

Global reach, local knowledge.  
Local focus. Worldwide strength. Multi-sector  
experience. Multi-disciplinary expertise.  
Faber Maunsell offers this all – delivering  
outstanding solutions that help to create  
a better world in which to work and live.

**Capacity Charge Tariff PR2008**

Recalculating the Capacity Charge Tariff for PR2008

Network Rail  
October 2007

Prepared by: .....  
Helen Page  
Principal Consultant

Approved by: .....  
Jane Cornthwaite  
Associate Director

#### Capacity Charge Tariff PR2008

Rev No	Comments	Date
1	Early draft	4/10/07
2	Report based on the draft tariff as at 18/10/07	18/10/07
3	Version suitable for publication – based on draft tariff as at 18/10/07	25/10/07

Marlborough House, Upper Marlborough Road, St Albans, Hertfordshire, AL1 3UT  
Telephone: 020 8784 5784 Fax: 020 8784 5700 Website: <http://www.fabermaunsell.com>

Job No T53783

Capacity Charge Tariff PR2008

Date Created October 2007

This contains confidential and commercially sensitive information, which shall not be disclosed to third parties.

# Table of Contents

<b>1</b>	<b>Overview .....</b>	<b>2</b>
	1.1 Background.....	2
	1.2 Principles of the Capacity Charge .....	2
	1.3 The Capacity Charge prior to PR2008 .....	3
	1.4 Scope of the PR2008 Capacity Charge review .....	4
<b>2</b>	<b>Process Map .....</b>	<b>6</b>
<b>3</b>	<b>Update Raw Tariff.....</b>	<b>7</b>
	3.1 Geographic Dimension .....	7
	3.2 Temporal Dimension.....	7
	3.3 Source Data for PR2008 Tariff .....	8
<b>4</b>	<b>Summary of the Raw Tariff Methodology .....</b>	<b>9</b>
	4.1 Calculate increase in CUI .....	9
	4.2 CUI : CRRD Relationship .....	9
	4.3 Calculate increase in CRRD .....	10
	4.4 Calculate cost to Network Rail of increase .....	10
<b>5</b>	<b>Details of Raw Tariff Methodology .....</b>	<b>11</b>
	5.1 Calculate increase in CUI .....	11
	5.2 CUI : CRRD Relationship .....	12
	5.3 Calculate increase in CRRD .....	14
	5.4 Calculate cost to Network Rail of increase .....	15
<b>6</b>	<b>Raw Tariff to Final Tariff .....</b>	<b>17</b>
	6.1 Geographic Dimension .....	17
	6.2 Temporal Dimension.....	18
	6.3 Tariff for the ICM.....	18
<b>7</b>	<b>Updated CUI:CRRD Relationship .....</b>	<b>20</b>



# 1 Overview

## 1.1 Background

In 2000 the Rail Regulator undertook a full review of (then) Railtrack's track access charges. At this time the Regulator proposed changes to the various elements of the charges, and introduced a new component known as the Capacity Charge. This meant that the track access charges now have five elements:

- Fixed charge
- Supplemental charges (Schedule 4 & Schedule 8)
- Usage charge
- Traction electricity charge
- Capacity charge

The result of these changes was to increase the variable element from around 8% to 20% of aggregate track access charges for passenger franchise operators.

The purpose of the Capacity Charge was to compensate Railtrack for the increased congestion costs arising from incremental traffic. In October 2001 ORR's conclusions on freight charging policy determined that freight operators should be subject to a similar charge because the same increase in Network Rail's costs arise. For freight services other than Royal Mail, charges were set at 90% of passenger rates, recognising the higher degree of flexibility in freight operations.

When the Capacity Charge was originally implemented, in the case of franchised operators, the congestion costs of the existing level of traffic in 1999/2000 were implicitly covered by the fixed track charge. These were represented by a term known as the CC term (also referred to as the Capacity Charge offset), which was netted off against the Capacity Charge. Thus franchised operators were only required to pay separately for the incremental traffic since 1999/2000 with the remainder being included in their fixed charges. This was designed to avoid unnecessary risk associated with the introduction of the new charge.

## 1.2 Principles of the Capacity Charge

Network Rail's objectives for the Capacity Charge Tariff were that:

- it should enable Network Rail to recover the costs of congestion that result in higher than expected performance regime payments;
- it should be as cost-reflective as practicable to enable the full recovery of these congestion costs from incremental changes in services;
- it should provide appropriate incentives for efficient network use in terms of both geographical location and time of day;
- it should provide clear information to users on the make-up of the charge and should not impose undue transaction costs in order to understand how the regime works;
- it should not unduly discriminate between users of the network; and
- it should allow funders to make decisions about service levels.

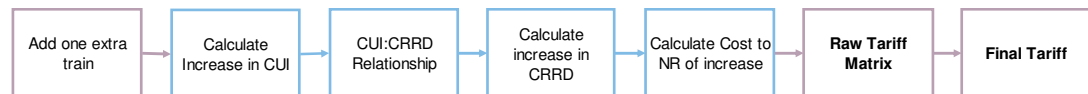
When a train operator increases their service volume, the amount of delay on the network goes up more-than-linearly, as there will be a greater propensity for trains to knock-on and exacerbate the effect of an incident. Network Rail's ability to recover from an incident is reduced, and the probability of delays arising from an incident is increased. These both contribute to an increase in Network Rail's expected costs under Schedule 8.

The first objective of the Capacity Charge is to compensate Network Rail for these extra congestion costs, and the second objective is to do this in a cost-reflective manner as possible. These requirements would tend towards a complex tariff with a high degree of granularity. However, the objectives about providing appropriate incentives and clear information to operators work in the opposite direction - tending to towards a simple matrix of charges that is transparent and easily understood. Thus the tariff needs to reflect a suitable balance between these requirements.

### 1.3 The Capacity Charge prior to PR2008

The calculation of the original tariff was undertaken by Network Rail's consultants, DeltaRail (then AEA Technology) and was independently reviewed by the ORR's consultants Symonds.

