Technical Seminar

Orion Central Gateway (OCG)
&
Orion Market Data (OMD-C)

December 2012

Rundown

Session 1 (OCG)

①   Enrollment and On-boarding Arrangement (15 Mins)

②   Network Arrangement (15 Mins)

③   OCG Interface Specification and Offline Simulator (1 Hr)

    - Q & A for Session 1 Topics (15 Mins)

    - Break (15 Mins)

Session 2 (OMD-C)

①   OMD-C Interface Specification and Offline Simulator (1 Hr)

    - Q & A for Session 2 Topic (15 Mins)

Orion Central Gateway

Technical Seminar

(On-Boarding Arrangement)

December 2012
Cash Market, Trading Division

OCG

On-Boarding Arrangement

Tentative Timeline

	Q4 2012	Q1 2013	Q2 2013	Q3 2013	Q4 2013
Distribution of offline simulators of OCG and OMD-C	■				
EP to return OCG enrollment form			▬		
EP to return OCG simulator test result			▬▬▬		
Open test (OMD-C) / End to end test (OCG) • OMD-C • OCG				▬▬▬ ▬▬	
EP to return declaration on readiness tests				▬▬	
Installation of production OCG/BSS and OMD-C circuits, and signing up Market Data Agreement				▬▬▬	
Market Rehearsals					▬▬
Rollout					■

OCG

Offline Simulators

- To facilitate EP's testing of their BSS enhancement on connection to the AMS/3 host through OCG, new functionalities of OCG (e.g. drop copy service) and receive market data from OMD-C

- 2 sets of simulators, one for OCG and one for OMD-C, will be distributed to all existing BSS vendors and BSS users in late December 2012. Non BSS users will be provided the simulator packages on request

- For EPs intend to be first batch users of OCG, they have to return:

  ➢ the enrollment form in March 2013. EPs have to indicate no. of OCG sessions and type of OMD-C feed (e.g. standard, premium, fulltick) to be applied, if applicable, based on their BSS enhancement progress and business needs

  ➢ the OCG simulator test result by mid June 2013

OCG

Open test (OMD-C) / End to end test (OCG)

Testing Lines Installation:

- EPs should apply directly with network providers and check the lead time

- For EPs intend to use OMD-C feed in the OCG/BSS, dual circuits have to be installed for OMD-C readiness test to cover failover situation of OMD-C. EPs should take note on the bandwidth requirement

- EPs are reminded to work out with network providers on the subscription period and conversion of the testing lines to production lines, if applicable

OCG

Open test (OMD-C) / End to end test (OCG)

Open test of OMD-C:

- Aim to provide the environment to EPs to test their OMD client systems prior to the readiness test of OMD-C.

- Testing environment only for testing the market data feed will be available from end May 2013 tentatively

End to end test of OCG:

- Testing environment will be available from mid July 2013 tentatively

- For EPs intend to use OMD-C feed in the OCG/BSS, testing environment of OMD-C will be available in parallel

OCG

Readiness Tests

- There will be separate Readiness Test Packages for OMD-C and OCG

- The OMD-C Readiness Test aims to verify EP's interface program with OMD under a controlled environment

- The OCG package will include a list of functional test cases that needs to be successfully executed by EPs

- EPs need to return declarations on their system readiness by early September 2013, before joining the Market Rehearsals

OCG

Installation of Production Devices and Circuits

- EPs to arrange with network providers for circuits installation and should complete before early September 2013

- HKEx to coordinate on provision of OMD-C feed and arrange for signing the Market Data End-User Licence Agreement

OCG

Market Rehearsals and Rollout

Market Rehearsals (MRs)

- MRs will be organized during September and October 2013

- EPs fail to successfully completed the MRs will not be the first batch users upon OCG rollout

Rollout

- Subject to the result of MRs, OCG is scheduled for rollout in Q4 2013 with 2-weeks stabilization period tentatively

OCG

Contingency Arrangement during Stabilization Period

- EPs who migrate their existing OG/BSS to OCG/BSS (i.e. all Broker IDs and throttles are transferred to OCG/BSS. The migrated OG/BSS will cease to connect AMS/3 from the date the OCG/BSS rollout) are reminded not to de-install the migrated OG/BSS until end of the stabilization period

- In an unlikely event the OCG fail or other contingencies, all the Broker IDs and throttles transferred to the OCG/BSS will be restored to the original OG/BSS, on Next Trading Day

Orion Central Gateway

Technical Seminar

(OCG Network Configuration)

December 2012
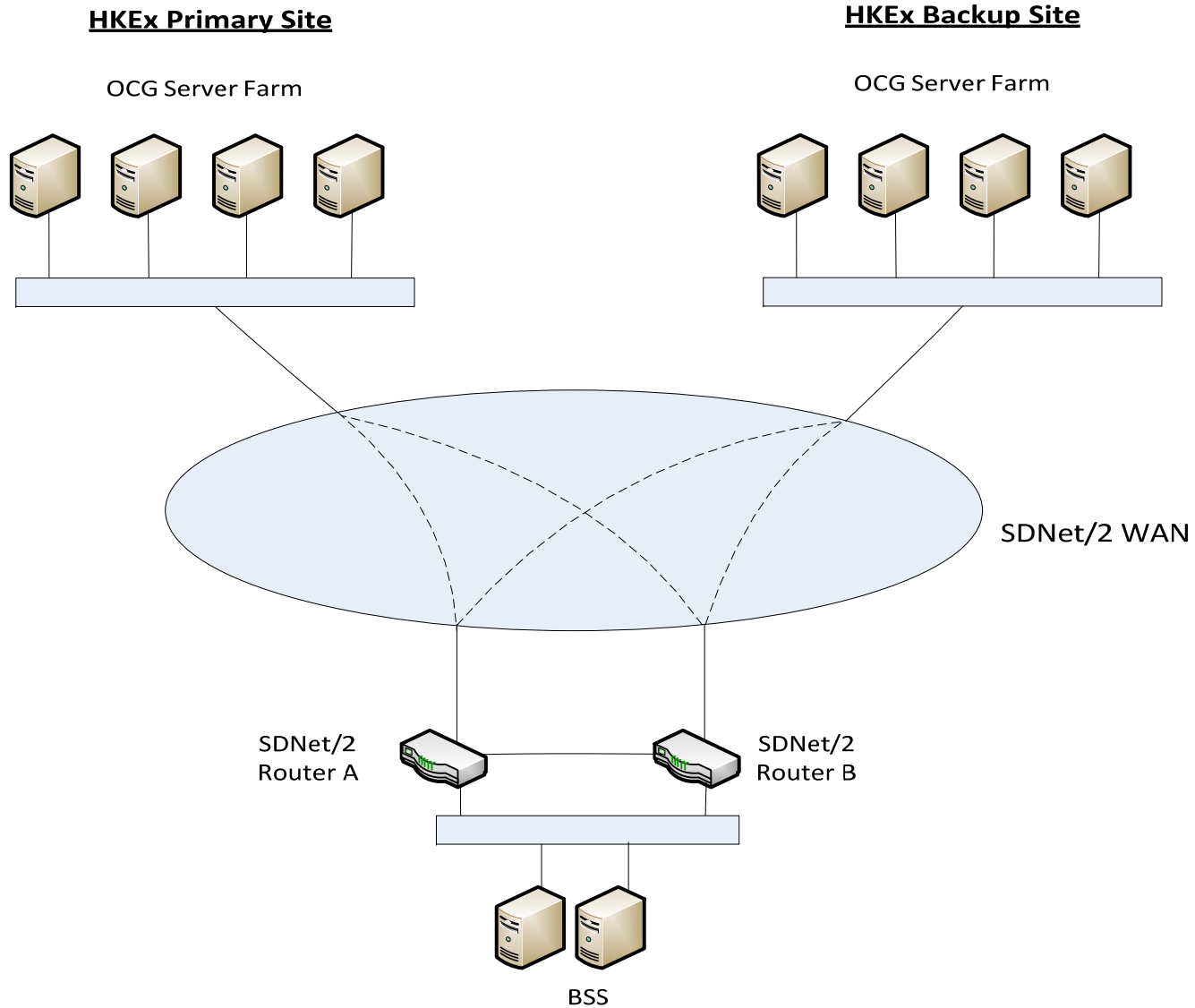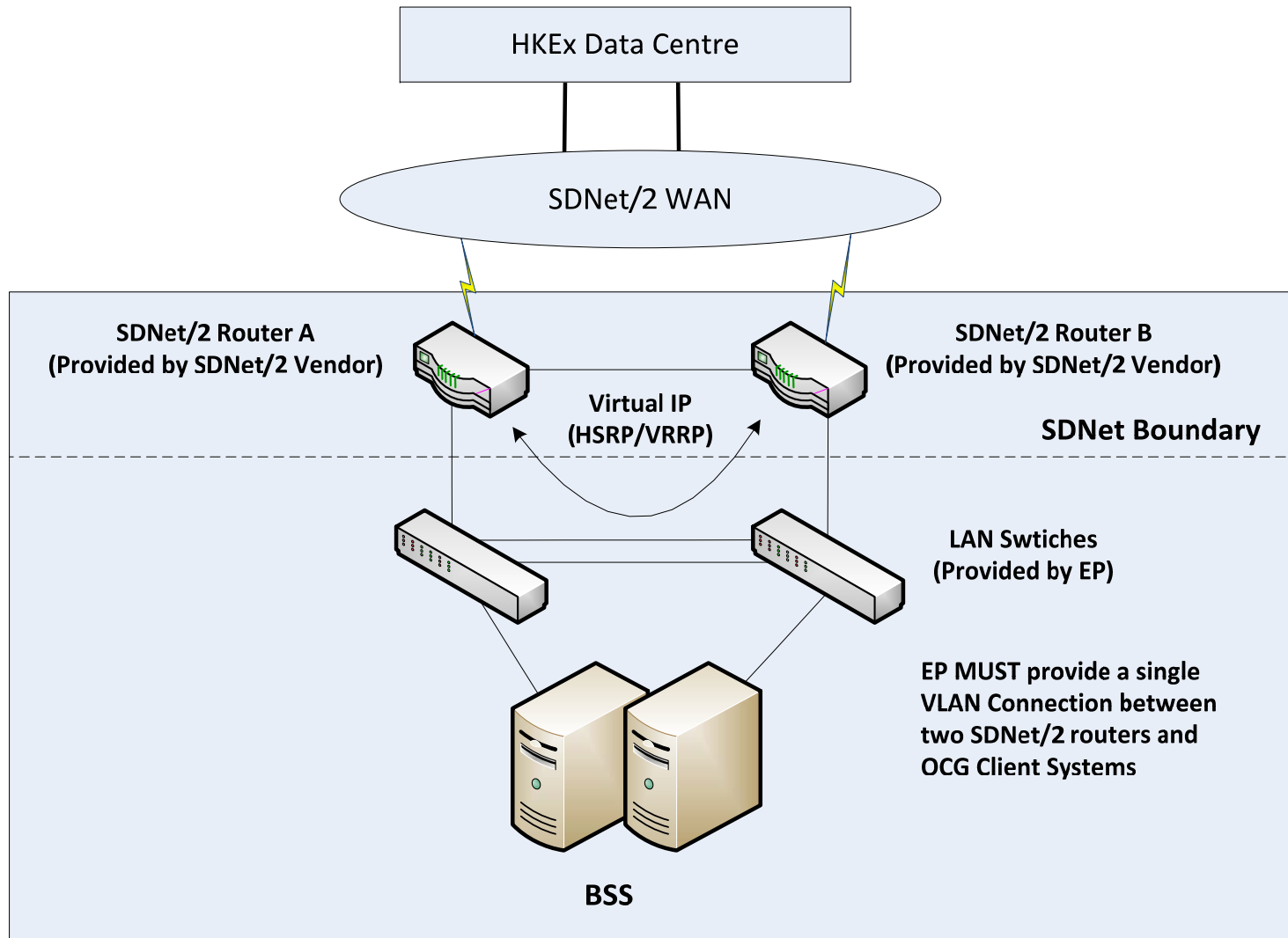### IT Infrastructure and Operations

Agenda

1. **Introduction**

2. **Network Configuration at EP Ends**

3. **Routing Setup on BSS**

4. **Sharing SDNet/2 Circuit between OCG and OMD-C**

5. **OCG Access for HSN Users**

6. **Migration from Testing to Production**

Introduction - OCG Network

HKEx Primary Site

OCG Server Farm

HKEx Backup Site

OCG Server Farm

SDNet/2 WAN

SDNet/2
Router A

SDNet/2
Router B

BSS

Network Configuration at EP Ends

HKEx Data Centre

SDNet/2 WAN

SDNet/2 Router A
(Provided by SDNet/2 Vendor)

SDNet/2 Router B
(Provided by SDNet/2 Vendor)

Virtual IP
(HSRP/VRRP)

SDNet Boundary

LAN Swtiches
(Provided by EP)

EP MUST provide a single
VLAN Connection between
two SDNet/2 routers and
OCG Client Systems
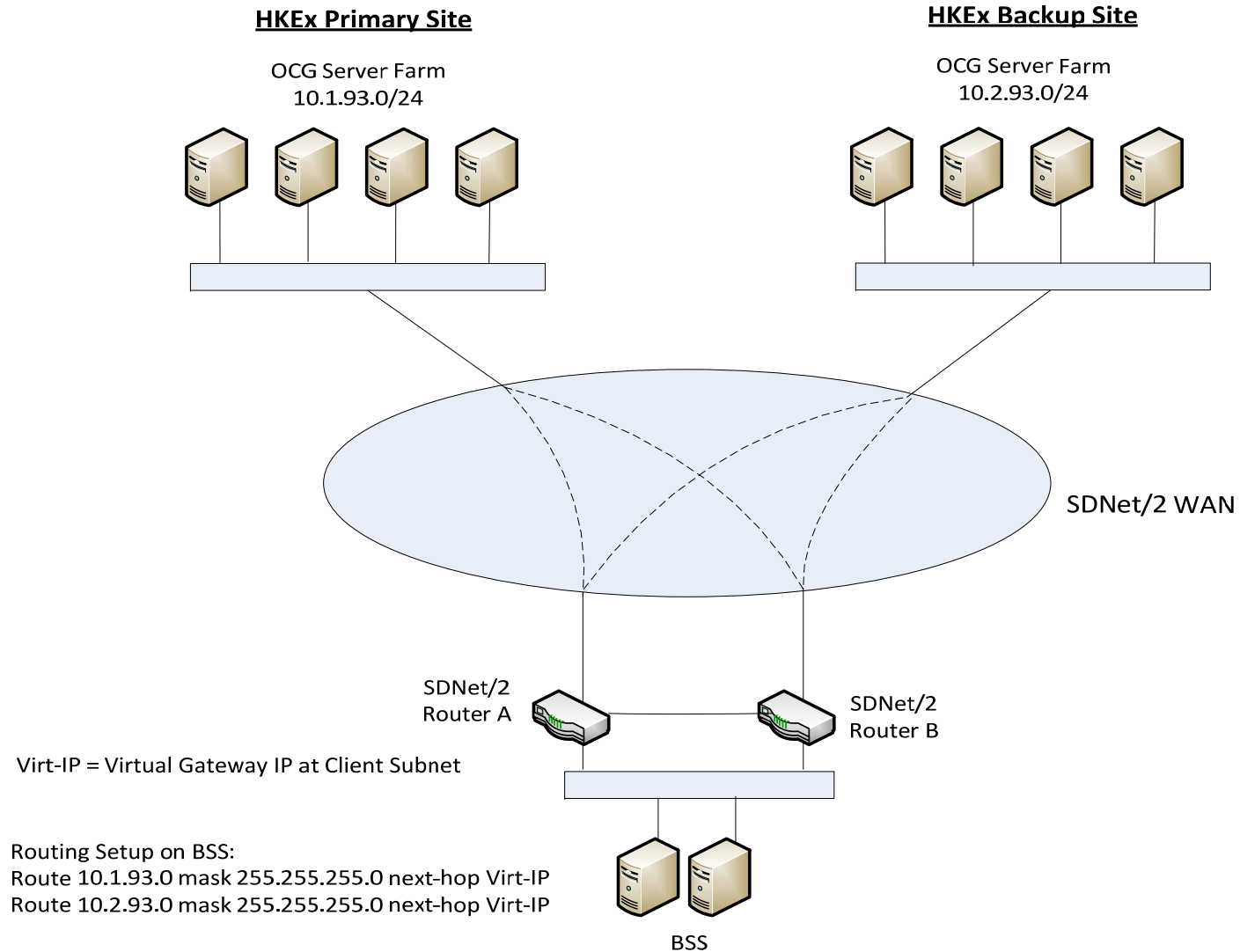
BSS

Network Configuration at EP Ends (Cont'd)

