

Ref:	SSI8003-51C
Issue:	11
Date:	05/09/2015
Compliance date:	06/12/2015

Chapter C:

Route Locking Across Boundaries Module

Endorsement and Authorisation

For endorsement, authorisation and issue record of this document, please refer to the SSI Applications Manual Contents, NR/L2/SIG/17002.

This document is the property of Network Rail. It shall not be reproduced in whole or part nor disclosed to a third party without the written permission of Network Rail.

© Copyright 2015 Network Rail.

Uncontrolled copy once printed from its electronic source.

Published and Issued by Network Rail, 2nd Floor, One Eversholt Street, London. NW1 2DN.



Ref:	SSI8003-51C
Issue:	11
Date:	05/09/2015
Compliance date:	06/12/2015

User information

This Network Rail standard contains colour-coding according to the following Red–Amber–Green classification.

Red requirements – *No variations, could stop the railway*

- **Red requirements shall** always be complied with and achieved.
- Red requirements shall be presented in a red box **with the word “shall” or expressed as a direct instruction**.
- Accountability for the efficacy of red requirements lies with the Professional Head/Standard Owner.
- Red requirements are monitored for compliance.
- Corrective actions shall be enforced if deviations are discovered through functional checks (e.g. engineering verification visits, audit or Operations Self-Assurance).

Amber requirements – *Controlled variations, approved risk analysis and mitigation*

- **Amber requirements shall** be complied with unless variation has been approved in advance.
- Amber requirements shall be presented with an amber sidebar **and with the word “shall” or expressed as a direct instruction**.
- Accountability for the efficacy of these requirements lies with the Professional Head/Standard Owner, or their nominated Delegated Authority.
- Amber requirements are monitored for compliance.
- Variations **may** be permitted. Variations are approved by the Standard Owner or through existing Delegated Authority arrangements.
- Corrective actions shall be enforced if **non-approved** variations are discovered through functional checks (e.g. engineering verification visits, audit or Operations Self-Assurance).

Green – *Guidance*

- Guidance is based on good practice. Guidance represents supporting information to help achieve **Red** and **Amber** requirements.
- Guidance shall be presented with a dotted green sidebar **and with the word “should” (usually in notes) or as a direct instruction**.
- Guidance is **not mandatory** and is not monitored for compliance.
- Alternative solutions may be used. Alternative solutions do not need to be formally approved.
- Decisions made by a competent person to use alternative solutions should be backed up by appropriate evidence or documentation.

Ref:	SSI8003-51C
Issue:	11
Date:	05/09/2015
Compliance date:	06/12/2015

1 Route Locking Across Boundaries Within an SSI Scheme

Figure C1 illustrates a simplified example of part of the split of a complex station area between two SSI Central Interlockings. The dividing line has been drawn through the platforms so that each end of the station is controlled by one Interlocking. This means that the points at each end of the station and their associated swinging overlaps, and the routes leading out of the platforms, are all contained within one Interlocking area only. The routes which require locking in both Interlockings are the approach routes leading into the platforms. The example illustrates one platform only and swinging overlaps have been omitted, but the data for the other platforms will repeat the pattern described below and the features described in SSI8003-65, "Swinging Overlaps", can be added where required.

The rules for the allocation and nomenclature for the additional identities required in the following sections are specified in Section 1.9.

1.1 Data Compression Techniques

In both the preceding examples the amount of information to be transferred between adjacent Interlockings has been very limited, and can be contained within a single telegram on the Trackside or Internal Data Links. Where a boundary between two SSIs has to be drawn through a complex station area, there may be several tracks and a large number of routes linking the two areas, and a much larger amount of information needs to be transferred. Because of the limited capacity of the Internal Data Links (each Interlocking may transmit 15 eight bit telegrams, 120 bits in all), it may be necessary to consider means of squeezing the maximum amount of information into a few telegram bits. Before attempting this, it is necessary to split the information to be transferred into three categories:

- (i) Information which must be continuously available, irrespective of which routes are set, e.g. the state of Track sections which are used for a number of different purposes. Each of these functions must be allocated its own telegram bit as described in Chapter B Section 2.
- (ii) Groups of pieces of information which are required continuously in certain circumstances, but always occur in set patterns. In the example, this applies to the aspect control information required by WEST from EAST to control its signal 33, and the map search information required for approach locking release of signal 34. As the routes from these signals oppose one another, there can never be a requirement to carry out a map search from signal 34 if a route is set from signal 33. This means that by means of a careful choice of three bit binary codes, we can convey both sets of information in the same three bits, as compared to the 6 bits which were required for the same information in Chapter B Section 2. The precise choice for the meaning of each individual code will depend on the circumstances. In the example, for four aspect signalling with main and warning routes, the three bit codes could be allocated as follows:

