

---

# Upgrading the Central Gilts Office

By Christopher P Mann of the Bank's Market Services Division and Controller of the CGO Project.

*The Central Gilts Office system, first introduced in 1986, was designed and built to meet basic market demands: the provision of settlement for gilt-edged securities through an efficient and secure system of electronic book-entry delivery of stock in real time against an assured payment. By 1994, it had become apparent that the system needed to be upgraded to reflect continuing improvements in information technology (especially in data security) and developments in market practices, as well as structural reforms in the gilt market and payments systems and the possibility of UK membership of European Monetary Union. This article explains the background to the decision taken in 1995 to upgrade the system, describes the process involved and sets out some of the features and changes introduced by the upgraded system.*

## Consultation

In August 1995, the Bank issued a consultative paper on the need for an upgrade of the Central Gilts Office (CGO) system and the options for achieving it.<sup>(1)</sup> There were a number of reasons for upgrading the system:

- the current software, though efficient, cost-effective and providing fault-free performance, could no longer easily be adapted for the new developments in prospect;
- Euroclear and Cedel, the international Central Securities Depositories, were preparing to become members of CGO. More sophisticated links between these systems and CGO could only be developed from an upgraded platform;
- trading in gilt repo<sup>(2)</sup> was planned to start in January 1996. Work during 1995 by the Gilt Repo Settlement Working Party had revealed the need for facilities specifically for repo settlement, which the existing CGO would find it difficult to provide;
- a market in gilt strips, and the ability to strip and reconstitute gilts<sup>(3)</sup> as an essential ingredient of such a market, could not be handled by the existing system;
- the existing system could not easily be upgraded to defend against increasingly sophisticated security attacks;

- the values settled each day in CGO, and the exposures incurred by settlement banks in the system to the CGO members on whose behalf they made payments, had grown considerably and were expected to grow further with the start of gilt repo. The need to be able to measure and control such exposures had grown commensurately; and
- similarly, the exposures settlement banks incurred to each other had grown with the system. The elimination of such risks via a link between CGO and the planned real-time gross settlement (RTGS) system<sup>(4)</sup> could only proceed on the basis of upgraded CGO software.

The options for upgrading the system were to amend the existing software or to adapt another platform. The two platforms considered were the European Securities Office (ESO) system, introduced by the Bank in September 1993 for settlement of Ecu-denominated bonds; and CREST, the platform then under development for the settlement of equity trades. Although ESO provided a sound platform, it had significant gaps—notably the fact that it was not built to handle registered securities and so had no link to a register; nor did it have the ability to handle deliveries by value (DBVs)<sup>(5)</sup> or strips. The CREST software, in contrast, built on the successful CGO, CMO and ESO systems and was an obvious platform for upgrading the CGO. A feasibility study by the Bank early in 1995 had shown that, as

---

(1) A description of the original CGO can be found in 'Gilt-edged settlement: Phase 2 of the CGO Service', in the *Quarterly Bulletin*, February 1987, pages 80–2.

(2) Repo is short for 'sale and repurchase agreement'. A gilt repo is a transaction where two parties agree that one will sell gilt-edged securities to the other and (at the same time and as part of the same transaction) commit to repurchase equivalent securities on a specified future date, or at call, at a specified price, under a formal legal agreement. The difference between the price at which the securities are bought and sold is expressed as an interest rate, the 'repo rate'. Where the stock to be received is not specified, the repo is known as 'general collateral' or GC repo. (In gilt repo, it is possible to provide general collateral by using the delivery-by-value (DBV) mechanism of CGO; it is then known as a DBV repo.) Where a particular stock is specified, the repo is known as a 'special' repo. Further details can be found in the Bank of England's *Annual Review of Gilts and the Gilt Market for 1996/97*, available from Public Enquiries on 0171-601 4012.

(3) Stripping is the process of separating a standard coupon-bearing bond into its individual coupon and principal payments, which can then be separately held and traded in their own right as (zero-coupon) bonds. Reconstitution is the reverse. Anyone who holds gilts in CGO, whether directly or through a nominee, is eligible to hold strips in CGO. The facility to strip and reconstitute gilts is available to the market through the gilt-edged market makers (GEMMs), who can use the facility specially added to the upgraded CGO. Further details can be found in the Bank of England's *Annual Review of Gilts and the Gilt Market for 1996/97*, available from Public Enquiries on 0171-601 4012.

(4) The RTGS system, which consists of accounts held by settlement banks in the books of the Bank of England that can be updated continuously, is described in the article 'The development of a UK real-time gross settlement system' in the *Quarterly Bulletin*, May 1994, pages 163–8.