The tariff was based on a set of relationships to predict extra congestion-related delay from Capacity Utilisation Indices (CUIs). More detail of the calculation process is found in Section 4 (Summary of the Raw Tariff Methodology), but an outline is given below:



1. The tariff is an estimate of the increased costs to Network Rail from an operator running an extra train on each geographic section and timeband.
2. For an extra train, there is an increase in the Capacity Utilisation Index (CUI) – a measure of how full the infrastructure is.
3. A set of relationships are found between CUI and Congestion Related Reactionary Delay (CRRD).
4. Using these relationships, the increase in delay as a result of the extra train is estimated.
5. The cost of this extra delay under Schedule 8 is found.
6. This produces a “Raw Tariff” matrix, which estimates the costs as accurately as possible.
7. The raw tariff is aggregated to a suitable level of detail that maintains the balance between conflicting objectives (cost-reflectivity vs. simplicity).

The outcome of the Capacity Charge consultation process was the industry acceptance of a final tariff which varied by about 3000 geographic sections and 13 timebands. However, due to a number of implementation issues related to billing, simplified arrangements were developed for both passenger and freight services, based on an average rate per service group. The simplified arrangements were formally introduced as part of the 2003 Access Charges Review.

#### **1.4 Scope of the PR2008 Capacity Charge review**

The calculation methodology and basic principles of the Capacity Charge are unchanged for the current periodic review (PR2008) re-calculation. The purpose of this review is:

1. To remove the CC term from the fixed charge, and to make the overall charge more transparent. The removal of the CC term does not affect the way that the tariff is calculated, it only has an impact on the way that it is billed.
2. To update the raw tariff with new data and underlying relationships.
3. To review the aggregation from the raw tariff to the final tariff. The aim is to remove the simplification to a tariff per service group (arising from limitations in the billing process), and to replace the final tariff with a version that varies by geography and time of day as originally intended.

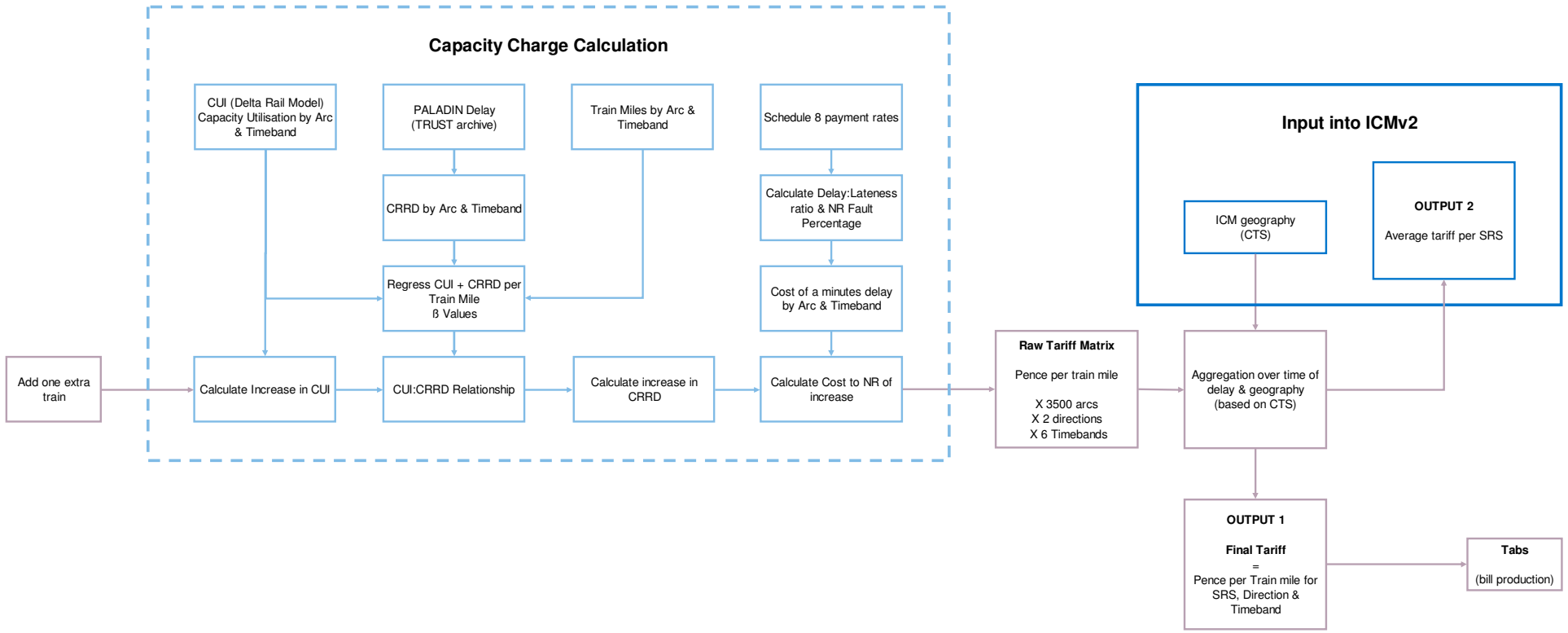
This rest of this report covers:

- The update of the raw tariff with new data
- The review of the aggregation from raw tariff to final tariff
- The results of the updated relationships



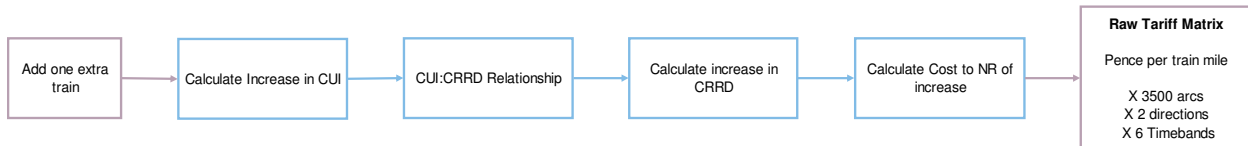
# 2 Process Map

## Capacity Charge Process Map



## 3 Update Raw Tariff

The first stage of the PR2008 Capacity Charge review is to update the raw tariff with new data, whilst leaving the methodology unchanged. The calculation process is summarised in the flowchart below, but more detail is found in Section 4 (Summary of the Raw Tariff Methodology).



### 3.1 Geographic Dimension

The raw tariff for PR2008 is calculated on the December 2006 version of DeltaRail's National Infrastructure Database (NID). This is a Tiploc to Tiploc definition of the network, consisting of about 6,000 geographic sections or arcs. These arcs are directional, so Tiploc A to Tiploc B is considered separately from Tiploc B to Tiploc A. This very detailed geographic definition is used for the raw tariff matrix, in order to retain a high degree of cost reflectivity.

