Some Notes on Teletype Corporation

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(Document Notes)

Abstract

This paper is a compilation of Jim's responses to email discussions on the greenkeys list. It is by no means complete, and the presentation is generally chronological, as there is no particular order to the topics discussed. Jim Haynes is a fountain of Teletype information, and this paper only scratches the surface [Gil Smith].

Mar 1993

The original TWX goes back to about 1930, used 3-row machines, and manual switchboards. In fact the introduction of TWX was what caused AT&T to buy the Morkrum-Kleinschmidt Corp. and rename it Teletype. At the time the service was provided using telegraph-grade circuits. You'll occasionally see a picture of an old TWX switchboard, maybe in an old encyclopedia. The switchboard operators used tape-strip printers to communicate with the customers. Telex was in use in Europe in about the same time frame, and used SXS switching technology and telegraph-grade circuits.

Western Union introduced Telex to the U.S. in the early 60s. This was probably a bad mistake for them.

1) They had to buy a lot of electromechanical switching equipment which was soon to be obsoleted by electronic switching.

2) AT&T was about to move TWX to the voice switched network, where the enormous volume of voice service had driven the cost of connections and bandwidth way down. The telegraph-grade lines were no longer cheaper than voice circuits; they were in fact more costly to AT&T.

3) It put W.U. into practically head-to-head competition with an AT&T service; and AT&T was a much stronger company financially.

4) W.U. was usually dependent on the telephone companies for local loops between customers' offices and the nearest W.U. office. Thus W.U. was at the mercy of its competitors rates for these private lines.

As an aside, European Baudot machines tended to have four-row keyboards. The digits were on the fourth row, like a typewriter. There were blocking bars such that if the machine was in FIGS case the digit keys were unblocked and the corresponding letters keys were blocked. So the user still had to send FIGS and LTRS as in the U.S.; it was just that the European machine design took a slightly different direction from that in the U.S.

The European machines also tended to have built-in paper tape facilities of the limited sort that Teletype introduced into the Model 32 and 33 machines. In previous Teletype designs the paper tape equipment was mechanically independent of the keyboard and printer. You could, for instance, be punching a tape from the keyboard at the same time you were receiving a message on the printer; and you could be sending from tape at the same time you were punching another tape from the keyboard. In the European machines, and later in the Teletype 32 and 33, the tape punch had some parts in common with the printer and the tape reader shared some parts with the keyboard. Hence you couldn't use the keyboard while sending from tape; you couldn't punch a tape from the keyboard while printing something else, etc.

The Teletype Model 15 has been mentioned as a heavy-duty machine dating from 1930. In the late 1930s some of the Bell companies asked for a less expensive machine for TWX service, recognizing that a lot of offices could use TWX but didn't need the heavy-duty machine. (The Model 15 is what was used for AP and UP news wires through the 1950s. It could stand up to the around-the-clock printing that occurs in that service.) The answer to this request was the Model 26. The 26 used a rotating type cylinder holding individual slugs of type. The cylinder stayed in one place and the paper platen moved from side to side as in a typewriter. (In the Model 15 and the later machines the paper platen is stationary and the printing element moves across the page.)

The Bell System phased out the Model 26 machines in, oh, the late 40s and 50s. The machine didn't save enough in first cost to be worth supporting both it and the Model 15 in terms of parts and maintenance training. Lots of Model 26 machines wound up in amateur radio service. The hams formed organizations to plead with the Bell companies to sell their used machines to hams rather than breaking them up (to prevent their falling into the hands of those who would use them in competition with Bell services). Hams had to sign a legal form to the effect that they would not use the machine outside the hobby, and would not sell it to anyone without requiring a similar promise.

In the late 50s and early 60s came all the work that resulted in ASCII -- first the upper-case-only 1961 ASCII and then the up/low 1968 ASCII. Prior to ASCII there were lots of codes floating around. Teletype made the Model 29, which was an eight-level four-row machine working on one of the IBM BCD codes. I believe this was used only internally in Western Electric; AT&T was scared to put an IBM coded machine out to the public lest non-IBM computer makers complain that the AT&T giant was favoring the IBM giant at their expense. The Model 35 was based on the 29; in fact I'm aware of some people converting 29 printers to ASCII by changing

just a few parts. Many parts were common between the five-level Model 28 and the eight-level Model 35.

The Model 32 and 33 machines actually started as a project to develop a light-weight machine for the military. The light-weight project didn't get very far; but a lot of the ideas wound up being used in the low-cost printer project. Again the Bell companies and Western Union saw a need for a machine that would cost a lot less than the heavy-duty machines, for use in offices that didn't have a lot of traffic. I might mention that Western Union dabbled in making its own teleprinters from time to time; occasionally one will see a sample of their Model 100 family. I believe W.U. was the main customer for the 32, for Telex service and the Bell companies were seen to be the main customers for the 33 for the new four-row dial TWX service. These machines had most of the parts in common. They were available with and without paper tape; where paper tape was present it followed the European style, so you couldn't do all the things with these machines that you could with a 28 or 35.

The design objective for the 32 and 33 was that they would be used on an average two hours per day. Cost was held down by not heat treating and hardening and nickel plating the parts; some adjustments were made by bending parts rather than by moving parts on elongated holes and that sort of thing; assembly was designed for high volume with a die cast base and self-tapping screws and parts that snapped together without bolting. Meanwhile along came the minicomputer companies who adopted the 33 as a console device, where it often ran around the clock (and generated a lot of cursing about the frequent need for maintenance).

