

WORLD

■ **GAF IN RED FLAG – ALASKA**

■ **P1E – LEAP IN CAPABILITY FOR TYPHOON**

■ **3(F) SQUADRON KEEPING BUSY**

■ **MULTIROLE FIGHTER DESIGN**

 **Farnborough INTERNATIONAL AIRSHOW**
9-15 JULY 2012

TYPHOON DISPLAY SPECIAL



THE ULTIMATE CHOICE

 **Eurofighter Typhoon**



08

PHASE 1
ENHANCEMENTS

14

MULTIROLE
FIGHTER DESIGN



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Title:

A Royal Air Force Typhoon aircraft is serviced after its first mission over Libya.

Photography:

SAC Neil Chapman, RAF

Enzo Casolini
CEO Eurofighter GmbH



Dear Friends and
Colleagues of
Eurofighter,

This second edition of
Eurofighter World for
2012 is a significant
one for Typhoon as

we can now provide details of the long-awaited Phase 1 Enhancement Programme known as P1E that will see upgrades to the aircraft's operational capability and see a step change in Typhoon's multi-role capabilities. There are so many positive messages to be delivered as a result of P1E, which has seen over 2000 additions to the programme over the past few years and will mean Eurofighter Typhoon moving another step forward in providing to our customers significantly more capabilities on their world class aircraft.

When speaking of our customers, we are also working hard to develop our support services through activities such as the recent signing of a five-year engineering support contract - part of a new contract suite agreed with the nations - to focus on performance and affordability that will ensure a range of support services for Typhoon users. Eurofighter's partner companies will work to enhance the close relationships they have with the local MODs and Air Forces to improve the way we deliver a range of support services.

Aside from our feature on the multi-role design of the aircraft and the cutting edge performance and operational affordability of the EJ200 engine, we have the usual selection of news from across the programme: Typhoons from the RAF have been preparing for this summer's Olympic Games in London which will showcase the vital air defence role the aircraft plays across our customer nations in the most high-profile of ways.

On a similar note, the Italian Air Force have now made the transition to operating solely with Eurofighter Typhoons in the role of national air defence and new Typhoon Squadrons have been announced for the Spanish Air Force as well as the RAF. The German Air Force deployed eight Typhoons to Alaska in May to join the challenging Red Flag exercise and demonstrated outstanding performance in a competitive environment. You will find more details about all of the above in this edition.

With Farnborough International Air Show and the Royal International Air Tattoo (RIAT) taking place in July, ILA Berlin in September and many other exhibitions and events across Europe where Eurofighter will be present, it will be a great summer to present the exciting future of Typhoon.

Enjoy the issue.

Enzo Casolini
CEO Eurofighter GmbH

AUSTRIAN TYPHOONS PARTICIPATE IN INTERNATIONAL EXERCISE "AMADEUS12"

■ Six Austrian Eurofighter Typhoons played a major role in the "Amadeus12" exercise that began on 7th May and ran until May 16th in the region of Allentsteig, Lower Austria. The exercise, which was the biggest for Austria in 2012, involved around 2,300 soldiers and 51 aircraft.

Alongside the Austrian Eurofighters

from Zeltweg Air Force Base in Styria, two German Eurofighters from JG 74 in Neuburg participated in the exercise. The purpose of the training was to prepare for the military evacuation of EU civilians in times of crisis or conflict. The EU aircraft, be it military transporters or chartered commercial airliners are escorted to safety

by combat ground and air assets. Only recently has this been demonstrated in Egypt and Libya. Eurofighter Typhoons participated in "Amadeus12" to provide quick reaction air support to the EU aircraft as well as offering an unquestionable deterrent to any potential aggressors.

NEW TYPHOON SQUADRON ANNOUNCED



■ The Royal Air Force announced in May that a fourth front line Typhoon squadron will stand up at RAF Leuchars in September 2012.

Number 1 (Fighter) Squadron will reform officially at the RAF Leuchars Jubilee Air Show on

15th September becoming the fourth front line squadron to operate the Typhoon in the UK. It will be the second Typhoon Squadron based in Scotland, following the stand up of 6 Squadron at Leuchars in 2010.

1(F) Squadron has a distinguished history, becoming a founder squadron in the Royal Flying Corps, the RAF's predecessor, in 1912. Typhoon will join iconic aircraft like the Hurricane and Harrier that the Squadron has previously flown.

Air Commodore Gavin Parker, RAF Leuchars said: "2012 is the 100th anniversary of the creation of 1(F) Squadron. I can think of no better way to celebrate in this Diamond Jubilee year, than to return the Squadron to front line status, equipped with Typhoon, an aircraft that is central to the RAF's current and future combat air capabilities."

"1(F) Squadron will be the second Typhoon squadron to stand-up at RAF Leuchars. Since standing up 6 Squadron in 2010, we have seen Typhoon come of age as a multi-role aircraft maintaining the defence of UK sovereign airspace through the Quick Reaction Alert role, both here and in the Falkland Islands, as well as conducting air-to-air and air-to-surface sorties to protect the civilian population of Libya during Operation Ellamy."

ITALIAN EUROFIGHTER PILOT ACHIEVES 1000 FLYING HOURS



Lieutenant Colonel Daniele L.

■ Lieutenant Colonel Daniele L. of the Italian Air Force became the first Italian Typhoon pilot to reach 1,000 flight hours on the aircraft. This milestone was achieved during an air defence training mission flown through Tuscany's air space in April 2012.

The officer, in service at Grosseto's 4th Wing as Chief of Flight Safety, has spent his flight career on the Typhoon mainly as instructor pilot at the 20th OCU Group (Operational Conversion Unit), contributing to

the transition of many pilots assigned to the Eurofighter.

The 20th Group, in addition to supporting the other 4th Wing group IX in Italian Air Space Surveillance Service, is in charge of the operational conversion of future Eurofighter pilots.

"The 20th Group counts in its ranks expert pilots coming from different operational groups - the Commander of the 4th Wing, Colonel Michele Morelli, said - and the instructors are selected both on the basis of indisputable professional skills and personal characteristics, fundamental in effectively sharing expertise to ensure the pilot's rapid operational qualification on the Eurofighter aircraft".

Two types of training course are run in Grosseto each year for up to twenty pilots. The first is the "complete" class, that lasts for nine months and is divided into two phases, one being a ground phase which covers all aircraft systems as well as the accomplishment of a first series of basic simulator activities, and the other being where pilots carry out real flight activities in parallel with simulated ones, with increasing levels of difficulty. The second is the "short" class, for the transition of pilots coming from F-16 squadrons or other combat aircraft and takes three months to complete.

EUROFIGHTERS TAKE FULL RESPONSIBILITY DEFENDING ITALIAN AIRSPACE: REPLACING F-16S

■ Eurofighter Typhoons of the Italian Air Force (ItAF) have replaced the last of the air force's F-16 jets, leaving the Typhoon solely responsible for the defence of Italian airspace. Entering into service in 2004 and now operational with four Typhoon Squadrons (Gruppi) across both northern and southern Italy - two at Grosseto air base and two at Gioia del Colle - Eurofighter is now the only air defence asset in the Italian Air Force.

Replacing the F-16 as a more modern weapon system, the Typhoon aircraft will bring to the air force operational benefits thanks to better effectiveness and capabilities of the new fighter as well as offering logistics benefits due to the standardisation of having only one operational line for air defence duties.

The ItAF leased 34 F-16s from the USAF for a period of five years, followed by an additional five years under the programme "Peace Caesar". The aircraft has been effectively used to fill a gap during the transition from the F-104 and the Eurofighter.

62 Typhoon aircraft have been delivered to the Italian Air Force to date and during operations in Libya in 2011, the Italian Air Force fleet completed over 200 missions and flew 1294 flying hours from their Forward Operating Base (FOB) in Trapani, Sicily.



NEWS

RAF TYPHOONS CELEBRATE 100TH ANNIVERSARY OF 3(F) SQUADRON



Images: RAF No 3 (Fighter) Squadron celebrate their centenary and new standard with a special colour scheme for the Typhoon.
Photo credit: RAF Station Photographers, RAF Coningsby

■ No 3 (Fighter) Squadron, the oldest fixed-wing squadron in the Royal Air Force, today flying the Eurofighter Typhoon, proudly celebrated their centenary on the weekend of 12th and 13th May 2012 at RAF Coningsby.

The squadron was formed as No 3 Squadron, Royal Flying Corps, on 13th May 1912 at Larkhill, Wiltshire. The Squadron has played an important role in the history of the Royal Air Force, taking part in many campaigns and operations over the last 100 years.

During a formal parade on Saturday 12th May, the squadron was presented with a new Standard by the Chief of the Air Staff, Air Chief Marshal Sir Stephen Dalton and RAF Typhoons from the Squadron displayed commemorative art work in a special colour scheme on their tail and fuselage to celebrate the important anniversary.



RAF TYPHOONS ON EXERCISE

FRISIAN FLAG

■ The Royal Air Force Typhoons have been busy in recent months, taking part in various training exercises. Two of the most key were exercise Frisian Flag in the Netherlands and exercise Olympic Guardian over London.

