# Requirements Specification


# DP-RAIL

## Digital Platform for Rail Freight

Version 1.0 – 28 September 2023

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DP- RAIL is an EU funded project, Grant number 10112265

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# 1 Definitions

DP-RAIL – Digital Platform Rail

TAF-TSI: Technical Specification for Interoperability relating to Telematics Applications for Freight

| | |
|---|---|
| API | Application Programming Interface |
| CI | Common Interface (of TAF/P) |
| CRD | Common Reference Data (of TAF/P) |
| ECN | Electronic Consignment Note |
| ETA | Estimated Time of Arrival |
| IM | Infrastructure Manager |
| RD | RailData |
| RFF | Rail Freight Forward |
| RU | Railway Undertaking |
| SWL | SingleWagonLoad |
| TCM | Train Composition Message |
| TRA | Train Running Advice |
| TRF | Train Running Forecast |
| UIC | Union Internationale des Chemins de fer |
| WDI | Web Data Interface |
| WDR | Wagon Damage Report |
| WPM | Wagon Performance Message |
| WSM | Wagon Status Message |

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# 2 Purpose

The purpose of this document is to specify the requirements (both functional as well as non-functional) for the technical data platform to be established as part of the DP-RAIL initiative. The requirements are listed as of Chapter 4 and form an essential artefact in the tender process and the selection of a tech partner to develop the prototype.

# 3 Background information DP-RAIL

## 3.1 Context Rail Freight Forward

Spurred on by the Rail Freight Forward (RFF) initiative, the railway sector acknowledged that only a collective approach to the issue of data exchange would deliver the much-needed benefits for the sector and for society. This has led to the proposal to create a Digital Platform with the objective to remove interoperability barriers in the freight market.

The "Digital Platform for Rail Freight" (DP-RAIL) project aims to achieve a decisive leap towards completing the SERA by transforming the current fragmented data exchange landscape through the set-up of a TAF-TSI compliant common interface enabling easy data provision and consumption for all RUs.

## 3.2 Data exchange in rail freight: current state of play

In the current European rail freight landscape, a lot of critical data is being produced and there will be more to come with the introduction of new technologies such as the Internet of Things and Edge Computing. However, the full potential of the currently available data is not being leveraged and data exchange between rail freight ecosystem entities is limited. Manual processes are still frequent (especially amongst smaller size companies) and bilateral exchanges are still the norm, leading to inefficiencies in the system, such as loss of time, sub-optimal use of capacity and human errors.

In recent years, efforts have been made to improve data exchange in rail freight operations to enhance efficiency, interoperability, and transparency across the European rail network. These initiatives aim to facilitate seamless information sharing between various stakeholders involved in rail freight, such as railway companies, freight forwarders, infrastructure managers, and shippers.

One key development in this area is the implementation of the European Rail Traffic Management System (ERTMS). ERTMS is a standardized signalling and train control system that allows for the exchange of real-time data between trains and the infrastructure. It helps optimize train movements, improve safety, and enhance the overall performance of the rail network.

Additionally, the digitalization of rail freight operations has gained attention, enabling more efficient data exchange. Various digital platforms and solutions have emerged to facilitate information sharing and collaboration among different actors in the rail freight ecosystem. These platforms often provide functionalities such as real-time tracking and tracing of shipments, electronic data interchange (EDI), and digital documentation management.

Lastly, initiatives like the European Rail Freight Corridors (RFCs) aim to improve cross-border rail freight operations by harmonizing procedures, infrastructure, and data exchange along specific routes. RFCs work towards enhancing cooperation among infrastructure managers, railway undertakings, and other stakeholders involved in international rail freight transportation.

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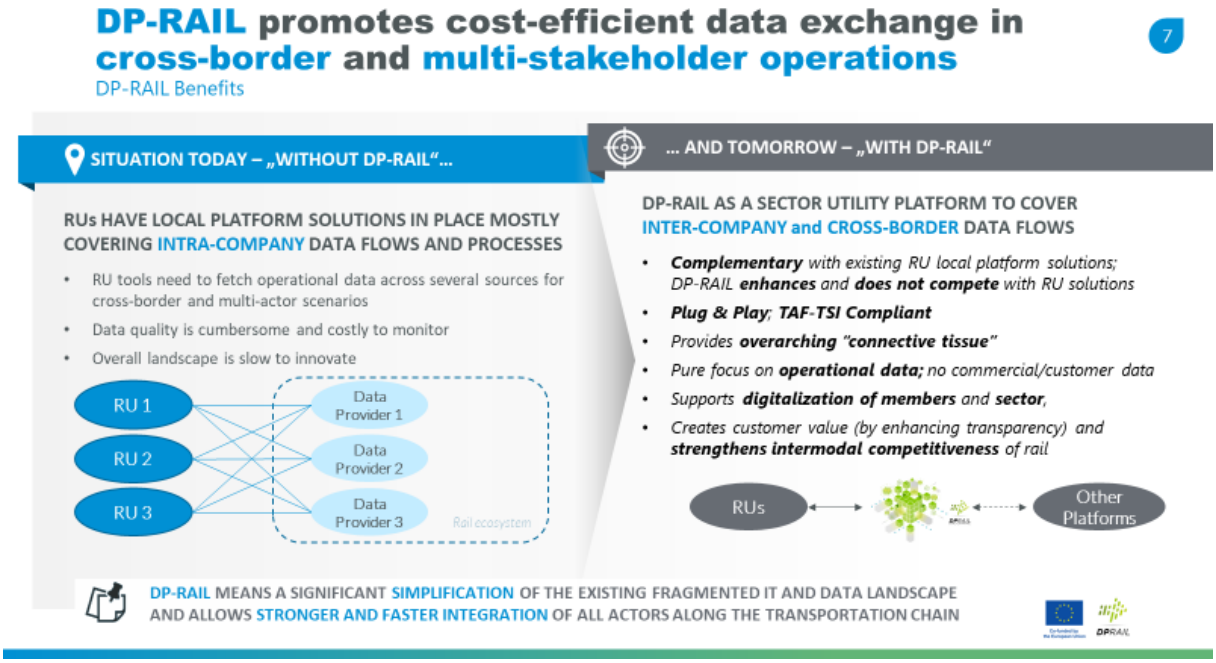


Figure 1: Situation today and tomorrow for operational data exchange.

