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AUTHOR Sipfle, William K.
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ABSTRACT

BELLTIP is an on-line library processing system concerned with book acquisitions, cataloging, and financial accounting for a newwork of 26 technical libraries. At its center is an interactively updated and queried set of files concerned with all items currently in process. Principal products include all purchase orders, claims, and cancellations; receiving and invoicing reports; catalogers' work-sheets and proofsheets; in process listings; and a variety of management and user reports. The system also supports the data base for an on-line circulation system (BELLREL) and a photocomposed printed book catalog. Operational since the beginning of 1972, BELLTIP provides a number of advantages over the previous manual system. These include faster processing of orders, better information about orders in process, automatic handling of routine processes, elimination of redundant record transcriptions, and better management information. (Author)

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William K. Sipfle

Bell Telephone Laboratories,
Murray Hill, New Jersey 07974

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Abstract

BELLTIP is an on-line library processing system concerned with book acquisition, cataloging and financial accounting for a network of 26 technical libraries. At its center is an interactively updated and queried set of files concerned with all items currently in process. Principal products include all purchase orders, claims and cancellations; receiving and invoicing reports; catalogers' work-sheets and proofsheets; in process listings; and a variety of management and user reports. The system also supports the data base for an on-line circulation system (BELLREL) and a photocomposed printed book catalog. Operational since the beginning of 1972, BELLTIP provides a number of advantages over the previous manual system. These include faster processing of orders, better information about orders in process, automatic handling of routine processes, elimination of redundant record transcriptions and better management information.

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INTRODUCTION

There are currently 26 library units at 20 locations in nine states in the Bell Laboratories Library Network. These libraries, together with other specialized units in the Libraries and Information Systems Center of Bell Laboratories, serve the information needs of about 16,000 Bell Labs scientists, engineers, and supporting personnel. Eight of the libraries are operated jointly with the Western Electric Co. and also serve Western people at those sites. The libraries operate in a highly-integrated network mode with extensive sharing of resources, a mix of centralized and decentralized services, and common systems, standards and goals.

Since 1958 the libraries have been utilizing computers to make information handling more effective (1), and since 1968, with the implementation of the BELLREL circulation system (2), on-line systems have been prominent. BELLTIP, an interactive system which controls book acquisition and cataloging, has been operational since January 1, 1972, but has not previously been detailed in the literature. It operates currently on a book collection of 56,000 titles (160,000 copies) and handles some 16,000 book orders annually.

SYSTEM OVERVIEW

BELLTIP is a library processing system concerned with the acquisition, cataloging and financial accounting of books (see fig. 1). Information is keyed on-line to a Honeywell-6000 computer through interactive terminals to maintain an In Process File (IPF) of all "active" titles, including order information on each copy from the time of initial entry until after the copy is sent to the library, and cataloger information for new titles and changes to old titles. The IPF hands off new and altered information to the BELLREL circulation system, to an accounting history file, and to a master file of cataloged data.

The terminals, in addition to their work for data entry and for a variety of on-line queries, are used as printers for those products where timeliness is essential to the proper flow of processing. Output accumulates as a result of system processing of data input and is printed at the terminals whenever convenient throughout the day. Such output includes all orders, cancellations, claims and other similar requests to suppliers, printed on a continuous form sorted in supplier order; receiving reports which give the disposition of all copies received ("send to preparations", "send to cataloging", etc.); cataloger's worksheets for the first copy of each new title which summarize all existing input and are used as coding sheets for additional cataloger in-

put; invoice reports which give a record of accounting data entered for each copy cited on an invoice; and proofsheets summarizing the complete current updated record as known to the system following each cataloger's change or initial entry. On-line queries display records, give up-to-the-minute accounting reports, monitor vendor performance, and monitor the utilization of file space.

In the batch world, products include book pocket and spine labels, library bulletin copy, vendor performance analyses, printed book catalogs, numerous statistical and management reports, and a weekly In Process List (IPL) distributed to all libraries which itemizes all copies in the various stages of acquisition/cataloging.

THE DISPLACED SYSTEM

Acquisitions, processing and cataloging have been centralized for many years in the Library Technical Processes (LTP) group at Holmdel, N.J. Prior to BELLTIP, five-part order forms were typed for each item selected by a local library; one copy was retained by the library for its outstanding order file and the balance sent to LTP. Two copies were retained by LTP for its order and, when appropriate, received files, and two were sent to the supplier, one to be used as a status report form or to be returned with the book. In all, a half dozen manual files were maintained to support the ordering/cataloging functions.

The system had many deficiencies. In general terms these were felt as a lack of control over individual orders (they had a tendency to get "lost in the system"), excessive time delays between order and receipt at the local library, and excessive clerical time at various stages. More specifically, the deficiencies included:

1. Tedious and time-consuming form processing. The individual order forms were first typed on by the local library, then typed on by LTP to enter supplier and control number information, then typed on again by LTP at time of receipt, etc.

2. Inconvenient order status queries. To follow up on the progress of an order the local library had to call LTP to look it up in the order file to see it it had been annotated with a supplier report or to see if it was in the recently received file, or cancelled, etc.

3. Difficult claiming. The only way to systematically claim orders was to periodically review the entire order file of 4000+ forms for those that were overdue.

4. Re-keying of information for different uses. Cataloging a title preserved none of the keystroking of ordering the title. Updating the circulation system (BELLREL) required manually keypunching cards for title and holdings information at time of initial entry and for all subsequent changes.

5. Uncoordinated network selection policy. Since individual libraries were not aware of the outstanding orders of other libraries, they could not readily coordinate selection. Inadvertent duplication of copies in their own library was not uncommon.

6. Costly or unavailable union card catalogs. The union card catalog containing some 200,000 cards was maintained in only 6 locations. The other libraries had a local card catalog and, from BELLREL, a one-line-per-title line-printer listing of titles in the network. It was not economically feasible to maintain a union card catalog for the smaller libraries, and even for the large libraries, updates to the catalog significantly lagged local receipt of new titles.

