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EXCLUSIVE:
INSIDE OPERATION SHADER

Eurofighter Typhoon

Cover: A fully armed Typhoon GR4 of the RAF prepares for take off on Operation Shader, the Counter-Daesh mission, from RAF Akrotiri in Cyprus. © UK MoD Crown Copyright 2017

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INTERNATIONAL FIGHTER CONFERENCE 2018 SPECIAL EDITION

PROGRAMME NEWS & FEATURES NOVEMBER 2018

EDITORIAL

WELCOME

Welcome to this special International Fighter Conference 2018 edition of Eurofighter World. We're going into the conference having just passed the 500,000 flying hours milestone.

A great deal has been achieved since Eurofighter Typhoon entered into service. We now have a fleet of almost 500 aircraft protecting Europe's borders, with the potential for this number to grow substantially in the next decades.

And, during this period, the aircraft has transformed its capability into a true swing-role combat aircraft, with significant combat operational experience under its belt from its first combat role over the skies of Libya in 2011 through to today's operations over Syria and Iraq.

In fact, there's a fascinating article in this magazine on how Eurofighter Typhoons are taking the fight to the terrorist group Daesh with daily operations conducted by the RAF from RAF Akrotiri in Cyprus. Today Eurofighter is also the backbone of NATO's European air defence and will continue to be developed to defend against all future threats for decades to come.

When you reach a milestone like this it's worth pausing for a moment to reflect on just what an important contribution Eurofighter makes. It represents the biggest and most successful defence collaboration programme ever undertaken in Europe. It has provided security, industrial and economic cooperation and sustainment on a previously unseen scale. And it's the model for future defence and industrial collaboration in Europe.

So what about the next 500,000 miles? Well that future looks exciting, with the Eurofighter Typhoon set to receive a new electronically-scanned array radar and an enhanced human machine interface. Already the best in their class, the EJ200 engines, will also be further developed, ensuring that Eurofighter Typhoon can maintain its combat edge.

In this edition of the magazine we take an in-depth look at the future battle space. Justin Bronk from RUSI talks about the future threats, while Bruno Fichefeux from Airbus Defence & Space outlines the potential technologies that could come into play in the development of a future European combat air system. Our own Head of Marketing, Raffael Klaschka, discusses how Eurofighter fits into this complex jigsaw.

What's clear from all these different contributors is the important role Eurofighter will play in the decades ahead.

We'll also take an in-depth look at the ground-breaking new Spear3 weapon and look at the campaign for a new fighter for Poland.

I hope you enjoy the read.

Volker Paltzo
CEO
Eurofighter Jagdflugzeug GmbH

RETAINING **COMBAT EDGE**

In this edition of Eurofighter World we talk to the author of a new report on the future threat environment facing the West and some possible solutions. **Justin Bronk** is Research Fellow for Airpower with the Military Sciences programme at the highly respected defence think tank RUSI (Royal United Services Institute).

Justin Bronk
Research Fellow, Airpower and Technology, RUSI

What do you see as the main emerging threats for Western governments?

There has been a proliferation of high-end threat systems, which previously would have been the preserve of peer states. There's been an increasing trend towards the spread of triple-digit Surface-to Air-Missile (SAM) systems, high end electronic warfare equipment and radars to countries like Iran, and plenty of others. These states are buying equipment which presents a threat level which we'd have considered as characterising high intensity warfighting in previous decades.

Clearly the ground-based threats are increasing. Russia in particular is continuing to pursue improvements in missile performance for both SAMs and in the air-to-air domain. It is also focusing on improving and broadening the range of different detection and tracking technologies that cue in those weapons. It's going to get harder and harder to remain unseen, and the kinematic threats that are then cued in when you are seen will continue to improve in range and agility.

Your research paper says that while Western air forces have got used to very low attrition rates in recent decades, there's significant potential for this situation to be reversed.

When you look at the systems which make up so-called anti-access area denial or A2AD bubbles, they're sophisticated and long-ranged enough that Western forces will take losses in degrading those capabilities. A2AD tends to be something which can impose attrition on the attacking force, delay it and increase the timescales and political appetite required to push on. The flip side is that there are plenty of techniques that you could deploy to start suppressing those defences and in the long term A2AD tactics are unlikely to actually stop a determined force.

Politicians tend to overestimate the capabilities of high end air defences and see them as an impregnable shield. They're not. They only become an impregnable shield if you're not politically willing to risk losses.

So there's an issue around how you square it with political risk. For a lot of nations, the serious prospect of taking losses will result in a greatly reduced political willingness to use force. Of course, if we find ourselves in a high intensity conflict against a peer then that's a different ball game, we have no choice but to engage. Then it's a question of how credible and sustainable your force is.

You talk about the decline of the technical edge that Western forces have long enjoyed; can you explain how that manifests itself?

It's basically a combination of Russian defence spending, particularly on ground based air defences after a 15-20 year gap, with the emergence of China as a potential peer competitor in technological terms. It's a trend that is going to accelerate.

It's not necessarily that the West has become worse at designing or procuring things, rather that for a while we were the undisputed masters of the game because other people weren't really trying to catch up.

So in a sense it's the erosion of a massive technological and operational advantage lead, in terms of the way we did things and how we linked them up. But that was fairly artificial because it was the result of some very specific geostrategic circumstances in a set period of time.

We're simply moving back to the natural status quo — which is a constant game of evolution between attack and defence in ground and air threats, and weapons systems. The 1990s and the 2000s were a bit of an aberration and Western air forces were able to reign unchallenged. Now we're having to relearn old lessons.

But the problem is that the mechanisms by which we develop, procure, design, pay for and value air power at a political and industrial level have unavoidably changed within those 20 years.

Procurement timescales and attitudes to attrition have been conditioned by those two decades. They're better suited to a time when the competition was from allies for exports, rather than a serious set of kinetic threats. Frankly, we need a much more rapid pace of iterative development, as well as a more serious look at forces in the round.

