

**MAS ELECTRONIC
PAYMENT SYSTEM
(MEPS)**

FUNCTIONAL SPECIFICATIONS

VERSION 6 (October 2003)

DOCUMENT CONTROL

Change Control

| Version | Date | Description of Changes |
|---------|-------------|--|
| 6 | 15 Oct 2003 | Updates include: <ul style="list-style-type: none">- SGD inclusion in CLS;- Extension of SGS operating hours;- Access policy;- MAS Notice 613; and- Implementation of CTS. |
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1 INTRODUCTION

1.1 System Overview

The MAS Electronic Payment System (MEPS) is owned and operated by the Monetary Authority of Singapore (MAS). It is a real-time gross settlement (RTGS) system designed for Singapore dollar high value funds transfers (IFT) and the settlement of scrippless Singapore Government Securities (SGS). The main feature of MEPS is the instantaneous and irrevocable transfer of funds and SGS as long as sufficient balances are available in participants' settlement accounts.

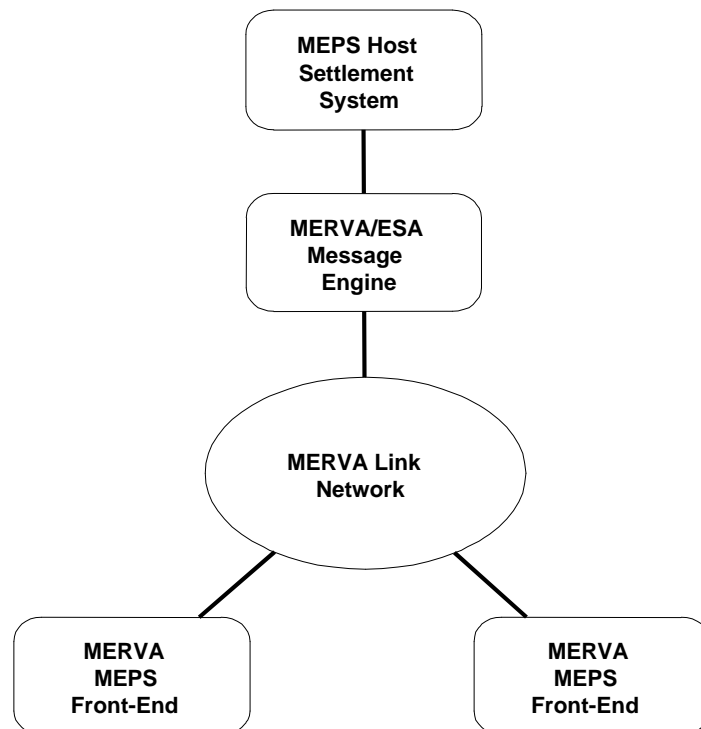
Participants require a front-end system to perform data entry and to transmit payment instructions to MAS¹. The front-end system also provides online host enquiry functions to allow participants to query their current account balances, SGS holdings and the status of their payment queues. It also provides a re-prioritization function for participants to manage queued payments and a cancellation function to cancel payments that have not been settled.

The heart of the MEPS is the host system that resides in the mainframe host at MAS. The host system is the central data store and it implements the processing logic for both the queuing and settlement functions. The MEPS host system is interfaced with other payment systems that settle via the participants' current accounts with MAS such as cheque clearing, interbank GIRO (IBG), and participants' transactions with MAS.

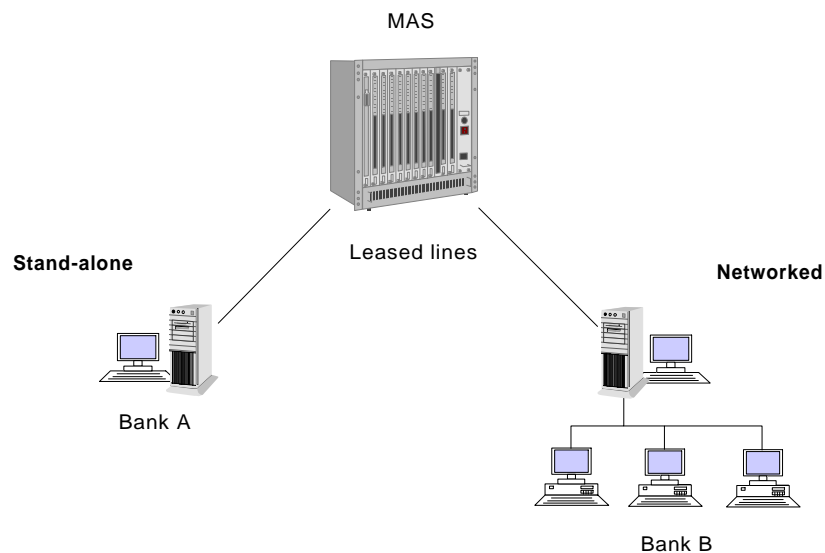
¹ Except for CLS Bank. For more information, please see paragraph 1.3 (b).

1.2 System Configuration

The front-end software for the MEPS is provided by IBM using the MERVA/AIX product customized for MEPS use (referred to as MERVA MEPS). It is linked to the host settlement system through MERVA/ESA on the IBM mainframe platform. The transmission of all settlement instructions and system messages for the MEPS operations is handled by MERVA Link. An overview of the MEPS configuration is as follows:



The MERVA MEPS front-end system supports two configurations on the RS/6000 platform: stand-alone and networked.



The stand-alone configuration is designed for participants with low transaction volumes. All message processing functions are performed on the server and only one user can access the system at any one time.

The networked configuration is meant for participants with higher transaction volumes. Depending on the participant's transaction volume and number of users, participants may connect as many workstations as desired to the server machine. However, all processing are still performed by the server. All MEPS functions are accessed via the workstations and multiple users may use the system concurrently.

1.3 External System Linkages

a) Automated Clearing House (ACH)

The MEPS is linked to the ACH for settlement of cheque and interbank GIRO transactions. Please see paragraph 2.4.

b) Debt Clearing & Settlement System (DCSS)

The DCSS is a system operated by The Central Depository (Pte) Limited (CDP) for the settlement of transactions in bonds. The real-time linkage between MEPS and DCSS provides market participants with the capability to settle all transactions in Singapore dollar bonds custodised with CDP on a model 1 DVP basis, where transfers of securities and cash occur simultaneously on a gross trade-by-trade basis. Prior to DVP settlement, securities are earmarked in DCSS awaiting payments. When payments are completed in MEPS, earmarked securities are simultaneously transferred via DCSS book entry system on a gross basis.

c) Continuous Linked Settlement (CLS)

CLS is a real-time global settlement system that aims to eliminate foreign exchange (FX) settlement risk due to time-zone differences. The CLS settlement service, provided by CLS Bank, allows both legs of a FX trade submitted by members to be settled simultaneously across the books of CLS Bank and therefore guarantees finality and irrevocability of the settlements.

