Our Vision on Urban Air Mobility
Challenges and Role of UTM

Alfredo Giuliano
PM of Network Operations

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Presenter Notes

Background

12 years in the aerospace industry

Flight Control Systems chief project engineer for manned and unmanned helicopters

Private life

Dad of a wonderful 3 year old lady and happy husband.

Love sailing!

Work at Aurora Flight Sciences

Program manager of the Network Operations Program, a heterogenous and extraordinary team of system engineers, ATM experts and autonomous engineers, all working hard to shape the future of the urban air mobility.

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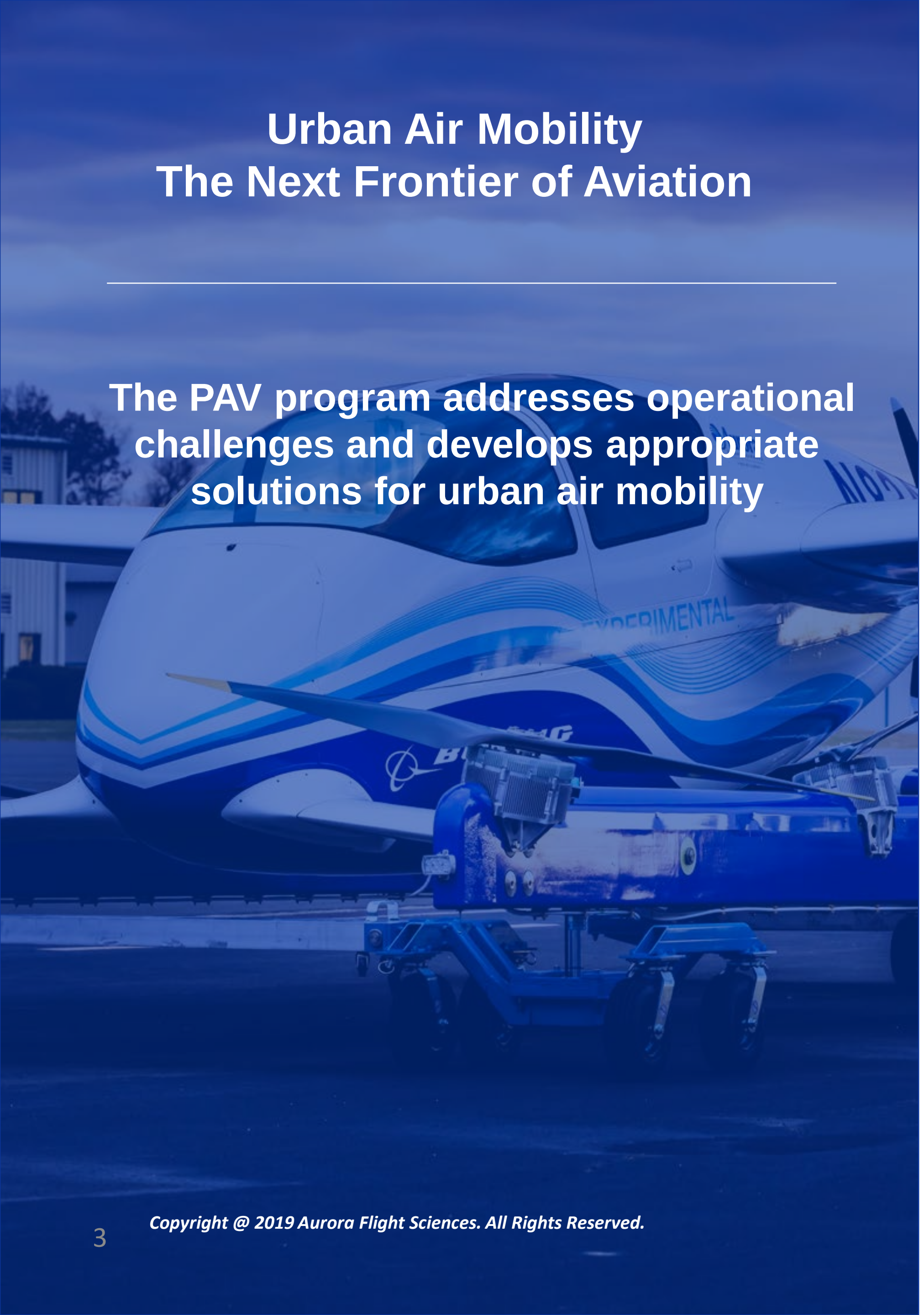

Urban Air Mobility
The Next Frontier of Aviation

The PAV program addresses operational challenges and develops appropriate solutions for urban air mobility

Passenger Air Vehicle (PAV) Urban Air Mobility Market

Intra-city mobility
Inter-city mobility

Personal mobility
pooling

Morgan Stanley says market for self-flying cars could rise to $1.5 trillion by 2040

NASA urban air mobility studies point to USD500 billion market but large regulatory hurdles

Urban Air Mobility Characteristics
(long term – high density)

Local:	20 miles avg
Payload:	2-4 pax,
Traffic volume	thousands Trips/day/city
Vehicles	Hundreds vehicles/city
City infrastructures:	10-20 Vertiports/city

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Many goals...