It's not enough to say 'Well we have the best individual platforms,' it's a question of whether they are credible in the whole force terms. Are they supportable? Are they adequately dispersed? Can we protect them on the ground? Are there enough weapons stockpiles to actually prosecute any sort of meaningful campaign? All of these things which we used to be very good at in the Cold War, and which have withered over 20 years.

It's a challenging scenario you've set up, can you explore some of the potential solutions?

There are good arguments for another manned programme and there will continue to be a lot of relevance and usefulness to be gained out of the current →

→ **RETAINING COMBAT EDGE**

generation of manned platforms, like Eurofighter Typhoon, for a long time to come.

However, if you accept the argument that those solutions alone are not going to give you an answer to the combat mass/attrition problem, you're going to have to add something more in there. And, of course, that something more is going to have to be paid for.

For me, the numbers don't really add up in terms of what we're prepared to spend and what we expect to lose (for European air forces in particular), to think that manned platforms alone offer a viable way forward long term.

The idea that makes most sense is a UCAV force capable of autonomous operations in contested airspace, within a new force mix. The manned force would be able to carry out many of the low intensity and discretionary taskings, with the UCAVs forming the leading edge and attrition sponge against very high risk threats. It would have to be something you could manufacture in enough numbers and reasonably rapidly.

Obviously in recent months we've heard about the ambition for two different FCAS programmes in Europe. What's your view on these?

It's not necessarily a terrible idea to have two competing programmes at the early stage, that way you don't get a single myopic view that takes you down one design philosophy route which may not be the optimal outcome. But at a certain point down the road, ideally no later than when you've got a couple of flying prototypes, then you really need to merge those programmes.

I just don't think the European market is large enough for two competing programmes to be viable in terms of production and competition for exports. And frankly, the operational requirements in Europe are not so different that a mutually suitable platform, or series of platforms as a system, could not be arrived at.

How do you see an evolving Eurofighter platform potentially fitting into this future force mix?

I think the airframe/engine combination that forms the basis of Eurofighter Typhoon is a strong one, particularly in terms of its potential for evolution to fulfil the sort of combat mass in discretionary conflicts and standoff roles needed in high intensity conflicts. It will be relevant for a long time to come.

It will be a very valuable part of any mixed force, particularly because of its ability to supply a lot of munitions, as well as having a lot of potential power for future electronic warfare packages.

It can operate at high altitudes with reasonably long endurance, loiter time and range, so it's a very useful capability. And it's proven. There's a lot of strength in the design. I think its future evolution will be predicated on being quite realistic about the Eurofighter's strength and limitations.

You talked as well earlier about its inherent flexibility being one of its core strengths that will keep it relevant, can you expand on this?

Typhoon's design philosophy means it's inherently flexible and capable (because of its specific excess power, its thrust to weight ratio, its payload capacity and high altitude performance, especially with a big radar aperture). So I'd say it's a very useful support to a cutting edge very low observable, eyes-forward platform, which by definition would have limited internal capacity and be available in limited numbers. One good option to allow Typhoon to better support the eyes further forward role in future might be to increase the missile carriage capacity, as Boeing has done with the latest F-15 variants.

What other technical areas, do you think, would it need to build on to keep it relevant?

I think building on the work which the RAF has done very successfully, in conjunction with BAE Systems with the TyTAN programme (the maintenance construct) to keep driving operating and maintenance costs down will be critical because the sticker price is only one element of what a nation looks at for in its force planning. How much it actually costs to run and own through its life is much more important than the upfront fly-away cost of the jet.

As an interested observer, how optimistic or otherwise are you about the future generally — how do you feel personally about the challenges and our fitness to face them?

I'm reasonably confident that technically speaking, it is within the capability of the European defence industry to meet future needs, however they choose to go about it. I'm fairly convinced that there is the technical capability within the funding available to come up with decent solutions.

I am less convinced there is the political focus and will behind these efforts to actually agree on and support everything required in the timelines needed. That's more of a concern. ←

TIPPING THE **SCALES IN POLAND**

In 2017 the Polish government launched the Harpia programme to define a requirement for a multi-role fighter and/or an airborne jamming system. In this edition of Eurofighter World we talk to **Andrea Nappi**, Vice President Eurofighter Export from Leonardo Aircraft Division, who is leading the campaign in Poland to find out how the competition is shaping up.

Andrea Nappi

It's very early in the race but Eurofighter is already off the starting block, aiming to win hearts and minds in Poland, as the nation starts to consider its future air power needs.

"We are really at square one of the definition phase," says Andrea, however, Leonardo has proactively started putting its case forward.

As the campaign takes shape, the Eurofighter message is clear. In essence it boils down to Eurofighter being the perfect military option for Poland and the right choice for the future of the Polish aerospace industry.

"Air defence is critical because Poland is right on the front line," says Andrea. "It is at the NATO border and as such represents the first line of defence, so it needs to be ready to defend itself until the support of its NATO allies is fully deployed.

"The presence of possible threats is embedded in the DNA of Polish people to a level that is far beyond that of other European countries. They are very conscious of it. That's why Poland has allocated a huge budget for the modernisation of its Armed Forces as well as procuring a multiple layered missile defence system.

"When considering an aircraft, some think in terms of a plane with an ability to attack. Over the course of this campaign I believe we will need to shift this thinking because our belief is that on day one of any war, Poland would need an aircraft that could effectively protect its country."

That's why the Leonardo team has been positioning the Eurofighter as the best air supremacy fighter available on the market.

"There's no question that from an operational perspective we see Eurofighter as the perfect answer to Poland's needs, but Eurofighter would bring a series of other benefits too.

"For one, it will guarantee Poland national sovereignty. They will have full control of the weapon system and there would be no issues with restricted black boxes as is often the case with non-indigenous aircraft. This is an important distinction because it means they could programme their mission data directly from their national intelligence database which means the integrity of this intelligence would not be compromised."

