

**For information**

**Legislative Council Panel on Financial Affairs**  
**Suspension of dissemination of Hang Seng family of indices**  
**on 22 January 2010**

**Purpose**

This paper gives an overview of the service interruption at Hang Seng Indexes Company Limited (**HSIL**) in the morning of 22 January 2010, and the contingency and remedial measures taken thereafter. For more specific details, Members may wish to refer to the two reports at Annex 1 and Annex 2 prepared by HSIL and Hong Kong Exchanges and Clearing Limited (**HKEx**) respectively.

**The incident**

*The service interruption*

2. HSIL is the manager and compiler of the various Hang Seng indexes. It calculates and disseminates these indexes on a real-time basis throughout every trading day.
3. In the morning of 22 January 2010, HSIL encountered a problem in its computer system that rendered it unable to update and disseminate updated indexes in the ordinary way for about 30 minutes from market opening at 10:00 am to around 10:33 am. HSIL and HKEx communicated at the first minute (09:52 hours) when the error popped up. There was no communication gap but all parties agreed to discuss further ways to enhance communication

*Cause of the problem*

4. HSIL has explained that the problem was caused by the occurrence of a very rare circumstance which its data processing methodology was not catered to handle. The rare circumstance was the occurrence of an “out-of-sequence” event (where an older stock price record was processed by the system after a newer stock price record) immediately at the end of the pre-opening trading session. This event caused the system processing to stop and affected the index calculation. Detailed explanation of the cause of the problem is provided by HSIL’s report at Annex 1.

*Impact on the market*

5. The service interruption did not have a significant impact on the market as existing

contingency arrangements were in place by both HKEx and HSIL to deal with the situation, and these were activated very soon after the service interruption was identified. Moreover, the problem was fixed within a short period of time and services resumed normally thereafter. Under the contingency arrangements, the Hang Seng Index (**HSI**) and the Hang Seng China Enterprises Index (**HSCEI**) were updated by HSIL's contingency system every 15 minutes (i.e. at 10:15 am and 10:30 am) and disseminated to HKEx and other information vendors by email (rather than through dedicated electronic links as is done in normal circumstances). Normal services resumed by around 10:33 am.

### ***Impact on products with HSI and HSCEI as underlying***

6. There are various products traded on HKEx's stock and futures markets with the HSI and HSCEI as their underlying. The service interruption had a limited impact on these products. In accordance with HKEx's contingency plan, trading in the products was allowed as HSIL had activated its contingency arrangements to provide updated indexes every 15 minutes.

7. The position of Callable Bull/Bear Contracts (**CBBCs**) with the HSI as their underlying is worth special mention. When HSIL's normal services resumed at around 10:33 am, thirteen CBBCs were suspended as a result of a mandatory call event. Trades executed in these CBBCs, after the mandatory call event, were cancelled. The suspension of trading of CBBCs and trade cancellation are standard procedures specific to the CBBC product which also happen during normal trading days. Detailed explanation of the mandatory call feature of CBBCs is provided by HKEx's report at Annex 2.

### ***Rectification steps taken***

8. HSIL has since taken steps to improve its system so that a similar event will not recur. Specifically, it has fine tuned its data processing methodology to deal with the occurrence of an out-of-sequence event.

9. HSIL will also be undertaking a comprehensive review of its system with a view to identifying any other potential points of failure, and if so, making the necessary changes.

10. Additionally, HSIL is also looking into improving its contingency arrangements. In particular, it is looking into shortening the existing 15-minute interval for calculating and disseminating the indexes, and enhancing communications with HKEx and the public.

### ***SFC's role***

11. The calculation and dissemination of indexes is not a regulated activity. As such,

the SFC does not have express regulatory oversight in respect of HSIL's activities. However, because the timely calculation and dissemination of updated indexes can affect market participants and the market as a whole, the SFC does have a vested interest in monitoring the provision of HSIL's services and following up on any problems.

12. In the present case, after the incident occurred, the SFC followed up with HSIL and HKEx to understand the situation. The SFC maintained a constant dialogue with both HSIL and HKEx throughout that day to assess the implication for the market and thereafter to follow up on the contingency arrangements and remedial measures.

### ***Conclusion***

13. While this incident inevitably affected the normal operation of the market, the contingency measures activated by HSIL and HKEx on 22 January 2010 helped to avoid significant disruption to the market. We believe improvements and enhancements proposed by HKEx and HSIL can help to further improve the contingency arrangements. The SFC will work closely with HSIL and HKEx to follow up on these proposed changes.

