



EnginAir

Connected Engine Data System

Administrative Portal

Design Review II

February 28, 2020

Team Members: Chloe Bates, Megan Mikami, Gennaro Napolitano, Ian Otto, Dylan Schreiner
Client: Harlan Mitchell, Honeywell
Mentor: Scooter Nowak





OUR TEAM



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Megan Mikami
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Mentor:
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Client:
Harlan Mitchell
Honeywell



INDUSTRY OVERVIEW

Aerospace & Defense

- Manufacturing, sale, service of aircraft, aerospace parts, space vehicles, and military defense systems
- Largest in the world
- \$838 billion [1]
- Over 2.5 million jobs: 20% of manufacturing [4]

Top Aerospace Companies (in revenue) [3]

- Boeing
- Airbus
- United Technology Corporation
- Honeywell (13)



[1]



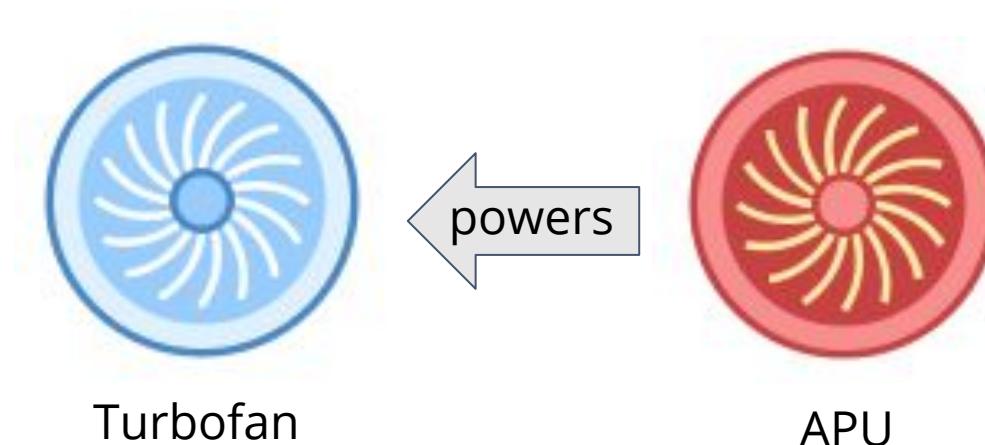
[2]



PROBLEM STATEMENT

Turbofan

- type of Jet Engine
- used for aircraft propulsion



Problem: Hot Start

ensuring airflow
before fuel [2]

- may cause
overheating and
damage

Auxiliary Power Unit (APU)

- Exhaust gases
are used to spin
the turbine
blades [2]
- serves as an
additional
energy source



SPONSOR OVERVIEW

Honeywell

- Leading producer in gas turbine APUs
- Applications on helicopters, military jets, and the US Army Abrams Tank

Honeywell

Harlan Mitchell

- Systems Technical Manager
- HTF7K Controls System Integration Unit



HTF7K Turbofan Engine Family

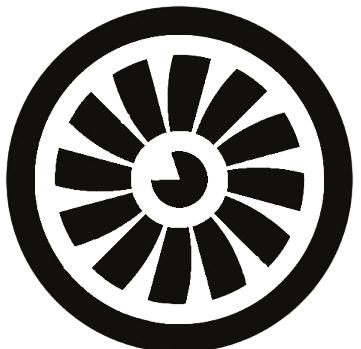
- Primary used on business jets
- Cessna Citation Longitude



[3]



ORIGINAL DESIGN PROBLEM



HTF7K Engine



USB



Email

What: Download and send diagnostic data

What's broken? Process of downloading diagnostic data from the jets

Why is this bad?

- Tedious; Small data set = missed maintenance opportunities



CURRENT PROBLEM



Honeywell's Solution: Connected Engine Data Administrative System (CEDAS)

- What if there are WiFi connection issues?

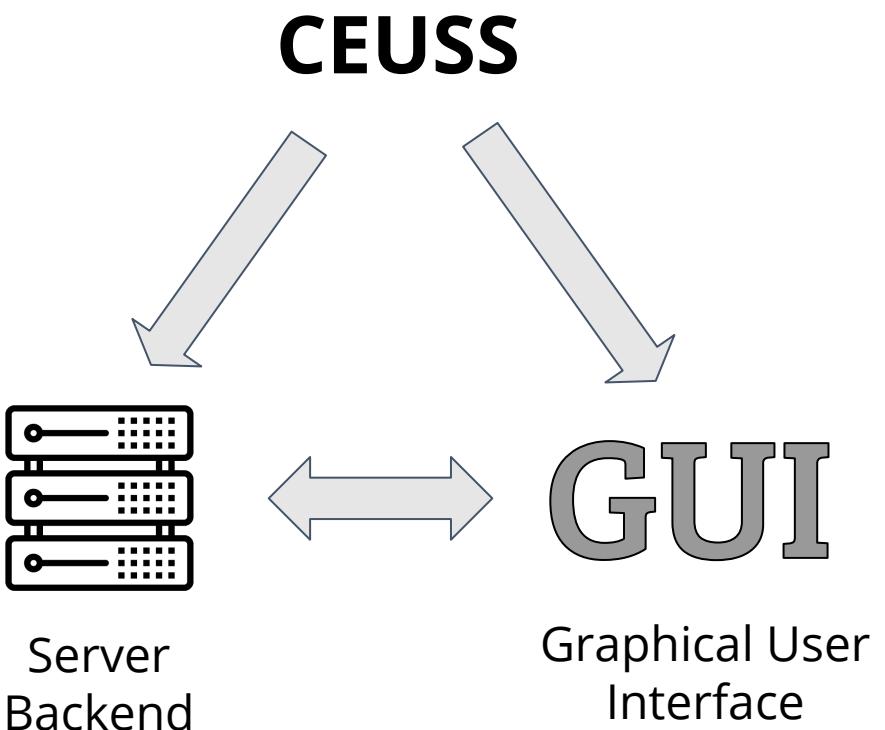
How can EnginAir fix this?