Of course, campaigns for combat aircraft export sales are always complex. Headline writers have a tendency to focus on performance, but there are a host of other factors that come into play: capability, through-life support, budgets, air force relationships, the political picture, jobs, and industrial partnerships. They're all factors that play a part. One area where the Eurofighter team believe they can tip the scales in their favour is in industrial terms.

"If you buy European you don't spend money, you invest money, and there is a huge difference between those two little words," says Andrea.

"For one thing, we can tailor the support model to meet Poland's specific needs. Right from the start, Eurofighter was built to support the needs of different nations — the UK, Germany, Spain and Italy — and therefore ours is an inherently flexible model and one that we can offer to Poland.

The presence of possible threats is embedded in the DNA of Polish people to a level that is far beyond that of other European countries.

"We can also offer the possibility for local industry to be involved in the programme at a level that would best fit their capabilities and aspirations. Eurofighter can offer significant packages of work, not only in support or manufacturing, but we can give Polish industry access to development work too. This is a unique opportunity for local industries to grow and improve their own capabilities. It could open the door for Polish companies to have a completely different future.

"Being involved in development work-would position Poland as a potential partner at a high level in any future European Combat Air System, or FCAS, programme as that emerges. Poland would be a perfect candidate to participate in any future programme and Eurofighter would be the perfect way in.

"Then there's the high reliability, increased maintenance scheduling and integrated training system which Eurofighter brings."

It's a very positive story and one which the Leonardo team is determined to ensure gets plenty of airplay in Poland. They've already hosted a number of media briefings, including arranging a visit for media to the Gioia del Colle Air Base in Italy, which have been well received by Polish journalists.

Says Andrea: "They are very keen to listen and understand. In Poland there's a lot of interest in defence-related topics among the public and because of that the media are keen to discuss defence issues. We believe that entering these forums is very important.

"The air base visit gave journalists the opportunity to talk directly to Eurofighter pilots and maintenance teams. It gave them a real insight into how the Italian Air Force operates and how effective the Eurofighter weapon system is. It generated lots of good publicity and this represents a very good start.

So how positive is Andrea that Eurofighter will ultimately emerge successful?

"A few years ago no one believed Poland would select our M-346 as a trainer, but they did, and now they are thinking of taking more. From a Eurofighter perspective, we've got a great offer — a weapon system that's perfect for air supremacy — and a great history of industrial collaboration in Poland through the Eurofighter Partner Companies that generates a huge economic impact in the country. I'm not a betting man but right now I'd say our chances are high." ←

THE ROAD TO **FCAS**

Over the last 12 months Airbus Defence & Space has built an organisation to coordinate their burgeoning FCAS programme. In this edition of Eurofighter World we talk to **Bruno Fichefeux** who leads it, to find out about how they see the future battlespace taking shape.

Bruno Fichefeux

Bruno Fichefeux is at the helm of Future Combat Air Systems for Airbus Defence & Space, in that role he leads Airbus's effort in its positioning in the future European programme and represents the group in front of European customers, industrial partners and suppliers.

Can you explain the Airbus FCAS philosophy?

For us, the FCAS idea is much more than a single platform — it is a combination of various assets working together as a global system. Each and every part of Airbus' business is involved, from UAV & military and combat aircraft to space, connectivity, cyber and security. All these elements have a special role in a common system. It's the first time we've had a programme which brings together the whole spectrum of what Airbus Defence & Space can do. This is also the reason why we decided to build an organisation that's able to drive such a programme across Germany, France, Spain and the UK and all programme lines. The level of ambition is high and we want to address it.

In particular, we are looking at what the future threats will be, and what technologies we will need to tackle them.

What's your view on what the main future threat scenario is, and how will this impact on FCAS planning?

From 2040 onwards we will face a massively increased threat level for air assets and these will require new technologies to address them. Even today we see the proliferation of threat systems with the advent of near and potential peer opponents. It's therefore vital to have a roadmap for capabilities and the technologies that leverage these.

At the same time, the way we manage information, the way it's analysed, processed, transformed into intelligence, transmitted and used will be on a whole new level, especially in the combat sphere. This will be supported by new technologies around artificial intelligence, communications and big data management. We're looking at a future with an information-centric system with connected platforms. Information will become a combat resource.

This approach will have a huge impact on all the platforms, both existing ones like Eurofighter and new ones that are still to be developed, indeed for everyone operating in the future combat space.

We see the necessity for the next generation combat system to be a combination of assets, or System of Systems, where manned and unmanned assets, combat and collaborative platforms, will need to operate jointly. The distinction between shooter and sensor platforms will blur. Even between kinetic and non-kinetic assets. The right effect at the right time matters. By working collaboratively, they will quantify their mission effectiveness, retaining a high flexibility .

Besides developing a new fighter or new unmanned air systems like the EURO Male, it's important to make existing ones smarter with a disruptive approach. For example, a future smart Multi-Role Transport Tanker (MRTT) – a persistent platform close to the battlespace — could contribute not only by giving fuel, but also be a contributor in the intelligence, surveillance and reconnaissance-processing, exploitation, and dissemination (ISR-PED) cycle by filtering information through AI analytics and pushing relevant intelligence back into the forward battlespace.

And all these will be connected through a joint IT and Communication →

From 2040 onwards we will face a massively increased threat level for air assets and these will require new technologies to address them.

network, distributing and managing the information between the platforms. In the end it's not a new fighter which will replace an existing fighter — it will be a whole new connected system.

What do you think will be the key areas that will drive technology change?

We believe there are four key elements that will be the building blocks of development of new technology.

The first one is the existing fleet of combat aircraft, the Eurofighter and others, which will need to be upgraded to new levels to face new threats.

The second is a new fighter, which will have new technologies, with things like a new approach to propulsion, stealth, new sensor and communications capability and new cockpit design that will allow the management of complex tasks in a distributed C2 environment.

