DATALINKS

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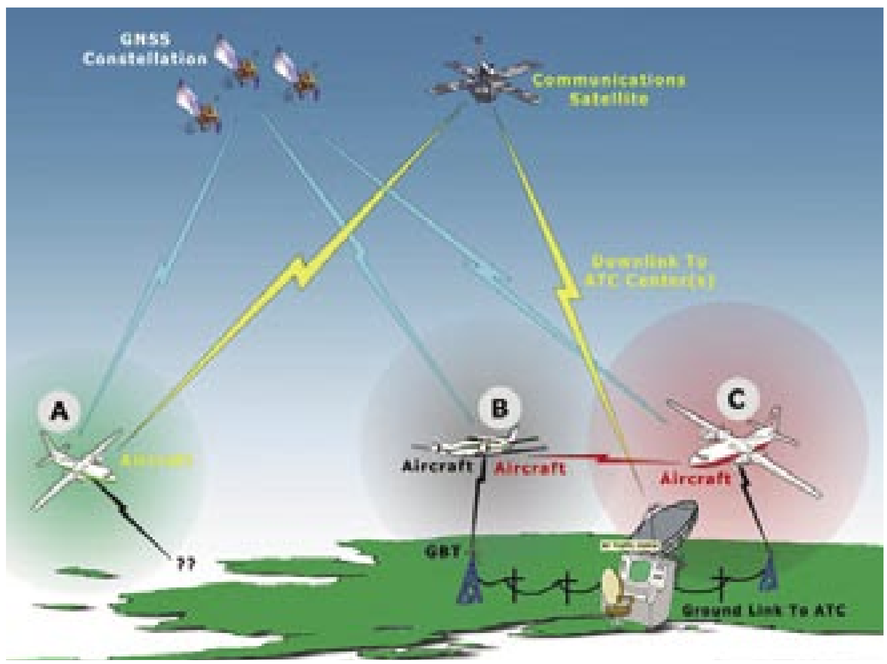
TECH-AID PRODUCTS

Although Free Flight is a broad concept consisting of multiple datalinks and still a product of the future, some of its concepts are in use today and are providing a great deal of situational awareness to pilots both in the commercial and general aviation markets. ADS-B stands for Automatic Dependent Surveillance—Broadcast and this datalink also will assist in visual acquisition of other aircraft. Datalink by definition is “the transfer of digitized information” (Air/Ground). This datalink concept is meant to form a series of networks in the air and on the ground where aircraft can broadcast a three dimensional position to each other and to ATC on the ground using a digital format called Compact Position Report or CPR. The Capstone project in Alaska has already proven this datalink concept. This concept evolved in the early 1990s and started as a relationship between NASA the FAA and a few select research groups. One intent is to provide precise and timely knowledge of both traffic and graphical weather information to the pilot. The genesis or driving force behind this effort was to try and minimize aviation fatalities through the presentation of better situational awareness to the cockpit. This was re-enforced in 1998 when the FAA identified CFIT and weather as a top priority in fatal general aviation accidents. These datalinks will bring: space awareness, improved safety, autonomous data transfer, enhanced



Search and Rescue, fleet monitoring, improved traffic spacing and strategic and tactical weather information. This knowledge can then be used to separate aircraft from weather like the air traffic controllers separate aircraft. The concepts floated included using either a bi-directional (request-reply) or a broadcast format. The system would require the necessary capacity coverage and timeliness to handle the data and the intensive bandwidth required by it to display this graphical weather format. Another important concept was the requirement of a soft integration into the existing FAA infrastructure and into the current evolution of avionics. There were three datalink types considered and they are: Ground Based Terrestrial, Satellite Based (LEO and MEO) or a mixture of both. Another promising datalink standard is the two-way addressable VHF Digital Link or VDL. Currently VDL Mode 2 (Air/Ground) seems to be favored by the FAA. VDL Mode 2 can handle data rates up to 31.5 Kbits/sec. VDL Mode 2 also requires guard bands for each frequency which in itself adds to frequency congestion. A VDL Mode 3 (Air/Air but requires ground station for time-base) radio has also been demonstrated. There is also argument that there is no upgrade path from VDL2 to VDL3 and if the ground station fails then communication will be lost by both. Others argue that VDL Mode 4 (Air/Air without a ground station requirement) is the most capable option and some European countries have already favored VDL4. This process of determining which to fully implement is a highly charged and of course a heavily politicized process. With voice communications increasing 4 percent every year, congestion is becoming reality. These VHF links would result in better audio quality and even give your aircraft specific communication, no more "you were stepped on" replies. The average pilot however might feel a bit uncomfortable not hearing what other aircraft are doing. Think about it, how much isolation and aircraft discrimination should we have in the airspace environment? This generation of VHF datalinks like Mode 2/3/4 are forecast to meet the system demands through the year 2030. The future will ultimately bring less dependence on voice communication and terrestrial based navigation, and more automation in what is delivered to the pilot. We will find ourselves separated more from other aircraft based on performance then on just following specific procedures. In July of 2002 the FAA decided that general aviation would use the UAT or Universal Access Transceiver (below FL180) while hi-performance aircraft would use the existing 1090 Mhz Extended Squitter (1090 ES) Datalink (above FL180). The UAT datalink already proven in the Capstone program operates at 900 Mhz and is intended to transmit reports and has better range and capacity than the 1090 Mhz datalink.

