Global Combat Air Programme

Mutual Defence Going Global

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Introduction

The world is navigating a moment in history where geopolitical context has brought the return of nation-state level conflict, previously considered unthinkable by many. It reminds us that security should not be taken for granted as we witness the beginning of a new era of worldwide international competition and disorder. National security and sovereignty have evolved into more complex and interconnected concepts that extend far beyond state borders. In today's globalized world, we are all inextricably linked to events, developments, and actors, no matter how geographically separated, rendering the strategy of isolation a mere illusion. Even if you live in the luxury and security of a penthouse, when the ground floor is on fire it is only a matter of time that you will be in trouble as well. Air power can exploit its speed, height, and reach to be the firefighters going FAST, going FAR, unimpeded and with short notice.

Current conflicts have reminded us that control of the air – a core competency of our tri-lateral and allied air forces – is still vital for national security because it enables the effectiveness of all other domains, perhaps more than ever before in history, especially considering increasing disparities in force size. Investing in the ability to control the air domain protects us from the alternatives, such as attritional warfare, where the cost in blood and gold is far greater than the cost required to control the air. Therefore, when thinking of future combat air capabilities through a global mindset, there are direct implications for certain characteristics and requirements such as range, logistics, and operational agility (high interoperability, low footprint, fast updates, and capabilities to adapt to new scenarios).

New and evolving threats and counters drive a mindset-shift in the requirements of traditional capabilities in the same way that drones have challenged the whole concept of armoured vehicles. Strategic offset strategies like Anti-Access/Area Denial (A2/AD) and an increasingly layered and contested zone have taken air power 'back to the future' calling for 'Survivability 2.0'. Just as with the maritime, land, and space domains, Control of the Air is now more diverse, high-stakes, and difficult than ever. At the same time, developments in cyberspace and space are altering long-standing assumptions and perspectives in all the traditional domains. With modern threats and in our technical environment,

there is even less time to prepare or update existing tools before the point of crisis.

These factors are why the development of future combat air systems is such a high priority for so many countries. Rooted in the European and Indo-Pacific regions, Italy, Japan, and the UK are leveraging their multiple commonalities – their operational journey with fifth generation aircraft, a proud and thriving aerospace and engineering industry, and a long, strong aviation history. Taking together all these common foundations, they bridge geographic and language barriers resulting in a tri-lateral arrangement that has the means, the understanding, the need, and the desire to commit to the next generation of combat air systems. The Global Combat Air Programme (GCAP) team has the responsibility to communicate our plan to our alliance partners to foster understanding and confidence in our choices and strategy. Also, because – sooner or later – we may employ several different systems alongside one another in the same formations and in the same challenging theatres. What follows is a discussion about the philosophy behind GCAP's development; by sharing these goals, we hope to increase the understanding of the program by NATO and our other allied partners.

Why We Declare 'Sixth-Gen' Up Front:

Military aviation technology is on the cusp of another significant leap forward in capability. In the last hundred years, the evolution of air systems has not followed a linear path, but rather it has been marked by sudden leaps and moments of strong discontinuity despite its overall rapid progression. Innovative technologies have enabled those leaps which in turn changed the rules of air warfare, such as radars, precision weapons, integrated avionics, and low observability. Those technologies have revolutionized doctrines, concepts of employment, and tactics. They have shaped the way effects are generated in and from the sky. As the air domain has established itself over the past century, it has been at the centre of key developments across domains from the Blitzkrieg through the second offset of the Gulf Wars.

Conditions are primed for another leap that will result in a capability level that justifies the naming of a new generation of fighter aircraft. Multiple diverse, but related, technologies are reaching maturity or rapidly developing in a disruptive way – driven by both commercial pressures and conflict – which will result in GCAP being more than 'just another fast jet'. GCAP is more than new stealth technologies, new effectors, the capability to coordinate collaborative combat aircraft

In December 2022, the Governments of Italy, Japan, and the UK announced the launch of the Global Combat Air Programme to develop a next-generation fighter.

