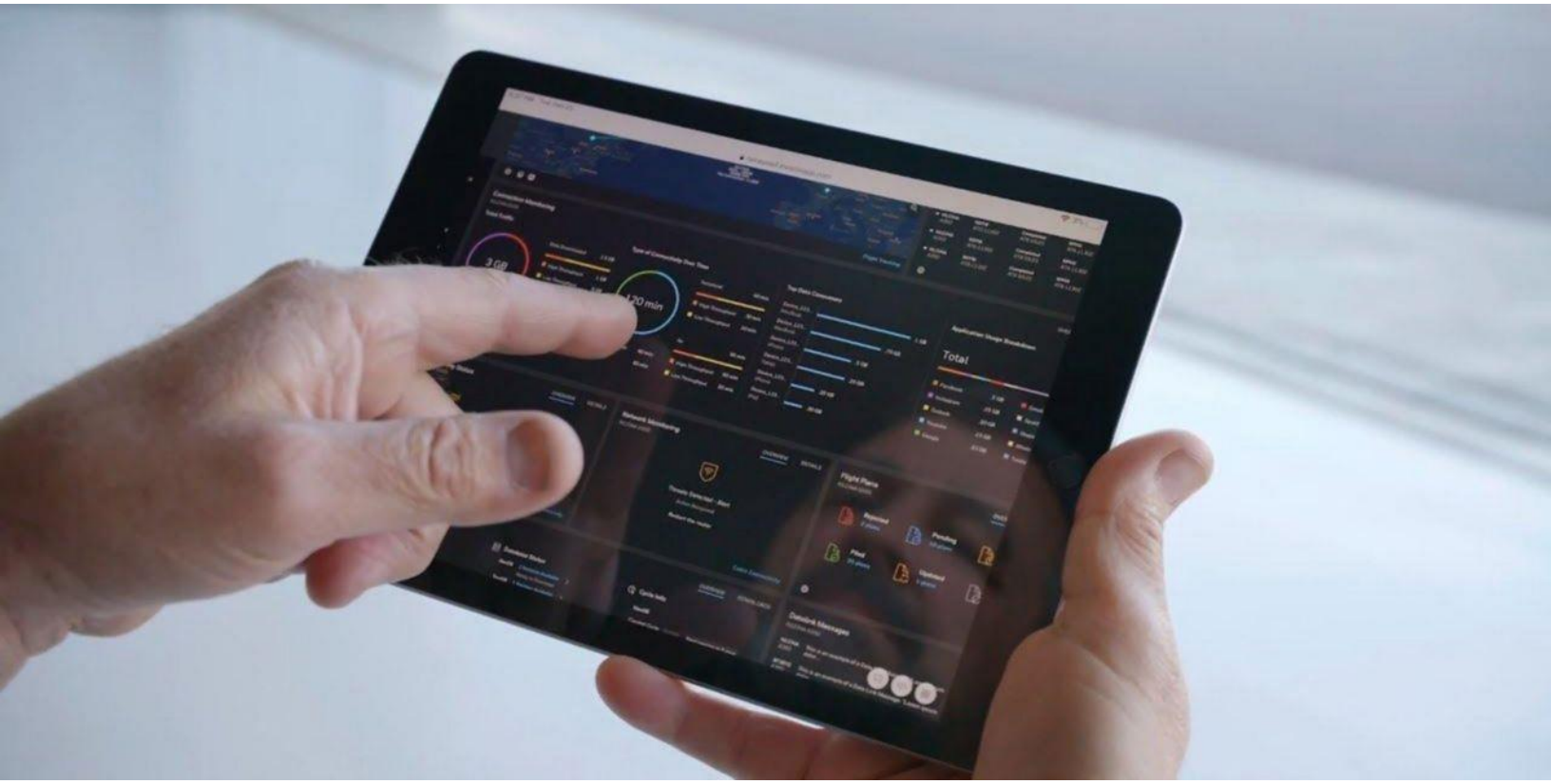

CONNECTED ENGINE DATA SERVICES (CEDS) USER GUIDE

Document Number : 21-16893 Rev A

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LIST OF ACRONYMS AND ABBREVIATIONS

ASDS	Aerospace Software & Data Service
BA	Business Aviation
CEDS	Connected Engine Data Service
CMMA	CEDS Mobile Maintenance Application
DEEC	Digital Electronic Engine Control
ECU	Electronic Control unit
EDG	Engine Data Gateway
EDV	Engine Data Viewer
ECFR	Engine Condition and Fault Reporting
ECTM	Engine Condition Trend Monitoring
EEI	Electronic Engine Interface
EEIFF	Electronic Engine Interface for Forge
EHM	Engine Health Monitoring
FBO	Fixed Base Operator
GSE	Ground Support Equipment
HDA	Honeywell Diagnostics Application
LMM	Light Maintenance Manual
MC	Maintenance Conditions
MCID	Maintenance Condition Identifiers
MSP	Maintenance Service Plan
RTDL	Real-Time Data Logger
SIGNS	Secure Infrastructure and Ground Network Service
TLD	Time-Limited Dispatch
WAP	Wireless Access Point
WOW	Weight On Wheels
STC	Supplemental Type Certificate
CDS	Cloud Data Services
FLS	Field Loadable services
FSS	Flight Service Station
OTA	Over the Air
MIMO	Multiple input Multiple Output

1.0 CONNECTED ENGINES DATA SERVICE (CEDS)

Connected Engines Data Service (CEDS) is an aircraft system that provides an autonomous wireless solution for monitoring engine health. CEDS is a Maintenance Service Plan (MSP) offering that enhances the engine reliability by increasing the volume and frequency of engine data that is available for Engine Health Monitoring (EHM). CEDS is powered by the Ensemble unit, CEDS Mobile Maintenance Application (CMMA) and Honeywell Forge. The system architecture is displayed in Figure **1**.

The Ensemble unit connects to authorized Wireless Access Points (WAP) when the aircraft is in the right conditions for engine data upload to Honeywell Forge. The Ensemble unit has the additional capability recording “Rich Engine Data” by its ability to access any engine parameter on the Engine Control unit (ECU) at a high frequency.

The Ensemble unit is controlled by the CEDS Mobile Maintenance App (CMMA) which communicate to the device via Bluetooth. The CMMA will give users the ability to setup WAP(s), initialize ECU(s), initiate engine data download, and monitor real-time parameters on the engine.

The Honeywell Forge platform is used to view the data that has been uploaded by the Ensemble unit using the Engine Data Viewer (EDV). Honeywell Forge is also integrated with CAMP EHM and automatically transmit engine data into the CAMP system for customers that have the service.

Typically, maintenance personnel conduct engine troubleshooting, data collection, analysis, and testing via a Honeywell PC-based software known as Electronic Engine Interface (EEI) or EEI for Forge (EEIFF). The use of EEI/EEIFF requires maintenance personnel to manually attach a PC to the ECU(s) Ground Support Equipment (GSE) port and download engine data to the PC. Once the data is on the PC, the data can be analyzed from the PC and/or it can be uploaded to Honeywell Forge for analysis and storage.

For aircraft upgraded with CEDS, the EEI system is replaced by the following hardware and software that autonomously access the same data and more:

- Hardware
    - Ensemble unit
        - Two Multiple Input Multiple Output (MIMO) Antennas with Wi-Fi and Bluetooth capability
    - Aircraft Installation Kit (Brackets & Wiring)
- Software
    - CEDS Mobile Maintenance Application (CMMA)
    - Honeywell Forge’s Engine Data Viewer (EDV)
    - Aerospace Software & Data Service (ASDS) E-library for field load configuration files or software

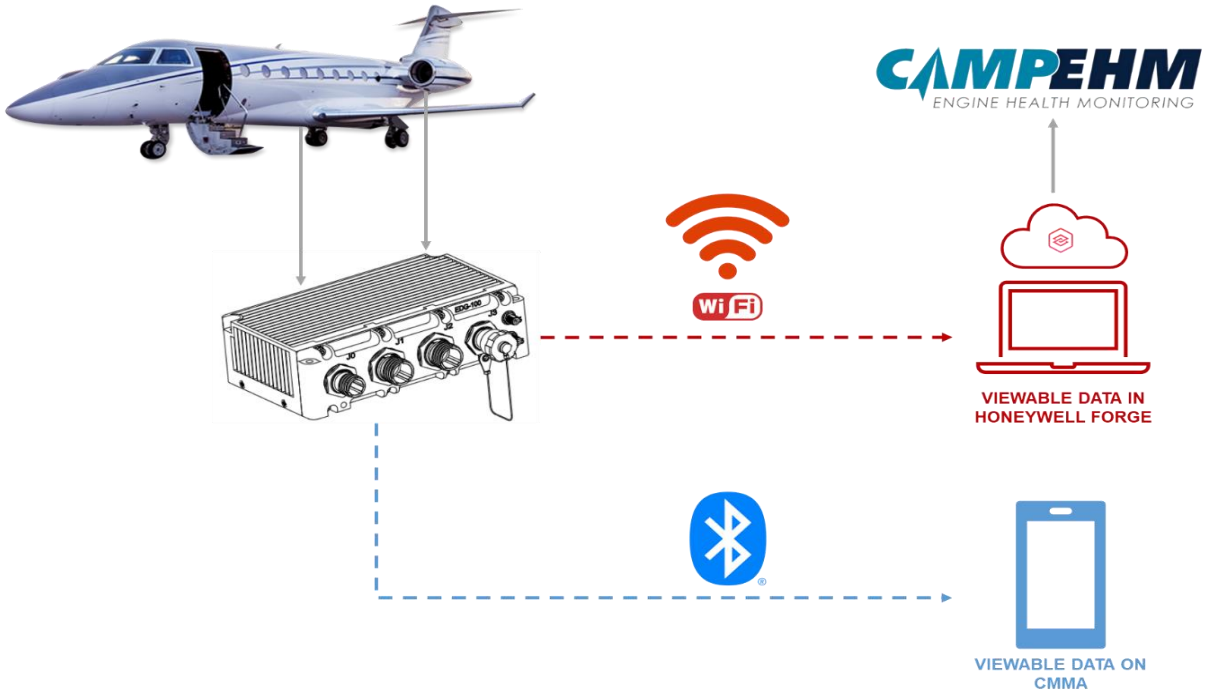


Figure 1. CEDS Connectivity Option

1.1 User Experiences

CEDS users can utilize the system for the following functions shown in Table 1.

Table 1. CEDS Use Cases

Personas	Uses	Tool
Aircraft Owner	• Monitor aircraft(s) engine health to ensure dispatch readiness	CMMA Honeywell Forge
FBO Manager	• Monitor fleet engine health to ensure dispatch readiness • Uses Honeywell Diagnostics Application (HDA) to quickly resolve necessary engine maintenance	Honeywell Forge
Field Support Engineer	• Uses Honeywell Diagnostics Application (HDA) to quickly resolve necessary engine maintenance • Uses Engine Data Viewer (EDV) analysis tools that are capable of cloud access to all ECFR data uploaded to Honeywell Forge • Uses CMMA to quickly display MCIDs on engines	CMMA Honeywell Forge
Maintenance Personnel	• Uses EEIFF Upload to place ECFR data on Forge cloud for all authorized users to access • Uses Honeywell Diagnostics Application (HDA) to quickly resolve necessary engine maintenance	CMMA Honeywell Forge

Personas	Uses	Tool
	• Uses Engine Data Viewer (EDV) analysis tools that are capable of cloud access to all ECFR data uploaded to Honeywell Forge • Uses CMMA to quickly display MCIDs on engines	
Pilots	• Monitor aircraft(s) engine health to ensure dispatch readiness • Uses CMMA to quickly display MCIDs on engines	CMMA Honeywell Forge
Service Center Manager	• Uses Honeywell Diagnostics Application (HDA) to quickly resolve necessary engine maintenance • Uses Engine Data Viewer (EDV) analysis tools that are capable of cloud access to all ECFR data uploaded to Honeywell Forge	Honeywell Forge

Honeywell

2.0 ENSEMBLE UNIT

The Ensemble unit, shown in Figure 2. Isometric View of Ensemble unit, is an engine data recording device that is Honeywell certified to directly interface with Honeywell engine's ECUs. Once in the following conditions, the Ensemble unit will automatically upload the recorded engine data to the Honeywell Forge Cloud Server for validation and display in the Honeywell Forge Engine Data Viewer.

1. Aircraft is powered up or after aircraft landed
2. Aircraft on Ground (WOW logic)
3. Aircraft engines are shutdown
4. 28 V power is supplied to ECUs and Ensemble unit
5. Connected to secure Wi-Fi Wireless Access Point (WAP)
6. Connected to the Cloud

The Ensemble unit has full access to ECUs RS422 data, which is firewalled from all other recording devices. This gives the additional capability of recording "Rich Engine Data" due to its ability to access configured engine parameter on the Engine Control unit (ECU) at a high frequency.

The Ensemble unit Wi-Fi and Bluetooth radio will not be active while the aircraft is in the air or the engines are running. Data security, user authentication and authorization are provided through the integration of Honeywell's Secure Infrastructure and Ground Network Service (SIGNS) protocol which is embedded in the Ensemble unit and the mobile application. The Ensemble unit gives higher preference to mobile app user over cloud connectivity, i.e., while active Bluetooth connection is detected all the cloud functions will be halted no ECFR / ECTM file will be uploaded to Forge.

Note:- Ensemble unit usually takes ~6-8 minutes to upload the ECFR / ECTM files to forge with internet bandwidth at ~21Mbps. Any interruption during this time would re-initiate the process. Interruption can be Engine start or loss of internet signal.

2.1 Hardware Identification

The Ensemble unit hardware can be identified by the nameplate shown in Figure 3. The part will be marked as follows:

- PNR: 99193-70500117-4 or -X
  - X is the latest part number revision
- SER: X-Y-Z
  - X is the last two digits of the manufacture year.
  - Y is the supplier's Honeywell-assigned supplier code.
  - Z is a unique five-digit sequence number.

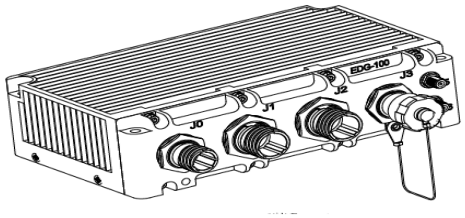


Figure 2. Isometric View of Ensemble unit

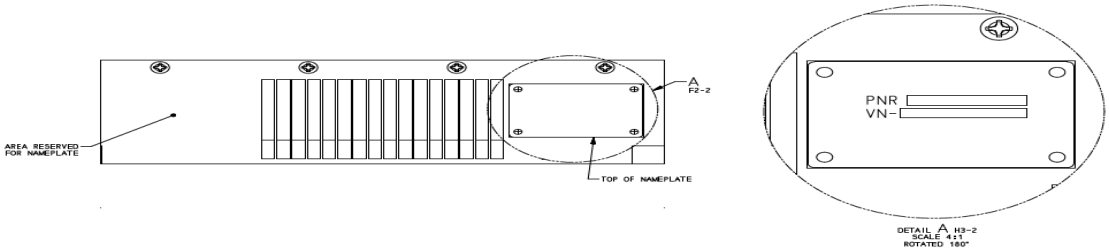


Figure 3. Ensemble unit Nameplate

3.0 HONEYWELL ACCOUNT CREATION

This section is specifically for new operators and users who need to create accounts to access the Ensemble unit data. This is applicable after the Ensemble unit is installed, the Aircraft Tail is linked to the Ensemble unit, and the customer has been successfully onboarded.

During the onboarding process for the Ensemble unit, Honeywell sets up a customer account along with an admin account for the aircraft owner. If the customer or admin wishes to grant access to new operators or users, those individuals can create Honeywell IDs and request access to the necessary applications by following the procedure outlined below.

3.1 New Operator/User Honeywell ID Creation

To access Honeywell applications and tools, such as CMMA, EDV, and ASDS, users must create or have a Honeywell ID in the Honeywell My-Aerospace portal.

- To create a Honeywell ID, please use the following URL:

  Create Honeywell ID

After creating your account, be sure to complete the setup by logging in immediately.

3.2 CEDS Applications/Tools Access for New Operator/User

After creating your Honeywell ID on the My-Aerospace portal, operators/users must follow these steps to request access to CEDS Ensemble unit data:

BA-Forge (EDV) Access:

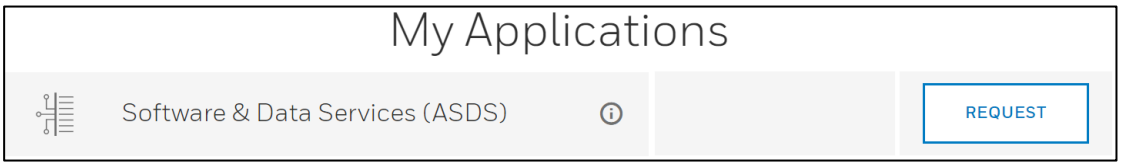
- Fill out the “Create User Account” form using the following link:

  https://aerospace.honeywell.com/us/en/secure/downloads/software-downloads

  Note: Please allow up to 1 day to receive access to BA-Forge

ASDS Access:

- Log in to the Honeywell My-Aerospace portal
- Click on your username in the upper right corner of the page
- Navigate to “Manage My Account.”
- Request access for the ASDS application as shown below



Accessing the CMMA App:

For CMMA app access, the operator/user should reach out to their operator admin.