NEW SYSTEM OBJECTIVES

The deficiencies just listed suggest some of the characteristics defined for the new system. The principal goals and gains projected for the new system were:

1. Faster processing of all book orders, i.e. complete clearing of all orders by LTP within 24 hours of receipt, including the activities of file look-up, data verification, data creation, elimination of unintentional duplicates, selection of supplier, preparation of order forms, etc.

2. More complete, current and readily accessible information for decision-making and control of all processes, including the capability of identifying accurately and promptly any book or set of books owned, on order, claimed, cancelled, in process, etc.

3. Elimination of virtually all manual files.

4. Improved communications with requesting libraries and individuals, both on a regularly scheduled and demand basis.

5. Automatic alerting to situations requiring prompt action, e.g. claims, cancellations, overexpenditures, etc.

6. Automation of all routine processes which could benefit therefrom, e.g. preparation of claim notices, in-process reports, cataloging worksheets, statistics, accounting, announcement bulletin preparation, BELLREL file updates, etc.

7. Reduction to the lowest practical level of all record transcriptions and repetitive operations, thereby cutting error rates and the total cost/effort required to get books into the library and into use.

8. Development of a master data base which would support all immediate services and products, including a

printed book catalog, and also be hospitable to likely extensions, such as new user services, e.g. SDI for monographs, on-line searches, etc.

9. Provision of management information sufficiently rich and reliable to aid in further improvement of the system and allowing significant monitoring and feedback so as to fine-tune the system in terms of responsiveness and efficiency, thereby improving service at less cost.

10. In summary, improvement of the total response of the library to the user.

FILE CONVERSION

The goals just listed were agreed upon in 1970 and active development of the BELLTIP (Bell Labs Libraries Technical Information Processing) system proceeded immediately. Programming (using primarily FORTRAN in both time-sharing and batch environments on the Honeywell) progressed so that new acquistions were ordered, received and cataloged under the new system on schedule, beginning January 1, 1972. Meanwhile, a massive conversion effort was required to convert the existing card catalog to machine readable form so as to merge the retrospective data base with the newly accumulating data base in machine-readable form. This basic conversion effort, begun in 1971, culminated during the

summer of 1972 and, after extensive proofing, editing and validation, led to the production of the first annual printed book catalog in the spring of 1973.

Before any conversion could begin all cataloging data elements had to be defined and designated. The MARC codes, an obvious choice, were carefully reviewed. A decision was made to simplify the codes for internal use; any incoming MARC records could be easily converted to the simplified scheme. All uniquely defined data elements were assigned a one or two character designator, to a great extent mnemonically chosen, and terminated by the reverse slash character, a character which would not naturally occur in the text and would not be used for any other purpose. The complete set of designators (i.e. data elements) chosen, including many not needed for the title conversion process, is shown as fig. 2. Note that the second character of a double designator is generally numeric, denoting a member of a class of elements. Thus, whereas the Standard Book Number is defined by the single designator s, authors, of which there may be more than one, are defined by double designators a1, a2, etc.

Editing of the shelflist cards for the keyboarding operation followed. This first required photocopying the cards on worksheet forms. The shelf list at the beginning of conversion, in January 1971, was frozen; new titles coming into

LTP during conversion in 1971 (i.e. prior to on-line entry through BELLTIP beginning the following January) were maintained in a supplementary file converted after completion of the original file. Even after January 1972 catalog cards had to be produced for the public catalogs until the printed book catalog became a reality.

Catalogers processed the worksheets in sequence, supplying data codes and edit fields. Conversion gave an opportunity, to some extent, to correct inconsistent practices of the past. (After conversion a major benefit of BELLTIP has been the relative ease with which additional cataloging practices may be altered through systematic identification and specific or global change of fields of interest.)

Keyboarding was done by an external contractor, using an on-line video-terminal data entry and edit system. The contractor was required to produce listings of the keyed input and provide basic validation of record characteristics as well as diagnostics on missing or illegal fields. In particular, data entry personnel were instructed to flag with a special character all fields which they had trouble reading or thougnt might be in error. Proofing was then done at Bell Labs. If corrections were necessary they were indicated on the contractor's listing which was returned for re-entry.

When all titles and changes were entered, the final cumulative tape was reprocessed from the contractor's character set (EBCDIC) and record format to the Bell Labs record format (in ASCII). The reprocessed tape was merged with files of data accumulated through BELLTIP after the conversion cut-off date to become the first complete "master file" of cataloged data. This tape was subjected to additional validation programs which complained about missing required fields, inappropriate combinations of fields, and illegal syntax for fields present. A number of programs were written to help the "clean-up" process.

BELLTIP FILES

From the user's viewpoint there are two basic files in BELLTIP. First, the In Process File (IPF) is an on-line randomly accessed file of all current acquisitions and recent catalogers' changes. Secondly, the Master File is an off-line sequential file on tape and/or demountable disk of all cataloged titles; it is accessed randomly for some applications when convenient. There is considerable similarity in the record structure of the two files; each has variable-length records consisting of variable length fields preceded by a record key, a bit inventory of fields present, and a string of pointers to locations within the record for the start of each field present. Other files are needed to support these two primary files.

Record Key

All files of book records are ordered on a six-digit accession number as key. For cataloged titles, this number (also called a one-number because of its lead digit) is in the range 100001-199999 and is the same as that in use for BELLREL since 1968. BELLTIP automatically assigns accession numbers to newly cataloged titles (numbers for titles purged are subject to re-assignment after two years) and hands-off this information to BELLREL. For new titles on order, a "temporary" accession number (in the range 300001-399999 and called a three-number) is automatically assigned by the system. The use of two series of numbers allows the relative volatility of acquisition activity (due to cancellations and consolidation of duplicate orders) to have no impact on the more stable world of cataloged titles (and the circulation files). When the first copy of a new title is received and cataloged, it and all related copies (with 3-numbers) are given a single permanent 1-number and appropriate cross-references are generated for the IPF. The Master File, since it contains only cataloged titles, sees only the 1-number series of accession numbers. When updating files, all accession numbers (1- or 3-) must be accompanied by a single alpha check character which is a characteristic of the number easily checked by the system but not discernable to the user. (The check character is obtained by relating one of 23 letters of the alphabet to

each remainder plus one, modulo 23, of the accession number.) This minimizes erroneous updates due to inaccurate keying of the accession number. Naturally all printouts of accession numbers by the system include this check character since it is needed for input.

