Meridian SL-1
2 Mb/S Digital Trunk Interface
General Maintenance

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Reason for revision

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This document was previously reissued to include information on the Japan Digital Multiplex Interface (DMI) included with phase 3 of the supplementary features.

Reformatted for CD-ROM application

Contents

General

The 2 Mb/s Digital Trunk Interface (DTI2) or the Japan Digital Multiplex Interface (DMI) provide an interface between the network of Meridian SL-1 and an external digital carrier termination for both voice and data transmission over 32 digital channels. The Clock Controller (CC) allows the system to synchronize with the incoming signal from one DTI2/DMI card thereby preventing slips on this Interface. Slips may occur on other DTI cards.The software is included in Generic X11 Supplementary features.

This practice describes DTI2/DMI maintenance resident functions, as well as local and remote alarms.

Fault Clearing procedures are described in 553-2911-510.

It is assumed that the reader is familiar with the general principles of maintenance as described in 553-2201-500.

Maintenance diagnostic programs
The DTI2/DMI features impact the following Diagnostic programs, which are described in 553-2301-511.

LD30Network Signaling

LD32Network and PE Replacement

LD36Trunk Diagnostic No. 1

LD41Trunk Diagnostic No. 2

LD45Background Signaling and Switching

LD60DTI Hardware

System utility

DTI2/DMI impacts two system utility programs which are described in 553-2301-511.

LD02Traffic Control

LD80Trace

Service change programs

DTI2/DMI impacts the following Service Change and Print programs, which are described in 553-2911-200 and 553-2321-311:

LD11SL-1/M1000 Series/Digital Telephones

LD14Trunks

LD16Routes

LD17Configuration

LD20Print Routine 1

LD22Print Routine 3

LD25Move Data Blocks

LD73Digital Trunk Interface

Terminal/Channel number translation

Each Digital Interface voice/data channel is assigned a Meridian SL-1 Terminal Number (TN) address with the Meridian SL-1 sending data to a given channel. The DTI2/DMI interfaces with one network loop only and no other peripheral shelf can be connected to the same loop. The Meridian SL-1 Terminal Number address to DTI2/DMI channel assignment is shown in Table 1-A, with the Interface always responding to Shelf 0.

Table 1-A

Terminal Number to Channel Number

The TN assignment shown is for the single density cards.

The DTI2/DMI Interface always responds to Shelf 0.

INTERFACE TIMESLOT	INTERFACE CHANNEL	TN (CARD-UNIT)
0	—	7-3
1	1	7-2
2	2	7-1
3	3	7-0
4	4	6-3
5	5	6-2
6	6	6-1
7	7	6-0
8	8	5-3
9	9	5-2
10	10	5-1
11	11	5-0
12	12	4-3
13	13	4-2
14	14	4-1
15	15	4-0
16	—	3-3
17	16	3-2
18	17	3-1
19	18	3-0

20	19	2-3

–Table Continued–

Table 1-A (Continued)

Terminal Number to Channel Number

INTERFACE TIMESLOT	INTERFACE CHANNEL	TN (CARD-UNIT)
21	20	2-2
22	21	2-1
23	22	2-0
24	23	1-3
25	24	1-2
26	25	1-1
27	26	1-0
28	27	8-3
29	28	8-2
30	29	8-1
31	30	8-0

Maintenance — resident functions

Peripheral monitoring

There are two groups of performance indicators monitored by the 2 Mb/s Digital Trunk Interface (DTI2) or Japan Digital Multiplex Interface (DMI) . The first group is shown as Type I indicators while the second group is Type II indicators.

Type I indicators

The first group of performance indicators (Type I) include all those indicators that increment a counter when an error is detected and are timed on how quickly they reach a specified count threshold.

Type I error types

- Bipolar violation rate (DTI2)
- Coded Mark Inversion Violation rate (DMI)
- Slip error rate (separate thresholds for data and voice)
- Frame alignment error rate.

When the number of one of these errors reaches a grade of service threshold (see below) the system reacts depending on the error type.

Maintenance threshold

When a maintenance threshold is exceeded, the Meridian SL-1 prints a warning message on all maintenance TTYs identifying the affected DTI2/DMI. This message is output on all maintenance TTY's.