Typhoon squadrons participated in the largest fast jet exercise to be held in Europe this year when they took part in exercise



Frisian Flag, organised by the Royal Netherlands Air Force (RNLAf). Six Typhoon jets deployed from RAF Coningsby based 3(F) Squadron joined units from nine other nations to fly in a series of increasingly complex training scenarios.

Frisian Flag provides experience of the planning, execution and debriefing of large scale composite air operations (COMAO) in realistic scenarios. Missions flown included air defence, protection of other aircraft and attacking of ground targets on land and sea in a high threat environment, which included

opposing fighter aircraft and ground based Patriot and SA-6 missile batteries.

Among the participants were six Eurofighter Typhoons from the German Air Force, ten F-16s from the Norwegian Air Force, five F-16s from the Belgian Air Force, seven F-16s from the Royal Netherlands Air Force, six F-16s from the Polish Air Force, six F-18C Hornets from the Finnish Air Force, eight Swedish Air Force Saab Gripen and the six Royal Air Force Typhoons.

The aircraft were deployed for the exercise to Leeuwarden Airbase, Netherlands, ideally located to access a huge area of unrestricted airspace extending into Germany and Denmark essential for an exercise of the size of Frisian Flag.

"The lessons to be learnt from operating with a large number of different aircraft types from a variety of nations is highly beneficial for the continued evolution of the Typhoon Force said Sqn Ldr Geoff Hall. "It's all about looking forward and this exercise is all about that."

"Frisian Flag gives us the opportunity to develop tactics and procedures with both Typhoon and other aircraft while demonstrating the capability of the system to all the exercise participants" explained Pilot Officer Oli Norris.

SPANISH AIR FORCE OPERATES NEW TYPHOON SQUADRON

■ Eurofighter welcomed 142 Escuadrón of the Ejército del Aire (Spanish Air Force) to the Typhoon family as the second Squadron operating the aircraft in Spain recently. The new unit, situated in Los Llanos Air Base in Albacete, operating under Ala 14 (14th Wing) replaced its Mirage F.1's with the new Typhoon fighter. The other Eurofighter units operating with the Eurofighter in Spain are the Escuadrón 111 and 113, both belonging to Ala 11 and based in Moron, close to Seville.

The 142 Escuadrón will bring the Typhoon in the exclusive club of the "Tigers", a gathering of units sharing a Tiger or big cat emblem - heraldry in Europe - established in 1961 and made famous thanks to NATO aircraft participating in the Tiger meet exercise where they were often brightly painted with tiger stripes.

EUROFIGHTER APP TO BE LAUNCHED

■ Eurofighter launched a brand new application for the iPad and Android tablets in July, offering fans of Eurofighter Typhoon a comprehensive, interactive guide to the aircraft. The new app brings you the latest news on the programme, squadron details, videos and images of the Typhoon as well as details of current and future capabilities which we hope will allow fans to further develop their passion for the Eurofighter Typhoon.

The app highlights how Eurofighter offers a wide-range of operational capabilities whilst at the same time delivering unparalleled fleet effectiveness. The application also gives an insight into the history of the aircraft, provides links to recent publications and unseen features about the Typhoon. The application has something for everyone. Look for Eurofighter Typhoon in your app store.

EXERCISE OLYMPIC GUARDIAN

■ Typhoon fighter jets arrived at RAF Northolt in May to take part in a major military exercise to test security for the forthcoming Olympic Games in London. The arrival of the jets - which was the first time fighter planes have been stationed at RAF Northolt since World War 2 - marked the start of specialist training over London and the Home Counties.

Codenamed Exercise Olympic Guardian, the eight-day exercise tested the procedures military aircrews will use to intercept and communicate with aircraft breaching the restricted airspace during the Olympic Games which begin on the 27th July, and the actions pilots must take in response. Pilots entering the restricted airspace can expect to be intercepted by Typhoon fighters, or military helicopters.

The Air Security Plan for the Olympic Games builds on the Royal Air Force's existing defence of UK airspace, which includes round-the-clock radar surveillance and Typhoon fighters held at high readiness every day of the year.

NEW HEAD OF PR AND COMMUNICATIONS



Theodor Benien
Vice-President
PR & Communications

■ As of 1st June 2012, Theodor Benien took over the position of Vice President PR and Communications at Eurofighter GmbH, replacing Valerio Bonelli who was in the role for three years and returned to Alenia Aermacchi as Head of Communications.

Theodor joins the Euro-

fighter team from Cassidian where his most recent role was as Head of Media Relations and Strategic Issues. He brings with him a profound knowledge of the Eurofighter Programme and a breadth of aviation experience. Prior to his role in Cassidian, Theodor worked as Head of Communications for Airbus Deutschland GmbH in Hamburg and as Head of Communications for EADS UK in London among other roles.

We would like to welcome Theodor to Eurofighter GmbH and wish him every success in his new role.



GERMAN AIR FORCE IN RED FLAG TRAINING EXERCISE - ALASKA



A Bavarian flag waving in tandem with the red, white and blue of the US, illuminated by 21 hours of daylight and set against a backdrop of snow topped mountains and military fighter jets. This unique scenario could only mean one thing: the presence of Luftwaffe's Jagdgeschwader 74 (JG 74) in Alaska to take part in the latest 'Red Flag' exercise alongside their American counterparts.

From May 21st until June 22nd 2012, eight Eurofighter Typhoons from the German Air Force in Neuburg participated in the internationally renowned exercise held at Eielson Air Force Base which on this occasion involved aircraft from Poland, Japan and Australia in addition to the German and American Air Forces.

Red Flag provided an opportunity for participants to gain invaluable experience in tactical missions, collective defence and conflict management. JG 74 took part in readiness for its assignment to the NATO reaction force this year, needing to prove the aircraft has the right level of interoperability and capabilities for such a role.

Marc Grüne, Lt. Col. of the German Air Force, said: "The German Air Force's decision to take part in the exercise Red Flag Alaska offered a great opportunity for the Fighter Wing 74 to train, test and improve the personal skills and aircraft capabilities. We wanted to see if the Eurofighter is capable of everything we think it is. And the aircraft is definitely capable. The challenging tasks and tough working days have brought the best out of everyone because of the spirit and passion of the people."

Red Flag - Alaska participants are organised into "Red" aggressor forces and "Blue" coalition forces. The Red force included air-to-air fighters, ground-control intercept, and surface air defence forces to simulate threats posed by potentially hostile nations. These forces employed defensive counter-air tactics directed by ground-control intercept sites. Range threat emitters – electronic devices which send out signals simulating anti-aircraft artillery and surface-to-air missile launches – provide valuable surface-to-air training. The Blue force - of which the JG 74 Typhoons were part - included the full spectrum of U.S. and allied tactical and support units.

German Air Force Col. Andreas Pfeiffer said of the exercise: "If you put all of the

factors together, this is probably the highest quality training you could possibly get in modern air combat."

During the two-week employment phase of the exercise, the JG 74 Typhoons flew 98 sorties of the planned 102. Aircrews were subjected to every conceivable combat threat. Scenarios were shaped to meet each exercise's specific training objectives. Typically about 70-90 jets are flying at the same time in one of the two daily so called 'waves'. The exercise has a building block approach, where mission difficulty will increase to a point where up to about 18 threat aircraft will present a highly capable, modern opponent.

Capt. Cory Farrer, an F-16 Fighting Falcon pilot from 18th AGRS, commented on the performance of the JG 74 Typhoons: "The Eurofighter is a very capable and formidable airframe, and it's a great and valuable asset (for our allies)."

Prior to the start of Red Flag, four Eurofighter Typhoons took part in exercise 'Distant Frontier' which was an opportunity for the American and German pilots to get to know each other and fly together before the start of Red Flag. The Typhoons flew 86 of the 88 planned sorties, mainly offensive counter-air (OCA). Major Marco Gumbrecht, Director of weapons and tactics with JG 74, said "We were testing the electronic warfare and DASS capabilities over the ranges". The Eurofighter Typhoons took part in eight 1v1 basic flight manoeuvre (BFM) sorties with the USAF's F-22A Raptors.

When asked how he felt flying with the American jets, Unit commander Colonel Andreas Pfeiffer, said: "Its unique capabilities are overwhelming from our first impressions in terms of modern air combat, but once you get to the merge, which is only a very small spectrum of air combat, in that area the Typhoon doesn't have to fear the F-22".

The deployment of the eight Neuburg based Typhoons to Eielson Air Force Base set a milestone in the history of the Luftwaffe with the 8000 kilometre, ten hour Atlantic crossing to the Alaskan base, located 42 kilometres south east of Fairbanks. The Eurofighter Typhoons made the trip in groups over two days, supported by two German tankers and proving yet again the ease of deployability over long distances.

