



CCASS/3 Messaging Specification for Participant Supplied System (PSS) – Part 1

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Modification History

Version	Date	Description and reason for modification	Changed Section(S)
1.0	13/9/01	1 st Creation	N/A
1.1	21/1/02	<ul style="list-style-type: none"> - Changed Section 5.1.2, Message Protocol to include "Multiple enquiry using Statement Message format". - Changed Section 8, Processing Notes for enquiry functions. - Changed Section 3.1.2, removed HA Virtual node option and renamed Standby Node to Secondary Node in the Sample IP table. - Changed Section 4.2, removed the workstation option of Win2K version. - Changed Section 6.2.1, modify the note in the message Header Block structure table to indicate that "<CRLF>" should not be considered in the message length computation. - Changed Section 6.2.3, modify the note in the message Trailer Block structure table to indicate that padding zero(s) are required to fulfil the checksum number length. 	3.1.2, 4.2, 5.1.2, 6.2.1, 6.2.3, 8
1.2	6/6/02	<ul style="list-style-type: none"> - Changed Section 6.2. All field in header block should be fix-length - Changed Section 7.1. Addition of "CCASS and Market Date Data File" and "Market Report Availability Date Data File" and removal of "Announcement Information File" for Start-of-Day report download 	6.2, 7.1
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		<p>and message flow for Enquire Settlement Account/Status functions</p> <ul style="list-style-type: none"> - Removed page 8 footnote. - Modified Section 6.2.1 to reserve Block 3's usage - Modified Section 7.1 to clarify that daily logon is required from PG to C/3 - Modified Chapter to include only Batch 3 Rollout functions - General editing changes in Chapter 8 	
3.1	19/04/06	<ul style="list-style-type: none"> - Modified Section 2.1 diagram to remove "ISDN" - Section 8.7.1 example, "E1" changed to "2M" 	2.1, 8.7.1
3.2	03/12/07	<ul style="list-style-type: none"> - Add Section 8.3.5 to illustrate the Input STI, Enquire STI functions - Remove Report list Appendix 	8.2, 8.3.5, Appendix A
4.0	02/05/08	<ul style="list-style-type: none"> - Modified Section 1.1 last paragraph on when HKEX will update this document - Modified Section 1.2 to remove ISO adoption of Corporate Action & Stock Borrowing & Lending in PG - Modified Section 2.1 to remove SWIFT Gateway as an access channel to CCASS; enhanced description of PG-API - General editing changes on Section 2.2 - Modified Section 3.2.3 to remove obsolete resilience mechanism in PG - Modified Section 4.1 to refer to PG Acquisition Information Package Section 5 for PG Hardware & Software configuration - Modified Section 4.2 on supported PSS platform - Modified Section 8.2 to provide notes on output message for online and overnight report download - Updated description, processing notes and reference notes of business functions in PG - Update Section 9.1 and related sub-sections on new PG-APIs: logonAtDayStart() and SubmitBig() 	<p>1.1</p> <p>1.2</p> <p>2.1</p> <p>2.2</p> <p>3.2.3</p> <p>4.1</p> <p>4.2</p> <p>8.2</p> <p>8.3.1.1, 8.3.1.4, 8.3.1.6, 8.3.2.1, 8.3.2.2, 8.3.3.1, 8.3.3.2, 8.3.4.1, 8.3.4.4, 8.4.1.1, 8.4.1.7, 8.5.1</p> <p>9.1</p>
4.1	20/10/2008	<ul style="list-style-type: none"> - Modified Table of Contents to show correct page number 	Table of Contents
4.2	04/03/2010	<ul style="list-style-type: none"> - Remove MC901 Start-of-Day Functions - Added Section 9.4 to explain PG-API connection usage 	Table of Contents, 2.3.2, 5.1.1, 7.1, 8.2, 8.6.5, 9.4
4.3	11/08/2010	<ul style="list-style-type: none"> - Introduction of Change Hold Matched SI and new report zipping mechanism 	Table of Contents, 8.2 & 8.3.1
4.4	15/10/2010	<ul style="list-style-type: none"> - Support Designated Bank User 	1 & 6.2.1
4.5	21/01/2014	<ul style="list-style-type: none"> - Update for PG Server 4.0 	3.1.2, 4.1, 4.2, 5.1.3, 8.7.1, 9.4
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4.7	26/10/2016	<ul style="list-style-type: none">- Update Section 9.4 about maximum connection value- Update Input SI Reference Notes	9.4 8.3.1.1
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1 Introduction

The objective of this CCASS/3 Messaging Specification is to provide functional and technical information for CCASS participants, its settlement agent and CCASS Designated Banks to develop interface between CCASS Participant Gateway (“PG”) and their in-house Participant Supplied System (“PSS”).

1.1 Overall PG/PSS Interface Development Approach

In the CCASS Architecture Upgrade Project, ISO 15022 Securities Messaging Standard (“ISO Standard”) will be adopted as the messaging standard which paves the road for Straight Through Processing. After conducting a thorough analysis on the ISO Standard, some ISO messages were selected for the interface development. The PG/PSS Interface Development Approach is defined as follows :

- ISO Message Development : For functionality that are fully compliant to ISO Standard in terms of business purpose and usage of fields.
- User-defined Message Development : For functionality that are not fit with ISO Standard, e.g., with different business usage, required additional fields.

This messaging specification will cover the necessary information for PSS interface development planning. This document will be subject to minor revisions from time to time due to enhancements initiated by the Exchange.

1.2 ISO Adoption in CCASS/3

Among the business transactions in ISO Standard, the following ISO messages will be used in the PG / PSS Interface :

Settlement Instructions

- MT540 Receive Free
- MT541 Receive Against Payment
- MT542 Deliver Free
- MT543 Deliver Against Payment
- MT548 Settlement Status and Processing Advice

Statements

- MT549 Request for Statement/Status Advice
- MT536 Statement of Transactions
- MT537 Statement of Pending Transactions

Account Transfer Instructions

- MT524 Intra-Position Instruction
- MT508 Intra-Position Advice

Proprietary ISO Message

- MT598 Proprietary Message

For the User-defined Messages, the message design will achieve conformity at the following levels which are in line with ISO Standard :

- Tag-based Message Design : Variable length / tag-based message design will be followed. Tags are classified as either mandatory or optional to reduce message size.
- Reference to Standard Tag Data Dictionary : ISO tags with same purpose and usage will be referenced in CCASS/3.
- Tag Format Convention : Representation of format convention will be followed in CCASS/3 (e.g., n represent numeric values and x represents any character).

Apart from messaging standard, the following data standards will also be supported in CCASS/3 :

- International Securities Identification Number (ISIN) Code for Securities Identification
- Bank Identification Code (BIC) for Participant Identification

1.3 Participant Supplied System (“PSS”) Interface Design Summary

The intended readers of this document are System Developers / Technical Support personnel responsible for the PSS Interface Development.

The content of this specification will provide relevant information for PSS Interface Developers to obtain an understanding on the following :

- Overview of CCASS/3 Initiatives related to PSS Design Implication.
- The approach to establish physical and network level communication between PG and PSS via LAN.
- Handling approach for message communication mechanisms of different message types.
- Standard and structure to be followed in the generation of PSS messages.
- Usage of API to provide communication between PSS and PG.

- An inventory of business functions and related message flows for implementation planning and subsequent detailed design and development.

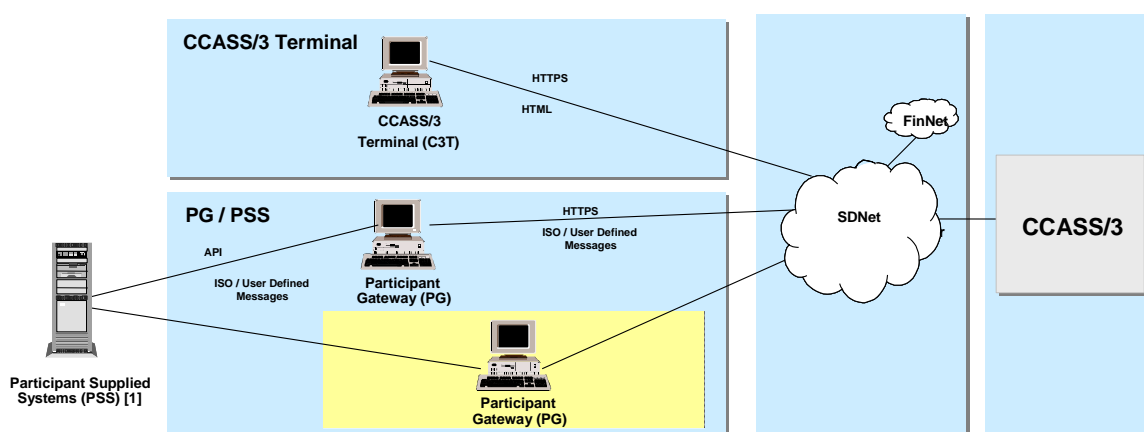
1.4 Document Structure

Section 2	Provides an overview of PG that includes its main features and capabilities. It describes the different types of information (Synchronous and Asynchronous messages and files) and their respective flow direction between PSS and CCASS/3.
Section 3	Provides general information about PG's network connectivity to PSS as well as to CCASS/3 WAN. It describes the 2 types of network configurations (single and dual PGs) that can be deployed by participants.
Section 4	Provides information about PG hardware and software configuration; and supported PSS platform.
Section 5	Illustrates the different types of message protocols (Interactive and Non-interactive) used in PSS and CCASS/3 communication. It also describes the communication flow for handling exceptional scenarios as well as the data security measures adopted in CCASS/3.
Section 6	Details the message structure of a message. This includes the illustration of message's Id, message's blocks, field format and message presentation.
Section 7	Illustrates the sequence of daily events in PSS and how these events are tied up with CCASS/3.
Section 8	Provides key design assumptions and requirements for PSS adopting CCASS/3 message format. It provides the complete list of functions/messages supported in CCASS/3 and information on how these functions/messages will be supported in CCASS/3.
Section 9	Provides a complete list of PG-API provided by CCASS/3. It details the requirements or parameters required by each API, followed by sample program codes on how these API are used.
Appendix A1	Example of ISO Message

2 Overview of Participant Gateway (PG)

This section provides an overview of key components of CCASS/3 (“C/3”) and the functionality of Participant Gateway (“PG”) and information flow between PG / PSS. The purpose is to give readers an understanding on PG and other related components so as to facilitate the development of PSS interface. Readers can also refer to other documentation published by the HKEX to obtain further information on C/3.

2.1 Overall Schematic



In C/3, a participant can access CCASS functionality via each of the following channels (or combination of channels):

- C/3 Terminal (“C3T”) – A browser-based interface that supports all existing CCASS Terminal functionality.
- PG – A message-based system that facilitates the integration with participant systems for accessing C/3 functionality. A participant system can connect to one or more than one PGs at one time.

PG is a C/3 feature implemented to facilitate the integration of the participant backend system with C/3, with the aim to achieve data straight through processing eventually. It is designed to support participant back office system (hereafter refer to as Participant Supplied System or PSS).

PG is a message-based gateway. This means that all communications between PSS and PG are done via messages. In general, each message sent from and received at PSS can represent a business transaction in C/3 (e.g., MT541 represents Input SI business transaction).

PSS would be either the participants’ custom developed system or commercial packaged solution. By integrating PSS to PG (via PG-API, a java-based library provided by HKEX and to be installed at PSS for message sending and receiving through API calls), participants can

design their clearing and settlement back-end process and front-end user interface to meet their business and operational requirements.

2.2 Features of PG

PG is a Windows-based device installed at the participant's premises which provides an access point through which a PSS can access C/3 system. This device will maintain an authorised point of contact as well as a secured communication channel for exchanging data between PSS and C/3 system.

PG will provide a connection point into the clearing system through the IP-based WAN. It will support an incoming TCP connection through which PSS can be connected.

PG system is a distributed system based on the client/server principle, where some of the functionality are decentralised among the participant installations (PG and PG-API) and other parts are centralised in the C/3 backend system. There are mainly 3 components in a PG system:

- **PG Administrator Main Window**
PG Administrator Main Window is the front-end GUI interface on a PG. It provides administrative functions that can be accessed in the PG. Through the Administrator Main Window, a participant can perform login/logout from C/3; check the communication status between PSS and C/3, etc.
- **PG Engine**
PG Engine serves as a common architecture component in PG that provides the technical services. This architecture component allows an integration of different electronic exchange platforms, information providers and other services in the future.
- **PG Application Programming Interface (PG-API)**
By using the programmable interface PG-API, it provides an open system that participants can attach their own applications. The Java-based application installed in PSS will shield away the technical complexity of communication between PSS and PG.

The following summarises the key features provided by PG:

<i>Message Routing</i>	PG acts as a router to route requests and responses between PSS and C/3. Except for certain participant functions that required asynchronous processing, all transactions from PSS are handled synchronously (e.g., request and response basis).
<i>Support for Concurrent Transactions</i>	PG is designed to support multiple transactions sent from PSS concurrently. Once PSS has performed valid login to PG, multiple transactions can be sent to C/3 (via PG) by using PG-API. However, PG's transaction throughput to C/3 is controlled within PG. Each PG is configured to be able to send a certain number of concurrent transactions to C/3 regardless of the total number of the transactions that it received from PSS.
<i>Message Encryption and Authentication</i>	PG is responsible to ensure secured transmission to C/3. All information transmitting between these 2 parties will be encrypted.

In addition, PSS will also have the flexibility to engage data encryption for communication between PSS and PG.

PG utilises smart card for its authentication to C/3, whereas PSS's authentication to PG is via PG-API that is using PSS Id and Password.

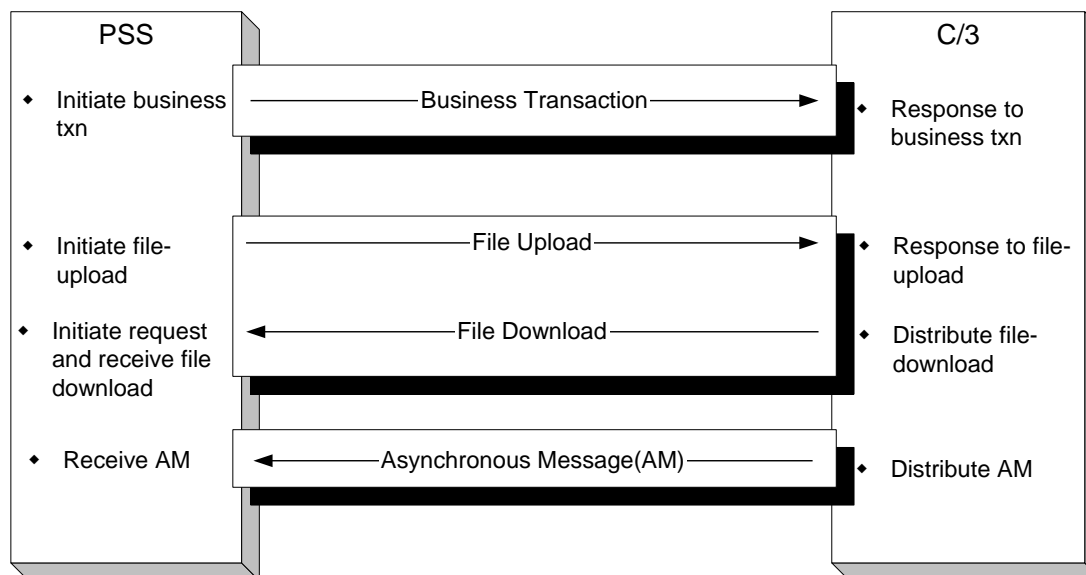
Asynchronous Message Processing

Asynchronous messages such as broadcast message and notification will be provided by C/3 (via PG). These messages will be distributed to PSS as and when they are available and received in PG.

