Upgrading Global Air Traffic Management

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CrossTalk

ONE on ONE

Traffic management for the airways is moving to a more efficient and effective method to track and control aircraft. While radar could track aircraft over land, verbal communication had to be used to track aircraft over water. This verbal requirement implemented the use of a middleman between the traffic controllers and the aircraft, allowing for communication problems. Now, a new Global Air Traffic Control system is being implemented that will allow traffic controllers to directly track and communicate with aircraft in order to improve navigation and safety.

Rockwell Collins contracted with the Systems Program Office for the U.S. Air Force (USAF) Aeronautical Systems Command to upgrade the Global Air Traffic Management (GATM) avionics in the KC-135 aircraft. On Nov. 20, 2002, the KC-135 GATM program successfully completed its South Pacific integrated systems evaluation mission. The mission was conducted during a span of seven days and covered more than 14,800 miles for the first-ever USAF GATM compliance testing with numerous civilian air traffic controllers. CrossTalk Associate Publisher Elizabeth Starrett interviewed John Schneider, program manager, about how civilian and military air traffic requirements and advancements are coming together throughout global airspace.

Q: How does the current Global Air Traffic Management (GATM) system operate?

Schneider: Traditionally, you use radar to track aircraft over land. You have radar coverage to understand exactly any given aircraft's location. When aircraft go oceanic, you lose that radar coverage because you can't put radar sites in the water. Traditionally air traffic controllers have communicated with the aircraft by voice when they are beyond line of sight.

For instance, Oakland Center oversees the whole Pacific region. They will send the request out for a position report to an intermediary communication company; in this case it is Aeronautical Radio, Inc. (ARINC). Then ARINC will, over high frequency, hopefully get ahold of the aircraft and communicate the [position report] request. The aircraft will report their position back to ARINC, who will then Teletype that information back to the air traffic services.

The need for GATM requirements stems primarily from the growth of air traffic and its burden on worldwide air traffic control services. The increase in air traffic places a greater emphasis on the need for aircraft to operate within closer spacing as well as air traffic services having greater situational awareness of these aircraft within controlled airspace. In support of these objectives, many domestic and international civil aviation agencies continue to phase in functional mandates that ultimately drive requirements into aircraft flight decks. In most cases, such requirements apply to both commercial as well as military aircraft, so it's very important for the USAF to stay in touch with the GATM initiative.

The importance in having these types of capabilities is that it often allows an aircraft access to airspace in which it would otherwise be denied. Denial could come in the form of access to preferred altitude blocks, time slots, airports, or bases. In some cases, access to airspace at all altitudes is possible. Because the USAF has a need to deploy their aircraft wherever and whenever, it's pretty easy to understand the importance of having their aircraft equipped with GATM capabilities.

Q: How will the GATM upgrade operate?

Schneider: The GATM focuses on capabilities in three general functional areas: navigation, communication, and safety/ surveillance. Adding related capabilities to the KC-135 aircraft is accomplished by adding several hardware components and software applications. These additions enhance existing navigation accuracy and add capabilities that allow the pilot to communicate with air traffic services via datalink as opposed to more traditional voice communications.

From a navigation standpoint, Rockwell Collins added an improved military global positioning system (GPS) receiver and two commercial GPS receivers to meet Required Navigation Performance (RNP) initiatives, which define the accuracy and reliability of navigation systems. Relatively speaking, navigation performance tends to be more critical when airspace congestion is greater, or the aircraft are departing or arriving. The need for greater levels of navigation performance increases as the aircraft transitions from oceanic and en route phases to terminal and approach phases or flights. We also added two multi-mode receivers to address the GATM requirements associated with FM-immune instrument landing system (ILS) capabilities. Lastly, we've replaced the legacy flight management function (FMF) with a commercial FMF to better align the aircraft's flight management capabilities with the commercial airline industry.

From a communication standpoint, Rockwell Collins has added systems that support datalink communication over VHF, HF, or satellite communications (SATCOM). The addition of the SATCOM system also provides another means of beyond-line-of-sight voice communications. We also added communication management units (CMU) that provide processing capabilities associated with controller/ pilot data link communications (CPDLC) and automatic dependent surveillance (ADS). CPDLC replaces traditional voice communications between a pilot and controller with data link-based communications and is intended to address ongoing concerns associated with high controller workload, misinterpretations of air traffic control communications, and overburdened voice communications networks.