SOLUTION OVERVIEW

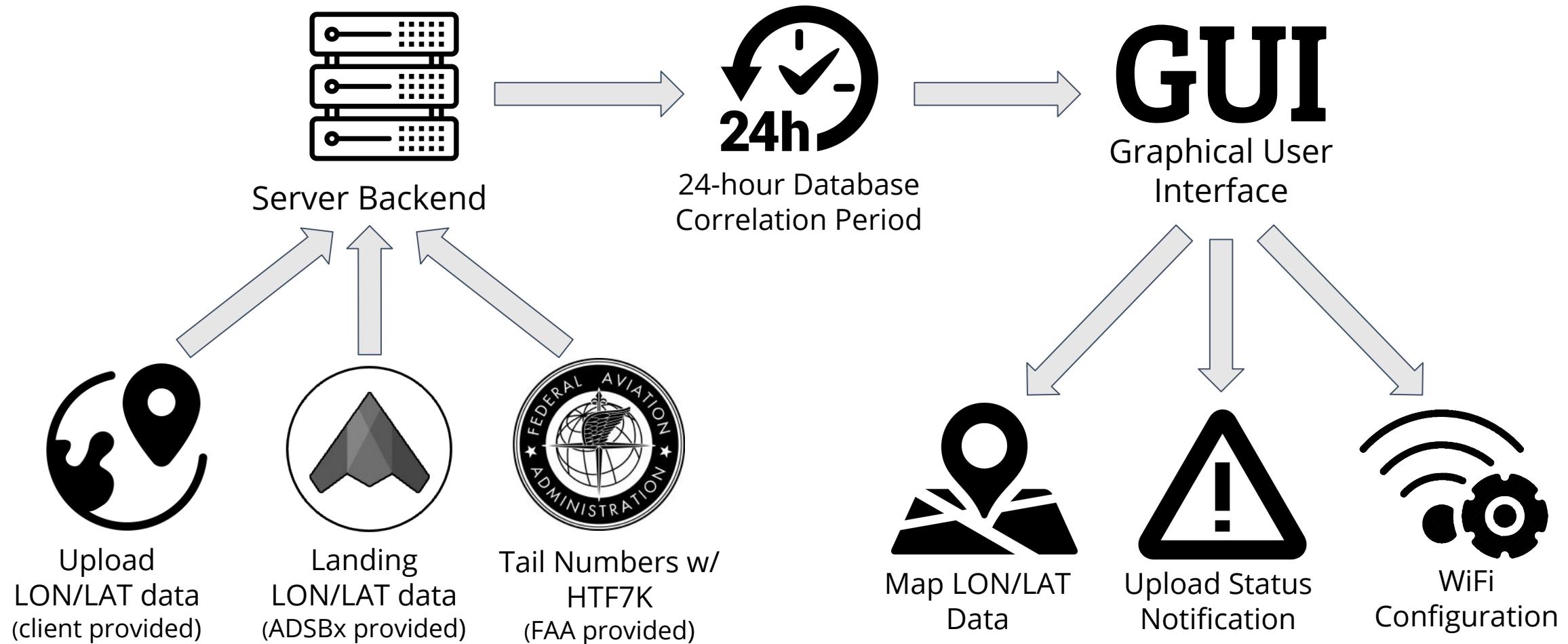
Connected Engine Upload Status System (CEUSS)

- **Serverside Back End Software**
 - Determine connectivity issues
 - Notifying users of issues
- **GUI Front End Portal**
 - WiFi
 - Airplane landing





SOLUTION WORKFLOW





REQUIREMENTS OVERVIEW

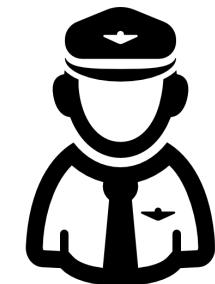
As an engine technician, I want to be able to:

- view all aircraft landing locations, every 24 hours.
- visualize all flights that are currently in progress.
- simulate various locations and their corresponding WiFi configuration.
- know the status of each landing/upload entry.
- visualize the status of each upload entry.
- run a report to determine the cause of a failed upload.



As an aircraft pilot/operator, I want to be able to:

- visualize locations on where to park the aircraft for an upload success.
- simulate locations and their WiFi strength.



