新聞稿
Press Release

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**港鐵公司就東鐵綫服務事故提交報告**

港鐵公司就二零一八年一月十一日早上發生的東鐵綫列車服務事故，今天(二零一八年三月十二日)向政府提交調查結果。

港鐵聯同信號系統供應商的專家就一月十一日的列車服務事故進行了詳細調查，以查找事故原因。調查確認事件起因是由於列車控制系統內一個負責執行列車調動特定指令的軟件程式，有一個隱藏的編碼誤差。由於過去數年，車務調動及班次持續增長，致使該隱藏的編碼誤差發生作用，而影響列車服務。事發當天，列車控制系統在執行該特定指令時，觸發了一個在特定情況下出現的軟件儲存資源問題，令系統的軟件發出了「無效訊息」，最終導致列車控制系統伺服器及所有工作站停止運作。

雖然系統即時按設定自動切換至後備系統，但不暢順的情況仍然持續。在工程人員以手動方式啟動額外備用系統及相關工作站後，系統回復正常運作。經檢查設備狀況，以人手重置部分主要調車軌道的道岔，並在確認路軌範圍沒有乘客後，列車服務陸續回復正常。事件令東鐵綫列車服務暫停一百二十二分鐘。

在整個事故及修復過程中，用以保障列車安全運作的自動列車保護及聯鎖信號系統一直運作正常。同時，信號系統供應商的專家亦確認今次事件與正在東鐵綫進行的信號系統更換工程無關。公司聘請的獨立信號系統專家亦已就是次調查進行審視，並認同調查結果和下列各項建議改善措施。

為避免同類事件再次發生，港鐵已採取下列多項改善措施：

- 下載了新的列車控制系統軟件，糾正軟件的編碼誤差，消除系統發出「無效訊息」的機會；

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- 進一步提升修復程序，確保如發生任何列車控制系統故障時，能更有效的修復；
- 將列車控制系統的額外備用工作站分隔於主系統外，避免一旦出現軟件問題時受到影響，確保在有需要時，可更快地以手動方式重置系統；
- 二十四小時長期監察系統及其軟件儲存資源運用，若出現任何異常的狀況，工程人員可更快地跟進及作出修復；及
- 加密於非行車時間對系統進行預防性系統重置，提升系統的穩定性。

此外，是次調查亦確認在事故發生及修復期間，在列車上、車站內和免費接駁巴士站各處的乘客處理工作，均安全及有序地執行。事故期間，港鐵一直透過車站及列車廣播、乘客資訊顯示屏、港鐵網頁及港鐵手機應用程式MTR Mobile，適時為公眾發放列車服務資訊。公司派出客務快速應變隊及辦公室後勤員工等合共額外三百二十名職員，到受影響車站協助乘客。期間，公司安排了一百三十一架免費接駁巴士行走受影響的車站，接載超過一萬六千四百名乘客。

為持續改善顧客服務，公司亦就事故期間的免費接駁巴士安排及資訊發放進行檢討，會進一步探討提升個別車站的免費接駁巴士調配、排隊設施和安排，並與相關政府部門商討。至於乘客資訊方面，公司會研究為乘客提供更全面的訊息。另外，公司亦會加強教育及推廣工作，呼籲乘客在車上等待時應聽從車長指示，不應擅自進入路軌範圍。

港鐵公司再次為當日事故引致乘客不便致歉。

(有關調查結果詳情，請參閱附件(只有英文版))

(完)

關於港鐵公司

港鐵公司在安全、可靠程度、顧客服務和成本效益之表現卓越，被公認為全球首屈一指的鐵路系統。港鐵植根香港，共營運十條客運鐵路綫、一個輕鐵網絡及一條高速的機場快綫，每周日的總乘客量約 560 萬人次。公司在中國內地、英國、瑞典及澳洲營運的鐵路綫，每天服務的乘客亦達 560 萬人次。此外，港鐵公司在世界各地參與鐵路建造項目，以及提供顧問及承包服務。港鐵公司運用在鐵路方面的專業知識，參與發展與鐵路相關的住宅及商業物業項目，並提供物業管理、商場租賃及管理、車廂及車站內的廣告媒體和電訊服務。

