1A RADIO DIGITAL SYSTEM
MAINTENANCE METHODS
DIGITAL TRANSMISSION TERMINALS FOR ANALOG FACILITIES
ANALOG MULTIPLEX TERMINAL EQUIPMENT

CONTENTS PAGE

1. GENERAL

1.01 The purpose of this section is to define the philosophy and responsibilities for maintenance of the Digital Data System (DDS) network as applied to the 1A Radio Digital System (1A-RDS) and to provide guidelines for locating service-affecting troubles. Detailed testing procedures that are contained in the Bell System Practices are referenced in Sections 356-454-010, 356-454-300, and 356-454-500.

1.02 This section is reissued to change Digital Message Unit Radio (DMUR) designations to Radio Unit Section (RUS) and to correct terminology relating to the 1A Radio Digital System (1A-RDS). ***Equipment Test Lists are not affected.***

1.03 The addition of DDS traffic in the form of "data under voice" (DUV) has placed new demands on the performance of the host radio systems. It is the objective of the DDS to maintain an average of 99.5 percent error-free seconds for the high-data rate (56 kb/s) user from customer station to customer station. To meet the DDS objective on the DUV route, a maintenance plan has been developed which complements and expands the analog maintenance procedures. Conditions may exist in the radio system which will affect the DDS service while having little or no effect on the message service. The several types of troubles, their identification, and possible maintenance solutions are presented in this section.

2. CONTROL OFFICE RESPONSIBILITIES

2.01 The majority of DUV systems pass through several maintenance territories, administered by different Long Lines regions and/or associated companies. The control office responsibilities are detailed in Section 660-230-100.

In locating troubles, the Facility Management Administration Center for AT&T Inter-Exchange (FMAC-A) has the responsibility for trouble isolation and sectionalization. The 1A Radio Digital Terminal (1A-RDT) offices may need to provide assistance during the trouble-locating phase. Once the service is switched to protection, the receiving 1A-RDT location cannot normally provide further assistance. When the switch section is identified, and service is made good, the FMAC-A is responsible for finding and clearing the trouble. When a trouble has been cleared, the FMAC-A should notify the 1A-RDT

control office. The FMAC-A should be kept informed of the status of the protection channel at all times. Trouble isolation and escalation procedures are detailed in Section 660-230-100.

2.02 Once a trouble indication has been received (it may be in the form of a customer complaint, alarm condition, excessive error rate at the receive end 1A-RDT, excessive errors observed by a performance surveillance network, or as a result of preventive maintenance tests), 1A-RDT personnel should determine if the trouble is in the terminal equipment or in the transmission system. If the trouble is in the terminal equipment, a switch to the protection terminal should clear the trouble indication. If the trouble is in the transmission system, monitoring equipment should be connected at the receiving end terminal and the in-service tests of Section 356-454-511 should be conducted to isolate the trouble. Once isolated, the appropriate Bell System Practice should be consulted to correct the problem. Close coordination between 1A-RDT, Radio, and FMAC-A personnel is required since switching activity (possibly long-term) may be necessary during in-service tests. A trouble report and the action taken should be forwarded as required by local instructions.

3. NATURE OF TROUBLES

3.01 A trouble that permanently affects service or the operation of the equipment involved, causing continuous failures until fixed or bypassed is called a ***hard*** or ***solid*** trouble condition. It should be corrected immediately by switching to protection circuits, patching spare equipment into the circuit, or through appropriate restoration procedures. The faulty equipment should then be repaired as quickly as possible and returned to service.

3.02 An ***intermittent trouble condition*** is one which occasionally affects service for a short period of time, and usually disappears too quickly to pinpoint on the first occurrences, but continues to cause trouble until eventually cleared. Intermittent troubles can be caused by noise, loose connections, microphonics, radio fading, or other causes. Troubles of this type are usually of short duration and unpredictable as to the frequency of occurrence. They often require extensive testing and careful analysis of test results acquired during several different occurrences. Intermittent troubles are also known as "dribbling errors".