- **EP has to subscribe one pair of SDNet/2 circuits per site**

- **3 carriers: HGC, PCCW and WTT**

- **Carrier will install a pair of SDNet/2 routers**

- **Carrier will provide following information:**

  - **Gigabit Ethernet access interface** connecting to the EP's network/switches

    - **Speed:** Auto Sense up to 1Gbps

    - **Mode:** Auto Negotiation

  - **IPv4 subnet address**

  - **A virtual Gateway IP address:** for accessing OCG servers
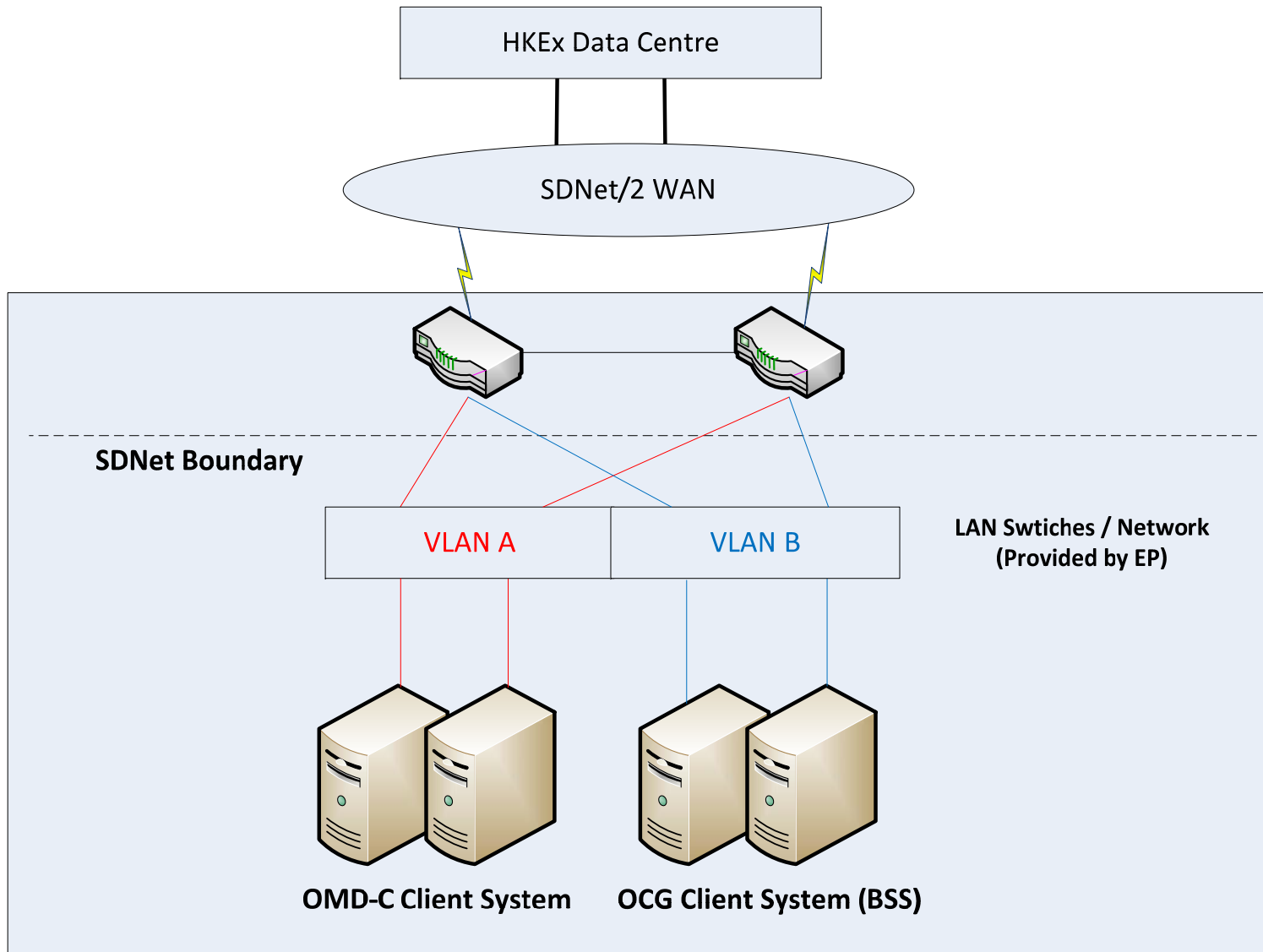
Network Configuration at EP Ends (Cont'd)

- **EP's network switches MUST provide a single VLAN (Layer 2) connection for the two SDNet/2 routers for HSRP/VRRP communication between themselves**

- **BSS must be configured with the recommended IP address within the allocated subnet**

- **All EPs has to submit their BSS IP addresses to HKEx for registration**

- **No routing protocol will be exchanged with the EP's network devices**

Routing Setup on BSS

HKEx Primary Site

OCG Server Farm
10.1.93.0/24

HKEx Backup Site

OCG Server Farm
10.2.93.0/24

SDNet/2 WAN

SDNet/2
Router A

SDNet/2
Router B

Virt-IP = Virtual Gateway IP at Client Subnet

Routing Setup on BSS:
Route 10.1.93.0 mask 255.255.255.0 next-hop Virt-IP
Route 10.2.93.0 mask 255.255.255.0 next-hop Virt-IP

BSS

Sharing SDNet/2 Circuit between OCG and OMD-C

HKEx Data Centre

SDNet/2 WAN

SDNet Boundary

VLAN A

VLAN B

LAN Swtiches / Network
(Provided by EP)

OMD-C Client System

OCG Client System (BSS)

Sharing SDNet/2 Circuit between OCG and OMD-C (Cont'd)

- **OCG and OMD-C can share the same pair of SDNet/2 circuits**

- **Separated Gigabit Ethernet interfaces on SDNet/2 routers for different applications**

- **If sharing same switches, two separated VLANs (e.g. VLAN A and VLAN B) must be configured**

- **HKEx will provide different client Subnets and Gateway IP addresses for OCG and OMD-C respectively**

- **Bandwidth is separated**

- **EP must subscribe sufficient bandwidth based on actual requirements (i.e. greater than the sum of OCG and OMD-C)**

Sharing SDNet/2 Circuit between OCG and OMD-C (Cont'd)

Typical Bandwidth Allocation for Sharing a 10M bps SDNet/2 Circuit		
OCG Session	OMD-C (SS) - Unicast	OMD-C (SS) - Multicast
800Kbps	200Kbps	9Mbps

- **800Kbps bandwidth is available for OCG trading and drop copy sessions**

OCG Sessions	Minimum Bandwidth Requirement (FIX & Binary)
Trading	40 Kbps / Throttle
Drop Copy (Orders and Trades Option)	40 Kbps / Throttle
Drop Copy (Trades Only Option)	20 Kbps / Throttle

OCG Access for HSN Users
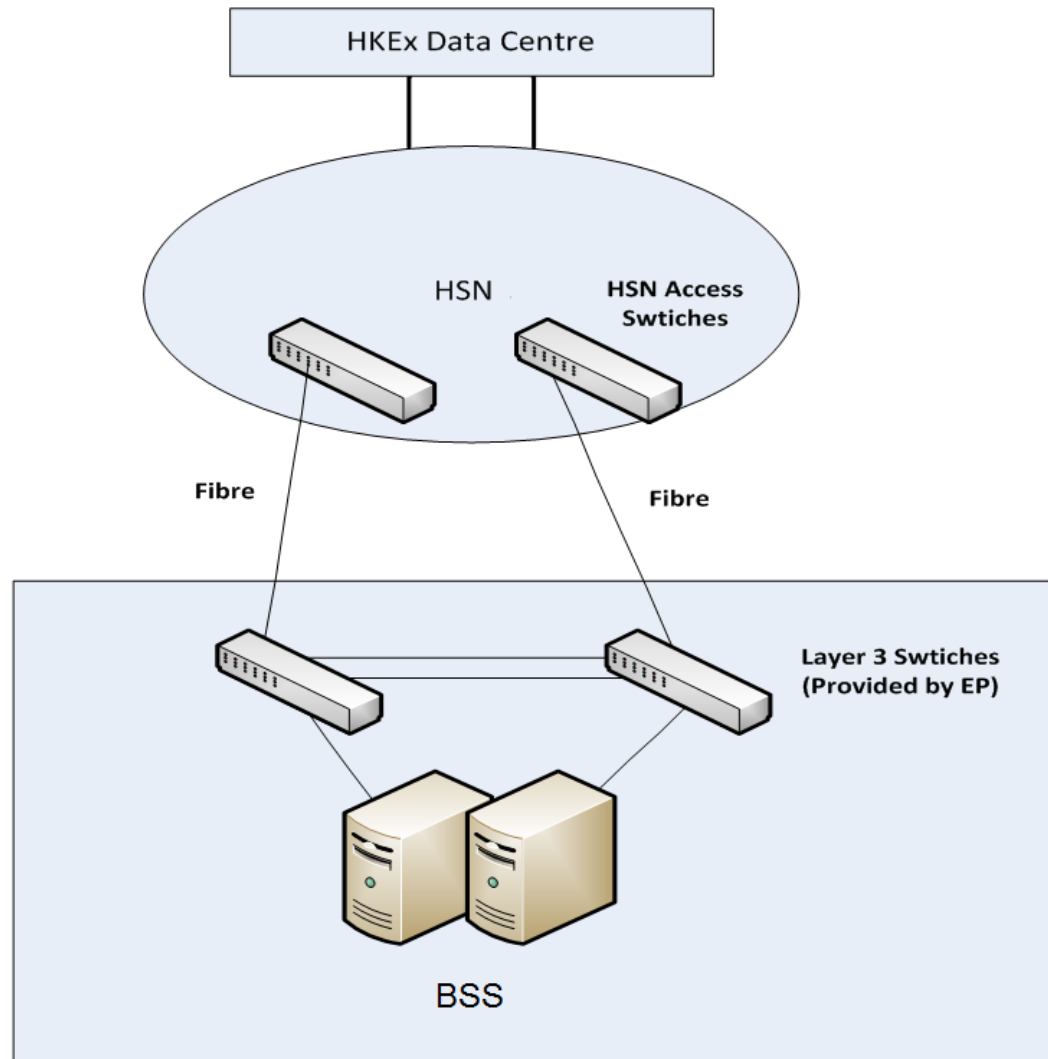
OCG Access for HSN Users (Cont'd)

- **EPs need to provide Layer 3 switches**

- **Refer to the "HKEx Hosting – Interface Specification on Connectivity Services and Timing Service"**

- **EPs has to submit their BSS IP addresses to HKEx for registration**

- **Following network information will be provided by HKEx for OCG application setup**

    - **IPv4 subnet address for BSS**

    - **OCG server subnets at Host End**

Development OCG Network (Dual Circuits)

HKEx Development Site
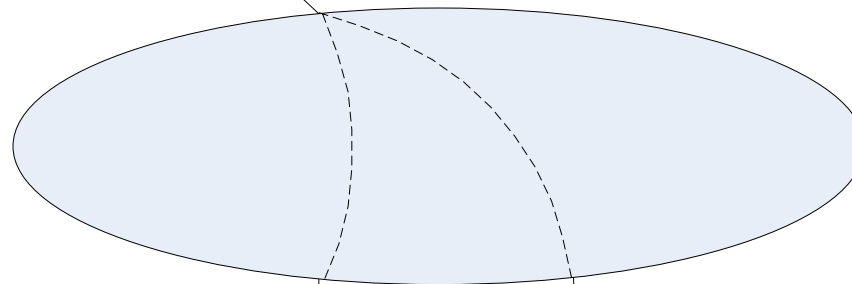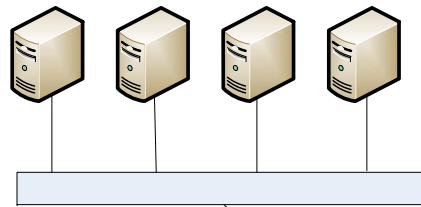
OCG Server Farm
10.1.93.0/24

SDNet/2 WAN

SDNet/2
Router A

SDNet/2
Router B

Virt-IP = Virtual Gateway IP at Client Subnet

Routing Setup at Client Servers:
Route 10.1.93.0 mask 255.255.255.0 next-hop Virt-IP

Servers of Client System

13

Development OCG Network (Single Circuit)

HKEx Development Site
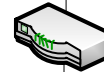
OCG Server Farm
10.1.93.0/24

SDNet/2 WAN

SDNet/2
Router A

Virt-IP = Virtual Gateway IP at Client Subnet

Routing Setup at Client Servers:
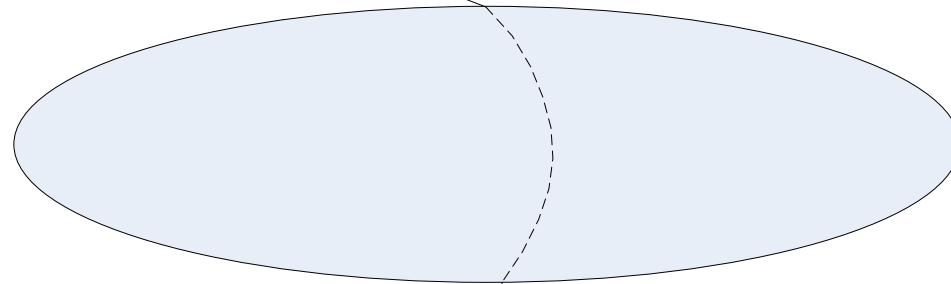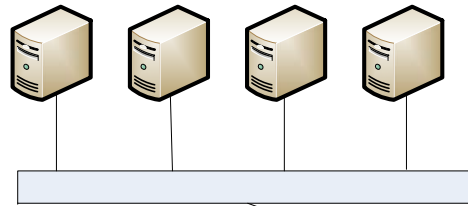Route 10.1.93.0 mask 255.255.255.0 next-hop Virt-IP

Servers of Client System

Sharing Development SDNet/2 Circuit between OCG, OMD-C and OG

Applications	Circuit Required	Minimum Bandwidth
OCG	Single / Dual	1Mbps
OCG + OMD-C(SS)	Dual	10Mbps
OCG + OG	Single / Dual	2Mbps
OCG + OMD-C(SS) + OG	Dual	11Mbps *

∗ Note: EP is advised to check with the network service providers on the applicable tariff plan.

Migration from Testing to Production (Cont'd)

OCG Development Servers at HKEx Data Centre

OCG Production Servers at HKEx Data Centre

Development SDNet/2 WAN

Production SDNet/2 WAN

SDNet/2 Router A

SDNet/2 Router B

SDNet Boundary

LAN Swtiches (Provided by EP)

