Road and Tram Traffic Signal Integration

1) This document accompanies Chapter 8 of LRG1.0 Tramway Principles and Guidance, published on 1.3.21 and available to view here. It provides best practice guidance on the integration of tram signalling with road traffic light signalling.

2) The detailed arrangements of any road and tram traffic signal integration should be agreed with the Highway Authority.

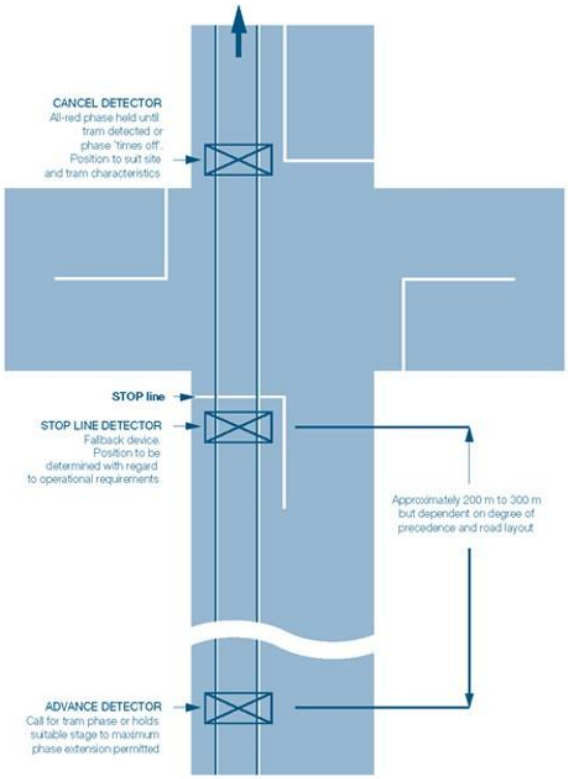
3) To give the appropriate priority to trams, the tram phase (when demanded) may need to run before any parallel or similarly compatible phase for other road users is initiated. The tram phases should terminate at the same time as any parallel stage or phase for other road vehicles.

Controlled Intersections

4) Tram detectors should be provided where road traffic light control systems employ some degree of demand dependency. The detector's function is to register a demand in the road traffic signal controller to call up the tram phase in the next appropriate stage in the sequence. **Figure A.1 below indicates typical tram detector positions.**

5) Tram selective detectors should only respond to trams. Selective detectors may also pass only information for tramway operational purposes.

Figure A.1: Typical Tram Detector Positions



6) A Stop line detector should be provided as shown in Figure A.1. This should register a tram demand if none is already present.

7) If the tram Proceed signal (as shown in Diagram 3013.2 of the TSRGD) is already present, departure from the Stop line detector may initiate a red period.

8) A cancel detector should be provided on the downstream side of the Stop line to enable the red period to be terminated before the end of the maximum period once a tram has cleared the intersection.

9) The minimum provision should be a stop line detector and a cancel detector.

10) An advanced detector may be provided further upstream of the Stop line detector on the tram approach to secure a tram Proceed indication without requiring the tram to stop at the Stop line. The advanced detector may then be used to prioritise the tram phase if required, including making provision for the passage of a tram in the opposite direction on a parallel track.

11) The maximum degree of priority that can be given to a tram will depend on:

- The distance of the advanced detector from the Stop line,
- Tram running speeds, and
- The staging and timing arrangements for the intersection.

12) Further advanced detectors may be necessary to allow the tram the maximum precedence, to permit it to run unimpeded through the intersection, or to improve junction capacity for other road users.

13) The distance between the outermost of advanced detectors and the intersection will be governed by the maximum permitted speed of the trams and the maximum attainable speed, whichever is less, as well as the time taken for the road traffic signal controller to change to the appropriate stage. The objective is that the Proceed aspect is shown before or just as the tram reaches an overall service braking distance (including reaction time) from the Stop line.

