Modem Standards

Mark E. Donaldson

The ITU-TSS (International Telegraphic Union Telecommunications Standards Sector),which replaced the CCITT (Consultative Committee of International Telecommunications and Telegraphy) is the international standards body responsible for creating and approving data communications standards. Although the standards development process is a mystery to most, we can find out here why they are necessary, how they come to be, and just what they are.

Why Modem Standards Are Necessary

Suppose all the railroads in the country operated on tracks of varying widths. This was actually the case at one point in 19th century England. As you might imagine, the resulting incompatibility between British rail lines caused more than a little frustration. Eventually, anxiety on the part of rail users resulted in a call for rail width standards. The standards established brought compatibility and relief to the U.K.'s railway system.

In much the same way, the ITU-TSS establishes standards which enable computers to communicate over telephone lines using modems. Like the U.K.'s railway system, the modem market has had a variety of competing proprietary designs over the years. Even though these products were often the testing ground for new modulation concepts, they have caused some confusion, leaving computer users with no real assurance that they could connect with modems made by other manufacturers.

Standards developed by the ITU-TSS are designed with an eye toward eliminating that confusion. ITU-TSS standards have brought uniformity to computer communications, ensuring that modems built to a specification will connect to one another no matter who the manufacturer.

The Approval Process - Who's Involved and How it Works

Operating under the umbrella of the United Nations, the ITU-TSS is the international organization that sets standards for data communications devices. Promoting cooperation between equipment vendors, the ITU-TSS includes representatives from modem manufacturers and telecommunications organizations on its standards-making committees. For example, the committee that worked on the V.34 standard included members from U.S. Robotics, Penril, Rockwell, Telebit, Motorola, and AT&T.

Generally, developing and enacting a completely new modem standard takes two to three years. The process of creating a new modem standard recommendation begins with a written request to an ITU-TSS Study Group, citing the need for a new recommendation or suggesting a study that subsequently leads to one or more recommendations. The Study Group leader then assigns the contribution to a Working Party within the Study Group. If there are other contributions on the subject and strong support in the Working Party for progressing toward a standard recommendation, the Working Party Chairman assigns a ***rapporteur*** to organize a rapporteurs group, made up of experts interested and qualified In the technical issues being debated.

This rapporteurs group conducts the bulk of the standards work. The group writes up a frame of reference, resolves technical issues, and drafts the actual recommendation. Generally, the rapporteurs group works on a consensus basis, as opposed to a majority-rule basis. That can lead to some political conflict within the group since the suggestion for a new standard normally occurs when there are a number of competing proprietary standards already in the market. Then it's the committee's job to sort out politics from practicality.

Once the rapporteur group is successful In reaching consensus, the draft recommendation is presented to the Working Party for approval. Approval is generally automatic, since interested Working Party members formed the rapporteur group. The Working Party next presents the draft to the overall Study Group. For the recommendation to proceed, the various country administrations, involved in the Study Group, must give unanimous approval. Generally, approval is unanimous because any concerns are discussed with the chairman before a final vote. Company representatives attend, but do not participate in this process. American manufacturers are represented by the head of the U.S. delegation appointed by the U.S. State Department.

If the Study Group approves the new standard, then the final step is to issue a ballot to all member nations for formal approval, since every country represented by the U.N. does not send a representative to the standards meetings. It takes a 70% yes vote from those who respond by ballot to complete the process. This last step is a formality because Study Group approvals have always been upheld. Generally very few ballots are even returned. No draft has ever failed approval once it has reached this point in the process. Once approved as a draft, the balloting procedure has always seconded that approval.

The Standards

The International Telegraphic Union (ITU) standards are prefaced by the letter "V" and include the following:

V.22 and V.22 bis

Synchronous/asynchronous data transmission, full-duplex operation over 2-wire leased or dial up lines; 1200-bps data rate (V.22 bis, 2400 and 1200 bps). Small businesses can beat the expense of leased lines by using V.22 modems with dial up lines. If they later add a 2-wire leased line, they can still use this modem. V.22 accommodates the equipment found in today's typical "hybrid" network: synchronous mainframes and terminals, and asynchronous PCs. V.22 bis doubles data throughput (to 2400 bps) for quick service of large file transfers.

V.25 and V.25 bis

Provides for automatic calling and answering circuitry for use on dial up lines. V.25 defines a dial up parallel interface; V.25 bis defines a dial up serial interface. These standards enable any computer, sync or async, to perform autodialing functions with a V.25-compliant modem.