2.3 Information Flow Between PSS and C/3 (via PG)

All functions supported by C/3 via PG can be categorised into 3 groups. They are categorised based on the flow of information and the type of information transmitting between the 2 parties.

The following diagram depicts the different types of information flow between PSS and C/3:



2.3.1 Business Transaction

Scope: Business transaction refers to most of the participant online functions. The transactions are initiated by PSS.

Information Flow: PSS ->PG->C/3

Message Type: Message-based using ISO and user-defined message format.

Example: Input SI, Input ATI, Change DI, Enquire Stock Account Movement, etc.

2.3.2 File Upload / Download

Scope: File-Upload refers to the Batch Input functions. The file contains multiple messages that are grouped together. This function is initiated by PSS.

File-Download refers to the report and data file sent by C/3 upon receiving the ad-hoc or scheduled request from PSS.

Information Flow: File-Upload: PSS ->PG->C/3

File-Download: C/3->PG->PSS

Message Type: File-Upload: File-based using user-defined message format. CCASS's existing file layout will be converted into Tag-based Message design that is aligned with ISO Standard.

File-Download: File-based using user-defined message format. In general, CCASS's existing IMG and RMF report layouts with minor modification will be used.

Example: File-Upload: SI File Transfer, ISI File Transfer, ATI File Transfer, etc.

File-Download: Provisional Clearing Statement, SI Activity Report, SI Batch Input Control Report, etc.

2.3.3 Asynchronous Message

Scope: Asynchronous messages refer to messages that are generated in C/3. PSS will be notified once the message is sent from C/3.

PSS is required to subscribe to this service using PG-API, if PSS prefers receiving asynchronous messages during C/3 business operation hours.

Information Flow: C/3->PG->PSS

Message Type: Message-based using user-defined message format.

Example: Broadcast and Notification messages.

Broadcast messages refer to CCASS existing messages to announce certain system events in CCASS such as "Provisional Clearing Statement is now available". These messages are generic to all participants.

Notification messages refer to messages that are specific to a participant. For example, it is used to notify certain participant about the completion of an ad-hoc SI batch file validation.

3 Network Connection

The section describes the network protocol and configuration that will be used by PSS to establish connection to PG.

3.1 The Network

Together with the introduction of the C/3 system, HKEX will build an efficient network infrastructure for accessing C/3 functionality on the basis of TCP/IP connection.

3.1.1 Network Connection

The following diagrams depict the possible connectivity for PG and PSS.

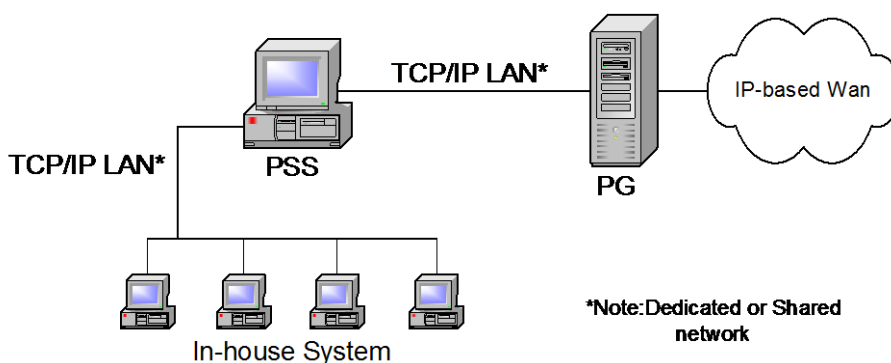


Figure 3.1-1: PG Network Connection with multiple PSS's Workstations

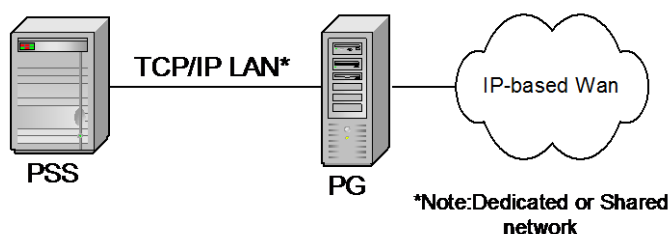


Figure 3.1-2: PG Network Connection with single PSS

Note that the participant's local area network (LAN) and the wide area network (WAN) to the C/3, if any, are transparent to PG application hence not shown in the above diagram. PSS can choose to have two Network Interface Cards (NICs) to separate the PG and In-house System, or PSS and in-house system could be on the same subnet.

On participant's side, PG is responsible for communicating with PSS but not further down to the other backend system. In order to guarantee maximum bandwidth available for traffic between PG, C/3 and participant's PSS, it is recommended to isolate the network segment between PG

and PSS from other participant's workstation although network topology allows one to connect all systems in a single network.

Each PG carries a PSS Id that is stored locally. The PSS Id is used to uniquely identify PSS connection to PG. It will not be sent to C/3 for authentication. PSS may connect to multiple workstations, and is expected to manage the multiple connections. PG will manage the single connection that coming from the PSS.

3.1.2 Network Protocols

Participant Gateway supports only TCP/IP protocol. The IP for the interface connecting to WAN is fixed and should be within the range of SDNet/2 assignment. For security reason, IP forwarding will not be enabled on PG. This is to avoid PSS to generate unnecessary traffic (via PG) to C/3 WAN.

3.2 Participant Network Configuration

The C/3 system network is a WAN, connecting to participant's LAN. The participant's network configuration consists of routers, PG, PSS and PSS's workstations in a LAN via Ethernet. HKEX will not test further technologies such as Token Ring or FDDI in order to limit the complexity of the PSS's front-end development and the test scenarios. However, these technologies can be considered as compatible for accessing C/3 system through PG.

3.2.1 Single PG Configuration

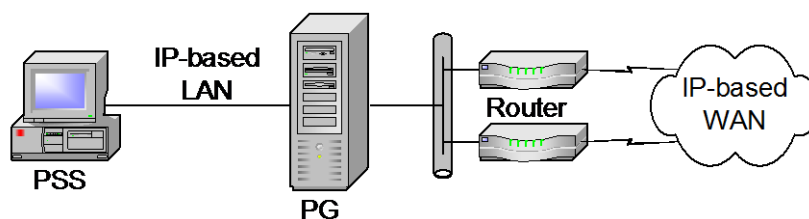


Figure 3.2-1: Network for Single-Node

An Ethernet LAN segment can be used for communication between PG and PSS using TCP/IP protocol. This refers to the Ethernet adapter being used for LAN Link as described in the hardware summary.

At the other end, another Ethernet WAN segment can be used for communication between PG and the router pair. The WAN segment refers to the Ethernet adapter being used for WAN Link as described in the hardware summary. This pair of routers provides network redundancy and their implementation is transparent to PG, which means PG communicates with only one router IP-address which may represent one router or another, or even just one physical router.

These two segments are effectively implemented as two separate subnets.

3.2.2 Dual PGs Configuration for High Resilience

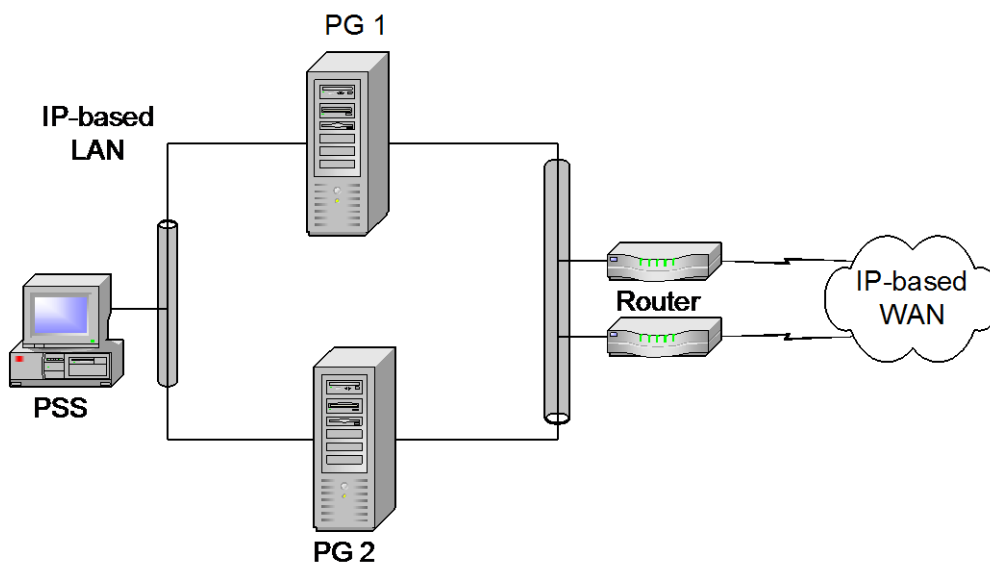


Figure 3.2-2: Network for Dual PGs Configuration

For each node of the PG pair, an Ethernet LAN segment can be used for communication between PG and PSS using TCP/IP protocol. This refers to the Ethernet adapter being used for LAN Link as described in the hardware summary.

At the other end of each node, another Ethernet WAN segment can be used for communication between PG and the router pair. This refers to the Ethernet adapter being used for WAN Link as described in the hardware summary. This pair of routers provides network redundancy and their implementation is transparent to PG, which means PG communicates with only one router IP-address which may represent one router or another.

3.2.3 High Resilience Mechanism

As there is no transactional data stored in PG, PG's high resilience option is best utilising the "active-active" type of configuration. In this configuration, one PSS can connect to one or more PGs at one time. However, each connection requires different login session from PSS that PSS will need to direct each transaction to the intended PG. In the event that if one PG fails, PSS can still continue sending transactions to the other PG without terminating all C/3 services.

In addition, availability of power supply can be improved by adding UPS behind a PC. Alternatively, redundant power supply that is in turn connected to different power sources, if hardware allows, also improves availability.

4 PG Hardware / Software Configuration

This section documents the hardware and software specifications for a PG.

4.1 PG Hardware & Software Configuration

PG is a Wintel-based Server to be installed at participant’s site. Participant should arrange to procure the hardware and software of production PGs from the accredited service vendors. The hardware and software configuration of PGs will be revised by HKEX from time to time based on the support status and models / versions available in the market. Please refer to “PG Acquisition Information Package Section 5” for the specification.

4.2 Supported PSS Platform

The platform independent nature of the Java technology allows PG-API that developed in Java Programming Language to benefit from the “write once run everywhere” feature. Hence, regardless of the PSS platforms, as long as there is a Java Runtime Environment (JRE) in the PSS platform, PG-API will be able to run. The following are the initial proposed JRE versions for various PSS platform for PG-API:

PSS Configuration	
Platform	Java™ Runtime Environment (JRE)
MS Windows Platform	Standard Edition version v 7 or above
Sun Solaris (SPARC and Intel)	Standard Edition version v 7 or above

If participants plan to use other combinations of platform and JRE, it is reminded that the selected platform and JRE should be included in the PG end-to-end test to ensure its smooth operation.

Note: The Java™ Runtime Environment (JRE) is the minimum standard Java platform for running applications written in the Java programming language. It contains the Java virtual machine (JVM), Java core classes, and supporting files. It does not contain tools or class that require for a development environment.

5 Message Protocol and Security Control

The section describes the various message protocols used between PSS and C/3, as well as the security control measures implemented for PSS and PG.

5.1 Message Protocol

Message Protocol refers to the communication mechanism and its corresponding message flows. It provides technical information on how the PSS should be designed to handle the different types of communication sequence when a message is transmitted between PSS and C/3.

In general, there are 2 types of message protocols in C/3 environment, namely:

- **Interactive Transactions:** This is used by most of the C/3 business transactions for both online and batch processing. It can be further breakdown into single and multiple responses sub-groups.
- **Non-interactive Transactions:** This is used to support C/3's Asynchronous Messages.

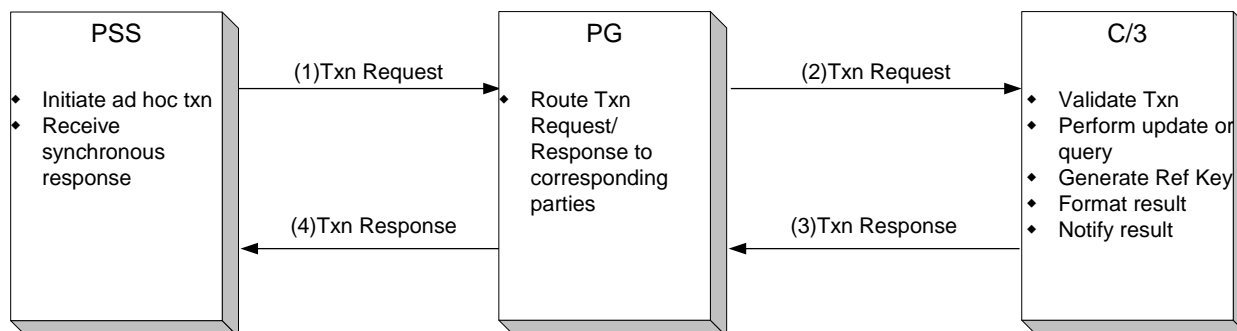
The following table shows how the different types of Information Flow (as described in section 2.3) that can be mapped to the message protocol:

Message Protocol	Message Protocol Sub-group	Information Flow
Interactive Transaction	<ul style="list-style-type: none"> • Single Response (IT-A) 	<ul style="list-style-type: none"> • Business Transactions: <ul style="list-style-type: none"> ○ Input/Add/Submit ○ Cancel ○ Change ○ Enquiry (Single Response) • File Upload • File or Reports Download (Single File)
	<ul style="list-style-type: none"> • Multiple Responses (IT-B) 	<ul style="list-style-type: none"> • Business Transactions: <ul style="list-style-type: none"> ○ Enquiry (Multiple Responses) • File or Report Download (Multiple Files)
Non-Interactive Transaction	<ul style="list-style-type: none"> • Subscribe/Notify (IT-C) 	<ul style="list-style-type: none"> • Asynchronous Message for Broadcast and Notification Messages.