A FORMER RED FLAG PILOT'S PERSPECTIVE



Gp Capt L Hilditch (RAF Ret'd), EF Head of Test and Evaluation and EF Head of Future Requirements Capture

'Firebirds - Heads Up! - Wall of Eagles over Worthington' from AWACS. The crews of eight rather elderly RAF F4 Phantom FGR2 fighters forming part of the 'Red Air' component in Red Flag 89-1 took a deep breath and accelerated off CAP towards what then seemed an invincible adversary. For me, this was the fighter pilot's nirvana - training in the Nevada desert in threat conditions and numbers of aircraft that was as close as one could get to full-on air combat. Fantastic training it certainly was, but knowing that one's aircraft was significantly out-classed and that the chances of coming back to the debrief at Nellis without collecting several simulated air-to-air missiles from the F-15 Fighter sweep was vanishingly small, left many pilots wishing they were in a different cockpit.

Well, time moves on and I have left the cockpit behind for an office at Eurofighter GmbH at Hallbergmoos, but the memories remain vivid - perhaps that is why I am still working on developing the Typhoon and its capabilities. Red Flag has been a success story as the ultimate training exercise and is now held at both Nellis and Eielson Air Force Bases in the USA. This time it is the turn JG 74 from the German Air Force in Neuburg to participate in Red Flag Alaska in June. The good news is that the Phantoms are gone and the Typhoon that replaced it may indeed be the one for others to fear!

I was just born a couple of decades too early! Good hunting JG74.

Group Captain L Hilditch (RAF Ret'd),
Head of Test and Evaluation and
Head of Future Requirements Capture,
Eurofighter GmbH

THE PHASE 1 ENHANCEMENT (P1E) PROGRAMME :

TYPHOON PREPARES FOR LEAP IN CAPABILITY

2012 IS SET TO BE AN IMPORTANT YEAR FOR EUROFIGHTER, WITH THE WORLDWIDE TYPHOON FLEET ABOUT TO RECEIVE THE BIGGEST BOOST TO THE AIRCRAFT'S OPERATIONAL CAPABILITY SINCE IT ENTERED SERVICE.

Such a claim might, on the face of it, seem extravagant, but the Phase 1 Enhancement (P1E) programme represents much more than an effort to advance the Tranche 2 Typhoon air-to-ground capability. Though P1E does integrate the Litening III laser designator pod, Paveway IV and EGBU-16 dual-mode laser/GPS guided bombs, it also does much more than this.

Typhoon was designed from the beginning as a swing-role aircraft with a single-seat multi-role capability.

The plan was to introduce improved air-to-ground capabilities on Tranche 2 aircraft in the 2012 timeframe, as part of the so-called Enhanced Operational Capability (EOC) concept. The priority for Tranche 1 aircraft was to have dominant air-to-air capabilities at Full Operational Capability (FOC) standard.

All 148 Tranche 1 aircraft have been delivered to five customer air forces. At this standard, Tranche 1 Typhoon aircraft also had a basic air-to-ground capability to deliver Paveway II (to the UK), GBU-10

and GBU-16 Laser Guided Bombs (LGB) with laser target designation - provided by external ground or air illuminators - and, of course, the onboard gun had an air-to-surface capability. This air-to-ground capability was also carried forward into the Tranche 2 aircraft delivered to date to the four core nations and the Kingdom of Saudi Arabia. Indeed the Royal Saudi Air Force began air-to-ground operations in December 2011 with its Tranche 2 Typhoons.

Furthermore, the RAF Tranche 1 aircraft received an 'Austere' Air-to-Ground clearance, providing the capability to use the UK Paveway II LGB with self designation using the Litening III designator pod. This represented a great enhancement to Eurofighter Typhoon's capabilities, as was demonstrated during the Libya operations where they achieved a greater than 97% success rate.

P1E will give Tranche 2 Typhoons seamless air-to-ground integration compared to that incorporated under the austere air-to-ground package, and the aircraft will have a full simultaneous

A fully loaded Eurofighter Typhoon pulls a high G turn in Farnborough 2010



swing-role capability, rather than being able to switch to and from air-to-air and air-to-ground operations.

The Phase 1 Enhancements will be achieved via two separate software releases (SRP 10 with P1Ea and SRP 12 with P1Eb).

The first of the P1E software releases (P1Ea/SRP 10) provides an initial swing role/precision air-to-ground capability, using Paveway IV, EGBU16 and an air-to-surface gun (using the internal 27-mm cannon against ground targets), and with a more mature and advanced LDP integration. Besides a deeper integration providing an improved Man Machine Interface, the latter allows the pod even greater 'look' angles than the Austere Tranche 1 clearance. In addition, SRP 10 will also give Typhoon an increased interoperability capability with coalition forces through an expanded communications fit, with new radios, MIDS enhancements, IFF Mode 5 and a new DGPS (Differential Global Positioning System).



Cassidian development aircraft DA5 with RBS-15 anti-ship missile

▼ A Royal Air Force Typhoon with full payload



The P1E upgrade gives enhanced capabilities in air-to-air missions, as well as in air-to-ground, with a full digital integration of the IRIS-T air-to-air missile (ASRAAM has had a digital integration since Tranche 1 Block 5), with high off-boresight targeting and firing via the HUD and the helmet. Coupled with the new Helmet Mounted Symbology System (HMSS), this capability will be a game changer in close air combat.

DASS improvements, including dual polarized antennas were intended to be part of the P1E upgrade, but have already been pulled forward for a previous clearance.

In all, P1E offers an array of additional functionality which includes a host of improvements to a range of systems including Rover, IFF, FLIR, Chaff/Flare and DASS, with improved accuracy of threat detection and enhanced countermeasures technologies, all that without exceeding the contracted budget and schedule boundaries.

P1E(b) will grow the new and improved precision air-to-ground capability to become a full swing-role capability, with the ability to undertake simultaneous air-to-air and air-to-ground engagements. It will add a full integration of GPS guided munitions - Paveway IV, GBU-10, GBU-16 and EGBU-16. The integration will give both dynamic and pre-planned targeting options, and Typhoon will gain the ability to simultaneously attack multiple ground targets during a single attack run, allowing different bombs to attack their targets from multiple directions and angles.

P1E(b) is new software based on a real time operating system and it adds new display formats for the air-to-ground role, significantly improving the already highly regarded Human Machine Interface (HMI), minimising the pilot's workload in the most complex scenarios and facilitating simultaneous swing-role operations by allowing a pilot to continue a bomb run while at the same time fighting off air at-

tacks. Pilot workload will be further reduced by expanded and enhanced MIDS datalink functionality, with much greater data transmission capacity notably enhancing the weapon system effectivity in complex scenarios.



Eurofighter Typhoon with full air-to-air configuration.

There will also be a two-stage delivery of DVI upgrades, with the first package of enhancements increasing the vocabulary to almost 90 commands, and allowing the pilot to request information to be displayed for any target or waypoint by voice command. It will also allow the pilot to manipulate the Laser Designator Pod and even to create a waypoint at a point of interest with just two commands.





Finally, P1E(b) will also include among other additional capabilities beyond the baseline contract, clearance for additional DASS improvements and the new Radar T2P SW version for enhanced AA capability, also provided without exceeding the contract funding and schedule boundaries.

The Phase 1 Enhancement contract was signed on 30th March 2007, and flight test activities began soon afterwards. A new process and tool set has been implemented to manage this highly complex and inter-linked System Software development.

The P1E test programme has encompassed a range of activities, involving a number of industry's Instrumented Production Aircraft (IPAs).

Alenia Aermacchi's IPA2 began flight trials with a 500-lb Paveway IV on 24th October 2008, and was subsequently joined by the Cassidian Germany-owned IPA7 which proved handling qualities and carefree handling with the 500-lb Paveway IV weapon

from 2009, and which also flew trials with the P1E standard Missile Approach Warner from May 2009. Between February and April 2009, Cassidian Spain's IPA4 flew a number of sorties with the 1,000-lb Enhanced GBU-16, making five drops. BAE Systems' IPA1 began release and jettison trials of the Paveway IV on 18th June 2009, making some fifteen Paveway IV releases over the Irish Sea. Flown by RAF and BAE Systems pilots, the aircraft dropped Paveway IVs in a number of store configurations to ensure safe separation and to verify that the bombs did not interfere with one another when released.

The successful conclusion of release and jettison trials led to fully guided drops, carried out by a BAE/RAF Combined Test Team and using both IPA6 and BT017 - a UK Instrumented Series Production Aircraft usually resident at BAE's Warton site. The first full avionic functional bomb release of a Paveway IV was carried out in February

2011 and by the beginning of 2012 the team was conducting testing of the full end-to-end autonomous designation capability.

P1Ea flight testing is now complete with very positive feedback from test pilots overall.

P1Ea (SRP 10), now in its final qualification stages is due to be delivered to NETMA. NETMA will then pass the underwritten clearance to the four nations, and this will clear the way to operational evaluation and national service clearances.

In-Service introduction is expected in the 1st quarter of 2013, with some in-service evaluation being done by RAF 17 Squadron in advance.

JUST THE BEGINNING....