The third element is around unmanned systems, where we'll have to invest in technology linked to automation, mission systems, swarming and connectivity.

The final driver of new technologies is around IT and communication technologies, the way we manage networks and the way we handle very large amounts of data. We will look at technology like artificial intelligence that will support decision-making in the system to ensure pilots don't drown in data whilst at the same time increasing their situational awareness.

What will be the key capability requirements for success in the air domain in the years and decades ahead?

Developing a so-called 'Combat Cloud Eco-system' where a range of networked fighters and other assets are all communicating and sharing information is a fundamental shift. We aren't simply talking interoperability, where you define some protocols and standards to exchange information, but rather a future of full integration. Here all the systems will be integrated and the level of exchange of data will be much higher.

The crucial point is this: the way you handle information will be the main differentiator between winning or losing in a battlespace.

When you look at the old mantra of requirements for fighter aircraft in the previous decades speed and agility were always top of the list. For the next generation the call will be information management because this is what will give you superiority in front of your enemy. It doesn't mean a future fighter won't need to have agility and air-to-air capabilities too, but what will make it a winner is the way it manages information.

Airbus has already started working on manned and unnamed teaming — can we assume that this will become increasingly important in the FCAS era?

Without a doubt. In the future we will see manned and unmanned teaming as standard. That's linking the platforms which are currently being developed, like Euro-MALE. They will provide information and support the tactical combat parts of FCAS.

However, we suggest there will be another type of manned and unmanned teaming. This is for very specific scenarios, in denied environment combat missions for example. Here you'll see a combination of smaller unmanned assets working with a fighter aircraft. At Airbus we call them a 'remote carrier', because the unmanned assets will carry some of the fighter's capabilities remotely.

The remote carrier concept is the logical conclusion when you think about the level of threat constantly or exponentially increasing over time. Given that reality you would not be able to develop an aircraft to fully answer these very high-end threat scenarios because it would drive the complexity of the aircraft to levels which are non-fundable and are not realistic.

The only way to respond is by combining assets. The sophisticated fighter aircraft combined with external unmanned systems that can perform a wide range of missions — be it kinetic or non-kinetic, from tactical to strategic level missions.

Combining assets will give flexibility to the system and will also have the very simple effect of saturating enemy defences through force mass, while limiting the risk for operators and with reasonable economic efforts.

The other advantage of this approach is that the development and upgrade cycles for a fighter aircraft are relatively long, whereas the threats will constantly evolve. The cycles that we expect for a remote carrier are much shorter. You can evolve the capabilities of the whole system by developing new remote carriers, in turn they will extend the capabilities of the aircraft. It makes the system both upgradable and scalable. In the process it protects the pilot and multiplies the impact of the attack and also, by downloading some capabilities from the fighter to the remote carrier, it increases mission efficiency.

How much progress have you made with manned and unmanned teaming work to date?

We have a successful track record for working on technologies linked to automation, swarming algorithms, and common mission systems. In fact, in October we demonstrated an example of what teaming manned and unmanned systems could look like. We used off-the-shelf target drones, and the core of the demonstration was around the intelligence in the swarming algorithm and in the level of automation.

The live demonstration featured five drones commanded by an aircraft. The aircraft gave the drones a series of high-level commands like 'identify the threats' and they automatically adapted their mission plan to perform the different tasks. They even split tasks between them to perform them in the most efficient manner.

It's a first step but it's the result of just one year's work so just imagine what could be achieved in the coming 10 or 15 years once we have put serious development into it.

How do you see Eurofighter's role in the future — could it be a good bridge for technology transfer?

People have described Eurofighter as a bridge into FCAS but I'd go further, Eurofighter will also be at the core of the FCAS system – whatever it turns out to be. You only have to look at the timeline, Eurofighter will fly alongside the new fighter and within the FCAS system for more than 20 years.

And until a new fighter is developed, Eurofighter will be the platform where we will test and operationally implement some of the technologies which will be required for an FCAS. Here we're looking at connectivity, networked weapons and the remote carrier, manned/unmanned teaming.

Just imagine in the timeframe before an FCAS we could have the Eurofighter flying with an unmanned system and that could dramatically increase the capability of the aircraft in theatre. It's a fantastic opportunity for Eurofighter because you can invest into increased capabilities, and that would enable it to operate in the networked environment of the future.

What advances do you see existing platforms having to make to remain relevant in a future battlespace?

If we had the Eurofighter or the FCAS flying in the future battlespace environment, they will need massive amounts of data. How do you bring all this data from space or from the command centres back in Europe to the theatre? You will need high speed and resilience to transmit all this information. One possibility is laser communication. Airbus has a project called Network For The Sky which is, among other technologies, looking into direct laser communication between satellites and airborne platforms, providing a very high data rate combined with resilient communication – safe against jamming. In addition, in another project mentioned earlier, we are working on a smart tanker. Here we are talking about using an MRTT, sat just behind the tactical area, that is able to provide, using artificial intelligence, all the necessary data (rather than just the fuel) to the fighter pilots in the theatre. These are bricks of what FCAS will need.

We also need to invest money into directional data links to get our own sovereign solutions.

Of course, Eurofighter will be compliant to the future standards and protocols of communication that will be required by an FCAS.

How important is the development of an FCAS project for Europe?

Recent global developments show a clear need for European sovereignty. We certainly need to reduce dependency on US systems and create solutions that are tailored to European needs. Europe will also require the ability to operate missions jointly according to our own standards, based on sovereign solutions, while maintaining interoperability into NATO.

However, Europe, over many decades, has been weakened by internal competition. There have been too many different platforms within Europe and there's a need to go for increased commonality.

And if we want to be able to perform missions in a coalition in the future, we will need to develop the appropriate standards, especially regarding communications but in many other aspects too. Indeed, the European view, by design, because it's made up of many nations and industries participating together, is based on collaboration.