Ref:	SSI8003-51C
Issue:	11
Date:	05/09/2015
Compliance date:	06/12/2015

- 000 Map search fails, no aspect control.
- 001 Map search clear back to EL, no aspect control.
- 010 Map search clear back to EN, no aspect control.
- 011 Map search clear back to EP, no aspect control.
- 100 Map search fails, S33 can go to yellow.
- 101 Map search fails, S33 warning/main route step up possible.
- 110 Map search fails, S33 can go to double yellow.
- 111 Map search fails, S33 can go to green.

Note that the choice of codes ensures that any failure which causes all bits to go to zero will enforce the most restrictive map search and aspect control results, and that a bit code has been allocated to allow EAST to inform WEST when the route step-up conditions are available for the warning route from signal 33 (i.e. forward route set from signal 35 and overlap tracks clear). The three bits allocated for these codes are only used for one line across a boundary, thus each additional line across an Interlocking boundary will require its own set of bits.

Where, in the Entrance Interlocking, the signal leading across the boundary is nearer to the boundary than the first signal leading away from boundary, and the latter signal requires map search information across the boundary then the same bits cannot be used for both map search and aspect controls as both need to be available simultaneously. Thus if in Figure C1, signal 34 were located between signals 31 and 33, there would be a requirement for the map search information to be still available for signal 34, **after** a route has been set from signal 33, for route release either through TORR or button cancelling.

As three-bit binary codes complicate the production, checking and testing of data, they should only be used where the amount of information to be transferred across the boundary requires this, i.e. there is insufficient capacity in the Internal Data Link telegrams to allow a single telegram bit per function. In this instance seven bits would have to be used in place of the three bits used above.

SSI8003-51 uses the one-bit-per-function allocation as standard, with the application of three bit binary codes covered in Section 1.10.

- (iii) Information which is not required continuously as it is related to the occurrence of specific events, such as the setting and release of routes can be compressed even further, by using a single telegram for all the information of this type output from an Interlocking. This can be achieved by treating the telegram as a single 8 bit code which can take numerical values from 0-255. This allows 255 different pieces of information to be transferred, leaving the zero code to mean "no action". This will usually be sufficient to allow a single telegram to cater for all the lines linking a pair of Interlockings.

These codes are used in a similar manner to the panel request codes passed from the Panel Processor to the Interlocking: outgoing codes are set up using the "code" version of the telegram command data type, and

Ref:	SSI8003-51C
Issue:	11
Date:	05/09/2015
Compliance date:	06/12/2015

incoming codes are converted into panel requests by the "Input List" data construct in the input telegram data. These data types are described in SSI8003-10D Section 1.13 and SSI8003-10E Section 1.4 respectively. For the example, the input telegram data for telegram 64 in "EAST" will be:

/ EAST Interlocking - IPT data

*I64 WEST 64 / input telegram 64 = output telegram 64 from WEST

```
_12 / input list for requests from WEST to EAST
=QR33(M)-RQ / 1: R33(M) route request
=QR33(W)-RQ / 2: R33(W) route request
=QR36(M)-AK / 3: R36(M) route acknowledge
=QR36(W)-AK / 4: R36(W) route acknowledge
=QUEJ>EK-RQ / 5: UEJ>EK special sub-route release request
=QUEK>EJ-AK / 6: UEK>EJ special sub-route release acknowledge
=QR33(SU)-RQ / 7: R33(W) to R33(M) step-up request
=QR36(SU)-AK / 8: R36(W) to R36(M) step-up acknowledge
=QREJ>EK-RQ / 9: Platform 1 routes (WEST-EAST) cancel request
=QREK>EJ-AK / 10: Platform 1 routes (EAST-WEST) cancel
acknowledge
=Q0302START-RQ / 11: Special sub-routes lock start-up request
=Q0203START-AK / 12: Special sub-routes lock start-up acknowledge
$ / end of input list
. / end of data for telegram 64
```

All the panel requests in the input list will have been defined in the last part of the QST identity file, following the "INTERNAL" key-word (see SSI8003-10C, Section 3.4). This is necessary to ensure that these cross-boundary functions cannot be triggered by an incorrect panel request received from the Panel Processor, which is not a safety-critical system.

