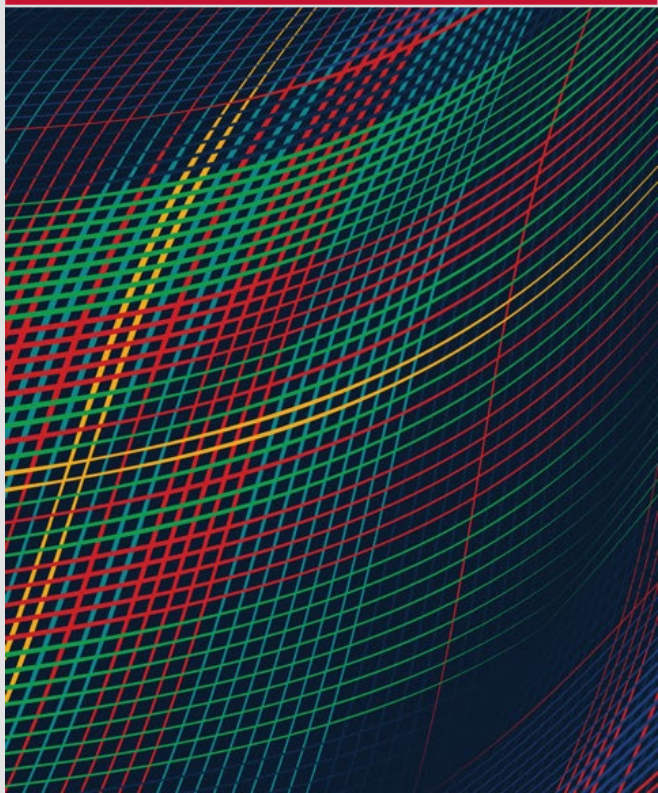
Carnegie Mellon University
Software Engineering Institute

