RAPTOR

Bringing home the goods

Right: *Tornado GR4 ZA401 from IX(B) Squadron gets airborne during early October on a RAPTOR training sortie from RAF Marham.* Mark Ranger

Below: *Official RAF release of RAPTOR imagery taken over Afghanistan. The distance and altitude of the Tornado have not been released.*
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Peter R Foster and AFM look at the history and future of the RAF's main reconnaissance tool, the RAPTOR pod, carried by the Tornado GR4

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COMMENTING ON the employment of the Reconnaissance Airborne Pod for TORnado (RAPTOR) system in an RAF news article in late 2011, Group Captain Peter Squires, then commanding officer of 906 Expeditionary Air Wing, stated: "A major deficiency we had in the Libyan campaign was the lack of human intelligence on the ground. So we relied a lot more on imagery intelligence."

RAPTOR was employed by the RAF Tornado force during Operation Ellamy over Libya, as well as Operations Telic and Herrick before it in Iraq and Afghanistan respectively. Developed and manufactured by Goodrich, it is one of the world's most advanced reconnaissance systems and comprises the DB-110 reconnaissance pod and the Goodrich Intel System used to process imagery data gathered by the pod. RAPTOR was described as a key element in the mission to enforce UN resolutions to protect the people of Libya.

Plugging the ISTAR gap

RAPTOR was born out of a capability gap identified through lessons learned from the first Gulf War in 1991 - the need for a stand-off reconnaissance, day/night, real-time system that could be downlinked to people on the ground.

There was hardly any breathing space between Operation Granby in 1991 and the introduction of Operation Southern Watch over Iraq in 1992, and as a stop-gap measure the UK Ministry of Defence (MoD) purchased the VICON 18 Series 601 GP(1) pod under an urgent operational requirement (UOR) to fulfil the medium-level requirement. Equipped with 450mm long-range oblique photography (LOROP) cameras, these pods were initially used by Jaguar and Harrier. However, when Tornado initially took up duties on Southern Watch, it took with it the TIALD (thermal imaging and laser designation) pod to support the in-house Tornado Infra-Red Reconnaissance System (TIRRS).

While the GP(1) pod was a very effective system in terms of cost and value for money, it only worked effectively at 6 to 8 miles – but in RAPTOR the RAF was looking for a 40-mile-plus stand-off capability. The real push for the operational requirement began in 1993 – a number of studies were carried under the applied research programme, ARP 2E, within the Defence Research Agency (DERA) which looked at various options for a LOROP day/night system. The technology was at a relatively early stage and at that time there was only one night, long-range infrared camera flying, and that was on the American U-2. A day-only variant of that system, but with a long focal length, had been acquired for use by the Canberra PR9s of 39 (1 PRU) Squadron.

It was in 1996 that the final specification was decided on and released for tender under Service Requirement (SR) (Air) Operational Emergency (OE) 1368. A number of companies including Thomson in France, El Op in Israel and Recon Optical and Hughes in the United States were considered. The Hughes system came out on top and was selected in 1997 to fulfil the requirement that was ultimately to become RAPTOR.

As far as the RAF was concerned it was a very complex programme deeply interwoven with the Tornado mid-life upgrade package. ▸

Here, the RAPTOR's doors are open to allow the telescope to capture imagery. It can operate at speeds up to Mach 1.1. Peter R Foster

Complex design

Development of the system began with the concept of being able to transition to real-time operations, a forerunner of time-sensitive-targeting – in other words, the ability to datalink either to forward force elements or back to a deployed headquarters. Datalink technology was therefore the driver and the dominant technology (next to that of the focal planes). The main problem lay in image stabilisation: if that could be overcome it would provide an exceptional, rather then just an adequate, imaging system.

Although the RAPTOR's electro-optical (EO) elements are very important, they are relatively easy to produce. They have to be made out of material that never changes size – the trick is to project a pixel onto the ground and hold it long enough to be able to get the signal back onto the focal plane: the key is to stabilise that pixel to avoid smearing and jittering of the image.