At Airbus, while focusing on the resilience of future systems, we are pushing for open architecture solutions within FCAS. First, it will enable other solutions and companies to plug in and second, it will enable upgradeability of the system over decades. We know the threats will change so the ability to upgrade constantly to meet the changing threat environment is vital.

What do you see as the big obstacles in the way?

If we take European sovereignty seriously we will have to invest both in further upgrades for Eurofighter and for the development of an FCAS. Both will require serious money and the current budgetary plans don't recognise the full extent of what needs to happen.

The development of a new model system is not cheap and the level of ambition is high. A connected system, with new aircraft with a new propulsion system, with unmanned elements is something big and needs the commitment of nations to invest. You can't go for the middle way, because you'd end up with something which can't respond to your needs.

Nations and industry also need to learn that what Europe really needs is for everyone to work together. We cannot repeat the scenarios of the early 80s where we ended with three fighter programmes.

Collaboration has also the great advantage that you put money together, you get more volume and by adding more volume, then you get a higher end solution to your needs. In addition, in export terms, you have all the European nations rowing in the same direction rather than battling against one another. ←

Eurofighter will be the platform where we will test and operationally implement some of the technologies which will be required for an FCAS.

EUROFIGHTER FLEET PASSES **500,000** FLYING HOURS

The Eurofighter fleet is celebrating after passing the 500,000 flying hours mark, as it cements its place at the heart of European air defence.

Eurofighter Typhoon has rapidly accumulated hours across the fleet, particularly in recent years, following an increase in the tempo of air policing and combat operations. There is now a fleet of almost 500 aircraft protecting Europe's borders, with the potential for this number to grow substantially in the coming decades.

Volker Paltzo, CEO of Eurofighter Jagdflugzeug GmbH, said: "Passing the 500,000 flying hours milestone underscores the fact that Eurofighter Typhoon is the backbone of NATO's European air defence. "But, looking to the future, it will continue to be developed to defend against all threats for decades to come. The aircraft will play a key role in the future battlespace, and will be a central pillar in any future European combat air system, developing and integrating key technologies that will feed in to that future system."

Clemens Linden, CEO of Eurojet Turbo GmbH, who provide the engines for the aircraft, said: "We have clocked up more than a million hours of engine performance for the EJ200 which is a major achievement and through countless deployments, both in Europe and internationally, we have enjoyed incredible engine reliability.

"There's no doubt, that throughout their million flying hour lifespan, the EJ200 engines have demonstrated they are the best in their class. But looking ahead to the next million the engine can also be further developed, ensuring that Eurofighter Typhoon can maintain its combat edge." ←

INSIDE **OPERATION SHADER**

For the past four years the UK Royal Air Force has been part of a coalition of nations fighting the terrorist group Daesh in Iraq and Syria. Daily operations have been conducted from RAF Akrotiri in Cyprus, with Eurofighter Typhoons playing a pivotal role. Eurofighter World was invited onto the base to find out how it performs this vital task.

The holidaymakers on Lady's Mile Beach in Limassol receive an early morning wake-up call. It's 7.38am, but a pair of RAF Eurofighter jets have just roared off to work. Their exact destination remains a classified secret but as part of Operation Shader their objective is clear — to defeat Daesh across Iraq and Syria.

Fighter jets on operational duty are a fact of life on sun-kissed Cyprus, where the UK has a Sovereign Base at RAF Akrotiri in the south of the island, a 25-minute drive from Limassol.

This particular pair of Eurofighters were facing the prospect of an eight-hour working day, consisting of a series of refuelling stages and a visit to one of the most dangerously-congested pieces of airspace on the planet.

This is what 'taking the fight to Daesh' actually means. There's a regular drumbeat of daily missions from coalition partners. On a day–to-day basis this involves some of the RAF's six Eurofighter Typhoon and eight Tornado aircraft stationed at Akrotiri, along with a Voyager air-to-air refuelling tanker and a Sentinel aircraft, which are all permanently allocated to 903 Air Wing.

77 nations form the coalition and their aim to date has been to squeeze Daesh out of the territory they've held in Iraq and Syria and to destroy their resources. So far it's been highly effective but that's not to say it's been straightforward.

"Syria is one of the most complicated air campaigns I have ever been involved in," says Group Captain Chas Dickens, Commanding Officer of the 903 Expeditionary Air Wing (EAW) at RAF Akrotiri.

"Daesh has been severely degraded but they are not defeated. It will not be long before we have destroyed the caliphate in terms of the land it holds but now we need to defeat them as an organisation. We need to disrupt their networks and their abilities to resupply. And that will take time."

However, their success to date has brought its own challenges.

"The issue with Daesh being reduced to a very small area means there is a serious concentration of aircraft, manned, unmanned, and attack platforms all in quite a small amount of space," says one of the RAF pilots who has flown multiple missions into Iraq and Syria. →

◀ Gp Cpt Dickens

"In such a busy airspace the biggest threat is other aircraft. The Eurofighter's radar is key, particularly after refuelling, because it allows you to get back into your airspace and see who is in there. Effectively it ensures you're safe because our biggest concern right now isn't enemy action but our own aircraft. We have to make sure we stay away from each other."

MORE THAN 1,700 STRIKES

The RAF conducted its first strikes against Daesh in 2014 and since then has carried out more than 1,700 over Iraq and Syria (about 1,400 have taken place in Iraq). Throughout most of this time Eurofighter has been a key player in the action. And it has performed well under pressure.

"It's a great aircraft to fly, you have so much thrust available, and even in its Operation Shader weapons-fit (when it carries a mix of bombs and missiles depending on the mission) there is no need to use afterburners to get airborne," says the pilot.

He explains that the aircraft's sensor fusion capabilities mean he doesn't have to worry about what each particular sensor is seeing, rather he can be confident he is receiving "a clear picture of what's out there." Which is far better than having lots of sensors showing you lots of information concurrently.

"As a pilot what you want is the aircraft to make it easier to process the information and help you understand what's going on. That allows you to make valid tactical decisions at the right time. It's a great suite and there's great capability in the aircraft."