For manual TWX Teletype supplied a basic machine to the phone company, which added some kind of Western Electric box on the wall for line interface. This might be a carrier channel terminal or some relays for a D.C. line; and there were schemes where ringing was used to control the motor on the Teletype machine, and schemes for cutting off current in the line when it was not in use. Telex and dial TWX required additional components for setting up and controlling the call. The Model 32 for Telex had a built-in Call Control Unit with a dial and line relays, all ready to connect to the D.C. local loop. For dial TWX there was a Western Electric modem stashed in the Teletype stand and a variety of call control units (pulse dial, tone dial, card dialer, loudspeaker vs. earphone, etc.) made by Teletype and connecting to the modem. This was a source of considerable annoyance to Teletype, as the interface involved 99 wires, each of which was negotiated between the modem designers at Bell Labs and the call control unit designers at Teletype. A little later some of the Bell companies would save money by furnishing a Bell modem with built-in telephone connecting over a few-wire cable to a Teletype private-line-version machine having no call control unit.

There is a lot of weird and interesting (perhaps) lore connected with the modems. Since dial TWX used a voice-bandwidth connection they could afford the luxury of full duplex modems using two different frequency pairs for the two directions of transmission. This introduced the complexity that a modem had to know whether it was originating or answering a call to know which pair of frequencies to use for which purpose. Even after Bell began supplying modems for connection of customer-provided data equpment (just before Carterfone) these modems could function in either originating or answering roles. After Carterfone the suppliers of modems for computer time sharing could take advantage of the fact that the terminal always originated and

the computer always answered; so we got reduced cost originate-only and answer-only modems.

It always seemed to me that the TWX section of Bell Labs was controlled by old geezers who had been around since 1930 and couldn't imagine that a TWX machine would ever want to talk to anything except another TWX machine. If you wanted to use the same kind of Teletype machine to talk to a computer, well that was another matter entirely. The modems had separate originate and answer frequency pairs, each binary FSK. This permitted two options for which frequency pair would be originate and which would be answer, and four possiblities (two for each pair) of which frequency would be mark and which would be space. Thus it was possible by wiring options to set modems up for as many as eight mutually-incompatible services, all using the same voice switched network without any restrictions on area codes and numbers. I remember hearing about TWX, and TWX-prime, and WADS (wide area data service) and WADS-prime, all of which were to use the same modems and switched network without any of these being able to communicate outside its own service. I guess they had in mind different tariffs for TWX machines talking to TWX machines versus terminals talking to computers, versus some other things. Practically all of this was swept away by Carterfone.

May 2000 and Oct 2000

The ribbon is a standard old Underwood typewriter ribbon, so you can still find them at office supply stores. But the real Teletype ribbons have heavier inking.

The usual advice on lubrication is to get 30 weight non-detergent engine oil, and basically oil everything in sight. Especially pry apart the felt-disk clutches and get lots of oil soaked into the felt.

Some of us are in the habit of just soaking the whole machine in kerosene for a while to remove old sticky oil and stuff. May not want to do that with the 31 - tho it would probably be OK. Grease - I've just been using a general-purpose automotive grease, or Vaseline would probably be OK too.

Even if you find the original KS oil, it's too valuable to use for lubricating machines. You need to put it up in vials or spray cans for use as a perfume, or maybe make scented candles or those new things that plug in the wall to dispense a scented oil.

Jim (who just made a 6-hour drive surrounded by some old Teletypes lubricated with Real (TM) KS-whatever oil and savored the aroma all the way)

But the answer used to be, get 30 wt. non-detergent engine oil. DEC recommended a 50/50 mixture of such oil and STP, but I don't know that machines under DEC maintenance were noticeably longer-lived than any others.

Jun 2000 and Jan 2001

Model 10 - made by Western Electric before it acquired Teletype.

Model 12 - was the first big seller for M-K or Teletype.

Model 14 - starts out as a keyboard tape strip printer. A receive-only version of course is possible by substituting a RO base for the keyboard base. Then the printer is made into a typing reperforator by adding the punch parts, and again it can be KSR or RO. The codes are FP for the printer, FK for the keyboard, FPR for the typing reperf.

The XD tape transmitter-distributor is usually considered part of the Model 14 line, even tho the code does not begin with F. (F is supposedly for "fourteen"). Also the GPE perforator, a.k.a. Iron Horse, is usually considered part of Model 14 even tho it has no parts in common with the rest of the 14 line. I guess the point might be that in the time frame of Model 14 you could use any combination of GPE, XD, and teleprinter to make an ASR set. Also the FRXD is considered part of the 14 line since the typing reperforator part is pretty much the same as the 14 typing reperf.

Model 14 was called the 2A and mostly 2B by Western Union. There was a W.U. 1B strip printer made by Kleinschmidt before the M-K merger.

There was also a nontyping reperforator, but I don't know if it is considered part of Model 14.

Morkrum-Kleinschmidt put out machines under that name before changing the name to Teletype. I have a W.U. 2B printer (Model 14) with the M-K nameplate.

Model 15 - we know well.