Out-Of-Service threshold

If any fault condition results in an out-of-service threshold violation, the Meridian SL-1 prints alarm messages (DTA error messages). The appropriate LED is lit on the Interface card depending on the error type

(I or II) and a minor alarms appears on all attendant consoles which belong to the customer group (or groups) that use the DTI2/DMI. The Interface is also disabled. The fault condition is removed after the guard timer has expired. However, if the system is out-of-service n times (OOSC prompt in program 73) then the DTI2/DMI is diabled until midnight.

Type II indicators

The second group of performance indicators (Type II) are those that may be continuous (i.e. not changing) or may be turning on and off very rapidly. The presence or absence of a problem from the Type II group is detected and timed by the Interface card circuitry. If an error continues for a 'Persistance Time' (programmable in program 73) then the situation is considered to be an out-of-service condition. If the error clears for a 'Persistance Time' the Meridian SL-1 returns to its normal condition.

Type II error types

- Loss of Frame Alignment Signal (FAS)
- Loss of Multiframe Alignment Signal (MFAS)
- Alarm Indication Signal (AIS) received
- Bit 3 of Time Slot 0 (TS0) in non-FAS frame received
- Bit 6 of Time Slot 16 (TS16) in frame 0 received.

Audit

The Interface Audit maps the DTI2/DMI software state into hardware during power-up or when a link is being put into or out of service.

Shelf test

The Interface Shelf Tests are invoked automatically or manually through Maintenance Overlay 60.

DTI2/DMI Link shelf test

With the far end Interface in a 30 channel remote loopback state, the Link is tested, on a per loop or per channel basis. The Interface sends the test result to the CPU.

DTI2/DMI hardware shelf test

The Interface hardware is tested on a per loop or per channel basis. The Interface sends the test result to the CPU.

DTI2/DMI loopback to remote location

Remote loopback is enabled on a per channel or per loop basis to set up a connection from the receive (RCV) channel or channels to the transmit (XMT) channel or channels, so that the far end can perform Interface loopback tests.

Slip logic

If the Interface is not synchronized, slips will occur. When this happens, the DTI2/DMI provides controlled slips which means either repeating or skipping one complete frame.

Bipolar violations (DTI2)

In a bipolar pulse stream, pulses alternate in polarity. If after transmission, two pulses of the same polarity are received in succession (the result of some electrical disturbance, i.e., noise), a bipolar violation is said to have occurred.

CMI violations (DMI)

In a Coded Mark Inversion (CMI) stream, 'ones' are coded as bit periods of alternating high and low levels while 'zeros' are coded as a low level in the first half of a bit period followed by a high level in the latter half. A violation is said to have occurred if two co secutive 'ones' are received with the same level.

Frame alignment (DTI2)

The loss and recovery of frame alignment occurs as follows:

(a) Frame alignment is assumed to have been lost when three or four consecutive frame alignment signals have been received with an error.

(b) Frame alignment is assumed to have been recovered when the following sequence is detected:

(1)   For the first time, a valid frame alignment signal is found.

(2)   The absence of the FAS in the following frame detected by verifying that bit 2 in time slot 0 is a 1.

Frame alignment (DMI)

The loss and recovery of frame alignment occurs as follows:

(a)   Frame alignment is assumed to have been lost when two consecutive frame alignment signals have been received with an error.

(b)   Frame alignment is assumed to have been recovered when the following sequence is detected:

(1) If a CMI violation is detected.

(2) A second CMI violation is found in the next occurrence of timeslot zero bit position zero.

Multiframe alignment (DTI2)

Multiframe alignment is assumed to have been achieved when the following sequence has occurred:

(a)   Frame alignment achieved.

(b)   Presence of a non-zero time slot 16.

(c)   Presence of a multiframe alignment signal.

Multiframe alignment is assumed to have been lost when two consecutive multiframe alignment signals have been received with an error.

Multiframe alignment is assumed to have been recovered as soon as the first correct multiframe alignment signal is detected.

Multiframe alignment (DMI)

Multiframe alignment is assumed to have been achieved when the following sequence has occurred:

(a)   Frame alignment achieved.

(b)   Presence of a zero in time slot zero bit position one.

Multiframe alignment is assumed to have been lost when two consecutive multiframe alignment signals have been received with an error.

Multiframe alignment is assumed to have been recovered as soon as the first correct multiframe alignment signal is detected.

Clock control

The Clock Synchronization subsystem consists of single or duplicate Clock Controllers (depending on system type). The active controller synchronizes to a reference clock (primary or secondary) by locking to an external clock frequency source via an Interface which is defined as primary or secondary, and supplies the system with clock signals. The second controller acts as a back-up in case of failure of the first.

