

PROVISIONAL PATENT APPLICATION

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TITLE OF THE INVENTION

"System, Methodology, and Process for Wireless Acquisition of Sensor Data Onboard an
Aircraft to a Portable Computer"

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CROSS-REFERENCE TO RELATED APPLICATIONS

Not applicable

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR
DEVELOPMENT

Not applicable

REFERENCE TO A "MICROFICHE APPENDIX"

Not applicable

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to methods and apparatus that include the acquisition of
data, analysis of the collected data, and transmission of the collected data and/or analysis of
the collected data to a destination by means known to a practitioner of ordinary skill in the
art. More particularly, the present invention relates to methods and apparatuses that include
collecting analog or digital sensor data onboard a vehicle, analyzing said data in real-time,
and transmitting the data and/or analysis of the data to a destination including a portable
storage device such as a portable computer or electronic flight bag (EFBs) by means
including wireless transmission. The application of this invention includes sensor data
gathered from vehicles used in field of avionics such as aircraft.

2. General Background of the Invention

In the normal operation of aircraft, pilots are required to carry flight bags that contain
reference material such as aircraft operating manuals, flight-crew operating manuals, and
navigational charts. In order to promote efficiency in flight management tasks and reduce

the usage of paper, electronic information management devices such as EFBs have been employed by flight crews. Such EFBs allow for use of various applications including static applications such as document viewers, flight crew operating manuals, electronic approach charts, and multifunctional displays for systems such as navigational systems and air traffic control instructions. Furthermore, EFBs can include various means of data transmission including memory stick transfer and wireless connectivity.

Also, aircraft in general have onboard systems which communicate in real-time with systems on the ground during the course of a flight. Methods and apparatus directed towards such systems have patented. For example, United States Patent No. 7,835,734 to Eckert et al. discloses an avionics system including a wireless router located on an aircraft and configured to transceive wireless signals; and a processing unit located in the aircraft and configured to supply the wireless router with configuration parameters after determining it is time to connect to a ground network, the configuration parameters based on the location of the aircraft; wherein the wireless router uses the configuration parameters to establish a wireless connection with the ground network and route data from at least one client application on the aircraft to at least one ground application server.

In view of the current state of art, current technologies related to electronic flight bags and real-time communications systems have yet to address the need for systems and apparatus that can efficiently collect, analyze, and transmit data recorded by an aircraft's sensors. Such systems could aid commercial aircraft carriers in improving efficiency in delivery of their services to customers as applied to concerns or issues that include flight costs or flight crew performance. Also, such systems could provide vital data to administrative agencies regulating the field of avionics for various investigatory concerns such as efficiently determining the cause of an aircraft failure. The disclosed invention addresses what the current state of the art has yet to address.

BRIEF SUMMARY OF THE INVENTION

The present invention relates to methods and apparatus that include the acquisition of data, analysis of the collected data, and transmission of the collected data and/or analysis of the collected data to a destination for storage or analysis, for example, from a vehicle or aircraft by transmitting the data to a portable device on the vehicle or aircraft which is carried onto the vehicle or aircraft by the driver or pilot and is removed by the driver or pilot when he exits the vehicle or aircraft. More particularly, the present invention relates to

methods and apparatus that include collecting analog or digital sensor data onboard a vehicle, analyzing said data in real-time, and transmitting the data and/or analysis of the data to a destination including a portable storage device such as a portable computer or electronic flight bag (EFB) by means including wireless transmission.

5 It is sometimes best to encrypt data first, then transmit to a device that will leave with the pilot. Preferably the data is wirelessly transmitted to a portable storage device in the airplane, but one could use cat-5 cable or other wire to connect to a computer or computer-like device.

10 Preferably one uses a powered device that can capture the data (a device with logic platform versus a simple storage device, such as an SD card), whether the data comes wirelessly or through a wire, and the device enters the aircraft with the pilot and leaves with the pilot.

15 The present invention includes moving a consolidated stream of data to a device that contains logic (preferably a computer), preferably in real time or near real time. Preferably, the computer has software that analyzes the data and can send messages to remote locations or simply let those in the aircraft know that there is an issue (the computer can be programmed to detect some issues that normal flight equipment might not).

Two recent events have occurred in FAA rules to make the present invention possible:

- (1) wifi can now be on aircraft;
- 20 (2) electronic flight bags are now allowed in the cockpit.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

25 For a further understanding of the nature, objects, and advantages of the present invention, reference should be had to the following detailed description, read in conjunction with the following drawings, wherein like reference numerals denote like elements and wherein:

Figure 1 is a perspective view displaying a preferred embodiment of the present invention. Figure 2 is a schematic view of a QAR transfer of data through a wireless network to an EFB.

Figure 3 is a schematic view of a process for transferring data from the QAR to the EFB.