### 3.2 Temporal Dimension

For the original tariff, the week was divided into 13 timebands, but for the PR2008 tariff the raw tariff is based on 6 timebands. Since the final tariff was unlikely to require such a detailed time definition, calculating the raw tariff on a smaller number of timebands saves on data volumes and makes it more transparent.

Pre PR2008 Timeband	PR2008 Timeband
A Weekday 00:00 – 05:00	C Weekday 06:00 – 09:30 D Weekday 09:30 – 16:30 E Weekday 16:30 – 19:30  N Weekday 00:00 – 06:30 & 19:30 – 24:00
B Weekday 05:00 – 06:30	
C Weekday 06:00 – 09:30	
D Weekday 09:30 – 16:30	
E Weekday 16:30 – 19:30	
F Weekday 19:30 – 21:00	
G Weekday 21:00 – 24:00	
H Saturday 00:00 – 05:00	J Saturday 08:00 – 18:00
I Saturday 05:00 – 08:00	
K Saturday 18:00 – 24:00	
L Sunday 00:00 – 09:00	M Sunday 09:00 – 24:00
M Sunday 09:00 – 24:00	

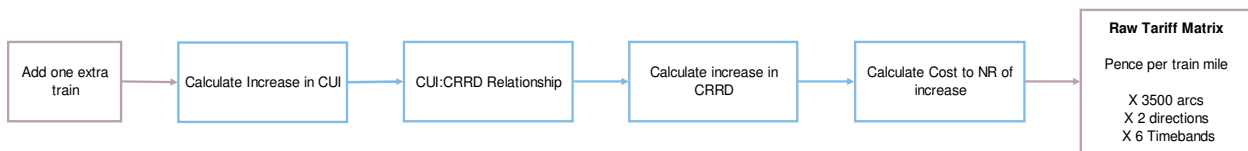
The tariffs for timebands J and M will be applied to the whole of Saturday and Sunday respectively.

### 3.3 Source Data for PR2008 Tariff

- CUIs are based on the December 2006 timetable.
- Congestion Related Reactionary Delay (CRRD) is taken from PALADIN (an archive of TRUST) for financial year 2006/07.
- Traffic volumes are taken from DeltaRails' ACTRAFF system for financial year 2006/07. This is a databank of historic train information, sourced from BIFS (Billing Infrastructure for Freight) – another TRUST archive.
- Mileages are taken from DeltaRail's National Infrastructure Database (NID).
- Schedule 8 lateness is taken from PEARS data (the Schedule 8 billing system) for financial year 2006/07.
- For passenger operators, Schedule 8 payment rates are generally taken from PEARS Reference Data for 2006/07 period 10 and are at 2006/07 RPI. The exceptions to this are payment rates for the service groups involved in the Cross Country/East Midlands/West Midlands re-franchises. These payment rates are taken from DeltaRail's Schedule 8 recalibration.
- For freight operators, payment rates are the Network Rail rates from the Schedule 8 freight regimes as at June 2006, at 2006/07 RPI

# 4 Summary of the Raw Tariff Methodology

This section summarises the methodology for calculating the raw tariff. A more detailed version is supplied in Section 5 (Details of Raw Tariff Methodology).



## 4.1 Calculate increase in CUI

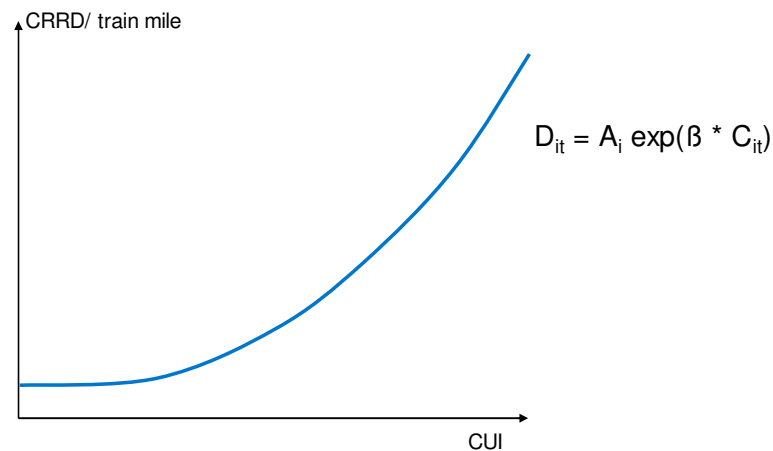
The tariff needs to reflect the cost of the extra delay incurred as a result of a train operator running a marginal train. The Capacity Utilisation Index (CUI) measure provides a way of estimating the impact of an extra train that is independent of the operator.

The index is a measure of how “full” the infrastructure is for a given timetable. The tariff calculation assumes that for an extra train the CUI will increase linearly, so the impact is that of an “average” train.

## 4.2 CUI : CRRD Relationship

A set of relationships are derived between CUI and Congestion Related Reactionary Delay (CRRD) per train mile. This subset of delay is the portion that will increase more-than-linearly with an increase in traffic.

The rail network has been divided into about 6000 geographic sections, each of which belongs to one of 24 routes. The week has also been divided into six different timebands. For each geographic section and timeband there is a relationship of the following form:



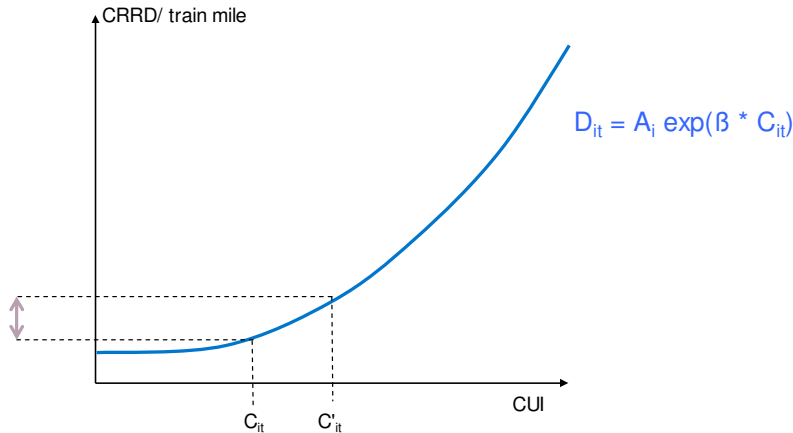
Where

- $D_{it}$  = CRRD per train mile on geographic section  $i$  and timeband  $t$
- $C_{it}$  = CUI for geographic section  $i$  and timeband  $t$
- $A_i$  = constant term for geographic section  $i$
- $\beta$  = constant term for the route which the geographic section belongs to

For a summary of the  $\beta$  values see Section 7 (Updated CUI:CRRD Relationship).

