SAGE DATA TRANSMISSION SYSTEMS
DESCRIPTION — RADAR DATA SYSTEMS

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1. GENERAL

1.01 The radar data transmission systems described herein are mainly used to transport flight information gathered by the radars. Most of the data handled by these systems flows toward the direction center. Only a relatively minor amount of information travels in the opposite direction; this last consists of data to control the height finding radars.

1.02 There are two general techniques used in transforming the radar information to a form that can be used by the data processing units of the SAGE system. One of these methods is called the SDV technique; the letters are an abbreviation of the term "Slowed Down Video." SDV systems are designed to provide enough information so that a coarse reproduction of the original radar plot may be built up at a point remote from the radar. The desired surveillance information is then obtained from the reproduced plot at the remote point.

1.03 The second method of handling radar information is called the FGD technique - here the letters stand for "Fine Grain Data." In this technique only the pertinent information about moving targets on the radar plot is sent. This includes range and azimuth data plus other miscellaneous information about the target.

2. SDV DATA SYSTEMS

2.01 SDV data systems are used to remote the plots of short range or gap filler radars. The purpose of these radars is just what their name implies - they are sited so that their area of surveillance covers the inevitable gaps in the coverage area of the larger long range radars. The plots of these gap fillers are remoted to both the heavy radar whose coverage they supplement and also to the SAGE direction center.

2.02 The basic characteristics of the data generated in SDV systems are as follows:

(a) Information is transmitted at the rate of 1600 bits per second. The data is arranged in messages approximately 60 bits long and the message rate is quite close to 25 per second. The messages are not subdivided into words.

(b) SDV information is composed of the usual three components; a start or synchronizing component, a data component and a timing component.

(c) Successive messages bear no real informational relation to one another. They do, however, relate to closely associated portions of the radar plot.

(d) SDV information does not have any error detection built into the message structure such as a parity check. Error detecting measures for this system are built into the data processing gear at the receiving and transmitting ends of the system. These measures are based mainly on what sort of data can logically be expected from the radar under normal operating conditions.

(e) Under normal conditions the data messages will usually have a succession of marking bits directly following each start pulse. Following this sequence the number of marking bits in the message will depend on the surveillance data - generally most of the remaining bits are spacing.

2.03 Fig. 1 illustrates the idealized SDV signal in its combined form before shaping and transmission. Amplitude separation is used to separate the start bit("S") from the information bits in the message proper. This message as shown contains just the start and data components. The timing component has not been shown because it may or may not be combined with the other two components depending on the data transmission system used.

3. FGD DATA SYSTEMS

3.01 FGD data systems are used to transmit the surveillance information on the plots of long range or "heavy" radars. This information is transmitted to one or more direction centers depending on the coverage area of the heavy radar and the location of the assigned subsector boundaries.

3.02 The surveillance information actually transmitted from the radar is confined to that relating to moving targets only. At the radar the FGD terminal apparatus selects the moving targets in the search area, transforms the azimuth and range to a coordinate form and adds the radar location and miscellaneous relevant information. This is all coded in a data message and sent to the direction center. One of these messages is generated for each moving target on every scan of the radar.

3.03 The basic characteristics of the data generated in FGD systems are as follows:

(a) Information is transmitted at the rate of 1300 bits per second. This data are arranged in the form of messages which are approximately 50 bits in length. Messages are sent at a rate of approximately 25 per second. Each message contains two data words.

(b) FGD information is composed of the usual three components; a start or synchronizing component, a data component and a timing component. The starting component only indicates the beginning of each message; indications of the starting points of the words in the message are not transmitted.

(c) Successive messages bear no informational relation to one another since they concern different targets.

(d) FGD messages have error detection built in the message structure. This takes the form of an odd parity check that is applied to each of the two words in the message.

3.04 A radar data system such as the FGD system only generates useful information when moving targets are present in the search area.