There will be no data in the corresponding output telegram 64 in WEST, as the request codes are set up using non-current telegram commands in the panel request data and elsewhere (see examples below). It is important that the output telegram data is omitted entirely (including the label and end marker) as the absence of data identifies the telegram as one which is being used to transmit request codes, and the Interlocking will then ensure that the code is transmitted at least twice so as to guarantee its reception in the second Interlocking. To ensure that this mechanism does not apply where a telegram is used to convey individual bits as described in (i) & (ii) above, a label and end marker must always be provided even when there is no other data (e.g. when the bits are controlled by means of non-current telegram commands from elsewhere in the data).

The uses of the various request and acknowledgement codes are described in the following Sections. To aid the understanding of the examples in these Sections, the equivalent data in the second Central Interlocking is listed here.

Ref:	SSI8003-51C
Issue:	11
Date:	05/09/2015
Compliance date:	06/12/2015

/ WEST Interlocking - IPT data

*I64 EAST 64 / input telegram 64 = output telegram 64 from EAST

```

_12 / input list for requests from EAST to WEST
=QR33(M)-AK / 1: R33(M) route acknowledge
=QR33(W)-AK / 2: R33(W) route acknowledge
=QR36(M)-RQ / 3: R36(M) route request
=QR36(W)-RQ / 4: R36(W) route request
=QUEJ>EK-AK / 5: UEJ>EK special sub-route release acknowledge
=QUEK>EJ-RQ / 6: UEK>EJ special sub-route release request
=QR33(SU)-AK / 7: R33(W) to R33(M) step-up acknowledge
=QR36(SU)-RQ / 8: R36(W) to R36(M) step-up request
=QREJ>EK-AK / 9: Platform 1 routes (WEST-EAST) cancel acknowledge
=QREK>EJ-RQ / 10: Platform 1 routes (EAST-WEST) cancel request
=Q0302START-AK / 11: Special sub-routes lock start-up acknowledge
=Q0203START-RQ / 12: Special sub-routes lock start-up request
$ / end of input list

. / end of data for telegram 64

```

In this example each telegram has been given the same number in each Interlocking, and the code values in the telegrams for each request and the corresponding acknowledgement are the same. This practice is not obligatory, and both telegram numbers and code values may be allocated on an arbitrary basis. However, experience has shown that data preparation is more straightforward if the same numbers are used. (This also applies to telegram numbers in the categories (i) and (ii) above.) Also in more complicated areas there is an advantage in using the highest available numbers in the 64-78 range for telegrams used for transmitting request codes (see Section 1.3 (i)).

1.2 Setting a Route across a Boundary

The process of setting a route across a boundary between two Interlocking areas is complicated, not only by the need for communication between the two Interlockings, but by the need to take precautions against any change in the locking conditions which may occur while the tests for route availability are taking place. For a route within a single Interlocking this problem does not occur as the route availability is checked and the route locked in a single process which cannot be interrupted by any updating of the availability conditions, but for a route across a boundary the design of the geographic data must protect against any changes which may occur between the times at which evaluation of availability takes place in the two Interlockings. The overall requirement is to ensure that the route is set only if it is available in both Interlockings, and that it is never possible to arrive at a situation where half of the route only is set as a result of a change in availability during the route setting process.

The sequence of events in setting a route is as shown in the following Sections. Figure C2 illustrates the included PRR file data in a tabular form for each Interlocking.

Ref:	SSI8003-51C
Issue:	11
Date:	05/09/2015
Compliance date:	06/12/2015

1.2.1 Generation of Panel Request

The panel request to set the route is generated within the Panel Processor for the area controlling the route entrance. As the exit button for the route will be at a signal in the other Interlocking's area, the wiring of the Panel must be arranged so that the push contacts of this button are connected to the Panel Multiplex for the Central Interlocking requiring the button as an exit, and the pull contacts and the button lamp to the Panel Multiplex for the Central Interlocking requiring the button as an entrance.

