Resilient, adaptable, and secure systems

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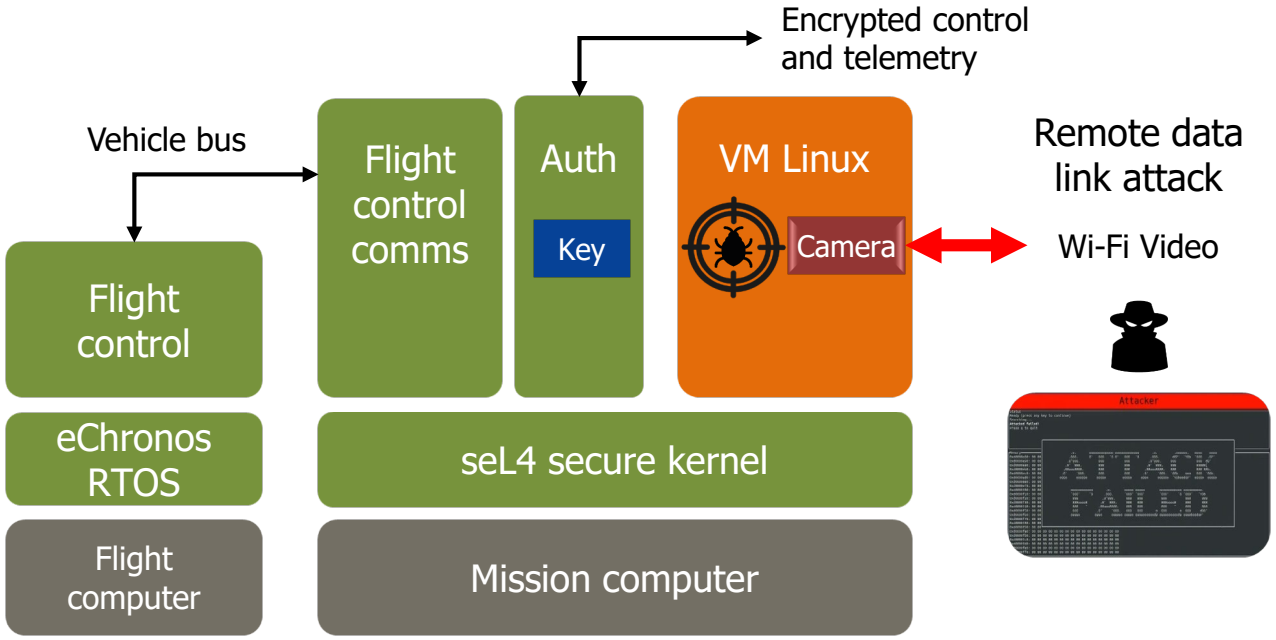
Formal methods can work

High Assurance Cyber Military Systems (HACMS)

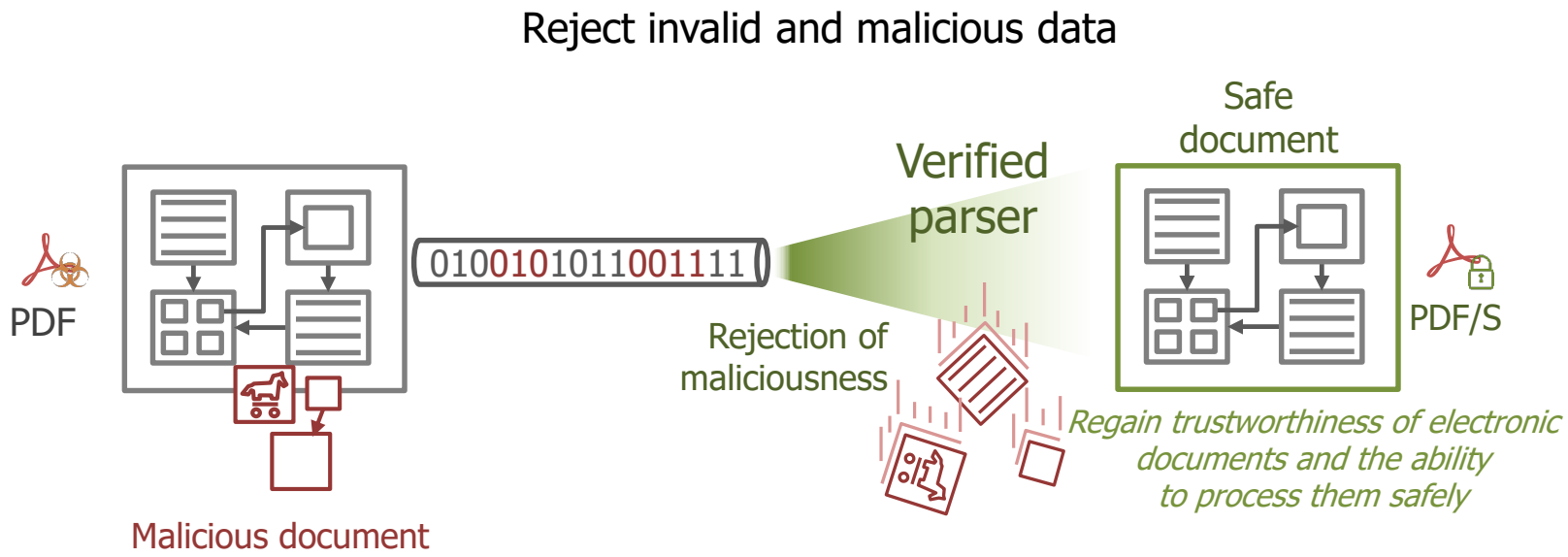
Skilled red teams were unable to compromise HACMS hardened platform