On demand service

As affordable as taxis

Faster than taxis

Customers point of view

Airspace structure, access and monitoring

Minimize the impact

Ensure safety through certification

Maximize the benefit

Regulators point of view

Society

Interact with ATC, passengers, dispatchers

Lower the costs

Operators point of view

SAFETY

... and challenges

1. **Introducing new vehicles into the air space**
   - Min vehicle spacing on air routes?
   - Max FATO or vertiport ops. per hour?
   - Min vehicle turnaround time
   - Max vehicle utilization

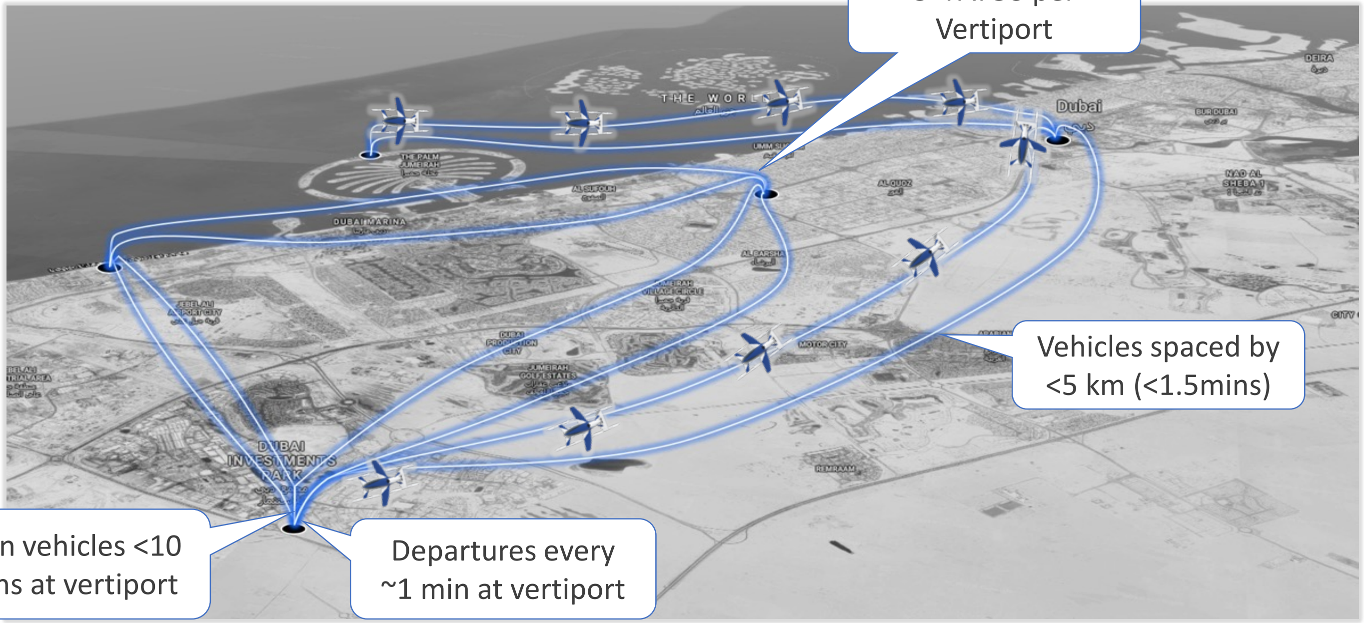
2. **Work split between humans and autonomy**
   - Manage network disruptions automatically
   - Define processes and procedures for human-autonomy interaction allowing for safe and responsible introduction of new technologies

3. **Define (common) Infrastructures req.**
   - Vertiport layout and equipment
   - Comms / nav infrastructure
   - Vehicle support equipment

4. **Customer / regulator / end user buy-in**

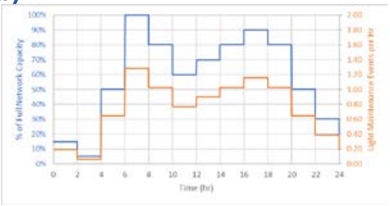
Urban Air Mobility Operational Considerations

Managing a dense network



Network structure (assuming heterogeneous and inhomogeneous demand)

- 5 vertiports
- 10-24 routes



Results in

- ~100 vehicles in operation
- ~50 in air
- 1.5k-3k vehicle trips/day

Neither IFR or VFR operations can cope with this, need a new paradigm with specific objectives in mind:

Autonomously enforced separation (not only DAA)

Autonomous Vertiport access and ground ops.

