Ameritech

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Public Packet Services Technical Interface Specifications

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Table of Contents

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This document contains generic requirements for Modem Interface Specifications. It has been written specifically for the Ameritech Operating Companies.

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1. 300/1200 BPS Asynchronous Switched Network Modem Interface Specifications

1.1. General Description

This interface specification was written to establish a standard interface to the Ameritech Packet Switch Network for full-duplex data communications on switched network applications operating asynchronously 300 bps, and at 1200 bps. The customer premise interface (modem) must meet the specifications covered in the following sections.

1.1.1. Functional Description

This specification provides for full-duplex data communications for switched network communications. The modem is full feature equivalent and line compatible with Bell 212A modems.

The data transmission in the central office uses different modulation and demodulation techniques for the high and low speed modes of operation in the low speed mode (300 bps), the modem uses frequency shift keying (FSK) with different frequencies to transmit mark and space data bits. One frequency range, 1070/1270 Hz is used for the originate mode transmit and a second range 2025/2225 Hz is used for receive. In the high speed mode (1200 bps), the modem uses phase shift keying (PSK), which carries the phase of a single frequency carrier signal. 1200 Hz is used for PSK transmission when in originate mode and 2400 Hz when in answer mode.

1.1.2. Customer Interface (Terminal Unit)

The electrical specifications of the customer data interface is the responsibility of the customer and terminal equipment vendor. However, the functions should be down-line compatible with the Electronics Industries EIA 232D electrical interface functions supported by the modems in the central office (shown in Exhibit 1).

1.1.3. Options

The basic options that the customer's unit should provide/consist of:

A. loss of carrier disconnect

B. send space disconnect

C. receive space disconnect

D. low speed, high speed or dual speed mode

1.1.4. Operational Tests

The customer's modem should be capable of performing Local Analog Loop (AL) and Remote Test (RT)/Digital Loopback (DL) loopback test.

When AL is invoked the transmitter output and the receiver input are disconnected from the communications line and connected together, creating a loop to test the back-to-back performances of the data terminal equipment (DTE) and the modem. In addition, the receive and transmit lines are connected to allow a signal to be maintained in both directions.

The RT test provides for remote DL looping of the customer's modem via a data test center. DL provides a manually controlled test in the terminating central office. DL disconnects the customer's DTE and loops toward the transmission facility. When the customer's modem is in the DL mode its Data Set Ready (DSR), Receive Line Signal Detect (RLSD), and Clear to Send (CTS) are turned off. The interface circuits to and from the customer's DTE are opened, the interface drivers should be turned off and Transmit Data (TD) and Receive Data (RD) clamped to mark.

1.2. Design Considerations/Specifications

The customer premise interface (modem) must meet the specifications covered in the following sections.

1.2.1. Subscriber Loop Considerations

This service is provided via 2 wire switched network facilities. The central office unit will assure acquisition with a receive level of -45 dBm for switched network applications.

1.2.2. Modem Specifications

The following is a summary of the 300/1200 bps modem specifications:

Data Rate:	High Speed 1200 bps Low Speed 300 bps
1200 bps overspeed:	Up to 2.4%
Operating Mode:	Full duplex
Operating Format:	Low Speed - asynchronous High Speed - character asynchronous

Modulation:	High Speed - differential PSK carrier Low Speed - Continuous Phase FSK
Carrier Frequency:	High Speed - 1200 Hz originate, 2400 Hz answer Low Speed - 1070/1270 Hz originate, 2025/2555 Hz answer
Output Level:	Set by FCC requirements. Part 68; Permissive or Programmable
Line Rquirements:	2 wire switched network
Line Impedance:	900 ohms, balanced
Transmitter Timing:	Asynchronous
Demodulation:	High Speed - differential decoding of PSK carrier Low Speed - FSK tone detection
Receiver Operating Range:	0 to -48 dBm
Carrier Detect Threshold Acquisition:	Assured with a receive level of -45 dBm
Carrier Detect Threshold Release:	Assured with a receive level below -48 dBm
Hysteresis:	2 dB minimum
Loss of Carrier Disconnect Time:	300 ± 50 ms
Receive Space Disconnect Time:	Optional, none or 1.5 sec
Port Security:	1.5 sec after disconnect
Digital Interface:	EIA 232D