Operator Admin Steps to Add Users

- Log in with your Honeywell ID at https://ads.honeywell.com and select the view under “Device Configurations.”
- Under the Customer Account section, select “Manage User Access.” Then click on **ADD USER** to add one of the following accounts for access to the Ensemble unit through the CMMA application
  - **Operator Admin:** Can add or remove other users in the ASDS portal
  - **Operator Accou**nt: Has limited permissions in the ASDS portal

  Note: Permissions are limited to the ASDS portal only. There are no restrictions or changes for either account when accessing Ensemble unit data through CMMA.

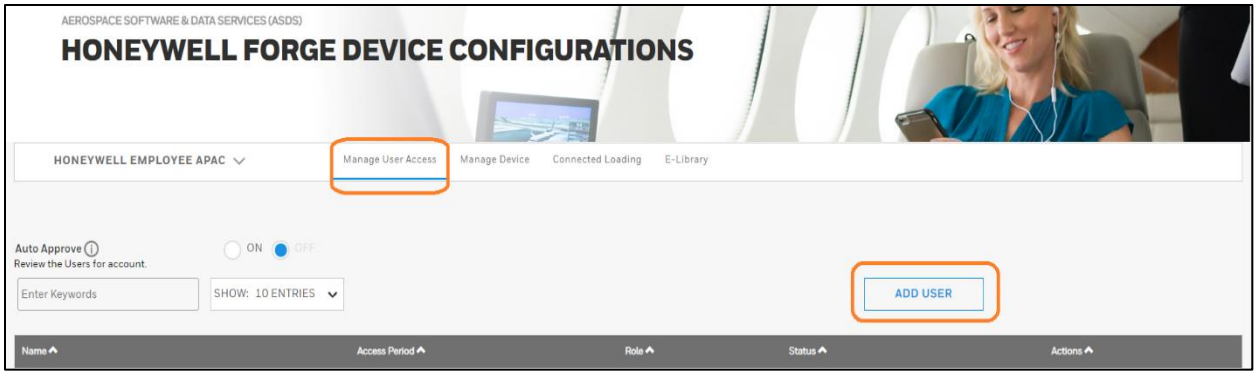


Figure 4: Add CMMA User Accounts

- After clicking on **ADD USER**, a window will open. Select the User Role, enter the Honeywell ID or registered email, and then click **ADD** to add the user

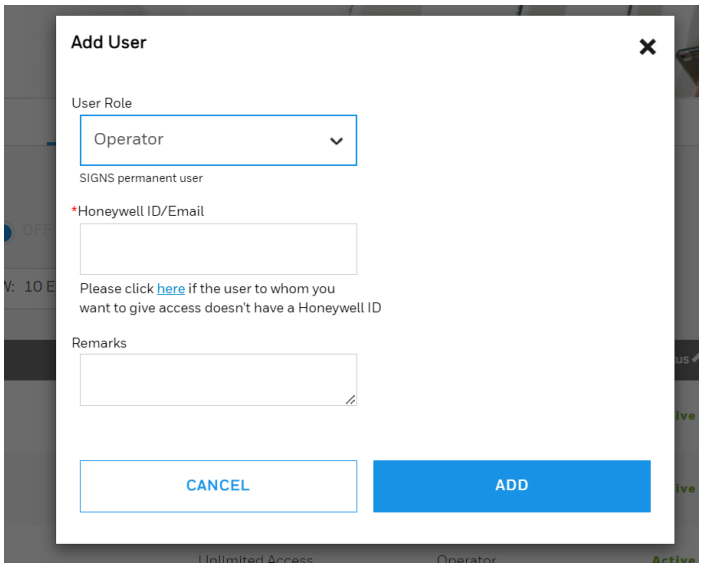


Figure 5: Add CMMA User

Note: If the user does not have access to the ASDS tool or lacks a Honeywell ID, they will not be able to access the Ensemble unit using the CMMA application

4.0 CEDS MOBILE MAINTENANCE APPLICATION (CMMA)

The CMMA is a software application that facilitates aircraft engine maintenance and diagnostics. The CMMA is targeted for operation on a handheld mobile device that runs Android or IOS latest version minus 1 with Bluetooth v4.2 at minimum.

4.1 Installation

To install the CMMA, visit the Apple App Store or the Google Play Store and search for “Honeywell Connected Engines”.

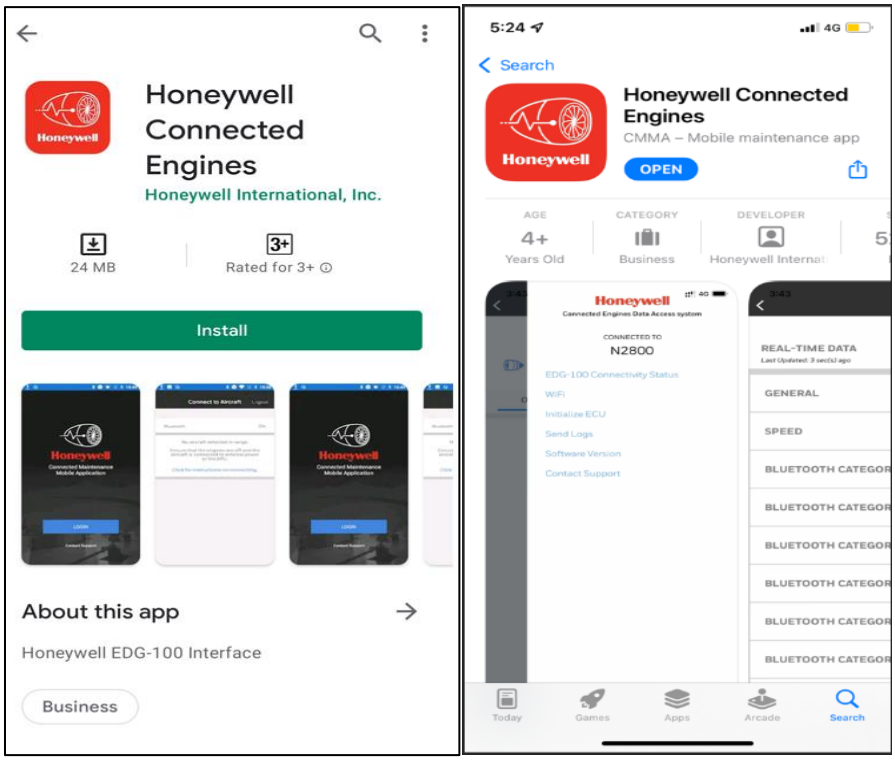


Figure 6: Honeywell Connected Engines Application on Apple App store and Google Play

4.2 Operations

Once the CMMA has been installed on your Bluetooth enabled mobile device, it can be used to complete the functions defined in this section. The CMMA can only interact with the Ensemble unit when the conditions (1 to 4) defined in Section 2.0. are met and user should have role as Operator Admin/Operator under Honeywell ASDS portal as specified in previous section 3.2.

Note: The CMMA application requires internet for login, to verify the login user is having active role under the ASDS portal. However, the Ensemble unit will not require active Wi-Fi connection to make connection with the CMMA mobile device.

4.2.1 Connect the CMMA to Ensemble unit

Follow below steps to connect to respective Aircraft Tail through “Honeywell Connected Engines” application.

1. Open the CMMA and login using your Honeywell My-Aerospace or Forge credentials as shown in Figure 7 & Figure 8.

Figure 7. CMMA Login

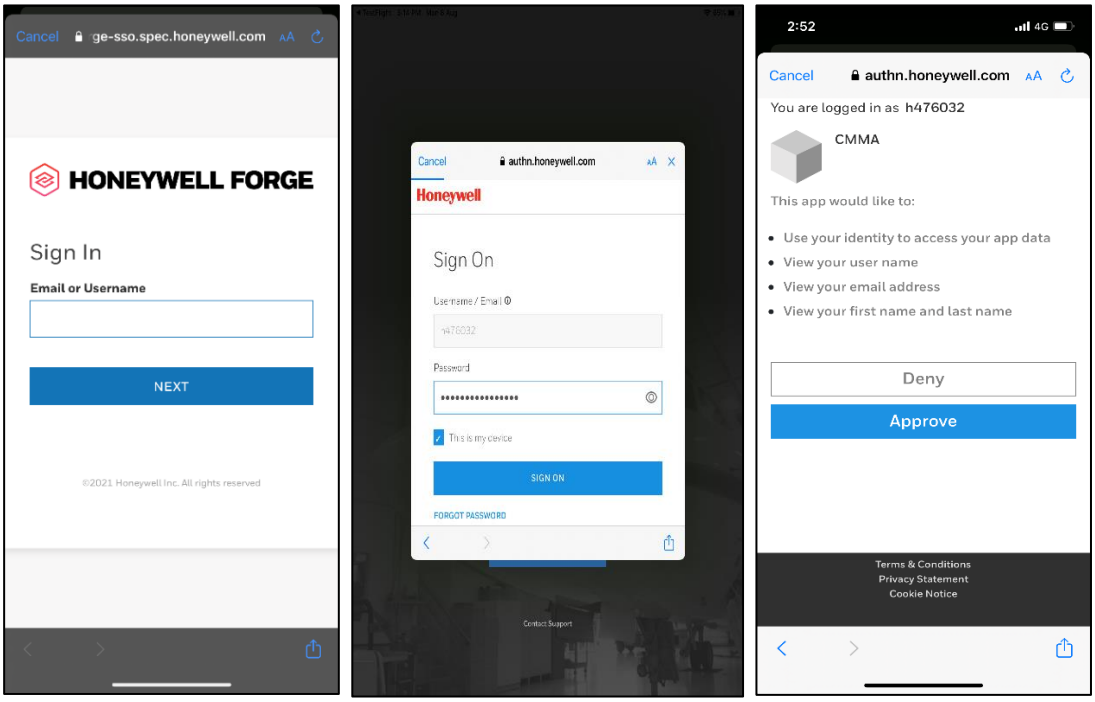


Figure 8. CMMA Login Process (Continuation)

2. Once login is completed, wait until Aircraft Tail number has appeared on CMMA Nearby Aircraft page as shown in Figure 9.

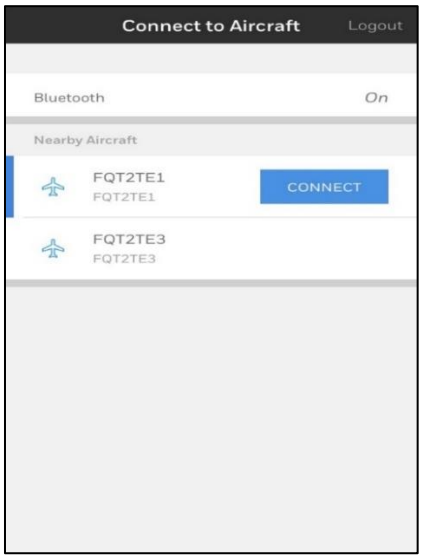


Figure 9: CMMA Nearby Aircraft List

Note: For very first usage after install the Ensemble unit default tail number "Unknown" or "PRODXX" where XX is last 2digits of Serial Number appears in place of Aircraft tail number on CMMA. In case, if no Aircraft tail appearing in the CMMA app then power cycle all ECU & the Ensemble unit by pulling out the circuit breaker and put it back on with interval of Approx. 2 mins.

3. Perform the Bluetooth Pairing as shown in Below steps.

    a. To activate pairing mode between Ensemble unit & new Bluetooth device with CMMA perform the following actions in the cockpit of an aircraft, as illustrated in Figure 10.

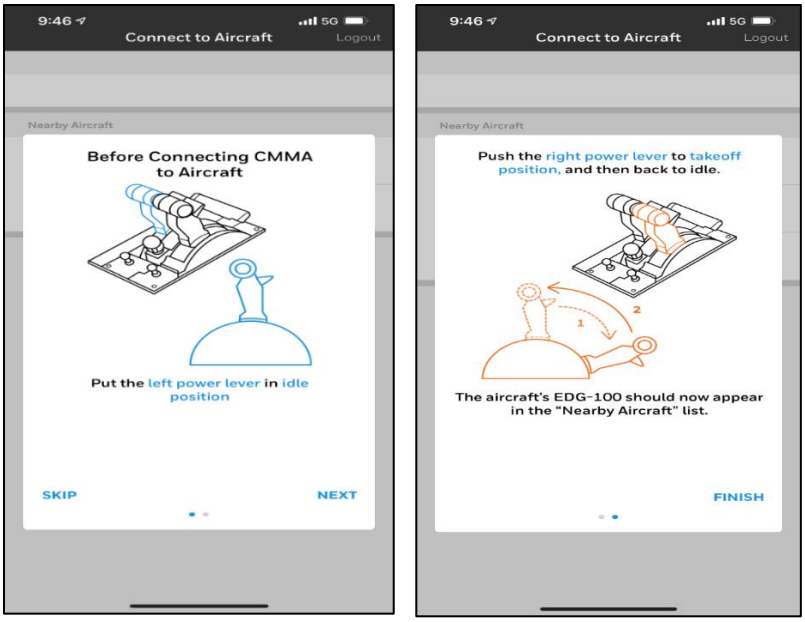


Figure 10: CMMA Pairing Initiation Procedure

b. Note that the Ensemble unit will start ECFR download upon bootup and irrespective of Wi-Fi connection, so to initiate a cockpit action please allow at least 6mins for Ensemble unit to bootup and complete ECFR download after a power cycle, so that it will detect Cockpit action immediately.

Note: This is one time activity for very first-time connection to the Ensemble unit using a new Mobile device.

c. Place the left power lever in idle position.

d. Place the right power lever in takeoff position and wait for 5s then return to idle position.

4. Select “Connect” on the desired tail number from the list of aircraft as shown in Figure 9.

5. To connect with assigned aircraft Tail, user should pair the Mobile device with the Ensemble unit for very first time, hence a screen with Bluetooth pairing request appears on CMMA.

6. User should enter the pin to pair received on top screen, in Bluetooth pairing request pop-up screen, as shown in Figure 11.

Note:

a) User should use Factory account login credentials for very first usage to configure Wi-Fi until device transfers to Customer account. Also, ***user should have Honeywell ASDS account, else user authentication may fail and the CMMA shows invalid user popup or no PIN and exits****.*

b) *User to also make sure that the procedure described in section 3.1 and 3.2 are followed properly. However, If the issue persists then user can contact fssaccounts@honeywell.com.*

In any case, if installer faces any issues, please go through the next section for troubleshooting steps or contact Honeywell.