(CCAs), or doing tasks with more autonomy than ever before. Instead, GCAP is a new paradigm of integration amongst platforms, systems, and components across all domains, including space and cyber that provide GCAP access to a whole range of 'new wingmen.'

This article details 'what' we need; however, more interesting should be 'how' we deliver it.

Capability Management from F-35 Users' Perspective

Italy, Japan, and the UK share common experiences and understandings through their experience with the F-35 programme. As F-35 users, GCAP nations are committed to developing a collaborative, complementary platform – not a competitor nor replacement of the F-35. GCAP has already digitally flown extensively in challenging virtual environments to assess performance and refine requirements among the competing interests and priorities. In this context, GCAP is deliberately positioned to be a complementary asset within the broader air power portfolio, enhancing – not replacing – the capabilities of the F-35.

To complement existing air power platforms, the main challenge is not only having the right set of capabilities, but rather in integrating new systems like GCAP into multinational operations from day-one, addressing interoperability with existing systems, and ensuring cultural shifts to train airmen to navigate the increasing complexity of today and tomorrow's operational environments.

Connect or Lose

Since Harold Brown's second offset in the 1970s, we and the other allied nations have sought to use technological means to offset an adversary's superior force size. The threat's numerical advantage remains, but the last 25 years have seen our technological advantage eroded and even overtaken in some areas. It is increasingly clear that the allied nations' advantage now resides in the information advantage, operational tempo and capability adaptability; all enabled by the combination of technology, training, tactics, and command and control (C2). Against a numerically superior threat employing increasingly peer technical capability, the only means to achieve the effectiveness required is for each of our fighting elements to be greater than the sum of their parts. In the air domain, the F-35 has been extraordinarily successful at this at a formation level, highlighting both the fundamental importance and the challenges of connectivity in the contested area. As A2/AD doctrine and technology increases the size of contested regions ever more, these are becoming even more congested. We are faced with conflicting challenges to our control of the air and freedom of manoeuvre:

- Our tempo and flexibility advantage are dependent on connectivity and transmissions.
- Those emissions are in tension with survivability in a contested region.
- Contested regions are expanding and becoming more congested.
- A greater proportion of our assets and capability must be capable of operating in the expanded contested regions.

It is becoming clear to all, including the threat, that connectivity is fundamental to our capability advantage. We must stay connected, or we lose. GCAP is being developed under this clear imperative and is actively incorporating lessons from past capability programmes to ensure it is a net contributor to connectivity across all domains.

GCAP's Contribution to Conventional Deterrence

Like all military programmes, GCAP has a responsibility to justify its cost and demonstrate value for money. The war in Ukraine has reminded everyone that conflict is always more expensive than deterrence; however, deterrence is not an argument for unconstrained cost because it is vital that nations' capability programmes identify the most efficient and cost-effective means to achieve the desired capability. Additionally, combat air systems are

GCAP is being developed from the outset as the core of a system-of-systems, providing the processing, sensors, and connectivity to enable high volume CCA.

good value for money because they provide adaptable, multi-use capability at every level, from peace to full-scale conflicts. Since development of that combat air capability advantage is a highly challenging and expensive endeavour, collaboration between like-minded and well-matched allies is the solution. Italy, the UK, and Japan are pooling our resources and sharing the costs and the burden to develop GCAP.

GCAP's freedom of manoeuvre is enabled by its evolved survivability, advanced sensing, expanded combat radius, and kinetic- and non-kinetic payloads. The combination of survivability, range, and payload allow GCAP to hold adversaries' logistical and supply lines, infrastructure, industrial and manufacturing bases, and C2 components at risk. GCAP freedom of manoeuvre and range forces the adversary to dilute its defences over a much wider area which increases other allied assets' freedom of manoeuvre, thus enabling the contribution of less capable platforms.