## 3.3 Strategic Objectives of DP-RAIL and Expected Benefits

By 2026, we want to achieve seamless, interoperable data exchange for core rail freight operations through a trusted digital ecosystem. The objectives of DP-RAIL are:

- To enable seamless interoperable data exchange across borders and companies
- To allow low-cost integration of small(er) entities and players
- To enhance standardisation and support TSI implementation
- To avoid multilateral, customized and costly interfaces
- To reduce manual data gathering efforts for participating entities
- To enable better utilization of capacity
- To support EU environmental goals
- To enable for future 3rd party innovation

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The DP-RAIL project (co-funded by the European union) will develop a prototype for a data exchange platform built around four distinct use cases until 2026. This prototype will serve as a decision-making tool regarding data exchange in the rail freight sector.

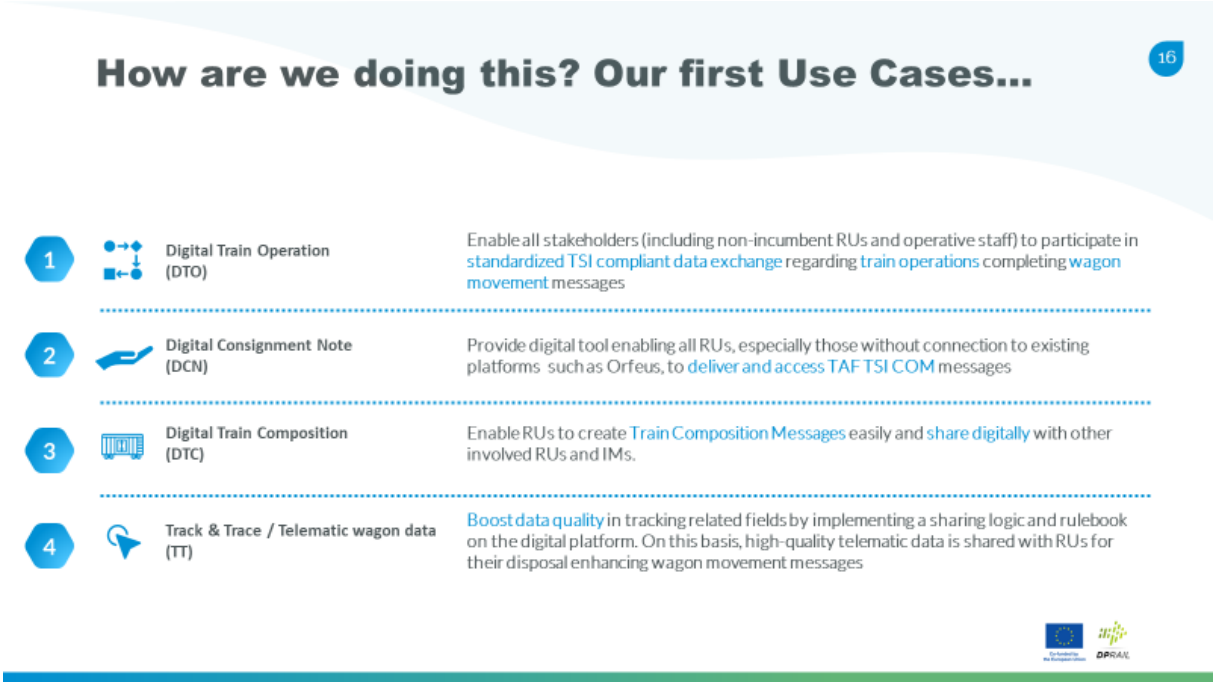


Figure 2: four use cases to be developed as part of the DP-RAIL initiative with a data platform prototype

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**Important note:**

The following chapters contain the functional and non-functional requirements for DP-RAIL platform for both the future target picture (full scope) and the prototype as the basis for the tender.

Whenever the scope of the prototype deviate from the scope of the future target picture, then it is clearly marked at the end of each chapter and listed as follows (examples):

- *Prototype*: Profile for users is generated and maintained by system administrators based on input provided by users; all information shall be handled with appropriate confidentiality.
- *Prototype*: not relevant, no DP-RAIL specific frontend will be provided

If the scope and, therefore, the requirements for full scope and prototype correspond, no extra reference for the prototype scope is given. Nevertheless, the technical architecture of the platform for the prototype shall enable the target picture by being scalable, flexible and offering basic services to be extended.