# Why Do We Have an Edge Computing Challenge in the DoD?
# -or-
# Computing at the Edge; Painting it Green

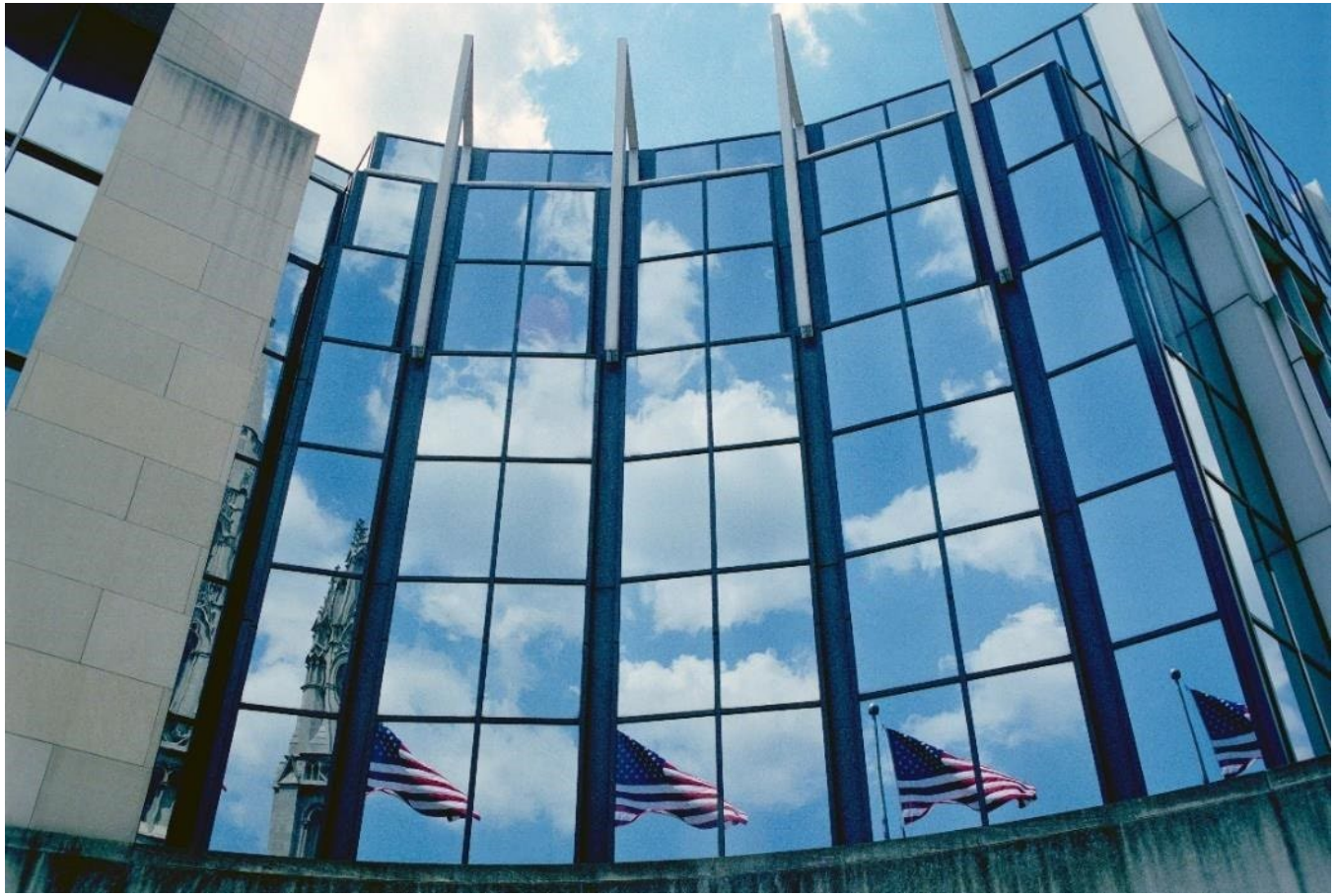


**NOVEMBER 30, 2022**

Thomas Longstaff
CTO

# CMU SEI is a DoD R&D Federally Funded Research and Development Center

Carnegie Mellon University Software Engineering Institute



- Established in 1984 at Carnegie Mellon University
- Charged to improve the state of the practice of software engineering and cybersecurity
- Added AI Engineering in 2018
- Collaborates with CMU and broadly in academia, government, and industry
- Capable of conducting both fundamental research and classified work
- Offices in Pittsburgh and DC, with locations near customer facilities in MA, TX, and CA

# Our Expertise: Assure Secure, Affordable, Rapidly Delivered, and Innovative Software

Carnegie Mellon University Software Engineering Institute

**Bring Capabilities** that make new missions possible or improve the likelihood of success of existing ones

**Be Trustworthy** in construction, correct in implementation, and resilient in the face of operational uncertainties

**Be Timely** so that the cadence of fielding is responsive to and anticipatory of the operational tempo of the warfighter

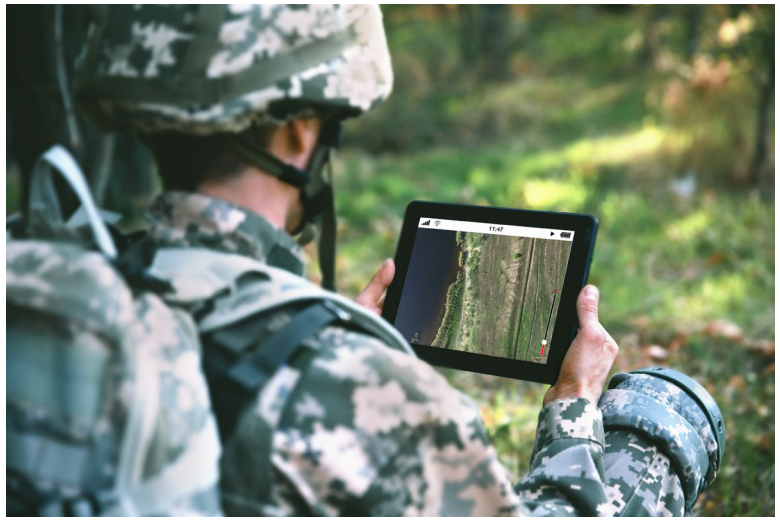
**Be Affordable** such that the cost of acquisition and operations, despite increased capability, is reduced and predictable