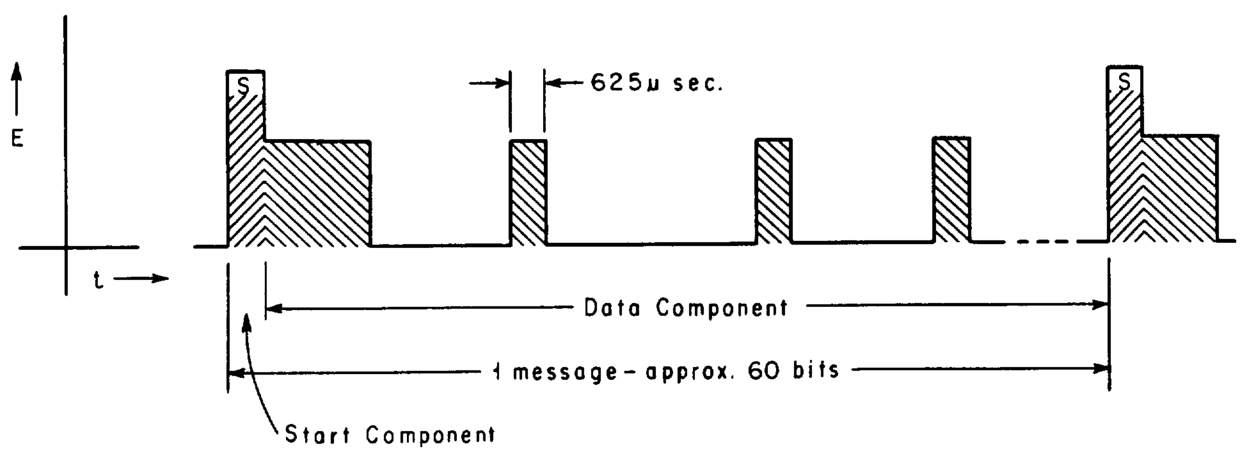

Fig. 1 - Idealized SDV Data

The system has necessarily a finite, though large, target capacity. Most of the time the number of targets being tracked does not approach this limit. The rate at which messages are sent, however, does not change. With low or medium target densities therefore the full information capacity of the system will not be used. Under these conditions the system continues to generate messages at the usual rate but only a moderate number of the messages contain target information. The rest of the messages follow a fixed pattern of marks and spaces which contain no target information and are recognized as "blank frames" or "no targets" by the data apparatus at the direction center. These blank frames are the standard message length but only contain a few marking bits.

3.05 Fig. 2 shows an idealized FGD message after combination but before shaping and transmission. Only two components, start('s') and data have been shown. The two words in the message are of approximately equal length, each concludes with a parity bit. Since odd parity is applied the total number of marks per message is always even. The timing component has not been shown in this message - here again it may or may not be combined with the other two components depending on the data transmission system that is used.

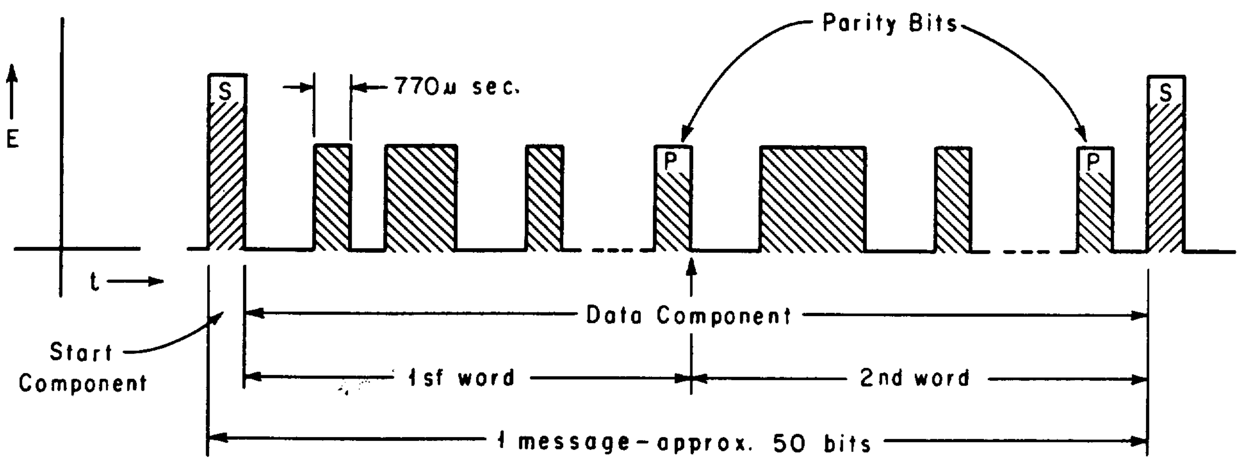

Fig. 2 - Idealized FGD Data