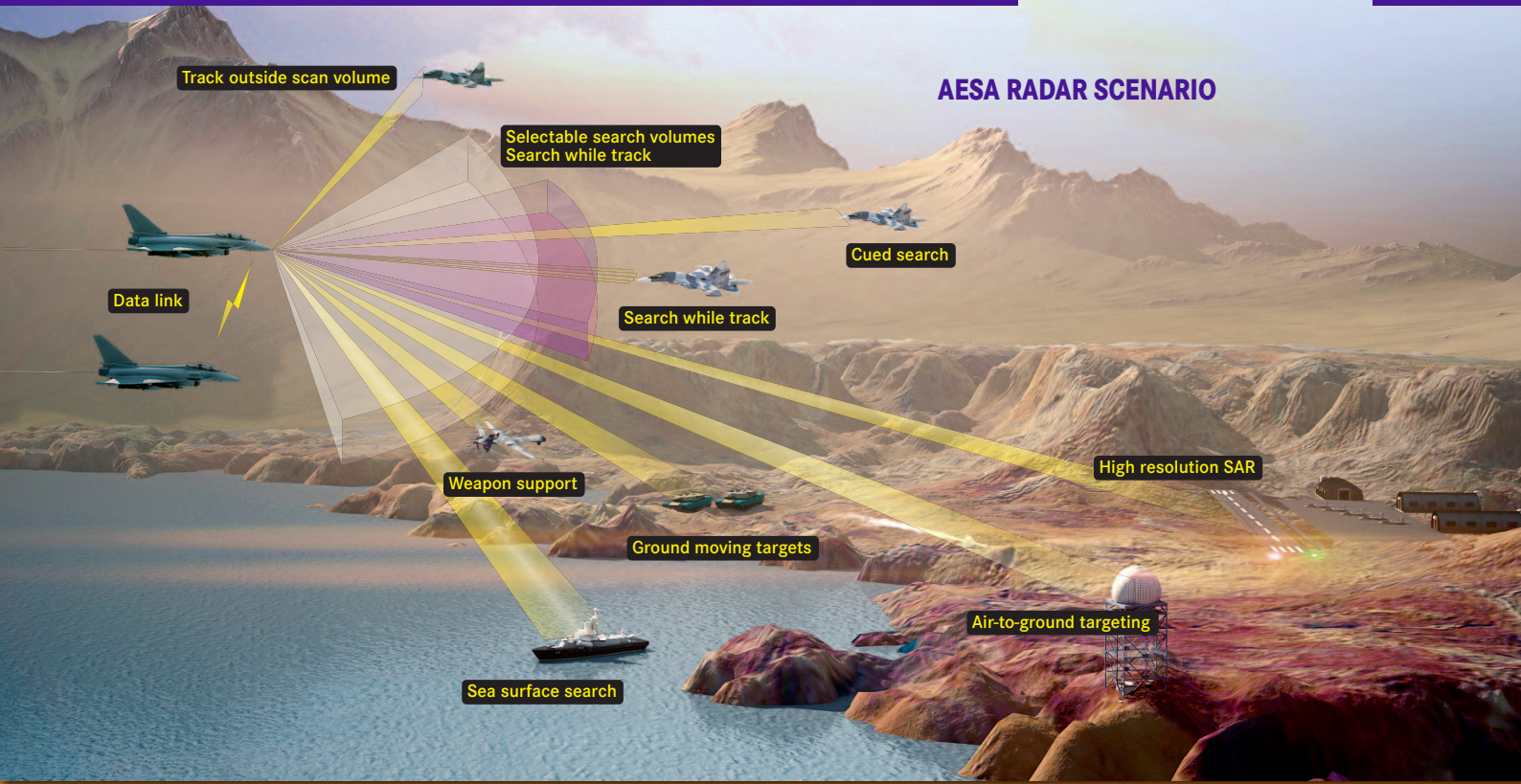
While P1E will transform Typhoon's operational capabilities, it marks just the beginning of the aircraft's capability growth and the enhanced software, new modings and improved Man Machine Interface providing an essential building block to which further capabilities will be added over the course of the next decade.

P1E is expected to be followed by a Phase 2 Enhancement package (known as P2E), which again will be delivered in incremental steps, allowing a more agile and responsive approach to capability insertion. This will also include other capability requirements apart from those from the traditional core nations.

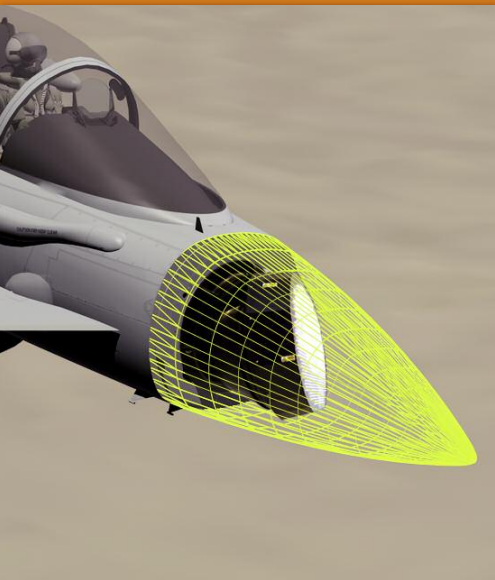
This is good news despite the four partner nations having different priorities, and still needing to determine the exact order in which new capabilities will be integrated, though the signature of 'Contract One', and developments in Saudi Arabia both point to new and more rapid means of incorporating new weapons and capabilities. In the future, it is anticipated that Nations can continue to develop the product but maintain a common baseline product and reduce the dependency on funding being available from other nations. This approach has already been successfully applied to the Tranche 1 product.

As it has done with AESA development, industry has self-funded some forward development work on advanced air-to-ground capabilities in support of the export campaigns.

There is a growing recognition that with the partner nations all under budgetary pressure, in order to sustain the technology base, Eurofighter may have to share the development of new technologies with partners beyond Europe. As a result, export



AESA RADAR SCENARIO



▲ The new AESA radar on the Eurofighter Typhoon will have latest generation capabilities

customers will have the same ability to push the pace of weapon integrations, even if the weapon required is not a priority for the partner nations.

The ability to integrate a new targeting pod and new weapons (ones not previously associated with the Typhoon), and in such a rapid timescale, speaks volumes for the adaptability and agility of the aircraft – and of its manufacturers.

The four nation future capability plan is also under evaluation, though it is likely that Storm Shadow/Taurus cruise missiles will be integrated by 2015, with the advanced Dual Mode Brimstone multi-role close air support weapon following. The Brimstone was the star of the Libyan operations when fired by the RAF Tornados, and is a precision air-to-ground stand-off strike weapon, highly resistant to battlefield obscurants and countermeasures and capable of 24 hour,

all-weather operation, while offering low collateral damage. The Typhoon will wait until mid 2016 for clearance of the Meteor BVR air-to-air missile under a specific Meteor Integration Contract, though development and risk reduction activities are moving ahead, and the planned AESA radar will be introduced in 2015.

Moreover, studies and plans are already set for a much longer list of capabilities for the Typhoon, with a range of new weapons including Long Range Glide Bombs, Anti-Ship Missile, SEAD/DEAD capabilities and new Recce/Advanced Targeting pods. Then there are conformal fuel tanks, thrust vectoring engine nozzles, Satellite Communications, and improved Laser and Passive Missile Warning systems. The enhancements provided under P1E will build the foundations for all of these further improvements.

JL







An RAF Eurofighter Typhoon painted in a special colour scheme to commemorate the 100th anniversary of 3(F) Squadron

CONINGSBY:

RAF TYPHOON 3 (F) SQUADRON KEEPING BUSY



Wing Commander Dicky Patounas spent most of Monday morning sat in a rubber flying suit at his desk in RAF Coningsby, answering questions for Eurofighter World whilst on alert as part of his QRA duties commanding 3 (F) Squadron. Despite the high readiness, today could indeed turn out to be a quiet one for Patounas if he doesn't get called upon which, I can assume, would serve as much needed respite in what has been a hectic few months for the Squadron.

Known as 'Dicky Pat' across the air forces, his career so far has been quite illustrious for a 41 year old, having flown and taught advanced flying on Hawk jets early in his career, taken part in Baltic operations with the Jaguars of 54 (F) Squadron and at 27, became one of the youngest ever pilots in the RAF's Red Arrows display team. Speaking of which, following promotion to Squadron Leader in 2002 and time on tour as the Typhoon Introduction to Service Project Officer where he served on 17(R) Squadron, Patounas returned to Hawk as Officer Commanding the Red Arrows where he led the Team in displays in over 20 countries around the world. Now as Wing Commander, he has spent time as Air Commander for the Air and Aviation assets supporting all UK Special Forces Operations in Afghanistan before moving to RAF Coningsby to take charge of 3 (F) Squadron which saw him, among other deployments, command the Typhoon Force Elements on Operation ELLAMY.

The squadron has been taking part in a host of exercises across Europe in the past few months including flying alongside France's Armee de l'Air's with Rafale 1/7 Squadron to develop relations in March, the recent Frisian Flag exercise run by the Royal Netherlands Air Force. All on top of training for the Olympics (protecting the skies, not competing) which has meant a busy few months for Patounas.



