Title: METHOD FOR RELEASING OVERLAPS IN A RAILWAY SIGNALLING SYSTEM

Abstract: A method for releasing an overlap in a railway signalling system, the system comprising a signalling interlocking, trackside processing equipment and at least one signal, the overlap being a section of railway located past the signal in the direction of train movement, comprises: configuring both the interlocking and the trackside processing equipment to treat the overlap as an individual overlap route, such that a train would require a movement authority to be granted to proceed into that route.
Method for releasing overlaps in a railway signalling system

This invention relates to a method for releasing an overlap in a railway signalling system, and swinging an overlap to an alternative overlap in a railway signalling system.

Background

Fig. 1 shows a simplified generic track layout, in which trains may approach from the right side as shown, along either of the two parallel track lines, with the intention, say, of stopping at Platform A on the upper line, or Platform B on the lower line. Past the platforms, points PI are selectively operable to pass a train on the lower line to join the upper line. The presence of a train on a particular section of track is determined through the use of track circuits as is well-known in the art, with the track circuits being labelled T1 to T6 on the upper line, and T11 to T14 on the lower line.

As will be readily apparent to those skilled in the art, rail system architectures may be broadly divided into two types: "conventional signalling", which relies upon information being passed to the train via trackside signals, and "communication-based signalling" such as "ETCS" (European Train Control System), itself part of ERTMS (European Rail Traffic Management System), and these will be discussed separately below. Fig. 1 shows three sets of trackside signals: S11 and S21 located before the platforms and relaying signalling information to trains on the upper and lower lines respectively, S13 and S23 located at the exit end of the platforms and relaying signalling information to trains on the upper and lower lines respectively, and SI5, located on the upper line some distance past the platform. If all trains are using communication-based signalling, the presence of these signals is not strictly necessary, but the general concept of
operation is sufficiently similar for the purposes of describing the present invention.

In conventional signalling (i.e. without ETCS) if a train is given authority by a lineside signal to proceed up to the next signal which is at red, then a safety margin beyond the red signal is normally set and locked for the train in case the train overruns the red signal. This safety margin is often called an "overlap". No other train is allowed to use the overlap section of track until it is proved that the train for which it has been set no longer needs the overlap. This is often achieved by timing the occupancy of the track circuit leading up to the red signal (the "berth track circuit") such that sufficient time is allowed for the train, for which the overlap has been set, to come to a stand (and it has not gone past the red signal into the overlap). The timer is calculated based on the length of the track circuit and could typically be of the order of 30 to 60 seconds.

In the case of communication-based signalling (e.g. ETCS Level 2) a movement authority (MA) is sent to a train by trackside processing equipment (TPE, i.e. a radio block centre (RBC) in the case of ETCS) which is consistent with the routes that are set and the proceed indications provided by a signal interlocking. The TPE is configured with track data which provides details of signal positions, track circuits, routes, overlaps, etc. It is expected that the interlocking would provide a proceed indication to the TPE for each route from a route entry point (i.e. a signal) when it is safe for an approaching train to enter the route. Conventionally each route would be from one signal to the next. In the example of Fig. 1 there is only one route from each signal shown to the next signal, but in more complex layouts there could be several possible routes from one signal.

A movement authority will typically define a position beyond which the train should not travel (i.e. an "end of authority" (EoA) in ETCS) and a safety limit beyond which the train must
be prevented from going (i.e. a "supervised location" in ETCS, the position of which can be specified in the movement authority by defining a danger point). Because of the cautious (i.e. safety critical) nature of the train protection system it will not allow the train to approach closely to the supervised location because it must always be possible to stop the train even if it makes an unexpected move.

A movement authority up to a red signal may typically define an EoA at the signal and a danger point (DP) at the end of the overlap, giving the train the longest available safety margin. This is schematically shown in Fig. 2. Here, a train would be expected to stop on the approach to the signal and not go right up to the EoA. The required stopping position in a platform, Platform A as shown for example, would not normally require the driver to drive up to the EoA.

In ETCS it is known that a facility exists where overlap information can be sent to a train with the MA which defines a temporary overlap limit, an overlap timer and the position of the train where timing should start, e.g. the start of the relevant track circuit. This overlap information can be sent with a shorter danger point, for example placed at the fouling point (FP), i.e. the point on the track beyond which a train would physically impede the movement of another train on another track, for converging tracks. The train protection system will initially use a supervised location at the end of the overlap. When the timer expires, the protection system on the train will shorten the supervised location to the danger point. This should only happen once the train is stationary because the timer will be similar to that used by the trackside. The trackside interlocking will also run a timer and allow the overlap to release when it expires. This arrangement is schematically shown in Fig. 3.