Directory

Since records occur in the IPF in arbitrary order, access is made through another file called the directory which is an index of pointers maintained in accession number order. The pointers are comprised of three computer words as follows:

word 1--bits 1-20, record key (accession number in integer)
bits 21-27, check character
bits 28-30, entry type
bits 31-36, sub-number

word 2--bits 1-4, status code
bits 5-24, various flags depending on type
bits 25-36, date of last status change

word 3--bits 1-22, beginning word on IPF
bits 23-28, flags depending on type
bits 29-36, length of record on IPF

Hence word 3 of the directory pointer locates a record on the IPF for the key given in word 1. Word 2 allows selection of records on the basis of status codes and other status-related flags. A given title may have multiple en-

tries in the IPF and, correspondingly, the directory. There are seven types of entry in the directory, five of which point to records in the IPF. Type-2 records (identified by bits 28-30 of word one) are concerned with "title" characteristics (title, author, publisher, etc.) assignable at order time. Type-4 records are for "supplementary" fields (added authors, added titles, subjects, etc.) assignable only by catalogers. Type-3 and Type-5 records are updates of type-2 and type-4 material, respectively, in the case that the original cataloging has already been handed off to the Master File. Since there may be multiple updates between handoffs, time sequence of changes is preserved using a sub-number in bits 31-36 of word one. Type-7 records are concerned with "copy" information (vendor, price, library, copy-number, order date, receipt date, etc.). Each copy has its own record, distinguished by a unique sub-number. Type-1 records in the directory are cross-references, where word 3 instead of pointing to the IPF gives a surviving accession number to be found elsewhere in the directory in lieu of the obsolesced number in word 1 of the cross-reference. Type-0 records include pointers to invoicing information in the IPF. When copies are invoiced, the copy record (type 7) includes reference to a system assigned invoice trace number (in the range 10000-99999) which, through use as a pseudo-accession number in the directory, points to additional invoicing information. In-

voice trace entries are handed off to the Accounting History File.

In addition to pointers to the IPF, the directory maintains some subfiles within itself. These files have three-word type-0 records (thereby resembling pointers) and pseudo-access numbers smaller than 10000. They include accounting information (three words consisting of key, cumulative encumbrance, and cumulative expenditure) for each library and each regular supplier.

The directory is written in 320-word blocks, the first of which serves as an index to the rest of the directory, each word giving the first key of successive blocks in the directory.

In Process File

The In Process File is a random file of variable-length records. When a record is updated, if the new record is larger, the old slot in the file is abandoned and the updated record is placed at the end of the file. Periodically, a "garbage collection" routine repacks the file to recover abandoned space. The directory is also rewritten at the same time since new pointers must be constructed.

An IPF record is constructed as follows: Word 1 is the same as word 1 in the directory; this is a redundancy check to

make sure the directory is pointing to the right record. The next one or two words (depending on type) are a bit inventory where each bit, in fixed position, refers to a legal field of information (corresponding to one of the designators in fig. 2). Since the machine uses 36 bit words, each word of bit inventory controls up to 36 fields; if the bit is "on", the field is present, otherwise not. The next several words are "starts" (packed 3 to a word, 12 bits each) corresponding, in fixed position, to each bit in the bit inventory. Since some designators never have content (i.e. they are flags) the corresponding bits are located at the end of the bit inventory without corresponding starts. Non-zero starts (corresponding to non-flag bit inventory bits which are "on") point to a character count which is followed by that many characters of content. Fig. 3 illustrates a sample IPF record.

Print Files

As input is processed and entered on the IPF, certain output reports become available for printing at the terminal. This printable ASCII output is saved on one of two "print" files until requested by a terminal. Two files are used so that at the beginning of a new processing run, leftover output may be repacked and consolidated on the alternate file before new output is accumulated with it.

Control File

A 64 word control file stores various parameters of interest to the system, including a pointer to the next available 1-number, the next available 3-number, the next available word on the IPF, the number of entries in the directory, the name of the current print file, the beginning and end words of various types of printable output available on the current print file, etc.

Save Files

As processing of input takes place, the IPF and directory get updated. Adequate information is saved during the update process to allow reconstruction of the original IPF and directory in the case of abnormal termination of processing. In many cases jobs are re-run automatically without the user being aware that difficulty was encountered.

Master File

Periodically, newly cataloged records, cataloging changes, and holdings changes are handed off to the Master File which at present normally resides on tape.

Since the Master File records are of variable length and written sequentially, they are written as two logical records. The first, of two words, gives key, date of creation, date of latest update, and number of words in the

second logical record. The second gives bit inventory, starts, holdings, and content similar (except for holdings) to the IPF record in fig. 3. The three words of holdings in each record allow for 27 libraries packed, in fixed position, at four bits per library. Unlike the IPF, there is only one type of Master File record, namely completed cataloged records. Since copy information does not go into the file, only the cataloging subset of the designators in fig. 2 are relevant.

For many reports, including formation of sorted files for the printed book catalog, it is desirable to access the master file randomly. This is done by loading the file onto disk in 1280-word segments and at the same time creating a file of pointers locating the start of each entry within a segment and pairing it with all desired keys. These keys, e.g. call number, title, etc.) may then be sorted (with the pointer as a passive element) and records retrieved from the disk master file in sorted key order.