Surveilled autonomy as the key to transition to vision system

Initial Airspace structure (enhance safety)

- Fixed Corridors
- Enforce rules of the air
- Time separated traffic (~1-2 min) 5 Km enroute, 3 Km on terminal area
- Reduce conflicts at the vertiports and optimize network throughput through schedule

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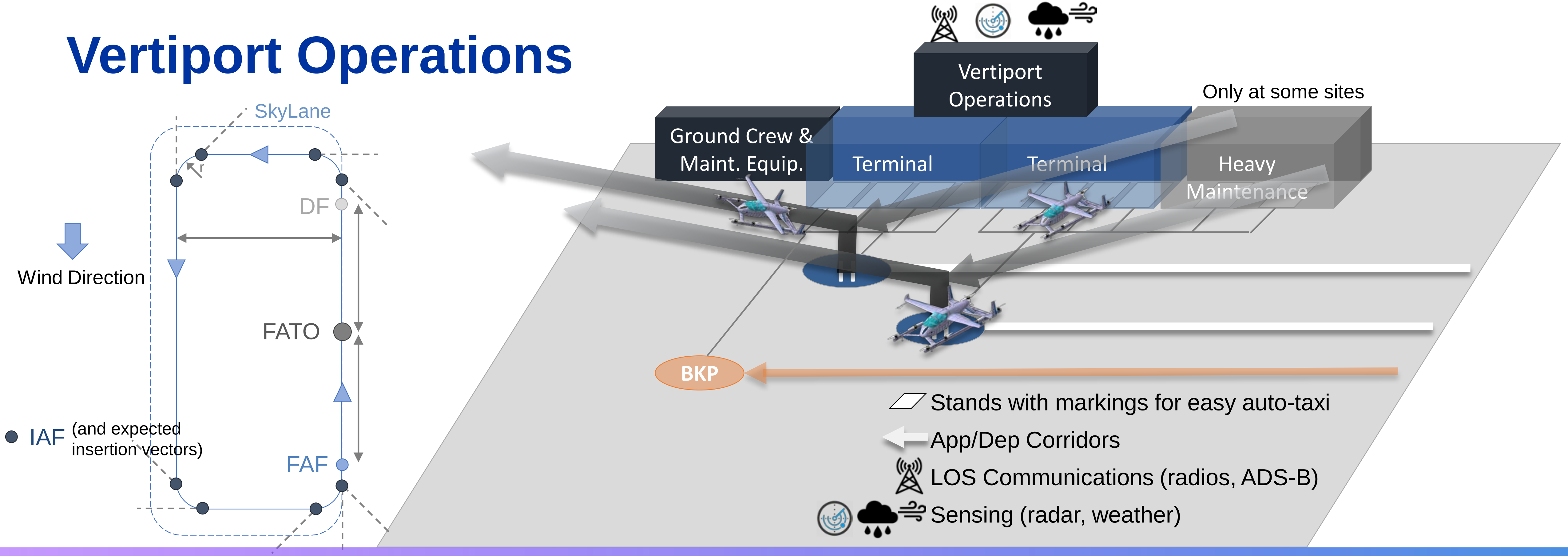
Vertiport Operations