### 4.3 Calculate increase in CRRD

Having derived a set of relationships to predict CRRD per train mile from CUI, it is possible to calculate the expected increase in CRRD as a result of adding an extra train to each section/timeband.



This is given by the formula

$$\Delta D_{it} = A_i \exp(\beta * C'_{it}) - A_i \exp(\beta * C_{it})$$

Where

- $\Delta D_{it}$  = increase in CRRD per train mile on geographic section i and timeband t
- $A_i$  = constant term for the geographic section i
- $\beta$  = constant term for the route which the geographic section belongs to
- $C_{it}$  = CUI for geographic section i and timeband t
- $C'_{it}$  = CUI for geographic section i and timeband t, increased by one train

### 4.4 Calculate cost to Network Rail of increase

The increase in delay now needs converting into a Schedule 8 cost. A set of ratios are applied to convert 1 minute of delay to x minutes of Schedule 8 lateness, which can then be valued at the Network Rail Schedule 8 payment rate.

Schedule 8 payments apply at a service group level, so to get a payment rate for each geographic section and timeband, an average of the payment rates for the service groups on that section/timeband is used, weighted by the historic delay on each service group.

Finally, a set of factors are applied to scale the cost down to the portion of delay that Network Rail are directly responsible for.

So the final tariff is given by the formula:

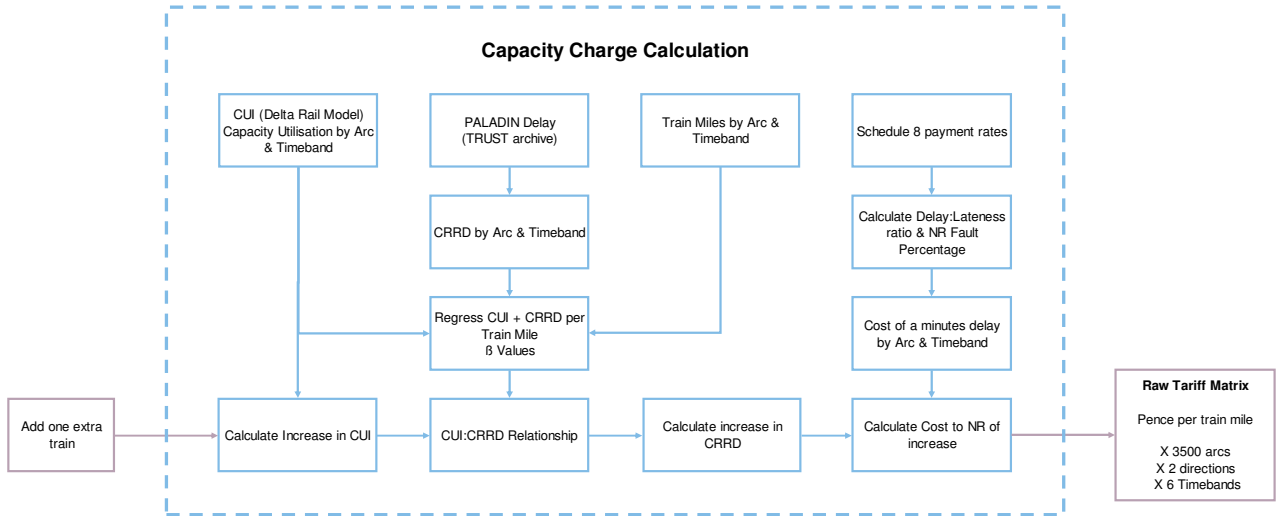
$$T_{it} = \Delta D_{it} * N_{it} * PR_{it} * F_{it}$$

Where

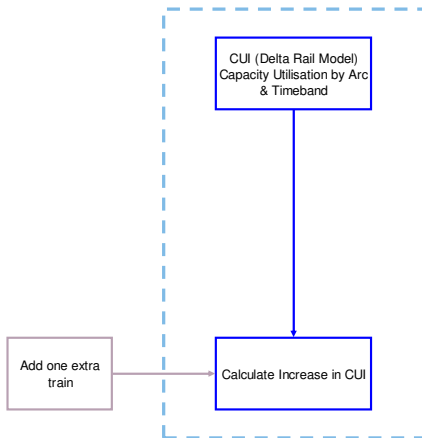
- $T_{it}$  = tariff per mile for geographic section i and timeband t
- $\Delta D_{it}$  = increase in CRRD per train mile on geographic section i and timeband t
- $N_{it}$  = number of trains on geographic section i and timeband t
- $PR_{it}$  = average cost of a minutes delay on geographic section i and timeband t
- $F_{it}$  = Network Rail fault percentage on geographic section i and timeband t

# 5 Details of Raw Tariff Methodology

The process diagram for calculating the raw capacity charge tariff is show below:



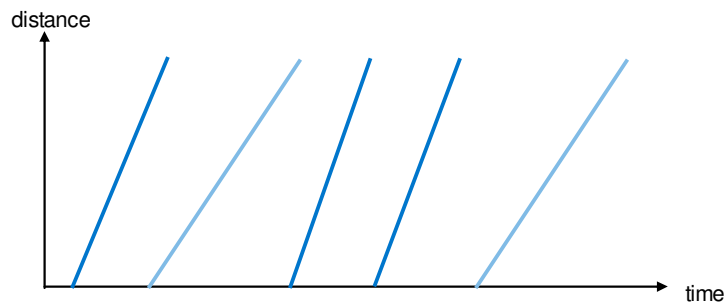
## 5.1 Calculate increase in CUI



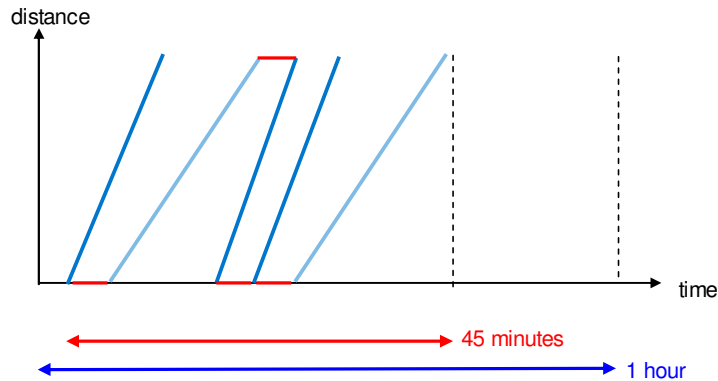
The tariff needs to reflect the cost the extra delay incurred as a result of a train operator running a marginal train. Ideally this should not be operator-specific, as two operators who want to run the same service should be charged the same tariff. The Capacity Utilisation Index (CUI) measure provides a way of estimating the impact of an extra train that is independent of the operator.

The CUI calculation is a model owned by DeltaRail, which gives a measure of how “full” the infrastructure is for a given timetable. The basic principle on which the calculation works is illustrated below:

Take a train graph:



And retaining the order and speed mix of trains, “squash up” the train graph - running them as close to one as possible, with only a headway separation between them:

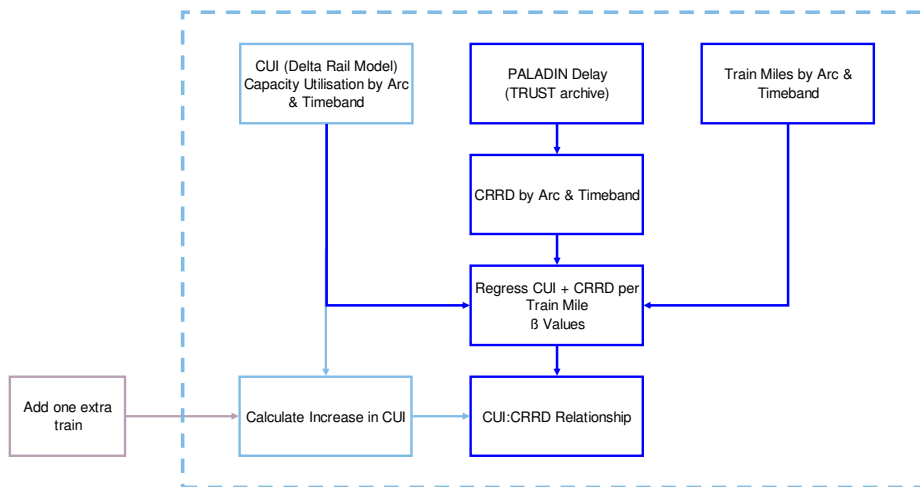


The Capacity Utilisation Index is the time that the trains could be run in, divided by the time that they actually run in – so in the example above = 45 minutes / 1 hour = 75%.

The methodology behind the CUIs is unchanged since the Capacity Charge was originally set. For the PR2008 tariff, the CUIs were re-calculated based on the December 2006 timetable. To take account of variations in traffic volumes, the calculation is repeated for 4 sample days of traffic, and the results are averaged.

The tariff calculation assumes that for an extra train the CUI will increase linearly, so the impact is that of an “average” train. Although the CUI measure is not necessarily linear to the number of trains, this assumption is reasonable for a marginal increase.

## 5.2 CUI : CRRD Relationship



The capacity charge seeks to compensate Network Rail for the cost of increased delays arising when operators run extra services. Having calculated the impact on CUI of an extra train, the next step is to derive a relationship between CUI and delay, in order to find the impact of the extra train on delay.

The first stage in deriving this relationship is to map both the CUIs and historic delay to the same geography/timeband definition, and the second stage is to derive a relationship between them.

### Part 1 – Mapping data to a consistent geography/timeband definition

As with the original tariff, for a consistent geographic definition we have used DeltaRail's National Infrastructure Database (NID). For the original tariff, the week was divided into 13 timebands, but for the PR2008 tariff the raw tariff was produced on 6 timebands.

There are three sets of data that must be mapped to the same set of arcs/timebands:

- CUIs – these are calculated directly on the NID.
- Delay – historic delay is recorded in TRUST and archived in PALADIN. DeltaRail owns a process to map this delay to the NID.
- Train Miles – these are taken from DeltaRail's ACTRAFF system. The source data is BIFS (Billing Infrastructure for Freights System) which is also a TRUST archive. This ensures that the train miles is what historically ran, and includes all short term and very short term workings.

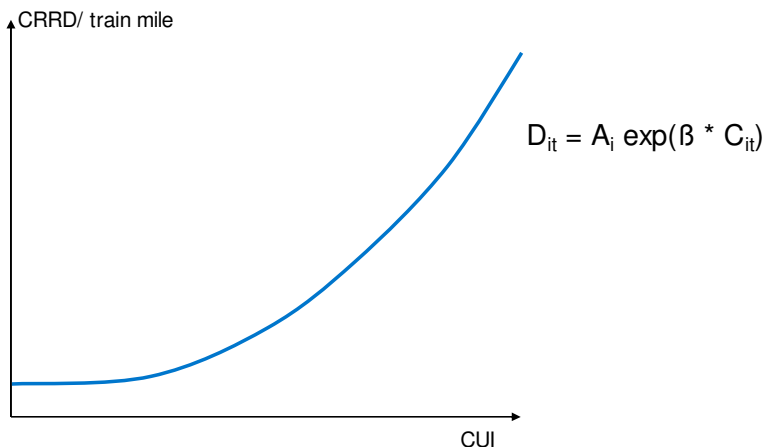
### Part 2 – deriving a relationship between CUI and delay

For PR2008 the form and structure of the relationship between CUI and delay was not reviewed. The relationships were simply updated based on more recent data.

It has been shown that there is a relationship between CUI and Congestion Related Reactionary Delay (CRRD) per train mile. This subset of delay is the portion that would be expected to increase more-than-linearly with an increase in traffic. It is defined as any delay attributed in TRUST to the following set of codes

Code	Description
YA	Lost path – regulated for train running on time.
YB	Lost path – regulated for another late running train.
YC	Lost path – following train running on time.
YD	Lost path – following another late running train.
YE	Lost path – waiting acceptance to single line.
YF	Waiting for late running train off single line.
YG	Regulated for late running high priority train.
YO	Waiting due to platform/station congestion or platform change.