1.3. References

FCC Regulations Part 15

FCC Regulations Part 68

EIA Standard EIA 232D

300/1200 BPS ASYNCHRONOUS MODEM

Pin No.	Function	EIA 232D Designation	AT&T Designation	CCITT Designation
1	Protective group (optional)	AA	FG	101
2	Transmit data	BA	SD	103
3	Receive data	BB	RD	104
4	Not Used			
5	Clear to send	CB	CS	106
6	Data set ready	CC	DSR	107
7	Signal ground	AB	SG	102
8	Received line signal detector	CF	CO	109
9	Not Used			
10	Not Used			
11	Not Used			
12	Speed Indicator (optional)	CI		
13-14	Not Used			
15	Not Used			
16	Not Used			
17	Not Used			
18	External control of make busy analog loopback (optional)	CN		
19	External control of remote digital loopback (optional)	CN		
20	Data terminal ready	CD	DTR	108
21	External control of remote Digital loopback (optional)			
22	Ring indicator (optional)	CE		
23	Speed selector (optional)	CH		
24	Not Used			
25	Test mode indicator or same As 19 (optional)			142

Exhibit 1

2. 300/1200 BPS Asynchronous Private Line Modem Interface Specifications

2.1. General Description

This interface specification was written to establish a standard interface to the Ameritech Packet Switch Network for 300/1200 bps Asynchronous modems. The customer premise interface modem must meet the specifications covered in the following sections.

2.1.1. Functional Description

This specification provides for 4 wire private line operation. The modem is designed for data rates of 300 or 1200 bps over 3002 type 4 wire voice grade private line facilities. The modem is fully compatible and equivalent to Bell 202 modems.

The modem accepts asynchronous serial digital data directly from business machines and transmits the data by modulated voice frequency (VF) carrier. Frequency shift keying (FSK) modulation is used. The modem also receives FSK modulated VF signals containing asynchronous serial digital data from other compatible modems and demodulates the incoming VF signals.

2.1.2. Customer Interface (Terminal Unit)

The electrical specifications of the customer data interface is the responsibility of the customer and terminal equipment vendor. However, the functions should be down-line compatible with the Electronics Industries Association EIA 232D electrical interface functions supported by the modems in the central office (shown in Exhibit 2)

2.1.3. Options

The basic options that the customer's unit should provide consist of:

A. RTS/CTS delay

B. carrier detect (CF) time constant

C. soft turnoff/squelch interval

2.1.4. Operational Tests

The customer's modem should be capable of performing Local Analog Loop (AL) and Remote Test (RT)/Digital Loopback (DL) loopback tests.

When AL is invoked the transmitter output and the receiver input are disconnected from the communications line and connected together creating a loop to test the back-to-back performance of the data terminal equipment (DTE) and the modem.

In addition, the receive and transmit lines are connected to allow a signal to be maintained in both directions. The RT test provides for remote DL looping of the customer's modem via a data test center. DL provides a manually controlled test in the terminating central office. DL disconnects the customer's DTE and loops toward the transmission facility. When the customer's modem is in the DL mode its DSR, RLSD and CTs are turned off. The interface circuits

to and from the customer's DTE are opened, the interface drivers should be turned off and TD and RD clamped to mark.

2.2. Design Consideration/Specifications

The customer premise interface (modem) must meet the specifications covered in the following section.

2.2.1. Subscriber Loop Considerations

Specifications is based on the design of type 3002 private line channels.

2.2.2. Modem Specifications

The following is a summary 300/1200 bps modem specifications:

Date Rate:	300 or 1200 Private Line
Operating Mode:	Full duplex - Private Line
Operating Format:	Asynchronous, binary, serial
Modulation:	Frequency Shift Keying (FSK)
Carrier Frequency:	1200 Hz and 2200 Hz±3Hz or 1300 Hz and 2100 Hz±3Hz
Output Level:	OdBm
Line Requirements:	4 Wire, Private Line (Type 3002)
Line Impedance:	600 ohms
Receiver Operating Range:	-16 to -45 dBm
Carrier Detect Threshold Acquisition:	Assured with a receive ine of -30 dBm for private line
Carrier Detect Threshold Release:	Assured with a receive level below -36 dBm for private line
Receiver Squelch:	9 ms
Soft Transmit Carrier Turnoff:	8 ms
Quick Receive Carrier Turnoff:	Loss than 1 ms
Hysteresis:	2 dBm minimum
Digital Interface:	EIA 232D