With Daesh squeezed into a smaller pocket, Group Captain Dickens says the biggest challenge for Operation Shader right now is finding the enemy. The Sentinel goes out and searches an area, typically around 50sq miles. He says: "We are looking to establish a pattern of life and seeing what is going on on the ground." Over time this activity — which he describes as 'armed overwatch' — allows the force to build a clear intelligence picture. Then other assets like the Eurofighter Typhoons, with their advanced targeting Litening pods, are used to add to that picture. Essentially there's a stack of aircraft constantly monitoring small areas.

"We look at where the friendly forces are, where people are going, and for an established pattern of life. Then we look for changes to try and understand them. Then it's a case of putting the pieces together so that we can target the enemy should they present themselves. Once we have established where Daesh are, that's where combat air comes into play."

However, the aircraft are still asked to operate in some of the busiest, most dangerous airspace on the planet. From a pilot's perspective the Eurofighter Typhoon is more than up to the task.

For the engineers, the shade of the hangars reduces the intensity of the heat — but only a touch.

"It offers excellent countermeasures and a lot of work goes on behind the scenes on these. It give me a great awareness of who is around, who is looking at me and who may be a threat.

"The helmet is another great strength. In the busy airspace we're operating in, in the middle of the Euphrates, the ability to cue something with your helmet and take a closer look at it is huge. It allows me to safely fly my aircraft and manage a formation in a very busy piece of airspace.

"If I see something of interest on the ground — say an explosion or something happening — I can rapidly move the sensor to it in a matter of seconds and use the targeting pod to take a closer look."

NEAR PERFECT RECORD

Back on the base, despite the constant breeze from Limassol Bay, it's hot and humid. For the engineers, the shade of the hangars reduces the intensity of the heat — but only a touch. The good news for them is the Eurofighter's near-perfect maintenance record, which in the light of the heavy mission workload is incredible. The RAF is the second largest contributor to the campaign and its 'attack assets' — Eurofighter included — are in constant daily use.

"Up to this point we have carried out 299 sorties since our Squadron was stationed here a couple of months ago and we haven't missed a single mission due to engineering issues, which is fantastic," says one of the engineers.

"At any one time we have five aircraft serviceable and one in the hangar for planned work. Our mission availability is running at 99 percent," he adds.

For now, the RAF's contribution to Operation Shader is proving to be a success and for Group Captain Dickens there's a genuine sense of pride about the work that's being undertaken at RAF Akrotiri.

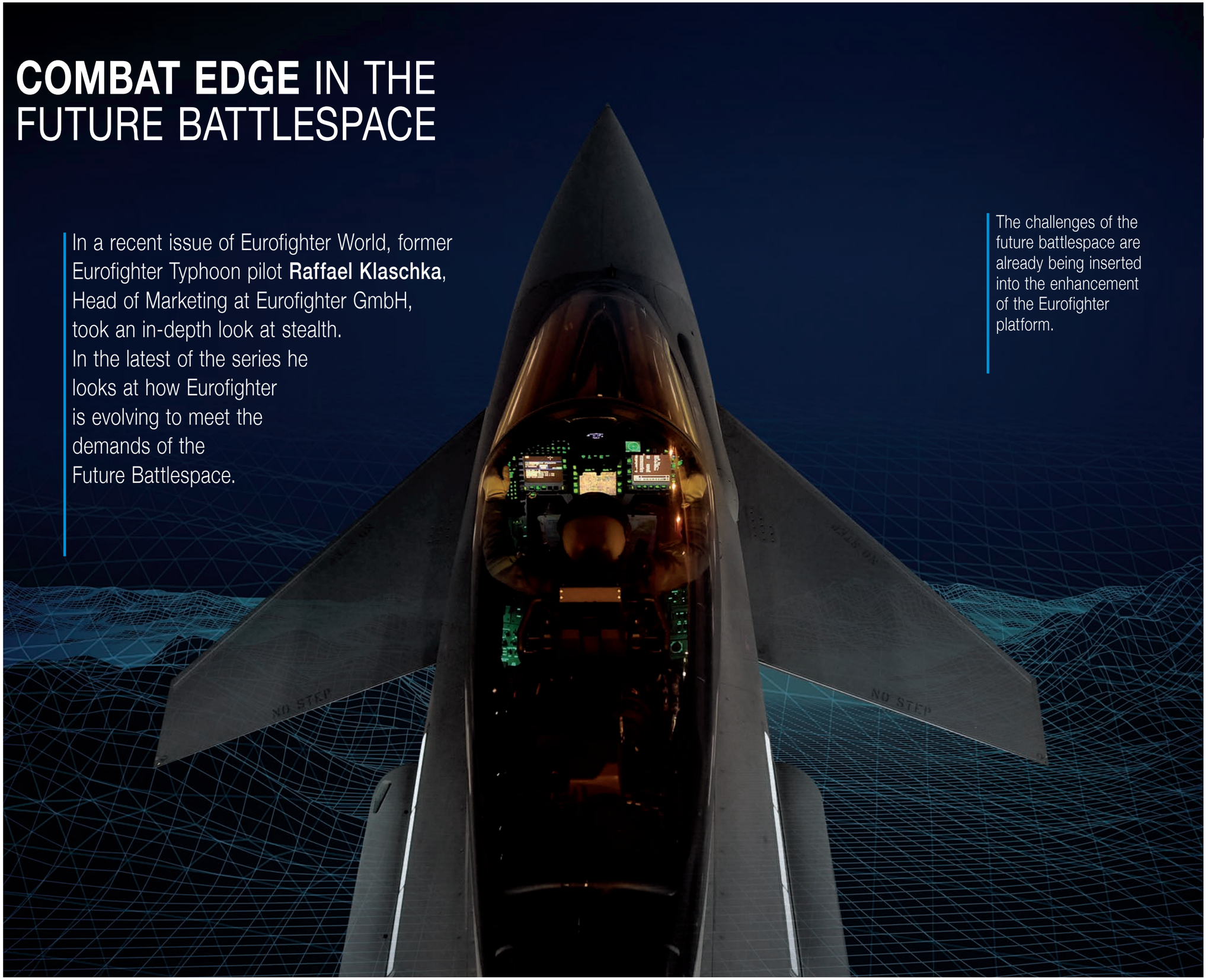
"Daesh is probably the most despicable group I've ever seen and I have previously been involved in operations in Iraq and Afghanistan. My crews have seen Daesh do some things to people I have not seen in other campaigns. It's a particular nasty bunch of people.

