leave unwanted crop dusting equipment out prior to delivery to IOMAX.

"That being the case," said Ron Howard, "I contacted Thrush Aircraft, and the company President Payne Hughes agreed to work with us directly. That allowed us to make the necessary changes to the basic design of the S2R-660 aircraft, so we switched supplier and now have a successful partnership with Thrush."



To close the loop on this part of the story, after Leland Snow resigned from Rockwell in 1970 he started the Air Tractor company also in Olney, Texas. The AT-300 was the first model of agricultural aircraft designed by Leland with the Air Tractor badge. Leland's legacy continues. Air Tractor continues to produce a range of agricultural planes and the man himself was the lead designer for both models of aircraft used by IOMAX to date: the AT-802 and the S2R-660.

### **Engineering History:** **BPA to Archangel**

IOMAX received its first order from UAE SOC for ten Block 1 BPA aircraft in 2009.

According to the IOMAX Chief Technical Officer Jim Toole, the original challenge was to convert a baseline AT-802 aircraft into a long endurance ISR platform. He said: "The avionics and the EO/IR sensor integrated on board were principally selected by the UAE SOC for compatibility with their existing

fixed wing fleet. We built them an aircraft that can operate up to 20,000ft MSL [6,096m]; remain on station for eight hours with oxygen; and placed the EO/IR sensor in a pod to provide a 360° field of view under the aircraft. We developed and built an ISR pod with a datalink capable of sending streaming video to a ground station facility. It was a rapid procurement-integration effort; the first aircraft was delivered six months after contract award."





On the first three aircraft, the IOMAX integration team had to remove the hopper and gate boxes and retro fit a fuselage fuel tank and electronics, whereas aircrafts four to ten were delivered from Air Tractor with a fuel tank installed.

Jim Toole said the first ten aircraft also had hard points installed in anticipation of a follow-on contract for the integration of the AGM-114 Hellfire air-to-surface missile.

The UAE SOC purchased 14 more BPA Block 2 aircraft in 2011 increasing its fleet to 24 aircraft.

The UAE has used its BPA aircraft in combat operations in Libya, Egypt and Yemen. Based on the type's performance and a need for improved capability, the UAEAF issued a requirement for an upgraded aircraft and subsequently awarded IOMAX a contract for another 24 more capable aircraft in September 2014.

The new partnership with Thrush meant that the IOMAX design and engineering teams were able to work with the company to make the modifications and structural changes required for the new Archangel aircraft. By mid-2014, IOMAX in partnership with Thrush had produced an Engineering, Manufacturing and Development (EMD) aircraft (N925KH) which made its maiden flight at Lake Norman Airport in July. N925KH remains in service as a test-bed for research and development.

New design features of the Archangel aircraft included a sleeker nose profile, remodelled wing roots and wingtips, a

relocated tandem cockpit for improved visibility and long mission operation, a properly sized vertical stabiliser, and underwing pylons spaced further apart to fit dual-ejector racks or dual-launcher rails each loaded with two stores.

Work on the EMD included integration of the Cockpit 4000 modular avionics suite produced by Esterline CMC electronics: an all-glass cockpit and fully-integrated avionics. This was a big deal for IOMAX because it provided the Archangel with a cockpit more akin to fighter aircraft, not least the Block 60 F-16 in service with the company's main customer the UAEAF. The new cockpit was demonstrated to the UAEAF in early 2015.

Following the UAEAF order, IOMAX awarded CMC a contract to supply 24 Cockpit 4000 avionic suites custom built for the Archangel aircraft. At the time of the CMC order award, Ron Howard said: "CMC's Cockpit 4000 provides a powerful, yet flexible avionics suite that is perfectly suited for the Archangel's requirements. The CMC solution was developed rapidly and cost-effectively, enabling us to offer a premium, tailored capability to our customer, while meeting an aggressive schedule."

Describing the cockpit, Jim Toole said: "Integrating the CMC cockpit made the Archangel aircraft a more effective aircraft for the ISR, close air support and airborne command and control missions. We have a great team of people working on the Archangel programme some of whom have backgrounds on the A-10, F-16 and F/A-18. We asked for their input on the design of the Archangel cockpit and built mock-up models. They worked with the models to help design and build the EMD aircraft incorporating the attributes they had identified. We tested them and that was the aircraft the customer got a

demo on. Using the customer's feedback, we then made some additional layout changes to the cockpit and locked that down as the production standard. It was an iterative process with the customer, though IOMAX engineers worked closely with our test pilots because it's the pilots that needed to determine exactly what the cockpit layout would be."