**Securities and Futures Commission**

**February 2010**



## Incident Report

### Service Interruption at Hang Seng Indexes Co Ltd on 22 January 2010

#### 1. Background of Hang Seng Indexes Company Limited (“HSIL”)

The Hang Seng Index (“HSI”) was launched by Hang Seng Bank in 1969.

Hang Seng Indexes Company Limited (“HSIL”) is a wholly-owned subsidiary of Hang Seng Bank established in 1984 to take over the compilation of the Hang Seng Index (“HSI”) from Hang Seng Bank.

HSIL is now an index compiler covering Hong Kong and mainland China markets. It manages and compiles the Hang Seng Family of Indexes (“Indexes”), which currently comprises 47 real-time price indexes. HSIL also compiles and disseminates day-end indexes after market close, covering total return indexes and multiple-currency indexes of the underlying real-time indexes.

The most widely quoted indexes are the HSI, which was launched in 1969, and the Hang Seng China Enterprises Index (“H-Share Index”), which was launched in 1994.

HSIL disseminates Indexes through a broadcast network to Hong Kong Exchange Ltd (HKEx) and other information vendors such as Reuters, Bloomberg and ET-Net. HSIL also grants index licences to product issuers for their launch of index-linked products such as index futures, exchange-traded-funds and index-linked derivatives.

#### 2. The Real-Time Index System (“RTI”) for index compilation

a. The RTI comprises three major modules:

- i. Message capturing – System captures data from the HKEx’s Market Data Feed (MDF), then identifies index constituent stock data and other useful information for further processing.
- ii. Index calculation – Calculates indexes using the identified data and information.
- iii. Index broadcasting – The calculated indexes are disseminated through a broadcast network to HKEx and HSIL’s information vendors.

- b. The setup of the RTI aims to achieve the highest standard in providing uninterrupted services to the public. The RTI comprises three self-sufficient systems - each connecting to an individual MDF for data capture - that disseminate indexes through a resilient broadcasting gateway. Two systems are located at the primary site and one at the backup site to cater for disaster recovery situations. All three systems perform index compilations during trading hours so as to minimise the system switchover time in the event that one system fails. (Appendix 1a)
- c. Under an extreme scenario when all three systems fail, the contingency mode under our Business Continuity Plan will be triggered. HSIL has two Contingency Systems to execute contingency mode index calculation in the very unlikely event that all three systems of the RTI fail. The Contingency Systems will perform index calculation every 15 minutes, and the indexes will be disseminated via e-mail to HKEx, information vendors and our clients. (Appendix 1b)

### **3. Incident summary on 22 January**

#### **a. The Incident**

At around 09:52, an error message appeared in the consoles of the RTI. An investigation was immediately undertaken to identify the source of the error message. When the market opened at 10:00, it was noticed that several indexes, including the HSI and the H-Share Index, remained unchanged after the first index ticks were disseminated at 10:00:15. Upon confirmation that the primary system and the back-up systems were all experiencing the same problem, at around 10:02, HSIL triggered its contingency plan, switched to the contingency mode, and immediately notified HKEx of the implementation of the contingency arrangement.

Real-time calculation of the indexes resumed at around 10:27 following the success of emergency system recovery procedures. Real-time dissemination of indexes resumed at 10:32:45 after confirming that the RTI was running normally.

No further system abnormality occurred for the rest of the trading day.

A chronology of key events on the day is provided in Appendix 2.

#### **b. The Contingency Arrangement Between 10:02 and 10:33**

When HSIL switched to the contingency mode at 10:02, the Contingency System was activated. Under the contingency mode, two sets of indexes were compiled at 10:15 and 10:30, and were sent out to HKEx and information vendors via e-mail at 10:17 and 10:32 respectively. The

Contingency System was deactivated after resumption of real-time dissemination.

HSIL issued two press releases, at around 12:26 and 17:08 respectively, announcing the service interruption, service resumption since 10:33, and snapshot index values of the HSI and the H-Share Index during service interruption. HSIL answered questions from over 30 journalists following the issue of the press releases.

c. Communication with HKEx

HSIL and HKEx first communicated at around 09:52 when an error message appeared in the RTI. Communications between HSIL and HKEx continued throughout the day through various means.

At around 10:05, HKEx was informed by phone that HSIL was triggering its contingency plan.

