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## The new face of airborne SIGINT: global, civil and in real time

**Intelligence gathering has gained new capabilities with advances in technology and the need to monitor insurgents, writes Martin Streetly**

On the surface, it appears that little has changed for decades in Western forces' approaches to airborne signals intelligence (SIGINT). Current UK and US capabilities, for example, primarily reside in the Nimrod R.1 and RC-135 respectively, both of which have been in service in some form since 1960 and the early 1970s.

During the Cold War, the airborne SIGINT club was an exclusive one, with membership largely restricted to the United States, Europe, Israel and the then-Soviet Union. SIGINT was considered a strategic tool and accordingly shrouded in secrecy. It was principally focused on detailing opposing air defences and ballistic missile disposition and developments. The term 'strategic' was equated with 'national' in regard to information dissemination.

The compartmentalisation and security considerations meant that tactical use of acquired data remained at a low level despite experience gained in the two World Wars, the Korean War, the Vietnam War and others that showed SIGINT's worth in real-time combat.

Today the club has gained several new members and the aircraft have stepped into a more everyday role, with clear applications in the fight against disparate, distributed organisations such as Al-Qaeda and their reliance on modern communications. Add to this the rise of new forms of global communications and a picture emerges of an environment where SIGINT is tactically important, but needs to be distributable across a host of civil and military users - both national and joint, intelligible at all levels and delivered in as near to real time as possible.

In this context, SIGINT is an overarching term for a range of techniques designed to acquire information from the electromagnetic spectrum, with subdivisions including communications intelligence (COMINT), electronic intelligence (ELINT), measurement and signature intelligence (MASINT), technical intelligence (TECHINT) and telemetry intelligence (TELINT).

### US collectors

As might be expected in an area that is extremely expensive to implement, the US remains preeminent in the field, with SIGINT collectors in all three services.

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The US Air Force's (USAF's) primary airborne SIGINT tool is the RC-135V/W 'Rivet Joint' COMINT/ELINT aircraft. This is backed up by smaller numbers of C-130 'Senior Scout' COMINT/ELINT, RC-135S 'Cobra Ball' imagery and TELINT, RC-135U 'Combat Sent' MASINT/TECHINT and U-2S multi-sensor aircraft.

In all, the USAF fields a total of 17 RC-135V/W aircraft, roughly half of which are undergoing maintenance and/or upgrading at any one time. Dating back to the early 1970s, the Rivet Joint architecture has undergone a series of block (now known as 'Baseline') upgrades to keep it abreast of the threat environment in which it works. Initially, the aircraft were used as 'bean counters' to establish the electronic orders of battle of the Soviet Union's and allied air-defence networks, but today the aircraft offers a real-time COMINT platform with an integral ELINT capability.

As of February 2010, the USAF was planning to support an RC-135V/W fleet made up of aircraft configured to Baselines 8, 9 and 10 standards during the period from US Fiscal Years 2010-15 (FY10-15).

A Baseline 8 aircraft is understood to incorporate improved collection techniques, user friendliness and system reliability, as well as automated and faster information dissemination capabilities. It is flown by a basic crew of 26 - three pilots, two navigators, three ELINT operators, four in-flight maintenance technicians and 14 COMINT operators - and Baseline 8 connectivity includes the satellite-based Remote Extended Aircraft Position Enabling Reachback (REAPER) and Network Centric Collaborative Targeting (NCCT) systems. REAPER facilitates off-board analysis and processing of acquired data, while NCCT creates machine-to-machine links that enable previously incompatible multi-intelligence (MINT) sources to work as collaborative teams.

Baseline 8 Rivet Joint is also reported to be able to 'talk' to the USAF's U-2S high-altitude reconnaissance aircraft and the ground-based, tri-service Distributed Common Ground System (DCGS) processing and dissemination architecture.

Baseline 9 adds a processor upgrade, new liquid-cooling and improved emergency exits, while Baseline 10 adds further improvements (including carbon wheel brakes) and, as of 2010, was scheduled to appear during the latter part of 2011.

There is plenty of life in the platform and in its recent Strategic Defence and Security Review, the UK reconfirmed its selection of the Rivet Joint to replace its Nimrod R.1 COMINT/ELINT platforms.

