RTI Connext Conference 2017

Vahana: Opening Up Urban Airways with DDS

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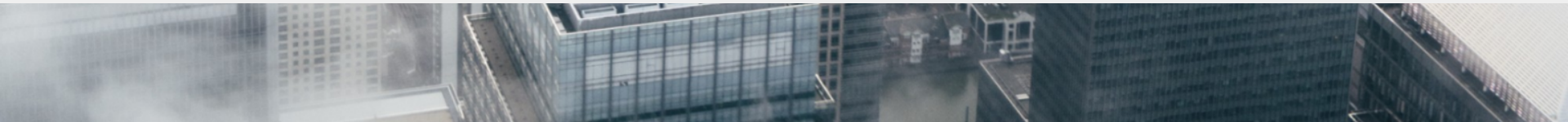
October 19, 2017



Agenda

- Objective
- A^3 and Vahana Intros
- Why DDS for Vahana?
- DDS Architecture Overview
- Why RTI?
- DDS Opportunities
- Looking Toward the Future
- Q&A

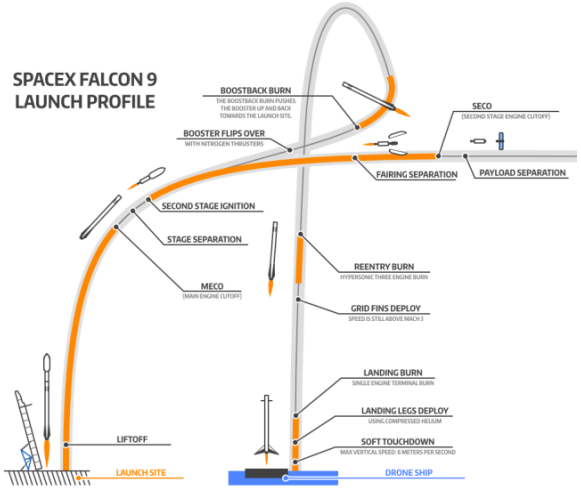
Objective

The objective of this presentation is to demonstrate how DDS is being used to fulfill the design constraints of the first Vahana prototype that will fly in 2017.

BY AIRBUS

What is A³?

- The mission of A³ is to disrupt Airbus and the rest of the industry before someone else does.
- We want to demonstrate the future of flight today.



April 18, 2014

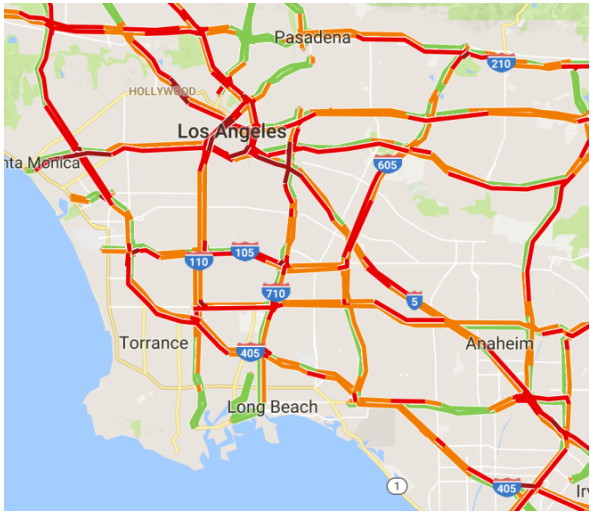
- Our projects must be disruptive to our core business, culminate in a productizable demonstrator in 2 to 4 years, and Airbus must be unable or unwilling to undertake them.

