

track information and has no indication of the client aircraft heading. In these installations, all intruder bearing information is referenced to ground track and does not account for wind correction. Additionally, since ground-based radar will require several scans to determine aircraft course following a course change, a lag in TIS display orientation (intruder aircraft bearing) will occur. As in (f) above, intruder distance and altitude are still usable.

**(h) Closely-Spaced Intruder Errors.**

When operating more than 30 NM from the Mode S sensor, TIS forces any intruder within 3/8 NM of the TIS client to appear at the same horizontal position as the client aircraft. Without this feature, TIS could display intruders in a manner confusing to the pilot in critical situations (for example, a closely-spaced intruder that is actually to the right of the client may appear on the TIS display to the left). At longer distances from the radar, TIS cannot accurately determine relative bearing/distance information on intruder aircraft that are in close proximity to the client.

Because TIS uses a ground-based, rotating radar for surveillance information, the accuracy of TIS data is dependent on the distance from the sensor (radar) providing the service. This is much the same phenomenon as experienced with ground-based navigational aids, such as a VOR. As distance from the radar increases, the accuracy of surveillance decreases. Since TIS does not inform the pilot of distance from the Mode S radar, the pilot must assume that any intruder appearing at the same position as the client aircraft may actually be up to 3/8 NM away in any direction. Consistent with the operation of TIS, an alert on the display (regardless of distance from the radar) should stimulate an outside visual scan, intruder acquisition, and traffic avoidance based on outside reference.

**e. Reports of TIS Malfunctions.**

1. Users of TIS can render valuable assistance in the early correction of malfunctions by reporting their observations of undesirable performance. Reporters should identify the time of observation, location, type and identity of aircraft, and describe the condition observed; the type of transponder processor, and software in use can also be useful information. Since TIS performance is monitored by maintenance personnel rather than ATC, it is suggested that

malfunctions be reported by radio or telephone to the nearest Flight Service Station (FSS) facility.

**NOTE-**

*TIS operates at only those terminal Mode S radar sites depicted in FIG 4-5-5. Though similar in some ways, TIS is not related to TIS-B (Traffic Information Service-Broadcast).*

**4-5-7. Automatic Dependent Surveillance-Broadcast (ADS-B) Services**

**a. Introduction.**

1. Automatic Dependent Surveillance-Broadcast (ADS-B) is a surveillance technology deployed throughout the NAS (see FIG 4-5-7). The ADS-B system is composed of aircraft avionics and a ground infrastructure. Onboard avionics determine the position of the aircraft by using the GNSS and transmit its position along with additional information about the aircraft to ground stations for use by ATC and other ADS-B services. This information is transmitted at a rate of approximately once per second. (See FIG 4-5-8 and FIG 4-5-9.)

2. In the United States, ADS-B equipped aircraft exchange information on one of two frequencies: 978 or 1090 MHz. The 1090 MHz frequency is also associated with Mode A, C, and S transponder operations. 1090 MHz transponders with integrated ADS-B functionality extend the transponder message sets with additional ADS-B information. This additional information is known as an “extended squitter” message and is referred to as 1090ES. ADS-B equipment operating on 978 MHz is known as the Universal Access Transceiver (UAT).

3. ADS-B avionics can have the ability to both transmit and receive information. The transmission of ADS-B information from an aircraft is known as ADS-B Out. The receipt of ADS-B information by an aircraft is known as ADS-B In. All aircraft operating within the airspace defined in 14 CFR § 91.225 are required to transmit the information defined in § 91.227 using ADS-B Out avionics.

4. In general, operators flying at 18,000 feet and above (Class A airspace) are required to have 1090ES equipment. Those that do not fly above 18,000 may use either UAT or 1090ES equipment. (Refer to 14 CFR §§ 91.225 and 91.227.) While the regulations do not require it, operators equipped with ADS-B In will realize additional benefits from ADS-B broadcast