

BELL TELEPHONE LABORATORIES
INCORPORATED

SUBJECT: "New-Line" Operation for Bell System
Teletypewriters - Case 39065

DATE: SEP 1 1967

FROM: D. A. Kerr

MEMORANDUM FOR FILE

ABSTRACT

It is proposed that new types of Bell System page teletype-writers utilize the "New Line" type of format control rather than the traditional "Carriage Return - Line Feed" approach, in order to enhance their utility and attractiveness to users. Specific advantages of this mode of operation are presented, as well as an analysis of certain corollary problems and proposed solutions therefor.

HO-3142

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Introduction

Ever since the earliest days of their evolution, most page teletypewriters developed in a "message communications" environment have utilized one coded character to control the function "Carriage Return" and a second to control the function "Line Feed". All "standard" Bell System page teletypewriters have followed this pattern, although variations have been applied in special applications.

On the other hand, most teletypewriter-like devices which have evolved, generally from typewriter mechanisms, in a "data processing" environment have used what is now called "New Line" operation, in which a single coded character produced the combined Carriage Return - Line Feed operation.

It is proposed that new types of Bell System teletypewriters and associated systems be arranged for "New Line" (NL) operation.

Advantages of "New Line" Operation

The most obvious advantages of the proposed method of operation relate to ease of keyboard operation. First, at the end of each line of page-format material, the operator would only have to stroke one key rather than two.* Second, the operation now becomes essentially identical to that found on electric office typewriters, a device already familiar to a significant class of potential users.

Third, the proposed method provides a more direct logical relationship between the organization of the message format and the associated keyboard action. The character Line Feed is by itself potentially sufficient to unambiguously delineate individual lines of text; the corollary Carriage Return

* Of course, a single key could generate a two character sequence, but this would add cost to the terminal.

required today is in this respect completely redundant. On the other hand, it is expected that in the future a number of new uses for Carriage Return alone will emerge, such as preparation for underlining a complete line or section heading in text. The user's association of Carriage Return with such operations, applying to the present line, would seem to make its use when advancing to the next line seem even more anomalous than at present.

These logical advantages would also seem to be of benefit when the composition of the data is to be by automatic means, rather than by keyboarding.

The planners of the BTL "MULTICS" time-sharing computation center valued "New Line" operation highly. As a result, most M37 teletypewriters yet produced, having been aimed initially at this application, have been arranged for "New Line" operation. Similar strong feelings in favor of "New Line" operation have been regularly expressed by prominent workers in the data processing field. For example, experts in data communications at the man-machine interface, coming from many companies to participate in USA Standards Working Group X4.A9.1 (ASCII Keyboards), have almost unanimously indicated their individual intent to utilize "New Line" operation wherever practical. In fact, this feeling is so extensive that it has been almost impossible to have that group take seriously the issue of the location of separate Carriage Return and Line Feed keys in proposed keyboard standards. They have further recommended to the ASCII code group, X3.2.4, that certain specific provisions be added to the ASCII standard to accommodate "New Line" operation.

The message seems quite clear: both tangible and psychological advantages of "New Line" operation are probably quite real to many of the potential users of our terminals. The introduction of this feature would seem to greatly enhance the utility and attractiveness of these terminals to such users.

Potential Problems

The problems which must be solved to admit the general introduction of this improved means of operation primarily fall into two classes:

- a. Problems related to the introduction of "New Line" terminals into systems today using "Carriage Return-Line Feed" terminals.

- b. Problems relating to the presently-used philosophy of providing time for the carriage return function in our low-speed page printers.

Proper choice of the encoding arrangement for "New Line" will admit practical solutions to the first class of problems, and it can be demonstrated that the second class does not really militate against the introduction of the proposed method of operation. Both aspects are discussed in detail below.

Encoding

The ASCII code provides two coded characters related to line format control, CR (Carriage Return) and LF (Line Feed). There is no express or implicit provision for NL (New Line) operation. Three approaches to the accommodation of such operation suggest themselves:

- a. Assign a third coded character for NL, retaining CR and LF with their present functional definitions.
- b. Assign the present CR character to the NL function, presumably retaining LF with its present definition.
- c. Assign the present LF character to the NL function, presumably retaining CR with its present definition.

Approach "a" seems impractical due to the undesirability of attempting such a reassignment within ASCII. It further seems to offer no possibility of an end-of-line sequence which both CR/LF and NL machines could handle; such a sequence would probably offer the best solution for coexistence of both types of machines during the introduction of the NL feature.

Approach "b" might be practical, since it does not require a new code position. However, it does also not offer any workable "universal end-of-line sequence": If the sequence CR(NL)-LF is sent to accommodate a CR/LF machine, the NL machine will double line feed, once on the CR(NL) and once on the LF.

Approach "c" seems to be the best. It again does not require a new code position, and offers a "universal" sequence as described above: CR-LF(NL). The CR/LF machines will perform in the classical manner, and the NL machine will carriage return on CR and then will carriage return (again, but that doesn't do anything) and line feed on LF(NL). It has the further advantage over "b" that it retains, of the

present "separate" functions, CR rather than LF. A separate CR is of some utility, for such purposes as preparing for underlining an entire line. A separate LF, on the other hand, seems to be of no real utility; it is of course commonly used today in message communication to "drop for signature" and similar purposes, but such operation is not consistent with today's requirement for consistent formats and format-generating routines.