In normal operation, as routes are set ahead of a train, the movement authority is replaced with a new extended authority allowing the train to proceed further along the railway. For
example, and as shown schematically in Fig. 4, MAI is replaced by MA2, with new associated end of authority EoA2 and danger point DP2, when a proceed authority is given by the interlocking for signal S11.

For any signalling system, if a proceed authority which has been given to a train is subsequently removed (for example the signaller may decide to allow another train to go first) then the route (s) beyond that signal are maintained in a locked state for that train until it is proved that the train will not use them. This form of locking is often referred to as 'Approach Locking'. Depending on the signalling system and the operating requirements, this proving can be performed in different ways. However one common feature is that a timer is again used which allows sufficient time for a driver to observe that the authority for the train has changed and for the train to be brought to a stand without entering the route from the replaced signal. This timer may typically be of the order of 3 or 4 minutes.

A facility which is known to exist in ETCS is what is called 'co-operative shortening of a movement authority'. ETCS provides a facility where the trackside equipment can send a message to a train to request a shortening of the MA. The train protection system will calculate new braking profiles to determine if the train can stop before the shorter MA limit and respond to the trackside to either accept or reject the shortening request. If the shortening request is accepted by the train, this allows the trackside protection equipment to inform the interlocking that the route (s) beyond the replaced signal no longer need to be held for the train. An example is shown schematically in Fig. 5, where a movement authority MAI might be shortened from S5 to S1 (i.e. MA2) in order to allow another train to proceed from S3.

As general prior art may be mentioned EP1752355, which describes a typical system architecture with a bi-directional
interface between a signalling interlocking and trackside processing equipment.

However, in certain circumstances it may be desirable to im-
5 plement the capability to release a signalling overlap when no forward route is set from the corresponding signal and the overlap is no longer required for an approaching train. As set out above, this can be achieved using a conventional timer based on the occupancy of the signal berth track, how-
10 ever it is desirable to provide improved performance for an ETCS fitted train by releasing the overlap, when no longer required, without waiting for the timer to expire. It has been suggested for the TPE (an RBC in this case) to inform the interlocking when a train is stationary in the berth track and the movement authority has been withdrawn. How-
15 ever, the functionality for an RBC to inform an interlocking of a stationary train is not standard ETCS functionality and not known to exist.

20 It is an aim of the present invention to provide an alterna-
tive method by which the operation of overlap release could be achieved using existing TPE functionality. This aim is achieved by effectively treating the overlap as a single route.

25 A second requirement is the capability to swing an overlap to an alternative section of track. This operation would for example be carried out when a train is not immediately ap-
30 proaching the signal at danger, the overlap currently set is blocking a path for another train and an alternative overlap is available.

It is a further aim of the present invention, solved in a similar manner, to provide a method to enable this capabil-
35 ity.

In accordance with a first aspect of the present invention there is provided a method for releasing an overlap in a
railway signalling system, the system comprising a signalling interlocking, trackside processing equipment and at least one signal, the overlap being a section of railway located past the signal in the direction of train movement, the method comprising:

configuring both the interlocking and the trackside processing equipment to treat the overlap as an individual overlap route, such that a train would require a movement authority to be granted to proceed into that route.

In accordance with a second aspect of the present invention there is provided a method for swinging an overlap to an alternative overlap in a railway signalling system, the system comprising a signalling interlocking and trackside equipment, comprising the steps of:

a) requesting the use of the alternative overlap;
b) determining, at the interlocking, if conditions are suitable for the overlap to swing,
c) if so, using the trackside processing equipment to provide an override to the interlocking, and releasing the overlap using a method in accordance with the first aspect, and

d) swinging the overlap to the alternative overlap.

The invention will now be described with reference to the accompanying drawings, in which:

Fig. 1 schematically shows a simplified generic track layout;
Fig. 2 schematically shows a movement authority granted for the layout of Fig. 1;
Fig. 3 schematically shows an overlap for the layout of Fig. 1;
Fig. 4 schematically shows a new movement authority for the layout of Fig. 1;
Fig. 5 schematically shows an example of co-operative movement authority shortening for a modified layout, so that overlaps do not conflict with other moves;
Fig. 6 schematically shows a track layout exemplifying an overlap releasing method in accordance with an embodiment of the present invention; and

Fig. 7 schematically shows a track layout exemplifying an overlap swinging method in accordance with the present invention.

A first embodiment of the present invention is schematically shown in Fig. 6, using for convenience the same track layout as Fig. 1.

