School of Computing and Communications, Lancaster University

SCC.200 Group Project 2025-26

Building a Regional Transport Service

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Contents

Acknowledgements

A considerable amount of information on data and protocol formats is taken from documents published by the UK Government and Network Rail.

Motivation

The Group Project aims to develop experience working in teams and is seen by companies and professional bodies as an essential part of becoming a rounded professional. Many otherwise good developers can struggle to adapt to working in the groups or teams required to produce commercial products and services: they may have overly rigid ways of working; they may find it difficult to communicate or document designs and implementation detail so other team members can work to a common goal; they struggle to communicate with non-technical audiences to elicit requirements or present effectively when delivering a product or service; etc.

Remember, it is rare for an individual to take a product or service from conception to release all by themselves, and even in cases where this might happen, someone – likely part of a team the developers have helped train -- still needs to interact with customers.

Professional developers must also understand project management as, even if they are not ultimately responsible for delivering the final product, they need to have an awareness of the costs, risks, and trade-offs that will have to be balanced throughout the product life cycle. They must also deal with somewhat 'elastic' specifications and evolving requirements as beyond simple pieces of coursework: specifications and requirements often change as constraints or possibilities become apparent with likely consequences for projects costs and risks.

Scenario

You are part of a company trying to win a contract for, and deliver, a transport application for regional government. For the purposes of the exercise, we imagine a local authority responsible for the coastal region between Preston and Lancaster including Blackpool, the Fylde and the Wyre coast.

The authority is trying to increase usage of public transport in the region and has concluded that fragmentation of information provision is limiting greater usage of public transport. There are many operators, each with their own timetable and planning applications, but these operate in isolation so getting between locations served by different operators can be overly complex. Commercial applications try to cover multiple operators, but these may involve fees to operators or public, have overly intrusive adverts, or miss smaller operators contracted to serve poorly connected rural communities. A further class of application or tools such as Google Maps, are good at providing multi-operator routes to a destination, but can be overly focused on a single journey and may route users via remote connections in preference to better served hubs, which risks users getting stranded in the event of unexpected delays or have possibly vulnerable users waiting in remote locations with few, if any, facilities.

Background

As part of what was an EU wide initiative, all transport operators are required to provide regularly updated timetabling information to central government. This information is collected along with details of places of interest and transport access points to form a national transport dataset. Operators are encouraged to provide live vehicle location information to enable navigation applications, live departure boards, reliability statistics, etc.

You are provided with rate-limited, cached copies of the data covering the region of interest pulled as needed direct from the main servers. This ensures the data is no more than a few seconds old, while ensuring that the core servers are not overloaded with users or requests. This is not unusual as there are a number of commercial caches, and not all systems go direct to the government provided servers – some of these commercial providers reformat the data, provide richer APIs, etc. For example, the bus times displayed around the University come via such a commercial provider.

You will find that operators are required to provide some information, but other data such as bus occupancy is optional. Operators may use the system in different ways, for example, some may publish vehicle registrations, while other may publish an internal vehicle identifier. You will undoubtedly also find places where operators position information in slightly different places within the schema. Remember, this is a real-world system in active use by many actors, with all the evolving complexities that typically involves.

For buses, route and timetable information is updated periodically and split by UK region and then by operator and route. Routes are specified between recognised stops, and then by segments that may be a few tens of metres in length. Timetables are published as initial departure times and routes. As routes have driving times between locations, timetables can be dynamically generated and updated to account for delays.

Note

- As timetables are valid for months at a time, you are unlikely to need to update these during the project, though you should have some mechanism for doing so.
- Datasets include services over a much wider area than needed for the project.

Live location information is updated every few seconds and published by operator, which in the above case would be Archway Travel; however, location XML files can list many services, and may include ones outside the area and even outside the region.

Local Transport Operators

The area is served by the following – shown with their National Operator Code (NOC):

- ARCT Archway Travel
- BLAC Blackpool Transport (also includes tram services)
- KLCO Kirkby Lonsdale Coach Hire
- SCCU Stagecoach Cumbria & North Lancashire
- SCMY Stagecoach Merseyside & South Lancashire
- NUTT Transpora North West (Formerly Nuttall's Coaches Ltd.)

There are also many contracted services such as those serving schools, which you can ignore for the purpose of this exercise.

National Public Transport Access Node database

This allocates a unique twelve-character AtcoCode and a short seven- or eight-digit NaptanCode to every location in the UK at which public transport can be accessed. Interchanges may have multiple entries where, for example, there are multiple entrances, platforms, or bays. Locations appear with their latitude and longitude.

Data is provided in two linked datasets, the National Public Transport Gazetteer (NPTG) and National Public Transport Access Node database (NaPTAN) itself.

Every local authority has a unique prefix for numbering to ensure stop numbers are not duplicated. You will also find that locations can be placed within the hierarchy of administrative areas.

Other Information

While the local authority has been primarily interested in expanding bus usage, it is aware that busses do not operate in isolation and that users are likely to need information about rail, road, and possibly weather conditions.

The authority is therefore particularly interested in bids that incorporate such information into an integrated transport application.

National Rail

Figure 1 – Track-Model: National Rail Network

National Rail also provides a number of datasets, although some are effectively just dumps of internal information. Where information isn't critical to operations, the quality of the data can vary, for example, while the centreline for all rail pathways is mapped to at least 1.5m accuracy, the locations of sites may be inaccurate as operations typically operate using schematics. Some areas may provide signalling, route, and track status updates as S-Class messages. Train running information is provided via C-Class messages that give movement between *berths*, which are, typically signalled, track sections. Graphing all berths would give a schematic for the whole rail network. Locations are given as a mix of Timing Point Location (TiPLoc) codes, such as, KIRKHAM, Station Number (StaNox) codes, such as 30044 – here a station can relate to any identifiable location, and National Location Codes (NLCs), such as 266800. NLCs are not used for operational purposes, rather ticketing, etc. Some codes are reused across the network, so it is useful to know and filter by region codes, for example, 6 or F for the North West, or from where the track is signalled, for example, PX for Preston or M9 for Manchester Regional Operations Centre (ROC) – Blackpool area, as these may be listed in messages.

An example of a schematic view of the berth data for part of the Blackpool to Preston line is shown below. C- and S-Class messages can be used to monitor signal state and selected track routes (points) and the movement of trains between the signalled berths.

In this example, taken from https://www.opentraintimes.com/, you can see train 1N66 is about to pass from berth 3863 to 3865 and is protected by the signal at 3861.

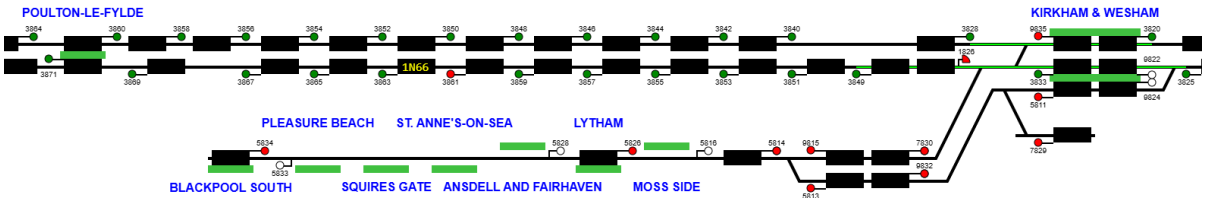


Figure 2 - Schematic of Blackpool Rail Lines (from opentraintimes.com)

Geographic, as opposed to schematic, views of the rail infrastructure are rare at this level of detail and location data (such as latitude and longitude, or GB eastings and

northings) tends to be limited to timing points, although it should be easy to identify a reasonable number of intermediate locations on, for example, Google Maps.

Useful starting points are the CORPUS and the BPLAN dataset, along with the working timetable. These datasets can be used with live operational data from the TD and TRUST data feeds.

The timetable is based on Long Term Planning, Short Term Planning, and Very Short-Term Planning (VSTP), less than 48hrs notice, so the published timetable can be amended at short notice if trains are cancelled, stopped short, or additional services are added.

There are also a number of live feeds available, giving train movement, signalling, timetabling, and arrival/ departure board data, for example. Given this information, you can easily replicate common passenger information, such as, the departure board for any station in the country, which for Lancaster might look like:

```
Time   Plat  Destination            Expected  Operator
-----  ----  ---------------------  --------  -------------------
17:51  3     Barrow-in-Furness      17:56     Northern

             Carnforth (18:00),
             Silverdale (18:06),
             Arnside (18:10),
             Grange-over-Sands (18:15),
             Kents Bank (18:19),
             Cark (18:23),
             Ulverston (18:31),
             Dalton (18:39),
             Roose (18:46),
             Barrow-in-Furness (18:52)

17:57  3     Glasgow Central        18:08     Avanti West Coast
18:04  5     Morecambe              On time   Northern
18:10  3     Edinburgh              18:20     Avanti West Coast
18:20  3     Glasgow Central        On time   TransPennine Express
18:27  4     Manchester Airport     On time   TransPennine Express
18:36  4     Liverpool Lime Street  On time   TransPennine Express
18:36  5     Millom                 On time   Northern
18:47  4     London Euston          18:52     Avanti West Coast
18:57  3     Glasgow Central        19:01     Avanti West Coast
```

Access is based on the station's three letter Computerised Reservation System (CRS) code, which for Lancaster is LAN. You can find these on the National Rail website or listed in departure board information for other stations. The following will likely cover most of what you need: BPN, LAY, PFY, BPS, BPB, SQU, SAS, AFV, LTM, MOS, KKM, SLW, PRE, LAN, CNF, SVR, BAR, MCM, HHB, LEY, BMB.