- Inserted mathematically-analyzed secure software kernel underneath mission computer software
- Added secure components to replace security-critical elements of the existing Unmanned Little Bird software

Verified secure Boeing Unmanned Little Bird

Ingesting data safely

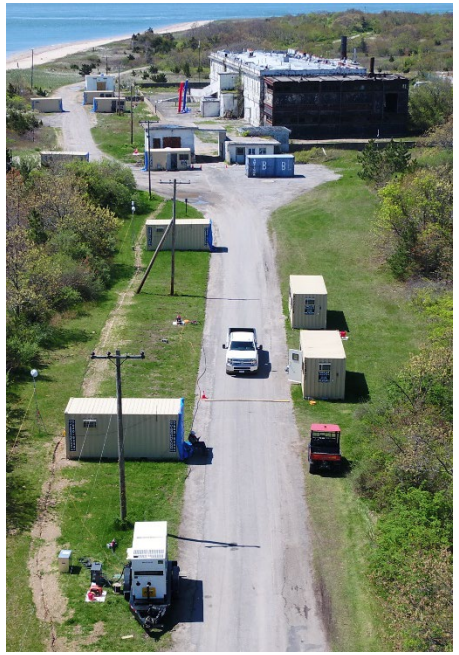


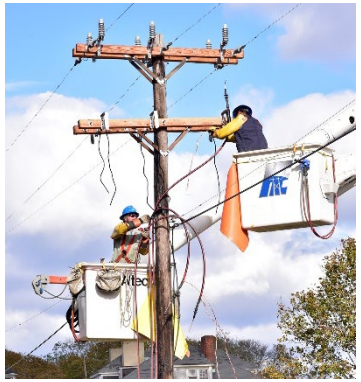
Safe Documents (SafeDocs)

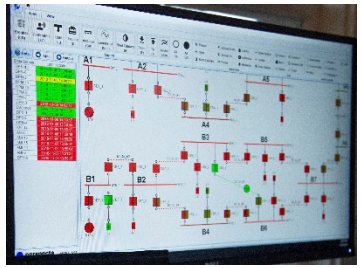
Accomplishments

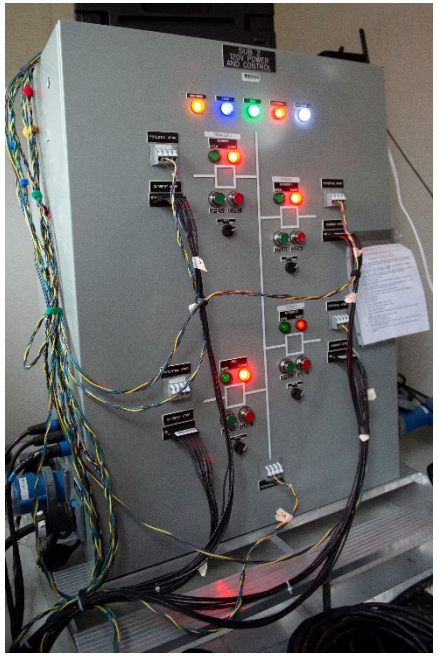
- Developed machine-readable descriptions and secure parsers for National Imagery Transmission Format (NITF), core structure of PDF, Air Vehicle Standard Interface (AVSI), Micro Air Vehicle Link (MAVLink)
- Developed tools to classify complex data objects as malicious or have violated standards
- Standards organization accepted 100 disambiguating edits into the ISO 32000-2 (PDF 2.0) International Standard
- Discovered a zero-day vulnerability in PDF digital signature handling across numerous workflow implementations

