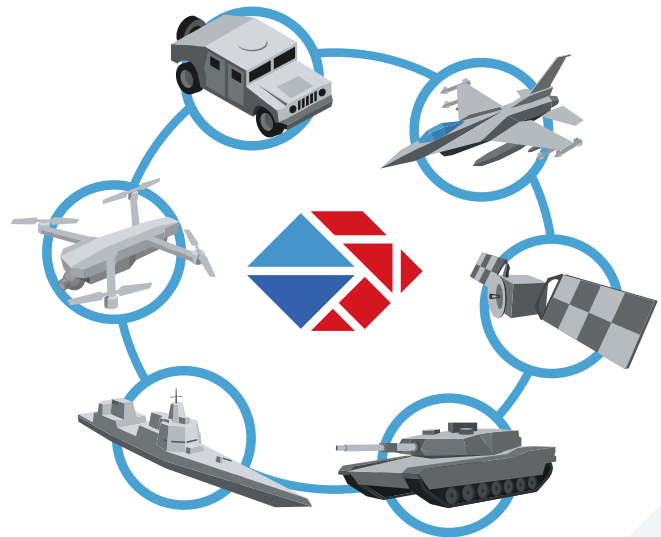


Mission Possible

Enabling Joint Force System Interoperability



Since 1776, the U.S. has relied on alliances to unite against shared enemies and bolster its military strength. The roots of these formidable relationships extend deep into military history and provide a cornerstone from which allied nations can rally to defend common interests and values against new threats.

The imperative to strengthen partnerships among U.S. Forces, partners, and allies has driven the Joint Force to adopt a multi-domain approach as its central operational concept. Joint All-Domain Command and Control (JADC2) depends on alignment and coordination, and U.S. leaders commit to maintaining these relationships to continually out-match and out-pace adversaries. However, coming together demands more than agreements and changes in bureaucratic structure. It also requires changing how we build and maintain the mission-critical systems on which our forces rely. Maintaining mission-critical systems requires interoperability. Interoperability enables components and systems to be integrated and become a system-of-systems through seamless communication. For JADC2 to be successful, it must rely heavily on system integration and interoperability.

Leveraging the capabilities of our combined forces is the sustainable and achievable route to ongoing competitive advantage. Yet, it remains a challenge. Patchworking conventional hardware engineering processes and hacking workarounds to fit a software-driven world has become our “good enough” solution. But, as General Brown Jr. wrote in 2020¹, “good enough today will fail tomorrow.”

Barriers to integrating new capabilities, improving cyber security, and adapting to constantly changing military landscapes are becoming more apparent each day. All branches of the Department of Defense (DoD) and our partners must change how we build and deliver software components to allow systems integration from multiple teams using unique tools and processes — all while continuing to meet cost, schedule, and performance demands. It’s a lot, but it’s not impossible.

“Without sustained and predictable investment to restore readiness and modernize our military to make it fit for our time, we will rapidly lose our military advantage, resulting in a Joint Force that has legacy systems irrelevant to the defense of our people.”

