Decimalisation without tears

By I. R. ELLIOTT

An approach based on a simple idea will help Centre-File to avoid reprogramming, printing and file conversion problems with the change to decimal currency in 1971

CENTRE-File Limited investigated the possibility of a shared on-line computer service for medium-sized building societies in 1967. At the end of 1967 the company's new owner, the National Westminster Bank Group, inherited a comprehensive survey of the marketing and technical aspects of the project, and quickly gave the go-ahead to set up this service. The service was introduced in 1969 according to plan and in January that year the first societies began sending paper tape each week, to Centre-File, to enable skeleton accounts to be established. On July 1st, 1969 they went on-line. By the end of 1969 ten societies, using IBM 3940 terminals linked through private GPO lines to an IBM 360/40 at Centre-File's London headquarters, were making use of the service.

The purpose of the service is to maintain the accounts of building society investors and borrowers, and handle all the associated functions such as the production of statements and the control of arrears. During office hours the societies use their terminals for enquiries and entering new data. The accounts, which totalled 400,000 at the end of 1969, are held on an IBM 2314 disc store which provides direct access facilities. Outside office hours various reports and print outs are produced by Centre-File and these are delivered overnight to the building societies.

The knowledge that decimalisation was due in 1971 had an important influence on the design of the system from the outset. Indeed it influenced everything from the choice of terminal to the layout of input, output and file formats. Many computer installations will be faced with the problem of converting applications which were designed before the announcement of decimalisation. And it is surprising how few of those in the more fortunate position (of appreciating this problem from the start) have taken advantage of it. The problems are generally underestimated, and it is even worth permanently compromising, within reason, on the efficiency of a system, in order to make life easier around D-Day.

Most installations with a conversion problem, including our own, will be in a maintenance state by then. That is to say many personnel who were engaged in the original project—the design and programming—will have likely moved on. For this reason alone, anything which makes conversion inherently easier is well worth considering.

It will be seen that the approach adopted by Centre-File is based on a very simple idea, namely the division of the pound into 1,200 units. This is allied to a flexible method of controlling the conversion since, in view of the unknown factors in 1967, it was important to leave as many options as possible. The system can, for example, be run in a mixture of £sd and decimal during a transitional period, if required. There is nothing peculiar to building societies and the system could be used equally well for other applications.

It is the pound which remains constant throughout, so to preserve the validity of programs it was decided to divide the pound into 1,200 units (u) which can be used to express £sd or decimal amounts exactly. Thus,

£1	=	1,200u	=	240d	=	100p
	i.e.	1d	=	5u (an old penny)		
		1p	=	12u (a new penny)		

All amounts stored on file or used for internal computer arithmetic are recorded in these units. Only actual £sd or decimal is used externally and the users are not aware of the units of calculation. The number used internally to represent an amount is five times the number of old pence or 12 times the number of new pence.

The universal nature of these units has innumerable benefits. Identical amounts of money, for example £5 17s 0d (£sd) and 5.85 (decimal), are stored identically. A mixture of £sd and decimal can be handled. An adjustment measured exactly in these units can be used to round balances to decimal near D-Day. Most important of all is the advantage of technical continuity for such a large project. File specifications and programming conventions do not change. All those extra utility programs that grow around any large application do not suddenly become useless.

It is true that amounts stored in 1,200ths are larger numbers and can, therefore, occupy more space than