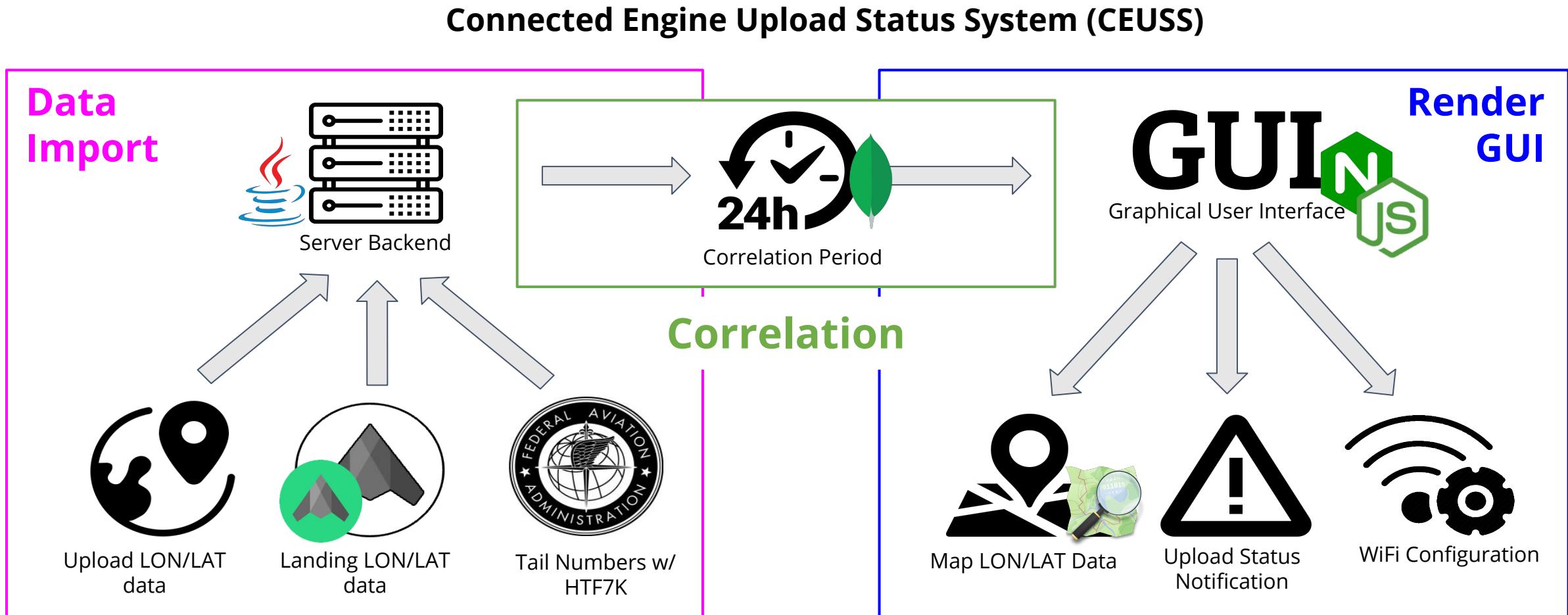


IMPLEMENTATION OVERVIEW

Public Flight Database	Command Line	Database	Web App Front End	Web App Back End	Graphical Illustration
 ADS-B Exchange	 Java	 MongoDB	 NGINX	 Node.js	 OpenStreetMap