(5) Stock to a specified aggregate value (as determined by system reference prices) can be selected and assembled automatically by the system and delivered on an overnight basis, the stock being automatically returned the following morning. This is known as a delivery by value. Deliveries by value are used primarily to provide collateral and, more recently, to settle repos.

designed, there was a large overlap between the facilities to be offered by CREST and the needs of the upgraded CGO. Key features were:

- forward-dated input, of particular value for the input of gilt repo;
- specific capability to handle stock loans;
- the ability to transfer stock free of payment and to make payments such as interest and redemptions without a movement of stock;
- a debit cap mechanism to control settlement banks' intra-day exposures to their clients;
- matching of inputs by each party to a trade;
- transaction reporting to regulatory authorities,<sup>(1)</sup> enabling a single input to fulfil several functions;
- a flexible account structure, allowing account designations and the sponsoring of members;
- enhanced file transfer capability to very high security standards; and
- a shorter registration cycle.

During the consultation period, it became apparent that a further option warranted consideration. This was the merger of settlement of gilts and equities to provide a single UK settlement system for gilts and equities. The Bank's advice was that this would be an extremely ambitious undertaking. Experience in delivering UK settlement systems led the Bank to believe that there were clear benefits in continuing, as in the past, deliberately to focus on building carefully specified systems. This was especially important given the range of major infrastructural projects in payment and settlement systems in which the London market was involved.

Following the consultation, the Bank announced, on 24 November 1995, that CGO was to be upgraded using the CREST software, a copy of which CRESTCo (the company that developed and runs CREST) had agreed earlier in 1995 to provide to the Bank as the basis for upgrading gilts settlement. But given the clear benefits that members saw in a single UK settlement system, the Bank also announced that CGO and CRESTCo would work to ensure that the option of merging the two settlement systems in due course was kept open. A committee, comprising members of both the CGO project team and the CRESTCo development team, was set up to ensure that CGO and CRESTCo were kept fully informed of the development of each other's services and, where possible, to minimise software differences and

duplication of effort. A joint Bank-CRESTCo working party concluded in November 1996 that full merger of the two systems was technically feasible. In July 1997, the Treasury announced that the Bank would consult market participants on priorities for IT development, taking into account the costs and benefits of a CGO/CRESTCo merger. This process is due to be completed by summer 1998. The Treasury is discussing with the Bank, CRESTCo and the Financial Services Authority (FSA) the regulatory and governance implications of merger, including possible legislative requirements.

One consequence of the decision to upgrade CGO using CREST software was the need to agree arrangements with CRESTCo for the shared use of the networks provided by the CREST network providers, SWIFT and BT Syntegra. In upgrading the system, it was decided that the legal and contractual foundations of the existing CGO would remain essentially unchanged except where necessary (eg to accommodate the introduction of debit caps or the sharing of networks), as would the Bank's role as operator of the system. The box on page 72 summarises the legal structure of the upgraded system.

### Specific gilt market requirements

The first task was to distinguish the specific requirements of the gilt market from those of the equities market, so that changes to the CREST software could be made. To this end, the CGO Upgrade Group was established. The Group's role was to assist the Bank in agreeing the scope of the changes, and to provide an effective means of exchanging and synthesising views on issues of concern to the gilt market. It also acted as a channel of communication specifically for the project, alongside the existing standing committees of the CGO, the Operational Subcommittee and the User Liaison Group, from which a number of members of the CGO Upgrade Group were drawn.

The Group met seven times between March 1996 and May 1997. By May 1996, agreement had been reached on the few areas of the CREST software where changes were considered necessary to meet the specific needs of the gilt market. These were:

- stock delivered by means of the DBV mechanism should continue not to be registered except (as previously in CGO) where it could not be returned. (The CREST software provides for the registration of DBVs.) Among other things, registration of gilt DBVs generates risks for the deliverer of a gilt, if a dividend is paid to the taker while the stock is registered in the taker's name. The Bank received legal advice that the arrangements that had been used since the inception of the CGO in 1986 were robust and that there was no need to change them;

(1) Members of the London Stock Exchange are required to provide full details of all trades conducted on the Exchange on the day that the trade is executed. If both parties to the trade are reporting to the same reporting system, transaction reports have to be matched by the two parties to the trade. These complement trade reports, which are one-sided reports that members have to provide, via the Exchange's Sequence system, within three minutes of the trade being transacted. Transaction reports are also required by the Financial Services Authority from all firms subject to regulation. Prior to the inauguration of CGO, transaction reports were provided via separate input to the Stock Exchange's Checking system. In May 1996, the London Stock Exchange and the Securities and Futures Authority agreed to take transaction reporting data from the upgraded CGO. Transaction reporting via a settlement reporting system reduces the number of inputs required by member firms.

## The contractual arrangements relating to CGO

Though a number of pieces of legislation, principally the Stock Transfer Act 1982, relate to the transfer of stock in CGO, the operation of the system rests on contracts signed between participants, rather than statute. This box explains the principal contracts.

