

Preliminary Report about Service Disruption on 27 February 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 27 February 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 10:50 on 27 February 2018, our Network Operations Centre (“NOC”) observed that large number of customers had failed to complete the “Location Update” (“LU”) process in our MNVO network (“Network”). The service disruption was found to be caused by a core dump problem resulting in malfunction of the 1-Card-Multi-Number system (“1CMN System”), which is responsible for managing the Signaling System No.7 (SS7) messages between MSC and HLR in the Network. 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
10:50 2018-02-27	Our NOC observed that large number of customers had failed to complete the LU process. The problem was immediately escalated to our Tier 2 network engineers and relevant vendors for investigation.
11:17 2018-02-27	Our support engineers detected the problem was caused by the 1CMN System and escalated to our 1CMN System vendor for investigation. Vendor remotely logged in the 1CMN System platform for troubleshooting. At the same time, the preliminary

	data obtained from the system indicated that the number of affected customers had been increasing and our NOC informed OFCA of the outage accordingly.
11:30 2018-02-27	Our vendor found that the drop in the successful rate of LU process is caused by a core dump problem in the 1CMN System, resulting in malfunction of the 1CMN System. They performed software reset action to the 1CMN System immediately under our permission.
13:00 2018-02-27	The vendor performed restoration actions to the 1CMN System but it could not take up traffic as normal. In parallel, our support engineers started to proceed with diverting the traffic to HLR directly, bypassing the 1CMN System, whereby leaving the 1CMN System idle for further remedial action.
14:20 2018-02-27	Hong Kong local services gradually resumed after the bypass action completed.
15:00 2018-02-27	Our vendor confirmed that the 1CMN System had been successfully restored. However, since the root cause of the core dump problem was yet to be identified, detailed testing was conducted to verify its proper functioning before re-diverting the traffic back to the 1CMN System.
16:15 2018-02-27	Our support engineers started re-diverting the traffic to the 1CMN System. The 1CMN System started to take up traffic in a controlled manner.
16:30 2018-02-27	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 took urgent remedial actions to restore the 1CMN System but it could not take up traffic as normal. 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 14:20 and local mobile

services gradually resumed. The 1CMN System was successfully restored by 15:00. However, since the root cause of the core dump problem was yet to be identified, detailed testing was conducted to verify its proper functioning before re-diverting the traffic back to the 1CMN System. At around 16:15, our support engineers started re-diverting the traffic to the 1CMN System and the 1CMN System started to take up traffic in a controlled manner. All mobile services including data, SMS and voice resumed normal at 16:30 upon completion of LU of customers' handsets.

4. Root cause analysis and problem resolution

Based on the investigation conducted jointly by us and vendor so far, the failure of LU process was caused by a core dump in the 1CMN System resulting in malfunction of the 1CMN System. The root cause of the problem and permanent solutions 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 the re-occurrence of the problem.

5. Number of affected customers

We estimate that around 150,000 customers of our "1-Card-Multi-Number" service who failed to complete the LU process, or 31.25% 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 12:11 on 27 February 2018. We also informed our customers that all services had resumed normal at 19:00 on 27 February 2018.
- b) Facebook: Announcement was posted on our official Facebook at 13:41 on 27 February 2018. At 19:21 on 27 February 2018, we informed our customer that our services had resumed normal.

- c) Customer hotline: We had increased manpower at our customer service hotline center to answer inquiries from customers.

7. Improvement measures

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

- Shutdown the malfunction software and hardware until the root cause is identified.
- 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 for your consideration.

China Unicom (Hong Kong) Operations Limited
2 March 2018