In the example, this would apply to button 35, which is an exit button for "WEST" and an entrance button for "EAST". The geographic data in the Panel Processor which receives the push operation of the button generates a panel request in the usual way when an exit button operation is recognised, and relays the button operation on to the other Interlocking when it is pressed as an entrance button. This is achieved by linking an output from one Panel Multiplex to an input to another. The data required is described in SSI8003-20C Section 5.1(iii).

1.2.2 Sending the request code from Entrance Interlocking "WEST"

The Interlocking controlling the route entrance evaluates the availability of the route within its own area. If the route is not available no action is taken. If the route is available then all points that have been tested are controlled to the required position, and the request is passed on to the second Interlocking by setting a code in the Internal Data Link telegram reserved for this purpose, and an elapsed timer is started. (Where a set of points with an automatic restoration feature, see SSI8003-66, is required reverse, then the controlling of these points reverse is not done at this stage, but is left until the acknowledgement, see Section 1.2.4 below. This delaying of the controlling of the points until route locking is applied avoids automatic restoration disrupting the route setting. This restriction also applies to certain points in alternative routes; see SSI8003-63.)

One of these timers is allocated for each telegram used to convey request codes to another Interlocking. In the example the timer is named EG64, referring to output telegram 64. This "telegram timer" is used to prevent any attempts to set any other routes using the same telegram while the second Interlocking is evaluating its response, by including a test for the timer stopped in the panel request data for each route. This prevents the route request from being over-written by a subsequent request to set or release another route.

The telegram timer is also used to give priority to all requests originating from the PRR file, and thus generated only once, over those generated continuously, until acknowledged, from other files. These latter requests also include a test for the telegram timer stopped but do not start it. The

Ref:	SSI8003-51C
Issue:	11
Date:	05/09/2015
Compliance date:	06/12/2015

same lower priority also applies to their acknowledgements, and examples of these requests are shown in Sections 1.3, 1.4 and 1.6.

In the example, the panel request data for R33(M) in "WEST" will be:

```
/ WEST Interlocking - PRR file data

*QR33 (M)
  if R33 (M) a , R33 (W) xs
    UEH-AC f , OEJ-AB f
    P222 cnf
    EG64 stopped
  then P222 cn
    EG64 = 0 , G64 = 1 / =QR33 (M) -RQ to EAST
\ .
```

1.2.3 Sending the acknowledgement request code from Exit Interlocking "EAST"

The Interlocking controlling the route exit receives this request in a code in an Internal Data Link input telegram, and this is translated into a panel request by the input telegram data as described in Section 1.1 (iii) above. The panel request then evaluates the availability of the second half of the route. If the route is available, and the telegram timer for the acknowledgement telegram is stopped, indicating that there is no attempt to set another route over the boundary already in progress, it goes on to lock the route in the usual manner, and generates an acknowledgement code to be transmitted back to the first Interlocking to confirm that the route has set. A route memory always has to be allocated to this second half of the route, and this is set.

The other classes of route over the same path are unset; this is necessary because the new route may be being overset while a train is still proceeding through a route of another class which has been already released in the first Interlocking. One set of panel request data is needed for each request which can be received from the other Interlocking, but where a number of routes of the same class converge before the Interlocking boundary, a common route memory can be allocated. E.g. a route from "WEST" over points 222 reverse into platform 1 in "EAST" could share the route memory REJ>EK(M) with route R33(M) in the example.

This route memory is used primarily as continuing proof in the aspect controls that the route is set in the Exit Interlocking and to decide which class of these aspect controls should be sent back to the first Interlocking (see Section 1.5). It is also used as part of the process of releasing overlaps (see Section 1.4), i.e. it has no direct route holding role. The Technician's control for route not prohibited need not be tested in the conditions, because routes will always be barred in the Interlocking controlling the route entrance.

The commands include those to lock a special sub-route at the boundary (see Section 1.3 below) and to start the telegram timer with an initial

Ref:	SSI8003-51C
Issue:	11
Date:	05/09/2015
Compliance date:	06/12/2015

value of 9 seconds. As this timer is stopped when it reaches a value of 11 seconds (see Section 1.2.5 below), this gives a 2 second period in which no other route requests, acknowledgements or releases over the boundary can be generated, ensuring that this acknowledgement is not over-written before it can be transmitted.