The scope of message protocols used in C/3 environment is illustrated as below:

5.1.1 Interactive Transactions – Single Response (IT-A)

The following diagram depicts the sequence of message flow and the role for each component in this message protocol:



Definition and Feature

- PSS is the main initiator for both online and batch transactions.
- All transactions are synchronous processing in nature. It is based on the Request-Response processing, such that PSS will have to wait for the response from C/3 for every transaction sent. An end-to-end transaction is considered complete once the Txn-Response is received.

Scope

- Scope of the transactions includes:
 - Update functions such as Input, Change or Cancel SI.
 - Single Enquiry function such as Enquire SI using SI Input Number. These functions are identified as single enquiry functions in section 8.2, PSS Business Transaction to Message Mapping summary table. For example, Enquire SI (single), Enquire ISI (single).
 - File-Upload or Batch Input function such as SI file-upload.
 - Single Data File/Report-Download function such as SI Activity Report download.
- For Update functions, a Txn-Response may contain reference key that generated by C/3. The reference key is used for subsequent transaction with C/3. For example, SI Input Number is used as the reference key to support other SI related functions such as Cancel or Enquire SI.
- For Enquiry functions, if no record is found, a Txn-Response with dummy values is returned. Refer to Section 8 for the expected Txn-Response.

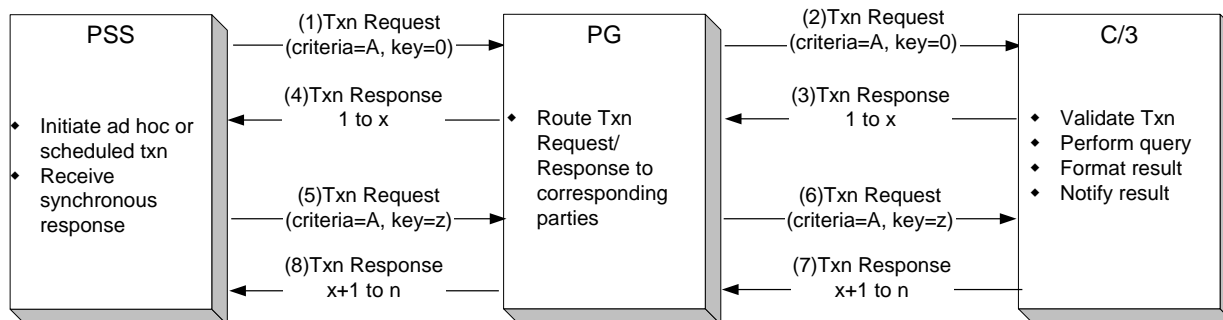
- For Batch Input functions, a Txn-Response indicates that the file is successfully received and validated at C/3. Details of the validation results that stored in the report (e.g., SI Batch Input Control Report) should be enquired and obtained separately.
- For Data File/Report Download functions, a Txn-Response will contain a single report (RMF format) or data file (IMG format).

Additional Notes

- A series of Txn Request/Responses are required to complete certain C/3’s business transaction. They include:
 - All Change and Cancel functions such as Change SI and Cancel SI. Each Change/Cancel function requires timestamp to ensure that the modifications are applied based on the latest data stored in C/3. This timestamp field can be obtained from an Enquiry function. Hence, an Enquiry function is required prior to the Change/Cancel functions. Please refer to “Processing Notes” section of each business transaction described in Section 8 for more details.
- For Update functions, a common MT598 that contains the status of the transaction can be used to represent most of the Txn-Responses of business transactions.

5.1.2 Interactive Transaction – Multiple Responses (IT-B)

The following diagram depicts the sequence of message flow and the role of each component in this message protocol:



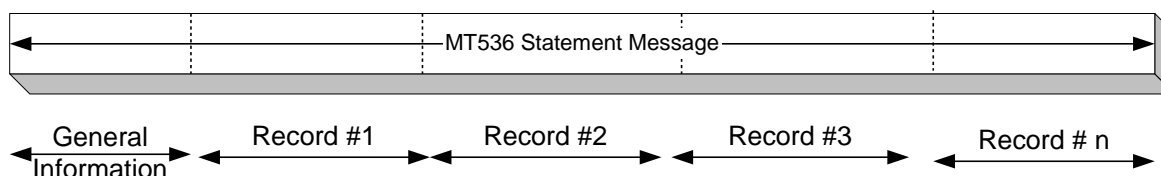
Note:
 x = maximum # of records can be stored in a single message
 n = total number of replies stored in C/3
 z = unique set of keys for retrieving next group/page of Txn-Response

Definition and Feature

- PSS is the main initiator for both online and batch transactions.
- All transactions are synchronous processing in nature. It is based on the Request-Response processing, such that PSS will have to wait for the response from C/3 for every transaction sent. An end-to-end transaction is considered complete once the Txn-Response is received.

Scope

- Scope of transactions includes:
 - Enquiry functions with multiple results, such as Enquire SI by specifying SI status as “matched”. These functions are identified as multiple enquiry functions in section 8.2, PSS Business Transaction to Message Mapping summary table. For example, Enquire SI (multiple), Enquire ISI (multiple)
- The multiple results or records from an enquiry function can be presented in a statement format. For example,



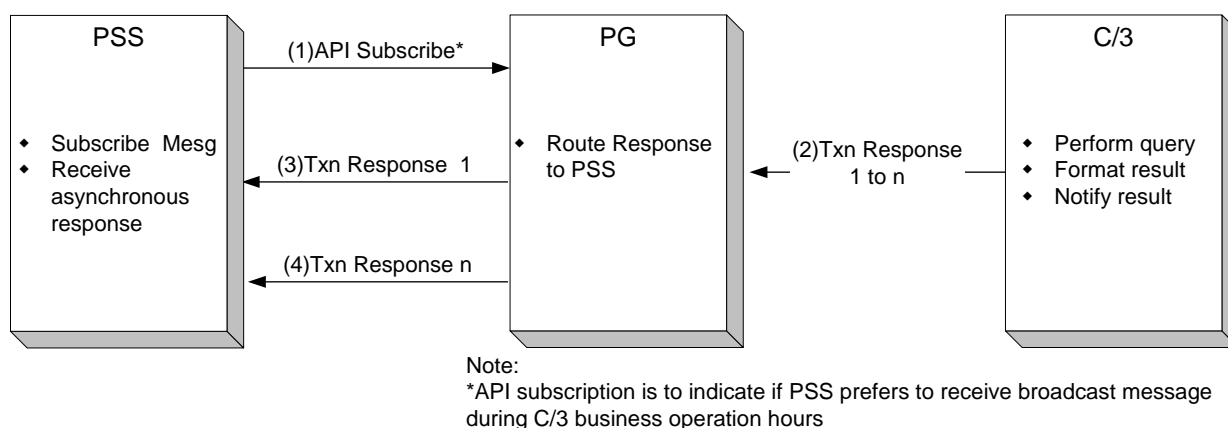
- For a statement message, generic information such as Preparation Date/Time, C/3 Transaction Reference fields of the message will be contained in the General Information sequence (e.g., mandatory sequence A) whereas, detailed information for the individual record will appear in the optional sequences such as sequence B, C, etc. For the optional sequences that represent the record-level, 2 types of details will be provided:
 - All parameters or the complete list of fields of the transaction will be provided. This is primarily used in ISO statement messages (e.g., MT536, MT537).
 - Only crucial information or a certain pre-defined set of fields for the transaction will be provided. If the complete list of fields is required, PSS is required to perform single enquiry to obtain all fields defined for that transaction. This is achieved using IT-A message protocol by submitting the reference key for that transaction (e.g., SI Input Number for Enquire SI status). In general, this applies to all user-defined statement messages (e.g., MC304 for Enquire ISI (multiple)).
- The maximum number of records that can be grouped together is defined in the message template for every Txn-Response. Hence, when this Txn-Response is received, PSS needs to compute the total number of records in it.
- For overnight report download, PSS is expected to schedule the Txn-Request to C/3 (after business operation hours) from time to time until all reports are received.

Additional Notes

- Txn-Request with certain criteria and a reference key is required to obtain multiple results. Subsequent results can be obtained by specifying the same criteria but providing another reference key.
- If no record is found for the Txn-Request, a Txn-Response with zero records can be expected. Refer to Section 8 for the expected Txn-Response.

5.1.3 Non-Interactive Transaction – Subscribe and Notify (IT-C)

The following diagram depicts the sequence of message flow and the role of each component in this message protocol:



Definition and Feature

- PSS is required to subscribe to PG (via PG-API), if PSS prefers receiving asynchronous messages from C/3.
- Txn-Response is generated in C/3 and distributed to PSS via PG.
- The Txn-Response from C/3 can contain more than one record (for both broadcast and notification), but these records will be distributed to PSS one at a time via function-callback mechanism. The function-callback is registered in PG-API when performing subscription. The end-to-end transaction is considered complete once all records are successfully distributed to PSS.
- C/3 is responsible to ensure that no duplication of message will be distributed to PSS.

Scope

- Scope of transactions includes:
 - Notification message such as announcement of the completion of ad hoc batch.

Additional Notes

- Based on the different types of messages received in PSS, PSS's callback function is expected to be able to interpret these messages and performs corresponding actions as required.
- C/3 will store both broadcast and notification messages for one business day, thus only messages for the day will be distributed to PSS.
- For dual PGs configuration, if the PSS subscribes both PGs for asynchronous messages, PSS may potentially receive duplicate messages. This is because messages are registered at PG /participant-level, and they will be delivered from C/3 to any PGs that have subscribed

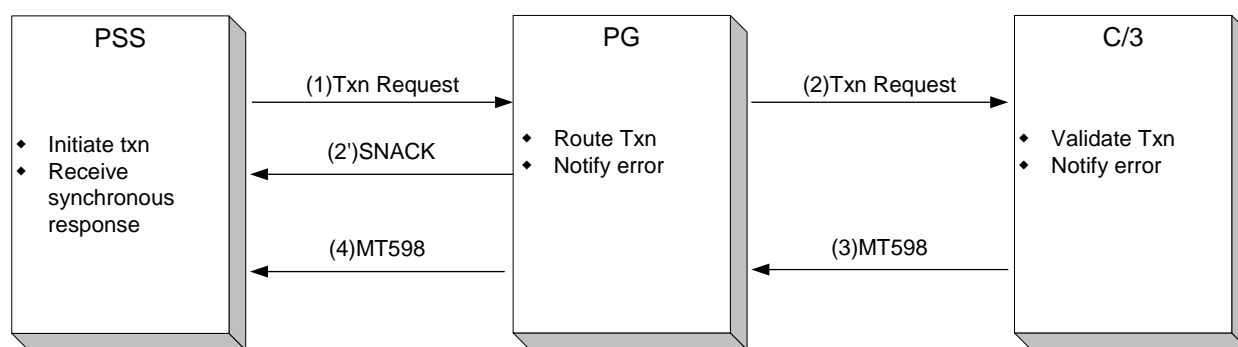
to asynchronous messages. Hence, PSS is recommended to perform only one subscription to either one of the PG in order to avoid receiving duplicate asynchronous messages. Please refer to section 9 for more details on the mechanism to subscribe C/3 asynchronous messages using PG-API.

5.2 Exception Handling

In C/3 the scope of the Exception Handling covers both Error Handling and Time out and Recovery scenarios.

5.2.1 Error Handling

The following diagram depicts the sequence of message flow and the role for each component in this message protocol:



Definition and Feature

- All transactions (Request/Change) sent from PSS will be validated in C/3.

Scope

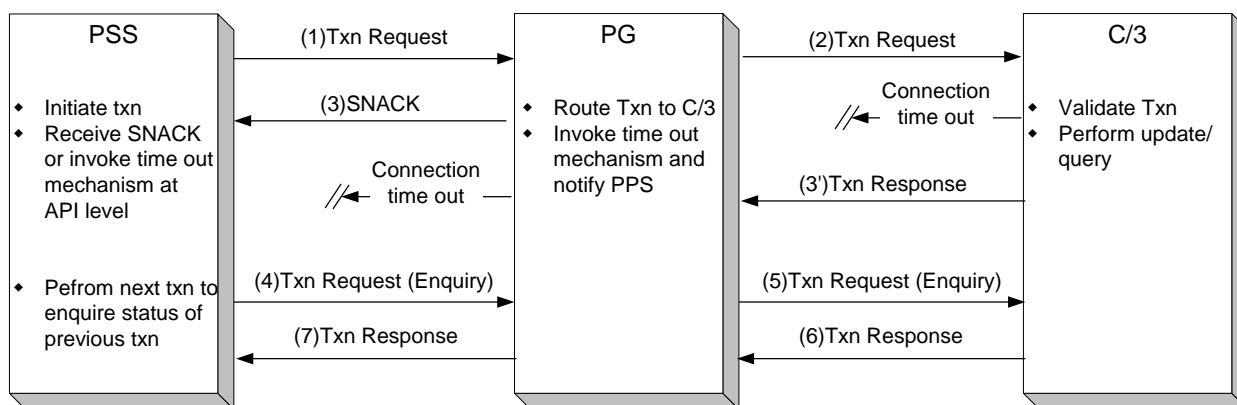
- Scope of validation includes:
 - Syntax checking such as message block structure, field format and field length
 - Content checking such as invalid Participant Id and stock code.
- SNACK represents system-related error messages generated in PG; MT598 represents error messages sent from C/3.

Additional Notes

- PSS is expected to perform its error handling or exception handling procedure when MT598 or SNACK is received.

5.2.2 Time out and Recovery

The following diagram depicts the sequence of message flow and the role for each component in this message protocol:



Definition and Feature

- Connection time out can happen in PG or PSS. Based on the different components where the time out takes place, the time out mechanism will be invoked.
- PSS is required to perform an Enquiry function to check the status of the previous transaction before deciding if resending of the previous transaction is required.

Scope

- All transactions including Interactive and Non-interactive modes.

5.3 Security Control

Several security control mechanisms are adopted to ensure secure transmission of information between PSS and C/3.

5.3.1 PSS logon and authentication

PSS is required to perform a valid login to PG before any transaction can be sent to or received from C/3. This is achieved by submitting a valid User Id and Password to PG via PG-API. A session ID that will be used for the rest of the communication between PSS and PG will be created for PSS if the login is successful.

PSS will also be notified of the connection loss if communication between PG and C/3 is terminated. Subsequently, PSS should perform re-login to PG after confirming that the communication between PG and C/3 is established. This is to avoid the transactions sent from PSS being rejected when the communication between PG and C/3 is no longer valid.