BSS
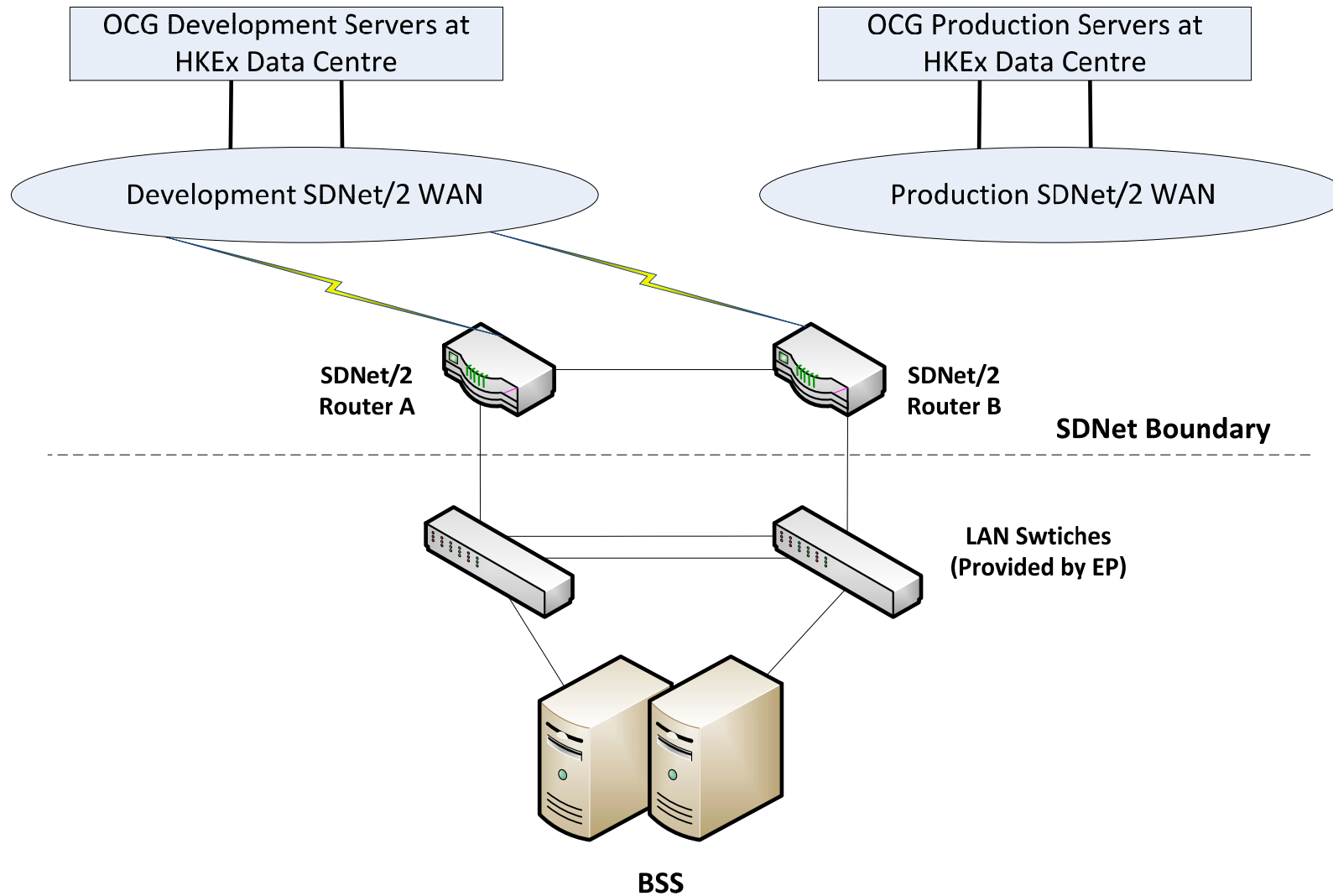
Migration from Testing to Production (Cont'd)
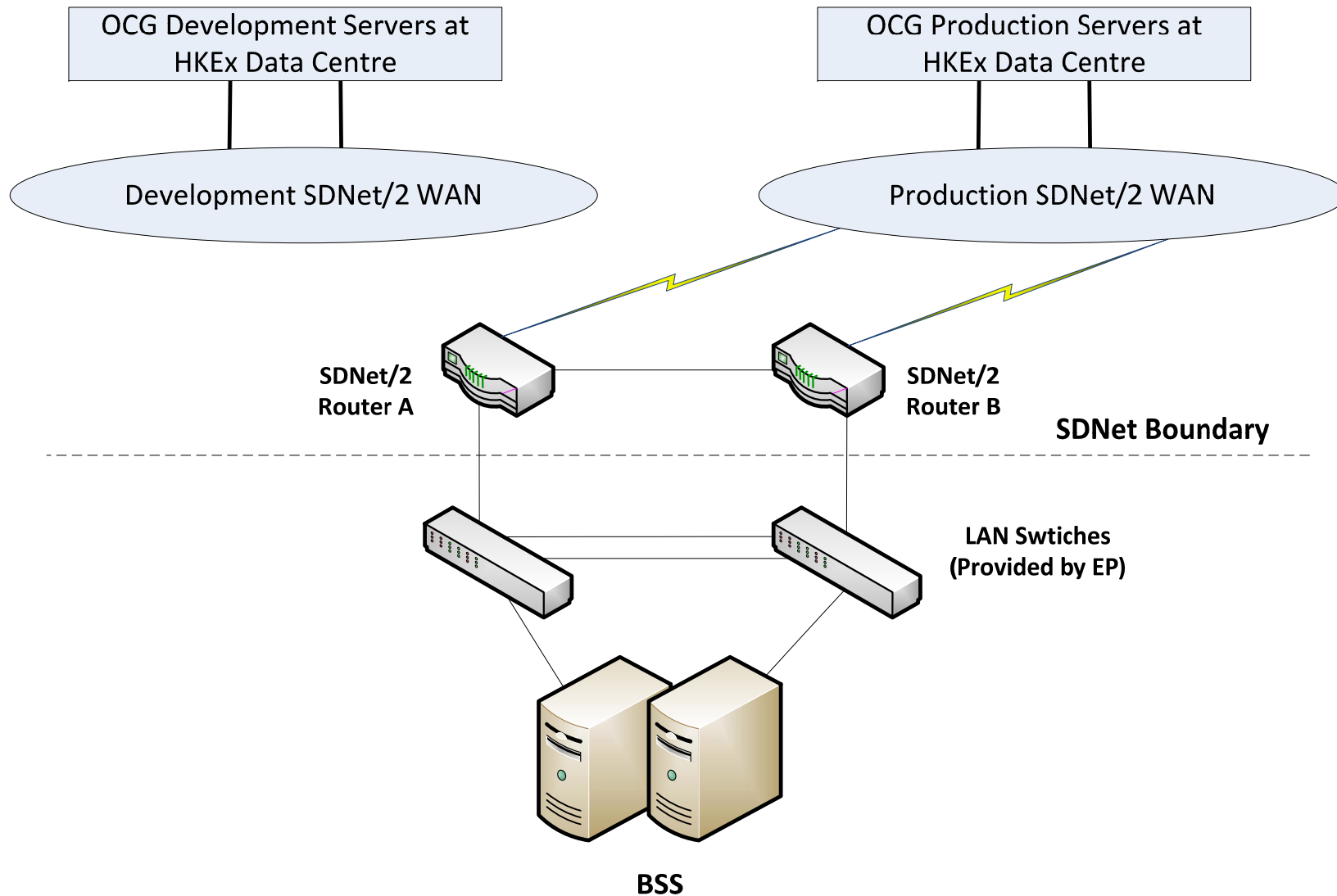
Migration from Testing to Production (Cont'd)

- Before Market Rehearsal, EPs have to place orders to carriers for switching the SDNet/2 connections from "development" to "production" platform (after completion of testing)

- The EP subnets, gateway IP addresses will be retained

- Carriers will switch over the SDNet/2 connections remotely at their exchange offices

- Carriers will re-configure the SDNet/2 routers accordingly

- If EP shares the OCG and OMD-C with the same SDNet/2 circuits, the migration from development to production MUST be implemented at the same time for both applications

Questions

Orion Central Gateway

Technical Seminar

(OCG Interface Specification and Offline OCG Simulator)

December 2012
Cash Trading System Development & Support

Agenda

1. **Introduction**

2. **New Features of OCG**

3. **Message Interface Highlights**

4. **Services Description for Trading Interface**

5. **Services Description for Drop Copy Interface**

6. **Offline OCG Simulator**

Introduction

- ❑ Orion Central Gateway (OCG) is part of the HKEx Orion Program

- ❑ For connection between Broker Supplied System (BSS) and HKEx Trading system (AMS/3.8 and future Orion Trading System)

- ❑ Standard interface protocol for ease of transition to the future Orion Trading System

Introduction(Cont'd)
❑ Architecture & Migration Path

Today's Open Gateway (OG) Architecture

- Access via OG Connection
- Gateway device in EP office, maintained by EP

Future Orion Central Gateway (OCG) Architecture

- Access via "OCG Session"
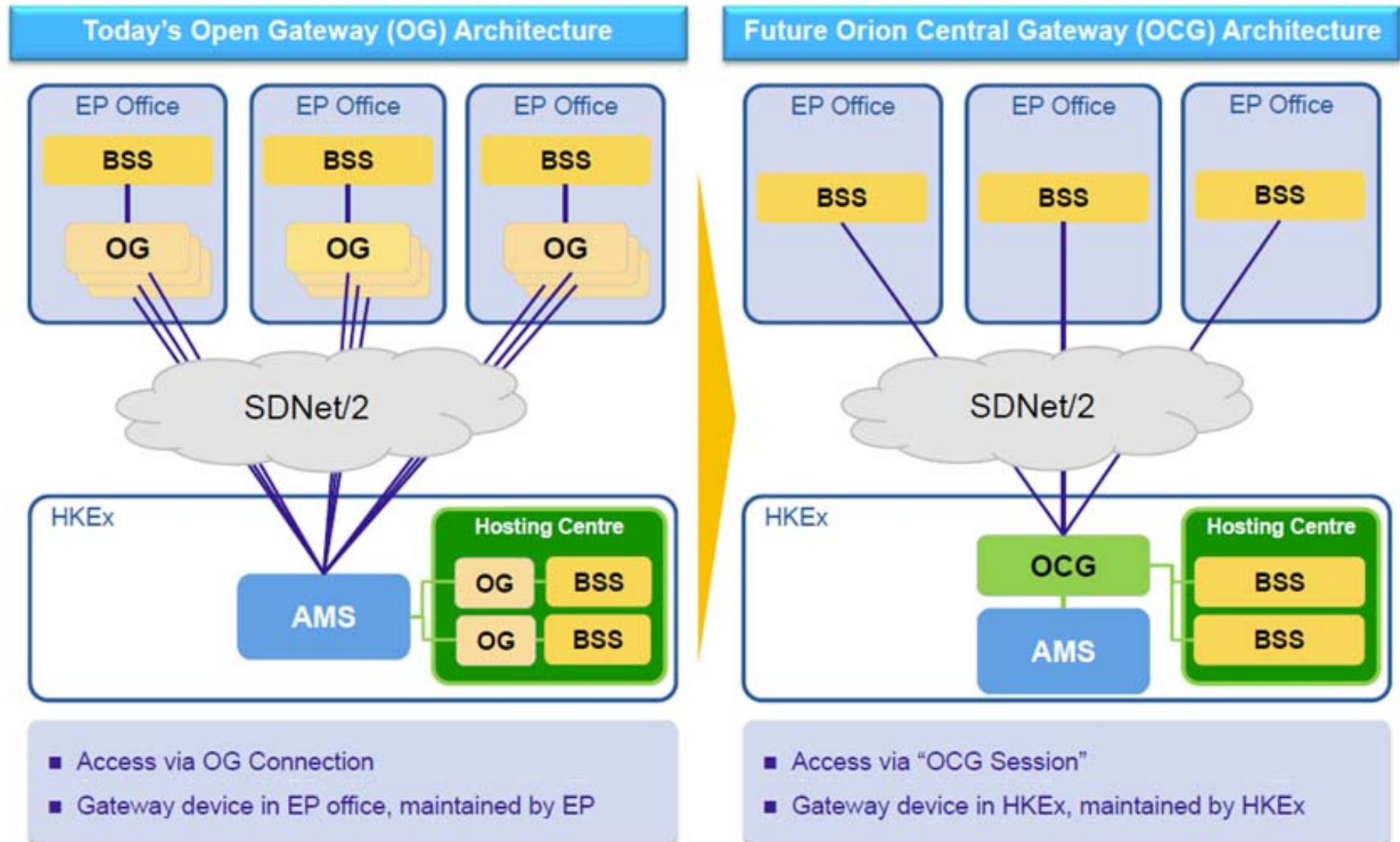- Gateway device in HKEx, maintained by HKEx

Agenda

1. Introduction

2. **New Features of OCG**

3. Message Interface Highlights

4. Services Description for Trading Interface

5. Services Description for Drop Copy Interface

6. Offline OCG Simulator

New Features of OCG

A. Service and Protocol

B. Cancel on Disconnect (COD)

C. Throttle Mechanism

New Features of OCG
A. Service and Protocol

- ❑ OCG supports two services
  - Order Trading Service – Order Management
  - Drop Copy Service – Publish Order and Trade Information
- ❑ Two message protocols are provided for each service
  - FIX(**F**inance **I**nformation e**X**change) Protocol
    - ➢ FIX is industry-driven standard protocol for financial securities trading
    - ➢ OCG uses FIX 5.0 SP2 with HKEx specific extension packs
    - ➢ http://www.fixprotocol.org/
  - Binary Protocol
    - ➢ Follows FIX semantics with binary message format
    - ➢ Designed for processing efficiency

New Features of OCG
B. Cancel On Disconnect

❑ Optional feature in OCG and EPs can request COD for any Order Trading Service session

❑ OCG will automatically cancel live orders in the affected session upon specific disconnection scenarios

❑ Cancellations are made on a best effort basis(i.e. executions that occur very near to the time of disconnect may not be reported to the client)

❑ Cancellations will be carried out only if OCG detects the BSS disconnects abruptly (e.g. Client disconnects without Logout, session timeout due to no heartbeats received)

New Features of OCG
B.   Cancel On Disconnect (Cont'd)

❑   Delayed cancel is supported upon detection of abrupt session disconnect

New Features of OCG
C. Throttling Mechanism

❑ All in-bound messages such as order submission, quote, trade report, etc. are collectively referred to as messages

❑ One Standard Throttle provides the throughput of 2 Messages per second (MPS)

❑ Throttle window is a one-second period that begins at the boundary of an actual clock second. For example:

- OCG local system time 10:23:36-10:23:37 is one throttle window
- OCG local system time 10:23:37-10:23:38 is next throttle window

Note: OCG will synchronize its system clock with GPS.

❑ Messages exceeding entitled limit will be rejected by OCG

New Features of OCG
C. Throttling Mechanism(Cont'd)

❑ **Throttle Mechanism(Illustration only)**

- Throttle is 4 (or 8 messages per second)
- BSS sends 12 messages within 1 second (10:23:36 - 10:23:37)
- The first 8 messages will be accepted while the last 4 messages will be rejected immediately
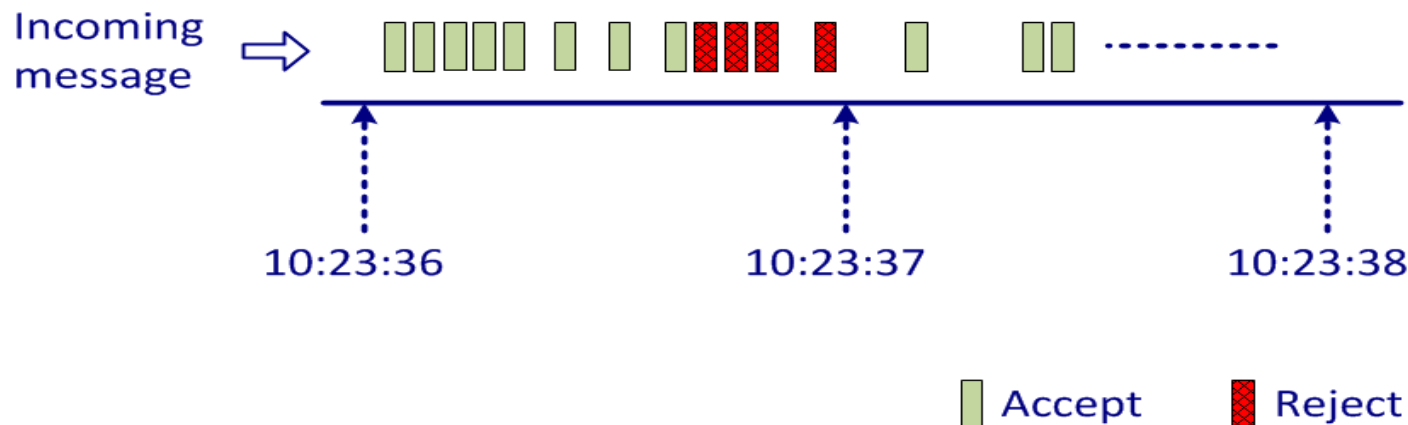
❑ **BSS may be disconnected forcibly if there are severe breaches of throttle limit (Protect the OCG for other EPs)**

Agenda

1. Introduction

2. New Features of OCG

3. **Message Interface Highlights**

4. Services Description for Trading Interface

5. Services Description for Drop Copy Interface

6. Offline OCG Simulator

Message Interface Highlights

A. Connectivity

B. Session Management

C. Recovery

D. Message Type

Message Interface Highlights
A.   Connectivity

❑ Session, Comp ID and IP Address

- A session is a standard TCP/IP point-to-point connection between Broker Supplied System ("BSS") and OCG

- To identify each session, a Comp ID is assigned by HKEx

- A Comp ID can have up to 4 IP addresses

❑ Basic connection configuration

EP

BSS
Comp ID = CO12345678
IP = 10.2.3.4

HKEx

OCG   AMS
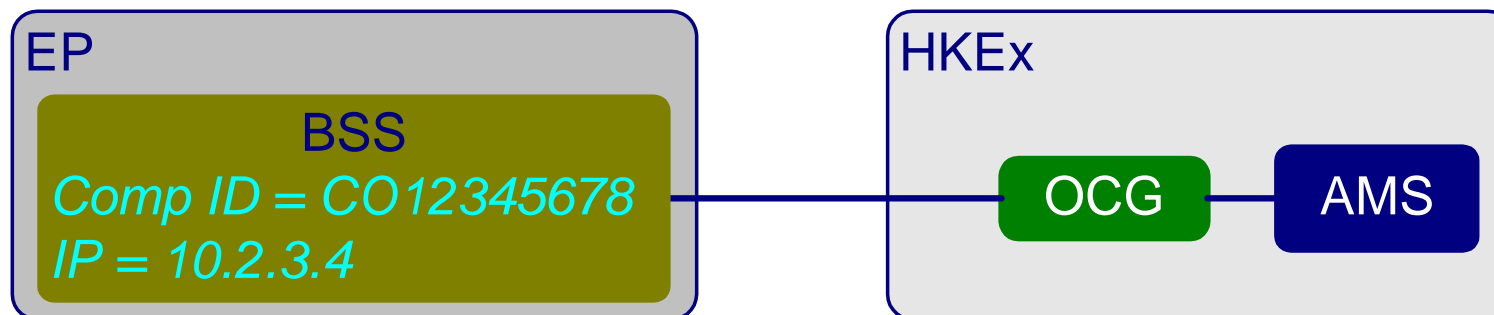
Message Interface Highlights
A.   Connectivity (Cont'd)