BY AIRBUS

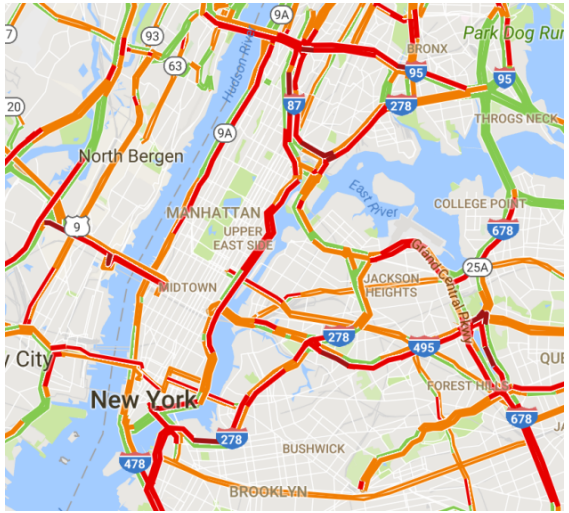
What is Vahana?

Problem

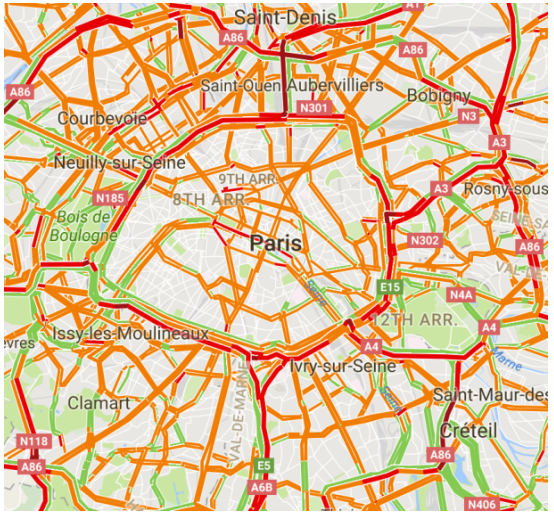
Typical Rush Hour Traffic



Los Angeles



New York City



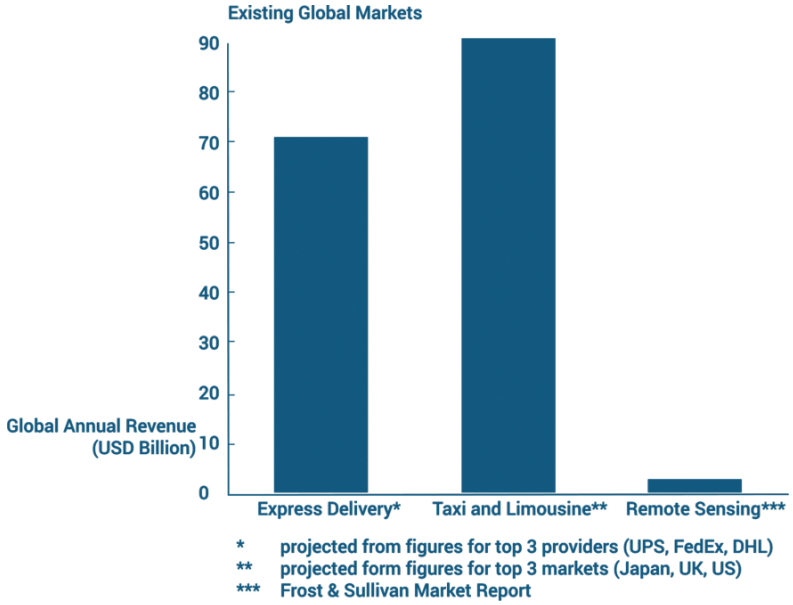
Paris

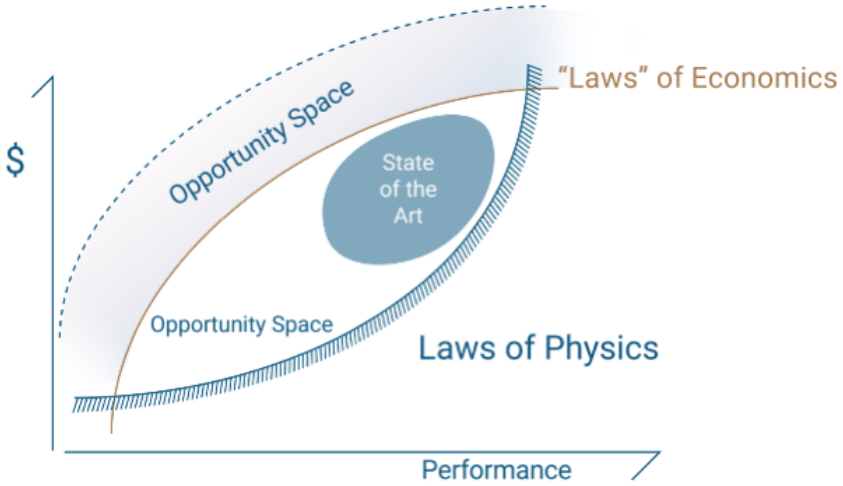
What if we could go 4 times faster than traffic at the cost of a taxi?

BY AIRBUS

What is Vahana?

Opportunity





Commuter and cargo transport is a $150 billion market …

… and we have no suitable vehicle to address it

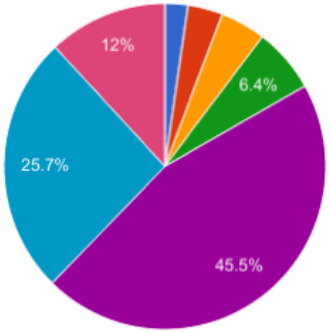
BY AIRBUS

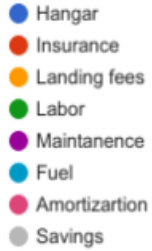
What is Vahana?