COMPUTER ENVIRONMENT

BELLTIP programs are resident with the Honeywell 6000 computer at Bell Labs' Murray Hill, N.J. location and accessed through its Time-Sharing System (TSS). BELLTIP users are thus part of a large community of TSS users and a small community of BELLTIP users. As part of the larger community

they benefit from a reliable, easy-to-use time-sharing environment (on a general-purpose computer) and a number of system utilities including a powerful text editor. This allows for easy data entry and correction with string or line replacement, deletion or insertion in the edit mode. All terminals and all system printers operate normally in upper/lower case using the full ASCII character set. COM and photocomposed output are also available if desired.

At present BELLTIP uses three Terminet (G.E.) 300 terminals at 30 cps for data input/output. These terminals provide relatively quiet, high-quality impact printing and are capable of handling sprocket-fed multipart forms. In addition, any ASCII terminal at any Bell Labs Library Network location can access the time-sharing system to query BELLTIP files, and several terminal models are used. While all data at the Technical Processes unit can be entered on-line, the terminals also support a magnetic tape cartridge unit for off-line entry. A rewound cartridge may be read into the system at a relatively fast rate under machine control, thereby saving on connect time; however, connect time charges are now significantly less than they once were, so the trade-off between cartridge unit rental and connect time charges for on-line entry is about even.

PROCESSING FLOW

Overview

BELLTIP input data is destined for one of four functions: order, receipt, invoice or catalog. In general, the goal is to enter the data using general-purpose time-sharing routines and editing facilities, and then save it in a file the name of which is the same as the function to which it applies (e.g. "order"). When a file is edited and ready for processing, it is submitted to a BELLTIP routine (on-line, interactive) called ENTER which checks it for various syntactic requirements and if satisfactory puts it in a queue for processing. If ENTER finds syntax errors, the file must be corrected and resubmitted. When program PROCESS (batch) is invoked, it processes all accumulated input queued by ENTER. PROCESS may be run at any time and is generally executed about 5-10 times per day to keep the flow of work moving. (Although a "batch" program, PROCESS is executed remotely from the terminals and takes about one minute to complete.) Program PRINT (interactive) allows all accumulated output prepared by PROCESS to be printed at the terminals. A short dialogue selects the output desired, allows for form alignment, and initiates printing. A response by the operator at the conclusion of printing is required to confirm successful printing (no paper jams, etc.) and to scratch the corresponding area of the print file. Program

PRINT also prints all error or warning diagnostics prepared by PROCESS. More than a score of possible diagnostics alert the operators to "problem" situations, e.g., duplicate copy orders discovered by the system, attempting to cancel an item already cancelled, or to invoice an item not received, etc. Such diagnostics are not detectable on the basis of syntax by ENTER.

Each PROCESS run accumulates updates on a separate file for the BELLREL circulation files, and for the preparation of pocket and spine labels. Once a week this data is "handed off", and the BELLREL publication file is updated which in turn produces "maintenance" (pocket labels, punched charge cards) needed for circulation. Paper tape is punched which drives a modified IBM Selectric typewriter to automatically print spine labels on SE-LIN stock using a specially-designed labeler. Labels and circulation file updates are done at time of order for added copies, and at time of cataloging for copies of newly cataloged titles. In this way the circulation system knows about copies on order (a fact particularly important to the libraries in responding to the weekly "Titles in Demand" report from BELLREL). Further, received added copies may be sent to the libraries immediately since maintenance (labels, etc.) has been prepared in advance.

At least once a month information is handed off from the IPF to the Master File so that the monthly printed book catalog cumulative supplement may be prepared. At this time a number of other reports are prepared from the Master File.

Order Function

All fields of information to be processed by BELLTIR must begin with a one or two character field designator and end with a reverse slash. All functions except the invoice function must begin with the b designator to specify the accession number of the item involved. If a previously entered title or copy is being referenced, the b designator is followed by the six digit 1- or 3-number plus check character and (for copies) subnumber of the referenced item. Most order function activity is for the purpose of preparing order forms to be sent to a supplier. From relatively free form and sometimes abbreviated input (generally received on a Library Order Request form--fig. 4--from a library) the order assistant enters data (sample shown in fig. 5) and the system prepares orders etc. on preprinted forms as illustrated in fig. 6. The same form is used for multiple purposes, as distinguished by the variety of possible system assigned headings: "Purchase Order", "Requisition", "Claim on Open Order", "Standing Purchase Order", "Confirming Telephone Order", "Cancellation" and "Request for Invoice". "Please Rush" may be added if appropriate.

With order input, a single set of "title" characteristic designators will be followed by multiple sets of copy designators if multiple copies are being ordered. Copy characteristics which are the same for all copies need not be repeated. The I.D. numbers of any requesters may be cited and these will automatically be queued in the circulation system. Also, a variety of flags etc. may be invoked, such as to inhibit listing of the title in an announcement bulletin, prevent claiming before a certain date, etc. When copies already on order are reported as cancelled or delayed, the reason for cancellation or delay is entered and will show on the In Process List.

Invoice and Receipt Functions

The invoice function is used for normal receiving of books. Its normal use implies that both books and invoice have been received. In the exceptional case that the books precede the invoice, they may be received using the receipt function; later they must be invoiced using the invoice function. Overdue invoices are listed on a weekly list (part of the production of the IPL) and may be claimed either automatically or specifically. Whenever an item is entered as received, up to three output products result. First, a receiving report (fig. 7) gives the disposition of each item received, routing it on the basis of whether it is a new title or an added copy, whether or not it is the first copy

received, and on the basis of other information supplied, e.g., to bypass cataloging or preparations. The receiving report also has annotations, such as RUSH (if so designated at time of order or later) and PUSH (an automatic system decision that excessive time has lapsed since placement of the order). A second report is the invoice report (fig. 8), a written record of all data recorded for each invoice. Finally, a cataloger's worksheet (fig. 9) is produced for the first copy received of each new title. This worksheet shows all information already in the system on the basis of order activity, and is used by the cataloger to alter and add information for cataloging function input.