The signalling interlocking is configured with the following:
- A route without an overlap up to each signal where the overlap is to be released, i.e. up to S13 and also up to S23;
- A 'route' from these signals (i.e. from S13 and from S23) up to the end of the overlap to be released (in addition to any normal routes configured from that signal);
- A 'proceed' indication for the overlap which is provided to the TPE whenever the overlap is available for use by an approaching train, and the route up to the associated signal is set but no other forward route from that signal is set.

The TPE is configured with the following:
- A route leading up to each signal where the overlap is to be released (i.e. S13 and S23) with an EoA at, or proximate, the signal and a danger point at the fouling point, a short distance beyond the signal. It should be noted that even though there is no overlap for this route there will, for this particular layout, be a short section of railway up to the fouling point which will not be required by any other train.
- A 'route' from these signals (S13 and S23) which includes only the overlap with an EoA at or proximate to the signal, i.e. as short a distance as possible (for example around 1m) beyond it, and a danger point at the
end of the overlap. It should be noted that it may be
system dependent as to whether the EoA can be in the
same place or not as the previous route. The train
should accept either.
5 - An indication to the interlocking which indicates
whether the overlap can be released or not.

When the interlocking provides a proceed indication to the
TPE for the route leading up to S13 (i.e. from signal S11)
10 the TPE sends a movement authority (MAI) to the train with
EoAl at the signal and a danger point DPI a short distance
beyond, at the fouling point FP. When the interlocking pro-
vides a 'proceed' indication for the overlap, the TPE sends a
new movement authority (MA2) with a similar EoA2 as EoAl, but
15 with a danger point DP2 at the end of the overlap.

It can be seen therefore that the overlap is configured both
in the interlocking and TPE as a separate "route" with con-
ventional interaction between them in order to establish a
"proceed" for the TPE.

When a request to release the overlap is received by the in-
terlocking, it removes the 'proceed' indication for the over-
lap from the TPE. The TPE then sends a request to shorten
25 the movement authority to the approaching train which speci-
ifies the end of authority and danger point of MAI again (i.e.
EoAl and DPI). If the train accepts the shorten request (for
example because it has already stopped), then the TPE can in-
dicate to the interlocking that the overlap can be released.
30 If the train rejects the shorten request then the overlap is
not released until, for example, a longer conventional time-
out has expired. If the train is stationary when the request
is received, then the reduction in movement authority should
not cause a problem for the train and the request would be
35 accepted. If the train is not on its final approach profile
to the stopping position then the train should also be able
to adjust its profile in order to accept the reduction in
movement authority. It is possible however that as the train
approaches the stopping position the sudden rearwards movement of the danger point would cause a potential infringement of the emergency braking profile and the request to shorten would be rejected by the train.

Assuming the train accepts the shorten request then the TPE will provide an approach locking override to the interlocking allowing the release of the overlap route.

The request to release an overlap could come from the signaler and used only when required. However it would also be possible for the overlap release to be requested automatically using a timer in the interlocking, based on the occupancy of the track circuit leading up to signal S13. The difference in this case is that the timer only needs to be set for long enough such that the train is likely to have stopped, and not that it has definitely stopped as was the case in the prior art, i.e. it is no longer safety critical. This is expected to reduce the timer used to trigger the overlap release by more than 10 seconds, which is significant in terms of railway operation.

A further embodiment of the present invention, relating to a method of swinging overlaps, is set out in more detail with reference to Fig. 7.

The swinging of an overlap is a common feature of conventional signalling (at least in the United Kingdom) and, if the signalling has been configured to provide such a feature, will be permitted under certain conditions – primarily that the approaching train is far enough away from the signal such that it could not enter the overlap during the time that the relevant points (shown as P2A and P2B) are moving, as described below. The possibility of swinging an overlap can be viewed as an extension to the capability of releasing an overlap. If the interlocking considers that conditions are suitable for an overlap to swing, i.e. the train is not immediately approaching the signal, then it can request release
of the currently set overlap. This should not cause any problem for any ETCS train, which should accept the small reduction in its movement authority. The TPE then provides an approach locking override to the interlocking which can then select an alternative overlap.

From the prior art it is expected that the TPE would indicate to the interlocking that the next train to approach a signal is an ETCS-controlled train. The involvement of the TPE in releasing and swinging an overlap can therefore be conditional within the interlocking on the next train being indicated as an ETCS train. If the next train is not indicated as an ETCS train, either because the next train is not an ETCS train or its movement authority has not yet reached that signal, then the interlocking can swing the overlap according to conventional rules.

