Preliminary Report on Service Disruption on 3 April 2015

1.　Introduction

This is the preliminary report submitted by China Unicom (Hong Kong) Operations Limited on an incident occurred on 3 April 2015 relating to a service disruption ("Incident").

2.　Description of the Incident

2.1　Events leading to the occurrence of the Incident

On 1 April 2015, our Network Operations Centre ("NOC") observed that the optical board alarm was on and the optical board needed to be replaced.

At around 1:43am on 2 April 2015, preventive HLR maintenance had been carried out and the optical board was replaced during our maintenance window which had no impact on our services.　Our NOC discovered that HLR encountered system faults which caused HLR running without redundancy.　As agreed with our equipment vendor, emergency maintenance would be carried out during the maintenance window the next day morning.

At around 1:30am on 3 April 2015, the maintenance window commenced and emergency maintenance had been carried out.　Until around 5:30 am on 3 April 2015, we observed that a number of our customers had lost connection from MVNO network when customers' mobile devices performed location update. The service disruption was preliminary found to be caused by the congestion of HLR signalling links. As a result, our customers services including SMS, voice and data services were affected.

2.2　Event Log

Time and Date	Event Description
5:30 am, 3 April 2015	Our NOC observed that the HLR system criticial alarm was on. The problem was immediately escalated to our network engineers and equipment vendor for investigation.
6:00 am, 3 April 2015	Our network engineers and vendor support team arrived on site and took immediate actions to solve the problem.
6:30 am, 3 April 2015	Engineers identified the problem was caused by overloading of HLR system which resulted in the new incoming signal messages abortion.
8:00 am,	Engineers performed actions to restore the HLR system

3 April 2015	but such system could not take up traffic as normal after restoration.
8:30 am, 3 April 2015	Engineers noted that the number of location update of authentication requests had exceeded the processing ability of HLR system after restoration.
9:30 am, 3 April 2015	Engineers tried different approaches to reduce incoming signalling traffic in order to decrease the loading of HLR system but no significant effect was found.
10:30 am, 3 April 2015	The congestion caused by the repeated authentication request failure deteriorated.
11:50 am, 3 April 2015	The preliminary data obtained from the system indicated that the number of affected customers had been increasing and we informed OFCA of the Incident.
12:30 pm, 3 April 2015	Our engineers and vendor support team worked out a system restoration plan to resume the services by steps, whereby the IMSI had been broken down into hundred batches. Each batch of IMSI was then resumed one by one in order to offload the number of location update authenication requests that took place at the same time into safety loading level.
2:30 pm, 3 April 2015	Around 10% of affected customer's services had resumed normal.
8:30 pm, 3 April 2015	Around 60% of affected customer's services had resumed normal.
2:30 am, 4 April 2015	All affected customer's services had resumed normal.

The prolonged restoration time was due to the fact that as a mobile virtual network operator, we do not have the control of MSC equipment and wireless base station which are under the control of other mobile network operators providing services to us. We are therefore unable to temporary block the excessive influx of location update authentication requests from MSC server immediately which is the fastest way to control the traffic according to our equipment vendor.

3.   Number of affected customers
We estimate that around 75,000 customers, or 83% of our active customers were affected.

4.   Remedial actions taken

Our engineers and vendor support team worked out a system restoration plan to resume the services by steps, whereby the IMSI would be broken down into hundred batches. Each batch of IMSI would be resumed one by one in order to offload the number of location update authenication that takes place at the same time into safety loading level.   All services had resumed normal at 2:30 am on 4 April 2015 when the restoration plan was fully executed.   Our duty engineers were arranged to monitor the HLR system status closely until network improvement works were finished to stablize the traffic flow.

5.   Root cause analysis

Based on our on-going investigation, the service disruption was found to be caused by the faulty HLR system. The root cause of the problem and a permanent solution for the problem are yet to be identified. While our vendor is still conducting detailed investigation on the root cause, a temporary workaround had been implemented to prevent re-occurrence of the Incident.

6.   Communication with the public

Soon after the coverage of affected customers was identified, we communicated with our customers, media and public on the Incident via the following channel:

6.1   Our website http://hk.chinaunicom.com: Pop-up announcements and up-dates were posted on our website at 11:50 am, 2:16 pm, 3:22 pm and 7:01 pm on 3 April 2015 respectively.   We also informed our customers that all services had resumed normal at 8:27 am on 4 April 2015.

6.2   Facebook: Announcements and up-dates were posted on our official Facebook at 11:38 am, 2:04 pm, 3:10 pm and 6:49 pm on 3 April 2015 respectively.   At 3:33 am on 4 April 2015, we informed our customers that our services had resumed normal.

6.3   Customer hotline: We had immediately increased manpower at our customers services hotline centre to answer inqueries from customers.

