# 620 – Signalling

## ATS Moving Block Berth Principle

### CRL Document Number: C620-SIC-R2-RSP-CR001-50219
Supplier Document Number: A6Z00041759097, E
Contract MDL Reference A09.079

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|  |  |  |  |  |  |

## 2a. Stakeholder Review Required?　　　YES ☐　　NO ☒

Stakeholder submission required:　　LU ☐　　RfL ☐　　Purpose of submission:　　For no objection ☐

NR ☐　　LO ☐　　For information ☐

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This document has been reviewed by the following individual for coordination, compliance, integration and acceptance and is acceptable for transmission to the above stakeholder for the above stated purpose.

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## Document History

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|---|---|---|---|---|
| 1.0 | 2017-06-22 | A | all | First version |
| 2.0 | 2018-06-12 | B | all | 1: Added a List of References<br>2, 3: Added rules and examples for Overlay areas and Handovers |
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| 4.0 | 2019-08-08 | D | all | Considered findings from off-site testing |
| 5.0 | 2020-03-13 | E | 2 | Updated Rule 39 |

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## List of References

| Ref. | Document Code | SAG Number | SRA Number | Document Title |
|------|---------------|------------|------------|----------------|
| [R01] | C620-SIC-R2-RSP-CR001-50218, Rev. 8.0 | A6Z00041759163, K | n/a | ATS COS Block Schematic |
| [R02] | C620-SIC-R2-RSP-CR001-50028, Rev. 6.0 | A6Z00035220929, F | n/a | IRS ATS-008-TRU C620/NR TRUST (CRL) |
| [R03] | C620-SIC-R2-RSP-CR001-50073, Rev. 5.0 | A6Z00036352349, E | n/a | IRS ATS-027-TDN C620/NR TD.NET (CRL) |
| [R04] | C620-SIC-R2-RSP-CR001-50025, Rev. 7.0 | A6Z00035220843, J | n/a | DIR ATS-004-AGE C620/NR ATS Data Exchange GEML (CRL) |
|  | C620-SIC-R2-RSP-CR001-50026, Rev. 6.0 | A6Z00035220873, H | n/a | DIR ATS-005-ANK C620/NR ATS Data Exchange NKL (CRL) |
|  | C620-SIC-R2-RSP-CR001-50024, Rev. 7.0 | A6Z00035220836, G | n/a | DIR ATS-003-AGW C620/NR ATS Data Exchange GWML (CRL) |
| [R05] | n/a | A6Z00045941228, - | n/a | RT/E/PS/00009, Issue 2 Specification for the preparation and implementation of train describer |
| [R06] | n/a | A6Z00045941238, - | n/a | RT/E/PS/00012 Issue 1 Message Handling and Data Transmission Requirements between Processor Based Systems |

Table 1    List of References

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# 1        Introduction

## 1.1        Purpose and Scope

The ATS has to provide to the external Systems NR ATS (GWML, GEML, NKL) (interface DIRs: [R04]) and TRUST (interface DIR: [R02]) Train movement and location messages according to the Train Describer (TD) principle (specification: [R06], [R05]). These TD messages contain so called C class messages that contain Train Stepping information related to berths. These berths are special locations that contain e.g. one train number (Head Code, Train Description) and are related to signals, routes and track sections.

This traditional berth concept must be extended for the Crossrail Train operations in the Central Operating Section (COS) as the trains here are not moving according to fixed block but to moving block principles.

Operation rules applicable for COS and NR operators have to be defined considering ATS Train Number Symbols (ATNS) on COS displays and berths on NR display.

General Hint: In special degraded scenarios it may happen that the COS Signaller on ATS has **different information** of the train position (based on ATNS) as the Signaller at neighbouring ATS (e.g. GWML IECC) (derived from TD Stepping). For example if there is a rescue operation, it can be that the COS ATS shows that two trains are in the same axle counter section, whereas on the neighbouring ATS the trains are still in two split sections. This results of the requirement to provide direction specific berths together with possible moving block operations. For more information about this, refer to examples below, e.g. in section 3.4 and 3.5.

## 1.2        Baseline

This design will be implemented first for TR2.

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## 2 Requirements & Rules

### 2.1 General rules

1. Each Axle Counter Section (AXC) has at least two Moving Block Berths (MBB), at least one for each direction. This rule is only valid for the COS, boarders are as defined in [R01].

2. Each MBB has a fixed direction

3. A MBB contains either no Headcode (HC) or one Headcode.

4. When a train steps into an AXC, the HC of this train is assigned to the last MBB (in train running direction) within this AXC.

5. If the next following MBB assigned to the same AXC is not assigned to a HC, the train will step into this MBB correspondingly. This applies until the train has reached the first MBB within one AXC that is free of a HC (this principle is according to the "Ripple Berth" principle).

6. Any train stepping related to MBBs will result in a C-class message transmitted from ATS to the corresponding external systems. This is only valid for MBBs which are governed by CRL RCC as described from rule 18 onwards.

7. When a train steps out of an AXC the HC of this train is removed from the corresponding MBB.

8. A train (HC) must step into a (next) logical berth before clearing an occupied berth

9. An AXC contains per direction at maximum a number of MBBs that corresponds to the maximum number of HC that can be within that AXC in any case (considering the length of train, length of AXC and minimum distance between two train as allowed by ATP).