V-32

Synchronous/asynchronous data transmission, full-duplex operation over 2-wire dial up or 2-wire leased lines; 9600-bps data rate (fallback to 4800 bps). The V.32 recommendation is the first universal standard for 9600-bps modems on dial up or leased phone lines. V.32-compliant modems are the industry standard for high-speed networks. Trellisencoding modulation allows high data speeds and reduces errors. Data can be sent over standard dial up lines-which are a lot less expensive to use than leased lines. And V.32compliant modems will work anywhere in the world. Any business, large or small, that handles large quantities of data transfers or huge data files can benefit from the fast, accurate data transfers of V.32 technology.

V.32 bis

Synchronous/asynchronous data transmission, full-duplex operation over 2-wire dial up or leased lines; 14,400-,12,000-, 9600-, 7200-, 4800-bps data rates. It offers two advantages over V.32. First, a V.32 bis modem transmits data faster-up to 14,400 bps. Second, V.32 bis redefines modem-

connection negotiations (called *training and retraining). Training* is the procedure two modems use to make a connection; they "discuss" and "agree upon" a data rate. *Retraining* is a subsequent negotiation after data exchange is under way: Both modems "agree" to reduce transmission to a slower speed to overcome ambient line noise. Retraining is triggered by the line noise. After modems retrain, data transfer resumes. V.32 bis also provides a new procedure called "fastrain," which allows the modem to fall either backward to a slower speed or forward to a faster speed. When two V.32 bis modems do a fastrain, they stop, determine that they can run faster, and then switch speed in a few milliseconds. One advantage of V.32 bis over V.33 (see next column): with V.33, you can send sync data at 14,400 bps over a 4-wire leased line, but with V.32 bis, you can do the same over a 2-wire dial up line-much less expensive to use than a leased line.

V.33

Synchronous data transmission, full duplex operation over 4-wire leased lines, 14,000or 12,000-bps data rate. A V.33-compliant modem uses the same signal modulation techniques that are used by V.32 modems, but you're restricted to using 4-wire leased lines. If your network requires very high-speed sync data transmission (as do many IBM" and all supercomputer environments), choose a V.33 modem.

V.34

Synchronous/asynchronous data transmission, full-duplex operation over 2-wire dial, and leased line with automatic fallback to compatible lower modems such as V.32 bis, V.32, and V.22 bis. V.34 supports speeds from 2.4 Kbps to 28.8 Kbps.

V.13

Provides for simulated half-duplex (switched-carrier) control. V.32- and V.33compliant modems that support V.13 can be used in sync IBM RJE environments, so these networks, too, can take advantage of V.32N.33 technology.

Bell Standards

In the 1960s and 1970s, Bell Labs created carrier standards for use with Bell equipment and lines, to accommodate customers fledgling networks. Today, a vast installed base of Bell Standard customers rely heavily on these Bell Standard modems. Bell Standards include the following:

Bell 103

Asynchronous data transmission with full-duplex operation over 2-wire dialup or leased lines. At a 300-bps data rate, these modems are Ideal for the low demand user who exchanges files infrequently with another PC user or an on-line bulletin board. Comparable to ITU V.21.

Bell 201 B

Synchronous data transmission with full-duplex operation over 4-wire leased lines, and half-duplex operation over 2-wire leased lines at a 2400 bps data rate. Bell 201 B compatible modems are the first of the fast modems. Many businesses still use them in typical terminal-to-host, multidrop applications. Comparable to ITU V.26.

Bell 201 C

Synchronous data transmission with half-duplex operation over 2-wire dialup lines at a 2400 bps data rate. Bell 201 C modems are for use with dialup lines and are basically a complement to the 201 B. If you need to transmit synchronous data (for example, IBM & 3780/2780 applications) at 2400 bps,

but don't need the on-demand performance and cost of a leased line, then consider the Bell 201 C. Comparable to ITU V.26.

BMI 208 A

Synchronous data transmission with full-duplex operation over 4-wire leased lines, with half-duplex operation over 2-wire leased lines, at a 4800-bps data rate. Comparable to ITU V.27.

Bell 208 B

Same as 208 A, but over 2-wire dialup lines. Comparable to ITU V.27. Both 208 standards were the first standards to enable higher-speed data transmission (4800 bps) over leased lines for multipoint networks. For example, these standards allow users to connect IBM mainframes at a central office to terminals in branch offices, with modems and more efficient in-house cable runs.

Bell 212 A

Synchronous/asynchronous data transmission with full-duplex operation over 2 wire leased or dialup lines at a 1200-bps data rate. This versatile standard provides for efficient full duplex operation over 2-wire dialup lines. This is a big advantage for small businesses that need to avoid the expense of leased lines, If a leased line is added, however, you can still use Bell 212A. Comparable to ITU V.22.