30 Figure 4 is a schematic of high level use for a preferred embodiment of the application of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 is a perspective view displaying an embodiment of the apparatus of the present invention. A preferred embodiment of the present invention includes an apparatus comprising a lithium battery or cap; inputs for a Cockpit Voice Recorder (CV2R) Ethernet Feed, an Ethernet Vibration Feed, a Mini-Flight Data Acquisition Unit (MFDAU) Data Feed; a Universal Serial Bus (USB) 3.0 Adapter to Hard Memory; a Quick Access Recorder (QAR) Board; at least one slot for receiving a storage medium to record data collected from a Cockpit Voice Recorder (CV2R) Ethernet Feed, an Ethernet Vibration Feed, a Mini-Flight Data Acquisition Unit (MFDAU) Data Feed; and means of transmission including wireless transmission. The apparatus further comprises a means for receiving power from an outside power source and a door providing access to the slot. The wireless transmission is preferably accomplished through a Wifi Router with the IEEE 802.11ac standard. The inputs are preferably connected by an RJ45 ethernet connection. The storage medium is preferably a Secure Digital (SD) memory card. The means of transmission can be transferring multiple external component data to other storage means such as an EFB, a computer, medical, or auxiliary equipment. In a preferred embodiment, the QAR preferably receives data from the CV2R Ethernet Feed, the Ethernet Vibration Feed, and the MFDAU Data Feed. The MFDAU feed preferably includes airframe, engine, and component data via a direct interface to digital ARINC (including but not limited to ARINC 717 and 429 data), serial (including but not limited to RS232, RS485) and analog data streams as well as aircraft state data as provided by internal or external gyros and accelerometers. The collected data preferably provides detailed aircraft state, including pitch, roll, G forces, vertical speeds, detailed engine operating parameters (i.e., turbine speeds, oil pressure & temperatures) and primary aircraft system parameters (rotor speeds, transmission and gearbox oil pressures and temperatures). Also preferably included in the data stream delivered to the QAR is the state of caution & warning lights and the position/state of significant system switches in the aircraft (i.e., landing gear switch and gear position indicator lights). Detailed GPS component data streams are preferably included in the acquired data. Once received, the QAR board preferably directs a composite data stream to the EFB and/or through the USB 3.0 Adapter to hard memory. The composite data stream is preferably transmitted from the QAR to the EFB wirelessly. This preferred embodiment preferably also includes light indicators for the QAR SD Card Write Status and WiFi Connection Status as well as a button for opening and closing a door. A preferred apparatus

is a NORTH QAR-3W Quick Access Recorder with a means for wireless transmission of data.

Figure 2 is a schematic view of the QAR transfer of data through a wireless network to an EFB. In a preferred embodiment, the QAR transmits data wirelessly to the EFB. In this transfer of data, an option is given as to whether the data should be encrypted. If the encryption is option is selected, the data is encrypted at a high level.

Figure 3 is a schematic view of the process for transferring data from the QAR to the EFB. In the preferred embodiment, the QAR board attempts to and establishes a secure connection with the EFB wirelessly. The QAR may also seek auxiliary wireless signals to establish a secure connection. In preparation for receiving data, the EFB may create files to incorporate the transmitted data within. Once a secure connection has been established, the QAR streams the data to the EFB. When the aircraft has shut down, the QAR may switch to a backup/cap power and may send an end-of-file message prior to a backup power timer expiring. Once the data is received from the QAR, the EFB may include means of distributing the data, encrypting the data, or writing the data to the previously created files. Once the data is written to files, the EFB may close the files and terminate the wireless connection with the QAR.

Figure 4 is a schematic of high level use for a preferred embodiment of the application of the present invention. A preferred embodiment of the present invention includes a system comprising a Cabin Tablet, a Pilot Tablet, vibration nodes, and a MFDAU. The system further comprises a WiFi Cabin antenna, a USB Hardened Memory Module, and an Ethernet switch. The system may be used pre-flight, during flight, or post flight. The cabin tablet is preferably connected to MFDAU, Pilot Tablet, and Vibration Nodes via the WiFi Cabin antenna. The Cabin tablet preferably has access to patient charts, 12 Lead Data, and Pictures in the pre-flight stage. The Cabin tablet preferably has access to text messages, patient charts, data such as generated by Golden Hour software, and 12 lead data during the inflight stage. The Cabin tablet preferably has access to patient data, pictures, and data such as generated by Golden Hour software in the post flight stage. The data accessible to the cabin tablet is preferably accessed by a NFDS Web Portal Download. The Pilot tablet is preferably connected to MFDAU, Cabin tablet, and vibration nodes via the WiFi Cabin antenna. The Pilot tablet preferably has access to flight plan and weight & balance data in the pre-flight stage. The pilot tablet preferably has access to data collection data and

vibration data during the inflight stage. During both the pre-flight and in flight stages, the pilot tablet may preferably access a flight data stream. The pilot tablet preferably has access to data collection data and vibration data in the post flight stage. The data accessible to the pilot tablet is preferably accessed by a NFDS Web Portal Download. The pilot table preferably includes maintenance functions such as SMART Config and System Config. These maintenance functions are preferably accessed when in close proximity to a WiFi connection. The WiFi Cabin antenna preferably makes use of SubMiniature version A (SMA) connectors. The USB Hardened Memory Module is preferably ED-155 and/or ED-112 crash and temperature compliant. The Ethernet switch preferably uses RJ-45 connectors to connect with the MFDAU and Pilot Tablet. The Ethernet switch also preferably inputs multiple external component data to data storage mediums such as secure digital memory cards. The MFDAU preferably includes a Comm Board/Processors, transport communications systems inputs, an audio and video card, and means of gathering internal data from sensors. The MFDAU may include a satellite connection such as a RS-232- Generic Satcom link. The Comm Board/Processors preferably include a modem, a code divisional multiple access (CDMA), a hard drive, and the means for wireless transmission. The modem is preferably an iridium short data burst modem. The CDMA is preferably a light squared CDMA 4G. The hard drive is preferably a solid state hard drive. The means of wireless transmission preferably includes use of the WiFi Cabin Antenna. The Comm Board/Processors preferably includes means of encrypting data from the audio and video card. The Comm Board/Processors also preferably includes means of converting acquired data into Aeronautical Radio, Incorporated (ARINC) 717. The MFDAU preferably includes inputs for: receiving internal data from sensors such as gyros, accelerometers, and magnetometers; pilot data; Co-pilot data; static data; auto pilot ARINC 429; FADEC/VEMD ARINC 429; Garmin global position system (GPS) ARINC 429; FDR-ARINC 717; Intellstart-RS-485; XM Weather RS-232; AC Tach Gen Inputs; 28x Digital; 32x low speed analog; 8x high speed analog; Video In – BNC Connectors; Area Mic ED-155 44.1kHz; ICS; and SMA to L-Band. The MFDAU preferably includes outputs for: an A,V,D,R Annunciator; Composite ARINC 717 out; and a USB hardened memory module. The MFDAU preferably includes outputs and inputs for a High-Definition Multimedia Interface connection, a touchscreen, RS-232 connection for a data stream output or a Generic Satcom Link; and Ethernet Switch. The present invention includes methods and