The Nimrods entered service during the early 1970s and have been subjected to a series of upgrades, most notably the 1992-vintage 'Starwindow', 1998 'Extract' and 2009 'Tigershark' efforts.

'Starwindow' introduced a network of two high-speed and 22 digital pooled receivers, the ability to handle frequency-agile emitters, an in-flight analysis capability, real-time preformatted tactical data report generation, and active matrix colour operator displays. The 'Extract' update was designed to increase the platform's level of automation, adding a central database and a data fusion capability, while 'Tigershark' appears to have been a COMINT

upgrade tailored for operations in Southwest Asia.

However, the aircraft's days are numbered and the last Nimrod R.1 is expected to be retired in March 2011.

Elsewhere within the USAF's RC-135 fleet, the two RC-135U 'Combat Sent' aircraft provide a MASINT/TECHINT capability frequently used in concert with the RC-135S platform.

As of the FY10-15 timeframe, the USAF is planning to operate Baseline 3 and 4 RC-135U configurations. Over time, its onboard mission suite has included the Precision Power Measurement System; Automatic Electronic Emitter Location System; the 'Compass Era' thermal imaging/radiometer/spectrographic system and various Quick Reaction Capability 'carry-ons'.

The service's trio of RC-135S 'Cobra Ball' aircraft provides TELINT and SIGINT during missile firing events and the type has been used as a theatre ballistic missile detection tool since Operation 'Desert Storm'.

Also within the USAF inventory, the roll-on/roll-off 'Senior Scout' capability is operated by the Air National Guard. It is essentially a cargo-bay operator shelter, with clip-on antenna arrays that convert a standard C-130E/H cargo aircraft into a COMINT/ELINT platform within a minimum of 10 to 12 hours.

Senior Scout was specifically designed for such environments as the US Southern Command area of operations. The latest known configuration is the Baseline 2, which adds (among other things) super resolution direction-finding to the original architecture.

The U-2S high-altitude reconnaissance aircraft also has a SIGINT role, recently outfitted with the Airborne Signals Intelligence Payload (ASIP), which appears to be intended to either replace or complement the type's existing 'Senior Glass' COMINT/ELINT fit. The U-2S' ASIP fit is understood to comprise a three-box high-band subsystem, a two-box low-band subsystem, an interface unit and a multiple-element antenna array.

Within the US, the army has truly pioneered and honed the concept of using COMINT/ELINT as a tactical intelligence tool, and the 'Guardrail' programme has been at the forefront of this. Guardrail comprises remotely controlled COMINT and ELINT receivers mounted aboard modified King Air business aircraft to gather intelligence data and targeting-grade emitter-location.

The latest Guardrail iteration has traditionally made use of four transportable ground-based Guardrail Common Sensor (GR/CS) architectures designated as GR/CS systems 1, 2, 3 and 4, which are used to control the airborne collection sensors and process acquired data.

GR/CS ground systems have also been cross-decked into fixed-site garrison facilities supported by the deployable Guardrail Ground Baseline payload control and data processing/dissemination facility, which provides reachback to the fixed-site architectures.

Guardrail was supposed to be replaced by the Aerial Common Sensor (ACS), but that programme's cancellation in 2006 has resulted in another project looking to create a

standardised airborne platform to support all four GR/CS and their eventual migration into the DCGS.

The army has 33 of the newly configured aircraft - 29 operational and four trainers - designated RC-12X. These modified RC-12K/N/P/Q airframes are equipped with: enhanced air-to-ground datalinks; the Communications High Accuracy Location Sub-system Compact geo-location sub-system; an Enhanced Situational Awareness capability based on a twin-chassis ASIP derivative; a new high-band COMINT capability; revised radio frequency distribution; and enhanced 'special signals' processing capability to intercept cellular phone traffic; as well as an X-Multi-user Interactive Digital Analysis System signal processor. Initial RC-12X full unit fielding was expected by the end of 2010.

As with the ACS programme, the US Navy's most serious recent attempt to introduce a new-generation EP-X SIGINT aircraft has come to nought, forcing the service to maintain its fleet of 16 EP-3E COMINT and ELINT platforms for longer than anticipated.