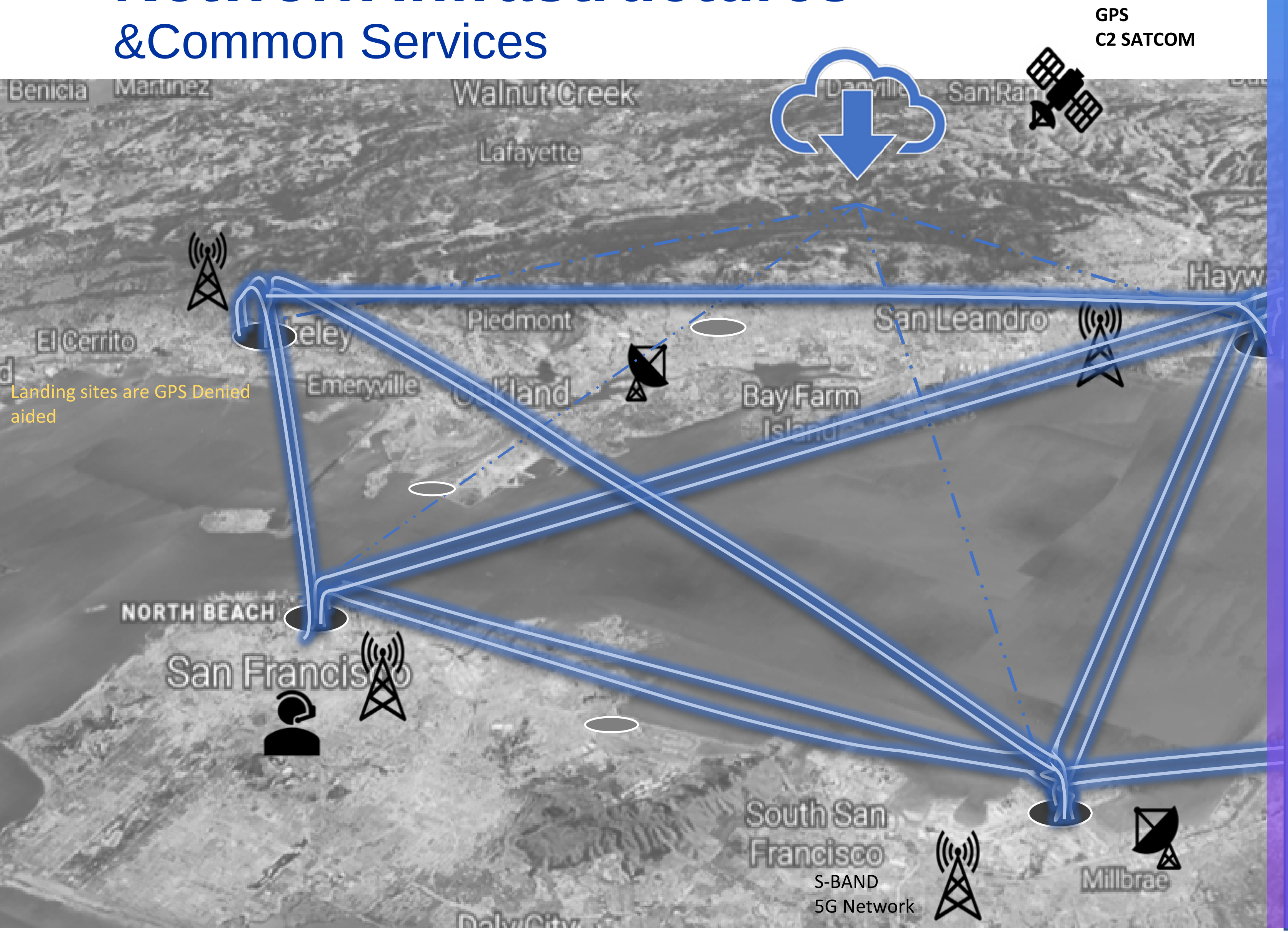
App-Dep Pattern

- Published
- Can be reversed
- requires authorization

Operations

- Turnaround Time: 10 minutes (or less)
- Auto-Taxi
- Parallel operations on FATOs for high throughput
- Designated Backup FATOs for Emergency situations (Initial operations)

Network Infrastructures
&Common Services



Common Services

- UTM* (Evolved)
- ATC (for initial operations)
- Communication Networks
- Positioning means

Infrastructure requirements

- Vertiports
- Air Routes / Airspace Structure
- Alternative landing sites
- Existing helipads

Airspace users/Operators

- Vehicles
- Vertiports
- Comms

Safety Means

Vehicles can be taken out of the network through dedicated corridors and alternative landing sites.