The ADS function actually falls under the surveillance portion of GATM and allows for the reporting of aircraft position (latitude, longitude, altitude, etc.) thereby allowing air traffic services to be continually aware of where each aircraft is located within a given airspace sector. Reporting this information typically requires no pilot interaction, and since the aircraft will have long-range data link capabilities via HF and SATCOM radios, these reports can be

downlinked independent of the aircraft's current position. This is especially useful when aircraft are in oceanic airspace beyond the reach of land-based radar. Without the GATM capabilities, pilots were forced to provide manual position reports via long-range voice communications, which typically involved a third party to relay this information to the appropriate air services center, as I mentioned earlier.

There are several other enhancements that while not considered GATM-specific, will aid the pilot from a situational awareness standpoint. For instance, we've added several additional display formats such as heading, tactical, and north-up maps. The system also provides the ability to display navigation background data. We've also included the Airline Operational Command (AOC) function that we believe will provide a great deal of utility. AOC gets its roots from the commercial airline industry and is a means to communicate between an airline's dispatch center and each of its aircraft via a series of data link messages. We've worked with our customer to adapt the standard AOC message set for military command and control purposes. We're really just scratching the surface when it comes to AOC, and we're very excited about its potential in the military arena.

Q: When did the GATM upgrade start?

Schneider: The requirements that bubbled up into GATM have slowly been put into place probably since the late 1990's when you started to see a lot of the civil requirements govern access to airspace. From our perspective, Rockwell Collins received the initial contract award in November 1999. Design, development and verification activities were performed during the next 30 months culminating in the first flight of the GATM system aboard the KC-135 aircraft on April 2, 2002. Delivery of the first production aircraft is scheduled for the summer of 2003.

Q: When is compliance required?

Schneider: It really depends on the specific requirement and the geographical location. There are many functional requirements associated with the GATM initiative and some of them are already being phased in by civil aviation agencies that govern global airspace. Requirements that have already been phased into a large extent, include Required Vertical Separation Minimums (RVSM), Required Navigation

Performance-5 (RNP-5) and FM-Immune ILS. We expect to see more stringent navigation requirements (i.e. RNP-4, RNP-1) phased in over the next several years. Additionally, there are several airspace sectors, including many in Europe and the South Pacific that are utilizing both CPDLC and ADS capabilities.

The genesis of the GATM requirements for the KC-135 platforms is from the GATM Operational Requirements Document (ORD) that was published by Air Mobility Command (AMC). The need for the GATM ORD is based upon the recognition that the associated requirements are commonly levied by civil aviation agencies or host nations and they don't typically discriminate between commercial and military aircraft. Since the USAF strives to

have unconditional access to global airspace, they recognize the importance of equipping their aircraft with capabilities that can satisfy these requirements.

Q: The future air navigation system (FANS) is just now coming on-line. How many aircraft are able to use this now?

Schneider: Within the U.S. Air Force, there are several GATM upgrade programs underway under the AMC organization, and Rockwell Collins is proud to say that the KC-135 GATM program is the first program to achieve first flight and achieve a follow-on production award. The initial production award for upgrading 50 aircraft has been awarded. Delivery of the first aircraft will take place this summer with the remaining aircraft scheduled for upgrade within a one-year period. The various air traffic control centers are getting the capability for FANS applications. I would say right now, it is predominantly in the South

Pacific. You are seeing a lot of CPDLC activity right now in the Pacific oceanic areas and Brisbane, Australia, New Zealand, and Fiji. In addition to that, you are starting to see those types of activities or applications become more prevalent in the European areas.

Q: It is my understanding that the military's KC-135 is the first aircraft to be tested with GATM. Is this correct?

Schneider: This is the first military application within AMC to be tested with GATM. I'll rattle off a couple AMC aircraft: There is KC-135, KC-10 has a GATM program, and C5AMP is adding

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>
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GATM capabilities. But KC-135 is the first program out of AMC to have GATM capabilities installed, and we have completed flight-testing and are going into production. The first aircraft is scheduled to come out of production in the July 2003 time frame. So there are many firsts, and that is a big one.

Yes, the KC-135 aircraft is the workhorse of the USAF when it comes to in-air refueling operations. It is one of several AMC aircraft platforms that are currently targeted for GATM capabilities.

Q: Do you know of any commercial aircraft that are implementing GATM yet?