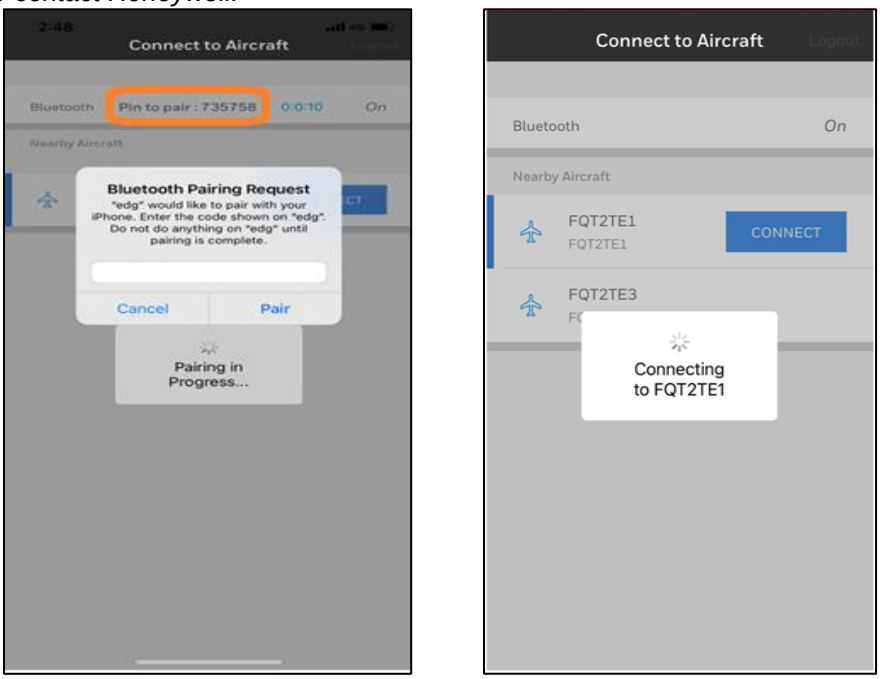


Figure 11: Connect to Aircraft Tail

7. User will see the following set of screens, establishing a secured connection with an Ensemble unit.

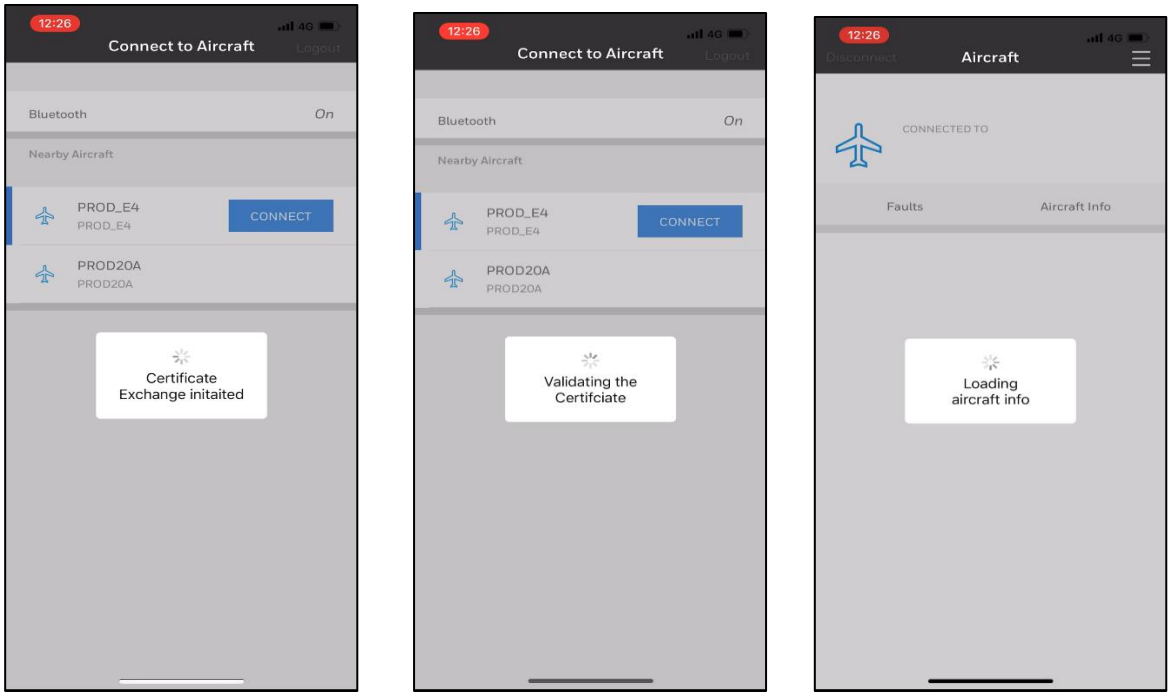


Figure 12: User Authentication to Aircraft Tail

8. User can now see respective aircraft tail details as shown in Figure 13. It displays two tabs option “Faults” and “Aircraft Info”, within the “Faults” tab, we have option to navigate to Left or Right engine, the users can select it for maintenance information of the respective engine. The “Aircraft Info” tab, where users can get details of the aircraft information, ECUs information for left and right engines.

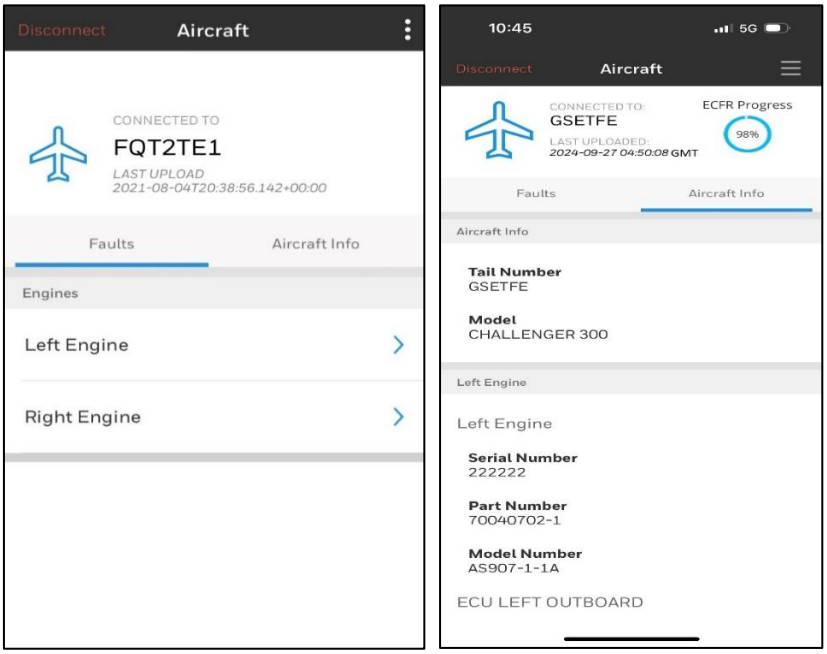


Figure 13: CMMA Home Screen

9. Users can access menu option in the top right corner as indicated by the three dots. This menu will be used to action some of the other functions like Ensemble unit Connectivity Status, FLS Software Status, Wi-Fi, Initialize ECU, software version and contact support as shown in Figure 14.

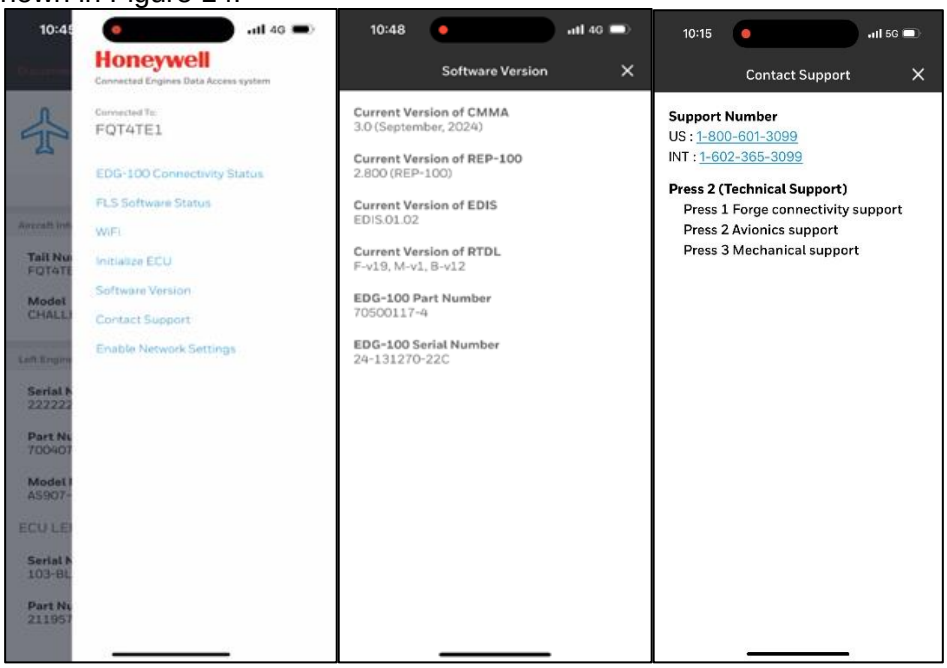


Figure 14: CMMA Side Menu

10. Select “Software Version”, it allows users to see current software details on the system. Selecting “Contact Support” gives users immediate access to support options.

4.2.2 Ensemble unit Connections Troubleshooting

Procedure to perform troubleshooting Ensemble unit connections:

1. Figure 15 can be used to troubleshoot Ensemble unit, as it will indicate where the system has failed to connect.

2. If the Ensemble unit is not connecting to the ECUs, check the connection and cabling to the Ensemble unit (J0, J1 and J2 connector ports).

3. It is recommended to wait at least 30 – 60 seconds after the connection established and before any operation on the CMMA. This will allow time for the CMMA to fetch required configuration parameters details from Ensemble unit in the background.

4. If CMMA does not retrieve Aircraft Info as expected, then try power cycle the Ensemble unit as this might occur due to prolonged operational hours (i.e., Greater than 6 hours).

5. If the CMMA trying to connect but shows getting aircraft info for an extended period then it means the CMMA is not paired/authenticated as trusted with Ensemble unit, hence Ensemble unit requires Cockpit action, refer section 4.2.1.

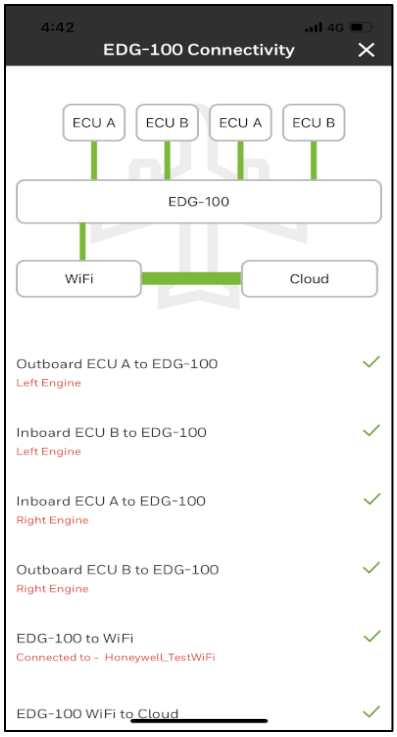


Figure 15: Ensemble unit connectivity Status

6. If the CMMA continuously fails to connect, try removing the paired Ensemble unit device from the phone settings -> Bluetooth -> click on ⓘ next to Ensemble unit and select “Forget This Device” as shown in Figure 16 and then try connecting from CMMA.

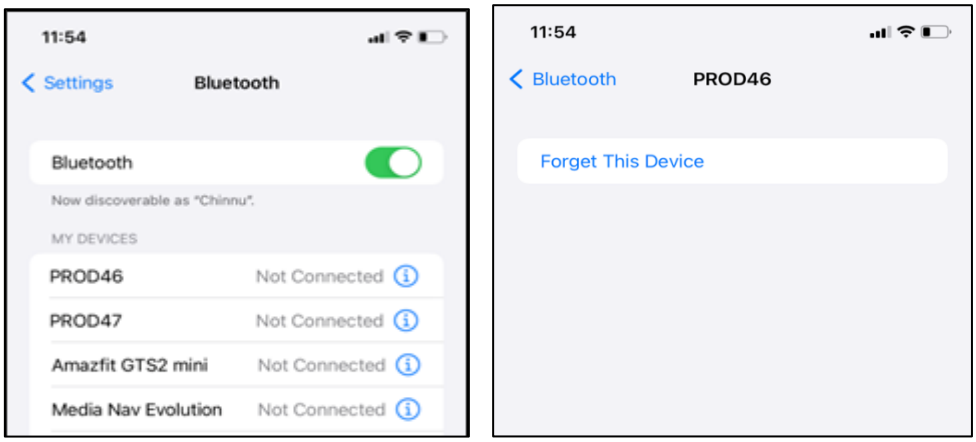


Figure 16: Remove the existing paired Ensemble unit device

4.2.3 Wi-Fi Configuration

The CMMA is used to configure and authorize the Ensemble unit connects to WAPs. Users can only manage Wi-Fi whenever the Ensemble unit is in the conditions (1 to 4) defined in Section 2.0. And then, users can search, save, and add new network connections. This includes wireless

hotspots that may be the mobile device that CMMA has been installed. This setting can be accessed by selecting “Wi-Fi” in the CMMA Side Menu as shown in Figure 14.

4.2.3.1 Connect to Available Networks

Follow below steps to connect to available Wi-Fi networks.

1. Users can view both nearby Available Networks and Saved Networks in the Ensemble unit as shown in Figure 17.

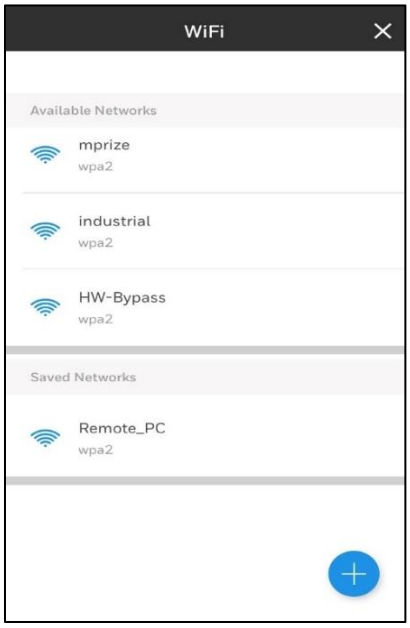


Figure 17: Available and Saved Wi-Fi Networks

Note: To connect to an open Wi-Fi network, go to next section 4.2.3.2.

2. To configure new Wi-Fi network to Ensemble unit, user can follow either of steps below:

   a) Select the Network name from Available networks list as shown in Figure 17 and enter only Password and Wi-Fi Nickname in next page as show in Figure 18. Click “Next” to proceed.

   b) Click on “+” symbol on right corner of the app page as shown in Figure 17. A new app page appears to Enter Wi-Fi Credentials as show in Figure 18. User should enter Network Name, Security Mode, Password and Wi-Fi Nickname. Click “Next” to proceed.

   Note: As a best practice avoid list of (any) special characters in for Network Name, example:- : ?, ", ‘, $, [, \,], +, space. If user accidently added any network with special character in it, then user is advised to remove the network using CMMA app.

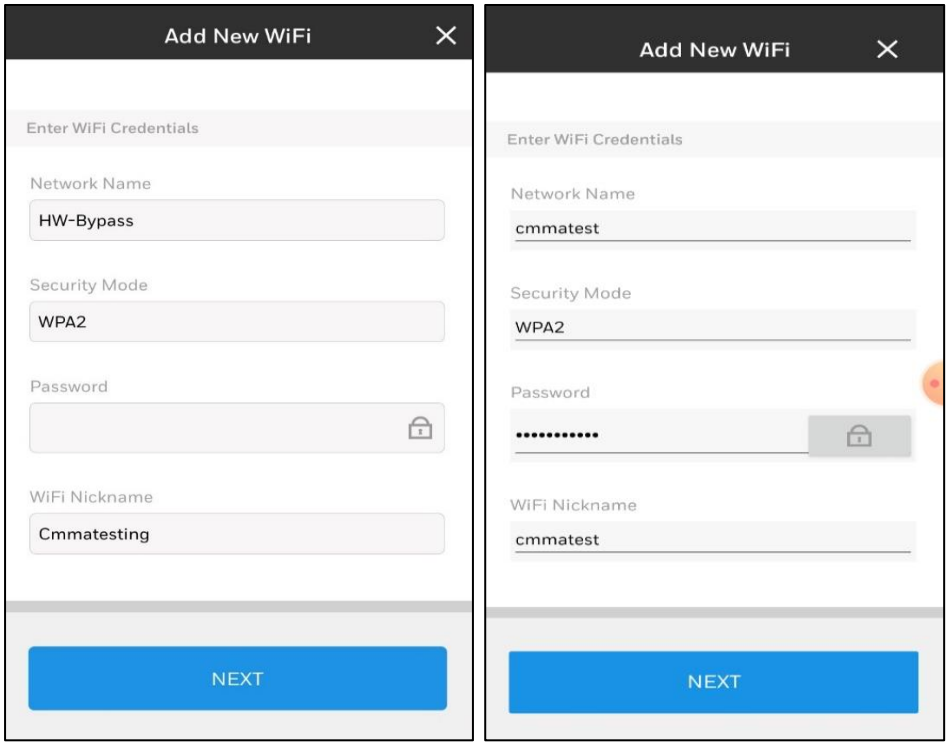


Figure 18: Adding Network Page 1

3. The next page request data regarding GPS Location as shown in Figure 19, by clicking “GET GPS COORDINATES”, it can automatically enter the latitude and longitude information. User can also enter the latitude and longitude information manually. Click “Next” to proceed.

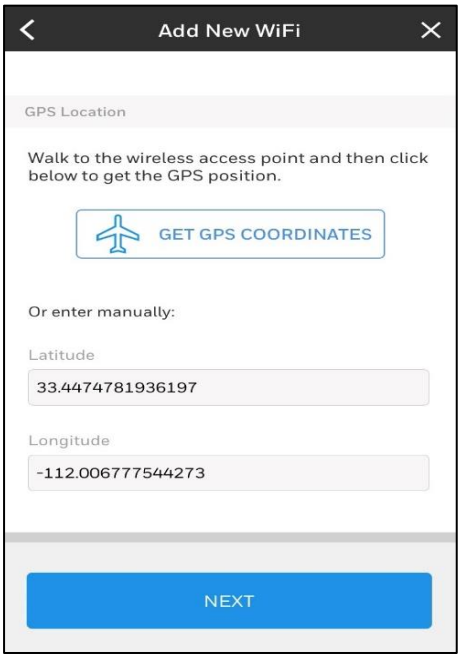


Figure 19: Adding Network Page 2

4. The next page request Additional Required information as shown in Figure 20. Users need to enter Wi-Fi Router model, install height, installation location, airport code, Wi-Fi owner, WAP type. If user don't want to share the network info to other Ensemble units then while adding the new Wi-Fi network user should keep the "Shared Network" to OFF. Click to "ADD CONNECTION".

