Incident Report on Service Disruption on 31 March 2018

1. Introduction

This report is submitted to OFCA by China Unicom (Hong Kong) Operations Limited ("**China Unicom**" or "**we**") on an incident occurred on 31 March 2018 relating to a service disruption in our MVNO network ("**Incident**"). We submitted a preliminary report on 6 April 2018 ("**Preliminary Report**") and this report aims to provide additional information on the Incident in order to assist OFCA's investigation.

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	Activation of standby system failed. We therefore

2018-03-31	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 channel:

6.1 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 has been resumed normal at 20:20 on 31 March 2018

6.2 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.

6.3 Contents of the announcements referred to in 6.1 and 6.2 above are set out in the table below:

Facebook Time	Website Time	Announcement
31 Mar 2018 15:06	31 Mar 2018 16:00	今早語音服務出現故障， 導致部份客戶話音服務不能使用， 現在正恢復中， 對你造成任何不便， 深感抱歉
31 Mar 2018 19:35	31 Mar 2018 20:20	由於今日中午時我們的部份網絡故障，引致部分客戶的流動電話服務受到影響。經全力搶修，受影響客戶已於 13 時 20 分起陸續恢復正常。我們對受本次故障影響的客戶深表歉意，同時也感謝客戶在服務受影響期間的包容與理解。 個別客戶如仍然未能使用服務，可以嘗試以下操作解決： 1、重新啟動手機；或 2、嘗試手動選擇網絡，先點選其他營運商，再選擇 Unicom HK 如仍未解決，請致電客戶服務熱線 2122 1188，或瀏覽 www.cuniq.com 點選 Online Chat 解決。

6.4 Customer hotline: We had immediately increased manpower at our customers' service hotline center to answer inquiries from customers. Details of the time and contents of the information provided to our hotline staff are as follows:

Date & Time	Contents
31 Mar 2018, 11:15	我們有收到部份客戶反映，語音服務出現問題，現正核查中，請問你現時位置是在那裡？ 我記錄下

	來交給工程部，請稍後再試

6.5 During and after the Incident, we received complaints from a total of 1,557 customers (including pre-paid and post-paid customers) at our retails outlets and customers' service hotline. 47 complaints received via social media.

6.6 In view of the inconvenience caused to our customers, China Unicom agreed to waive 7 days' service fees for postpaid customers who contacted our customers' service hotline, retails outlets or via social media, which will be reflected in customers' invoice in May 2018.

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
23 April 2018