❑ Connection configuration with EP Backup site

  ▪ Same Comp ID
  ▪ Assume the EP has pre-registered 2 IP Addresses: one for Main site; another for Backup site
  ▪ EP enables connection for its Backup site when necessary
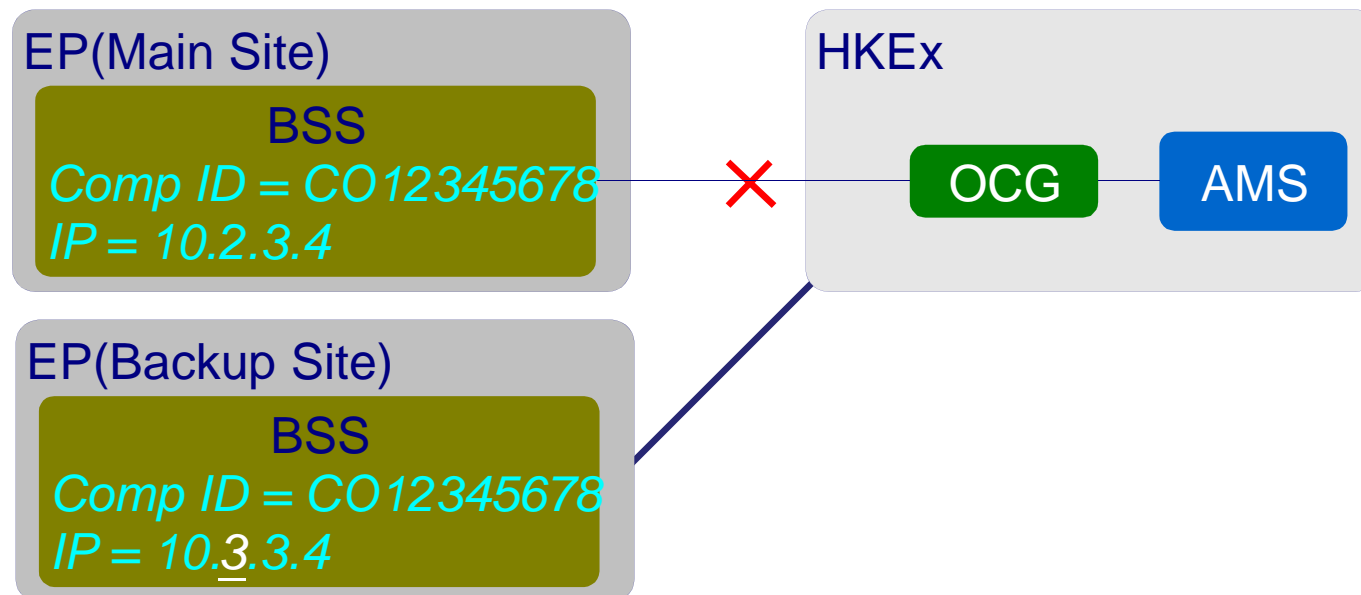
EP(Main Site)

BSS
Comp ID = CO12345678
IP = 10.2.3.4

HKEx

OCG

AMS

EP(Backup Site)

BSS
Comp ID = CO12345678
IP = 10.3.3.4

Message Interface Highlights
A. Connectivity (Cont'd)

❑ Establish connection to the allocated OCG - **FIX Protocol**

- A pool of connection points (IP Address and Port Number) will be provided by HKEx

- Hunt for a connection point one by one (First connection point → second one → … →last one → cycle back to the first one and retry)

- During a reconnection within the same day
    1. Connect to the already identified designated OCG
    2. If failed, move to/hunt for the other connection point

Message Interface Highlights
A. Connectivity (Cont'd)

❑ Establish connection to the allocated OCG – **Binary Protocol**

▪ Lookup Service for Binary Protocol

▪ BSS has to connect to the Lookup Service via the following sequence:

1. Primary site primary Lookup Service

2. Primary site secondary Lookup Service

3. Backup site primary Lookup Service

4. Backup site secondary Lookup Service

5. Cycle back to primary site primary Lookup Service

▪ Lookup Service will deliver two IP Address & Port pairs (one for the primary and one for the secondary). BSS should then connect to OCG using the primary IP Address & Port pair first.

Message Interface Highlights
B.   Session Management

❑ Both FIX and Binary protocol of OCG follow **FIX semantics** to establish a session

❑ BSS initiates a session by sending a **Logon request** message. OCG will respond with a **Logon reply** message

❑ **Heart Beat** and **Test Request** message to maintain session

❑ Either side can terminate the session using **Logout** message

❑ Each session for a new trading day must start with Sequence Number from 1

❑ Password is required to be specified in Logon and it must be encrypted (RSA) and comply with HKEx's password policy

Message Interface Highlights
C. Recovery

❑ Both FIX and Binary protocol of OCG follows FIX semantics to conduct recovery

❑ Message gap can be determined by the Next Expected Message Sequence field in the Logon message

❑ Resend Request to request counter side to retransmit messages

❑ Use Sequence Reset message with Gap Fill mode to increase the Next Expected Message Sequence

❑ Set PossDupFlag and PossResend as appropriate during the message retransmission

Message Interface Highlights
C.   Recovery(Cont'd)

❑ High Level Failure and Recovery Scenario for BSS

Scenario	FIX Protocol	Binary Protocol
Session Disconnection (Re-connection step)	■ Recap: A pool of connection point will be provided by HKEx ■ BSS connects to the OCG that it could successfully connect to previously ■ If failed, move to/hunt for the other connection point	■ Recap: IP Address & Port pairs of Primary and Secondary OCG will be delivered to BSS from Lookup Service ■ BSS always re-connects to the Primary OCG first and then the Secondary one. ■ If both failed, consult Lookup Service once again

Message Interface Highlights
C.   Recovery(Cont'd)

Scenario	FIX Protocol	Binary Protocol
Primary BSS fails and needs to switch to Backup BSS	■ Assume the EP has Backup site, i.e. has pre-registered more than one IP addresses for the Comp ID ■ Start the BSS in another machine (e.g. Backup site) with the same Comp ID ■ Hunt for a connection point one by one	■ Assume the EP has Backup site, i.e. has pre-registered more than one IP addresses for the Comp ID ■ Start the BSS in another machine (e.g. Backup site) with the same Comp ID ■ Consult Lookup Service for the Primary and Secondary OCG

Message Interface Highlights
D. Message Type

- ❑ Two message categories: Administrative and Business

- ❑ Administrative Messages (Session-level Message)

  - Messages for session establishment and maintenance

  - Messages for recovery (i.e. Resend Request, Sequence Reset)

  - Reject message(in response to an invalid message)

- ❑ Business Messages

  - Order related messages (e.g. New Order, Execution Reports, etc.)

  - Quote related messages (e.g. Quote, Quote Cancel, etc.)

  - Off-exchange Trade Report messages (a.k.a. Manual Trade, e.g. Trade Capture Report, etc)

  - Business Message Reject (in response to throttle exceeded or conditional field missing)

Agenda

1. Introduction

2. New Features of OCG

3. Message Interface Highlights

4. **Services Description for Trading Interface**

5. Services Description for Drop Copy Interface

6. Offline OCG Simulator

Service Description for Trading

A. Order Handling

B. Quote Handling

C. Trade Report Handling

Service Description for Trading
A.   Order Handling

❑ BSS can input/cancel/amend order or mass cancel orders via OCG Trading Interface

❑ BSS is able to submit OBO (On Behalf Of) cancel request or OBO mass cancel request for orders submitted by brokers belonging to the same EP from other OCG sessions or non-OCG devices (e.g. Terminals, BSS/OG, MWS/OG)

❑ Order message from BSS(In-bound Message)
- New Order – Single
- Order Cancel Request
- Order Cancel/Replace Request
- Order Mass Cancel Request
- OBO(On Behalf Of) Cancel Request
- OBO Mass Cancel Request

Service Description for Trading
A. Order Handling(Cont'd)

❑ Response of order message(Out-bound Message)

- *Reject and Business Message Reject*
- Execution Report (ER)
- Order Mass Cancel Report

❑ Execution Type Field in ER – Cater for different scenarios

- Order Accepted
- Order Rejected
- Order Expired
- Order Executed (Trade)
- Order Cancelled
- Order Amended
- Trade Cancel
- Cancel Rejected in Binary protocol / Cancel Reject Message in FIX protocol
- Amend Rejected in Binary protocol / Cancel Reject Message in FIX protocol

Service Description for Trading
A.   Order Handling(Cont'd)

❑ Order Status Field in ER – Provide more information

- New
- Partially Filled
- Filled
- Cancelled
- Pending Cancel
- Rejected
- Expired
- Pending Amend

❑ Refer to the Interface Specifications for the detailed description on Execution Types and Order Status

http://www.hkex.com.hk/eng/market/sec_tradinfra/ocg/orioncg.htm

Service Description for Trading
A. Order Handling (Cont'd)

❑ Message Flow (Illustration only) – Submit New Order and is rejected due to message validation failure, throttle limit exceeded or market validation failure

BSS   **OCG**

New Order Request →

Reject ←
    Message rejected due to invalid message

Businese Message Reject ←
    Message rejected due to throttle exceeded

Execution Report
(ExecType = Reject, Order Status = Rejected) ←
    Message rejected due to market validation failed
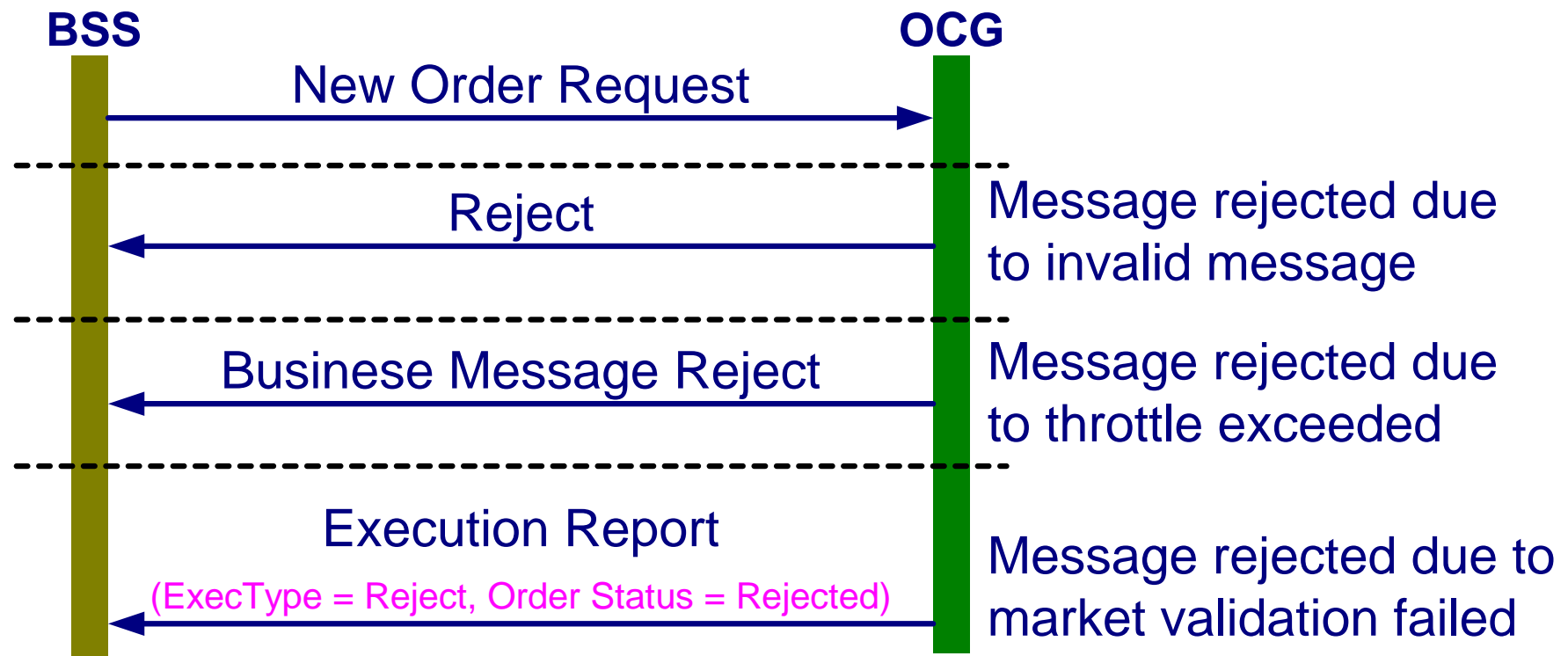
Service Description for Trading
A. Order Handling (Cont'd)

❑ Message Flow (Illustration only) – Submit New Order and it is accepted. The order is partially filled and then fully filled.

BSS   **OCG**

New Order Request →

Execution Report

(ExecType = New, Order Status = New)
←
New order is accepted

Execution Report

(ExecType = Trade, Order Status = Partially Filled)
←
Order is partially filled

Execution Report

(ExecType = Trade, Order Status = Filled)
←
Order is fully filled
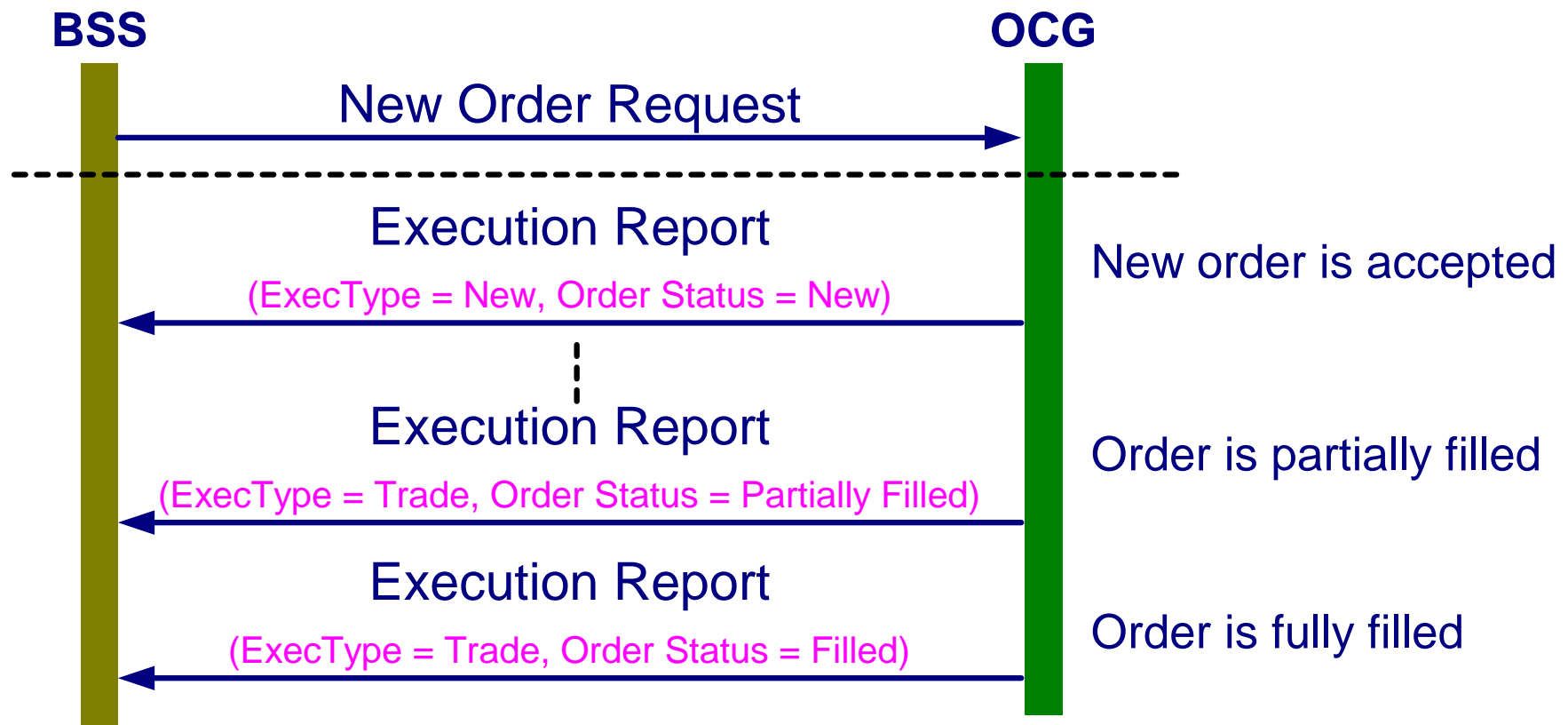
Service Description for Trading
B. Quote Handling

❑ Quotes are input or modified as a two-sided order pair

❑ Updating a quote
  ▪ Update both sides of a quote
  ▪ Update one side of a quote and leave the other side unchanged

❑ BSS can cancel a quote entry (both bid and ask sides)

❑ Quote message from BSS (In-bound Message)
  ▪ Quote
  ▪ Quote Cancel

❑ Response to quote messages (Out-bound Message)
  ▪ *Reject and Business Message Reject*
  ▪ Quote Status Report (for Quote or Quote Cancel rejection)
  ▪ Execution Report (ER)

B.   Quote Handling (Cont'd)

❑ Message Flow (Illustration only) – Input Quote and it is rejected due to message validation failure, throttle limit exceeded or market validation failure

BSS   **OCG**

Quote →

Reject ←   Message rejected due to invalid message

Businese Message Reject ←   Message rejected due to throttle exceeded

Quote Status Report
(Quote Status = Rejected) ←   Message rejected due to market validation failed