Schneider: Certainly. When we talk GATM, it means a lot of things. There is the data link side and the navigation side, but from a FANS standpoint (which is on the data link communications side) there are commercial aircraft that utilize data linking for CPDLC. What you are seeing is the merging of the commercial require-

ments with the military requirements so they can all play in the same airspace together. The FANS requirements came out of the commercial industry, and there are civilian requirements. I think the Department of Defense is looking at this and asking, "How do we equip our aircraft to make them compliant with all of these civilian requirements to ensure access to global airspace?"

Many foreign and domestic air carriers are currently equipped with various GATM-related capabilities such as RNP, RVSM and FM-Immune ILS. Additionally, the air cargo industry is using ADS rather extensively.

Q: Do you envision your software or some of the other earlier versions of this software being reused by different aircraft, or is everybody developing their own software?

Schneider: Our customer has expressed a strong desire for not only software reuse, but technology reuse. This generally can come in two different aspects. The first has to do with the ability of our program to leverage software and technologies previously developed elsewhere. This program has been very successful in leveraging commercial off-the-shelf (COTS) products to fulfill GATM requirements. This includes the reuse of the FMF from Rockwell Collins's Business and Regional Systems division and the SATCOM receiver and MMR developed by our Air Transport division.

The second aspect has to do with ability for other programs to leverage the technologies and software that have been developed for the KC-135 GATM program. The cornerstone of the KC-135 GATM upgrade is Rockwell's Flight 2 architecture and is very much predicated on commercial design standards, thereby ensuring an open architecture that is transferable to other platforms.

Q: Do you know if other contractors are also leveraging off of software that is also being developed for this, or does each contractor have to develop their own software to leverage for themselves?

Schneider: I don't know. I can tell you that Rockwell Collins has certainly achieved a great deal of software reuse across pro-

grams where the company is contracted to not only develop software but also the target hardware on which the software resides. Our philosophy is to develop software in accordance with widely adopted, commercially available, and endorsed standards. This helps promote the transfer of the software to other targets and its ability to integrate with third-party software. However, for business reasons, many companies would prefer to develop their own software applications as opposed to purchasing a similar application from a competitor. The bottom line is that Rockwell Collins has been able to reuse technology from the KC-135 GATM program on

other programs in which we're involved with, and we'd be happy to sell or license these products to other contractors.

Q: What happens now as far as the global system?

Schneider: Well, I believe we will continue to see the evolution of GATM requirements, and they will continue to be phased in over time. This places an emphasis on the need for upgrading aircraft with these capabilities in the near term and having a cockpit architecture that has the growth and flexibility to address future requirements when they become mandated.

It is really key that you get out in front of these requirements as far as capabilities are concerned. You don't want to wait until the requirements are so limiting that it then forces you to add capabilities to the aircraft. It could take months or years to add those capabilities to a fleet like KC-135, which is 540 strong. We positioned the aircraft to meet the requirements (the GATM requirements that we know of at this point in time), and we have also positioned the aircraft because of our Flight 2 growth story to meet the requirements as they do evolve.

Q: Getting more specific to your own project, what makes KC-135 GATM architecture an innovative solution?

Schneider: The cornerstone of the GATM upgrade is Rockwell Collins' Flight 2 architecture. Within this architecture resides the Integrated Processing Cabinet (IPC) which as the name implies, is an integrated, modularized avionics cabinet that hosts many of the GATM software applications. The cabinet itself is highly scalable and flexible and the software applications are partitioned so it can accommodate future program requirements while minimizing design and cost impacts. This is extremely important to the program since GATM requirements continue to evolve, and it's likely that there will be

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system adaptations to meet these requirements.

The architecture was also designed using widely adopted, commercially available and endorsed standards in order to ensure an open systems architecture. This is important in order to allow third-party development, facilitate insertion of new technology, and safeguard against the development of point solutions.

Lastly, the architecture utilizes several high-speed Ethernet interfaces internal and external to the IPC. One of the chief benefits here is the ability to transfer system information at rates that are significantly higher than traditional interfaces such as ARINC-429 or MIL-STD-1553. The end result is a more capable, responsive system.◆

About the Interviewee
John D. Schneider is a Rockwell Collins program manager for the C/KC-135 Global Air Traffic Management (GATM) program. His responsibilities include execution of GATM design, development, and verification activities. Schneider has more than 15 years of engineering and program management experience associated with U.S. Air Force tanker and transport avionics upgrades, including C-17, KC-10 and KC-135 aircraft. He is a native of Joliet, Ill. Visit Rockwell Collins at <www.rockwell collins.com>.