如欲進一步了解港鐵公司，請瀏覽 www.mtr.com.hk。

# Investigation Results on Train Control System Failure on East Rail Line on 11 January 2018

**Investigation Results on Train Control System Failure on East Rail Line on 11 January 2018**

## 1. The Incident

1.1 On 11 January 2018, at 0912 hours, the controllers in Operations Control Centre (OCC) observed an unstable condition of the server of Train Control System (TCS) which controls the signalling system of East Rail Line (EAL). In response, the system switched over from the Master TCS Server A (TCS-A) to Slave TCS Server B (TCS-B). However, the operation remained unstable. Subsequently, technical team needed to manually restart the servers but unsuccessful.

1.2 Having considered that the situation might persist for some time, the OCC made a prudent decision to temporarily suspend the train service of EAL at 0926 hours while the recovery work continued. Some trains which stopped between stations had to be operated in manual mode at low speed to station platforms after station staff went to trackside to do the manual setting of points.

1.3 During the incident, several passengers from 2 trains stranded between stations descended onto the track on their own by operating the Interior Emergency Door Release device. Station staff had to conduct a check along the concerned sections of track according to safety procedures and to escort the passengers back to station.

1.4 The OCC and recovery team successfully recovered and activated the TCS Fallback Server (TCS-FB), and the signalling system resumed normal operation at 1021 hours. After confirming that all sections of track were cleared of passengers, and the restoration of some manually secured points at those essential crossover tracks, train service gradually resumed at 1128 hours. The incident caused a suspension of EAL service for 122 minutes.

## 2. Incident Handling and Operational Arrangements

2.1 Having considered that the incident would last for more than 8 minutes, the OCC notified Transport Department promptly at 0918 hours (6 minutes after the occurrence). After further confirming that the signalling system could not be recovered within a short period of time and the delay would be over 20 minutes, the OCC declared it a major incident and suspended the train service of EAL at 0926 hours.

2.2 Red Alert was also issued. Transport Department, Railways Branch and the media were notified so that Transport Department could coordinate with other public transport operators to strengthen their service to cope with the passenger demand.

2.3 At the time of the incident, there were totally 31 trains running on the EAL. All of them maintained full air conditioning and lighting inside the compartment throughout the incident. As information of trains could not be displayed on the TCS, in order to ensure the safety of passengers and train operations, the OCC had to stop all train movements into or out of any station. Subsequently, the OCC had to contact the Train Captains to identify the location of each train. The identification of the location of all the 31 trains was completed at 0950 hours (24 minutes after major incident was declared).

2.4 Out of these 31 trains, 14 of them were identified to be stranded between stations. As a result, time was needed for station staff to access the track to secure points at crossover tracks before the stranded trains could be arranged to move safely into station platforms for detrainment. According to contingency plans, it will take not less than 60 minutes to complete securing points manually on EAL in case of relevant failures, taken into account the walking distance between stations. In this incident, a total of 28 points along the EAL were required to be secured by staff from 9 stations. The securing of points was completed at 1031 hours. Upon completion of securing the points of the locations concerned, trains were arranged to move slowly to station platforms for detrainment, which was completed at 1045 hours.

2.5 During the incident, 3 passengers respectively from 2 stranded trains descended onto the track on their own by operating the Interior Emergency Door Release device.

(i) At 0950 hours, 3 passengers on the train stranded at about 500 metres away from Fanling Station descended onto the track from the train on their own. Station staff had to conduct a check along the concerned section of track according to safety procedures and to escort the passengers back to the platform.