The relationship between the Bank and the CGO members (for these purposes including sponsors) is governed by the CGO Rules. The Rules consist of the *Reference Manual*, and the *Membership Agreement* that all members sign with the Bank. The former describes in some detail how the Bank will operate the system. The latter sets out the rights and obligations of the Bank and the member, and provides the contractual basis for the transfer of equitable title within the system.

Settlement banks are also subject to the CGO Rules, and each signs a bilateral agreement, similar to the *Membership Agreement*, with the Bank. In addition, all settlement banks enter into a multilateral *Assured Payment Agreement* with one another, governing the creation and settlement of assured payments within the system.

CGO also shares certain facilities with CRESTCo: the communication networks provided by SWIFT and BT Syntegra; the certificated gilt delivery service operated by TNT; and two computer sites. It is important that CRESTCo can demonstrate to its regulator, the FSA, that CGO's use of these facilities will not compromise the CREST system. To enable it to do so, the Bank has signed an agreement with CRESTCo governing the use of these facilities by CGO, and all CGO members are likewise required to sign an agreement protecting CRESTCo from loss.

Finally, the Bank has also signed agreements with each of the network providers, regarding the provision of communications networks for CGO. These agreements govern the standards with which the networks must comply, the procedures for making changes to the networks, and the respective rights and obligations of the Bank and each network provider.

- the ability to specify an interest rate for the settlement of a DBV repo. No other changes to facilitate the settlement of repos were deemed necessary, given that the key requirements (ie the ability to input both legs of a repo at the same time, taking advantage of the forward input facility, and the ability to make margin payments using the facility to deliver stock free of payment, or to make a payment without movement of stock) were present in the CREST software. Possible changes that were rejected on the grounds that they were desirable but not essential were the ability to flag a DBV used to settle a DBV repo; automatically rolling over a DBV until the maturity of a DBV repo; the automatic revaluation of repos; and generation of margin payments, and of the return leg of a repo. At some stage in the future, consideration may be given to adding these features, possibly by development of the separate stock loan capability of the system, which has some of these features; and
- the introduction of a degree of tolerance into matching.<sup>(1)</sup> (There is currently no tolerance in CREST matching. Its introduction in 1998 is being considered.)

The Group also agreed to the retention of a number of features available in CREST that had not previously been available in CGO. These were:

- the ability to provide transaction reports to specified regulators such as the London Stock Exchange (LSE) and the FSA;
- the provision of a more flexible account structure, including sponsored membership and account designation. The box on page 73 summarises the key features of the revised structure;
- the use of five decimal places for reference prices, allowing more accurate stock valuations (prices were expressed as an integer in the original CGO); and
- the use, unchanged, of the graphical user interface (GUI) provided by CREST, by which members can communicate with the system. The box on page 74 describes how members can communicate with CGO.

## Managing project risks

One risk in adapting the CREST software (which was recognised at the time) was that, when the decision was made, the software had yet to be tested and trialled and proved in a live environment. The inauguration of CREST and the start of a six-month period of transition of equities

(1) In the original CGO, the deliverer of stock input the information, which the recipient could view and accept without further input. This was known as 'acceptance'. It allowed considerable flexibility. For example, for a large-value trade, a buyer, up against a deadline, might choose to accept a consideration perhaps many thousands of pounds different from what he considered to be the correct amount, though a trivial difference in comparison with the value of the trade, which might run to hundreds of millions of pounds. In this way, he would avoid the trade not settling at all and the risk of a potentially large late-settlement charge. The difference would be resolved later. But acceptance was open to error, and potentially fraud, and it did not meet the standards required for transaction reporting. It has therefore been replaced by 'matching' in the upgraded system, a procedure found in most securities settlement systems. Matching requires both parties to a trade to input certain key pieces of information, which must agree exactly if the trade is to move forward to settlement. To prevent trades failing because the consideration does not match exactly, for example if the two parties to a trade use slightly different ways to translate a fraction to a decimal, or to calculate the price including accrued interest, the Upgrade Group agreed that the software should be amended to allow a small margin of disagreement. It is currently set at £20 in CGO.



## Membership structure in the upgraded system

The upgraded system allows a more flexible approach to membership and account arrangements. Members may have direct or sponsored membership. To all intents and purposes, sponsored members enjoy all the rights of a direct member, except that another user of the system provides the interface with the system, carrying out the sponsored member's requirements for settlement. Direct and sponsored members have a unique participant ID; users of the system also require a unique user ID. Sponsored members do not need a user ID, as another party uses the system on their behalf.

Sponsored and direct members both have accounts in their own name in CGO and on the register. Both types of member must arrange for a settlement bank to provide assured payment facilities on their behalf. In addition, an insubstantial company, such as a nominee company, or one which is prohibited from assuming the liabilities of a sponsored member, may join as a Sponsored Member (Nominee), as long as a member undertakes its liabilities on its behalf. In all other respects, such a member enjoys the same status as a sponsored member.