10. The maximum number of MBBs per direction per AXC can be limited due to operational reasons.

11. When there are multiple MBBs assigned to an AXC and if in train running direction a MBB of an AXC in front of a train is cleared, then the HC of the train will step into that MBB that has cleared.

12. If a train changes its running direction it will step to the corresponding MBB available in the new running direction within that AXC only if no train within the corresponding AXC is in front of the train that just has reversed (related to new train running direction) that has different running direction.

13. The name of a MBB is related to the name of the next signal "(block marker)" in running direction.

14. If a train "A" reversal leads to a step to a MBB of the new running direction (e.g. eastbound) of the train "A" and if there is a train "B" behind this train "A" within the same AXC (related to the new running direction, e.g. eastbound) that has the same running direction (related to

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the new running direction, e.g. eastbound) the train "B" shall also step into the corresponding MBB of the new running direction (e.g. eastbound).

15. A train "A" with a distinct running direction (e.g. eastbound) is only allowed to step into a MBB of an AXC if there is no train "B" in any MBB of the same AXC in opposite direction (e.g. westbound).

16. If a Signaller manually deletes a HC from the ATNS, the ATS will generate a corresponding Clear out / Cancel (CB) Message. Deleting a HC from the ATNS is for a CRL Signaller only permitted for MBBs which are governed by CRL RCC as described from rule 18 onwards.

17. If a Signaller manually changes a HC from the ATNS, the ATS will generate one corresponding CB and one corresponding CC (interpose) message. Deleting a HC from the ATNS is for a CRL Signaller only permitted for MBBs which are governed by CRL RCC as described from rule 18 onwards.

## 2.2 Boundary of this Interface

18. The boundary for this Interface is defined in [R01]. Train stepping messages and delay information outside of this boundary (e. g. for Reading and Heathrow) will be derived from the TD.Net Interface (see [R03]). This is e. g. necessary for the LWOD and the SOD functionalities.

19. Train stepping messages inside of this boundary will be derived from this Interface, but not only from CRL RCC. Each MBB within the mentioned boundary is either allocated to the CRL RCC or to one of the adjacent control systems (GWLM, GEML, NKL). This separation is determined by the signalling boundaries. The impacts of this separation are described in the following rules.

## 2.3 Overlay Areas

20. Overlay areas are defined as the connections between GWML, GEML, NKL and COS. For Overlay areas there is signalling equipment from two IXL available. However, only one RCC can be responsible to determine the content of a MBB. Therefore, all MBBs are defined as Receiving (R) or Transmission (T) MBB. Receiving means, that the position information from the respective adjacent RCC shall be used and the information from CRL RCC shall be ignored. Transmitting means that the position information from CRL RCC shall be used and the information from the respective adjacent RCC shall be ignored. The assignment of the MBBs is specified in [R01]. At the boarders where MBBs change from R/T or vice versa, a Handover between the systems is necessary; refer to Rules 26-29.

21. Links within the block schematic [R01] clearly define the sequence of transmission messages between CRL RCC and the adjacent RCC's.

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## 2.4 Rules for Communication with TRUST

22. CRL RCC shall transmit data to TRUST as defined in [R02] for all Transmitting MBBs and for the COS (all MBBs in [R01] without any T/R definition).

    *Hint 1: For the COS (all MBBs in [R01] without any T/R definition), data is send only to TRUST and not to the adjacent RCC's.*

    *Hint 2: No STIN/COUT Messages as defined in the section 2.6 will be sent.*

23. No information from TRUST will be received with this Interface (therefore the TD.Net Interface is used).

## 2.5 Rules for Communication with the adjacent RCC's

24. All train stepping messages in the Transmitting Area shall be transmitted to the respective Adjacent RCC (the respective Adjacent RCC is defined in brackets at each MBB in [R01]). Exception: This rule is not valid if a berth is flagged as handover MBB; refer to Rules 26-29.

25. All train stepping messages in Receiving Area shall be received from the adjacent MBBs. Exception: This rule is not valid if a berth is flagged as handover MBB; refer to Rules 26-29.

## 2.6 Handover

26. Handovers between GWML RCC, GEML RCC, NKL RCC and CRL RCC take place at Handover MBBs, which are located at the transitions between R/T MBBs. It is allowed that the last R or the last T Berth is flagged as Handover MBB, dependent on the local situations. The assignment is defined in [R04]. The defined Handover Berths from [R04] are:

    − GEML: 415A, 0243, 417A, 0233
    − GWML: 0099, 095S, 0091, 018A, 012A, 10RA
    − NKL: X397, 0501

27. The System behaviour at Handover MBBs shall be the following: System 1 steps into the Handover MBB and System 2 steps out of it. System 1 transmits step from the previous berth into the Handover berth to System 2. System 2 transmits either the step (CA) from the Handover MBB into the next MBB or a step (CA) of the Handover MBB to the 'COUT' MBB back to System 1 if the next MBB after the Handover MBB is not flagged for transmission to System 1.

28. Trains approaching the CRL RCC area from an Adjacent controlling RCC shall be identified by messages received from the Adjacent RCC. Transmission messages shall be received from the Adjacent RCC indicating the MBB at which the train is located. After CRL RCC detects an occupation of the Handover MBB, no more transmissions from the respective adjacent RCC are sent for that train run. From there onwards CRL RCC will issue transmission messages reporting the position of the train using the MBB location. This means that as first action from CRL RCC, the movement from the handover berth to the next Transmitting

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MBB shall be transmitted to TRUST and the adjacent RCC. After that, the respective train number shall be stepped accordantly.