5.3.2 Encryption and Smart Card Login

Session encryption using 128-bit SSL technology is deployed for the connection between PG and C/3, and between PSS and PG. However, PSS will have the option via PG-API, to indicate whether the SSL encryption is necessary for PSS to PG connection that is resided within the participant's premises.

SSL encryption between PG and C/3 is default, and the encryption session is established when participant performs valid login to C/3 from PG. PG's login to C/3 is achieved using smart card

technology that is provided by C/3. The PG's credential (e.g., PG User Information) stored in the smart card will be used to identify a valid PG user.

5.3.3 Data Integrity and Duplication Checking

All messages transmitting between PSS, PG and C/3 will be checked for data integrity. A control record is added in the message trailer to ensure that the message is not being altered or there is no data loss during the transmitting process from one point to another.

Every transaction sent from PSS will need to include a Participant Transaction Reference ("PTR") to uniquely identify the transaction from others in C/3. C/3 will perform PTR's uniqueness checking to ensure that there is no duplication of PTR will be accepted. This PTR will be also be inserted in the response message in order to reference back the previous request message sent by PSS. For a doubtful transaction (e.g., timeout scenario), PSS can opt to submit the same transaction with the same PTR to check whether the previous transaction was successfully received in C/3. If the transaction was not received in C/3, the transaction will be accepted by C/3 otherwise, it will be rejected by C/3.

6 CCASS/3 Message Standard

This section describes the naming standard and message structure that adopted in C/3 message standard.

6.1 Naming Standard

6.1.1 Message Type

There are 2 types of messages used in C/3 Message Standard:

- a) Transactional Message – This includes both message-based and file-based transactions. These transactions are always initiated from PSS, and the corresponding responses are received from C/3 synchronously.
- b) Asynchronous Message – This refers to the messages sent from C/3 where no reply message is required from PSS:
 - Broadcast Message, such as announcement for batch settlement runs, report availability, marks calculation and other special notices.
 - Notification, such as announcement for the completion of ad hoc batch run.

6.1.2 Message Id

Individual C/3 message is identified by a Message Id that contains a 5-digit alphanumeric character. The format of the message Id is illustrated as below:

Macc

where “M” is the message prefix , “a” is the message type indicator, and “ccc” is a 3-digit fixed length numeric to indicate the function of the message. For example:

Message Types	Indicator	Message Id – Example	Function or role of Message
Transactional <ul style="list-style-type: none"> • ISO • User-defined 	<ul style="list-style-type: none"> • T • C 	<ul style="list-style-type: none"> • MT541 • MC001 	<ul style="list-style-type: none"> • Input SI • Input DI
Asynchronous Message <ul style="list-style-type: none"> • Broadcast • Notification 	A (for both)	<ul style="list-style-type: none"> • MA001 • MA002 	<ul style="list-style-type: none"> • Broadcast • Notification

In the examples shown above, the character “C”, and “A” are used to represent the C/3’s user-defined and asynchronous messages respectively.

6.1.3 Data Field and Format

Data fields contained in a message is recognised by a Field Tag. Individual Field Tag is a 3-digit value that can be represented in the following format:

nn***a***

where “nn” is 2-digit numeric characters that identifies the field and “a” is an uppercase letter that represents the field option used for that field. For example:

Field Tag	Field Name and Description
23G	Function of Message
35B	Identification of the Financial Instruction

The following shows the conventions used for the field format:

- Length restrictions
 - nn** – Maximum length
 - nn!** – Fixed length
 - nn * nn** – Maximum number of lines times maximum line length
- Type of characters
 - n** – Numeric (e.g., 4n means 4 numeric digits, “1234”)
 - d** – Digits with a decimal comma (e.g., 4d means 3 numeric digits with a decimal comma, “200,”)
 - a** – Uppercase letters (e.g., 5a means 5 uppercase letters, “ABCDE”)
 - c** – Uppercase alphanumeric (e.g., 3c means 3 uppercase alphanumeric, “A12”)
 - h** – Uppercase hexadecimal (e.g., 2h means 2 uppercase hexadecimal, “3E”)
 - e** – Space (e.g., 2e means 2 empty spaces, “ ”)
 - x** – This refers to the X Character Set defined in SWIFT (e.g., 4x means 4 alphabetic characters, “TIME”). Please refer to Messaging Spec Vol. 2 Session 1.2 point 12.
 - /, word** – Character as-is, or, word as-is (e.g., LINK means the indicated word will be used, “LINK”)
 - [...]** – Optional element with “...” represents any allowed combinations of length/character (e.g., [/4!c] can mean “/NEWM” or empty field)

The following are some sample data:

Field Tag	Field Name	Option	Field Format	Example and Description
16R	Start of Block	-	LINK	LINK -This is a constant character that indicates the beginning of a message block
23G	Function of Message	-	:4!c[/4!c]	:NEWM -NEWM indicates that this is a input message -[/4!c] is an optional field and it is not used
20C	Sender's Reference	-	:4!c//16x (Qualifier)(Reference)	:SEME//1234567890123 - "SEME" is the default value for Qualifier
35B	Identification of the Financial Instrument	-	[ISIN1!e12!c] (Identification of Security)	ISIN HK1234567890 - The ISIN code is "HK1234567890"
98a	Settlement Date	A	:4!c//8!n (Qualifier Date)	:SETT//20010613 - "SETT" indicates it is a settlement date and the date is June 13, 2001. - Option "A" is used. This indicates the date format is "YYYYMMDD"

6.2 Message Structure

C/3 message standard consists of the following blocks:

- Header – contains information to uniquely identify the message such as message length, message Id, session Id, message types and etc. All fields in the header block are of fixed length and mandatory. In the event that certain fields are not used, these fields should be filled with spaces or zero as indicated.
- Body – contains field tags with value that construct a message. The field tags used in a message are decided by the message Id that defined in the Header block.
- Trailer – contains checksum information to ensure data integrity. Data integrity is ensured for all information exchanging between PSS, PG and C/3.

All C/3 messages adopt the ISO block structure concept. Each block in a message is a logical grouping of data that serves a particular purpose.

Each block of a message begins and ends with a curly bracket character "{" and "}". All blocks are numbered, and the block numbers followed by a colon ":" are always the first characters within any block.

All messages sent from PSS are referred to as Input Message; all messages sent to PSS are referred to as Output Message.

For example, a Transactional Message may consists of:

{1: BASIC HEADER BLOCK}

{2: APPLICATION HEADER BLOCK}

{3: USER HEADER BLOCK}

{4: BODY TEXT BLOCK}

{5: TRAILER BLOCK}

Block 1, 2 and 3 contain header's information, block 4 contains business transaction related information, and block 5 is control record. Block 1, 2, 4 and 5 are the mandatory for all messages whereas, Block 3 is used depending on the purpose of the message.

6.2.1 Header Block

There are 3 header blocks in C/3 message standard. Block 1 and 2 are common and mandatory to all messages whereas, block 3 is optional depending on the type of messages used. In addition, these header blocks are also used for both Input and Output messages.

All fields within a header block for an Input Message can be constructed by PSS or PG; all fields within a header block for an output message can be constructed by C/3 or PG. All fields within header blocks are of fixed length; no delimiters are used. In the following table, the "Prepared by" column indicates that if PSS, PG or C/3 is required to prepare the header's field when constructing a message.

Block 1- Basic Header (Mandatory)

Field Name	Format	Field Description	Prepared by		
			PSS	PG	C/3
Block Identifier	1!a	The first character of this block. The identifier is defaulted to "1".	✓	✓	✓
Application Identifier	1!a	The Identifier is defaulted to "C" to indicate C/3 application.	✓	✓	✓
Message Type	2!a	Indicate message types: Transactional Message: <ul style="list-style-type: none"> - "MT" to indicate ISO message - "MC" to indicate user-defined message Asynchronous Message: <ul style="list-style-type: none"> - "MA" to indicate Notification and Broadcast messages. 	✓	✓	✓

Field Name	Format	Field Description	Prepared by		
			PSS	PG	C/3
Session ID	10!x	Session Id between PSS and PG. Generated by PG when PG-PSS connection is established for the first time using Logon() API. Subsequently, PSS needs to include this in the Input Message to C/3.	✓	✓	
Message Length (in bytes)	8!n	Pad with leading zeros by PSS for Input Message. This field is used by C/3 to compute total message length for Input message and by PSS for Output message that contained in block 4 (excluding "{4:<CRLF>" and "-}" characters).	✓		✓

Example:

{1:CMT000002059900065000}

For the purpose of demonstrating the composition of the different fields contained in the header block, even number fields are highlighted.

Block 2- Application Input/Output Header (Optional)

This block is required for Transactional and Asynchronous Messages.

Field Name	Format	Field Description	Prepared by		
			PSS	PG	C/3
Block Identifier	1!a	The first character of this block. The identifier is defaulted to "2".	✓		✓
I/O Identifier	1!a	"I" -to indicate Input message. It is prepared by PSS. "O" -to indicate Output message. It is prepared by C/3.	✓		✓
Message Id	3!a	Message Id for the Transactional and Asynchronous messages.	✓		✓
Participant ID/Bank ID*	6!a	Participant Id/Bank ID that assigned by C/3.	✓		✓
Message Priority	1!a	Reserved for future usage. Default to "X".	✓		✓

* Bank ID will be in following format BNK3!n, example BNK004

Example (This is an input message, MT541):

{2:I541B50011X}

Block 3- User Header (Reserved for future use)

This block is reserved for future use.

6.2.2 Body Block

The content of C/3 message is constructed in block 4.

Transactional and Asynchronous Message

The following are the generic characteristics of Transactional and Asynchronous messages for the body block:

- Each data field in this block begins with field tag defined between colons ":", and followed by the appropriate variable field value.
- A Carriage Return and Line Feed <CRLF> is a mandatory field delimiter that separates all fields in this block. A hyphen "-" is used right before the close curly bracket "}" to indicate the end of block 4.
- Each message body is of variable length as defined in each message.

- Data fields contained in a message have to be sequenced according to the order defined for that message.
- Fields or Sequences defined as optional are only required if they are applicable to that message. Hence, message with same Message Id can have different message length.
- Fields are logically grouped according to their usage for ease of reference (e.g., stock code, quantity are grouped in Mandatory Sequence B Trade Details of MT541 message).

Examples (only showing Sequence A, General Information of MT541):

```
{4:<CRLF>
:16R:GENL<CRLF>
:20C::SEME//PARTX12345<CRLF>
:23G:NEWM<CRLF>
:98A::PREP//20010606<CRLF>
:16R:LINK<CRLF>
:20C::PREV//123456789012345<CRLF>
:16S:LINK<CRLF>
:16R:LINK<CRLF>
:20C::RELA//123456789<CRLF>
:16S:LINK<CRLF>
:16S:GENL <CRLF>
....
-}
```

6.2.3 Trailer Block

Trailer is added to the message for control purpose (e.g., ensuring data integrity). It is always the last block in a message. PSS and C/3 are expected to prepare this information when preparing Input and Output messages respectively.

Block 5- Trailer (Mandatory)

Field Name	Format	Field Description	Prepared by		
			PSS	PG	C/3
Block Identifier	1!a	The first character of this block. The identifier is "5".	✓		✓
Checksum	16!h	<p>Begin with "CHK:" character and followed by the checksum information.</p> <p>It is the CRC32 of block 1, 2, 3 and 4 content. The CRC value is representing as 16 characters string of hexadecimal number.</p> <p>It is computed by PSS and C/3 for Input and Output Messages respectively.</p> <p>This checksum number should be padded with leading zero(s) to meet the required length.</p>	✓		✓

The trailer information appears as a sub-block and is bounded by block delimiters. For example:

```
{5:{CHK:1122334455AABBCC}}
```

6.3 Message Presentation

The following demonstrates the different types of messages that can be used within C/3 environment:

Input Transactional Message – MT541

```
{1:CMT000002059900065000}
{2:I541B50011X}
{4:<CRLF>
:16R:GENL<CRLF>
:20C::SEME//PARTX12345<CRLF>
:23G:NEWM<CRLF>
:98A::PREP//20010606<CRLF>
:16R:LINK<CRLF>
:20C::PREV//123456789012345<CRLF>
:16S:LINK<CRLF>
:16R:LINK<CRLF>
:20C::RELA//123456789<CRLF>
:16S:LINK<CRLF>
:16S:GENL <CRLF>
...
-}
{5:{CHK:1122334455AABBCC}}
```

In this example:

- Block 3 is not used and only Sequence A of MT541 is shown.
- Checksum digit in Block 5 is shown for illustration purpose only.
- The <CRLF> is only used in within Block 4 to separate one field Id to another; it is not required between blocks.
- Character “I” in Block 2 in to indicate that this is an Input Message.

Output Transactional Message – MT548

```
{1:CMT000002059900066770}
{2:O548B50011X}
{4:<CRLF>
:16R:GENL<CRLF>
:20C::SEME//PARTX12345<CRLF>
:23G:INST<CRLF>
:98A::PREP//20010606<CRLF>
:16R:LINK<CRLF>
:20C::RELA//D20123456<CRLF>
:16S:LINK<CRLF>
:16R:STAT<CRLF>
:25D::SETT/PEND<CRLF>
:16R:REAS<CRLF>
:24B::DEND//NARR<CRLF>
:28E::REAS/PAGE/00001/ONLY<CRLF>
:16S:REAS<CRLF>
:16S:STAT<CRLF>
:16S:GENL<CRLF>
...
-}
{5:{CHK:1122334455AABBCC}}
```

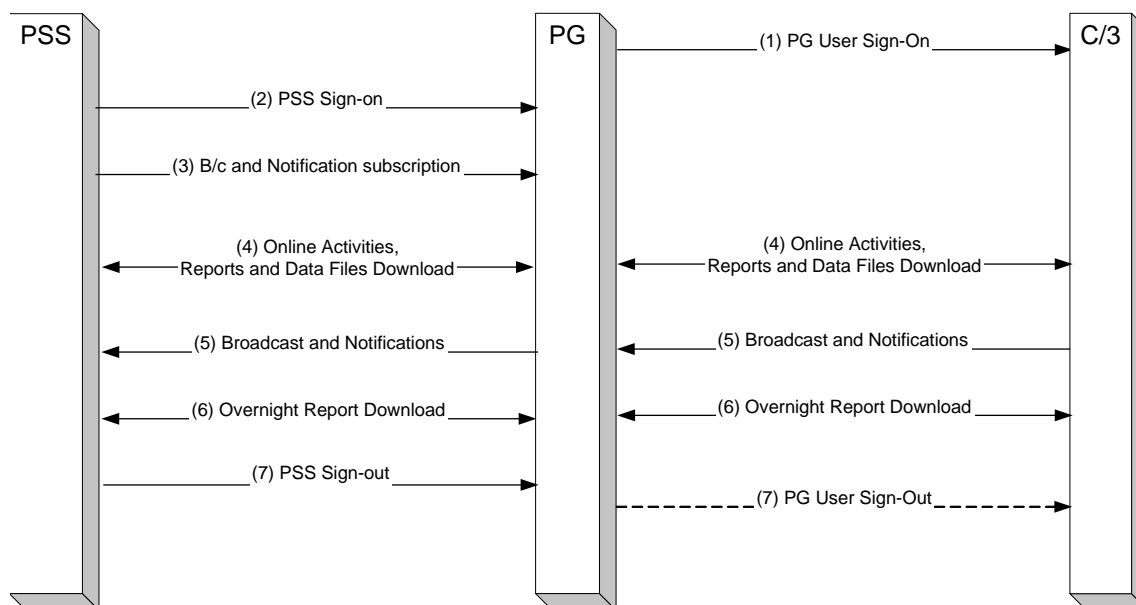
In this example:

- Block 3 is not used and only Sequence A, A1 and A2 of MT548 are shown.
- Checksum digit in Block 5 is shown for illustration purpose only.
- The <CRLF> is only used in within Block 4 to separate one field Id to another; it is not required between blocks.
- Character “O” in Block 2 in to indicate that this is an Output Message.