Users, who have a link to the system, can operate solely on behalf of third parties, (such as partnerships, which

may not become direct or sponsored members of the system), or act as direct members, carrying out their own business as well as that of other companies, for example in the same group. As in CREST, all users of the system, including providers solely of interface services not otherwise authorised, are subject to authorisation under the *Financial Services Act*. (Users have the power to send instructions on behalf of others. So through error or fraud, they could misdirect ownership of another party's gilts.) Being a user of the system, either as a direct member or sponsor, costs £5,000 per annum. Membership of the system, either direct or sponsored, costs £20 per annum.

Other entities with access to the system are settlement banks, the Bank of England's Registrar's Department and regulatory bodies.

In addition to an account in their own name, members may open any number of separately designated accounts. The charge for each extra account is £5 per annum. The designation of such accounts is reflected on the register. This facility allows custodians, for example, to segregate stock into separately designated accounts for individual clients. (Such clients are often referred to as indirect participants in the system.)

from the Stock Exchange's Talisman system did not take place until July 1996. The original date proposed for the inauguration of the upgraded CGO was early 1997. It was not possible to be more specific for three reasons. It was necessary to see how the CREST software performed in a live environment; volume and response time tests had to be performed and assessed, which could not be done until the Bank team had taken delivery of the software (in September 1996); and it was necessary to assess the state of preparedness of software suppliers to CGO members and third parties.

By late November 1996, it had become clear to the Bank that a number of prospective members and suppliers were unlikely to be fully ready to commence participant trialling in time for inauguration in early 1997. It was also becoming clear that the time allotted for trialling in the original timetable was unlikely to be adequate to generate the necessary confidence that the upgraded system would run smoothly at full volume from the outset. This was essential because, with the endorsement of the Upgrade Group, it had been agreed earlier in 1996 that, in order to avoid disruption to the gilt market, it was necessary to transfer from the existing to the upgraded system over a single weekend. On 3 December 1996, the Bank announced that an extension to the timetable for upgrading CGO until 26 August 1997, following the August bank holiday, was

sensible, to enable market firms to concentrate in the immediate period ahead on the transition of equities into CREST, and for changes to the CREST software to be applied to the version being developed by the Bank for CGO. The date was chosen because, at the time, it was believed that transfer could only be achieved prudently over a bank holiday weekend. The box on page 75 discusses the approach to the transfer in more detail.

The extension to the timetable allowed further work, undertaken by three new groups. The first was convened to review thoroughly the strategy for trialling and transfer; the second was formed to help the Bank assess the readiness of members and other participants for trialling and eventually for inauguration. The assessment was based on a number of agreed criteria ('acceptance' or 'success' criteria).

The experience gained from transition to CREST also led to the creation of a third group to advise on market practices in the use of CGO. The upgraded system provides considerably greater flexibility in its use, with a number of options. CRESTCo's experience in transition had identified that it was essential for the efficient use of the system that norms on the use of such options should be established. The norms are enshrined in the rules for the use of the system by members, and are expected to be observed except where there is bilateral agreement to the contrary.<sup>(1)</sup>

(1) Full details can be obtained from the Central Gilts & Moneymarkets Office at the Bank of England.

## Communicating with CGO

In the original CGO, members were provided with terminals linked to CGO via the Stock Exchange's Integrated Data Network (IDN). Input was mainly clerically through terminals, though some rudimentary file transfer was available.

In the upgraded CGO, members can communicate with the central system in two ways. They can either use the CGO-provided graphical user interface (GUI), a Windows-based set of screens by which members input data and are able to view data in real time, interactively, or they can build (or purchase from third parties) a system that interfaces with the central system using real-time file transfer or interactively. Interactive transfer involves the transmission of a single message at a time and receipt of its associated response, and is generally clerically operated; file transfer allows the packaging into a single file of a number of messages, to which all the responses are returned, also in a single file. So it allows the automation of much of the input and processing previously done manually, and paves the way for 'straight-through' processing<sup>(1)</sup> and the possibility of a significant reduction in costs. CGO provides detailed instructions on the formats and protocols that must be followed in constructing files to be sent to the central system by means of Data Exchange Manuals (DEX) for both file transfer and interactive methods. Messages either transfer data from the member's systems to the central system, or request data to be transferred from the central system to the host system (eg

requests for the status of a transaction as it moves through the various stages from input to final settlement). Messages are transferred via two dedicated networks.

Each network provider has to demonstrate that its network services will comply with rigorous requirements on functionality, security and performance. The networks are shared with the CREST service, and members can use the same gateways and network links to access both CREST and CGO. The Bank and CRESTCo monitor the performance of the two networks closely.