Carnegie Mellon University
Software Engineering Institute

# Need: Increased Capabilities Beyond Those in Commercial Technology

# Need: Development and Delivery Matched to Operational Tempo

# Need: Robust and Resilient Solutions



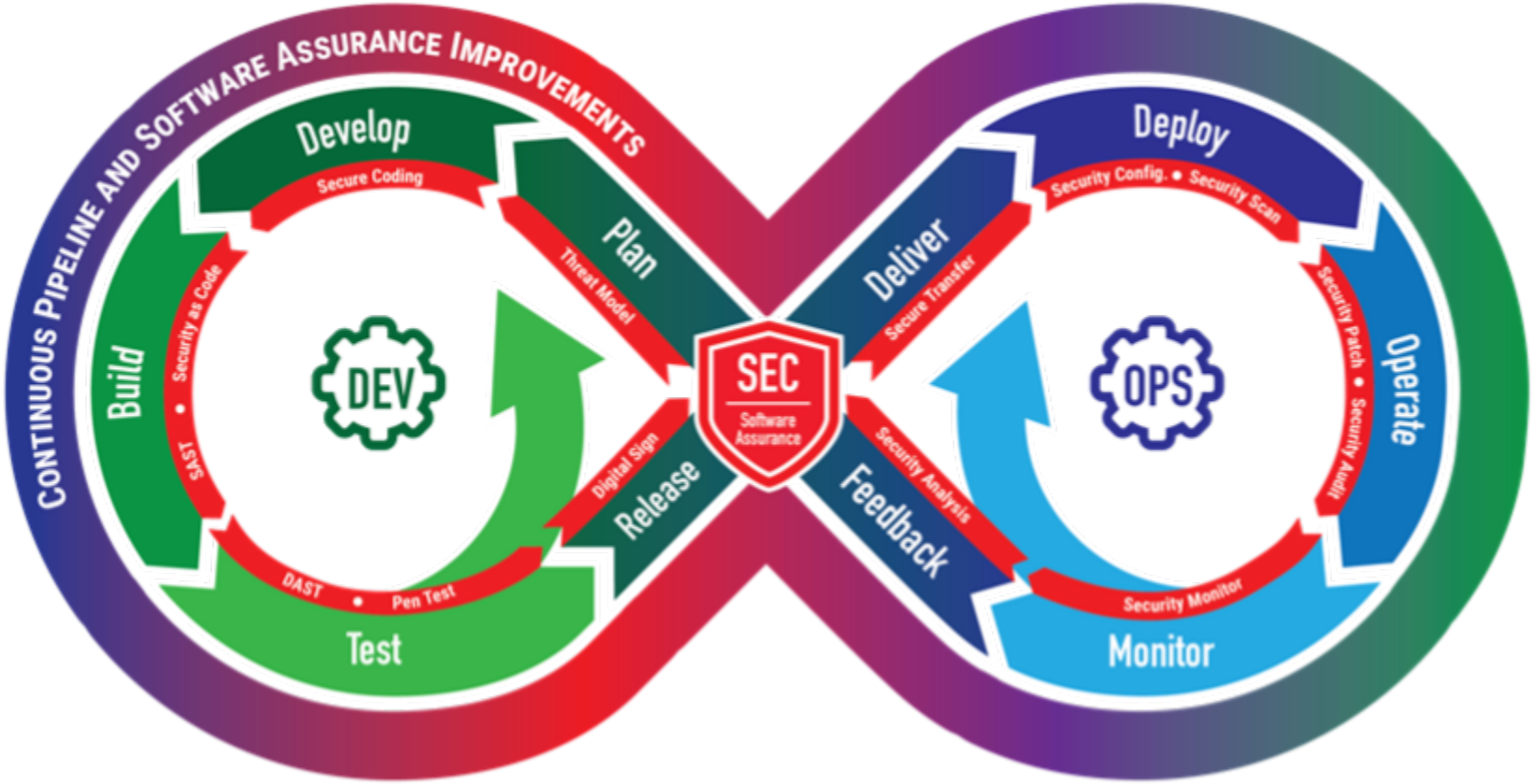
Carnegie Mellon University Software Engineering Institute

"The threats the U.S. faces change rapidly, and DoD's ability to adapt and respond is now determined by its **ability to develop and deploy software to the field**."

