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Agile Condor: Scalable High Performance Embedded Computing Architecture

September 2015

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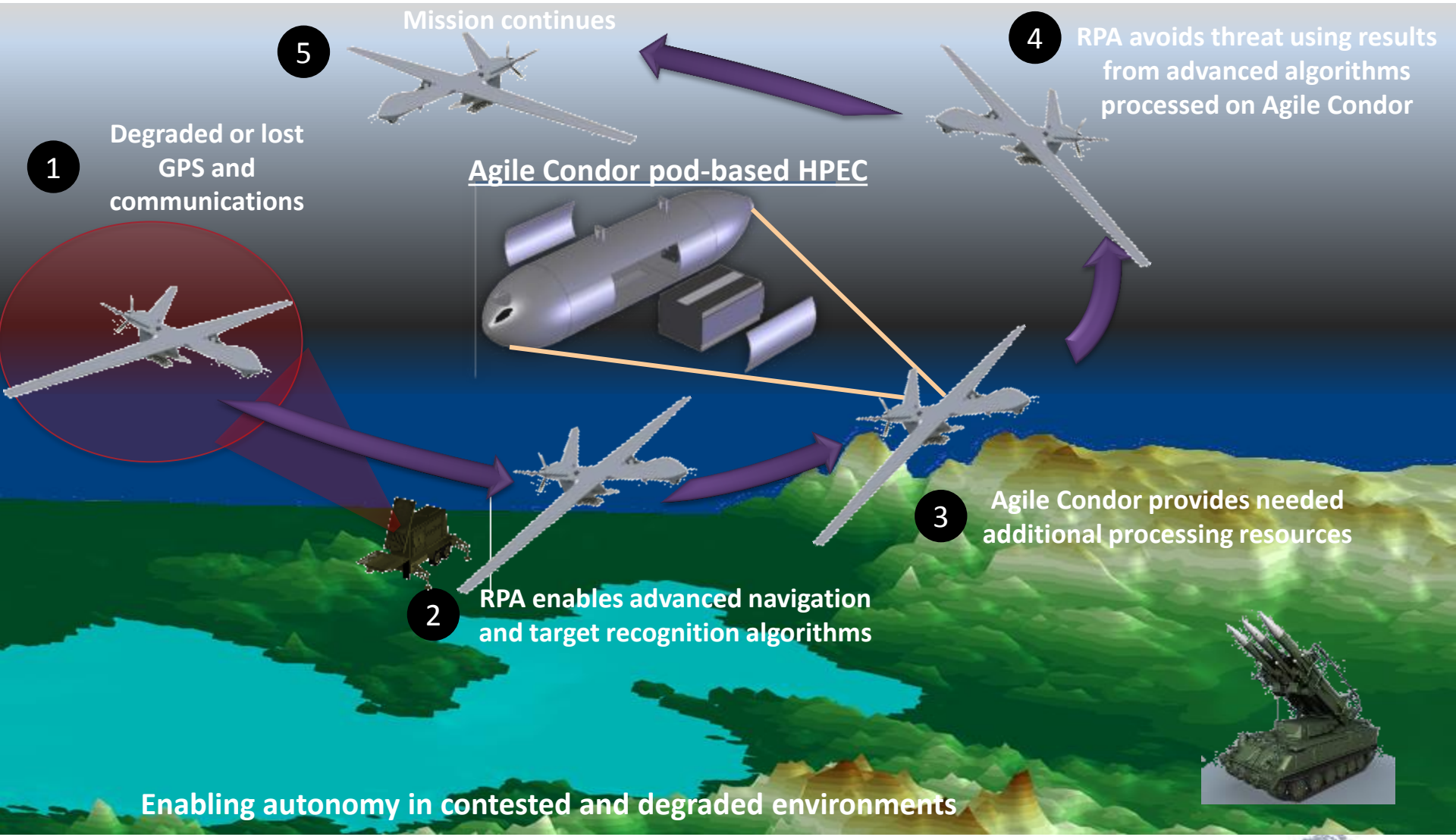
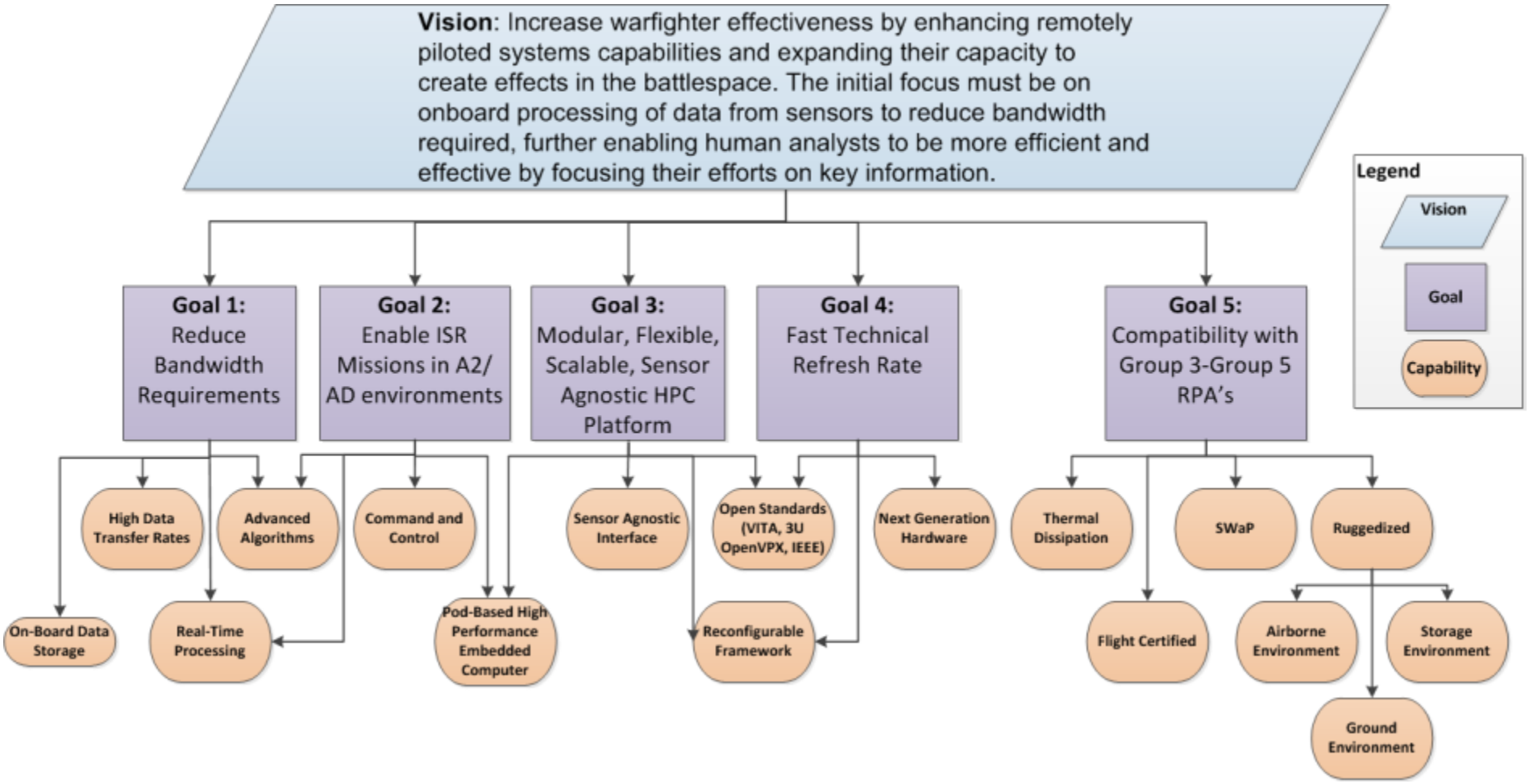
AGILE CONDOR
Agenda