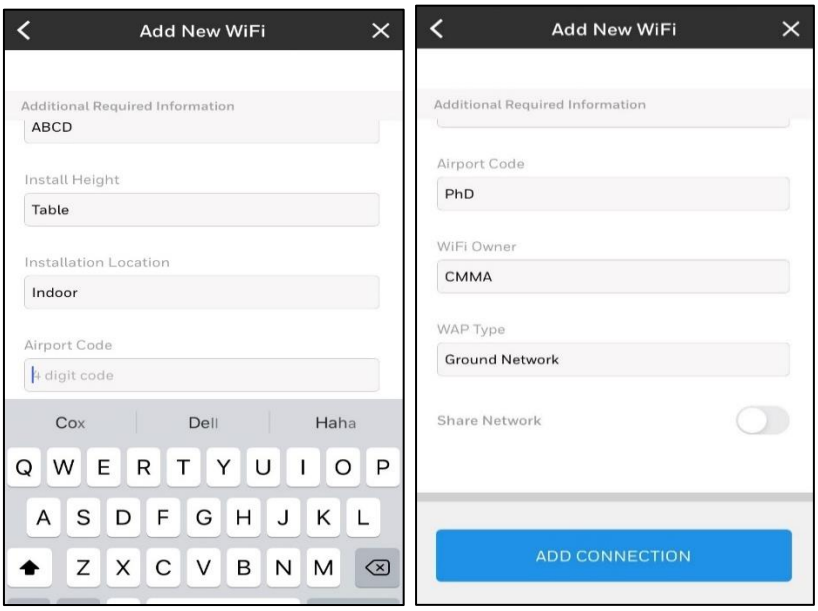


Figure 20: Adding Network Page 3

5. Once Network details have been provided, the network will be added to the Saved Networks list as shown in Figure 21.

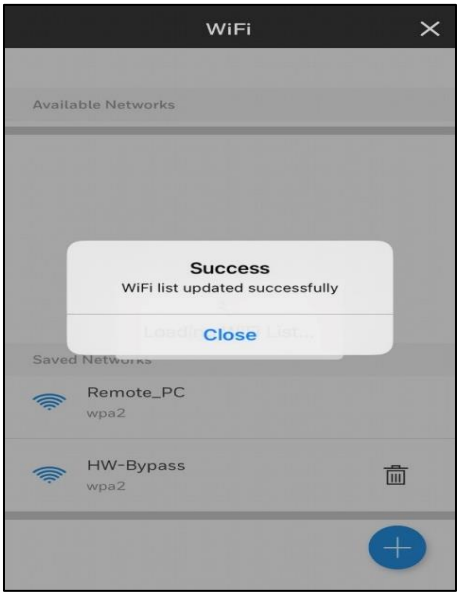


Figure 21: Adding Network Status

6. Once the Network is added successfully, check the Ensemble unit Wi-Fi connection status by accessing the “Ensemble unit Connectivity Status” in the CMMA Side Menu as shown in Figure 14 and ensure all the connections in green as shown in Figure 15.

7. If Shared Network is selected to ON, the network will be placed on the Saved Networks list of shared type and the user cannot delete afterwards. However, the network will be shared to the other EDG100s belongs to the same customer/operator.

8. Otherwise, if Shared Network is not selected or set to OFF, the network will be placed on the Saved Networks list of private type. A trash can symbol will show next to the respective network, as shown in Figure 22, to allow the user to delete the network from Saved Networks list if necessary.

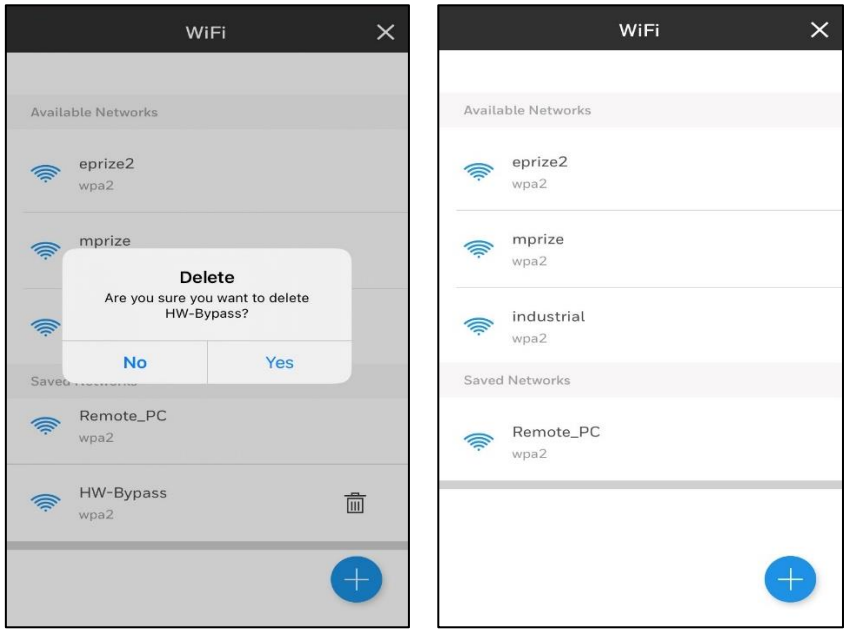


Figure 22: Deleting Saved Network

4.2.3.2 Connect to OPEN Networks

Connecting the Ensemble unit to OPEN type networks raises security concerns as the OPEN networks are not secure and prone to hacking and illegal access to connected devices. By default, adding an OPEN network is disabled on CMMA app for security purpose as shown in Figure 23.

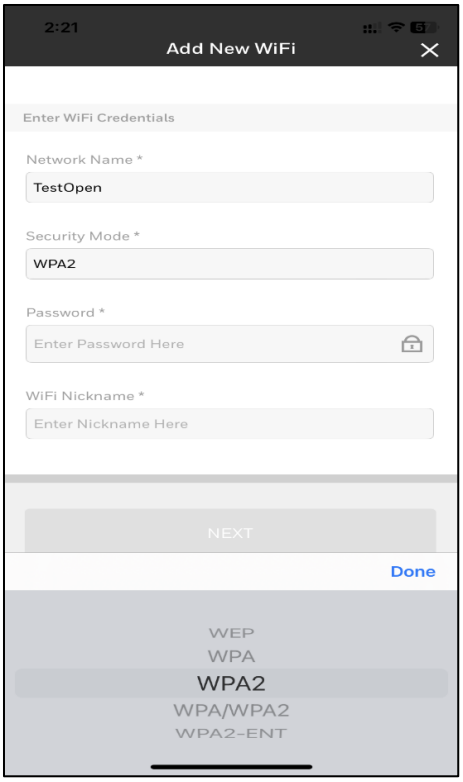


Figure 23: CMMA without OPEN Network

However, the user can enable adding an OPEN network to the Ensemble unit through CMMA provided for only certain business cases which the user is responsible for consequences.

Click on the “Enable Network Settings” option from the CMMA Side Menu as shown in Figure 24 and then proceed to click “Enable” on the next popup to enable the OPEN network option in Wi-Fi adding page.

User can navigate to the Wi-Fi page to add OPEN network as shown in Figure 25 with subsequent warning messages to user.

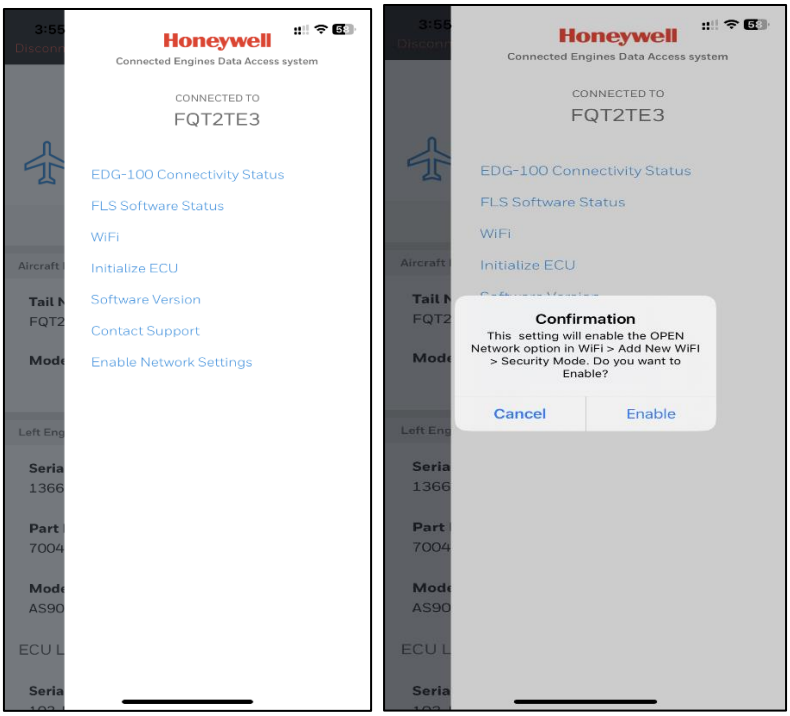


Figure 24: Settings to enable OPEN network

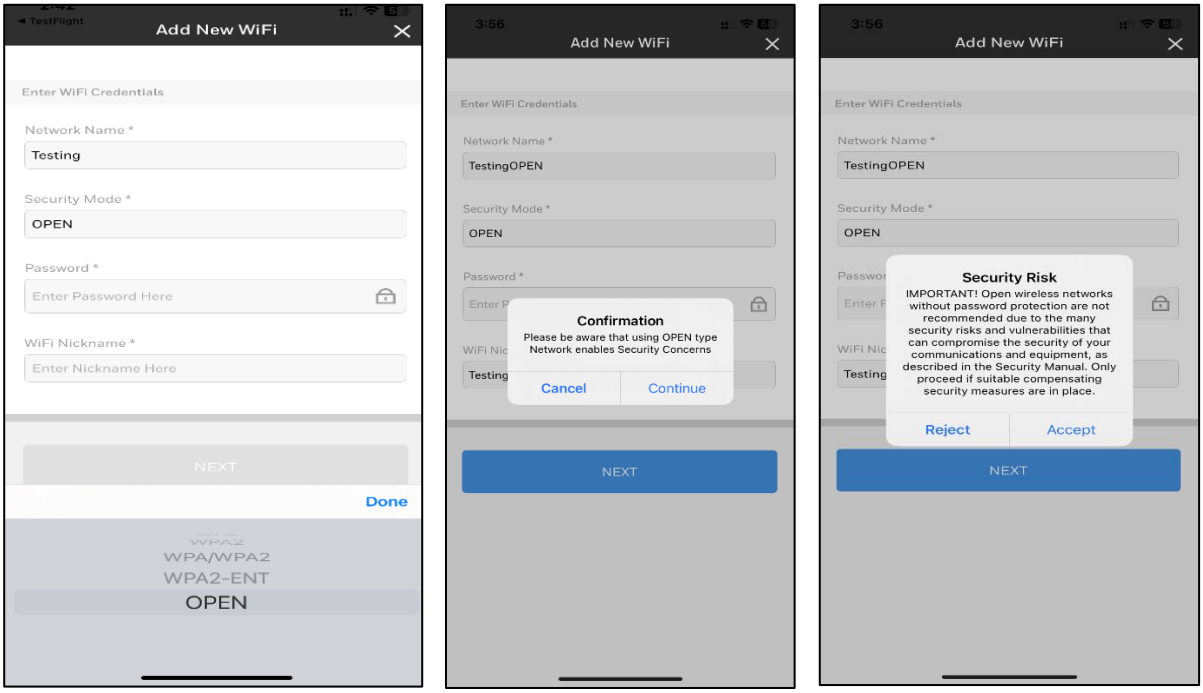


Figure 25: CMMA with OPEN network enabled

Now the user can proceed to add OPEN network following the steps from section 4.2.3.1. However, user should click on Continue and accept the Security Risk before proceeding to add OPEN network.

4.2.3.3 Wi-Fi Status & Switching Option

On CMMA app user can view the Wi-Fi Network name (SSID) to which Ensemble unit is connected to on the connectivity page. On CMMA, the user has option to switch to another saved Wi-Fi networks in the Wi-Fi page by clicking the switch network icon on listed saved networks.

Note:- User should make sure the Wi-Fi is active before it can be switched.

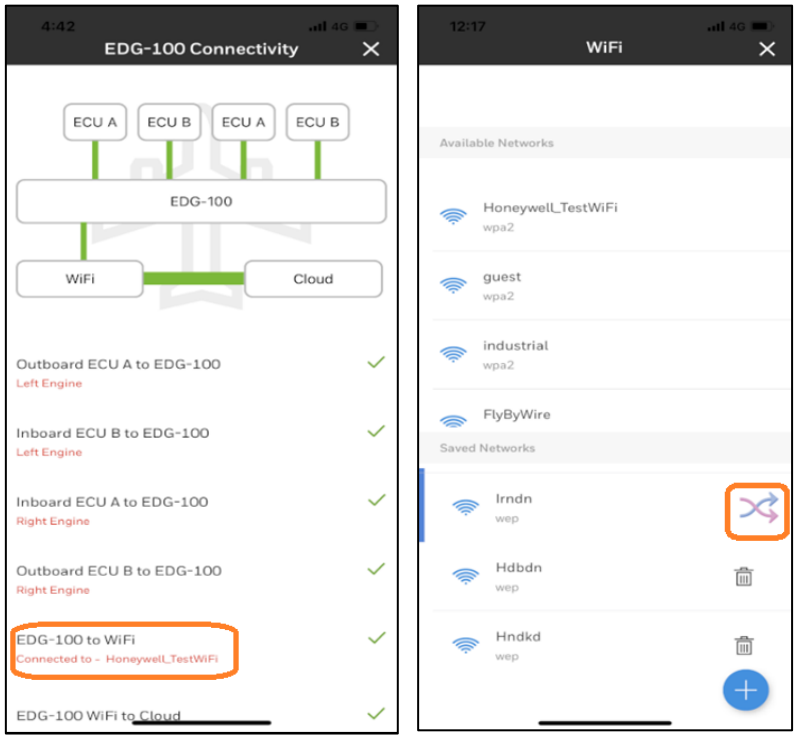


Figure 26: Switch Wi-Fi

4.2.3.4 Setting Wi-Fi (mobile phone) Hotspot

Operator can configure his/her mobile hotspot for Ensemble unit to connect to internet in case there is no AC Wi-Fi onboard, or the hangar Wi-Fi access point is unavailable. The hotspot settings in android and apple devices are different. Following links will guide on how to enable mobile hotspots.

Apple -> https://support.apple.com/en-us/HT204023

Note: To change the name of your Personal Hotspot: Go to Settings → General → About → Name (Ensure to type only ASCII characters). Also stay on hotspot screen until Ensemble unit is connected to your Wi-Fi network.

Android -> https://support.google.com/android/answer/9059108

Users are advised to use different devices for Wi-Fi hotspot and CMMA app, as switching out of setting tab disables the hotspot in few devices.

4.2.4 Real Time Engine Data Monitoring

The CMMA has the capability of reading current or stored faults or monitoring real-time parameters of the ECUs. This capability can be very useful to technicians and maintenance personnel to troubleshoot the aircraft that an Ensemble unit is installed on, even in remote locations.

Maintenance Condition Identifier (MCID) and Real Time Data Logger (RTDL) parameters can be configurated on the Ensemble unit based on customer needs and ECU software version, please contact Honeywell.

4.2.4.1 Maintenance Condition Identifier (MCID)

To access the faults that may be current or stored on the ECU, users must select the desired engine under the Faults tab of the CMMA Home Screen, as shown in Figure 13. This will display the MCIDs that are currently on the ECU, as shown in Figure 27. At the top of the list, there are tabs to select either the Outboard ECU A or Inboard ECU B. On the right-hand side of the MCID, users can select the troubleshoot icon which will take them to the Honeywell Forge Diagnostics, described in section 8.b, which will assist in getting to the root cause of the MCID.

Note: CMMA should not be used for TLD determination. Review validated data on Honeywell Forge Engine Data Viewer, described in Section 5.1.1.

Note: For the first time connect to an aircraft, CMMA requires few minutes to fetch MCIDs from ECUs.

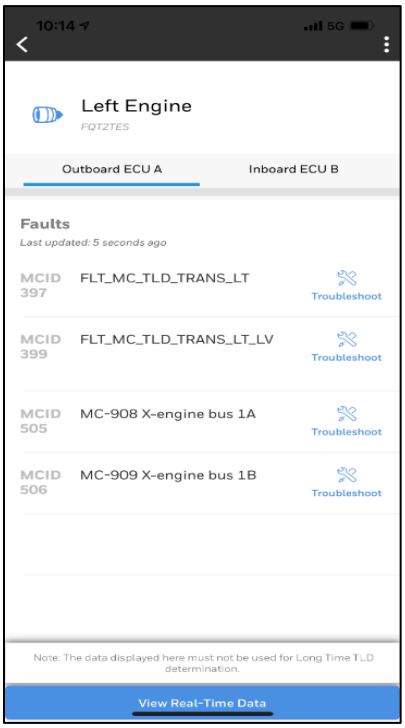


Figure 27: Viewable Maintenance Conditions

4.2.4.2 Real Time Data

To access Real-Time data, select the “View Real-Time Data” button at the bottom on the Faults page, shown in Figure 27. This will display the Real-Time Data page shown in Figure 28. Users will have access to the following sections of data for real-time viewing.