7 Daily Operation Flow

7.1 Daily Event in PSS

The following diagram depicts the sequence of events that PSS has to perform in order to complete the clearing activities for the day.



1. PG user sign-on to C/3

Participant is required to perform login to C/3 system using smart card provided by HKEX. Each smart card contains participant's credential that can be used to authorise participant access to C/3.

2. PSS sign-on to PG using PG-API

This is achieved at the application-level authentication via PG-API (Logon()) by submitting the valid PSS Id and Password to PG. Each PSS will be assigned an Id and Password.

Without valid sign-on to PG, PSS will not be able to submit any transactions to C/3.

3. Start of Day- perform subscription for broadcast and notification

Once PSS has successfully logon to PG, PSS can choose to receive broadcast and notification messages from C/3 during C/3 business operation hours.

This is achieved by performing subscription to PG using PG-API (SubscribeAsync()).

4. C/3 Online Activities

C/3's participant functions are accessible using PG-API (Submit()) throughout C/3 business operation hours.

- Reports and data files can also be downloaded as and when they are available in C/3.
5. Asynchronous Messages Depending on the availability of the asynchronous messages in C/3 (broadcast and notification), these messages will also be distributed to PSS.
 6. Overnight Report Download As C/3 certain reports are only available after business operation hours, PSS is required to schedule its job to request for the reports accordingly.

During this period, PSS can perform housekeeping for the non-reports related application and only have the scheduled job running until all reports are received in PSS.
 7. End of Day Once all requested reports are received, PSS can choose to disconnect from PG using PG-API (Logoff()). Subsequently, all applications in PSS can be shutdown (if applicable) and have the system ready for the next business day.

Participant can choose to Sign-Out from PG if required.

8 Business Transactions to Message Mapping

This section lists the application-level messages that are supported by C/3 (via PG). It describes the key processing logic required in PSS for handling messages that are mapped to C/3 business transactions.

8.1 Key Message Design Concepts / Assumptions

The following are highlights of the key design assumptions / requirements for PG / PSS interface:

- a) Proper User Access Control : Access Control and authority for PSS users are required to be defined and built in PSS. Proper security, e.g., password logon, should be implemented in their PSS.
- b) Transaction Amount Checking : Transaction Amount Checking at C/3 (which is used to determine whether approval is required or not) will NOT be performed for transactions input through PG.
- c) Maker-Checker Processing : Internal workflow processing, i.e., Maker-Checker Processing, will be removed for transactions input through PG.
- d) Local Validation : Basic validation should be performed in PSS, e.g., format validation, static data validation.
- e) Unique Participant Transaction Reference (PTR) : Transaction reference number should be unique in order to link update from C/3.
- f) Notification to PG Users : PSS has to implement user level message routing through the connecting PG if required.
- g) Resilience in PG : With the above design, participants can install more than one PGs to fulfil resilience requirements.
- h) Data Download : To support local validation, static information (e.g., stock list) should be downloaded and stored in PSS.
- i) Recovery of Critical Data : Regular data backup should be performed in case there is data corruption.

8.2 Summary of PSS Business Transactions to Message Mapping

The following is an inventory of business transactions and their related message flow and messages that will be supported by the C/3 via PG :

Business Transaction Group	Business Transaction	Message Flow (IT)	Message		Message Template (Input, Output)
			Input	Output	
Clearing & Settlement					
Maintain SI	Input SI	A	MT540, MT541, MT542, MT543	MT598	T01A, T29A
	Change SI	A	MC544	MT598	T01B, T29A
	Change Hold Matched SI	A	MC545	MT598	T34A, T29A
	Cancel SI	A	MT540, MT541, MT542, MT543	MT598	T01C, T29A
	Revoke Matched SI	A	MT540, MT541, MT542, MT543	MT598	T01D, T29A
	Enquire SI (single)	A	MC556	MT548	T04H, T03A
	Enquire SI (multiple)	B	MC557	MC558	T04J, T03C
	Enquire SI Unmatched Reason	B	MC559	MT560	T04I, T03B
Maintain DI	Input DI	A	MC401	MT598	T12A, T29A
	Change DI Requirement	A	MC402	MT598	T12B, T29A
	Enquire DI	A	MC403	MC404	T12C, T12D
Maintain ATI	Input ATI	A	MT524	MT598	T10A, T29A
	Enquire ATI	A	MC525	MC526	T10G, T10H
	Input Mass ATI	A	MT524	MT598	T10B, T29A
	Change Mass ATI	A	MT524	MT598	T10E, T29A
	Cancel Mass ATI	A	MT524	MT598	T10F, T29A
	Enquire Mass ATI	A	MT524	MT508	T10C, T10D
Maintain ISI	Input ISI	A	MC301	MT598	T11A, T29A
	Change ISI	A	MC306	MT598	T11B, T29A
	Cancel ISI	A	MC307	MT598	T11C, T29A

Business Transaction Group	Business Transaction	Message Flow (IT)	Message		Message Template (Input, Output)
			Input	Output	
	Enquire ISI (single)	A	MC302	MC303	T11D, T11E
	Enquire ISI (multiple)	B	MC304	MC305	T11F, T11G
Maintain STI	Input STI	A	MC192	MC193	T32A, T32B
	Enquire STI (single)	A	MC194	MC195	T32C, T32D
	Enquire STI (multiple)	B	MC196	MC197	T32E, T32F
	Revoke STI	A	MC198	MC193	T33A, T32B
<u>Enquiries</u>					
Enquire Settlement Account/Status	Enquire Due/Overdue Position	B	MC550	MT537	T04A, T06A
	Enquire Stock Account Balance (By Account)	B	MC551	MT536	T04B, T02B
	Enquire Stock Account Balance (By Stock)	B	MC552	MT536	T04C, T02C
	Enquire Stock Account Movement (By Account)	B	MC553	MT536	T04D, T02D
	Enquire Settlement Activity	B	MC555	MT536	T04F, T02F
	Enquire Stock Account Movement (By Stock)	B	MC554	MT536	T04E, T02E
	Enquire Money Position	A	MT549	MT536	T04G, T02G
<u>Asynchronous Message</u>					
Asynchronous Message	Broadcast / Notification Messages	C	NA	MA191	NA, T27B
<u>Report Download</u>					
Overnight Report Distribution (Download)	Refer to Section 4.2 "List of Reports and Availability Schedule" of CCASS Terminal User Guide For Participants in HKEX web site for the list of reports can be download (RMF and IMG)	A	MC905(retrieve ISO message)/ MZ905(retrieve zip stream)	Note (1)	T28E, NA
Report Download (Online)	Refer to Section 4.2 "List of Reports and Availability Schedule" of CCASS Terminal User Guide in HKEX web site for the list of reports can be download (RMF and IMG)	A	MC901(retrieve ISO message)/ MZ901(retrieve zip stream)	Note (1)	T28A, NA

Business Transaction Group	Business Transaction	Message Flow (IT)	Message		Message Template (Input, Output)
			Input	Output	
Report Profile Maintenance	Update Report Profile	A	MC910	MT598	T31A, T29A
	Enquire Report Profile	A	MC911	MC912	T31B, T31C
	Enquire Report Master/Availability List	A	MC913	MC914	T31D, T31E
<u>File Transfer</u>					
General File Transfer	SI File Transfer	A	MC801	MC898	T30A, T29B
	ATI File Transfer	A	MC802	MC898	T30B, T29B
	ISI File Transfer	A	MC804	MC898	T30D, T29B
	STI File Transfer	A	MC808	MC898	T30H, T29B

Note (1): Please refer to “CCASS/3 Messaging Specification for Participant Supplied System (PSS) – Part 2” Section 1.8 for handling of output message for report download.

8.3 Clearing and Settlement

The followings are the brief descriptions of Clearing and Settlement business transactions that are supported by the C/3 via PG.

8.3.1 Maintain SI

8.3.1.1 Input SI

This function is to submit a Settlement Instruction for delivery / receipt of securities either free of payment, delivery vs. payment (can be real time delivery vs. payment).

Processing Notes

- Different message types may be generated for receiving / delivering party as well as the payment method.
- Upon successful submission of the Settlement Instruction, C/3 will return a reply message specifying the SI Input number as a unique reference to the instruction.
- The following table shows the linkage of the message reference to the different Instruction Types and Payment Methods:

Instruction Types	Payment Methods	Message Reference
Receive	FoP	MT540
	DvP / RDP	MT541
Deliver	FoP	MT542
	DvP / RDP	MT543

- If the input message is processed successfully, the status of SI become “Unmatched”.

Other Reference Notes

- Please check the latest Terminal User Guide for Participant of SI Maintenance available window.
- SIs input/uploaded by the two concerned participants are automatically matched by CCASS during matching runs. Please refer to Section 6 of CCASS Operational Procedures for the timing of the matching runs (<http://www.hkex.com.hk/rule/ccassoptpcd/SEC06.pdf>).

8.3.1.2 Change SI

This function is used to change the details of a pending or an unmatched Settlement Instruction (SI) input by the participant if any error is found.

Processing Notes

- PSS is required to obtain the latest SI information stored in C/3 by sending a Single Enquire SI message (using SI Input Number) prior to sending the Change SI message.

- If the input message is processed successfully, the status of SI become “Unmatched”.

Other Reference Notes

N/A.

8.3.1.3 Change Hold Matched SI

This function is used to change the Hold Matched SI indicator for holding a matched SI for settlement or for releasing a matched on-hold SI for settlement.

Processing Notes

- PSS is required to obtain the SI input number and the timestamp of the SI record by sending a Single Enquire SI message prior to sending the Change Hold Matched SI message.
- If the input message is processed successfully, the Hold Matched SI indicator of the selected SI will be changed.

Other Reference Notes

- If either party or both parties have selected the Hold Matched SI indicator as “Yes” for the SI inputted, the status of the SI would become “Matched On-hold” after successful matching. After the initiating party(ies) of the “on-hold” mechanism has/have released the SI via Change Hold Matched SI function, i.e. change the Hold Matched SI indicator from “Yes” to “No”, the status of the SI would become “Matched” and the SI is ready for settlement.
- On the contrary, either delivering or receiving party or both parties can change Hold Matched SI indicator from “No” to “Yes” via Change Hold Matched SI function if they would like to put on-hold the SI from settlement. The SI status would become “Matched On-hold” after successful change.

8.3.1.4 Cancel SI

This function is to cancel a settlement instruction that is in pending or unmatched status.

Processing Notes

- PSS is required to obtain the latest SI information stored in C/3 by sending a Single Enquire SI message (using SI Input Number) prior to sending the Cancel SI message.
- The full message of the SI is required for the Cancel SI operation. However, only the key values will be validated, all other values are only for reference.
- Different message types may be generated for receiving / delivering party as well as the payment method.
- The following table shows the linkage of the message reference to the different Instruction Types and Payment Methods:

Instruction Types	Payment Methods	Message Reference
Receive	FoP	MT540

Instruction Types	Payment Methods	Message Reference
	DvP / RDP	MT541
Deliver	FoP	MT542
	DvP / RDP	MT543

Other Reference Notes

N/A.

8.3.1.5 Revoke Matched SI

This function is to cancel a settlement instruction that is in matched or matched on-hold or shares-on-hold status.

Processing Notes

- PSS is required to obtain the latest SI information stored in C/3 by sending a Single Enquire SI message (using SI input Number) prior to sending the Revoke SI message.
- The full message of the SI is required for the Revoke SI operation. However, only the key values will be validated, all other values are only for reference.
- Different message types may be generated for receiving / delivering party as well as the payment method.
- The following table shows the linkage of the message reference to the different Instruction Types and Payment Methods:

Instruction Types	Payment Methods	Message Reference
Receive	FoP	MT540
	DvP / RDP	MT541
Deliver	FoP	MT542
	DvP / RDP	MT543

Other Reference Notes

- For SI with ‘matched’ or ‘matched on-hold’ status, revocation of the matched SI is completed if either one of the concerned participants inputs a revocation instruction. It is unnecessary for both counterparties to do so. For SI with ‘shares-on-hold’ status, revocation can only be made by the receiving participant. After revocation is completed, the status of SI changes from ‘Matched’ / ‘Matched On-hold’ / ‘Shares-on-hold’ to ‘Revoked’.
- ‘Matched’ / ‘Matched On-hold’ / ‘Shares-on-hold’ SI revoked by the counterparty can be known immediately using the Enquire SI function or shown in the SI Activity or Intra-Day Due/Overdue ISI/SI Full List Reports.

- If corresponding settlement position is 'frozen' or 'cancelled', no revocation of the SI is allowed. When SI status is updated, corresponding status of settlement position will be updated to 'revoked'. Stock/money position will also be updated. For RDP SI, status of Payment instruction will also be updated.

8.3.1.6 Enquire SI

This function is to enquire details and current status of one or more SIs (after matching process performed at C/3).

Processing Notes

- This enquiry function supports both single and multiple enquiry modes.
- A Timestamp is returned in the single enquiry response message.

Other Reference Notes

- For single mode, SI input No. is a mandatory field.
- For multiple mode, SI information could be enquired with or without specifying a combination of category fields.

8.3.1.7 Enquire SI Unmatched Reason

This function is used to enquire the details of unmatched SIs with unmatched reasons.

