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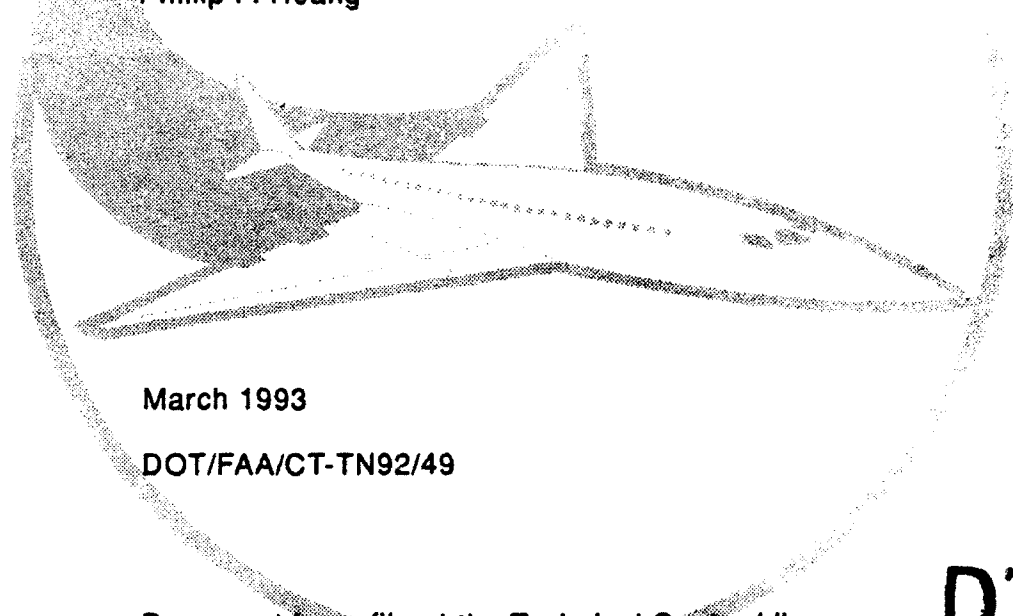
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# Data Multiplexing Network (DMN) Phase III Equipment Operational Test and Evaluation (OT&E) Integration Test Report

Wayne E. Bell  
Phillip P. Hoang



March 1993

DOT/FAA/CT-TN92/49

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93-08457



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1. Report No. DOT/FAA/CT-TN92/49	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle DATA MULTIPLEXING NETWORK (DMN) PHASE III EQUIPMENT OPERATIONAL TEST AND EVALUATION (OT&E) INTEGRATION TEST REPORT		5. Report Date March 1993	6. Performing Organization Code
7. Author(s) Wayne E. Bell, Phillip P. Hoang		8. Performing Organization Report No. DOT/FAA/CT-TN92/49	
9. Performing Organization Name and Address Federal Aviation Administration Technical Center Atlantic City International Airport, NJ 08405		10. Work Unit No. (TRAIS)	11. Contract or Grant No.
12. Sponsoring Agency Name and Address U.S. Department of Transportation Federal Aviation Administration Technical Center Atlantic City International Airport, NJ 08405		13. Type of Report and Period Covered Technical Note	
14. Sponsoring Agency Code		15. Supplementary Notes	
16. Abstract  This test report contains the test results of the Operational Test and Evaluation (OT&E) Integration testing of Data Multiplexing Network (DMN) Phase IIIB Commercial Off-The-Shelf (COTS) equipment. The OT&E Integration testing was accomplished by conducting unit level tests at the Federal Aviation Administration (FAA) Technical Center, and integration tests at the Air Route Traffic Control Center (ARTCC) in Minneapolis, Minnesota.  Based on the test results, it is concluded that the Motorola Codex COTS equipment performed its function of providing data exchange between NAS facilities and is considered qualified for the NAS environment.			
17. Key Words Data Multiplexing Network Deterministic Time Division Multiplexing Codex Modem Codex 9800 Network Monitoring System		18. Distribution Statement Document is on file at the Technical Center Library, Atlantic City International Airport, NJ 08405	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 25	22. Price