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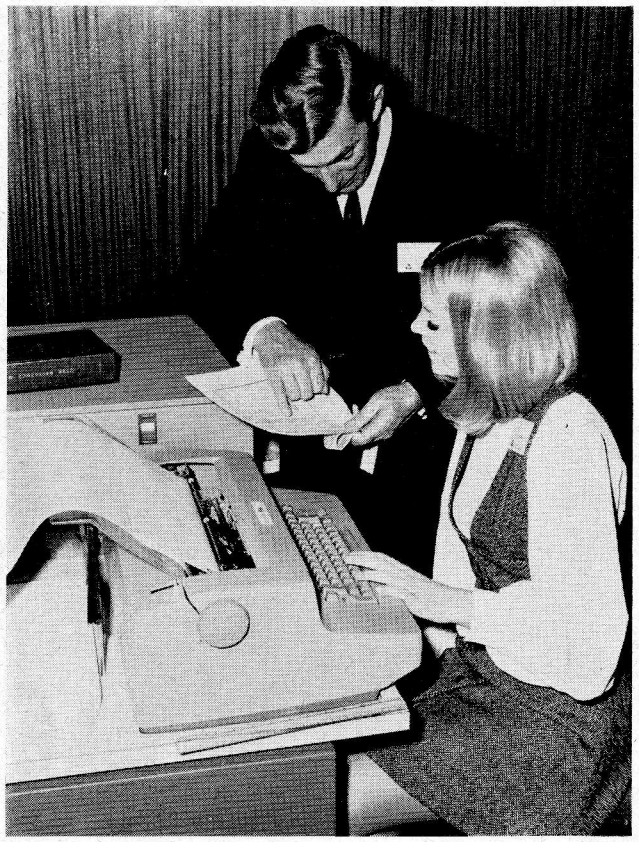
the straightforward old or new pence. On file, we use variable length binary which saves so much space that a little wastage can be tolerated. Even this apparent disadvantage of wasted space can be turned into an advantage because not every number of units is a valid amount. For example 11u cannot be expressed as either £sd or decimal. If such amounts appear on file or in programs something may have gone wrong, but at least it can be detected. Any person who is responsible for a large business computer file is prone to the nightmare of a corrupted file and there are many techniques, such as control totals, for ensuring the integrity of data. The use of 1,200ths for money is an additional safeguard because only four numbers in every 15 represent valid amounts; the remainder can be errors. We do not explicitly check the use of units at every stage of the program, but erroneous amounts have a peculiar output format which makes them stand out. This check on the end result of a program was very useful during testing.

The use of 1,200ths also happens to be valid for applications using the ½p, though it will not be needed for building society accounting. Any application needing the ½d could use 2,400ths. Furthermore, the use of these small subdivisions of the pound enhances the accuracy of internal calculations. For example, when calculating interest, though the final result may be rounded to the nearest 1d or 1p, it is desirable to use greater accuracy in intermediate steps. The use of 1,200ths provides greater accuracy in such a case.

All input data from a society are from its terminal, either directly entered, or punched off-line on paper tape and transmitted by means of the terminal's reader. The on-line typewriter is a modified IBM 735 golfball machine with a fairly conventional keyboard. A similar machine is used for off-line punching in the same format. The tabulate or "tab" character is used as a field separator. For example, a batch of ledger transactions can be entered one on each line, a tab character being used to separate transaction type, account number and amount, within a line. The effect of a "tab", apart from punching or transmitting a code, is to slide the golfball across to a set of predetermined positions. These positions are set 13 characters apart to give hard copy a neat columnar layout. The computer is also programmed to optimise terminal output speeds by taking advantage of these positions.

Input data are entered via an IBM 3940 terminal



An amount can be entered in up to 12 characters within its appropriate field, in a relatively free format, viz:

A field containing only a whole number e.g. 17 represents that number of pounds.

A field containing two full stops e.g. 17.3.9 represents £sd.

A field containing one full stop e.g. 17.53 represents decimal.

Such monetary fields also have to pass the usual tests. For instance less than 12d on the end of £sd and exactly two digits of new pence if decimal is used. Thus the meaning of these formats never changes so the recognition and conversion of amounts into internal form can be programmed once and for all. It might be thought tiresome that three shillings and eleven pence has to be entered as 0.3.11. In practice, however, amounts less than one pound are not very common, and in any case inefficiencies of this type do not occur once the change to decimal input is complete.