/ EAST Interlocking - PRR file data

```
*QR33(M)-RQ
  if UEK-AB f
    EG64 stopped
  then REJ>EK(M) s , REJ>EK(W) xs
    UEJ>EK 1 , UEK-BA 1 , OEL-BA 1
    EG64 = 9 , G64 = 1 / =QR33(M)-AK to WEST
\ .
```

If this request is split (see SSI8003-52 for splitting requests) then the above telegram timer test and command are only provided in the final part request.

1.2.4 Processing the acknowledgement request in Entrance Interlocking “WEST”

The Interlocking controlling the route entrance receives the acknowledgement that the second half of the route has been set, and again translates the code in the Internal Data Link telegram into a panel request.

Because the request code for the acknowledgement is automatically sent twice by EAST (see Section 1.1 (iii)), this panel request may be generated once, twice or thrice in WEST. These repeats of the panel request must be suppressed as route setting failure and erroneous route setting and releasing can arise if they are received whilst another closely following route is being set across the boundary.

A latch is required for each acknowledgement, named after the acknowledgement request, e.g. LR33(M)-AK, together with an additional elapsed timer named after the associated input telegram, e.g. EG64AK. This acknowledgement latch is tested not set by the acknowledgement requests, with the first received one setting it thus inhibiting the repeats. This telegram acknowledgement timer is zeroed by each of these requests, data elsewhere (see Section 1.2.5) stopping the timer and unsetting the latch when enough time has elapsed to ensure no further repeat requests will be received. (An alternative method that minimises changes to older data is shown in Section 1.2.7.)

The first acknowledgement request checks that the first half of the route is still available, the points being checked to ensure that they are still controlled in the positions commanded to in Section 1.2.2 above. If it is available and the telegram timer started when the original panel request was received registers less than 11 seconds, the route is set in the usual way, except of course that no point commands are required. (Normally such requests are processed with the telegram timer only having

Ref:	SSI8003-51C
Issue:	11
Date:	05/09/2015
Compliance date:	06/12/2015

reached 3 or 4 but 11 caters for the absolute worst case combination of delayed request and fast running timer.)

(Where a set of points with an automatic restoration feature, see Section 1.2.2 above, is required reverse, then a test for these points controlled or free to go reverse is included in the availability tests, and a command to control them reverse is included in the route setting commands. This restriction also applies to certain points in alternative routes; see SSI8003-63.)

The commands to set the route include the unsetting of a special latch (route-released latch) used to control the passing of "route released" across the boundary for overlap releasing (see Section 1.4 below) where this feature is required. Whether or not the route is set, the telegram timer is stopped, the acknowledgement latch (see above) is set and another special latch (sub-route-releasing latch), used to control the releasing of sub-routes locked by this route across the boundary, is unset.

In the unlikely event that the route is no longer available (this can only be due to a failure, overrun or Signaller error), this ensures that the second half of the route, which has already been set in the other Interlocking, will release, using the usual mechanism for this as described in Section 1.3 below.

/ WEST Interlocking - PRR file data

```
*QR33 (M) -AK
  if LR33 (M) -AK xs
    then if R33 (M) a , R33 (W) xs
      UEH-AC f , OEJ-AB f
      P222 cn
      EG64 < 11
    then R33 (M) s , LREJ>EK xs
      UEH-CA 1 , UEJ-BA 1
      S33 clear bpull
    \
    LUEJ>EK xs , EG64 stopped , LR33 (M) -AK s
  \
  EG64AK = 0 .
```

If an acknowledgement request is split (see SSI8003-52 for splitting requests) then the above data tests and commands operating on the acknowledgement latch and the telegram acknowledgement timer are provided as shown above in the first part request only. The telegram timer is tested in the first part request only and stopped (unconditionally) in the final part request only. The sub-route releasing latch is unconditionally unset in the final part request and unset in the earlier part requests if route setting fails. The route released latch (if provided) is unset, in the final part request, if route setting is successful.

Ref:	SSI8003-51C
Issue:	11
Date:	05/09/2015
Compliance date:	06/12/2015

1.2.5 FOP file data for stopping telegram timers and unsetting latches

If the Interlocking controlling the route exit does not acknowledge acceptance of the request to set the route within 11 seconds, it is necessary to stop the telegram timer in the Interlocking controlling the route entrance, so as to allow attempts to set other routes to be transmitted.

The telegram acknowledgement timer has to be stopped when it reaches 3 seconds (see the Section above). All acknowledgement latches associated with this telegram are also unset at the same time, but a "carry out commands at ..." list is used to minimise data processing time.