31
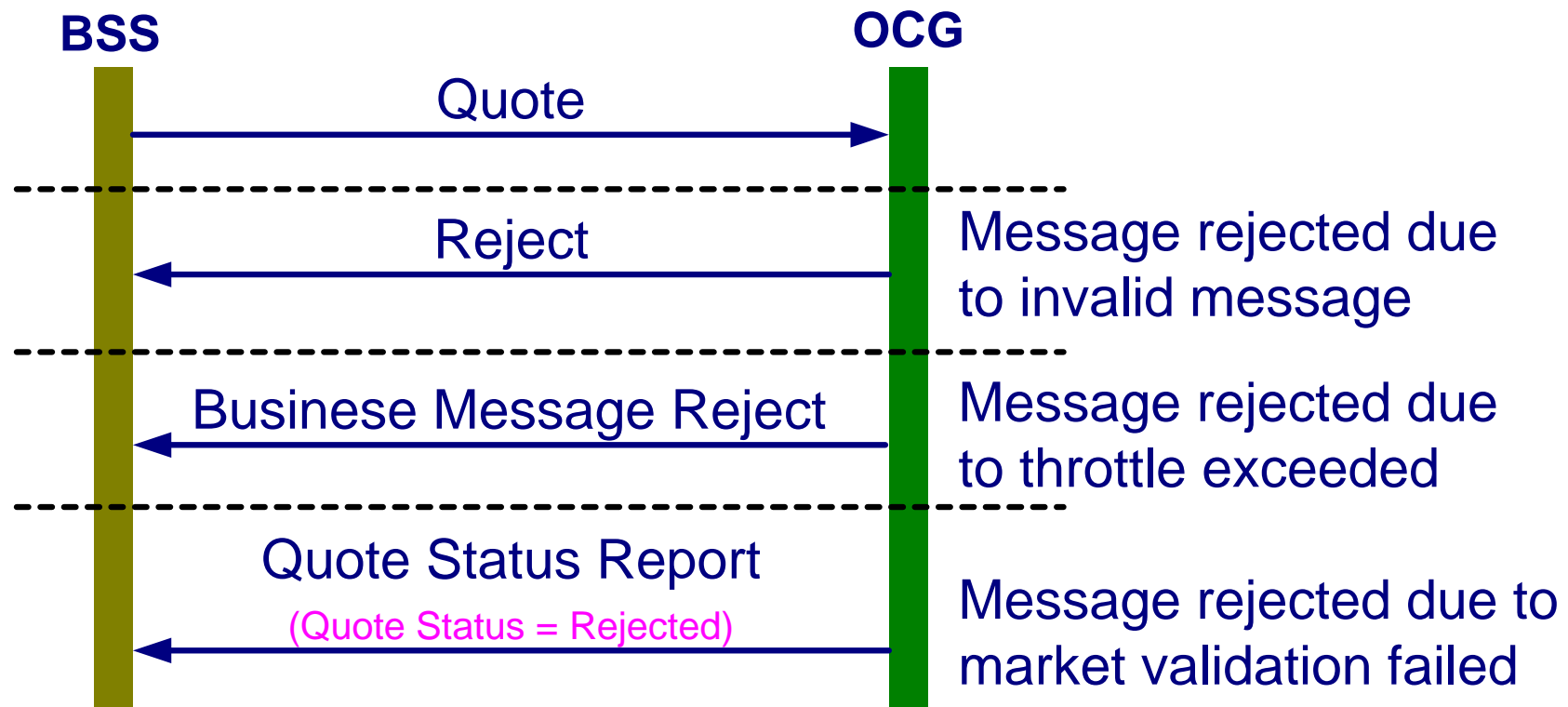
B.   Quote Handling (Cont'd)

❑ Message Flow (Illustration only) – Input Quote and both sides are accepted
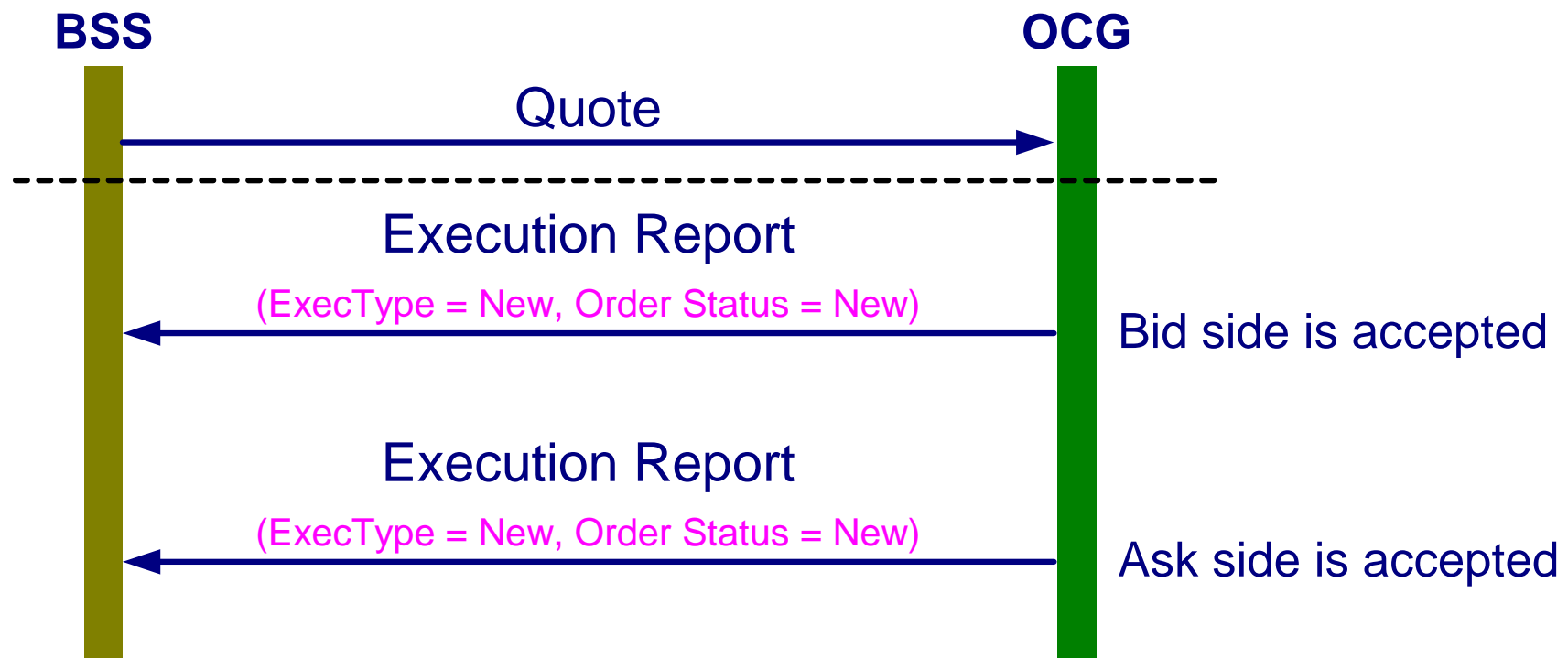
Service Description for Trading
B.   Quote Handling (Cont'd)

❑ Message Flow (Illustration only) – Input Quote and quote is accepted but bid side is rejected

BSS   **OCG**

Quote →

Execution Report

(ExecType = Reject, Order Status = Rejected)

←

Quote is accepted but bid side fails the market validation

Execution Report

(ExecType = New, Order Status = New)

←

Ask side is accepted
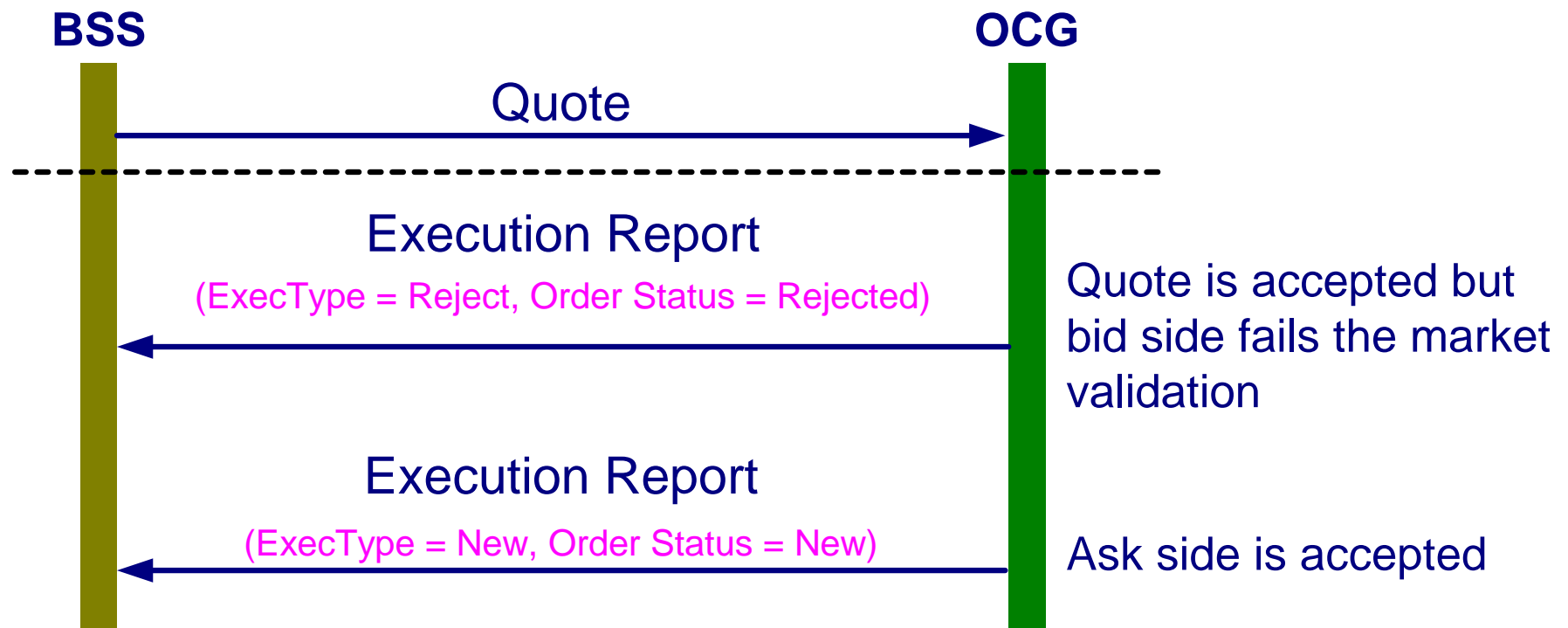
Service Description for Trading
C.   Trade Handling

❑ BSS is able to report an off-exchange trade (a.k.a. Manual Trade) or cancel an off-exchange trade reported by the counterparty.

❑ Trade Report message from BSS (In-bound Message)
- Trade Capture Report for submission *(TradeReportType = New)*
- Trade Capture Report for cancellation *(TradeReportType = Cancel)*

❑ Response to trade message (Out-bound Message)
- *Reject and Business Message Reject*
- Trade Capture Report Ack for trade report rejection
- Trade Capture Report for trade accept *(ExecType = Trade)* – will send to both sides (if applicable)

Agenda

1. Introduction

2. New Features of OCG

3. Message Interface Highlights

4. Services Description for Trading Interface

5. **Services Description for Drop Copy Interface**

6. Offline OCG Simulator

Service Description for Drop Copy

❑ OCG Drop Copy Service publishes all order and trade transactions originated from trading devices belonging to the same EP

❑ Trading devices
  ▪ First Terminals/Second Terminals
  ▪ BSS/OG(s) or MWS/OG(s)
  ▪ BSS(s) connecting to OCG Trading Interface
  ▪ Must belong to the same EP

❑ EPs can register the Broker IDs of order and trade transactions that they wish to receive through a Drop Copy Session

Service Description for Drop Copy (Cont'd)

❑ Two options available for Drop Copy Service

- **Trades Only** - Execution Reports related to auto-matched trades, Trade Capture Reports and odd-lot trades (analogous to existing CTF)
- **Orders & Trades** - All orders (board and odd-lot), quote related Execution Reports and Trade Capture reports

Business Message Type	Order &Trades	Trades Only
Execution Report - Exec Type = New	√	X
Execution Report - Exec Type = Expire	√	X
Execution Report - Exec Type = Cancel	√	X
Execution Report - Exec Type = Amend	√	X
Execution Report - Exec Type = Trade	√	√
Execution Report - Exec Type = Trade Cancel	√	√
Trade Capture Report - Trade Accepted	√	√
Trade Capture Report - Trade Cancelled	√	√

Service Description for Drop Copy (Cont'd)

❑ In-bound Messages
  ▪ *Only Session-level messages*

❑ Out-bound Messages
  ▪ *Session-level messages*
  ▪ Execution Report
  ▪ Trade Capture Report

❑ Copy Message Indicator
  ▪ Set to "Yes" to indicate that the given message is a drop copy of another message

Service Description for Drop Copy (Cont'd)

❑ Message comparison of Drop Copy and Trading Service

	OCG Trading Session	Drop Copy Session
Rejected ER for New/Cancel/Amend Order	Through the Trading Interface	Not published
ER for odd-lot/special lot order (non-OCG devices)	Not supported	Will publish
ER for odd-lot/special lot semi-auto trade (non-OCG devices)	Not supported	Will publish
Amend order originated on **OCG** for price change and/or quantity increase	Will publish one ER ▪ ExecType=Replaced	Will publish one ER ▪ ExecType=Replaced
Amend order originated on **non-OCG** devices for price change and/or quantity increase	Not applicable	Will publish two ERs ▪ ExecType=Cancelled ▪ ExecType=New

Service Description for Drop Copy (Cont'd)

❑ One usage of OCG Drop Copy Service (Illustration only)

- There is no order/trade enquiry function through the OCG Trading Service in order to allow more effective usage of network bandwidth for trading only session

- With "Orders & Trades" option enabled, OCG Drop Copy Service will publish all order and trade transactions originated from trading devices belonging to the same EP

- EP may then consolidate all order and trade information on their own and handle their enquiries internally as needed (e.g. for risk management, cross device order enquiry for OBO cancel orders)

Agenda
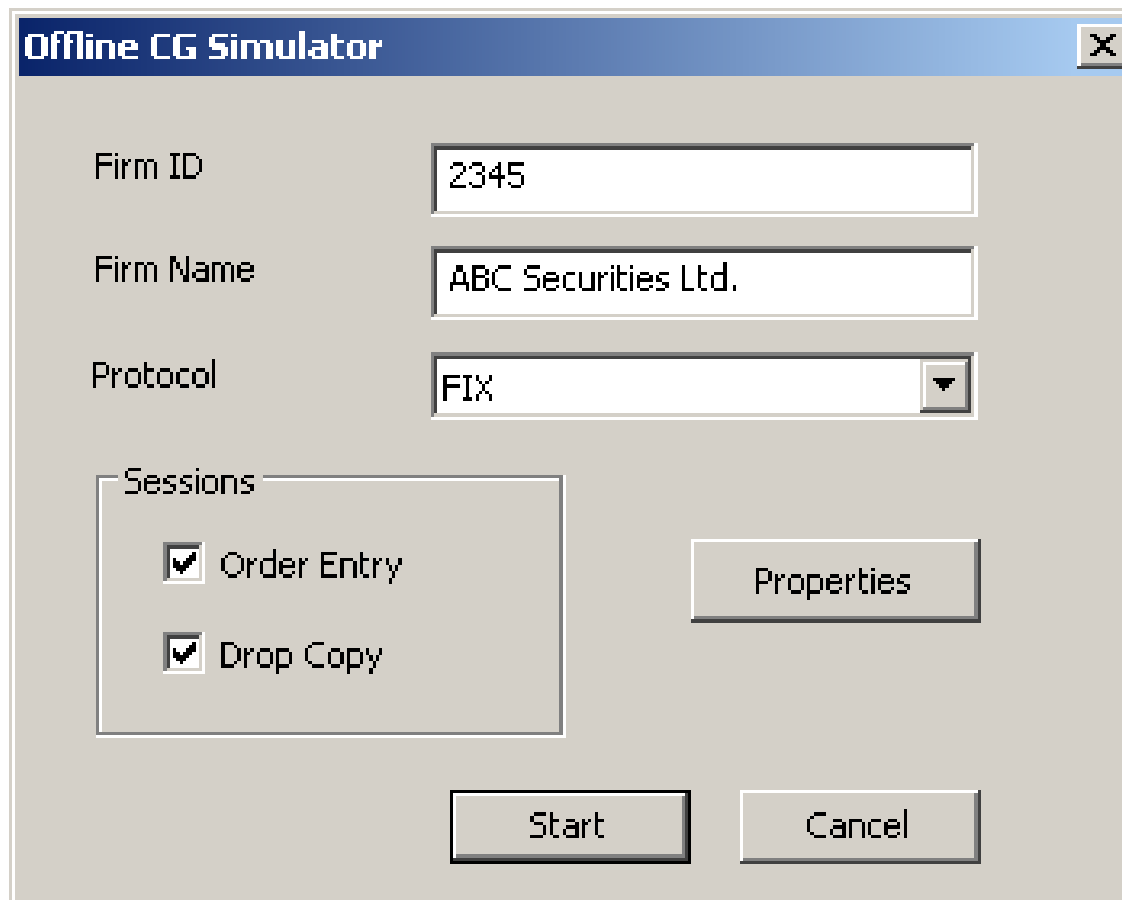
1. Introduction

2. New Features of OCG

3. Message Interface Highlights

4. Services Description for Trading Interface

5. Services Description for Drop Copy Interface

6. **Offline OCG Simulator**

Offline OCG Simulator

❑ A standalone Microsoft Windows application

❑ EP can install the Offline OCG Simulator in their premises

❑ To facilitate EPs or BSS vendors in developing and testing their own systems in offline mode before connecting to HKEx's end-to-end OCG testing environment

❑ Service can be either Trading or Drop Copy or both.