Black-start recovery of the electric power grid during a cyber attack

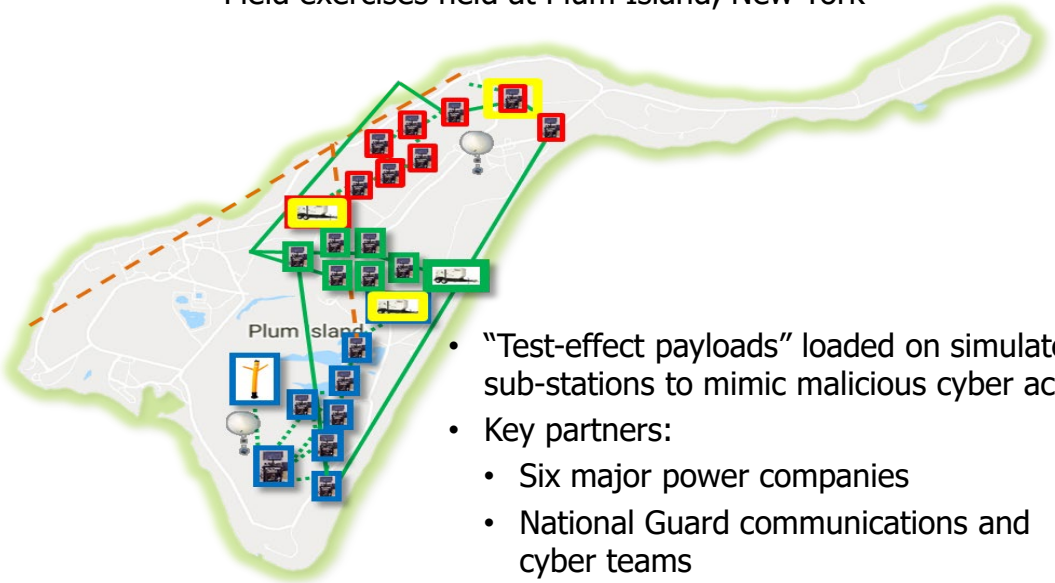








Field exercises held at Plum Island, New York



- "Test-effect payloads" loaded on simulated sub-stations to mimic malicious cyber actors
- Key partners:
  - Six major power companies
  - National Guard communications and cyber teams
  - Department of Energy
    - Liberty Eclipse partner

Rapid Attack Detection, Isolation and Characterization Systems (RADICS)

Accomplishments

- Developed grid sensing tools to identify cyber attacks
- Demonstrated isolation of compromised communication channels and nodes
- Developed secure emergency network communications
- Demonstrated a cyber weapon hunting system integrating traffic analysis, SCADA and IT protocol inspection, telemetry power reasoning, device configuration inspection, binary code behavior analysis, and RF emanation anomaly detection
- Demonstrated remote forensic analysis capability to analyze relays, energy controllers and networks

