Expression of Interest for RSSB1992 – Simulator requirements for research project (T1091 - Transitions to/from ERTMS operation – impact on operations)

1. Project background

The roll out of ERTMS in the UK has the potential to expose drivers in particular and other operational staff, to numerous and frequent transitions between ERTMS and conventional signalling operation during the course of a journey or a work shift.

On the approach to a transition border, the driver will receive notification that a transition to a new method of operation is going to happen. This notification (announcement) could be at any time between a designed earliest and latest location on the approach to the border. When the announcement is received, the driver is required (OPE TSI) to prepare to apply the rules for the new area i.e. the driver must determine what the change in method of operation will be and be prepared to adjust to that new method of operation.   The driver may also be required to acknowledge the transition before transitioning. These tasks are in addition to the normal driving task associated with the current method of operation.

After the transition there may be a period of adjustment before the driver is completely secure in the new method of operation. During this adjustment period, there is the potential for degradation in the effectiveness of the driving task, for example in speed management or, after transition to conventional signalling, interpretation of and reaction to signal aspects. This degradation may impact on:

- Performance if drivers slow down until they have adapted to and are confident in the new method of operation, and

- Safety, especially if the transition border is located such that the adjustment period encompasses areas or infrastructure features where the driver workload is increased, for example, speed changes, stopping at a platform, taking a diverging route, changing radio channels or types, changing traction type or monitoring a locally monitored crossing.

Repeated transitions between different signalling systems and their associated methods of operation, may result in increased confusion over the method of operation the driver is required to employ and lead to degradation in effectiveness of the driving task. This

may be exacerbated if transitions are occurring at high frequency or at a location where a driver has a high workload i.e. transitions to a new method of operation after a short period of operation in another.

The research will seek to identify safety and performance issues that can be attributed, either directly or indirectly, to frequent transitions between ETCS and Class B (AWS/TPWS) signalling systems employed on GB mainline.

2. Why is a simulator required?

Should a suitable simulator become available to support this research driver performance measures and potential hazards identified in the early stages of the research to assess the impact of transitions could include: response to external stimuli eg track workers; change of signal aspects; speed management, stopping position accuracy; and compliance with rules relevant to the mode of operation. Simulator trials would also give an understanding of:

- How drivers adapt to a new method of operation and the factors that would affect adaptation.

- The effect of increasing the number of transitions (eg under patchwork ERTMS implementation approach) on the ability of the driver to adapt to that method of operation post transition.

- The effect of the amount of time spent in the previous method of operation on the ability of the driver to adapt to the new method of operation post transition.

- The effect of the speed of the train during transition on the ability of the driver to adapt to the new method of operation post transition.

Simulator trials would also be used to validate the following research questions which will be investigated during workshops in the early stages of the project:

- The impact of the presence of transition borders near to infrastructure features (eg level crossings, junctions, stations) on driver workload and driving performance post transition.

- The effect of the new method of operation (eg level NTC, pure ERTMS or ERTMS overlay) on the ability of the driver to adapt to this method of operation post transition.

- Mitigations for any hazards arising from any degradation in driver performance caused by transitions.

3. Simulator requirements

3.1. Hardware requirements

- Driver's desk configuration

- View out of the cab window e.g. via a TV display (including track curvature, junctions and scenery)

- Desk open/close functionality (with the driver's key). This will enable the driver to move the train and shut down the cab at the end of the simulation.

- Direction controller to select whether the driver wants the train to travel forwards or reverse

- UK power control (that you pull towards you to increase speed)

- UK brake control (that you push away from you to apply the brakes)

- AWS sunflower

- AWS reset button

- TPWS panel

- Warning horn

- Softkey ETCS DMI or touchscreen ETCS DMI

- Line light and VCB light (or appear on the DMI?)

- GSM-R

Non-essential hardware

- DSD pedal

- AWS/TPWS isolation switches (not required to work)

3.2. Software requirements

The software required needs to enable the driver to:

- Pass through a neutral zone on the track and see the relevant signage on the approach to the neutral section.

- Display lineside signals where required (4 aspect signalling).

- Drive through stopping and non-stopping stations.

- Display relevant lineside signage and infrastructure eg level crossings and speed restriction signage.

- Display ETCS information on either a touchscreen or softkey ETCS DMI display. Needs to display transition related information (when moving from conventional

aspect signalling to ETCS operation and vice versa). This includes changing the units on the speedometer from km/hr (when the train is in ERTMS level 2) and mph (in Class B AWS/TPWS operation) and vice versa.