# 4 Functional Requirements

## 4.1 Overview Platform Functionalities

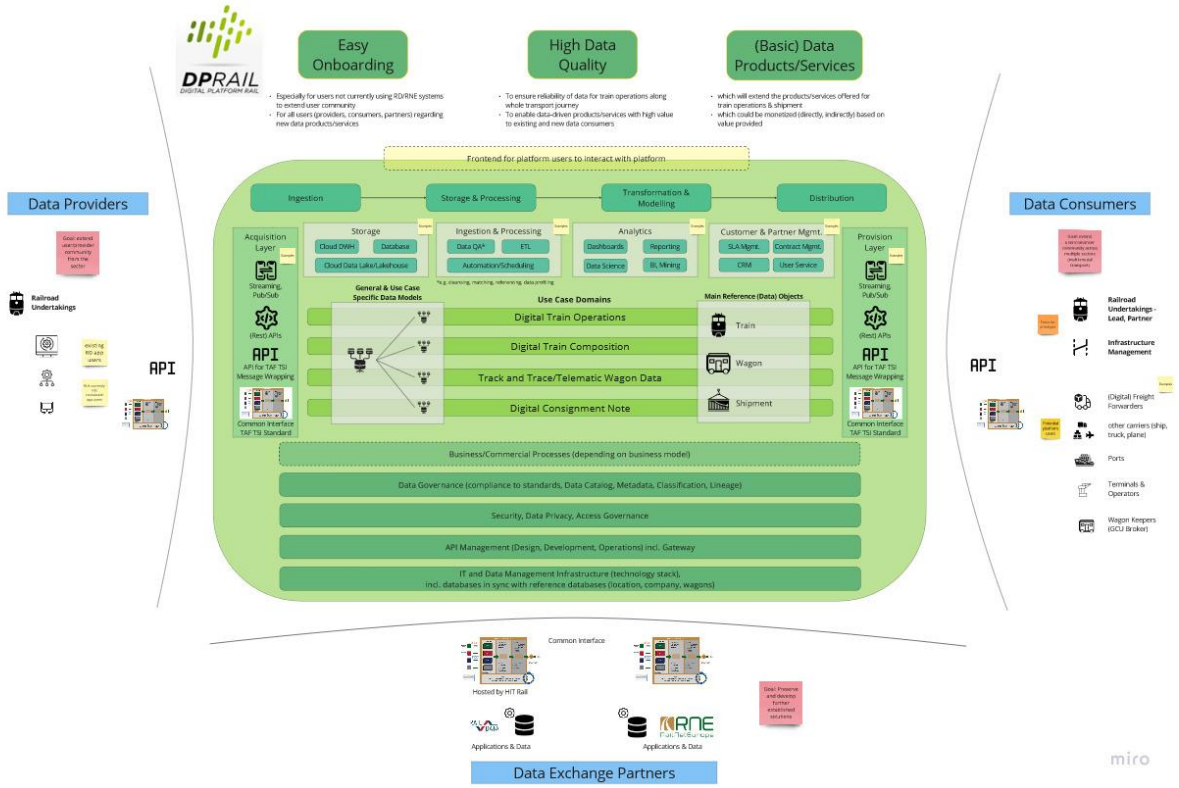


Figure 3: Target picture of DP-RAIL Platform Business Architecture

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The platform will act as a data exchange for all parties involved – data providers, data consumers and partners – to realize maximum benefits for users based on the 4 use cases defined:

1. Digital Train Operations: TSI compliant data exchange for freight train operations
2. Digital Train Composition: enable the creation and exchange of Train Composition Messages between RUs and other involved RUs and IMs for cross-border transports
3. Track and Trace/Telematic Wagon Data: enable access to and exchange of telematics data for enhanced wagon movement messages
4. Digital Consignment Note: exchange of consignment order messages compliant with TAF TSI

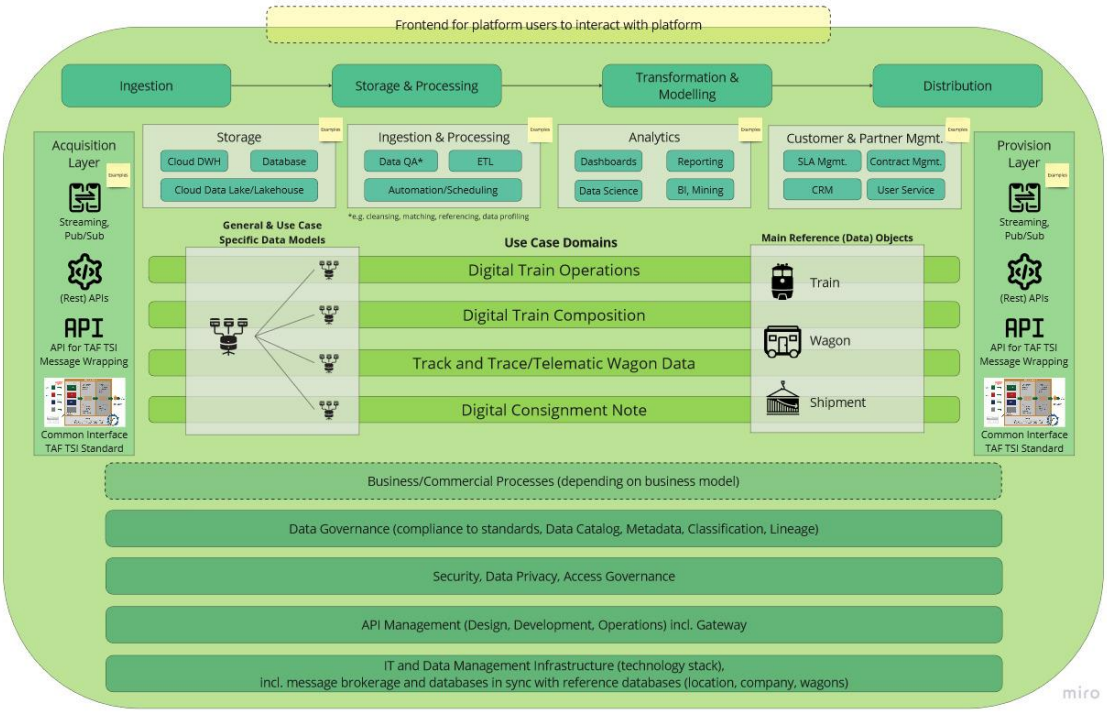


Figure 4: Zoom-in on Capabilities of DP-RAIL

The platform will support the data exchange across all 4 use cases:

- Facilitate data exchange based on the data and message models and standards defined, e.g.
    - General TAF TSI standard data and message model / TAF reference files
    - Data and message model for platform
    - Data and message models for each use case (domain)
- Provide functionality for integration via standardized interfaces (as laid out in the Acquisition and Distribution Layer) to enable easy data/message ingestion and consumption

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- Process data and messages based on rules set by the use cases along data value chain: ingestion – storage & processing – transformation & modelling – distribution and based on message standards, especially TAF TSI

- Ensure high data quality with quality assurance services

- Ensure data security along the value chain based on rule set defined

To ensure future viability the components of the platform shall be cloud-based and based on independent services which build on existing services of either data exchange partners (RailData, RNE) or existing solutions on the market.

## 4.2 User Management

### 4.2.1 Registration and Authentication

Validation and activation of the user account is handled by the participating organization through own platform administrator in a self-organized manner based on the user roles and permissions set by the platform. The initial organizational account is validated and activated by the system administrator.

Users shall be able to register for an account on the platform using their email address. Registrations from different corporate e-mail domains are to be supported.

The registration process shall include a verification step to ensure the user's identity, e.g. confirmation of e-mail address used for registration. An e-mail template shall be provided in different languages based on the language set by the user device or browser (localization).

*Prototype*: Organizations participating in the prototype are registered by system administrator and will receive their credentials to be used for platform access.

Users shall be able to log in or connect to the platform using their chosen credentials.