It should further be pointed out that the ISO 7-bit code (an international standard, related to ASCII, which is now near final approval) makes provision for method "c" as an alternative to straight CR/LF operation. IBM has also adopted method "c" for use in ASCII-oriented terminals, despite their consistent prior use, in older codes, of something similar to method "b". USA Standards Working Group X4-A9.1, ASCII Keyboards, has also endorsed method "c" and recommended its recognition by the ASCII code group, X3.2.4.

The "Timing Problem"

When the possibility of the adoption of "New Line" operation is discussed, reference is invariably made to the "timing problem". Let us review the origin of this concern.

In most Bell System low-speed teletypewriters, past and present, the carriage return function has required more time for reliable completion than was provided by the duration of the initiating CR character. Since, with CR/LF operation CR was generally followed by LF, the time of the LF character was also available for completion of the CR function. With NL operation, this situation does not obtain: only a single character time is available for the CR function, unless "time fill" is provided in some manner. It has been suggested by some workers in the field that this would necessarily require the operator to key "NL" plus a fill character (such as DEL - Delete), thus negating the advantage of NL operation to the operator.

Consider, however, that the present method of operation does not itself produce a utopian situation in this respect. First, many operators are today trained to use a fill character anyway, as in the sequence CR-LF-DEL, or the old Navy favorite CR-CR-LF. This habit comes partially from the need of some older Bell System machines, and some present machines (Kleinschmidts, for example), for a "second fill" after CR, and partially from the fact that such use of

"Letters Shift", the "DEL" of the 5-level code, was desirable to restore the shift state of a 5-level printer if it has become stuck in "figures case" due to some transmission error. Today such a "second fill" is recommended for reliable operation of the CR function on the new M37 teletypewriters when operated at 150 wpm. It should be further pointed out that certain other contemporary types of terminals* require even longer CR times, and thus the present means of operation will not suffice when interoperation on a more flexible basis is desired, an increasing need in today's diverse data systems.

Thus, it seems that some more automatic means is required to accommodate the true "timing problem", which exists whether or not we adopt NL operation.

Actually, when sending in real time from a keyboard to one or more printers, the problem is "solved" unconsciously by the operator just as on an electric typewriter: the operator pauses after each "NL" at least until her own machine is ready again, thus accommodating the distant machine if its requirement for CR time is comparable to that of the local printer.

When transmission is not direct from the keyboard but, for example, is from tape in an ASR station, other means may be applied. For example, it is currently expected that the transmitter control logic of the 37ASR station will momentarily halt the transmitter on some or all control characters, in order to allow feedback from the local typing unit to hold the transmitter stopped if a time-consuming function such as tabulation has been initiated. By proper adjustment of the timing of this arrangement, it can inherently supply a delay or control insertion of fill characters if appropriate - to accommodate the execution of the carriage return function on machines similar to those now in use.

This same approach, incidentally, can be easily extrapolated to include the addition of "restraint control" for accommodating the timing needs occasioned by the operation of grossly dissimilar terminals, as proposed elsewhere by the author**.

* Notably those based upon typewriter mechanisms, such as that of the IBM "Selectric" typewriter. These require approximately one character time (at 150 wpm) per 10 spaces of travel to execute the Carriage Return function.

** Revertive Control of Terminal Function Timing - Case 39065, by D. A. Kerr - To be published.

It should be kept in mind that the transmitter control timing arrangements described here need not necessarily be applied to existing stations; whenever they are sending they must send the sequence CR-LF, as required by their own printer, thus providing the requisite time intervals at both ends.

Extension of Concept to Other Format Effectors

The "New Line" concept can be naturally extended to the other vertical format effectors, Vertical Tabulation (VT) and Form Feed (FF). In effect, the receipt of either of these characters would cause the printer to execute the carriage return function as well as the traditional associated function. The need to have these functions executed without the carriage return seems to be quite minimal. It is possible that where such separate use is found today it is only because forms designers have taken arbitrary advantage of the existing mode of operation.

Grouping of New Features

The author has previously proposed that the three following "new" teletypewriter features should be grouped in their standard application to stations in common-user or quasi-common-user services, such as TWX:

1. Backspace
2. Up-low printing character set
3. New Line operation.

Operators of stations having any or all of these need to know which are provided on the distant station in order to most appropriately format messages. By grouping the features, it is then necessary to distinguish between but two classes in this regard, the "haves" and the "have nots". One method suggested for indicating this distinction on line-switched services is to include a lower-case alphabetic character in the answer-back sequence of stations having all three features. Thus, when calling from one such station to another, the appearance of such a lower-case character would indicate the presence of the new features. If the called station did not have them, no such indication would be given. If the calling station did not have them, the indication, even if given, would not appear: the lower-case letter would "fold" and print upper case one. But in this circumstance, the limitations of the calling station should preclude use of the features. Thus, the operator is automatically informed of the joint - and controlling - capabilities of both stations.

Conclusions

Adoption of the "New Line" mode of operation, at least for terminals of new designs, seems to offer numerous advantages, and appears to present no serious problems. On this basis, it is recommended that steps be taken to introduce this method of operation as standard for all new types of Bell System page-oriented data terminals, including the 37-type teletypewriter.



D. A. KERR

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