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Voiceband Modem Standards

For many years, voiceband modems used in the United States were based on standards developed by the AT&T Bell System. In the rest of the world, voiceband modems were based on similar, but incompatible, standards developed by the CCITT (now ITU-T).[1] Almost all currently manufactured modems comply with international recommendations published by ITU-T, such as V.32bis (up to 14.4 kb/s) and V.34 (up to 28.8 kb/s). Except for some private line applications, most modems are backward compatible with earlier CCITT and ITU-T recommendations and the Bell standards.

The questions often arises: "What does "V.such-and-such" mean, or what is a Bell 212 modem?" These are not easy questions to answer without referring to each published specification, but detailed answers are not always needed. I have provided a brief answer in the attached table. This compares important characteristics such as bit rates, modulation types, and encoding levels.

Of special interest is the recently published ITU V.34 recommendation. This recommendation describes the requirements for modems that use the PSTN and operate at line rates from 2.4 to 28.8 kb/s and at symbol rates from 2,400 to 3,429 baud. The actual symbol rate depends on a training sequence that the modems go through upon initial connection. The V.34 recommendation also provides for data and symbol rate changes "on-the-fly." However, not all DTE interfaces on the user side of the modem support this feature. Trellis Coded Quadrature Amplitude Modulation (TC QAM) is specified, but the actual constellation size and configuration depends on the data and symbol rates. As would be expected, the higher data rates require higher symbol rates. It is unlikely that very many PSTN connections actually support the highest specified speed of 28.8 kb/s and certainly very few long distance analog connections support 3,429 baud.

References:

1. CCITT Blue Book, Vol. VIII - Fascicle VIII.1, Data Communication Over The Telephone Network, Series V Recommendations, Geneva, 1989.
2. ITU-T Recommendation V.34, Data Communication Over The Telephone Network, A Modem Operating At Data Signaling Rates Of Up To 28 800 bits/s For Use On The General Switched Network And On Leased Point-To-Point 2-Wire Telephone-Type Circuits, Sept. 1994.
3. ITU-T Recommendation V.32bis, A Duplex Modem Operating At Data Signalling Rates Of Up To 14 400 bits/s For Use On The General Switched Network And On Leased Point-To-Point 2-Wire Telephone-Type Circuits, Feb. 1991.
4. Bell 103 and 113 (PUB41106), Bell 108 (PUB41215), Bell 201 (PUB41216), Bell 202 (PUB41212), Bell 208 (PUB41209 and 41211), Bell 212 (PUB41214).

Availability: The standards and recommendations mentioned in this application note are available from several sources. CCITT and ITU recommendations through December 1994 are available on CD-ROM at very low cost ($30) from InfoMagic, P.O. box 30370, Flagstaff, AZ 86003-0370, tel. 800-800-6613, fax 602-526-9573. Recommendations and standards are also available on CD-ROM or paper directly from ITU, Sales Service, CH-1211, Geneve 20 (Switzerland), fax 41+22-730-5194. The CCITT Blue Book and some individual ITU recommendations are available from NTIS, US Department of Commerce, Springfield, VA 22161, fax 703-321-8547. Bell standards (PUBs) are available from AT&T Customer Information Center, Order Entry, 2855 North Franklin Road, Indianapolis, IN 46219-1999, tel. 800-432-6600, fax 317-322-6699.