14) The signal aspect Cluster (as shown in Diagram 3013.5 of the TSRGD) should be displayed for a period commensurate with the service braking performance and approach speed of the tram. A shorter period, commensurate with the emergency braking performance, may be used if the signalling design ensures that a signal will only return to Stop as a tram is approaching under exceptional conditions, for example an emergency services vehicle hurry call or a fault. However, the period should be consistently applied throughout each individual system.

15) The nominal time for this Cluster aspect to be displayed is normally five seconds. However, this may be varied between systems according to local geographic, climatic and traffic conditions, which in turn may affect the braking performance of the trams.

Priorities at Controlled Intersections

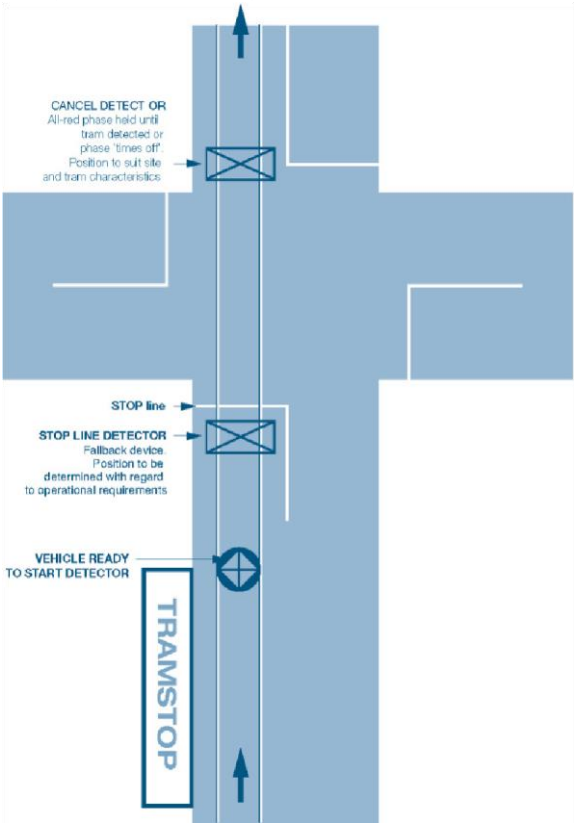
16) Hurry call signals for emergency service vehicles should override all other demands of the tram signals.

17) Where a tramstop is located between where the advanced detector would be positioned and an intersection, a tram ready to start (TRTS) detector should be provided so that the tram driver can initiate the tram phase when the tram is ready to depart from the tramstop. **Figure A.2 shows a tramstop with a TRTS detector.**

18) Where a tramstop is so close to the intersection that the TRTS detector would be located with or very close to the Stop line detector, then the TRTS detector should replace and also assume the role of the Stop line detector.

19) If the last detector before a junction is a TRTS detector, but the tram can move forward from this detector to the Stop line at the junction, sufficient means should be provided for a tram phase demand if the driver forgets to use the TRTS feature and moves forward off the detector.

Figure A.2: Tramstop With a TRTS Detector



Pedestrian Crossings

20) A pedestrian crossing located at a signalled road intersection should be controlled by the road traffic signal controller.

21) A hold detector should always be installed to prevent the tram signal changing to stop after the tram is within its service braking distance (although the hold detector may be subject to a timeout if the tram is unduly delayed).

22) Further guidance is provided in LRG 2.0 Guidance on Tramway Crossings for Non-Motorised Users.