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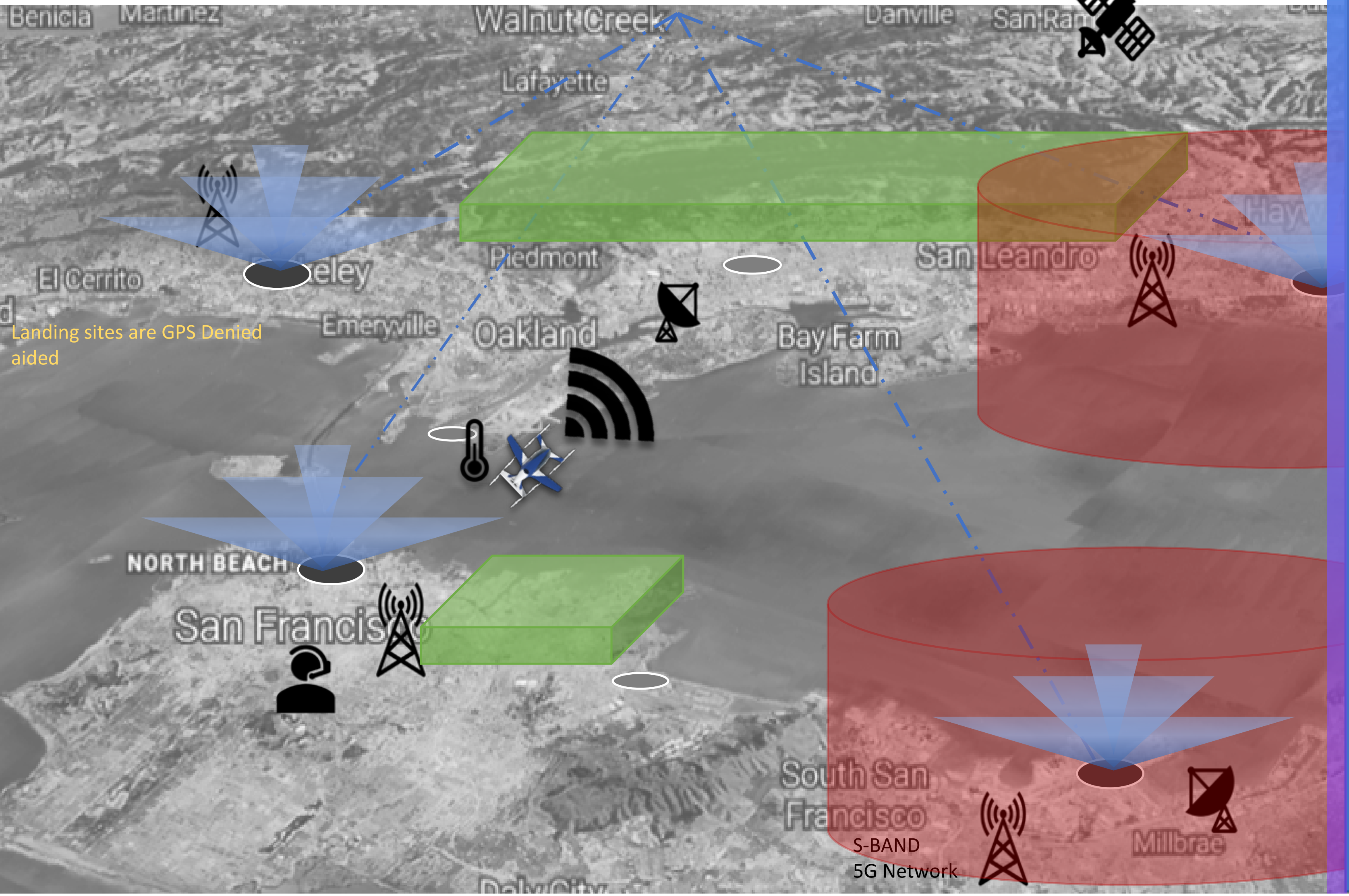
Data Services



Vehicles

- Location broadcast
- Detect and avoid
- Meteorological sensing

Ground-based data sensing or provision through UTM

- Traffic data
- CTR
- Obstacle maps
- Vertiport control
- Micro-weather forecasting

Contingency management

- Alternative landing site status

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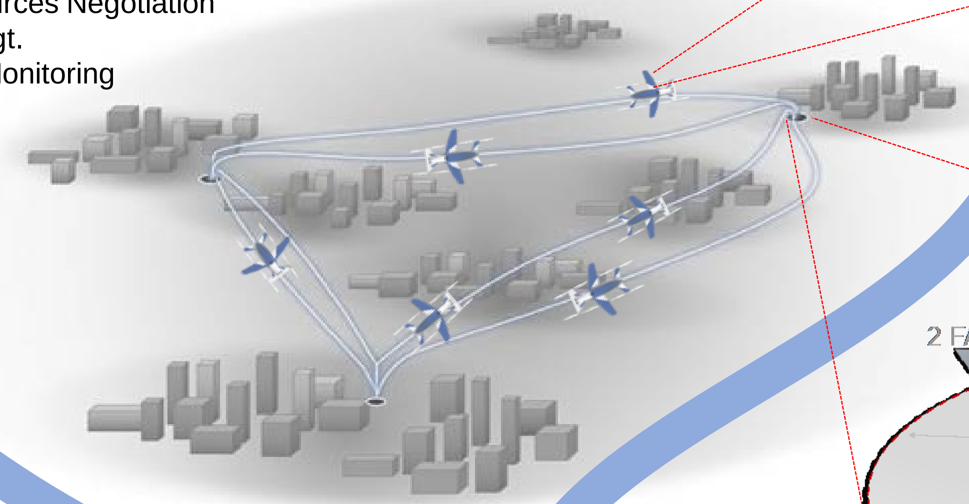
Functional allocation and common interfaces (high level)

