Simulation and Modeling Concepts for Secure Airspace Operations

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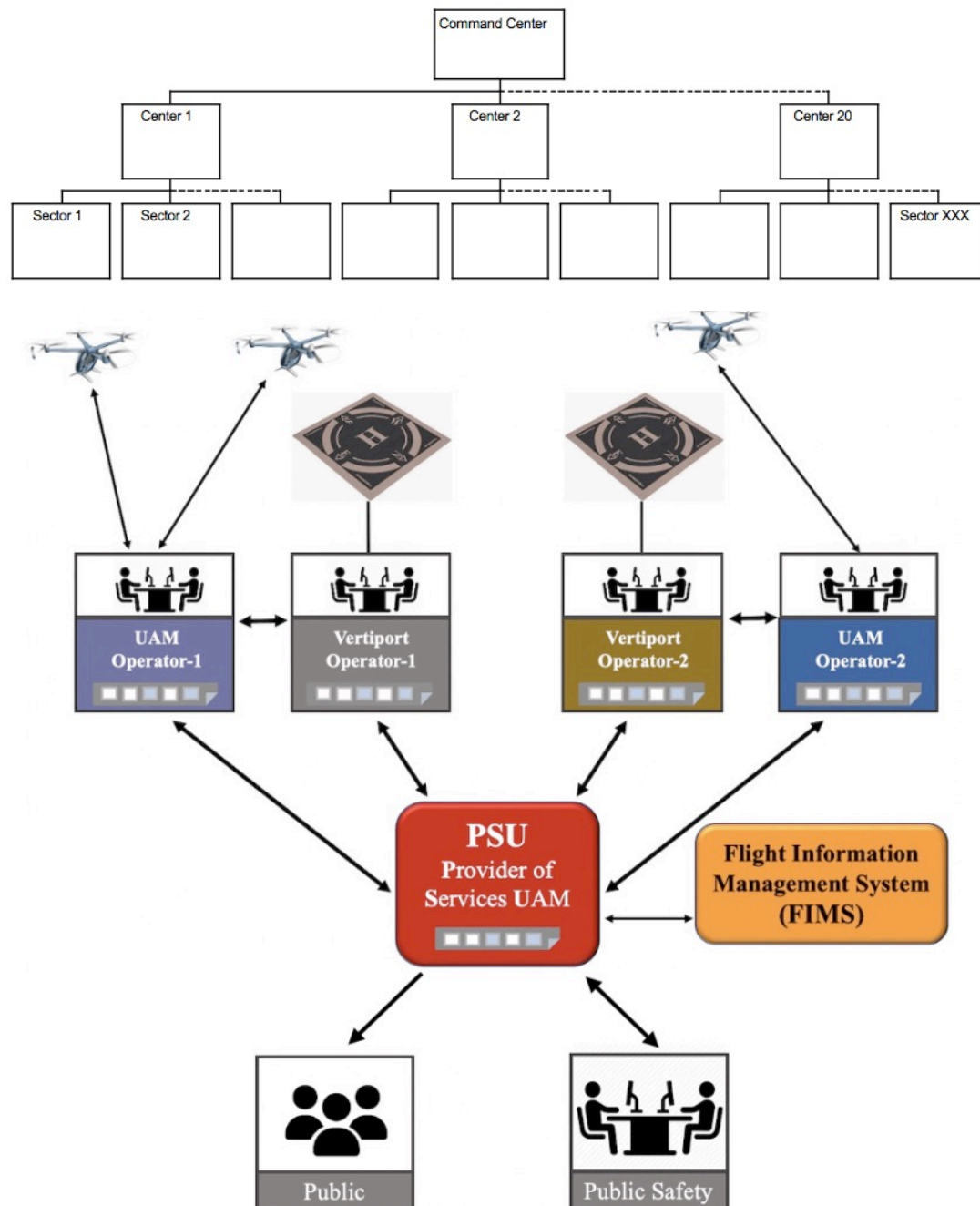NSF-PIRE Workshop : US-Germany CPS Collaborations