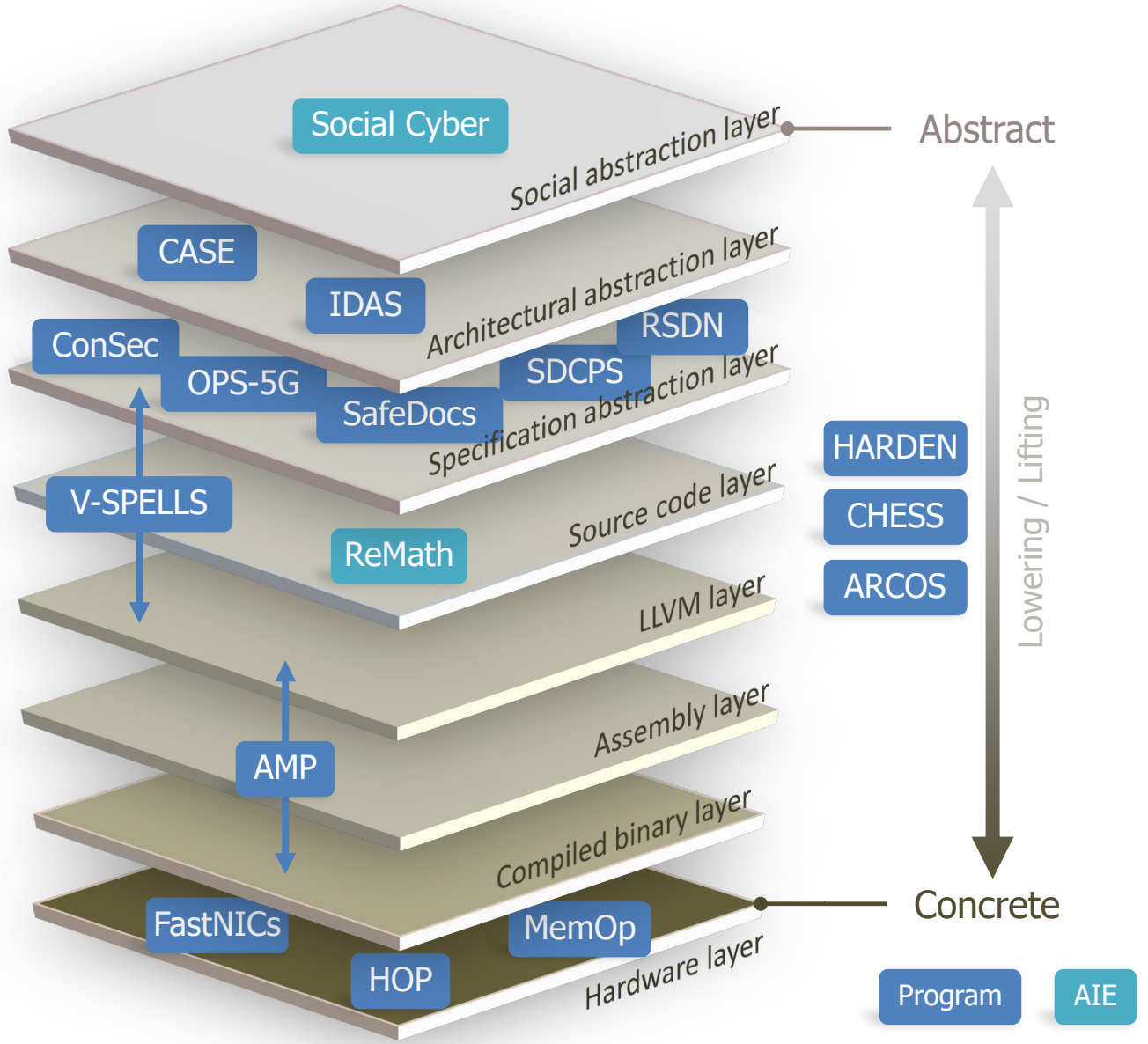
Resilient, adaptable, and secure systems

Goal

- Reduce our attack surface
- Enable faster development and deployment of high-quality software systems

Approach

- Build our systems with proofs of correctness
  - Verify properties using formal methods and models
- Develop high-assurance computing architectures
- Leverage AI/ML to scale faster
- Track software origins and create transparency
  - Enable information integrity via data provenance
  - Mine binaries, legacy code, and social forums
- Continuously collect artifact-based evidence for assured test & evaluation and certification



AMP: Assured Micropatching
ARCOS: Automated Rapid Certification Of Software
CHESS: Computers and Humans Exploring Software Security
ConSec: Configuration Security
CASE: Cyber Assured Systems Engineering
FastNICs: Fast Network Interface Cards
HARDEN: Hardening Development Toolchains against Emergent Execution Engines
HOP: Hardware Optimization
IDAS: Intent-Defined Adaptive Software

MemOp: Memory Optimization
OPS-5G: Open, Programmable, Secure 5G
ReMath: Recovery of Symbolic Mathematics from Code
RSDN: Resilient Supply-and-Demand Networks
SafeDocs: Safe Documents
SDCPS: Symbiotic Design for Cyber Physical Systems
Social Code: Hybrid AI to Protect Integrity of Open Source Code
V-SPELLS: Verified Security and Performance Enhancement of Large Legacy Software