- General
- Speed
- Command Category
- Position Category
- Flight Category
- Speed Category
- Temperature Category
- Engine Category
- Fuel Category
- Fault Category
- Pressure Category

Each category can be expanded by selecting the dropdown icon on the right side of the section header. The ECU parameters displayed here can be very helpful while troubleshooting the aircraft. For details of the available parameters, refer to Section 9.0.

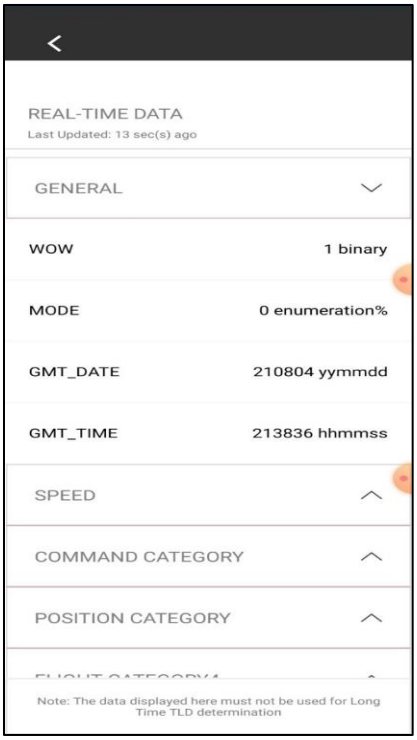


Figure 28: Real-Time Data Display

4.2.5 ECU Initialization

The CMMA has the capability to initialize the ECUs of the aircraft if required. To start this process, complete the following.

1. Select “Initialize ECU” in the CMMA side-menu by selecting the three dots on the top-right corner of the home screen as shown in Figure 14.

2. CMMA will direct to the ECU Initialization screen, where the user should select “Start Initialization” to start the process and selecting “Continue” to the prompt as shown in Figure 29.

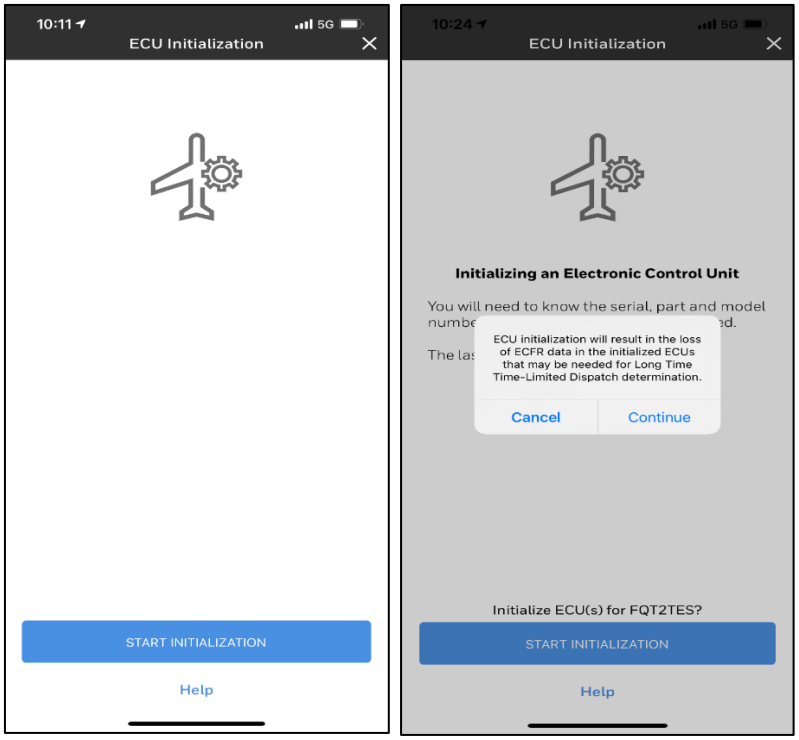


Figure 29: ECU Initialization Screen & Warning

3. Select the ECU(s) on the aircraft that are being initialized and select “Next: Enter Serial Number” as shown in Figure 30.

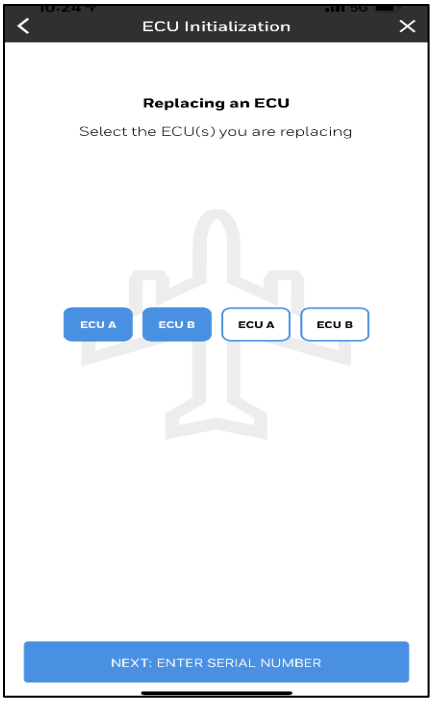


Figure 30: ECU(s) Selection

4. Update the specific Engine details as shown in Figure 31 that need to be changed and select “Next: Confirmation”.

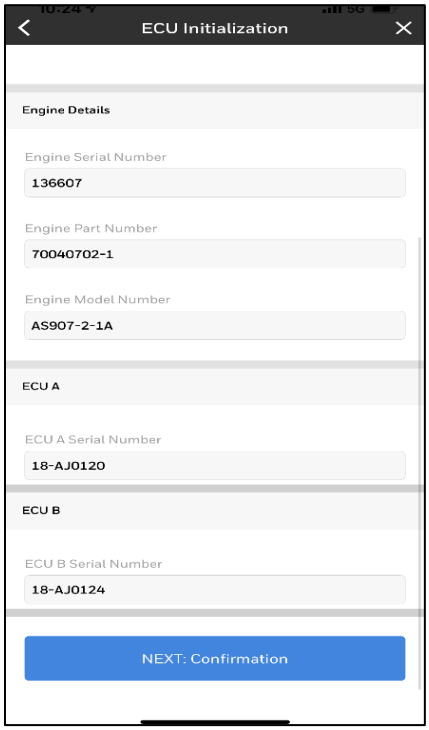


Figure 31: Update Engine Details

5. Confirm the Engine details as shown in Figure 32 that have been updated as indicated by the “NEW” icon and select “Initialize” to start the ECU initialization.

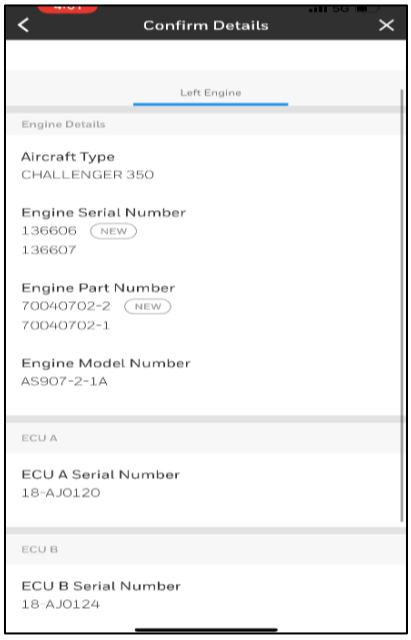


Figure 32: Confirm Engine Details

6. The ECUs will upload data, clear all data and notify when the Initialization has been complete. Close the page when complete

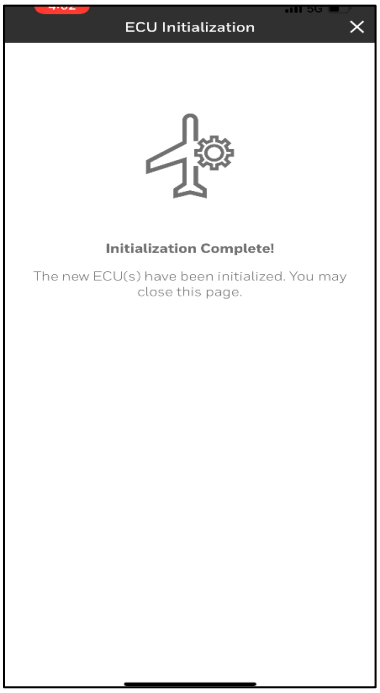


Figure 33: ECU Initialization Status

4.2.6 Ensemble unit Configuration Files/Software Update

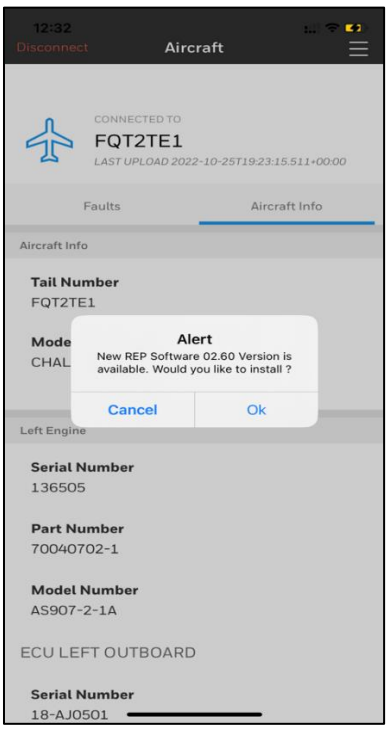
An automatic software update feature is support by Ensemble unit, that allows future software upgrades to the Ensemble unit to be completed over a wireless connection. No manual intervention is required except the approval process on the CMMA mobile application.

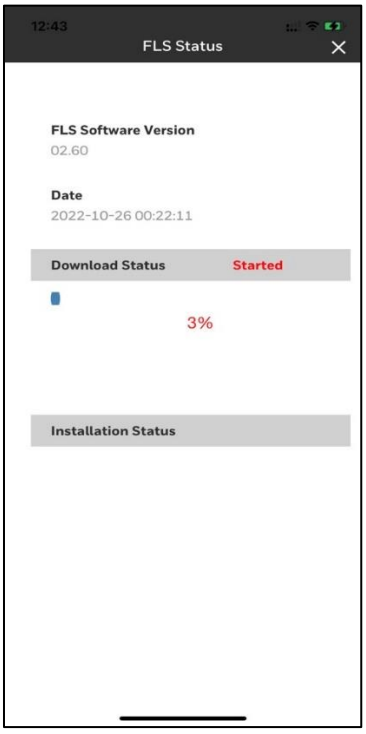
Users will be notified of new software release by Honeywell through the CMMA app once connected to the Ensemble unit. To initiate installation, the user approval is required as shown in Figure 34. Users have the option to either initiate installation by clicking “Ok” button or defer the installation for later time by clicking the “Cancel” button.

The software upgrade process takes approximately 10-15 minutes based on the internet speed. User should initiate the software upgrade only if a stable internet connection is available to Ensemble unit. During the software upgrade process, a progress bar will be shown for both new software download and the software installation as shown in Figure 34.

Once the updates are finished, the Ensemble unit will restart automatically to complete the installation process. As a result, the CMMA app will be disconnected.

Note: Post user approval, during software update, it is optional for user to stay connected using CMMA and user can connect at any time to see status on the CMMA.





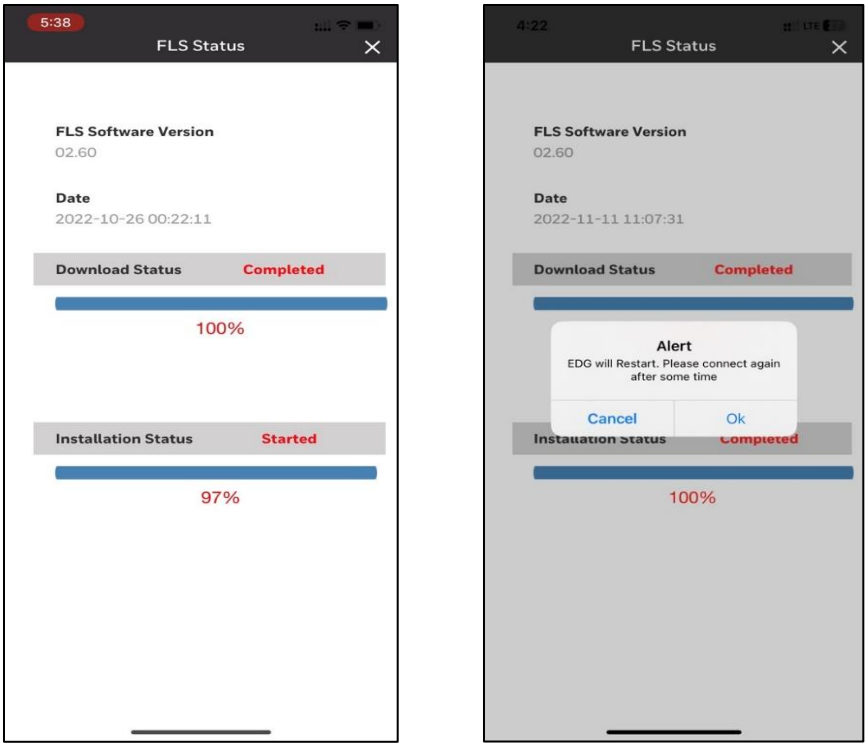


Figure 34: Software Update Screen and Progress

For the configuration files update to the Ensemble unit, no user approval is required on the CMMA application. The user can see the version of configuration files present in Ensemble unit using the CMMA application.

4.2.7 Error message displayed on CMMA

Below table shows the error message displayed on CMMA when Ensemble unit is unable to perform assigned requests.

S. No	CMMA Error Message Display	Description
1	Data not confirmed by ECU or Ensemble unit	Data is not sent by ECU or Ensemble unit.
2	Communication with ECU has been lost or disabled	Communication with ECU has been lost or disabled
3	Illegal Command, Flight Statusnot WOW_AND_OFF.	This error code will appear when Ensemble unit do not get the correct Flight status from ECUs. WOW_AND_OFF means Weight on Wheel and Engine OFF.
4	Command cannot be executed in the current mode	The command provided cannot be executed by Ensemble unit due to current mode of operation.
5	Command data was corrupted after being received	The command data received to CMMA got corrupted.
6	Command refused until previous command completes	Ensemble unit process one command at a time and waits until it completes.
7	Command parameters are not valid	Command provided to Ensemble unit is not valid
8	Date and Time mismatch between ECU	Date and Time mismatch between ECU or Ensemble unit

	or Ensemble unit	
9	Bad Acknowledgement received on Ensemble unit	Invalid Acknowledgement received from ECUs to Ensemble unit

Table 2: CMMA Error Message Display

5.0 HONEYWELL FORGE

Honeywell Forge (https://bga.honeywellforge.com/) is a connectivity solution that uses a comprehensive portfolio of flight database services, including engine health monitoring, on a single seamless web-based platform. It allows aircraft maintenance personnel, service center mechanics, pilots and private aircraft owners to access the Engine Condition and Fault Reporting (ECFR) and Engine Condition Trend Monitoring (ECTM) data that is captured by the ECUs and DEECs of authorized aircraft on the Forge account. It is the final tool used to view engine data and perform Time-Limited Dispatch (TLD) determination. The Honeywell Forge dashboard display can be seen below in Figure 35.