- National Defense Strategy

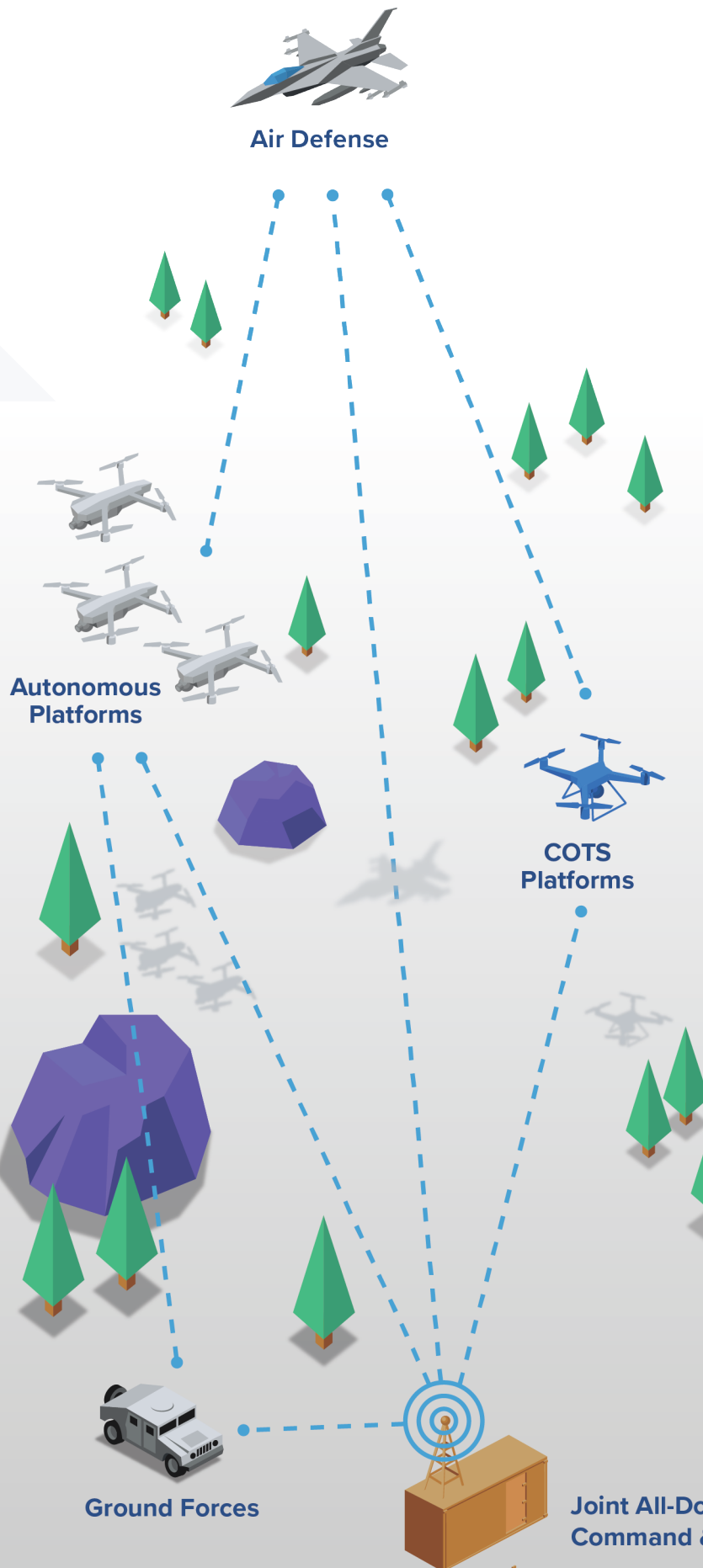


“Accelerate, Change, or Lose”

General Brown noted in 2020 that gaps between designing, developing, and fielding new system capabilities are not new or easy to overcome. Software complexities make the disparities between our forces, allies, and teams more treacherous. Each military branch, contractor, and ally has its own preferred standards and coding languages, and the lack of standardization and limited interoperability makes accomplishing JADC2 even more problematic. The DoD requires modernized systems, yet software and security environments and ever-changing technological advances make keeping pace more challenging.

Sharing technology and integrating systems across JADC2 challenges even the most advanced engineering teams. Substantial manual coding is required to connect disparate systems and components, a problem not exclusive to DoD systems but one made more severe by long-standing policy and acquisition processes that exacerbate vendor lock and prevent sharing strategies, tools, and processes.

Today’s missions demand access to proprietary and off-the-shelf software components from large primes, commercial industry, and non-traditional companies to keep pace with our adversaries— and we need them quickly. This is a need the DoD understands and has publicized as a strategic goal, but the path to true interoperability and consistent upgrades remains unclear. Achieving interoperability and delivering at the speed of relevance requires changing how DoD systems are maintained.



Standards Aren't Standard

The commercial world has made considerable strides in adopting state-of-the-art technologies and integrating between platforms. In the past five years alone, backup cameras and adaptive cruise control technologies have transitioned from high-priced luxury option packages to standard features in almost every car. The advent of open-source software and cooperation among industries has allowed commercial systems manufacturers to quickly adapt to changing markets and technological advancements as they arise. Consumers have come to expect easy and affordable access to the latest capabilities, and, in most cases, it is widely available on demand.

