Deliverable D6.2

Data report on network-related technical and operational data

Submission date: 17 June 2018
Lead contractor

UIC

Project Coordinator

University of Sheffield, USFD
Executive Summary

In the context of the project NeTIRail-INFRA WP6, a railway network-related technical and operational data collection for supplying the GIS-based web application is required.

The European Register of Infrastructure (RINF) data provides adequate, network-related technical information for Europe (EU). The state of progress and the foreseen evolution of RINF make alternative data sources obsolete.

The integration of operational data from MERITS, as envisaged in the Grant Agreement, is sought but not certain, given the current change in MERITS project governance.

It is necessary to ensure integration of RINF collected data into the GIS-based web application. For that purpose, a hosting database structure has been defined, which reflects the RINF topology and matches the requirements for developing a Web-based GIS application as foreseen under WP6.2. Python as a development language, Django as a framework, and PostgreSQL 9.6 as a database system, are being used; these choices are adequate for open-sourcing.
# Table of contents

Executive Summary ........................................................................................................... 3
Table of contents .................................................................................................................. 4
Abbreviations and acronyms ............................................................................................... 5
1. Requirements ................................................................................................................... 6
   1.1 Background ............................................................................................................... 6
   1.2 Data requirements for GIS-based web application ................................................... 6
2. Basic dataset: RINF data ................................................................................................. 6
   2.1 Presentation of RINF Data ....................................................................................... 6
   2.2 Data availability and ownership .............................................................................. 6
   2.3 Exploration of RINF data ....................................................................................... 7
      2.3.1 Data structure ................................................................................................. 7
      2.3.2 Detailed data ................................................................................................. 7
      2.3.3 Data completeness ....................................................................................... 8
2.4 Conclusion .................................................................................................................... 8
3. Using the RINF data set ................................................................................................. 8
   3.1 How to incorporate RINF data into the target database ........................................... 8
   3.2 Managing the data .................................................................................................. 9
   3.3 How to persist RINF data set ................................................................................. 10
   3.4 Conclusion ............................................................................................................. 10
4. Further data .................................................................................................................... 10
   4.1 Outside the EU ....................................................................................................... 10
   4.2 Inside the EU ......................................................................................................... 10
      4.2.1 Additional parameters .................................................................................... 10
      4.2.2 Data mapping .................................................................................................. 11
5. Conclusions ................................................................................................................... 11
6. References ...................................................................................................................... 11
## Abbreviations and acronyms

<table>
<thead>
<tr>
<th>Abbreviation / Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EUAR</td>
<td>European Union Agency for Railways</td>
</tr>
<tr>
<td>ERTMS</td>
<td>European Railway Traffic Management System</td>
</tr>
<tr>
<td>FR</td>
<td>France</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographical Information System</td>
</tr>
<tr>
<td>MERITS</td>
<td>Multiple European Railways Integrated Timetable Storage</td>
</tr>
<tr>
<td>OP</td>
<td>Operational Point</td>
</tr>
<tr>
<td>RINF</td>
<td>European Register of Infrastructure</td>
</tr>
<tr>
<td>SoL</td>
<td>Section of Line</td>
</tr>
<tr>
<td>TSI</td>
<td>Technical Specification for Interoperability</td>
</tr>
<tr>
<td>UK</td>
<td>United Kingdom of Great Britain and Northern Ireland</td>
</tr>
<tr>
<td>UML</td>
<td>Unified Modeling Language</td>
</tr>
<tr>
<td>XML</td>
<td>Extensible Markup Language</td>
</tr>
</tbody>
</table>
1. Requirements

1.1 Background
The major goal of deliverable 6.2 is to report the state of data collection analysis and the integration of these data into the GIS-based web application.