apparatus directed to collecting internal and external analog and digital sensor data; analyzing the sensor data; and transmitting of said data to a portable storage device.

5 In one embodiment of the present invention, the method or apparatus includes a process of collecting data. The data preferably includes internal and external data that may further include data acquired from an analog or digital sensor. Sensor data also includes aircraft, state, component data, voice, video and vibration information. The data recording is preferably combined into a combined data stream. The combined data stream is preferably transferred to either a fixed or portable onboard storage device via wireless transmission. The combined data stream preferably includes data from similar and dissimilar devices (i.e. aircraft data; video and still camera images such as jpeg, mpeg formats; forward infrared camera images, radioactive particle sensor data, medical device data)

10 In another embodiment of the present invention, the method or apparatus includes a process of analyzing data. Analysis of such data may include analysis of aircraft sensor data in a virtual live basis in flight with Flight Operational Quality Assurance (FOQA). The analysis may also include an analysis of aircraft sensor data with vibration software that preferably compares the composite data stream to either a predetermined set of events criteria or historical data trends.

15 In another embodiment of the present invention, the method or apparatus includes transmitting an alert with an exceedance message via a cellular or satellite data conduit after processing the sensor data analysis. This element differs from downloading raw aircraft data wirelessly in that the sensor data has been processed prior to transmission.

20 In another embodiment of the present invention, the method or apparatus includes transmitting the aircraft sensor data to a crash hardened device installed onboard the aircraft by wireless means.

25 In another embodiment of the present invention, the method includes combining hardware and software into an apparatus that can be carried, wherein the apparatus wirelessly collects, encrypts, provides for critical near real time processing, and packages data for off load to a corporate data infrastructure for long time processing and preservation. This embodiment of the invention may be further defined to include a process of removing a portable or quasi portable device that has acquired data from onboard wireless devices from an aircraft then acquiring a wired or wireless connection (to the internet or possibly a company's/entity's intranet) and sending that composite data via that wireless

connection/conduit. A process of encrypting all collected data and delivering either encrypted or non-encrypted data is a preferable part of this process. The process of taking the composite data stream, breaking it up and sending it to either one or multiple locations or applications which may or may not act independently. (i.e., send aircraft data to FOQA app, medical data to hospital or doctor, video data to video or motion picture platform, thermal images to law enforcement entities, radioactive readings to an engineering firm). This process is meant to cover the acquisition of dissimilar data via onboard wireless and the administration and distribution of the data from a portable or quasi portable computer and/or electronic device which contains logic.

In another embodiment of the present invention, the method and apparatus includes an avionics data acquisition and recording system. Such system preferably provides an ability to collect wired and wireless sensor data and to deliver a composite data stream through a wireless router (such as 802.11n or 802.11AC) to a portable or quasi portable device that contains logic. The preferred system function would be to have one device mounted in the aircraft that collects : cockpit voice and video from a CV2R device, aircraft flight data (i.e., engine, airframe, and component generated data); aircraft vibration data via airframe mounted sensors or other vibration acquisition components, and external devices data via wi-fi connection (i.e., heart monitor). Once the data is collected by a NORTH QAR-3W Quick Access Recorder, it preferably distributes/writes each primary data stream to an appropriate SD card within the QAR and combines all data source information and transmits it to a portable computer (i.e., EFB, tablet, semi fixed computer device, possibly in a permanently mounted docking station) via a wi-fi transmission.

When the system initially boots up the QAR-3W wifi preferably looks for a receiving device. Each receiving device preferably has been programmed with the appropriate router address and WPA password. The NORTH software/app is preferably set to run when the device is powered up and when the EFB recognizes the QAR wifi and opens a connection to write LIVE stream of data to the EFB memory. When this link is established a “Blue” LED on the QAR preferably illuminates indicating a positive connection and the NORTH app preferably places a “Blue Light” on the tray at the bottom of the EFB screen to preferably indicate positive connection. The QAR preferably sends a “message” to the MFDAU which in turn sends a message/flips a bit, which illuminates a light on the system A,V, D, R annunciator (and may turn the letter Blue) to indicate to the pilot that the system is

connected and recording via wifi to the EFB.

As the composite data stream is received, the NORTH app preferably takes the data and applies 128 bit encryption as it writes the data to the computer's memory. The recorded data is preferably made available to other software programs the customer wishes to run. The NORTH app preferably monitors the data stream and connection. If the connection is lost, the NORTH app preferably tries to re-establish the connection. If the wifi connection remains intact but the data ceases to flow, the NORTH app preferably initiates the shutdown and closing of files.