Archangel's custom-built Cockpit 4000 supports both the front and rear cockpits. The front cockpit features three 5x7-inch multi-function displays (MFD); the SparrowHawk head-up display (HUD); and an up front control panel (UFCP): the alpha-numeric interface to the avionics and weapon system. The rear cockpit comprises two 5x7-inch MFDs, and a 17-inch display used for ISR.

Driving the avionics, MFDs and UFCPs are two mission computers which provide control and display functions for the high-resolution graphics for navigation and mission data. The mission computers are integrated with an IOMAX tactical system computer (TSC) that manages the MX-15Di high-definition imaging system; controls the weapons; and provides additional mission functionality. CMC's avionics run on an operational flight program that integrates the sensors, navigation radios and communication radios.

Discussing the Archangel EMD aircraft, Jim Toole said that the company chose to buy a stock S2R-660: "Once we started to work with it, we realised we had to make some significant modifications. We lengthened and moved the tandem cockpit forward by 43 inches (1.09m) to increase the available space for the WSO; improve the pilot's forward and downward view; and elevate the aft cockpit to improve visibility for the WSO [weapon systems operator].

As a result of the cockpit reconfiguration, we also had to increase the height of the

### IOMAX BLOCK PRODUCTION

Block	Type	Configuration	Delivery
Block 1 (10)	AT-802	BPA (ISR capable only)	September 2010 to June 2011
Block 2 (14)	AT-802	BPA with heavier payload	January 2012 to May 2013
Block 2.5	AT-802	BPA upgraded with Archangel systems	
Block 3 (24)	S2R-660	Archangel	June 2015 to January 2017



Measuring 9ft 8in (2.94m) long, the IOMAX modular pod was designed to house ELINT or SIGINT systems, a radar, datalinks and carry the MX-15Di imaging system as shown.



1



2

vertical stabiliser and increase the area of the rudder to improve the aircraft's directional stability. These were the two initial major modifications made.

"Smaller mods included things the customer wanted; self-sealing fuel tanks for protection against small arms fire (see later); armour protection fitted around the engine; development of an autopilot integrated with the weapon system and the flight management system. The autopilot integration has proven to be very effective. We also undertook a complete lay down and re-do of the avionics for better accessibility to

make sure crews can get to them to maintain them. Their positions on the aircraft are appropriate for weight and centre of gravity. That was a major effort."

IOMAX's Senior Director of Integration, Doug Klevisha, described the timelines and extent of the work undertaken on a baseline S2R-660 aircraft. He said: "It takes a couple of days to de-fuel, de-panel and de-mod the ferry equipment installed on an aircraft. Then we completely gut the aircraft. This allows us access to all areas so we can begin to install the sheet metal required for the cockpit console, side consoles and instrument panels,

in addition to the avionics suite, radios, antennas, tactical lighting and systems required for ISR, weapons and datalinks."

With a wing span of 57ft (17.37m), the positions of the under-wing hard points are well spaced so the effort to install wiring and wiring harnesses to them, and all of the other points on the aircraft, is significant. In total the team fits just over six miles of wiring cable as part of the integration effort.

IOMAX Instructor Pilot John Passant recalled how quickly the integration team is able to de-skin a baseline aircraft: "We were racing to convert and complete aircraft No.20 in time for its deployment to Marine Corps Air Station Yuma (see later). The crew had the aircraft de-skinned by the time I'd completed the paperwork after the aircraft's delivery flight from Albany. Huge skin panels [fixed with Phillips head cam lock screws] can be removed in a short space of time."

Doug Klevisha said the heavy structural provisions - the hard points for the camera, the pod and three on each wing for the pylons - are all fitted by the factory. He explained: "The PT6A-67F engine and the MT propeller come fitted. Other than some minor rigging adjustments, all of the alterations required for the engine and propeller have already been completed by Thrush when they fit the engine."

One large part of the integration effort is devoted to the aircraft's fuel system. An additional 315-gallon fuel tank is fitted in the fuselage, positioned where the hopper usually



**1** This shot shows the amount of space available to both aircrew in the Archangel's voluminous cockpit. **2** The aft cockpit comprises two 5x7-inch MFDs, a 17-inch display and an up front control panel. **3** The Archangel's front cockpit features a SparrowHawk HUD, three 5x7-inch multi-function displays and an up front control panel.

sits on a baseline S2R-660, a 5-gallon header tank is installed in the fuselage and each wing has an additional 50-gallon fuel cell installed. Standard wing fuel cells hold 114 gallons, one on each side, for a total fuel load of 648 gallons. As part of its work, the integration team installs a self-sealing application in all of the fuel cells and the tank. The application has a level two ballistic rating. Should any of the fuel cells get penetrated by a round, they self-seal.