#### **4. Root cause of the incident and actions taken to address the issue**

a. Root cause (Appendix 3)

- i. The message-capturing module of the RTI uses a parallel data processing methodology to ensure quick data processing from the tremendous amount of MDF data that arrives every second. Message records from the MDF arrive in sequential order, and each message record contains a large amount of transaction and non-transaction data. Under the parallel processing methodology, the system application will update the price table for all constituent stocks based on the transaction data, and the majority of the data is processed in sequential order. However, there are some cases where data is processed “Out-of-Sequence”, i.e. an older stock record is processed AFTER a newer record (“OFS event”). The system application handles OFS situations properly by not processing the older stock record using an OFS process.
- ii. A matching indicator (“MA”) – indicating close of the pre-opening auction and start of the matching period – arrives through the MDF once every trading day at around 09:50 and will lead to the opening index calculation for the day. On 22 January, the MA indicator arrived at 09:50 – immediately after a stock transaction record that had triggered an OFS event and OFS process. When the programme started to run the opening index calculation process after receiving the MA indicator, it clashed with the OFS process and the system stopped.
- iii. OFS events are rare and difficult to replicate. The MA indicator only comes into the system once a day. The combination of the arrival of an MA indicator immediately after an OFS event and the OFS process

it simultaneously triggers under the parallel process is an extremely rare situation which had not been foreseen.

- iv. It has been confirmed that the incident was not caused by HKEx's MDF, its data volume or the recent MDF capacity upgrade.

**b. Actions**

- i. The root cause of the incident was identified on the evening of 22 January. The application relating to the handling of OFS events was modified to resolve the issue and avoid future system crashes related to the MA indicator. The modification made will also enable the application to handle all message sequences without clashing with the OFS process.
- ii. Thorough system testing was undertaken on Saturday 23 January to confirm that the changes to the application had successfully resolved the root cause of the problem.
- iii. HSIL successfully completed a special test with HKEx on Saturday 23 January.
- iv. HSIL issued a press release on 24 January, announcing the result of problem investigation and the successful completion of necessary programme changes.

## **5. Reviews & follow-up actions**

HSIL has conducted internal review meetings since 22 January to discuss issues arising from the incident. The objectives of the reviews have been as follows:

- to prevent future occurrences of service interruption; and
- to identify possible areas for further improvement of its contingency plan.

HSIL has also reviewed its communications and other arrangements during the contingency period with HKEx.

Action items identified are listed below:

**a. Actions completed immediately**

- i. Raised the highest level of alert at HSIL – activated a live conference bridge during trading hours since 25 January and dedicated staff have been assigned and empowered to detect any system problem and to take necessary actions during trading hours. This will ensure that

system recovery can be achieved in the shortest possible time in the event of a system failure.

- ii. Inclusion of media e-mail addresses on the distribution list of those who will receive information about the contingency mode.

**b. Short-term measures**

**System (target completion within 1 month)**

- i. A working group has been established to undertake a comprehensive application review to identify potential points of failure for the system applications and to make necessary programme changes to preempt any future service interruption caused by these applications.
- ii. To study the enhancement of the existing Contingency System to allow calculation and dissemination of indexes at shorter intervals during contingency mode.

**Contingency Plan (target completion within 1 to 3 months)**

To review the contingency plan and identify possible areas for further improvement, including but not limited to the following:

- i. External communications with HKEx.
- ii. The public alert system to inform market participants, information vendors and media of any service interruption.
- iii. Frequency of contingency index calculation during contingency period.
- iv. Recalculation of missing index points during contingency period.
- v. Arrangement related to Estimated Average Settlement Price (EAS) calculation.

**c. Medium-term measures**

To undertake a feasibility study on other potential long-term system improvements, including using alternate systems to improve service resilience.