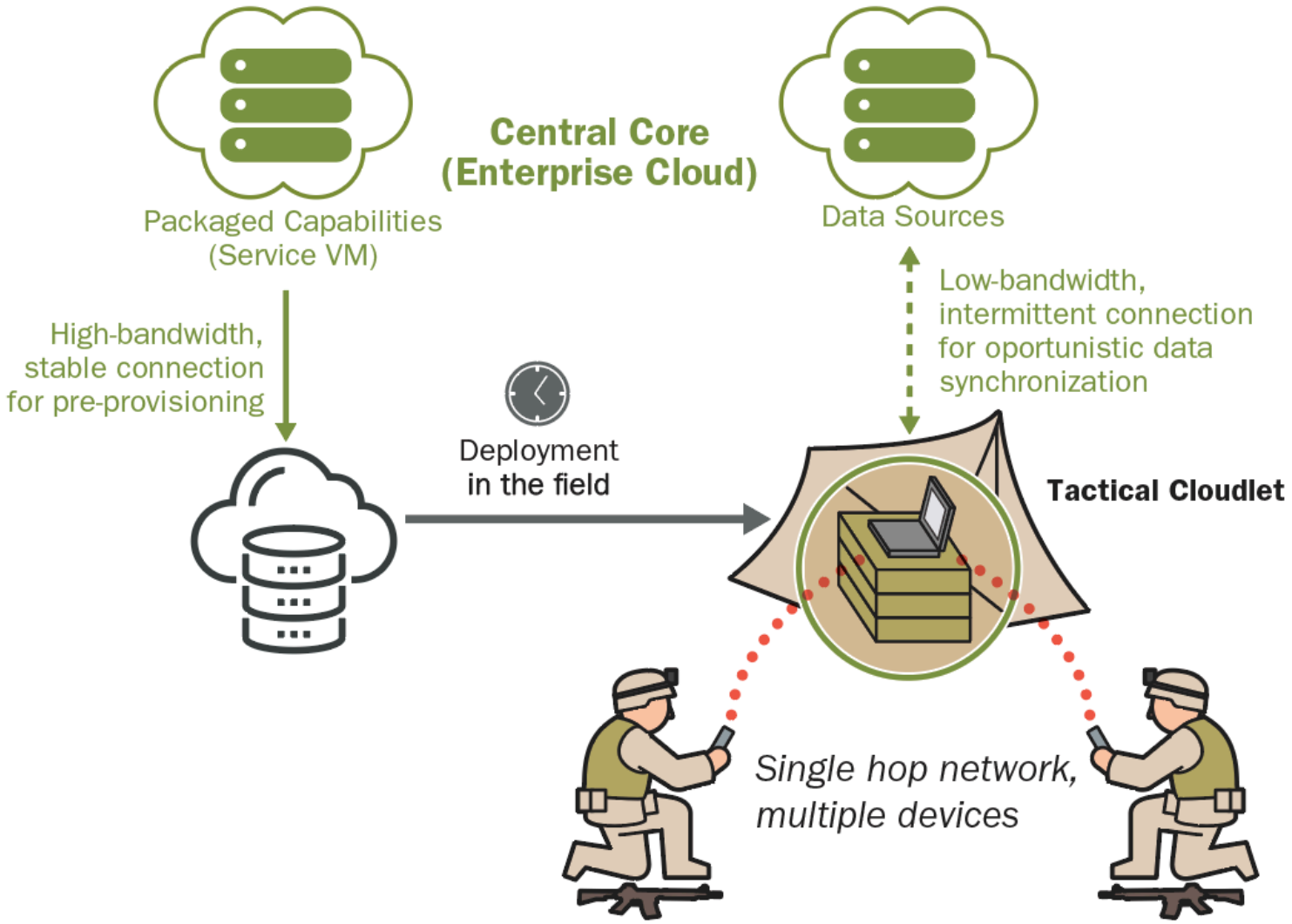
- *Software Acquisition & Practices Study*

https://innovation.defense.gov/software/#:~:text=Software%20Acquisition%20and%20Practices%20%28SWAP%29%20Study