The networks enable settlement instructions and enquiries to be transmitted securely and speedily between CGO members' offices and CGO. All messages passing over the networks are encrypted and authenticated using the latest cryptographic techniques. The networks are designed to have a high level of resilience to ensure minimal loss of service.

Members can also acquire backup gateway equipment from the network providers that enables them to choose the level of contingency that best suits them. In the original CGO, the Bank provided access to terminals for members unable to use their own. With the greater variety of means of communication available with the upgraded system, this service has been withdrawn, and members are required to provide their own contingency arrangements.

(1) 'Straight-through' processing is the transfer of data from one electronic system to another without clerical intervention. It can be limited to a member's own internal systems (eg between a trading platform and a back-office system); it may involve the automatic generation of messages to be sent to central settlement or payment systems, or to correspondent bank or custodians in other financial centres; at its best, it will allow the recipient automatically to process the inward message without manual intervention, updating its own systems, and in some cases delivering the message to other banks or payment and settlement systems. Though very hard to achieve in practice, except in a highly controlled environment where a set of file standards and protocols can be imposed, it nevertheless represents a major goal of payments and settlements because of the huge cost savings it can generate.

## Trialling

Participant trialling commenced on 12 May 1997 and continued until the end of July. The box on page 76 describes the approach to testing and trialling. At the end of July, the acceptance criteria were carefully reviewed. It was concluded that, though the programme of trialling had shown that the physical infrastructure of the upgraded system could handle the volumes likely to be experienced in live running, and that the system had the necessary capability in place and was operating substantially as intended, the criteria had not been fully met. Trialling had revealed the need to make certain adjustments to the system in two key areas: there had been occasional instances where the system had allowed payments to be made in excess of debit caps (which limit the amount of credit members are granted intra-day by their settlement banks); and there had been occasions when more stock had been delivered than the deliverer held, resulting in a stock overdraft and more stock apparently in existence in CGO than on the register. It also appeared that not all trades that could settle were settling. For this reason, it was decided

that a further dress rehearsal was needed and that the upgraded system would not be inaugurated on 26 August.

A further dress rehearsal was held at the end of September 1997, after which the Bank concluded that the conditions for a successful implementation of the upgraded system had been met, and announced on 3 October that inauguration should take place on 10 November. The opportunity was also taken to announce the planned start of the official gilt strips facility on 8 December, with trading on a when-issued basis in strips permitted from 1 December.

## Benefits of the upgraded CGO

Apart from introducing features intended to improve the efficiency of settlement, the upgraded system also reduces risk in settlement, as well as providing a platform from which further steps in risk reduction can be taken.

The most significant change, which gave rise to the greatest change to the system and for members using it, was the introduction of debit caps. Members can pay for stock

## Transferring to the upgraded CGO

Early on in the project, the Bank adopted the principle that no interruption to the smooth functioning of the gilt market should arise from the upgrade. Since the start of 1996, the introduction of gilt repo meant that gilts were used more than before in members' day-to-day financing needs. At the end of 1997, the Bank announced its decision to start operating in the money markets via gilt repo. The new operating techniques were introduced in March 1997.<sup>(1)</sup> The gilt market is the vehicle through which the government raises funds. For it to be able to do so at the most advantageous rates, it is essential that there is a deep, liquid market. A condition for this is smooth, efficient settlement of trades, often of very large value: on a typical day, stock to the value of some £100 billion can be transferred in CGO.

A key element in the decision on how best to transfer was the use of gilts as collateral for short-term financing, which enables traders to finance their positions. Since all gilts enjoy the same credit status, they are used indistinguishably as collateral. The need to avoid any disruption to the orderly functioning of the market, so as not to raise traders' financing costs, and the need to maintain the general acceptability of all gilts as collateral, so as not to undermine the liquidity of any issue, led to the conclusion that transfer to the upgraded system had to be achieved over a single weekend. Initially, it was considered prudent to allow three days as a sufficient (contingency) period in case of problems, but in the event it was achieved smoothly over an ordinary weekend.

Special software was written to aid the transfer of data from one system to the other. In addition, at transfer the register had to be brought into line with CGO: prior to the upgrade, movements of stock in CGO were reflected on the register three days later. Over the transfer weekend, this delay had to be eliminated because of the introduction of a real-time link between the two systems in the upgraded system. Finally, numerous reconciliations had to be performed, for example, between CGO and the register at the end of each update of the register, to eliminate the timing difference between the two systems, and between the original and the upgraded database in CGO.

Reconciliations had also to take account of withdrawals of stock from CGO in certificated form that had yet to be registered.