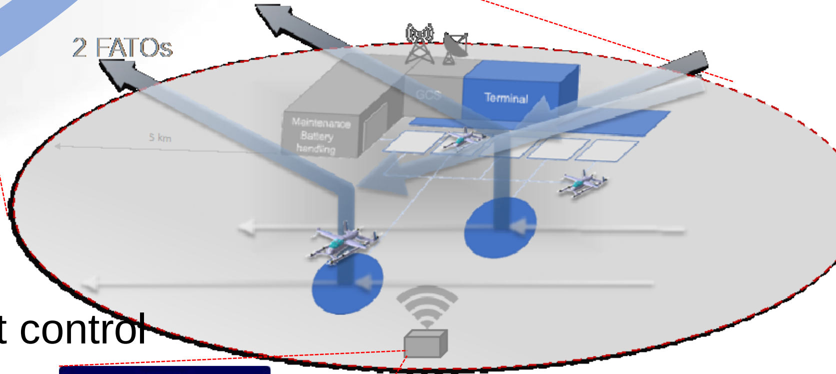
Fleet command center

- Fleet schedule
- Mission & resources Negotiation
- Disruptions mngt.
- Conformance Monitoring

Onboard Autonomy

- Time constrained navigation
- Mission feasibility
- DAA
- Contingency mngt.





UTM*

Courtesy of NASA

- Conformance monitoring
- Mission authorization
- Critical resources allocation/deconfliction/ Disruptions mngt

Vertiport control

- Time constrained landing allocation
- Access to vertiport airspace
- Ground Operations coordination

* Air traffic is regulated by authority through an evolved version of the UTM concept

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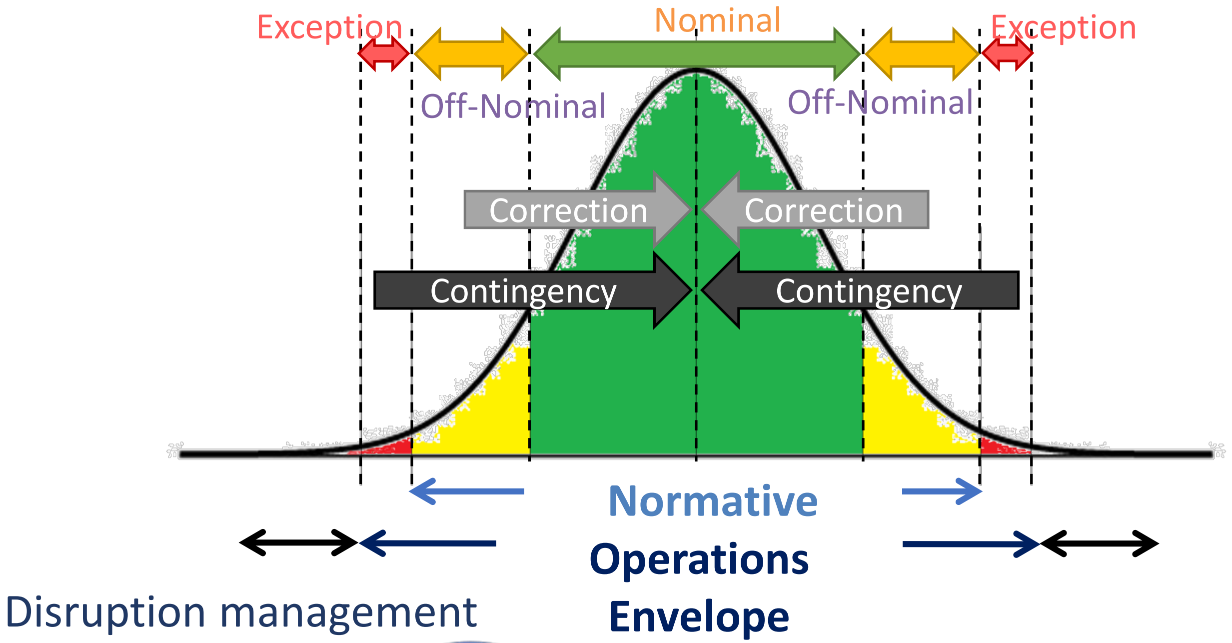
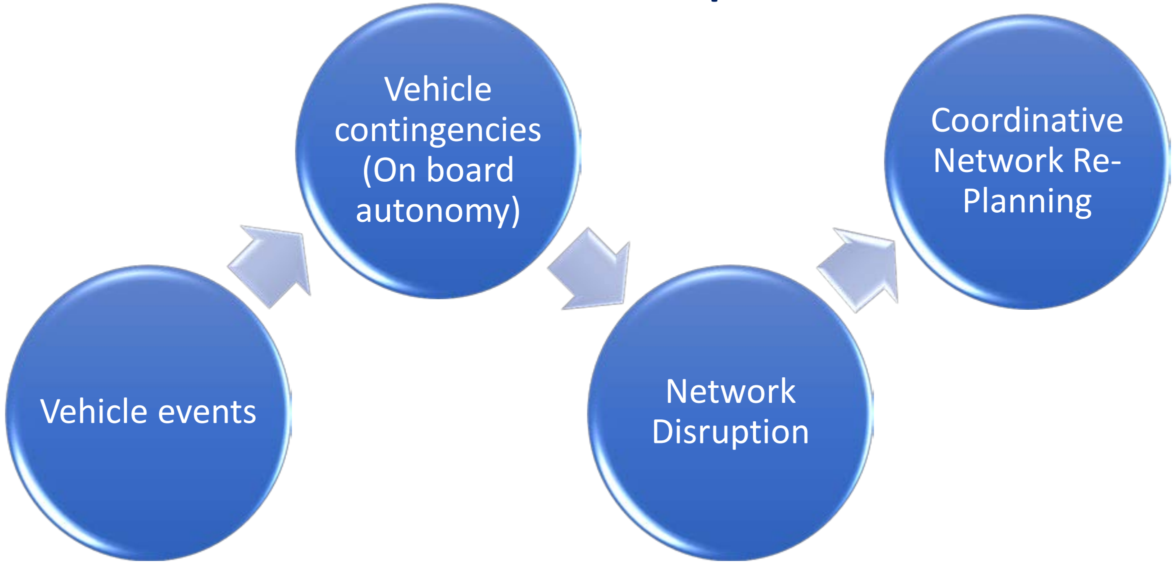
Safety: Contingencies and Disruptions