UK MoD/Crown Copyright 2012

DICKY PATOUNAS WING COMMANDER INTERVIEW

To top off a successful few months for 3 (F) Squadron, RAF Coningsby hosted a 100th anniversary celebration for them in May 2012. We asked Dicky to explain the significance of such an anniversary and what it means for the Squadron.

DP: The weekend of 11-13 May 2012 was a huge deal for us. We officially became 100 years old on 13th May as we originally formed on that date in 1912 at Larkhill (near Stonehenge). Numbers 1(F) Sqn, 2 (AC) Sqn and 3(F) Sqn were all formed on exactly the same day making them the three oldest squadrons in the world. We have lots of friendly banter between us about who is the oldest but I like the facts to be known so that you can make up your own mind:

- No 1(F) Sqn was formed and equipped with only balloons. No 1(F) Sqn is not in service today.
- No 2(AC) Sqn was formed and equipped with a mixture of balloons and aircraft.
- No 3(F) Sqn was formed and equipped with only aircraft meaning that we are the ONLY Sqn in the world that has only ever operated aeroplanes and is 100 years old. I rest my case... To mark our anniversary we were presented with a brand new Squadron Standard. We held a wonderful parade to mark the occasion and then a family's day which was very well attended.

EF: After the past few months, what would you say has been your highlight and why?

DP: It has to be commanding the Typhoon Force Elements on Operation ELLAMY. It is an honour and a privilege to lead any front line Sqn in the RAF but to take one on operations is the icing on the cake. It was especially rewarding as we were operating the Typhoon for the first time and it performed superbly well. When I mention Operation ELLAMY I always like to remember the Libyan people; we were acting on their behalf and helped NATO return Libya to its people. I hope that

they now have a long, peaceful and happy journey as they begin their new lives without a dictator.

EF: How did your Typhoons perform in the Frisian Flag exercise?

DP: Our Typhoons, ground crew and pilots all performed very well on Exercise Frisian Flag. We had a high level of service ability and earned professional respect from the participating nations. By the second week of the exercise every Mission Commander would make the most of the Typhoons performance and capability. We were normally put out front to clear up any enemy forces and would then protect the package until all had left before we closed the door safely behind the last aircraft. When we were swing role we would take the largest number of bombs the furthest distance, service our target, often service another target from a formation that needed our extra bombs and then swing into an air-to-air role to protect the package because we were still carrying a full air-to-air load out.

EF: How do exercises like this help during real operations?

DP: This was an excellent exercise for developing our personnel. When we deploy on a real operation (just like ELLAMY) we always work with other nations. If we train together we soon understand each others strengths and so can use those tactically, for real, to ensure the best possible results. We also get to know each other personally. Air Forces around the world are not that big any more and the shelf life of a fighter pilot is about 20 years. So now, as I am getting old, I will always bump into a fellow fighter pilot who I have worked with before. This can make a real difference especially when you are operating in the same skies and lives are depending on the outcome of your work. This is equally true for the ground crew, and there is nothing like a friendly face when you are trying to source some fuel or oil on an unfamiliar airfield.

EF: If you could go back over the past 100 years, which aircraft from 3 (F) Squadron would you have liked to fly?

DP: That answer is easy for me. Whilst I would perhaps like to have flown the Sopwith

**„TO MARK OUR ANNIVERSARY
WE WERE PRESENTED WITH A
BRAND NEW SQUADRON STANDARD“**

Camel in 1917 which was just boy's own flying, or be in the Hurricane during the Battle of Britain, there is only one aircraft that can do so much and operate so impressively anywhere in the world - Typhoon. To be able to climb comfortably in dry power to 40000 ft carrying 4 EPWII bombs, 2 supersonic fuel tanks, a Litening III designation pod, four AMRAAM missiles and 2 ASRAAM missiles is hugely impressive. To have global situational awareness delivered by our Mission Information Distribution System, to be protected by the Defensive Aids Sub System and to have all of that agility and power makes you feel pretty invincible against any threat out there. I find it even more exciting that this is only the beginning of the journey for our Typhoons, I would love to fly the Tranche 3 with all of the capabilities that we are going to integrate on to it but alas I fear that I am already getting a little too old!

EF: What do you think lies in store for 3 (F) Squadron for the next 100 years?

DP: If I knew that I would be a very rich man! All I do know is that we train very hard to prepare for any contingent operation that we may be asked to undertake. We will be deploying to protect the airspace above London during the Olympics and we continue 24/7 to protect UK airspace sitting Northern and Southern Quick Reaction Alert, as well as alert in the Falkland Islands. We are very proud of our rich history and we will continue to uphold the finest traditions of this magnificent squadron.

EF: As a former display pilot, what can visitors to Farnborough and RIAT expect from this year's RAF Typhoon display?

DP: Raw power and performance. Look closely and you will see that the pilot is often out of re-heat, sometimes there is simply too much power. Look closely again and you will be able to see how quickly the aircraft can accelerate even after it has slowed down. I love to watch the Typhoon fly; I love it even more when I am flying her!

MULTIROLE FIGHTER DESIGN

Good designs tend to enjoy long life spans. Good designs in the aeronautical field in particular are destined to last a very long time. Given the expected operational life of the Eurofighter Typhoon, one should consider this project as having proven – in service with six Air Forces – its ambitious key design points and that it is now mature enough to move down a roadmap rich in options for new technology insertions and roles expansion.

One has only to look at the Boeing 747 whose first flight took place in Feb 1969 and whose latest variant, the 747-8, has just been delivered to Lufthansa. Forty-two years on and the original design is still being refined, updated, manufactured and sold to very exacting and discerning customers. An economic service life span approaching one hundred years may not be a far-fetched dream! The C-130 Hercules first flew in 1954, it is in production and may well still be flying in 2050.

The longevity of good aeronautical designs is somehow based on the unusual beneficial effects of combining a rather stable and mature technological core with some of the most fast paced and disruptive technological trends of our age. The lucky confluence of such differing trends allows the (good) designer to achieve a high level of perfection and stability in the air vehicle main architectural features while at the same time having the opportunity to improve the design's overall effectiveness, capability, economy of operations and expansion of roles via continuous insertions of electronic technologies.

A good design is a lasting design and a lasting design is one that is adaptive to change. In aeronautics as in nature, the

Darwinian imperative of being able to adapt is a clear indicator of innate strength.

It goes without saying that, given the nature of the different technological trends at play in the design of an airplane, the utmost care must be taken of those aspects that are less affected by this continuous change and which constitute the solid foundations of a successful and lasting design. It is important to observe that the key design choices in the air vehicle general architecture – wing area and profile, fuselage section, radar antenna size, thrust class, internal fuel capacity to name just a few – are extremely difficult and expensive to change later on in life.

The design requirements of a fighter are far more complex than the relatively straightforward need to fly a certain distance with a given payload at the lowest possible cost. For a fighter, the cruise element of flying from A to B is only the beginning of the story, because when it arrives at its “destination” is when its real work starts. This may be engaging enemy fighters in air combat or initiating the penetration towards heavily defended surface targets to be attacked. The combat phase drives and pushes the envelope of the fighter design, as it requires high kinematic qualities to accelerate,

▼ Two Eurofighter Typhoon from the Royal Saudi Air Force visiting Zeltweg Air Show 2011



▼ An Austrian Eurofighter Typhoon in formation with a C-130 Hercules



- SUPERIOR WEIGHT
- 11T WEIGHT (EMPTY)
- 70% CARBON FIBRE



- Carbon Fibre Composites (CFC)
- Glass Reinforced Plastic (GRP)
- Aluminium Alloy
- Titanium Alloy
- Acrylic (Röhm 249)

climb and turn in a wide range of altitudes, so as to outperform the opponents and get the most advantageous firing solution first. This in turn requires a suite of diversified onboard and offboard passive and active sensors to achieve a dominant situational awareness, which is a fundamental requisite for a successful target engagement. But in air combat, having good eyes (sensors and network-centric abilities) is useless unless there are also good muscles (the air vehicle kinematics) to take advantage of such superior situational awareness, and to pursue the target to put a weapon on it. And last but not least, it must survive the opponents' inevitable counterfire!

And if this fighter is required to cover more roles than just air superiority or surface attack, the design variables increase considerably, the complexities become difficult to manage and the risk of ending up with a "jack of all trades and master of none" is very real indeed.

▼ USAF F-16



THE MULTI-ROLE FIGHTER

If advances in electronics and sensor technologies have made the advent of a "true" multirole fighter possible and desirable, the sheer multitude of options and compromises available to the designer to achieve such a versatility of roles within a single platform have increased the risk of ending up with an "average fighter". A notional multirole fighter not excelling in any particular task and likely to fail miserably when it is most needed.

The road to the multirole fighter is quite interesting and worthy of a brief examination, before delving into the details of what is the best design approach for an outstanding versus an average or notional multirole fighter.

Interestingly enough, the first true multirole fighters were not conceived to be multirole platforms, but were designed for a single, dedicated role.