Although an input routine can recognise both types of currency, it refers to two logical switches, which are set up when the on-line system is in operation, to ascertain if the format is acceptable on that day. The first switch turns the acceptance of £sd on or off, the second turns decimal on or off. Note that the whole pounds format is always valid; if £sd is "off" then amounts including two full stops are rejected; if decimal is "off" amounts with one full stop are rejected. Note also that both switches can be "on" to allow all input formats to be used. It is our intention to allow only £sd input until the end of 1970, then to switch decimal "on". Finally, after a transitional period, we shall switch £sd "off" for good.

The output of amounts occurs both on the terminal, for error reports, and in response to enquiries, and on reports and pre-printed stationery at the computer centre, on cheques of interest remittance, for example. The question is how to print an amount when it can be expressed in either format. For example, 1,260 units could be printed as 1.1.0 or 1.05. On the other hand, 1,250 units can only be 1.0.10, and 1,248 units can only be 1.04. Therefore, output routines refer to a logical switch which specifies the "preferred" way of output, £sd or decimal. If an amount turns up which cannot be expressed exactly in either way, the closest approximation using minus signs instead of full stops in the preferred format is used. For example, 1,223 units comes out as 1–0–5 in £sd or 1–02 in decimal, whichever is the preferred way at that time. This is the

way in which erroneous amounts stand out as mentioned previously, although such formats have a limited period of validity while unrestricted input is allowed, such as the balance of an account with mixed £sd and decimal.

The output of whole pounds varies with the context. There would be no full stops in the highly optimised terminal output, but on a cheque or statement (run off centrally every six or 12 months for each account) 10.0.0 or 10.00 would be printed depending on the preferred way. Any amount printed on a cheque is also accompanied by the number of pounds in words.

It can be seen that input and output for the whole system is controlled by three switches, two for input and one for output, represented by three core store bits. No reprogramming is required to adjust the system in 1971. The preferred output switch is turned to "decimal" on D-Day.

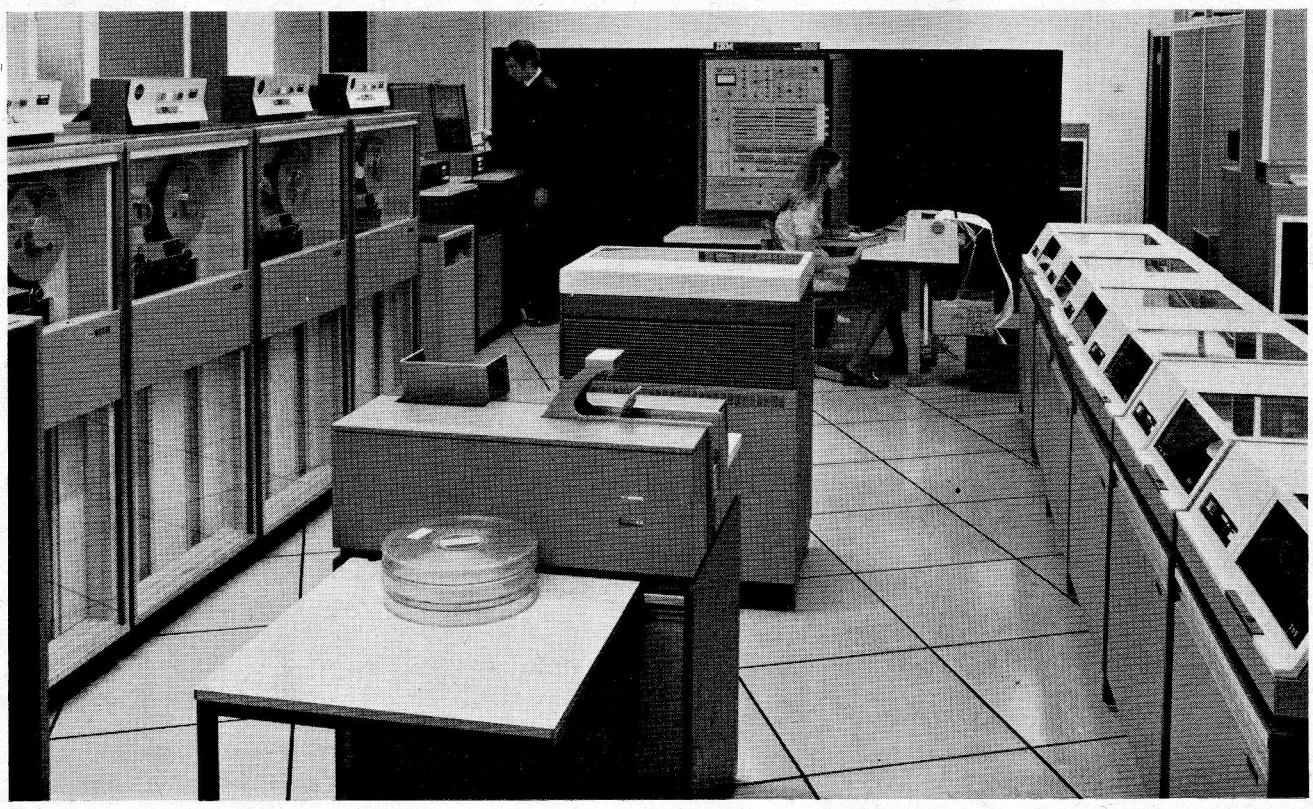
The power of the output system was amusingly illustrated recently when a user wanted a preview of a new enquiry facility known to contain a program "bug". Supplying ten dubious amounts to the output routine led to two being printed in pure £sd, seven with minus signs and one in decimal, rather ahead of its time!