29. Trains departing the CRL RCC area shall be reported to the Adjacent RCC. Transmission messages shall be transmitted to the Adjacent RCC indicating the MBB at which the train is located. After CRL RCC detects, that a train run is leaving to the Handover MBB, no more transmissions from CRL RCC are sent for that train run. From there onwards the respective Adjacent RCC will issue transmission messages reporting the position of the train using MBB locations. This means that as last action from CRL RCC, the movement to the handover MBB shall be transmitted. After this telegram is sent the Adjacent RCC will transmit all further telegrams to CRL RCC and to TRUST.

## 2.7 STIN/COUT Telegrams

30. For Trains approaching the first MBB with a T/R definition of a row, a STIN telegram shall be transmitted/received to/from the adjacent RCC (STIN: see 6.2.25 in [R05]). This telegram shall cause, that a HC is shown on the respective MBB as well. Furthermore, TRUST will Transmit/Receive a normal train stepping telegram. Attention: if there is a direct change from T to R or vice versa in the same row, no STIN/COUT Messages shall be sent.

    *Row = direct connection to each other, no MBB without a T/R function in between*

    *First MBB of a row = first MBB can be in the middle of a row as well, see rule 29*

31. STIN telegrams can be sent in the middle of a row as well. This can occur for example at Stratford and Paddington, when a train (e. g. for maintenance) approaches from the overground area to the COS.

32. For Trains departing the last MBB with a T/R definition of a row, a COUT telegram shall be transmitted/received to/from the adjacent RCC (COUT: see 6.2.26 in [R05]). This telegram shall cause, that a HC is deleted from the respective MBB as well. Furthermore, TRUST will Transmit/Receive a normal train stepping telegram. Attention: if there is a direct change from T to R or vice versa in the same row, no COUT/STIN Messages shall be sent.

    *Row = direct connection to each other, no MBB without a T/R function in between*

    *Last MBB of a row = last MBB can be in the middle of a row as well, see rule 31*

33. COUT telegrams can be sent in the middle of a row as well. This can occur for example at Stratford and Paddington, when a train departs unplanned to the overground area instead of the COS (e. g. because of a defect).

## 2.8 Exceptions

34. If no telegram is received for rule 27, then the HC shall be deleted from the MBB. This action shall be executed after CRL RCC detects that the last Transmitting MBB is reported free.

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35. [Deleted.]

36. If a stepping telegram is received for the Receiving area, that is not logical connected with the actual berth of the train (=no direct link between the actual occupied MBB and the target MBB of the stepping telegram), then the HC shall be shifted nevertheless to the target berth of the received stepping information. This can occur e. g. if a single (or more) telegram(s) is(are) not received for the Receiving area due to a connection failure.

37. If a train sends a stepping telegram to an occupied MBB in the Receiving area, then the HC on that MBB shall be deleted from the MBB and the received stepping message shall be executed.

38. If one channel to an adjacent RCC fails, the operator will get an alarm about this failure.

39. If all channels to an adjacent RCC fail, no HC shall be indicated for this Receiving area. If there are already HCs shown, there shall be configurable option, that all HCs for that area will be automatically deleted. Furthermore, the operator will get an alarm about this failure.

40. If no telegram is received for rule 28, then the system shall use the first received train stepping message to show the HC on the respective target MBB.


## 2.9     MBB Names

41. The internal naming in CRL ATS system is sometimes different compared to the naming which is expected by GEML/GWML/NKL. This approach was implemented to have unique names inside CRL ATS system. The matching table can be found in [R01].

42. Internally, CRL ATS shall use the internal naming.

   If transmitting messages, CRL ATS shall use the expected naming from GEML/GWML/NKL.

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# 3 Examples

This section explains the principle based on special scenarios.

The following excerpt of the Scheme Plan applies:
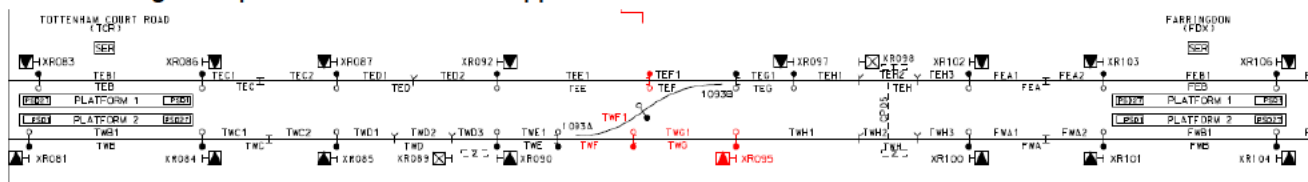