The EP-3E was first fielded during 1991 and has since undergone a complex sequence of upgrades starting with the Sensor System Improvement Program, which was followed by the Joint SIGINT avionics family modernization (JMOD) effort. In turn, JMOD morphed into the spiral JMOD Common Configuration (JCC) programme, which in its Spiral 1 iteration includes an expansion in frequency coverage, improved emitter geo-location and electronic support functionality, together with enhanced communications, signal processing and exploitation.

JCC Spiral 2 adds improved information-fusion and decision-making aids, while Spiral 3 incorporates better signals exploitation and improved low-band coverage and direction-finding. Eight EP-3E aircraft have also benefitted from the introduction of an AN/AAS-52 electro-optical (EO) sensor to give them a MINT capability for operations in Southwest Asia.

Alongside these reinvigorated Cold War-era systems, the US has introduced a new breed of purely tactical MINT platforms that are designed for the sort of asymmetric warfare being conducted in Afghanistan and which combine EO and COMINT sensors to locate and target hostile forces. Perhaps the best known of this new breed is the USAF's MC-12W 'Liberty' platform, which is based on the King Air 350/350ER turboprop-powered business aircraft and is fitted out with a mission suite that includes an MX-15 EO sensor, datalinks and a COMINT subsystem codenamed 'Pennant Race'.

As such, 'Pennant Race' has been likened to the sorts of equipment that have been applied to unmanned aerial vehicles (UAVs) and it is reported to be used to cue the platform's imaging sensor in addition to collecting intelligence data in its own right.

Such combinations are not new, however, and Israel's IAI Elta Systems, for example, has sold its combined EO/COMINT EL/I-3100 SpyHawk package to a number of customers around the world (including Colombia) for use in counter-narcotics and counter-insurgency operations in relatively benign threat environments.

The US Army is pursuing a similar capability with its King Air 300/350-based Medium

Altitude Reconnaissance and Surveillance System (MARSS - which has also been sold to Canada) and Enhanced MARSS programmes, and it can be assumed that the UK's Shadow R.1 aircraft includes a COMINT component in its overall data output.

## European systems

Western European SIGINT operators include France, Italy, Spain and Sweden (as well as the UK).

The French capability is vested in a pair of C.160G Gabriel COMINT and ELINT aircraft that entered service during 1989 and were originally intended to provide tactical SIGINT support for the country's armed forces. Until 2004, France also maintained a DC-8-based SARIGUE-NG strategic system, but its withdrawal on cost grounds has meant that Gabriel's operational remit has perforce been extended. Accordingly, it has been upgraded (by national contractor Thales), with the first reworked example scheduled for re-delivery during December 2010.

The Italian Air Force currently operates a single G222VS SIGINT aircraft that is understood to be equipped with a mixture of Italian and US-sourced sensors. It has been in service since 1981 and Italy is known to have an active requirement for a replacement - designated at one time as the Joint Airborne Multi-Sensor Multi-Mission System (JAMSMMS) - which has been repeatedly delayed due to lack of funds.

A Gulfstream G550-based JAMSMMS-type capability appears to have been the front runner for a new acquisition. It is perhaps worth noting that March 2011 is scheduled for the fielding of Italy's Jamming and Electronic Defence Instrumentation C-27J, which will provide counter-improvised explosive device (IED) initiation and SIGINT capabilities in support of coalition forces in Afghanistan.

The Spanish Air Force has taken a similar route to that of the US, using a Boeing 707-based multisensor SCAPA aircraft that entered service during 2000. Its SIGINT capability is vested in an enhanced variant of Israeli contractor IAI Elta's EL/L-8300 SIGINT suite, with the platform's integration and operational software carried out in Spain by Indra.

Sweden is a long-term SIGINT specialist and has maintained an airborne SIGINT capability since the 1940s. Its current operational platform is the S 102B Korpen, which provides COMINT and ELINT collection from a pair of modified Gulfstream IV business jets. One of these aircraft is reported to have recently flown to the US for upgrade, but exact details of the upgrade are sparse.