OpenStreetMap

This is an open-source mapping dataset that can be used to generate maps. For example, the diagram shows a subset of local bus routes and bus locations overlaid on an extract from OpenStreetMap, along with the timetable for a selected bus. (This is just showing what is possible and there is no requirement to use this as a template for your system.) OpenStreetMap and the Track-Model dataset was used to generate the National Rail network map shown earlier, although you may be fine with OpenStreetMap by itself.

The widely available Folium and leaflet.js libraries are useful for visualising data on OpenStreetMap tiles.

Figure 3 - Bus Locations and Routes

Datasets and Feeds

The following feeds are provided for your use at: http://transport.scc.lancs.ac.uk You will find feeds cross reference each other and sites within the National Public Transport Gazetteer (NPTG) and National Public Transport Access Node database (NaPTAN).

You don't have to use all the feeds but may wish to do so… Have fun!

NOTE: You must be on campus or use the University VPN to access the server.

National Public Transport Gazetteer and Access Node Database

`/nptg/nptg.xml`	National Public Transport Gazetteer, *for whole UK*
`/nptg/naptan.xml`	Nat. Public Transport Access Node database, *Lancashire*
`/nptg/naptan-full.xml`	As naptan.xml, *but for whole UK*

Note these are large files, 53MB, 17MB, and 548MB respectively, and they rarely change.

National Highways

`/road/vms` Messages on information displays along major routes

Traffic flow and average speed data can be found at:
https://webtris.nationalhighways.co.uk/api/swagger/ui/index

Weather

`/weather?lat=54.05&lon=-2.80`		Current weather for Latitude and Longitude
`/weather/icons/`*`XXX`*	(e.g., 04n)	Icon specified in above report (.png format)

Data updated every few minutes, and locations binned into areas due to API rate limits.

Buses

Times gives route information with links to timetables and *live* gives GPS tracking data.

`/bus/times/XXXX`	Reply includes URL for actual timetable data
`/bus/live/XXXX`	Where *XXXX* is the Nat. Operator Code (NOC), e.g., ARCT or BLAC

Rail

`/rail/departures/XXX`	Where *XXX* is the CRS code for station, e.g., LAN
`/rail/facilities/XXX`	Where *XXX* is the CRS code for station, e.g., PRE
`/rail/bplan.txt`	Incl. location of, and timing between all sites (89MB)
`/rail/corpus`	Locations, incl. STANOX and TIPLOC codes (7MB)
`/rail/smart`	TD berth offset data used for train reporting (7MB)
`/rail/delay-codes.json`	List of Delay Attribution Codes used in reports
`/rail/schedule`	Gzipped JSON of timetable for current day (~122MB)

You may also find the following useful:

`/rail/timetable/`	Published Working (Long-Term Planning) Timetable
`/rail/track-model/`	Directory of geo-spatial files for UK Track Model

To access live train running and signalling information, and late timetable updates, you need to use the Streaming Text Oriented Messaging Protocol (STOMP)[1] to access network **port 61613** on the **host transport.scc.lancs.ac.uk**; note the **vhost must be /** to connect to the correct message exchange. The connection header should be:

```
{ "username": "guest", "passcode": "guest", "wait": True }
```

Information is provided as a set of message queues you can subscribe to:

- `/topic/TRAIN_MVT_ALL_TOC` TRUST Train movement feed
- `/topic/TD_ALL_SIG_AREA` Train Describer (TD) feed
- `/topic/VSTP_ALL` VSTP Timetable updates
- `/topic/TSR_ALL_ROUTE` Temporary Speed Restrictions*

* TSR messages are normally sent once a week, typically around 06:00 on Friday; they are also one of the places you will commonly see distances in yards and chains.

Each subscription must have a distinct ID, for example:

```
{"destination": "/topic/TRAIN_MVT_ALL_TOC", "id": 1, "ack": "auto"}
{"destination": "/topic/TD_ALL_SIG_AREA",   "id": 2, "ack": "auto"}
```

[1] stomp.github.io/stomp-specification-1.2.html

Network Rail: TRUST Messages

These messages are generated by Network Rail's Train Running and Unscheduled Service Tracking (TRUST) system in batches using JSON format, as one of eight types:

Type	Indication
0001	Train Activation
0002	Train Cancellation
0003	Train Movement
0004	Unidentified Train (not used in production)
0005	Train Reinstatement
0006	Change of Origin
0007	Change of Identity
0008	Change of Location

There are typically around 30 such messages per minute although you might expect a few hundred per minute. TRUST links to a number of information sources so state may be updated as new details come in. Reports have limited time granularity, +/- one minute.

Network Rail: Train Describer (TD) Messages

This provides more detailed movement information along with track and signalling state. There are typically around 230 such messages per minute although you might expect a few thousand per minute. Messages can be one of two classes, C- or S-Class.

See Appendix C: Train Describer (TD) Messages for an outline of the data format.

Details of Network Rail locations and datasets can be found in Appendix A: Network Rail Locations and Datasets

The Task

The exercise has five main phases:

Bid for the contract

In this phase you will need to provide a compelling offer at a reasonable fixed price – note, we won't actually pay you! You should assume that this is a competitive process and that other companies will be proposing solutions and costs. The more advanced your proposed system and lower the cost, the more likely you will win the contract; however, you must ensure your proposal is realistic and that you can deliver for the price – remember you need to account for your development and operational costs or you'll make a loss and risk going out of business. (Costs should be based on typical industry rates.)

You will need to review existing transport applications to get ideas.

Note

- Unlike modules that focus on algorithms and coding, etc., this course is more interested in the management of the project and the group dynamics. As such **you are required to make use of libraries and tools such as agentic AI** to design, develop, test, and evaluate parts of the system. This should not be seen as a green light for use in other modules… remember interaction with these systems, like that with any other developer, is a negotiation and someone that is themselves a good code designer and implementor will be far better at this than someone that loosely describes what's required and blindly accepts the first solution offered. These systems are arguably little different to one or more developers an experienced coder might manage.
- Given the use of AI, you will need to consider something significantly more complex than you might otherwise attempt. If specified in the right way, a basic solution to the problem is trivial for an AI system, so you should be considering things like scalability, resilience, multi-platform use, back-end services, multi-leg route planning, arrival and departure information for arbitrary stations and bus stops, using historical data (i.e., that collected over days) to improve or expand your system's accuracy or functionality.

Develop a design

Having won the contract, you need to refine the design along with more detailed costings, identify and consider mitigations for any risks, and develop a final set of requirements. These need to be within the constraints of the bid you made and the resources available. You will also need to define specific activities that team members

can undertake and consider a concrete timeline for the work with milestones and deliverables so progress can be monitored, and the client convinced work is on track.

You will almost certainly want to research existing systems, communication protocols, transport terminology, etc. As in the real-world, this is expected as some things will be unclear. Remember, you are free to use search engines, AI, etc., to help you.

Implement your system

Realise the design keeping the client updated with periodic progress reports and presentations. You should establish and follow a Continuous Integration and Continuous Delivery/Deployment (CI/CD) process so the client can comment on early versions of the system and so, once delivered, the system is more maintainable over its lifetime.

Note

- The normal rules of plagiarism apply. Any libraries or code developed by AI must be clearly identified as such, and any other form of outsourcing is strictly prohibited.
- You must consider and mitigate against possible security issues with any libraries or code (AI generated or otherwise) you include.
- You are personally responsible for any code you submit to your group's code repository. Don't just blindly submit AI generated code without properly checking for possible security or other problems, testing it, and ensuring it matches the agreed design/ architecture, APIs, etc., that you have agreed within your team.
- Each team member is limited to their normal monthly education token allocation/ allowance for GitHub CoPilot Pro. Across the group this is significant, and no additional tokens, or top-ups will be provided.
- You must abide by the fair-use, or other, policies for any third-party services you make use of, for example, OpenStreetMap.

Evaluate your system

You will need to carry out final testing to check your system works correctly and undertake a user evaluation to ensure the system is usable and meets all the expected requirements, particularly those relating to inclusivity. You will also need to carry out a security audit of your system and complete an industry standard security self-assessment form.

Deliver your system

You need to present your system and demonstrate its use to a mixed audience comprising both technical and non-technical members, along with some additional documents to wrap up the module assessment.

Ethics Process

You will find a document providing general guidance and an overview of the process on Moodle.

The ethics process **must** be completed **before** you undertake any work, study, or evaluation including human participants. You will need to complete the SCC ethics form on Moodle **and MUST have this approved BEFORE you progress** to any form of human based study. As part of this application, you will need to provide information for participants and a consent form that participants will need to sign.

Participant Information Sheet and Consent Form

You should find these two files on Moodle:

- Participant Information Sheet
- Sample Consent Form

After discussing your plan with your lab supervisor, build the Participant information sheet and the Consent Form based on the content and structure of your study. You are encouraged to discuss the content of these documents prior to submitting your ethics application.

These documents MUST be submitted along with the ethics application.

These documents should also be shared with every single participant who takes part in the study. They should be able to get copies of both documents if they demand it. **Do not undertake any human based study without first** providing participants with the approved information sheet **AND** having them formally indicate their consent by signing the consent form.

Failure to follow the ethics process may result in severe penalties.