A possible sequence of events in accordance with this embodiment might be:

1) The signaller sets the route for a first train up to signal S13, including the overlap beyond points PI, referred to as "Overlap 1";
2) As described earlier, the RBC issues a movement authority MAI initially up to the signal, which includes EoA1 and DPI. It should be noted that DPI in this case is configured to be at the point of divergence for the alternative paths through points P2A;
3) The interlocking provides a proceed indication to the RBC for Overlap 1 and the RBC extends the movement authority for the first train by sending MA2, which includes EoA2 and DP2;
4) The signaller then, for example, may wish to allow a second train to proceed from signal S23. If "Overlap 2" from signal S13 is available and does not conflict with any other moves, then the signaller may request that the overlap be moved, or 'swung', away from the path of the second train from S23;
5) The interlocking checks that the approaching train is not too close to the signal then, as described previously, the
interlocking removes the proceed indication for Overlap 1 from the RBC. This causes the RBC to issue a request to shorten the movement authority back to EoA1 and DPI (i.e. essentially back to MAI);

6) Because the first train is known to be some distance from signal S13, it is expected that the train will accept the shorten request allowing the RBC to indicate to the interlocking that Overlap 1 may be released;

7) The interlocking releases Overlap 1 and moves the points P2A and P2B to the reverse position. (A note on terminology: conventionally points P2A and P2B are so numbered, i.e. 'A' and 'B', because they are always moved together and cannot be controlled independently; additionally, points have a 'normal' position and a 'reverse' position, with diagrams usually showing them in the normal position);

8) Once the points P2A and P2B have been locked and detected in their required reverse position, the interlocking can provide a proceed indication for Overlap 2 to the RBC. This allows the RBC to again extend the movement authority of the first train this time by sending MA3, including EoA3 and DP3. EoA3 can be configured at the same location as EoA2; and

9) Having completed the process of swinging the overlap, the interlocking will then allow the signaller to set the route for the second train from signal S23.

It should be noted that in step 6, the locking of Overlap 1 is maintained by the interlocking until the RBC indicates that it can be released. If for whatever reason the train decides that it cannot accept the shortened movement authority request, or fails to respond, then Overlap 1 will remain locked for the first train and swinging will not be permitted. In this case it is expected that the interlocking will wait for a defined time for a release from the RBC, after which the interlocking will cancel the request to swing the overlap and re-establish the proceed indication for Overlap 1 to the RBC.
The above-described embodiments are exemplary only, and other possibilities and alternatives within the scope of the invention will be apparent to those skilled in the art.
Claims

1. A method for releasing an overlap in a railway signalling system, the system comprising a signalling interlocking, trackside processing equipment and at least one signal, the overlap being a section of railway located past the signal in the direction of train movement, the method comprising: configuring both the interlocking and the trackside processing equipment to treat the overlap as an individual overlap route, such that a train would require a movement authority to be granted to proceed into that route.

2. A method according to claim 1, comprising the step of configuring the interlocking with:

a route without an overlap up to the signal, and
the overlap route being from the signal up to the end of the overlap.

3. A method according to either of claims 1 and 2, wherein the method comprises the step of configuring the trackside processing equipment with:

a first route leading up to the signal, having an end of authority proximate the signal and a danger point beyond the signal, and
the overlap route including only the overlap section with an end of authority at or proximate to the signal and a danger point at the end of the overlap.

4. A method according to any preceding claim, comprising the step of configuring the interlocking with:

a proceed indication for the overlap route, and
providing the proceed indication to the trackside processing equipment if the overlap is available for use by an approaching train.

5. A method according to claim 4, wherein
if a request to release the overlap is received by the interlocking, the interlocking removes the proceed indication for the overlap from the trackside processing equipment.

6. A method according to claim 5 when dependent on claim 3, wherein, following removal of the proceed indication, the trackside processing equipment sends a request to shorten the movement authority to an approaching train which specifies the end of authority and danger point associated with the first route.

7. A method according to claim 6, wherein, following sending of the request, if the train accepts the shorten request, then the trackside processing equipment indicates to the interlocking that the overlap can be released.

8. A method according to any of claims 5 to 7, wherein the request to release the overlap is sent by a signaller.

9. A method according to any of claims 5 to 7, wherein the request to release the overlap is generated automatically by the interlocking, based on the time of occupancy of the track circuit in a section of railway track leading up to the signal.

10. A method for swinging an overlap to an alternative overlap in a railway signalling system, the system comprising a signalling interlocking and trackside equipment, comprising the steps of:

a) requesting the use of the alternative overlap;
b) determining, at the interlocking, if conditions are suitable for the overlap to swing,
c) if so, using the trackside processing equipment to provide an override to the interlocking, and releasing the overlap using a method in accordance with any preceding claim, and

d) swinging the overlap to the alternative overlap.

11. A method according to claim 10, wherein
in step a), the request is sent by a signaller.

12. A method according to either of claims 10 and 11, wherein in step d), an authorisation is provided to the trackside processing equipment to use the alternative overlap.