1.2 Data requirements for GIS-based web application
The data must:
- contain geographic references for the purpose of connecting all other geographic objects (data) and visualizing them simultaneously.
- be both manageable and computable in GIS application.
- provide rail infrastructure information to help a better understanding of European rail infrastructure, for the purpose of infrastructure procurement and maintenance planning.
- allow transport planners, infrastructure procurement, and maintenance staff to make strategic decisions

2. Basic dataset: RINF data

2.1 Presentation of RINF Data
The European Register of Infrastructure (RINF) is referred to by Article 49 of Directive (EU) 2016/797 and provides data concerning the main features of the European Railway infrastructure. The data are made public (Art. 1) and provide the actual values of railway infrastructure parameters listed in TSIs (Art. 1), also allowing prior checks of compatibility of rolling stock with infrastructure (Art. 2).

Furthermore, the RINF Decision obliges each Member State to nominate an entity (NRE) in charge of setting up and maintaining its register of infrastructure and to notify an implementation plan.1

2.2 Data availability and ownership
RINF data are publicly available. The current public website hosted by the European Agency for Railways (EUAR). It does not, however, provide access to “bulk” data (e.g. for a complete network), but rather by network element. UIC therefore sought and obtained bulk access to data for the purpose of the Project (Dec. 2016), first with subsets (FR, UK), then the whole available data.

The RINF dataset is made available to Member States by the EUAR website in XML format; this access has been

---

1 http://www.era.europa.eu
extended to UIC for the purpose of the Project. According to the analysis of XML files performed in November 2016, RINF currently includes the networks of 21 Member States.

Two NeTIRail-INFRA consortium members do not have their national networks documented in RINF, namely Turkey (as it is no EU Member State) and Romania (as data collection is still ongoing).

### 2.3 Exploration of RINF data

#### 2.3.1 Data structure

The RINF dataset is primarily composed of “Operational Points” (OPs) and “Section of Lines” (SoLs). Each OP has a geographic coordinate, and it is linked to end or start of a SoL, which means that RINF dataset is integrable into a GIS-based web application.

RINF can easily be mapped to other macro-level representations of the railway network, i.e. those not distinguishing between tracks or not detailing the contents of railway nodes.

#### 2.3.2 Detailed data

RINF contains technical information associated with each OP and SoL. These are:

- descriptive parameters such as overhead contact line system, signalling subsystem, tunnels, platforms, ... making reference to TSIs or standards.
- Performance parameters, such as speed limit or axle load limit.

The metadata (parameter lists) partly suits the needs of the project:

- Descriptive parameters are more numerous than strictly necessary for characterizing line sections;
- Operational and commercial parameters are, as expected, missing.

A detailed account of RINF parameters deemed useful is given under Annex 1 (below). This list is currently under review with other project participants.

The parameters will be further investigated under the Project, in order to determine computation rules used by the Web Application. Roughly speaking, parameters are either extensive, or intensive.

Extensive parameters of different line sections, such as line length or track length, will sum up when considered the union of said line sections.

Intensive parameters do not sum up, but can be compared and, in most cases, can be summarized in a meaningful and useful way.

*For instance, if line section A and line section B are electrified under 25kV under 1.5kV respectively, the most meaningful conclusion about sections “A and B” is that they are electrified. For axle loads limits, if the values are 22.5t and 20t respectively, the limit applying to A+B is 20t. If A has ERTMS and B has not, then A+B has no (available, usable) ERTMS.*

A systematic characterization of the selected parameters (derived from Annex 1), including meaningful computation rules for qualitative or intensive parameters, has yet to take place before the end of the project.

---

2 List of Member states for which data can be found in the RINF dataset:
AT, BE, BG, CZ, DE, DK, EL, ES, FI, FR, HR, IT, LU, LT, LV, NL, PL, PT, SE, SI, UK
2.3.3 Data completeness
Data have been made available in RINF for 21 Member States. However, while the provided networks (sets of SoLs and OPs) seem to be complete, parameters are far from being available systematically. We have therefore selected a set of parameters in order to:

- Meet the Project basic needs, and
- Avoid “patchy”, and therefore unusable, data.

The resulting parameter culling is materialized by Annex 1.