7.   Improvement measures

We had been closely monitoring the HLR system in order to prevent occurrence of similar incident in the future.

China Unicom (Hong Kong) Operations Limited
10 April 2015

Preliminary Report on Service Disruption on 5 April 2015

1. Introduction

This is the preliminary report submitted by China Unicom (Hong Kong) Operations Limited on an incident occurred on 5 April 2015 relating to a service disruption ("Incident").

2. Description of the Incident

2.1 Events leading to the occurrence of the Incident

At around 4:00 pm on 5 April 2015, we observed that there was signal link congestion in our system which may cause service disruption to our customers. Parts of our services including SMS, voice and data services were affected.

2.2 Event Log

Time and Date	Event Description
4:00 pm, 5 April 2015	Our Network Operations Centre ("NOC") observed that the mobile system signal links encountered congestion problem. Signalling link overloading alarm had been detected. The problem was immediately escalated to network engineers and our equipment vendor for investigation.
4:30 pm, 5 April 2015	The situation of signal links congestion deteriorated. Engineers and vendor support team had immediately implemented traffic control policy and bypassed part of the traffic to improve the situation.
5:00 pm, 5 April 2015	The effect of traffic control was not significant, more traffic were therefore bypassed to avoid further deterioration.
6:00 pm, 5 April 2015	The preliminary data obtained from the system indicated that the number of affected customers had been increasing and our NOC informed OFCA that there was a service disruption in our network.
8:00 pm, 5 April 2015	Engineers applied different traffic control approaches and closely monitored the traffic of the signal links. "Tidal flow" control system was implemented in order to relieve congestion.

10:00 pm, 5 April 2015	Signalling link congestion relieved. The affected services had been resumed gradually.
11:30 pm, 5 April 2015	All local services had resumed normal. Part of the roaming services were still affected.
0:30 am, 6 April 2015	All affected services (including voice, data and SMS services) had resumed normal.
1:12 am, 6 April 2015	Our NOC informed OFCA that all of our service had resumed normal.

The prolonged restoration time was due to the fact that as a mobile virtual network operator, we do not have the control of MSC equipment and wireless base station which are under the control of other mobile network operators providing services to us. We are therefore unable to temporary block the excessive influx of location update authentication requests from MSC server immediately which is the fastest way to control the traffic according to our equipment vendor.

3.   Number of affected customers

We estimated that around 31,500 customers, or 35% of our active customers, were affected.

4.   Remedial actions taken

Engineers had taken immediate action to apply traffic control policies when the congestion occurred.   By estimating the number of active user blocks and registration numbers in specific MSC, we had bypassed and routed the traffic towards specific MSC to ensure that the services of attached users would not be affected and overcome the traffic congestion.   After serveral rounds of traffic control, the customer services had resumed normal at 0:30 am on 6 April 2015.   Our duty engineers were arranged to closely monitor the traffic flow of signal links until network improvement works completed.

5.   Root cause analysis

At around 4:00 pm on 5 April 2015, the ratio of increased traffic in a specfic region was beyond our expectation and there was a large proportion of location update authentication requests within the region of Shenzhen and Hongkong border.   The traffic volume increased about 40%-100% compared to the same period of previous day and such volumn reached the designed limit of our system.   The cause for such increase in traffic might need to be further investigated.

Due to the sudden and unexpected increase in traffic, the mobile core system had therefore experienced high ultilization and resulted in signalling link congestion. The traffic congestion happened within a very short period of time and the number of successful location update rate dramatically degraded to 65%. During the recovery process, our engineers tried to reduce the traffic by apply different approaches in order to secure the uninterrupted services of attached users. "Tidal flow" control system was implemented in order to relieve congestion and as a result, the recovery time was longer than expected.

The root cause of the problem and a permanent solution for the problem are yet to be identified. While our vendor is still conducting detailed investigation on the root cause, a temporary workaround has already been implemented to prevent re-occurrence of the Incident.

6. Communication with the public

Soon after the coverage of affected customers was identified, we communicated with our customers, media and public on the Incident via the following channel:

6.1   Our website http://hk.chinaunicom.com: Pop-up announcement was posted on our website at 7:24 pm on 5 April 2015. We also informed our customers that all services had resumed normal at 1:35 am on 6 April 2015.

6.2   Facebook: Announcement was posted on our official Facebook at 6:50 pm on 5 April 2015. At 1:30 am on 6 April 2015, we informed our customers that our services had resumed normal.

6.3   Customer hotline: We had immediately increased manpower at our customers services hotline centre to answer inqueries from customers.

7.   Improvement measures

We have implemented the following measures to prevent occurrence of similar incident in the future:

● increased the number of signal links; and
● closely monitoring of the HLR system.

China Unicom (Hong Kong) Operations Limited
10 April 2015