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## EXECUTIVE SUMMARY

This report describes the tests performed on equipment which was added to the Data Multiplexing Network (DMN) program after the initial procurement. This included six new modems and Software Upgrades to the Codex 9800 Network Management System (NMS) to correct Program Technical Reports (PTRs) generated during Operational Test and Evaluation (OT&E) Integration tests. Tests on the additional equipment were performed at the Federal Aviation Administration (FAA) Technical Center and at the Minneapolis Air Route Traffic Control Center (ARTCC).

All six modems were tested at the Technical Center. The software upgrades, however, were not available for testing at the Technical Center. Only two of the modems and the Codex 9800 NMS software upgrades were tested at the Minneapolis ARTCC.

All tests on the modems were successfully completed. Fourteen PTRs remain open; seven are Class 3B and seven are Class 2B. These are considered low priority and need not be resolved before commissioning this equipment.

## 1. INTRODUCTION.

This report will present the results of the Program Technical Reports (PTRs) generated during Operational Test and Evaluation (OT&E) Integration tests at the Federal Aviation Administration (FAA) Technical Center in Atlantic City, New Jersey, and the key test sites (Albuquerque, New Mexico; Denver, Colorado; and Minneapolis, Minnesota), from March through August of 1991; and the test results for the equipment added to the Data Multiplexing Network (DMN) program.

### 1.1 BACKGROUND.

A discussion on the background for the original DMN equipment is provided in Data Multiplexing Network (DMN) Phase III Equipment Operational Test and Evaluation (OT&E)/Integration Test Report, DOT/FAA/CT-TN91/50, dated December 1991. Additional equipment was added to the DMN program in 1992, to further improve the National Airspace System (NAS). This report will describe the testing of this new equipment and present the results of these tests.

### 1.2 PURPOSE.

The purpose of the DMN equipment is described in DOT/FAA/CT-TN91/50.

### 1.3 PARTICIPANTS.

Same as listed in DOT/FAA/CT-TN91/50.

### 1.4 REFERENCE DOCUMENTS.

Same as listed in DOT/FAA/CT-TN91/50.

## 2. TEST APPROACH AND CONCEPT.

The test approach was to conduct Unit Level tests at the FAA Technical Center and System Level tests at the Minneapolis, Minnesota, field site on this new equipment. A listing of this new equipment and test location is provided in table 1. The OT&E Integration Test Plan, written by ACW-400A, was used as a guide during these tests. Subtest procedures were written by the OT&E Integration test team. These procedures were used with minor modification, for equipment tested at the Technical Center. These procedures will also be used during the transition from the Paradyne equipment to the Codex equipment.

The PTRs generated during the OT&E Integration tests were provided to Motorola Codex Corporation for resolution. The PTRs were classified according to categories listed below.

TABLE 1. ADDITIONAL DMN EQUIPMENT

DMN COTS EQUIPMENT	TECHNICAL CENTER	TEST SITE
Codex 2400 Fastalk Modem	X	
Codex 3600 Standard Modem	X	
Codex 3600 Modem with Digital Interface Option	X	X
Codex 3600 Modem with Single Line Dial Option	X	X
Codex 6216 DTM with Redundant V.35 Port Card	X	
Codex 6216 DTM with Enhanced Common Logic Card	X	
Codex 9800 NMS Software Upgrade	*	X

\* - The Software Upgrade was not available for the Technical Center.