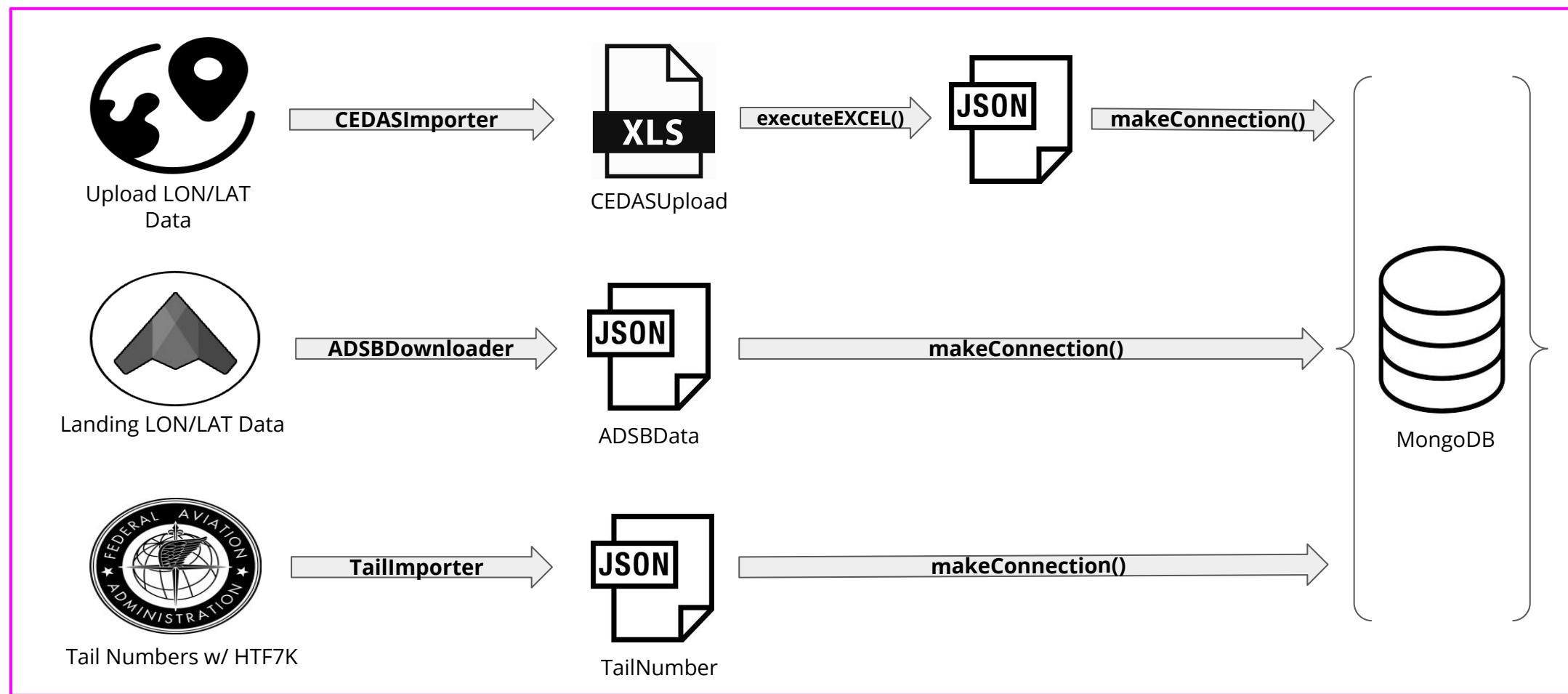


ARCHITECTURE OVERVIEW



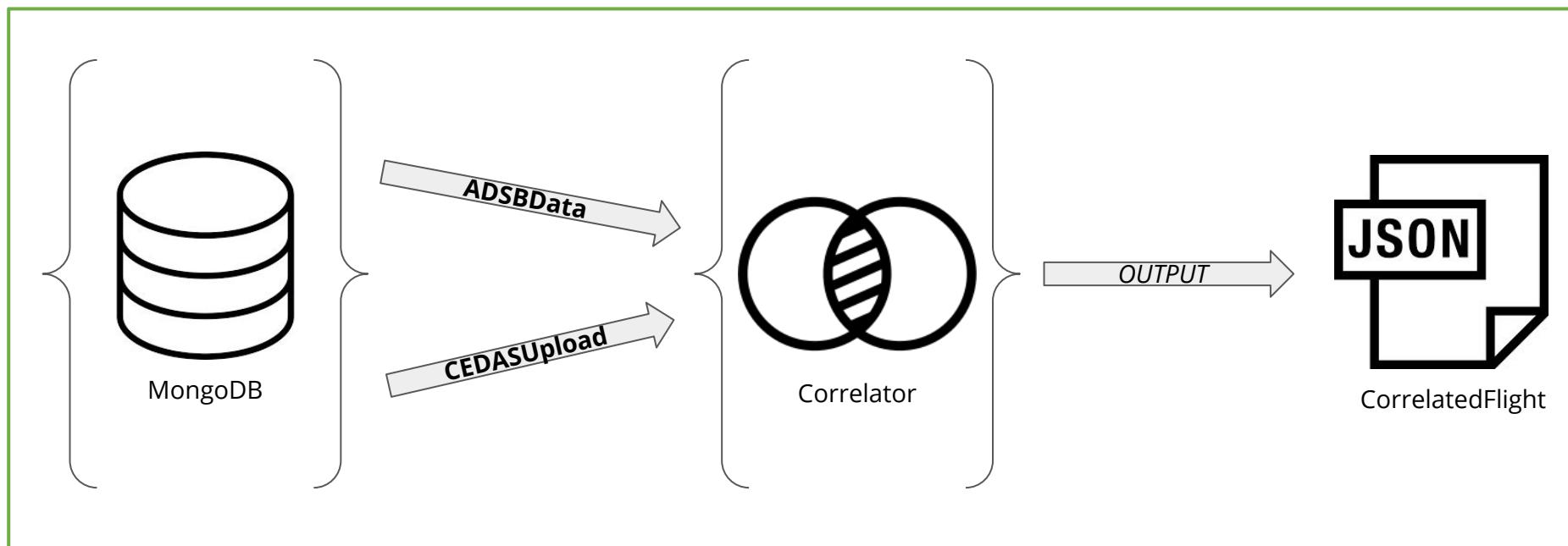


DATA IMPORT





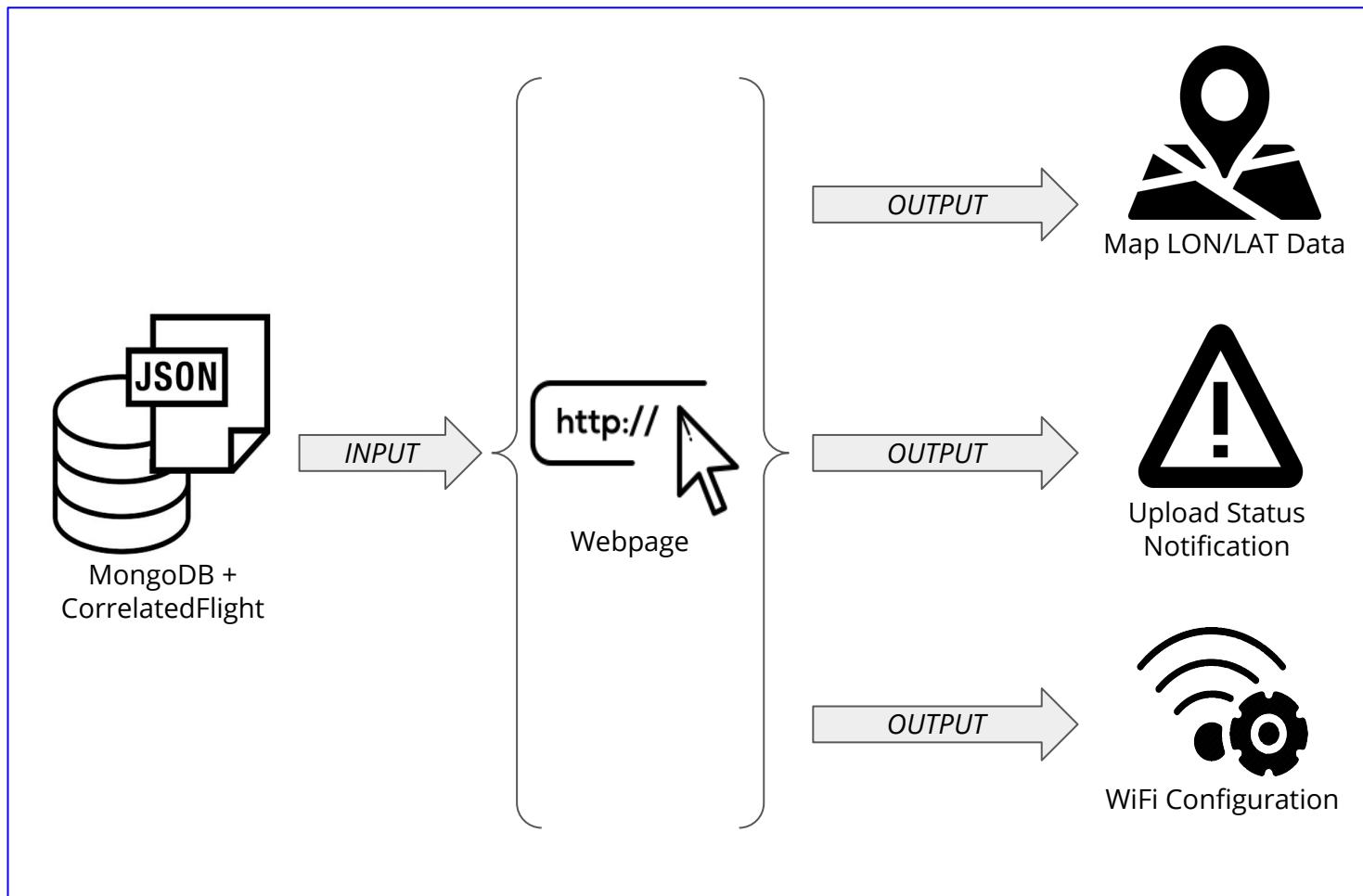
CORRELATION



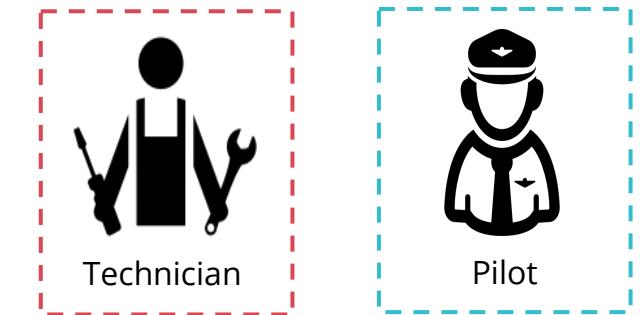
CorrelatedFlight
Tail Number
Landing Point
Take-off Point
Landing Date
Flight Path
Outcome