❑ Provide both FIX and Binary protocols

❑ Cover all business messages

❑ 1st step of certification process

Offline OCG Simulator

❑ Offline OCG Simulator – Startup Menu (Selection of Protocol and Interface Session)
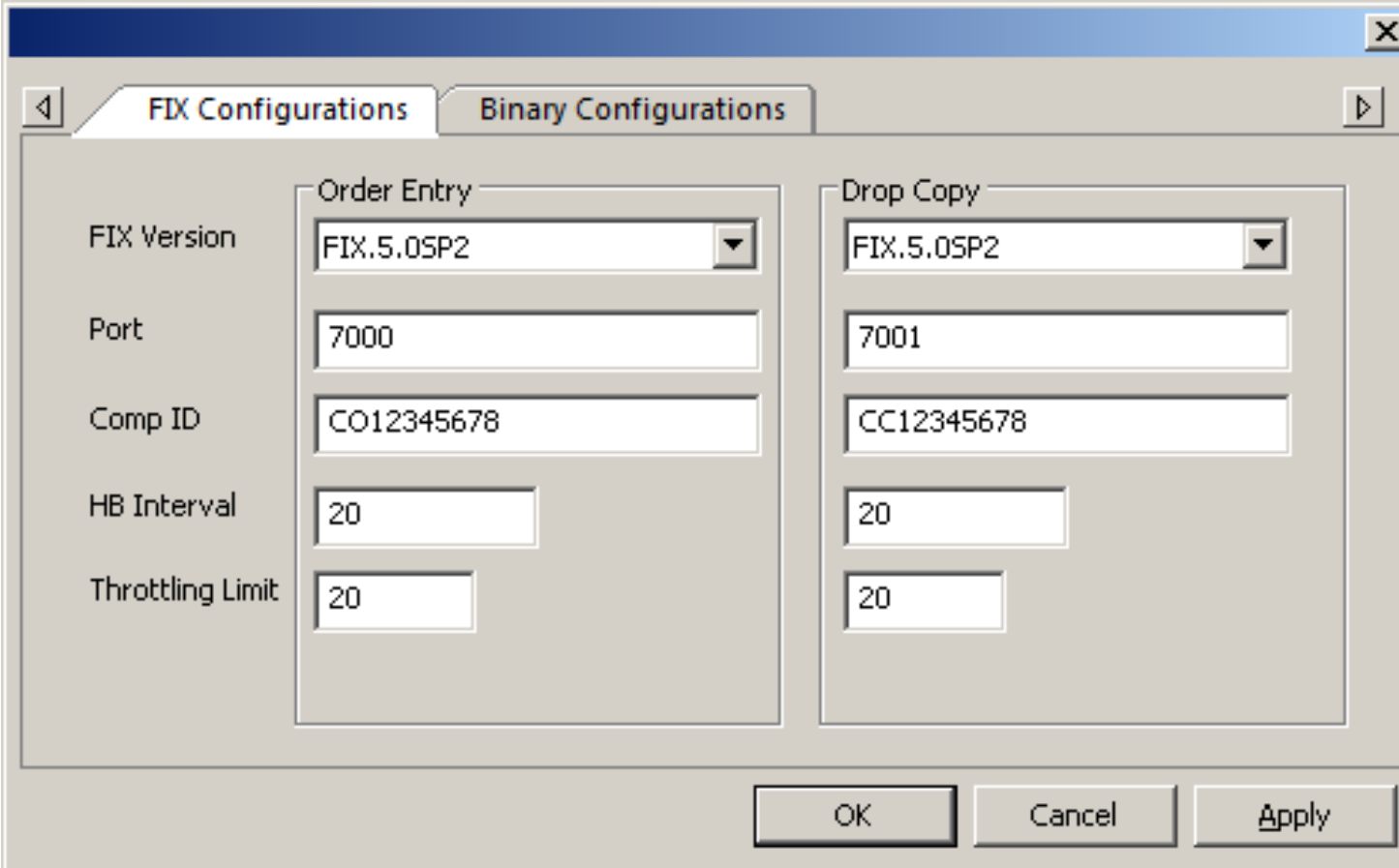
Offline OCG Simulator

❏ Offline OCG Simulator – Configuration Menu (Selection of Port and Comp ID)
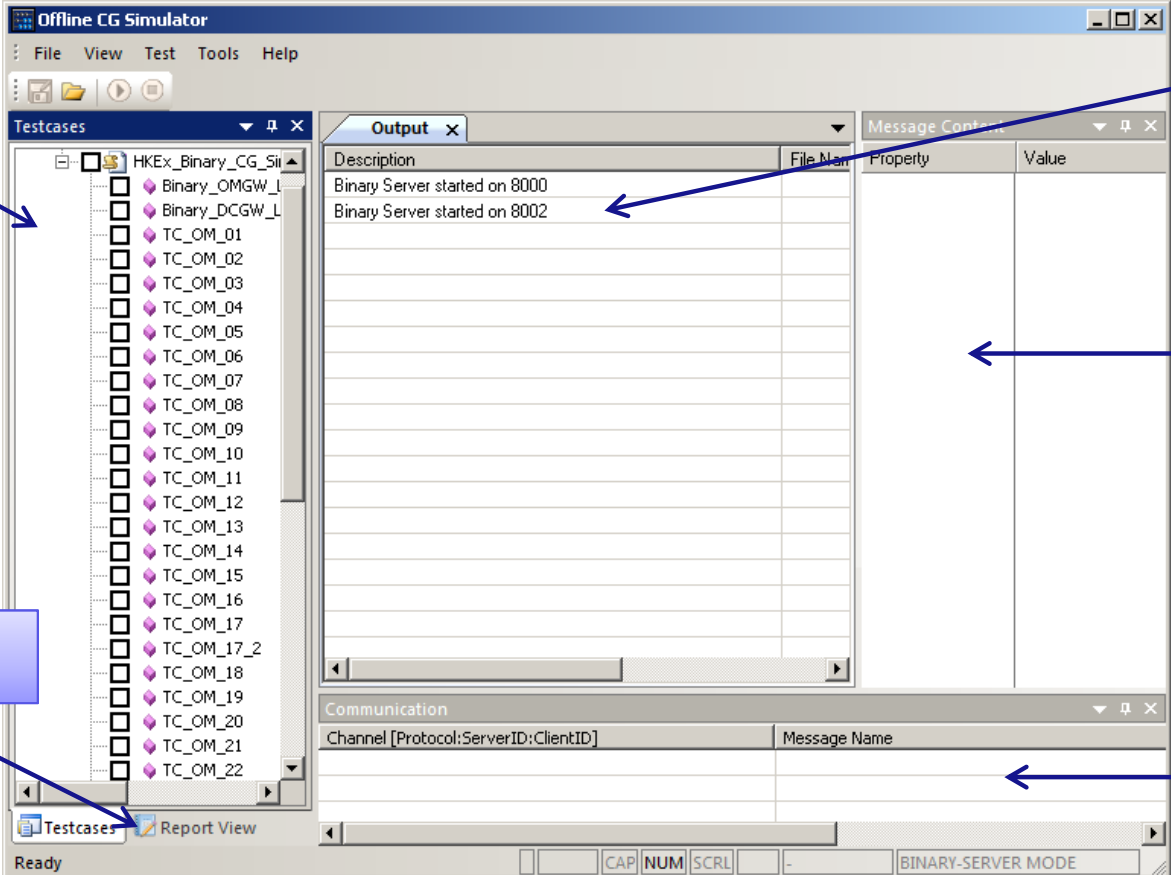
Offline OCG Simulator

❑ Offline OCG Simulator – Main Testing Window

Offline OCG Simulator

❑ Offline OCG Simulator – Certification (Summary Report)
  ▪ After finishing all test cases, EP should consolidate all Summary Report files and submit to HKEx according to selections in the enrollment (e.g. protocol & service supported) for verification

Summary Report

Q&A

Appendix

Appendix - OCG and OG Features Comparison

❑ Below are the high level features comparison between Orion Central Gateway(OCG) and Open Gateway(OG)

	OCG	OG
Hardware	No hardware is needed on the EP premises.	Physical Hardware is needed.
Market Data	No market data and reference data from OCG. EP may source market data, reference data and market information from OMD.	Market data, reference data, and market information are transmitted to BSS through OG.

Appendix - OCG and OG Features Comparison (Cont'd)

	OCG	OG
Message Protocol	FIX or Binary	AMS/3 Open Message
Bandwidth Requirement	Multiple OCG and OMD sessions for the securities market can connect through the same pair of SDNet/2 circuit. SDNet/2 circuits cannot be shared amongst different EPs.	Each OG needs to have its own pair of SDNet/2 circuit.
Throttle mechanism	Throttling is done on a rejection basis. Messages exceeding limit will be rejected. All business messages are in the same queue. One Standard Throttle provides the throughput of 2 Messages per second (MPS). BSS is required to implement throttle control to ensure submission to OCG is within the assigned Throttle limit.	Throttling is done on invitation basis. Invitations are sent by OG to BSS for receiving EPs' requests.

	OCG	OG
Throttle Capacity	Maximum capacity of OCG order flow session is 250 throttles (equivalent to 500 messages per second).	Maximum capacity per OG is 60 standard throttle rates (equivalent to 60 orders per second).
Throttle Breach	OCG order flow sessions may be disconnected automatically if there are severe breaches of throttle limit to protect the OCG for other EPs.	Not applicable.
Logon	Comp IDs (Computer IDs) will be provided by HKEx to each OCG Session (Trading or Drop Copy) to logon to OCG servers. No SMART card is needed. A pair of public and private keys will be provided by HKEx to EPs to encrypt the logon password.	Trader IDs are used for EPs to logon to AMS host via OG. SMART cards are used for encryption of message with sensitive information.

	OCG	OG
Backup and Recovery	OCG will run in High-Availability (HA) mode so that EPs can connect to mirror servers in a short time if primary OCG server fails. EPs do not need to call HKEx Market Operation for connecting to secondary OCG server. EPs can pre-register 1 IP address for each OCG Session. In addition, EPs can pre-register up to 3 backup IP addresses for same Comp ID. This set up allows BSS to use backup BSS if primary BSS fails.	EPs can choose to deploy stand-alone OG or HA OG (which is at a higher cost) for resilience. EPs need to deploy backup OGs on their own if necessary. If primary OG fails, EPs need to call HKEx Market Operation for activating their backup OGs, if any.

Appendix - OCG and OG Features Comparison (Cont'd)

	OCG	OG
Order and Trade Information	There are two types of Drop Copy Service: ▪ Trades Only ▪ Orders & Trades EP can subscribe Drop Copy Service which provides real-time copy of order and trade reporting of all broker IDs belonging to the EP regardless of the trading input device used.	Central Trade Feed will provide the firm-wide trade reporting to EPs.
Spread Table and Trading Timetable Information	Spread table and trading timetable information will not be provided through OCG or OMD. EPs should refer to HKEx's website for the information.	Spread table and timetable is transmitted through OG.

Appendix - OCG and OG Features Comparison (Cont'd)

	OCG	OG
Authorization control in Cross Device Function	In order to conform to FIX standard, there is no authorization required to perform cross device(or OBO) cancellations. Authorizer control should be done within BSS if necessary.	EPs have to logon as authorizer to perform cross device enquiries and cancellations.
Odd/Special Lot Order and Trade Input	In order to conform to FIX standard, OCG will not support semi-automatic matching method. Therefore, it will not support odd/special lot order inputs. Information of odd/special lot orders input by OGs and terminals will be available in OMD for EPs' information. Odd/special lot can be entered as manual trade to OCG.	Odd/special lot order and trade inputs are supported.

Appendix - OCG and OG Features Comparison (Cont'd)

	OCG	OG
Quote Withdrawal	In order to conform to FIX standard, quote withdrawal must be done on both sides of the quote.	Quote withdrawal can be done on one side of the quote.
Enquiry functions	There is no enquiry function through the OCG trading session to allow more effective usage of network bandwidth for trade only session. Information will be transmitted to EPs through OCG order flow and drop copy sessions as well as OMD in a real-time manner. EP can implement their own databases to consolidate all information and handle their enquiries internally as needed.	There are enquiry functions for order, trade, market and news information.

	OCG	OG
ORS Support	OCG will not support ORS service	OG supports ORS service.
Special Limit Order with All-or-Nothing	Special Limit Orders with the All-or-Nothing flag on will not be supported. Special Limit Order is available in FIX by using Limit Order with Time-in-Force attribute as IOC ("Immediate or Cancel"). For other orders, "All-or-Nothing" can be specified by having Time-in-Force as FOK ("Fill or Kill").	Special Limit Orders with the All-or-Nothing flag on are supported.
Amendment of Trade Classification	In order to conform to FIX standard, amendment of trade classification of auto-matched and manual trades is not supported.	Amendment of trade classification of auto-matched and manual trades is supported.

	OCG	OG
Cancel on Disconnect (COD)	An optional feature of Cancel on Disconnect (COD) is introduced. EPs can apply for COD where OCG will automatically cancel live orders in the affected session upon specific disconnection scenarios. The cancellations are done on a best effort basis.	There is no COD service.

AGENDA

Overview of OMD

OMD Securities Market
(OMD-C)

Securities market data sent via dual lines
- OMD Securities Standard (SS)
- OMD Securities Premium (SP)
- OMD Securities FullTick (SF)
- OMD Index (Index)
- (Complimentary) Odd Lot Order Feed
- (Complimentary) Conflated Broker Queue Feed

OMD Derivatives Market
(OMD-D)

Derivatives market data sent via dual lines
- OMD Derivatives Standard (DS)
- OMD Derivatives Premium (DP)
- OMD Derivatives FullTick (DF)

SDNet/2.0

Primary
Line
Secondary
Line

OMD Clients

Overview of OMD

Real-time Service

Channel 1
Channel 2
Channel 3
Channel n

Real-time multicast data broadcast via different sets of dual multicast channels

Retransmission Service

Retransmission of missed data in all channels transmitted in unicast

OMD-C sends requested lost messages via Unicast or responds error if request cannot be fulfilled

Refresh Service

Channel 1
Channel 2
Channel 3
Channel n

Refresh (market state image) multicast data broadcast periodically via different sets of dual multicast channels, same channel ID as real-time for same type of data

SDNet2.0

Primary Line

Secondary Line

OMD-C Clients subscribe to set(s) of dual multicast channels. OMD-C sends messages over primary channel(s) via primary line

Clients send retransmission request via Unicast over primary/secondary line to OMD-C if message(s) lost in both channels

OMD-C Clients subscribe to set(s) of dual multicast channels for refresh market data messages if late connect or fail to recover lost messages from retransmission service

Clients apply Line Arbitration to merge data from dual channels into single copy of messages

UDP by nature not reliable, OMD-C thus sends duplicated messages over secondary channel(s) via secondary line to mitigate packet loss

Similar to real-time service, OMD-C sends duplicated snapshot messages over secondary channel(s) via secondary line

Similar to real-time service, clients apply Line Arbitration to merge data from dual channels into single copy of messages

OMD-C Clients

4

Overview of OMD

- **Messages published in one-to-many mode using IP multicast and UDP transport protocols, supported by retransmission & refresh services**

- **Duplicated messages sent over dual multicast channels via primary & secondary SDNet/2 lines, line arbitration applied**

- **Retransmission service offered for recovery of few lost packets in dual multicast channels**

- **Refresh service published snapshot market state using IP multicast and UDP transport protocols, line arbitration applied**

- **OMD-C adopt multicast in order to achieve**
  - **Fairness**
  - **Low latency**
  - **Small footprint in OMD-C host**

AGENDA

Use of Developers Guide

- **Provide supplementary information to clients to support development of their own feed handler to process OMD-C messages**

- **Address potential queries raised by clients after reading OMD-C Interface Specification**

- **Help clients to get familiar with multicast message handling**

- **Cover different topics in deeper level of details to facilitate client development**

  - ➢ **Line Arbitration**

  - ➢ **Packet and message processing**

  - ➢ **Retransmission and refresh mechanism**

  - ➢ **Aggregate order book management and order book maintenance**

  - ➢ **Exception handling**

Use of Developers Guide

- **Illustrate with flow diagrams the possible logics in processing**

  - **Retransmitted data from OMD-C retransmission server**

  - **Refresh snapshot messages from OMD-C refresh service**

- **Demonstrate with pseudo codes as examples for message processing & exception handling**

  - **Connect and receive multicast channel**

  - **Line Arbitration**

  - **Processing retransmitted data**

  - **Processing refresh snapshot packet**

  - **Processing Aggregate Order Book message**

- **Objectives – use with OMD-C on-boarding tools to assist clients in OMD-C on-boarding**