- Class 1: A class 1 PTR documents a technical discrepancy in which the Codex equipment does not meet the specification requirements of FAA-E-2786.
- Class 2: A Class 2 PTR documents an FAA operational requirement that would lead to modification of Codex equipment. Two subcategories are defined:
- Class 2A: A Class 2A PTR documents an FAA operational requirement that is essential and must be available before equipment can be commissioned into the NAS.
- Class 2B: A Class 2B PTR documents a desirable enhancement to the Codex equipment that is not essential to commissioning the equipment.
- Class 3: A Class 3 PTR documents discrepancies between Codex's stated performance or functional specifications and the observed performance or functional characteristics during OT&E Integration. Two subcategories were defined that distinguish between documentation errors and equipment discrepancies.
- These are:
- Class 3A: A Class 3A PTR documents a discrepancy that may require a change in the Codex documentation.
- Class 3B: A Class 3B PTR documents a discrepancy that may require a change to the Codex equipment.

The PTRs were prioritized from highest to lowest in accordance with the following list:

- Priority I - Class 1
- Priority II - Class 2A
- Priority III - Class 3 for both A and B
- Priority IV - Class 2B

The DMN Program Office and Motorola Codex Corporation have agreed that all Class 1, 2A, and 3A PTRs will be resolved before the first site implementation at the Minneapolis Air Route Traffic Control Center (ARTCC).



### 3. UNIT LEVEL TESTS AT THE FAA TECHNICAL CENTER.

All of the new DMN phase IIIB Commercial Off-The-Shelf (COTS) equipment was evaluated at the FAA Technical Center, except the new Software Upgrade for Codex 9800 Network Monitoring System (NMS), Codex Command Line Interface (CLI), and Tail Circuit Synchronizer. Acceptance testing on the DMN equipment was performed jointly by Codex and FAA Technical Center personnel. The new modems were categorized in accordance with FAA-E-2786 and are described in the following sections.

#### 3.1 CODEX 2400 FASTALK MODEM UNIT TEST.

The Codex 2400 Fastalk modem is classified as Type 1A, PC plug-in modem, transmitting and receiving asynchronous data at a rate of 300, 1200, and 2400 bits per second (bps) in a full-duplex mode of operation on the Public Switched Telephone Network (PSTN).

The Codex Fastalk 2400 Modem was tested over the PSTN to verify that the modem could transfer text and binary files several asynchronous using protocols. These protocols included Crosstalk, XMODEM, KERMIT, Hayes, and YMODEM. The Fastalk Modem plug-in cards were installed in two compatible personal computers for this test.

#### 3.2 CODEX 3600 STANDARD MODEM.

The Codex 3600 Standard Modem is classified as a Type III Modem, transmitting and receiving synchronous data at a rate of 4800 bps in a full-duplex mode of operation on the PSTN or a leased line, with the function of multiplexing two serial binary input channels of 2400 bps on to one output channel of 4800 bps.

This modem can also be classified as a Type IV modem when transmitting and receiving synchronous data at a rate of 9600 bps in a full-duplex mode of operation on the PSTN or a leased line, with the function of multiplexing four serial binary input channels of 2400 bps on to one output channel of 9600 bps.

Subtest 2.1, Codex 3600 tests, of the Operational Test and Evaluation Test Procedures, were performed on this unit with minor variations. The Bit Error Rate (BER) was checked for 1000 blocks rather than for 1 minute and the modems' M1 and M2 was configured to MUX MOD "k" rather than "M." In addition, the END-TO-END Multiplexer Test and Operation on the Public Service Net was not performed.

#### 3.3 CODEX 3600 MODEM WITH DIGITAL INTERFACE OPTION.

Subtest 2.2, Codex 3600 Digital Modem Tests, of the Operational Test and Evaluation Test Procedures, were performed on this unit with minor variations. The Gemini 1022-Dual BERT Tester was used in place of the HP-4925/RS-232 BERT Tester.

### 3.4 CODEX 3600 MODEM WITH SINGLE LINE DIAL OPTION.

Subtest 2.2, Codex 3600 Dial Line Tests, of the Operational Test and Evaluation Test Procedures were performed on this unit with minor variations. The Bit Error Rate (BER) was checked for 1000 blocks rather than for 5 minutes and a TAS Series II Telephone Network Emulator was used in place of a voice frequency (VF) channel.