In addition to database transfer, it was also agreed with the membership that there should be a 'big bang' transfer to the wholly new stock loan capability provided by the upgraded system. Stock loans were not separately identified in the original CGO. The only way loans outstanding at transfer to the upgraded system could be reflected in the new system was for the stock out on loan to be returned (by means of an ordinary member-to-member delivery) to the lender, who would return it to the borrower on the same day, using the stock loan function of the upgraded system. The alternative was to allow loans outstanding at transfer not to be reflected as loans in the upgraded system, leaving them to mature, whereas new loans entered into after inauguration of the upgraded system would be settled using the new capability. The gilt stock lending market is highly concentrated and intermediated, as was revealed by a survey of the market, specially commissioned in early 1997 by the project team. On the survey date in early April 1997, of the approximately 2,000 loans outstanding, seven main holders of stock accounted for around two thirds and five main intermediaries, a fifth. On the borrowing side, eleven main borrowers accounted for half of all borrowings and the intermediaries, a third. (The intermediaries tend to parcel their borrowings into fewer loans for on-lending.) Stock loans should be revalued each day and, if necessary, margin called. To have to operate two systems side by side—one for existing loans not reflected in CGO until they were called or matured, and another taking advantage of the upgraded systems' extra capability (which revalues loans automatically for members and generates the margin call if required)—was considered undesirable by members. The decision was taken to transfer to the new function a week after inauguration. But because it was essential that no stock should end up in the wrong place, and because all loans had to be closed out and entered into afresh in the new system, nearly doubling the number of inputs required on the day, two of the dress rehearsals (see the box on page 76) involved a dress rehearsal of stock loan transfer.

(1) Further details of the new arrangements can be found in the article 'Operation of monetary policy' in the *Quarterly Bulletin*, February 1997, page 12.



## Testing and trialling

Large IT systems go through a series of tests and trials before inauguration. Once the overall capability to be delivered by the software has been agreed, more detailed design specifications are drawn up. These are used as the basis for programming, usually in modular form. The modules are then tested singly and in functional groups, using scripts developed from the design specification. This process is called system testing. The application software is then handed over to the business development team, who have the task of exercising it according to pre-defined scripts, designed to capture as far as possible all the ways in which the software might be expected to be used. The Bank describes this as internal trialling. Errors detected at this stage or the previous stages are referred for correction either by the designers or the programmers as appropriate. Changed modules are again tested and, depending on the analysis of the impact of any changes requested on other parts of the system, other modules may be re-tested to establish that they have not been affected. This is called regression testing. Tests are also performed to establish system response times, so as to identify any problems in system performance.

At the end of this process, the application software is subjected to trialling by all the users of the system. This is known as external or participant trialling.<sup>(1)</sup> In the CGO project, this was divided into two parts. The first consisted of scripted trials, during which members used the system adhering strictly to scripts prepared by the Bank business team, to ensure that all the functionality was correctly exercised. This was followed by a period of unscripted trialling, which was in two parts: dress rehearsals during which real days' business from earlier dates was 'replayed' on the new software over a weekend; and unscripted use of the system during business days by members wishing to test out their own software and communications, as

well as providing staff training. (A computer-based training module was built and supplied to members as part of the project.)

There were four dress rehearsals in all, three in July 1997 and a final one in late September 1997, involving the full membership and other users of, or suppliers to, the system. Dress rehearsals can usually only be carried out on non-business days, since the staff involved in them are carrying out live business on business days. Dress rehearsals are an invaluable way of demonstrating that the system as a whole meets the business needs of all the members. It allows the system operators to ensure that their ability to handle the system is fully proved, and it gives a good idea of how the application software is likely to perform in a live environment.

In the case of CGO, the transfer of stock from the old to the upgraded database required that on the day of inauguration, members carefully reconciled their balances in CGO to their own systems before and after the return of DBVs (the only term transaction to be identified separately as such in the old CGO). In addition, settlement banks had to input and authorise debit caps for each member. As a result, the opportunity was taken during the dress rehearsals to rehearse the extra, one-off work involved on the day of inauguration itself, to ensure that it went as smoothly as possible, but also in order to establish the extra amount of time needed.

Because the networks are shared with CREST and so members can, in consequence, use the same gateway to access both services, a need was identified for a certain degree of joint trialling with both services simultaneously. CRESTCo was able to provide test facilities for members at the same time that trialling was taking place with CGO.

(1) In some cases, full external trialling is preceded by use of the system by a selected sub-set of users, in part on a scripted basis, to flush out any residual problems. This is sometimes known as 'beta' testing. It was used prior to the final dress rehearsal.

either by drawing down a balance on their cash memorandum account<sup>(1)</sup> or by drawing down secured or unsecured credit granted by their settlement bank. Secured credit is secured against stock in a member's account, as well as stock being received for which payment is being made.<sup>(2)</sup> This is achieved by linking to the debit cap the member's account in which the stock is held or is to be

received. If an account is not linked, stock balances in it, or to be received, cannot be used as collateral for a debit cap. At present, members have the sole ability to link accounts to debit caps or to de-link them, and the responsibility to ensure that only proprietary stock, or stock in custody for which there is authority for use as collateral, is used. But with effect from the early part of 1998, linking or de-linking

(1) Track of payments and receipts by customers in CGO is kept on memorandum accounts in CGO. Actual payment takes place between settlement banks only at the end of the settlement day, each bank making or receiving a payment to or from each other settlement bank, representing the net of all such payments during settlement. Credits and debits are passed by the Bank of England across the settlement banks' accounts in the Bank's books. In addition, each settlement bank is advised of its net position *vis-à-vis* each of the members on whose behalf it has been making or receiving payments, and credits or debits the member's account in its books accordingly, also at the end of the day.

