WHERE HAVE ALL THE RADIOS GONE

With the constant advances in system integration that confront us on a monthly and yearly basis I have to ask; where have all the radios gone? The avionics of today are fast evolving and becoming so integrated that they are, to some extent disappearing from the panel. They have found their way behind the panel in a modular rack assembly or remotely located in the same manner. In some shops the laptop computer has become one of the most essential tools for the technician, more so then an oscilloscope. This evolution in technology and system architecture has proven to be a great success for the industry and we now find ourselves confronted with an imbedded suite of radios surrounded and interconnected via a common backplane. What does this remind you of? This architecture provides significant advantages in weight savings by providing a reduction in wire count and connectors as well as in system reliability. The time in which real time data (weather, traffic and attitude) can be presented to the pilot is enhanced. The FAA's automated highway in the sky concept is gradually approaching and the capabilities of these new systems will make it much easier to advance. The reliability of systems has significantly increased due to minimizing the number of connector/wire interfaces that are required, imbedding the radio modules into one common rack and sharing common resources. Integrated Modular Avionics (IMA) is the term used for a common computer network aboard an aircraft. The airframe is becoming a network of integrated modules and sensors most of which perform multiple tasks and all to the benefit of the pilot.

In the 1990's the new systems coming out consisted of Line Replaceable Units (LRU's) that while becoming interconnected in a digital fashion were still distributed throughout the airframe. This system organization while improving upon older avionics still left a significant amount of wire and connectors to deal with because the architecture remained the same. While industry standards for the new data bus types where developed there was little standardization of certain protocols. Next we saw a move to integrate several radios into one package and thus minimize the distribution of radios around the airframe. In the mid 1990's Rockwell Collins introduced the Pro Line 4 system which was their first attempt into system integration. They later changed their architecture name to Pro Line 21 which blended in the use of large LCD's utilizing embedded processing. The Integrated Avionics Processing System (IAPS) was utilized in both systems. The Collins Pro Line 21 and Honeywell Primus Epic systems have further enhanced the capability of integration. Honeywell and Rockwell Collins each have developed retrofit systems based on this architecture. The recent FAA mandates for RVSM, TAWS and EGPWS have only gone to show the importance of this type of integration where a lot of the changes are implemented onto a common display. The limit of integration in these systems will be determined by the systems I\O capabilities. We will also see a basic platform with hardware modules containing just "boot-up" and data loading code that an OEM can configure with different manufacturer's software to provide a specific function. This is unique in that software will not change the aircraft weight and balance but can substantially increase the aircraft's capability.

This current path in architecture seems to indicate that we should maintain a common core system. This architecture in cabinet form and containing individual modules serves the aircraft environment well. The backplanes within these cabinets do have some Ethernet capability among the modules as well as up to the display itself. Rockwell Collins calls their system the "Integrated Processing System" (IPS). The Ethernet will also extend to a remote File Server Unit (FSU) for system and data uploads. This FSU will enable an array of functionality such as electronic charts and enhanced moving maps. In 2008 Rockwell Collins will implement a 10/100 Mbit Ethernet technology into the ARJ21 aircraft which is a Chinese Regional Jet. Honeywell's Primus Epic suite takes it to the next level by allowing other manufacturers to plug their cards into the Primus processing cabinet. The Hawker Horizon is one aircraft to implement this scheme and make it possible to handle large amounts of data efficiently. The increasing requirement for aircraft data links between terrestrial stations and satellites will easily interface to this architecture.

Garmin has recently introduced an all glass cockpit in their G1000 system, which is made up of multiple LRU's in a modular system rack. The rack can be mounted remotely or directly behind the panel mounted displays. The G1000 system suite is installed only by OEM's and is currently available in the Cessna Mustang, Skylane and Stationairs. This system is also available on the Diamond DA42 and most

recently the Beechcraft G36 Bonanza aircraft. Garmin has now provided a much-anticipated path down to the smaller aircraft market, which previously did not exist. The displays (GDU 1040) are 10.4 inch TFT sunlight-readable LCD's (PFD/MFD) with 1024 x 768 resolution and a viewing angle of +/-35°. The displays communicate with each other and the integrated avionics unit (GIA 63) through a High-Speed Data Bus (HSDB) Ethernet connection. The audio interfacing is done through the GMA1347 and it utilizes an RS232 connection to the GIA 63's. The heart of the LRU's is the GRS 77 Attitude and Heading Reference System (AHRS). This unit contains a myriad of sensors and accelerometers required to formulate both aircraft attitude and direction. This information is sent to the GDU 1040's via an ARINC 429 bus. The GMU 44 a remote magnetometer (Flux Sensor) even communicates digitally to the GRS 77 using the RS-485 format. The GMU 44 is considered a smart sensor in this form just like the automotive sensors of today. The GDC 74A is another LRU and it serves as the Air Data Computer and provides pressure altitude, airspeed, vertical speed and OAT information to the system. The GDC 74A communicates with the GIA 63's and GDU 1040's using an ARINC 429 bus. The G1000 system while maintaining the LRU type architecture does incorporate digital communication throughout the system. While reading through the system manual I noted the following under the title "Recommended Tools"; a #2 Phillips screwdriver, a 3/32ND inch hex tool and a voltmeter. This is a striking change and a sign of the future. Ramp generators of course will always be a necessary however our toolbox's will be shrinking. The bigger challenge to the technicians may be how quickly they master the over 100 knobs and buttons in the system.

We have seen the general aviation airframe evolve into a computing platform that even prompts us with troubleshooting and system alignment procedures. All these systems certainly provide a picture of confidence to the pilot in the level of situational awareness that they can provide. These highly integrated, open architecture systems that are networked together have made great strides in providing the pilot with a wealth of information. This technology to some extent has provided the technician with less to do, as we tend to "plug and play" with the modules. While some of this technology has been around for some time it is important to note that students are now training with it. With this new architecture the smaller aircraft are fast approaching the benefits once only seen in the corporate jets. To some degree an Ethernet connection will be as important to the technician as the external power cart connector. The technician may also need an Ethernet connection on his bench to plug avionics modules into and let the OEM diagnose the problem. This will have an effect on the size of repair stations and how they grow in the future and hopefully our customer base will be understanding of our limited capabilities. As we get closer to the FAA training mandate for repair stations I am hopeful that system architecture, theory and troubleshooting will be fully explored so that a strong bridge is maintained between OEM's and the customer base that we all support.

Kim Wiolland
Avionics News February 2006 Issue