Security self-assessment

You will find a security self-assessment form on Moodle:

- Software Security Code of Practice Self-Assessment Template

This form allows a developer to provide evidence in support of their self-assessment against the principles contained in the National Cyber Security Centre (NCSC) Software Security Code of Practice. It is expected that you carefully consider security risks and mitigations during the development of your system and that you complete a security audit of your finished system and, as part of that audit, complete a self-assessment.

Timeline

Weeks	Indicative Tasks	
11-12	Research background and create proposal/ bid	*Pitch/ 'bid' week 12*
13-14	Detailed system design	*Submit week 15*
15-17	Implementation with initial release	*In-Lab demo week 17*
18-19	Second release	*In-Lab demo week 19*
20	User Evaluation	
Easter		
21	Main submission (code, plus video-of presentation and demo)	
22	Security self-assessment, plus two individual reports	

Note that you are expected to attend your place of work (allocated lab session) and **you must get timesheets signed off by your group lead and lab GTA each week**. These must show all hours worked on project tasks. Week 21 will be your last lab session.

Formal submissions		**Weight**
Week 15:	Design Report (one per group)	30%
Week 21:	Code (one submission per group)	60%
	Video (one per group)	
Week 22:	Security self-assessment (one per group)	Ind. assessments
	Peer assessment (individual)	
	Self-reflective report (individual)	10%

Failure to submit the individual assessments may result in a module mark of zero.

Lectures

- Andrew Scott (AS) – convenor
- Elmira Yadollahi (EY)
- Amit Chopra (AC)
- Richard Jiang (RJ)

Week	Topic	Staff
11	Introduction, Group work + Project mgmt. (costs, risks, …)	AS
12	Program and system design, architecture and notation	AC
13	Effective use of Agentic AI: *GitHub CoPilot*	EY
14	GitHub, Git version control, and CI/CD	RJ
15	Testing and debugging: *strategies, code reviews, regression testing*	AC
16	Security and secure code	RJ
17	Ethics, the ethics process, and user evaluations (qual. and quant.)	EY
18	Accessibility and Internationalisation	AS
19	The final presentation: *creating videos, etc.*	AS
20	*No lecture*	

Appendix A: Network Rail Locations and Datasets

Locations on the rail network can be identified by several different methods:

3-Alpha Codes - A three-character code used for stations. Previously referred to as CRS (Computer Reservation System) or NRS (National Reservation System) codes.

NLC (National Location Code) - A six-digit code generally used for retail purposes.

TIPLOC (Timing Point Location) - Codes relating to points used in deriving train schedules.

STANOX (Station Number) - These codes can refer to non-station locations such as sidings and junctions. STANOX codes are grouped by geographical area - the first two digits specify the area in which the location exists.

ATCO Code – Taken from the Government NaPTAN database and used by multi-modal journey planners and timetables.

A single location may have multiple codes of the same type representing it, such as underground and overground, and different sets of platforms in one location may also have differing codes.

Some examples:

Station	3Alpha	NLC	TIPLOC	STANOX	ATCO
Leeds	LDS	848700	LEEDS	17132	9100LEEDS
Kings Cross	KGX	612100	KNGX	54311	9100KNGX
Lincoln Central	LCN	634000	LINCLNC	44038	9100LINCLNC
Glasgow Central High Level	GLC	981300	GLGC	07257	9100GLGC
Gatwick Airport	GTW	541600	GTWK	87911	9100GTWK

As mentioned earlier, geographic locations in the National Rail datasets are not necessarily reliable as they've been pulled in from other rail sectors and there are some translation errors. You will likely find latitude, longitude or OS Grid coordinates more accurate within the NaPTAN database. See Appendix G: Example NaPTAN Entry.

Network Rail BPLAN

A set of geographical data released by Network Rail that contains data to be used when planning trains. It also includes other data, such as platform numbers at stations, and details of activity codes. See Appendix E: BPLAN 'PIF' File Format.

Network Rail CORPUS

Codes for Operations, Retail & Planning – the CORPUS can be used to translate STANOX, TIPLOC, NLC, UIC and 3-alpha (CRS) codes to location descriptions.

Field	Description
STANOX	STANOX code
UIC	UIC code
3ALPHA	3-letter location code
TIPLOC	TIPLOC code
NLC	NLC code
NLCDESC	Description of the NLC
NLCDESC16	NLC description (16-character version)

Network Rail SMART

The SMART database contains details of train describer berths and allows movements into berths to be translated into arrivals and departures from locations.

Field	Description
TD	Train describer area (Code for signal control centre or signal box)
FROMBERTH	TD berth movement is from (unique within a TD)
TOBERTH	TD berth movement is to
FROMLINE	Line the movement is from
TOLINE	Line the movement is to
BERTHOFFSET	Difference between time berth event occurs and time to be recorded in TRUST, in seconds
PLATFORM	Platform
EVENT	One of A, B, C, D
ROUTE	
STANOX	STANOX code for location
STANME	Abbreviated description of location, see Step Types
STEPTYPE	One of B, F, C, D, I, T, E
COMMENT	

For directions, up is generally toward London.

EVENT	Description
A	Arrive Up
B	Depart Up
C	Arrive Down
D	Depart Down

Step Types

B: Between

Move between directly adjacent berths, which is preferred type of movement. Time reported to TRUST is time train enters the 'to' berth.

C: Clearout

Used to report a movement where only indication is a cancel message. For example, when a train leaves Network Rail infrastructure and moves into a siding or area not covered by a train describer (signal box or equivalent), the only message that will be received is a Clearout (CB) message.

I: Interpose

Opposite of the 'C' step type. Used to report on a movement where only indication is an interpose message. For example, when a train arrives on Network Rail infrastructure from a siding. Time reported to TRUST is time the interpose happened.

F: From

Used to record a time for a train going in either direction (up or down) from specified berth to any other berth. Time reported to TRUST is time that train leaves 'from' berth.

T: To

Opposite of 'F' step type. Used to record a time for a train from any berth to specified berth. Time reported to TRUST is time that train enters 'to' berth.

D: Intermediate First

Used to specify route train is taking, usually when departing a station or junction.

For example, if a 'D' move is specified as **0101** to **0407**, and a train moves between berths **0101**, 0203, 0305 and **0407**, move will be reported for time train left first berth.

E: Intermediate

Similar to 'D' move but usually used for arrivals. Time reported to TRUST is time last berth step was made.

Appendix B: Example TRUST Messages and their format

0001 – Train Activation message

```
{
    "header": {
        "msg_type": "0001",      # Always 0001 for Train Activation
        "source_dev_id": "",     # Always empty
        "user_id": "",           # Always empty
        "original_data_source": "TSIA",     # Should always be TSIA
        "msg_queue_timestamp": "1511528234000",  # Unix timestamp
        "source_system_id": "TRUST"         # Should always be TRUST
    },
    "body": {
        "schedule_source": "C",
        "train_file_address": null,
        "schedule_end_date": "2017-12-08",
        "train_id": "775F25MP24",
        "tp_origin_timestamp": "2017-11-24",
        "creation_timestamp": "1511528234000",
        "tp_origin_stanox": "",
        "origin_dep_timestamp": "1511535420000",
        "train_service_code": "25470001",
        "toc_id": "25",
        "d1266_record_number": "00000",
        "train_call_type": "AUTOMATIC",
        "train_uid": "C21373",
        "train_call_mode": "NORMAL",
        "schedule_type": "O",
        "sched_origin_stanox": "77301",
        "schedule_wtt_id": "5F25M",
        "schedule_start_date": "2016-12-12"
    }
}
```

Train Activation Body Fields

Field	Description
schedule_source	Set to C for schedules from CIF/ITPS, or V for schedules from VSTP/TOPS
train_file_address	The TOPS train file address, if applicable
schedule_end_date	The end date of the schedule
train_id	The 10-character identity for this train. If the schedule is due to run over multiple months, the identifier can be used on the same date every month (12th Feb, 12th March, etc). This is used in other TRUST messages to identify the train. The train activation message links the train_id with a particular schedule. train_id is of the format **AABBBBCDEE** where: • **AA** is the first two digits of the origin STANOX, and represents the area where the train starts • **BBBB** is the signalling ID (headcode) used within the data feeds to represent the train • **C** is the TSPEED value of the train (see valid TSPEED values) - note: this does not refer to the actual speed (velocity) of the train • **D** is the Call Code of the train - a letter or number based on the departure time from the origin • **EE** is the day of the month on which the train originated
tp_origin_timestamp	The date, in YYYY-MM-DD format, that the train runs. For trains activated before midnight that run after midnight, this date will be tomorrow's date. **Note**: there is currently a problem with the tp_origin_timestamp field due to the truncation of the timestamp. This only occurs during daylight savings for trains which start their journey between 0001 and 0200 the next day. To work around this problem, use the date in the origin_dep_timestamp field.
creation_timestamp	The timestamp (in milliseconds since the UNIX epoch) when the train was originally created in TRUST
tp_origin_stanox	The STANOX code of the origin of the train. If the train is due to start from a location other than the scheduled origin (i.e. it is part-cancelled), this will be the STANOX of the location at which the train starts. Otherwise, this field will be empty and you should refer to the 'sched_origin_stanox' field. If this field is populated, it will be typically be in response to a VAR issued through VSTP or SCHEDULE.
origin_dep_timestamp	WTT time of departure from the originating location. A UNIX timestamp in milliseconds since the UNIX epoch, in UTC.
train_service_code	Train service code as per schedule
toc_id	Operating company ID as per TOC Codes
d1266_record_number	Either 00000 for a CIF/ITPS schedule, or the TOPS unique ID of the schedule. This will always be 00000 for train activation messages, as TRUST generates the train activation message as part of the train call process, then sends the train to TOPS if appropriate, where it is assigned a D1266 record number
train_call_type	Either AUTOMATIC for auto-called trains, or MANUAL for manual-called trains