### 3.5 CODEX 6216 DTM WITH REDUNDANT V.35 PORT CARD AND ENHANCED COMMON LOGIC CARD.

This subtest checked the redundancy option of this High Speed Time Division Multiplexer (HSTDM). The test used two methods to verify that the redundant Common Logic and Aggregate Interface Daughter cards operate transparently with the 6216. The first method was done manually by issuing the SWAP command at the control terminal. The second method was done automatically by the 6216 upon failure of one or both of the above cards.

The laboratory tests simulated various DMN network connectivities. Test messages were inserted at various input and receiving locations and were monitored to verify equipment operation in accordance to manufacturers' specifications.

## 4. SYSTEM TESTS AT THE MINNEAPOLIS ARTCC.

The following three new equipment items were tested at the Minneapolis ARTCC:

1. Codex 3600 Modem with Digital Signal Interface
2. Codex 3600 Modem with Single Line Dial Option
3. Codex 9800 NMS Software Upgrade

Tests performed on these equipments are described in the following sections.

### 4.1 CODEX 3600 MODEM WITH DIGITAL SIGNAL INTERFACE.

Subtest 2.2 of the Operational Test and Evaluation Test Procedures was performed on this unit.

### 4.2 CODEX 3600 MODEM WITH SINGLE LINE DIAL OPTION.

Subtest 2.2 of the Operational Test and Evaluation Test Procedures was performed on this unit.

### 4.3 CODEX 9800 NMS SOFTWARE UPGRADE.

The purpose of the software upgrades was to correct PTRs generated during OT&E Integration tests.

## 5. TEST RESULTS.

Test results for Unit Level tests and System Level tests are discussed separately below:

### 5.1 UNIT LEVEL TEST RESULTS.

Unit Level test results for those test conducted at the Technical Center are provided in the following sections:

#### 5.1.1 Codex 2400 Fastalk Modem.

All tests on this modem were successfully completed. The test procedures are available from ACW-400A.

#### 5.1.2 Codex 3600 Standard Modem.

This unit passed all tests. The test procedure and test results are available from ACW-400A.

#### 5.1.3 Codex 3600 Modem with Digital Interface Option.

This unit passed all tests. The test procedure and test results are available from ACW-400A.

#### 5.1.4 Codex 3600 Modem with Single Dial Line Option.

This unit passed all tests. The test procedure and test results are available from ACW-400A.

#### 5.1.5 Codex 6216 DTM with Redundant V.35 Port Card and Enhanced Common Logic Card.

This unit passed all tests. The test procedure and test results are available from ACW-400A.

### 5.2 SYSTEM LEVEL TEST RESULTS.

System Level test results for those test conducted at the field site are provided below.

#### 5.2.1 Codex 3600 Modem with Digital Interface Option.

This unit passed all tests. The test procedure and test results are available from ACW-400A.

#### 5.2.2 Codex 3600 Modem with Single Line Dial Option.

This unit passed all tests. The test procedure and test results are available from ACW-400A.

### 5.2.3 Codex 9800 NMS Software Upgrade.

One Class 1, one Class 3A, six Class 3B, and seven Class 2B PTRs remain unresolved. A detailed discussion on these PTRs is provided in appendix A, in the memo from James W. Hall, ZAB AFS TSSE, to Chuck Morrow, dated July 24, 1992.

## 6. CONCLUSION.

Based on test results contained in this report, it is concluded that the following additional Motorola Codex COTS equipment meets the FAA-E-2786, Specification DMN equipment.

- Codex 2400 Fastalk Modem
- Codex 3600 Modem with Digital Interface Option
- Codex 3600 Modem with Single Dial Line Option
- Codex 6216 DTM
- Codex 9800 Software Upgrades

The seven Class 3B and seven Class 2B PTRs need not be resolved prior to commissioning.