Nominal Operations

- Vehicles fly predefined missions according to schedule
- Status or the resources (vehicles, Vertiports) don't show anomalies
- Deconfliction and slight variation of the flight according to flight traffic instructions is considered normative

Off Nominal Operations

Is a temporary situation (loss of separation, out of schedule) that requires correction. Corrections require coordination among multiple elements with the scope of regain the initial mission goal.

Exceptions

Unexpected events might result in the impossibility of accomplishing the original mission even after applying corrections. The vehicle must execute a contingency that takes it out of the grid (e.g. land as soon as practical or possible). New mission shall be executed safely, might expect to use alternative landing sites.

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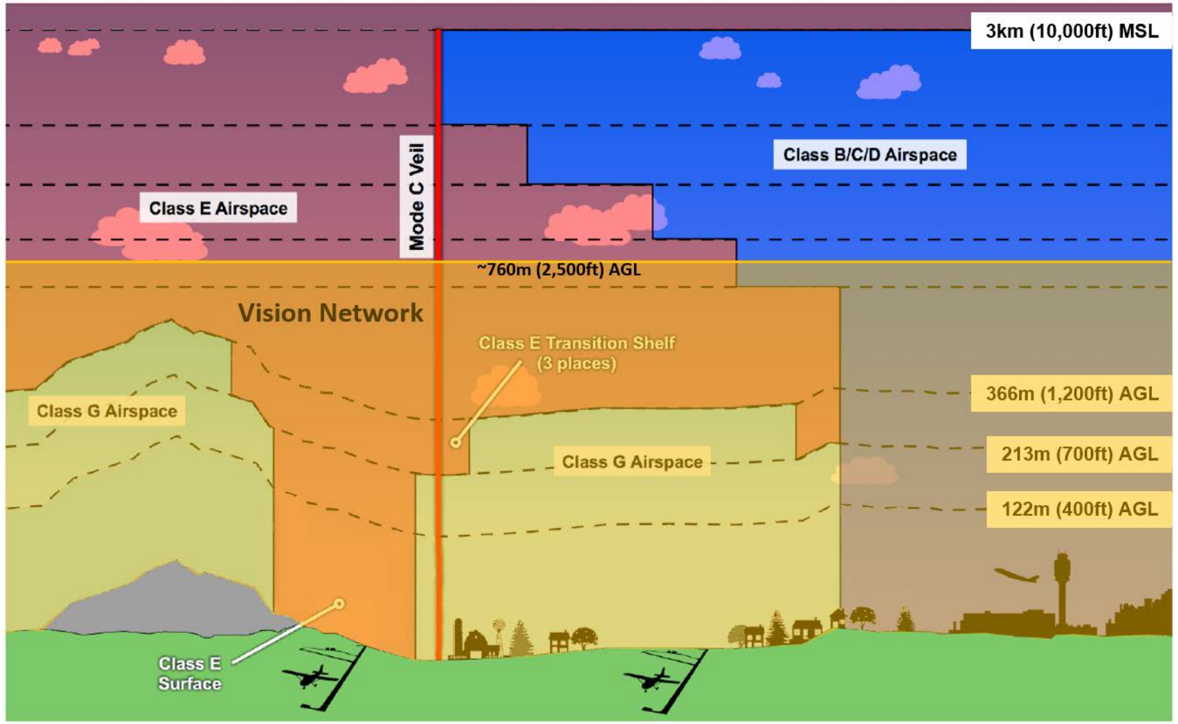
UTM Evolution