Naturally, the password requirements follow best practices such as:

- Minimum Length: Set a minimum password length, typically between 8 to 12 characters, to ensure passwords are not too short and easily guessable.

- Complexity: Require a combination of uppercase letters, lowercase letters, numbers, and special characters to create a more secure password.

- Avoid Common Passwords: Implement checks to prevent users from using commonly used passwords or dictionary words to enhance password strength.

- Password Expiration: Set a password expiration policy that prompts users to change their passwords periodically (e.g., every 90 days) to mitigate the risk of compromised accounts.

- Account Lockout: Implement an account lockout mechanism that temporarily locks a user's account after a certain number of failed login attempts to prevent brute-force attacks.

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- Password History: Enforce password history to prevent users from reusing their previous passwords and encourage them to choose unique passwords each time.

- Two-Factor Authentication (2FA): Provide an option for users to enable two-factor authentication, such as SMS verification codes or authenticator apps, to add an extra layer of security to their accounts.

- Password Strength Meter: Provide a real-time password strength meter that guides users in creating strong passwords and indicates the strength of their chosen password.

Users shall be able to change and reset password strictly following the requirements set for the initial password.

1. Change password: users change password in the user profile management stating the existing and new password and confirming the new password

2. Reset password: users trigger the password reset process from the login screen. They shall provide the e-mail-address registered and receive a notification with further instructions how to reset password. The notification shall be provided in different languages based on the language set by the user device or browser (localization).

*Prototype*: Password reset is initiated by the user but is carried out by the system administrators.

### 4.2.2 User Roles and Permissions

The platform must support multiple user roles, such as data providers, data consumers, partners, and administrators.

Each user role shall have a specific set of permissions to provide, access and interact with data on the platform. The platform shall also support technical users without a personal profile but needed to interact automatically with the platform and partners through the platform.

Administrators must have the ability to manage user roles and permissions including creating new roles and modifying existing roles.

We currently distinguish the following roles on the DP-RAIL platform:

#### 4.2.2.1. Data Providers

Data Collection Entities: These users are responsible for collecting and generating data related to rail freight operations. They could be sensors, IoT devices, or other systems that capture data such as train location, shipment details, temperature, or performance metrics.

#### 4.2.2.2. Data Consumers

Analysts: These users utilize the data available in the platform to perform analysis, generate insights, and make data-driven decisions related to rail freight operations. They may use statistical models, visualization tools, or reporting capabilities to interpret the data.

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Planners: These users utilize the data platform to plan and optimize rail freight operations, including resource allocation, scheduling, and route planning.

Executives and Managers: Users in leadership roles utilize the data platform to monitor key performance indicators (KPIs), track operational efficiency, and make strategic decisions based on the insights derived from the data.

4.2.2.3. Partners

Partners are providing complementary and additional services to platform users. They are (technically) closely connected to the platform and constantly interacting with the platform using standardized interfaces (like Common Interface). User of the platform may also be users of partners therefore the platform shall support ways for straight through processing from platform to partner application and vice versa including credential handling (e.g. Single Sign On/SSO).

4.2.2.3. Administrators:

System Administrators: These users are responsible for managing the overall operation and maintenance of the rail freight data platform. They handle tasks such as user management, system configuration, security, and ensuring data integrity.

Data Administrators: Users in this role manage data governance, data quality, and data access control. They define and enforce data standards, policies, and procedures within the platform.

4.2.2.4. System Integrators:

Developers: These users are responsible for integrating the rail freight data platform with other systems, applications, or external APIs. They develop custom functionalities, build data connectors, and handle API integrations.

### 4.2.3 User Profile Management

Users shall be able to manage their profile information, including their name, email address, contact information, and profile picture. They shall also have the option to provide additional details, such as their organization, job title, or department.

Users shall be able to update their notification settings and preferences, including email notifications and frequency of updates.

Users shall be able to change their password (see chapter 4.2.1).

The user profile shall be available in different languages based on the language set by the user, user device or browser (localization).

*Prototype*: Minimal profile for users must be generated and maintained by system administrators in database based on input provided by users; all information must be handled with appropriate confidentiality.

## 4.3 Data Governance

### 4.3.1 Data uploading and downloading

Data providers must be able to upload data sets and send messages to the platform based on roles and permissions using the options provided by the platform.

Data consumers must be able to download or request data sets of and receive messages from the platform based on roles and permissions using the options provided by the platform.

The platform shall therefore provide and support various means for data & message transfer:

- interfaces, such as Common Interface, Rest APIs, Streaming, Pub/Sub
- file formats, such as CSV, JSON, and XML
- protocols, such as SOAP
- networks, such as public internet / VPN and Hermes

The platform shall also provide capabilities regarding data export for analysis or compliance purposes.

*Prototype*: Platform must support the following interfaces including underlying file formats & protocols:

- Common Interface as described in chapter 4.8.1
- Rest APIs as described in chapter 4.8.2

### 4.3.2 Data Sharing and permissions

Users shall be able to specify in sharing controls and permissions who can access, process and download their data maintaining data privacy and security; see 4.5 for details.

*Prototype*: not relevant due to only test data used. All data on the prototype platform shall be accessible by all parties by default.

### 4.3.3 Data Catalog and organization (incl. search)

Data shall be catalogued, organized, and searchable based on metadata and relation of

- Use case/process
- Reference object (train, wagon, shipment)
- Attributes (of object, e.g. speed for train)
- Data point (e.g. 60 km/h for train speed)
- Source (origin of information)
- Level/degree of quality

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All requirements for data search on the DP-RAIL platform shall focus on providing users with efficient and effective ways to find the desired information

- Keyword Search:

  Users shall be able to perform keyword-based searches to find specific data related to rail freight operations.

  The search functionality shall support partial matching, stemming, and synonyms to improve search accuracy and relevance.

- Advanced Search Filters:

  The platform shall offer a range of advanced search filters to narrow down search results based on various criteria such as date, location, train ID, shipment ID, or specific parameters related to freight operations.

  Users shall be able to combine multiple filters to create complex search queries.

- Real-time Search:

  The search functionality shall provide real-time search results, updating dynamically as the user enters search queries or modifies filters.

  The platform shall efficiently handle and display search results, even when dealing with large datasets.