Weather

As the weather datalink technology evolved and matured it became apparent that Satellite S-Band (2.332 Ghz to 2.3345 Ghz) was one way to deliver it to the cockpit. The S-Band spectrum was used because of its ability to penetrate dense storm cells and still reach the pilot. One effort was a combined one between XM and Heads-Up Technologies and in March 2004 the FAA issued certification for their XM WX MFD datalink Receiver the model XMD076. This datalink is a more recent development and it will transfer critical and real-time NexRad weather to the pilot with wind speed and direction at the normal 3K ft intervals and also lightning strike data. WXWorx Inc. manages this graphical format. The satellites used are in stationary orbits centered above the United States for the most complete coverage. Terrestrial repeaters could also be employed to extend coverage throughout some urban areas. After a long anticipated wait the marriage between the Avidyne EX500 and the XM Weather receiver should prove a strong contender to exploit this datalink format. The addition of this faster datalink for graphical weather to the pre-existing Narrow Cast (Orbcomm) datalink the EX500 already was using will provide a complimentary multi-link approach to weather information.

Collins has been working with NASA on a form of "Enhanced Weather Radar" (EWXR) where they can monitor both airborne and ground radar and then provide automatic storm analysis. The display would then separate the onboard radar from the datalinked radar with a "fence" type boundary to provide a more comprehensive picture of the storm.

Mode S

In 1987 it was thought that the 1090 Mhz datalink would become the main datalink in the overall concept of CNS/ATN. Mode S was already a requirement of the TCAS system and therefore some of the groundwork had been completed. As this initially started out in the commercial marketplace there were no real benefits to an aircraft that was not TCAS equipped. To the general aviation public without an FAA requirement and no benefit to the pilot, the concept lay dormant. With the evolution of TCAS and further mandates, its Mode S datalink format has become more congested but also more useful to the non-commercial pilot. Traffic Information Service-Broadcast (TIS-B) has essentially become a source of "Free" traffic information (for aircraft below FL180) that is up-linked over the ADS-B datalink system to the aircraft and updated every 5 to 12 seconds. In order to receive the TIS-B service the host aircraft must be equipped with a UAT ADS-B transceiver and a compatible cockpit display. The aircraft must be in range of a compatible Ground Based Transceiver (GBT) configured for TIS-B uplinks and the target aircraft must be within coverage of the ATC radar serving the GBT. This traffic broadcast is not intended to replace TCAS however. TIS-B is not the same as Traffic Information Service (TIS) also a ground–based datalink provided by Mode S radar sites with an update rate of once every 5 seconds. Like TCAS, however, TIS-B will only show transponder–equipped altitude reporting aircraft. The transponder, by taking advantage of the digital numeric frame formatting of this datalink,

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Garmin's GDL90 is a Universal Access Transceiver to support ADS-B.

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gives the pilot the ability to see the same secondary targets that the controller is presented with. This datalink however is limited to the service area as defined by the FAA deployed transceiver or in the case of TIS the Mode S ground stations. The effective range of the Mode S ground station is typically 60 miles. This information transfer actually yields better bearing accuracy to traffic then the TCAS system as its accuracy decreases with range. The pilot's aircraft must have GPS on board to provide not only aircraft position but also Flight ID, intent, altitude, track and turn reports, heading and speed. In essence then ATC knows exactly who you are and where you are going. With the current congestion in TIS-B it is more likely that another more common datalink be required, like the Universal Access Transceiver (UAT). Currently the UAT operates on a single frequency with a bandwidth of approximately 1.5 Mhz and no tuning is required by the user.

Garmin's GDL69 is an XM compatible weather receiver.

As the FAA migrates through this technology and external influences abound they ultimately will find the best solution for the National Airspace System. This evolution of the system generates a few questions:

Do we want a system so dependent on satellites?

Will the FCC get involved in some of the regulation?

Should we have a world standard?

Whatever datalinks become the standards the best use of the frequency spectrum is one of the biggest concerns as spectrum managers worldwide must come to a common agreement. The antenna population on the airframe is also a major consideration if multiple independent systems are required. Multi-Mode radios would minimize the antenna requirements. A full worldwide interoperability will be required from whatever system evolves over the next decade. Many now argue that the current ATC system is straining to keep up with the increasing traffic demand and that technology is outpacing ATC's growth. The CDTI or multi-function Cockpit Display of Traffic Information will be used to integrate all this new datalink information and is available today. The ADS-B technology may eventually leapfrog over TCAS systems as it is a more digital based approach to a total awareness system for the cockpit. Regardless of what system evolves, the air traffic controller will remain a vital part in the final product. ❑