How to expand UTM autonomous access to the airspace to a wider Urban Air Mobility?



- Own the Airspace
- Integrate with Vertiports
- Air Traffic deconfliction
- Integrate with CTR
- Coordinative functionalities
- Secure comms
- Shared services
- Conformance monitoring

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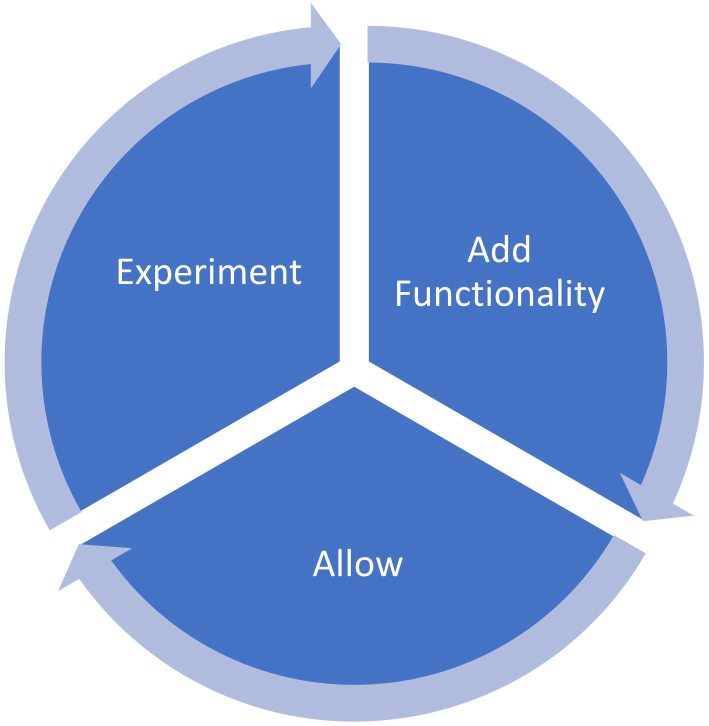
CLOSING A HEALTHY VIRTUAL LOOP

- Simulate & Fly, stress the concepts in a very severe way in a safe environment
- select the winning solutions
- distribute the lessons learned

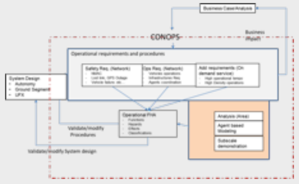
- Define use cases
- add functionalities
- expand the envelope

- Facilitate the experimentation allowing testing new paradigm (1:N control, autonomy)
- Expand the envelope, integrate



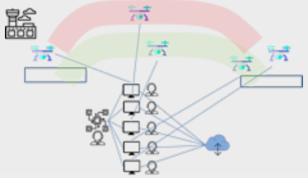
Sys Architecture
ConOps
Validation

Conceptual Study



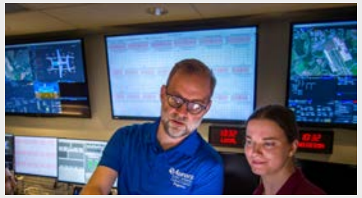
Subscale Experimental activity
Simulation
BVLOS Op
UTM Int. Safety Analysis

Feasibility evaluation

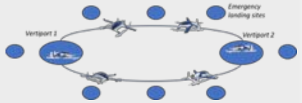


Full scale experimental ops.
Operations optimization
ATC Integration
Automated Airspace Integration

Experimental Operations



Revenue generating Operations



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Thanks for your attention!

Q&A

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