Model 17 - if I am not confused, is a machine along the lines of the Hellschreiber, stores fax-like images of characters on a cylinder, keyboard selects which ring on the cylinder is to be transmitted.

Model 19 - we know well.

Model 20 - the upper/lower case printer derived from Model 15 for Teletypesetter use.

Model 21-A - some of us know, but I don't know if that is part of the same series or if it was a Western Union number.

Model 24 - a predecessor of the 26.

Model 26 - improves on the 24.

Model 28 - we know well.

Model 29 - maybe it's an up/low case 28, or maybe the Model 28 IDP ASR set.

Model 31 - the lightweight printer set.

Model 32/33 - started out as a project to make a light weight machine for the military, as well as a low cost machine. Somewhere along the line the light weight military project got dropped. One point on the light versus medium duty angle is that Teletype was going to use felt friction clutches (as in Model 15) in the 32/33, and Western Union persuaded them to use M28 style clutches.

Model 35 - we know. Was Model 34 a Baudot machine in Model 35 clothing?

Model 37 - the aggregate-motion family, first as a stock ticker, then a page printer set.

Model 38 - the up/low stretched version of the 33.

Model 40 - the CRT set with a line printer attachable.

Model 43 - the dot matrix machine. Was there a 42, a Baudot version?

Inktronic - (RO and KSR) don't seem to have model numbers.

There were some later CRT terminals that as I recall had 4-digit numbers.

Going back to earlier times were some odd machines. Like a system for in-plant telegraphy, used a rotating type wheel and a single pulse of variable length to send a character. The pulse was just the right length to fire the print hammer when the desired character on the wheel was in position. Did this have a model number?

Then there are the model letters, used on non-Bell products.

Model 14 uses F: FP for printer, FK for keyboard, FPR for reperforator, etc. Ran Slayton's paper says the F is for Fourteen.

Model 15 uses B: BP, BK, BB, etc. Slayton's paper says the B is for Bell; BP was the Bell Printer. This product line came into existence after the Western Electric purchase, so that is plausible.

Model 31 uses K.

What does Model 26 use? I don't have one to look at.

Model 28 and 35 both use L, since they are of the same family.

Model 37 uses Y.

Does the 32/33 family have a letter?

Model numbers were used in the manual titles, even for non-Bell customers.

The "iron horse" perforator is called GPE. Slayton says this is for Green perforator. There was a Blue model for Postal Telegraph and a Green model for W.U.

There was a perforator-only version of the Model 19 keyboard, called DPE.

High speed equpment had its own letters, unrelated to the low speed. E.g. the perforators BRPE and DRPE, the readers BX and CX and DX. Maybe there was an ARPE punch and an AX reader that were not produced?

There's the MXD family of multiple tape readers - don't know if they had numbers and/or letters.

Starting in the 1960s the prefix V was used for some complete sets. VSL for a complete set and VCL for a set that might be a part of something bigger. These I think were mainly for convenience in ordering - you could order a VCL-something set and get out of having to order the base, motor, keyboard, typing unit, punch, reader, cabinet, etc. separately. As I recall the Dataspeed sets were VCLs.

There must have been somebody who came up with these letters and numbers, but I don't know who he was.

Jun 2000

There is parallel-input multi-magnet reperforator called the LARP that works up to 200 wpm. These were used in store-and-forward switching systems for cross- office operation. They wanted to run cross-office faster than the lines so that traffic wouldn't pile up in the cross-office part of the operation. Western Union Plan 55 is an example of such a system.

Now around Teletype some of us talked about what we thought was Model 29, and it was officially the Model 28 IDP ASR set - the one that used IBM BCD code and was supposedly made only for internal Bell System use. Ran Slayton's museum tour document calls Model 29 an upper/lower case version of Model 28 that was intended to replace the Model 20 (model 15 derivative) in newspaper service. Says it was never produced due to lack of demand. Either way you get a machine with six bit code and no shifts. Maybe it was a case of having a lemon and making lemonade - they wouldn't buy the up/low Teletypesetter printer, so you make it into a BCD or Fieldata machine when the need arises.

That is not necessarily a conflict, because the same changes to a Model 28 to make it print upper/lower case from Teletypesetter code would apply to making it print from 6 bit IBM BCD code. Whatever you call it this typing unit was a precursor to the Model 35 - I know a couple of people who bought a handful of parts and converted Model 29 typing units to Model 35s.

The numbered models of Teletype equipment seem to be a Bell System concept, even though they were used around Teletype as well. But Teletype had its own system of codes. For instance, F is for what Bell calls Model 14; B is Model 15; K is Model 31; L is Model 28. Hence you

could have a typing unit labelled 28-A and a Bell System nameplate, or labelled LP-2 with a Teletype nameplate.

Jul 2000

There is an article by W. L. Dusenberry in the April 1931 Bell Telephone Quarterly, titled "Teletypewriter Service and its Present Day Uses." I thought a few paragraphs are worthy of quoting here.

"Teletypewriter Service is the answer to today's exacting demand from business concerns for a communication service that is almost human and less prone to error than a human being. Breifly described, it is typewriting by wire. The distance, whether a few feet or the width of the continent, is of no consequence. The results are the same -- accurate, fast, and reliable."