Each NID arc has been assigned to one of 24 routes. There is a separate regression calculation for each of the 24 routes, and for every NID arc within the route a separate curve is fitted of the following form:



Where

- $D_{it}$  = CRRD per train mile on geographic section  $i$  and timeband  $t$
- $C_{it}$  = CUI for geographic section  $i$  and timeband  $t$
- $A_i$  = constant term for geographic section  $i$
- $\beta$  = constant term for the route which the geographic section belongs to

The 24 routes are as follows:

- West Coast Main Line
- East Coast Main Line
- Great Western Main Line
- Midland Main Line
- Brighton Main Line
- West Anglia
- Birmingham
- Northern Trans Pennine
- LTS
- North London Lines
- North East Scotland
- Cumbria
- West Coast Main Line Branches
- East Coast Main Line Branches
- Great Western Main Line Branches
- Kent Main Line
- Brighton & Kent Branches
- Great Eastern
- Chiltern
- Wales and Borders
- South West
- Manchester, South & West Yorkshire
- Strathclyde & Glasgow-Edinburgh
- North West & South West Scotland

These relationships between CUI and CRRD were initially derived by DeltaRail (then AEA Technology) on behalf of Railtrack. ORR's consultation document following Railtrack's proposed charging structure is found at:

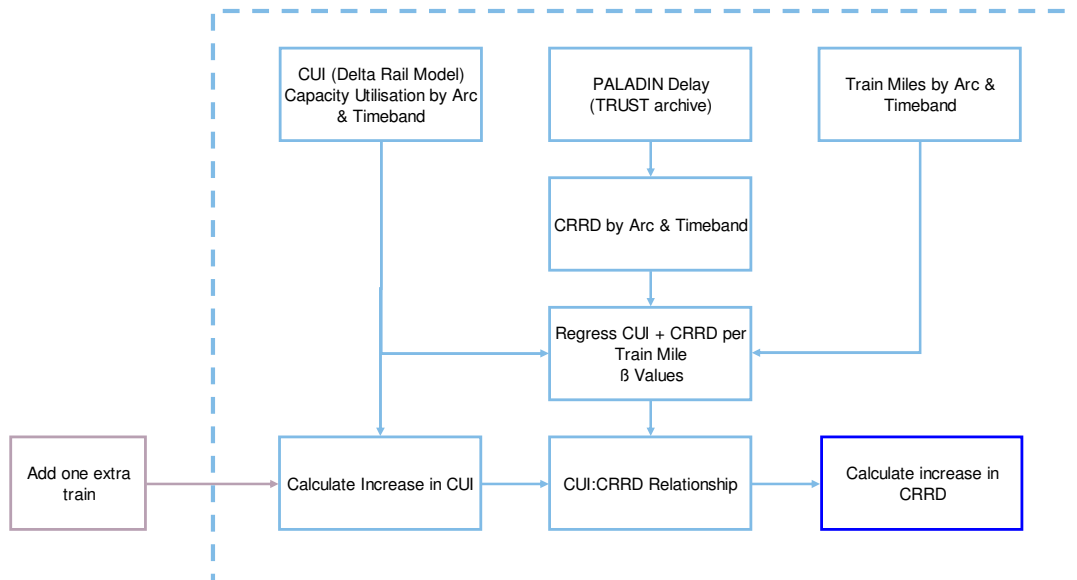
<http://www.rail-reg.gov.uk/upload/pdf/110-capcharge.pdf>

Symond's independent assessment of DeltaRail's research is found at:

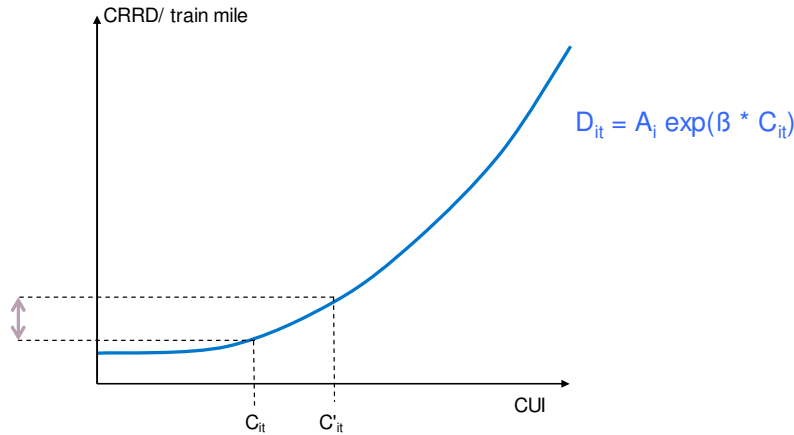
[http://www.rail-reg.gov.uk/upload/pdf/symonds28\\_7.pdf](http://www.rail-reg.gov.uk/upload/pdf/symonds28_7.pdf)

The results of this regression analysis for PR2008 are found in Section 7 (Updated CUI:CRRD Relationship).

### 5.3 Calculate increase in CRRD



Having derived a set of relationships to predict CRRD per train mile from CUI, it is possible to calculate the expected increase in CRRD as a result of adding an extra train to each section/timeband.