- CONOPS- Why Agile Condor?
- System Overview
- Pod and Chassis Design
- Scalability of the system
- AirWASP Processing Framework
- Future Work
- Summary

AGILE CONDOR Operations Concept

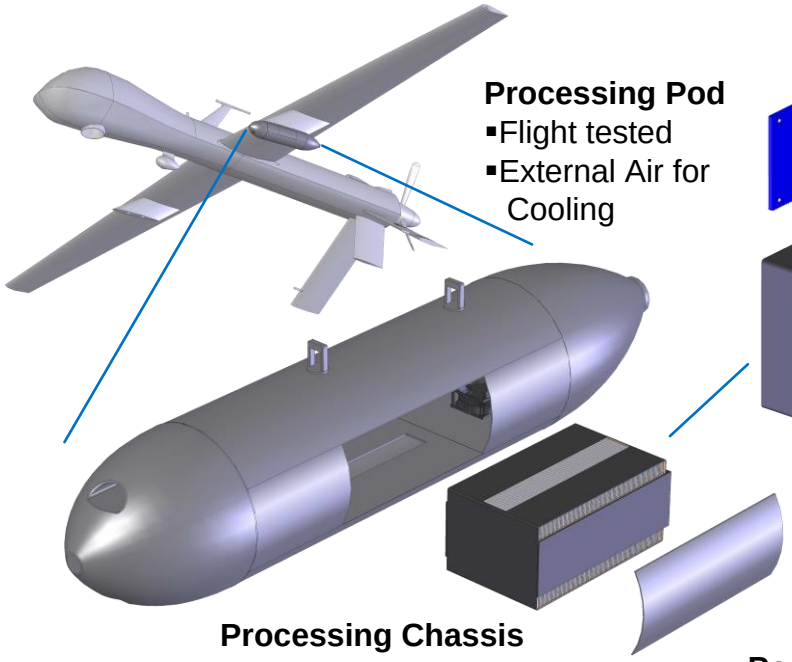


AGILE CONDOR Capability Vision



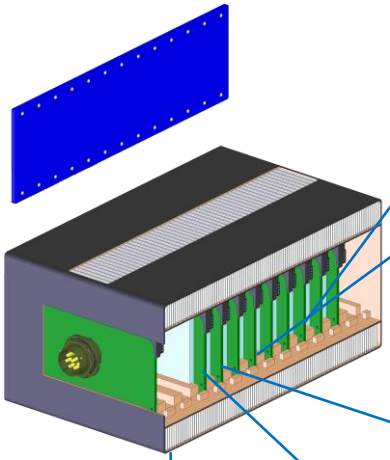
AGILE CONDOR System Overview

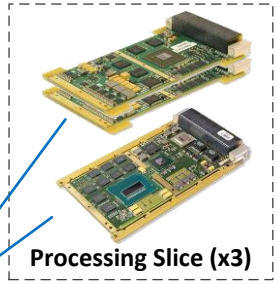
3U VPX Backplane
- Design considerations for OpenVPX
- High speed PCIe data plane



Processing Pod
- Flight tested
- External Air for Cooling

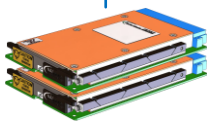
Processing Chassis
- Conduction Cooled 3U VPX
- Environmentally Sealed



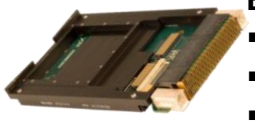


SBC / GPU (x2) per slice
- Latest generation Intel i7
- Latest generation mobile 'Kepler' GPU
- 1096 GOps x2
- COTS Upgradable

