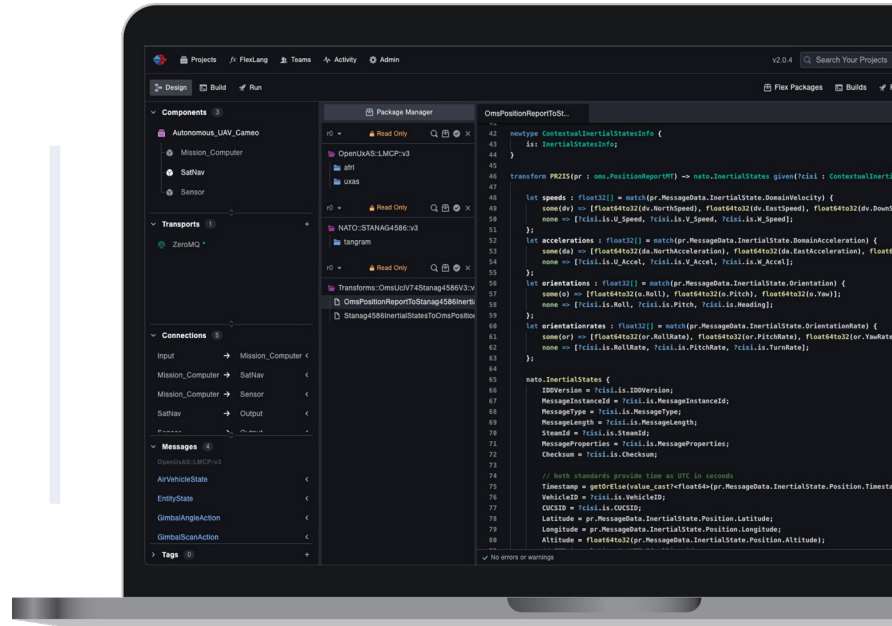# Why Flex?

Technical White Paper

2023

TANGRAMFLEX

Tangram Flex Overview

Tangram Flex®, Inc. (Tangram) is a software integration company founded in 2018 as a spin-out of a Defense Advanced Research Projects Agency (DARPA) initiative. Tangram modernizes software engineering practices by enabling the defense market to design and integrate new capabilities into existing systems. Tangram solves integration and interoperability challenges using our software integration platform, Tangram Pro®, and our hands-on engineering expertise.

Tangram Pro is a collaborative software design, development, and verification platform that provides scalable solutions to build and update mission-critical systems. Tangram enables the defense market to adapt and modernize legacy systems to meet evolving mission requirements for continued interoperability.
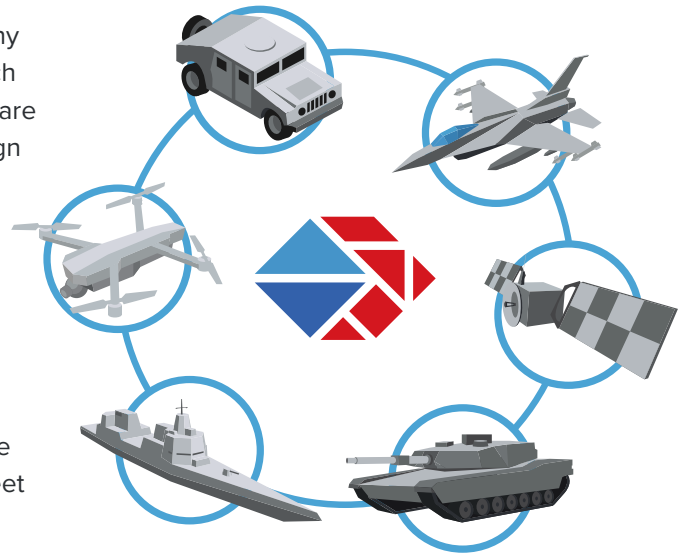
Foundations

Trust in Integration is Critical for Today's Mission

Trusted communication interfaces and adapters are critical to predictable and secure system behavior.

The Department of Defense (DoD) uses systems and subsystems developed by multiple vendors using different standards. DARPA recognized translation challenges and initiated two programs to explore the art of the possible:

1 System of Systems Integration Technology and Experimentation (SoSITE) demonstrated that computer-generated translation code can connect components to achieve new capabilities. (**SoSITE**).

2 High Assurance Cyber Military Systems (HACMS) demonstrated that using mathematical techniques to separate components and generate interface code transforms the cybersecurity posture of military systems. (**HACMS**).