AGENDA

Multicast Channel Assignment

- **OMD Securities Standard (SS)**

Multicast Service	Contents	Real-time Service Channel ID	Refresh Service Channel ID
Securities Static Data Channel	*Market Definition (10)* *Currency Rate (14)* *Security Definition (11)* *Liquidity Provider (13)*	1	501
Securities Status Channel	*Trading Session Status (20)* *Security Status (21)*	2	502
Securities Value Add Data Channel	*Market Turnover (61)*	3	503
Securities News Channel	*News (22)*	4	504
Securities Level 2 Conflated Channel	*Trade Ticker (52)* *Nominal Price (40)* *Indicative Equilibrium Price (41)* *Closing Price (62)* *Aggregate Order Book Update (53)* *Statistics (60)* *Yield (44)* *Broker Queue (54)*	10	510

Multicast Channel Assignment

- **OMD Securities Premium (SP)**

Multicast Service	Contents	Real-time Service Channel ID	Refresh Service Channel ID
Securities Static Data Channel	*Market Definition (10)* *Currency Rate (14)* *Security Definition (11)* *Liquidity Provider (13)*	1	501
Securities Status Channel	*Trading Session Status (20)* *Security Status (21)*	2	502
Securities Value Add Data Channel	*Market Turnover (61)*	3	503
Securities News Channel	*News (22)*	4	504
Securities Level 2 Streaming Channel	*Trade (50)* *Trade Cancel (51)* *Nominal Price (40)* *Indicative Equilibrium Price (41)* *Closing Price (62)* *Aggregate Order Book Update (53)* *Statistics (60)* *Yield (44)*	20 – 28	520 – 528

Multicast Channel Assignment

- **OMD Securities FullTick (SF)**

Multicast Service	Contents	Real-time Service Channel ID	Refresh Service Channel ID
Securities Static Data Channel	*Market Definition (10)* *Currency Rate (14)* *Security Definition (11)* *Liquidity Provider (13)*	1	501
Securities Status Channel	*Trading Session Status (20)* *Security Status (21)*	2	502
Securities Full Book Channel	*Trade (50)* *Trade Cancel (51)* *Add Order (30)* *Modify Order (31)* *Delete Order (32)* *Indicative Equilibrium Price (41)*	30 – 38	530 – 538

Multicast Channel Assignment

- **OMD Index (Index)**

Multicast Service	Contents	Real-time Service Channel ID	Refresh Service Channel ID
Hang Seng Index Channel	*Index Definition (70)* *Index Data (71)*	41	541
CSIC Index Channel	*Index Definition (70)* *Index Data (71)*	42	542
S&P Index Channel	*Index Definition (70)* *Index Data (71)*	43	543

Multicast Channel Assignment

- **(Complimentary) Odd Lot Order Feed**

Multicast Service	Contents	Real-time Service Channel ID	Refresh Service Channel ID
Securities Market Odd Lot Full Book Channel	*Add Odd Lot Order (33)* *Delete Odd Lot Order (34)*	70 – 78	570 – 578

- **(Complimentary) Conflated Broker Queue Feed**

Multicast Service	Contents	Real-time Service Channel ID	Refresh Service Channel ID
Securities Market Conflated Broker Queue Channel	*Broker Queue (54)*	60	560

AGENDA

1	Overview of OMD
2	Use of Developers Guide
3	Channel Assignment
4	**Control Message**
5	Recovery Mechanism
6	OMD-C Failure Recovery
7	Market Data Message
8	Highlights on Aggregate Order Book Management

Control Message

- **Multicast packet structured into a Packet Header followed by 0 or more messages, each starts with a 4-byte Message Header**

Packet Header

PktSize	MsgCount	Filler	SeqNum	SendTime
2 bytes	1 byte	1 byte	4 bytes	8 bytes

Message 1 — variable length
Message 2 — variable length
Message n — variable length

maximum length <= 1500 (including IP header & UDP heeader)

Message Header

MsgSize	MsgType
2 bytes	2 bytes
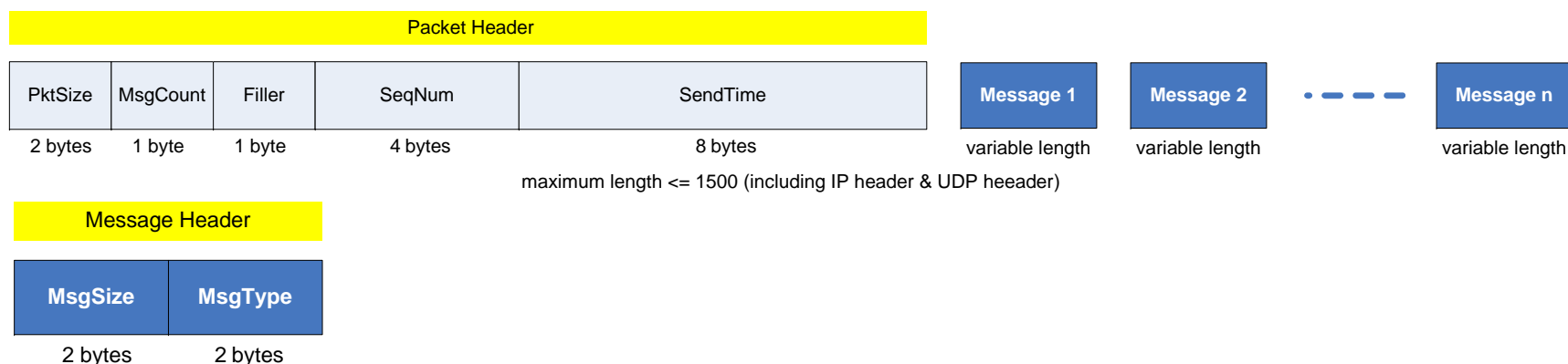
  - ➢ **Same packet structure applied to unicast messages**

- **There are 2 kinds of messages in OMD-C**

  - ➢ **Control message**
    - ● *Heartbeat, Sequence Reset (100), Refresh Complete (203), Logon (101) & Logon Response (102), Retransmission Request (201) & Retransmission Response (202)*

  - ➢ **Market Data message**

Control Message

- **Heartbeat**

  - **Unique message in a packet with MsgCount 0**

Field	Value
PktSize	16
MsgCount	0
Filler	
SeqNum	Sequence number of previous message
SendTime	Send time of the heartbeat

  - **Heartbeat frequency**

    - **Multicast – 2 seconds**

    - **Unicast**

      - **30 seconds**

      - **Need response in 5 seconds otherwise TCP/IP session will be terminated**

      - **Heartbeat response from clients is an exact copy of the incoming heartbeat**

Control Message

- **Sequence Reset (100)**

MsgSize = 8	MsgType = 100	NewSeqNo = 1
2 bytes	2 bytes	4 bytes

➢ **Per channel in real-time & refresh**

➢ **Once at Start of Day, multiple for resend of Reference data under very rare condition – this apply to real-time channel only**

➢ **Possible sent following OMD-C failure recovery**

➢ **Set next expected sequence number to 1**

➢ **Processing highlights to be covered in next topic**

Control Message

- ### Refresh Complete (203)

MsgSize = 8	MsgType = 203	LastSeqNum
2 bytes	2 bytes	4 bytes

  - ➢ **As a marker between successive full refresh snapshots**

  - ➢ **Clients cache real-time data before full refresh snapshots received**

  - ➢ **Process real-time data with sequence number greater than <u>LastSeqNum</u> and discard the rest**

- ### Logon (101) & Logon Response (102)

Logon (101)		
MsgSize = 16	MsgType = 101	Username
2 bytes	2 bytes	12 bytes

Logon Response (102)			
MsgSize = 8	MsgType = 102	SessionStatus	Filler
2 bytes	2 bytes	1 byte	3 bytes

  - ➢ **Authenticate <u>Username</u> & client IP**

  - ➢ **Reject logon for duplicated logon, invalid username or client IP**

  - ➢ *Logon / Logon Response* **timeout – 5 seconds**

Control Message

- **Retransmission Request (201) & Retransmission Response (202)**

Retransmission Request (201)					
MsgSize = 16	MsgType = 201	ChannelID	Filler	BeginSeqNum	EndSeqNum
2 bytes	2 bytes	2 bytes	2 bytes	4 bytes	4 bytes

Retransmission Response (202)						
MsgSize = 16	MsgType = 202	ChannelID	RetransStatus	Filler	BeginSeqNum	EndSeqNum
2 bytes	2 bytes	2 bytes	1 byte	1 byte	4 bytes	4 bytes

- ➤ **Requested messages will be sent after successful *Retransmission Response***

- ➤ **SeqNum in packet header carries no meaning, simply ignore it**

- ➤ **BeginSeqNum & EndSeqNum in *Retransmission Response* copied from *Retransmission Request*, carry no meaning & can be ignored**

AGENDA

Recovery Mechanism

- **UDP protocol is unreliable & exposed to risk of packet loss**

- **Infrastructure-wise SNDet/2 offers extremely low packet loss rate ➔ compensate UDP shortfall**

- **Clients may still experience, though some are rare:**

  ➢ **Late connection**

  ➢ **Client application restarts**

  ➢ **OMD-C restart or node/site failover**

- **To address the above OMD-C implements below different recovery mechanisms:**

  ➢ **Line Arbitration**

  ➢ **Retransmission Service**

  ➢ **Refresh Service**

Recovery Mechanism – Line Arbitration

- **Data broadcast in different sets of dual multicast channels via primary line (Line A) & secondary line (Line B)**

- **Content comparison for Line A & Line B**

Identical	(Possible) Difference
Sequence number (SN)	Number of message in a packet (MsgCount)
Messages that are sent	SN of 1st message in the packet (SeqNum)
Sequence of the message sent	

- **Contents of Line A & Line B can be**

Line A		
Message	**MsgCount**	**SeqNum**
Add Order 1 Add Order 2 Modify Order 1	3	101
Trade 1 Delete Order 1	2	104
Trade 2 Statistics 1	2	106

Line B		
Message	**MsgCount**	**SeqNum**
Add Order 1 Add Order 2	2	101
Modify Order 1 Trade 1 Delete Order 1	3	103
Trade 2 Statistics 1	2	106

Recovery Mechanism – Line Arbitration

- **Listen to both Line A & Line B, set same priority for both lines**

- **Whenever a gap is detected in Line A or Line B, either**

  - ➢ **Wait some finite time, issue retransmission request if gap cannot be filled from same line (due to out of order) or alternate line**

  - ➢ **Issue retransmission request directly**

- **Gap detection mechanism may work as follows**

  - ➢ **Set next expected sequence number (NSN) to s+1, assuming**

    - ● **Sequence number (SN) of last message in $(n-1)^{th}$ packet = s**

    - ● **No gap detected in (n-1) packets**

  - ➢ **For each message in n^{th} packet compare message SN with NSN**

    - ● **If SN = NSN, process message, advance SN & NSN by 1**

    - ● **Duplicate message if SN < NSN ➜ discard message**

    - ● **Gap detected if SN > NSN**

Recovery Mechanism – Retransmission Service

- **Recover small number of message gap (real-time feed only)**

- **Primary/secondary retransmission server (RTS) for resilience**

- **Clients can establish connection to RTS when their system starts up or when retransmission is needed**

- **Check heartbeat to detect connection drop, reconnect to same RTS or switch to secondary RTS**

- **Missing messages sent in packets not exceeding 1,500 bytes**

- **Several limits to take note**

System Limit	Value
Available number of messages per channel ID	50,000
Maximum sequence range for request per channel ID	10,000
Daily maximum of requests (counting all channel IDs)	1,000

Recovery Mechanism – Retransmission Service

- **Cache real-time data & process after gap filled**

- **Multiple gaps may occur in same channel while a gap awaiting filled or occur in different channels**

  - ➢ **Keep a list of gaps to be filled**

  - ➢ **Process distinct retransmission request/response with RTS to fill gap one by one**

  - ➢ **RTS accepts multiple concurrent requests from same client**

    - **FIFO**

    - **May interleave with requests from other clients**

    - ***Clients should send new request to RTS only after previous gap is filled***

- **Use refresh service if gap size exceeds available number of messages in the channel**

Recovery Mechanism – Refresh Service

- **Allow clients to late connect to OMD-C or recover from significant packet loss**

- **Publish latest market states periodically in for the followings:**

  - **Latest images of all reference data & index definition**

  - **Latest snapshots for each security/market/index**

    - **Market & halted securities status**

    - **Market & securities statistics and securities prices data**

    - **Aggregate order book updates & broker queue**

    - **Outstanding orders in board lot & odd lot books**

    - **Index data**

  - **All news**

Recovery Mechanism –
Refresh Service

- **Refresh processing may work as follows**

  - ➢ **Clear all cached market data before processing refresh data**

  - ➢ **Cache real-time data to be processed after refresh complete**

  - ➢ **First build market/securities/index static images from refresh channels for reference data before listen to other channels**

  - ➢ **Line Arbitration for real-time data applies to refresh data except**

    - ● **No retransmission service**

    - ● **No need to check any message gap before first arrived packet**

  - ➢ **Any gap cannot be filled from same/alternate line ➔ discard the cached data & wait for next 'full' refresh snapshot**

AGENDA

OMD-C Failure Recovery

- **OMD-C builds different levels of resilience to address the followings:**

  - ➢ **SDNet/2 client line failure – dual client lines**

  - ➢ **SDNet/2 host line failure – multiple host lines**

  - ➢ **OMD-C node failure – dual nodes for node restart/failover**

  - ➢ **OMD-C site failure – primary & DR sites for site failover**

- **Apply below recovery mechanisms for SDNet/2 client/host line failure or OMD-C node restart**

  - ➢ **Line Arbitration**

  - ➢ **Retransmission Service**

  - ➢ **Refresh Service**

OMD-C Failure Recovery

- **Apply same recovery mechanism for node failure except for**

  - ➢ **SS clients to check ticker ID to avoid duplication for possible sending of duplicated trade tickers from OMD-C**

- **Clients may receive *Sequence Reset* messages when OMD-C node restarts or fails over to DR site**

  - ➢ **Sequence reset processing may work as follows:**

    - ● **Receive *Sequence Reset* message from any multicast channel, ignore subsequent *Sequence Reset* messages from other channels**

    - ● **Reset next expected sequence number to 1 for all channels**

    - ● **Clear all cached data for all instruments**

    - ● **Subscribe to refresh channels for latest market states**

    - ● **Resume to process real-time messages**

AGENDA

Market Data Message

- ## Message Overview

Reference Data

Market Definition (10)

Security Definition (11)

Liquidity Provider (13)

Currency Rate (14)

Status Data

Trading Session Status (20)

Security Status (21)

Order Book Data

Add Order (30)

Modify Order (31)

Delete Order (32)

Add Odd Lot Order (33)

Delete Odd Lot Order (34)

Aggregate Order Book Update (53)

Broker Queue (54)

Trade and Price Data

Trade (50)

Trade Cancel (51)

Trade Ticker (52)

Closing Price (62)

Nominal Price (40)

Indicative Equilibrium Price (41)

Value Added Data

Statistics (60)

Market Turnover (61)

Yield (44)

News

News (22)

Index Data

Index Definition (70)

Index Data (71)

Market Data Message

- Spread table is not OMD-C reference data, clients should reference to below link to build its own for spread compilation

  http://www.hkex.com.hk/eng/rulesreg/traderules/sehk/documents/sch-2_eng.pdf

- 3 decimal places implied for all prices and turnovers market data except

  - CurrencyRate in *Currency Rate* – 4 implied decimal places

  - EAS in *Index Data* – 2 implied decimal places

  - Indexes & turnovers in *Index Data* – 4 implied decimal places

- All time fields are in number of elapsed nanoseconds since midnight Jan 1, 1970 (UTC), convert to the date-time format if needed

Market Data Message

- **Highlights of some market data messages provided in subsequent slides to help clients in system development**

- **Reference Data**

  - ➢ **Currency Rate (14)**

    - ● **Mainly for SF clients to calculate the market turnover in HKD**

    - ● **Clients will not receive this message during trading hours**

- **Status Data**

  - ➢ **Security Status (21)**

    - ● **At Start of Day (SOD), clients should set all security statuses to active**

    - ● **Set security status to suspended/halted when receiving this message at SOD, which are only be sent when a security is suspended/halted**

Market Data Message

- **Order Book Data**

  - **Add Order (30), Modify Order (31), Delete Order (32)**

    - **Not available in Auction Session until completion of auction**

  - **Add Odd Lot Order (33), Delete Odd Lot Order (34)**

    - **Not available in Auction Session until completion of auction**

    - **Difference from board lot order book messages – extra BrokerID field**

  - **Aggregate Order Book Update (53)**

    - **Send delta change instead of full 10BBO to reduce bandwidth usage**

    - **Use PriceLevel instead of Tick Level to follow international practice**

    - **Processing highlights to be covered in next topic**

Market Data Message

- **Trade and Price Data**

  - **Closing Price (62)**

    - **SS clients should ignore <u>NumberOfTrades</u> field which is not available**

  - **Nominal Price (40)**

    - **SF clients should derive their own nominal price according to Trading Rules in HKEx website, if needed**

- **Value Added Data**

  - **Statistics (60)**

    - **SS clients should ignore <u>VWAP</u> field which is not available**

    - **<u>ShortSellSharesTraded</u> & <u>ShortSellTurnover</u> sent twice a day to replace existing data sent as ShortSell news in MDF 3.8 feed**