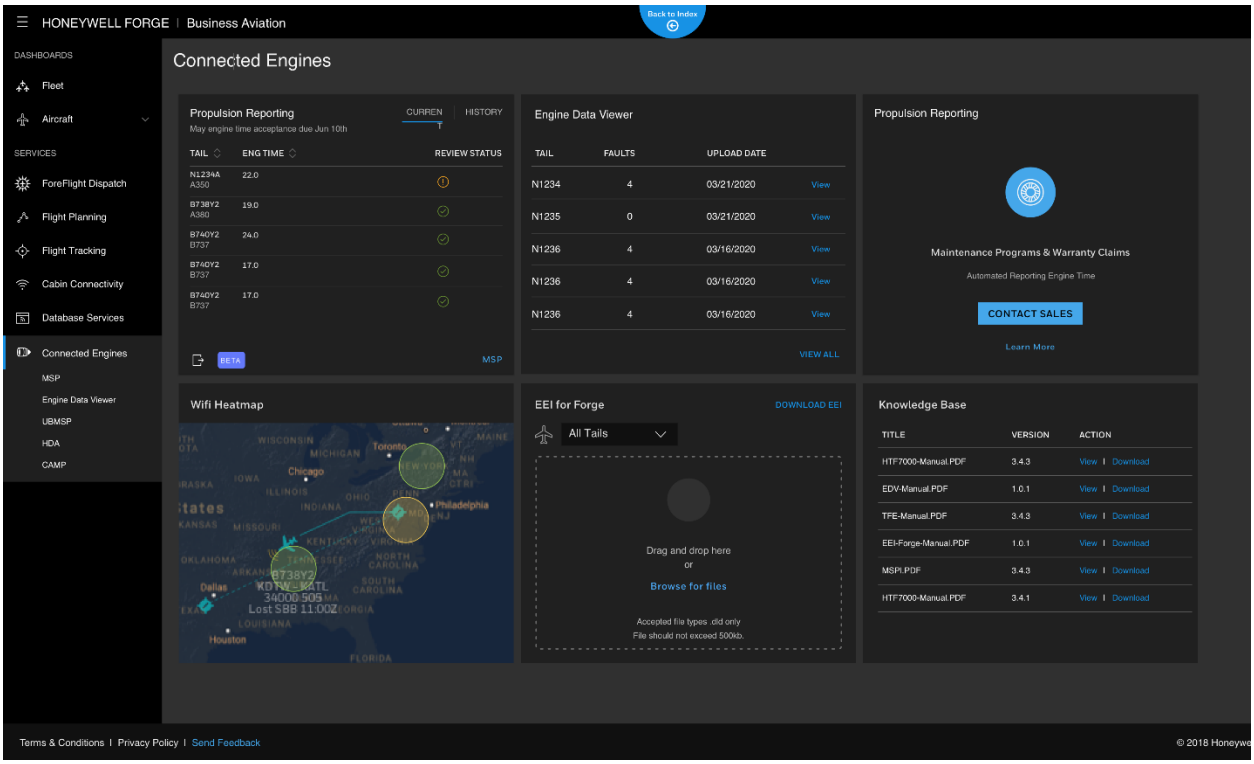


Figure 35: Honeywell Forge Dashboard Display

5.1 Connected Engines Functions

Engine data will be uploaded to Honeywell Forge autonomously via the Ensemble unit of the CEDS system. Uploaded data is then verified and stored in Honeywell Forge where it is viewable for analysis or periodic inspection. Engine data can also be automatically transferred to CAMP for advanced data analytics and trending if the aircraft or Forge account is setup for that service.

Engine data can be loaded manually as well. On the Forge Dashboard go to “EEI for Forge Upload”, here the user can manually upload the ECFR.tar.gz file using the “upload” tab and then view the ECFR.tar.gz uploading status under “File Status” tab as shown in Figure 36.

Note: To download ECFR manually, user should turn OFF the Ensemble unit, so that manual operation doesn’t cause any communication errors to Ensemble unit as both EEI & Ensemble unit shares same RS422 channels.

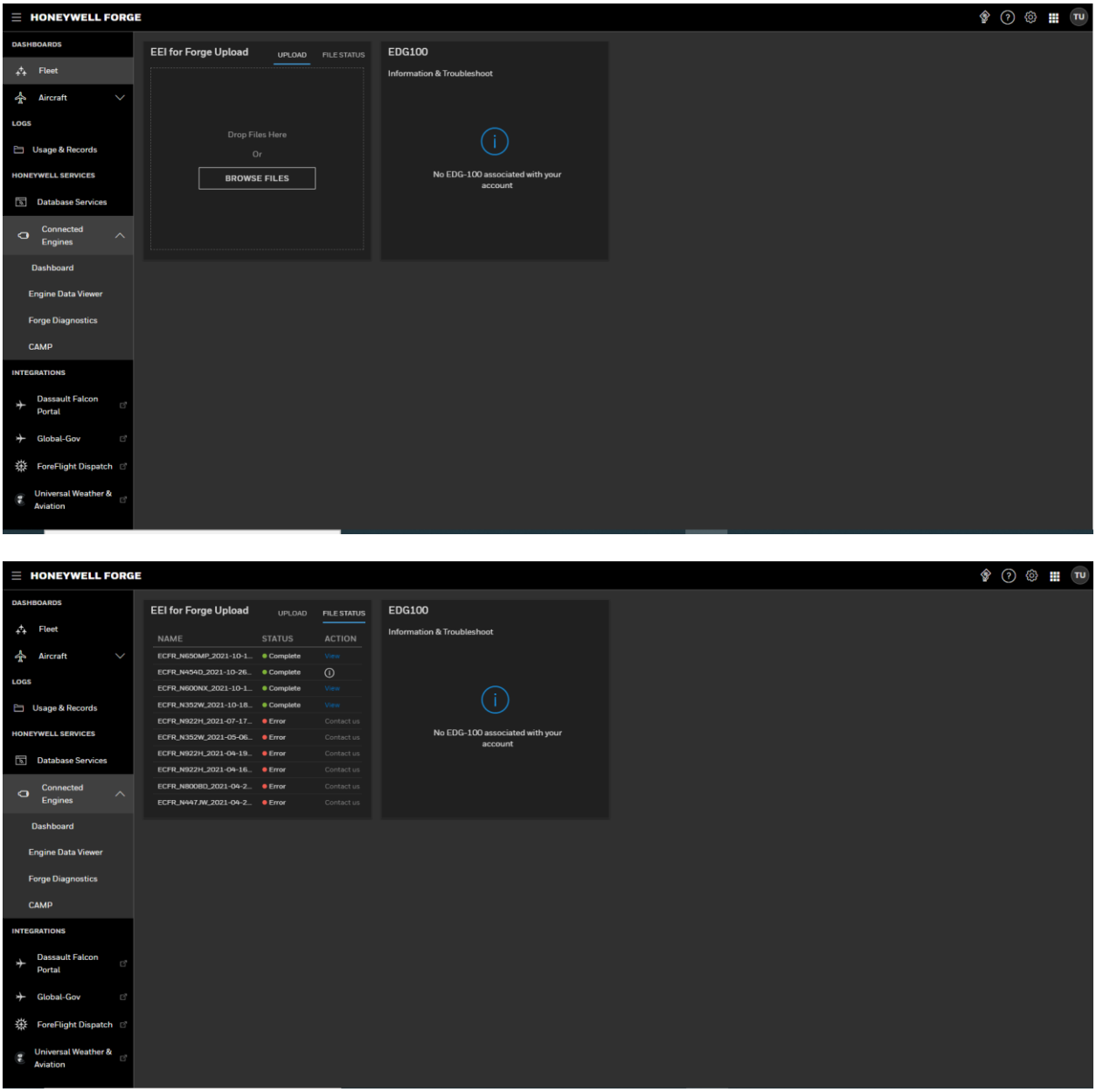


Figure 36: Upload File Status

5.1.1 Engine Data Viewer

The Engine Data Viewer (EDV) provides a means to view the data that was previously downloaded from the aircraft via CEDS. Data download by the Ensemble unit, via the CEDS system, will be autonomously uploaded to Honeywell Forge once when the conditions called out in Section 0 are met.

5.1.1.1 Manage Fleet Data

Engine Data Viewer also gives the capability to view fleet information of all the Aircraft Tail Numbers registered to your Honeywell Forge account. As shown in Figure 37, the Make, Model,

Last Upload, Number of Fault Codes and Access Type are viewable from this page. The last upload indicates the last ECFR file that was uploaded to Honeywell Forge with performance data. User can also add new tail using link “ADD TAIL” on the right-side corner at EDV page for the respective user id. For adding new tail, the user is requested to add details of Aircraft information, Aircraft settings and user information. Once the details are provided and end user agreements accepted, the requested TAIL gets added to the user id. Refer Figure 38.

User can view the aircraft tail number information and the current maintenance conditions on EDV as shown in Figure 39.

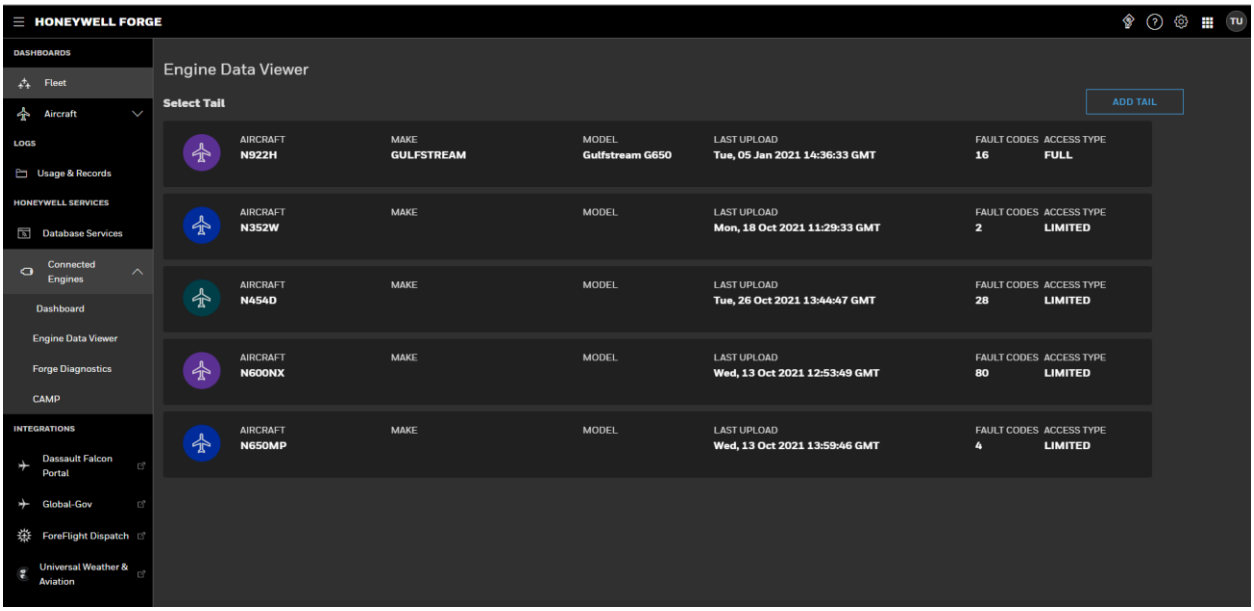
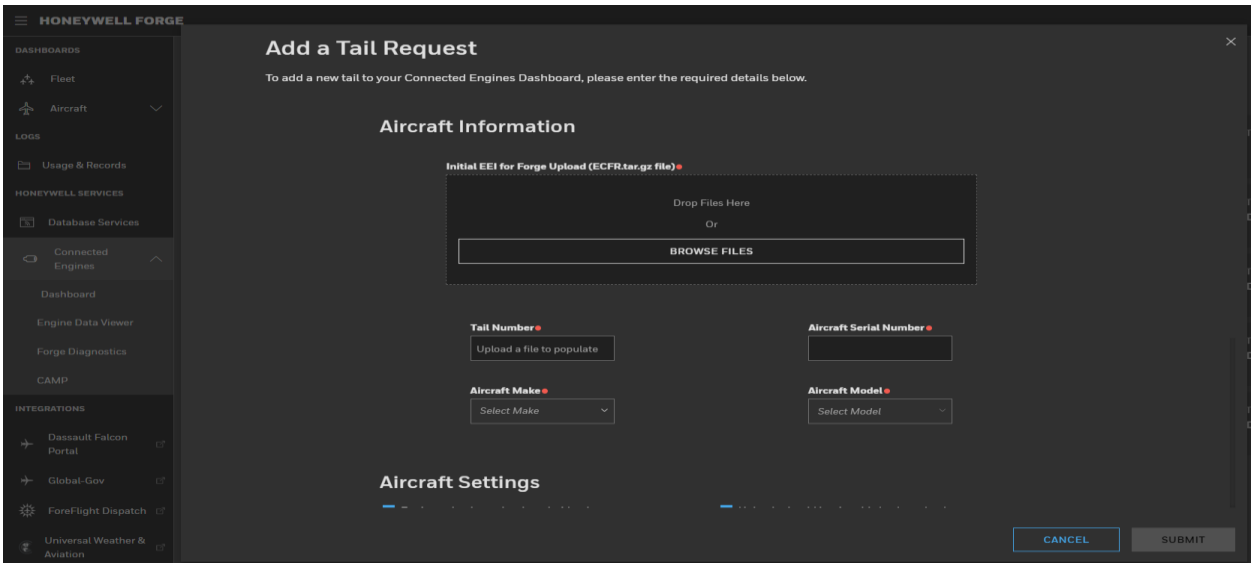


Figure 37: Engine Data Viewer Fleet Status



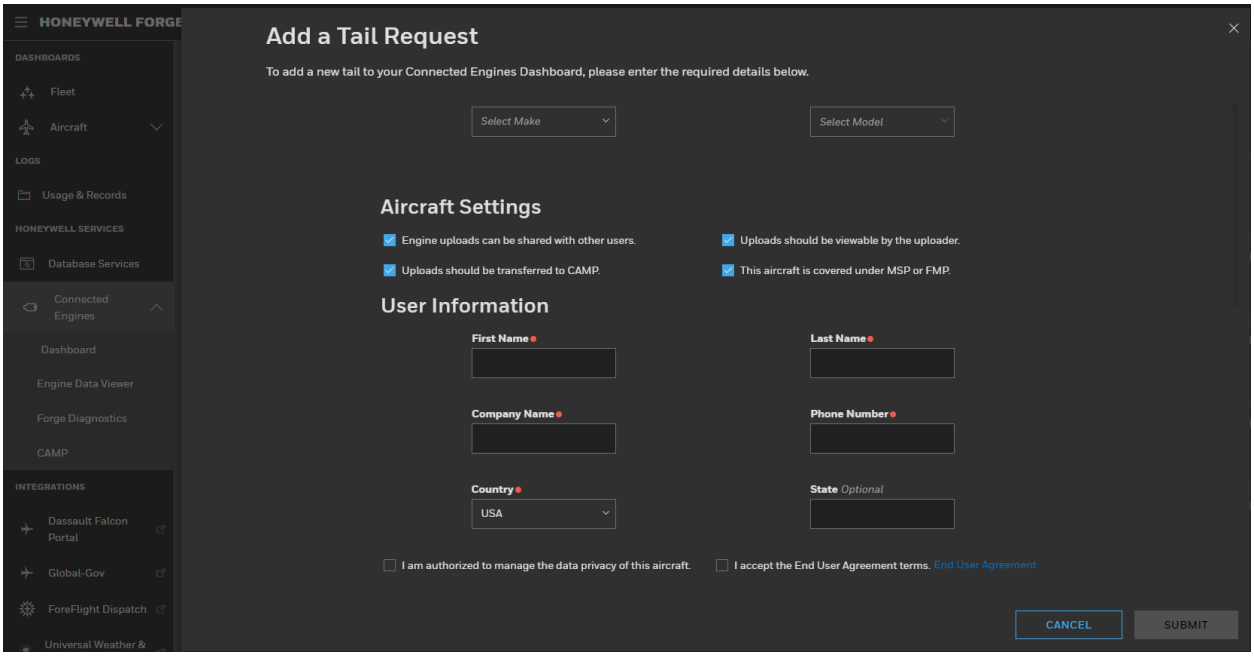


Figure 38: Adding New Tail to User ID

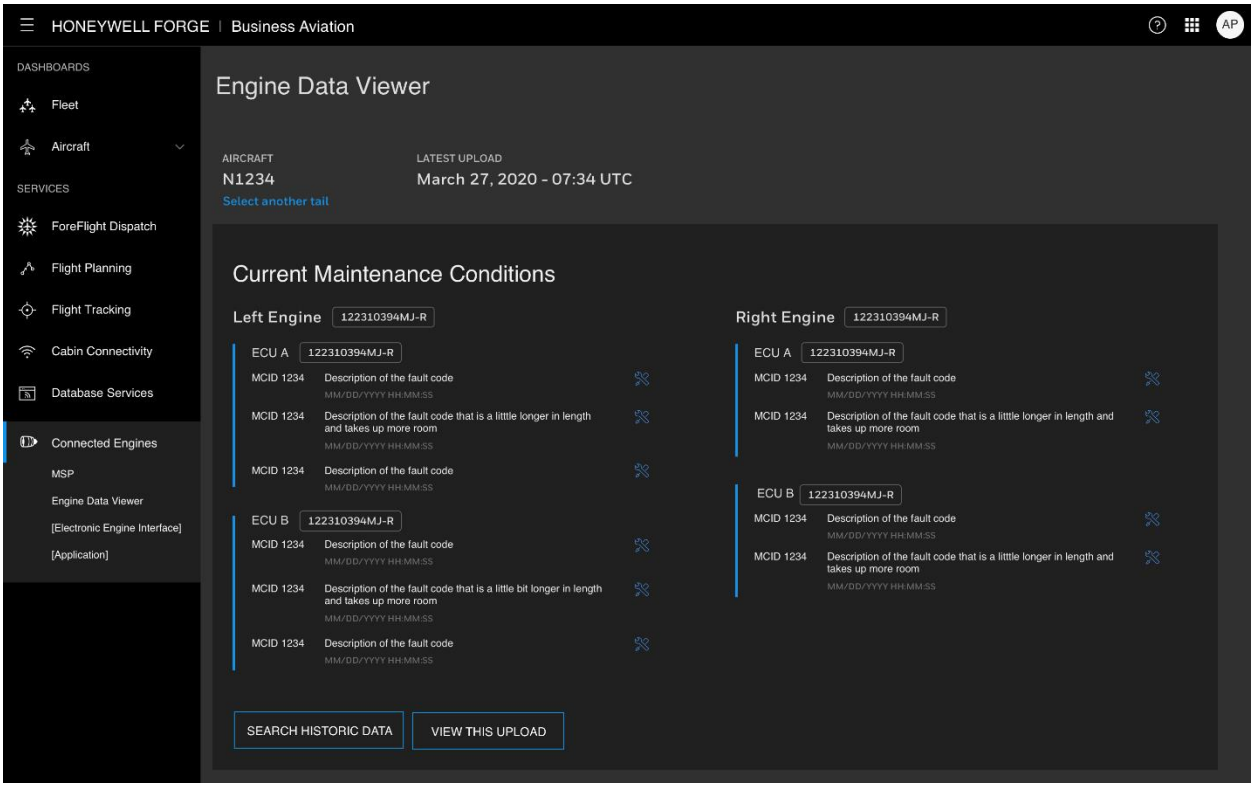


Figure 39: Engine Data Viewer for Specified Tail Number

5.1.1.2 Perform Period Inspection

Periodic Inspections may be required per the aircraft engine's Light Maintenance Manuals (LMM) to clear Time-Limited Dispatch (TLD) faults that may be stored in the engine ECUs. The following steps should be followed to complete the Periodic Inspection:

1. Click the desired aircraft for Periodic Inspection in the EDV and select "Yes" when prompted to do Periodic Inspection, as shown in Figure 40.