According to Doug Klevisha the total production turn time is about 30 days – three weeks of heavy installation work, followed by a week of continuity and basic system configuration checks, and re-panelling. He said: “Within a 30-day period of the aircraft arriving, it’s ready for power-on checks followed by its first flight.”

Prior to first flight, each Archangel aircraft undergoes one ground run involving compass calibration and engine tuning. Test pilots contracted in by IOMAX fly the first flight to check basic handling, after which one of the company pilots flies the aircraft to Donaldson Field, South Carolina for painting. Upon return to Lake Norman Airpark, company pilots fly a minimum of two flights to check the TSC is operating properly in the simulated mode; to simulate release of the different weapons; and conduct laser range finding to make sure all the tactical systems are up and running.

### MT Propeller

A key requirement of the UAEAF for its



Archangel aircraft was inaudible operation above 15,000ft (4,572m). In a bid to meet the customer's requirement, IOMAX contracted German company MT-Propeller to design a custom-built propeller for the Pratt & Whitney Canada PT6A-67F turboprop engine. The propeller, dubbed the MTV-27, features composite scimitar-style blades.

However, the MT propeller was one of two under consideration by IOMAX: the other option was the five-bladed Hartzell propeller used on the earlier BPA aircraft. Both types were flight tested on the Archangel EMD aircraft. According to Jim Toole, the MTV-

27 propeller gave improved performance with greater thrust and operated at lower noise levels. He said: “The customer likes the MT propeller because in theatre it has demonstrated it can’t be heard overhead.”

### IOMAX Mission Pod

Carried on the centreline fuselage pylon, the 9ft 8in (2.94m) long IOMAX modular pod was designed to house ELINT or SIGINT systems, a radar, datalinks and carry the MX-15Di imaging system. ELINT and SIGINT are abbreviations for electronic intelligence and signals intelligence gathering.

The pod, developed and manufactured for the UAEAF, houses two different datalinks; a broadcast microwave system (a commercial HD video downlink) and an L-3 Vortexi, a military system that's compatible with the ROVER or Remote Operational Video Enhanced Receiver. ROVER is used by a Joint Terminal Air Controller (JTAC) to receive streaming video downlinked from an aircraft.

The centre part of the pod is empty and can house a variety of payloads: modification to facilitate a different payload is a straightforward and quick process. Both the aft and forward fairings are radomes; the aft fairing houses antennas for the BMS and Vortexi datalinks and the forward fairing also houses an antenna.

Existing pods in service with the UAEAF do not house a radar, but a new buy of 12 pods can have a radar system fitted.

### **MX-15 Imaging System**

In February 2015, IOMAX awarded a contract to L-3 Wescam for 28 MX-15Di imaging systems for the UAEAF's Archangel fleet.

Weighing up to 50lb (22kg), the MX-15Di can support up to six sensors; a mix of HD electro-optical (EO) and infrared (IR) cameras; colour low-light, wide-angle zoom EO and short wave IR imagers; and lasers for long-range target illumination, laser pointing and range-finding. The system blends EO and IR imagery to create spectrally-rich image yields that are invisible in individual sensor images. All payloads are fully stabilised by a four-axis gimbal with an internal inertial measurement unit.

### **Systems Development**

IOMAX developed the Archangel's systems from the ground up. Its mission computer is a generation beyond the one used for the original BPA aircraft, and as one would expect, features many significant improvements including software-driven stores management; a graphical user interface that provides the pilot with the guidance information required to get to the target and accurately drop weapons.

Symbology was added to the SparrowHawk HUD to meet the specific customer requirement to hit a five mil (milliradians) accuracy for weapon release. The requirement drove much of the design which in itself was based on symbology used on the A-10 Thunderbolt II but incorporates changes and developments by the company's own design team.

Explaining the different ways of guiding weapons with the Archangel, IOMAX Weapons Engineer James Menzinger said the company developed the software for the mission computer's guidance function. The forward cockpit is equipped with an armament control panel, which houses the master arm switch and an armament interface unit which is a safety system that drives the smart pylons. He explained: "The pylons have their own software and we maximise the generic architecture of the interface between the mission computer and the pylons to enable pretty much any interface [including MIL-STD-1760, Ethernet and RS422] to communicate with the mission computer to control the stores."