To do this, CLS Bank maintains multi-currency accounts for its Settlement Members (SM). In turn, CLS Bank holds accounts with the central banks of all the CLS eligible currencies. CLS Bank uses these accounts to receive funds from and to disburse funds to SMs through

the RTGS systems of the various CLS eligible currencies. As the Singapore Dollar is an eligible currency in the CLS system, the settlement of Singapore Dollar FX trades occurs between SMs and CLS Bank via MEPS.

CLS Bank participates directly in MEPS as a member institution. As CLS Bank does not have any offices located in Singapore, it participates in MEPS on a "remote access" basis and exchanges payment and reconciliation messages with MEPS via the SWIFT network.

To facilitate the linkage between MEPS and CLS, MEPS was enhanced with an interface that transforms MEPS IFT-format messages into SWIFT MT-format messages and vice versa. The transformation capability of the MEPS-CLS interface allows (a) CLS Bank to send payment instructions to other MEPS participants using SWIFT MT messages, and (b) MEPS participants to send payment instructions to CLS Bank using MEPS IFT messages.

2 THE MEPS HOST SYSTEM

2.1 Operational Features

The MEPS system has the following operational features:-

a) Operational Hours (Please see Appendix 1)

- Same-Day Transactions

- Interbank Funds Transfer (IFT)

Mondays – Fridays : 9.00 am – 6.30pm
Saturdays : 9.00 am - 2.45 pm

- Singapore Government Securities-Delivery vs Payment

Mondays – Fridays : 9.00 am - 5.00 pm
Saturdays : 9.00 am – 12.30 pm

- Forward-Dated Transactions

The MEPS accepts forward-dated IFT (up to 2 working days forward) and SGS transactions (up to 20 calendar days forward) from:-

- IFT Transactions

| | |
|--------------------------|-------------------|
| <u>Mondays – Fridays</u> | <u>Saturdays</u> |
| 6.00 am – 8.00 pm | 6.00 am – 3.00 pm |

- SGS Transactions

| | |
|--------------------------|-------------------|
| <u>Mondays – Fridays</u> | <u>Saturdays</u> |
| 6.00 am – 6.30 pm | 6.00 am – 3.00 pm |

Forward-dated MEPS transactions will be processed only on their value dates.

- Sundays and Public Holidays

The MEPS does not operate on Sundays and Singapore Public Holidays.

b) Participants

All banks in Singapore are eligible to participate directly in the MEPS. Banks that choose not to participate in the system may appoint participating banks as their agents to make payments on their behalf.

To do so, non-participating banks may enter into private agency agreements with any of the participating banks. The terms of such agreements should be bilaterally negotiated between the banks, and are outside the ambit of the MEPS. MAS however provide some services for non-participating banks to transfer funds and SGS out from their MAS current accounts and SGS-MLA accounts respectively (please see paragraph 2.7).

In addition, regulated non-banks of systemic importance may seek approval from MAS to participate in MEPS. As part of the evaluation process, MAS will consider the applicants' nature of businesses, financial strength, operational and IT capabilities amongst other things. This is to minimise the risk of liquidity gridlock in MEPS caused by the incumbent's participation in MEPS.

c) Minimum Cash Balance (MCB) Requirements

Under Section 39 of the Banking Act, all banks in Singapore are required to maintain MCB with MAS. In accordance with MAS Notice 613 to Banks, a bank is required to maintain its MCB by means of an average fortnightly amount. On a day-to-day basis, a bank's closing MCB is allowed to vary within a band of 1% above or below the required 3% MCB, i.e. the closing MCB balance on any day should not drop below 2% of the liabilities base (LB) and any balance in excess of 4% will not be counted towards the fortnightly average. The average closing MCB balance held over the fortnightly maintenance period must be at least 3% of the liabilities base. On an intra-day basis, banks may use funds in excess of their intra-day Reserve account balances to make payments.

d) Minimum Liquid Assets (MLA) Holdings of SGS

In accordance with MAS Notice 613 to Banks, banks that do not qualify for the bank-specific MLA requirement are required to maintain MLA of 18% of their LB, of which at least 10% of LB must be in the form of SGS and at least 5% of LB must be in the form of SGS held outright.

For banks that qualify for the bank-specific MLA requirement, please refer to MAS Notice 613 for details.

e) Charges

The operating cost recovery method is used to determine the pricing of transactions in MEPS. Each transaction is charged at S\$1.25 per

message, payable by the party initiating the transfer. The MEPS message types which are chargeable are listed at Appendix 2.

2.2 The MEPS Interbank Funds Transfer (MEPS-IFT) Sub-System

The MEPS-IFT sub-system have the following main features:-

a) Participants' Accounts with MAS

Participants' current accounts with MAS are structured to provide the following 2 sub-accounts during the operating hours of the MEPS:-

- Reserve Account

Banks' intra-day MCB requirement, if any, is maintained in the Reserve account. Funds in the Reserve account cannot be used for the settlement of MEPS payments. On an intra-day basis, participants may draw down amounts in excess of their intra-day MCB requirement to make payments.

- RTGS Account

Funds exceeding the intra-day MCB requirement in the Reserve account are transferred at the start of the day to the RTGS account, where they may be used for the settlement of MEPS payments.

The MEPS would, at the start of the day, transfer balances exceeding the intra-day MCB requirement from the Reserve account to the RTGS account, where they may be used for the settlement of MEPS payments. During the MCB Funding Period (Mon to Fri: 6.15 pm to 6.30 pm, Saturdays: 2.30 pm to 2.45 pm), all incoming receipts of banks which do not meet the end-of-day MCB requirement of at least 2% of LB would be set aside, i.e. transferred to the Reserve account. Only funds exceeding the 2% MCB requirement may be used to settle MEPS payment instructions during the MCB Funding Period.

b) Same-Day Value Transactions

The MEPS-IFT sub-system only processes same-day value transactions. However, the system also accepts forward-dated transactions up to 2 working days forward. Such forward-dated transactions sent to the MEPS host system are stored in the host database and are only processed on their value date. All same-day value transactions that affect the participants' current accounts with MAS are credited or debited (as long as there are sufficient balances) to the RTGS accounts. At the end of the business day, the balance in the RTGS accounts is transferred back to the Reserve accounts.

c) Queuing Mechanism

Payment instructions entered into the system, which are not settled immediately because of insufficient funds in participants' RTGS accounts, would be queued. Payments in the payment queue are settled on a first-in first-out (FIFO) basis, within each of the Priority Levels below, as sufficient funds become available in participants' RTGS accounts.