Figure 1    Excerpt from Scheme Plan

The following figure shows the berths related to that section:
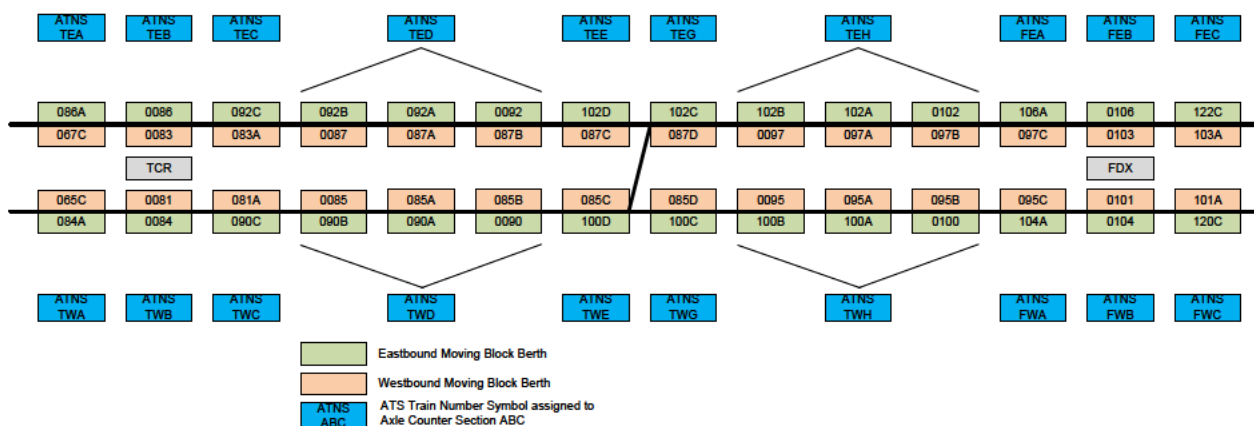


Figure 2    Excerpt Moving Block Berths

The following table assigns the MBB to AXCs, the maximum number of MBBs per direction is set to 3:

Train length: 205 m, minimum distance between two trains (might be more due to uncertainty, last read in balise) is 15m: in sum 220m.

| AXC | Chainage | Length (m) | Max. HC | ATNS | Resulting MBBs | Direction | Notes |
|---|---|---|---|---|---|---|---|
| TEB | 4788.79 – 5003.52 | 214 | 1 | 1 | 0086 0083 | Eastbound Westbound | Station |
| TEC | 5003.52 – 5073.52 | 70 | 1 | 1 | 092C 083A | Eastbound Westbound | |

| AXC | Chainage | Length (m) | Max. HC | ATNS | Resulting MBBs | Direction | Notes |
|---|---|---|---|---|---|---|---|
| TED | 5073.52 – 5936.0 | 862.48 | 4 | 1 | 0092,092A,B<br>0087,087A,B | Eastbound<br>Westbound | |
| TEE | 5936.0 – 5971.0 | 35 | 1 | 1 | 102D<br>087C | Eastbound<br>Westbound | |
| TEF | 5971 – 6057.61 | 86.61 | 1 | - | - | | Point |
| TEG | 6057.61 – 6092.61 | 35 | 1 | 1 | 102C<br>087D | Eastbound<br>Westbound | |
| TEH | 6092.61 – 6932.39 | 839.78 | 4 | 1 | 0102,A,B<br>0097,097A,B | Eastbound<br>Westbound | |
| FEA | 6932.39 – 7002.39 | 70 | 1 | 1 | 106A<br>097C | Eastbound<br>Westbound | |
| FEB | 7002.39 – 7217.12 | 214.73 | 1 | 1 | 0106<br>0103 | Eastbound<br>Westbound | Station |
| TWB | | | 1 | 1 | 0081<br>084 | Westbound<br>Eastbound | Station |
| TWC | | | 1 | 1 | 081A<br>00C | Westbound<br>Eastbound | |
| TWD | | | 4 | 1 | 0085,085A,B<br>0090,090A,B | Westbound<br>Eastbound | |
| TWE | | | 1 | 1 | 085C<br>100D | Westbound<br>Eastbound | |
| TWF | | | 1 | - | - | | Point |
| TWG | | | 1 | 1 | 085D<br>100C | Westbound<br>Eastbound | |
| TWH | | | 4 | 1 | 0095,095A,B<br>0100,100A,B | Westbound<br>Eastbound | |
| FWA | | | 1 | 1 | 095C<br>104A | Westbound<br>Eastbound | |
| FWB | | | 1 | 1 | 0101<br>0104 | Westbound<br>Eastbound | Station |

Table 2    MBB Configuration Example

## 3.1 Example 1: Zorro Move

Train (HC 1A23) starts eastbound from Tottenham Court Road Platform 1 up to XR098 and re-verses (new HC 1B34) via the point 1093 to the XR089 and then again reverses (new HC 2A23) to continue eastbound on the westbound track to Farringdon Platform 2. Hint: XR098 and XR089 are no Route Marker Boards, but Reversal Marker Boards.

Assumption: no further train is during this Zorro Move Operation between TCR and FDX.