"Its uses are infinite; it serves the rapid, continuous, high-pressure demand of the Press, the extraordinarily complex demands of financial organizations for a flexible and fool-proof service to handle transactions affecting the world or involving millions; it fits into the methodical, ceaseless grind of the industrial world when handling its manufacturing problems, shipping instructions, orders, price changes, or the many burdensome problems requiring prompt administrative opinion and advice. Then, too, we find it on the great national airways, at the landing fields, in the weather bureau offices, the radio stations of the Department of Commerce, and even in automobile clubs whose members may be interested in weather information which is so essential to the successful conduct of air navigation, our fastest modern means of transportation, yet which after all is slow compared to the functioning of the teletypewriter in transmitting messages, ideas, thoughts, in fact all but the physical being, from one location to another. Finally, as if to demonstrate conclusively its practically limitless application for making easier business burdens, the teletypewriter holds an enviable place among the important tools of the police departments of the United States in handling information designed to assist in the capture of criminals, in the tracing of missing persons, as well as in the normal, and more or less routine, operations of these many and scattered police departments with their numberous branches, precincts, headquarters, and remote stations."

"Anything that does all of these things must be interesting -- its history must be interesting. Teletypewriter Service and its history are interesting."

followed by a lot of text, and then, finally,

"If this is the development that has taken place in Teletypewriter Service and it is used as extensively as we have said, perhaps in your mind will rise the thought that we have found nearly all the use for it that exists. Hardly. Teletypewriters are now numbered in the thousands. Their future lies in the millions. They are as inevitable as the telephone and will, before many years have passed, rank with it as an absolutely essential office appliance. Where there are now thousands in use in business, in a few years there will be infinitely more thousands located in homes where they will be considered to be as desirable as a radio with the added value that the running story of the event can be received on tape whether you are there or not, so that when you

come in from the theatre or a bridge game you can consult the teletypewriter for the latest news of the world, political, economical, sporting, or whatever it is that holds your interest."

Sep 2000 and Dec 2000

In 1948 when the Model 12s were being replaced by Model 15s the 15 was the latest thing. The 28 had not been developed yet, and the 26, althought later than the 15, was about to be discontinued if it had not been already.

There were three families of six-level equipment. One we have already talked about is Teletypesetter, where six levels were used to get enough codes for upper and lower case alphabets. Another is in stock tickers, where six levels were used to avoid the loss of time that would have been required for LTRS and FIGS shifts in stock market reporting where letters and digits are intermixed so frequently. The third was used in data processing.

There was a line of products made under the name Teletypesetter for that application. There were keyboard perforators, nontyping reperforators, a printer (Model 20, similar in design to Model 15) and the tape-controlled adapter that controlled the type setting machines. (I don't know if there was a typing reperforator.) The perforator, as shown in the recent ebay item, had four rows of keys and various other special features making it different from a Baudot perforator. In particular they had a special kind of character counter to allow for the fact that type casting machines can insert variable amounts of space between letters to produce left and right justified type. That was not visible in the picture that was on ebay. Model 20 could not reproduce the variable spaces but was good for reading what the copy was going to say. A Model 28 printer was modified for 6-level operation but did not go into production, as the Model 20 machines were considered entirely adequate.

Teletype produced a new stock ticker circa 1930. Recall that the prelude to the 1929 stock market crash was a great increase in stock trading activity. The old-style tickers, which operated on a code of one pulse for A, two for B, three for C, etc. could not keep up. The new ticker was a six-level machine with a type wheel and a type wheel positioning mechanism very similar to that later used in Model 26. The sixth pulse controlled whether the LTRS or FIGS print hammer would press the tape against the inked type wheel. These tickers were used until circa 1966, when they were replaced (at least in the NYSE) by a new Teletype design similar to the ill-fated Model 37.

I remember reading an article in an old ARTS bulletin (ARTS was a New York based RTTY society of the 1950s) about converting a "bulletin" printer for use in amateur radio. It was some kind of typewheel machine printing on a narrow page. The alphabetic characters were the same as in 5-level code, but the upper-case characters were all different. The ham who did the modification went to a rubber stamp company to get a new typewheel strip made that would print standard TTY code.

Prior to 1964 practically all the computer companies had some kind of six-level code in which the decimal digits were encoded in a binary subset of the character set. There was a fairly

straightforward correspondence between these various codes and punched card codes. Generically they are called BCD codes because of the way the digits are coded in binary. Teletype made some equipment for internal Bell System use only that used one of these codes. At least they were supposed to be used only internal to the Bell System; I saw some of the machines at G.E. Computer Dept. in Phoenix. Later some turned up at a surplus store in Oakland in connection with a junked RCA computer. There was a lot of similarity between these machines and the Model 35. In fact you could convert one of the typing units to Model 35 by changing a few parts. Although the code was basically six-bit I seem to recall the tape equipment being 8-level; and I don't know whether the transmission code was 6-level or 7 or 8. Maybe Ben Stephens remembers.

The "Fairchild Teletypesetter" is a tape perforator for 6-level tape used in connection with type setting machines. This started out in life as a Teletype product. Teletypesetter was made a separate company. Later it was sold to Fairchild as the Bell System was required to get rid of unrelated businesses.