These innovations are available to the DoD, but delivering them to the systems our warfighters have at hand is much slower than in the open market. Many defense systems need to modernize, and programs need help to repurpose technologies. Engineering skills and lack of access to innovation aren't the problems; it's an issue of highly specialized standards and a disconnect across teams within the engineering

lifecycle. Lifecycle gaps between requirements, system design, software development, and implementation slow down component software integration across DoD systems. It's difficult to keep pace even if the same standards apply to every team in a program—the problem multiplies when working alongside partners with different standards, as in the JADC2 arena. Shorter timelines and high-quality benchmarks prevent program leaders from delivering more capability. However, introducing new technologies becomes slow and painful when teams must continue using outdated tools.

Moving at the speed of relevance is taxing for many large DoD projects— especially those that include software. A single miscommunication or design error can cascade into miswritten code and deep errors that escape detection until after integration or make it to the field and fail when the system is needed most. Joint interoperability increases the complexity of requirements, designs, and implementation and, in turn, the risk to mission success.

"We can build the best airplanes and satellites, but we will lose if we can't update the software at the speed of relevance in this century."

- Dr. Will Roper

*former assistant secretary
of the Air Force*



Bridging the Gap

To be ready against future threats, the Government is working to adopt solutions that reduce barriers to joint interoperability in mission-critical systems. Through continued research initiatives, it is clear that systems can be developed, tested, and maintained more effectively and made interoperable when able to:

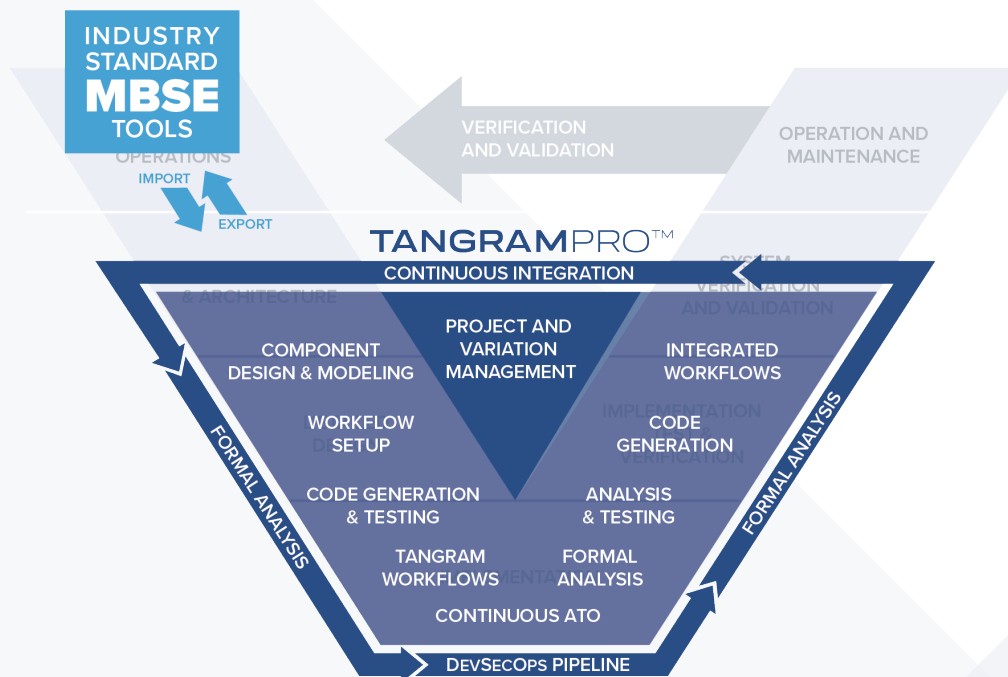
- Define system components
- Constrain software interfaces between components
- Apply focused, integrated testing and analysis
- Embrace approaches to system safety
- Share models, code, and requirements between teams

Model-based systems engineering (MBSE) is one approach to consider for JADC2. It provides a solid foundation for identifying requirements but doesn't solve disparities between tools, software languages, standards, and cultures that block interoperability. Software Integration platforms, however, are built to mitigate these differences.