- Sound AWS, TPWS, ETCS, warning horn tones/alerts.
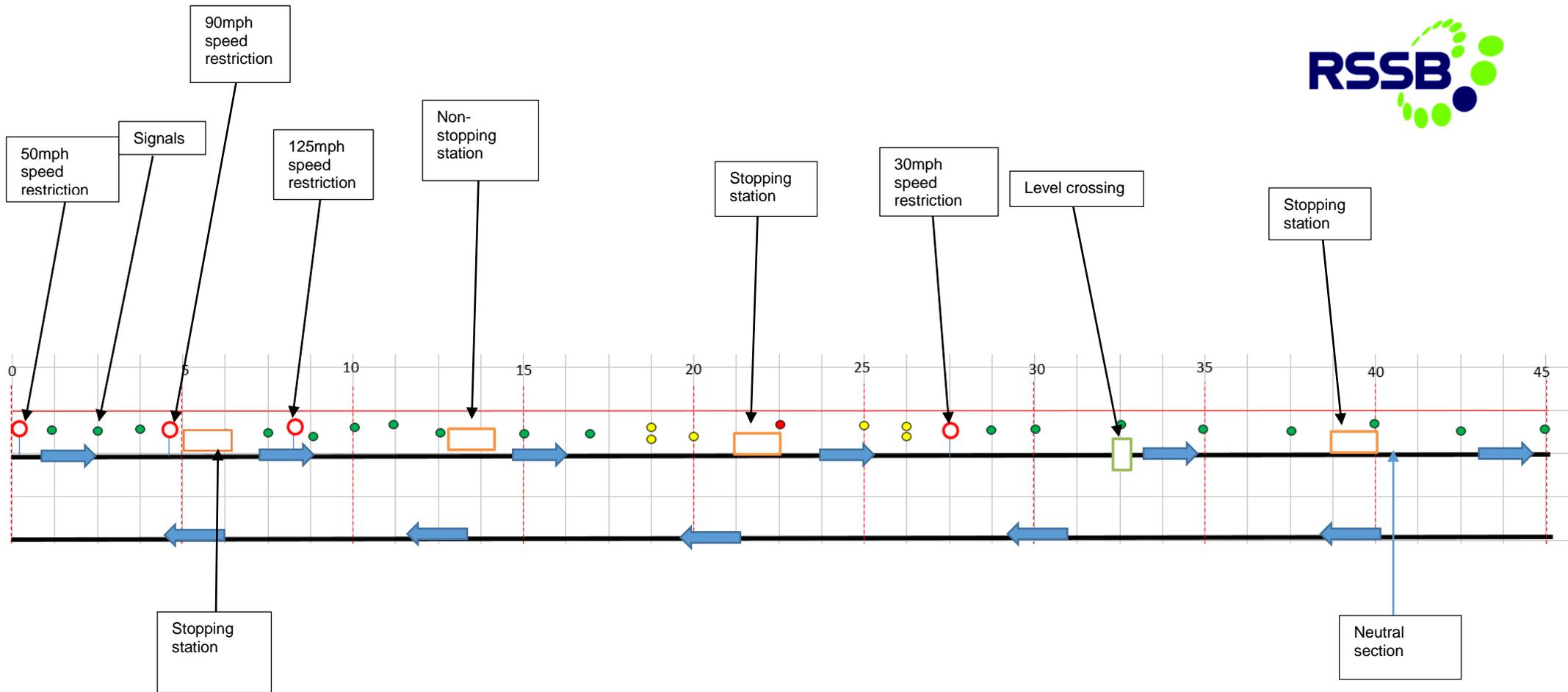
3.3. Operational scenarios

The scenarios outlined in this section are the predicted scenarios for the simulator testing. These might change as the project progresses based on the findings of the early stages of the project.

Scenario 1: Baseline (no transitions)

There needs to be two versions of this scenario. The first version will require the driver to drive/familiarise themselves with the route in Class B AWS/TPWS operation. The second version will require the driver to drive/familiarise themselves with the route in ERTMS level 2. Other requirements for scenario 1 are:

- 45 minutes in length

- 2 tracks with curves in the track

- Speed varies between 30 and 125mph

- Four aspect signalling spaced as per the relevant Railway Group Standard (RGS) eg at speeds of 125mph a signal may be encountered as frequently as every 30 seconds but at slower speeds there will be a longer time between signals.