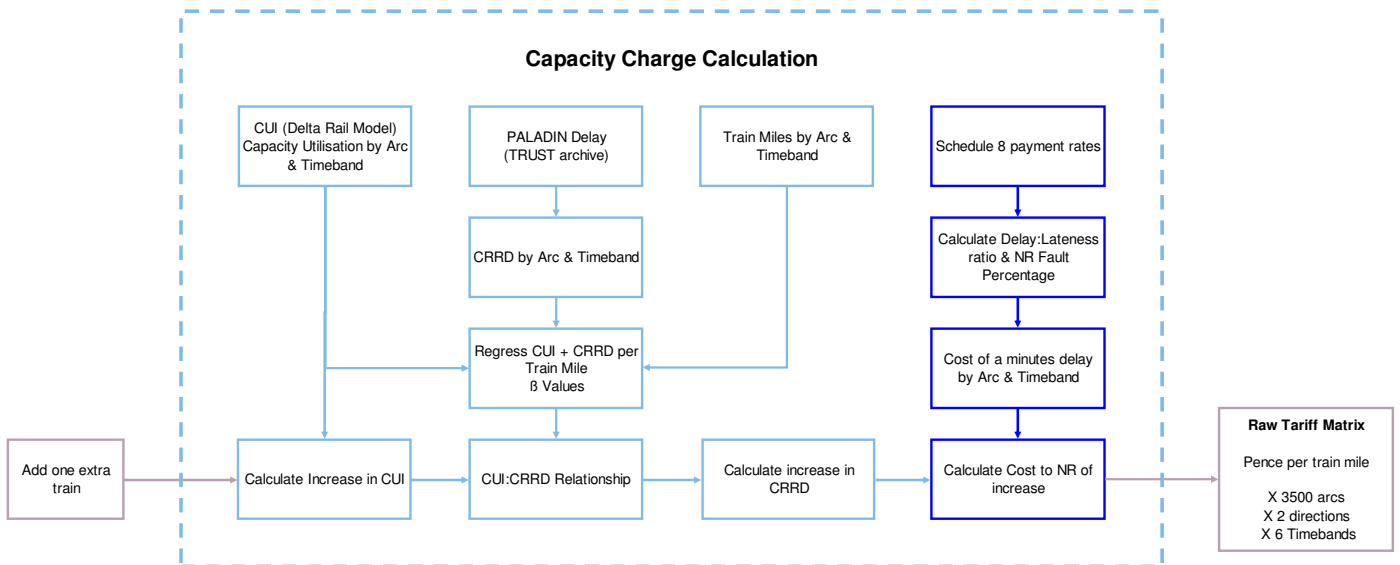
This is given by the formula

$$\Delta D_{it} = A_i \exp(\beta * C'_{it}) - A_i \exp(\beta * C_{it})$$

Where

- $\Delta D_{it}$  = increase in CRRD per train mile on geographic section i and timeband t
- $A_i$  = constant term for the geographic section i
- $\beta$  = constant term for the route which the geographic section belongs to
- $C_{it}$  = CUI for geographic section i and timeband t
- $C'_{it}$  = CUI for geographic section i and timeband t, increased by one train

#### 5.4 Calculate cost to Network Rail of increase



The increase in delay now needs converting into a Schedule 8 cost.

### *Part 1 – Delay:Lateness Ratios*

Schedule 8 costs the weighted average lateness of a service group. Therefore a set of ratios are found to convert 1 minute of delay to x minutes of Schedule 8 lateness.

For PR2008 these ratios were based on delay data from the PALADIN archive of TRUST and lateness data from the PEARS system, both for financial year 2006/07. Before this data could be used, it had to be cleaned to ensure that all services throughout the year related to the same franchise map. The set of franchises used were those in operation at the time of calculation – i.e. as at June 2007.

### *Part 2 – Cost of Delay*

Schedule 8 payments apply at a service group level, so to get a payment rate for each geographic section and timeband, an average of the payment rates for the service groups on that section/timeband is used, weighted by the historic delay on each service group.

### *Part 3 – Network Rail Fault Percentage*

Finally, a set of factors are applied to scale the cost down to the portion of delay that Network Rail are directly responsible for.

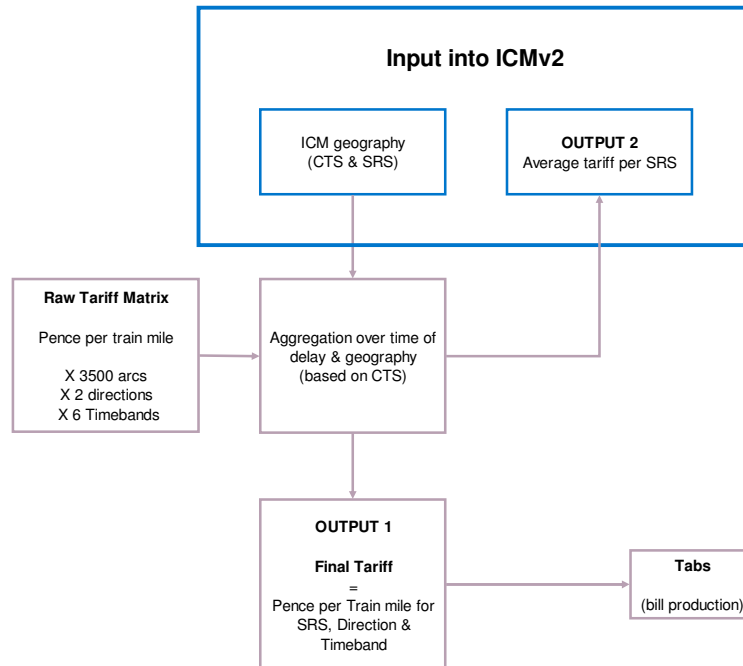
So the final tariff is given by the formula:

$$T_{it} = \Delta D_{it} * N_{it} * PR_{it} * F_{it}$$

Where

- $T_{it}$  = tariff per mile for geographic section i and timeband t
- $\Delta D_{it}$  = increase in CRRD per train mile on geographic section i and timeband t
- $N_{it}$  = number of trains on geographic section i and timeband t
- $PR_{it}$  = average cost of a minutes delay on geographic section i and timeband t
- $F_{it}$  = Network Rail fault percentage on geographic section i and timeband t

## 6 Raw Tariff to Final Tariff



Once the raw tariff has been calculated, the next step is to group up to a final tariff. Up to the point of the raw tariff the methodology has remained unchanged, but now the step to move from raw tariff to final tariff has been reviewed and improved.

Prior to PR2008 the tariff was intended to be billed on about 3,000 geographic sections and 13 timebands. This proved to be too complex to bill, and a simplification to service group level was introduced.

For PR2008 the final tariff has been produced on 600 geographic sections and 6 timebands. Network Rail's billing processes have developed since the Capacity Charge was first introduced, and it is reasonably certain that this level of granularity can be implemented.

### 6.1 Geographic Dimension

The final tariff is based on the same geography as Network Rail's Infrastructure Cost Model (ICM). This is the same geography as is used in the Network Modelling Framework (NMF), and is therefore already industry-accepted. This divides the network into about 300 sections known as Strategic Route Sections (SRS).