## 7. RECOMMENDATIONS.

Based on the test results contained in this report, ACW-400A recommends deployment of the additional Codex equipment listed in table 1. We further recommend acceptance of the Codex 9800 NMS Software upgrades.

**APPENDIX A**

**CODEX 9800 SOFTWARE UPGRADE STATUS**

U.S. Department  
of Transportation  
  
Federal Aviation  
Administration

---

Subject: PTR Resolutions

Date: Jul 24 1992

From: James W. Hall, ZAB AFS TSSE

Reply to  
Attn. of: J. Hall

Re: Chuck Morrow, ANC-140

I have enclosed a report of PTR resolutions grouped by class based on the latest information available to me.

The print type of the PTR numbers gives a quick view of its standing based on my information and is presented as follows:

Normal print means the PTR is resolved.

Boldface print means the PTR is unresolved and not in class 2B.

Underlined print means the PTR warrants discussion, is an unresolved PTR classified as 2B, or was resolved but no evidence existed at ZMP.

A breakdown of the PTRs is as follows:

Class 1 - 1 unresolved  
6 resolved

Class 2A - 0 unresolved  
1 resolved

Class 3A - 1 unresolved  
2 resolved

Class 3B - 6 unresolved  
4 warrant discussion  
15 resolved

Class 2B - 7 unresolved (non-essential for commissioning)  
7 resolved

If you have any questions, please feel free to call me at  
(505) 823-0413.

  
James W. Hall

Attachments: 14 pages

Class 1 PTRs

ZAB 001A

Description: Hadax patch panel lacks external clock monitor.

Codex response: Monitor modules will provide this function.

Evaluation: Resolved but have seen no evidence yet.

-----  
ZAB 030

Description: Analog line failure takes more than 15 seconds to report.

Codex response: Fixed with new software release.

Evaluation: The polling scheme and the local modem threshold straps (DCD off, RSQ off = 5) were changed to meet the 15 second reporting time.

-----  
ACN 003

Description: No modem fallback occurs when error rate is  $> 1 \times 10^{-6}$ .

Codex response: The Codex alternative was supplied..

Evaluation: Specification change.

-----  
ACN 004

Description: In turbo mode, 3500 does not report phase hits, gain hits, and impulse noise.

Codex response: Error probability reporting is a more effective indicator.

Evaluation: Specification change.

ACN 005

Description: Ports 7 and 8 do not support external timing.

Codex response: Port 7 and 8 can support tail circuits (buffering) but can not provide external modem timing on ports 7 and 8.

Evaluation: Specification change.

-----  
ACN 006

Description: Bit error rate  $> 1 \times 10^{-6}$  on U1 conditioned line with acceptable S/N ratio.

Codex response: FAA OCU tests showed test passed.

Evaluation: Resolved.

-----  
ASW 006

Description: Command Line Interface (CLI) unit does not provide the same interface as workstation.

Codex response: Separate letter was written.

Evaluation: N/A



AUG-26-'92 THU 13:31 ID:ALBUQUERQUE NTS

TEL NO:505-842-2140

#193 P03

Class 2A PTRs

ZAB 024

Description: 3500 DSU/CSU disrupts timing when DDS line fails.

Codex response: Increase ALBO setting to 5 in 3500 DSU/CSU.

Evaluation: Resolved.

Class 3A PTRs

ZAB 007

Description: 9800 reports absence of DCD on port 1 as DCD loss which can be misinterpreted as a loss of line.

Codex response: Use RSQ as the line loss event.

Evaluation: Resolved.

-----  
ZAB 014

Description: 9800 screens do not match modem menus when manually strapped.

Codex response: Additional funding required.

Evaluation: No change.

-----  
ZAB 027

Description: No procedure supplied to load defaults in 6216.

Codex response: Procedure supplied.

Evaluation: Resolved.

Class 1B PTRs

ZAB 001

Description: 2800 does not support 24kbps on one port.