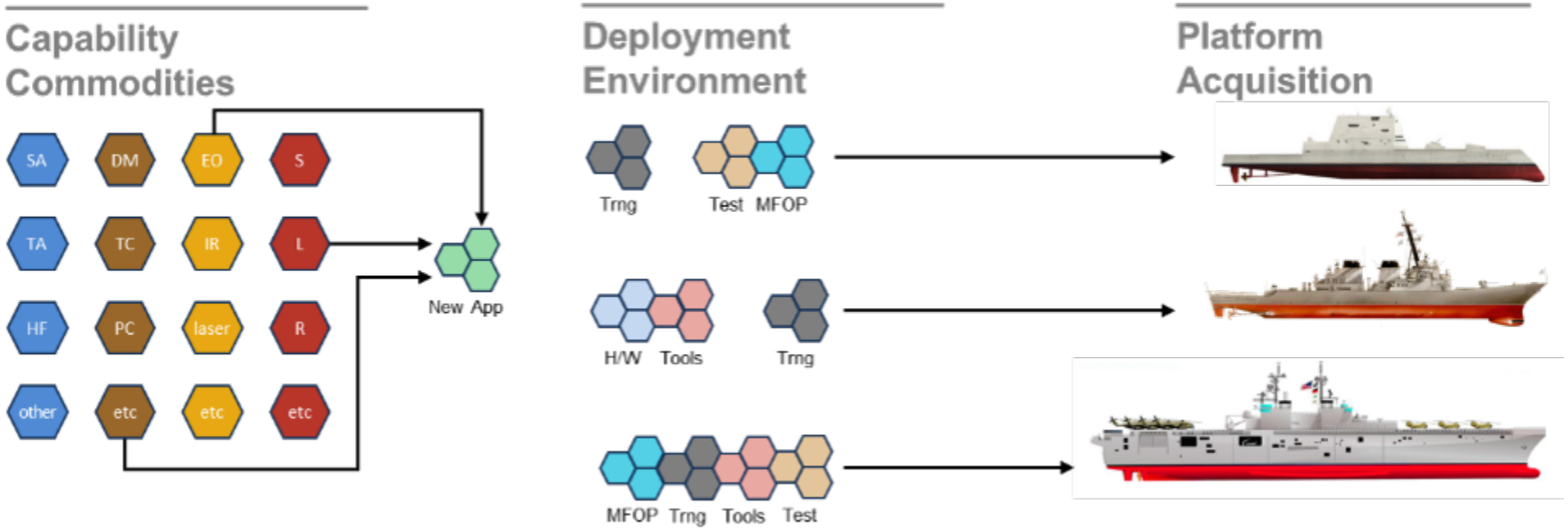
# Deploy Rapidly and Flexibly and Extend DevSecOps Infrastructure to the Field



# Improve Capability at the Edge in Near Real Time



# Opt for Modular Over Bespoke Design

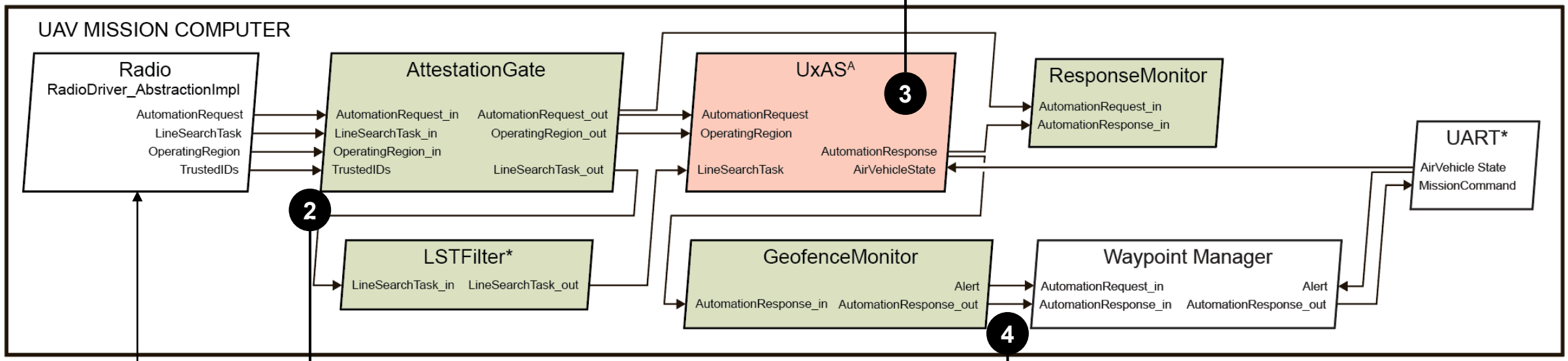


# Pay Attention to Architecture Seams

Carnegie Mellon University Software Engineering Institute

Trojans added to UxAS PlanBuilderService, replacing AutomationResponse with plan that violates KeepOutZone