- 4 train stations (3 stopping stations)

- A locally monitored level crossing with a 30mph speed restriction over the level crossing.-

- On the other line, it would be good to include stations and another train

The aim of this scenario is to get drivers familiar with the route and simulator. An example of this scenario is shown in the figure below:

50mph speed restriction

Signals

90mph speed restriction

125mph speed restriction

Non-stopping station

Stopping station

30mph speed restriction

Level crossing

Stopping station

Stopping station

Neutral section

0   5   10   15   20   25   30   35   40   45

5

Scenario 2: Single transition (from ETCS to Class B AWS/TPWS)

The idea of scenario 2 is to have a single transition in the journey from ERTMS level 2 to Class B AWS/TPWS operation. The transition will occur close to the beginning of the journey or deep in to the journey. To achieve this, the transition point border will be located in the same place on the track. However, if we are testing the effect of having the transition close to the beginning of the journey, the drivers will need to start in a location closer to the transition point (not at the beginning of the baseline track). There will need to be some speed supervision (eg through adding some track curvature) to get the drivers accustomed to ETCS level 2 operation before they transition regardless of where they start the simulator scenario.
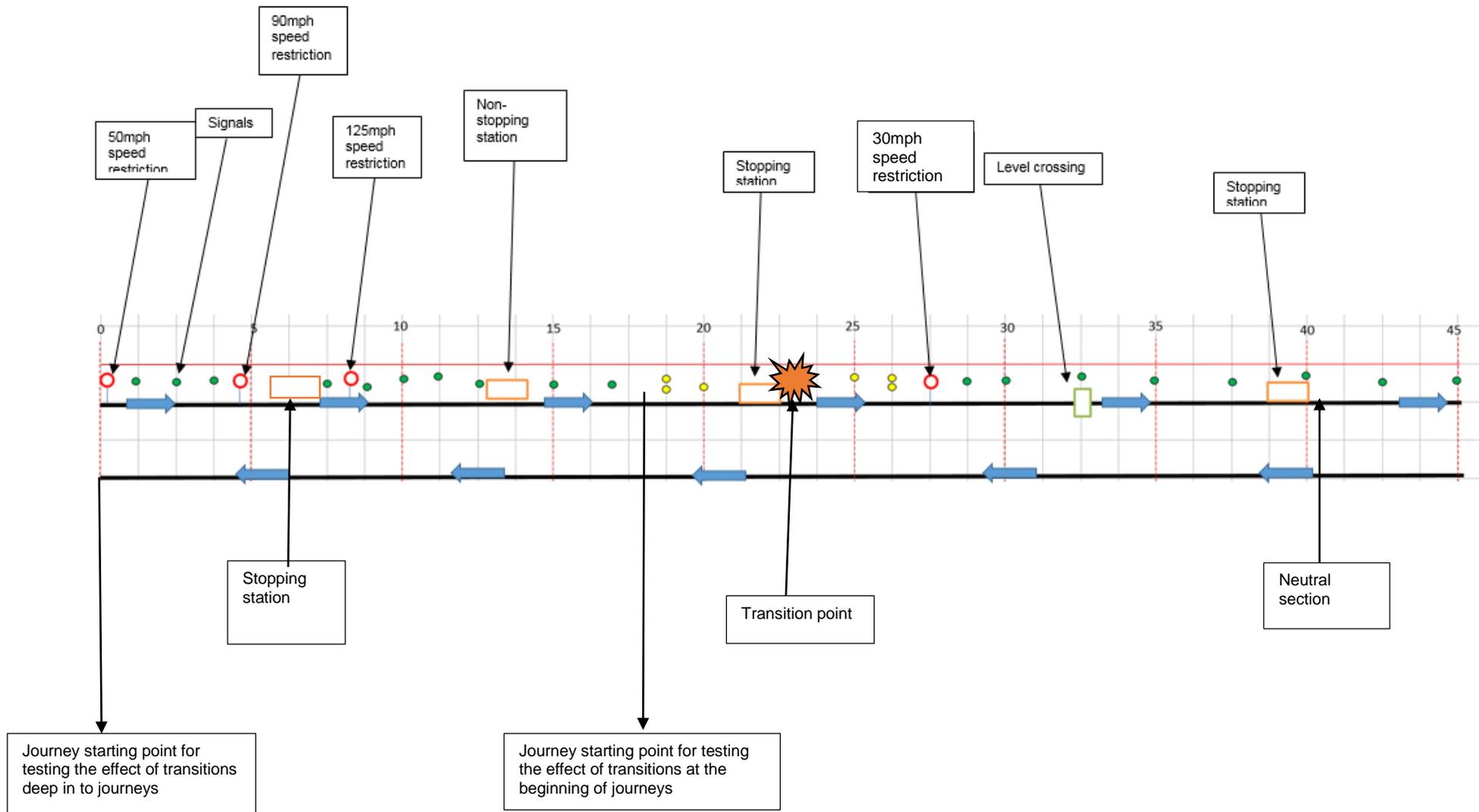
The following variations to the simulator scenario described above are:

- 2B standard scenario 2 with ETCS level 2 with lineside signals for trains on which ETCS is not operating.

- 2C standard scenario 2 with a reduction in speed prior to the transition (transitioning at a reduced speed). The speed needs to be reduced using the DMI rather than using controlling signal aspects.

This will answer the following research questions:

- How drivers adapt to a new method of operation and the factors that would affect adaptation.

- The effect of the amount of time spent in the previous method of operation on the ability of the driver to adapt to the new method of operation post transition.

- The effect of the speed of the train during transition on the ability of the driver to adapt to the new method of operation post transition.

An example of what this scenario might look like can be found below:

90mph speed restriction

Signals

50mph speed restriction

125mph speed restriction

Non-stopping station

Stopping station

30mph speed restriction

Level crossing

Stopping station

Stopping station

Transition point

Neutral section

Journey starting point for testing the effect of transitions deep in to journeys

Journey starting point for testing the effect of transitions at the beginning of journeys
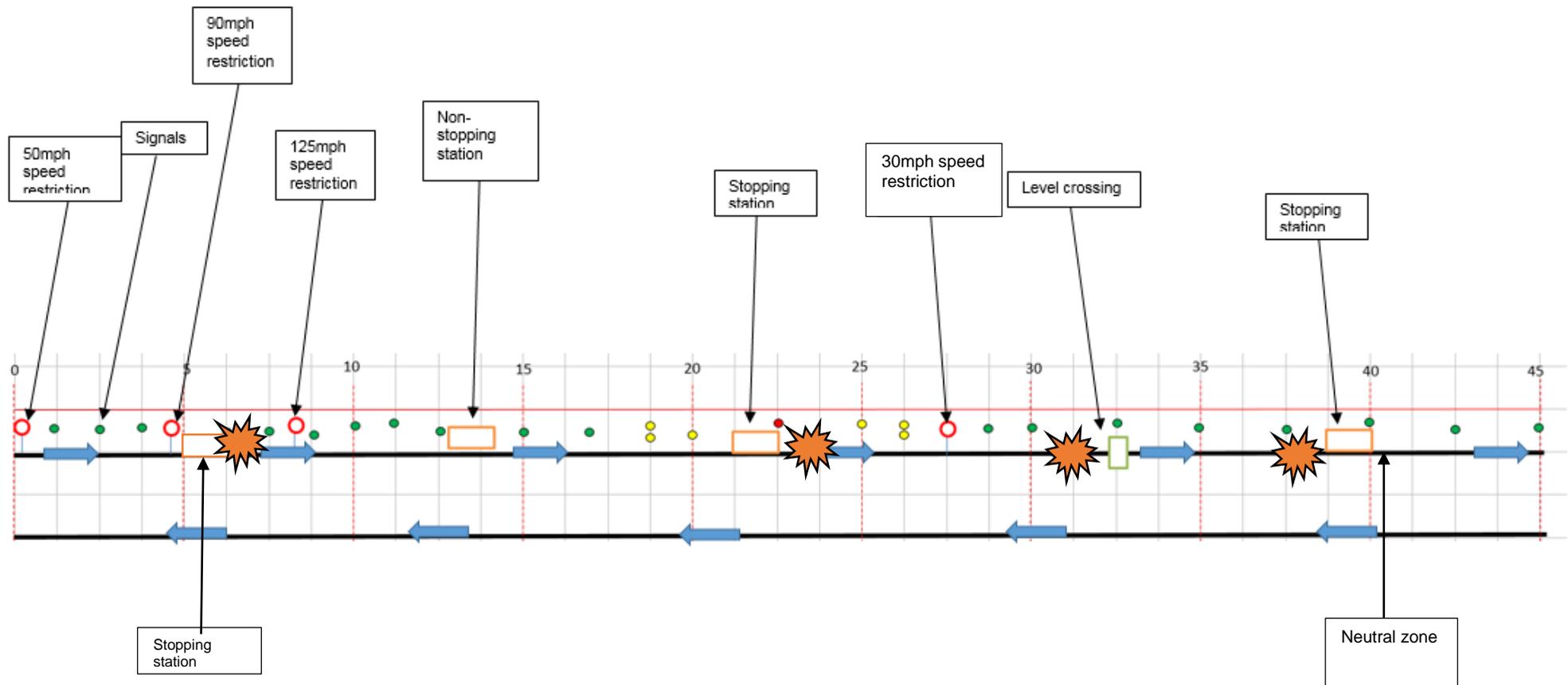
Scenario 3 (multiple transitions)

