Preliminary Report about Service Disruption on 31 March 2018

1. Introduction

This is the preliminary report submitted to the Office of the Communications Authority by China Unicom (Hong Kong) Operations Limited ("China Unicom", "we" or "our") on an incident occurred on 31 March 2018 relating to a service disruption in our MVNO network ("Incident").

China Unicom regrets the inconvenience caused to our customers and we are determined to ascertain the root cause of the Incident and make necessary improvements to prevent occurrence of similar incidents in future.

2. Incident Description

2.1 Events leading to the occurrence of the Incident

At around 11:15 on 31 March 2018, our Network Operations Centre ("NOC") observed that there was traffic congestion in the 1-Card-Multi-Number system ("1CMN System") of our MVNO network. Similar to the cause of the incident occurred on 27 February 2018, the Incident was caused by software bug in the 1CMN System. As a result, our "1-Card-Multi-Number" service customers who failed to complete the LU process were unable to access our data services, SMS and voice services.

2.2 Event Log

Time and Date	Event Description
11:15 2018-03-31	Our NOC observed that that there was abnormal alarm on the 1CMN System. The problem was immediately escalated to our Tier 2 network engineers and on-site engineer of our vendor for investigation.
11:40 2018-03-31	Vendor's on-site engineer found that there was abnormal message queue buffer causing some of our customers could not use our services. The standby system of the 1CMN System was activated.
12:00 2018-03-31	Activation of standby system failed. We therefore immediately started preparing bypass action.

12:10 2018-03-31	Bypass action commenced in a controlled manner. Traffic was diverted to HLR directly, bypassing the 1CMN System, whereby leaving the 1CMN System idle for further remedial action.
13:00 2018-03-31	Vendor restarted the main system of the 1CMN System and conducted call tests. Test results were unsatisfactory. Main system could not be resumed.
13:10 2018-03-31	NOC informed OFCA of the outage accordingly.
13:15 2018-03-31	Bypass action completed. All MO call gradually resumed after the bypass action completed. Data service was 100% resumed provided that customers' handsets completed the LU process.
14:15 2018-03-31	Vendor attempted to restart the main system and standby system of 1CMN System.
15:20 2018-03-31	Standby system successfully resumed and call tests succeeded. Part of the traffic had been diverted to the standby system. However, the loading of the standby system was maintained at a high level. NOC conducted investigation to find out root cause.
16:20 2018-03-31	We discovered that the cause of the high level loading of the standby system was due to high incoming traffic.
17:00 2018-03-31	The routing changed and incoming traffic relieved. Standby system loading decreased.
18:30 2018-03-31	Standby system loading was back to normal.
18:40 2018-03-31	After roll backing the bypass actions done, all mobile services including data, SMS and voice resumed normal upon completion of LU of customers' handsets.

3. Remedial actions taken

After the Incident, our support engineers and vendor conducted examination on the 1CMN System and confirmed the problem was in the 1CMN System. We therefore immediately activated the standby system. However, the standby system could not be activated as normal. In order to resume our mobile service,

our support engineers worked in parallel to bypass the 1CMN System by diverting the traffic to HLR directly. The 1CMN System was left idle for further remedial action. The bypass action completed at 13:15. All MO call gradually resumed. Data service was 100% resumed provided that customers' handsets completed the LU process.

At around 15:20, standby system successfully resumed and call tests succeeded. Part of the traffic had been diverted to the standby system. However, the loading of the standby system was maintained at a high level due to high incoming traffic. After the routing changed, the high level loading relieved. Standby system loading was back to normal at 18:30. At 18:40, the bypass action had been rolled back and all mobile services including data, SMS and voice resumed normal upon completion of LU of customers' handsets.

4. Root cause analysis and problem resolution

Vendor confirmed that, similar to the root cause for the incident occurred on 27 February 2018, there was software bug in the main system of the 1CMN System, causing the processing capacity degraded unexpectedly. Permanent solutions for the problem are yet to be identified. A temporary workaround has already been implemented to prevent the re-occurrence of the problem.

5. Number of affected customers

We estimate that around 138,157 customers of our "1-Card-Multi-Number" service/ products who failed to complete the LU process, or 15.78% of our active customers, were affected.

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 channels:

a) Our website http://www.cuniq.com: Pop-up announcement was posted on the website at 16:00 on 31 March 2018. We also informed our customer that all the services had been resumed normal at 20:20 on 31 March 2018.
b) Facebook: Announcement was posted on our Facebook on 15:06 on 31 March 2018. At 19:35 on 31 March 2018, we informed our customer that our services had resumed normal.
c) Customer hotline: We increased manpower at our customer service hotline to answer inquiries from customers.

7. Improvement measures

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

a) shutdown the malfunction software and upgraded the problematic software; and
b) close monitoring of the 1CMN System.

Since the problem occurred in the system software which is beyond our control, we are awaiting vendor to provide detailed improvement measures.

China Unicom (Hong Kong) Operations Limited
6 April 2018