Airborne Internet CIE: Applications Abound

Ralph Yost
William J Hughes FAA Technical Center
Atlantic City Airport, NJ 08405
(609) 485-5637
Ralph.Yost@faa.gov

The Airborne Internet will provide a tremendous opportunity for new applications to be utilized on board aircraft. Flight deck functionality can be greatly improved when the Airborne Internet is implemented and the Collaborative Information Environment (CIE) is the enabling technology to transform the flight deck from a relatively static information user to a dynamic node on an information network. Through the use of TCP/IP and XML Web Services, the Airborne Internet CIE will provide the foundation upon which numerous new applications can be used by the people in aircraft.

Airborne Internet CIE applications could include the System Wide Information Management (SWIM), Controller Pilot Data Link (CPLDC), regular downloading of the aircraft’s “black box” data, priority TCP/IP message delivery, voice over IP (which then could be used as voice in the Oceanic or Gulf of Mexico airspace), better and enhanced weather information, Airport/Facility Directory, FAA NOTAMs (including "special use airspace (including TFR)), telemedicine, special homeland security functions, and electronic flight bag applications such as conflict detection and avoidance. Flight deck applications could be commanded and controlled by the flight crew’s voice rather than mouse, keypad and pointing devices which are clumsy and difficult to use in the sometimes high turbulence environment of an aircraft.

SWIM
Airborne Internet could provide the secure airborne data platform for the development of the System Wide Information Management (SWIM) infrastructure. SWIM is a transformation from point-to-point communications to information-centric operations. Airborne Internet network enabled aircraft can become a more integral part of the information-centric system. These operations are characterized by widely shared information that can be exploited.

The three primary elements of SWIM could benefit by using Airborne Internet: as augmentation to the surveillance data network, enabling better weather products to the aircraft, and facilitating the airborne element of the Aeronautical Information Management (AIM) network. With network-enabled air traffic operations and network enabled aircraft, collaborative decision-making is more possible and could enable more rapid responses to unforeseen events such as aviation weather or security threats. Airborne Internet enabled aircraft could have early detection sensors on board the aircraft that would immediately inform the other aircraft in the area and the essential government authorities on the ground network. Network connectivity to aircraft provides an
opportunity for the flight crew and the Federal Air Marshals (FAMs) to privately be digitally connected to the ground counterparts and provide information at the soonest opportunity about activities in the aircraft.

**CPDLC**
As the Aeronautical Telecommunications Network (ATN) is converted over to use the Internet Protocol (IP), Airborne Internet provides a unique opportunity for the Controller Pilot Data Link Communications (CPDLC) to become operational in the most economic operational form. Instead of using the proprietary radio system initially used for CPDLC operational trials, Airborne Internet could provide the revenue enhancing platform that is co-shared with CPDLC that could virtually eliminate the former CPDLC message costs. By utilizing an Airborne Internet infrastructure that is designed for both income generation and aircraft operations, the net cost of CPDLC operations would be more than offset by the income side of the Airborne Internet investment. CPDLC is a relatively low bandwidth application that only uses short bursts of text messaging and could more than likely be utilized even in narrowband Airborne Internet installations.

**Weather to the Cockpit**
“Real time” weather to the cockpit has been a long time goal of the aviation community. Airborne Internet will make it possible for all aviators (air transport, business jets, commuter aircraft, and general aviation class) to view text or graphical weather products in real time. Pilots will be able to know about local and national weather conditions. Flight crews will also have the capability to recall weather history, to look at and analyze weather trends. Storm history will be readily available and easy to use to determine future track.

Pilots will be able to plan for diverted routes due to weather much sooner. And because Airborne Internet is a network capability to aircraft at all flight levels from the ground up, pilots will be able to get last minute looks at the weather and make changes to their route just prior to takeoff. Good and real-time weather data will enable more precise flight routing. By having greater precision about a storm’s edge boundaries, aircraft operators will have the information tools needed to save both fuel and time. NASA Langley Research Center has conducted studies that show a potential fuel savings of up to 5% in fuel costs for airlines by enabling the flight crew with better strategic view of weather conditions. Real-time weather data to the flight deck can help pilots avoid turbulence and resulting injuries to passengers.

The ideal use of weather information for flight is for the airline dispatcher, air traffic controller, and flight crew to all see the same weather products. Airborne Internet can provide the network capability to aircraft to enable the flight crews to receive the same weather products as the dispatcher and controller. This creates the ideal decision making collaboration situation. In the aircraft, the weather information does not need a specialized display device to be used. A normal multi-function display, an electronic flight bag (EFB), or a tablet PC could be used to display weather obtained from the aircraft’s Airborne Internet network capability.
TAMDAR
Tropospheric Airborne Meteorological Data Report (TAMDAR) is a program whose goal is to install an inexpensive instrument in aircraft that would measure meteorological variables from commuter aircraft flying to small and medium size cities. It is anticipated that TAMDAR will result in more accurate weather forecasts and reduce aircraft accidents and delays. Airborne Internet will provide an opportunity for the data from TAMDAR sensors to be collected and routed to the ground network in real time. TAMDAR data from Airborne Internet enabled commuter aircraft will provide needed data for improvements in computer models used in weather forecasting. The data will also be directly useful to flight crew, and to meteorologists in the National Weather Service and airline weather and operations offices. TAMDAR data will be available on a public web page via a web browser that will display flight paths, winds at different altitudes, and soundings near airports. The data can also be converted to plain text format. Airborne Internet enabled aircraft will have the ability to instantly access TAMDAR weather information for their flight route. And because TAMDAR data will be made available to the public web site within fifteen minutes, it is always relatively fresh to the Airborne Internet aircraft.