While the live data feed is being received by the EFB, a customer can preferably run a live data analysis programs. This may include but not limited to FOQA analysis, and vibration data analysis.

When the aircraft is shut down and power is removed from the NORTH Flight Data System, the battery and/or capacitors preferably provide power to perform the following function: the CV2R will preferably continue to run and power the video camera for one (1) minute. It will preferably record/send data from all 6 channels of audio and one channel of video to: an internal CV2R compact flash memory; a QAR-3W for writing to the QAR "CV2R" SD card; and QAR WiFi router for transmission to the EFB device. The MFDAU will preferably continue to send any available sensor data to the QAR-3W for one (1) minute and continue to send power (POE) to the QAR for approximately 30 seconds after cessation of data feed to facilitate the closing of the "MFDAU" SD card data file. The QAR-3W will preferably receive its primary power from the MFDAU via power of Ethernet (POE) and write any received data to the appropriate SD card and continue to transmit that composite data stream over the wifi router as long as it receives that MFDAU power. Upon cessation of the MFDAU POE the internal QAR-3W battery or cap will preferably provide power for the closing of files on all SD cards and preferably send an electronic message to the EFB via wifi to close the files on the EFB. When the EFB returns a message that the files have been closed properly, the QAR will preferably terminate the wifi connection and shutdown.

After the shutdown process is completed the NORTH EFB app will preferably provide a written message to EFB to confirm a successful shutdown or note an error has occurred. If the EFB loses power by either having ship's power removed from the "docking station" or other source, the NORTH app will preferably close the received data files under the EFB

internal battery power. If the EFB or such device has sensed the internal battery may not have sufficient power to continue operation (i.e., low battery alert), the NORTH app will preferably initiate the proper closing of files on the EFB.

If there is a data feed interruption for more than 15 seconds sensed by the EFB (either by the lack of data or a break in the wifi connection), the NORTH app will preferably initiate the closing of previously received data files. If the wifi link is lost, both the QAR-3w and the EFB via the NORTH app will preferably try to re-establish the link for a period of one (1) minute. When the wifi link is lost, the blue LED light on the QAR will preferably turn red and the annunciator light will either turn off or turn amber in color.

EFB/Tablet Collection and Processing:

An embodiment of the invention includes placing the computing device or EFB in the aircraft and allowing the computing device or EFB to operate on its own battery power (physical security of the device to be determined by aircraft pilot/operator)

Another embodiment of the invention includes mounting the computing device or EFB in the aircraft via a docking station which has been permanently affixed to the airframe.

Another embodiment of the invention includes a display being an integral part of the computing device or EFB, which is considered “carry on equipment”.

Another embodiment of the invention includes a display for the computing device or EFB that can be considered “Loose carry on equipment” to be secured at the discretion of the pilot/operator.

When an aircraft is initially powered up, the recorder (QAR) preferably goes through a system check and the WiFi router preferably broadcasts a Service Set Identifier (SSID) for an EFB receiving device to “see”. If necessary the QAR preferably stores accumulated data from the MFDAU, CV2R and Vibration acquisition units and “buffers” that data until the WiFi router is activated and can make a positive connection with the EFB. Upon establishing a positive connection to the EFB, the QAR preferably transmits all stored/buffered data and initiates the continuous flow of received data. If for some reason (regulatory or otherwise) the WiFi router must be disabled (possibly during takeoff or approach/landing) the QAR will preferably store/buffer the collected data and upon reactivation of the WiFi router and/or connection the stored data will be sent to the EFB.

When an EFB is identified by the QAR router, the EFB and QAR router preferably conduct a security check via a shared security key encryption. When a positive connection is

made, a signal is preferably sent to the QAR to illuminate the “Blue” WiFi connection LED light on the QAR. Simultaneously, a signal will be preferably sent to the optional panel mounted Annunciator to indicate positive connection (this can be by either turning a segment light on; the segment light can be preferably illuminated in Blue and when a connection is lost it can either turn off or alternatively turn amber).

Upon the acquisition of a positive WiFi connection, the EFB preferably creates four (4) primary files (MFDAU, Voice, Video, and Vibration) in which to store the received data. The EFB software will preferably “listen” for auxiliary data streams (e.g., medical equipment, Wx radar data) and preferably will create a file to capture that data if the stream is present.

The EFB will preferably contain a governing application which drives the logic for WiFi connection, security, file structure, and data processing including the option to apply high level encryption to a specified data stream. The application will have a preferable set up function that will store security settings and customer driven options within nonvolatile memory.

When the data stream(s) are received by the EFB, the EFB will preferably encrypt the data (if selected by the customer) prior to storing the data in the designated file. All encrypted files preferably include individual passwords associated with them to ensure that only authorized users can read that particular data.

During aircraft operation (based upon customer selections) a data stream can be preferably accessed by other applications running on the same EFB which display, analyze and interact with customer commands (e.g., FOQA, Vibration Analysis, medical charting software).

When the flight is complete and the aircraft is shut down, the EFB application preferably closes the files.

All measurements disclosed herein are at standard temperature and pressure, at sea level on Earth, unless indicated otherwise. All materials used or intended to be used in a human being are biocompatible, unless indicated otherwise.

The foregoing embodiments are presented by way of example only; the scope of the present invention is to be limited only by the following claims.