Sep 2000

Last year or so a pianist playing with the local symphony did an encore from one of the Prokofiev piano sonatas, and it reminded me of being in the midst of a bunch of Model 28s. Not so much chugging like a Model 15 as all those little parts moving in a 28. He said at the time that was composed Prokofiev was much into what he called "machine-age music". That further reminds me of a book I read once about history of art and architecture, "Theory and Design in the First Machine Age" by Reyner Banham. He writes about an early 1900s movement called Futurism where the artists were fascinated and inspired by technological society. He quotes a passage where an artist is ecstatic about having his car roll over and deposit him in a ditch of muddy water.

And about the fascination with steam locomotives. And that brings us right back on topic, because if artists have been inspired by steam locomotives, as so many of them have, they can just as well be inspired by Teletype machines.

Nov 2000

LBXD is a dual-shaft transmitter-distributor in which the reader part and the distributor part are separate. This allows tricks like reading from the tape without sending to the line, and sending characters to the line that were not read from the tape. So to make it work like an ordinary XD you have to wire the reader contacts to the distributor contacts. If I remember correctly there is a contact on the reader shaft that is to control the clutch on the distributor shaft.

Dec 2000

So far as I know the modern ink jet printers have nothing in common with Inktronic technology, which was a dead end. I'm not exactly sure how modern ink jet printers work, but think it involves blasting droplets out of a whole bunch of individual nozzles, using thermal or piezoelectric controls per nozzle, and scanning the nozzles over the paper mechanically.

Inktronic worked by electrostatically deflecting ink droplets in two dimensions. If there had been a market for a high speed tape strip printer this might have been worth something. As a page printer it was pretty unsuccesful because there were 40 nozzles and it was just about impossible to keep them all printing clearly at once. There was the additional problem of non-uniform droplet sizes, as the Inktronic did not have any sort of ultrasonic thing to goose the droplets out. About the same time as Inktronic, Hewlett-Packard had a strip chart recorder that worked on the principle of one-dimensional deflection of ink droplets, the paper motion providing the other axis of motion, and did use an ultrasonic vibrator to get the droplets to come out evenly.

If Teletype had been working on the Model 40 all that time we might have had something useful sooner. Although the G.E. Terminet series of terminals used the same printing principle in a lot simpler machine.

Dec 2000

There was a brief association between the Bell System and Western Union. George Oslin's book is a good place to start. He says, page 230, "Control of the Western Electric Manufacturing Company was purchased [by AT&T] from Western Union. It was renamed Western Electric Company, incorporated November 26, 1881, and became the manufacturing arm of the Bell System." About the same time Western Union was fighting a losing battle against the financier Jay Gould. Later in a footnote he tells how Western Electric Manufacturing Co. was formed out of Gray & Barton to supply W.U. with equipment. Another descendant of Gray & Barton is the Graybar company, still in business as an electrical distributor.

Oslin devotes a whole chapter to the AT&T-Western Union Merger-Divorce. Jay Gould and his man Eckert could have acquired the Bell companies for W.U. but were more interested in taking as much money as they could out of W.U. The result was that W.U. was in such bad shape that AT&T in 1909 was able to buy control of W.U. from Gould; and Vail of AT&T became president of W.U. Later he picked Newcomb Carlton to head W.U. They cleaned up a lot of the damage the Gould interests had done, such as remodelling the dingy offices and improving pay for the employees. Then in 1913 under government anti-trust pressure sold its entire holdings of W.U. and make it an independent company again. Newcomb Carlton continued as president of W.U.

Dec 2000

Gear shifts are fairly rare items on Teletype equipment. They were expensive and added some noise to the operation. They were used mostly on monitoring machines, where one machine had to be able to copy several speeds, and in switching centers where a reperforator-transmitter set

might have to be used as a spare on any circuit of any speed.

60 WPM is of course the old standard for TWX, press, amateur RTTY, military, and practically everything else.

67 WPM is probably for 50 baud, the European and Telex standard.

75 WPM was the maximum design speed of Model 15 equipment, used in some private wire networks and in switching centers.

Model 15s were operated at 100 WPM during World War II. At this speed they need a lot of maintenance attention; but the war emergency was deemed to justify it.

100 WPM is the maximum design speed of Model 28 equipment, and was used in the field as systems were converted to elminate the older equipment. For example, the FAA converted from 60 to 100 WPM circa 1960.

WPM can be confusing. What we call 60 wpm is 45.45 baud, or a 22 millisecond bit length. Teletype machines, except those made for Western Union, generate a stop pulse that is at least 1.42 times as long as the other pulses, hence we say 7.42 unit code. That works out to 367.52 operations per minute, which is usually rounded up to 368. Dividing that by 6 characters per word gets you 61.25 words per minute, which is usually rounded down to 60.

Western Union and some other machines use a 1.0 unit stop pulse, or 7.0 unit code. That works out to 389.6 operations per minute, or 64.9 words per minute. You don't need a gearshift to copy 7.0 unit code on any machine made for 7.42; it just means that the receiving shaft stops for a shorter period of time between characters when sending at full speed. The bit lengths are the same and you want the receiving shaft speed to be the same. What's changed is the sending cam, and the gear driving the sending cam, so it spins a little faster. This is compensated for by the pulses taking up more degrees of rotation on the cam.