The forward and rear cockpits have identical displays and capabilities. Both the pilot in the forward cockpit and the WSO in the rear can view the status of the stores, select the store required for release and the mode of release. For example, either crewmember can set lock-on before launch or lock-on after launch mode of operation for an AGM-114 Hellfire missile.

The button to apply power, the master arm switch that allows a weapon to be released, and the pickle and fire switches are all in the front cockpit only, so the pilot has control and release authority of the stores.

The WSO can perform all of the tasks associated with managing the stores, and based on his display can fly all the way to the target if required, just as the pilot can. This is not the typical way a crew operates the Archangel because the WSO uses the 17-inch display to look at video imagery generated by the MX-15 or to designate a target.

The MX-15 imaging system is integrated to the mission computer so target data can be passed between the two systems, so if the mission computer receives a target, the system allows the data to be passed directly to the MX-15.

The MX-15 is also integrated to the AeroComputers UC-5300 digital moving mapping system which provides the pilot with detailed elevation data.

James Menzinger explained how integrating the imaging and mapping systems provides seamless targeting capability using either the map or the laser rangefinder.

Note the array of antennas fitted to the Archangel aircraft.



Using the map, the pilot can move the cursor around the map and hit enter on a target. The MX-15 and the TSC then pick-up that target or the MX-15's laser rangefinder can create a target which is passed to both the map and the mission computer. This allows the operator to input the target data to the stores management system via the data entry pad.

Consequently, when a JTAC calls in a target on the radio, the operator can create the target on the TSC and then pass it to the map and the MX-15 using single push commands. Auto-target and auto-slew functions allow the operator to quickly move between target fits, a function that's popular with pilots and WSOs.

Additionally, the HUD also has a targeting capability. By using the HUD's target dissemination view, the pilot can create a target and the MX-15 immediately slews to the target. If the pilot sees a potential target he can mark it, send it to the WSO and it appears in the mission computer. Likewise, if the WSO sees something, he too can mark it with the MX-15 so the pilot can see it in the HUD and it's targeted in the mission computer. IOMAX put a lot of effort into seamless targeting capability and making it intuitive to the pilot and WSO.

Of the three targeting solutions available, IOMAX developed all of the mission computer software to support the MX-15 and the SparrowHawk HUD. Software used to operate the moving mapping system was modified by AeroComputers.

IOMAX Test Pilot John Passant explained that the TSC can link a moving target being tracked by the MX-15 to the autopilot. He said:

"That means the pilot no longer has to fly with his knees or elbow on the column as he is trying to write and deal with stuff, the autopilot will follow the target and the aircraft's orbit moves in relation to the target's position."

### Weapons Integration

IOMAX leads all weapons integration programmes. Initial weapon integration – drop test, firing test and safe separation – is undertaken in the United States and the remaining events, all the way through to full operational evaluation, are done in the United Arab Emirates.

The North Carolina-based company adopted the protocol and procedures used by the Air Force Seek Eagle Office based at Eglin Air Force Base, Florida – the US Air Force centre for aircraft-store compatibility – for each weapon integration effort. Jim Toole explained the objective of the Seek Eagle Office is to have a structured procedure that is used for the integration and qualification of a weapon on a platform, so that the weapon is operationally suitable. There is a series of steps that must be accomplished for each weapon integration programme: environmental testing, flying qualities, flutter, flutter analysis, pit drops, safe separation and separation analysis. He said: "We follow all of the steps and document the data, which is provided to the user. We even bring a third party evaluator in to ensure we have done everything in a manner that's safe and effective. As a result, our weapon integration complies with US Air Force standards."

IOMAX has completed weapons integration for four guided air-to-surface weapons on the Archangel; two types of gravity-released laser-guided bomb, the 500lb GBU-12 using a Mk82 warhead and the 250lb GBU-58 using a Mk81 warhead; the Lockheed Martin AGM-114 Hellfire missile and the Roketsan CIRIT 70mm laser-guided rocket.

Each of the six hard points is cleared to carry a pylon loaded with up to 1,000lb (454kg); the heaviest store currently carried is the GBU-12.

According to Jim Toole, following the GBU-12, IOMAX integrated dual-ejector racks (DERs), custom built for the UAEAF to double the aircraft's load-out from six to twelve GBU-58s. The hard points are specifically spaced along the wing to facilitate a DER with two stores on each pylon. Separation testing demonstrated safe release of GBU-58s from DERs fitted to all six pylons.