Request to Send (RTS) Clear to Send (CTS) Time:	8 ms
Data Carrier Delay:	ON: 7 ms; OFF: less than 5 ms
Receive Sensitivity:	-45 dBm

2.3. References

AT&T PUB 41004

FCC Regulations Part 15

FCC Regulations Part 68

EIA Standard EIA 232 D

300/1200 BPS ASYNCHRONOUS PRIVATE LINE MODEM

Pin No.	Function	EIA 232D Designation	AT&T Designation	CCITT Designation
1	Protective ground (optional)	AA	FG	101
2	Transmit data	BA	SD	103
3	Receive data	BB	RD	104
4	Request to send	CA	RS	105
5	Clear to send	CB	CS	106
6	Data set ready	CC	DSR	107
7	Signal ground	AB	SG	102
8	Received line signal detector	CF	CO	109
9	Not Used			
10	Not Used			
11, 19	Not Used			
12	Not Used			
13	Not Used			
14	Not Used			
15	Not Used			
16	Not Used			
17, 24	Not Used			
25	Not Used			

Exhibit 2

3. 300/1200/2400 BPS Asynchronous Switched Network Modem Interface Specifications

3.1. General Description

This interface specification was written to establish a standard interface to the Ameritech Packet Switched Network for full-duplex data communications on switched network applications operating asynchronously 300 bps, 1200 bps and at 2400 bps. The customer premises interface (modem) must meet the specifications covered in the following sections.

3.1.1. Functional Description

This specification provides for full-duplex data communications for switched network communications. The modem is fully compatible with CCITT V.22 bis for 2400 bps, Bell 212A or CCITT V.22 for 1200 bps and Bell 103 for 300 bps modems.

3.1.2. Customer Interface (Terminal Unit)

The electrical specifications of the customer data interface is the responsibility of the customer and terminal equipment vendor. However, the functions should be down-line compatible with the Electronics Industries Association EIA 232D electrical interface functions supported by the modems in the central office (shown in Exhibit 3).

3.1.3. Options

The basic options that the customer's unit should provide consist of:

A. RTS/CTS Delay

B. constant or switched carrier

C. OdBm transmit line signal

D. transmitter timing

Exhibit 2 contains a table which explains all the options which will be supported in the central office.

3.1.4. Operational Tests

The customer's modem should be capable of performing Local Analog Loop (AL) and Remote Test (RT)/Digital Loopback tests.

When AL is invoked the transmitter output and the receiver input are disconnected from the communications line and connected together, creating a loop to test the back-to-back performance of the data terminal equipment (DTE) and the modem.

In addition, the receive and transmit lines are connected to allow a signal to be maintained in both directions. The RT test causes the remote modem to go into the DL mode, allowing remote loop testing via a data test center. The DL test provides a manual looping of customer's modem toward the terminating central office. DL disconnects the customer's DTE and loops toward the transmission facility. When the customer's modem is in the DL mode its DSR, RLSD and CTS are turned off. The interface circuits to and from the customer's DTE are opened, the interface drivers should be turned off and TD and RD clamped to mark.

3.2. Design Considerations/Specifications

The customer premises interface (modem) must meet the specifications covered in the following sections.

3.2.1. Subscriber Loop Considerations

This service is provided via 2 wire switched network facilities. The central office unit will assure acquisition with a receive level of -45 dBm for switched network applications.

3.2.2. Modem Specifications

The following is a summary 300/1200/2400 bps modem specifications:

Date Rate:	High Speed 2400 bps Low Speed 300 bps
Overspeed:	Up to 2.5%
Operating Mode:	Full duplex
Operating Format:	1200/2400 bps Synchronous 1200/2400 bps Character Asynchronous 300 bps Asynchronous

Modulation:	2400 bps: 16 level QAM 1200 bps: 4 level PSK 300 bps: 2 level FSK
Carrier Frequency:	1200/2400 bps: 1200 Hz originate, 2400 Hz answer 300 bps: 1070/1270 Hz originate, 2025/2225 Hz answer
Output Level:	-9 or -12 dBm
Line Requirements:	2 wire switched network
Line Impedance:	900 ohms, balanced
Transmitter Timing:	Internal, external
RTS/CTS Delay:	15 ms
Carrier Detection:	Acquisition: -45dBm Release: -48dBm Hysteresis: -2 dBm minimum
Loss of Carrier Disconnect Time:	350 ms
Port Security:	1 sec after disconnect
Digital Interface:	EIA 232D