(2) The stock is valued according to reference prices held in the system. Settlement banks can set a margin to be deducted from the system value of the stock, known as a 'bank category margin'. The margins can be applied to four categories of stock—short, medium, long and undated—reflecting the different price-volatility characteristics of the stock concerned. (Strips are allocated to the date category that follows the category to which they would be allocated on the basis of their maturity date, to reflect their potentially greater volatility. So for example, medium-dated strips are allocated to the long-dated category.)

an account will require the electronic sanction of the settlement bank concerned.

Settlement banks have control over the credit limits they are prepared to grant in the system, and have to activate the debit cap (the sum of the secured and unsecured credit granted) before any settlement for that member can take place. Settlement banks are also able to reduce, to nil if they choose, credit limits in real time during settlement. Settlement banks put great reliance on the operation of debit caps, and it was this part of the system that required the most thorough testing.

In the original CGO, there was no mechanism to limit the payments that settlement banks undertook to make on behalf of members. It was therefore not subject to any cash constraints, and settlement took place whenever stock was available. In the upgraded CGO, settlement can only take place if there is sufficient cash or credit available to the parties to a trade as well as sufficient stock. Situations where the delivery of stock is dependent upon a receipt of stock, where for example a member has sold stock short before buying it back or borrowing it, are resolved by a mechanism called 'circles'. In the upgraded system, the circles mechanism, which was present in the original system, is designed also to resolve situations where a cash payment is dependent on a cash receipt because the member has insufficient cash or credit. The need for the system to check that there is both adequate cash or credit, as well as stock, before settlement can take place represents a very considerable processing overhead compared with the original CGO.

The procedures for depositing stock in certificated form<sup>(1)</sup> in CGO have also changed as part of the upgrade.

In the original CGO, whether stock was being deposited or transferred within the system, registration took place two days later. This meant that stock deposited in CGO could be on-delivered within the system on the same day it was deposited, since both movements would register on the same day. Market makers could, therefore, offer the same settlement cycle for retail as for wholesale trades, since the matching sale of a purchase of certificated stock could settle at the same time.

In the upgraded CGO, the CREST standard for the registration of transfers has been adopted. Intra-CGO transfers and withdrawals of stock have to be registered within two hours, whereas stock being deposited has up to 28 hours to be registered from the time the certificate and the stock transfer form are received at Registrar's, usually

the day following the deposit in CGO, to allow time for processing. The reduction to two hours in the interval for the registration of trades settled within CGO significantly reduces risk in the wholesale market, by ensuring that the buyer acquires legal title shortly after settlement; and it opens up the possibility of abolishing the ex-dividend period for holders of stock in CGO.<sup>(2)</sup> In the upgraded CGO, therefore, if a matching on-delivery of stock within CGO on the same day as it was deposited were to be allowed, its registration would be attempted before the stock being deposited could be registered. If the member did not have sufficient stock already registered in his name, the on-delivery within CGO could not be registered. This would give rise to a bad delivery in CGO—a transfer of equitable title that cannot be followed by a transfer of legal title. The rules of CGO require bad deliveries to be reversed.<sup>(3)</sup> Because bad deliveries are to be avoided if at all possible, since they undermine the basis on which secured credit is granted and assured payments made, in the upgraded system the on-delivery of stock deposited into CGO is not allowed until the original deposit has been successfully registered. This has increased the period for the settlement of a purchase by a CGO member from a non-CGO member by two days. As a result, market makers now quote prices for such trades based on five or ten-day settlement, depending on circumstances. The box on page 78 provides further details of the settlement of certificated gilts (retail gilts) in the upgraded system.

## Summary

The upgrading of CGO, using CREST software, has made available new features for the continued efficient and safe settlement of trades in the gilt market. These new features:

- facilitate stripping and reconstitution of gilts;
- allow back offices to process repos and stock loans more efficiently, helping them to settle a greater volume of trades as the market develops;
- effect automatic reporting to the FSA and the LSE, reducing back-office work for all gilt deals settled through CGO;
- offer more flexible membership and account management arrangements. It is expected that this will result in a widening of membership and increase the scope for investors to hold gilts in dematerialised form, reducing the volume of paper in the settlement process;

(1) Stock held in CGO is dematerialised. The instruction to the Registrar's Department to register a transfer in CGO is represented by the electronic registrar update request (RUR). Most gilts in CGO can also be held and transferred outside CGO in certificated form; the legal instrument on which Registrar's will register such transfers is the stock transfer form. Stock in certificated form can be deposited into CGO, whereupon it is dematerialised and the certificate is cancelled by Registrar's, or withdrawn, whereupon a new certificate is issued. Gilts that cannot be held in certificated form and which, in consequence, can only be transferred in CGO, are strips and the Floating Rate Treasury Stock 2001.