The queuing mechanism has the following levels of priority:-

- Priority 1 - MAS transactions
- Priority 2 - Cheque/Interbank GIRO (IBG) transactions
- Priority 3 - Urgent transactions
- Priority 4 - SGS transactions
- Priority 5 - Normal transactions
- Priority 9 - Payments on hold

Participants can choose to place their payment instructions at Priority 3 or 5. To allow efficient queue management, payments queued in Priority 3 or 5 may be re-prioritized to Priority 3, 5 or 9. However, participants may not re-prioritize payments due to MAS (Priority 1), paper clearing and IBG transactions (Priority 2) and SGS transactions (Priority 4).

Once there are incoming funds to a participant or when the order of a participant's payment transactions in the queue is changed, the system checks if the participant's RTGS account balance is sufficient to meet the first payment in its queue. If the balance is sufficient, the system debits its RTGS account and credit that of the receiving participant. This process is repeated until there is no more transactions in the queue or when the RTGS account has insufficient balance to meet the next queued payment.

Same-day transactions still pending in the queues after MEPS cut-off time are automatically deleted by the system. For reconciliation, MAS sends each participant a report listing the transactions deleted at the end of day.

d) Payments Due To/Due From MAS

Participants' IFT and SGS transactions with MAS resulting in payments due to or due from MAS are initiated by MAS. All such

payments are automatically placed at Priority 1 when the participants do not have sufficient funds to settle the payments.

Instructions for IFT payments due from MAS are inputted to the MEPS on value date at 9.00 am, i.e. at the opening of the MEPS for that day.

Similarly, instructions for participants' IFT payments due to MAS are generated and inputted to the MEPS as a Priority 1 payment in favour of MAS at 9.00 am on value date (except for payments to Government's Account with MAS for the allotment of new SGS issues which are input as a Priority 4 payment). Participants must ensure that they maintain sufficient balances in their RTGS accounts to enable such payments to MAS to settle as soon as possible. Participants should note that MAS may impose interest charges detailed at Appendix 3 for IFT payments to MAS that remain unsettled in the Priority Level 1 queue from the various cut-off times onwards.

2.3 The MEPS Singapore Government Securities-Delivery Vs Payment (MEPS-SGS) Sub-System

The MEPS-IFT sub-system is linked to the SGS Book-entry System to provide Delivery-versus-Payment (DVP) for SGS transactions. The MEPS-SGS sub-system opens at 8.50 am daily to process same-day SGS transactions. For SGS transactions with payments, however, the payment instructions are processed for settlement from 9.00 am. The MEPS-SGS sub-system has the following features:-

a) SGS Accounts

Under the MEPS-SGS sub-system, banks maintain the following 2 accounts:-

- **SGS-MLA Account**

Banks would deposit SGS for compliance with the MLA requirement to hold at least 10% of LB in SGS at all times in this account prior to the start of the 2-week maintenance period.

Banks may not sell SGS in the SGS-MLA account directly. To give banks the flexibility to manage their holdings of SGS issues, transfers of SGS holdings between the SGS-MLA account and the SGS-Free account can be made at any time when the system is in operation, subject to the 5.00 pm deadline for same-day SGS

transfers. Transfers of SGS holdings out of the SGS-MLA account to the SGS-Free account are permitted only if the remaining value of SGS holdings in the SGS-MLA account after the transfer is at least 10% of LB. Transfers to or from the SGS-MLA account will not be queued for settlement, i.e. if there is insufficient securities in the account (either SGS-Free or SGS-MLA accounts) to be transferred out, the transaction will be rejected. When checking whether there is sufficient securities, transactions that are queued for settlement will be taken into consideration.

- SGS-Free Account

SGS holdings in excess of the minimum 10% MLA requirement may be deposited in the SGS-Free account. SGS holdings in this account can be used for trading. Primary and approved SGS dealers would maintain additional customers' accounts under the SGS-Free account for the SGS holdings of their customers. Holdings in customer accounts can be transferred free-of-payment to the bank's SGS holdings, or to another bank's or its customer's SGS holdings. Purchases/sales on delivery against payment of SGS holdings in bank customer's account from/to another bank or its customer's SGS holdings can also be transacted.

- b) DVP Procedures

Under the MEPS SGS-DVP system, if the seller of SGS has insufficient SGS for delivery, the transaction is queued (except for transfers to or from SGS-MLA accounts, which would be rejected). When the seller's SGS-Free account has sufficient SGS, the SGS would be earmarked for transfer to the buying bank, and a IFT payment message sent to the MEPS. If the buying bank has insufficient funds to pay for the SGS purchase, the payment is queued at Priority 4. Once funds become available, the amount is debited from the RTGS account of the buying bank and credited to that of the selling bank. The MEPS-IFT sub-system will notify the MEPS-SGS sub-system, which will then transfer the securities irrevocably to the purchasing bank.

- c) MLA Compliance

For system and operational efficiency, banks' SGS portfolios held in the SGS-MLA accounts are valued fortnightly, according to the closing price of each SGS issue one working day before the start of the maintenance period. Hence, SGS holdings in the SGS-MLA account are valued based on Tuesday's closing prices (including accrued interest), provided by MAS through the MEPS and MASNET

Homepage by Wednesday 10.30 am and the prices, in the absence of significant SGS price movements, will not change for the two-week maintenance period. In the event of a public holiday, the closing prices of the earlier working day will be used so that banks have at least one day to decide which SGS issues to deposit in the SGS-MLA account. Banks have up to 10.30 am on the start of a new maintenance period to comply with the 10% MLA requirement.

On Wednesday, prior to the start of the next MLA maintenance period, banks may input the instruction to transfer SGS from the SGS-Free account into the SGS-MLA account for value Thursday. The MEPS will process and effect the transfers during Wednesday night/Thursday morning after the system cut-off on Wednesday. Banks should ensure that there are sufficient SGS in the SGS-Free account for the transfer, otherwise the transaction will be rejected.