3.3. References

FCC Regulations Part 15

FCC Regulations Part 68

EIA Standard EIA 232 D

CCITT Recommendation V.22

CCITT Recommendation V.22 bis

300/1200/2400 BPS ASYNCHRONOUS MODEM

Pin No.	Function	EIA 232D Designation	AT&T Designation	CCITT Designation
1	Protective Ground (optional)	AA	FG	101
2	Transmitted Data	BA	SD	103
3	Received Data	BB	RD	104
4	Not Used			
5	Clear to send	CB	CS	106
6	Data set ready	CC	DSR	107
7	Signal ground	AB	SG	108
8	Received Line Signal Detector	CF	CO	109
16	Not Used			
17	Not Used			
18	Not Used			
19	Secondary Received Line Signal Detector	SCF	SO	122
10	Secondary Clear to Send	SCB		121
11	Secondary Transmitted Data	SBA		118
12	Transmitted Signal Element Timing	DB		114
16	Secondary Received Data	SBB		19
17	Receiver Signal Timing	DD		115
18	External ANALOOP	CN		
13	Not Used			
20	Data Terminal Ready	CD	DTR	108.2
14	External Remote Digital Loopback	CN		
22	Ring Indicator	CE		125
23	Data Rate Indicator	CH		
21	Transmitter Signal Element Timing	DA		113
22	Not Used			

Exhibit 3

4. 1200/2400 BPS Synchronous Modem Interface Specifications

4.1. General Description

This interface specification was written to establish a standard interface to the Ameritech Packet Switch Network for 1200/2400 bps synchronous, full duplex private line modems. The customer premise interface modem must meet the specifications covered in the following sections.

4.1.1. Functional Description

This specification provides for full-duplex (4 wire only) point-to-point synchronous data communications at 1200/2400 bps over 3002 type 4 wire voice grade private line facilities. The modem is fully compatible with Bell 201C and CCITT V.26 modems.

The data transmission generated in the central office consists of differentially phase-shift keyed (DPSK) modulations with a carrier frequency of 180 Hz.

4.1.2. Customer Interface (Terminal Unit)

The electrical specifications of the customer data interface is the responsibility of the customer and terminal equipment vendor. However, the functions should be down-line compatible with the Electronics Industries Association EIA 232D electrical interface functions supported by the modems in the central office (shown in Exhibit 4).

4.1.3. Options

The basic options that the customer's unit should provide consist of:

A. RTS/CTS delays

B. constant or switched carrier

C. OdBm transmit line signal

D. transmitter timing

4.1.4. Operational Tests

The customer's modem should be capable of performing Local Analog Loop (AL) and Remote Test (RT)/Digital Loopback tests. The customer's unit should be capable of performing these tests in 4 wire service applications.

When AL is invoked the transmitter output and the receiver input are disconnected from the communications line and connected together, creating a loop to test the back-to-back performance of the data terminal equipment (DTE) and the modem.

In addition, the receive and transmit lines are connected to allow a signal to be maintained in both directions. The RT test provides for remote DL looping of the customer's modem via a data test center. DL provides a manually controlled test in the terminating central office. DL disconnects the customer's DTE and loops toward the transmission facility. When the customer's modem is in the DL mode its DSR, RLSD and CTS are turned off. The interface cir-

cuits to and from the customer's DTE and opened, the interface drivers should be turned off and TD and RD clamped to mark.

4.2. Design Consideration/Specifications

The customer premise interface (modem) must meet the specifications covered in the following sections.

4.2.1. Subscriber Loop Considerations

Specification is based on the design of Type 3002 private line channels.

4.2.2. Modem Specification

The following is a summary of the 1200/2400 bps synchronous modem specifications:

Data Rate:	1200/2400 bps
Operating Mode:	Full duplex - Private Line
Operating Format:	Synchronous, binary, serial
Modulation:	Differential phase shift keyed
Carrier Frequency:	1800 Hz±1 Hz transmitter 1800 Hz±7 Hz receiver
Output Level:	OdBm
Line Requirements:	4 wire type 3002 Private Line
Line Impedance:	600 ohms balanced
Transmitter Timing:	Internal and external
RTS-CTS Delay:	7.1 ms±0.5 ms
Receiver Operating Range:	-16 dBm to -26 dBm
Carrier Detect Threshold Acquisition:	Assured with a receive level of -26 dBm or greater.
Carrier Detect Threshold Release:	Assured with a receive level below -31 dBm
Hysteresis:	2 dB minimum
Business Machine Interface:	EIA 232D