Road Traffic Signal Controllers

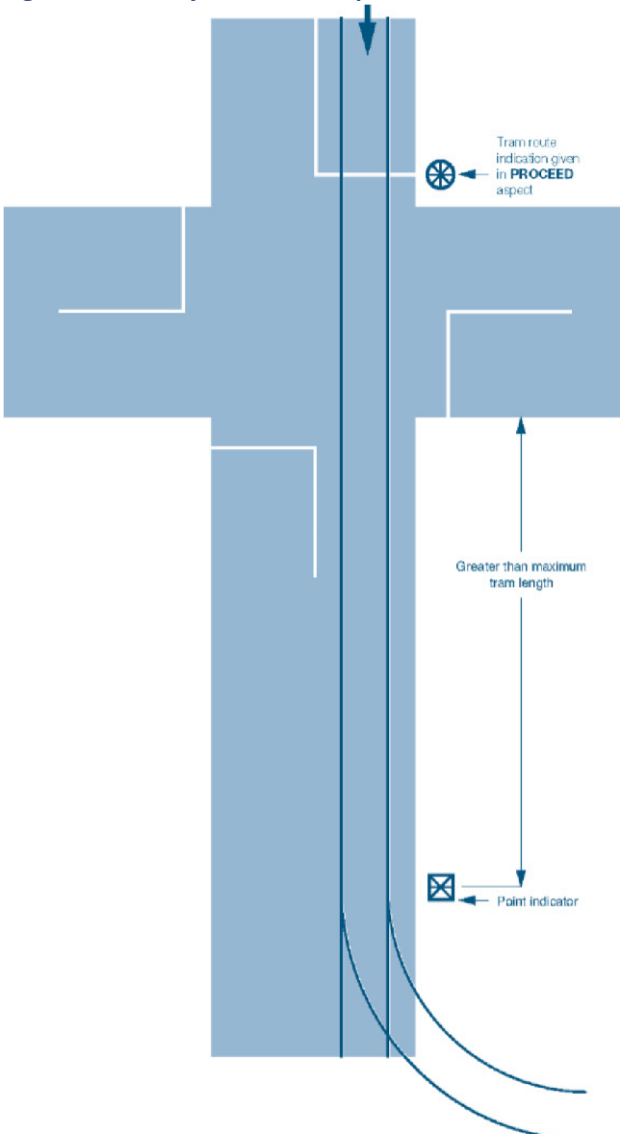
23) Communication is required between the road traffic signal controller and any tram detectors. The road traffic signal controller should analyse the information from these tram detectors to determine when to call and cancel the tram phases. Tram route information for the intersection may be supplied directly by the detectors or from a tramway traffic control facility.

24) In some cases, it may be necessary to provide an interface unit between the road traffic signal controller and the tram detection equipment.

25) The maximum distance for points to be located downstream of an intersection is that of the length of the tram in order that the driver can reliably observe the lie of the points.

26) In situations where points are located at a greater distance, information regarding the lie of the points will not be provided to the tram signal, but the proposed route may be indicated in the Proceed aspect. This situation is illustrated in **Figure A.3.**

Figure A.3: Tram junctions with points after road intersection



27) Where the tram turnout lies within a tram length of an intersection, the points should be located on the approach to the intersection to avoid a tram stopping on the intersection awaiting the points being set and a Proceed aspect being given. This situation is illustrated in **Figure A.4.**

28) Local point indicators should be provided adjacent to the point ends. Only these indicators, and not the tram signal, should show the lie of the points.

29) The routing of trams and the detection and control of point mechanisms should be wholly contained within the tramway control system.

Urban Traffic Control Systems

30) The tram signal system may be interfaced with an urban traffic control system (UTC). The interface will depend on the individual UTC used and also the coverage of the UTC as in some areas they are regional, and in others, they are within local authority boundaries. However, suitable tram detector arrangements in keeping with those described above are required for all types of UTC.

31) Road traffic signal controllers should comply with Highways England specifications in document TR 2500 Specification for traffic system controller.