- Auto-suggestions and Autocomplete:

  The search interface shall offer auto-suggestions or autocomplete functionality to help users find relevant search terms or commonly used queries.

  This feature shall anticipate user queries based on their input and previous search patterns.

- Saved Searches and Favorites:

  Users shall have the ability to save their frequently used or favorite search queries for quick access in the future.

  The platform shall allow users to bookmark or tag specific search results for easy retrieval.

- Search Result Sorting and Ranking:

  The search functionality shall provide options to sort search results based on different criteria, such as relevance, date, or specific data attributes.

  The platform shall implement a ranking algorithm to prioritize more relevant search results based on user preferences and behavior.

*Prototype*: Platform must provide data catalog incl. metadata and functionality to search with keywords and advanced search filters based on all data being available in platform.

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### 4.3.4 Data Lineage and Data Classification

Data Lineage: The platform shall provide means and tools (e.g. patterns, tags) to support the process of understanding, recording, and visualizing data as it flows from data sources (data providers) to consumption (Data Consumers, Partners). This includes all transformation the data underwent along the way – how the data was transformed, what changed, and why.

Data Classification: The platform shall provide tools for assigning data into categories based on user-configured characteristics as a basis also for data security.

### 4.3.5 Data visualization and analytics

The platform shall provide data visualization tools, such as charts and graphs, to help users understand and interpret the data.

The platform shall provide tools and features to help users optimize their data sets for processing and analysis. The platform shall support basic data analysis features, such as drill-down, summary reviews and hierarchy.

*Prototype*: Platform must provide options to download data and reports in specified format for further analysis (e.g. xml-, csv-files).

## 4.4 Data Management

### 4.4.1 Data storage

The platform shall provide various means to store data cloud-based depending on requirements set by the use cases and based on general hosting requirements (see 5.10.1 for details). Regarding the platform certain overarching data storage functionality shall be provided:

- Databases reflecting external reference databases especially regarding company, location (station, train) and wagon. The reference databases of DP-RAIL need to be in sync with the external reference databases
- Warehouse or data lake (or combination: data lakehouse) to store data and messages for further processing and transformation
- Caching of data to improve performance and throughput for data and messages being processed

### 4.4.2 Data extraction, transformation and load

The platform shall provide ETL-features and tools for data extraction from different sources, transformation and conversion between different formats to match requirements of different users or systems as well as loading them into the data storage (e.g. database, data warehouse, data lake). Loading shall be possible in batch and real-time.

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### 4.4.3 Data and message processing

As laid out in section 4.8 the users of DP-RAIL platform will rely on fast data and message processing for their train operations based on the standardized TAF TSI message standard. The platform therefore shall provide functionality for fast transaction processing incl. brokerage to manage jobs based on rule sets (processing logic) and to balance load for processing, e.g. through message queues, data pipeline.

### 4.4.4 Data versioning

The platform shall support version control for data files and access to historical versions of data tracking all changes.

### 4.4.5 Data quality assurance

Users shall be able to run data quality checks and validations on processed data. The platform shall provide quality assurance features/tools to automatically ensure reliability of shared data based on KPIs and/or ranges defined:

- Completeness: data sets & messages are received/provided as defined, all requisite data is available for the use cases defined, no data (value) is missing
- Consistency: the data is consistent between systems / services on the platform and data values are the same across data sets used by use cases especially with reference data sets
- Conformity: data is exchanged in compliance with specified formats (like TAF TSI) and schemas (e.g. xml/xsd, JSON)
- Accuracy: data objects accurately represent the “real world” values they are expected to model. Checks on plausibility are performed – where possible – using other data sources for reference
- Integrity: the relations between entities and attributes are consistent across all systems, data sources and uses cases
- Validity: closeness of data value to predetermined values/ranges, acceptance rules or a calculation
- Timeliness: data incl. updates is available as defined and at the time needed
- Uniqueness: duplicate or overlapping data identified and marked

The platform shall therefore provide functionality for data cleansing, matching, referencing and data profiling including ability to automate such tasks ensuring constant quality controls. In addition, data quality measurements (automatically and manually) need to be enabled, also as a basis for quality reports and complaints. Consequently, reports and/or dashboards shall support data administrators of the platform to monitor data quality and analyse root causes for faults or significant deviations.

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## 4.5 Data Security and Privacy

### 4.5.1 Access Control and Encryption

The platform shall implement secure access control measures to ensure that users can only access the data and functionalities they are authorized for.

Access control shall be based on user roles and permissions, restricting unauthorized access to sensitive information or administrative features. Data owners shall be able to set and revoke permissions for their data (sets) and messages.

The platform shall enforce strong password policies to ensure user account security.

The platform shall use encryption to protect data in transit and at rest.

*Prototype*: Platform must provide basic functionality for access control and data encryption due to prototype acting on test data and all data on the prototype platform being accessible by all parties by default.

### 4.5.2 User Activity Monitoring

The platform shall record and log user activities, including login attempts, data access, and modifications made by users. Administrators shall have the ability to review user activity logs for security and auditing purposes. The platform shall provide alerts or notifications for suspicious or unauthorized user activities.

### 4.5.3 Data Anonymization, -Masking and De-Identification

The platform needs to support data anonymization and de-identification features to protect the privacy of individuals and organizations.

The platform shall therefore provide guidelines and best practices for data providers to follow when anonymizing or de-identifying data sets.

*Prototype*: not relevant

### 4.5.4 Compliance with Data Protection Regulations

The platform shall comply with relevant data protection regulations, such as the General Data Protection Regulation (GDPR).

The platform shall provide tools and features to help users comply with these regulations, such as data retention policies and data subject access requests.

*Prototype*: not relevant

## 4.6 Notification and Communication

### 4.6.1 System and User Notifications

The platform shall send notifications to users regarding updates to data sets, new data uploads, and system maintenance.

Users shall be able to opt in or out of specific notification types.

*Prototype*: not relevant

### 4.6.2 Message and Chat Features

The platform shall provide a centralized location for users to discuss data sets and ask questions.

*Prototype*: not relevant

## 4.7 Content Management

### 4.7.1 Content Management System

The platform shall provide tools for administrators to manage platform content including content moderation, automated and manual content review.