Field	Description
train_uid	The unique ID of the schedule being activated - either a letter and five numbers, or a space and five numbers for VSTP trains
train_call_mode	Always set to NORMAL. Historically, this could contain OVERNIGHT if the train is called as part of an overnight batch process to activate peak period trains early, but this no longer happens
schedule_type	Either C (Cancellation), N (New STP), O (STP Overlay) or P (Permanent i.e. as per the WTT/LTP) Note: There is a bug that causes this field to be populated incorrectly. The value O should be P and P should be O.
sched_origin_stanox	STANOX code for the originating location in the schedule
schedule_wtt_id	The signalling ID (headcode) and speed class of the train
schedule_start_date	The start date of the schedule

0002 – Train Cancellation message

Trains may be cancelled at activation time/ ON CALL, AT ORIGIN, EN ROUTE, or off route/ OUT OF PLAN.


```
{
    "header": {
        "msg_type": "0002",      # Always 0002 for cancellation
        "source_dev_id": "",     # Address of terminal used user_id
        "user_id": "",           # Who/ what initiated update
        "original_data_source": "SDR",
        "msg_queue_timestamp": "1511528427000",
        "source_system_id": "TRUST"    # Should always be TRUST
    },
    "body": {
        "train_file_address": null,
        "train_service_code": "22721000",
        "orig_loc_stanox": "",
        "toc_id": "88",
        "dep_timestamp": "1511527680000",
        "division_code": "88",
        "loc_stanox": "87701",
        "canx_timestamp": "1511528400000",
        "canx_reason_code": "YI",
        "train_id": "871B26MK24",
        "orig_loc_timestamp": "",
        "canx_type": "EN ROUTE"
    }
}
```

Train Cancellation Body Fields

Field	Description
train_file_address	TOPS train file address, if applicable
train_service_code	Train service code as per the schedule
orig_loc_stanox	For an "OUT OF PLAN" cancellation, this is location that train should have been at according to the schedule
toc_id	Operating company ID as per TOC Codes
dep_timestamp	Departure time at location that train is cancelled from (in milliseconds since the UNIX epoch)
division_code	Operating company ID as per TOC Codes
loc_stanox	STANOX of location that train is being cancelled from. For an "OUT OF PLAN" cancellation, STANOX will not be in schedule, but a Train Movement message will have already been sent.
canx_timestamp	Time at which cancellation was input to TRUST
canx_reason_code	Reason code for cancellation, taken from list of Delay Attribution codes
train_id	10-character unique identity for this train (sent in TRUST activation message). If a change of identity occurs, this will still continue to be original train_id from activation message.
orig_loc_timestamp	For "OUT OF PLAN" cancellation, this is departure time of location that train should have been at according to schedule
canx_type	Either "ON CALL" for a planned cancellation, "AT ORIGIN", "EN ROUTE" or "OUT OF PLAN"

Delay Attribution codes

Prefix	Classification
A*	Freight Terminal Operations Causes
D*	Holding Codes
F*	Freight Operating Causes
I* and J*	Infrastructure causes
M* and N*	Mechanical or Fleet Engineer Causes
O*	Network Rail Operating causes
P*	Planned or excluded delays or cancellations
Q*	Network Rail Non-Operating causes
R*	Station Operating Causes
T*	Passenger Operating causes
V*	External events – TOC Responsibility
X*	External events Network Rail
Y*	Reactionary Delays
Z*	Unexplained delays and cancellations

0003 – Train Movement message


```
{
	"header": {
		"msg_type": "0003",   # Always 0003 for movement
		"source_dev_id": "VLA5", # Addr. of terminal used user_id
		"user_id": "#QHPA026", # Who/ what initiated update
		"original_data_source": "SDR",
		"msg_queue_timestamp": "1511528232000",
		"source_system_id": "TRUST"
	},
	"body": {
		"event_type": "DEPARTURE",
		"gbtt_timestamp": "",
		"original_loc_stanox": "",
		"planned_timestamp": "1511524620000",
		"timetable_variation": "0",
		"original_loc_timestamp": "",
		"current_train_id": "",
		"delay_monitoring_point": "true",
		"next_report_run_time": "9",
		"reporting_stanox": "52701",
		"actual_timestamp": "1511524620000",
		"correction_ind": "false",
		"event_source": "MANUAL",
		"train_file_address": null,
		"platform": "",
		"division_code": "79",
		"train_terminated": "false",
		"train_id": "515G531I24",
		"offroute_ind": "false",
		"variation_status": "ON TIME",
		"train_service_code": "25936005",
		"toc_id": "79",
		"loc_stanox": "52701",
		"auto_expected": "true",
		"direction_ind": "",
		"route": "",
		"planned_event_type": "DEPARTURE",
		"next_report_stanox": "52226",
		"line_ind": ""
	}
}
```

Train Movement Body Fields

Field	Description
event_type	Type of event - either "ARRIVAL" or "DEPARTURE"
gbtt_timestamp*	Planned GBTT (passenger) date and time that the event was due to happen at this location
original_loc_stanox*	If location changed after activation, original STANOX where train was due to report. If reporting_stanox field not 00000, field may not be present
original_loc_timestamp*	Planned time associated with the original location
planned_timestamp	Planned date and time that this event was due to happen at this location
timetable_variation	Number of minutes variation from the scheduled time at this location. Off-route reports will contain "0"
current_train_id*	Where a train has had its identity changed, the current 10-character unique identity for this train
delay_monitoring_point	Set to "true" if this is a delay monitoring point, "false" if it is not. Off-route reports will contain "false"
next_report_run_time*	Running time to the next location
reporting_stanox*	If 00000, the STANOX to which this report refers is in the original_loc_stanox field
actual_timestamp	Date and time that this event happened at the location
correction_ind	Set to "false" if this report is not a correction of a previous report, or "true" if it is
event_source	Whether the event source was "AUTOMATIC" from SMART, or "MANUAL" from TOPS or TRUST SDR
train_file_address*	TOPS train file address, if applicable
platform*	Two characters (including a space for a single character) or blank if the movement report is associated with a platform number
division_code	Operating company ID as per TOC Codes
train_terminated	Set to "true" if the train has completed its journey, or "false" otherwise
train_id	10-character unique identity for this train at TRUST activation time
offroute_ind	Set to "false" if this report is for a location in the schedule, or "true" if it is not
variation_status	One of "ON TIME", "EARLY", "LATE" or "OFF ROUTE"
train_service_code	Train service code as per schedule
toc_id	Operating company ID as per TOC Codes
loc_stanox	STANOX of the location at which this event happened
auto_expected*	Set to "true" if an automatic report is expected for this location, otherwise "false"
direction_ind*	For automatic reports, either "UP" or "DOWN" depending on the direction of travel
route*	A number or blank to indicate exit route from this location. A value of 'F' indicates train failed to stop here
planned_event_type	Planned type of event - one of "ARRIVAL", "DEPARTURE" or "DESTINATION"
next_report_stanox*	STANOX of location at which next report for train is due
line_ind*	A single character (or blank) depending on the line train is travelling on, e.g. F = Fast, S = Slow

0004 – Unidentified Train message

This type of message should not be seen in production.

0005 – Train Reinstatement message

```
{
    "header": {
        "msg_type": "0005",      # Always 0005 for reinstatement
        "source_dev_id": "LYUD", # Addr. of terminal used user_id
        "user_id": "#QRP0059",   # Who/ what initiated change
        "original_data_source": "TRUST DA",
        "msg_queue_timestamp": "1511528258000",
        "source_system_id": "TRUST"    # Should always be TRUST
    },
    "body": {
        "current_train_id": "",
        "original_loc_timestamp": "",
        "train_file_address": null,
        "train_service_code": "21734000",
        "toc_id": "20",
        "dep_timestamp": "1511533980000",
        "division_code": "20",
        "loc_stanox": "32530",
        "train_id": "321P42MP24",
        "original_loc_stanox": "",
        "reinstatement_timestamp": "1511528220000"
    }
}
```

Train Reinstatement Body Fields

Field	Description
train_id	10-character unique identity for this train at TRUST activation time
current_train_id	Where a train has had its identity changed, the current 10-character unique identity for this train
original_loc_timestamp	Planned departure time associated with the original location
dep_timestamp	Planned departure time at the location where the train is being reinstated
loc_stanox	STANOX of the location at which the train is reinstated
original_loc_stanox	STANOX of the location in the schedule at activation time, if the location has been revised
reinstatement_timestamp	Time at which the train was reinstated
toc_id	Operating company ID as per TOC Codes
division_code_id	Operating company ID as per TOC Codes
train_file_address	The TOPS train file address, if applicable
train_service_code	Train service code as per schedule