Many installations have fixed format data preparation equipment, often a by-product of accounting machinery, which does not lend itself to our dual currency approach. In the building society system there were other arguments for the selection of free format equipment, such as the need for preparing name and address data on the same machines. At least our users have no equipment conversion problem. Some other means of preparing ledger transactions do offer the advantage of simultaneously calculating control totals, but in our system these are calculated by cashiers in reconciling their tills, and are then entered on their punching documents. A total is then entered at the end of each batch of transactions and checked by the computer. Also we have suggested to our users that they enter amounts in the minimum number of characters, so that pounds, shillings and pence (or new pence) do not align under each other, though spaces can be introduced, if desired. This does not really matter because people rarely add the amount, on hard copy; if the total disagrees it is quicker to use an adding machine to trace the discrepancy, and this is just as easy from free format fields. In any case, such errors may result from the punching document itself (which is columnar within amount fields), or from the fact that an amount has been entered incorrectly.

The system has been designed so that with decimal input switched "on" and £sd "off" all future transactions will be in decimal, but there has to be method of making balances exactly decimal in order finally to eliminate £sd. This is achieved not by actual conversion but by generating adjustment transactions where needed. Each account on file is made up of a brought forward balance, a number of transactions, and a current balance. The latter is strictly speaking redundant, since it is calculated from the other items, but it is maintained on file as a self-checking device and is updated as transactions are recorded.

If the number of units (1,200ths of a pound) representing the balance is divisible by twelve, no conversion is needed because it can be expressed exactly in decimal.

Centre-File's shared on-line computer service for medium-sized building societies is based on an IBM System/360 Model 40 computer



Otherwise if the balance is divisible by five it can be expressed in £sd, and must be converted. This is performed by reference to the "Banking and Accounting Table" recommended by the Decimal Currency Board and accepted by the Government for such transactions. It is sometimes known as the "Whole New Penny" table, as distinct from the "Shoppers Table," which uses new half-pennies.

The Table gives, in intervals of 1d up to 2s 0d, the whole new penny approximation to be used in conversion. Over a large number of transactions the adjustments up and down are intended to more or less cancel out. This is why the table goes up to 2s 0d to balance the rounding up of 6d to 3p by the rounding down of 1s 6d to 7p. The conversion is applied to the remainder of an amount after division by 2s 0d.

For example 1.13.5 = 1.12.0 plus 0.1.5. The 1.12.0 is 1.60 and the 1/5 becomes 7p according to the Table, so the new balance should be 1.67. In other words, an account with balance 1.13.5 must be adjusted by

0.07 minus 0.1.5.

= 84u minus 85u = −1u.