The F-15 Eagle has been produced in two variants of the initial air superiority design: the F-15A-C as a single-seat air superiority fighter and the F-15E (and its export derivatives) as a two-seat strike fighter. The original operational requirement was for a pure air superiority machine whose design should not be compromised by even the slightest demand for any other secondary role. The credo for such a resolute design philosophy was egregiously and succinctly epitomized by the famous plaque on the door of the Project Office at the Wright-Patterson AFB stating simply: "Not a Pound for Air-to-Ground". The F-15A and C turned out to be the outstanding air superiority fighters of the epoch and remained unchallenged until the emergence of the latest generation European designs of the late 1990s.

Even more interesting from a conceptual perspective was the fact that a very capable strike platform was derived from a design that did not allow for any single concession to the air-to-ground requirement and was so uncompromisingly air-to-air.

The original F-15A design clearly demonstrated that a fighter designed solely for the air superiority role possessed the inherent qualities to be further developed for vastly different roles and to accomplish them very successfully too. In this case the design approach demonstrated its inherent multirole potential, even though the F-15 itself never became a true multirole platform capable of doing both air-to-air and air-to-ground. It remained two distinct variants of the same basic design.

The F-15 was not an isolated example of the new design philosophy stating that a fighter designed for air-to-air possessed also a very good potential to be developed for the air-to-ground role. The F-16 was conceived as a lightweight air defence fighter to complement the heavier (and more expensive) F-15A. In successive iterations this superb air-to-air design was able to accommodate all the necessary modifications to transform it into a capable strike platform, without impairing its air combat capability.

▼ USAF F-22



The F-16C became the most successful multirole fighter of its generation and the most convincing proof that a fighter designed for air-to-air is eminently suitable to be developed into a multirole weapon system.

Both these early Seventies designs have now reached the end of their remarkable trajectory and have been superseded.

THE EUROFIGHTER TYPHOON DESIGN CONCEPT

There has been some misunderstanding concerning Typhoon's inherent capabilities and potential for evolution, which may be caused by a weak appreciation of the design approach used and its impact on the end product. The discussion above hopefully will have shed some light on an arcane subject and cleared some prejudices.

Some people admit that Typhoon is indeed a superb air superiority fighter, second only to the mythical F-22, but incapable of any other roles beside air-to-air. They



compare it with the self-styled omnirole Rafale and conclude that Typhoon is a lesser fighter because at present it cannot fire an anti-ship or a cruise missile. Such a judgment, based exclusively on a certain point in time, is flawed as it measures only the timing of introduction of given capability and is not based on the inherent potential of a design.

Nobody doubts the capability of the Eurofighter consortium of integrating a cruise missile or a recce pod on Typhoon. With a weapon system lifetime measured in half centuries, such a concentration on the present, rather than on the overall balance is rather short-sighted. The true discriminator instead is looking at what will not be achieved in a given design, at any time, because of its in-built limitations. For example Rafale will never be able to have a big AESA radar



antenna because of its small frontal section. And even more impossible to have it mounted on a swivel mechanism, so as to increase its scan volume and consequently the fighter combat effectiveness. The propulsion shortcomings is another well recognised critical area where changes are extremely expensive and so far have proven fruitless.

Understanding the operational requirement and the relevant design cardinal points will help clear the air and dispel some of these misunderstandings. The background in the design process of some earlier generation successful fighters, such as the F-15 and F-16, should also help in putting the discussion in a proper context and in recognising key analogies.

Unlike these illustrious predecessors, the Typhoon joint operational requirement of the UK, Germany, Italy and Spain Air Forces was not for a dedicated air superiority platform but for a multirole fighter, as

the UK and Spain also needed to replace some strike assets in their inventory. So on the door of NETMA and Eurofighter project agencies there was no sign of that famous plaque stating "Not a Pound for Air-to-Ground"!

The design guidelines were tough, very clearly and unequivocally oriented towards the primacy of the air superiority goals, in the firm belief that a fighter shaped mainly by these priorities would also satisfy the less demanding design challenges of the air-to-surface roles. These were of course part of the operational requirement and were included in the original design. The other key guideline was that in any conflict between the air-to-air and air-to-ground roles, the air superiority requirement would have the priority. For this reason the Eurofighter Typhoon is frequently referred to as a multirole design optimised for air superiority.

Such a pedigree is evident in the four cardinal points dictated by the Joint Air Staff at the launch of the project. These



being an empty weight of 9.5t, thrust of 40,000lb, wing area of 50 sq. m. and internal fuel of around 5t. These design points are a classic example of a thoroughbred high performance fighter, implying a thrust-to-weight ratio around 1.15, a wing loading of 315 kg/sq.m. and a fuel fraction of around 0.30. Another important sizing factor, with a huge impact on the evolutionary growth path of the future design, was requiring a sizeable fuselage nose section to accommodate a radar antenna of about 75cm diameter. This fundamental design constraint will prove the wisdom of the customer and

option, by conformal fuel tanks.

In a nutshell the design philosophy of the multirole fighter Typhoon was based on the credo that a weapon system which is shaped mainly by the air superiority requirements will be also a highly capable strike platform. A corollary to such a theorem is that in designing a multirole fighter an air superiority focus is much more desirable than a strike focus. It is of vital importance that a true multirole fighter performs outstandingly not only in the strike roles, but also in air combat. This means that it must be able to defeat the most capable

with air superiority provided either by F-22 or Eurofighter Typhoon.

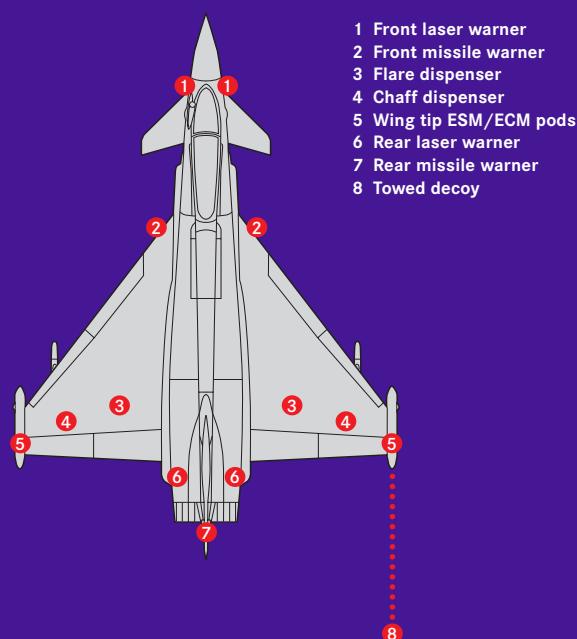
When looking ahead at the emerging technologies affecting the conduct of future air warfare, two megatrends appear on the horizon:

1) The air superiority mission will remain the preserve of the manned fighter for the foreseeable future because of the extremely dynamic and interactive nature of modern air combat.

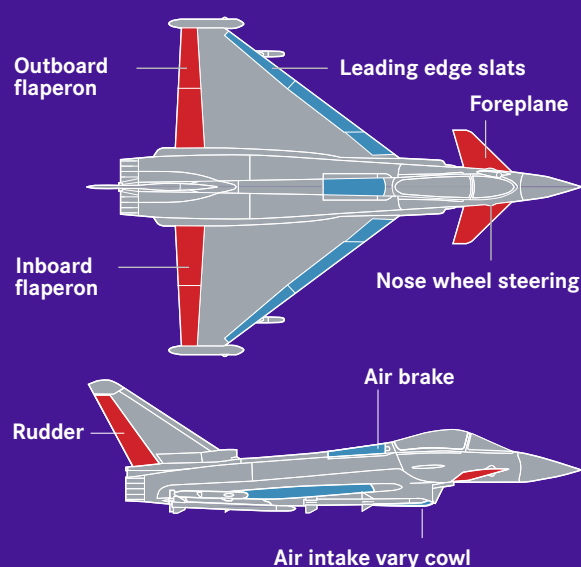
2) The strike missions will gradually move to ever more capable unmanned platforms.

With such a perspective in mind, the

■ HIGH SPEED ■ HIGH ALTITUDE OPERATION



■ FLY BY WIRE ■ LOW PILOT WORKLOAD



design teams, when the nosecone houses a big new AESA radar antenna and its re-positioning mechanism to allow a formidable scan angle of 200 degrees.

The area where the A-G requirement had to concede most to the air superiority focus of Typhoon and where no compromise resulted possible was in the internal fuel volume and the relevant design fuel fraction. Increasing the internal fuel fraction beyond the typical fighter design point chosen, while beneficial for range and persistence, would have impacted negatively on thrust-to-weight ratios and wing loading, resulting in a less combat effective fighter. Range and endurance extensions - important especially for some strike missions - would be achieved by supplementary external drop tanks and by aerial refuelling and, as an

enemy fighters with an ample margin of superiority. Otherwise it is a notional multirole fighter which, when the moment comes, will be unable to deliver and will fail when it is most needed.