0006 – Change of Origin message

```
{
    "header": {
        "msg_type": "0006",      # Always 0006 for change of origin
        "source_dev_id": "V3HS", # Addr. of terminal used user_id
        "user_id": "#QRP0059",   # Who/ what initiated change
        "original_data_source": "SDR",
        "msg_queue_timestamp": "1511528282000",
        "source_system_id": "TRUST"    # Should always be TRUST
    },
    "body": {
        "reason_code": "TH",
        "current_train_id": "",
        "original_loc_timestamp": "",
        "train_file_address": null,
        "train_service_code": "21734000",
        "toc_id": "20",
        "dep_timestamp": "1511540100000",
        "coo_timestamp": "1511528280000",
        "division_code": "20",
        "loc_stanox": "16416",
        "train_id": "321P42MP24",
        "original_loc_stanox": ""
    }
}
```

Change of Origin Body Fields

Field	Description
train_id	10-character unique identity for this train at TRUST activation time
dep_timestamp	Planned departure time at the location where the train is being reinstated
loc_stanox	STANOX of the new origin of the train
original_loc_stanox	If the location has been revised, e.g. the new origin is 'out of plan' for the train, the STANOX of location in the schedule at activation
original_loc_timestamp	Planned departure time associated with original location
current_train_id	Always blank
train_service_code	Train service code as per schedule
reason_code	Reason code for cancellation, taken from list of Delay Attribution codes
division_code	Operating company ID as per TOC Codes
toc_id	Operating company ID as per TOC Codes
train_file_address	TOPS train file address, if applicable
coo_timestamp	Time at which the Change of Origin is entered into TRUST

0007 – Change of Identity message

These messages are sent for freight trains if they run in different format to that timetabled, for example, something that will cause them to run at a faster or slower speed than expected. This may occur mid-route, an example being if the locomotive is changed for one of a different class.

```
{
    "header": {
        "msg_type": "0007",      # Always 0007 change of identity
        "source_dev_id": "V2WX", # Addr. of terminal used user_id
        "user_id": "#WAELKNK",   # Who/ what initiated change
        "original_data_source": "SDR",
        "msg_queue_timestamp": "1511531881000",
        "source_system_id": "TRUST"    # Should always be TRUST
    },
    "body": {
        "current_train_id": "",
        "train_file_address": "BAX",
        "train_service_code": "56609010",
        "revised_train_id": "86417G1J24",
        "train_id": "86678V1J24",
        "event_timestamp": "1511531880000"
    }
}
```

Change of Identity Body Fields

Field	Description
train_id	10-character unique identity for train at TRUST activation time
current_train_id	If this is the second or subsequent change of identity for a train, this field will contain the revised_train_id field from the previous change of identity message
revised_train_id	New 10-character unique identity for this train. You should continue to track the original train_id field as well, as some other message types will not contain this new ID.
train_file_address	TOPS train file address, if applicable
train_service_code	Train service code as per schedule
event_timestamp	Time, in milliseconds, when the train's identity was changed

0008 – Change of Location message

```
{
    "header": {
        "msg_type": "0008",      # Always 0008 change of location
        "source_dev_id": "VNHY", # Addr. of terminal used user_id
        "user_id": "#PEE0031",   # Who/ what initiated change
        "original_data_source": "TOPS",
        "msg_queue_timestamp": "1511532209000",
        "source_system_id": "TRUST"    # Should always be TRUST
    },
    "body": {
        "original_loc_timestamp": "1511528640000",
        "current_train_id": "",
        "train_file_address": "BDI",
        "train_service_code": "56461882",
        "dep_timestamp": "1511528640000",
        "loc_stanox": "36108",
        "train_id": "174M37CF24",
        "original_loc_stanox": "36169",
        "event_timestamp": "1511532180000"
    }
}
```

In the example above, the train scheduled to call at Stanox 36169 (Tuebrook Sdgs Gbrf) will now call at Stanox 36108 (Liverpool Biomass Tml Gbf)

Change of Location Body Fields

Field	Description
train_id	10-character unique identity for this train at TRUST activation time
current_train_id	
dep_timestamp	Planned arrival/ departure time at location where train will call
loc_stanox	STANOX of the new calling point of the train
original_loc_stanox	STANOX of the original location in the schedule
original_loc_timestamp	Planned arrival/ departure time associated with original location
train_service_code	Train service code as per schedule
train_file_address	TOPS train file address, if applicable
event_timestamp	Time at which Change of Location is entered into TRUST

Appendix C: Train Describer (TD) Messages

TD C-Class messages

These messages a generated as trains move between locations in the network, typically corresponding to signals. Each location is known as a *berth*, typically identified by four digits; however, other formats are used to identify platforms, trains entering or leaving a signalling area, etc.

There are four types of C-Class message:

Type	Name	Use
CA	STEP	Train moved from one berth to another, implicitly cancelling train in from berth. Any existing entry in *to* berth should be overwritten.
CB	CANCEL	Explicitly removes any entry in *from* berth.
CC	INTERPOSE	Explicitly overwrites any existing entry in *to* berth.
CT	HEARTBEAT	Periodically sent.

Messages contain a number of fields from:

Field	Description
time	Unix timestamp in milliseconds
area_id	Area code such as M9 for Manchester ROC (Blackpool area)
msg_type	CA, CB, CC, or CT
from	berth
to	berth
descr	Four-letter alphanumeric ‘headcode’ for train
report_time	Time, e.g., 1145

The table below lists the format of berth names.

Berth Name	Description
[0-9][0-9][0-9][0-9]	Numeric berths usually represent specific signals within a train describer area. Depending on the coverage of the TD area, these may also include signals from fringe boxes to show a queue of trains approaching an area. If a fringe signal shares a number with a signal within the TD area, it may be given a different first character, for example, if the fringe signal is 0453 and this is already allocated to a signal within the TD area, the berth may be named Q453
[A-Z][A-Z][A-Z][A-Z]	Text berths represent sidings, fringe boxes or other special berths. These will be specific to the TD area and are not found on signalling diagrams. They often represent trains waiting to enter a TD area, or trains sent to another area
A*, **B***, **C***	A, B and C berths are often found on permissive platforms or bay platforms. They represent the first, second (and optionally, third) train descriptions waiting in the platform
R*	R (Rear) berths usually represent a train arriving into a bay platform
F*	F (Front) berths usually represent a train departing from a bay platform. The front berth often shows the first outbound train of the associated A, B and C berths
LS or **LS**	Last Sent (LS) berths represent the last train descriptions sent to a fringe box or area. This is the most recent train to have been passed to that area's control
STIN	Strike In: a train entering a train describer's area
COUT	Clear Out: a train leaving a train describer's area
TR/SMT***	Train Reporting (TR) or SMART (SMT) link status. SMT1/2 or TRT1/2 are usually links to SMART, and other values are links to train describers at fringe signal boxes
DATE	Contains the current date in DDMM format
TIME/CLCK	Contains the current time in HHMM format

Example messages:

```
{'CA_MSG': {'msg_type': 'CA', 'area_id': 'PX', 'time':
'1762009114000', 'from': '0323', 'to': '0325', 'descr':
'2K60'}}

{'CB_MSG': {'msg_type': 'CB', 'area_id': 'G1', 'time':
'1762009114000', 'from': 'G669', 'descr': '2J05'}}

{'CC_MSG': {'msg_type': 'CC', 'area_id': 'Y5', 'time':
'1762009114000', 'to': 'CLCK', 'descr': '1508'}}

{'CT_MSG': {'msg_type': 'CT', 'area_id': 'SK', 'time':
'1762009114000', 'report_time': '1500'}}
```

TD S-Class Messages

These messages are generated for signalling changes, track changes, etc. There is currently no published mapping for the data, but if you want to look at this, mappings can, to some extent, be deduced by careful monitoring of messages over time.

Each bit in the data field will correspond to a signal, track circuit, a Train-Ready-To-Start button on a platform being pressed, etc., and, for example, in the case of a signal will be 0 for red, and 1 for anything else. As a train moves from one birth to the next, a C-Class message will be generated, and an S-Class message will soon follow as the signal behind the train turns red. By tracking bit changes between matching area-address combinations over time, you can work out which bit corresponds to which signal.

As the network can be busy and multiple things may change at once, signals, track circuits, level crossing barriers, etc., you may need to watch multiple transitions between berths to understand which bits you need to watch.

Note that track routes consist of multiple, likely two, not necessarily adjacent, bits. All zeros mean no path selected, one bit set to 1 might mean platform 3 to the up-fast line, and the other bit set to one may mean platform 3 to the up-slow line.

Type	Name	Use
SF	UPDATE	Updates bytes starting at given address.
SG	REFRESH	One of *n* messages refreshing all signalling state for whole area. Should end with an SH_MSG message.
SH	END	Last message of signalling refresh.

Messages contain a number of fields from:

Field	Description
time	Unix timestamp in milliseconds
area_id	Area code such as M9 for Manchester ROC (Blackpool area)
msg_type	SF, SG, or SH
address	For an SF_MSG, this is the individual signalling element. For an SG_MSG or SH_MSG, this is the starting address for the four bytes supplied in the data field
data	*n* bytes, each bit corresponding to a 'signalling' element or device

Example messages:

```
{'SF_MSG': {'msg_type': 'SF', 'area_id': 'D6', 'time':
'1762010229000', 'address': '14', 'data': '5F'}}

{'SG_MSG': {'msg_type': 'SG', 'area_id': 'RW', 'time':
'1762010229000', 'address': '00', 'data': '06880306'}}

{'SH_MSG': {'msg_type': 'SH', 'area_id': 'RW', 'time':
'1762010229000', 'address': '04', 'data': '35000000'}}
```

Appendix D: Understanding the National Rail Timetable

Timetabling begins with the Long-Term Plan (LTP), some 67 weeks before a train runs. This timetable is typically published 26 weeks before a train runs.