Enablers

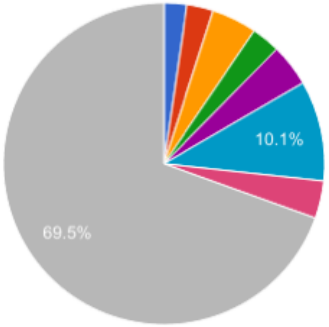
Direct Operating Cost

Average Helicopter





Vahana



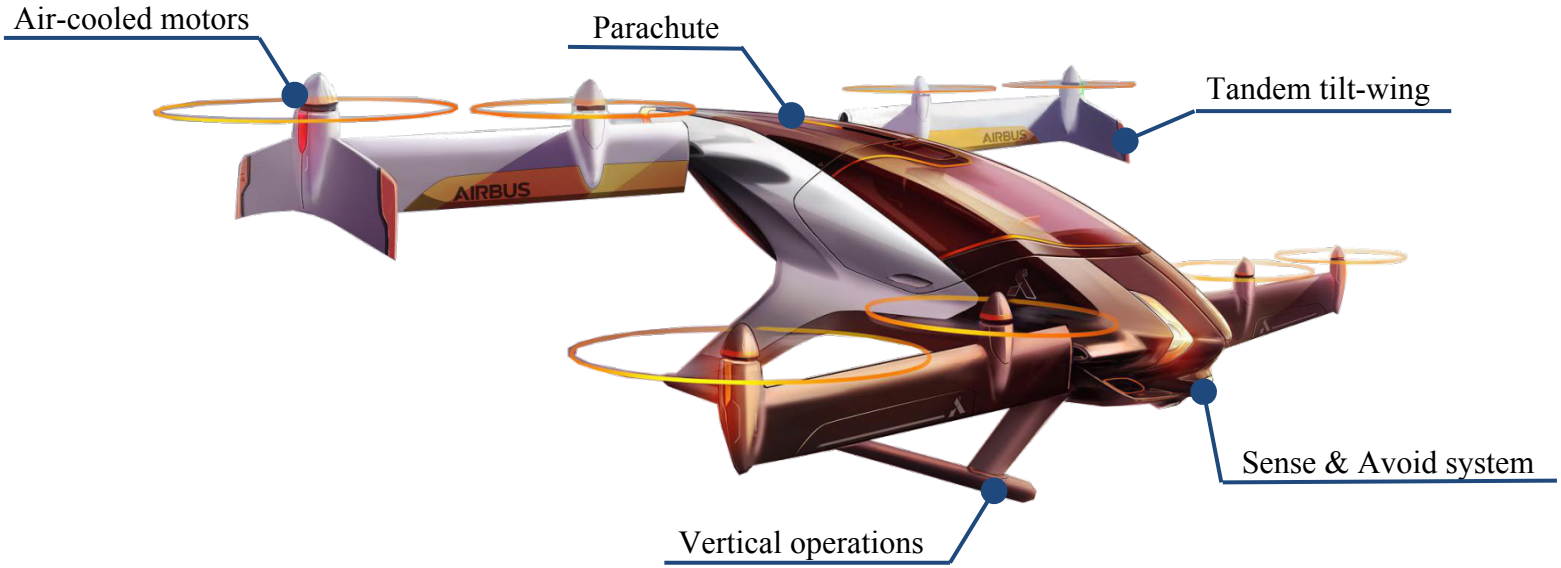
From Porsche 911 Turbo S …

… to Honda Civic EX

What is Vahana?