Looking at other contemporary designs one can say that the F-22 followed a design philosophy (excluding the stealth considerations) similar to Typhoon, whereas Rafale represents a multirole fighter with a strike focus. For what regards the JSF multirole capabilities, it must be noted that its design center of gravity is admittedly in the strike area. The platform does not possess any of the genetic traits typical of a high-end fighter in terms of thrust-to-weight, wing loading, acceleration, climb and turn rates. Its operational customers (e.g. US and UK) will operate the aircraft mainly in the strike role

design choice of a multirole fighter optimised for air superiority is again proving its wisdom and is further proof that Eurofighter Typhoon is a solid and sound investment for the foreseeable future.

OF

“CUTTING EDGE PERFORMANCE
COMBINED WITH OPERATIONAL AFFORDABILITY”

EJ200: PERFORMANCE WHEN YOU NEED IT

As a rule, cutting edge performance and low cost of ownership are rarely compatible attributes. Conventionally, in gas turbine engine design, top end performance drives higher temperatures and speeds in combination with lightweight materials; all of which drive material costs up and drive down time-on-wing. This is further complicated on military engines because of the need to perform extremely arduous manoeuvres against a backdrop of flight at high altitudes and high Mach numbers.

THE EJ200 IS DIFFERENT

From the outset the EJ200 was designed with high operational availability and low maintenance as key attributes, not to mention high performance combined with low fuel burn.

The rationale adopted during the design and development of the EJ200 was to ensure safe, affordable operational capability and to keep the engine ‘on wing’ for as long as possible. Experience has shown that engine removal from the aircraft generates significant costs because of the need to supply a serviceable spare engine for continued operation and also due to the inevitable increase in repair scope during overhaul of the removed engine.

To maximise the ‘on-wing-time’ of the EJ200 engine, there was a conscious decision to increase component life, increase levels of reliability and to provide a ‘no surprise’ approach to engine management through intelligent Engine Health Monitoring (EHM).

The demonstrated result of these design choices is an engine that requires only infrequent maintenance, remaining on wing for industry leading periods and an engine that is simple to maintain when necessary.

HIGH COMPONENT LIFE

The major, lifed components in the EJ200 have been purposely designed such that their lives are synchronised, resulting in the number of removals throughout the engine life being reduced to an absolute minimum (Figure 1). This is especially difficult for the hot gas path parts which typically suffer more frequent removals, a circumstance specifically designed out of the EJ200.

In addition, the EJ200 follows an ‘on condition’ maintenance philosophy. In practice, this means components are not just simply replaced once a set number of engine hours are reached, instead, they are continually monitored and replaced only when their physical condition is deemed to be unacceptable or when the EHM system (see later for more details) identifies that component life has been consumed. The latest in-service experience confirms that the components achieve their requirements, often with scope to increase life in the future, further reducing maintenance activities and costs.

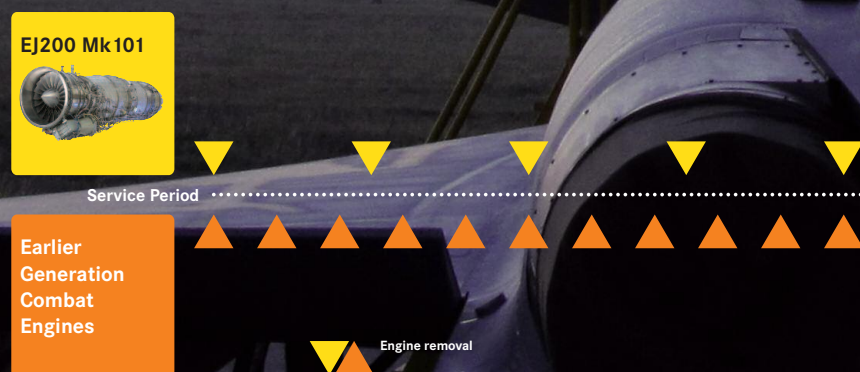
INTEGRATED ENGINE HEALTH MONITORING

The EJ200 has a world leading, state-of-the-art EHM system. Intentionally designed as an ‘end-to-end’ system, the EHM is fully integrated within the Typhoon airframe. This results in an unimpeded flow of validated data from the engine through to the operator. Additionally, EHM data can be viewed while the aircraft is standing on the apron through use of the aircraft mounted maintenance data panel (MDP). Having access to EHM data during aircraft operations is a cost and time efficient way of confirming engine health before the aircraft is dispatched for operations. At the heart of the EHM system is the Digital Electronic Control & Monitoring Unit (DECMU). This powerful engine-mounted accessory fulfils a combined role of engine control and monitoring.

The monitoring aspect of the DECMU has been specifically designed to continuously monitor multiple data streams from the EHM sensors. It also has the capacity to accept and process additional data should the need arise in the future.

Through intelligent interpretation of the engine data, the EHM system is capable of monitoring the engine’s operational performance both on the ground and in-flight. Easy access to this detailed data for each engine, combined with off-line analysis capability at the end of each sortie provides a key advantage, particularly when taking executive decisions such as whether to deploy an engine or to send it to the repair and overhaul depot for maintenance.

Figure 1: EJ200 vs. Earlier generation engine removals



To support maintenance activities, the DECMU is equipped with a sophisticated built-in capability called the Automated Engine Testability System (AETS), see Figure 2, which supports a systematic approach for fault findings. Should a malfunction of sensors or systems occur that cannot be clearly identified, the system automatically provides a proposal for LRI exchange based on pre-defined decision parameters. This enables the ground crew to solve the issue without any experience-based maintenance procedures. Again, this leads to high availability, minimised maintenance efforts, low quantities of spares/spare modules/spare engines and, therefore, low life cycle costs.

FULLY MODULAR DESIGN

Should maintenance be required, it is key that this can be achieved quickly and effectively. As described, the DECMU with its EHM capability supports on-condition maintenance and the highly modular design allows only those components/modules that require work to be targeted. The EJ200's 15 modules (see Figure 3) are fully interchangeable, meaning that, should modules need to be exchanged, there is no requirement for any matching and special adjustment. Indeed, for the exchange of some key modules, no engine test is required, allowing exchange at main operating bases. This philosophy minimises turnaround times and leads to high availability, minimum spare engine and spare parts requirement and corresponding low life cycle costs.

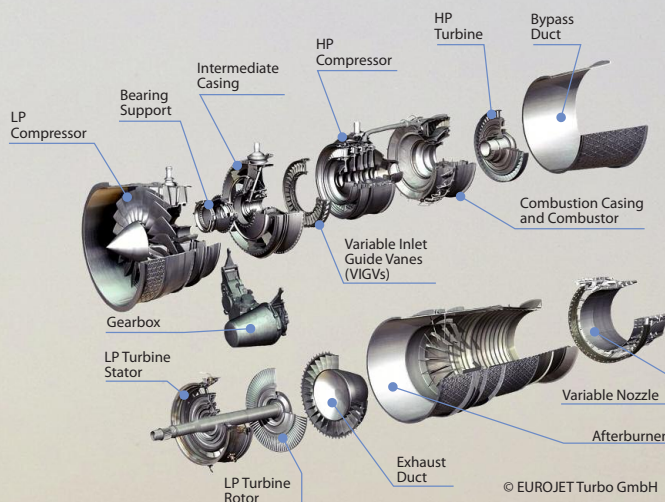
LOW FUEL CONSUMPTION

The fuel consumption of the EJ200 is extremely low for an engine of its class. This is largely due to careful selection of the key gas turbine design parameters (the engine cycle) which results in the EJ200 delivering unrivalled installed engine performance with minimal fuel consumption. In addition, the use of latest generation turbo-engine technologies provides the highest level of fuel efficiency. For example, through clever use of hot section advanced cooling and sealing technologies, engine cooling requirements are kept to a minimum and very high cycle temperatures can be realised. This then leads to an extremely efficient thermodynamic cycle and reduced fuel consumption at a given thrust level. A final contributor to the EJ200's outstanding level of fuel consumption is the fact that the fuel system is primarily managed and controlled by the onboard DECMU. The DECMU continuously evaluates whole engine performance alongside key fuel system parameters. This ensures continued optimal fuel system management at all times.

CONCLUSION

The EJ200 has been designed to provide high end performance with minimal maintenance. The design thinking from the outset placed maintainability and low

Figure 3: The EJ200 Consists of 15 Fully Interchangeable Modules

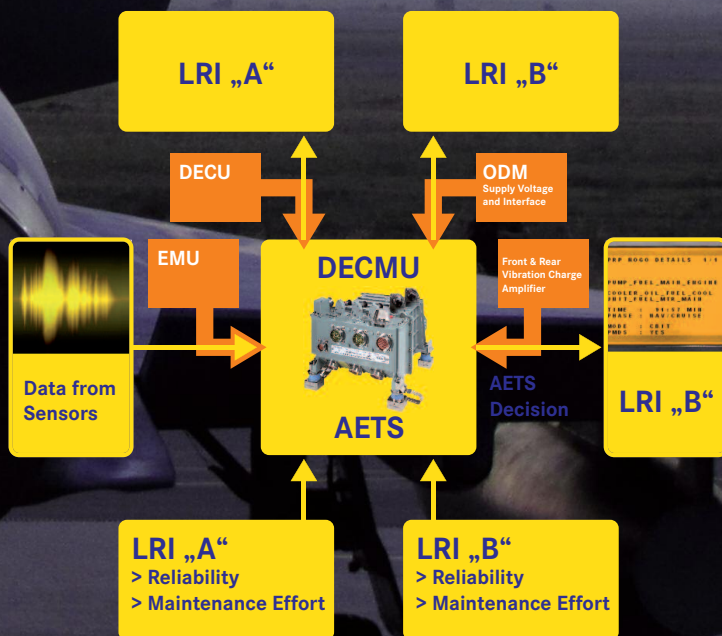


operational costs high on the attribute list. This has been demonstrated in service with approximately 300,000 flying hours achieved.