Between 30 and 12 weeks before the trains run updates are made to the Short-Term Plan (STP).

The daily timetable is set around 01:00 and released to the schedule feed around 06:00.

Indicator	Name	Abbreviation	Description
P	Permanent (LTP)	WTT	Working Timetable: Base schedule created as part of LTP process
O	Overlay (LTP)	VAR	Variation to schedule created as part of LTP process
C	Cancellation (LTP)	CAN	Planned cancellation of an LTP schedule - this means the schedule does not apply, not that an expected train will not run.
N	Short-Term Planned (STP)	STP	Schedule created as part of STP process

You may see two entries for a service, for example, P and C; notice that the lowest alphabetic indicator should apply, in this case the P service from the WTT has been ‘cancelled.’ Cancelled in this case means the service doesn’t apply on this date, for example, on a bank holiday.

Later changes, not in the daily schedule, typically within 48 hours of a train running, are announced via the Very Short-Term Planning (VSTP) feed.

Appendix E: BPLAN 'PIF' File Format

The format of the file is straightforward:

- The first field on a record is a 3-character field identifying the record type
- The second field is the Action Code, which will always be 'A' - Add. The action codes 'C' and 'D' should not be seen from the Data Feeds platform, as they are extracted as reference data, and not updates to the existing data
- The subsequent fields are tab-separated and variable-length
- Records are terminated by CRLF characters (ASCII carriage return and newline characters, DOS-style line terminators)
- The character encoding is, or may contain, characters from Windows-1252.
- A single trailer record reports the number of records of each type in the file, and indicates the end of the file
- Within each record, the 'type' column indicates whether the field is part of a record key, mandatory or optional:

  P: Primary key - a field, or set of fields, that uniquely identify entity instance

  A: Alternate key - an alternate set of fields that also uniquely identify entity

  M: Mandatory field

  O: Optional field

  Data will be provided for P, A and M fields, but not necessarily for O fields. However, the field will still be present and will be empty, i.e. the file will have two TAB characters for the entry.

Record type	Description
PIF	Header record
REF > ACC	Accommodation Class codes
REF > ACT	Activity codes
REF > BHX	Bank Holiday Excepted codes
REF > BRA	Brand codes
REF > BUS	Business Sector codes (no longer used)
REF > CAT	Catering codes
REF > OPC	Operating Characteristics
REF > PWR	Power Supply Type codes
REF > RES	Reservations codes
REF > SER	Service Codes
REF > SLE	Sleeper codes
REF > TCL	Train Class codes
REF > TCT	Train Category codes
REF > TOC	Train Operating Company codes (not ATOC codes)
REF > TRS	Train Status codes used in bid/offer files (not released as Open Data)
REF > TST	Publication Status codes

Record type	Description
REF > ZNE	Data Areas
TLD	Timing loads
LOC	Location codes
PLT	Platform data
NWK	Network links
TLK	Timing links
PIT	Trailer record

Control 'PIF' Record

Type	Field	Format	Length	Values
M	Record type	Text	3	'PIF'
M	File version	Text	3	Interface specification version
M	Source system	Text	30	Database from which file was extracted
M	TOC ID	Text	2	TOC identifier
M	Timetable start date	Date		Start date of the timetable period to which this data applies
M	Timetable end date	Date		End date of the timetable period to which this data applies
M	Cycle type	Text	1	I - Iterative, or S - Supplemental
M	Cycle stage	Text	1	0 - Base data from Network Rail
M	File creation date	Date		
M	File seq. number	Number	4	Unused

REF Record

Type	Field	Format	Length	Values
M	Record type	Text	3	REF
M	Action code	Text	1	A
P	Reference code type	Text	3	See REF Record Code Types
P	Reference code	Text	3	Up to 3 characters long - may be blank
M	Description	Text	64	Free-format text

REF Record Code Types

Code type	ID
Accommodation	ACC
Activities at a location	ACT
Bank Holidays Excepted	BHX
Service brands	BRA
Business sector	BUS
Catering codes	CAT
Operating characteristics	OPC
Power supply type	PWR
Reservation codes	RES

Service codes	SER
Sleeper codes	SLE
Train class	TCL
Train category	TCT
Train Operator codes	TOC
Train status	TRS
Train publication status	TST
Reference code types	REF
Network Rail zones	ZNE

Timing Load (TLD) Records

There are several point-to-point timings (Timing links) across a Network Link. When timing a train across a network link, the timing link to use depends on the train formation, as well as its entry and exit speeds.

Point-to-point timings are not needed for every train formation, as many have effectively the same timings. Timings across a network link are defined for a variety of timing loads, each applicable to a number of train formations. The timing load to use for a train may depend on its class/ subclass, planned load, planned maximum speed and RA number.

Type	Field	Format	Length	Values
M	Record Type	Text	3	TLD
M	Action Code	Text	1	A
P	Traction type	Code	6	Type of traction, e.g., 321, 153, 2x86, EMU
P	Trailing Load	Code	5	Tonnes (up to 4 digits) plus an empty/ loaded character for freight. Blank for trains with a standard trailing load
P	Speed	Code	3	Maximum permitted speed for the timing load
P	RA/Gauge	Code	3	First digit is the RA number, then two characters for gauge - may be blank
M	Description	Text	64	Free-format text
M	ITPS Power Type	Text	3	Power type as shown in ITPS
M	ITPS Load	Text	4	Load as shown in ITPS
M	Limiting Speed	Text	3	Limiting speed as shown in ITPS

- ITPS is the Integrated Train Planning System

Location (LOC) Records

Type	Field	Format	Length	Values
M	Record type	Text	3	LOC
M	Action Code	Text	1	A
P	Location Code	Text	7	TIPLOC
M	Location name	Text	32	Free text
M	Start date	Date		
O	End date	Date		
O	OS Easting	Number	6	Ordnance Survey reference
O	OS Northing	Number	6	Ordnance Survey reference
M	Timing point type	T/M/O		TRUST, Mandatory or Optional
M	Zone	Code		Zone responsible for maintaining record
O	STANOX code	Number	5	Station Number code
M	Off-Network ind.	Y/N	1	Y if location is off Network Rail network, N if it is on-network
O	Force LPB	L/P/B/space	1	L if running line code should appear in timetable when approaching location, P if path should appear in timetable when leaving location, B for both, space for neither

PLT Records: *Platforms and Sidings*

Type	Field	Format	Length	Values
M	Record Type	Text	3	PLT
M	Action Code	Text	1	A
P	Location code	Text	7	TIPLOC
P	Platform ID	Text	3	UID for the platform at location
M	Start date	Date		
O	End date	Date		
O	Platform/ Siding length	Num	4	Maximum usable length in metres
M	Power supply type	Code		A valid power supply type code
O	DOO (Passenger)	Y/N		Driver-Only Operation allowed?
O	DOO (Non-Passenger)	Y/N		Driver-Only Operation allowed?

Network Link (NWK) Records

Type	Field	Format	Length	Values
M	Record Type	Text	3	NWK
M	Action Code	Text	1	A
P	Origin location	Text	7	TIPLOC
P	Destination location	Text	7	TIPLOC
P	Running line code	Code	3	e.g., FL, SL to distinguish parallel running lines
O	Running line descr.	Text	20	Description for non-standard line code
M	Start date	Date		
O	End date	Date		
M	Initial direction	U/D		Up/ Down direction indicator - used for timetables and junction reports rather than physical line descriptions
O	Final direction	U/D		May differ from initial direction, e.g., where an up link merges into a down link
O	Distance	Number	5	Distance in metres
O	DOO (Passenger)	Y/N		Driver-Only Operation allowed?
O	DOO (Non-Passenger)	Y/N		Driver-Only Operation?
O	RETB	Y/N		Radio Electric Token Block in use at locn
M	Zone	Code		Zone responsible for record
M	Reversible line	B/R/N		B - Bi-directional, R - Reversible, or N - Neither
M	Power supply type	Code		A valid power supply type code
P	RA	Code	2	Route Availability number
O	Maximum train length	Num	4	Maximum length of train that can use this network link, in metres

Timing Link (TLK) Record

Type	Field	Format	Length	Values
M	Record Type	Text	3	TLK
M	Action Code	Text	1	A
P	Origin location	Text	7	TIPLOC
P	Destination	Text	7	TIPLOC
P	Running line code	Code	3	To distinguish parallel running lines
P	Traction type	Code	6	Type of traction, e.g. 321, 153, 2x86, EMU
P	Trailing Load	Code	5	Tonnes (up to 4 digits) plus an empty/loaded character for freight. Blank for trains with a standard trailing load
P	Speed	Code	3	Maximum permitted speed for timing load
P	RA/Gauge	Code	3	First digit is the RA number, then two characters for gauge - may be blank
P	Entry speed	Number	3	0 starting or -1 for pass at max. app. speed
P	Exit speed	Number	3	0 stopping or -1 for pass at max. app speed
P	Start date	Date		
O	End date	Date		
M	Sect. Run Time	SRT		mmm'ss
O	Description	Text	64	

Footer (PIT) Records

These confirm the number of entries for each class of record.

Type	Field	Format	Length	Values
M	Record Type	Text	3	PIT
M	Record Type code	Text	3	Any record type code
M	Addition count	Number	N/A	Number of addition (A) records
M	Change count	Number	N/A	Number of change (C) records
M	Delete count	Number	N/A	Number of delete (D) records

Appendix F: Operator Business Codes

Business Code is a two-character code used within the TRUST system. It is used in the names of the individual train movement feeds.