As might be expected, the Russian Federation has tried to maintain an airborne SIGINT capability from the vestiges of its Soviet-era equipment.

Unlike many of its Western counterparts, Russia has a long history of fielding airborne SIGINT systems as part of multi-sensor suites - examples being the SRS-13 Tangazh ELINT system installed aboard the Su-24MR and Tu-22MR 'Backfire' platforms and the Kvadrat-2 or Romb ELINT equipment fitted to the Il-20M 'Coot-A'. Indeed, the only known dedicated Russian SIGINT aircraft to have been fielded in recent memory is the An-26RT/RTR/RR

'Curl B' series of COMINT platforms.

As a result, the current Russian airborne SIGINT capability is but a shadow of its former self, with *Jane's* sources suggesting that the country can field about 70 Su-24MR 'Fencers', 10 Tu-22MRs and perhaps as few as five Il-20Ms.

In much the same way, airborne SIGINT provision within the countries of the former Warsaw Pact has withered on the vine, with only the Polish Army able to field a trio of W-3 helicopters modified to carry the nationally produced Procjon SIGINT system.

## Middle East intelligence

Airborne SIGINT proliferation in the Middle East, however, appears to have been driven partly by confidence-building between Israel and those Arab nations willing to reach accommodations with it, and partly by US attempts to bolster support in the region.

Within the Israeli camp, self-sufficiency is at the core of the country's SIGINT doctrine. Israel's latest system is the Gulfstream V-based Shavit COMINT and ELINT system, three of which currently serve with the Israeli Air and Space Force alongside six RC-12D/K 'Guardrail' aircraft, which are believed to have been supplied by the US after the 1979 peace deal between Israel and Egypt.

Egypt is understood to have acquired a pair of ELINT-configured C-130 transport aircraft, together with at least two COMINT- and ELINT-gathering Hawker Beechcraft 1900C-1 platforms. In all cases, the Egyptian aircraft are believed to be fitted with US-sourced sensors.

The US has also supplied Saudi Arabia with a pair of RE-3 Rivet Joint clones, one of which returned to the US for upgrade in mid-2010.

Elsewhere, it is possible that Iran has managed to sustain parts of the US-sourced 'Ibex' airborne SIGINT capability supplied to the country prior to the fall of the Shah in January 1979. Photographic evidence shows that the Islamic Republic of Iran Air Force is still flying examples of Boeing 707 and C-130 aircraft that were at one time part of the Ibex programme, although whether the onboard Ibex sensor systems are still functional remains unclear.

## Asia and South America

US SIGINT largesse also extends to Asia, with India, South Korea and Taiwan all having received airborne SIGINT systems.

The Indian Air Force is understood to operate a single Boeing 707 SIGINT platform on behalf of the country's external intelligence service. This aircraft was originally modified for the role by then-US contractor E-Systems (now subsumed into Raytheon) and is thought to be in urgent need of replacement.

South Korea's quartet of Hawker 800SIG COMINT and ELINT aircraft emanates from the same contractor, while Taiwan's C-130HE aircraft is fitted out with the Airborne Electronic

Surveillance System that has been jointly developed by Lockheed Martin and Taiwan's Chung-Shan Institute of Science and Technology. More intriguingly, US industry may be involved in a putative Australian 'Peace Mate' P-3/C-130-based COMINT programme that has been consistently denied by the Australian government and reported as real by *Jane's* sources.

Elsewhere in the region, Thailand and Singapore are reported to be operating SIGINT aircraft outfitted with Israeli equipment, while Japan has fielded the EP-3 and YS-11EB SIGINT aircraft that carry locally produced 'high-' and 'low-band' sensor sub-systems.

Much of Asia's SIGINT effort is directed at China and North Korea, with the former country fielding its own airborne capability in a series of platforms predominantly based on the Y-8 turboprop transport aircraft.

In South America, Brazil and Chile have developed indigenous ELINT aircraft with the R-35A and Beech 99 'Petrel Beta' platforms respectively.