Codex response: Fixed with new software release.

Evaluation: Resolved.

-----  
ZAB 002

Description: Ports on CAP expansion cards are incorrectly labeled.

Codex response: Fixed for future deliveries.

Evaluation: ZMP relabeling was correct (homemade labels).

-----  
ZAB 004

Description: Tags above icons often are misaligned with icons, making them unreadable.

Codex response: Fixed with new workstation.

Evaluation: No change. A procedural fix was used with the old workstation. It required the user to rewrite the screen by zooming in and out. While performing this function, I discovered a problem with the zoom out function.

The large window is represented by a small box in the locating window (small window under the menu). When the user zooms out, only the devices in the small box are cleared so your new large network window shows a mixture of the new and old views. This will occur whenever devices exist just outside the large network window before it is zoomed out.

-----  
ZAB 006

Description: Fallback event no. 736 reported erroneously.

Codex response: Fixed with new software release.

Evaluation: No change. To force this event to occur, one needs merely to power cycle the modem.

ZAB 010

Description: Refer to ZAB 26.

ZAB 011

Description: 9800 historical filter does not work properly.

Codex response: Fixed with new software release.

Evaluation: Resolved.

ZAB 013

Description: Cursor moves activation point.

Codex response: New workstation will resolve this PTR.

Evaluation: No change.

ZAB 015

Description: Message stating that device and manager report different parameters is reported when modem is removed from override.

Codex response: Fixed with new software release.

Evaluation: Resolved by uploading to inventory.

ZAB 017

Description: Some keyboard functions do not perform as documented.

Codex response: Documentation to resolve PTR.

Evaluation: Keys that emulate left and center mouse buttons still do not function as documented.

ZAB 020

Description: CAP and MAP device inventory screens appear incorrectly. Node ID field should be white to indicate it is a required field.

Codex response: Fixed with new software release.

**ZAB 21**

**Codex response:** Fixed with 2.0 release of 3600.

**Evaluation: Resolved.**

**ZAB 22**

**Description:** 3500 does not detect DDS line type and configure itself for use.

**Codex response: Documentation change.**

**Evaluation:** N/A

**ZAB 025**

**Description:** EIA ports do not report events correctly.

**Codex response: Works as documented.**

**Evaluation:** Unable to duplicate consistently but I do believe there is an intermittent problem. The attachment enclosed shows one such instance and others have occurred but were not saved.

**ZAB 026**

**Description:** Copy function does not work properly.

**Codex response: Fixed with new software release.**

**Evaluation: Resolved.**

**373 028**

**Description:** 9800 Mux functions do not function properly.  
Some examples are:

1. Screen shows incorrect channel speeds when selecting predefined mux configurations.
2. All predefined mux configurations are not available through 9800.

3. Predefined mux configurations are numbered in 9600 and lettered in 3600 modem.

4. UDM2 can not be edited.

5. UDM2 can be activated but screen shows incorrect strap settings.

**Codex response:** Fixed with new software release.

**Evaluation: As follows:**

1. No change.

2. All 13 mux configuration are now available.

**3. No change.**

4 and 5. UDM2 no longer exists in 9800.

**ZAB 031**

**Description:** "Switched follows leased" strap is misnamed.

**Codex response: Fixed with new software release.**

**Evaluation:** Name more closely resembles modern strap and the help info (available with 3rd mouse button) is very detailed.

**ZAB 032**

**Description:** Refer to ZDV 006.

ZAS 033

Description: Snapshot of current status of modem is incorrect while on dial back-up.

**Codex response: Fixed with new software release.**

**Evaluation: Resolved.**

**228 034**

**Description:** "Receive level" statistic gives faulty data when a modem has dropouts.

**Codex response: Fixed with new software release.**

Evaluation: The receive level of an open line is still recorded as "0 dBm". Also, when one chooses to see the average of the specified time interval (in the tested case this was 6 minutes), dropouts were ignored. For example, for a given 6 minute time interval, I had the line disconnected for the first 5 minutes. When I viewed the average receive level for that interval it said -13 dBm, although -13 dBm was the correct level for only the last minute of the interval.