To date, IOMAX has successfully integrated three versions of Hellfire: the laser-guided AGM-114K, AGM-114M and AGM-114N. The integration effort successfully cleared all versions to operate in both lock on before launch and lock on after launch modes. Hellfire passed the UAEAF's operational evaluation and has been used in combat.

IOMAX worked with Cobham to develop a custom-built Hellfire dual-rail launcher for the Archangel, which is based on a derivative of the Brimstone missile launcher. Fitting dual-rail launchers to each pylon enables an Archangel to carry up to 12 AGM-114 Hellfire missiles.

More recently IOMAX received a contract from the UAEAF to integrate the Roketsan







New design features incorporated into the S2R-660-based include a sleeker nose profile and remodelled wing roots.

70mm CIRIT laser-guided rocket which passed its operational evaluation and is currently being used in combat.

The UAEAF has plans to integrate two new weapons on the Archangel in 2017: a GPS/INS semi-active laser-guided bomb kit and a forward-firing imaging infrared 70mm laser-guided rocket. IOMAX and the UAEAF plan to contract each weapon manufacturer to support the integration programme led by IOMAX.

### Yuma, Arizona

During the final week of the US Marine Corps' latest Weapons and Tactics Instructor course, dubbed WTI 1-17, IOMAX funded the deployment of two Archangel aircraft (c/n 19 and 20) to Marine Corps Air Station Yuma, Arizona.

For the final phase of the seven-week course, Marine Aviation Weapons and Tactics Squadron 1 (MAWTS-1) – the aviation weapons school – conclude the course with a multiday final exercise dubbed FINEX 1, FINEX 2 and FINEX 3. It was this phase that the Archangel participated in.

IOMAX Instructor Pilot John Passant, a former US Marine Corps F/A-18 Hornet pilot and a WTI graduate, flew a couple of

the missions. During the latter stages of his Marine Corps career, John was attached to the Imminent Fury programme, and was an advocate of the light attack class of aircraft. As a Marine Corps officer in 2007 during the US combat surge in Iraq, he wrote a paper for the Marine Corps Gazette on the use and applicability of light attack aircraft in that campaign. In that paper he expressed concern that the United States was not employing the correct aircraft to counter the insurgency and was hemorrhaging money on costly warplanes to provide close air support. He advocated flooding the battlefield with cheaper but arguably more effective aircraft.

Approval for the company-funded deployment to Yuma was coordinated by MAWTS-1 and cleared by HQ US Marine Corps so the weapons school staff could experience the aircraft's capabilities during some of the live missions flown as part of WTI 1-17.

An IOMAX team and two aircraft were hosted at Yuma by the Aviation Tactics Development and Evaluation department of MAWTS-1.

An Archangel aircraft participated in three events: the Air Officer Department (AOD) FINEX at Twentynine Palms; the helicopter assault dubbed FINEX 1; and a MARSOC raid into a

combat town east of Yuma dubbed FINEX 2. All three involved the aircraft conducting long-endurance, armed ISR missions.

Support for the AOD FINEX involved a 7.2-hour mission flown with a MAWTS-1 Harrier instructor pilot in the aft seat. Discussing the mission, John Passant said the 150-mile transit to Twentynine Palms was flown at 16,500ft (5,029m) and the mission was conducted at 21,000ft (6,400m), a favoured altitude that yields maximum endurance, and once established in the operating area, the Archangel simulated a series of weapon releases. "We were watching Harriers come in for an attack and returning after visiting a tanker for further attacks to release their entire air-to-surface payload. We were present during several fixed and rotary wing sections' entire times on station. Marines were impressed with the Archangel's endurance.

Different Air Officer students were rotating through on the radio to get targets knocked out. The Air Officer course is designed to integrate available fire support, so integrating air support with artillery and mortars, and in this event 0.50 calibre weapons providing direct fire suppression. We were cooperating and integrating with the Harriers; we would shoot a simulated Hellfire they would follow with bombs. A measure of the Archangel's endurance was demonstrated when we had to return to Yuma before the Harrier instructor pilot's crew day ran out: he had flown a maintenance flight in the morning before flying in the Archangel. At the point we had to return, we had enough fuel to remain on station for another hour."

The Archangel aircraft cannot operate in an environment with radar-guided surface-to-air missiles and anti-aircraft artillery threats. In the words of John Passant: "Once you talk a radar threat, we have no game. At 21,000ft it would be pretty hard to get ahold of us with MANPADs. That's an altitude that pushes the kinematic edge of most MANPAD weapons and we have countermeasures on board the aircraft:



UAEAF Archangel serial number 2362 seen in the static display of the 2015 edition of the Dubai Air Show. Mr Alan

a common missile warning system and flares.”