CLAIMS

1. An apparatus comprising:
 - a) means for receiving data;
 - b) means for recording data;
 - 5 c) a Quick Access Recorder (QAR) Board;
 - d) and a means of transmission of data from the QAR board to a removable device in an aircraft or vehicle which can retransmit the data automatically when removed from the aircraft or vehicle.
- 10 2. The apparatus of claim 1, wherein the means for receiving data includes inputs, and the means for recording data includes a slot, and further comprising:
 - a) a battery;
 - b) a Universal Serial Bus (USB) Adapter to Hard Memory;
 - c) a means for receiving power from an outside power source; and
 - d) a door providing access to the slot.
- 15 3. The apparatus of claim 1, wherein the means for receiving data includes inputs, and wherein the inputs receive data from for a Cockpit Voice Recorder (CV2R) Ethernet Feed, an Ethernet Vibration Feed, and a Mini-Flight Data Acquisition Unit (MFDAU) Data Feed.
- 20 4. The apparatus of claim 4, wherein the inputs are connected to the feed by an RJ45 ethernet connection.
5. The apparatus of claim 1, wherein means for recording data includes a slot, and wherein the slot receives a storage medium.
6. The apparatus of claim 5, wherein the storage medium is a Secure Digital (SD) memory card.
- 25 7. The apparatus of claim 6, wherein the QAR records data acquired from a CV2R Ethernet feed, an Ethernet Vibration feed, and a MFDAU Data Feed on the storage medium.
8. The apparatus of claim 1, wherein the QAR board receives data from a CV2R Ethernet feed, an Ethernet Vibration feed, and a MFDAU Data Feed.
- 30 9. The apparatus of claim 1, wherein the QAR board directs a composite data stream of multiple external data to the means of transmission.
10. The apparatus of claim 2, wherein the QAR board directs a composite data stream

of multiple external component data to the Universal Serial Bus (USB) Adapter to Hard Memory.

11. The apparatus of claim 1, wherein the means of transmission is wireless transmission.
12. The apparatus of claim 11, wherein the wireless transmission is accomplished through a
5 wireless router with the IEEE 802.11ac standard
13. The apparatus of claim 12, wherein the wireless router provides access for between the QAR and an electronic flight bag (EFB) or portable computer.
14. The apparatus of claim 13, wherein the QAR transmits a composite data stream of multiple external component data through the wireless router and to an EFB or portable
10 computer.
15. The apparatus of claim 13, wherein the QAR transmits the multiple external component data through the wireless router and to medical or auxiliary equipment and receives multiple external component data through the wireless router from medical or auxiliary equipment.
- 15 16. The apparatus of claim 13, wherein the EFB allows for encryption of the multiple external component data.
17. A method for acquiring data, analyzing said data, and transmitting the data and/or analysis of the collected data to a destination by using the apparatus of claim 1.
18. The method of claim 17, wherein said data is data derived from internal and
20 external sensors of an aircraft.
19. The method of claim 18, wherein the data is digital or analog.
20. The method of claim 17, wherein the data comprises:
 - a) data acquired from a CV2R Ethernet feed;
 - b) data from an Ethernet Vibration feed;
 - 25 c) data a MFDAU Data Feed; and
 - d) aircraft flight data.
21. The method of claim 17, wherein the data analysis is conducted in real-time.
22. The method of claim 21, wherein the data analysis further comprises comparing the data against a predetermined set of events.
- 30 23. The method of claim 21, wherein the data analysis further comprises comparing data in a virtual live basis in flight with Flight Operational Quality Assurance (FOQA).

24. The method of claim 17, wherein the transmittal of data is directed to a crash hardened device installed onboard the aircraft.
25. The method of claim 17, wherein the transmittal of the analysis is directed to a crash hardened device installed onboard the aircraft.
- 5 26. The method of claim 17, wherein the transmittal of data is directed to an EFB or portable computer.
27. The method of claim 17, wherein the transmittal of the analysis is directed to an EFB or portable computer.
28. The method of claim 17 wherein the transmittal is accomplished wirelessly by a
10 wireless router.
29. The method of claim 17 further comprising a means of encrypting the data.
30. A method of transmitting QAR data from an aircraft, comprising:
transmitting the QAR data to a portable electronic device which an aircraft crew member brings with him onto the aircraft and which will leave the aircraft with the aircraft crew
15 member when he leaves the aircraft;
automatically transmitting the QAR data from the portable electronic device when the pilot connects the electronic device to a network.
31. The method of claim 30, wherein the data is wirelessly transmitted to the portable electronic device in the aircraft.
- 20 32. The method of claim 30, wherein the data is encrypted before transmission to the portable electronic device.
33. The method of claim 30, wherein the portable electronic device has software that analyzes the data and can send messages to remote locations or simply let those in the aircraft know that there is an issue.
- 25 34. The method of claim 33, wherein the software detects some issues that normal flight equipment does not.
35. A method of transmitting QAR data from an aircraft, comprising:
transmitting the QAR data to a portable electronic device which a pilot brings with him onto the aircraft and which will leave the aircraft with the pilot when he leaves the aircraft;
30 automatically transmitting the QAR data from the portable electronic device when the pilot connects the electronic device to a network.
36. The method of claim 35, wherein the data is wirelessly transmitted to the portable

electronic device in the aircraft.

37. The method of claim 35, wherein the data is encrypted before transmission to the portable electronic device.

5 38. The method of claim 35, wherein the portable electronic device has software that analyzes the data and can send messages to remote locations or simply let those in the aircraft know that there is an issue.

39. The method of claim 38, wherein the software detect some issues that normal flight equipment does not.

10 40. The method of any one of claims 30-39, wherein the data is transmitted substantially continuously while the portable electronic device is in the aircraft.