Solution

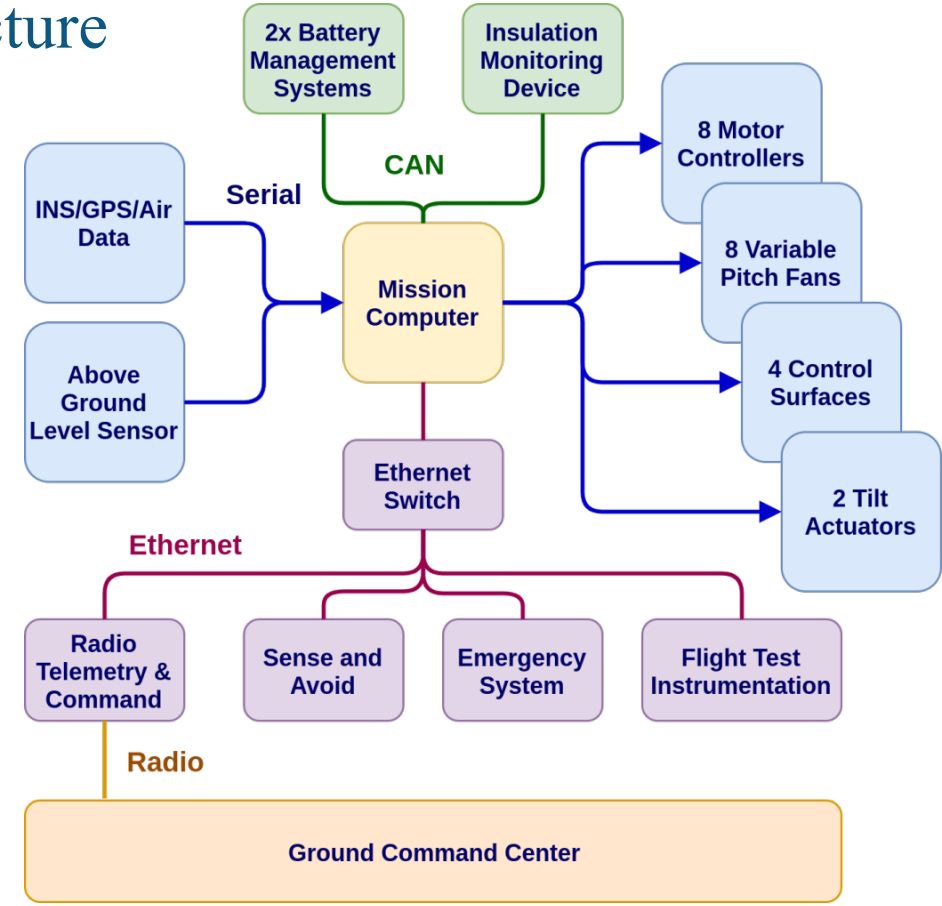
Provide a self-piloted low operating cost aircraft that will enable safe full scale Urban Air Mobility, for both passenger carrying and cargo carrying applications.