The MEPS will re-compute the daily total holdings of SGS in the SGS-MLA account using the same prices (including accrued interest up to Tuesday only) for two weeks to determine if the holdings are at the required level.

SGS issues in the SGS-MLA account that mature during the maintenance period are removed from the SGS-MLA account when due, and the maturity proceeds credited to banks' RTGS accounts by 9.00 am on maturity date. If the removal of such SGS issues from the SGS-MLA results in SGS holdings falling below the required level of at least 10% of LB, the onus is on banks to transfer other SGS issues from the SGS-Free account into the SGS-MLA account by 10.30 am on the maturity date of the SGS in order to satisfy the MLA requirement.

A list of banks that do not comply with the MLA requirement at the cut-off time of 10.30 am are generated and forwarded to MAS' Prudential Supervision Group for follow-up action.

d) New SGS Issues

Banks that have successfully tendered for new SGS issues are credited with such SGS issues when they have sufficient funds in their RTGS accounts to pay for the issues. At 9.00 am on the issue date, a payment to the Government's account with MAS for the amount of SGS successfully tendered is generated by MAS. If a bank does not have sufficient funds at this time, its payment would be queued at Priority 4.

Once funds become available in the bank's RTGS account, the payment is settled, and the SGS issues credited to the bank's SGS-Free account. If the bank wishes to use the new SGS issues to meet MLA requirements, it would then have to transfer the SGS issues from its SGS-Free account to its SGS-MLA account.

e) Forward-dated Transactions and Forward-leg of Repurchase Transactions

Banks are allowed to input forward-dated transactions up to 20 calendar days forward. The limit of 20 calendar days forward does not, however, apply to the value date for the forward-leg of a repurchase (repo) transaction. Forward-dated transactions as well as the forward-legs of repo transactions are processed on their value dates and queued for settlement based on a FIFO sequence by input date and time. For SGS sales and repo transactions, the input date and time refer to the date and time of the receipt of the confirmation message for that transaction by the MAS host system.

2.4 Cheque and Interbank GIRO (IBG) Clearing

Under the MEPS, the procedures for the clearing of the cheque and IBG net settlement figures are as follows:-

a) Clearing Sessions

There are 2 clearing sessions during the day to lessen banks' end-of-day funding burden as follows:-

- Mid-day Cheque Clearing

| | | Cut-Off Time (Mon-Fri) | Cut-off Time (Saturdays) |
|---------------------------------------|---|-----------------------------------|-------------------------------------|
| Mid-day Funding Period | Cut-off for Transmission of Cheque Data to ACH via the Cheque Truncation System (CTS) | 2.30 pm | NA |
| | MAS to Broadcast Mid-day Net Clearing Figures to Banks Note: Net debits/credits to be posted to banks' payment queues at this time | 3.05 pm | NA |
| | Cut-off for Funding by Net Debit Banks | 3.45 pm | NA |

- End-of-Day Cheque/IBG Clearing

| | Cut-Off Time (Mon-Fri) | Cut-off Time (Saturdays) |
|--|-------------------------------|---------------------------------|
| MAS to Broadcast Net IBG Clearing Figures to Banks Note: For information only. No debits/credits to be posted at this time. | 3.30 pm | 12.15 pm |
| Cut-off for Transmission of Cheque Data to ACH via CTS | 5.00 pm | 1.30 pm |

| | Cut-Off Time (Mon-Fri) | Cut-off Time (Saturdays) |
|--|-------------------------------|---------------------------------|
| MAS to Broadcast End-of-day Net Cheque and IBG Clearing Figures to Banks Note: Net debits/credits to be posted to banks' payment queues at this time | 5.45 pm | 2.05 pm |
| Cut-off for transmission of cheque data to ACH via CTS as late submission items for next business day mid-day clearing (or end-of-day clearing if the next business day is a Saturday). | 6.00 pm | 2.00 pm |
| Cut-off for Funding of Net Cheque/IBG Debits | 6.15 pm | 2.30 pm |

End-of-day Funding Period

To assist banks to determine their end-of-day funding obligations due to IBG clearing, individual banks' IBG clearing figures are made available via the MEPS at 3.30 pm (Mondays – Fridays) or 12.15 pm (Saturdays). However, the net debits/credits arising from IBG clearing are not posted to banks' payment queues at this time. Instead, IBG clearing net debits/credits are consolidated with the end-of-day net cheque clearing figures and posted to banks' payment queues at the start of the End-of-Day Funding Period at 5.45 pm (Mondays – Fridays) or 2.05 pm (Saturdays).

b) Funding Periods

Debits/credits arising from clearing are posted to banks' payment queues at 3.05 pm (for mid-day cheque clearing) or 5.45 pm (for end-of-day cheque/IBG clearing). Such debits/credits would not however be settled until all net debit banks have funded their RTGS accounts to cover their obligations. Prior to the settlement of the clearing figures, however, the system would earmark balances in net debit banks' RTGS accounts to settle their clearing figures. Net debit banks with insufficient balances in their RTGS accounts to fully meet their

clearing obligations may fund their RTGS accounts during the Funding Period. The MEPS would effect the final settlement of the clearing figures once all net debit banks have sufficient "available funds".

c) System to Lend "Pending Funds"

After the broadcast of the cheque/IBG clearing figures, net debit banks' balances in their RTGS accounts are earmarked to settle their clearing obligations as long as there are sufficient funds in their RTGS accounts. The earmarked funds may not be used for the settlement of other MEPS transactions. If there are insufficient funds in their RTGS accounts, the cheque/IBG clearing figures of net debit banks would be queued at priority level 2. Net credit banks would only receive and may only use such funds ("Pending Funds") when all net debit banks have funded their RTGS accounts and final settlement of the clearing figures has been effected. Hence, during the period of time after the broadcast of the clearing figures and prior to their settlement, liquidity in the banking system would be reduced.

In order not to deprive the banking system of such liquidity, a system is established to allow "Pending Funds" to be lent by the net credit banks to the net debit banks for the settlement of cheque/IBG clearing figures. This system for lending "Pending Funds" operates during both the Mid-day and End-of-day Funding Periods. The loan of "Pending Funds" would however be conditional upon the settlement of the cheque/IBG clearing figures. If the cheque/IBG figures are not settled, the loan of "Pending Funds" would be cancelled.

Only banks with net debit clearing figures may borrow "Pending Funds". The amount of "Pending Funds" that such net debit banks may borrow would be capped at the amount of its net clearing debit (up to the nearest S\$1m). Banks with net credit clearing figures would not be entitled to borrow "Pending Funds".