For arrangements where more than one DTI2/DMI loop exists, one loop can be defined as the primary reference source and a second loop can be defined as a secondary reference source. Similarly, no Interface loop need be defined as primary or secondary reference sources. In this case, the controller is said to run free.

Monitoring

Resident software periodically monitors the Clock Controller status (programmable rate between 1 and 15 minutes).

(a)   If the software is unable to track on primary or secondary references respectively, and if automatic switching is permitted, software switches the clock from primary to secondary, or secondary to free run and sends out the appropriate DTC maintenance messages. Automatic switching of reference clocks is enabled or disabled in the DTI Maintenance Diagnostic, LD60.

(b)   If a DTI2/DMI loop running in the tracking mode is put out of service, software will transfer to an alternate source or will free run.

Recovery

Once the clock goes into free running mode, the recovery must be performed manually by changing the primary or secondary reference sources to other Interface loops in the system or by issuing a command

from the DTI diagnostic, Overlay 60, to track on a primary or secondary source. When locking on to a reference clock:

- The QPC471 Clock Controller will take approximately 20 minutes to track and may take up to two hours to attain full tracking stabilization. This does not necessarily indicate a tracking problem.

- The QPC775 Clock Controller will lock and track within 10 s.

Fault conditions could conceivably create a situation in which the system had to operate without a QPC471/QPC775 Clock Controller. It is capable of doing so using clock signals from a QPC411 SCG, or from signals resident on the Peripheral Signaling card. Under these fault conditions, voice impairment on a carrier line will be imperceptible (the general threshold of perception for voice is 20 slips/s), but data traffic will experience increased errors which could be as large as 1 slip/s. This may or may not be acceptable to the user, depending upon the nature of the error correction system being used.

Note: Switching Clock Controllers does not produce perceptable noise on voice calls, but it can cause a few errors in data transmission. Therefore automatic maintenance switching should be scheduled during off-peak hours for data traffic.

Alarm processing

Alarms are provided for both local and remote conditions. The conditions are identified as follows:

(a) Local Alarm Conditions:

- loss of Frame Alignment
- loss of Multiframe Alignment
- out of service due to:

  (1) — excessive FAS error rate

  (2) — excessive BPV error rate (DTI2)

  (3) — excessive CMV error rate (DMI)

  (4) — excessive slip error rate.

(b) Remote Alarm Conditions:

- bit 3 TS0 received

- bit 6 TS16 of Frame 0 received

- AIS frame remote end detected.

Note:

FAS = Frame Alignment Signal

BPV = Bipolar Violations

CMV = Coded Mark Inversion Violations

TS = Time slot

AIS = Alarm Indication Signal.

LED alarm processing

Five Light Emitting Diodes (LED) are provided to indicate various conditions. Each LED is independent of other LED. One or more of the yellow LED may be lit at the same time. The conditions that apply for each LED (one red and four yellow) are as follows:

(a) Red LED (Red Alarm).

Lit when the Digital Interface is disabled.

(b) Yellow LED 1.

Lit when the Interface circuit pack is taken out of service due to the number of errors exceeding the out-of-service limit.

(c) Yellow LED 2.

Lit if the near-end maintenance limits are exceeded. It is sometimes referred to as the "Red Alarm" by the hardware. If the near end error limits exceed those for out-of-service, both Yellow LED 1 and Yellow LED 2 will be lit.

(d) Yellow LED 3.

Lit if the far end maintenance limits are exceeded. If the far end out of service limits are exceeded then both Yellow LED 1 and Yellow LED 3 will be lit.

(e) Yellow LED 4.

Lit when loop-back is taking place:

(1) — by near end only (CPU to DTI2/DMI channel)

(2) — by near end to far end (from near end CPU through DTI2/DMI to far end Interface circuit pack, then back again)

(3) — by far end to near end (signals returned by near end Interface circuit pack).

Alarm responses

Fig. 2-1 summarizes the action taken after certain alarm conditions have been detected for the DTI2, Fig. 2-2 summarizes these actions for the DMI.

Trunk signaling faults

The Meridian SL-1 detects and processes digital trunk signaling faults in a similar manner to the analog trunk processing. Signaling faults that include seizure faults, short holding time, ringing failure, supervision failure and lst incoming call are monitored by the resident software and their thresholds are defined by the Service program.

Fig. 2-1

Response to Alarm Conditions

Fig. 2-2

Response to Alarm Conditions (DMI)

Note 1:

Note 2:

Note 3:

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