PEX431
- PCIe switch base card



Power Supply
- 800 Watts
- Smart Monitoring

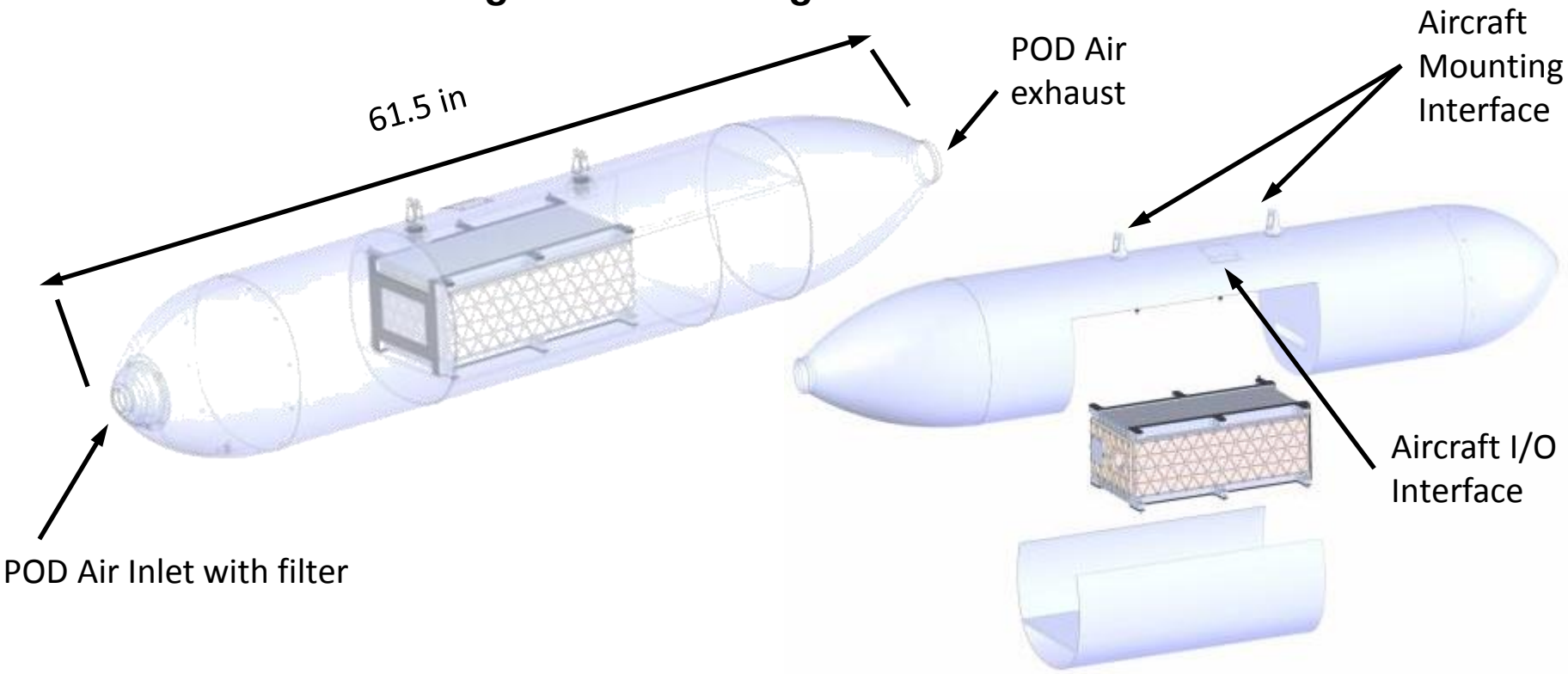


Expansion Slots / Mezzanines
- 10Gbase-T
- 16Gbps Application Specific IO