Catalog Function

The cataloger may add to, revise, or delete any of the title characteristics supplied at time of order (a, c, d, e, p, q, s, t, or u designators). The cataloger must also assign a main entry (m1--author, m2--conference, or m3--title), a call number (#), an abbreviated author-title statement for use in BELLREL and on some reports (z8), and either at least one subject (w1) or a positive indication that no subjects are being assigned (w1\). If the main entry is m1, there must be at least one author (a1); if m2 there must be a conference entry (c); and if m3 a title (t). Any added or surviving ISBN (s) field must be a legal ISBN as cited in the book, as both the q (LC card number) and s fields are

checked for correct syntax by our programs when used by the catalogers. (Sometimes the order clerk uses the s field for non-ISBN purposes in the case of orders for reports; also, books have been known to cite illegal ISBN numbers as detected by our programs.) If, on rare occasion, a cataloger wishes to intentionally omit a required field, the designator must still be included, but with null content, e.g. d\ for "date omitted". PROCESS will report diagnostics from failure to adhere to these rules. (In the case of updates to previously cataloged titles, validation is also done on the updated Master File record at time of integration into the Master File.)

At the time of original cataloging, or later, the cataloger may give additional subjects (w2-w9), added author entries (x1-x9), added conference entries (y1-y9), added titles (z1-z7), notes (n1-n8) foreign language code using MARC abbreviations (f1) media code (f9) flags (f2-f5) and other fields, some of which are described elsewhere.

Any title given (t field) will always appear as an entry in the printed book catalog (PBC), sorted alphabetically. If the title begins with digits, or if for any reason the title would not naturally sort as desired, a sort key must be given to determine its proper position in the author-title section of the PBC. If a sort key field is given, the title entry of the book will sort as if filed under the sort key, but print according to the title field.

Multi-volume sets may be defined as two or more related but bibliographically distinct volumes sharing the same call number. Since BELLTIP must be able to sequence every volume properly in the classed catalog or any report arranged by class number, volumes with the same call number are differentiated by being assigned unique sequence (*) fields in numerically ascending order. Sequence numbers are also useful in sorting entries in the author-title and subject catalogs into a preferred order. Commonly, sequence fields are initially assigned in the sequence *004, *008, *012, etc. so as to allow for additional intermediate volumes. Only books not part of a set (and hence with a unique call number) are allowed to have sequence 000 or sequence omitted. In addition to unique sequence numbers, volumes of a set should have, for identification in BELLREL and certain reports, unique z9 fields. These "variable data" fields, like the abbreviated author-title (z8) statement, are fixed length title identifiers which do not print in the public PBC where full titles are given, but are useful in line-printer produced reports where field length is a consideration. z9 fields generally give volume identification in order to distinguish among volumes which have the same (z8) author-title statement.

Volumes of a set may, of course, be cataloged individually. That is, each may appear with its own description in the PBC. However, in many cases it is preferable to combine

volumes for a single PBC entry, similar to the "open entries" of card catalogs. In this case the lowest volume of a set (or subset) must be defined as the "base" volume of the set or subset, and the others become "subordinates". Only the base volume appears in the PBC. It must contain a multi-volume note (n9) which acknowledges each of the subordinates it relates to. While subordinate entries do not individually appear in the PBC, they are important and distinct for the purposes of BELLREL and the identification of holdings for inventory and circulation purposes.

For each batch of cataloging input, PROCESS prepares proofsheets (fig. 10) giving the complete updated record as then known to the IPF.

Once an item is successfully cataloged and handed off to the Master File, fields are generally corrected or updated by entire field replacement. However, since some fields are very long and complex (in particular, the n9 field must be frequently updated), it has been made possible to alter "handed-off" fields without total replacement. There are three edit functions paralleling in concept three Time-Sharing System edit commands. These include replacement, deletion, or insertion of selected portions of a field. Each function requires an unambiguous and exact specification of an existing string to be replaced, deleted, or after which an insertion is to be made. The three commands have the following syntax:

1. string replacement: Dr^s1^s2\
2. string deletion: Dd^s1\
3. string insertion: Di^s1^s2\

Here D stands for the designator of the field to be edited, s1 stands for a string of characters in the existing field, and s2 stands for a string of characters to replace, or insert after, those defined by s1.

QUERIES AND REPORTS

All users of BELLTIP are necessarily interested in the current status of titles and copies. The order and receiving assistants are primarily interested in the active copies in the In Process File (IPF), and for this purpose the In Process List (IPL), a weekly listing of the IPF, is usually adequate. If more recent, or slightly more complete, information is required an on-line query (command "run l", l=look) displays IPF records at the terminal; the command uses the accession number as key.

Catalogers and their assistants are interested not only in current copy and recent cataloging information (IPF) but also in earlier cataloging and holdings information (Master File). A complete line-printer dump of the Master File in call number order (two columns, upper-lower case) is obtained about twice a year with cumulative updates frequently. Any more recent changes can still be displayed on-

line. Of course the public photocomposed printed book catalog also gives cataloging information, but omits certain non-printing fields and obscures some spacing and punctuation.

Everyone is interested in the current holdings of a title, and in addition to being displayed in the cataloger's master file dump just mentioned, this is given in a monthly public holdings list report. More recent changes are displayed on-line through either BELLTIP or BELLREL terminals, or in the IPL.

Finally, management is provided with a number of accounting and statistical reports through both additional on-line and batch procedures.

In Process List

In addition to the main network comprehensive IPL, BELLTIP produces a number of specialized listings, all issued weekly in the same basic format shown in fig. 11. Technical Processes gets individual cumulative listings of items overdue in various statuses, such as in cataloging, in preparations, on order, awaiting invoice, etc. They also get a non-cumulative list of all items sent to the libraries since the previous IPL. The individual libraries get unit IPL's (referencing only their books) of all items in process (cumulative), and, separately, all items cancelled and all items sent since the previous listing (both non-cumulative).