Instructions to extend a loan of "Pending Funds" will be rejected by the MEPS host system if such instructions are received outside the Mid-Day or End-of-Day Funding Periods or if all banks with net debit figures have covered their debit positions before the end of the relevant Funding Periods.

d) "Available Funds"

To determine whether the clearing figures may be settled, the MEPS host system checks whether all the net debit banks have sufficient "available funds".

"Available funds" consist of the aggregate of the:-

- balance in the RTGS account that has been earmarked for cheque/IBG clearing; and/or
- the "Pending Funds" incoming from the net credit banks.

Settlement of the clearing figures is effected once the "available funds" of all net debit banks is sufficient to cover their net debit obligations fully. Once the clearing figures are settled, the loan of "Pending Funds"² from the net credit banks to the net debit banks is confirmed. The interest on the loan would be negotiated bilaterally between the banks.

e) Default

Should one or more net debit banks have insufficient "available funds" by the end of the Funding Period, a default would be triggered. This would result in:-

- Mid-Day Cheque Clearing
Suspension of mid-day cheque clearing in which all debits/credits posted would be deleted from banks' payment queues. The mid-day cheque clearing figures would then be incorporated in the end-of-day cheque/IBG clearing figures;
- End-of-Day Cheque/IBG Clearing
Re-casting of the cheque/IBG items to exclude the defaulting bank/s.

f) Default Fees

To ensure that banks manage their RTGS accounts to have sufficient cover for their clearing obligations, the following default fees are imposed on banks that fail to cover their funding obligations by the cut-off time for funding:-

² The loan of "Pending Funds" are conditional upon the settlement of the clearing figures. If the clearing figures fail to settle, such loans would be cancelled.

- Mid-day Cheque Clearing

| | |
|-------------------------------------|-------------|
| For funding obligation (X) < S\$10m | - S\$ 5,000 |
| S\$10m ≤ X < S\$30m | - S\$ 7,500 |
| X ≥ S\$30m | - S\$10,000 |

- End-of-Day Cheque/IBG Clearing

| | |
|-------------------------------------|-------------|
| For funding obligation (X) < S\$10m | - S\$10,000 |
| S\$10m ≤ X < S\$30m | - S\$15,000 |
| X ≥ S\$30m | - S\$20,000 |

MAS would debit the RTGS accounts of the defaulting banks for the amount of the default fees on the next working day after the default. As a default deprives net credit banks of the timely receipt of good funds, the default fees received by MAS, less MAS' processing fee of S\$500, would then be re-distributed to the net credit banks, by directly crediting their RTGS accounts, in proportion to the amount of their net credits.

2.5 Extension of Short-Term Intra-Day Credit By MAS

To minimize the possibility of "gridlock" occurring, MAS may extend short-term intra-day credit to banks on the following basis:-

- collateralised by banks' holdings of SGS held in excess of what is required to meet their MLA requirements. Banks must ensure that they have sufficient SGS before approaching MAS for short-term intra-day credit;
- short-term intra-day credit from MAS is charged at market interest rates;
- short-term intra-day credit would not be available automatically; banks have to approach MAS for credit on a case-by-case basis. MAS would, at its sole discretion, decide whether to extend the loans, taking into consideration the orderly functioning of the money market and MAS' monetary policy objective; and
- automatic repayment of the intra-day credit to MAS by 2.30 pm the same day. MAS would generate the repayment instruction. MAS would impose penalty interest charges (please see Appendix 3) on

repayments to MAS that do not settle at this time because of insufficient cover in the paying banks' RTGS accounts.

2.6 End-Of-Day Liquidity Facility

End-of-day liquidity facility will be an additional source of funds for banks to meet their liquidity needs. Under this facility, banks may borrow S\$ funds from MAS via overnight repo transactions of SGS. The details of the end-of-day liquidity facility are as follows:

- This facility is available to all participating banks of MEPS. Non-participating banks of MEPS should make appropriate arrangements with their agent banks for their financing needs. The operating window of this facility is available from the time of broadcast of cheque clearing figures to 5.50 pm daily, Monday to Friday.
- Banks drawing on this facility will receive S\$ funds only on an overnight basis via a SGS repurchase transaction. As a guide, the amount of funds that can be borrowed is subject to a maximum of 1 % of the bank's liability bases, or S\$200 million, whichever is lower. Where this amount is less than S\$2 million, the bank may borrow up to a maximum of S\$2 million. The minimum amount that a bank may borrow each time is S\$0.5 million.
- The interest rate to be charged on the repo transaction will be 2% above the reference rate. The reference rate is the 1-month S\$ SIBOR fixed by the Association of Banks in Singapore at 11 am Singapore time on the same working day.
- For the repurchase transaction, banks may use as collateral only SGS held in excess of what is required to meet their MLA requirements. Banks must ensure that they have sufficient SGS before utilising the facility. When valuing the collateral, the MAS will use the average closing prices of the SGS submitted by primary dealers.
- To effect timely settlement of the repurchase transaction, banks must ensure that confirmation for the transaction is sent to the MAS by 6.05

pm. Confirmations should be sent to the MAS' Finance Department either via fax at 6229 9393 or SWIFT authenticated message MT199.

- Only banks that have executed the Public Securities Association - International Securities Market Association (PSA-ISMA) master repo agreement with the MAS will be able to draw on the facility. Copies of the agreement are available upon request from the Monetary Management Division.
- Notwithstanding the maximum amount of S\$ funds that banks may be able to access through the facility, the MAS has the discretion to decide the final amount of funds which banks may borrow. The MAS reserves the right to revise the margin over the 1-month S\$ SIBOR as warranted by market conditions.
- The MAS also reserves the right to suspend the facility in exceptional circumstances, or deny any bank access to the facility if it is found to have abused the facility to contravene any of the MAS' regulations and guidelines.

2.7 Services for Non-Participating Banks

- a) Transfer of Funds/SGS into Non-Participating Banks' MAS Accounts
Notwithstanding their non-participation in the MEPS, non-participating banks would still be able to receive funds and SGS in their MAS current accounts and SGS-MLA accounts respectively. They will only have a SGS-MLA account (without free account nor a customer account).

Funds transfers from participating banks to non-participating banks would be credited directly to the non-participating banks' MAS Current accounts, while SGS issues would be credited into such banks' SGS-MLA accounts. However, participating banks may only make SGS transfers to non-participating banks on a "free of payment" basis, i.e. a transfer of SGS without a corresponding funds transfer instruction.