"We are trying to defeat them and trying to stop them from exporting terrorism around the world. What we have done here has been able to keep the public back in Europe and the UK safe and make the life of the people in Iraq and Syria better. For me that is our mission's lasting legacy.

"So my sense when this is over will be pride in a job well done." ←

COMBAT EDGE IN THE FUTURE BATTLESPACE

In a recent issue of Eurofighter World, former Eurofighter Typhoon pilot **Raffael Klaschka**, Head of Marketing at Eurofighter GmbH, took an in-depth look at stealth. In the latest of the series he looks at how Eurofighter is evolving to meet the demands of the Future Battlespace.



The challenges of the future battlespace are already being inserted into the enhancement of the Eurofighter platform.

We're living through a time of rapid technological developments that are shaping the thinking about the future of air power. Recent conflicts have seen a shift from symmetric to asymmetric warfare, with fast moving elusive targets. Threats that demand a high degree of flexibility and precision to avoid or minimise collateral damage. At the same time, from a technology perspective, we are seeing the dawn of new weapons systems, including new drone-based and advanced land-based air defence systems. We also see an emerging threat from advanced passive radar systems, which will pose an increasing danger for current platforms, with low observable characteristics, reliant on a reduced radar signature.

Another important factor is cyber technology. Around 80 percent of the capabilities of future aircraft will be software-based and ensuring the whole infrastructure and system is robust and resilient against cyber-attacks will be crucial. All of these developments are driving Europe's future air warfare requirements. What's already clear is that new approaches and solutions will be required. In recent months, a direction of travel has started to emerge in Europe about the capability need for future combat air systems.

However, the challenges of the future battlespace are already being inserted into the enhancement of the Eurofighter platform. That's why an evolving Eurofighter is set to be the logical bridge to any future combat air system. Clearly an enhanced Eurofighter will be part of the DNA of the future fighter – working hand in hand with other systems in a future battlespace, whether those are manned or unmanned.

WINNING FUTURE BATTLES

So you can ask what does the future battlespace look like and what factors are key for success? Is it capability? Is it super cruise? Is it agility in the dog fight? Is it stealth? Is it sensor fusion?

Well, my answer is that it's none of those factors. Or rather, it's the combination of those capabilities to be able to attain a certain freedom of movement in a contested airspace to be able to fulfil your mission, be it kinetic or non-kinetic. And for that, you need different capabilities which depend on the type of mission.

So how well is Eurofighter currently able to meet these challenges and what are the pressing needs to ensure that it remains at the heart of European air defence in the decades ahead? Well, I'm convinced that for current scenarios, Eurofighter is a very good choice for a military decision maker.

It's proven daily in international operations. But we are also looking at →

what are the best technologies to ensure Eurofighter meets the operational demands of the future battlespace too. To simplify this complex question we should look at six key enablers to maintain combat edge in the future battlespace.

SIX KEY ENABLERS FOR THE FUTURE BATTLESPACE

1 KNOWLEDGE IS POWER

Interoperability and connectivity will be key requirements of the future battlespace. Decision speed depends on it.

Coalition forces will have to be able to talk the same language, to exchange information, data and targeting solutions to a far higher degree – and speed - than they do today. We currently have common NATO standards but demands for data will intensify in the future.

The Eurofighter of the future will see new data links introduced and existing ones enhanced. Our view is that in the near future, the player who doesn't have the required degree of connectivity will not be able to take part in coalition operations because it would have a negative effect on efficiency and safety of your own troops and forces.

Everybody in the network — the soldier on the ground, the ship, the pilot, the weapons system, the weapon itself — will all be connected. This will contribute to the situational awareness of the decision maker. The dynamics around the exchange of information and intelligence will drastically increase.

2 DIFFERENT MISSIONS, DIFFERENT CAPABILITIES

A one-size-fits-all solution doesn't exist. If you want stealth, you can't have payload. If you want payload, you can't have stealth. If you want survivability, you need two engines. If you want vertical take-off capability you can only have one engine, which can have an impact on the survivability of your jet.

Eurofighter is built on a philosophy that a broad set of equalised capabilities is future-proof in a future battlespace because there are a whole set of capabilities needed and not just a single one.

3 SENSOR SHOOTER OPS VS KILL WEB

Current combat scenarios are 'Sensor Shooter' led, which means the platform carrying the weapon uses its own sensors to create a targeting solution, then employs its weapon against it.

> Even in the future battlespace robust capabilities will always be of fundamental importance

However, the new technological developments that are coming on stream will make it viable for the platform to rely on a targeting solution from another sensor. It's a concept known variously as 'Kill Web' or 'Combat Cloud'. Essentially, it means you can use target data from another asset in the network, for example, a ship, and then employ your weapon on it. This shift, from the traditional Sensor Shooter scenario, to a future battlespace is an evolutionary change — it's a continuous transition and we're living through it. A platform like Eurofighter will evolve with it and through it and will therefore play a crucial role in future.

So we need to get used to the concept of having a ship as your wing man. The future battlespace will inevitably be a highly networked environment and network enabled weapons will be a key requirement. We are already seeing the introduction of these — like SPEAR3 — onto Eurofighter. You can employ them from the most suitable location or you can get the best data available to your weapon, without necessarily using your own sensors.