Software integration tools connect and unify processes across the development lifecycle. They provide a shared interface that narrows the gaps between system design and implementation by combining requirements, system models, and software code. Whether integrating Silicon Valley software into the next-gen UAV or scaling a training environment to simulate JADC2, a software integration tool enables you to build rapidly reconfigurable, interoperable systems.

These tools also provide a single collaborative place where team members can trace their work from the system's design to its code. A good tool plays well with system design tools like Cameo, includes a library of verified, reusable components, and can integrate with the organization's existing deployment processes.

With a dynamic understanding of the properties of each software component, a software integration tool allows for breakthroughs to the warfighter's advantage. These repurposing systems have yet to be integrated or even envisioned.



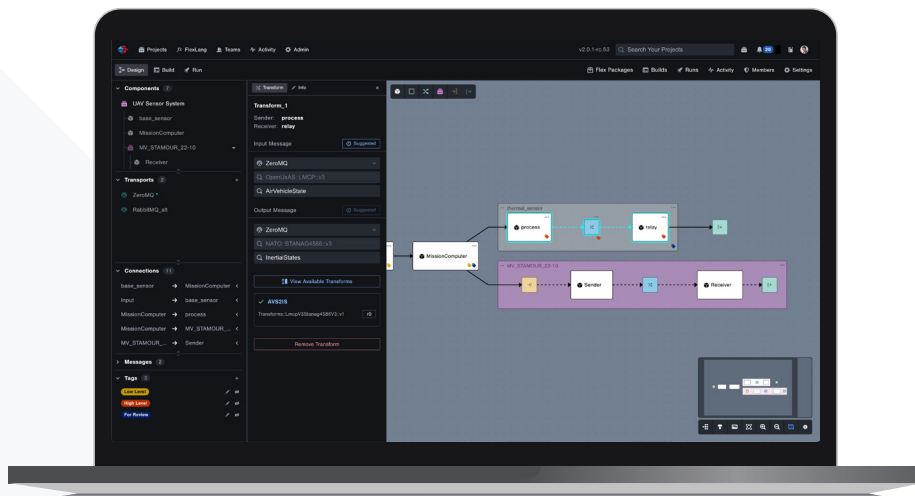
Improvements to the Engineering V with Tangram Pro®

Integrating the full system implementation lifecycle to support rapid development and deployment goals.

Delivering Interoperability at Speed

To support the DoD and the JADC2 imperative, Tangram Flex, Inc. has developed a software integration platform, Tangram Pro, which is a collaborative software design, code generation, and verification platform helping the defense market adapt mission-critical systems and modernize legacy systems for continued interoperability to meet evolving mission requirements. This platform understands the disconnect between model requirements and code implementation and addresses the gap through Cameo ingestion, eliminating disparities between system design and interface code development across components. A collaborative workspace and the ability to develop transforms between uncommon message sets overcome the biggest challenge of JADC2: communication.

Tangram Pro fosters a culture of sharing that is critical to joint interoperability. Bringing components, tools, and people together links disparate tools and processes for technical teams and promotes the reuse of components across systems and programs. The result: greater alignment among partners and reduced time to identify threats, deliver capabilities to the field, and meet the needs of today's missions. The call for joint force interoperability is essential and challenging. Still, we can continue to address lifecycle gaps and meet demands when they arise by remaining agile and adaptable. Tangram Flex commits to supporting JADC2 and providing solutions to enable interoperability and integration and maintain competitive advantage.



Tangram Pro is the first collaborative platform that solves software design, code generation, and validation challenges by reducing the disconnect between software requirements and system integration.

About Tangram Flex

At Tangram Flex, we understand the challenges of security, speed, and safety. We simplify software integration for mission-critical defense systems. Our team combines engineering expertise with our core product, Tangram Pro, to arm customers with customized toolkits for meeting mission needs. Headquartered in Dayton, Ohio, home of Orville and Wilbur Wright, Tangram Flex shares a love for defense innovation.

Learn more about how we can tackle your technical of software integration challenges at **tangramflex.com**.



¹ https://www.af.mil/Portals/1/documents/csaf/CSAF_22/CSAF_22_Strategic_Approach_Accelerate_Change_or_Lose_31_Aug_2020.pdf