The Enquire Unmatched SI Reason function can be used to make enquiries on the details of unmatched SIs with the unmatched fields identified. The unmatched fields are identified referring to the counterparty's most possible matching SI (i.e. having 3 unmatched fields or less) if found. Details of counterparty's unmatched SI will also be shown if the counterparty chooses not to hide the unmatched SI field contents to its SI counterparties.

Processing Notes

- This enquiry function supports only the multiple enquiry mode.

Other Reference Notes

N/A

8.3.2 Maintain DI

8.3.2.1 Input DI

Input a Delivery Instruction is to settle a due / overdue position which participant has opted for DvP / FoP settlement, or to put shares-on-hold pending money confirmation for a due / overdue position which participant has opted for RDP settlement. DI must be input by the delivery participant.

Processing Notes

- Timestamp is a mandatory field in the input message of 'Input DI'. Participant can obtain the timestamp of a position from the reply message of 'Enquire DI'.
- Upon successful submission of the Delivery Instruction, C/3 will return a reply message specifying the DI number as a unique reference to the instruction and the position will be settled.

Other Reference Notes

- CNS (Continuous Net Settlement) short positions, delivering IT (Isolated Trade) positions, and delivering SI (Settlement Instruction) and ISI (Investor Settlement Instruction) positions can all be settled by inputting a DI.
- IT, SI and ISI positions with 'DI requirement = Yes' must be settled by a DI input.
- Although IT, SI or ISI positions with 'DI requirement = No' and CNS positions are handled by CCASS's multiple batch settlement runs, settlement can also be effected by a DI input before the multiple batch run.
- The participant inputting the DI must be the **delivering** party for the position and the positions can only be settled one at a time. A position is **immediately** settled by inputting a DI, if the participant has opted for DVP/FOP settlement. A SI or ISI position status is updated to 'shares-on-hold' by inputting a DI, if the participant has opted for RDP settlement. Once a DI is input, it cannot be changed.
- Participants can specify:
 - Which **stock account** (clearing or segregated account) is to be used for settlement by the DI, if the position is to be settled on DVP/FOP basis. For positions to be settled on a RDP basis or linked SI position with its linked receiving SI settled (i.e. non-blanked SI on-hold quantity), the stock account originally specified when creating the transaction should be used.
 - Either a **full or partial** settlement. Partial settlement is allowed only for (1) IT positions with payment instruction as FOP and (2) CNS positions. Other types of position must be settled fully.
 - There are three **payment instructions** (FOP, DVP or RDP). FOP is for IT positions only (CNS positions must be of DVP type; SI positions' payment instructions are fixed at the time of SI matching); ISI positions' payment instructions are fixed at the time of ISI affirmation.

Upon successful submission of the Delivery Instruction, PG will return a reply message specifying the Delivery Instruction number as a unique reference to the instruction.

8.3.2.2 Change DI Requirement

Change the Delivery Instruction requirement for settling an IT, SI or ISI position. DI requirement can only be changed for unsettled positions.

Processing Notes

- Upon successful submission of the Change DI Requirement message, a positive acknowledgement will return.

Other Reference Notes

- DI requirement of unmatched SI and unaffirmed ISI cannot be changed by “Change DI Requirement” business transaction. A cancellation of the original unmatched SI or unaffirmed ISI has to be submitted and followed by a submission of new transaction or solely by submitting a ‘Change SI’ / ‘Change ISI’ input message.

8.3.2.3 Enquire DI

This function allow enquiry on the details of a position that requires Delivery Instruction.

Processing Notes

- Upon successful submission of the Enquire DI message, a positive acknowledgement with the position detail and timestamp will return.

Other Reference Notes

N/A

8.3.3 Maintain ATI**8.3.3.1 Input ATI**

This function is to transfer stock from one stock account to another, except Stock Collateral Control Account and SSA with Statement Service, of the same participant.

Processing Notes

- Before inputting an ATI message, the user should use the Enquire ATI in section 8.3.4.2 to confirm the stock amount is available.
- Upon successful submission of the Input ATI message, C/3 will return a reply message specifying the ATI number as a unique reference to the instruction.
- User could use the Enquire ATI in section 8.3.4.2 to check the account balance after inputting ATI message.

Other Reference Notes

- As CCASS uses the *Clearing* Account for stock settlement in multiple batches processing, this function is especially useful for transferring stock to the *Clearing* Account to prepare for settlement.
- Participants are required to specify the stock Accounts involved in the ATI (TO and FROM), the quantity of stock to be transferred and any additional remarks.

- Based on the current operation schedule, first session of input ATI service is available from 9:00 a.m. to 3:45 p.m., then second session commences at approximately 4:00 p.m. (announced by a broadcast message) and closes at 7:00 p.m.

8.3.3.2 Enquire ATI

This function is for enquiring balance (in number of shares) that is available for use in all valid stock accounts from account no. 1 - 20 for the selected stock before inputting Account Transfer instruction.

Processing Notes

- Upon successful submission of the Enquire ATI message, C/3 will return a reply message specifying the different available stock account balance for Input ATI function.

Other Reference Notes

- Based on the current operation schedule, first session of Enquire ATI service is available from 9:00 a.m. to 3:45 p.m., then second session commences at approximately 4:00 p.m. (announced by a broadcast message) and closes at 7:00 p.m.

8.3.3.3 Input Mass ATI

This function is to transfer all stocks that are eligible for Mass Account Transfer (e.g., excluding CNS On-hold shares on S-day) from the Clearing Account to a designated account of the same participant.

Processing Notes

- Upon successful submission of the Input Mass ATI message, a positive acknowledgement will return.

Other Reference Notes

- The mass ATI is only executed after the day-end batch processing. The mass ATI is created to transfer all stocks in the Clearing Account to another Account. Participants can specify the receiving account involved in the Mass ATI. If the transfer of only one stock is required, the Input ATI function should be used instead.
- Quantities of stock eligible for Mass Account Transfer are freely transferable shares which exclude shares allocated from batch settlement run on S-day. The participants cannot specify the particular stocks to be involved in the Mass ATI.

8.3.3.4 Change Mass ATI

This function is used to change the designated Account, to which stock will be transferred via the mass ATI transaction to transfer Stock from the Clearing Account (01) to a designated Account of the same Participant.

Processing Notes

- User needs to use the Enquire MASS ATI message to obtain the timestamp of the ATI that needs to be changed.
- Upon successful submission of the Change Mass ATI message and the ATI's timestamp, a positive acknowledgement will return.

Other Reference Notes

- Quantities of stock eligible for Mass Account Transfer are freely transferable shares which exclude shares allocated from batch settlement run on S-day. The participants cannot specify the particular stocks to be involved in the Mass ATI.

8.3.3.5 Cancel Mass ATI

This function is used to cancel the mass ATI transaction

Processing Notes

- Upon successful submission of the Cancel Mass ATI message, a positive acknowledgement will return.
- A timestamp is required to perform a Cancel Mass ATI function and the timestamp is available from the Enquire Mass ATI (8.3.3.6) response message.

Other Reference Notes

- Quantities of stock eligible for Mass Account Transfer are freely transferable shares which exclude shares allocated from batch settlement run on S-day. The participants cannot specify the particular stocks to be involved in the Mass ATI.

8.3.3.6 Enquire Mass ATI

This function is to enquire the details of mass ATI transaction.

Processing Notes

- The target Mass ATI account will return for this enquiry.
- A timestamp is returned from the response to reference a specific instance of the ATI for the Change and Cancel Mass ATI (8.3.4.3 and 8.3.4.4) function.

Other Reference Notes

- Quantities of stock eligible for Mass Account Transfer are freely transferable shares which exclude shares allocated from batch settlement run on S-day. The participants cannot specify the particular stocks to be involved in the Mass ATI.

8.3.4 Maintain ISI

8.3.4.1 Input ISI

This function is used to submit an investor settlement instruction for delivery / receipt of securities either free of payment, delivery vs. payment (can be real time delivery vs. payment).

Processing Notes

- A proprietary message is generated to handle all the receiving / delivering party as well as the different payment methods.
- Upon successful submission of the Investor Settlement Instruction, C/3 will return a reply message specifying the ISI Input number as a unique reference to the instruction.
- If the input message is accepted, the ISI status becomes Unaffirmed.

Other Reference Notes

- Based on the current operation schedule, first session of maintaining ISI is available from 9:00 am to 3:45 pm, then second session commences at approximately 4:00 p.m. (announced by a broadcast message) and closes at 7:00 p.m.
- Except those ISIs of which CCASS participants elect to effect ISI (Without Affirmation), ISIs input by CCASS participants must be affirmed by the investor participants counterparties.
- If the designated bank of the IP (investor participant) provides confirmation of EPI service and with the consent of the IP, CCASS participant may put the shares on-hold in the IP's stock account upon settlement until the corresponding payment is confirmed good by the designated bank on the following bank day. To adopt the DVP on-hold mechanism, CCASS Participant has to set the 'DVP ON-HOLD REQ' indicator of the relevant ISI to 'Y'. The indicator will be read out or displayed during affirmation for the IP to confirm.
- Upon successful submission of the Investor Settlement Instruction, PG will return a reply message specifying the ISI number as a unique reference to the instruction.

8.3.4.2 Change ISI

This function is used to change the details of a pending or an **unaffirmed** Investor Settlement Instruction (ISI) entered by the participant if any error is found.

Processing Notes

- PSS is required to obtain the latest ISI information stored in C/3 by sending a Single Enquire ISI message (using ISI Input Number) prior to sending the Change ISI message.
- If the input message is accepted, the ISI status becomes Unaffirmed.

Other Reference Notes

- ISI details can only be changed if the ISI has not yet been affirmed (i.e. PENDING OR UNAFFIRMED) by the counterparty.

8.3.4.3 Cancel ISI

This function is used to cancel an investor settlement instruction that is at pending or unaffirmed.

Processing Notes

- A proprietary message is generated to handle all the receiving / delivering party as well as the different payment methods.
- PSS is required to obtain the latest ISI information stored in C/3 by sending a single Enquire ISI message (using ISI Input Number) prior to sending the Cancel ISI message.

Other Reference Notes

- Only pending ISIs and unaffirmed ISIs can be deleted with this function.

8.3.4.4 Enquire ISI

This function is used to enquire the status of one or more SIs by specifying the selection criteria in the enquiry request.

Processing Notes

- This enquiry function supports both single and multiple enquiry modes.
- A timestamp is returned in the single enquiry response message.

Other Reference Notes

- The possible status of ISI can be pending, pending for affirm, unaffirmed, pending for settlement, settled, shares on hold or payment validated, DVP on-hold and unwinded.
- For single mode, ISI Input No. is a mandatory field.
- For multiple mode, ISI information could be enquired with or without specifying a combination of category fields.

8.3.5 Maintain STI

8.3.5.1 Input STI

Stock Segregated Account Transfer Instruction (STI) is used to effect stock transfer between Participant's stock segregated account (SSA) with Statement Service and its other Stock Accounts (including other SSA with Statement Service but excluding Stock Collateral Control Account) in CCASS.

Processing Notes

- Upon successful submission of a STI and the STI is accepted by CCASS, C/3 will return a reply message specifying the STI Input number as a unique reference to the instruction.

- In addition, STI status will also be returned in the reply message if the STI is successful accepted by CCASS. Those STI that are accepted by CCASS will be in 'Transferred' or 'Pending For Transfer' or 'Unaffirmed' status.
- For those STI that are successfully inputted via PG, no further authorisation is required.

Other Reference Notes

- Based on the current operation schedule, first session of STI input is available from 8:00 to 3:45 p.m., and then second session commences at approximately 4:00 p.m. (announced by a broadcast message) and closes at 7:00 p.m.

STI can be settled on a 'Free of Payment' (FOP) or 'Delivery verse Payment' (DVP) basis. STI between SSA with Statement Service should be settled on a "Free of Payment" (FOP). DVP STI is only available to the transferring of Eligible Securities out from a SSA with Statement Service (i.e. with payment to be credited to the SSA Statement Recipient).

8.3.5.2 Enquire STI

This function is to enquire details and current status of one or more STIs.

Processing Notes

- This enquiry function supports both single and multiple enquiry modes.

Other Reference Notes

- For single mode, STI Input No. is a mandatory field.
- For multiple mode, STI information could be enquired with or without specifying a combination of category fields.

4) Revoke STI

Revoke STI is used for revocation of STI under 'Unaffirmed' and 'Pending For Transfer' status.

Processing Notes

- PSS is required to obtain the latest STI information stored in C/3 by sending a Single Enquire STI message (using STI Input No.) prior to sending the Revoke STI message.
- Upon successful revocation of a STI, C/3 will return a reply message specifying the related STI Input Number and the updated status of the STI which should be 'Revoked'.

Other Reference Notes

- In the input message of Revoke STI, STI Input No. is a mandatory field.

8.4 Enquiry

8.4.1 Enquire Settlement Activities / Status

8.4.1.1 Enquire Due / Overdue Position

This function is used to enquire the summary/details of a stock's **due/overdue** positions, which helps prepare the settlement.

Processing Notes

- The position type and stock code are used as the keys of the Due/Overdue Position enquiry.
- For enquiry with multiple results returning, PSS can specify the selection criteria in the enquiry message.
- This template supports two different response patterns for the Enquiry Due/Overdue Position function. It supports the Summary List response pattern and the Position Detail response pattern.
- For Summary List response pattern, Block B will be repeated, with Block B1, B2, B2a, B2b and B2b1 inside. In Block B1, enquiry key, delivery quantity, receiving quantity and net quantity will be shown while for others, default value will be displayed. In the 1st Block B2b, only stock code will be shown while in the 2nd Block B2b, only position type and market will be shown. All the remaining fields will show default value.
- For Position Detail response pattern, Block B will be repeated with Block B1, B2, B2a, B2b and B2b1 inside. The Block B2b and B2b1 pattern must appear at least twice to represent a complete single response detail. In the 1st Block B1, enquiry key, original position quantity sign, outstanding position quantity sign will be shown while in the 1st Block B2b, stock code, original position quantity, original position trade amount, original position accrued interest, SI matched date/ISI affirmation date, settlement date, last update by, counterparty, internal transaction reference, settlement position number, SI linkage reference, participant reference and delivery/receiving account will be shown. In the 2nd Block B2b, outstanding position quantity, outstanding position accrued interest, outstanding position trade amount, purpose of SI/ISI, updated date/time, position type, payment instruction, DI requirement, frozen/buy-in trade/buy-in request alert, counterparty internal transaction reference, market and client account number will be displayed. All the other fields will show default value.

Other Reference Notes

- Two types of information for current due/overdue positions can be enquired via this function. They are:
 - Summary list of one or more position type(s) of a stock or a specific position type of stock positions
 - Details of an individual settlement position
- For enquiry of 'Position Detail', 'Stock', 'Indicator' and 'Market' are mandatory fields while for enquiry of 'Summary List', only 'Market' and 'Indicator' are mandatory fields.

