Goldstone Radio Spectrum Signal Identification March 1980–March 1982

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The Goldstone radio spectrum environment contains countless signals that are a potential source of electromagnetic interference to the Goldstone tracking receivers. The identification of these signals is accomplished by the use of signal parameters and environment parameters. This article describes the signal identification process and provides statistical data on the Goldstone radio spectrum environment from 2285 to 2305 MHz.

I. Introduction

Goldstone is located within one of the largest military training areas in the United States. In addition there are several military installations very near to Goldstone. Most of the military installations operate ground and airborne equipment that may be potential sources of electromagnetic interference (EMI). To assist in the identification of the potential sources of EMI, the Goldstone Radio Spectrum Surveillance Station provides data on the signals detected above its threshold in the frequency band being monitored.

The Goldstone Radio Spectrum Surveillance Station is a wideband signal presence indicator used to monitor the Goldstone radio frequency environment for the presence of signals in and near the deep space frequency band. The surveillance station was upgraded in March 1980 to provide real-time radio spectrum monitor capability. Subsequent to the upgrade, additional improvements were made to increase the sensitivity of the system during the relocation of the equipment to the Goldstone Radio Spectrum Surveillance Site. Since the upgrade, thousands of signals have been detected and identified with the aid of the information gathered by the Radio Spectrum Surveillance Station. This report is intended to explain in general terms portions of the signal identification process developed by the Goldstone Radio Spectrum Office and to present statistical data on the Goldstone radio frequency environment in the 2285 to 2305 MHz band.

II. Signal Identification Process

The actual signal identification process ranges from immediate identification to "unable to identify." The priority with which one attempts to identify a detected signal also varies from immediate, in the case of a signal in the DSN band (2290-2300 MHz) that is interfering with or has the potential to interfere with a Goldstone station, to a lower priority for those signals which are near the DSN band (2285-2290 and 2300-2305 MHz).

The signal identification process for the signals detected by the Radio Spectrum Surveillance Station relies on human interaction to correlate and interrogate signal parameters and environmental parameters. The most significant of the signal parameters are frequency, time, bandwidth, azimuth and signal magnitude. The most useful environmental parameters are known scheduled activities, previously identified sources and unscheduled airborne activity within line of sight of Goldstone.

It is important in the signal identification process to make an early determination to classify the signal into one of the following categories:

(1) Satellite (SAT)

(2) Airborne telemetry (TM)

(3) Airborne electronic countermeasure (ECM)

(4) Fixed location

To determine one of these classes of signals may require considerable study and in many cases the easiest method is by eliminating the categories that are easy to identify. Experience indicates that there are certain leading characteristics about each category that will aid in the identification process. These characteristics (see Table 1) will generally hold true.

As you can see in Table 1 there are many things in common; for example, a satellite could look similar to airborne electronic countermeasure if the countermeasure signal had a magnitude of -115 to -123 dBm. This is when the environment parameters become important. A check of the satellite schedules for the appropriate frequency could validate the presence of a satellite during the time in question. A check of the scheduled airborne activity at the azimuth and time in question could be helpful.

The most difficult signals to identify are those on a single frequency that are not reflected in any frequency management records as an assigned frequency. In these cases when there are no scheduled or potential users, the identification follows two paths. First, attempts are made to determine if activity may have been taking place at the azimuth in question by calling potential user locations. The parameters taking precedence in these cases are time and azimuth. Operations personnel will usually have some information concerning time and location but will seldom have information concerning the emission characteristics of equipment. Secondly, additional effort is expended on the documentation of the identification effort. If the process of the two paths fails to identify the origin of the signal, the signal is classified as unidentified and carried in an abeyance file for possible future identification or correlation.

To assist in the signal identification process, selected signals that are frequently detected by the surveillance station are identified as they are detected. This is a first level cull with frequency being used to identify the signal. This method can produce some errors in signal identification, but to date has proven to be adequate and correct over 99% of the time.

III. Signal Identification Statistics

The information in Table 2 represents a breakdown of the various categories of the signals sighted by the surveillance station. The total sightings in each category provide an indication of their relative duration. The number of incidents is an indicator of either a number of sightings in a satellite orbit, a large number of sightings in a 2-hour shuttle test or a single sighting for an activity in which an aircraft may be within line of sight of the surveillance station for an instant.

The quantity and hence the duration of sightings range in time from one sighting for an incident to a maximum of 4 hours. The variance in the duration may be due to emitter on and off times, emitter antenna altitude and line of sight conditions.

IV. Conclusion

The surveillance station described is a highly useful tool to aid in the identification and confirmation of signals that are potential EMI threats to the Goldstone stations. As each new source is identified, the appropriate coordination channels are established to preclude or minimize EMI. The ideal situation would be that the knowledge of the RF environment will be maximized to the extent that coordination would eliminate unidentified EMI except for occasional equipments with unknown emission characteristics or human error.

Table 1. Signal identification categories

Category	Frequency	Bandwidth	Azimuth	Duration	Magnitude, dBm
Satellite	Discrete	Narrow	Moving	2-15 min	-110-123
	Discrete	Narrow	Fixed	1-50 min	-115-123
Airborne TM	Discrete	Narrow	Moving	5-50 min	-110-123
Airborne ECM	Various	Broad	Moving	1-10 min	-90-123
	Discrete	Narrow	Fixed	0-2 min	-90-123
Fixed azimuth	Discrete	Narrow	Fixed	Various	-115-123

Table 2. Radio spectrum surveillance station sightings April 1980 to December 31 1981

Sighting category	1980		1981	
	Total sightings	Number of incidents	Total sightings	Number of incidents
All sightings	8121	1198	30,583	3285
NASA satellites	6082	1010	22,906	2860
Identified	1821	19	7,318	291
DOD ECM	88	7	1,501	66
DOD TM	331	12	1,714	28
DOD SAT	7	4	37	5
Foreign SAT	439	73	463	123
Amateur radio	971	23	2,174	48
Shuttle	–	–	1,055	13
Lightning	–	–	364	8
Unidentified	218	69	369	134
ECM	84	13	147	26
TM	52	4	91	7
SAT	3	1	13	3
Unknown	76	51	118	98