2.4 Conclusion
Given the current state of completeness, the level of detail, the quality of the data and the legal basis of RINF, it is an adequate primary source for the NeTIRail-INFRA application.

This choice is reinforced by:

- The European Agency for Railways being open to release bulk data;
- The ongoing interest of stakeholders to enhance RINF usability for further purposes [insert: link with Agency Work Programme].

The consequence is that other sources, as mentioned in the Grant Agreement, will play a very secondary role (see dedicated section hereunder).

3. Using the RINF data set

3.1 How to incorporate RINF data into the target database
The described RINF metadata should be integrated into the application by first establishing a UML class diagram.

Basing on a UML diagram, we designed a database in which the RINF dataset (provided as XML files) can be stored. This database structure will allow to use infrastructure information proposed by RINF in the GIS-based web application.

The technology used is Python (as a programming language) and Django (web application development framework), which is also the same used for the development of the GIS-based web application. This choice reduces complexity, and is in line with the aim of delivering an open source application: Python and Django are license-free, open source projects.

The python libraries psycopg2, lxml will be used for the loading of RINF XML files in the GIS-based web application.³

³ Python POC Code of import RINF data collection can be provided
3.2 Managing the data

RINF data can be manipulated using the following UML class model:

The data model is “centred” on the RINF topology concepts (OP, SoL), to ensure its usability by the web application.
3.3 How to persist RINF data set

The data will be persisted by our application in a PostgreSQL 9.6 database system. See annex 3 for a more readable view.

![Target Database Structure](image)

Figure 3 - Target Database Structure (see also Annex 3 for an enlarged view)

Since we expect the RINF parameters (metadata) to evolve with time, these parameters are not “hard coded” as attributes in tables; instead, the Parameter table will be able to store those parameters deemed useful, including newly created ones. The same table will allow the storage of project-specific or user-defined parameters, if any.

3.4 Conclusion

As mentioned previous chapters, the RINF data structure meets the need of an GIS-based application. It is therefore possible to integrate the collected RINF data with the solutions prescribed in this deliverable.

4. Further data

4.1 Outside the EU

TCDD network data are only available as shape files for the time being, except for the line sections under consideration in the project. As a minimum, these line sections shall be added manually, using the RINF-based file structure.

4.2 Inside the EU

4.2.1 Additional parameters

More data sets are worth reconsidering:

- UIC EURAIL DATA MAP aged data:
  - Technical parameters are superseded by the RINF data collection
  - Operational and economic parameters are definitely “aged”, but currently have no equivalent in RINF. The parameters (metadata) shall be reviewed and
integrated into the database structure, if relevant to the Project or to foreseeable future usage.
- MERITS passenger train data: the parameter of interest is the average, daily number of trains running through a line section or stopping at a station. However, given the current governance change in the MERITS project, the integration of MERITS-derived data into the Project Database has yet to be formally approved.
- Other sources (direct contribution by Project members)

4.2.2 Data mapping
In any case, it will be necessary to map (not by hand!) the network data from “other sources” to the network structure established by RINF, in order to map the parameter values associated with sections of line. Once the mapping stage is overcome, computation rules (extensive / intensive data etc., see above) will allow to integrate the source data into the destination database.

5. Conclusions
WP6 needs to provide technical infrastructure information for railway players. RINF data and the proposed database structure fulfil this requirement.

Given the lack of information for NeTIRail-INFRA consortium members in RINF, these members will be contacted soon in order to fill the gap.

6. References
1. RINF Application Guide version 1.2.1
DESCRIPTION OF BASIC FEATURES OF THE RINF

Line: A line is a continuous chain of sections of lines and operational points when except beginning and end of a line, the OP at end of a SoL is the OP at start of consecutive SoL. So a “line” is an aggregation of continuous interconnected OPs and SoLs in such a way that it can be seen as an area-entity with (possibly) common equal characteristics.