## **6. Conclusion**

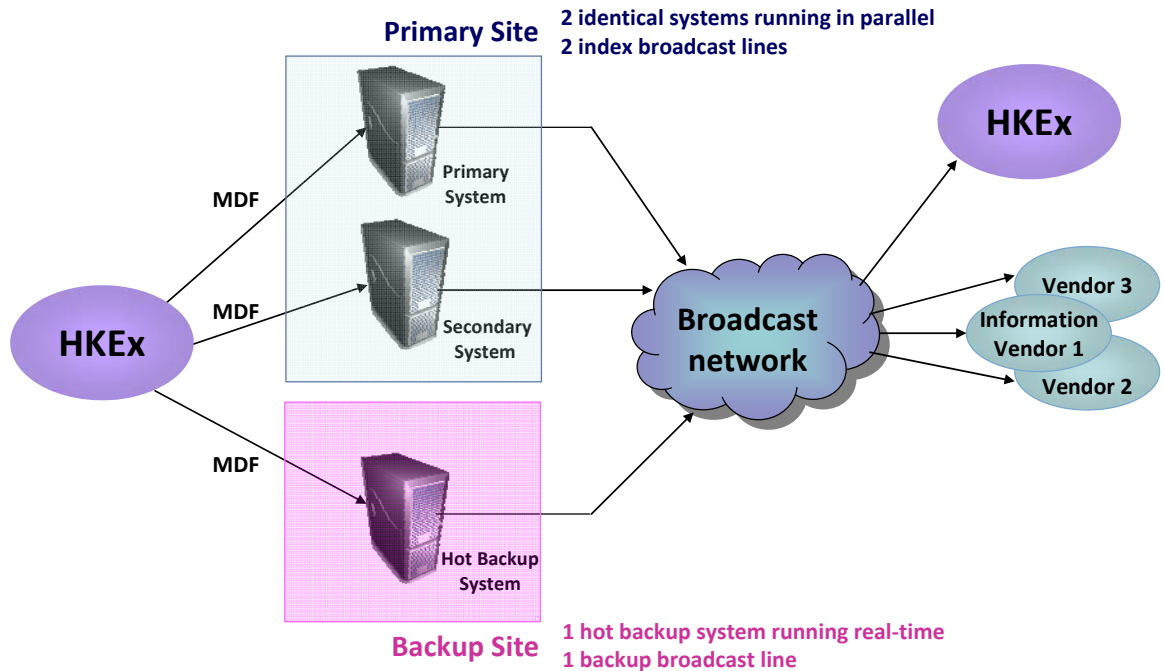
- a. The incident on 22 January was caused by a rare incoming message sequence which the application, using a parallel handling process, had not previously encountered or foreseen.
- b. The contingency plan was triggered and functioned according to the plan during the service interruption.
- c. Immediate remedial actions were taken. The application was modified to address the root cause of the incident and the modified system was well tested.
- d. Reviews have been undertaken to identify possible areas for further improvement. A follow-up action plan covering both the system application and contingency plan has been devised.