- Support for fiber optic links
- FPGA option for pre-processing

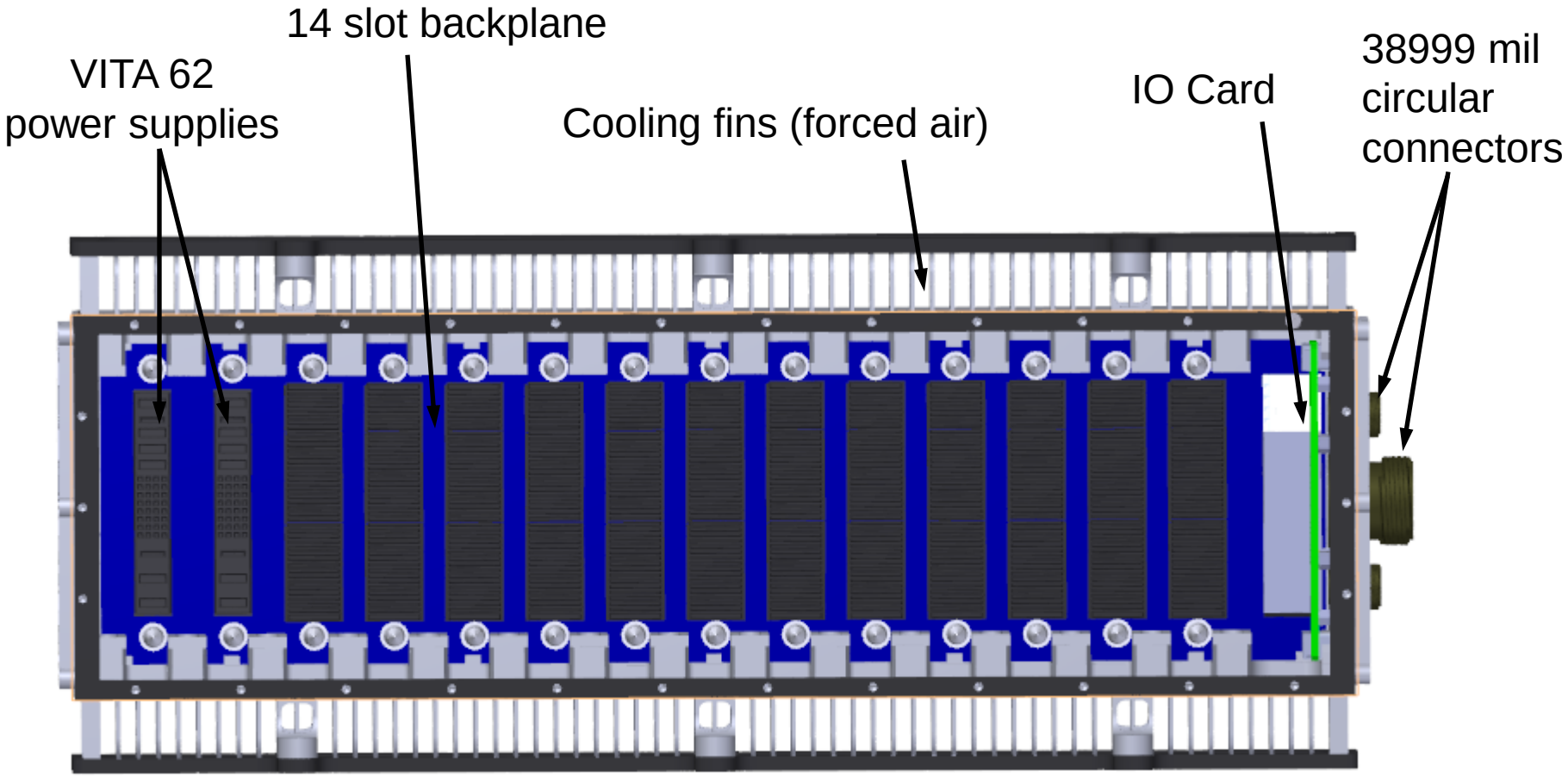
Agile Condor brings distributed high-performance computing closer to the sensor