The design and manufacture of the pod was therefore a major part of the development of RAPTOR. Although most of the components were industrial-grade, they had to be able to withstand extremes of temperature. Anti-vibration mounts were fitted to protect equipment, although 'g' is not such a problem in electronics because of its fairly slow onset; some components are susceptible, such as spinning discs, but the introduction of mini-discs reduced both gyroscopic and 'g' effects. RAPTOR has its own autonomous environmental conditioning system provided by a ram scoop along the left hand side of the pod which drives air turbines to provide cooling: this was forced on the design as the Tornado is hungry for electric power and did not have a lot to spare. RAPTOR's EO/IR medium-level capability is datalinked for direct exploitation in the datalink ground station (DLGS) cabins.

RAPTOR innards

Built around the Goodrich DB-110 dual-band sensor, RAPTOR delivers high-definition imagery in the visible and infrared bands at both medium and long ranges. Capable of fully autonomous operation, it has an altitude operating range of between 10,000 and 50,000ft (3,050m and 15,240m). Its 11-inch (280mm) aperture telescope has focal lengths adjustable to fit application with a nominal 110 inches (3.39m) visible and nominal 55 inches (16.76m) IR. The system has a 180-degree field of view across the line of flight, plus a 20-degree field of view along line of flight. Panoramic scanning and two-axis line-of-sight stabilisation systems mean it can operate at a ground speed range of Mach 0.1 to 1.1.

Autonomous operation of the DB-110 system is controlled by the pod's reconnaissance management system (RMS) situated in the aft compartment between the camera and the aft datalink module. Imagery itself is displayed on the Tornado's TVTAB (cockpit video) display enabling the Weapons Systems Officer to verify target acquisition or conduct tasks such as battle damage assessment. The imagery recording is stored on a 45GB digital tape within the pod itself. The entire pod weighs some 2,200lbs (1,000kg).

RAPid Development

RAPTOR first flew in February 2001 although a DB-110 in a demo pod first took to the air back in 1997 on Tornado GR1 ZA326 from Boscombe Down in Wiltshire on a limited flight envelope, purely to ensure it could be flown and take pictures. The RAPTOR pod was designed in conjunction with QinetiQ at MoD Boscombe Down in Wiltshire, and Pod number 2 was the first to actually take to the skies – Pod 1 had been used as the build-qualification article. Test flying was initially undertaken at BAE Systems' facility at Warton in Lancashire, but with the build-up of tension in the Gulf in 2002 the programme was accelerated. At that point, development flying was transferred to RAF Marham, where Squadron Leader Dave Postlethwaite of II(AC) Squadron took charge of the RAPTOR project – a role the squadron retains today.

No II(AC) Squadron initially flew under a test clearance and undertook an interim acceptance in October 2002 when the system was deployed to the Gulf.

'Best thing since sliced bread'

In the Operation Telic debrief in June 2003, the Air

Above: ***The bulky RAPTOR pod considerably reduces ground clearance on the Tornado, the main reason it can't be used on Typhoon.*** Crown copyright/MoD

Officer Commanding 1 Group, Group Captain Greg Bagwell, commented that RAPTOR was "a quantum leap in surveillance and reconnaissance capability of the Tornado". Four pods were taken to theatre and used operationally ahead of the system's official acceptance into squadron service. This was "not an ideal way to introduce the pod", said the Group Captain, "but the risks were worth taking".

The imagery supplied by RAPTOR is one of the things that persuaded the Chief of Staff of the US

"A quantum leap in surveillance and reconnaissance capability of the Tornado"

Air Force, General T 'Buzz' Moseley, into getting back into the 'tactical recce' game. At that time all the Americans had was the Tactical Airborne Reconnaissance Pod System (TARPS) on the F-14 Tomcat and a small pod carried by US Navy and US Marine Corps F/A-18 Hornets. They produced nothing like the quality of imagery supplied by RAPTOR. This subsequently saw the DB-110 sensor undertake trials on Predator Unmanned Aerial Vehicles from Creech AFB, Nevada.

Eight RAPTOR pods were built and delivered to the RAF initially for use solely with II(AC) and XIII Squadrons. However, the Tornado mid-life update for GR4 and the down-declaring of TIRRS (which rendered the GR4A designation obsolete) gave the then entire Tornado fleet a common ability: RAPTOR can be carried on any jet as most of the control software is contained within the pod. There is no special equipment other than an umbilical which connects the pod to the aircraft. During 2007 the RAF completed a six to nine-month cycle of fitting pods to every Tornado GR4, checking that everything

Above: ***Tornado GR4 ZG709/120 over Iraq in 2009. RAPTOR proved its worth in Operation Telic between 2003 and 2010.*** Peter R Foster

worked as planned. TIRRS was fully withdrawn in 2006 and RAPTOR evolved to fill the gap.