- b) Transfer of Funds or SGS Out of the Current or SGS-MLA Account
While non-participating banks should make S\$ interbank payments through participating banks appointed as their agents, it is recognized

that non-participating banks could, from time to time, need to withdraw funds or SGS from their MAS accounts for MCB or MLA purposes, respectively, in line with the level of their LB. In this regard, MAS' Finance Department would accept written authorized requests, in hand-delivered hardcopy or transmitted via SWIFT MT199, from non-participating banks to transfer funds or SGS out of their MAS Current accounts or SGS-MLA accounts, respectively.

Funds/SGS transfers effected by MAS are subjected to the following charges and conditions:-

- Charges

- Transfers to adjust balances in MAS Current account or SGS-MLA account for MCB or MLA purposes, respectively; : One free transfer at the beginning of each maintenance period
- All other transfers : S\$50 per transfer

- Conditions

- Funds Transfers

Requests for same-day transfers, which are duly authorized, must be received by MAS' Finance Department by 5.00 pm on weekdays and 12.30 pm on Saturdays;

Only balances in the MAS Current accounts of non-participating banks in excess of the intra-day MCB requirement, if any, may be transferred out of non-participating banks' MAS Current accounts; and

MAS will debit the MAS Current accounts of paying non-participating banks but will not input customer information on behalf of such banks.

- SGS Transfers

Requests for same-day transfers, which are duly authorized, must be received by MAS' Finance Department by 4.00 pm;

Only SGS in the SGS-MLA accounts of non-participating banks in excess of the 10% MLA requirement may be transferred out of the non-participating banks' SGS-MLA accounts; and

MAS would only accept SGS transfers out of the SGS-MLA account on a "free of payment" basis.

c) Account Statements

Non-participating banks will receive the statements of their MAS current and SGS-MLA accounts from MAS via MASNET.

3 THE MEPS FRONT-END SYSTEM

3.1 Introduction

The MEPS front-end system is built upon IBM's MERVA/AIX system that is customized to cater for the additional requirements of MEPS. The main functions available at the MEPS front-end system are:

- Message processing
- Queue management
- Online host enquiry
- Reports and backup
- User administration
- Static information maintenance
- Customization

The front-end system will also make provisions for interfacing messages generated by the participants' in-house systems for straight-through processing.

3.2 Message Processing

Message processing includes the following processes:-

a) Create

The message processing cycle begins when the user selects the create function to create a new MEPS message. After filling in appropriate information for the message, the user can choose to save it as draft for editing later or to accept and route it to the verification queue.

b) Verify

Another user will verify that the message has been keyed in correctly by re-typing selected important fields such as the transaction amount, value date and counterparty. If re-type fails, the user can try to re-type again. After three failed attempts, the message will be rejected and routed to an edit queue for amendments. When the message has been amended, it will return to the verification queue for re-typing again. When the message has been re-typed correctly, it will be accepted and routed to the authorization queue for approval.

c) Approve

The message in the authorization queue needs to be approved before it can be released to MAS. The approving user can choose to reject or accept the message. If the message is rejected, it will be routed to the edit queue for amendment or deletion. If it is subsequently amended, the message will have to be verified again before it can be approved.

d) Re-Approve

If the message is accepted, then depending on the transaction amount, it will be routed to the send queue for transmission or to a second level authorization queue for re-approval. The re-approving user can similarly reject or accept the message. If rejected, the message will be routed to the edit queue. If accepted, the message will be routed to the send queue and transmitted to MAS.

e) SGS Confirm

For SGS transactions, other than those initiated by MAS, such as sales and repo transactions, a confirmation procedure is required. The seller will construct the SGS message and send it to the buyer for confirmation. Upon the receipt of the buyer's confirmation, the SGS transaction will be processed by the MEPS host system. The front-end system provides a SGS confirmation queue for incoming SGS messages requiring confirmation.

The confirmation procedure is similar to that for verification for IFT transactions. The confirming user needs to re-type only selected important fields of the incoming message. If re-type is successful and the user choose to accept the message, a positive confirmation message will be generated. Alternatively, the user can choose to reject the message whereby a negative confirmation message will be generated. However, if re-type fails three times, a negative confirmation will be generated. In all the above cases, a user will be prompted to enter additional information before the confirmation message is routed for approval. A user can also choose to cancel the confirmation message at this point and repeat the above procedure to confirm the message.

The confirmation message will need to be approved (and re-approved if the transaction amount exceeds the re-approval limit) before it is released to MAS. The confirmation message will then be relayed to the sending participant.

f) Cancel

When there are insufficient funds and/or securities in the participants' settlement accounts, the transactions will be queued at the MEPS host system. These transactions pending settlement may be cancelled by the participants if required. The front-end system provides separate IFT and SGS pending settlement queues for participants to cancel transactions if they are not yet settled. The user initiates the cancellation process by choosing the transaction to be cancelled from a panel. When he confirms his intention, a cancellation message will be generated. Like other transaction messages, the cancellation message needs to be approved (and re-approved depending on the transaction amount) before it can be released to MAS.

For SGS sales and repo transactions, either seller or buyer can initiate the cancellation process. Unlike IFT cancellations, SGS cancellations, other than those initiated by MAS, require the counterparty's confirmation before they can be effected. Thus, a SGS cancellation message has to be sent to the counterparty for confirmation. When the counterparty confirms³ the cancellation, a confirmation message will be sent to MAS and relayed to the initiator of the cancellation process.

The cancellation request will be rejected if the original transaction is settled before MAS receives the cancellation request.

3.3 Queue Management

The participants can manage their IFT payment queues at the MEPS host by re-prioritizing the transactions. The participant can queue transactions under three priorities:

| <u>Priority</u> | <u>Description</u> |
|-----------------|--------------------|
| 3 | Urgent payments |
| 5 | Normal payments |
| 9 | Payment on hold |

(For the initial message create function, only priority 3 and 5 will be accepted by the system. Priority 9 is valid for the re-prioritization function only.)

³ Confirming a cancellation message is similar to confirming a SGS sales or repo message.

A confirmation message will be generated and this needs to go through the approval process.

By moving transactions from one priority level to another, participants can effectively determine the settlement sequence of their payments.

The front-end system provides the re-prioritization function only for the IFT pending settlement queues. Payments for SGS transactions cannot be re-prioritized. The user can select the IFT transaction to be re-prioritized from a panel. When he confirms his intention, a re-prioritization message will be generated and sent immediately to MAS.