AGILE CONDOR POD & Chassis

- **Existing pod baseline flight certified**
- **MIL-STD-8591 design for aircraft interface and aerodynamics**
- **Ambient air cooling thermal management**



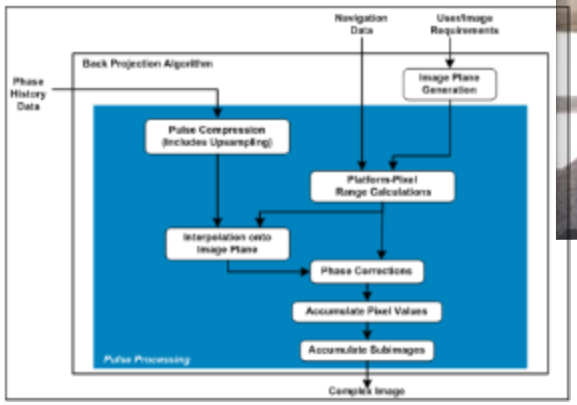
AGILE CONDOR Chassis Details



14 slot, 3U, VPX Conduction Cooled Chassis

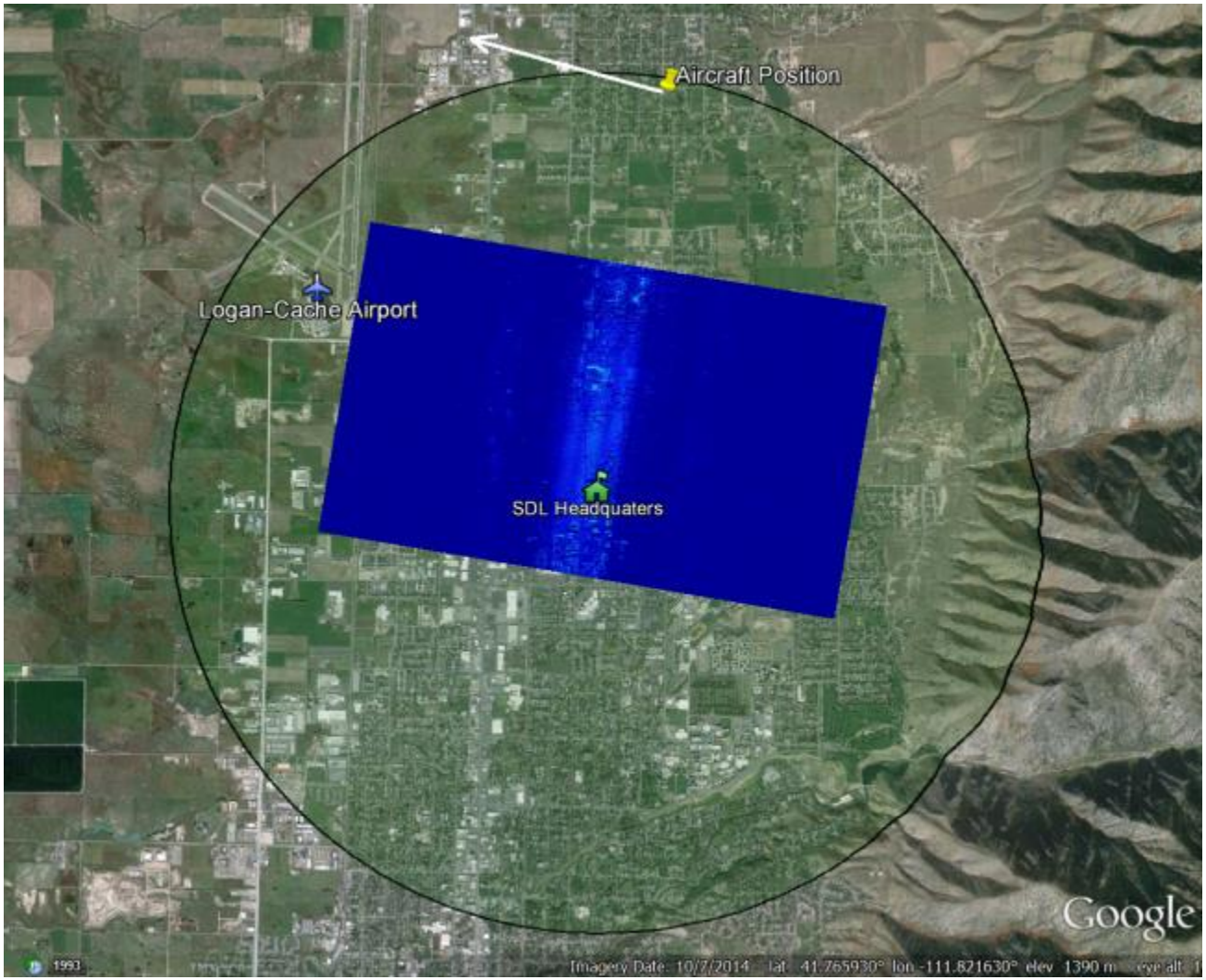
Embedded HPC 2015 Flight Test

- **Embedded real-time experiments**
  - AirWASP
    - FY15 Flight tests (July 2015, Utah)
    - 18Tflops – 1400W