Ongoing Development

On July 5, 2007 the RAF deployed a squadron of Tornado GR4s to China Lake Naval Weapons Center in California under Exercise Empire Challenge 07, an intelligence, surveillance, target acquisition and reconnaissance (ISTAR) exercise. One of the tasks was the operational evaluation (OPEVAL) of RAPTOR as part of the final acceptance procedure into the RAF inventory – and declaration of full operational capability five years after it was first deployed operationally. No IX(B) Squadron took four RAPTOR pods, some fitted with a solid-state recorder, a new component replacing the original tape system. Also deployed was a detachment of analysts from the Tactical Imagery Intelligence Wing (TIW) at RAF Marham, who were able to exploit the imagery datalinked to the DLGS. This was then presented to the exercise commanders and intelligence agencies from Australia, Canada, the UK and the US.

Operation Ellamy

Unlike the manner in which RAPTOR has been used over both Iraq and Afghanistan in the strategic role (as well as for high-definition reconnaissance, particularly in the war on improvised explosive devices, or IEDs), in Operation Ellamy over Libya it was 'back to basics' in a more tactical application.

TIW personnel were justifiably proud of the quality of intelligence their analysts and the Tornado crews had provided to the Combined Air Operations Centre (CAOC). Given the short notice and the lack of good reliable intelligence on the ground, airborne ISTAR assets became the major players in the overall campaign. ►

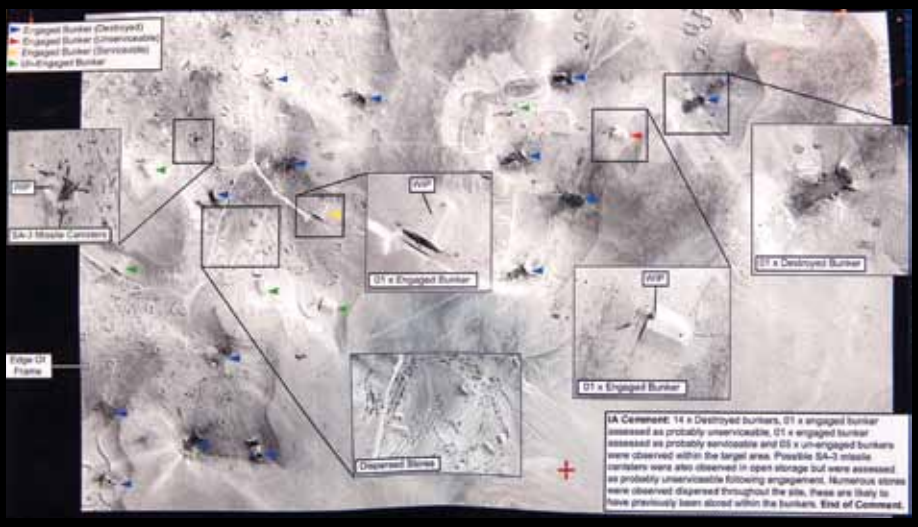
Tactical Imagery Intelligence Wing (TIW)

THE ESTABLISHED concept of relatively small reconnaissance intelligence centres as integral parts of individual squadrons started to become untenable following the second Gulf War, where the tempo of operations and increase in reconnaissance data, as well as the emphasis moving from low to medium level, began to overwhelm the units.

TIW formed in April 2002 by combining II(AC), XIII and 39 (1 PRU) Squadrons' Reconnaissance Intelligence Centres (RIC) and was in an embryonic state at the beginning of the second Gulf War in 2003. In July 2003, 41(F) Squadron's RIC, also became part of TIW.

Today TIW is a Force Element within 1 Group, which confers a similar status to that of a flying squadron. It is responsible for the processing and exploitation of fast-jet electro-optical imagery on deployed operations, exercises and routine training. The imagery comes from the RAPTOR pod on the Tornado GR4 and the Litening pod carried on both Typhoon FGR4 and Tornado GR4. TIW is also responsible for providing specialist training of all Imagery Analysts (IA) within 1 Group.