In order to unset any of these acknowledgement latches left set at start-up, a command to set each telegram acknowledgement timer to 2 has to be included in the "carry out commands at ..." list *STARTUP (see SSI8003-10H Section 2). This will result in each of these timers, when it reaches 3, unsetting its associated acknowledgement latches.

/ WEST Interlocking - FOP file data

```
if EG64 > 11 then EG64 stopped \ .
```

```
if EG64AK > 3 then EG64AK stopped , @LR64AK \ .
```

```
*LR64AK    LR33(M)-AK xs , LR33(W)-AK xs , <unset any other AK latches> \
```

```
*STARTUP    EG64AK = 2 , <any other start-up commands> \
```

In the Interlocking controlling the route exit, similar flag FOP file data serves to stop the telegram timer which was started with a value of 9 seconds when the route acknowledgement was generated.

Where route setting requests cross more than one Interlocking boundary before an acknowledgement is received by the Entrance Interlocking, the timer extension method detailed in Chapter E Section 1.2 has to be used in order to allow for the greater request transition time.

Where the route setting request in the Exit Interlocking is split into more than three parts, then the timer extension method in Chapter E Section 1 is to be used, adapted to extend the allowed time by one second (rather than the seven seconds shown), or by two seconds if this request is split into more than six parts. (Note that, as advised in Chapter E, this requires data changes in the Entrance Interlocking FOP and PRR files.)

1.2.6 Miscellaneous general notes

In the Interlocking controlling the route exit, care should be taken when testing route memory (REJ>EK(M), REJ>EK(W), etc. in the example above) to ascertain the route class of an approaching train, as after oversetting by a route of a different class, the class of route memory will no longer be that of the first approaching train. Sub-overlaps themselves

Ref:	SSI8003-51C
Issue:	11
Date:	05/09/2015
Compliance date:	06/12/2015

should be tested to ascertain class of overlap, i.e. as for routes that do not cross Interlocking boundaries.

When evaluating route availability, checking for directly opposing routes is done by testing the same opposing sub-routes free, in the appropriate Interlocking, as would be done if Interlocking boundaries were not involved. Thus, in the above example UEK-AB is tested because it is the last sub-route in opposing route 36(M) and not because it is the first opposing sub-route in the second Interlocking.

In panel-controlled CIs, each route-setting request is usually received twice by the Interlocking MPMs, i.e. one from each of the two PPMs. On cross-boundary routes, with the first request having started the telegram timer, the route setting by the second request is halted when it fails its telegram-timer-stopped test. Because of this, each telegram-timer-stopped test must always be positioned such that the failure of the test simply halts the route setting. For consistency of application this applies whether or not panel control is employed.

This is especially important where alternative strategies are present such as alternative routes or alternative overlaps, one or more of which cross Interlocking boundaries. Whether a telegram-timer-stopped test passes or fails must not affect which alternative is set. In other words, the failing of a telegram-timer-stopped test must not result in the processing of an 'else' clause.

1.2.7 Alternative methods

Elsewhere in SSI8003, the use of the methods that these alternatives replace is assumed.

- (i) An earlier, still acceptable but non-preferred, method of testing and calling the points in the Entrance Interlocking is to just test them for availability in the initial request in Section 1.2.2 above, and then re-test for availability and call them in the acknowledgement request in Section 1.2.4. The advantage of this method is that the points are not called if the route is not available in the Exit Interlocking. However this is often outweighed in complicated areas by the disadvantage of additionally having to split the second request due to the repeated points availability tests (see SSI8003-52).
- (ii) An alternative non-preferred method of suppressing repeat acknowledgement route setting requests (see Section 1.2.4) is available. It has the advantage of being simpler to retrofit to existing data, but has a greater chance of causing IDL telegram congestion thus leading to a greater risk of routes failing to set across busier boundaries.

