

Future of Aerospace Workshop - Integration Discussion

AIR TRAFFIC CONTROL CONSIDERATIONS

Strong Consideration

- Power sources will be primarily electric in nature

Underlying assumptions:

- ATC is fully automated.
- All systems should be self-monitoring and report off-nominal operations to ATC and other aircraft.

Scenarios

1. Personal air vehicles
 - a. Fully automated formal flight path rules and problem resolution capabilities
2. Mach 2 aircraft –
 - a. Flight paths and noise on the ground.
 - b. Optimal altitude would be above normal traffic.
 - c. Polar routes and
 - d. refueling would also have ATC implications
3. thrust will be environmentally friendly - NONE
4. large air transports will have 2x current volume capabilities / number of flights for large aircraft will double
 - a. Segregated airspace for classes of aircraft (routes, process, etc.)
 - b. Separation on take-off due to wing tip vortices
 - c. Ground segment traffic coordination (to avoid runway incursions, etc...)
5. access to space and near-space will be affordable
 - a. 24/7 launch/reentry operations (Terrestrial weather considerations)
 - b. Expedient integration with NAS
 - c. Space debris prediction
 - d. Space weather considerations
 - e. Coordination with all commercial, civil and military interested parties
6. Manual fail-safe capability
 - a. Under normal autonomy, ATC is a passive monitor.
 - b. If autonomy fails, ATC would be one of the options to become the safety system.
 - c. If ATC is the monitor then it also can tap into diagnostics.



TECHNICAL CHALLENGES

Underlying Assumptions

- Learning machines exist (Artificial Intelligence) at a very high cognitive level.
- High cost of verification/validation /qualification/certification of mission-critical hardware, software, manufacturing processes...

Scenarios

1. access to personal flight capabilities – solved by 2062
 - a. Check that we have all the information necessary before flight can be initiated.
 - b. Probably electric power plant.
 - c. Still don't have a vehicle that's mechanically reliable and has sufficient level of autonomy.
2. business jet operations will be at Mach 2 (perhaps up to Mach 4 or 6) – solved by 2062
 - a. Fuel consumption considerations (in-flight fueling stations)
 - b. Noise abatement for supersonic flight by flight path or airframe design.
 - c. New aerodynamics to utilize shorter runways.
3. thrust will be environmentally friendly – solved by 2082
 - a. Electric driven propulsion systems (unless nonchemical emitting propulsion is developed)
 - b. Noise abatement
 - c. Future noise cancellation technologies when solved will improve flight path management and allow 24/7 operations.
 - d. Better isentropic chemical propulsion (no thermal combustion products)
4. large air transports will have 2x current volume capabilities / number of flights for large aircraft will double – solved by 2042
 - a. Structural integrity (Material science solutions)
 - b. Special runway pavement and designs for durable operation
 - c. Wingtip vortex cancellation
 - d. Airport design
 - e. Improved engines
5. access to space and near-space will be affordable – solved by 2042 (to be corrected)
 - a. Debris (detection, avoidance, not producing it in the first place and cleaning (mitigation))
 - b. Better understanding of terrestrial and space weather to make it a more predictable process, using supercomputers.
 - c. Technical solutions to cost problems – details to be specified by Ken at a later date...
6. all flight vehicles will have fail safe manual capabilities – solved by 2032
 - a. Cybersecurity issues
 - b. Infrastructure deficiencies
 - c. No issues with automated flight systems