Now the European standard speed is 50 baud, often transmitted with a 1.5 unit stop pulse, giving 7.5 unit code. This speed was introduced into the U.S. when Western Union brought in Telex starting in 1958, because they had to be able to interoperatewith Telex machines all over the world. If you use 50 baud and 7.5 unit code you get a speed of 66.66 wpm. Now this is not interoperable with 45.45 baud operation because the receiving shaft speeds have to be different for the 20 versus 22 millisecond pulse time. So you need a gear shift if you are going to use the same machine on 45.45 baud and 50 baud operation.

Historical note: In World War II most of the U.S. Teletype machines in the field had speed governed motors since you don't get accurate 60Hz power frequency from field generator sets. To interoperate with British 50-baud machines it was convenient to simply speed up the motors in the U.S. machines by 10%. Hence there are tuning forks lying around that are stamped with something like "British Speed 66WPM" and were used for the purpose.

For what is commonly called 75 wpm the bit length is 18 milliseconds, giving a rate of 55.55

baud. With 7.42 unit code this works out to 449.19 operations per minute or 74.86 words per minute. Again because of the different bit length you need a gear shift if a machine is to copy this speed and one of the others.

For what is called 100 wpm the bit length is 13.477 milliseconds, giving a speed of 74.2 baud. This gives 10 characters per second, or 600 operations per minute.

The bottom line is that words-per-minute is a very inexact concept even though we use it all the time. What really matters is the bit rate.

Jan 2001

There are two varieties of two-headed XD machines.

One has the distributor segments split in the middle, with one half connected to one set of reading contacts and the other half connected to the other set. This was used, going back to World War II, as a cheap two-channel time-division multiplex. You simply adjusted the range finders on the two printers so that one selects early, in the middle of the first half of the pulse, and the other selects late, in the middle of the second half. So long as the circuit is good enough to propagate half-length pulses (and contains no regenerative repeaters) you get two channels over one wire.

The other is for the Vernam cipher, going back to World War I. It transmits the exclusive-OR of what the two tape heads read. You put a one-time key tape into one head and the message tape into the other and it sends encrypted text. At the receive end you put a copy of the key tape in one head and a tape with the encrypted text in the other and clear text comes out. If the key tape is truly random and is never re-used the cipher is unbreakable. The cost is that you need as many characters in key tape as you are going to transmit characters of message; and you have to get a copy of the key tape to your recipient before you can communicate. (and there is the operational problem of getting the key tape at the receiver properly aligned with the message tape.)

So if the unit in hand has split distributor segments it is for the two-channel multiplex. Either way it's a nice collector's item; you don't see the two-headed XDs very often.

Jan 2001

We old geezers always hooked up the 120 volt, 60 ma loop with 2K ohms of resistor and a relay or transistor or tube or whatever and the selector magnet follows the well-known exponential formula for current rise with time. When I cooked up the low voltage selector for Teletype it was just winding the selector coils with 1/10 the number of turns of thicker wire and running at 12V, 600 ma. While I was away somebody there decided on the much more complicated circuit used in the Model 32/33/35 machines with 20 volts, 500 ma and a constant-current transistor connection.

Jan 2001

Teletype slogans: The one I remember is "Machines That Make Data Move" and I just ran across an envelope with "The Computercations People" Anybody remember any other slogans used by Teletype?

Feb 2001

About TWX and Telex:

There were two kinds of Model 32 Telex CCUs, or rather there was a polar adapter option for the Telex CCU -- you will need to take out the polar adapter to operate on a neutral line.

With correct polarity the motor should come on and the thing should work; and that's on a 50-60 ma loop current. There is a whole protocol for connecting in Telex; but at the end of it all the line current reverses direction and that turns on the motor and enables conversation.

TWX was a Bell System service from the 1930s, and until 1961 used manual switchboards and 60 WPM Baudot. Normally they operated the stations over telegraph loops, which is to say DC loops from the central office and those might be wire pairs or they might be derived from carrier channels or something so that the bandwidth was just enough for TTY operation. In some cases they ran a voice-grade pair to the customer's premises and used a one-channel carrier as a modem. This was just so they could use an available voice grade circuit.

TWX was converted to dial service overnight about 1961; and for that they used the voice switched network. There was a mixture of 60 speed Baudot and 100 speed ASCII as the system developed. Telephone numbers were such that you couldn't dial between voice telephone and TWX; and also if a machine at one code and speed called a machine at the other there would be a speed/code converter stuck in between them. Although they used the voice switched network and voice lines to the stations there was provision for use of telegraph trunks between switching centers for conservation of bandwidth.

Telex started in Europe in the 1930s and was always a customer dialled service, using step-by-step switching. The machines ran at 50 baud Baudot. Western Union decided to introduce Telex to the US, starting in a few big cities in 1958 and gradually spreading over the whole country. I'm not sure just what their motive was; and in my opinion it was a monumentally bad business decision.
- It put them into head-to-head competition with the Bell System for similar services; and the Bell System owned the majority of the wire plant needed to connect customers to the W.U. switching offices.
- It required them to spend a lot of money buying electromechanical switching equipment (mostly from Siemens in Germany) at a time when that kind of equipment was about to become obsolete.

- It inconvenienced customers since there were then two competing but not interconnecting services. Like having two telephone companies in a town that refused to connect to each other.