The Vahana Experience

Vahana Communication Architecture

- Serial (RS-485/RS-422): Safety critical communication links with strong real-time constraints.
- Ethernet: Whenever possible, providing high throughput and ease of integration.
- CAN: When Serial or Ethernet were not available.
- An IP Radio links the Vehicle with the Ground Command Center for Telemetry & Telecommands.



Why Data Distribution Service (DDS) for Vahana?

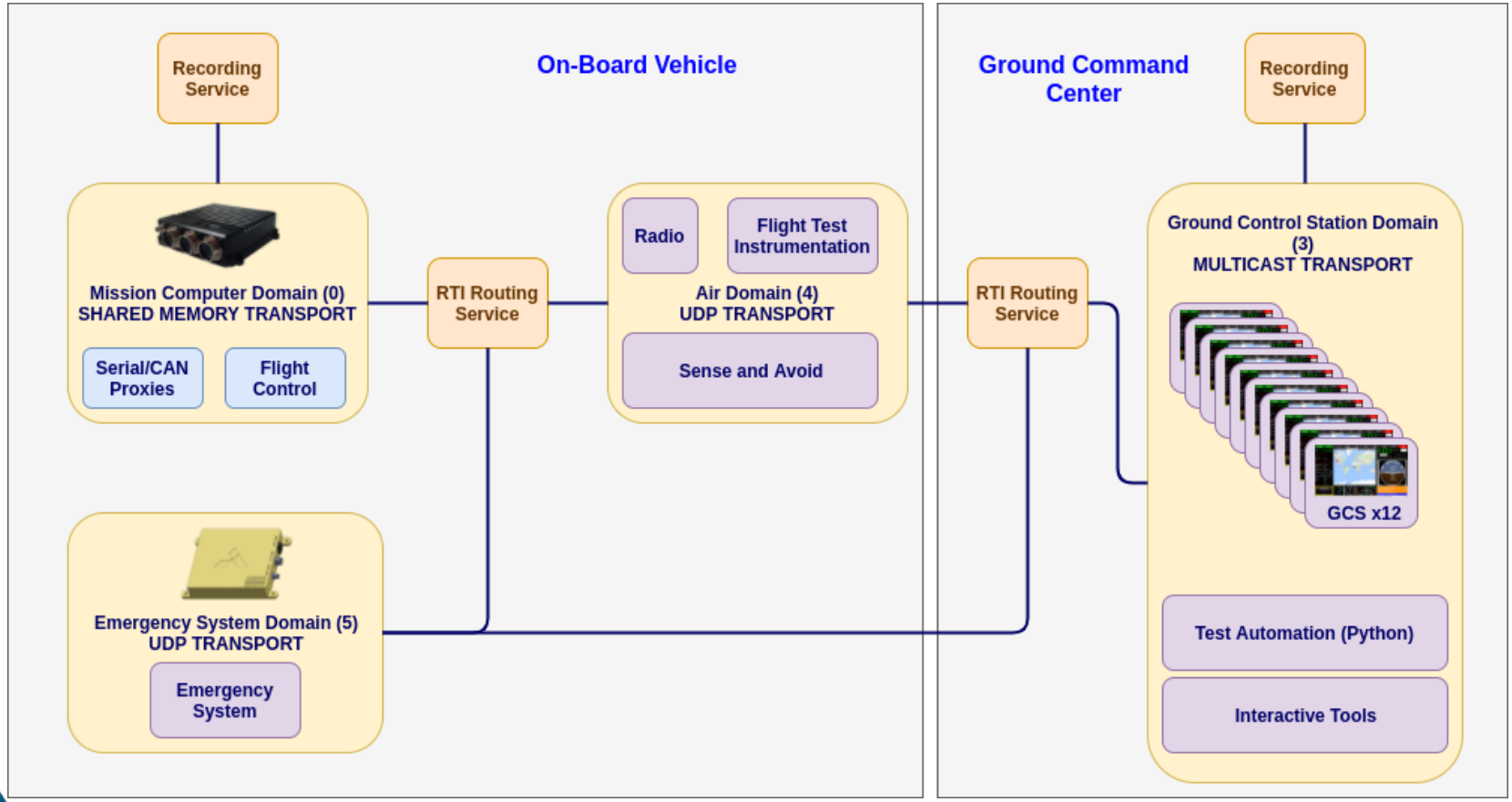
Given the constraints (real-time, reliability, etc…) of Vahana, two main options for Ethernet communications were considered:

- Defining a custom communication protocol over UDP
- Leveraging of an existing middleware

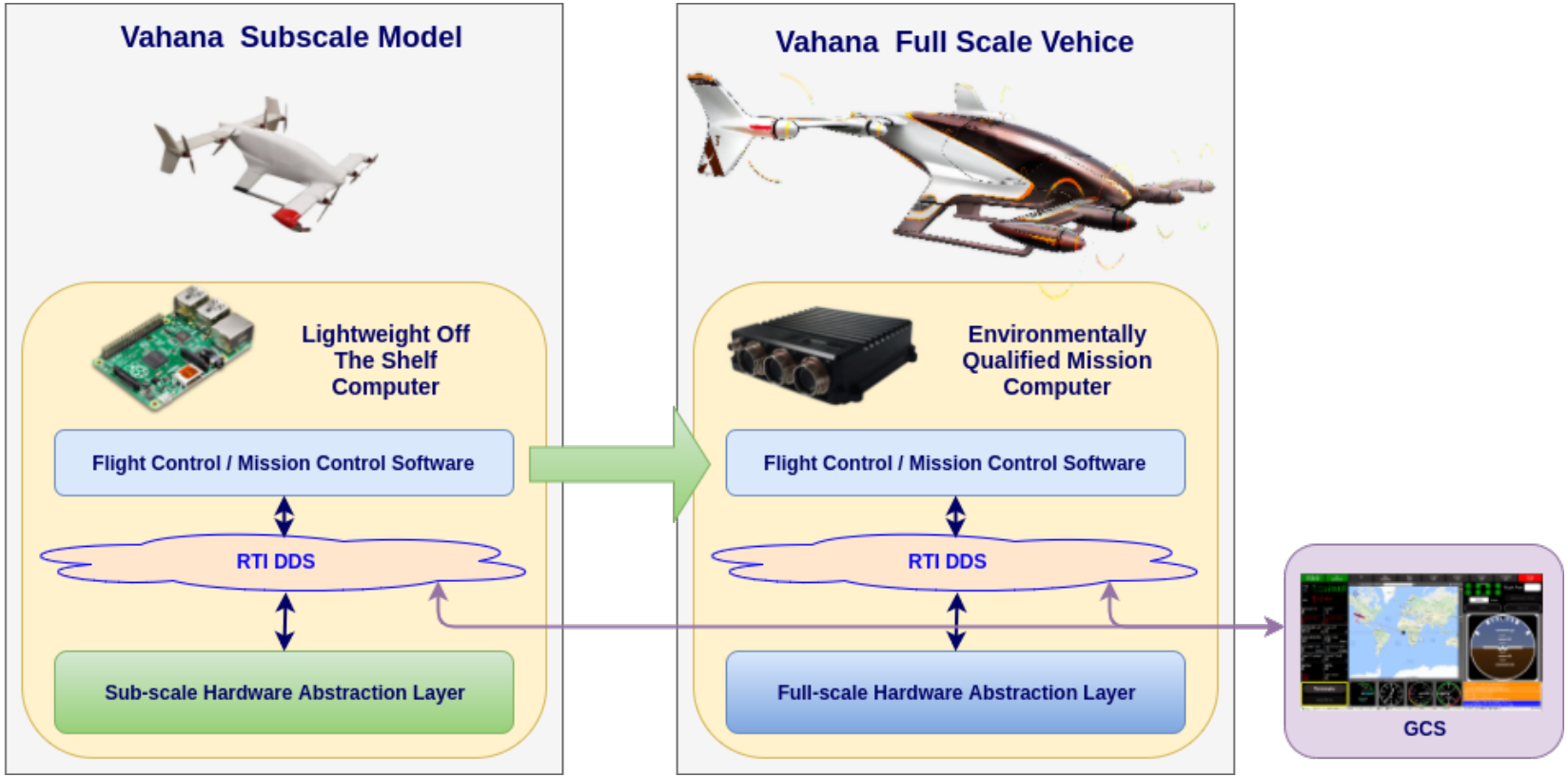
DDS has been found as being the most advanced **open standard** targeting **embedded** and **real-time** systems for communications over UDP.