Autonomous Mission Planner




Sends automation request

GND STN

1

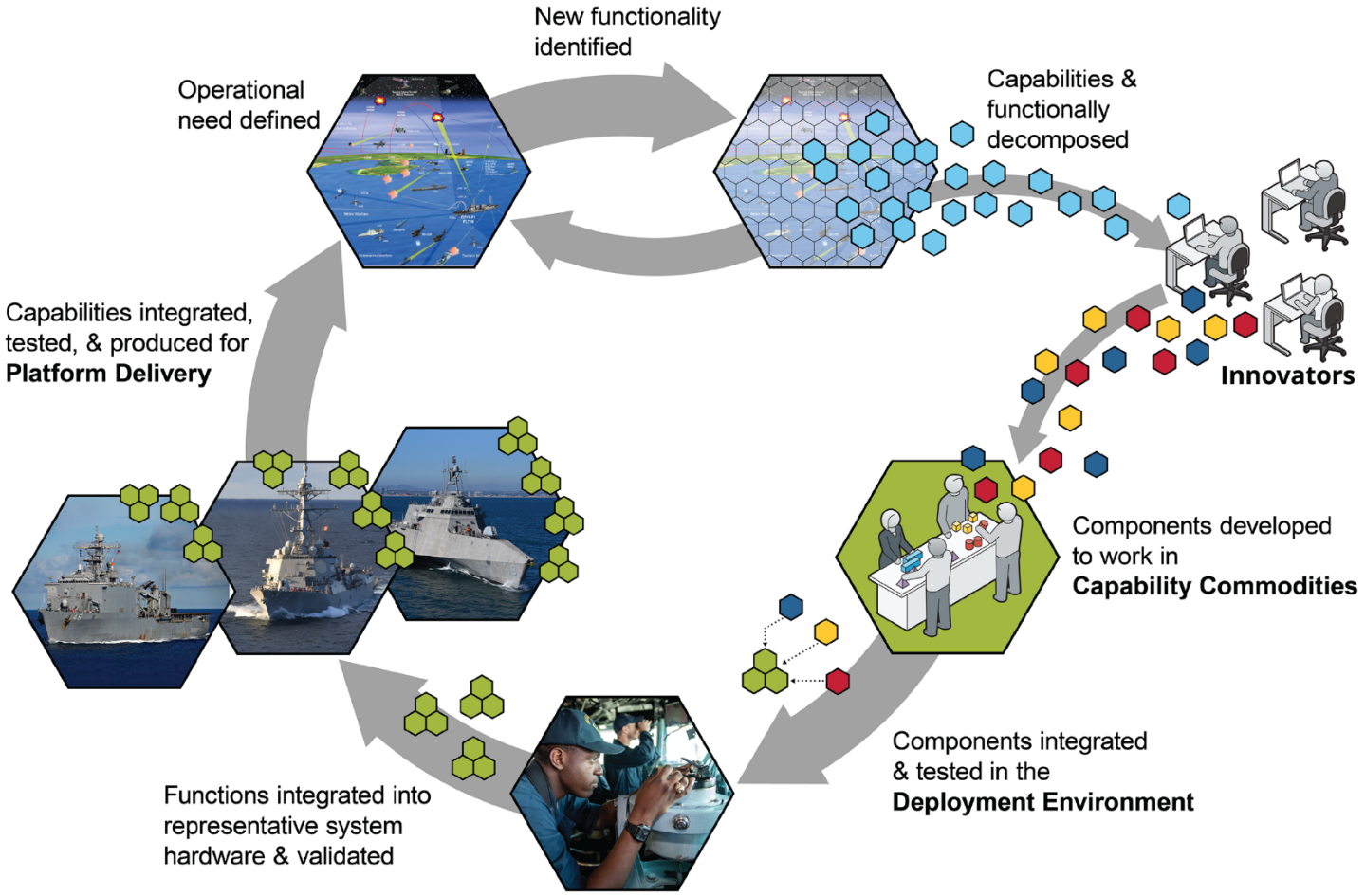
Code added to ground station:
Software to generate malicious requests

Remote attestation measures ground station software and detects modified code. Malformed messages blocked by high-assurance filter.