2. As shown in Figure 40, several prompts will be displayed. Click the check mark to confirm prompts.
   Note: If Engine or ECU serial numbers are incorrect, then contact ConnectedEngines@HoneywellProd.onmicrosoft.com.
   If customer tail information or customer account information are incorrect, then contact fssaccounts@honeywell.com

3. Once all prompts have been confirmed the Periodic Inspection is complete, as shown in Figure 41.

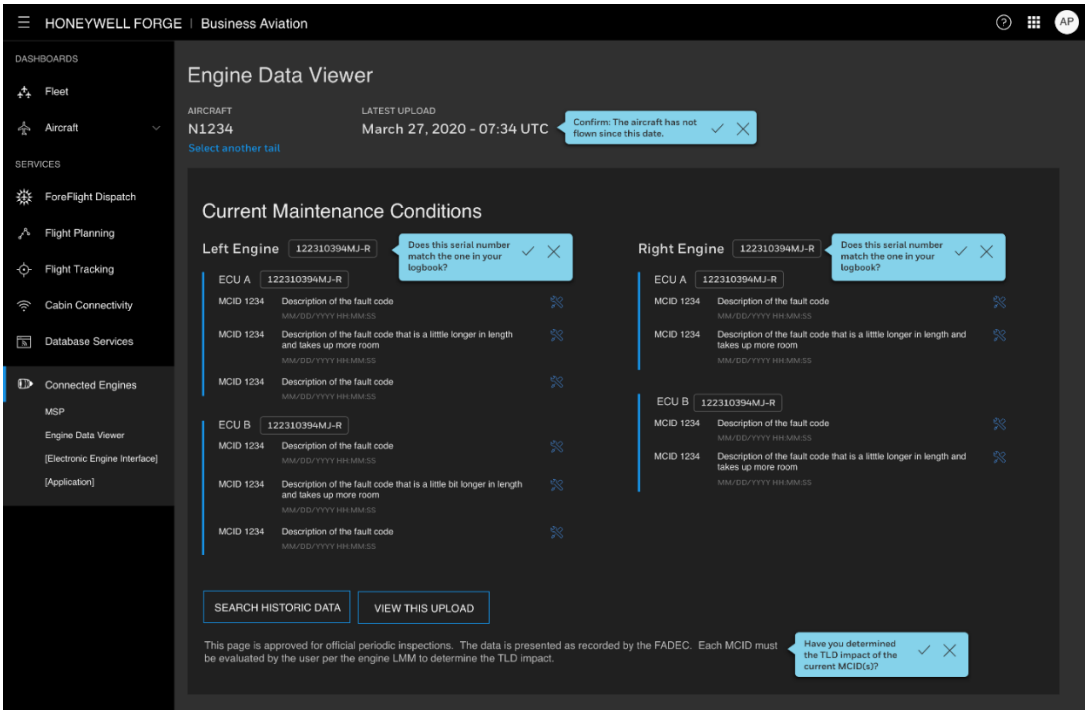


Figure 40: Engine Data Viewer TLD Determination

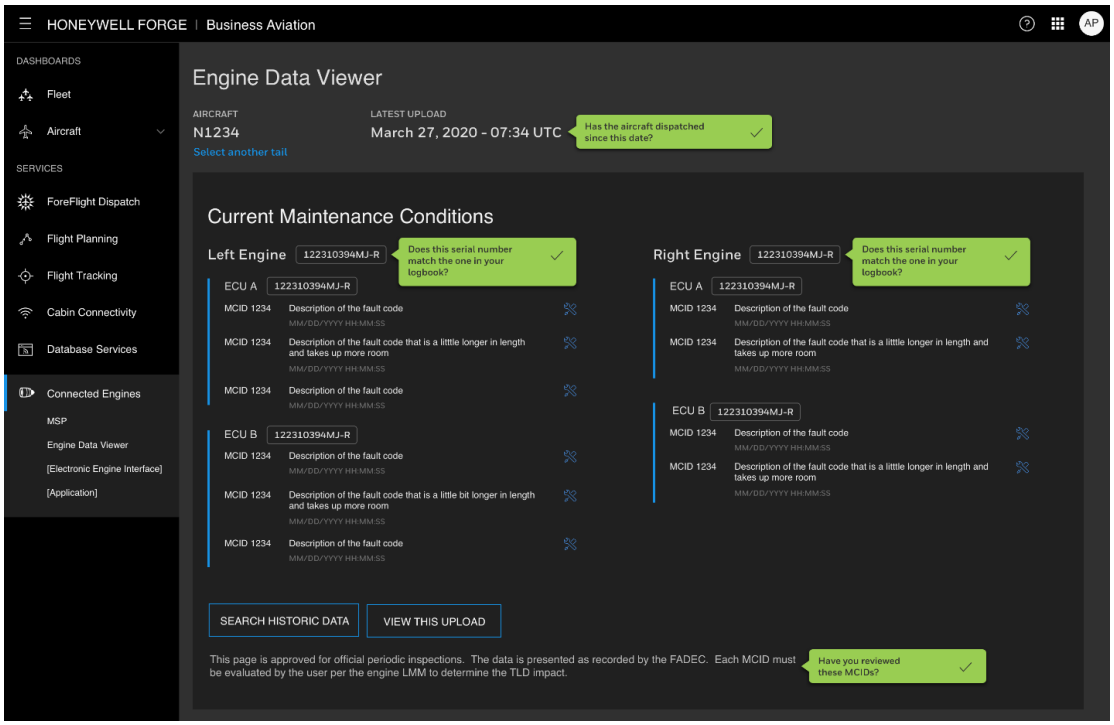


Figure 41: Engine Data Viewer TLD Determination Complete

In case user is viewing an incorrect file for TLD inspection, a message appears on EDV page “This page is not approved for TLD inspection”. Refer Figure 42.

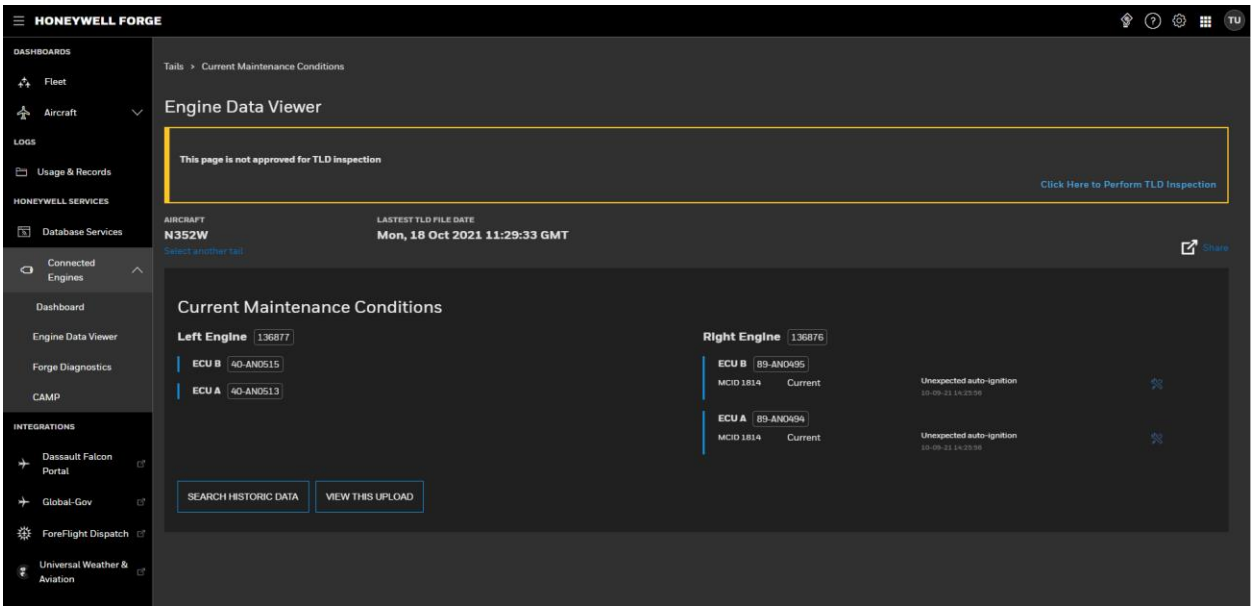


Figure 42: Engine Data Viewer TLD Inspection Not Approved

5.1.1.3 Engine performance data view on EDV

User can search the historical data or view the current ECFR data for the selected tail number by clicking on “Search Historic Data” or “View This Upload”. User can also share the current ECFR file using the “Share” link on the right corner page as shown in Figure 43.

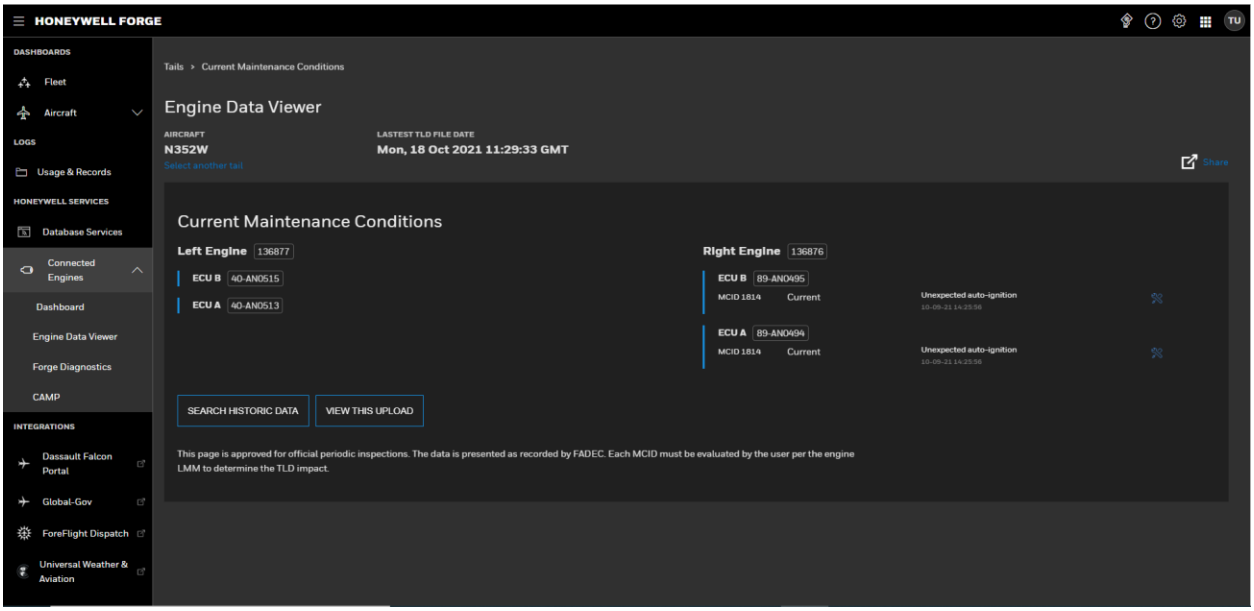


Figure 43: Engine Data Viewer Current Maintenance Conditions

Under “View This Upload” user can review the ECFR data on different tabs and user can also download the .dld file using download link as shown in Figure 44.

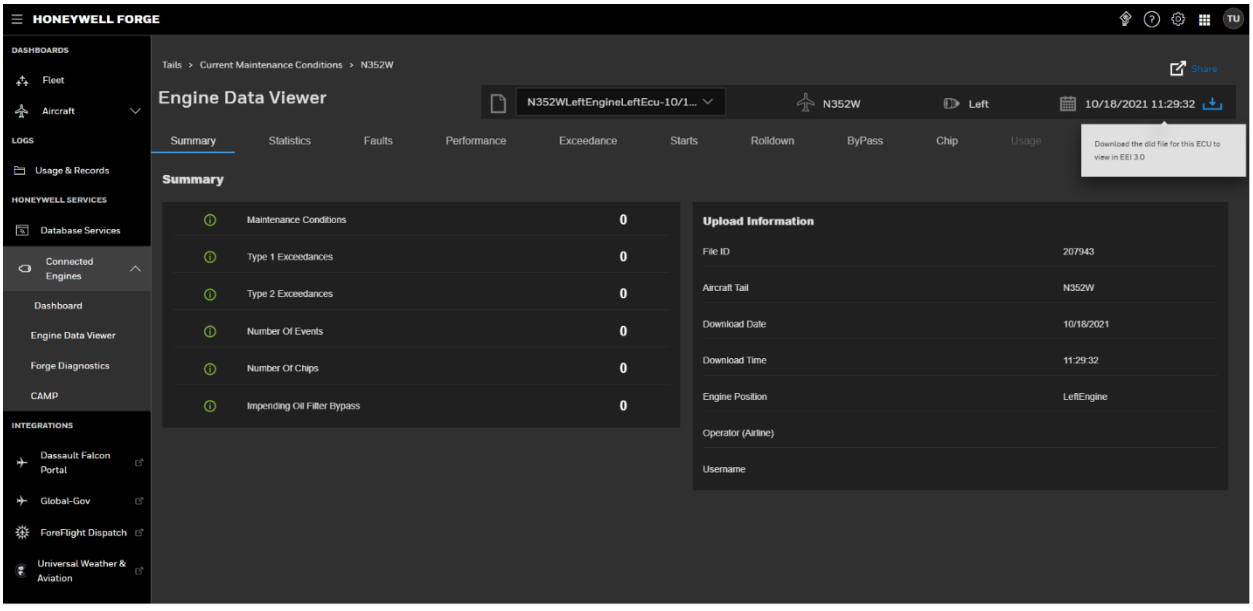


Figure 44: Engine Data Viewer ECFR Data

There are multiple tabs to show the different parameters on Engine Performance as defined in below **Table** 3.

S.No	EDV Tabs	Description
1	Summary	It summarizes the engine performance parameters for the aircraft tale.
2	Statistics	It shows the Engine information and ECU information like Part number, serial number, software version information etc.
3	Faults	It shows the maintenance condition (MCID) information.
4	Performance	It Shows the Engine Performance data.
5	Exceedance	For Future implementation
6	Starts	It shows the Engine start parameter details for a particular Flight Leg.
7	Rolldown	It shows the Engine rolldown parameter details for a particular Flight Leg.
8	ByPass	For Future implementation
9	Chip	For Future implementation
10	Usages	For Future implementation
11	Chronology	It shows the Engine performance chronology for multiple takeoffs instances.
12	Events	For Future implementation

Table 3: EVD Tab Description

6.0 ECFR DATA TO FORGE AND CAMP

To ensure a successfully upload of engine ECFR data files from the Ensemble unit to the Honeywell Forge Cloud. Procedures are provided for aircraft arrival and aircraft Departure.

Additional notes and things to be aware of:

- The below procedure assumes that the Ensemble unit was previously paired/ connected to an available Wi-Fi network. Honeywell recommends the device be paired to the aircraft on-board Wi-Fi system.

- If the Aircraft GPS signal is not available, please set the Aircraft Date &Time (GMT) in cockpit to latest GMT Date & Time, upon Aircraft power up and if required do a power cycle of ECUs & Ensemble unit to retrieve the latest GMT. This will enable a valid connection to Honeywell Cloud from Ensemble unit.

Sequence to transmit engine ECFR data file prior to departure:

1. Flight ready for departure.

2. Aircraft is powered up (via APU or ground power unit). This applies power to the all ECU and Ensemble unit.

3. Wi-Fi source configured to Ensemble unit is powered On and working. Use the Honeywell CMMA App to add new Wi-Fi source (4.2.3).