**Hang Seng Indexes Company Limited**

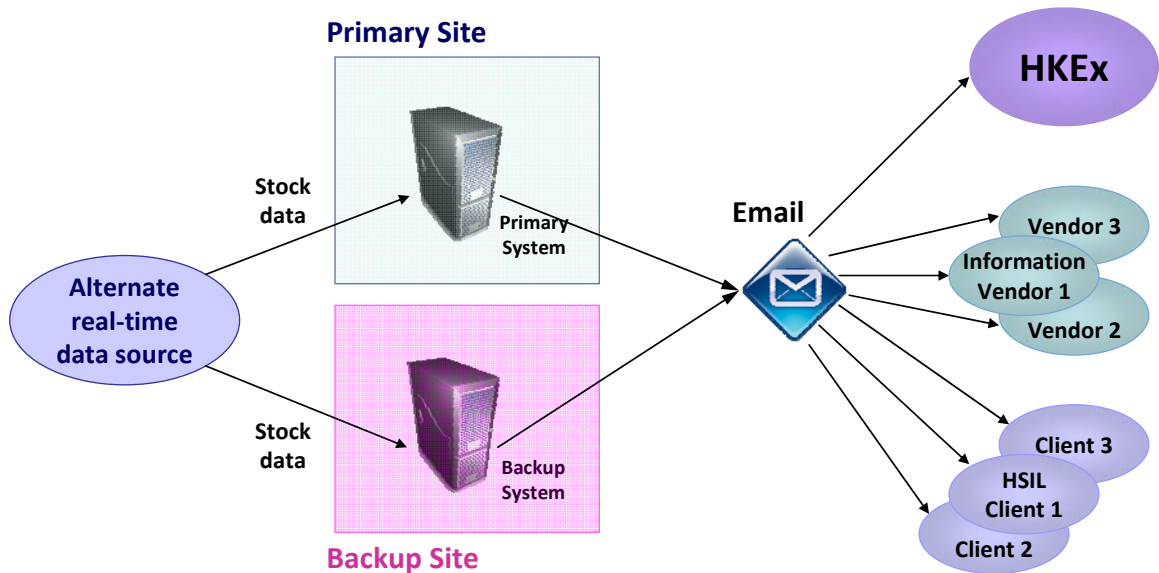
**2 February 2010**

Appendix 1

a. Real-Time Index System



b. Contingency system

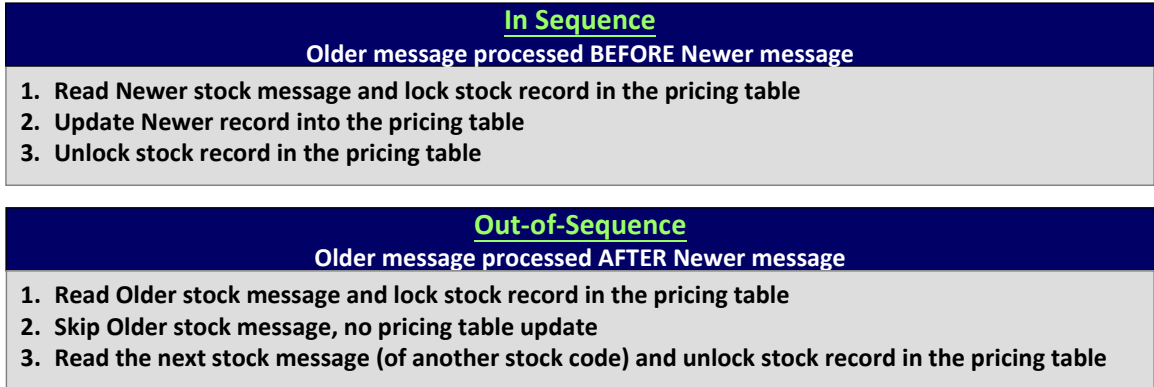


**Appendix 2 - Chronology of key events**

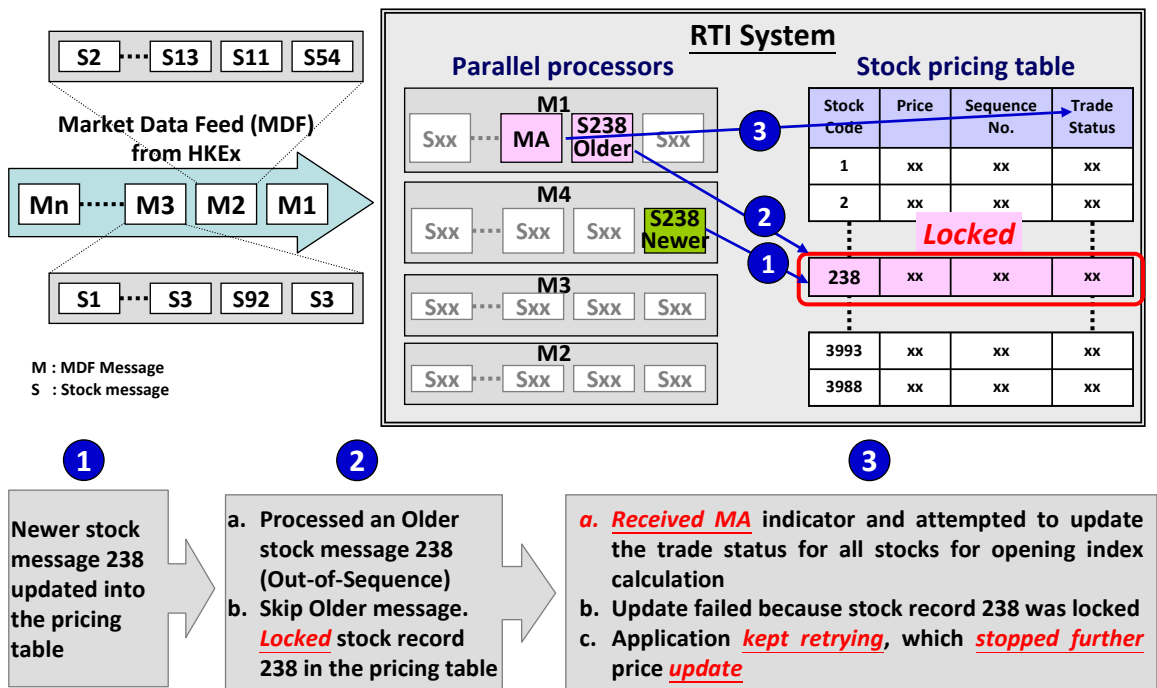
<b>Approximate Time</b>	<b>Event</b>
09:52	<ul style="list-style-type: none"> <li>• RTI generated an error message.</li> <li>• System investigation started.</li> </ul>
09:52 – 10:02	<ul style="list-style-type: none"> <li>• System health check.</li> <li>• Communication with HKEx to check status of MDF.</li> <li>• First set of real-time indexes disseminated at 10:00:15, no subsequent new index updates.</li> </ul>
10:02	<ul style="list-style-type: none"> <li>• Confirmed same problem at all three RTI systems.</li> <li>• Triggered contingency plan and switched to contingency mode.</li> </ul>
10:03 onwards	<ul style="list-style-type: none"> <li>• Notified HKEx of the contingency arrangement at around 10:05</li> <li>• Activated contingency index calculation system.</li> <li>• Emergency system diagnosis and recovery started.</li> <li>• Began talking to HSI index-linked product issuers on service interruption.</li> <li>• HKEx started to notify exchange participants and information vendors through its various standard and emergency channels.</li> </ul>
10:15 – 10:17	<ul style="list-style-type: none"> <li>• Indexes at 10:15 calculated and sent out at 10:17 via e-mails to HKEx and information vendors.</li> </ul>
10:27	<ul style="list-style-type: none"> <li>• System recovered, RTI index calculation resumed, but dissemination of indexes not resumed.</li> </ul>
10:30 – 10:32	<ul style="list-style-type: none"> <li>• Indexes at 10:30 calculated and sent out at 10:32 via e-mails.</li> </ul>
10:33	<ul style="list-style-type: none"> <li>• Dissemination of indexes resumed after confirming the system was operating normally.</li> <li>• Dissemination of HSI resumed at 10:32:45, and dissemination of H-Share Index resumed at 10:33.</li> </ul>
10:33 – 12:25	<ul style="list-style-type: none"> <li>• Preparation of press releases.</li> <li>• Discussion with HKEx on resumption of index dissemination and index levels between restart of calculation and dissemination.</li> <li>• Answering questions from product issuers, information vendors and media.</li> </ul>
12:26	<ul style="list-style-type: none"> <li>• Issued first press release about service interruption between 10:00 – 10:32 and resumption of normal service at 10:33. Published snapshot index levels for HSI and H-Share Index during service interruption in the press release.</li> </ul>