AGENDA

Highlights on
Aggregate Order Book Management

- ## Tick Level vs Price Level

Tick Level	Price Level
Defined as how many spreads from the best bid/ask price	Assigned to each price existing in the OMD order book
A tick level of 10 means the order price is 9 spreads from the best price	A price level of 10 means the order price is the 10th best prices in the order book
Used in MDF 3.8 and AMS/3.8	Widely used in other Exchanges
MDF 3.8 sends tick level in XO element	OMD-C sends price level in message (53)
Empty tick level is possible	No empty price level

- ## Relationship between Tick Level & Price Level shown below

  - ➢ **Assume**
    - ● **Security code = 1234**
    - ● **Best bid price @ 9.8000**
    - ● **Spread = 0.01 at this price**
  - ➢ **Top 5 bid prices (5 Price Levels) spread across 10 Tick Levels**
  - ➢ **OMD-C sends message (53) to allow clients maintain their aggregate order books for 10 Tick Levels at most**

Bid Side			
Tick	PriceLevel	AggregateQuantity	Price
1	1	700	9.800
2	2	350	9.790
3			
4			
5	3	150	9.760
6			
7			
8			
9	4	250	9.720
10	5	100	9.710

Highlights on Aggregate Order Book Management

- **Illustration of different techniques used for processing *Aggregate Order Book Update,* take SS as reference**

  ➢ **At time T we have the following OMD-C book image**

	Bid Side				Ask Side		
Tick	**PriceLevel**	**AggregateQuantity**	**Price**	**Price**	**AggregateQuantity**	**PriceLevel**	**Tick**
1	1	250	9.730	9.800	700	1	1
2	2	50	9.720	9.810	350	2	2
3	3	700	9.710	9.820	150	3	3
4	4	350	9.700				4
5	5	150	9.690	9.840	250	4	5
6	6	250	9.680	9.850	100	5	6
7	7	100	9.670				7
8	8	150	9.660	9.870	400	6	8
9	9	50	9.650	9.880	200	7	9
10	10	150	9.640	9.890	300	8	10
11	11	100	9.630				11
12							12
13							13
14							14
15							15
16							16

  ➢ **At time T+1 we have the following sequence events:**

  - ❖ **(1) An aggressing ask order @ 9.730 completely matched resting bid order @ tick level 1;**

  - ❖ **(2) A modify order to reduce resting bid order quantity @ tick level 3 from 700 to 300;**

  - ❖ **(3) New ask orders at 3 different prices (9.740, 9.750 & 9.760) arrived**

Highlights on
Aggregate Order Book Management

➢ **OMD-C sends the following Aggregate Order Book Update message**

Offset	Field Name	Value
0	MsgSize	252
2	MsgType	53
4	SecurityCode	1234
8	Filler	NULL
11	NoEntries	10

Offset	Field Name	Value
12	AggregateQuantity	250
20	Price	9.730
24	NumberOfOrders	1
28	Side	0 (Bid)
30	PriceLevel	1
31	UpdateAction	2
32	Filler	NULL

Offset	Field Name	Value
36	AggregateQuantity	300
44	Price	9.710
48	NumberOfOrders	1
52	Side	0 (Bid)
54	PriceLevel	2
55	UpdateAction	1
56	Filler	NULL

Offset	Field Name	Value
60	AggregateQuantity	100
68	Price	9.630
72	NumberOfOrders	1
76	Side	0 (Bid)
78	PriceLevel	10
79	UpdateAction	1
80	Filler	NULL

Offset	Field Name	Value
84	AggregateQuantity	450
92	Price	9.740
96	NumberOfOrders	1
100	Side	1 (Offer)
102	PriceLevel	1
103	UpdateAction	0
104	Filler	NULL

Offset	Field Name	Value
108	AggregateQuantity	550
116	Price	9.750
120	NumberOfOrders	1
124	Side	1 (Offer)
126	PriceLevel	2
127	UpdateAction	0
128	Filler	NULL

Offset	Field Name	Value
132	AggregateQuantity	650
140	Price	9.760
144	NumberOfOrders	1
148	Side	1 (Offer)
150	PriceLevel	3
151	UpdateAction	0
152	Filler	NULL

Offset	Field Name	Value
156	AggregateQuantity	250
164	Price	9840
168	NumberOfOrders	1
172	Side	1 (Offer)
174	PriceLevel	7
175	UpdateAction	2
176	Filler	NULL

Offset	Field Name	Value
180	AggregateQuantity	100
188	Price	9850
192	NumberOfOrders	1
196	Side	1 (Offer)
198	PriceLevel	7
199	UpdateAction	2
200	Filler	NULL

Offset	Field Name	Value
204	AggregateQuantity	400
212	Price	9870
216	NumberOfOrders	1
220	Side	1 (Offer)
222	PriceLevel	7
223	UpdateAction	2
224	Filler	NULL

Offset	Field Name	Value
228	AggregateQuantity	200
236	Price	9880
240	NumberOfOrders	1
244	Side	1 (Offer)
246	PriceLevel	7
247	UpdateAction	2
248	Filler	NULL

Highlights on Aggregate Order Book Management

Top-left table

	Bid Side				Ask Side		
Tick	PriceLevel	AggregateQuantity	Price	Price	AggregateQuantity	PriceLevel	Tick
1				9.800	700	1	1
2	2	50	9.720	9.810	350	2	2
3	3	700	9.710	9.820	150	3	3
4	4	350	9.700				4
5	5	150	9.690	9.840	250	4	5
6	6	250	9.680	9.850	100	5	6
7	7	100	9.670				7
8	8	150	9.660	9.870	400	6	8
9	9	50	9.650	9.880	200	7	9
10	10	150	9.640	9.890	300	8	10
11	11	100	9.630				11
12							12
13							13
14							14
15							15
16							16

Right-side entries

2nd aggregate book order update entry

12	AggregateQuantity	250
20	Price	9.730
24	**Order Reduction**	1
28		0 (Bid)
30	PriceLevel	1
31	UpdateAction	2

1st aggregate book order update entry

44	Price	9.710
48	NumberOfOrders	1
52	**Explicit Deletion**	0 (Bid)
54		2
55	UpdateAction	1
56	Filler	NULL

Implicit Level Adjustment
Change Price Levels from 2 – 10 to 1 – 9 (by clients)

Explicit Addition
After best bid order matched, original order @ tick level 11 becomes tick level 10 → OMD sends 'new' entry for the 10th tick

3rd aggregate book order update entry

60	AggregateQuantity	100
68	Price	9.630
72	NumberOfOrders	1
76	Side	0 (Bid)
78	PriceLevel	10
79	UpdateAction	1
80	Filler	NULL

Bottom table

	Bid Side				Ask Side		
Tick	PriceLevel	AggregateQuantity	Price	Price	AggregateQuantity	PriceLevel	Tick
1	1	50	9.720	9.740	450	1	1
2	2	300	9.710	9.750	550	2	2
3	3	350	9.700	9.760	650	3	3
4	4	150	9.690				4
5	5	250	9.680				5
6	6	100	9.670				6
7	7	50	9.660	9.800	700	4	7
8	8		9.650	9.810	350	5	8
9	9	150	9.640	9.820	150	6	9
10	10	100	9.630				10
11				9.840	250	7	11
12				9.850	100	8	12
13							13
14				9.870	400	9	14
15				9.880	200	10	15
16				9.890	300	11	16

Highlights on Aggregate Order Book Management

Bid Side

Tick	PriceLevel	AggregateQuantity	Price
1	1	250	9.730
2	2	50	9.720
3	3	700	9.710
4	4	350	9.700
5	5	150	9.690
6	6	250	9.680
7	7	100	9.670
8	8	150	9.660
9	9	50	9.650
10	10	150	9.640
11	11	100	9.630
12			
13			
14			
15			
16			

Ask Side

Price	AggregateQuantity	PriceLevel	Tick
9.800	700	1	1
9.810	350	2	2
9.820	150	3	3
			4
9.840	250	4	5
9.850	100	5	6
			7
9.870	400	6	8
9.880	200	7	9
9.890	300	8	10
			11
			12
			13
			14
			15
			16

Implicit Level Adjustment
Change Price Levels
from 1 – 8 to 4 – 11 (by clients)

84	AggregateQuantity	450
92	Price	9.740
96	NumberOfOrders	1
100	Side	1 (Offer)

5th aggregate book order update entry

		1
103	UpdateAction	
104	Filler	

Explicit Addition

4th aggregate book order update entry

116	Price	9.750
120	NumberOfOrders	1
124	Side	1 (Offer)
126	PriceLevel	2
127	UpdateAction	0
128	Filler	NULL

Explicit Addition

6th aggregate book order update entry

132	AggregateQuantity	650
140	Price	9.760
144	NumberOfOrders	1
148	Side	1 (Offer)
150	PriceLevel	3
151	UpdateAction	0
152	Filler	NULL

Explicit Addition

Bid Side

Tick	PriceLevel	AggregateQuantity	Price
1			
2			
3	3	350	
4	4	150	9.690
5	5	250	9.680
6	6	100	9.670
7	7	150	9.660
8	8	50	9.650
9	9	150	9.640
10	10	100	9.630
11			
12			
13			
14			
15			

Ask Side

Price	AggregateQuantity	PriceLevel	Tick
9.740	450	1	1
9.750	550	2	2
9.760	650	3	3
			4
			5
			6
9.800	700	4	7
9.810	350	5	8
9.820	150	6	9
			10
9.840	250	7	11
9.850	100	8	12
			13
9.870	400	9	14
9.880	200	10	15
9.890	300	11	16

Bid Side

Tick	PriceLevel	AggregateQuantity	Price
1	1	250	9.730
2	2	50	9.720
3	3	700	9.710
4	4	350	9.700
5	5	150	9.690
6	6	250	9.680
7	7	100	9.670
8	8	150	9.660
9	9	50	9.650
10	10	150	9.640
11	11	100	9.630
12			
13			
14			
15			
16			

Ask Side

Price	AggregateQuantity	PriceLevel	Tick
9.800	700	1	1
9.810	350	2	2
9.820	150	3	3
			4
9.840	250	4	5
9.850	100	5	6
			7
9.870	400	6	8
9.880	200	7	9
9.890	300	8	10
			11
			12
			13
			14
			15
			16

156	AggregateQuantity	250
164	Price	9840
168	NumberOfOrders	1
172	Side	1 (Offer)
174	PriceLevel	7
175	UpdateAction	2

8th aggregate book order update entry

7th aggregate book order update entry

188	Price	9850
192	Nu...	1
196	Sid...	(Offer)
198	PriceLevel	7
199	UpdateAction	2
200	Filler	NULL

Explicit Deletion

9th aggregate book order update entry

204	AggregateQuantity	400
212	Price	9870
216	NumberOfOrders	1
220	Side	1 (Offer)
222	PriceLevel	7
223	UpdateAction	2
224	Filler	NULL

Bid Side

Tick	PriceLevel	AggregateQuantity	Price
1	1	50	9.720
2	2	500	9.710
3	3	350	9.700
4	4	150	9.690
5	5	250	9.680
6	6		9.670
7	7		9.660
8	8	50	9.650
9	9	150	9.640
10	10	100	

Ask Side

Price	AggregateQuantity	PriceLevel	Tick
9.740	**450**	**1**	1
9.750	**550**	**2**	2
9.760	**650**	**3**	3
			4
			5
			6
			7
9.800	700	4	8
9.810	350	5	9
9.820	150	6	10
9.840	250	7	11
9.850	100	8	12
			13
9.870	400	9	14
9.880	200	10	15
9.890	**300**	**11**	16

Explicit Deletion

Explicit Deletion

Highlights on Aggregate Order Book Management

Bid Side				Ask Side			
Tick	PriceLevel	AggregateQuantity	Price	Price	AggregateQuantity	PriceLevel	Tick
1	1	250	9.730	9.800	700	1	1
2	2	50	9.720	9.810	350	2	2
3	3	700	9.710	9.820	150	3	3
4	4	350	9.700				4
5	5	150	9.690	9.840	250	4	5
6	6	250	9.680	9.850	100	5	6
7	7	100	9.670				7
8	8	150	9.660	9.870	400	6	8
9	9	50	9.650	9.880	200	7	9
10	10	150	9.640	9.890	300	8	10
11	11	100	9.630				11
12							12
13							13
14							14
15							15
16							16

8th aggregate book order update entry

228	AggregateQuantity	200
236	Price	9880
240	NumberOfOrders	1
244	Side	1 (Offer)
246	PriceLevel	7
247	UpdateAction	2
248	Filler	NULL

Implicit Deletion
OMD sends explicit deletion for orders within 10 price level.
This order is of Price Level 11, clients have to perform implicit deletion to delete the entry so as to correctly maintain their book

Bid Side				Ask Side			
Tick	PriceLevel	AggregateQuantity	Price	Price	AggregateQuantity	PriceLevel	Tick
1	1	50	9.720	9.740	450	1	1
2	2	300	9.710	9.750	550	2	2
3	3	350	9.700	9.760	650	3	3
4	4	150	9.690				4
5	5	250	9.680				5
6	6	100	9.670				6
7	7	150	9.660	9.800	700	4	7
8	8		9.650	9.810	350	5	8
9	9		9.640	9.820	150	6	9
10	10						10
11				9.840	250	7	11
12				9.850	100	8	12
13							13
14				9.870	400	9	14
15				9.880	200	10	15
16				9.890	300	11	16

Explicit Deletion

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Highlights on Aggregate Order Book Management

- **Strictly follow the sequence in the book entry list of the *Aggregate Order Book Update (53)* to apply changes to 10BBO**

- **Apply implicit level adjustment to PriceLevels following addition/deletion of aggregate order book entry**

- **OMD-C sends explicit deletion/addition for book entries within 10 PriceLevel**

- **Clients perform implicit deletion for book entries beyond 10 PriceLevel**

- **Techniques used in aggregate order book management:**
  - **Explicit Deletion/Addition**
  - **Quantity Reduction**
  - **Implicit Deletion**
 - **Implicit Level Adjustment**

OMD-C On-boarding Tools

- **Run on RedHat Enterprise Linux (RHEL) 6.2 64-bit Edition or CentOS 6.2 64-bit**

- **Provide testing facilities and simulated market data (canned data) for the Clients**

- **Facilitate development, enhancement and testing of the Clients' systems to receive and process data from OMD-C**

- **Help Clients to ensure their readiness for the implementation before joining the Open Test, Certification Test and MR**

- **Support Clients' capacity and performance tests via allowing canned data to be replayed at various fixed rates**

- **Include separate data sets for functional test and volume test**

- **Run on different or same machine as the Client's system**

OMD-C On-boarding Tools

- **Overview**

  ➢ **RTS Simulator – Simulates OMD-C retransmission server to handle client's logon/logon response & retransmission request/response**

  ➢ **Multicast Injector - Broadcasts OMD-C canned data via multicast over the networkXDP**

  ➢ **Canned data - Fictitious trading data to facilitate functional & volume testing**

  ➢ **XDP Dump - Decodes data into a readable ASCII format**
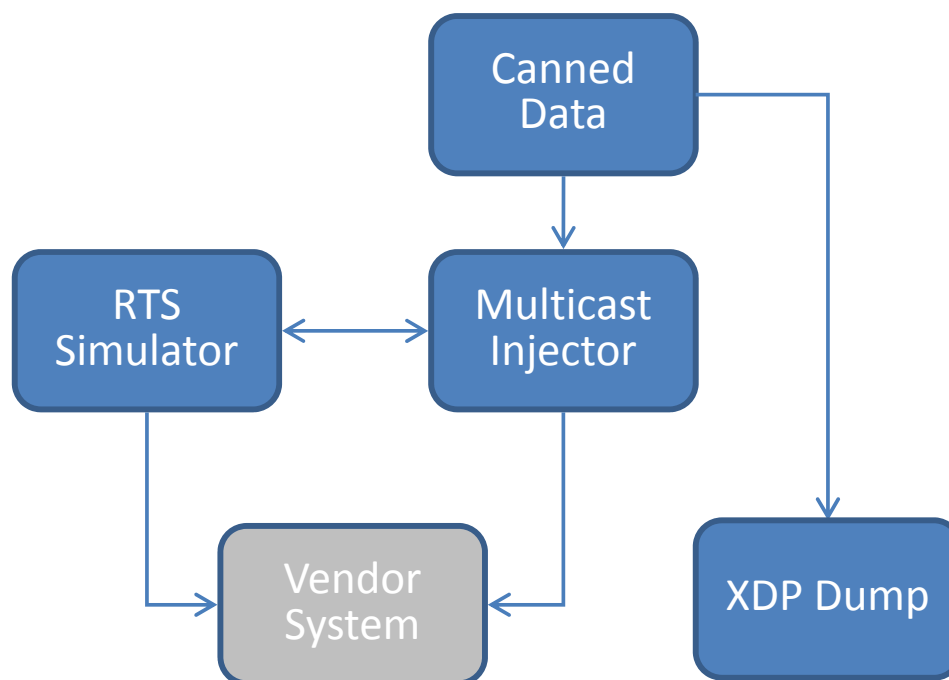
OMD-C On-boarding Tools

- **Limitations :**

  - ➢ **Refresh service is not included, need to be tested in Open Test environment**

  - ➢ **No missing packet (gap) is introduced in the canned data, Clients can generate packet loss events by using Linux 'tc' or 'iptables' applications to drop data on OMD-C multicast IP's/Port's if necessary**