QoS
Quality of Service (QoS) is the capability of a network to provide better (or priority) service to selected network traffic. In a shared network in which flight deck or security functions are using the same network infrastructure and bandwidth as passenger services, (as Airborne Internet proposes to do), it is essential to be able to prioritize the network for flight deck and security functionality. The goal of Airborne Internet QoS is to provide priority (including dedicated bandwidth and reduced latency) for specified network user functions. It is also important to ensure that when an Airborne Internet QoS priority is provided for a function that the network does not make other passenger services fail. Airborne Internet would utilize congestion and queue management for functions on the same network. Airborne Internet architecture could be designed to guarantee a specified throughput level for higher priority functions. This in turn would allow end-to-end latency to not exceed predetermined levels.

Oceanic Data Channel
Airborne Internet provides an opportunity to use electronic air/ground communication services for aircraft operating over the Atlantic or Pacific Oceans. Airborne Internet could provide the network connectivity from aircraft that could allow air traffic controllers to have two-way electronic communications with aircraft equipped with data link. Using a digital data link could eliminate the need for voice communication between data link-equipped aircraft and air traffic controllers, improving the reliability and timeliness of message delivery. Once the aircraft is reliably networked via Airborne Internet, the existing high frequency communications problems with aircraft, such as frequency congestion, transcription errors, and lack of timeliness could be eliminated.
Automatic Dependent Surveillance (ADS) is another function that Airborne Internet network connectivity between aircraft could provide. Network connectivity between aircraft and between aircraft and the ground networks could allow aircraft to automatically send navigation and guidance data derived from its flight management system and onboard navigation sensors, such as the Global Positioning System (GPS), to air traffic control facilities for the purpose of accurately determining aircraft position and intent. CPDLC, ADS, and GPS, coupled with enhanced controller automation tools would form the basis to achieve an eventual oceanic free flight.

**VoIP**

The network connectivity that Airborne Internet will provide to aircraft will also provide the opportunity for the flight deck and passengers to use Voice over Internet Protocol (VoIP). Currently voice communications from aircraft to ground is expensive, costing more than a $1 per minute. In addition, there is no direct method to call a VoIP user in another aircraft. Airborne Internet can change that. VoIP makes easy some things that are difficult to impossible with traditional phone networks. Incoming phone calls are automatically routed to your VOIP phone where ever you plug it into the network. VoIP users can take their phone with then on a flight, and anywhere the Airborne Internet-enabled aircraft flies, they can receive incoming calls. Flight crews will have the capability to have low cost (nearly free) high quality voice communications to speak with their operations offices, get direct voice weather briefings, or speak directly to the flight crew of another aircraft. For example, an aircraft flying ahead of another could be able to call back and report turbulence. Using VoIP for private conversations such as this, instead of the voice radio communications channel, would free up over crowded voice radio communications channel for ATC functions.

**Black Box Data**

Airborne Internet could provide the communications channel that will enable software on an aircraft to monitor flight conditions and transmit flight safety information (e.g., aircraft performance/flight parameters) to the ground network. The application could use Airborne Internet to transmit the data off the aircraft as it takes place during flight. The data is normally stored in the Flight Data Recorder in the aircraft. This application could provide monitoring software on the ground the data to determine safety issues (i.e., in-flight emergencies) if certain alarm parameters were breached. In the event of an accident, more information would be available and cover a longer period of time about this flight, thus providing investigators more insight as to why the eventual accident occurred.

**EFB**

Electronic Flight Bags (EFB) are rapidly changing the information is being consumed and brought to the cockpit. EFBs are replacing the old, large, heavy flight bag that so many pilots used to carry on board that contained their charts, approach plates, and other flight related paper products. Airborne Internet is now providing network and information connectivity to EFBs that will save airlines lots of money as they move towards a paperless cockpit. An obvious first step to get to a paperless cockpit is to replace the
paper operating manuals with the EFB. Airlines will save precious weight but will also see significant savings in document reproduction and distribution costs. Because the documents are in electronic form, they can then electronically load and update information. Updating EFB documents can be done over the Airborne Internet using secure network techniques. Electronic transmission of data via Airborne Internet from the company's office directly to the airplane would produce tremendous savings. Because the EFB is a tablet PC or similar device, numerous applications could be run on it. For example, conflict detection & alert software could be used to alert the flight crew when the EFB was networked into the Airborne Internet system.

**Conclusion**

As Airborne Internet enabled aircraft begin flying and the aviation community realizes the power of aircraft networking, the number of applications that can utilize Airborne Internet will greatly increase. There will be an increased demand for greater bandwidth from Airborne Internet in aircraft just as there was greater demand for increased bandwidth to our businesses and to our homes. Airborne Internet will start out with a few obvious applications, but as bandwidth capability increases, so will the number of applications……or will it be that the number of applications will increase and in turn will create a demand for greater bandwidth? Only time will tell.