4.3. References

AT&T PUB 41004

CCITT Recommendation V.26

CCITT Recommendation V.24

FCC Regulations Part 15

EIA Standard EIA 232 D

1200/2400 BPS ASYNCHRONOUS MODEM

Pin No.	Function	EIA 232D Designation	AT&T Designation	CCITT Designation
1	Protective Ground (optional)	AA	FG	101
2	Transmit data	BA	SD	103
3	Receive data	BB	RD	104
4	Request to send	CA	RS	105
5	Clear to send	CB	CS	106
6	Data set ready	CC	DSR	107
7	Signal ground	AB	SG	102
8	Received line signal detector	CF	CO	109
9	Not Used			
10	Not Used			
11	Not Used			
12-14	Not Used			
15	Serial clock, transmit	DB	SCT	114
10	Transmit digit clock			
17	Receive clock	DD	SCR	115
18	External AL (optional)	CN	AL	141
19	Not Used			
20	Data terminal ready	CD	DTR	108
21	Signal quality monitor or ext control of remote digital loopback (optional)	CG		110
22	Not Used			
23	Ext control of terminal speed (optional)	CH		111
24	Transmit signal element Timing	DA		113
25	Test mode indicator (optional)	TM		142

Exhibit 4

5. 4800 BPS Synchronous Modem Interface Specifications

5.1. General Description

This interface specification was written to establish a standard interface to the Ameritech Packet Switch Network for 4800 bps Synchronous modems. The customer premise interface (modem) must meet the specifications covered in the following sections.

5.1.1. Functional Description

This specification provides for full-duplex (private line: 4 wire voice grade Type 3002 circuits) synchronous data communication at 4800 bps. The 4800 modem is full feature equivalent and line compatible with Bell 208 modems.

The data transmission generated in the central office consists of 8 phase differential PSK (phase-shift keying) modulation with a carrier frequency of 1800 Hz.

5.1.2. Customer Interface (Terminal Unit)

The electrical specifications of the customer data interface is the responsibility of the customer and terminal equipment vendor. However, the functions should be down-line compatible with the Electronics Industries Association EIA 232D electrical interface functions supported by the modems in the central office (shown in Exhibit 5).

5.1.3. Options

The basic options that the customer's unit should provide consist of:

A. switched or constant carrier operation

B. 1 second holdover selection

C. OdBm transmit level

D. compromise equalizer

E. transmitter and receiver timing

F. RTS-CTS delay

5.1.4. Operational Tests

The customer's modem should be capable of performing Local Analog Loop (AL), Digital Loop (DL) and Remote Digital Loop (RT).

When AL is invoked, the transmitter output and the receiver input are disconnected from the communications line and connected together, creating a loop to test the back-to-back performance of the data terminal equipment (DTE) and the data set.

The RT test causes the remote modem to go into the DL mode, allowing remote loop testing via data test center. The DL test provides a manual looping of customer's modem towards to terminating central office. DL disconnects the customer's DTE and loops toward the transmission facility. When the customer's modem is in the DL mode its DSR, RLSD and CTS are turned off. The interface circuits to and from the customer's DTE are opened, the interface drivers should be turned off and TD and RD clamped to mark.

5.2. Design Consideration/Specifications

The customer premise interface (modem) must meet the specifications in the following sections.

5.2.1. Subscriber Loop Considerations

Specification is based on the design of Type 3002 private line channels.

5.2.2. Modem Specifications

The following is a summary of the 4800 bps modem specifications.