Equipment Monitoring

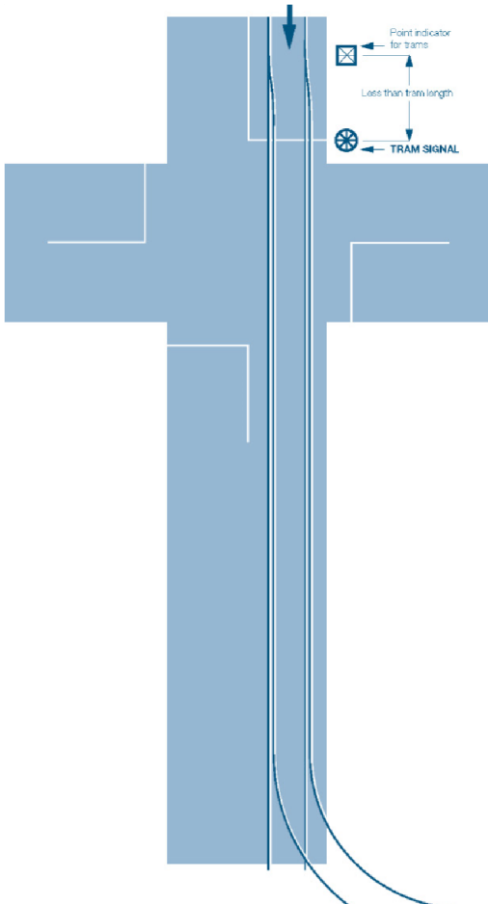
32) The road traffic signal controller should be designed to monitor the failure of lamps in the tram signal.

33) The road traffic signal controller should be designed to monitor tram detectors to ensure they are functioning correctly and do not cause any conflicting aspect to be shown.

34) Where tramway systems operate within a UTC area, the road traffic signals will be monitored regularly. In addition, monitoring of the tram signal lamps is required.

35) In order to prevent a misleading tram signal aspect being shown in a combined, single-unit array, individual lamps or clusters of a minimum of three out of the five LED, lamps or clusters should be lit. Where the aspect is provided by a fibre optic or LED display giving the appearance of a continuous band, the monitoring system should reveal the condition when less than 60% of the band is visible or the light output of the band has fallen below 60% of the normal. In either case, provision should be made for the control room or UTC to be alerted. Requirements for signal performance is specified by Highways England in TR 2514 Performance Specification for Light Signals for the Control of Tramcars .

Figure A.4: Tram junctions with points before road intersection



36) Where tram systems operate outside UTC areas, or in towns and cities without UTC, a monitoring system should also comply with TR 2514.

37) The default mode during the failure of any detector should provide the following facilities as a minimum, unless an agreed equivalent system is installed:

- The failure of an advanced detector should not register a demand for a tram phase,
- The failure of a Stop line detector should register a permanent demand for a tram, and
- The failure of a cancel detector should cause the all-red period to run to the maximum time permitted (sufficient to allow a tram to clear the intersection in accordance with current traffic management practice).

38) An alternative means of registering a tram demand is required in the event of failure of a detector. Some alternatives are suggested below:

- One such alternative could be a TRTS detector which doubles as a Stop line detector,

- The creation of a plausible demand that can be used to call up a tram phase if any detector fails and where other detectors are available,
- The recognition of a Stop line detector registering a permanent demand, by reference to inputs from other detectors may enable the demand to be downgraded to a non-priority demand. Where this is not possible, a tram phase should have a maximum time allotted to it, following which it should be shut down and the tram phase thereafter appear automatically at a fixed time within each cycle, either running concurrently with other appropriate phases or separately,
- A key-operated override switch located at the local road traffic signal controller or adjacent to the signal can enable a tram input command to a road traffic signal controller if any of the tramway equipment upstream of and including the tramway interface unit should fail, or
- Remote input from the UTC system / tramway control room to insert a tram demand via the UTC equipment to assist trams that are unable to indicate their presence to the local road traffic signal equipment.

Approval of Equipment

39) All equipment must be approved before being put into service. This includes the following equipment (not exclusively):

- Used to control road traffic on the highway,
- Connected to a road traffic signal controller, or
- Housed with the road traffic signal controller;

40) Further information regarding approval procedures can be obtained from the Highways England documents TR 2500 and TRG 0600 , and also in document TD 07/07 of the DMRB.

41) For traffic signal controllers this approval extends to the content of all instructions either stored in or executable by the controller, not simply the hardware.

42) Systems employing radio techniques must be approved by the Office of Communications (Ofcom)26.