12:25 – 17:00	<ul style="list-style-type: none"> <li>• Dialogue with all parties including HKEx, information vendors and media continued in the afternoon.</li> </ul>
17:08	<ul style="list-style-type: none"> <li>• Issued second press release on the high/low/close index levels for HSI and H-Share Index.</li> </ul>
17:00 – 23:00	<ul style="list-style-type: none"> <li>• Answered media questions about service interruption and provided initial findings of the investigation that the problem occurred in the message-capturing module of the RTI.</li> <li>• Confirmed to media that the problem did not arise from the MDF of HKEx.</li> </ul>

Appendix 3 - Graphical illustration of the root cause

a. Incoming stock message and stock pricing table update processes



b. Failure in the update process on 22 Jan 2010



c. Rare sequence of data

The problem occurs only if all the following conditions happen at the same time:

- An Out-of-Sequence event - the chance of which is very low as the time needed to process each price record is in split second.
- The one and only MA indicator message for each trading day comes right after an Out-of-Sequence stock message.

**HKEx Report for the Financial Affairs Panel of the Legislative Council**  
**on Service Interruption of Hang Seng Indexes Company Limited on 22 January 2010**  
**and Its Impact on HKEx Operations**

### **Summary of the Incident**

1. On 22 January 2010, Hang Seng Indexes Company Limited (“HSIL”) encountered a problem in their index calculation and distribution system. As a result, the updates of all of HSIL’s indexes were not available after the opening of the continuous trading session (10:00am) until approximately 10:33am when they resumed their normal index dissemination.
2. HSIL executed their contingency arrangement to calculate their indexes every 15 minutes (instead of 15 seconds) and disseminate the index levels to their information vendors, customers and HKEx by e-mail. Two snapshots, one for 10:15:00 and one for 10:30:00 were calculated and disseminated under this arrangement.
3. Details of the incidents are contained at Appendix I. Some further reference information is contained at Appendix II.
4. For further details about the incident including the root cause of the incident, HSIL’s contingency plan and actions taken by HSIL to address the issues, please refer to a separate report submitted by the HSIL.