-----  
ZDV 006

Description: "Channel Bandwidth" template is not retrieved properly in the 9800.

Codex response: Fixed with new software release.

Evaluation: Resolved.

-----  
ZDV 010

Description: Refer to ZDV 006.

-----  
ZDV 011

Description: After power interruption, 9800 did not report events that occurred prior to power loss.

Codex response: Fixed with new software release.

Evaluation: When the system comes up after a power failure, the current alarm conditions are reported. The alarms that occurred just prior to the power failure will not be in the outstanding events screen but a historical event query can be performed to retrieve events that occurred prior to the power failure.

-----  
ZDV 012

Description: Job history of a Line BER test did not report correct channel number.

Codex response: Fixed with new software release.

Evaluation: Resolved.

ASW 003

Description: Two modems did not re-establish RTS/DCD signalling after a retrain.

Codex response: Fixed with new 3600 firmware.

Evaluation: Performed test using Fireberd and HP 4925 BER tester. I alternately raised and lowered RTS on the Fireberd and broke the line. I then connected the line while RTS was high and again while RTS was low. In both cases, I could not duplicate the the problem.

-----  
ASW 004

Description: Modem Substitution Switch oscillates between two modems.

Codex response: Restored with service call.

Evaluation: Resolved.



Class 2B PTRs

ZAB 003

Description: 9800 does not prevent unauthorized characters.

Codex response: No plans to change at this time.

Evaluation: No change.

-----  
ZAB 005

Description: Screen blanks.

Codex response: Can be user strapped. (scrto)

Evaluation: Resolved.

-----  
ZAB 006

Description: Refer to ASW 001.

-----  
ZAB 009

Description: Large network window difficult to center using small window.

Codex response: No current plans to correct this function.

Evaluation: No change.

-----  
ZAB 012

Description: Pop-up messages are vague. Some examples are:

1. "Could not contact source".
2. "One or more devices not changed".
3. "One or more straps invalid".

Codex response: Description B to be included in new software release. (Whatever that means).

Evaluation: As follows for the examples:

1. No change.
2. No change.
3. The event occurred previously when the "carrier detect"

threshold" strap did not agree in the 9800 and 3600 modem. They now agree and I have noticed no other disparity between the modem and 9800 that will allow the message to reoccur.

-----  
ZAB 016

Description: Print time of laser printer excessively slow.

Codex response: Additional funding required.

Evaluation: No change.

-----  
ZAB 018

Description: No keyboard template.

Codex response: Additional funding required.

Evaluation: No change.

-----  
ZAB 019

Description: When initializing database, no indication of when complete.

Codex response: Banner should be observed and disregard the lack of "complete" statement in 2nd window.

Evaluation: Resolved.

-----  
ZAB 023

Description: Event 453 can not be filtered out without losing test mode event.

Codex response: Additional events occur while in test mode.

Evaluation: Resolved.

-----  
ZAB 029

Description: Improper use of "delete" or "erase" causes system to crash.

Codex response: Fixed with new software release.

Evaluation: No change in behavior of new software but I learned

that with the old system when the multiple occurrences of the error message appear, you can ignore them and they will eventually clear. The new software behaves the same way.

-----  
ZDV 005

Description: Procedure for obtaining software/firmware revisions is not established.

Codex response: Configuration Management Plan

Evaluation: Resolved.

-----  
ZDV 010A

Description: Mouse cord too short.

Codex response: No plans to change.

Evaluation: No change.

-----  
ASW 001

Description: No echo from 6216.

Codex response: Put "6216" in device type field in inventory record.

Evaluation: Resolved.

-----  
ASW 005

Description: Refer to ZDV 005.