## UAV platforms

Manned airborne SIGINT platforms have always been vulnerable to interception but have been retained because of their versatility and operational flexibility, certainly when compared with satellites in fixed orbits. A transition to UAV-based systems offers the prospect of retaining manned aircraft-like versatility with an enhanced ability to go into harm's way without loss of life and persistence. Additionally, current UAVs offer mission times measured in days, with ongoing developments being designed to stay aloft for months if not years.

As has frequently been the case within the domain, Israeli industry has been an early player in the marketplace, with Elta Systems' EL/K-7071 COMINT and EL/L-8385 ELINT packages specifically tailored to UAV applications. The emphasis has been on Israel Aerospace Industries' Heron family of UAVs, with Canadian and Indian examples of the type (as well as Dutch Aerostars) exhibiting the EL/K-7071's distinctive antenna array. An Israeli-made SIGINT system may also be associated with the UK's Watchkeeper UAV programme, Tadiran's Skyfix COMINT system having been exhibited as a potential sensor for the air vehicle.

Elsewhere, Rafael Advanced Defense Systems and Saab's South African arm promote UAV-applicable equipment, with the Top Scan ELINT system and Electronic Surveillance Payload respectively.

In the US, the big-ticket unmanned option is Northrop Grumman's ASIP architecture installed aboard the RQ-4 Block 30 Global Hawk and under development for installation on the Predator (ASIP-1C) and Reaper (ASIP-2C) UAVs.

ASIP is the USAF's next-generation airborne SIGINT sensor and is modular and scalable to accommodate a wide range of platforms. With regard to the UAV applications, ASIP-1C is a basic COMINT application aimed at telecommunications traffic and has a limited emitter-location capability. ASIP-2C adds a direction-finding facility and simultaneous

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(rather than sequential) functionality. For its part, the Global Hawk application is a six-chassis architecture that is COMINT and ELINT capable and offers direction-finding, emitter geo-location and telecommunications intercept facilities. The Global Hawk application is just entering service, while contracts have been awarded for the development of ASIP-2C.

Europe's main interest is based on Cassidian Electronics' Integrated SIGINT System (ISIS) which the company is developing for installation aboard the Euro Hawk variant of the RQ-4. As such, ISIS provides COMINT and ELINT and incorporates automatic signals analysis and classification, results correlation, a high level of automation and comprehensive ground support facilities.

The prototype ISIS-configured Euro Hawk air vehicle made its maiden flight in June 2010. If all goes well with the system's ongoing development programme, Germany may procure up to five ISIS-equipped air vehicles to replace its now-withdrawn 'Peace Peek' Breguet Atlantic SIGINT aircraft from 2011-12 onwards.

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*Kawasaki's EP-3 SIGINT aircraft is a key component of the Japanese Maritime Self-Defence Force's intelligence-gathering capability. (JMSDF) 0051064*

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*The USAF's Senior Scout roll-on/roll-off SIGINT capability includes the cargo bay operator shelter shown here, being loaded aboard a C-130E Senior Scout-configured transport aircraft. (Lockheed Martin) 0059963*



*The Swedish Air Force operates a pair of S 102B Korpen SIGINT aircraft. (Gulfstream) 0063876*

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*The EP-3E aircraft is at the heart of the US Navy's airborne SIGINT capability.*  
(USN)  
0529536



*After 2011, the UK Royal Air Force's Nimrod R.1 SIGINT aircraft are to be replaced by a trio of RC-135 Rivet Joint platforms.*  
(USN)  
0561205

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*Assuming the availability of funding, Italy intends to replace its existing G222VS SIGINT aircraft with a multi-sensor platform in the short to medium term.*  
(NATO)  
1046198



*The Polish Army is understood to operate a trio of W-3 Procjon SIGINT helicopters.*  
(WZE)  
1046307

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*The USAF operates a fleet of 17 RC-135V/W Rivet Joint SIGINT aircraft. (USAF) 1195553*



*Y-8(DZ) aircraft 9351 is one of a number of supposed SIGINT derivatives of China's Y-8 turboprop-powered transport aircraft. (Chinese Internet) 1299060*

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*The RC-12X is the latest airborne collection platform associated with the Guardrail Common Sensor SIGINT architecture. (Northrop Grumman) 1305672*

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