The IPL listing is largely self-explanatory, but a few comments are in order. Statuses (column "S") include R (requisition written), O (order written), F (claim written), X (cancelled), U (received and sent uncataloged), C (in cataloging), P (in preparations), S (sent) and I (awaiting invoice, but received and sent). These codes may be preceded by a code (+ or #) indicating aging relative to order date, and followed by a variety of single character codes. An asterisk after the status code implies the item has been in the current status an excessive amount of time (e.g. C* indicates more than 4 weeks in cataloging, F* more than 4 weeks on current claim, etc.) Other codes give reasons for delay (e.g. 9--not yet published) or for cancellation (e.g. 7--out of print, C--no response to claim). There are currently 15 distinctive reasons for delay or cancellation.

Dates on the IPL (O.D.--order date, S.D.--date of latest status change, and A.D.--alert date before which claim should not be made) are given in Julian form. Hence 5184 refers to day 184 of 1975.

Column "T" (order type) includes A (reorder), D (do not list in announcement bulletins), G (gift), R (rush), S (standing order), and U (not-to-be cataloged). Multiple codes may occur.

On-Line Record Displays

Fig. 12 illustrates the kind of record information which may be displayed on-line, namely, all information on a title and its copies which is in the IPF.

Holdings List

Individual library holdings of a title are always of interest for inventory and accountability purposes. The holdings list (fig. 13) gives precise holdings as known to BELLTIP and is produced in public form each month.

On-Line Accounting Queries

Information on library or vendor budgets, expenditures and encumbrances is obtained with an on-line query (command "run q", q=query). The program also provides the name, address and purchase order number(s) for each regular vendor. Some of the output reports have been formatted for use directly as cost-of-work reports. For the occasional user, the program is self-instructional, as shown in fig. 14. A password protected program is also available for the use of supervision to alter budgets and other accounting information.

Vendor Performance Analysis

Accounting information for all received copies is transferred to a cumulative Accounting History File. This file

is used to report various measures of vendor performance which has proven to be quite helpful. Fig. 15 illustrates the kind of information available in a monthly report. A somewhat abbreviated report is also available on-line.

Titles Held by Class Number Report

One example of the statistical reports available is illustrated in fig. 16, where the number of titles held at each location in each classification area is given. Broader class divisions are also displayed as summaries of this report. Another report focuses on the number of titles acquired and the number of dollars spent for each class area during the current year, and allows comparison with a selection "profile level" established for each library for each class area indicative of the depth of the collection desired. These listings help the libraries to coordinate their selection activity so that each library emphasizes certain areas of local concern which also serve the network as a whole.

Printed Book Catalog

A most important product of BELLTIP is the printed book catalog which now runs to 10 annual volumes and a monthly cumulative supplement. The catalog is divided into three sections--subject, author-title, and classed. There are about 250,000 entries in the book catalog which is photocom-

posed by an outside contractor from exploded and sorted magnetic tapes prepared by BELLTIP. The considerations in the design of this catalog were extensive and will be reported elsewhere as a separate topic (3). Also, the catalog requires the support of author-title and subject heading authority files which generate cross-references, give notes, and validate headings used. The maintenance of the authority lists has been extensively automated as recently reported elsewhere (4).

A sample page from the subject catalog is shown in fig. 17.

SUMMARY

After four years of successful service to the Bell Labs Library Network, BELLTIP continues to evolve. It has met all its objectives--providing more effective control over acquisitions and suppliers, shortening order cycles, reducing labor, keeping processing costs down, supplying much-needed management information, and using resources more effectively.

Two new developments are now underway. First, the Master File of cataloged data was originally designed as off-line because of disk storage costs. With a dramatic lowering in costs during the past few years, all or part of the Master File will go on-line allowing terminal search of the entire, or almost entire, cataloging base. This has significant im-

pact for both users and staff. Secondly, development is proceeding on a serials control system, patterned in many respects after BELLTIP, to meld with the existing computer-aided serials catalog and circulation systems.

ACKNOWLEDGEMENTS

From its inception BELLTIP has been the cooperative effort of many people in the Information Systems department, in the Technical Processes group, and in the libraries which both serve. In particular, the contributions of R. A. Kennedy, R. E. Furlong, I. C. Ross, and F. H. Spaulding have been essential to the development of the system and to the writing of this paper.

REFERENCES

1. Lowry, W. Kenneth: "Use of Computers in Information Systems," Science, 175 (4024): 841-846 (25 February 1972).

2. Kennedy, R. A.: "Bell Laboratories' Real-Time Loan System (BELLREL)," Journal of Library Automation, 1 (2): 128-146 (June 1968).

3. Kennedy, R. A. and I. C. Ross: "Bell Laboratories Book Catalog," to be published.

4. Ross, I. C.: "A Cataloger's Authority List Maintenance System," to be published.

*****CAPTIONS*****

Fig. 1--Overview of BELLTIP.

Fig. 2--Designators used in BELLTIP. Functions are: o, order; i, invoice; c, cataloging; e, editing input (all functions).

Fig. 3--IPF record structure. Data is stored at four characters per 36 bit computer word. In this example the record begins with eight fixed words of packed information followed by a variable number of words of data. The example assumes up to 18 distinct fields may have content, and that three--namely positions 3, 4 and 6 in the inventory--actually do. The corresponding starts point to a field length character count followed by the data.

Fig. 4--Library Order Request. This form is submitted by a library for each new order and used as source document for input at the terminal. Request shown is for a copy of title listed on the In Process List (Fig. 11).

Fig. 5--Sample Order Function Input. Using Honeywell 6000 timesharing, data is put into a permanent file. Error correction using the text editor is also shown.

Fig. 6--Orders, Claims, etc. These are printed on a common continuous form at an interactive terminal in supplier order.

Fig. 7--Receiving Report. Report specifies action on each item received. RUSH means RUSH order, PUSH identifies item excessively delayed.

Fig. 8--Invoice Report. A written record of data recorded for each invoice.

Fig. 9--Cataloger's Worksheet. Each copy received and "sent to cataloging" (fig. 7) gets a worksheet showing order information which a cataloger updates. Only altered or added information need be input as a cataloging function.

Fig. 10--Cataloger's Proofsheet. Produced after cataloging is input. Reissued each time cataloger makes a change.

Fig. 11--In Process List. Weekly report of all items in process for Network. Each library also

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receives certain subsets individualized for its own unit.