GCAP will provide commanders fully scalable options from non-kinetic to significant volumes of high-yield, wide-area, or long-range kinetic effectors. Few assets offer the level of deterrence and freedom of manoeuvre that a credible, long-range, persistent, and survivable platform can–and those that do are rare. The conventional deterrence and freedom of maneuver provided by GCAP will benefit our nations and our allies. Securing that deterrence capability will always be cheaper than the conflict it prevents. It represents a cost-effective and integrated solution for the three nations and all our alliance partners.

GCAP's Approach to Payload: Not Just Weapons or Sensing

GCAP's role as a connectivity node capable of operating deep in a contested region explains why we have expanded our approach to payloads and the resulting benefits. Payload is the fundamental purpose and priority of the GCAP system:

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GCAP is embracing innovative methodologies for faster, cost-effective development and adaptation.

- Kinetic effectors are the first and obvious component of GCAP's payload. We are making every effort to maximize the new platform's flexibility and relevance. This involves applying adaptability lessons from the B-52, which has a long history as a 'payload reinvention platform,' and incorporating lessons on survivable combat air payload bays from the F-22 and F-35. Kinetic payload and magazine depth (at a platform and formation level) are being driven by the adversaries' saturation tactics, hardening, dispersal, contested electromagnetic environment (EME), and expanding range of A2/AD. These same factors are driving effector size and numbers, which in turn puts pressure on the bay sizes of aerial vehicles. Low-cost asymmetric threats are driving consideration of cost-per-kill and stockpile sustainability which in turn puts pressure on payload bay adaptability. Addressing all this is core for GCAP's concept and design.
- Non-kinetic effectors are the second, and increasingly normalized, component of the payload, providing the combat air form factor with previously unprecedented capabilities. But non-kinetic capabilities drive array size, to which power generation challenges must be solved.
- As the third component of the GCAP payload, the sensor suite provides crucial situational awareness and high-fidelity insights. To enable freedom of maneuver, sensor reach is vital, even with impressive survivability. However, sensor range remains proportional to size and power, creating a challenge for the platform's overall size, weight, and power (SWAP) limitations.
- Connectivity is a critical fourth component of the GCAP concept. It serves two purposes: first, it allows GCAP to exploit other capabilities, ensuring it contributes as much to situational awareness and tempo as it consumes. Second, it creates a survivable network node deep within contested environments, enabling less capable, lower-cost, or expendable parts of the overall system to participate.
- Finally, computing represents the fifth component of the GCAP payload, becoming increasingly essential

as the high-low mix concept is leveraged. It enables operations within contested environments by integrating with local and survivable networks to deliver the computational support, functional capabilities, and operational tempo required across platforms to achieve mission success.

GCAP is aiming to balance the five components of payload with its survivability and range to provide the freedom of manoeuvre to deliver and sustain the payload where it is needed.

Effects Reach

GCAP integrates payload, range, and survivability to establish what the programme defines as 'Effects Reach'. Survivability constrains combat radius, while the range of payloads – whether sensors or effectors – is limited by survivability factors (such as external stores or emissions) or by SWAP constraints (including bay size, radar cross-section, and aerodynamic drag). The interplay between combat radius and the range of sensors and effectors determines GCAP's overall 'Effects Reach'. This concept serves as a framework for assessing GCAP's freedom of manoeuvre and ability to hold targets at risk that other platforms cannot. This insight has guided critical design and capability choices during the development phase to ensure the platform achieves its intended effectiveness and capability.

Crewed vs Uncrewed: The Role of the Quarterback

GCAP is being developed from the outset as a formation-capable, system-integrated, and system-of-systems platform. While it must retain the ability to operate independently in high-threat or contested EME, its design prioritizes leadership, coordination, and integration with other platforms–whether from other GCAP platforms, crewed systems, or assets within human-machine teams. The 'quarterback' metaphor, increasingly associated with 'sixth-gen' crewed platforms, aptly captures this role. A quarterback platform must be survivable enough to endure threats, capable of independently delivering decisive effects, but most effective when adapting to and orchestrating the actions of other assets in real time.