Analog Voiceband Modem Recommendations and Standards

Recommendation or Standard	Line Rate (b/s)	Half-Duplex or Full-Duplex	Transmit-Receive Separation	Carrier Frequency (Hz)	Modulation	Symbol Rate (Baud)	Bits per Symbol	Synchronous or Asynchronous	Back Channel	PSTN (2-wire)	Private Line (2-wire or 4-wire)	Equalization	Scrambling
CCITT													
V.21	300	Full	Frequency	1080 and 1750	FSK	300	1	Either	Not specified	Yes	No	Not specified	Yes
V.22	600	Full	Frequency	1200 & 2400	PSK	600	1	Either	Not specified	Yes	2-wire point-to-point	Fixed	Yes
V.22	1200	Full	Frequency	1200 & 2400	PSK	600	2	Either	Not specified	Yes	2-wire point-to-point	Fixed	Yes
V.22bis	2400	Full	Frequency	1200 & 2400	QAM	600	4	Either	Not specified	Yes	2-wire point-to-point	Fixed/adaptive	Yes
V.23	600	Half	N/A	1300 & 1700	FM	600	N/A	Either	Yes	Yes	No	Not specified	Not specified
V.23	1200	Half	N/A	1300 & 1700	FM	1200	N/A	Either	Yes	Yes	No	Not specified	Not specified
V.26	2400	Full	N/A	1800	PSK	1200	2	Synchronous	Yes, per V.23	No	4-wire point-to-point or multipoint	Not specified	Not specified
V.26bis	1200	Half	N/A	1800	PSK	1200	1	Synchronous	Yes	Yes	No	Fixed	Not specified
V.26bis	2400	Half	N/A	1800	PSK	1200	2	Synchronous	Yes	Yes	No	Fixed	Not specified
V.26ter	1200	Either	Echo cancellation	1800	PSK	1200	1	Either	Not specified	Yes	2-wire point-to-point	Fixed or adaptive	Yes
V.26ter	2400	Either	Echo cancellation	1800	PSK	1200	2	Either	Not specified	Yes	2-wire point-to-point	Fixed or adaptive	Yes
V.27	4800	Either	Physical	1800	PSK	1600	3	Synchronous	Yes	No	4-wire	Manual	Yes
V.27bis	2400	Half/Full	2-wire/4-wire	1800	PSK	1200	2	Synchronous	Yes	No	2-wire/4-wire	Adaptive	Yes
V.27bis	4800	Half/Full	2-wire/4-wire	1800	PSK	1600	3	Synchronous	Yes	No	2-wire/4-wire	Adaptive	Yes
V.27ter	2400	Half	None	1800	PSK	1200	2	Synchronous	Yes	Yes	No	Adaptive	Yes
V.27ter	4800	Half	None	1800	PSK	1200	3	Synchronous	Yes	Yes	No	Adaptive	Yes
V.29	4800	Either	4-wire	1700	PSK	2400	2	Synchronous	Not specified	No	4-wire point-to-point	Adaptive	Yes
V.29	7200	Either	4-wire	1700	PSK	2400	3	Synchronous	Not specified	No	4-wire point-to-point	Adaptive	Yes
V.29	9600	Either	4-wire	1700	QAM	2400	4	Synchronous	No	No	4-wire point-to-point	Adaptive	Yes
V.32	4800	Full	Echo cancellation	1800	QAM	2400	2	Synchronous	Not specified	Yes	2-wire point-to-point	Adaptive	Yes
V.32	9600	Full	Echo cancellation	1800	TC QAM or QAM	2400	4	Synchronous	Not specified	Yes	2-wire point-to-point	Adaptive	Yes
V.32bis	14400	Full	Echo cancellation	1800	TC QAM	2400	6	Synchronous	Not specified	Yes	2-wire point-to-point	Adaptive	Yes
V.33	14400	Full	Physical	1800	TC QAM	2400	7	Synchronous	Not specified	No	4-wire	Adaptive	Yes
V.34	2400 to 28800	Half or Full	Echo cancellation	1600 to 1959	TC QAM	2400 to 3429	2 to 10	Synchronous	Not specified	Yes	2-wire point-to-point	Not specified	Yes
Bell													
103/113	300	Full	Frequency	2225 & 1270 (orig.) 2025 & 1070 (answ)	FSK	300	1	Either	No	Yes	No	Fixed	No
108	300	Full	Frequency	2225 & 1270 (orig.) 2025 & 1070 (answ)	FSK	300	1	Either	No	Yes	No	Fixed	No
201	2400	Half	None	1800	PSK	1200	2	Synchronous	No	Yes	2-wire point-to-point	Adaptive	Yes
202	1200	Half	None	1200 & 2200	FSK	1200	1	Either	Yes	Yes	2-wire point-to-point	Fixed	No
208	4800	Half	None	1800	QAM	1600	3	Synchronous	No	Yes	2-wire point-to-point	Adaptive	Yes
212	1200	Full	Frequency	1200 & 2400	PSK	600	2	Either	No	Yes	No	Fixed	Yes

Analog Voiceband Modem Recommendations and Standards

Related V-series recommendations:

V.24	CCITT equivalent of RS232 specification
V.25	Procedures for automatic answering and calling and for disabling echo control devices
V.25bis	Procedures for automatic answering and calling using the V.24 interface (dialing specification)
V.28	Unbalanced circuit electrical characteristics
V.31	Contact closure controlled circuits
V.31bis	Optocoupler controlled circuits
V.35	48 kb/s Wideband modems (obsolete). Note: See ISO 2593 for V.35 connector requirements
V.36	48, 56, 64, 72 kb/s Wideband modems
V.37	72 kb/s wideband modems
V.40	Error control
V.41	Error control
V.42	Error correcting procedures

Note to Readers:

Readers are encouraged to send the author their opinions, suggestions and comments. Send subscription requests or contact the author at any of the following addresses:

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[1] As a consequence of a reform process within the International Telecommunication Union (ITU), the CCITT ceased to exist in February 1993. Its functions were taken over by the ITU Telecommunication Standardization Sector (ITU-T). Bound volumes of published recommendations by CCITT are still valid except where subsequently updated or changed by individually issued recommendations published by ITU-T.