During this scenarios drivers are required to transition four times during the 45 minute baseline track.

- Baseline track

- Multiple transition points (3A – starting in ETCS level 2) and then with the following variations:

    o 3B multiple transition points (starting Class B AWS/TPWS operation)

    o 3C multiple transitions with ERTMS overlay

    o 3D multiple transition at a reduced speed as per scenario 2.

Research questions answered:

- The effect of increasing the number of transitions (eg under patchwork ERTMS implementation approach) on the ability of the driver to adapt to that method of operation post transition.

- The impact of the presence of transition borders near to infrastructure features (eg level crossings, junctions, stations) on driver workload and driving performance post transition.

- The effect of the new method of operation (eg level NTC, pure ERTMS or ERTMS overlay) on the ability of the driver to adapt to this method of operation post transition.

An example of what this scenario might look like is below:

50mph speed restriction

Signals

90mph speed restriction

125mph speed restriction

Non-stopping station

Stopping station

30mph speed restriction

Level crossing

Stopping station
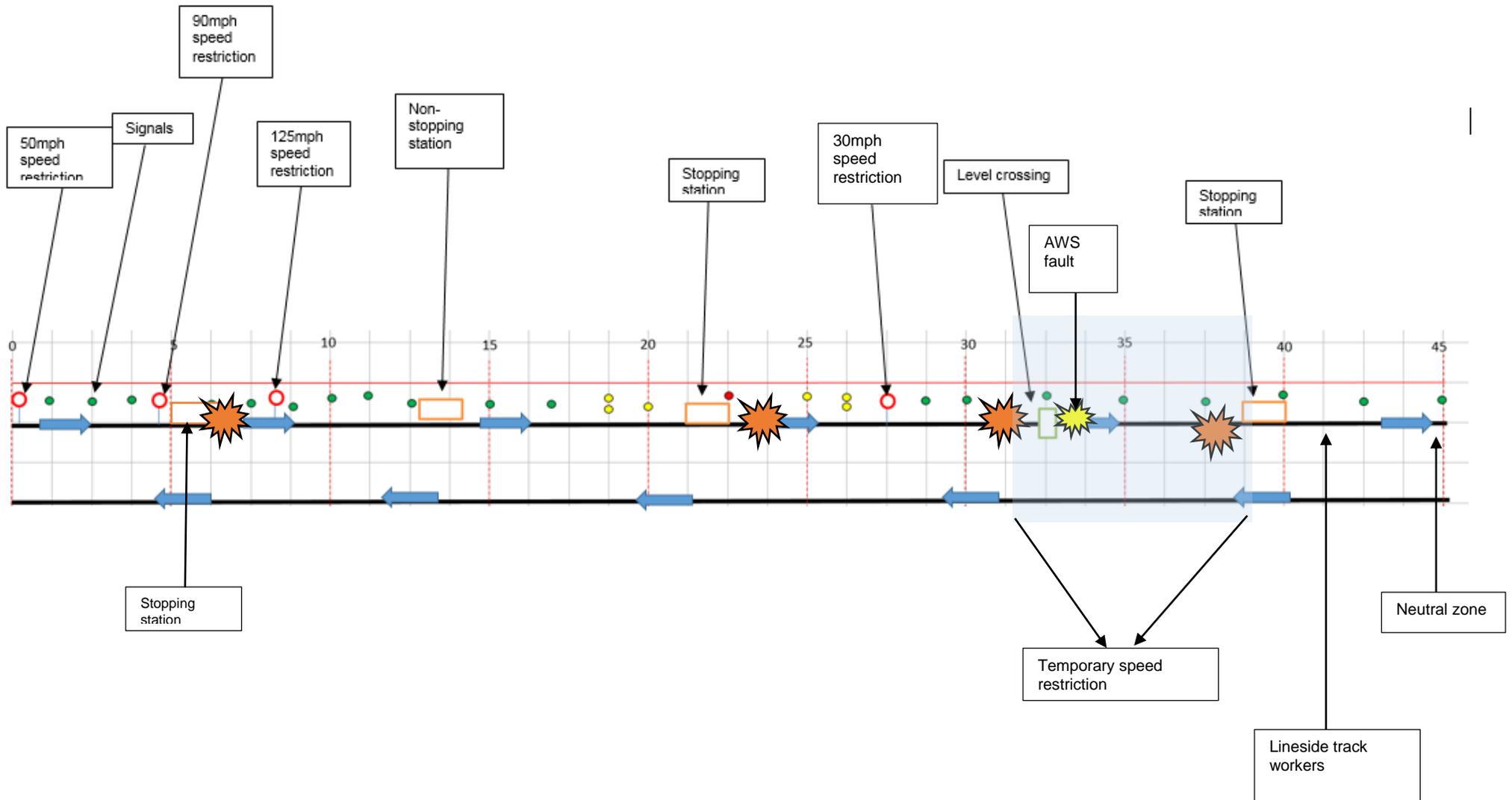
Stopping station

Neutral zone

Scenario 4 (multiple transitions with additional workload)

- Baseline track
- Multiple transitions
- More restrictive signalling (for example, running on single yellows)
- A temporary speed restriction
- Track workers lineside (that will require the driver to sound the horn so they can acknowledge the warning from a position of safety)
- AWS fault (bell sounded rather than a horn)
- Multiple transitions with additional workload (4A) and then the following variations:
  - 4B transitions with additional workload with ETCS level 2 with lineside signals for trains not fitted with ETCS.
  - 4C transitions with additional workload at a reduced speed as per previous scenarios

Research questions answered:

- The effect of increasing the number of transitions (eg under patchwork ERTMS implementation approach) on the ability of the driver to adapt to that method of operation post transition.

- The impact of the presence of transition borders near to infrastructure features (eg level crossings, junctions, stations) on driver workload and driving performance post transition.