Date Rate:	4800 bps
Operating Mode:	Full duplex (private line)
Operating Format:	Synchronous, binary, serial
Modulation	8 level DPSK
Carrier Frequency:	1800 Hz±1 Hz
Output Level:	0 dBm
Line Requirements:	4 wire private line (type 3002)
Line Impedance:	600 ohms balanced
Transmitter Timing:	Internal, external timing
Receiver Operating Range:	-16 dBm to -28 dBm
Demodulation:	Differential coherent detection of DPSK
Carrier Detect Threshold Acquisition:	Assured with a receive level of -28 dBm or greater

Carrier Detect Threshold Release:	Assured with a receive level below -33 dBm
RTS/CTS Delay:	50 ms (carrier controlled by RTS) 8 ms (continuous carrier)
Equalization Time:	50 ms (Bell 208 training sequence)
Hysteresis:	2 dB minimum
One Second Holdover:	Equalizer sitting and carrier ON is maintained for 1 second in absense of received signal
Automatic Retrain:	Local retraining of equalizer initialed automatically of equalizer is sensed to be improperly adjusted
New Sync:	Out
Business Machine	EIA 232D, EIA 334A

5.3. References

AT&T PUB 41004

EIA Standard EIA 232 D

EIA 334 A

FCC Regulations Part 15

4800 BPS SYNCHRONOUS MODEM

Pin No.	Function	EIA 232D Designation	AT&T Designation	CCITT Designation
1	Protective Ground (optional)	AA	FG	101
2	Transmit data	BA	SD	103
3	Receive data	BB	RD	104
4	Request to send	CA	RS	105
5	Clear to send	CB	RS	106
6	Data set ready	CC	DSR	107
7	Signal ground	AB	SG	102
8	Received line signal detector	CF	CO	109
9	Not Used			
10	Not Used			
11	Not Used			
12-13	Not Used			
12	Not Used			
15	Serial clock, transmit	DB	SCT	114
16	Divided Transmit clock		DCT	
17	Serial clock, receive	DD	SCR	115
18	Divided Receive clock		DCR	
	or Ext. AL (optional)	CN	Ext. AL	141
19	Not Used			
20	Data terminal ready	CD	DTR	108
21	Signal quality detector	RDL		
	or Signal quality monitor (optional)	CG		110
22	Not Used			
21	Not Used			
24	External clock	DA	SCTE	113
24	Test mode indicator or analog Loopback (optional)			

Exhibit 5

6. 4800/9600 Synchronous Switched Network Modem interface Specifications

6.1. General Description

This interface specification was written to establish a standard interface to the Ameritech Packet Switched network for full-duplex data communications on switched network applications operating synchronously at a primary data rate of 9600 bps or at a fall back rate of 4800 bps. The customer premises interface (modem) must meet the specifications covered in the following sections.

6.1.1. Functional Description

This specification provides for full-duplex data communications for switched network communications. The modem is fully compatible with CCITT V.32, V.52, V.54 recommendations and EIA 232D.

The data transmission generated in the central office consists of Quadrature Amplitude Modulation (QAM) for transmitter modulation and receiver demodulation.

6.1.2. Customer Interface (Terminal Unit)

The electrical specifications of the customer data interface is the responsibility of the customer and terminal equipment vendor. However, the functions should be down-line compatible with the Electronics Industries Association RS 232D electrical interface functions supported by the modems in the central office (shown in Exhibit 6).

6.1.3. Options

The basic options that the customer's unit should provide consist of:

A. RTS/CTS Delay

B. Trellis Encoding at 9600 bps

C. OdBm or -12 dBm transmit line signal

D. transmitter timing source

6.1.4. Operational Tests

The customer owned and maintained modem should be capable of performing Local Analog Loop (AL) and Remote Test (RT)/Digital Loopback tests.

When A1 is invoked the transmitter output and the receiver input are disconnected from the communications line and connected together, creating a loop to test the back-to-back performance of the data terminal equipment (DTE) and the modem.

In addition, the receive and transmit lines are connected to allow a signal to be maintained in both directions. The RT test causes the remote modem to into the DL mode, allowing remote loop testing via data test center. The DL test provides a manual looping of customer's modem toward the terminating central office. DL disconnects the customer's DTE and loops toward the transmission facility. When the customer's modem is in the DL mode its DSR, RLSD and CTS are turned off. The interface circuits to and from the customer's DTE are opened, the interface drivers should be turned off and TD and RD clamped to mark.

6.2. Design Consideration/Specifications

The customer owned and maintained interface (modem) must meet the specifications in the following sections.

6.2.1. Subscriber Loop Considerations

This service is provided via 2 wire switched network facilities. The central office unit will assure acquisition with a receive level of -45 dBm for switched network applications.