8.4.1.2 Enquire Stock Account Balance (By Account)

This function is used to enquire the balances of all stock accounts holding a specific stock. The function helps participants check whether there is enough stock in their accounts for settlement.

Processing Notes

- The stock account number is used as the key for this Stock Account Balance (By Account) enquiry.
- For enquiry with multiple results returning, PSS can specify the selection criteria in the enquiry message.
- For Stock Account Balance response pattern, Block B1 will be repeated, with Block B1a inside. If the statement is empty, no B1 block will be shown.

Other Reference Notes

- Enquiries on the movement activities of a particular stock for the current day can also be made via Enquire Movement by A/C (8.7.1.4).

8.4.1.3 Enquire Stock Account Balance (By Stock)

This function is used to enquire the balances of all stocks in a specific stock account. The function helps participants check whether there is enough stock in their accounts for settlement.

Processing Notes

- For enquiry with multiple results returning, PSS can specify the selection criteria in the enquiry message.
- This template supports two different response patterns: Total Stock Account Balance pattern (TSAB) and Stock Account Balance by Stock response pattern (STAB).
- The stock code is used as the key for enquiry under Stock Account balance by Stock response pattern.
- For Total Stock Account Balance response pattern (TSAB), Block B will be repeated, with Block B1 and B1a2 inside. In each Block B the Stock Account Number is shown with a default value, as the function data is not presented by accounts. In each repeating Block B1 a Stock and ISIN code is shown with account balance. Market information is shown in Block B1a2. In the last repeating block of the page, the enquiry key is shown if this is not the last page.
- For Stock Account Balance by Stock response pattern (STAB), Block B will be repeated, with Block B1 and B1a2 inside. In each Block B one Stock Account Number is shown. In each repeating Block B1 a Stock and ISIN code is shown with account balance, which is always the stock code inputted for enquiry. Market information is shown in Block B1a2, with detailed on hold values and with hold divided balances. In the last repeating block of the page, the total on hold balance and total stock balance is shown. If this is not the last page the enquiry key is also displayed.

Other Reference Notes

- Enquiries on the movement activities in a particular stock account for the current day can also be made via Enquire movement by A/C (8.7.1.4).

8.4.1.4 Enquire Stock Account Movement (By Account)

This function is used to enquire the **movement activities** of any stock account occurring within one month.

Processing Notes

- The stock account number is used as the key for this Stock Account Movement (By Account) enquiry.
- For Stock Account Movement response pattern, Block B1 will be repeated, with Block B1a, B1a1 and B1a2 inside. If the statement is empty, no B1 block will be shown.

Other Reference Notes

- This allows enquiries on all stock account movements of a **particular stock account**.

8.4.1.5 Enquire Stock Account Movement (By Stock)

This function is used to enquire the **movement activities** of any stock account occurring within one month.

Processing Notes

- The stock code is used as the key for this Stock Account Movement (By Stock) enquiry.
- If transactions exist, Block B is repeated, with B1, B1a, B1a1, B1a2 inside, to show the transaction details. If the statement is empty, no Block B will be shown.

Other Reference Notes

- This allows enquiries on all stock account movements of a **particular stock**.

8.4.1.6 Enquire Settlement Activity

This function is used to enquire the settlement activities of all positions which have been settled on the current day.

Processing Notes

- The stock code, position type, settlement method and market are used as the keys for this Settlement Activity enquiry.
- For Settlement Activity response pattern, Block B will be repeated, with Block B1, B1a, B1a1, B1a2, B1a2a inside. The Block B1a must appear at least three times to represent a complete single response detail.

Other Reference Notes

- The user can specify the criteria (Stock, Position Type and Settlement Method and Market) for listing settled positions as per specified.

8.4.1.7 Enquire Money Position

This function is used to enquire settled and unsettled money positions due to/from HKSCC (for CNS positions) or other participants (for IT position and STI to be settled on DVP basis and SI and ISI to be settled on DVP or RDP basis) on the **current** day. This function helps participants plan their funding arrangements.

Processing Notes

- The currency is used as the key for this Money Position enquiry.
- Enquiry with multiple results returning is not supported. PSS can only specify one currency in the enquiry message.
- For Money Position response pattern, Block B1 will be repeated, with Block B1a inside.

Other Reference Notes

- Only CCASS eligible currencies are available for enquiry.

8.5 Asynchronous Messages

8.5.1 Broadcast / Notification Message Download

This function facilitates participants to receive C/3's general broadcast messages to all participants and notification messages for a specific participant during the online business hours. Messages of the current CCASS day are allowed to be retrieved with this function.

Processing Notes

- A submit message is required to initiate this message download process.
- Each broadcast and notification message is returned to PSS one at a time.
- From the message's Participant ID, the PSS could distinguish between a broadcast message and a notification message.

Other Reference Notes

- The following CCASS's processing status is available from this function each day:
 - Information on batch settlement runs
 - Periodic batch SI matching
 - Report availability - to assist the printing of reports and downloading of report data images (only shows availability of the current day's reports: e.g. *Provisional Clearing Statement, Final Clearing Statement, Settled Position Report*).

8.6 Report Download

8.6.1 Report and Data File Download (Online)

This function allows participant and designated bank to download C/3 participant report and data files during the online business hours. In general case, the report and data files of a maximum of three settlement days are allowed to be retrieved with this function.

Processing Notes

- For single or multiple files request, PSS can specify the different criteria such as report or data files' ID, CCASS date and market in the enquiry message for downloading a single file or specific group of files.
- Files are returned in open plain text format or zip stream and require simple parsing to retrieve different downloaded files one at a time.

Other Reference Notes

NA

8.6.2 Report and Data File Download (Overnight)

This function allows participant to download C/3 report and data files beyond the online business hours. In general case, the report and data files of current day are allowed to be retrieved with this function.

Processing Notes

- For single or multiple files request, PSS can specify the different criteria such as report or data files' ID, CCASS dates and market in the enquiry message for downloading a single file or specific group of files.
- Files are returned in open plain text format or zip stream and require simple parsing to retrieve different downloaded files one at a time.

Other Reference Notes

NA

8.6.3 Update Report Profile

This function allows participants to update C/3 participant report profile information related to the Overnight Report Distribution function.

Processing Notes

- Single or multiple report download requirements could be supported in one single message.
- Full report list from the Enquire Report Profile function is required to submit for this function.

Other Reference Notes

- Both Report Download and Data File Download Profiles are maintained using this function.
- Report profile is update at user ID level.

8.6.4 Enquire Report Profile

This function allows participants to enquire C/3 participant report profile information related to the Overnight Report Distribution function.

Processing Notes

NA

Other Reference Notes

- Both Report Download and Data File Download Profiles can be viewed using this function.

8.6.5 Enquire Report Master/Availability List

This function is used to enquire the C/3 report master list and the daily report availability list. The report master list refers to the list of all available reports provided by C/3. The daily report availability list refers to the list of available reports in C/3 at the time the request is submitted.

Processing Notes

- An indicator field within the message is to indicate different list (report master or daily report availability) requests.
- The most updated report list will return for each request.

Other Reference Notes

The report master list should be the same throughout the same business day if there is no further broadcast message notice.

8.7 File Transfer

8.7.1 General File Transfer

This function is used to **upload** batch file from PSS to C/3 (via PG).

Note: This batch option should be use only if the transaction data are generated in the participant's system in batch mode. The better approach would be inputting the data via the corresponding PG online option, i.e. online input to CCASS as soon as each transaction is generated in PSS

Processing Notes

- This General File Transfer message is capable of handling multiple instructions of the same function within one upload message.
- Upon successful submission of the General File Transfer Instruction, C/3 will return a positive acknowledge message.

Other Reference Notes

- The Batch File includes the following different file uploads: SI, ATI, ISI and STI.
- For PSS to successfully perform file upload before different batch upload cutoff time, PSS should allow sufficient time for file upload operation before the cutoff time. The file upload operation time is mainly composed of the network transmission time and the ISO format parsing time on C/3. From empirical study, ISO format parsing in C/3 takes approximately 0.06s per instruction.
- For all the PG upload files above, Corporate Communications Recipient upload file will only allow a max of 5002 records including 1 header record and 1 trailer record. All other upload files will allow 8002 records including 1 header record and 1 trailer record.
- C/3 may reject all the instructions within the upload file even if a single ISO formatting error is detected.
- Instead of inputting each entry at a time by on-line data entry, batch file containing a number of entries is uploaded to the C/3 to shorten the total data entry time. All upload batch files are ASCII files created according to the formats stipulated by HKEX.
- The validation rule of each entry is the same as their corresponding on-line data entry function.
- Since uploading a large file in ISO format through PG requires extra ISO format parsing, below are some examples to illustrate how to determine the minimum lead-time required for a file to successfully upload through PG to C/3 before the actual cutoff time. These examples are done based on a record size of 750bytes; in case the record size is different, the calculation needs will need adjustment accordingly.

The lead-time is mainly composed of ISO format parsing in C/3 and network transmission time calculated as following:

For Line speed of 1M with a SI File with 1000 records:

HKEX validation/processing time (80% are for ISO parsing):

$1000 \text{ records} * .06 \text{ sec/records} / 0.8(\text{ISO parsing factor}) = 75\text{sec}$

Network transmission time (assuming full bandwidth is available):

$1000 \text{ records} * 750 * 8 \text{ bits} * 1.3 \text{ network overhead} / 1024\text{kbit/sec} = \sim 7.5\text{sec}$

Total lead-time:

$75 \text{ sec} + 7.5 \text{ sec} = 82.5\text{sec} = \sim 1.3 \text{ minutes}$

For Line speed of 2M with a SI File with 8000 records:

HKEX validation/processing time (80% are for ISO parsing):

$8000 \text{ records} * .06 \text{ sec/records} / 0.8(\text{ISO parsing factor}) = 600\text{sec}$

Network transmission time (assuming full bandwidth is available):

$8000 \text{ records} * 750 * 8 \text{ bits} * 1.3 \text{ network overhead} / 2\text{Mbit/sec} = \sim 31\text{sec}$

Total lead-time:

$600 \text{ sec} + 31 \text{ sec} = 631\text{sec} = \sim 11 \text{ minutes}$

- After C/3 successfully parsed the ISO format and returned a positive acknowledgement message to PSS, the uploaded records will be further validated in C/3 Host. Participant should get the corresponding Input Control Report to ensure all the records have been successfully processed in C/3 Host.

9 Usage of APIs

This section describes the usage of PG-APIs to provide communication between PSS and PG.

9.1 Overview of PG-API

The PG-API is an interface, which provides the functionality and flexibility needed to serve as a standard open interface to the C/3 services. It is a set of HKEX custom-built Java library calls that facilitate the connection from the participant PSS to PG that passes messages, and return the responses for interactive access. Its role is to shield away the low level technical complexity involved in connecting PSS to PG. Participant will be able to incorporate these library calls to PSS or 3rd-party application to access C/3 online and batch functions.

Java is the supported programming interface language for the PG-API. PG-API uses socket and data stream as the communication mechanism to link PSS and PG. In this context, when PG first started, it will listen to a predefined port number waiting to be connected from the PSS. By specifying the predefined port number embedded in the PG-API, PSS will establish a socket session to the PG. If the credential information (e.g., PSS Id and Password) provided by the PSS for connection matches with the information stored in PG, a socket connection will be successfully established. Subsequently, all C/3 transactions will be sent and received through this connection.

As an option, the communication between PSS and PG can be under SSL protection. PG-API accepts an indicator stored in a configuration file to specify whether SSL is used. If SSL is used, 3rd party Java based SSL library is required for data encryption between PG and PSS.

PG-API is responsible for all operations of C/3 functions. They are summarised as below:

Logon()	<ul style="list-style-type: none"> Responsible for establishing socket connection to PG Performs login authentication by submitting valid PSS Id and Password Returns Session Id for subsequent PSS-PG communications
LogonAtDayStart()	<ul style="list-style-type: none"> This function is similar to Logon(), except that it will trigger PG to logon C/3 again.
Submit() / SubmitBig()	<ul style="list-style-type: none"> Sends PSS's messages and files to C/3 Receives C/3's synchronous message and file responses from C/3
SubscribeAsync()	<ul style="list-style-type: none"> Enables PSS's subscription of Asynchronous Messages (broadcast and notification from C/3) Stores PSS's callback function so that PG can deliver Asynchronous Message to PSS by invoking this function
UnsubscribeAsync()	<ul style="list-style-type: none"> Disables PSS's subscription of Asynchronous Messages, thus no

)	asynchronous messages will be delivered to PSS
Logoff()	<ul style="list-style-type: none"> Responsible for terminating PSS-PG communication
PGException	<ul style="list-style-type: none"> Responsible for error handling for PG-API. It allows PSS application to retrieve error codes and messages when exception is captured in PG-API.
IAsyncCallback	<ul style="list-style-type: none"> Provides an interface to PSS that requires implementation in PSS. PG-API will call the defined methods to deliver messages to PSS.

9.2 List of PG-API

PG-API is synchronous in nature. It supports business functions that require immediate feedback. For example, after an enquire SI message is sent to the PG from the PSS, the PG passes the message to C/3. PG will not reply to the PSS until a response message is returned from C/3.

9.2.1 Logon()

Logon() API is used by PSS to login a PG. This API requires the PSS Id and PSS password to connect to PG. In return, PG's response message will contain a PSS's Session Id that is required by the PSS application when creating business messages to be sent to the PG. Please consult the message format document to see how/where the SessionId should be written.

Syntax:

Logon (pssID: String, pssPassword: String): String

Input Description:

pssID

- The unique PSS Id for the PSS. This Id is assigned and stored in PG upon PG's first installation.

pssPassword

- The unique PSS password for the PSS. This password is assigned and stored in PG upon PG's first installation. This password is maintainable using PG Administrator Main Window.

Output Description:

- Positive response contains the unique Session Id required for subsequent API calls.
- Negative response is a PGException that contains error code, error message to describe the cause of the error. Please refer to subsequent section for more details on the usage of PGException class.