The re-prioritization request will be rejected if the original transaction is settled before MAS receives the re-prioritization request.

3.4 Online Host Enquiry

The front-end system provides separate online host enquiry functions for IFT and SGS. This allows the participants to monitor their current account balances and SGS holdings and to retrieve the details of all the transactions pertaining to them. Upon request, a summary of their incoming queues, details of their outgoing payment queues, net cheque and IBG clearing amounts, SGS transactions (both payments and receipts) and the participants' transactions with MAS will be provided online.

3.5 Reports

Participants may also access the following front-end system databases to produce their own reports:-

- List of Participants
- List of Securities Issues
- List of Customers

3.6 User Administration

The user administration function allows the participant's MEPS administrator to create and delete users, and to define and maintain the security profiles of users authorized to access the system. The user's security profile includes access rights for the message processing

functions, queue management, online host enquiry, static information maintenance and customization.

3.7 Static Information Maintenance

The participant file maintenance function is provided for participants to maintain their counterparty institutions' current account codes, descriptions and shortnames. The participants will be provided with a pre-loaded participant file on initial roll-out.

A customer file maintenance function is also provided for participants to maintain their customers' information. Shortnames can be defined in the customer file for speedier data entry during message creation.

A database file of all outstanding SGS issues is maintained on the MEPS front-end system. The SGS issues file will be used for validation check during message creation. The front-end system will update the SGS issues file automatically whenever a new issue record is broadcast by the MEPS host settlement system.

3.8 Customization

The customization function allows participants to modify the front-end system to meet their unique needs. However, participants that do so will be responsible for ensuring the integrity of their front-end systems. Customization allows participants to:

- Adapt the supplied queues and routing tables to match their organization structure,
- Set and change approval and re-approval limits for various users, and
- Set up automatic printing of messages.

In addition to queue and routing table definitions, participants may also extend the front-end system via API programs.

3.9 External Systems Interface

Sample API interface programs for loading and unloading messages to and from the front-end system and detailed message formats will be provided to the participants.

4 THE MEPS SECURITY SYSTEM

4.1 Introduction

The areas of security covered are described briefly as follows:

- Operating system security
- Front-end application security
- Message security

As each participant will have its own system/security administrator and specific operational procedures, each will have to use its own discretion to implement the most appropriate security controls for the system if the participant chooses to deviate from the standard guidelines provided by MAS.

4.2 Operating System Security

The MEPS front-end system runs on IBM's AIX operating system. The key elements of AIX security for MEPS are:

- a) Password security
Password control parameters are set to enforce a certain level of password quality.
- b) File security
Critical files and directories are protected by appropriately setting permission bits.
- c) Captive accounts
Users are prevented from accessing AIX freely by implementing captive accounts.
- d) Network security
Unnecessary network services are disabled.
- e) System integrity
The Trusted Computing Base is installed.

4.3 Front-End Application Security

The following aspects of the front-end application security will be described here:

- a) Message processing security
- b) User administration security
- c) Database security
- d) Network communication security

4.4 Message Processing Security

The message processing functions for IFT and SGS operations are clearly separated and every stage of the message processing cycle can be controlled by granting or denying users access to the relevant queues. In addition, the dual control principle can be enforced by disallowing sequential operations on messages by the same user. Hence, the user who created the message cannot verify the same message; the user who verified the message cannot approve it; and the user who approve the message cannot re-approve it.

4.5 User Administration Security

Adding or changing a user's security profile involves two steps. The first is the actual definition or modification to the profile. The second step is approval of the change, only after which will the changes take effect.

The front-end application will not allow the administrator to approve changes to his own security profile. In addition, a user sequential access flag can be set so that two administrators are needed to add a new user or to effect changes to a user's security profile.

4.6 Database Security

The contents of the front-end system's message database are not encrypted but are protected against changes outside the front-end application by Cyclic Redundancy Checksum (CRC) checking. Messages manipulated directly in the database will fail checks by the front-end application and will be routed to CRC error queues to alert the security administrator.

4.7 Network Communication Security

MERVA link implements a form of network communication security by requiring two communicating systems to authenticate using a shared conversation user id and password when establishing connection and transferring data. The conversation user id and password are defined in both front-end and host systems. MERVA link will fail if either user id or password matching fails. The password is encrypted using MERVA's proprietary encryption routine.

4.8 Message Security

The MEPS messages will be protected by a combination of hardware and software security solution supplied by security vendor Algorithmic Research Limited. The tamper-proof cryptographic hardware (smart card readers at the participants and cryptographic server at MAS) ensure the secure storage of RSA private keys and perform all RSA cryptographic computations internally. The cryptographic software allows the implementation of sophisticated encryption and authentication algorithms for the MEPS. The key features of message security are digital signature and encryption.

4.9 Digital Signature

Digital signature for messages will use the 1024-bit RSA algorithm. Messages will be signed at the institution level. Digital signature performs two functions. Firstly it allows the receiver of the message to detect if the message has been tampered with during transmission. Secondly, it prevents the sender of the message from denying ownership because the signature can only be generated using the private key known only to the sender.

4.10 Encryption

Encryption will use triple DES keys. All MEPS messages will be encrypted before transmission to maintain the secrecy of their contents. A different, random encryption key will be used for each message and the protocol for exchanging the encryption keys will be transparent to the users.

4.11 Key Management

MAS is the Certification Authority for the participants. Keys generated by the participants need to be certified by MAS before they can be used. MAS will thus act as the trusted intermediary between participants. Messages sent from one participant to another through MAS will be authenticated and re-signed by MAS before being forwarded to the receiver participant. This simplifies the key management procedures as the participants will need to know only MAS' public RSA keys. MAS will know the public keys for all the participants and will store them in its public key database. MAS will not know the participants' private keys.