RENDER GUI



GUI
Graphical User Interface





LANDING/UPLOAD DATA

Honeywell Technician

Home Landing Data WiFi Strength ▾ Database ▾

Landing Data

Filter by Upload Status

- Success
- Pending
- Failed

Search By

Lat

Lon

DB#

Airport

Search Search

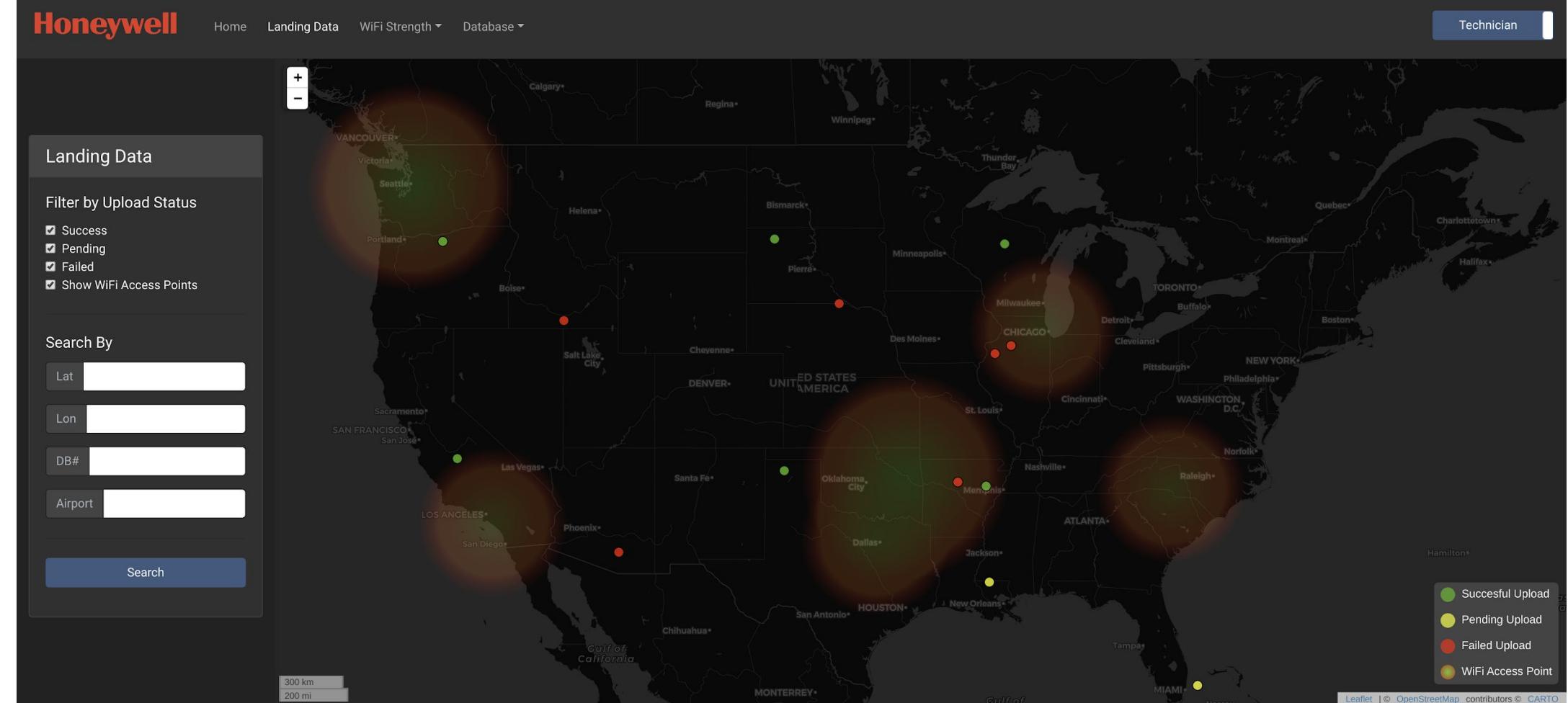
300 km
200 mi

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Leaflet | © OpenStreetMap contributors © CARTO



WiFi CONFIGURATION





DATABASE

Honeywell Technician

Home Landing Data WiFi Strength ▾ Database ▾

ID	RDL	RDT/D	STL	ST/D	UL	WSS	WID	CODE	CODE
<input type="text" value="ID"/>	<input type="text" value="RDL"/>	<input type="text" value="RTD/T"/>	<input type="text" value="STL"/>	<input type="text" value="ST/D"/>	<input type="text" value="UL"/>	<input type="text" value="1"/>	<input type="text" value="WID"/>	<input type="text" value="BHM"/>	<input type="text" value="SUCCESS"/>
<button>Filter</button> <button>Clear Filter</button>									

Show 10 ▾ entries

ID	Engine Roll-down GPS Location (RDL)	Engine Roll-down Date/Time (RDT/D)	Engine Start GPS Location (STL)	Engine Start Time/Date (ST/D)	Upload GPS Location (UL)	WAP Signal Strength (WSS)	WAP ID (WID)	Airport Code	Status
134820	33.348928/-84.523423	1/19 15:02	32.13/-81.2	1/5/19 21:04	32.18/-82.03	Good	123	PHX	FAILED
223421	33.348928/-84.523423	1/19 15:02	32.13/-81.2	1/5/19 21:04	32.18/-82.03	Good	123	PHX	FAILED
3239480	33.348928/-84.523423	1/19 15:02	32.13/-81.2	1/5/19 21:04	32.18/-82.03	Good	123	PHX	FAILED

Showing 1 to 3 of 3 entries Previous 1 Next



PROBLEMS & CHALLENGES

CURRENT CHALLENGES	RESOLUTION
GoogleMaps API costs money	Changed to OpenStreetMaps API

PREVIOUS CHALLENGES	STATUS
Node.js Scalability	Fixed; Used Node.js package PM2
MongoDB Speed	Potential; Not currently an issue