### **Assessment on Impact on HKEx Operations**

5. In accordance with the HKEx Market Contingency Plan, the securities and derivatives markets of HKEx remained open during the period of HSIL service interruption and operated normally during the day. Trading, clearing and settlement of HSIL index-related products on the HKEx on the incident day had not been affected by the interruption of the HSIL services.
6. As a result of the HSIL service interruption, the dissemination of HSIL's indexes through HKEx's trading and information systems was suspended between approximately 10:00am and 10:32am. The dissemination of HSIL’s indexes through our systems resumed as soon as the HSIL service resumed normal at approximately 10:33am.
7. On the incident day, HKEx had through its various communication channels kept our Exchange Participants and information vendors informed of the HSIL service interruption, the corresponding contingency arrangements as well as the subsequent service resumption. HKEx also informed the public through a wide range of media of the same and it issued a press release on the incident in that morning.

8. Thirteen Callable Bull Bear Contracts (“CBBCs”) on Hang Seng Index (“HSI”) at call level of 20500 were automatically suspended due to a Mandatory Call Event (“MCE”) (for detailed explanation of MCE, please refer to paragraph 3 of Appendix II) when HSI resumed at 10:32:45 at 20511.75 spot and Day Low value of 20496.05. HSIL subsequently confirmed that the spot level crossed 20500 and reached 20,496.05 at 10:30:30. On that basis, HKEx proceeded with its standard procedures to inform the affected CBBC issuers on the MCE time for the publication of the MCE announcements and carried out other standard MCE processes including trade cancellation. Fifteen post-MCE trades for six CBBCs with turnover of HK\$47,220 required cancellation as per standard procedures.
9. On 22 January, HKEx received 31 public enquiries in relation to the captioned matter. Among them, 27 enquired about the interruptions to dissemination of HS indexes whereas four others asked about handling of the MCE of CBBC. HKEx had not received any investor complaint in relation to trading, clearing, or settlement of HSIL index related products including the MCEs of CBBCs. In addition, HKEx received 39 media enquiries from 10:10 am on that day regarding the index interruption.

### **Follow Up Actions**

10. HKEx and HSIL met on 26 January 2010 to review the contingency arrangements on the incident day and going forward. It was generally agreed that the contingency arrangements had largely been executed according to plan. The meeting also discussed areas for further review and possible improvement during a contingency such as –
  - increased automation of HSIL back-up services,
  - enhanced communications,
  - more frequent index snapshots,
  - re-calculation of any missing index points, and
  - the arrangements relating to Estimated Average Settlement Price (“EAS”) should a service interruption happen on a last trading day of relevant index futures and options contracts in the derivatives market.

HKEx and HSIL will meet further to discuss those issues.

HKEx  
February 2010

**Details of Events**

Approx. Time	Event/Action
9:50 – 9:55	<ul style="list-style-type: none"><li>▪ HKEx noted that the opening indexes from HSIL were received at 9:52, later than the normal time of 9:50:30.</li><li>▪ HKEx called HSIL for the reason for the delay and HSIL replied that the late transmission was due to their system.</li></ul>
10:00 – 10:30	<ul style="list-style-type: none"><li>▪ HKEx noted that there was no movement of HSI on the AMS/3.</li><li>▪ HSIL informed (at approximately 10:05) HKEx that they would execute their contingency arrangement to calculate their indexes every 15 minutes instead of every 15 seconds.</li><li>▪ The incident was considered major and immediately reported to the senior management.</li><li>▪ The securities and derivatives market of HKEx remained open and continued to operate according to the Exchange’s Market Contingency Plan.</li><li>▪ HKEx contacted several major CBBC issuers to advise them of the problem with the HSI real-time index service and enquired if it had any impact on their ability to provide Liquidity Provider (“LP”) services. All indicated that they could use HSI futures as the reference prices to continue their LP services</li><li>▪ Shortly after the service interruption occurred, HKEx informed the media, and hence the public, of the incident and its latest developments, and that HKEx’s markets remained open.</li><li>▪ HKEx notified SFC of the incident by phone; and exchange participants and information vendors via different channels including AMS Exchange News, HKATS critical market message, emergency notice to information vendors.</li><li>▪ HKEx received HSIL’s notice of their index levels as at 10:15:00 calculated under HSIL contingency arrangement.</li><li>▪ HKEx updated the index values on HKATS.</li></ul>
10:30 – 10:35	<ul style="list-style-type: none"><li>▪ HSIL resumed their real-time index calculation and transmitted the first snapshot of HSI of 20511.75 points as at 10:32:45 and the first snapshot of HSCEI of 11747.41 as at 10:33:00.</li><li>▪ HKEx notified SFC, as well as exchange participants and information vendors via different channels of the resumption of the index dissemination.</li><li>▪ Thirteen CBBCs on HSI of call level 20500 were suspended automatically at the resumption of the index dissemination due to the MCE triggered by the Day Low index level of 20496.05.</li></ul>