High-assurance geofence monitor detects plan that violates processor KeepOutZone and sends alert to WaypointManager to trigger return to base

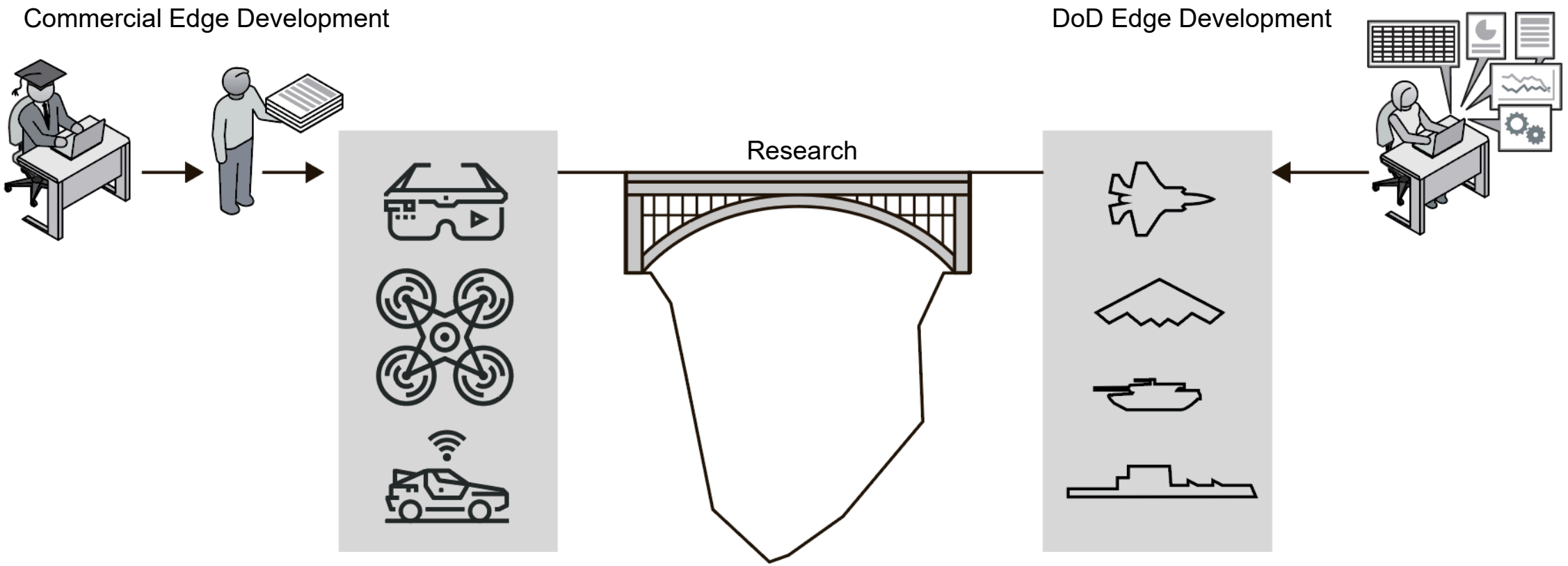
Source: Cyber Assured Systems Engineering with AADL, 2022 AADL User Days

# Move Research into Deployment, with Operational Feedback




Virtuous Cycle of Rapid Feedback for Capability Integration and Deployment

# Paint it Green: DoD Software Acquisition for the Edge



Carnegie Mellon University
Software Engineering Institute



This material is based upon work funded and supported by the Department of Defense under Contract No. FA8702-15-D-0002 with Carnegie Mellon University for the operation of the Software Engineering Institute, a federally funded research and development center.



DM22-1127