Section of line (SOL): Sol means part of line between adjacent operational points and may consist of several tracks. The SOLs are linked to lines. A single SOL may be settled to be a line at its own. A section of line is the connection between two adjacent OPs.

Operational point (OP): An operational point (OP) is a demarcated area on the micro topology of the railway network which has, as one coherent unit, a function in routing and time-tabling of train services on macro-level. OP also means any location at boundaries between Member States or infrastructure managers.

Track: A track has defined boundaries and normally it is only a part of a rail-section, marked out by its boundaries. A track is locally identified by a unique local code combined with an Operational Point or SoL code.

Micro Level: “Micro-level” means the detailed railway network defined for sections of line by tracks and for operational points by tracks and sidings.

Macro Level: ‘Macro-level’ means the overall railway network defined by sections of line and operational points.

LIST OF SELECTED TECHNICAL PARAMETERS OF RINF FOR WP6.1, NETIRAIL

Infrastructure Subsystem

Performance parameters

- TEN classification of track: Indication of the part of the trans-European network the line belongs to
- Category of Line: Classification of a line according to the INF TSI
- Part of a Railway freight corridor: Indication whether the line is designated to a Railway Freight Corridor
- Load Capability: A combination of the line category and speed at the weakest point of the track
- Maximum permitted speed: Nominal maximum operational speed on the line
- Temperature range: Temperature range for unrestricted access to the line according European standard
- Maximum altitude: Highest point of the section of line above sea level

Line layout
- **Interoperable gauge**: Gauges GA, GB, GC G1, DE3, S, IRL1 as defined in European standard.
- **Multinational gauges**: Multilateral gauge or international gauge other than GA, GB, GC, G1, DE3, S, IRL1 as defined in European standard.
- **National gauges**: Domestic gauge as defined in European standard or other local gauge.
- **Standard combined transport profile number for swap bodies**: Coding for combined transport with swap bodies as defined in UIC Code.
- **Standard combined transport profile number for semi-trailers**: Coding for combined transport for semi-trailers as defined in UIC Code.
- **Gradient profile**: Sequence of gradient values and locations of change in gradient.
- **Minimal radius of horizontal curve**: Radius of the smallest horizontal curve of the track in metres.

**Track parameters**

- **Nominal track gauge**: A single value expressed in millimetres that identifies the track gauge.
- **Cant deficiency**: Cant deficiency is present when a vehicle's speed on a curve is greater than the speed at which the components of wheel to rail force are normal to the plane of the track.\(^5\)

In RINF, maximum cant deficiency expressed in millimetres defined as difference between the applied cant and a higher equilibrium cant the line has been designed for.
- **Rail inclination**: An angle defining the inclination of the head of a rail relative to the running surface.

**Switches and crossings**

- **Minimum wheel diameter for fixed obtuse crossings**: Maximum unguided length of fixed obtuse crossings is based on a minimum wheel diameter in service expressed in millimetres.

**Track resistance to applied loads**

- **Maximum train deceleration**: Limit for longitudinal track resistance given as a maximum allowed train deceleration and expressed in metres per square second.
- **Use of eddy current brakes**: Indication of limitations on the use of eddy current brakes.
- **Use of magnetic brakes**: Indication of limitations on the use of magnetic brakes.

**Health, safety and environment**

- **Use of flange lubrication forbidden**: Indication whether the use of on-board device for flange lubrication is forbidden.
- **Existence of level crossings**: Indication (Yes or No) whether level crossings exist on the section of line.
- **Acceleration allowed at level crossing**: Existence of limit for acceleration of train if stopping close to a level crossing expressed in metres per square second.

**Energy System**

**Contact line system**

---

\(^5\) Source: wikipedia
• **Type of contact line system**: Indication of the type of the contact line system.
• **Energy supply system**: Indication of the traction supply system (nominal voltage and frequency).
• **Maximum train current**: Indication of the maximum allowable train current expressed in amperes.
• **Permission for regenerative braking**: Indication whether regenerative braking is permitted or not.
• **Maximum contact wire height**: Indication of the maximum contact wire height expressed in metres.
• **Minimum contact wire height**: Indication of the minimum contact wire height expressed in metres.