The wing is split into two squadrons: Operations and Capabilities. Within the Operational Squadron are three Imagery Intelligence Flights assigned to various recce platforms; and a tasking cell that interfaces with collection, collation and intelligence requirements management (CCIRM) within the MoD. The Capability Squadron delivers that capability to the Operational Squadron through its IA Support Flight, Engineering and Mobility Flight, Photographic Engineering Section and Geo Support Section. No 7010(VR) Squadron



Above: ***Released TIW imagery of an airfield in Libya after coalition attacks on the base.*** Peter R Foster

Royal Auxiliary Air Force forms the strategic reserve for the wing.

Traditionally, TIW was considered to be part of the role known as tactical reconnaissance or 'tac recce'. As traditional tasking and reporting has evolved to provide a much broader, more complex and often more dynamic set of questions, the term 'Combat-aircraft ISTAR' better describes the role of TIW and the aircraft that collect the imagery. The intelligence, surveillance and reconnaissance (ISR) and imagery-intelligence (IMINT) provided by TIW is complementary to that offered by JARIC, the National Imagery Exploitation Centre (which has kept its acronym from the former Joint Air Reconnaissance Intelligence Centre), and Airborne Stand-Off Radar (ASTOR).

Operation Telic in Iraq proved the concept and although the embryonic TIW was at full stretch during this period it has been able to build upon the lessons learnt to produce a far more effective and coherent system today. Wing Commander Andy Hetterley currently heads the TIW at RAF Marham.

The more versatile Litening can be downlinked via Remote Optical Video Enhanced Receiver (ROVER) to troops on the ground, but the definition provided by RAPTOR is significantly better. During Ellamy such an immediate requirement was not necessary, given that recce sorties were tasked specifically by CAOC following intelligence from other sources: therefore all analysis was carried out post-sortie back at the TIW headquarters.

Operation Herrick – still there in Afghanistan

In Afghanistan today, the Tornado's job is as much about intelligence-gathering as it is fighting. RAPTOR is the platform of choice for observing areas ground troops can't reach and planned sorties are flown several times a week, the imagery still eagerly sought by the US forces in theatre. "A lot of that imagery is used for finding places where IEDs have been set, observing the pattern of life for an area, detailed analysis – entrances, exits, that kind of thing," said Wing Commander Jim Mulholland, the Officer Commanding 31 Squadron, which was in theatre early in 2012. "If you then add on top of that the Litening pod, which we have for targeting but which also has a recce capability, it adds another aspect. The quality of imagery from Litening is a significant jump in capability from what we had four or five years ago, and allows us the fidelity to do the task that is now required." Sorties of up to five hours are normal and are conducted at around 20,000ft (6,100m), well out of the way of any potential small-arms fire.

"We can identify people on the ground – whether they're male, female, adult or child," TIW intelligence analyst SAC Simon Emmott told the British Forces Broadcasting Service last September. "We can identify different makes and models of vehicles – we can pull out detail such as a washing line in a compound." The TIW personnel at Kandahar work long shifts of between 12 and 18 hours, but the results are worth it. Recently three car bombs in Kabul were prevented from exploding thanks to the work of the TIW staff.

A team of two squadron personnel tend to the RAPTOR pods' needs in between sorties with two or three hours of preparation required between each mission. No II(AC) Squadron was deployed to Kandahar until early November 2012, when IX(B) Squadron took over. Recently the Tornados have been providing support to Afghan National Security Forces operating in the north of the country, a role that is likely to grow as responsibility for security passes from International Security Assistance Force (ISAF) troops to those of the Government of the Islamic Republic of Afghanistan.

Above: ***The RAPTOR pod is seen to advantage on this shot of Tornado GR4 ZA406 with 'Shiny Two' Squadron nose bars. The pod is carried on the left-hand under-fuselage stores station.*** Peter R Foster

Survivor

RAPTOR is undoubtedly a major factor in the ongoing survival of the Tornado force – it couldn't have been carried by Harrier and can't be by Typhoon. An alternative needs to be developed for Typhoon and F-35, or possibly a new unmanned aerial system. But by March 2015 the Tornado force will have been reduced from 40 Force Elements at Readiness (ie, aircraft available at any one time) to just 18, suggesting just three squadrons will remain by then through to the type's out-of-service date of 2019. But until that time, Tornado and RAPTOR will still be scanning from the sky. afm

The effect of coalition bombing in Iraq – here, a destroyed MiG-25 lies crumpled outside its hardened aircraft shelter. RAPTOR imagery would have been essential in planning such raids. Yves Debay