One advantage of Telex was that it was an international service, whereas TWX was strictly US and Canada. But there were complications because W.U. was not permitted to handle international traffic; so international Telex had to route via other companies. But you could make Telex calls between the US and Europe.

WU was in a downward spiral anyway, so in the late 60s they more or less forced AT&T to sell them TWX so they wouldn't have any competition. They continued to supply TWX and Telex service, and arranged for the two to interconnect. For the first few years AT&T was required to give them cheap rates on the wiring and switching that implemented TWX. When that time ran out WU had to pay essentially the same private line charges that anybody else would be charged for customer loops between the customer and the WU office. Meanwhile the bottom was about to drop out of the business anyway. In the early 60s the Bell System had opened the voice network to data with the DataPhone modems. Then the CarterFone decision required them to allow 3rd party modems to connect to the network. And meanwhile the volume of TWX and Telex traffic fell off. This was partly because more traffic was being handled terminal-to-computer rather than terminal-to-terminal. It was even more so because cheap fax came along and was more competitive than TWX and Telex had ever been. I don't know if the Bell System realized this when they handed over TWX to WU; but in any case they got rid of a service at a very opportune time.

Dial TWX station sets are a mess. The modem sits in the bottom of the TTY machine and is a blank box. Hence all the telephone part of the modem is built into the TTY machine, as the call control unit. it all leads to a 99 wire interface between the Teletype and the modem. Some of the Bell operating companies decided to beat the system by buying much cheaper private line Teletype machines, putting in a little current-loop to EIA converter, and attaching to a DataPhone modem, which could be strapped to operate with TWX or DataPhone.

The modems for TWX and DataPhone have one FSK pair of frequencies used by the originating station and another by the answering station, for full duplex. Strapping options allow either frequency pair to be used for originate, as well as whether mark is high or low frequency for each direction. This gives a total of eight combinations of mutually incompatible services that can be served with the same modems. At one time they were talking about TWX and TWX-prime and WADS (Wide Area Data Service) and WADS-prime and I don't know what other services, that would all work this way and be unable to talk to one another. I don't think most of those were ever implemented.

Feb 2001

MXD is in general the code for multiple transmitter distributor. The typical thing is an L-shaped base with one motor driving three tape readers. The tape goes from front to back. There is also a 6-headed version that I have seen in pictures. There was a Model 28 version made for the FAA that I have seen only in a picture, appeared to use LBXDs.

These things are used mostly in torn-tape manual switching systems. One version from the 1940s is the AN/TGC-1, a refrigerator-size cabinet containing two 14 typing reperfs and the 3-headed MXD. Typically this serves one or two lines. The third tape reader reads a message number tape so it can send a message number ahead of each message. The other two readers are operated in "flip-flop", which is to say both send to the same line; when one uses up the tape the other one starts up. But they can be split to send to two different lines. AN/TGC-1 and later versions of the same idea have the convenient feature that you can built a switching center of any size just by putting them in there, since a single cabinet contains everything that is needed to serve one or two lines. For more permanent installations a different arrangement is preferred, in which all the reperfs are together in one bank and all the tape readers are together in another bank.

Mar 2001

I picked a fight with the mechanical designers of the Model 37 over their online settable tab stops. They were determined to do them. I argued that in the world of TTY machines as mostly computer terminals that the feature wouldn't be worth much, that it would be much more useful to have a simple horizontal jump that would do 3 spaces in the time of 1. (3 because the horizontal tabbing speed was 3 spaces per character time). Then a computer program would just send the right number of jumps and spaces to position the print element where it wanted, and that would be about as fast as using tab. Unlike tab it would take a known number of character times; you wouldn't have to wait some magic time after sending a tab character to know when the machine had come to rest. The mechanical types would have none of it.

I remember newline being talked about, but not much of what was said about it. The basic idea was to make the TTY machine more typewriter-like; and typewriters have a single key for carriage return and line feed. It takes some extra learning for a typewriter typist to use a Teletype machine.

One might wonder why the LF character was chosen as NL rather than the CR character. I believe the reason was compatibility. If you send CR-LF to a machine that is set up for NL, then the carriage returns and the line spaces once, which is what you had in mind. Whereas if CR had been used for the newline character then sending CR-LF would result in two line spaces rather than one.

ASCII-EBCDIC:
The big issue was this: you would like to have a code where the alphabet is represented as an unbroken sequence of binary numbers. That way you can use numeric comparisons to sort things alphabetically. However the punched card code was based on decimal numbers and even then has a couple of breaks in the alphabetical sequence. IBM wanted a code to be easily translatable to-from punched card code, which would have prevented putting the alphabet into an unbroken sequence. So after failing to get their way in the ASCII standardization effort IBM essentially walked away and developed their own code that was the way they wanted it. They probably did figure that with their market dominance they could make ASCII wither away. And they had some success: Burroughs for one adopted EBCDIC as one of the code for their large computers.

There was a slight problem with the government accepting ASCII as a federal standard and requiring it in the computers they bought. IBM put an "ASCII mode" bit into the System/360 architecture. This didn't really do anything, and was removed from System/370.

Not that IBM could maintain consistency even internally. Their printing terminal offerings, 2740 and 2741 didn't use EBCDIC; and then they brought out the 96-column card with a 6-bit code for some of their small systems. Further, they had developed a good 8-bit code for their semi-experimental STRETCH (7030) machine; but that didn't make it into System/360.