- The effect of the new method of operation (eg level NTC, pure ERTMS or ERTMS overlay) on the ability of the driver to adapt to this method of operation post transition.

An example of what this scenario might look like can be found below:

90mph
speed
restriction

Signals

50mph
speed
restriction

125mph
speed
restriction

Non-
stopping
station

Stopping
station

30mph
speed
restriction

Level crossing

AWS
fault

Stopping
station

0   5   10   15   20   25   30   35   40   45

Stopping
station

Neutral zone

Temporary speed
restriction

Lineside track
workers

Other simulator requirements
- The simulator used will need to record data from the train journey (e.g. when a speed board came in to view, when the driver applied the brake and the speed of the train). It would also be useful to be able to analyse station stopping accuracy.
- It would be useful to have the ability to align driver reactions with the information that the driver has seen on the outside screen to the cab. This will allow us to compare the driver input with what the driver is actual seeing.
- The simulator needs to be at a location that can be easily accessed so that drivers can travel to site for the trials.
- The simulators need to be available for use over a period of testing.
- The simulator needs have the flexibility to allow us to make adjustments to the scenarios eg moving and installing speed restriction signs etc.
- Degraded operations are not part of the current project scope but there may be a requirement to simulate degraded operations in the future.

4. Questionnaire

1. Do you have a full UK driving cab simulator and the expertise/ability to make modifications to the simulator?
2. Is the simulator located somewhere that is easily accessible for UK train drivers?
3. Would the simulator be available for a significant period of testing between the beginning of Autumn 2016 and late Winter 2017?
4. Could the simulator be modified to meet the research requirements specified in the attached spreadsheet and how much would it cost to make any required modifications?

Your response along with the indicative cost breakdown spreadsheet must reach Hazel Fernandes (hazel.fernandes@rssb.co.uk) by 1200 on Thursday 12 November 2016.