4. Engines are not running and are OFF.

5. Apply power if required to ECUs and Ensemble unit using circuit breaker switches.

6. The Ensemble unit will search for the configured Wi-Fi network(s) and connect to the network that has the strongest signal. This takes less than a minute.

7. Wait up to ~10 minutes for ECFR upload. Do not turn on engines until ECFR transmission has completed. Alternatively, ECFR progress can be viewed on the CMMA app per Figure **13**.

8. You will receive an email (Figure 45) from Honeywell Forge notifying ECFR file upload status.

9. Turn Engines ON and prepare for departure.

Sequence to transmit engine ECFR data file upon aircraft arrival:

1. Aircraft landed at destination.

2. Aircraft on board Wi-Fi system is turned on and working or Ensemble unit is paired to another wi-fi source (such as a mobile phone or hangar Wi-Fi). If required use Honeywell CMMA to complete Wi-Fi setup.

3. Engines are turned OFF.

4. The Ensemble unit will search for the configured wi-fi network(s) and connect to the network that has the strongest signal. This takes less than a minute.

5. Wait up to ~10 minutes for ECFR upload.

6. You will receive an email (Figure 45) from Honeywell Forge notifying ECFR file upload status.

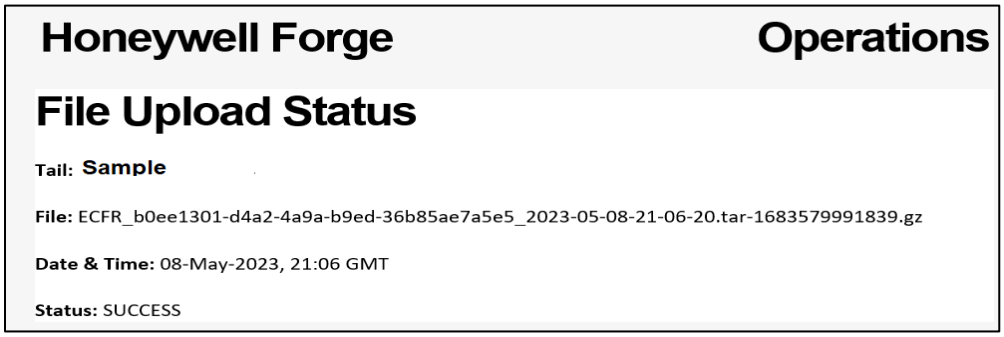


Figure 45: Sample ECFR upload notify Email

7. Now you can shutdown aircraft power.

If the ECFR upload fails, retry the above steps verifying all are correctly followed.

Note: The latest CMMA application will show the ECFR download progress when connected to the Ensemble unit.

7.0 WI-FI TROUBLESHOOTING

Procedures to perform Wi-Fi troubleshooting (multiple cases)

1. If the Ensemble unit does not connect to the Wi-Fi, ensure that the Wi-Fi is operational and that the antennas are connected to the Ensemble unit (J5 and J6 connectors).

2. If you are unable to connect with the Honeywell Cloud, retry after some time.

3. Sometimes the connection will take longer than expected (~5mins). If connection was not established, confirm that aircraft flight status is on ground.

4. Ensure you have entered the correct Wi-Fi password. If the network name & password both are same with previous entry, then Ensemble unit will not add a new entry to the Saved Networks.

5. Ensure the added WAP is available/reachable from Ensemble unit and has active internet (data) network for Ensemble unit to send/receive data from Honeywell Forge.

6. If Wi-Fi connection was established, then restart Ensemble unit (by pulling out and putting back the circuit breaker with an interval of approx. 2 min)

7. Sometime, a Wi-Fi connection is established but Ensemble unit does not connect to CDS. This can occur if the GMT date-time does not match. Check aircraft cockpit display is showing the latest date-time, if date-time is incorrect or zero on the cockpit panel then possible reason aircraft is not receiving GPS signal. Try to fix date-time issue followed by restart of ECU & Ensemble unit (by pulling out and putting back the circuit breaker with an interval of approx. 2 min).

8. If reason not listed above, then reset the network connection. i.e., Delete the current Wi-Fi network, try configuring to the Wi-Fi network again.

8.0 ADDITIONAL HONEYWELL SERVICES

a. Maintenance Service Plan (MSP)

Maintenance Service Plan (MSP) umbrella of offerings from Honeywell is evolving the way maintenance planning for airlines works. Incorporating all legacy maintenance services, all of our service offerings will now sit under the Maintenance Service Plan umbrella.

MSP is a maintenance solution that makes it easy for you to choose from a range of selectable coverage options, tailored to your platform and operations. We offer a range of flexible, customizable maintenance options, designed to make it easy for you to control the unexpected and keep your aircraft where it belongs – in the sky.

We understand that your aircraft is a big investment – one worth protecting. MSP is the perfect solution for operators who want to keep their aircraft flying and control their annual maintenance budget with the industry's premier fixed-price protection plan.

Our Maintenance Service Plan coverage options are flexible. You can choose the coverage that best meets your needs. With different subscription options, you can rest easy knowing you are benefiting from more than 40+ years of expertise.

https://aerospace.honeywell.com/en/learn/services/maintenance-and-service-plans/maintenance-service-plan-propulsion

b. Honeywell Forge Diagnostics

Forge Diagnostics is an advanced troubleshooting tool to help identify solutions for engine issues experienced in the field. By entering symptoms such as fault codes or pilot observations, users are provided the most likely solutions based on years of troubleshooting experience. The diagnostic reasoner which determines the most likely solutions was derived from sophisticated on-board maintenance computers developed by Honeywell for large transport aircraft. The reasoner utilizes rich fault models specific to each engine model, matured over many years of field experience, where the results of each troubleshooting session have been used to further train the model and refine the percentages of each solution to address the reported symptoms. Not sure where to start when the engine controller reports multiple fault codes? Forge Diagnostics is also able to recognize fault code patterns and identify the true cause.

c. CAMP (CAMP Engine Health Monitoring)

CAMP is the exclusive Engine Health Monitoring provider for Honeywell TFE, HTF and TPE engines, and is provided by CAMP Systems. CAMP Engine Health Monitoring checks the health of aircraft engine(s). By using information recorded during flight either by the flight crew or through the engine controller, CAMP Engine Health Monitoring can identify small problems before they become big problems and big problems before they become catastrophic. In CEDS, the information from EDV gets uploaded to CAMP automatically if the aircraft is signed up for CAMP services.

Honeywell

9.0 LIST OF PARAMETERS

Chip O/F Bypass	Oil filter bypass indication status when chip impedance becomes low enough for zapping.
Chip Oil Pressure	Oil pressure indication status when chip impedance becomes low enough for zapping. (psid)
Chip Oil Temperature	Oil temperature indication status when chip impedance becomes low enough for zapping. (psid)
Chip Record Count	Previous chip detections count when chip impedance becomes low enough for zapping. (integer)
Chip Vibration Average	Engine vibration during operation average chip when chip impedance becomes low enough for zapping. (ips)
Chip Zaps This Chip	Number zap attempts to clear the chip for this occurrence of chip detection. (integer)
CMODE	Which governor/fuel schedule is in control
Cruise ADC Average PS	Static-Inlet-Pressure average from ARINC captured at the last, highest cruise point (psia)
Cruise ADC Average TT2	Inlet temperature average from ARINC captured at the last, highest cruise point (degC)
Cruise Altitude	Altitude captured at the last, highest cruise point (ft)
Cruise CGV Position	Compressor Guide Vane captured at the last, highest cruise point (deg)
Cruise Chip Detector	Chip detector captured at cruise
Cruise Control Mode	cmode captured at the last, highest cruise point
Cruise ECU PS	Static-Inlet-Pressure captured at the last, highest cruise point (psia)
Cruise ECU TT2	Inlet temperature after x-channel select (tt2) captured at the last, highest cruise point
Cruise EGT	Exhaust gas Temperature captured at the last, highest cruise point (degC)
Cruise Engine Hours	Accumulation of engine operating hours captured at cruise (hrs)
Cruise Engine Status	Engine status captured at the last, highest cruise point
Cruise EQA	Engine quality adder during cruise (%)
Cruise Fuel Flow Meter	Fuel Flow Meter captured at the last, highest cruise point (lb/hr)
Cruise Fuel Temperature	Fuel temperature captured at cruise (degC)
Cruise Fuel Usage	Fuel usage captured at the last, highest cruise point (lb/hr)
Cruise GMT Date	ARINC GMT date captured at the last, highest cruise point (yymmdd)
Cruise GMT Time	ARINC GMT time captured at the last, highest cruise point (hhmmss)
Cruise ITT	"Inner Turbine Temperature Calculated" captured at the last, highest cruise point (degC)
Cruise Latitude	Latitude position of the aircraft during cruise ARINC label 310 (RX1) (%)
Cruise Longitude	Longitude position of the aircraft during cruise ARINC label 311 (RX2). (%)
Cruise Mach	Mach captured at the last, highest cruise point
Cruise Main Metering Valve	Main Metering Valve captured at the last, highest cruise point (lb/hr)

Cruise N1 Compensation	N1 compensation during cruise (%)
Cruise N2	N2 captured at the last, highest cruise point (%)
Cruise Oil Pressure	Oil pressure during cruise (psid)
Cruise Oil Temperature	Oil temperature during cruise (degC)
Cruise P3	Compressor Discharge Pressure (p3) captured at the last, highest cruise point (psia)
Cruise Power Lever Angle	Power Level Angle captured at the last, highest cruise point (deg)
Cruise Rate of Climb	Altitude rate of climb captured at the last, highest cruise point (ft/min)
Cruise Vibration Average	Vibration running average captured at cruise (ips)
EGT	Exhaust Gas Temperature (degC)
IPS	units of vibration
ITT	Inner Turbine Temperature calculated from egt, n2, and n1
Lube Chip	Chip resistance prior to or after an impending bypass indication (ohms)
Lube ECU Operating Time	ECU operating time prior to or after an impending bypass indication (seconds)
Lube Engine Hours	Engine operating hours at time of impending bypass indication (hours)
Lube Fuel Flow Meter	Lube fuel flow measurement prior to or after an impending bypass indication (lb/hr)
Lube Fuel Temperature	Fuel temperature prior to or after an impending bypass indication
Lube N2	N2 prior to or after an impending bypass indication (%)
Lube Oil Pressure	Oil pressure prior to or after an impending bypass indication (psi)
Lube Oil Temperature	Oil temperature after an impending bypass indication (degC)
Lube Record Count	Number of impending bypass indications (integer)
Lube Vibration Average	Running average of engine vibration prior to or after an impending bypass indication (ips)
N1	Speed in % or RPM
N2	Speed in % or RPM
p3	Compressor Discharge pressure (psia)
PLA	Power-Lever-Angle with flats built in around idle/cruise/climb/takeoff/apr (degrees)
Rolldown Checksum	32-bit checksum of all previous data block parameters contained in the data block record
Rolldown Count	Accumulation of total number of rolldow ns
Rolldown ECU Operating Time	ECU operating time captured during rolldown (sec)
Rolldown GMT Date	ARINC GMT date captured during rolldown (yymmdd)
Rolldown GMT Time	ARINC GMT time captured during rolldown (hhmmss)
Rolldown Leg Number	Aircraft flight leg number captured during a rolldown. ARINC label 251 (RX1)
Rolldown N1 Time	Time to complete n1 rolldown, eliminating time spent wind milling (sec)
Rolldown N2 Time	Time to complete n2 rolldown, eliminating time spent wind milling (sec)

Start AC Serial Number 0	Aircraft serial number or unique numerical identifier for the aircraft captured during fuel and ignition on. ARINC label 154 (RX1)
Start Average ADC PS	ps adc average (psia)
Start Average ADC TT2	adc tt2 average value captured during a start (degC)
Start Control Mode Status	32 bit word used to determine which cmodes are being used during a start
Start Count	Accumulation of total number of successful starts
Start Date 0	ARINC GMT date captured during start captured when fuel and ignition on (yymmdd)
Start ECU Operating Time 0	ECU operating time captured during fuel and ignition on (sec)
Start ECU Operating Time 1	ECU operating time captured during start(sec)
Start EGT	egt captured at min n2dot during start (degC)
Start EGT Total	integration of egt from lite-off to when N2 is greater than N2 at idle (fl_idle) (degC x sec)
Start Engine Quality Adder	Engine quality adder capture during a start (%)
Start Engine Status	Engine status captured at min N2dot during start
Start Engine Status 0	Engine status word captured when fuel and ignition on
Start Engine Status 1	Engine status word captured at end of start
Start Fuel Flow Meter	Fuel flow meter captured at min n2dot during start (pph)
Start Fuel Temp 0	Fuel temperature captured when fuel and ignition on (degC)
Start Idle ECU Operating Time	ECU operating time captured at idle. (sec)
Start Idle Engine Status	Engine status word captured during start at idle.
Start Idle Fuel Temp	Fuel temperature captured during start at idle. (degC)
Start Idle Leg Number	Aircraft flight leg number captured when fuel and ignition on. ARINC label 251 (RX1).
Start Idle Mach	Mach captured during start at idle
Start Idle Oil Pressure	Oil pressure during start at idle. (psid)
Start Idle Oil Temp	Oil temperature during start at idle. (degC)
Start Idle PS2	ps2 captured at idle (psia)
Start Idle Tamb	Ambient temperature captured at idle. (degC)
Start Latitude 0	Latitude position of the aircraft captured when fuel and ignition on. ARINC label 310 (RX1). (%)
Start Longitude 0	Longitude position of the aircraft captured when fuel and ignition on. ARINC label 311 (RX2).
Start Low Idle Timer	Time from engine lit to idle. (sec)
Start Mach 0	Mach number captured when fuel and ignition on
Start N1	N1 captured at min n2dot during start. (%)
Start N1 Compensation	N1 compensation for thrust to n1 variation captured during a start. (%)
Start N2	N2 captured at min n2dot during start. (%)
Start N2 Liteoff	N2 captured at lite off. (%)
Start Oil Temp 0	Oilt captured when fuel and ignition on (degC)

Start P3	Compressor Discharge Temperature (p3) captured at min n2dot during start (psia)
Start PS2 0	ps captured when fuel and ignition on (psia)
Start Tamb	Ambient Temperature captured when fuel and ignition on (degC)
TT2	Inlet temperature after x-channel select. (degC)
Usage 100ms Cycle	ECU measurement of maximum usage timing number of 100-msec time slice to be provided by the OS
Usage 25ms Cycle 1	ECU measurement of maximum usage timing number of Cycle 1 to be provided by the OS
Usage 25ms Cycle 2	ECU measurement of maximum usage timing number of Cycle 2 to be provided by the OS
Usage 25ms Cycle 3	ECU measurement of maximum usage timing number of Cycle 3 to be provided by the OS
Usage 25ms Cycle 4	ECU measurement of maximum usage timing number of Cycle 4 to be provided by the OS
Usage 25ms Cycle 5	ECU measurement of maximum usage timing number of Cycle 5 to be provided by the OS
Usage 25ms Cycle 6	ECU measurement of maximum usage timing number of Cycle 6 to be provided by the OS
Usage 25ms Cycle 7	ECU measurement of maximum usage timing number of Cycle 7 to be provided by the OS
Usage 25ms Cycle 8	ECU measurement of maximum usage timing number of Cycle 8 to be provided by the OS
Usage Engine Flight Hours	Accumulation of engine flight hours during flight operation only (hrs)
Usage Engine Operating Hours	Accumulation of engine operating hours during ground and flight operation
Usage Landings	Accumulates the number of landings
Usage Landings w/o Shutdown	Accumulates the number of long weight on wheels (wow)
Usage System TLD	Time limited dispatch status (tld_status) captured in the usage data block.
Usage Takeoffs	Accumulation of total number of all take-offs
Usage Touch and Go	Accumulation of the total number of short weight on wheels (wows)
Usage Type 0 Exc ITT accum	Accumulates the time above an itt type 0 exceedance in seconds and tenths of seconds between ECFR downloads. (sec)
Usage Type 0 Exc ITT count	Accumulates the number of itt type 0 exceedances between ECFR downloads.
Usage Type 0 Exc N1 accum	Accumulates the time above an n1 type 0 exceedance in seconds and tenths of seconds between ECFR downloads. (sec)
Usage Type 0 Exc N1 count	Accumulates the number of n1 type 0 exceedances between ECFR downloads.
Usage Type 0 Exc N2 accum	Accumulates the time above an n2_gage type 0 exceedance in seconds and tenths of seconds between ECFR downloads. (sec)
Usage Type 0 Exc N2 count	Accumulates the number of n2_gage type 0 exceedances between ECFR downloads.
Usage Type 0 Exc OILT accum	Accumulates the time above an oilt type 0 exceedance in seconds and tenths of seconds between ECFR downloads. (sec)
Usage Type 0 Exc OILT count	Accumulates the number of oilt type 0 exceedances between ECFR downloads.