Vahana aims at leveraging existing technologies to fly its first prototype in 2017.

DDS Architecture Overview



How DDS simplifies our testing workflow



The Benefits of DDS

DDS has many benefits included real-time onboard communications, improved integration, and network configuration, and a unified interface.

The publish/subscribe model we employ provides some more specific benefits including:

- A distributed architecture enabling distributed telemetry, distributed logs, command transmissions while eliminating Single Points of Failures.
- A simplification of the integration and test of each component.
- An increased adaptability to design changes by facilitating re-architecture and improving modularity.

Why RTI for Vahana?

Multiple competitive and interoperable implementations of DDS by independent providers are an evidence of the credibility of the standard. RTI was chosen for Vahana:

- The RTI Micro DDS product has been certified DO178, providing an important path to certification for Vahana.
- RTI demonstrated the Micro DDS could run on a single chip with an integrated PHY and limited memory (TI TM4C).
- The distributed nature of DDS and the tools from RTI provide advanced monitoring and debugging capabilities.
- The below tools helped us significantly reduce our development efforts:
  - RTI Recorder: Off-the-Shelf Flight Data Recorder
  - RTI Routing Service: On-Board/Ground segregation for increased safety
  - RTI Connector: Interface the system with an automated test framework in Python

Meeting Real-Time Performances

- The Flight Control Loop runs at high frequency and meeting timings with limited latency and jitter is critical.
- Optimizing the DDS performances for this application has been a challenge for the team.
- Some of the optimizations that have been done include:
  - Using exclusively shared memory transport for inter-process communication and route the traffic externally using the routing service. (Comes at the expense of additional complexity and reduced debugging capabilities).
  - Configure receiver threads with well chosen real-time priorities.

Other Opportunities for RTI and Vahana

- Recording all the data at full rate with RTI recorder.
- The interoperability between RTI DDS Micro and Connext Pro.
- The detection of communication failures with the existing Connext Pro API.
- Versioning of interfaces: interfaces change frequently during development breaking compatibility between components.

Looking Toward the Future

When choosing software for the Alpha vehicle, we focused on those that could enable fast prototyping while limiting the certification gap. While this will always remain important a host of new opportunities will accompany the Beta phase including:

- Embedding DDS directly inside the sensors and actuators with limited compute power would allow to build a truly distributed system and greatly simplify integration.
- Using DDS for safety critical communication will require to demonstrate reliability and determinism.
- The Vahana vehicle will have to interact with a broader system and we need to understand if DDS can help within this system of systems.

Q&A Session

Stay Connected

@VahanaAero

Vahana.Aero

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