ATS will transmit the following TD messages:

```
CA 0086 092C 1A23
CA 092C 092B 1A23
CA 092B 092A 1A23
CA 092A 0092 1A23
CA 0092 102D 1A23
CA 102D 102C 1A23
CA 102C 102B 1A23
CA 102B 102A 1A23
CA 102A 0102 1A23
CB 0102 1A23           (train changes HC)
CC 0102 1B34
CA 0102 097B 1B34      (train continues in reverse direction)
CA 097B 097A 1B34
CA 097A 0097 1B34
CA 0097 087D 1B34
CA 087D 085C 1B34
CA 085C 085B 1B34
CA 085B 085A 1B34
CA 085A 0085 1B34
CB 0085 1B34           (train changes HC)
CC 0085 2A23
CA 0085 090B 2A23
CA 090B 090A 2A23
CA 090A 0090 2A23
CA 0090 100D 2A23
CA 100D 100C 2A23
CA 100C 100B 2A23
CA 100B 100A 2A23
CA 100A 0100 2A23
CA 0100 104A 2A23
CA 104A 0104 2A23
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## 3.2 Example 2: Two Eastbound Trains in Ripple Berth, both reversing, but East Train first



Figure 3      Example 2 Sequence

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## 3.3 Example 3: One Eastbound Train and one Westbound Train entering Ripple Berth, then Eastbound reverses



Figure 4    Example 3 Sequence

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## 3.4 Example 4: Rescue Operation -1

This example is a visualisation for rules 15 – 17.

1. Starting point

2. 1A23 approaches to the last free axle counter section and stepping messages are sent until the last free MBB of that section is reached.

3. 1A45 approaches to the axle counter section of train 1A23 as well. In this case no TD stepping occurs (rule 15.)

4. Both trains are standing in front of each other and will be combined.

5. After the trains are mechanically combined HC 1A45 is deleted from the MBB (rule 16) and the overall HC is changed to 2B45 as well (rule 17.)

6. 2B45 departs as usual.

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**Berth Stepping Sequence**

**Physical train locations**

Berth 0014

1A23

1A45

1A45

Berth 0015

XR015

No change according to rule 15 of MBB prinicple

In this case no TD Stepping occurs

1A23

1A45

1A23

1A45

1A23

1A45

1A23

1A45

1. Signaller deletes 1A45
→ CB 0015 1A45      **Rule 16**

2. Signaller changes HC 1A23 to 2B45
→ CB 0014 1A23
→ CC 0014 2B45      **Rule 17**

2B45

2B45