Fig. 12--On-line Display of Specified Record. "Run 1" (=look) gives current disk record of title and copies in process.

Fig. 13--Holdings List.

Fig. 14--On-line Accounting Report. "Run q" (=query) gives current accounting for one or more libraries or suppliers.

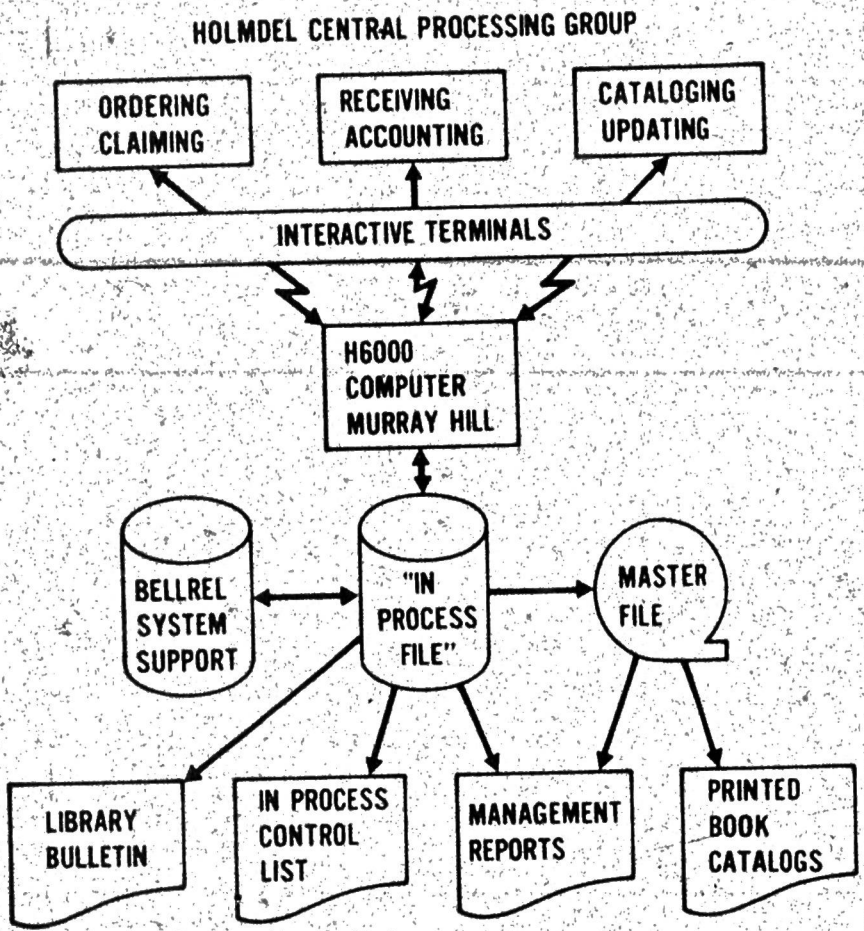
Fig. 15--Vendor Performance Analysis.

Fig. 16--Titles Held. Summarizes number of titles held by each library by Dewey classification.

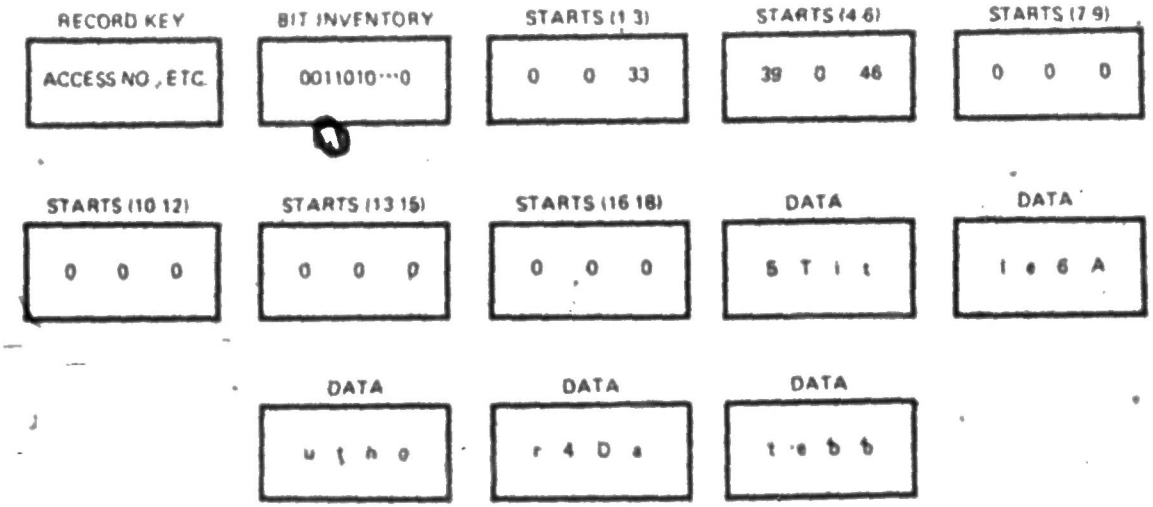
Fig. 17--Subject Catalog Page.

