Future Airspace Operations and Cyber Physical Security Considerations

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NASA's Airspace System Program is planning for an exciting new activity titled "*AutoMax.*" "Auto" refers to automation, autonomy, and autonomicity attributes and "Max" refers to maximizing the performance of future airspace operations.

Key goals of AutoMax are increased mobility, diversity of airspace use, affordability, efficiency, and scalability. The motivation of AutoMax is as follows:

1. The need to accommodate a wide range of airspace user preferences and allow for significant growth in passenger and cargo volume (such as 100X and beyond).
2. The need to include a wide range of future airspace users and vehicle classes and associated performance characteristics; in particular, the need to accommodate autonomous and non-autonomous operations.
3. The need to ensure global competitiveness for airspace users and service providers with highest possible productivity, to enable and sustain growth.
4. The need to manage the air transportation system so that it provides maximum efficiency and productivity, at best economic value to all users, while ensuring that the total cost of operations is affordable and sustainable.
5. The need to leverage advances in computing, software, and networking by developing air transportation service architectures that reduce duplication, reduce upgrade times, and accelerate transformation.
6. The need to accommodate/promote performance-based services. Allow third-party vendors to offer services that may enable fee-for-service applications.
7. The need for user networking/cloud-computing options to reduce duplication of data, information, processing, prediction among airspace users, and air navigation service providers.

The key metrics for AutoMax are generating more economic value from airspace use and reducing the total cost of operations, as well as enabling important new services that benefit the public, such as autonomous emergency services and transport in currently under-serviced areas.

It is expected that the vehicle mix (e.g., jet-stream wind mills, unmanned air vehicles, large aircraft, airship, balloons, commercial space launches) preferences, and complexity of operations will increase. This will generate a pressure to increase air transportation productivity, overall airspace efficiency, to maintain global competitiveness. Meeting the National Airspace System level goals of efficiency, throughput, capacity and individual user goals of mobility and flexibility will require higher levels of automation, autonomy, autonomicity and networking.

Given the dependence of future aviation operations on autonomy, automation, networking, and safety critical considerations, it is imperative that the required cyber physical system aspects be identified and incorporated in the design of future system. Further, government and non-government infrastructure may be used to leverage fee-for-service applications to increase efficiency of vehicle trajectories as well as air traffic management system. Such connection further requires CPS considerations and processes. One of the key items of research is prediction, detection, and mitigation of CPS event so that its influence does not impact the airspace and vehicle (e.g., UAV cargo delivery) operations.