Example:

```
// one time only, this is used to initialise and create the PGDriver object
PGDriver.init("c:\\servers.conf");
//servers.conf file reference to server configuration file that
// required to start-up the PG-API application.
//It maps the servername to its server configuration file
//(e.g., server1=\\pss\\server1.conf)

// the following creates PGDriver object
// for cases that PSS connect to single PG server
PGDriver server1 = new PGDriver ("server1");

// Logon the PG server with PSS ID and password.
String sessionid = Server1.logon("pssid", "password");
//Depending on the return value, process next steps accordingly.
```

9.2.2 LogonAtDayStart()

LogonAtDayStart() API is used by PSS to login a PG. This API requires the PSS Id and PSS password to connect to PG. Comparing with Login() API, this LogonAtDayStart() API will force PG Server to logoff CCASS first and then re-logon CCASS System. After successful logon, a non-zero valued session ID of 10 characters will be returned. Subsequent message should specify this session ID otherwise the request will be rejected by PG server. With the use of this API, participants may opt to logon & logoff PG Server with smartcard less frequently, e.g. weekly rather than daily, and use this LogonAtDayStart() API to replace daily PG Server logon. It should be note that this API assumes smart card logon at PG Server is performed successfully previously e.g. during a weekly start-up, and under normal circumstances this API should only be called once per day.

Syntax:

LogonAtDayStart (pssID: String, pssPassword: String): String

Input Description:

pssID

- The unique PSS Id for the PSS. This Id is assigned and stored in PG upon PG's first installation.

pssPassword

- The unique PSS password for the PSS. This password is assigned and stored in PG upon PG's first installation. This password is maintainable using PG Administrator Main Window.

Output Description:

- Positive response contains the unique Session Id required for subsequent API calls.

- Negative response is a PGException that contains error code, error message to describe the cause of the error. Please refer to subsequent section for more details on the usage of PGException class.

Example:

```
// one time only, this is used to initialise and create the PGDriver object
PGDriver.init("c:\\servers.conf");
//servers.conf file reference to server configuration file that
// required to start-up the PG-API application.
//It maps the servername to its server configuration file
//(e.g., server1=\\pss\\server1.config)

// the following creates PGDriver object
// for cases that PSS connect to single PG server
PGDriver server1 = new PGDriver ("server1");

// Logon the PG server with PSS ID and password.
String sessionid = Server1.logonAtDayStart("pssid", "password");
//Depending on the return value, process next steps accordingly.
```

9.2.3 Submit() & SubmitBig()

Submit() & SubmitBig() API is used for submitting requests to C/3 via PG. This API requires the Input Message as the parameters. The Input Message must be a well-formatted structure as described in Section 6. The Session Id that was returned from the Logon() or LogonAtDayStart() API is required in the Input Message so that PG can identify and authorise the PSS's request.

Syntax:

Submit(inMsg : byte[]) :byte []

Submit(inMsg : byte[], timeout : int) :byte []

SubmitBig(inMsg : byte[]) : InputStream

SubmitBig(inMsg : byte[], timeout : int) : InputStream

Both formats can be used when submitting request to C/3 via PG.

Input Description:

inMsg

- Contains values for block 1, 2, 4 and 5. Block 3 is optional depending on the type of messages used. The SessionId should be written into block 1.

timeout

- This is for PSS to specify the socket timeout value for the communication with PGServer. If not specified, the socket (and in turn the API call) will wait indefinitely. The recommended timeout value for online transactions (input / change / cancel / enquiry) is > 45 seconds, and that for file transfer and report download is > 45 minutes.

Output Description:

- Output message with message structure described in each Message Id. For SubmitBig(), the output datatype is an InputStream, this allows the PSS to read the output message in a controlled manner so as to control the java heap usage of their PSS application, especially in case of report download where the size of output message can be of many mega bytes.
- Negative response is a PGException that contains error code and error message describing the error cause.

Example:

```
//one time only for initialisation. PSSApplication should keep reference of the //created PGConnection object
PGConnection con1 = server1.getConnection();

// submit 2 messages through server1
InputStream result2 = con1.submit(message1);
InputStream result3 = con1.submit(message2);

//Depending on the return value for result2 and result3, process next steps //accordingly
```

9.2.4 SubscribeAsync()

SubscribeAsync() API is used for subscribing to C/3's Asynchronous Messages. It requires a Java "class" implemented in PSS as the input parameter.

Syntax:

SubscribeAsync(callback : IAsyncCallback)

SubscribeAsync(callback : IAsyncCallback, asynIndex : int, broadcastIndex : int)

Both formats can be used when calling the SubscribeAsync() API.

Input Description:

callback

- Callback function written in PSS. This function is required to interpret the Asynchronous Message sent from C/3 via PG and perform subsequent processing logics in PSS.

Note: The following parameters are optional for this overloaded method call. If they are not specified, the PG's asynchronous(notification)/broadcast message service will distribute messages from its current state of the day. Otherwise, the service will use the supplied parameters and reset its state. In the case of one PSS connecting to multiple PGs , there is a risk of duplicate messages.

asyncIndex

- The starting point (asyncIndex +1) of the Notification/Asynchronous message that PSS prefers receiving from.

broadcastIndex

- The starting point (broadcastIndex +1) of the Broadcast message that PSS prefers receiving from. Output Description:

Invoke callback function implemented in PSS when a new message or other event occurs.

9.2.5 UnsubscribeAsync()

UnsubscribeAsync() API is used for un-subscribing to C/3's Asynchronous Messages.

Syntax:

UnsubscribeAsync()

Input Description:

None.

Output Description:

None.

Example:

Usage of SubscribeAsync() and UnsubscribeAsync() API

```
// AsyncCallback is an class written by client.
```

```
IAsyncCallback callback = new AsyncCallback();
```

```
server1.subscribeAsync(callback);
```

```
// continue with other business function.
```

```
// do not want to receive async message from server1 anymore.
```

```
Server1.unsubscribeAsync();
```

```
// receive from a certain index number, asyncIndex and broadcastIndex  
Server1.subscribeAsync(callback, 50, 41);
```

Note: Please refer to subsequent IAsyncCallback() Interface section for more details on the implementation of IAsyncCallback() in PSS.

9.2.6 Logoff()

Logoff() API is used for closing the connection from PG. When this API is issued, no more requests are allowed from PSS and the broadcast connection will be cut off. However, existing requests are allowed to be completed.

Syntax:

```
Logoff( )
```

Input Description:

None.

Output Description:

None.

Example:

```
// logoff to disconnect from PG.  
server1.logoff();
```

9.2.7 PGException Class

PGException is an exception class that is invoked when any error occurs in processing the API methods. There are two methods that PSS application can be used to notify the errors.

9.2.7.1 getErrorCode()

This method returns the error code of the exception caught during the processing of PG API method.

Syntax:

```
getErrorCode( )
```

Input Description:

None.

Output Description:

Error code of long data type.

Example:

```

Try
{
    // calling PGAPI methods.
}
catch (PGException exp)
{
    // print the error code
    System.out.println("Error code = " + Long.toString(exp.getErrorCode()));
    // print the error message
    System.out.println("Error message = " + exp.getMessage());
}

```

9.2.7.2 getMessage()

This method returns the error description of the exception caught during the processing of PG API method.

Syntax:

```
getMessage( )
```

Input Description:

None.

Output Description:

Error description in String data type.

Example:

```

Try
{
    // calling PGAPI methods.
}
catch (PGException exp)
{
    // print the error message
    System.out.println("Error message = " + exp.getMessage());
}

```

9.2.8 IAsyncCallback Interface

IAsyncCallback is an interface that requires implementation in PSS application in order to receive asynchronous messages. PGAPI will call these methods to deliver the message when the message is available.

9.2.8.1 newMessage()

PG API calls this method to pass the asynchronous message to PSS application.

Syntax:

```
newMessage( )
```

Input Description:

Byte array of message text.

Output Description:

None.

9.2.8.2 shuttingdown()

PG API calls this method to inform PSS application that the asynchronous message socket has been closed down. Upon receiving this event, PSS should subscribe to PG again in order to receive further asynchronous messages.

Syntax:

```
shuttingdown( )
```

Input Description:

None.

Output Description:

None.

Example:**Implementation of IAsyncCallback() in PSS**

```
Import com.hkex.pg.client.IAsyncCallback;
public class AsyncCallback implements IAsyncCallback
{
    // When the incoming async message is detected,
    // the relevant method on the callback object will be invoked.
    // When implementing newMessage(), remember that the PG-API's thread is invoking
    // this method, so the implementation should not block or spend time processing.
    // It is recommended that the implementation push the message onto
    // an application queue to be processed by daemon threads.

    public void newMessage( byte[] message ) {
        // Push message onto queue to be displayed in window, or
        // call other function to process the message according to business requirement.
    }
}
```

```
}
```

```
// If the broadcast connection dies, the method shuttingDown() will be invoked.
```

```
// The application can then attempt to subscribe again if it so wishes.
```

```
public void shuttingDown() {
```

```
    // Set an application flag so that PSS application knows that the
```

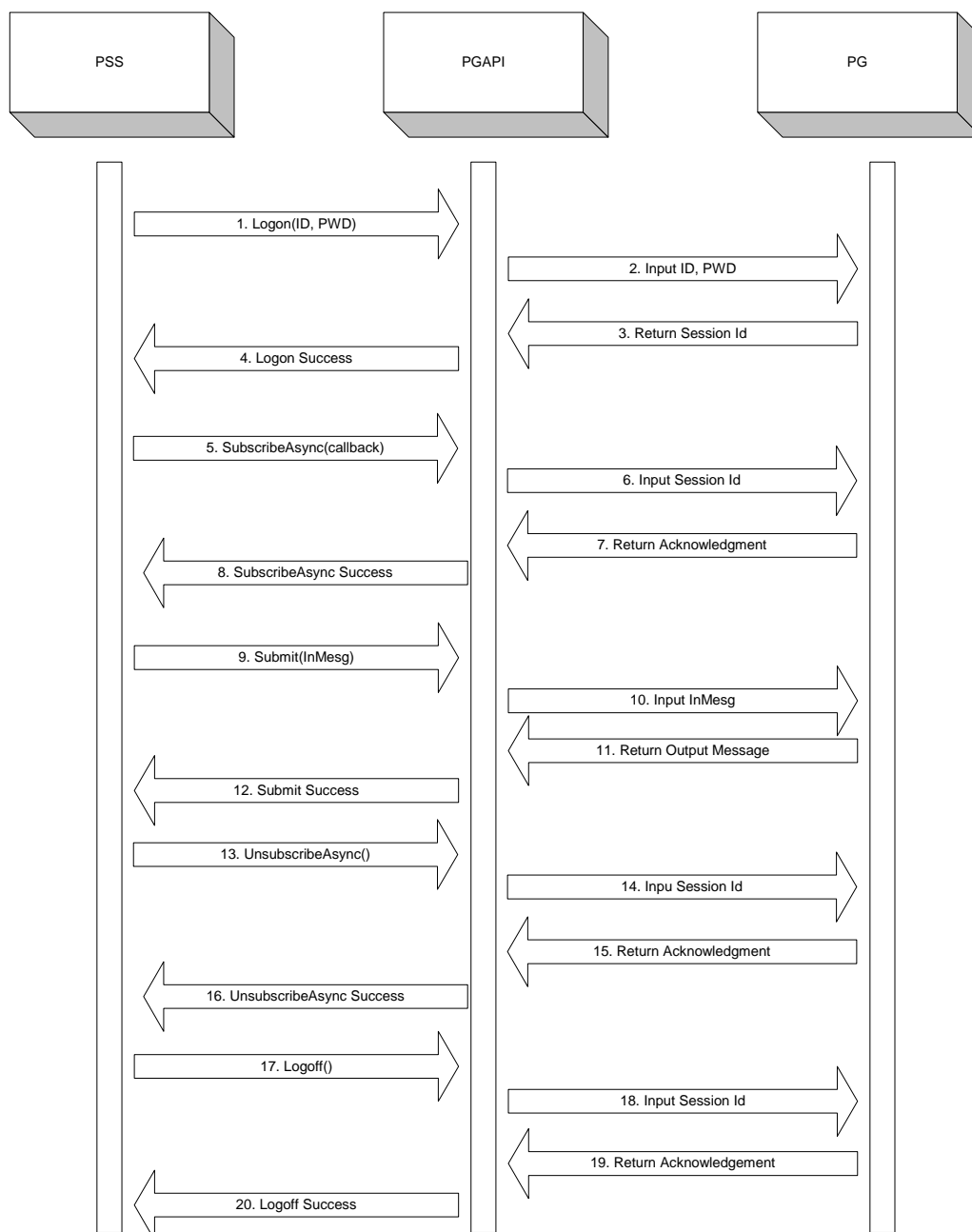
```
    //broadcast is closing (unsubscribing)
```

```
}
```

```
} // end of callback object
```


9.3 PG-API Flow

The following diagram depicts the communication flow for Logon() /SubscribeAsync() / UnsubscribeAsync() /Submit () / Logoff():



9.4 PG-API Connection Usage

Currently PSS is allowed to establish at most 12 connections with each PG server for submitting request. If excluding file transfer and report download whose response highly depends on the file size, PG can complete on average 240 transactions (input / change / enquiry) per minute.

The following highlights the rules on the connection usage:

1. PSS can make use of all the 12 connections for update transactions and single-record enquiry.
2. PSS can make use of at most 1 out of 12 connections for report download and file upload.
3. PSS can make use of at most 1 out of 12 connections for multiple-record enquiry (e.g. enquire ISI (multiple))

Below are examples illustrating the correct use of connections for carrying out combination of transactions:

Scenario 1:

1 connection doing report download or file upload

1 connection doing multiple-record enquiry

10 connections doing Input ATI (or other input and single enquiry)

Scenario 2:

1 connection doing multiple-record enquiry

5 connections doing Input SI

6 connections doing Input ATI

Scenario 3:

12 connections doing Input ATI

A. Appendix

A.1. Example of ISO Message

The following is the sample data derived from MT541 template, including block 1, 2 and 5:

```
{1:CMT1tboajhwjc00000457}
{2:I541B05508X}
{4:<CRLF>
:16R:GENL<CRLF>
:20C::SEME//0000000000000002<CRLF>
:23G:NEWM<CRLF>
:98A::PREP//20020820<CRLF>
:16S:GENL<CRLF>
:16R:TRADDET<CRLF>
:98A::SETT//20020820<CRLF>
:35B:/HK/1<CRLF>
:70E::SPRO//REMK/PG Sample Message from Broker<CRLF>
// B00001 - MT 541<CRLF>
:16S:TRADDET<CRLF>
:16R:FIAC<CRLF>
:36B::SETT//UNIT/99000, <CRLF>
:97A::SAFE//01<CRLF>
:16S:FIAC<CRLF>
:16R:SETDET<CRLF>
:22F::STCO/CCAS/DINR<CRLF>
:22F::SETR//TRAD<CRLF>
:22F::RTGS//NRTG<CRLF>
:16R:SETPRTY<CRLF>
:95R::DEAG/CCAS/B00001<CRLF>
:16S:SETPRTY<CRLF>
:16R:AMT<CRLF>
:19A::SETT//HKD10,12<CRLF>
:16S:AMT<CRLF>
:16S:SETDET<CRLF>
-}{5:{CHK:00000000A1D26CF3}}
```