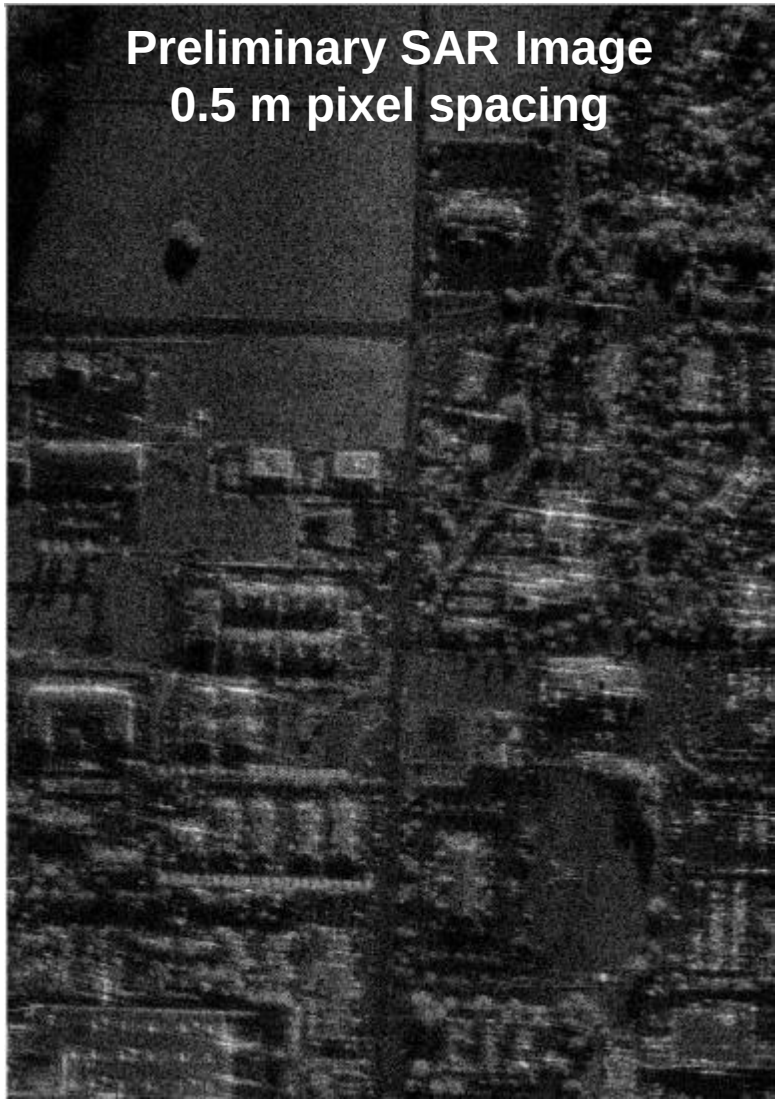


Embedded HPC 2015 Flight Test

Range-Doppler Plot – Flight 1, Orbit 4, Dwell 1609

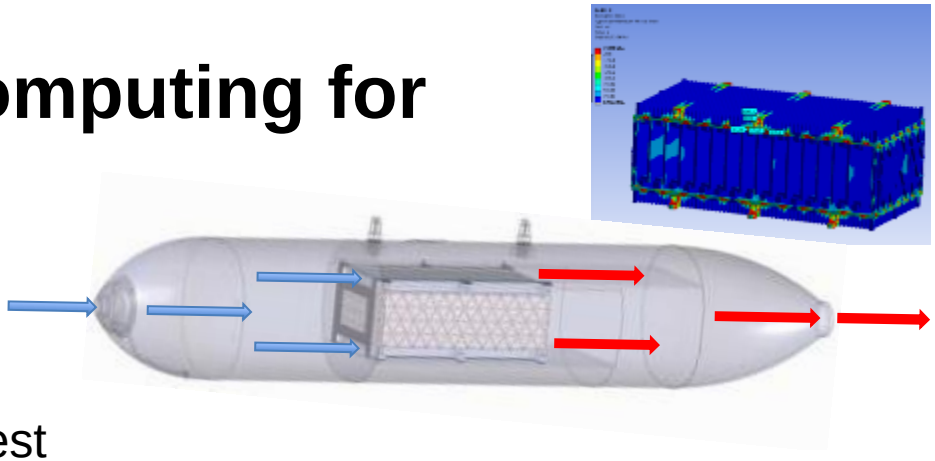


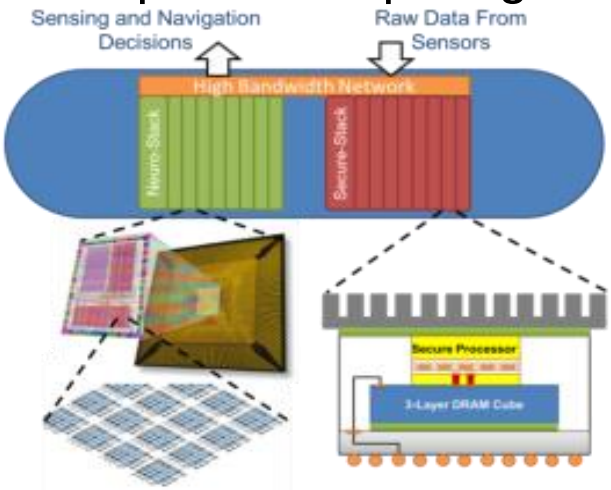
Embedded HPC 2015 Flight Test



Future Work

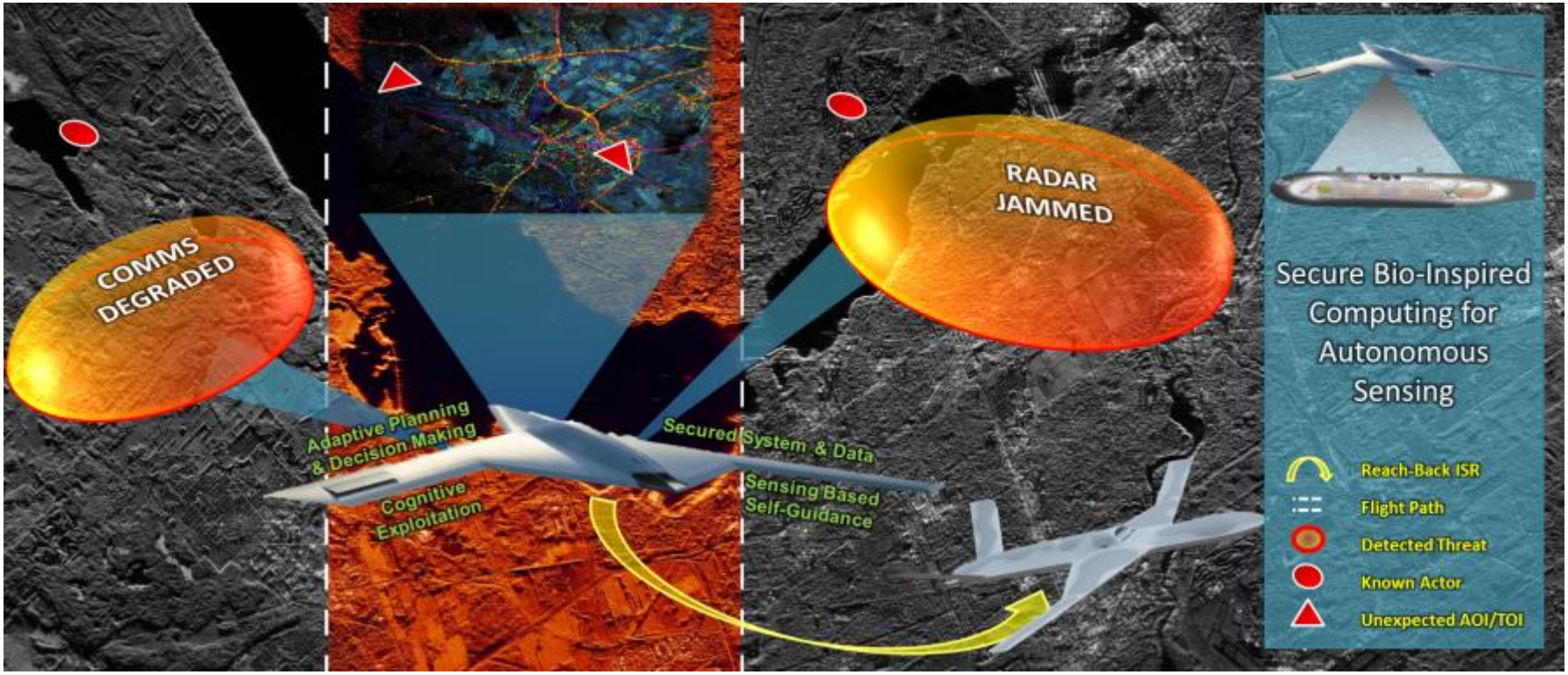
- **Onboard embedded computing for Autonomous Sensing**
  - FY16 Embedded HPC Pod
    - 5-10 Tflops ~ 400 W
    - October 2016 Planned Flight Test
  - FY18 Secure Processor & Bio-Inspired Computing





The Agile Condor form factor, power, weight, environmental, and thermal management capability will support Group 3 (e.g. RQ-7 Shadow) to Group 5 (e.g. MQ-9 Reaper) DoD UAS platforms.

Secure Bio-Inspired Computing



Challenges

- Degraded communication links
- Dynamic ISR situations
- Dynamic surface-to-air threats
- Targeted cyber attacks
- GPS jamming

R&D Needs

- Cognitive Exploitation
- Adaptive decision making
- Secured system and data
- Sensing-based self-guidance
- SWaP-efficient on-board comp.

Benefits

- Human-in-the-loop: high situational awareness and performance, reduced comm.
- Human-out-of-the-loop: continue ISR mission, survive unexpected threats.

AGILE CONDOR Summary

- Leader in Embedded HPC technologies
  - First Embedded HPC POD based system (SRC-AFRL, Patent Pending)
  - 5-10 Tflops (400-500 Watts)
- Embedded HPC Flight Tests
  - Provide realistic environment and integration challenges
- Secure Bio-Inspired Computing CRDF
  - 17 TrueNorth small factor boards (Oct-Nov 2015)
  - Increased processing capability (100-1000x) in size, weight and power constrained applications
- Greater system resilience, adaptability, autonomy and intelligence

Questions?