Approx. Time	Event/Action
11:00 – 11:30	<ul style="list-style-type: none"> <li>▪ HKEx requested HSIL to investigate if the index level fell below 20500 before the first snapshot at 10:32:45 and to confirm when that level was hit so as to proceed with the standard CBBC MCE procedure and to identify post MCE trades for cancellation.</li> </ul>
11:49	<ul style="list-style-type: none"> <li>▪ HKEx emailed the online press release on the interruption of dissemination of Hang Seng Indexes.</li> </ul>
12:28	<ul style="list-style-type: none"> <li>▪ HSIL issued press release on the service interruption and the subsequent service resumption.</li> </ul>
16:48	<ul style="list-style-type: none"> <li>▪ HSIL confirmed in writing that HSI reached 20496.05 at 10:30:30.</li> </ul>
16:48 – 17:00	<ul style="list-style-type: none"> <li>▪ HKEx informed the affected CBBC issuers on the MCE time at 10:30:30 with the HSI level at 20496.05 for their preparation of the MCE announcements.</li> </ul>
17:45 – 18:55	<ul style="list-style-type: none"> <li>▪ The affected CBBC issuers published the MCE announcements in respect of the 13 suspended CBBCs.</li> <li>▪ A total of 15 post-MCE trades for 6 CBBCs with total turnover of HK\$47,220 required cancellation.</li> <li>▪ All (a total of 18) affected Exchange Participants received trade cancellation notification by phone before 18:00. Trade files were provided to them via Participant E-mail System (“PES”) during the period from 17:47 to 18:13.</li> </ul>
23 January morning	<ul style="list-style-type: none"> <li>▪ HKEx arranged a special test for HSIL to facilitate HSIL to identify and test the root cause of the problem. HSIL subsequently confirmed that the test result was positive.</li> </ul>



**Other Information for Reference**

*Derivatives products on HSIL's indexes tradable at the HKEx*

1. Futures and Options contracts on HSI and HSCEI are available for trading on the Derivatives Market of HKEx.
2. HSI and HSCEI are also popular underlying assets of structured products traded on the Cash Market of HKEx. As of 22 January 2010, there were 348 Derivatives Warrants ("DWs") and 734 CBBCs on HSI and 57 DWs and 53 CBBCs on HSCEI available for trading on the Cash Market of HKEx.

*Knock-out Mechanism of CBBC*

3. CBBC has a Call Price and a Mandatory Call Feature - for Bull contracts, the Call Price must be either equal to or above the Strike Price. For Bear contracts, the Call Price must be equal to or below the Strike Price. If the underlying asset's price reaches the Call Price at any time prior to expiry, the CBBC will expire early. The issuer must call the CBBC and trading of the CBBC will be terminated immediately. Such an event is referred to as a Mandatory Call Event ("MCE").

*Cancellation of Post MCE Trades*

4. Any trades concluded after the MCE time ("Post MCE Trades") will be cancelled either on the MCE Day or on the trading day following the MCE Day at the latest.
5. After the MCE, HKEx will issue details of trades subject to cancellation to EPs in a trade file for EPs' information before 6 pm on the MCE Day.

*Liquidity Provider*

6. CBBC issuers are required to appoint a Liquidity Provider (LP) for each of their listed CBBCs. The exact obligations of the LP for each CBBC are shown in the listing document. In normal circumstances, LPs should provide liquidity for CBBC issues through continuous quotes or in response to quote requests from five minutes after the market has opened until the market closes.

*Estimated Average Settlement Price ("EAS")*

7. EAS is the average of quotations (or index levels) taken at (i) five (5) minute intervals from five (5) minutes after the start of, and up to five (5) minutes before the end of, the Continuous Trading Session of the Stock Exchange of Hong Kong ("SEHK"); and (ii) the close of trading on SEHK. EAS of HSI and HSCEI are calculated and provided by HSIL. The final settlement price of an expired HSI / HSCEI Futures or Options contract is the EAS on its last trading day.