Assured CPS Autonomy for 3d Urban Transportation:
Drones, Flying Cars and Beyond

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Urban Air Mobility (UAM)

Air Traffic Management (ATM) and UAM

- ATM is a hierarchical system with a centralized control and limited automation
- UAM is a distributed system, managed by multiple service providers, with evolving levels of automation with ATM functions provided as a service

Security Issues in Mobile Networks

- Wireless technology expected to be ubiquitous in UAM
  - ADS-B, GPS, 4G and 5G networks
  - 5G networks needed to support data exchange between vehicles
  - Some 5G technologies support mission critical activities with a latency of less than 5ms and 99.999% availability
- Current ATM: closed, regulated and operated by a single entity
- Data broadcast presents trade-offs between scale, latency and security in UAM applications
- Impact of security issues increase with higher levels of automation as the need for data exchange grows

Traffic levels and complexity

- Separation in a stream maintained by vehicles staying within their block

- If the blocks of aircraft in two different streams interact
  - X_A listens to verify all incoming messages, determine overlap, change its plan, generate and sign its broadcast
  - X_B reciprocates

- Amount of data transfer depends on the number of vertiports, traffic density and level of automation

- Creating scenarios to match maturity levels

  - 100 vehicles in level 4
  - 1000-10,000 and automation in levels 5-6
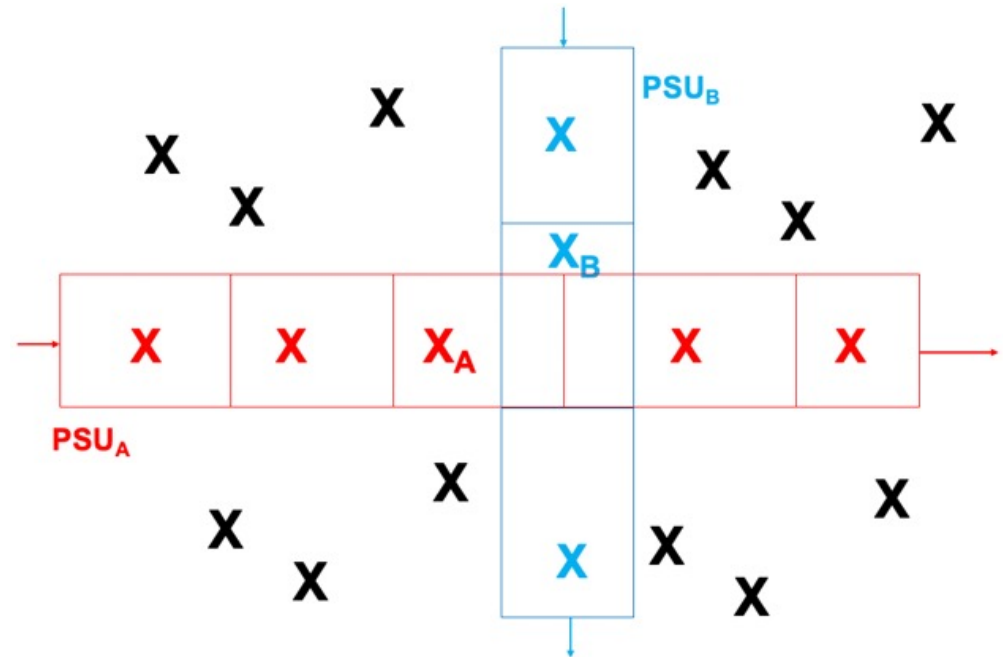
Concluding Remarks

- Cybersecurity like wind and weather is pervasive in all UAM operations
- Cybersecurity should be addressed at many different levels
  - Enterprise level, FAA, PSU, Vehicle, People
  - Level of security varies with the system risk associated with the function
- Proper mix of advances in Hardware and Software Technologies
  - Trusted Platform Module, Encryption Algorithms, Blockchain, Virtual Information Fabric Infrastructure, Anomaly detection
- Build extensible modeling capability to assess performance trade-offs in different UAM services to enable Secure Airspace Operations
  - Authentication to anomaly detection