*Prototype*: not relevant

### 4.7.2 Content Management

The platform shall provide ability to create, edit, and delete content (e.g., text, images, videos). It shall also enable content categorization and tagging.

*Prototype*: not relevant

## 4.8 Integration and Interoperability

### 4.8.1 Common Interface (Application)

The platform must integrate the Common Interface (CI) as a TAF/TAP TSI message exchange peer to peer application to ensure integration with existing CI implementations on data provider, data consumer and partner side.

Especially to ensure handling TAF/TAP TSI messages with existing applications from RailData (RD) and RailNet Europe (RNE), the platform needs to implement a standardised and therefore frictionless way to exchange data/messages with those two partners.

Functional structure of the CI

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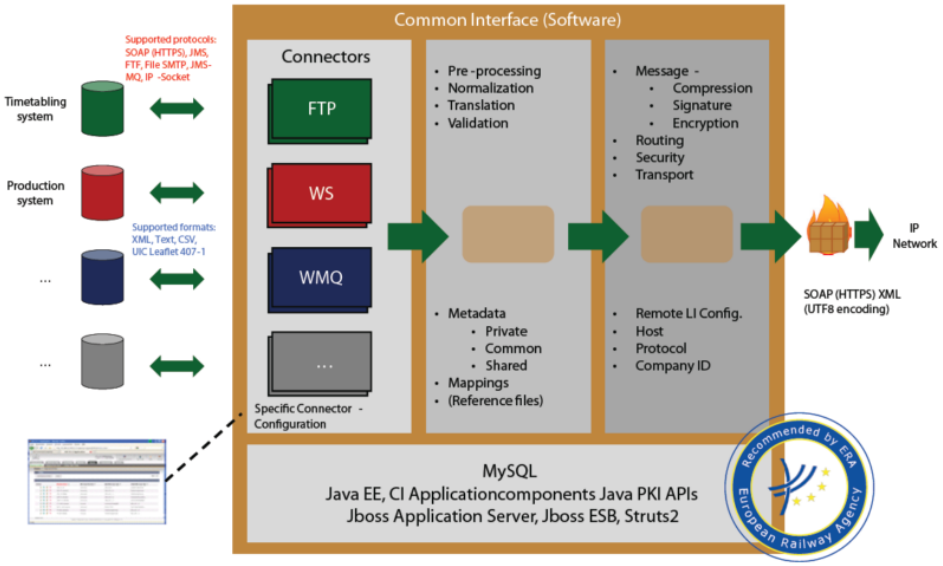


Figure 5: Schema for The Common Interface (CI)

Regarding CI see also https://rne.eu/it/rne-applications/ccs/common-interface/ for further information. Other related information can be found on the TAF TSI section of the European Union Agency for Railways (ERA) website. It includes also TAF TSI Technical Documents (TD´s).

### 4.8.2 APIs

**Standardized Data Formats**
APIs shall support both XML (as recommended by TAF-TSI) and JSON for data exchange. Ensuring compatibility with widely used data formats facilitates integration with modern applications.

**Authentication and Authorization**
APIs shall implement means for authentication, like API keys or secure token-based (OAuth). Additionally, Role-Based Access Control (RBAC) shall be implemented to ensure users/systems access only permitted resources.

**Versioning**
APIs shall be versioned to ensure backward compatibility. This allows the platform to introduce updates without disrupting existing integrations.

**Rate Limiting**
Rate limiting shall be enforced to prevent misuse or overloading of the platform. This ensures the platform's stability and availability.

**Endpoint Structure and Naming Conventions**
API endpoints shall follow RESTful principles, ensuring intuitive design and clear naming conventions.

**Error Handling**
APIs shall provide clear error messages and status codes, assisting developers in troubleshooting integration issues.

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**Data Validation**
All data passed through APIs shall be rigorously validated to ensure data integrity and compliance with TAF-TSI standards.

**Real-time and Batch Processing**
APIs shall support both real-time interactions for immediate operations and batch processing for handling large data volumes.

**Monitoring and Analytics**
Continuous monitoring of API endpoints is crucial. Analytics on API usage can offer insights into integration patterns and potential bottlenecks.

**Webhooks and Push Notifications**
To support event-driven architectures, the platform shall offer webhooks and push notifications, ensuring stakeholders receive real-time updates on significant events.

### 4.8.3 API Security

All APIs developed for and used by the platform must be secured – “security by design” to be implemented. Each API itself needs to be secured to validate traffic as well as contents and data. API Gateway: across all APIs on the platform a solid control for access and rights must to be in place to check if an application can access the platform APIs – either for data provision or consumption. Authorization and authentication shall be realized using schemes like API keys, tokens, OAuth2 to manage access to services and resources. Unauthorized access including attempts incl. Denial of Service (DoS) shall be detected and prevented by the platform.

The API security shall be constantly monitored and analyzed by API Management e.g. to identify anomalies early, also based on quotas and throttling.

### 4.8.4 Data Format and Protocol Interoperability

The platform shall support industry-standard data formats and protocols, such as EDI, TAF TSI, to ensure interoperability with other systems also in compliance with the standards. See also chapter 5.5.3 for further details.

The platform shall provide tools and guidelines for data providers to follow to ensure that their data sets are compatible with other systems.

*Prototype*: Platform must ensure compliance with TAF TSI data message schemas

### 4.8.5 Compatibility with Existing Rail Freight Operational Data Systems

As laid out in the overview section the DP-RAIL platform shall build on existing systems of the major data exchange partners: RailData, RailNet Europe. Both use the Common Interface as basis for their data and message exchange.

#### 4.8.5.1 RailData

RailData applications are extensively message/data exchange oriented using FTP/SFTP/HTTPS for message exchange, SOAP/XML Webservices for their applications based on TAF TSI standard, e.g.

- ISR (International Service Reliability): Wagon status & tracking
- RTIS (Running Train Information System): Information about movements of freight trains
- ORFEUS (Open Railway Freight EDI System): Consignment (note) data exchange

For more information and full list of RailData services see https://www.raildata.coop/

#### 4.8.5.2 RailNet Europe

RailNet Europe (RNE) is an association of European Rail Infrastructure Managers. It provides services regarding capacity management, traffic management, corridor management, such as

- ECMT (European Capacity Management Tool): providing a centralised capacity supply and capacity model overview of railway lines and routes
- TIS (Train Information System): real-time data on passenger and freight trains
- CCS (Common Components System): Common Interface, Central Reference Files Database, Central Certification Authority

For the full list of RNE's application see https://www.rne.eu/

*Prototype*: platform must ensure compatibility through integration of Common Interface and be able to ingest data/messages from as well as provide data/messages to RailData and RailNet Europe systems based on existing interfaces and the requirements defined in detail by the 4 use cases.