6.2.2. Modem Specifications

The following is a summary 4800/9600 bps modem specifications:

Date Rate:	Primary 9600 bps Fallback 4800 bps
Operating Mode:	Full-duplex
Operating Format:	Synchronous
Modulation:	QAM
Carrier Frequency:	1800Hz
Output Level:	-9 dBm
Line Requirements:	2 wire switched network
Line Impedance:	900 ohms, balanced
Transmitter Timing:	Internal, external
RTS/CTS Delay:	15 ms

Carrier Detection:	Acquisition:-43 dBm Release: -48 dBm Hysteresis: -2 dBm minimum
Loss of Carrier Disconnect Time:	350 ms
Line Break Holdover:	1 sec
Digital Interface	EIA 232D (CCITT V.24/V.28)

6.3. References

FCC Regulations Part 15

FCC Regulations Part 68

EIA Standards EIA 232D

CCITT Recommendation V.24

CCITT Recommendation V.28

CCITT Recommendation V.32

CCITT Recommendation V.54

CCITT Recommendation V.52

4800/9600 BPS ASYNCHRONOUS MODEM

Pin No.	Function	EIA 232D Designation	AT&T Designation	CCITT Designation
1	Protective Ground (optional)	AA	FG	101
2	Transmitted Data	BA	SD	103
3	Received Data	BB	RD	104
4	Request to send	CA	RS	105
5	Clear to send	CB	CS	106
6	Data Set Ready	CC	DSR	107
7	Signal Ground	AB	SG	108
8	Received Line Signal Detector	CF	CO	109
9	Not Used			
10	Not Used			
11	Not Used			
9	Secondary Received Line Signal Detector	SCF	SO	122
13	Secondary Clear to Send	SCB		121
14	Secondary Transmitted Data	SBA		118
15	Transmitted Signal Element Timing	DB		114
16	Secondary Received DAta	SBB		19
17	Receiver Signal Timing	DD		115
18	External ANALOOP	CN		
19	Not Used			
20	Data Terminal Ready	CD	DTR	108.2
21	External Remote Digital Loopback	CN		
22	Ring Indicator	CE		125
23	Data Rate Indicator	CH		
24	Transmitter Signal Element Timing	DA		113
25	Not Used			

Exhibit 6

7. 9600 PBS Synchronous Modem Interface Specifications

7.1. General Description

This interface specification was written to establish a standard interface to the Ameritech Packet Switch Network for full duplex 9600 bps synchronous modems. The customer premise interface (modem) must meet the specifications covered in the following sections.

7.1.1. Functional Description

This specification provides the full-duplex, point-to-point synchronous data communications over 4 wire Type 3002 voice grade circuits. It operates at a data rate of 9600 bps.

7.1.2. Customer Interface (Terminal Unit)

The electrical specifications of the customer data interface is the responsibility of the customer and terminal equipment vendor. However, the functions should be down-line compatible with the Electronics Industries Association EIA 232D electrical interface functions supported by the modems in the central office (shown in Exhibit 13).

7.1.3. Options

The basic options that the customer's unit should provide consist of:

A. controlled or constant carrier operation

B. RTS/CTS delay

C. OdBm transmit signal level

D. transmitter timing

7.1.4. Operational Tests

The customer's modem should be capable of performing Local Analog Loop (AL) and Remote Test (RT)/Digital Loopback (DL) loopback tests.

When A1 is invoked the transmitter output and the receiver input are disconnected from the communications line and connected together, creating a loop to test the back-to-back performance of the data terminal equipment (DTE) and the modem. In addition, the receive and transmit lines are connected to allow a signal to be maintained in both directions.

The RT test provides for remote DL looping of the customer's modem via a data test center. DL provides a manually controlled test in the terminating central office. DL disconnects the customer's DTE and loops toward the transmission facility. When the customer's modem is in the DL mode its DSR, RLSD and CTS are turned off. The interface circuits to and from the customer's DTE are opened, the interface drivers should be turned off and TD and RD clamped to mark.

7.2. Design Considerations/Specifications

The customer premise interface (modem) must meet the specifications in the following sections.

7.2.1. Subscriber Loop Considerations

Specification is based on the design of type 3002 private line channels.