4 SURVIVABILITY

When you talk about survivability people often jump to considering the quality of the hardware on the jet and the fidelity of the sensors, the way it displays information and so on. But that's just one part of the equation. Just as important is the mission data — the data that you insert into the jet so that it's able to 'know' what's going on in the future battlespace.

It has to be able to gather data, save it and make it downloadable in the fastest possible time. Then it has to be analysed by specialists who can share it with your forces. With mission data we're talking about several factors: the software, the people who are trained to analyse it, and your experience as a force.

With Eurofighter, forces in operations have the ability to re-programme the software in the jet as quickly as possible. That's because Typhoon has no black boxes. And this is really important. If you don't have good mission data, your survivability decreases and therefore your efficiency and survivability is at risk.

5 SENSOR FUSION

Eurofighter Typhoon already has a very high level of sensor fusion capabilities but, as sensors improve, the amount of data will increase. In order to remain future-proofed, the capacity and the processing speed of our equipment will increase as part of our future evolution.

The bottom line is sensor fusion has to serve the pilot so he can take the right decision and can focus on his mission, and other tasks are taken from him and carried out by smart systems, for example, a sensor manager.

6 PAYLOAD CHOICE

Flexibility — in terms of the weapons you have at your disposal —will be crucial in terms of effectiveness and survivability. The more weapons you can choose from, the more flexible you are in using your weapon platform.

Eurofighter already has a broad weapons suite to call on but that's expanding with the arrival of Brimstone, Marte ER and Spear3, to name just a few. On top of this Eurofighter has the ability to carry both American weapons and European weapons, which all adds to its flexibility. ←

SPEAR3 – FLEXIBILITY AND AN **ALMIGHTY PUNCH**

The battlespace of the future will be a highly-contested, networked environment with far greater integration of different assets. It's an environment where Eurofighter, through the integration of new capability, will thrive, playing a leading role and countering future threats.

Helping it evolve is a new weapon that will be integrated on the near horizon – SPEAR3 which stands for Selected Precision at Range, type 3. Hailed as a breakthrough capability, SPEAR3 is a mini air-to-surface cruise missile that promises to bring new power and flexibility to Eurofighter both in terms of individual capability and force mass.

"With SPEAR3 each Eurofighter Typhoon will be capable of carrying up to 12 mini cruise missiles, compared to two standard cruise missiles currently, as well as a full air-to-air weapons suite, bringing revolutionary capability for the platform. Crucially, that extra capacity will give Eurofighter the ability to overwhelm enemy air defence capabilities and the flexibility to engage multiple targets per sortie," says Paul Mead, Director of Business Development at MBDA.

"The Royal Air Force sees the need to engage enemy air defences as a primary role. One way to do that is to saturate and overwhelm them, ideally from standoff ranges. That means you've got to be able to have a high load out, to have time on target, and you need a warhead capability that's able to make variable effects on whatever target you're going after. And that's what SPEAR3 brings.

"But recent conflicts have also demonstrated the need for precision-strike weapons that can operate in all conditions, against severe countermeasures, and attack moving and manoeuvring targets in all weathers.

"So the RAF is looking for a flexible solution – one that's able to adapt to a complex environment, but also one where they can control through the data linking, and the ability to have third party control of the weapon as well. SPEAR3 ticks all the boxes.

"There is nothing else like this in the world. It's a unique capability and one that sits alongside (the air-to-air-missile) Meteor in terms of the unique differentiators for Eurofighter as a platform." →

With SPEAR3 each Eurofighter Typhoon will be capable of carrying up to 12 mini cruise missiles.

The integration process is moving at pace. SPEAR3 underwent its first test firing from a Eurofighter at Aberporth in Wales in March 2016 and was placed on contract later the same year. The development phase is due to be completed in early 2020, with an in-service date anticipated in the early 2020s.

Powered by a turbojet engine, SPEAR3 has the beyond-horizon reach — something in the order of about 140 kilometres — to ensure that the aircraft remains safely away from hostile air defence units.

Impressive stand-off capability is one key feature, but SPEAR3 is also equipped with the latest generation multi-mode sensor seeker, providing increased flexibility in the kind of complex scenarios commonly envisaged in the future battlespace. It's designed to be effective against air defence units, ballistic missile launchers, hardened structures, fast-moving and manoeuvring vehicles, main battle tanks, armoured personnel carriers and naval vessels.

State-of-the-art data imaging software ensures high precision and high collateral management. "It gives us the ability to look at and match images so that we know exactly what we're going after."

SPEAR3 features a two-way data link which allows in-flight updates, retargeting and abort functions and, because it's network enabled, it can be controlled and take targeting data coming from third party assets.

"Another key feature is low altitude launch — you can keep the platform both at range and also at low level and, through the weapon's turbo jet, launch off low and then climb to altitude."

The Royal Air Force confirmed the integration of SPEAR3 to Eurofighter at the Royal International Air Tattoo (RIAT) this year and it's set to be a key weapon for years to come. It forms part of a dynamic weapons set for the UK RAF. SPEAR 1 is Paveway, SPEAR 2 is Brimstone, SPEAR 4 Storm Shadow and SPEAR5 is another for the future — a cruise and anti-ship weapon.

SPEAR3 was also revealed as a fundamental component of Team Tempest at Farnborough, so it's a capability that's being looked at for a future combat air system. "It's a future-looking weapon," says Paul. "We've got the ability to upgrade it over time to put in different modes, different variants and to make it a weapon with longevity." ←

An Italian Air Force Eurofighter Typhoon during a NATO Air Policing mission over Estonia. Photo: Giovanni Colla

Two Royal Air Force Eurofighter Typhoons during a training sortie over the United Kingdom. Photo: Aviation Photocrew

EUROFIGHTER — THE AIRCRAFT FOR ALL SEASONS

An Italian Air Force Eurofighter Typhoon with deployed break chute, escorted by a group of 5 Typhoons. Photo: Giovanni Colla

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