**Pantograph**

• **Accepted TSI compliant pantograph heads**: Indication of which TSI compliant pantograph heads are allowed to be used.
• **Accepted other pantograph heads**: Indication of which pantograph heads are allowed to be used.
• **Requirements for number of raised**: Indication of maximum number of raised pantographs per train allowed and minimum spacing centre line to centre line of adjacent pantograph heads, expressed in metres, at the given speed.
• **Permitted contact strip material**: Indication of which contact strip materials are permitted to be used.

**Overhead Contact Line (OCL) separation sections**

• **System separation**: Indication of which contact strip materials are permitted to be used.
• **Information on system separation**: Indication of required several information on system separation.

**Control-Command and Signalling Subsystem**

**TSI compliant train protection system (ETCS)**

• **ETCS level**: ERTMS / ETCS application level related to the track side equipment.
• **ETCS baseline**: ETCS baseline installed lineside.

**TSI compliant radio (GSM-R)**

• **GSM-R version**: GSM-R version installed lineside.

**Train protection legacy systems**

• **Existence of other train protection, control and warning systems installed**: Indication if other train protection, control and warning systems in normal operation are installed lineside.

**Train detection systems not fully compliant with the TSI**

• **Type of train detection system**: Indication of types of train detection systems installed.
- TSI compliance of maximum permitted distance between two consecutive axles: Indication whether required distance is compliant with the TSI.
- Maximum permitted distance between two consecutive axles in case of TSI non-compliance: Indication of maximum permitted distance between two consecutive axles in case of TSI non-compliance, given in millimetres.
- Minimum permitted distance between two consecutive axles: Indication of distance given in millimetres.
- Minimum permitted distance between first and last axle: Indication of distance given in millimetres.
- Maximum distance between end of train and first axle: Indication of maximum distance between end of the train and first axle, given in millimetres, applicable for both sides (front and rear) of a vehicle or train.
- Minimum permitted width of the rim: Indication of width given in millimetres.
- Minimum permitted wheel diameter: Indication of wheel diameter given in millimetres.
- Minimum permitted thickness of the flange: Indication of flange thickness given in millimetres.
- Minimum permitted height of the flange: Indication of height of flange given in millimetres.
- Maximum permitted height of the flange: Indication of height of flange given in millimetres.
- Minimum permitted axle load: Indication of load given in tons.
- TSI compliance of rules on the use of composite brake blocks: Indication whether rules are compliant with the TSI.

Platform and Tunnel

Platform

- TEN Classification of platform: Indicates the part of the trans-European network the platform belongs to. (Comprehensive Network, Core Freight Network, Core Passenger Network Off-TEN)
- Usable length of platform: The maximum continuous length (expressed in metres) of that part of platform in front of which a train is intended to remain stationary in normal operating conditions for passengers to board and alight from the train, making appropriate allowance for stopping tolerances.
- Height of platform: Distance between the upper surface of platform and running surface of the neighbouring track. It is the nominal value expressed in millimetres.
- Existence of platform assistance for starting train: Indication of existence of equipment or staff supporting the train crew in starting the train.

Tunnel

- Length of tunnel: Length of a tunnel in metres from entrance portal to exit portal.
- Cross section area: Smallest cross section area in square metres of the tunnel.
- Existence of emergency plan: Indication (Yes or No) whether emergency plan exists.
- Fire category of rolling stock required: Categorisation on how a passenger train with a fire on board will continue to operate for a defined time period. (A, B, None)
• **National fire category of rolling stock required:** Categorisation on how a passenger train with a fire on board will continue to operate for a defined time period - according to national rules if they exist.
D6.2 – Data Report – Annex 2: UML diagram for database

NeTIRail-INFRA
H2020-MG-2015-2015 GA-636237
2015/09/09