Ref:	SSI8003-51C
Issue:	11
Date:	05/09/2015
Compliance date:	06/12/2015

The use of the existing telegram timer is extended thus rendering the telegram acknowledgement timer and acknowledgement latches redundant. The data in the PRR file (Section 1.2.4) and the FOP file (Section 1.2.5) is reduced accordingly, the former becoming:

/ WEST Interlocking - PRR file data

```
*QR33 (M) -AK
  if R33 (M) a , R33 (W) xs
    UEH-AC f , OEJ-AB f
    P222 cn
    EG64 < 8
  then R33 (M) s , LREJ>EK xs
    UEH-CA l , UEJ-BA l
    S33 clear bpull
  \
  LUEJ>EK xs , EG64 = 8 .
```

Note the changes to both the data test and command on the telegram timer (shown in **bold**). The period between this timer being 8 and being stopped at 11 by FOP file data is reserved for suppressing route setting by repeat acknowledgement requests. For any acknowledgements that generate further cross-boundary request codes in the same telegram (such as some cross-boundary alternative routes), the method in Sections 1.2.4 and 1.2.5 must be used, but both methods can co-exist in the same Interlocking data.

1.3 Freeing of Sub-routes across a Boundary

The release of the route in the Interlocking controlling the route entrance is carried out in the route release section of the output telegram data for the signal in the usual way. The sub-routes up to the Interlocking boundary are then freed sequentially by means of their flag operations. At the boundary a special latch (sub-route-releasing latch) is defined in the Interlocking controlling the route entrance and a special sub-route in the Interlocking controlling the route exit which are used to record when the route over the boundary has been released.

This latch is unset and the special sub-route locked with the other sub-routes when the route is set (see Section 1.2 (iii-iv) above). When, in the Interlocking controlling the route entrance, the latch is still unset, but the last sub-route in this Interlocking is free, a request is sent to the second Interlocking to release the special sub-route. The latch in the first Interlocking is then set when this request has been acknowledged. Once the special sub-route has been released in the second Interlocking, the subsequent sub-routes are then sequentially released in the usual way. The sequence of events in the unsetting and freeing of this latch and special sub-route respectively in the two Interlockings is as follows:

- (i) The flag operations data for the sub-route-releasing latch in the first Interlocking tests that this latch is at present unset and the last sub-route in this Interlocking is free, and, if so, a request code is generated to free the special sub-route in the second Interlocking. This data will generate a release request in every major cycle when the conditions are satisfied,

Ref:	SSI8003-51C
Issue:	11
Date:	05/09/2015
Compliance date:	06/12/2015

but unless there is an Internal Data Link fault or one of the Interlockings is disabled, the request will be acknowledged and the sub-route-releasing latch set within a few seconds. To ensure that this does not overwrite higher priority requests which need to be sent over the same Internal Data Link telegram then the elapsed timer defined above must be in the stopped state before this request is generated.

Also, the flag operation should be located near the beginning of the FOP file, in the first 1/16 of the flag operations. This is to avoid simultaneous sub-route releases in opposite directions across the boundary overwriting each other's acknowledgements, i.e. in any major cycle the flag operations should be processed before any outgoing acknowledgements are generated as the result of the processing of internal input telegrams containing opposite direction requests. Where necessary this 1/16 figure can be increased by $(N-64)/32$ where N is the input telegram number used for requests from the other Interlocking concerned. This is useful where the order of FOP data has to be re-arranged because of excessive minor cycle times (see SSI8003-52 Section 5.2), and to optimise this the telegram numbers used for telegrams transmitting request codes should be taken from the higher end of the 64-78 range.

/ WEST Interlocking - FOP data

```
if LUEJ>EK xs , UEJ>BA f , EG64 stopped
then G64 = 5 / =QUEJ>EK-RQ to EAST
\ .
```

- (ii) The second Interlocking translates the sub-route cancellation request code received over the Internal Data Link into a panel request, and the panel request checks that the timer is stopped and then frees the special sub-route, releases whichever route across the boundary is set, and generates an acknowledgement code in the Internal Data Link telegram back to the first Interlocking. The timer test again ensures that this data does not over-write a route request. Note that the commands to unset the route memories are still included even if the mechanism employed in Section 1.4 is used.

/ EAST Interlocking - PRR data

```
*QUEJ>EK-RQ
if EG64 stopped
then UEJ>EK f , REJ>EK(M) xs , REJ>EK(W) xs
G64 = 5 / =QUEJ>EK-AK to WEST
\ .
```

- (iii) When the first Interlocking receives the Internal Data Link code acknowledging freeing of the sub-route, this is again translated into a panel request. The panel request data checks that the last ordinary sub-route leading up to the boundary is still free, then sets the sub-route-releasing latch.