Sector Code is the sector code used to represent the Train Operating Company (TOC) in TRUST messages.

ATOC Code is a two-character code used to representing the TOC in the schedule feed. Non-passenger operators are represented by an ATOC code of ZZ.

Business Code Prefix

Code	Description
C	Central Services
D	Railfreight Distribution
E	Train Operating Companies
G	British Rail International
H	Train Operating Companies
J	Other Businesses
K	BREL and Level 5 Depots
L	Train Operating Companies
P	Train Operating Companies
Q	British Rail Headquarters
R	British Rail Infrastructure Services
T	NRCC
U	Ex-British Rail (now privatised)
V	Ex-British Rail (now privatised)
W	DB Cargo UK
X	Private owners
Y	Private owners
Z	Other businesses

Network Rail Business Codes

Network Rail Route	Business Code
HQ Functions	QA
Sussex	QB
Wessex	QC
Western	QD
Central	QE
North West	QF
North East	QG
Anglia	QH
East Coast	QI
Eastern	QJ
Southern	QK
Scotland	QL
Kent	QM
WCML South	QN
High Speed 1	QQ
North West & Central	QR
Scotland	QS
Wales & Western	QU
East Midlands	QV
Wales	QW

Non-Network Rail

Company Name	Business Code	Sector Code	ATOC Code
Virtual European Paths	EU	?	EU
Northern Trains	ED	23	NT
Transport for Wales	HL	71	AW
c2c	HT	79	CC
Caledonian Sleeper	ES	35	CS
Chiltern Railways	HO	74	CH
CrossCountry	EH	27	XC
DC Rail	PO	34	ZZ
East Midlands Railway	EM	28	EM
Eurostar	GA	06	ES
Hull Trains	PF	55	HT
GB Railfreight	PE	54	ZZ
Govia Thameslink Railway (Great Northern)	ET	88	GN
Govia Thameslink Railway (Thameslink)	ET	88	TL
Grand Central	EC	22	GC
Grand Central (North West)	LN	14	GC/LF
Great Western Railway	EF	25	GW
Greater Anglia	EB	21	LE
Heathrow Connect	EE	24	HC
Heathrow Express	HM	86	HX
Island Lines	HZ	85	IL
Locomotive Services	LS	89	LS
West Midlands Trains	EJ	29	LM
London Overground	EK	30	LO
LUL Bakerloo Line	XC	91	LT
LUL District Line - Richmond	XE	93	LT
LUL District Line - Wimbledon	XB	90	LT
Merseyrail	HE	64	ME
Network Rail (On-Track Machines)	LR	15	LR
Nexus (Tyne & Wear Metro)	PG	56	TW
North Yorkshire Moors Railway	PR	51	NY
ScotRail	HA	60	SR
South Western Railway	HY	84	SW
South Yorkshire Supertram	SJ	19	SJ
Southeastern	HU	80	SE
Southern	HW	88	SN
Swanage Railway	SP	18	SP
Elizabeth line	EX	33	XR
TransPennine Express	EA	20	TP
Avanti West Coast	HF	65	VT
London North Eastern Railway	HB	61	GR
West Coast Railways	PA	50	WR
JSD Rail Research & Development	RR	02	ZZ
Victa Westlink Rail (defunct)	PV	03	ZZ
DB Cargo Charters	FM	04	ZZ
DB Cargo Freight	WA	05	ZZ
Rail Operations Group	PH	07	ZZ

Company Name	Business Code	Sector Code	ATOC Code
DB Cargo International	FD	08	ZZ
Freightliner Intermodal	FL	09	ZZ
Serco Rail Operations	FX	10	ZZ
Freightliner Heavy Haul	DH	11	ZZ
Europorte Channel	PT	13	ZZ
LORAM	LC	16	ZZ
Hanson & Hall Rail Services	YG	17	ZZ
Network Rail Virtual Freight Company	QJ	31	ZZ
Vintage Trains	TY	36	TY
Harsco	RT	39	ZZ
Balfour Beatty Rail	RZ	40	ZZ
Colas Rail	RG	42	ZZ
Amey Fleet Services	RE	43	ZZ
Carillion Rail	RB	44	ZZ
Lumo	LD	45	LD
SB (Swietelsky Babcock) Rail	RD	46	ZZ
VolkerRail	RH	49	ZZ
Pre Metro Operations	PK	52	ZZ
SNCF Freight Services	PS	53	ZZ
Go-Op	GO	57	
On Route Logistics	PM	59	ZZ
Railadventure	SO	11	unknown
Fishbone Solutions		62	FS
Grand Union Trains	LF	12	LF
Legge Infrastructure Services	LG	72	ZZ
Network Rail Reserved Pathings (non-QJ)	NR	92	ZZ
Ffestiniog Railway	XJ	94	
Varamis Rail	MV	95	
Direct Rail Services	XH	97	ZZ
Internal Testing	RM	98	ZZ

Appendix G: Example NaPTAN Entry

Lancaster Railway Station

```
<NaPTAN>
    <StopPoints>
        <StopPoint>
            <AtcoCode>2500LANCSTR0</AtcoCode>
            <Descriptor>
                <CommonName>Lancaster Rail Station</CommonName>
                <Street>Meeting House Lane</Street>
                <Indicator>East Entrance</Indicator>
            </Descriptor>
            <Place>
                <NptgLocalityRef>E0057514</NptgLocalityRef>
                <Suburb>City Centre</Suburb>
                <Town>Lancaster</Town>
                <LocalityCentre>false</LocalityCentre>
                <Location>
                    <Translation>
                        <GridType>UKOS</GridType>
                        <Easting>347255</Easting>
                        <Northing>461726</Northing>
                        <Longitude>-2.807076857</Longitude>
                        <Latitude>54.048786448</Latitude>
                    </Translation>
                </Location>
            </Place>
            <StopClassification>
                <StopType>RSE</StopType>
                <OffStreet>
                    <Rail>
                        <Entrance />
                    </Rail>
                </OffStreet>
            </StopClassification>
            <StopAreas>
                <StopAreaRef>910GLANCSTR</StopAreaRef>
            </StopAreas>
            <AdministrativeAreaRef>087</AdministrativeAreaRef>
            <PlusbusZones>
                <PlusbusZoneRef>LANCSTR</PlusbusZoneRef>
            </PlusbusZones>
        </StopPoint>
        <StopPoint>
            <AtcoCode>2500LANCSTR1</AtcoCode>
            <Descriptor>
                <CommonName>Lancaster Rail Station</CommonName>
                <Landmark>Rail Station</Landmark>
                <Street>Station Road</Street>
                <Indicator>West Entrance</Indicator>
            </Descriptor>
```

```
    <Place>
        <NptgLocalityRef>E0057514</NptgLocalityRef>
        <Suburb>City Centre</Suburb>
        <Town>Lancaster</Town>
        <LocalityCentre>false</LocalityCentre>
        <Location>
            <Translation>
                <GridType>UKOS</GridType>
                <Easting>347186</Easting>
                <Northing>461709</Northing>
                <Longitude>-2.808127627</Longitude>
                <Latitude>54.048626596</Latitude>
            </Translation>
        </Location>
    </Place>
    <StopClassification>
        <StopType>RSE</StopType>
        <OffStreet>
            <Rail>
                <Entrance />
            </Rail>
        </OffStreet>
    </StopClassification>
    <StopAreas>
        <StopAreaRef>910GLANCSTR</StopAreaRef>
    </StopAreas>
    <AdministrativeAreaRef>087</AdministrativeAreaRef>
    <PlusbusZones>
        <PlusbusZoneRef>LANCSTR</PlusbusZoneRef>
    </PlusbusZones>
</StopPoint>
<StopPoint>
    <AtcoCode>9100LANCSTR</AtcoCode>
    <Descriptor>
        <CommonName>Lancaster Rail Station</CommonName>
        <Street>-</Street>
        </Descriptor>
        <Place>
            <NptgLocalityRef>E0057514</NptgLocalityRef>
            <MainNptgLocalities>
                <NptgLocalityRef>E0006137</NptgLocalityRef>
                ...
                <NptgLocalityRef>N0078733</NptgLocalityRef>
            </MainNptgLocalities>
        <LocalityCentre>1</LocalityCentre>
        <Location>
            <Translation>
                <GridType>UKOS</GridType>
                <Easting>347230</Easting>
                <Northing>461720</Northing>
                <Longitude>-2.80745759975</Longitude>
                <Latitude>54.04872996399</Latitude>
            </Translation>
```

```
                </Location>
            </Place>
            <StopClassification>
                <StopType>RLY</StopType>
                <OffStreet>
                    <Rail>
                        <AccessArea />
                        <AnnotatedRailRef>
                            <TiplocRef>LANCSTR</TiplocRef>
                            <CrsRef>LAN</CrsRef>
                            <StationName>Lancaster Rail Station</Station…
                            <Location>
                                <GridType>UKOS</GridType>
                                <Easting>347230</Easting>
                                <Northing>461720</Northing>
                            </Location>
                        </AnnotatedRailRef>
                    </Rail>
                </OffStreet>
            </StopClassification>
            <StopAreas>
                <StopAreaRef>910GLANCSTR</StopAreaRef>
            </StopAreas>
            <AdministrativeAreaRef>110</AdministrativeAreaRef>
            <PlusbusZones>
                <PlusbusZoneRef>LANCSTR</PlusbusZoneRef>
            </PlusbusZones>
        </StopPoint>
    </StopPoints>
    <StopAreas>
        <StopArea>
            <StopAreaCode>910GLANCSTR</StopAreaCode>
            <Name>Lancaster Rail Station</Name>
            <AdministrativeAreaRef>110</AdministrativeAreaRef>
            <StopAreaType>GRLS</StopAreaType>
            <Location>
                <Translation>
                    <GridType>UKOS</GridType>
                    <Easting>347230</Easting>
                    <Northing>461720</Northing>
                    <Longitude>-2.80745759975</Longitude>
                    <Latitude>54.04872996399</Latitude>
                </Translation>
            </Location>
        </StopArea>
    </StopAreas>
</NaPTAN>
```