TIMINGS FOR THE MAS ELECTRONIC PAYMENT SYSTEM (MEPS)

| | Mondays – Fridays | Saturdays |
|---|-------------------|-----------|
| System opens to receive forward-dated IFT and SGS transactions | 6.00 am | 6.00 am |
| System opens to process same-day SGS transactions Note: For SGS transactions with payments, the payment instructions will only be processed for settlement from 9.00 am | 8.50 am | NA |
| System opens for real-time IFT and SGS settlement MAS inputs payments to/from participants due from/to MAS | 9.00 am | 9.00 am |
| <i>Cut-off for compliance with requirement to hold a minimum of 10% of liabilities base in SGS (whenever there is maturing SGS or at the start of a new maintenance period)</i> | <i>10.30 am</i> | NA |
| <i>Cut-off for provision of SGS closing prices (including accrued interest) by MAS before the start of a new maintenance period</i> | <i>10.30 am</i> | NA |
| Cut-off for settlement of IFT payments due to MAS before imposition of penalty interest charges by MAS | 10.30 am | 10.30 am |
| Cut-off for the repayment of short-term intra-day credit to MAS | 2.30 pm | NA |
| Cut-off for transmission of cheque data to ACH via CTS for mid-day cheque clearing | 2.30 pm | NA |
| Processing of CTS cheque data for mid-day cheque clearing by ACH | 2.30 pm – 3.00 pm | NA |
| Broadcast of mid-day net cheque clearing figures by MAS to banks <u>Note:</u> Net debits/credits to be posted to banks' payment queues at this time. | 3.05 pm | NA |
| Broadcast of net IBG clearing figures by MAS to banks <u>Note:</u> For information only. No debits/credits would be posted to banks' payment queues at this time. | 3.30 pm | 12.15 pm |

MEPS Functional Specifications

| | Mondays – Fridays | Saturdays |
|---|-------------------|-----------|
| Cut-off for funding of mid-day net cheque clearing debits | 3.45 pm | NA |
| Cut-off for receipt by MAS of requests for same-day SGS transfers by non-participating banks | 4.00 pm | NA |
| Cut-off for transmission of cheque data to ACH via CTS for end-of-day cheque clearing | 5.00 pm | 1.30 pm |
| Cut-off for receipt by MAS of requests for same-day funds transfers by non-participating banks Cut-off for same-day value SGS transactions | 5.00 pm | 12.30 pm |
| Broadcast of end-of-day net cheque and IBG clearing figures by MAS to banks <u>Note:</u> Net debits/credits to be posted to banks' payment queues at this time. | 5.45 pm | 2.05 pm |
| Cut-off for transmission of cheque data to ACH via CTS as late submission items for next business day mid-day clearing (or end-of-day clearing if the next business day is a Saturday). | 6.00 pm | 2.00 pm |
| Cut-off for funding of end-of-day net cheque/IBG debits Start of MCB funding period | 6.15 pm | 2.30 pm |
| Cut-off for funding of MCB shortfall Close of system for same-day value IFT transactions | 6.30 pm | 2.45 pm |
| Cut-off for forward-dated SGS transactions | 6.30 pm | NA |
| Cut-off for forward-dated IFT transactions | 8.00 pm | 3.00 pm |

MEPS CHARGES

The following MEPS messages are charged on a per-message basis, payable by the party initiating the MEPS message:-

| <u>Message Type</u> | <u>Name</u> | <u>Description</u> |
|--------------------------------------|-----------------------------------|--|
| <input type="checkbox"/> IFT100 | Customer Transfer | Payment advice with beneficiary or ordering parties information |
| <input type="checkbox"/> IFT202 | Interbank Transfer | Interbank payments without beneficiary or ordering parties information |
| <input type="checkbox"/> IFT113 | Pending Fund Loan | Loan of Pending Funds from a net credit bank to a net debit bank |
| <input type="checkbox"/> IFT754 | Notification | Payment notification without settlement |
| <input type="checkbox"/> SGS522 | SGS Transfer Free of Payment | SGS transfer free of payment initiated by seller |
| <input type="checkbox"/> SGS523 | SGS Sale/When Issue | - |
| <input type="checkbox"/> SGS542 | SGS Re-Purchase Agreement | - |
| <input type="checkbox"/> MT199 | Authenticated Free Format Message | - |
| <input type="checkbox"/> MT999 | Free Format Message | - |
| <input type="checkbox"/> SWIFT MT942 | Intra-day Statement | SWIFT statement generated by the MEPS-CLS interface. |
| <input type="checkbox"/> SWIFT MT950 | End-of-day Statement | SWIFT statement generated by the MEPS-CLS interface. |

INTEREST CHARGES FOR UNSETTLED IFT PAYMENTS TO MAS

Interest charges payable by participants for unsettled IFT payments to MAS, subject to a minimum of S\$100 or such larger sum as MAS may determine, shall be calculated from the repayment cut-off time of 10.30 am, 2.30 pm or 2.45 pm, as the case may be, on the value date until the time when payment is settled, whether on the value date or a date subsequently, and shall be calculated as follows:

- (a) the period or periods of time covered, or part thereof, in which the IFT amount remains unsettled, shall attract interest charge based on the prevailing intra-day or overnight interest rate, as the case may be, to be determined by MAS, calculated on the original unsettled IFT amount; and
- (b) the total interest charge shall be the aggregate of the interest charges computed for all the periods in which the original IFT amount remained unsettled,

where the interest charges are calculated according to the rate as corresponds to the period as follows:

| PERIOD | INTEREST CHARGE CALCULATION AND RATE |
|--|--|
| <u>Period 1</u> : 10.30 am to 2.30 pm on a business day (except a Saturday and 31 December) | Amount x Highest Intra-day Rate ¹ on the business day x 1/365 |
| <u>Period 2</u> : 2.30 pm to 5.30 pm on a business day (except a Saturday and 31 December) | Amount x Highest Intra-day Rate ¹ on the business day x 1/365 |
| <u>Period 3</u> : 5.30 pm on a business day, including the eve of a public holiday but excluding a Saturday and 31 December, to 10.30 am on the business day immediately following | Amount x Highest Overnight Rate ¹ on the first-mentioned business day x 1/365 (Applies to each business day on which repayment is overdue in Period 3. However, where the first-mentioned business day is a Friday or the eve of a public holiday, the Highest Overnight Rate ¹ on the Friday or eve of the public holiday shall apply to each overnight period from Friday through to Sunday and any public holiday in a continuous stretch, or to each public holiday, as the case may be.) |
| <u>Period 4</u> ² : 10.30 am to 2.45 pm on a business day which is a Saturday or 31 December | Amount x Highest Intra-day Rate ¹ on the Saturday or 31 December x 1/365 |
| <u>Period 5</u> ² : 2.45 pm on a business day which is a Saturday or 31 December, to 10.30 am on the business day immediately following | Amount x Highest Overnight Rate ¹ on the Saturday or 31 December x 1/365 (Applies to the overnight period on the Saturday or 31 December, and to the Sunday and any public holiday in a continuous stretch.) |

¹ As determined by MAS.

² Applies only where the repayment value-date is a Saturday or 31 December.