FLYGSPORTFÖRBUNDET
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What is Mode S and is it really needed?

Is General Aviation threatened by unmotivated costs?

As an introduction a short description of today's situation is presented.
For several years most General Aviation aircraft have ATC-transponders of type Mode A or Mode A/C. That is a radio transceiver, which automatically responds to interrogations from ATC- ground radars and makes it possible to display aircraft ID (and altitude) to ATC- controllers. Now a new version of the transponder called Mode S is being introduced. It is a costly piece of avionics, which gives a unique identity code for each aircraft. The ground radar can then handle more targets by a selection of the targets, which cannot be made with older transponders (type Mode A or Mode A/C). In various European countries implementation has been initiated. However, it is delayed in several countries and further delays are likely.

One problem is that there are absolutely no benefits to the aircraft owner or pilot offered by Mode S. It will be "business as usual" with the difference that costs will be higher. Furthermore, experts on European ATM issues have stated that the system must be changed in about 5-10 years time as the radio frequencies (1030 MHZ and 1090 MHz) will become completely saturated due to traffic growth. Consequently, it is a bad solution to use yesterday's technology to solve tomorrow's problems. A different, better and more cost effective way to solve the radar problems is to start implementation of modern technology for communication, navigation and surveillance rather than continuing with the 50-60 years old concepts of technology and operations. The present ATC systems have not kept up with the opportunities offered by new technology. As a result ATC is based largely on the same concept it was fifty to sixty years ago while technology in e.g. the consumer market has progressed immeasurably in that time. Costs for today's ATC systems in Europe are about 6,5 billion EUR/Year yet causing delays that has been estimated to cost another 4 billion EUR/Year.

Now, more than ever, there are major technology decisions to be made. New technologies such as data links and global navigation satellite systems (GNSS) will enable new operational concepts to better meet user requirements. The choice and design of these technologies is critical for ATC if it is not to miss out on the opportunities offered.

An alternative system has been tested in Sweden and many other countries over more than a decade. ICAO standards and European Norms are completed and available. The system has many far-reaching advantages. It is the ADS-B/VDLMode 4 system, which may replace ATC radars and ground navigation aids, while enhancing GA navigation, safety and provide communication services. Big savings could be made by the less complicated infrastructure on the ground. The biggest

advantage is for the aircraft owner /pilot who can combine navigation, traffic situational awareness and communication in the same avionics unit. It has been subject to successful validation and demonstrations in dozens of EU-Commission sponsored projects. The system is today successfully being tested in Sweden and in the Mediterranean area. A number of aircraft of different types are taking part in the validation activities addressing e.g. airport surface operations, Free Routing and Free Flight applications.

Power consumption is low. Glider installations has demonstrated that battery operated transponders have same endurance as the VHF voice radio.

Do not force us to use Mode S transponders.
Use a system that gives us what we want.

- **Added safety and access to the airspace**
- **Simplify navigation**
- **Easy handling of the equipment**
- **Cost efficiency for all parties concerned**

What is ADS-B?
ADS-B stands for Automatic Dependent Surveillance - Broadcast. That is a radio based system which automatically every other second is reporting the aircraft position, track, altitude, call sign etc. The radio signal carrying data is received by all other equipped aircraft and/or vehicles (the units are called transponders). Other aircraft and ground-based transponders can receive the signal and display the data to the pilot and for the ATC controllers and e.g. vehicles on the ground.
ATC Radar stations can be replaced. The system works equally well without any infrastructure on the ground as over the oceans or remote areas of the continents. ICAO has for years advocated that the cornerstone of the future ATC system shall be based on ADS-B.

To send the ADS-B data information between aircraft and to ground stations (e.g. ATC) a data link is needed. The VHF data link, called VDL Mode 4 by ICAO, has been designed for that purpose.

What is VDL Mode 4?
VDL Mode 4 is the ICAO term for the ADS-B VHF digital link. The transponders using VDL Mode 4 can transmit and receive the ADS-B data, GNSS Augmentation, Traffic Information Broadcast, weather data, etc. The aeronautical radio band 108.00 - 136,95 MHz is used. The radio operates on 25 kHz bandwidth. Transmissions are made in timeslots and the timing for that is provided by the accurate GPS time signal or in combination with the Russian GLONASS. Later on the European Galileo satellite system can be used. All transmissions are organized to prevent interference between stations occurs. Therefore even time critical messages may safely be sent over the data link. No ground stations are required for timing as this is made with the GPS and/or GLONASS signals. The radio range for VHF is the horizon so timeslots may be reused beyond the horizon without interference. Therefore the same radio channels may be used worldwide.

136.950 MHz has temporarily been allocated to VDL Mode 4 in Europe and in some areas additional frequencies are allocated (e.g. 136,970 and 136,925).
The system works even with the radio channel loaded up to 200-300 %. Graceful degradation and the selected modulation give robust behaviour also when all time slots are occupied, without loss of information from nearby stations. With additional channels simulations with traffic load up to 2,700 aircraft has shown that the system works well also in those conditions.

VDL Mode 4 is now Euro Norm (EN) and all ICAO standards (Annex 10 and Doc.9816) and European Telecommunications Standards Institute (ETSI) EN's are published. The ETSI standards for VDL Mode 4 has been developed under the European Commission Mandate M/318.

Note: A maritime version of the ADS-B Mode 4 is since some years implemented worldwide on all ships of more than 300 tons. It is called **Automatic Identification System (AIS).**
Martitime AIS transponders are produced worldwide by many companies. An AIS transponder costs for commercial large ships € 5000 and for smaller ships/yachts € 830 - € 300. The hardware is similar to the aviation version ADS-B VDL Mode 4.

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