(2) The period between the ex-dividend date and the date the dividend is due is called the 'ex-dividend period', and is to facilitate the preparation and despatch of dividend payments. The ex-dividend date is the latest date for registration of a transfer for the new holder to receive the next dividend. In January 1996, the ex-dividend period was reduced from thirty seven days to seven working days (with the exception of 3/4% War Loan, where the period is ten working days because of the large number of holders). Further details on consequential changes to ex-dividend arrangements proposed by the Bank can be found in the *Annual Review of Gilts and the Gilt Market for 1996/97* and in the article on page 55-69 in this *Quarterly Bulletin*.

(3) A bad delivery reversal is a separate transfer of stock, not the unwinding of the original transfer for which there is no provision in CGO, all transfers taking place with finality at the point of transfer. It is up to the parties involved to make arrangements for the reversal of any associated payment, the reversal of stock taking place without payment.



### Settlement of retail gilt trades

Though CGO was originally conceived principally for the use of the wholesale market, the recent upgrade has made the service more accessible to retail market practitioners, and so to their clients, by introducing a more flexible membership structure and by reducing costs. A number of retail brokers have already become direct members of the system, and a number of others have expressed interest. Sponsored membership is a low-cost alternative for those firms whose gilts volumes do not merit direct access to the system, but who still wish to offer their clients a safer, faster settlement, registration and custody service.

In order to make the most of the CGO service, members, or investors holding their stock with members, will need to 'dematerialise' their holdings—in other words to deposit their certificates into CGO and to hold their stock in the system in book-entry form, much as they would deposit cash into their bank. Otherwise, the investor will not be able to settle transactions according to wholesale market timetables. Dematerialisation is very simple, and can be carried out by the investor's broker.

Investors who continue to hold their stock in certificated form have two options. They can choose to buy and sell stock through a CGO broker. The broker will deposit their clients' stock into CGO for onward delivery to a market maker within the system, or withdraw stock received from a market maker into their name. This can be done in as little as three days. Alternatively, for those acting through non-CGO brokers, stock and money will need to be exchanged outside the system.

Because delivery of stock and cash takes place outside the system, those using non-CGO brokers will face a slightly longer settlement period than those using member brokers. The Bank has introduced arrangements designed to minimise, at least for a period, the settlement cycle for those using non-member brokers, by effecting transfers between investor and market maker by electronic input to the register. These procedures are carried out by the Bank's Registrar's Department.

- allow better control by settlement banks of their exposure to the CGO members for whom they act, reducing any residual risk in the settlement process; and
- reduce the interval between transfer of equitable title in CGO and legal title on the register, from three days to not more than two hours.

### Future developments

The Bank is working on a number of developments that will affect the CGO service.

Most immediately, it is introducing a real-time register. Apart from speeding up processes at the Bank's Registrar's Department, for example the registration of stock deposits, it will be able to handle stocks denominated in more than one currency, enabling the introduction of euro stocks to the register and CGO. It will also make it possible for dividends and redemption payments to be made direct to members' cash memorandum accounts, rather than outside the system as at present. As noted above, registration on the same day as a transfer in CGO opens up the possibility of abolishing the ex-dividend period for holders of gilts in CGO. There may be advantages in doing this, in that the existence of the ex-dividend period can be a source of credit risk in the gilt repo market if a dividend is paid to the purchaser of the stock after a repo has matured.

As mentioned above, work is under way to enable settlement banks electronically to sanction the linking or de-linking of accounts to or from debit caps. This enhancement is expected to be introduced early in 1998. In addition, in 1998, the Bank intends to enable the multi-currency capability available in the software to accommodate the use of the euro as a payment currency by the start of European Monetary Union. It will also be completing its programme of ensuring Year 2000 compliance.

The Bank plans to link CGO in real time to the Bank's RTGS system. Payment obligations arising between settlement banks in CGO will then be able to be settled gross in the Bank's books as they arise, instead of on a multilateral net basis at the end of the day as at present. Such a link will further reduce settlement risk in UK large-value payment and settlement systems. A working group established by the Bank, with APACS and CRESTCo, to look at the technical options for the introduction of such a link, completed its initial work in late 1996 on a number of potential models. This has been followed up by more detailed analysis of the options. No timetable for its introduction has yet been established. One reason for this is the current consultation, mentioned on page 71, on relative IT priorities.