Thus, if the account is in credit, it must be debited by one unit (1,200th of a pound). A single program has been written to go through the file generating "mini" transactions where necessary, to make all balances decimal in this way. Those strange balances, if any, which have resulted from mixed £sd and decimal input are brought into line at the same time. Ideally, decimal input before D-Day should be limited to whole shillings.

This process is not exactly file conversion, due to the fact that items are added to the file as mini transactions, and this is the only special program to run by D-day. This program could be run again later if users do not want £sd input excluded immediately. Our present plan is to keep the service open during part of the public close down period for the input of final £sd returns, then switch £sd "off" and convert balances as described. Nevertheless if users wish to do some more tidying up of £sd after D-Day it can be left "on", and those few balances which become corrupted can be corrected by a later run of the special program. The extra mini transactions would not take much more file space, as most balances would already be in decimal format.

As in most accounting applications we have a "contra" system for cancelling erroneous transactions, not by eliminating them but by generating equal and opposite transactions so that a record of the cancellations is on file for audit purposes. Obviously there is a problem if £sd input is forbidden in matching an earlier amount of say 1.2.11 in order to contra it after D-Day. Users have been warned of this, but it is nice to know we can turn £sd on again if they insist!

When individual balances are decimalised in the way described, control accounts are also adjusted and the totals of credit and debit units are produced for each range of accounts, so that differences due to conversion can be written off.

Every weekend a job is run for building societies which examines all the files, generating various management reports, and checks the consistency of these files. During the weekend before D-Day (Monday, February 15th, 1971) this job will be run both before and after balance conversion as a check. Since one option of the job is to produce complete lists of individual balances, the societies may no doubt find it useful to have these as a by-product, all in decimal.

There are some other amounts on file which do not form part of the ledger account but are needed to operate it. For example, a borrower's account is to be automatically debited by a certain amount each year in payment of an insurance premium. In such a case the amount will not be converted at D-Day, it is simply checked at any future time if a debit has to be made. An insurance instruction to debit 1.13.5 annually would in fact effect a debit of 1.67 after D-Day, by reference to the Table. Most instructions of this type are in whole shillings anyway. The fact that units remain meaningful on file even if not converted enables compromises of this nature to be made, thus minimising pre-D-Day work. After all, machine time will be at a premium and the whole operation must work and be checked within such a short time, so the simpler the better, especially if this is achieved without turning the files upside down. If any user wishes to tidy up such amounts later, as with insurance instructions, they will appear as £sd in reports which can be requested of such items. However, for accounting purposes the conversion is complete because only decimal amounts are generated for the ledgers.

Transactions on file

Under the building society system ledger transactions have to remain on file for six to 12 months. In response to a ledger enquiry we shall try to print all transactions in decimal but those effected before D-Day which can not be converted exactly will still appear as £sd. This is logical because the conversion applies only to balances and the rounding of individual transactions might not add up in a way consistent with a balance conversion. It is indeed one of the merits of the system that historical information can still be meaningfully handled due to the continuity of file formats and the output method. The amount in an adjustment transaction made before D-Day would be printed 0–00 (not quite 0.00).

Existing pre-printed stationery will continue to be used because decimal amounts can be accommodated in the space allocated for £sd. Societies usually send their borrowers a full statement once each year, and those for the year including D-Day, could contain odd £sd and 0-00 transations. This can be explained in a covering note. It may be a little untidy but at least the statements are precise. With other accounting applications it is no doubt being planned to clear ledgers down to a converted balance at D-Day because it will be impossible to continue with dual currency on file. Unless installations can spread the work this approach could be dangerous. It is problems such as simultaneous high-volume reprogramming, printing, and file conversion operations which, because of our approach, we intend to avoid.

The job market in business data processing will be highly volatile in 1970, particularly as people flee from installations while others desperately recruit staff in the hope of salvaging their systems as D-Day approaches. In the process of interviewing potential systems analysts from various installations I have encountered an astonishing naïveté and procrastination with regard to the problems of conversion. But perhaps I am exaggerating other people's problems.