7.2.2. Modem Specifications

The following is a summary 9600 bps modem specifications:

Date Rate Normal:	9600 bps
Operating Mode:	Full duplex point-to-point, 4 wire private line
Operating Format:	Synchronous, binary, serial
Modulation:	8 Phase, 4 Amplitude QAM per CCITT V.29
Carrier Frequency:	700 Hz±1.0 Hz
Output Level:	0 dBm
Line Requirements:	Type 3002 4 wire private line
Line Impedance:	600 ohms balanced
Transmitter Timing:	9600 Hz±0.01% Internal
Signal Quality Retrain:	Initiates Retrain if Bit Error Rate (B.E.R.) exceeds 1 X 10 -4 for 3 sec.
Round Robin Retrain Delay:	1.7 sec±10ms
Carrier Detect Threshold Acquistion:	-43 dBm
Linebreak Holdover:	1 sec.
Carrier Detect Threshold Release:	-45 dBm
Hysteresis:	2 dBm minimum
RTS/CTS Delay:	15 ms
Business Machine Interface:	EIA 232D CCITT V.24/V.28
Line Equalization:	Automatic Adaptive

7.3. References

AT&T PUB 41004

CCITT Recommendation V.26

CCITT Recommendation V.24

FCC Regulations Part 15

EIA Standard EIA 232 D

CCITT Recommendation V.29

9600 BPS SYNCHRONOUS MODEM

Pin No.	Function	EIA 232D Designation	AT&T Designation	CCITT Designation
1	Protective Ground (optional)	AA	FG	101
2	Transmit dta	BA	SD	103
3	Receive dta	BB	RD	104
4	Request to send	CA	RS	105
5	Clear to send	CB	RS	106
6	Data set ready	CC	DCR	107
7	Signal ground	AB	SG	102
8	Received line signal detector	CF	CO	109
9	Not Used			
10	Not Used			
11-14	Not Used			
15	Transmitted signal element timing	DB	SCT	114
16	Not Used			
10	Receiver signal element timing	DD	SCR	115
18	Local AL (optional)		AL	
19-20	Not Used			
21	Signal Quality Detector	CG		110
23	Data signal rate indicator (optional)	CI		112
24	Transmitter signal element timing	DA		113
25	Test mode indicator (optional)			142

Exhibit 7

8. General Information

8.1. Interchange Circuits by Category

Circuits Mnemonic	CCITT Number	Description	Circuit Type
AA	101	Protective Ground	Ground
AB	102	Signal Ground	Ground
BA	103	Transmitted Data	Data
BB	104	Received Data	Data
CA	105	Request to Send	Control
CB	106	Clear to Send	Control
CC	107	Data Set Ready	Control
CD	108.2	Data Terminal Ready	Control
CE	125	Ring Indicator	Control
CF	109	Received Line Signal Detector	Control
CG	110	Signal Quality Detector	Control
CH	111	Data Signal Rate Selector (DTE)	Control
CI	112	Data Signal Rate Selector (DCE)	Control
DA	113	Transmitter Signal Element Timing (DTE)	Timing
DB	114	Transmitter Signal Element Timing (DCE)	Timing
DD	115	Receiver Signal Element Timing (DCE)	Timing
SBA	118	Secondary Transmitted Data	Data
SBB	119	Secondary Received Data	Data
SCA	120	Secondary Request to Send	Control
SCB	121	Secondary Clear to Send	Control
SCF	122	Secondary Received Line Signal Detector	Control

8.2. Reference Definitions

8.2.1. CCITT Series V Recommendations

V.22	1200 bits per second duplex modem standardized for use in the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits.
V.22bis	2400 bits per second duplex modem using frequency division technique standardized for use in the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits.
V.24	List of definitions for interchange circuits between data terminal equipment and data circuit terminating equipment.
V.26	2400 bits per second modem standardized for use on 4-wire leased telephone-type circuits.

V.28	Electrical characteristics for unbalanced double-current interchange circuits.
V.29	9600 bits per second modem standardized for use on 4-wire leased telephone-type circuits.
V.32	A family of 2-wire, duplex modems operating at signalling rates of up to 9600 bits per second for use on the general switched telephone network and on leased telephone-type circuits.
V.52	Characteristics of distortion and error-rate measuring apparatus for data transmission.
V.54	Loop test devices for modems.

8.2.2. Federal Communications Commission Regulations

Part 15	Radio Frequency Devices
Part 68	Connection of Terminal Equipment to the Telephone Network

8.2.3. Electronics Industries Association Standards

EIA 232D	Interface between data terminal equipment and data communications equipment employing serial binary data interchange.
EIA 334A	Signal quality at interface between data processing Terminal equipment and Synchronous data communications equipment for serial data transmission.