41. The method of any one of claims 30-39, wherein the data is transmitted substantially continuously while the aircraft is in flight or taxiing.

42. The invention(s) substantially as shown and/or described herein.

15

ABSTRACT OF THE DISCLOSURE

The present invention relates to methods and apparatus that include the acquisition of detailed aircraft state and systems data, analysis of the collected data, and transmission of the collected data and/or analysis of the collected data to a destination automatically via a portable electronic device which is carried onto and off of the aircraft by the pilot. More particularly, the present invention relates to methods and apparatus that include collecting analog or digital sensor data onboard a vehicle, analyzing said data in real-time, and transmitting the data and/or analysis of the data to a destination including a portable storage device such as a portable computer or electronic flight bag (EFBs) by means such as wireless transmission.

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NORTH QAR-3W

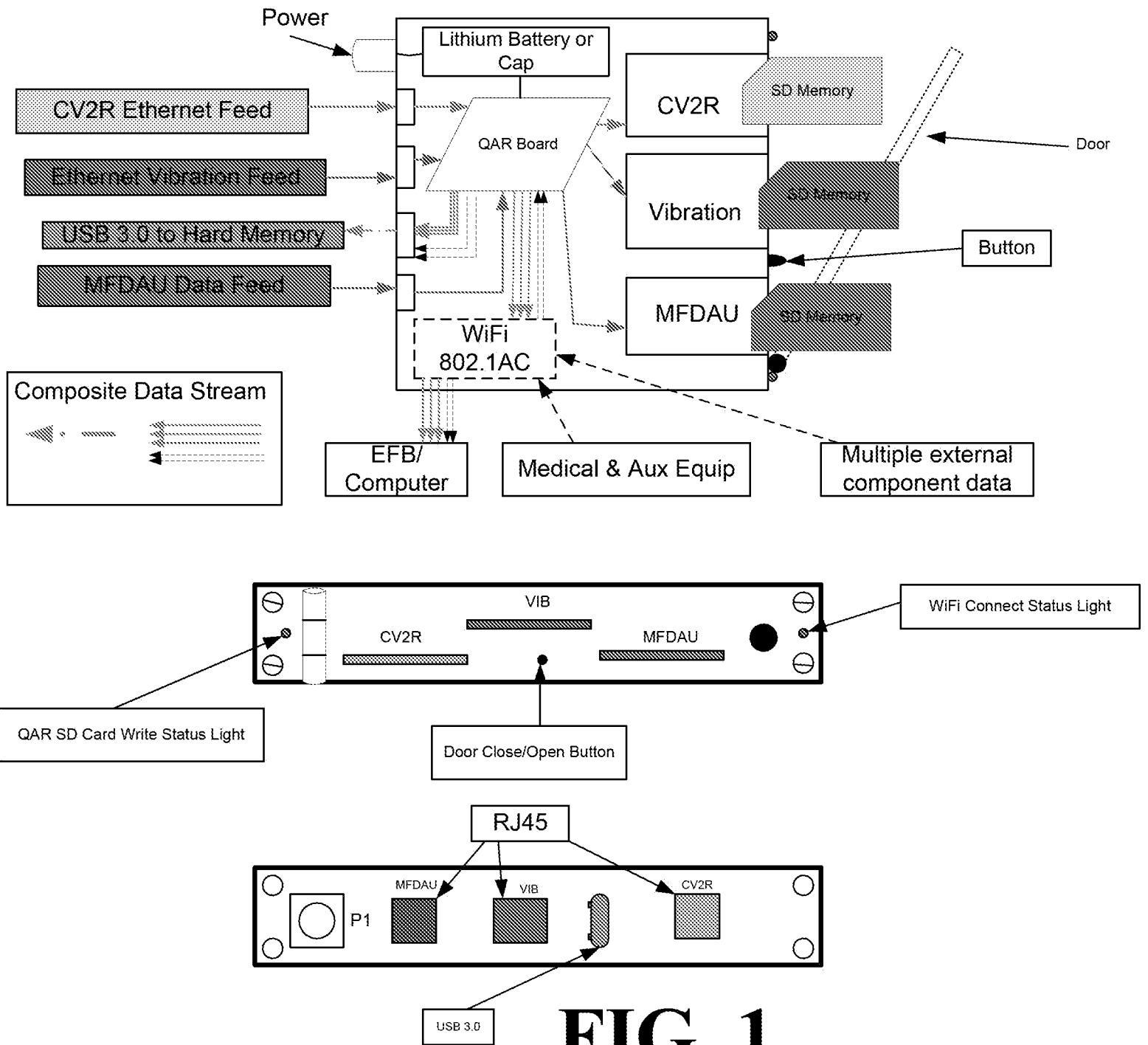


FIG. 1

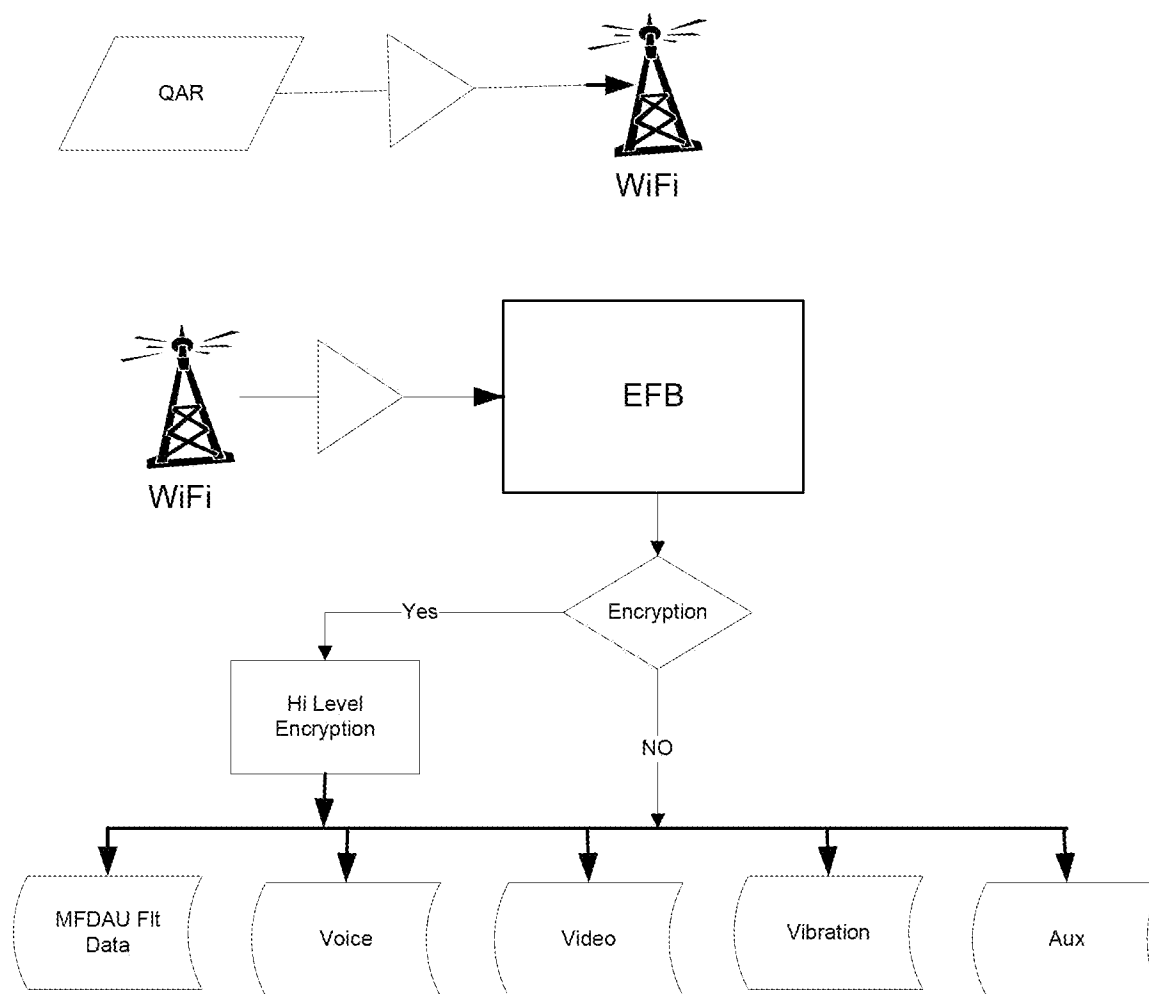


FIG. 2

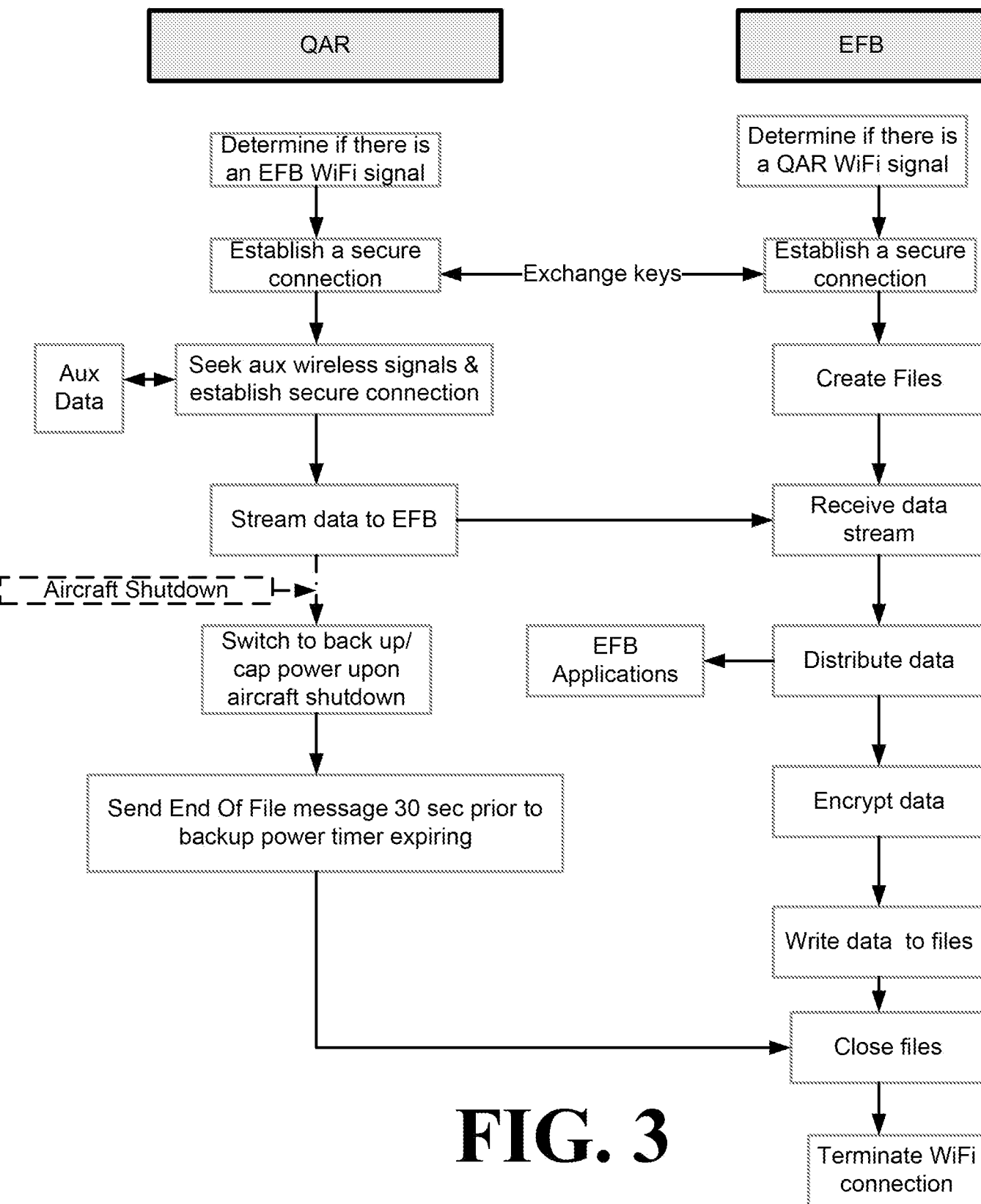


FIG. 3

**NORTH Flight Data System
Model C-2000**

CONFIDENTIAL

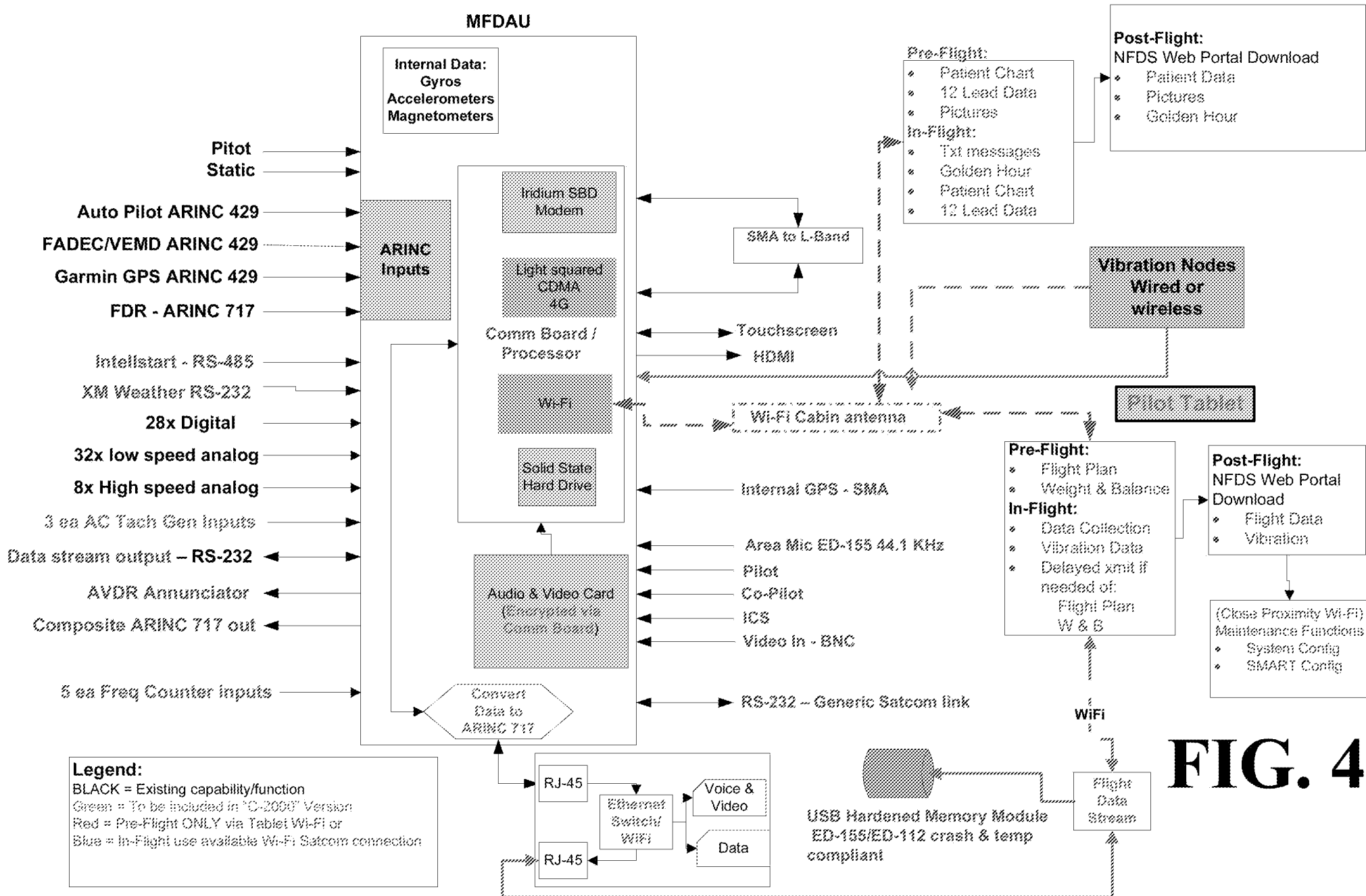


FIG. 4