Ref:	SSI8003-51C
Issue:	11
Date:	05/09/2015
Compliance date:	06/12/2015

/ WEST Interlocking - PRR data

```
*QUEJ>EK-AK    if UEJ-BA f then LUEJ>EK s \ .
```

- (iv) The special sub-route freed in the second Interlocking (see (ii) above) is tested for in the data for freeing subsequent sub-routes. The associated route memories at the boundary (REJ>EK(M) & REJ>EK(W) in the example) are there only as a record of class of route set and thus do not have to be tested. (They are in any case unset with or prior to the freeing of the special sub-route).

/ EAST Interlocking - FOP data

```
UEK-BA f    if UEJ>EK f , TEK c \ .
```

Figure C3 illustrates the above data in a tabular form for each Interlocking.

Adding the mandatory enhanced track circuit bobbing protection to the data in (iv), this then becomes

```
UEK-BA f    if UEJ>EK f , TEK c
              ( TEL o or LTEJOCC s , LUEK>EJ xs or TEK c > 15 )
              \ .
```

This allows for both the forward move and the set-back move from signal 34. See SSI8003-10F Section 1.1 for further details. Note how the tests on cross-boundary functions are done.

Occasionally, an Interlocking function may need to test the state of the normal sub-route nearest the border in the adjacent Interlocking. The state of the sub-route can be copied across the Interlocking boundary, using a bit in an Internal Data Link telegram that is set when the sub-route is free, with this stored in a duplicate sub-route memory.

In two cases it is not necessary to copy the sub-route across the boundary, with the special sub-route or sub-route-releasing latch in the same Interlocking being tested instead. This is dictated by the sequence of operation of these sub-routes and latches across the boundary during route setting or releasing. The two cases are:

- In lieu of testing the last sub-route free in the first Interlocking, the special sub-route in the second Interlocking may be tested for being free.
- In lieu of testing the first normal sub-route locked in the second Interlocking, the sub-route-releasing latch in the first Interlocking may be tested for being unset.

The converse of these tests must be done by copying the relevant normal sub-route across the boundary and testing the state of the duplicate memory.

1.4 Passing "Route Released" across a Boundary for Overlap Release

In the example shown in Figure C4, there is a requirement that in some circumstances the overlap beyond signal 35 may be freed before the sub-

Ref:	SSI8003-51C
Issue:	11
Date:	05/09/2015
Compliance date:	06/12/2015

routes across the boundary have been freed by the mechanism described above.

This can be caused by the train standing across the boundary on Track sections EJ and EK, or the train standing or moving on EK and a route not requiring the overlap overset up to signal 35. In all three cases the overlap release conditions will include a requirement that the route originally set for the train has been released. To allow these conditions to be applied the Interlocking controlling the overlap needs to be informed when the route has been released in the entrance Interlocking, even though the sub-routes up to the boundary have not yet been freed. Thus generally this will be required whenever a route across a boundary has a locked overlap to be released.

At the boundary a special latch (route-released latch) is defined in the entrance Interlocking only, which is used to record when the route over the boundary has been released. This latch is unset when any route over the boundary is set (see Section 1.2(iv) above), and when it is still unset but all these routes have been released a request is sent to the second Interlocking to release the route. The route-released latch in the first Interlocking is then set when this request has been acknowledged. The sub-overlaps in the second Interlocking can then be freed by means of the usual tests on the route memory and berth Track sections as described in SSI8003-63. The sequence of events is as follows:

- (i) The flag operations data for the route-released latch in the first Interlocking tests for the latch unset and all routes over the boundary unset. In the case of a route which includes preset position light shunting signals between the main signal and the Interlocking boundary, the special preset route memory (see SSI8003-68) for the last intermediate signal before the boundary should be tested instead of the corresponding route from the main signal.

If these conditions are satisfied, a request code is generated to cancel the route in the second Interlocking. The elapsed timer must be tested and the data located near the start of the FOP data file as for the subroute release data described above.

/ WEST Interlocking - FOP data

```
if LREJ>EK xs , R33(M) xs , R33(W) xs , EG64 stopped
then G64 = 9 / =QREJ>EK-RQ to EAST
\ .
```

- (ii) The second Interlocking translates the route cancellation request code received over the Internal Data Link into a panel request, and the panel request checks that the timer is stopped and then releases whichever route across the boundary is set, and generates an acknowledgement code in the Internal Data Link telegram back to the first Interlocking. The timer test again ensures that this data does not over-write a route request.