> ## SoSITE and HACMS blazed the trail to show how rapidly technologies can integrate without compromising security

Tangram's mission is to bring HACMS-like trust to SoSITE-like integration capabilities. Our engineers developed the Tangram Pro software integration platform to realize this vision.

The Approach: Integration and Interoperability through Flex

Using Software to Connect Components

Flex is a specification language that identifies data format and provides translations between software components within a system. Flex enables precise definitions of the software interfaces, including logical assertions, requirements, and constraints. Since different components are likely to communicate using other formats, protocols, or standards, Flex also enables message translations to be defined between component software interfaces.

Flex provides a unique solution to interoperability challenges. It enables disparate system components to communicate and translate messages between different data formats.

Flex is compliant with Modular Open System Architecture (MOSA) standards. It improves the developer experience for engineers creating component software interfaces and adapters while instilling confidence that the code is correct and operational.
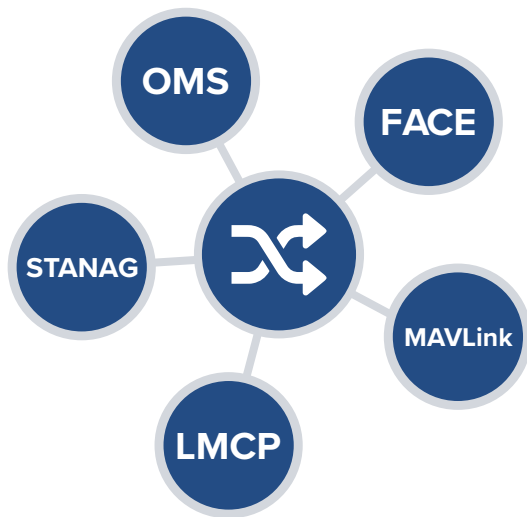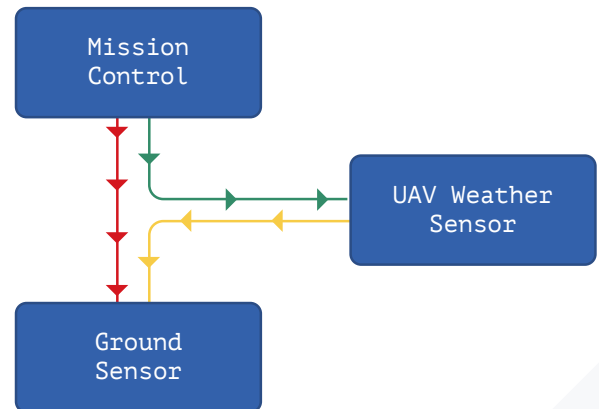
Flex in Today's World

Systems engineers design mission-critical systems based on how the system needs to operate. The systems engineer delivers these requirements to software developers who build the code to implement the system. As these developers create their code, they must collaborate with the systems engineers to establish alignment with standards and evolving requirements.

Most mission-critical systems use both C and C++ programming languages, and Tangram designed Flex with developer who understands those fundamentals in mind. Anyone with a background in C languages or Java can quickly pick up writing with Flex and ensure it is human-readable when developing or outputting solutions.

A "transpiler" is a tool that generates source code from specifications or source code in another language. The Flex transpiler inputs Flex specifications and generates C++, Java, Rust, or MISRA-C compliant code. Flex can add additional source languages as required. This allows a software engineer to meet evolving mission standards while ensuring that the translations between source code variations are confidently output as desired.

When Flex auto-generates component software interfaces and adapters, it provides interfaces to many different open system standards, and all output files are user-owned. Flex is a key enabler of the MOSA mandate because it quickly generates adapters between non-compliant standards and message sets using the transform functions and provides users with confidence that their solutions are correct.

Confidence By Design

Though subtle, coding errors lead to disastrous results and take months to correct. We've designed Flex to automatically implement mathematical principles to reduce manual errors, improve code outputs, and test throughout the software lifecycle development process.

Flex looks like code, but it is a precise specification language adhering to mathematical principles

Flex specifications are mathematically precise and unchanging. This means that given the same input, Flex will always result in the same code generation output.

Flex and the code auto-generated from the specification are amenable to different analysis techniques, from automated test generation to formal methods.

Flex is independent of execution speed, time, source code, compiler, or computer architecture, enabling it to have more freedom in the kinds of optimizations it can perform.

Flex is ideally suited for rigorous testing and validation protocols because component software interfaces and adapters designed in Flex produce the same result repeatedly.

Summary

Systems engineers and software developers must have confidence in mission-critical systems. Tangram developed the Flex language to merge integration and assurance capabilities for the warfighter. Flex's modularity enables access to the latest innovation and substantially reduces the time from development to fielding.