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# 5 Non-functional Requirements

## 5.1 Infrastructure

### 5.1.1 Hosting Requirements

The platform and all of its services shall be hosted in the cloud including data storage.

Data must to be stored within EU territory, data must not leave EU territory also for processing.

### 5.1.2 Hardware and Software Dependencies

Hardware, software, and third-party dependencies to be factored in will be worked out during the prototype and will be documented. To ensure compatibility with TAF TSI standard the Common Interface application needs to be integrated.

*Prototype*: Platform needs to account for existing technology stack from RailData based on AWS

### 5.1.3 Licenses

Licenses associated with applications or services used and build for DP-RAIL platform need to be made transparent and listed. The use of Open Source (software) is encouraged.

## 5.2 Platform Performance and Scalability

### 5.2.1 Data Processing Speed and Efficiency

The platform shall be able to route and process messages, process and analyse data sets quickly and efficiently based on processing logic defined and technical resources available (e.g. message queueing)

### 5.2.2 System Capacity and Expandability

The platform shall be scalable and able to handle increasing amounts of data, messages and users.

The platform shall support future growth and expansion through cloud-based infrastructure and other technologies. The platform shall enable adding and integrating new features or modules as needed and therefore shall be service-oriented to allow for “plug and play”.

## 5.3 Performance and Efficiency

### 5.3.1 System Response Time and Throughput

The average response time for data retrieval, filtering, and visualization shall be within an acceptable range, with a maximum threshold of 2 seconds. The platform shall be able to handle a high volume of concurrent user requests without significant degradation in performance. Up to 4000 users are to be expected by 2026.

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### 5.3.2 Quantity structure based on RailData systems

#### 5.3.2.1 ISR

Amount of message interfaces (incoming and outgoing): 23 interfaces to 18 different companies. Some companies may have multiple interfaces for their affiliates.

Amount of users in web frontends: Round about 1.000

| | Average | | Peak | |
|---|---|---|---|---|
| **Message Type** | **No. of messages** | **data (MB) exchanged** | **No. of messages** | **data (MB) exchanged** |
| Incoming | 390.000 | 665 | 490.000 | 928 |
| Outgoing | 800.000 | 928 | 1.000.000 | 1.422 |

ISR objects are stored for 30 days (queue size) in ISR database. Purged messages are not backed up.

#### 5.3.2.2 ORFEUS

Amount of message interfaces (incoming and outgoing): 19 interfaces to 18 different companies.

Amount of users in web frontends: Round about 1.000

| | Average | | Peak | |
|---|---|---|---|---|
| **Message Type** | **No. of messages** | **data (MB) exchanged** | **No. of messages** | **data (MB) exchanged** |
| Incoming | 3.000 | 38 | 3.200 | 55 |
| Outgoing | 7.800 | 79 | 9.000 | 112 |

ORFEUS objects are stored for 90 days (queue size) in ORFEUS database. Purged messages are not backed up.

### 5.3.3 Scalability

The system shall be scalable to accommodate increasing user loads and data processing requirements over time due to growing number of participants expected for the platform. It shall have efficient data processing algorithms and optimization techniques to minimize response time and maximize throughput. The system shall have mechanisms in place to monitor and optimize response time and throughput, such as performance profiling and load testing.

The platform shall be able to handle large datasets and process them efficiently without causing delays or timeouts. The system shall have caching mechanisms in place to store frequently accessed data and reduce response time for subsequent requests. The platform shall have mechanisms to handle peak usage periods, such as during data-intensive operations or during high-demand periods.

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The system shall provide feedback to users during data retrieval or processing to indicate progress and estimated completion times. The platform shall have failover mechanisms and redundancy measures to ensure high availability and minimize system downtime.

The system shall handle increased loads by adding resources (memory, CPU etc.) also based on historical usage data predicting peaks and lows.

Vertical Scaling – adding more resources to single component

Horizontal Scaling – adding more instances or nodes

*Prototype*: Any data request shall be fulfilled within a range of up to 5 seconds including response by the system.

### 5.3.4 Data Loading and Transfer Speed

The requirements regarding data and message processing and the expected performance under various load conditions will be defined within the respective use cases. The platform nevertheless shall be able to ensure meeting existing benchmarks based on RailData systems, e.g. 1 minute max. for message processing and distribution for ISR and ORFEUS messages.

### 5.3.5 System Resource Utilization and Optimization

The platform shall allow for monitoring of system resources and performance to be able to extend or reduce system resources if necessary (extension) or possible (reduction). That will ensure cost effectiveness in a cloud-based environment.

### 5.3.6 Load Balancing

The system shall distribute incoming requests and messages across multiple servers or resources.

*Prototype*: not relevant

### 5.3.7 Scalability and Performance Testing

The testing scenarios and performance benchmarks that need to be met will be defined within the respective use cases. The platform nevertheless need to scale based on cloud technology and support different testing scenarios and performance benchmarks.

## 5.4 Reliability and Availability

### 5.4.1 Platform Availability and Reliability

The platform shall be available to users 24/7 with minimal downtime.

The platform shall be reliable and able to handle large amounts of traffic and data.

*Prototype*: The platform must be available during European working hours, Monday – Friday.

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### 5.4.2 System Stability and Fault Tolerance

Within the course of the prototype the requirements will be defined. In general the platform shall consider hardware or software failures to occur and provide means to prevent failures, log any failures detected for further analysis and quickly react on them, e.g. by switching to secondary instance. In any case it shall be secured that a detected failure does not harm the entire platform.

### 5.4.3 Disaster Recovery and Backup Mechanisms

The platform shall provide means for regular data backups and recovery procedures. The concrete requirements will be determined within prototype to accommodate requirements set forth by the use cases incl. backup frequency, retention periods, and recovery procedures from failures or crashes.