2B45

2B45

Figure 5     Example 4 Sequence

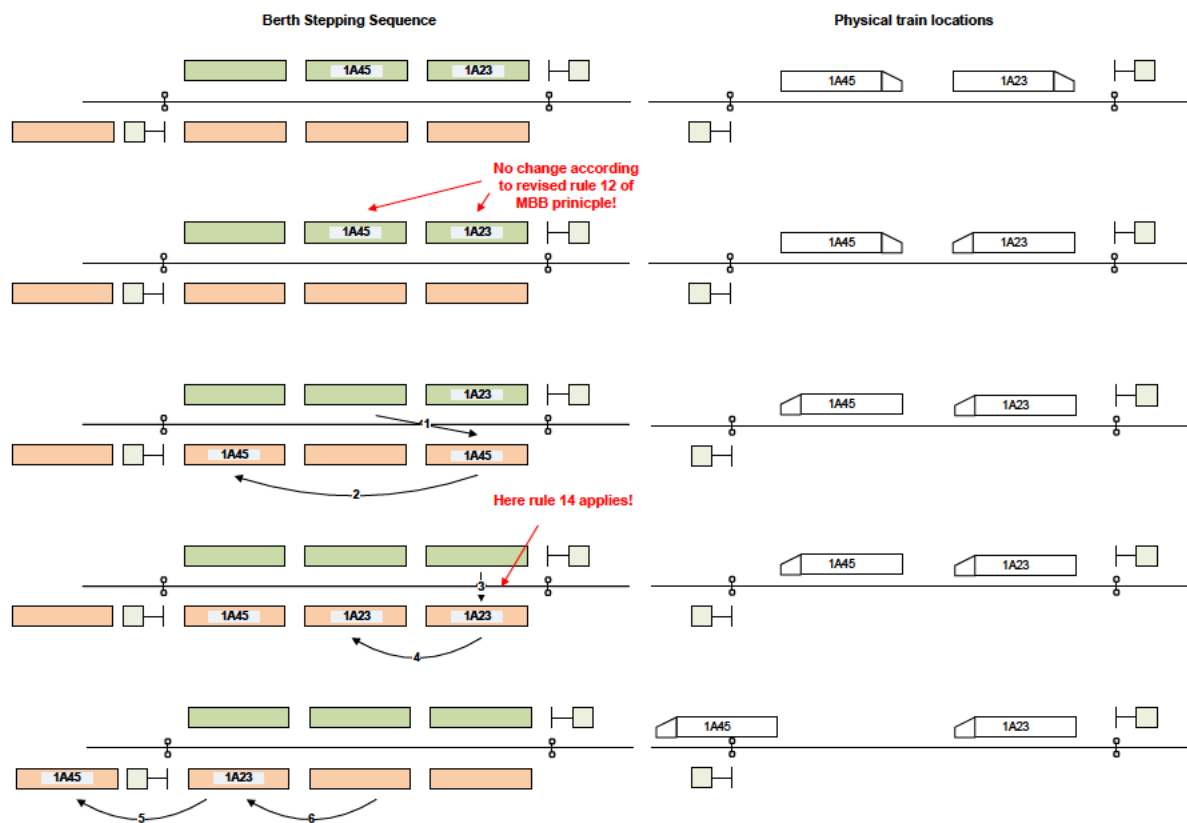| Project Crossrail – Contract C620 | Contract MDL Reference: A09.079 |
|---|---|
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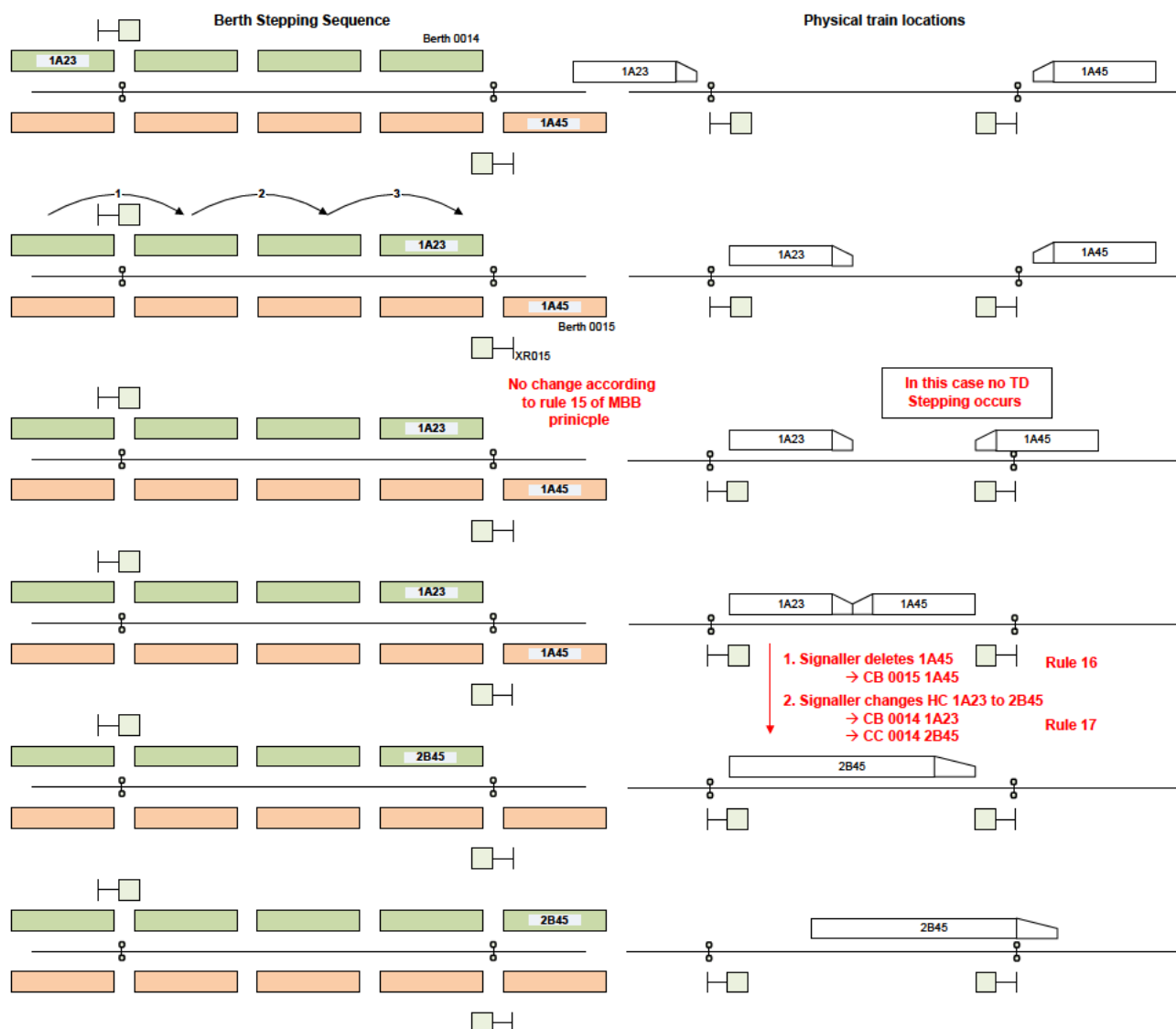## 3.5 Example 5: Rescue Operation -2

This example is a visualisation for rules 15 – 17.

1. Starting point

2. 1A23 approaches to the last free axle counter section and stepping messages are sent until the last free MBB of that section is reached.

3. 1A45 approaches to the axle counter section of train 1A23 as well. In this case no TD stepping occurs (rule 15).

4. Both trains are standing in front of each other and will be combined.

5. After the trains are mechanically combined HC 1A23 is deleted from the MBB (rule 16) and the overall HC is changed to 2B45 as well (rule 17.) Compared to the example in section 3.4, the HC is now part of a different MBB and against travel direction.

6. With the next stepping, 2B45 is shifted to the MBB which is in travel direction.

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**Berth Stepping Sequence**      **Physical train locations**

Berth 0014

Berth 0015

XR015

No change according to rule 15 of MBB prinicple

In this case no TD Stepping occurs

1. Signaller deletes 1A23
   → CB 0014 1A23    **Rule 16**

2. Signaller changes HC 1A45 to 2B45
   → CB 0015 1A45
   → CC 0015 2B45    **Rule 17**

Figure 6     Example 5 Sequence

| | |
|---|---|
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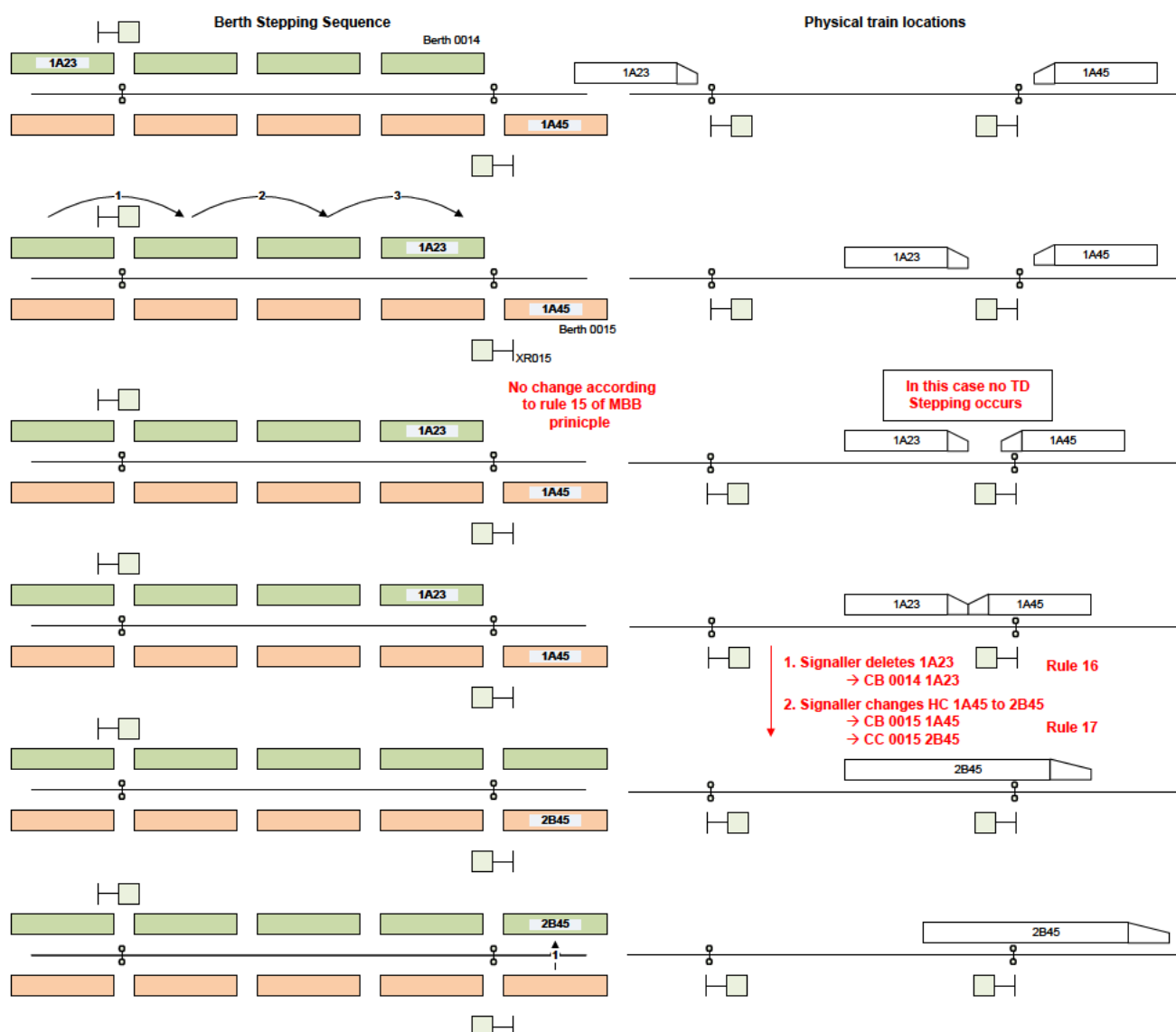## 3.6 Example 6: Block Schematic

The following figure shows exemplarily how the Block Schematic looks like for an excerpt of the above topology according to the MBB principle:
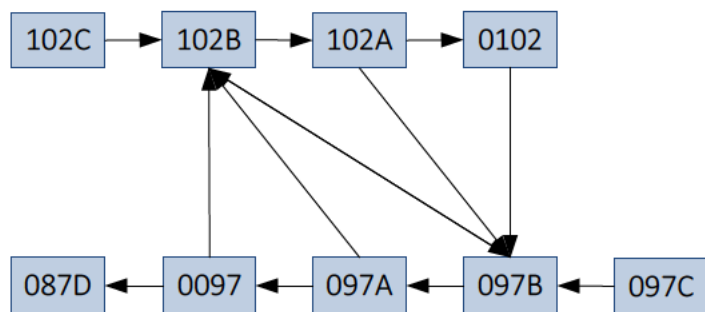


Figure 7     Example Block Schematic

## 3.7 Example 7: Overlay Areas

The following train movement telegrams show exemplarily, how the communication between the RCC's shall happen. The examples are split, based on the three existing Overlay areas: NKL, GEML and GWML.

Hint: in this example the internal berth numbers from the CRL ATS system are used.

Scenario North Kent Line

Leaving the area:

```
CA STIN 0398 HC  -> Message from CRL RCC (Rules 24, 30)
CA 0398 602A HC  -> Message from CRL RCC (Rule 24)
CA 602A 0602 HC  -> Message from CRL RCC (Rule 24)
CA 0602 501B HC  -> Message from CRL RCC (Rule 24)
CA 501B 501A HC  -> Message from CRL RCC (Rule 24)
CA 501A 501N HC  -> Message from CRL RCC (Rule 24)
CA 501N COUT HC  -> Message from CRL RCC (Rules 24, 32)
```

(There are no messages received from NKL RCC as HC leaves the CRL area of control)

one row

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Entering the CRL area:

```
CA STIN N120 HC  -> Message from NKL RCC (Rules 25, 30, 26, 27)
CA N120 397A HC  -> Message from CRL RCC (Rules 24, 26, 27)
CA 397A 0397 HC  -> Message from CRL RCC (Rule 24)
CA 0397 395A HC  -> Message from CRL RCC (Rule 24)
CA 395A 0395 HC  -> Message from CRL RCC (Rule 24)
CA 0395 391A HC  -> Message from CRL RCC (Rule 24)
CA 391A 0391 HC  -> Message from CRL RCC (Rule 24)
CA 0391 COUT HC  -> Message from CRL RCC (Rules 24, 32)
```

one row

Scenario Great Eastern Main Line

Leaving area on east bound:

```
CA STIN 202C HC  -> First Message from CRL RCC (Rules 24, 30)
CA 202C 202B HC  -> Message from CRL RCC (Rule 24)
..
..
CA 233A 0233 HC  -> Message from CRL RCC (Rules 24, 26, 27)
CA 0233 0257 HC  -> Message from GEML RCC (Rules 25, 26, 27)
CA 0257 0267 HC  -> Message from GEML RCC (Rule 25)
..
..
CA 0287 0293 HC  -> Message from GEML RCC (Rule 25)
CA 0293 COUT HC  -> Message from GEML RCC (Rules 25, 32)
```

one row

Entering area on east bound:

```
CA STIN 0308 HC  -> Message from GEML RCC (Rules 25, 30)
CA 0308 0294 HC  -> Message from GEML RCC (Rule 25)
CA 0294 0266 HC  -> Message from GEML RCC (Rule 25)
CA 0266 0238 HC  -> Message from GEML RCC (Rule 25)
CA 0238 417A HC  -> Message from GEML RCC (Rules 25, 26, 27)
CA 417A 0417 HC  -> Message from CRL RCC (Rules 24, 26, 27)
..
..
CA 143A COUT HC  -> Message from CRL RCC (Rules 24, 32)
```

one row

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Entering area on east bound but departing at Pudding Mil Lane Portal:

```
CA STIN 0308 HC -> Message from GEML RCC (Rules 25, 30)

CA 0308 0294 HC -> Message from GEML RCC (Rule 25)

CA 0294 0266 HC -> Message from GEML RCC (Rule 25)

CA 0266 0238 HC -> Message from GEML RCC (Rule 25)

CA 0238 COUT HC -> Message from GEML RCC (Rules 25, 33)
```

one row

Scenario Great Western Main Line

Entering area on east bound:

```
CA STIN S144 HC -> Message from GWML RCC (Rule 25, 30)

..

..

CA 0112 S092 HC -> Message from GWML RCC (Rule 25)

CA S092 018A HC -> Message from GWML RCC (Rules 25, 26, 27)

CA 018A 0018 HC -> Message from CRL RCC (Rules 24, 26, 27)

..

..

CA 0086 092C HC -> Message from CRL RCC (Rule 24)

CA 092C COUT HC -> Message from CRL RCC (Rule 24, 32)
```

one row

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Leaving area on east bound:

`CA STIN 083A HC` -> Message from CRL RCC (Rule 24, 30)

`CA 083A 0083 HC` -> Message from CRL RCC (Rule 24)

`..`

`..`

`CA 017A 0017 HC` -> Message from CRL RCC (Rule 24)

`CA 0017 0099 HC` -> Message from CRL RCC (Rules 24, 26, 27)

`CA 0099 0115 HC` -> Message from GWML RCC (Rules 25, 26, 27)

`CA 0115 COUT HC` -> Message from GWML RCC (Rule 25, 32)

one row

## 3.8 Example 8: Handovers

In addition to example 7, the handovers between GWML and CRL RCC were cross checked by Resonate. The result is as defined in the rules above. STIN/COUT messages are not listed in this section.

Entering area on east bound:

`CA 0112 S092 HC` -> Message from GWML RCC

`CA S092 018A HC` -> Message from GWML RCC

`CA 018A 0018 HC` -> Message from CRL RCC

Entering area east bound on Turnback A:

`CA 0110 S090 HC` -> Message from GWML RCC

`CA S090 012A HC` -> Message from GWML RCC

`CA 012A 0012 HC` -> Message from CRL RCC

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Entering area east bound on Westbound:

`CA 0110 S090 HC` -> Message from GWML RCC

`CA S090 10RA HC` -> Message from GWML RCC

`CA 10RA 010R HC` -> Message from CRL RCC


Leaving area west bound on Eastbound:

`CA 017A 0017 HC` -> Message from CRL RCC

`CA 0017 0099 HC` -> Message from CRL RCC

`CA 0099 0115 HC` -> Message from GWML RCC


Leaving area west bound on Westbound:

`CA 009A 0009 HC` -> Message from CRL RCC

`CA 0009 0091 HC` -> Message from CRL RCC

`CA 0091 0111 HC` -> Message from GWML RCC


Turn-back on Turnback A from CRL side of the fringe - not a train that is fully traversing the fringe CRL to NR on Turnback A:

`CA 009C 0011 HC` -> Message from CRL RCC

`CA 0011 095S HC` -> Message from CRL RCC

`CA 095S 012A HC` -> Message from CRL RCC


Train fully traversing the fringe CRL to NR on Turnback A:

`CA 009C 0011 HC` -> message from CRL RCC

`CA 0011 095S HC` -> message from CRL RCC

`CA 095S 0115 HC` -> message from GWML RCC

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Train turning back on Turnback A from NR side of fringe:

`CA S090 012A HC` -> message from GWML RCC

`CA 012A 0012 HC` -> message from CRL RCC

`CA 0012 0011 HC` -> message from CRL RCC

`CA 0011 095S HC` -> message from CRL RCC

`CA 095S 0115 HC` -> message from GWML RCC

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