3.03 A ***marginal trouble*** is defined as a condition wherein the operational reserve of the equipment circuitry is exhausted and corrective action must be taken before it becomes service-affecting. Marginal troubles are usually discovered during routine tests or observed as an increasing average error rate on a surveillance network and may be a contributor to intermittent troubles.

3.04 Service affecting troubles in the 1A-RDS DUV band are usually in the form of excessive line errored seconds (LES) or partial response violation seconds (PRVed seconds). A PRVed second is an LES that occurs in the 1A-RDS terminal equipment. The number of LES expected for a particular DUV route is carefully calculated depending upon the number of RUS and radio hops within the route. The occurrence of more than the expected number of LES indicates that special action is needed. Some of the things contributing to LES on the DUV route are: (1) microphonics, (2) interference, either cochannel or from stray radio frequency (RF) energy, (3) switching activity (each switch contributes errors to the DUV signal), (4) noise, steady state and impulse, (5) RF leakage, (6) tip-ring turnovers, and (7) poor maintenance practices. Any of these contributors will affect the message and data networks in varying degrees; but DUV has a greater sensitivity to many of them, especially those introducing impulse and low-frequency baseband noise to the radio line signal.

4. PREVENTIVE AND CORRECTIVE MAINTENANCE

4.01 Preventive maintenance is the term applied to the activities of finding, repairing, and recording troubles (service-affecting or not) which are not associated with a trouble report or alarm indication. Preventive maintenance may be separated into three divisions: (1) the analysis of corrective maintenance records for evidence of frequent troubles and the testing of associated equipment for further evidence, (2) the performing of periodic tests on critical equipment that may not have adequate alarm indicators, and (3) the analysis of trouble reports and trouble detected during preventive maintenance, in order to develop documented evidence to support an accurate and efficient corrective maintenance program.

4.02 Preventive maintenance is the responsibility of everyone associated with the network: 1A-RDT personnel, RUS terminals, and radio maintenance personnel, each using all the available information at hand. Some examples of the information that may indicate degraded DUV performance are: (1) switch register logs indicating how many times a regular radio channel has required protection, (2) LES or PRV records, and (3) 1A-RDT alarm records.

4.03 Corrective maintenance consists of: (1) the recording of details of troubles reported by customers, alarm indications, test personnel or other sources; (2) locating and repairing the reported troubles; and (3) logging and reporting the details of the troubles for further analytical study. Some corrective maintenance required by a hard or solid trouble can be quickly completed. Others required by intermittent or marginal troubles may be more time consuming and require extensive search before the fault is located. Examples of these troubles are loose connections, corroded terminals or tube sockets, RF leakage, or other interference.

5. DIGITAL TRANSMISSION SURVEILLANCE SYSTEM (DTSS)

5.01 The DTSS monitors the in-service performance of the DDS service. This system monitors and processes channel errored seconds (CES) at a 56 kb/s rate.

5.02 The quality of the DDS service is determined by the number of channel errored seconds. Channel errored seconds are determined by the DTSS monitoring the 56 kb/s signal. Channel errored seconds ***cannot*** be directly correlated with line errored seconds or PRVed seconds as described in paragraph 3.04.

5.03 The DTSS is administered by the Digital Network Administration Center (DNAC) in Chicago. Instructions for field forces on how to utilize DTSS information is detailed in Section 314-984-101.

6. DOCUMENTATION

6.01 Records should be maintained (by the responsible control office) of all alarms received and of all steps taken and problems encountered during any test or analysis process. When an equipment problem is located, this should be noted in the records and forwarded to management per local instructions. The analysis of previous data can often be useful in locating trouble of an intermittent nature. Those which come and go at the same time of day can usually be located if someone is in the right station when the problem is being seen. A log of local design containing date, time, trouble indication, and action taken should be satisfactory.

7. RETENTION OF RECORDS

7.01 All data received as a result of tests, complaints, alarms, etc, should be retained for at least one year from date of occurrence.