1

BELLTIP SYSTEM



Designator	Description	Function
a1,a2,a3	Authors	o,c
b	BILLTIP accession number	o,i,c
c	Conference title	o,c
d	Date published	o,c
e	Edition	o,c
f0	Flag for exceptional inclusion in catalog supplement	c
f1	Language code	c
f2	Bibliography flag	c
f3	Review flag	c
f4	Serial flag	c
f5	Flag for exceptional exclusion from announcement bulletin	o,c
f7	Purge title flag	c
f8	Not to be cataloged flag	o
f9	Non-print media code	c
g	Gift flag	o
h	Holdings (exceptional correction)	c
i	Invoice number	i
j	Invoice date	i
k	Shipping charge	i
l	Holding library and copy number	o
m1,m2,m3	Main entry (auth, conf, title) flag	c
n1-n8	Notes	c
n9	Multiple volume note	c
p	Publisher	o,c
q	LC card number	o,c
r	Requester	o
r	Received flag	i
s	Standard book number	o,c
t	Title	o,c
u	Volume	o,c
v0	Vendor number	o
v1-v4	Vendor name and address (non-regular)	o
v8	Prepaid flag	o
v9	Purchase order number (non-regular vendor)	o
w1-w8	Subject entries	c
x1-x9	Author added entries	c
y1-y9	Conference added entries	c
z1-z7	Title added entries	c
z8	Abbreviated author-title statement	c
z9	Abbreviated volume statement	c
*0	Abort item flag	o
*1	Alert date	o
*2	Claim flag	o
*7	Cancel flag	o
*4	Cancel and reorder flag	o
*5	Rush flag	o
*6	Confirming telephone order flag	o
*7	Request for invoice flag	o
*8	Out of stock flag	o
*9	Not yet published flag	o
@	Call number	o
#	Estimated price	o
$	Final price	i
%	Percentage discount	i
+	Sequence control	c
>	Standing order flag	o
&	Copy addition or deletion (exceptional)	c
~	Base volume for subordinate	c
[	Sort control field	c
<	Delete fields	o,c
=	Equivalence accession numbers	o,c
*	Copy data from another record	o,c
\	Field terminator	*
]	Delete current input field	*
^	Replace field	*
!	Delete all previous fields this record	*
@	Delete preceding character	*
*	Master file editing signal	*


RECORD KEY
ACCESS NO , ETC.
BIT INVENTORY
0011010···0
STARTS (1 3)
0 0 33
STARTS (4 6)
39 0 46
STARTS (7 9)
0 0 0
STARTS (10 12)
0 0 0
STARTS (13 15)
0 0 0
STARTS (16 18)
0 0 0
DATA
DATA
DATA
DATA
DATA

LIBRARY ORDER REQUEST

B-NO : 339/62 E

REQUEST DATE : 3/12/75

CALL NO:

APPROVAL: .DEC

TITLE : Intro. to operational amplifier theory and applications

ED :

VOL(S) :

AUTH : #1

#2

YEAR : 75

#3

LC :

PUB :

ISBN :

ADDRESS:

LIB/COP (S) : HO 01

COST : $ 15.00

REQUESTED BY, NAME :

PAN :

LOC : X

SOURCE : IPL ☒ CAT ☐ OTHER:

SPECIAL HANDLING:

NOT IN LIBRARY BULLETIN (/3) ☐

COMMENTS :

RUSH (*5) ☐

UNCATALOGED (/8) ☐

ALERT DATE (*1)________________

GIFT (g) ☐

COPY OF TITLE PAGE ATTACHED
SEND MAINTENANCE AND SPINE LABEL ☐

8-811 (3-72)

```
SYSTEM? edit new
ready
*b343996J1\*2\
*b337741K2\*2\
*b344106D1\*3P\
*b344156H1\*b75345\
*b3475904J\*2\
*b156660w\$15.00\v#16\1HH01\
*b159039S\$19.50\v#16\1HO01,WH01\
*b156974I\$15.00\v#16\1WH01\*5\
*b156634w\$17.00\v#4\1HH01\*5\r682d0\
*b244170I\$6.25\v#6\1CB01,02\
*b3\tAdhesive bonding\a1Shields, J.\pOxford U.P.\
*d1974\$3.25\v#16\1HH01\r68413\*5\I6\
*b3\tTheory of defects in solids\a1Stoneham, A.M.\
*pOxford U.P.\d1975\s0-19-851331-3\$79.50\v#16\1HH01,02\
*b3\tHandbook of moisture determination and control\
*a1Pande, A., ed.\pDekker\d1974\uv.1\$26.50\
*v#16\1HH01\
*b3\tEnergy conservation papers\a1Williams, R., ed.\pBallinger\
*d1975\s0-88410-335-0\$17.50\v#5\1HH01\
*b3\tAdvances in chromatography\a1Giddings, J.C.\a2Gruska, E.\
*a3Keller, R.A.\pDekker\d1975\uv.12\s0-8247-6206-1\
*$22.74\v#5\1HH01\
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ITEMS ON ORDER ARE CLAIMED OR CANCELLED

ADDITIONAL COPIES ORDERED OF TITLES ALREADY IN FILE

NEW TITLES ORDERED

TIME-SHARING EDITOR USED TO CORRECT DATA INPUT

FILE SAVED AS ORDER FUNCTION INPUT

PURCHASE ORDER
PLEASE RUSH

SUPPLIER COPY

TITLE
Applications to GPSS V to discrete system simulation

ORDER DATE
04/22/75

PURCHASE ORDER NUMBER
589530

AUTHOR
Gordon, G.

EDITION | VOLUME | YEAR 1975 | PUBLISHER Prentice

CONTROL NUMBER
342594K1

COPY NUMBER
H001

COPIES 01 | EST COST $15.95 | SBN 0-13-039057-7

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Prentice-hall, Inc.
C/O bob Kapke
N.D. #2 box 23bA
Milford, N.J. 08848

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PURCHASE ORDER

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TITLE
Lineman's and cableman's handbook

ORDER DATE
04/22/75

PURCHASE ORDER NUMBER
588063

AUTHOR
Kurtz, E.b.

EDITION 5th | VOLUME | YEAR 1974 | PUBLISHER McGraw

CONTROL NUMBER
338332C8

COPY NUMBER
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COPIES 01 | EST COST $20.00 | SBN

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Newark book Center
162 washington Street
Newark, New Jersey 07102

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CLAIM on open order
please supply report within 2 weeks

SUPPLIER COPY

TITLE
American Math Soc translations vol. 15, series 2

ORDER DATE
06/23/75

PURCHASE ORDER NUMBER
589540

CLAIM DATE: 08/22/75

AUTHOR

EDITION | VOLUME V.15 | YEAR 1960 | PUBLISHER Amer Math Soc-Providence, R.I.

CONTROL NUMBER
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COPY NUMBER
AM01

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