(ii) At 1033 hours, another 3 passengers on the train stranded between Fo Tan Station and University Station (at about 1300 metres from the latter) also descended onto the track from the train on their own. Station staff had to spend some time again to handle the situation in addition to securing points. The passengers were intercepted and escorted back to the train, and check was conducted along the concerned section of track according to safety procedures.

2.6 The signalling system resumed normal at 1021 hours. After checking and testing equipment condition, and confirming that no passengers were stranded on track according to safety procedures, and the restoration of some manually secured points at those essential crossover tracks, train service gradually resumed at 1128 hours. The incident caused a suspension of EAL service for 122 minutes.

2.7 A total of 131 MTR Free Shuttle Buses were operated throughout the incident, carrying affected passengers to stations between Kowloon Tong Station and Lo Wu / Lok Ma Chau Stations. Display boards and banners with free shuttle bus information were posted at affected stations to direct passengers to the bus boarding points. The free shuttle buses ran from 0940 hours to

1222 hours, i.e. with extension of service for almost one hour after train service resumption. Over 16,400 passengers were served.

2.8 Around 320 additional staff members, including operations staff, support staff from back offices, and Customer Service Rapid Response Unit, etc. were deployed to affected EAL stations to provide assistance to passengers and to assist in crowd management and shuttle bus operation.

2.9 Throughout the incident, station staff activated the designated incident mode on ticketing system so as to enable passengers to exit through the gates efficiently without deduction of fare.

2.10 Service disruption information, including information about alternative transport as well as free shuttle bus service were disseminated in timely manner to customers through various channels, such as station and train public announcements, passenger information displays, Service Information Panels, website and smartphone apps (MTR Traffic News).

2.11 In addition, the Train Captains of the stranded trains constantly provided incident information to passengers through public announcement and advised passengers that the trains were being arranged to move into the stations.

2.12 Latest traffic updates were also provided through MTR Traffic News and communicated to the media. When train service gradually resumed at 1128 hours, the information was also disseminated to the public through MTR Traffic News and to the media.

2.13 The safety and order of passengers on trains, at stations and shuttle bus stops were maintained throughout the incident and during the recovery process.

2.14 The sequence of event is listed in Appendix.

## 3. Technical Recovery

3.1 The existing EAL signalling system ensures train operation safety through the Automatic Train Protection (ATP) system and Solid State Interlocking (SSI) system. The two systems were intact throughout the incident, which protected train operation safety. Trains will be stopped automatically if any abnormality situation was detected. The unstable system involved in this incident is mainly for train service regulation purpose.

3.2 Currently, train service regulations on EAL are made by executing train regulation commands on the TCS at the OCC. It was revealed that just before the incident a controller at the OCC had executed a train regulation command, thereafter, the TCS operation became unstable.

3.3 It was identified in subsequent investigation that TCS-A sent out an "invalid message" after the controller had executed the concerned train regulation command, which triggered a situational software issue. It resulted in the halting of all the OCC workstations including the fallback ones at the OCC as well as TCS-A due to surge use of its software memory resource. Figure 1 below shows the TCS servers and workstations configuration during the incident.