The whole thing seems silly now, and was probably a bit silly even then, since if you have a computer it's duck soup to convert from one code to another. In any case, the Teletype Model 33 was a big hit with minicomputer makers and as a time sharing terminal; and IBM was behind the game in both of those fields.

Apr 2001

Refinishing:
I guess there was a period when Western Union used glossy black for some items, as I have seen black under later paint. They also used some colors, dark and light olive, that might have been camouflage colors left over from World War I. Sad to say, it is historically authentic to see W.U. equipment with a lousy-looking brushed-on blue-gray-green paint finish, as offices were supplied with cans of paint and the employees would go through repainting everything when the original paint started looking dirty and dull.

I took a piece of Western Union painted metal, which had been out of sight and out of reach of the paint brush, to a local paint store and their computer produced a match in an oil-based semi-gloss paint. That seems to be the way the paint biz is these days; there are no stock colors anymore; they mix up whatever color you want. I have used this paint so far to paint over some scratched and discolored Western Union gray-green wrinkle paint, applying it with a foam roller. The result doesn't look totally authentic but it does look better than before.

Years ago I had a happy accident. Wanting to spray paint some smooth stuff I bought the cheapest spray paint outfit Sears has, and some industrial paint that was supposed to give a smooth finish. What in fact happened was that the spray outfit sprayed the paint out in globs and gave a beautiful textured finish, almost like professional textured vinyl but less durable. The spray paint outfit uses a diaphragm compressor and no storage tank, hence the air comes in pulses and I guess that is what causes the texturing. The paint formula happens to be right at my fingertips. It is one gallon Kem Lustral dark gray plus 4 ounces green. Mix 3:1 with multipurpose flatting base. Mix 5:1 with VM&P naphtha for spraying. These are Sherwin-Williams products.

Teletype used to use a baked-on wrinkle finish paint and then switched to a textured vinyl, as did most of the industry.

The Model 15 case uses safety glass. I haven't tried to get a glass shop to make me one but that seems like a reasonable suggestion. Also the glass shop could bevel the edge for a tearoff edge. Plexiglas is also historically authentic, and you can do that yourself. Then there is Lexan, which is harder to cut than Plexiglas but is pretty indestructible.

Apr/May 2001

Model 14 tape strip printers used 3/8" paper tape, except Western Union used 5/16". I remember reading somewhere once long ago about the huge amount of money W.U. saved every year by slicing 1/16" off the tape. And W.U. was just the penny-pinching kind of company that would do that sort of thing.

The model 14 was called 2B by W.U. There was an earlier 2A which was also an early Model 14; and there was a 1B (and presumably a 1A before it) from Kleinschmidt, before the Morkrum-Kleinschmidt merger.

Perforator tape:

11/16" for 5 levels (plus feed holes).

Maybe 3/4" or maybe 13/16" for 6 levels.

Maybe 7/8" for 7 levels. Also Kleinschmidt and some Western Union printer perforators use 7/8" tape for 5 levels where they print on the unpunched edge of the tape.

1" for 8 levels.

I don't think there was a 6-level version of the Model 19 because the perforator for 6-level tape was quite a special item. Since the purpose was typesetting it had to keep track of the accumulating width of a line so the operator could put in a carriage return at the appropriate time. The Linotype has something called "space bands" which are adjustable spaces between letters that can fill out a line to both margins are even. The Model 20 keyboard perforator had a scale on it with several pointers to show the operator how much space was left in a line. All this being the case, the operator had to punch "blind". If you want to see some more about this, point your web browser at www.uspto.gov and search for patent 2,755,859 Incidentally, there was a perforator-only machine made from the Model 19 line. It was called a DPE and was like a Model 19 keyboard without the shaft and transmitting distributor. 7-level was not used a lot. There was a time when the computer industry used all 6-bit codes. This plus a parity bit would give 7 levels. I don't know offhand what if any machines used 7-level tape. I just remember the Dataspeed equipment that had adjustable tape guides and a switch for 5, 6, 7 or 8 level tape. IBM had a product called the 1050 that was essentially a modular ASR set and it might have used 7-level tape, but I don't remember.

May 2001

I'm guessing that the picture in The Teletype Story is Model 11, but I'm not sure. Model 10 was a Western Electric item. I have a photo of it, but I don't have a scanner yet.

Blue Code was made for Postal Telegraph, because their corporate color was blue. Then Green Code was made for Western Union for the same reason.

People have been looking for a Model 10 for years and not finding one. Teletype Corp once had a museum, and after the company was dissolved that may have gone to Lucent, but now that Lucent can't seem to make up its mind what business it is in there's no telling what happened to the collection. I have a type script that accompanies a slide show, but I haven't seen the slides and don't know where they might be.

Well I guess getting the tape upside down might have been a problem with 6 level tape, but then if you tried to use the tape you would see right away you were getting gibberish. Or maybe the operators learned to read the code from the tape and knew which side was up by what it said. Of course with any size of tape if you tear off a piece of it you might get the wrong end into the reader.

Document Notes

This document was comiled and formatted (and edited somewhat) by Gil Smith, July 2001. The original file, haynes--tty-models.txt a compilation of emails, is courtesy of Jim Haynes.