The threat environment for AOD FINEX was niche enough to permit the Archangel to remain on station to deal with the multiple targets called throughout the day.

FINEX 1 involved a helicopter assault at Twentynine Palms during which a battalion of Marines and a forward air controller were inserted into a landing zone. The Archangel undertook a strike coordination and reconnaissance (SCAR) style mission – coordinating and marking targets for armed reconnaissance missions and precisely locating targets for air interdiction missions – and to attack targets as detected.

The Archangel pilot had full situational awareness of the battlefield so as the helicopter sections checked in, the Forward Air Controller instructed them to contact the Archangel, call sign Rustic, for target information.

The story given to the Archangel pilot was that an Air Officer instructor from MAWTS-1 asked the duty officer back at Yuma who and what platform Rustic was, citing he was on scene the entire time, knew where all the targets were, and had situational awareness of everything going on. He was really impressed.

During the mission planning stage of FINEX 1, nobody really grasped the capability of the Archangel which only became evident during the mission because the aircraft covered the insert and remained on station all the way through to the conclusion of the extraction. No other platform did that.

FINEX 2 involved a MARSOC helicopter raid for which the Archangel was tasked with the initial terminal guidance by marking the zone for two CH-53Es to land. Unfortunately, the mission was terminated because the lead CH-53 suffered a mishap. Fortunately, no Marines were seriously injured in the incident. Overhead, the Archangel was designated as the on-scene commander transmitting information between the remaining helicopters and the duty office back at Yuma.

Despite the mishap, the Archangel crew was able to validate the Vortexi video downlink with the MARSOC helicopter force who could view real-time imagery of the target house and compound, the helicopter landing zone and other tactical requirements of the mission’s execution before the helicopter assault force launched from the staging area.

In addition to the three big missions, IOMAX pilots also flew a series of demo flights for Marines from other communities so they had a chance to experience the aircraft and see what



The Archangel has a straight constant chord wing making it structurally efficient and ideal for short take-off and landing operations: a requirement at the heart of its requirement as a crop duster. Wing area is 326ft<sup>2</sup> (30.3m<sup>2</sup>).

it can do. These included one from infantry, artillery and the AH-1 Cobra.

### New Gear, New Markets

According to Ron Howard, IOMAX is now offering a SIGINT payload carried in the modular pod. He said: “Broadly speaking, the system has the capability to conduct network surveys and network tower locations and is subject to State Department export rules so we are working with the department to determine what they will allow us to fit on the aircraft.”

IOMAX has its current customer base in the United Arab Emirates and Jordan. Ron Howard said the UAE donated six of its original BPA aircraft to the Royal Jordanian Air Force in 2013, for which IOMAX has supported, maintained, and undertaken all of the training. He explained: “We are about to upgrade the Jordanian aircraft with the systems integrated on the Archangel. In addition, another four AT-802s which were originally supplied by L-3 to the US Government configured as ISR aircraft for Yemen. Before the situation in Yemen worsened, the aircraft were gifted to Jordan. Now IOMAX is upgrading those aircraft to BPA Block 2.5 standard equipped with the systems used on the Archangel.”

Ron Howard told AIR International that almost a billion dollars has been spent on the 48 aircraft produced by IOMAX to date, much of which was used to develop the Archangel. He said: “IOMAX invested significant amounts of company money into the programme as has the UAEAF, which is a limited partner in the programme.”

None of the contracts between IOMAX and the UAEAF are Foreign Military Sales (FMS) programmes. Without Federal Aviation Administration certification, the US Government will not include an aircraft in the FMS programme. IOMAX is content with the situation because the company has yet to refine and finalise the Archangel’s design for the FMS market. Ron Howard confirmed IOMAX is in discussions with the US Government and has a lot of interest in the product. He said: “We wanted to satisfy the MENA [Middle East North Africa] market first. We’ve satisfied the requirements of the UAEAF, which is looking to buy more aeroplanes, and are currently negotiating with Saudi Arabia and Egypt. The programme has been running for six years, and we are now positioned to enter the market in a big way.”

One of ten IOMAX Border Patrol Aircraft (not an Archangel) in service with the Royal Jordanian Air Force. This example, serial number 1584, is loaded with two GBU-12 laser-guided bombs and the IOMAX mission pod fitted with an MX-15Di imaging system. *Arnold ten Pas*