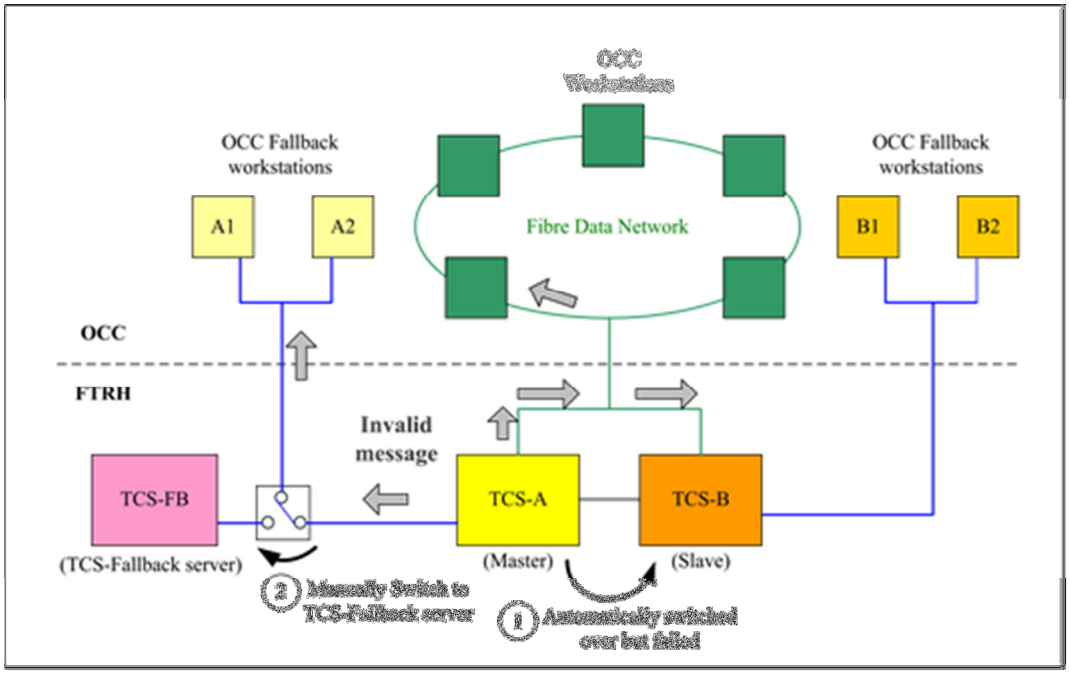


Figure 1: EAL TCS Servers and Workstations configuration

3.4 At the beginning of the failure, the system automatically switched over the server from TCS-A to TCS-B, but the system failed to recover with sluggish response because TCS-B was busy performing synchronization of trackside signalling status with the SSI and responding to the workstations rebooting.

3.5 The technical team had to manually switch over the server to TCS-FB while carrying out a few attempts to reset TCS-A and TCS-B servers. It took more time than expected because the fallback workstations were also disturbed by the "invalid message", which needed to be rebooted.

3.6 The system eventually resumed normal operation at 1021 hours after the TCS-FB server and fallback workstations had been activated successfully.

## 4. Technical Root Cause

4.1 Right before the failure on 11 January 2018, a controller had executed a specific train regulation command on the TCS. Subsequently, TCS-A sent out an “invalid message”, which triggered situational software issue, resulting in the halting of all the workstations at the OCC as well as TCS-A due to surge use of its software memory resources.

4.2 Detailed investigation with experts from the signalling equipment supplier together with the TCS simulator server built to facilitate fault diagnosis and software testing confirmed that the failure was due to a hidden software coding error in the software application module of that specific train regulation command that had been applied right before the incident. It was also confirmed that the concerned command is the only command among all in the TCS software which may trigger the “invalid message” problem when being executed.

4.3 Because of such hidden software coding error, the actual execution time of this command would depend and be prolonged with respect to the ever traffic demand changes over the years resulting in more complex timetable, and also the situational software memory resources level. When the execution time reaches a threshold set in the software code, it will trigger the “invalid message” problem. Such execution time prolongation and its threshold limit built in the software was not known to MTR since day one revenue service of TCS system in 2003 noting the traffic demand has been kept on increasing over the years.

4.4 Signalling equipment supplier has already developed working method of using alternative command to replace the concerned command. A new TCS software patch has been downloaded to the TCS to remove the concerned command and hence eliminate the chance of triggering “invalid message” again. Moreover, it can also improve the TCS system stability.

4.5 Signalling equipment supplier also confirmed that the “invalid message” incident has no direct relationship with the signalling system upgrade work on EAL. It was also confirmed that the incident was not caused by sabotage. The Independent Signalling Expert Consultant employed concurred with the cause of the incident and the improvement measures set out below.