Protocols for Error Correction and Data Compression

Error correction and data compression ensure accurate, swift data transfers. The protocols are employed during the data exchange between two modems. The following protocols are the most widely used by today's modems:

MNP Levels 1-4

Microcom Networking Protocol (MNP), developed by Microcom Systems, Inc., enables error free asynchronous data transmission. Although MNP is proprietary, it became an industry standard in the '80s because users demanded it from manufacturers. Both modems in a connection must use the same MNP protocols.

MNP Level 5

Incorporates the first four levels and also applies a data-compression algorithm. It compresses data 2:1 so the amount of data sent can be doubled at the modem's top transmission speed. For example, modems that transmit data at 4800 bps would send, with MNP Level 5, an amount of data equal to an uncompressed 9600 bps.

V.42

These "V Series" protocols are internationally recognized standards for error control and data compression. V.42 is the recommendation of the ITU for error control. It contains two algorithms (LAPM, or Link Access Protocol, and MNP 1-4). When two V.42-compliant modems establish a connection, they use LAPM to control data errors and retransmit bad data blocks. If one modem supports V.42 and the other supports only MNP, then the two negotiate to use MNP protocol. In both cases, the error-control process is automatic and requires no special user actions or software programs.

V.42 bis

V.42 bis roughly corresponds to MNP Level 5. The difference is the amount of data compressed. V.42 can usually generate a 4:1 ratio of data compression, depending on the type of file transmitted.

The New V.34 and Beyond 28.8

A new version of V.34 ., which increases modems' top speeds to 33.6 Kbps., is currently being approved by the ITU- TSS. What will the 33.6 standard mean to us?

When V.34 products started shipping in late 1994, many believed that V.34's top speed of 28.8 Kbps would mark the last technological evolution of modems. Most thought that they had reached their greatest throughput capacity. But the data communications industry is always pushing the envelope of faster speeds, and the latest round of standards activity is no exception. The ITU-TSS has completed the technical specification for a new version of V.34, adding two new speed options. The new V.34 standard allows top speeds of 33.6 Kbps.

The standards process has made the evolution of high-speed data communications standards possible. It has also brought the industry to speeds once thought unattainable over normal telephone lines. The move to 33.6 is yet another example of the constant evolution of standards. In the past, ITU-TSS modem recommendations, have allowed for interworking with other types of ITU modems. Manufacturers have been successful in negotiating the highest common speed.

In its original form, V.34 defined speed switching among the suite of speeds between 28.8 Kbps and 2400 bps. The new version of V.34 adds speeds of 33.6 Kbps and 31.2 Kbps. The speeds will be optional, enabled at a manufacturer's discretion and negotiated at the beginning of a call.

If there are significant changes to a standard, an extension to the standards name is usually added, creating a completely new standard. For example, when the V.32 standard for 9600 bps communications increased its speed 50 percent to 14.4 Kbps, they called it V.32 bis. The ***bis*** extension designates a significant addition or supplement to the original standard. ***Ter (ter)*** is another extension sometimes used by the ITU-TSS to denote enhanced standards. However, in the case of the new version of V.34, the ITU-TSS will keep the V.34 name. The top speed of 33.6 will simply be added to the existing standard. It will still be designated V.34.

The 33.6 speed is the maximum provided for by the standard. Like other data transmission standards, V.34 products supporting the 33.6 speed go through a negotiation process to establish a connection rate. Depending on telephone line conditions, connections may occur at 33.6. Two modems may also ***step down***, or negotiate a lower speed more appropriate to the quality of the telephone line. Based on field testing of the new software, customers should expect connections at higher speeds than they typically experience. For example, under conditions where a customer might typically experience 26,400 bps, it's likely the new software will allow a connection at 28.8 on a regular basis. By pushing the barriers of higher speeds, we've been able to enjoy a dividend of better performance at all speeds. A result of the engineering for the higher rates is that performance at all speeds is improved, and, in general, we are seeing that connections running the new software consistently from 2400 to 4800 bits per second faster than they were using the previous version of software.

Currently, there are a limited number of products on the market supporting the proposed new version of V.34. Connections at speeds above 28.8 will only occur between two modems supporting the new standard. Although the new version of V.34 is not formally approved, manufacturers usually ship products based on standards before those standards are actually approved. If there are changes to a standard, which is unlikely once the rapporteues group comes to a technical consensus, they could

be implemented by revising the modem software and providing a software upgrade for customers. Flash ROM has made it easier to keep users on the cutting edge without requiring them to invest in new technology. Flash ROM has also extensive field trials on the new 33.6 modems to ensure that products are widely tested for compatibility before they are released to market.