SCHEDULE

Task	Jan 19 - 25	Jan 26 - Feb 1	Feb 2-8	Feb 9-15	Feb 16-22	Feb 23-29	March 1-7	March 8-14	March 15-21	March 22-28	Mar 29 - Apr 4	April 5-11	April 12-18	April 19-25	Apr 26-May 2	May 3-9
Backend Architecture UML																
Backend Importer Development																
Backend Correlator Development																
Software Design Document Draft/Final			Feb 7	Feb 14												
Front End Development																
Front/Backend Integration																
Design Review II						Feb 28										
Full Prototype Tech Demo							buffer	Mar 9								
Testing/Refinement																
Software Testing Plan											Apr 3					
Design Review III											Apr 3					
Team Website												Apr 24				
Capstone Poster												Apr 24				
UGRADS Conference												Apr 24				
Final Acceptance Demo												buffer	Apr 27			
Team Reflection Document														May 7		
User Manual														May 7		
Final Checkoff Sheet													Apr 30	May 7		
Final Project Report															May 7	

Legend:

- Completed (Green)
- In-Progress (Yellow)
- Not Complete (Orange)
- Buffer (Light Gray)



CONCLUSION

Aerospace Industry

- \$838 billion [1]
- Over 2.5 million jobs: 20% of manufacturing

Honeywell

- Largest producer of gas turbine APUs

Problem/Solution

- Data download is tedious
- CEDAS → Poor WiFi connectivity
- CEUSS → Predicts problems

Architecture

- Backend → Server
- Front End → GUI

Next Steps

- Refinement
- Testing
- Documentation





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<https://www.tealgroup.com/index.php/pages/press-releases/53-global-aerospace-industry-worth-838-billion-according-to-aerodynamic-advisory-and-teal-group-corporation>.
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- [1] <https://www.istockphoto.com/photos/aerospace-industry?mediatype=photography&phrase=aerospace%20industry&sort=mostpopular>
- [2] <http://www.aeroprobe.com/aerospace-industry/>
- [3] <https://www.aviationtoday.com/2019/09/23/textron-aviation-announces-revolution-in-business-aviation-after-faa-certifies-citation-longitude/>

Last Slide (L-R)

[4] Citation Longitude:

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[5] Bombardier Learjet 40 / 45:

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[6] Praetor 600: <https://www.airway1.com/embraer-praetor-600-receives-certification-in-brazil/>

[7] Embraer Legacy 450/500:

<https://www.safran-nacelles.com/nacelle-systems/nacelle-systems-business-jets/embraer-legacy-450/500-thrust-reversers>

[8] Gulfstream G280: <https://aerospace.honeywell.com/en/learn/supported-platforms/business-jet/gulfstream/gulfstream-g280>

[9] Bombardier Challenger 350: <https://businessaircraft.bombardier.com/en/aircraft/challenger-350#!#bba-pdp-section-4>

[10] Bombardier Challenger 350:

<https://aerospace.honeywell.com/en/learn/supported-platforms/business-jet/bombardier/bombardier-challenger-350>



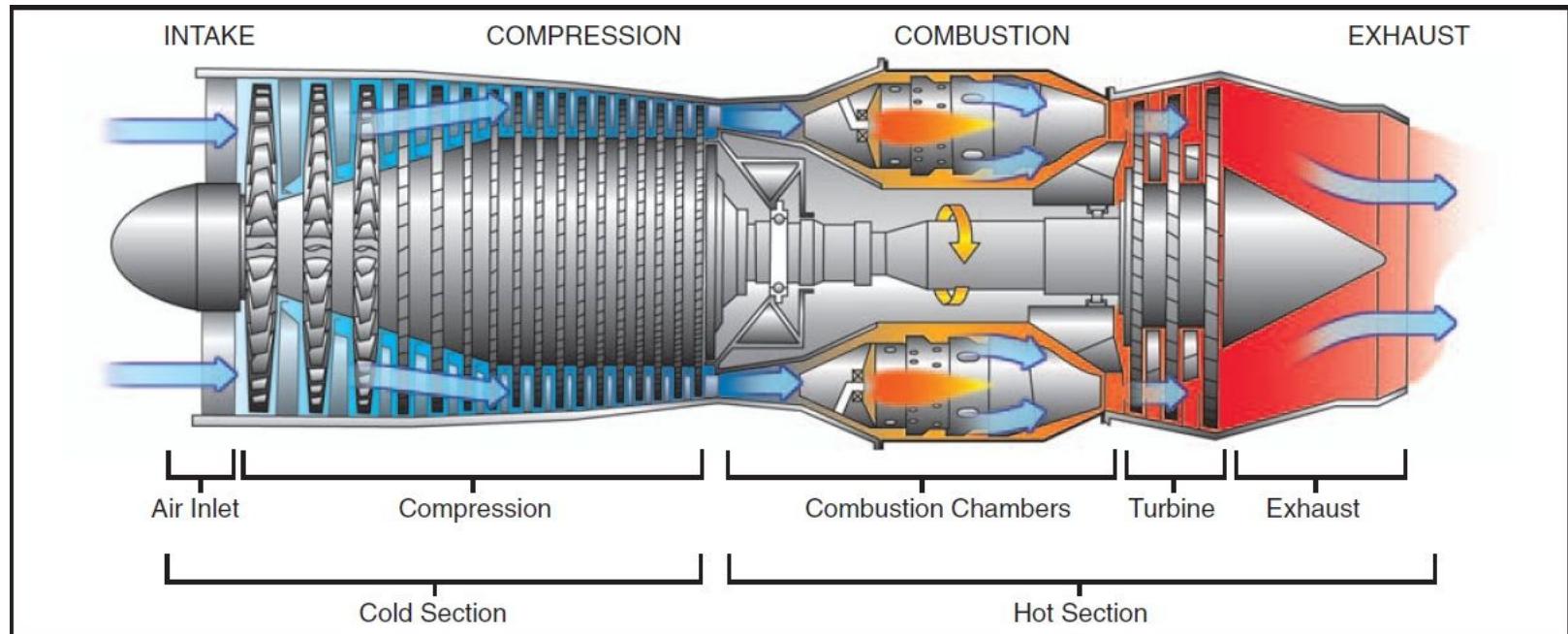
QUESTIONS?