For each SRS there is a different tariff in each direction in order to maintain cost reflectivity. For example, on routes coming into London we expect a high tariff in the morning peak in one direction, and in the evening peak in the opposite direction. The 300 SRS over two directions gives a total of about 600 geographic sections.

Grouping the raw tariff to SRS has been done in two steps. First the tariff has been grouped to Constant Traffic Sections (CTS). Since each SRS is defined as a grouping of CTS it is then easy to group the tariff up to SRS. At each stage of grouping up, the averages are weighted by the historic train miles.

## 6.2 Temporal Dimension

The original tariff was indented to have 13 timebands. These have been reduced to 6 for the PR2008 tariff:

Pre PR2008 Timeband	PR2008 Timeband
A Weekday 00:00 – 05:00 B Weekday 05:00 – 06:30 C Weekday 06:00 – 09:30 D Weekday 09:30 – 16:30 E Weekday 16:30 – 19:30 F Weekday 19:30 – 21:00 G Weekday 21:00 – 24:00	C Weekday 06:00 – 09:30 D Weekday 09:30 – 16:30 E Weekday 16:30 – 19:30  N Weekday 00:00 – 06:30 & 19:30 – 24:00
H Saturday 00:00 – 05:00 I Saturday 05:00 – 08:00 J Saturday 08:00 – 18:00 K Saturday 18:00 – 24:00	J Saturday 08:00 – 18:00
L Sunday 00:00 – 09:00 M Sunday 09:00 – 24:00	M Sunday 09:00 – 24:00

The tariffs for timebands J and M are applied to the whole of Saturday and Sunday respectively.

## 6.3 Tariff for the ICM

A second output required from the Capacity Charge recalculation process is a tariff that can be used within the Infrastructure Cost Model (ICM). Since the ICM is also based on SRS, this simply requires grouping up the tariff by CTS to SRS, ignoring the timeband and the direction elements.



## 7 Updated CUI:CRRD Relationship

Each of the 6000 NID arcs (geographic sections) of the raw tariff belongs to one of 24 routes. For each NID arc and timeband, using regression analysis we have found a relationship between CUI and Congestion Related Reactionary Delay per train mile (CRRD per train mile) of the form:

$$D_{it} = A_i \exp(\beta * C_{it})$$

where

- $D_{it}$  = CRRD per train mile on geographic section  $i$  and timeband  $t$
- $C_{it}$  = CUI for geographic section  $i$  and timeband  $t$
- $A_i$  = constant term for geographic section  $i$
- $\beta$  = constant term for the route which the geographic section belongs to

The output of the regression analysis is a set of  $A_i$  parameters (one for each of the 6,000 NID arcs), and a set of  $\beta$  parameters (one for each of the 24 routes). It is the  $\beta$  parameter that is used to determine how good the relationships are:

Route	Original Relationships				PR2008 Relationships			
	$\beta$	Tprob	Lower Confidence Interval	Upper Confidence Interval	$\beta$	Tprob	Lower Confidence Interval	Upper Confidence Interval
WCML Branches	3.227	0.0000	2.202	4.252	1.947	0.0000	1.237	2.658
WCML Main	2.910	0.0000	2.485	3.336	1.992	0.0000	1.474	2.509
ECML Branches	1.563	0.0000	0.894	2.232	2.263	0.0000	1.596	2.930
ECML Main	2.055	0.0000	1.401	2.708	1.259	0.0011	0.509	2.009
GWML Branches	2.631	0.0000	1.666	3.595	2.425	0.0000	1.443	3.406
GWML Main	2.622	0.0000	1.962	3.283	2.578	0.0000	1.976	3.180
Midland	4.091	0.0000	3.461	4.722	2.433	0.0000	1.826	3.039
Kent Main	2.828	0.0000	2.240	3.416	3.107	0.0000	2.426	3.788
Birmingham	2.066	0.0005	0.911	3.220	0.878	0.0432	0.027	1.728
Chiltern Main	2.446	0.0000	1.563	3.329	3.260	0.0000	2.568	3.952
Northern Trans Pennine	2.736	0.0000	1.948	3.525	6.109	0.0000	4.721	7.497
Wales & Borders	3.156	0.0000	2.033	4.279	-0.214	0.7425	-1.493	1.065
NE Scotland Strathclyde & Glasgow - Edinburgh	-0.710	0.1901	-1.772	0.353	3.669	0.0000	2.260	5.079
West Anglia	3.876	0.0000	2.928	4.823	3.650	0.0000	2.742	4.559
West Anglia	3.723	0.0000	2.479	4.966	1.809	0.0000	1.130	2.488
Great Eastern	1.997	0.0000	1.076	2.918	3.001	0.0000	2.254	3.747
LTS	3.267	0.0000	2.014	4.519	4.305	0.0000	3.065	5.546
Brighton & Kent Branches	1.076	0.0012	0.428	1.723	1.705	0.0000	1.030	2.379
Brighton Main	3.343	0.0000	2.316	4.370	2.592	0.0000	1.598	3.585
South West	1.657	0.0000	1.006	2.309	3.248	0.0000	2.579	3.917
North London Lines G. Manchester, S & W Yorkshire	-0.684	0.5005	-2.681	1.312	-0.390	0.7537	-2.839	2.059
Cumbria	1.980	0.0000	1.359	2.601	2.915	0.0000	2.366	3.464
Cumbria	-2.341	0.0077	-4.055	-0.627	1.232	0.0081	0.324	2.140
NW & SW Scotland	-1.627	0.0594	-3.318	0.065	-0.206	0.8653	-2.612	2.201

The table above compares the  $\beta$  values for the relationships used to generate the original tariff, and the  $\beta$  values produced using the new data.

The Tprob column is the result of a t-test that the true value of  $\beta$  is different from zero – i.e. it is the probability that the  $\beta$  could really be zero. Any routes where the  $\beta$  is not significant at the 5% level (there is a 5% chance or more that the  $\beta$  is really zero) are not considered to have a strong enough relationship to base the tariff on.

The new set of relationships includes 3 routes where the  $\beta$ s are not significant at the 5% level. For these routes, the tariff will be set to zero. Previous investigation into these kinds of problems suggested that the insignificant  $\beta$  occurred when there was not enough variation in CUI and levels of delay across different timebands to determine how the CRRD per train mile varied at different levels of capacity utilisation.