## 5. Improvement Measures

5.1 To prevent recurrence, the following improvement measures have been implemented.

(i) New software patch has been downloaded to TCS system to eliminate the chance of triggering the “invalid message”.

(ii) The recovery procedure has been further enhanced to ensure more effective recovery process in case of TCS failure including this new failure symptom.

(iii) The TCS fallback workstations have been completely isolated from TCS-A and TCS-B to avoid disturbance by whatever software issues so as to ensure quick manual start-up whenever necessary. Figure 2 below shows the enhanced TCS servers and workstations configuration.

(iv) Round-the-clock monitoring of the TCS performance and its software memory resources level has been carried out to enhance responsiveness to any abnormality and recovery need.

(v) The frequency of TCS software restarting in non-traffic hours has been increased as an additional preventive measure.

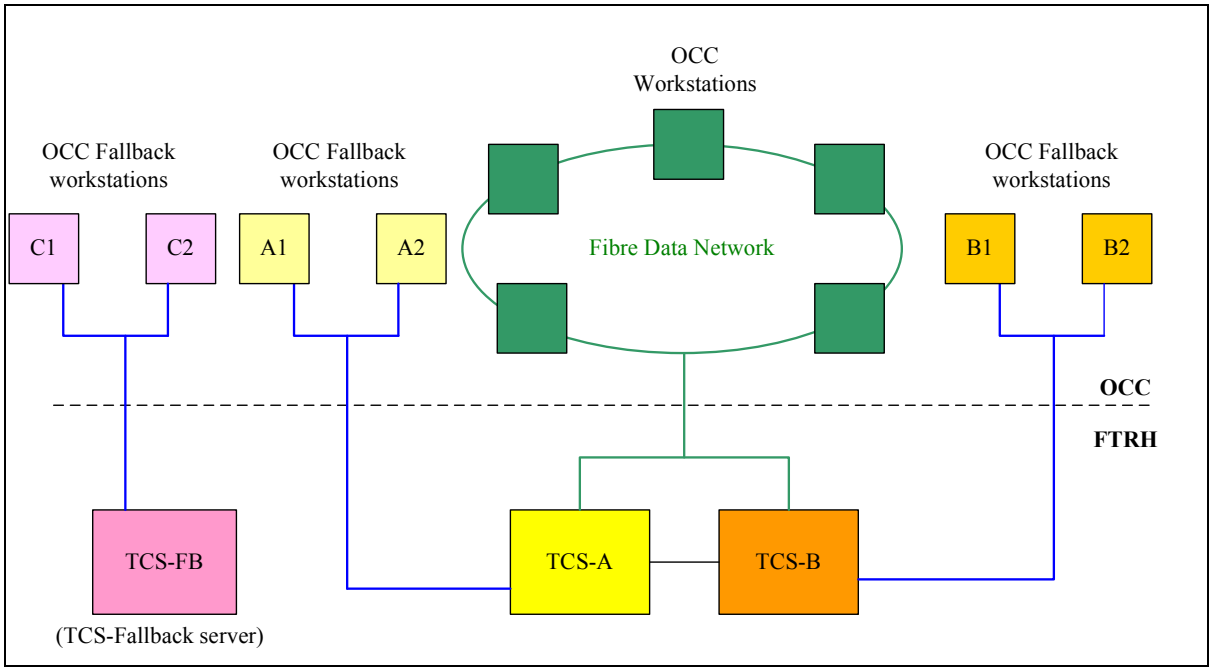


Figure 2: EAL TCS Servers and Workstations enhanced configuration

5.2 For continuous improvement in customer service, the Corporation will further look into enhancing the effectiveness of the despatch of free shuttle buses, queuing plans and facilities at individual stations in consultation with relevant Government Departments as appropriate; and will further review how best to provide passengers with more informative messages during service disruption. Meanwhile, public education will also be enhanced to advise passengers to follow the guidance of Train Captains in stranded trains and not to descend onto railway tracks without instructions.

