Case Study: Class 390 Train Management System (TMS) Upgrade

Situation and nature of failure mode

- A software update was planned to the Class 390 TMS software to upgrade five system functions
- Regression testing was performed on the manufacturer's test facility and functionality testing was performed
- The software was initially tested on a small number of trains and performed satisfactorily
- The upgrade was then rolled-out to the whole fleet
- During operation it was noted that on some trains it was not possible to reset the Vacuum Circuit Breaker (VCB) after a neutral section resulting in half-power
- The only way to overcome this fault was to perform a system reset

Investigation and action taken

- Initial analysis suggested it was processor overload due to the 'random' appearance of the fault
- Further investigation identified the fault only occurred on certain trains (head codes*) at certain locations/direction and on certain routes
- The root cause of the fault was traced back to the number of stations within the diagram and a counter overflowing
- It took one year to fully understand the issue involving an interim TMS version with improved fault logs; it was then possible to recreate the event in order to confirm the fault
- The fault was fully fixed when a new version of software was installed to address the problem

*initially it appeared to look like only certain physical trains or TMS modules but this was due to those working the affected diagram more often plus a degree of randomness

Key Learning

The software design and testing should consider the full range of credible operating conditions that could be experienced in service including operating time e.g. a one-off test is not reflective of 24 hours operation in service