Notice the rail specific annotation shown in blue, how each entrance is listed separately, and that the highlighted *AdministrativeAreaRef* codes reference entries in the National Public Transport Gazetteer – See: Appendix H: Example NPTG Entry

Appendix H: Example NPTG Entry

Lancaster

```
<NationalPublicTransportGazetteer>
    <Regions>
        <Region>
            <RegionCode>GB</RegionCode>
            <Name xml:lang="en">Great Britain</Name>
            <Country>UK</Country>
            <AdministrativeAreas>
                <AdministrativeArea>
                    <AdministrativeAreaCode>110</AdministrativeAreaCode>
                    <AtcoAreaCode>910</AtcoAreaCode>
                    <Name>National - National Rail</Name>
                    <ShortName>National - Rail</ShortName>
                    <National>0</National>
                    <NaptanPrefixes>
                        <AlphaPrefix>nre</AlphaPrefix>
                    </NaptanPrefixes>
                </AdministrativeArea>
                <AdministrativeArea>
                    <AdministrativeAreaCode>087</AdministrativeAreaCode>
                    <AtcoAreaCode>250</AtcoAreaCode>
                    <Name>Lancashire</Name>
                    <ShortName>Lancs</ShortName>
                    <NptgDistricts>
                        <NptgDistrict>
                            <NptgDistrictCode>111</NptgDistrictCode>
                            <Name>Lancaster</Name>
                        </NptgDistrict>
                    </NptgDistricts>
                    <National>0</National>
                    <NaptanPrefixes>
                        <AlphaPrefix>lan</AlphaPrefix>
                    </NaptanPrefixes>
                </AdministrativeArea>
            </AdministrativeAreas>
        </Region>
    </Regions>
    <NptgLocalities>
        <NptgLocality>
            <NptgLocalityCode>E0057514</NptgLocalityCode>
            <Descriptor>
                <LocalityName xml:lang="EN">Lancaster</LocalityName>
            </Descriptor>
            <AdministrativeAreaRef>087</AdministrativeAreaRef>
            <NptgDistrictRef>111</NptgDistrictRef>
            <SourceLocalityType>US</SourceLocalityType>
            <Location>
                <Translation>
                    <Easting>347650</Easting>
```

```
                    <Northing>461584</Northing>
                    <Longitude>-2.80102</Longitude>
                    <Latitude>54.04755</Latitude>
                </Translation>
            </Location>
        </NptgLocality>
    </NptgLocalities>
</NationalPublicTransportGazetteer>
```

Appendix I: VMs and Containers

MyLab VM

If you wish to use mylab we recommend SCC Scafell for use in SCC.200.

Containers

It is likely that you will want to bring up webservers, databases, etc. to form part of your infrastructure. The easiest way to do this is to run these as containers on lab machines or your laptops – this is how we're running the back-end services providing the feeds.

Podman is installed on the lab machines as it is more suited to the lab environment than Docker, although both appear very similar in use. There is plenty of documentation online that can be found with a web search or AI.

There's lots you can do such as bringing up private networks, etc. but if, for example, you just wanted to bring up your own MySQL server you might run the commands:

```
podman pull docker.io/library/mysql:latest
```

```
podman run -d --name mysql-pod \
    -e MYSQL_ROOT_PASSWORD=myAdminPassword \
    -e MYSQL_DATABASE=mydb \
    -e MYSQL_USER=myuser \
    -e MYSQL_PASSWORD=myuserPassword \
    -v /tmp/mysql:/var/lib/mysql \
    -p 53306:3306 \
    mysql:latest
```

```
podman ps
```

At this point you should see MySQL running and listening on host port 53306, which is mapped to the normal MYSQL port (3306) inside the container. **Note only TCP ports 5000-5100 are usable between lab machines.** Similarly, anything the container stores in `/var/lib/mysql` should be visible within the host directory `/tmp/mysql`, which allows data to persist outside the container and across container restarts. In practice, you would need to use your H-Drive as /tmp is not persistent.

Other useful commands are:

```
podman logs mysql-pod
```

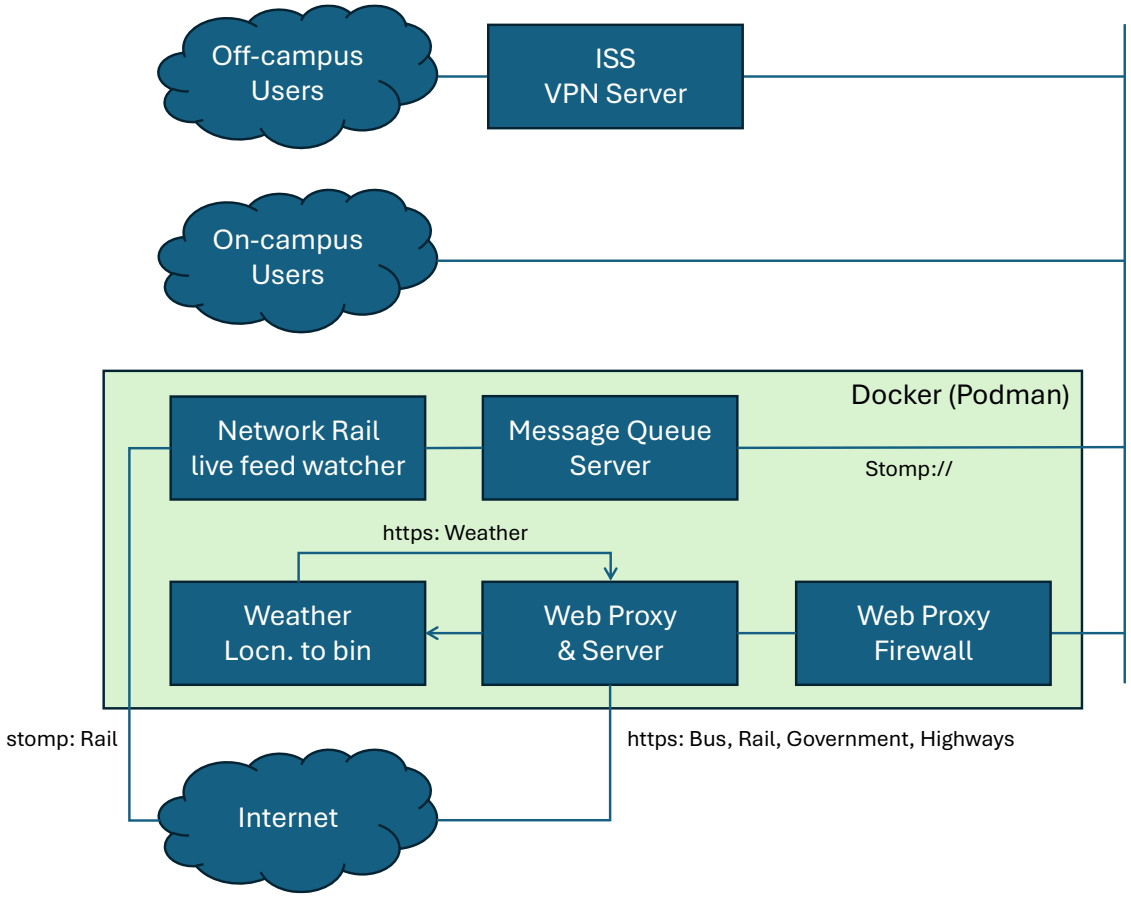
```
podman stop mysql-pod
```

```
podman start mysql-pod
```

A list of pre-built images can be found at https://hub.docker.com/u/library, but stick to those listed as **Docker Official Images** as these should be safe for use.

Appendix J: Server Architecture

If you're interested in the backend services, you can see how the server, transport.scc.lancs.ac.uk, is configured below.



Appendix K: Some Existing Apps and Systems

Archway Travel: https://archwaytravel.co.uk/live-times/

Bus Times.org: https://bustimes.org/map#12/54.03653/-2.79778

National Rail: https://www.nationalrail.co.uk/live-trains/departures/preston-lancs/

Northern: https://webcis.northern.ketech-uis.com/departures?target=PRE

Open Train Times: https://www.opentraintimes.com/maps/signalling/lancaster

Rail announcements: https://railannouncements.co.uk/amey-live-train-announcements/

Realtime Trains: https://www.realtimetrains.co.uk/search/detailed/gb-nr:LAN

Signalbox: https://www.signalbox.io/

Stagecoach: https://www.stagecoachbus.com/plan-a-journey

Traveline: https://nextbuses.mobi/WebView/BusStopSearch/BusStopSearchResults/landagwp

Vail Data: https://vaildata.uk/maps/ecml?mode=live