Even when isolated within the contested region, GCAP will remain capable of enacting the strategic intent tactically but with the intelligence to dynamically adapt the plan in response to adversary behaviour. This metaphor encapsulates several emerging requirements for 'sixth-gen' offensive core platforms: limited reliance on reachback connectivity once deployed; integration with less capable or expendable systems; technology to enable the networks and processing to support tempo and adaptability; concentrated C2 authority; and the flexibility to trade traditional attributes like speed for enhanced capabilities. Although developing such a core platform is complex and resource-intensive, it is essential for realizing the 'greater than the sum of its parts' operational concept. This approach is critical to achieving the necessary operational tempo, effectiveness, and enablement of CCA operations by providing resilient communications, sensing, computing, and C2 capabilities within contested environments.

Conclusion

The trilateral partnership among Italy, the UK, and Japan is advancing GCAP development through a systemic and integrated approach from the outset. This strategy aims to prevent a future scenario – 10 to 15 years from now – where a fragmented fleet of fourth-, fifth-, and sixth-generation fighters operates with limited interoperability, constrained by divergent safety standards, security regulations, and industry priorities. The risks associated with such fragmentation are too significant for any single nation to manage independently, including the most capable states. In today's strategic environment, fragmentation is no longer a viable option. Failure to act cohesively now would necessitate even greater effort and resources to rectify the consequences later. For these reasons, and in alignment with the opening remarks of this article, we welcome this opportunity to share our perspectives, challenge the traditional definitions and roles of combat air, and lay the groundwork for robust cooperation among NATO Allies and Partners. ●

ABOUT THE AUTHORS

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Col Maurizio De Guida is currently assigned to the GCAP Government Agency (Reading, UK), as Requirements Management and Operational Factors branch lead. He joined the Italian Air Force in 1998. After Pilot Training in Sheppard AFB (ENJJPT) he was assigned to AM-X, progressing to Qualified Weapons and Tactics Instructor. He has been selected for an exchange with the USAF, on A-10C. He then transitioned to F-35A, serving as Squadron Commander and leading to Initial Operational Capability (IOC) the first F-35 OCONUS Operational Unit. With over 3,200 hours, including 600 in real operations, he joined the Air Staff Policy and Plans department, focusing on Air Force Capabilities Requirements and then Chief of Future Combat Air System–Planning Office. He holds a degree in Political Science, a master's degree in Leadership and Strategic Analysis and attended NATO Defence College Senior Course.

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Group Captain Bill Sanders leads the UK's Requirements and Concepting team contribution to the tri-lateral Global Combat Air Programme (GCAP). He has served as a pilot in the Royal Air Force for 30 years; with an operational career that began on the Tornado F3 Air Defence Variant, before moving to the Typhoon FGR4 and in the process accumulating over 2,000 flight hours across the two types. He is a Qualified Weapons Instructor with a Test & Evaluation and capability acquisition background–specializing in sensors, data-links, and weapons integration. For the last 10 years he has worked exclusively in Combat Air capability acquisition and management in large multi-national programmes.

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Col Taro Murao currently serves as the Flight Group Commander of the 3rd Air Wing (Misawa Air Base) which operates F-35As. He was assigned as Chief of the GCAP Office, Defense Plans/Policies and Programs Division, Air Staff Office, JMOD. During this assignment he coordinated JASDF operational requirements with Italy and UK within GCAP Programme. Throughout his career he has over 2,000 flight hours, mainly on the F-15J. He previously was commander of the 204th Fighter Squadron (Naha Air Base), Okinawa. He earned his wing through SUPT in the US Air Force and he is a graduate of the US Air War College, the Republic of Korea Joint Forces Military University, and Osaka University.