The engine design with high component life minimises the time between overhauls and, through the use of an on-condition maintenance philosophy, reduces significantly the number of times the engine and its modules need to be removed during their time in-service.

This is further reinforced by the advanced EHM system which is highly integrated into aircraft systems and provides a 'world leading' capability. With easy and immediate access to real-time engine data, the EJ200 offers maximum flexibility of engine management for today and in the future.

Figure 2: The Automated Engine Testability System (AETS)



AUTOMATED ENGINE TESTABILITY SYSTEM (AETS)

SYSTEMATIC APPROACH TO FAULT FINDING

Removes the need for „experience“ based maintenance

Significantly reduces NO FAULT (NFF) rejections

- Eliminates iterative fault finding activities
- Avoids unnecessary detailed and costly LRI inspection
- Avoids the requirement to maintain high levels of inventory

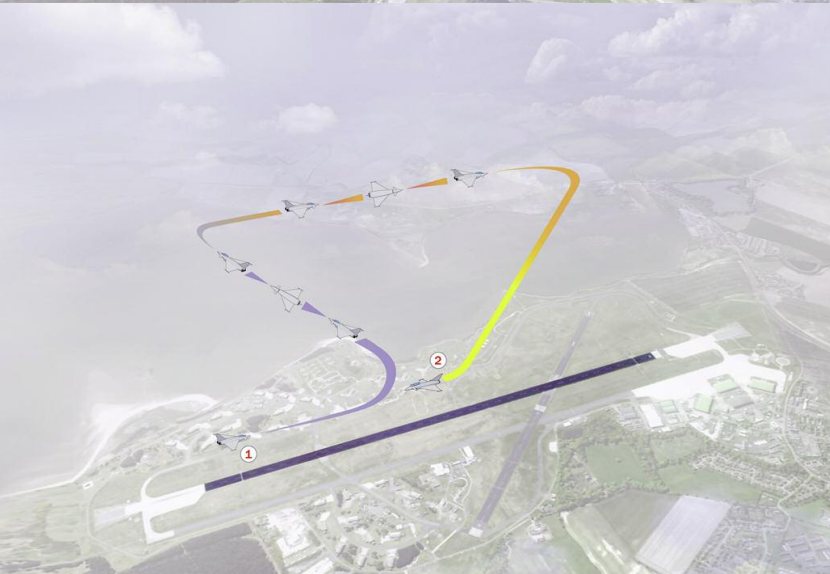
Farnborough
INTERNATIONAL
AIRSHOW
9-15 JULY 2012

2012 TYPHOON DISPLAY

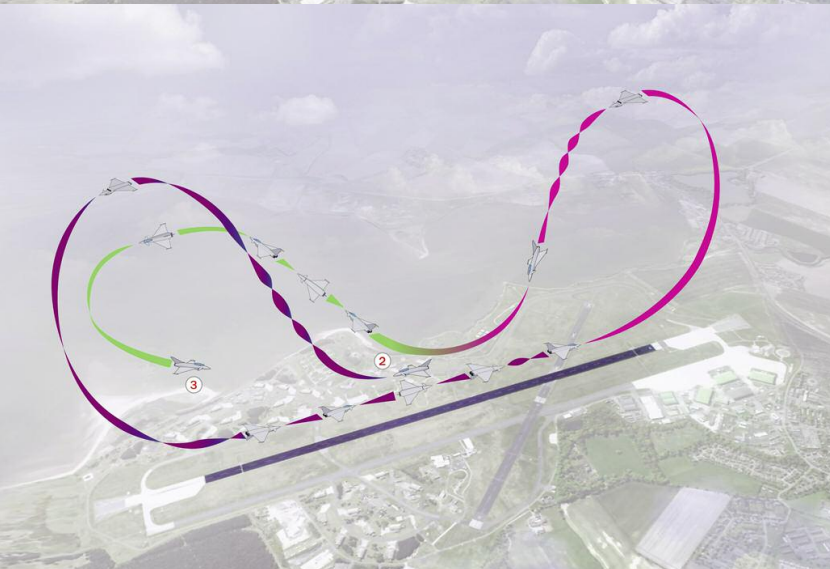
This year's RAF Typhoon aerial display will be another fantastic demonstration of the raw power and agility of the aircraft for the spectators down on the ground who will see the aircraft perform at various air shows across the UK this summer. With experienced Squadron Leader Scotty Loughran at the helm, we know the Typhoon will be in good hands.



1 The aircraft accelerates from 0 to 160 mph in just 3 seconds before getting airborne to fly a barrel roll, and at the same time the landing gear is retracted. The aircraft then turns back towards the crowd to fly 2 aileron rolls and a derry turn. The aircraft is then turned hard back towards the display line before entering an outside turn. At this point the pilot is pushing to minus 3Gz.



2 Just prior to datum the aircraft is turned hard at 9Gz away from the ground and after a roll and further turn the aircraft is positioned for the slow pass. Having passed the crowd at over 450 mph moments earlier the aircraft is now flying at less than 100 mph.



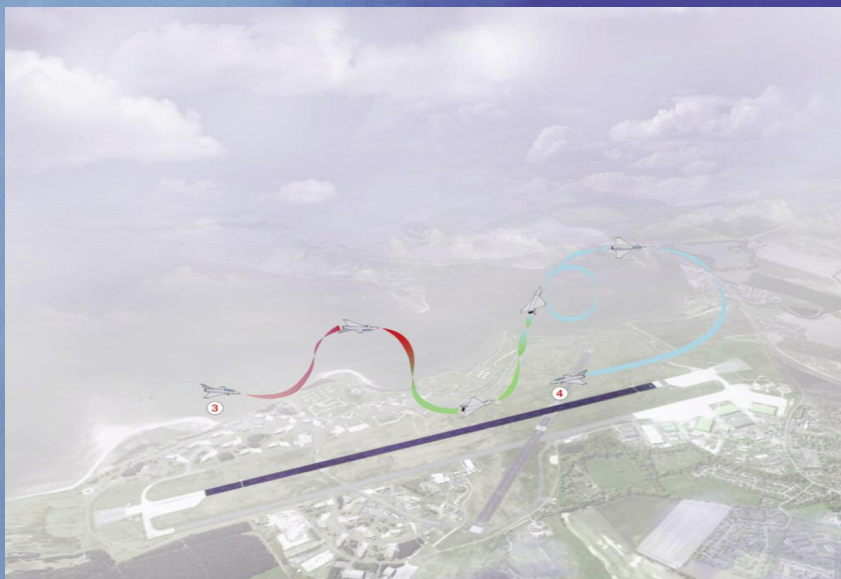
3 The next manoeuvre shows just how powerful the aircraft is as it accelerates from slow speed into the near vertical for a slow speed ½ Cuban with 540 degrees of roll. This is followed by an inverted flypast with a 360 degree roll at datum and another 9Gz pull into a ½ horizontal with a 540 degrees of roll on the way back down. The aircraft is then turned to fly away from datum.



4 A turn back is followed by a barrel roll towards the crowd and another away. These manoeuvres demonstrate the aircraft's ability to fly around its own velocity vector and the flight control systems' excellent carefree handling characteristics.

5 An oblique loop is flown from datum with an aileron roll flown at the apex. Once complete the aircraft turns away and begins to climb before starting a roll which transitions into two barrel rolls, each barrel bigger than the last. The next manoeuvre is a high speed pass flown at 100 feet and accelerating in full reheat. The aircraft is gaining 40 mph every second and the pilot has to select idle before the end of the runway to stop the aircraft going supersonic.

6 The aircraft is then flown in a 9Gz climbing turn to position for a bunt towards the crowd. The aircraft is pushed to the near vertical and descends rapidly before levelling to perform a minimum radius turn. The aircraft has so much thrust that it immediately finishes the turn and pulls up into the vertical with 3 aileron rolls to depart.



TOTAL CAPABILITY



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Benchmarking Excellence

Typhoon: the world's most advanced new generation multi-role combat aircraft. Representing the combined strengths of Europe's leading aerospace and defence companies, the Typhoon provides engineering and industrial benefits for all customer nations. Designed with an established technology insertion programme, Eurofighter Typhoon is an open platform offering industrial partnership, shared development and affordable logistics solutions.



nothing comes close