## 6. Conclusion

6.1 Unstable condition of the server of TCS was experienced at the OCC in the morning of 11 January 2018. The situation persisted despite switchover and rebooting of the servers. Having considered that the situation might persist for some time, the OCC made a prudent decision to temporarily suspend the train service of EAL at 0926 hours.

6.2 To ensure the safety of passengers and train operations, time was inevitably needed for identifying the location of each train. Subsequently, manual securing of points at crossover tracks on the whole line and manual train movements at low speed to station platforms for detrainment were required.

6.3 During the incident, 3 passengers respectively from 2 stranded trains descended onto the track on their own by operating the Interior Emergency Door Release device.

6.4 The signalling system resumed normal at 1021 hours. After checking and testing equipment condition, and confirming that no passengers were stranded on track according to safety procedures, and the restoration of some manually secured points at those essential crossover tracks, train service gradually resumed at 1128 hours.

6.5 The incident caused a suspension of EAL service for 122 minutes. MTR Free Shuttle Bus service was provided during the affected period. The safety and order of passengers on trains, at stations and shuttle bus stops were maintained throughout the incident and during the recovery process. The shuttle bus service arrangement and dissemination of passenger information were reviewed for continuous improvement in customer service.

6.6 From the detailed investigation conducted jointly with experts from the signalling equipment supplier, it was found that a situational software issue was triggered after a specific train regulation command had been executed in the TCS, resulting in the halting of all the workstations at the OCC and TCS-A due to surge use of its software memory resource. The root cause of generating the “invalid message” was due to a hidden software coding error in the software application module of that specific command.

6.7 The improvement measures stated in 5.1 above to prevent recurrence of the incident and enhance the recovery process have been completed. The new software patch with the software coding error rectified has been downloaded to the TCS system to eliminate the chance of generating “invalid message” again. The recovery procedure has also been further enhanced to ensure more effective recovery process in case of TCS failure including this new failure symptom.

6.8 The Independent Signalling Expert Consultant employed concurred with the cause of the incident and the identified improvement measures.

**Appendix**

## East Rail Line Incident (11 January 2018)

## Sequence of Events

| Time | Event |
|---|---|
| 0912 | The Controllers in OCC observed an unstable condition of the server of TCS which controls the signalling system of EAL. Technical team attempted to manually restarted the server but unsuccessful. |
| 0913 | TCS server switched over from TCS-A to TCS-B automatically. |
| 0917 | Execution of TCS application for resuming TCS-B failed. |
| 0924 | Switchover of TCS to TCS-FB was carried out. |
| 0926 | OCC made a prudent decision to temporarily suspend the train service of EAL while the recovery work continued.<br><br>14 trains were identified to be stranded between stations. Station staff needed to access the track to secure points before the stranded trains could be arranged to move safely into station platforms for detrainment.<br><br>OCC disseminated the service disruption information to customers through smartphone apps (MTR Traffic News). |
| 0940 | The first shuttle bus departed Kowloon Tong Station for Lok Ma Chau Station. |
| 0950 | 3 passengers descended onto the track from a stranded train near Fanling Station by operating the Interior Emergency Door Release device. Station staff conducted checking along the concerned section of track according to safety procedures, and escorted the passengers back to the platform. |
| 1021 | TCS-FB server was reinstated after several attempts of switchover and rebooting. TCS resumed normal. Checking and testing of |

| Time | Event |
|---|---|
| | equipment condition and the restoration of some manually secured points at crossover tracks were arranged. |
| 1033 | Another 3 passengers on a stranded train between Fo Tan Station and University Station descended onto the track on their own by operating the Interior Emergency Door Release device. Station staff had to spend some time again to handle the situation before train service could resume safely. |
| 1125 | Station staff brought all passengers back to the train and confirmed the track was clear of passengers. |
| 1128 | Train service of EAL gradually resumed. |