WHAT IS A HOT START?

- Improper start technique
- Injecting fuel prior to sufficient airflow
- Engine overheats and causes damage





CEDAS & ECU

Engine Control Unit (ECU)

- Saves trending and maintenance data in non-volatile memory (NVM) during normal operation

How Does Connected Engine Data Administrative System (CEDAS) Work?

- Autonomous process
- Data wirelessly uploads to the cloud
- Data is then accessible remotely
- Hosted on a small embedded computer in the aircraft



ELECTRONIC ENGINE INTERFACE (EEI)

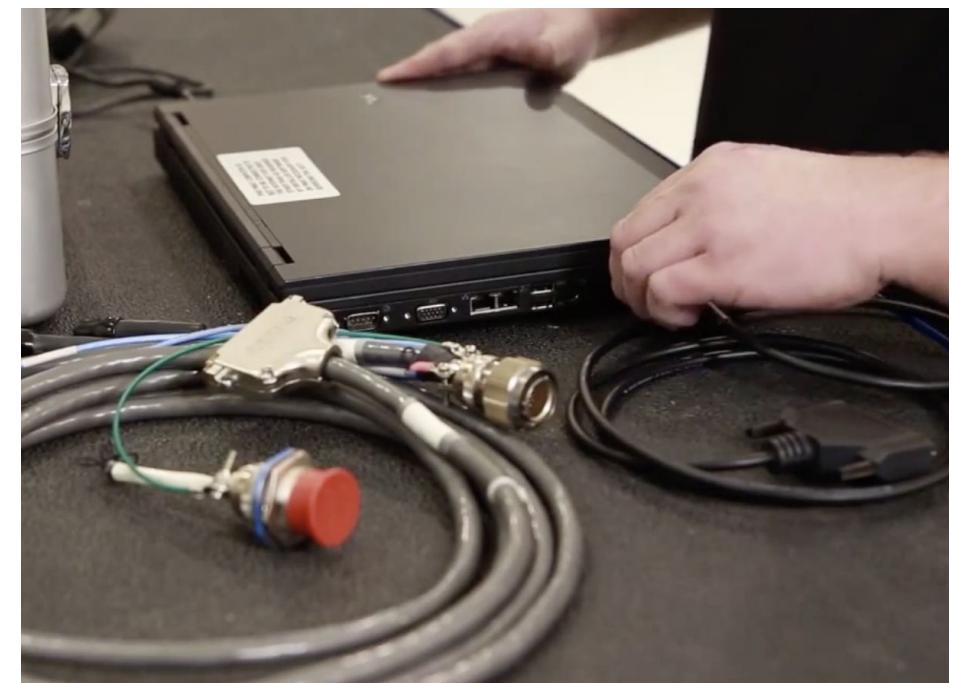
EEI: software used to get diagnostic data from the HTF7K engine

Materials needed:

- Laptop running the EEI software
- EEI download kit

Diagnostic data download process

1. Connect to the aircraft
2. Perform the download





CorrelatedFlight JSON FILE

```
  className: "edu.nau.enginair.models.CorrlellatedFlight"
  tailNumber: "N672WM"
  ✓ landingPoint: Object
    type: "Point"
    ✓ geometry: Array
      0: -95.29151153564453
      1: 29.991790771484375
  > takeoffPoint: Object
    landingDate: 2016-08-01T02:23:51.619+00:00
  > flightPath: Array
    outcome: "FAIL_NO_WIFI_AIRCRAFT"
```



CorrelatedFlight JSON FILE

OUTCOME
<ul style="list-style-type: none">• SUCCESS_UPLOAD: Indicates a successful upload with correct WAP credentials and confirmed landing location• FAIL_NO_LANDING: Indicates that the aircraft took off but did not record a landing within 24 hours of takeoff• WARN_IN_PROGRESS: Indicates that the flight was in-progress during the ADSBx download procedure; Flight must be reverified after the next ADSBx download• FAIL_NO_WIFI_AIRPORT: Indicates a failed upload due to missing WiFi connection at an airport• FAIL_NO_WIFI_AIRCRAFT: Indicates a failed upload due to missing WiFi connection configuration on aircraft• FAIL_DEAD_EDG100: Indicates a failed upload due to a broken EDG100 upload mechanism onboard the aircraft• FAIL_WAP_CHANGED: Indicates a failed upload due to changed or unconfigured airport WAP credentials