*Prototype*: not relevant

### 5.4.4 System Maintenance and Updates

Maintenance windows and update schedules to be defined: see above for general platform availability and reliability

*Prototype*: Maintenance and updates need to be scheduled either overnight or – if not in testing period – during working hours with appropriate prior announcement.

## 5.5 Security and Compliance

### 5.5.1 Data Privacy and Confidentiality

The DP-RAIL platform shall ensure the privacy and confidentiality of all data and messages stored and processed within the system. Data privacy in this context refers to protecting personal and sensitive information from unauthorized access or disclosure. Data confidentiality refers to ensuring that only authorized individuals or entities have access to the data, preventing unauthorized disclosure.

- User Access Control:

  The platform shall implement robust user access control mechanisms to restrict access to data based on user roles and permissions. Only authenticated and authorized users shall have access to specific data sets or functionalities. The system shall enforce strong password policies, including complexity requirements and periodic password changes.

- Data Encryption:

  The platform shall employ industry-standard encryption techniques, such as TLS (Transport Layer Security), to protect data transmission between users and the platform.

  Sensitive data, both at rest and in transit, shall be encrypted to prevent unauthorized interception or disclosure.

- Role-Based Data Access:

The platform shall provide granular control over data access based on user roles and responsibilities. Users shall have access only to the data necessary to perform their assigned tasks. Data access permissions shall be regularly reviewed and updated as user roles change within the organization.

- Anonymization and Pseudonymization:

  Personally identifiable information (PII) or sensitive data shall be anonymized or pseudonymized when stored or shared within the platform. Anonymization techniques shall be employed to ensure that data cannot be directly linked to specific individuals or entities.

- Secure Data Transmission and Storage:

  The platform shall utilize secure protocols and encryption for data transmission between internal components and external integrations.

  Data storage shall adhere to industry best practices, ensuring that data is securely stored, backed up, and protected from unauthorized access or tampering.

- Audit Trails and Logging:

  The platform shall maintain comprehensive audit trails and logs of user activities, data access, modifications and permission changes. These logs shall capture details such as user IDs, timestamps, and actions performed to enable accountability and traceability.

- Data Breach Prevention and Incident Response:

  The platform shall implement proactive measures to prevent data breaches, including intrusion detection systems, firewalls, and regular vulnerability assessments. In the event of a data breach or security incident, the platform shall have an incident response plan in place to identify, contain, mitigate, and recover from the incident promptly.

- Compliance with Data Protection Regulations:

  The platform shall adhere to applicable data protection regulations, such as GDPR. Data privacy policies, consent management, and data subject rights shall be supported and compliant with applicable regulations.

- User Consent and Transparency:

  The platform shall provide clear and transparent information to users regarding the types of data collected, purposes of data processing, and any third-party data sharing. Users shall be given the ability to provide or withdraw consent for data collection, processing, and sharing. Users are able to specify licensing terms and conditions for data sharing.

Prototype: See also section 4.5 for further reference. The scope for the prototype will be mainly specified based on the use case requirements, but the platform does not need to cover compliance with data protection regulations as well as user consent and transparency.

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### 5.5.2 Security Audit and Monitoring

The concrete need how the platform shall support will be defined during the prototype; for monitoring see several sections, incl. 5.6.

*Prototype*: platform must provide basic security and monitoring features for system administrators

### 5.5.3 Compliance with Industry Standards and Regulations

#### 5.5.3.1 TAF-TSI

The data platform shall support the TAF-TSI data exchange formats, message structures, and protocols for seamless integration with other systems and stakeholders.

The platform shall include data validation mechanisms to ensure that the exchanged TAF-TSI data complies with the TAF-TSI regulation and meets the required standards.

The data platform shall enable the integration of TAF-TSI data from various sources, such as railway undertakings, infrastructure managers, and freight forwarders.

The platform shall provide capabilities to ingest, process, and store TAF-TSI data in a standardized format.

The platform shall support data mapping and translation functionalities to convert TAF-TSI data into a format compatible with internal systems or other external interfaces.

The platform shall include mechanisms to monitor and track compliance with TAF-TSI regulations, including data quality, timeliness, and completeness of TAF-TSI data exchanges.

#### 5.5.3.2 electronic Freight Transport Information (eFTI)

#### 5.5.3.3 UN/CEFACT Multimodal Transport Reference Data

#### 5.5.3.4 Data Retention

Data retention policies and archiving requirements will be settled throughout the prototype based on concrete requirements from the use cases. In any case all data in transit and at rest needs to be stored within EU territory.

*Prototype*: Platform must ensure compliance with TAF TSI and all data shall be stored for the duration of the project (June 2026)

## 5.6 Monitoring and Logging

The platform shall monitor and log different events on various levels using standardised tools and mechanisms allowing also real-time monitoring. The concrete events and levels of detail for logging levels need to be defined based on the use case requirements.

Prototype: platform must provide basic monitoring and logging features based on off-the-shelf solutions regarding system health, data and message processing, security and availability.

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## 5.7 Testing & QA

### 5.7.1 Testing Standards, Methodologies and Acceptance Criteria

During the build of the prototype use cases and platform will define test cases and scenarios as well as general acceptance criteria.

The following levels of testing shall be completed:

- Unit Test: Test individual component
- Integration test: test integrated component
- System test: test entire system
- Acceptance test: test final system

Within agile development Epics and User Stories contain acceptance criteria to verify definition of done (DoD) at the end of each iteration. The product owner will decide whether being accepted or not enforcing rework.

*Prototype*: Platform and use cases will be developed based on Epics and User Stories containing acceptance criterias. Integration tests will be performed also together with data exchange partners and prototype users of the platform. The platform therefore must provide basic tooling to document test cases and scenarios as well as test results.

### 5.7.2 Defect Tracking

Defect tracking allows for managing detected defects during various stages of testing. The two main parameters for effective defect tracking and resolution are severity and priority.

Defect severity/impact, defined and documented by developer or test engineer:

- Severity 1: Critical
  A defect that completely hampers or blocks testing of the platform/ feature is a critical defect. For any reason, if the application crashes or it becomes unusable / not able to proceed further, the defect could be classified under critical severity.

- S2: Major
  Any major feature implemented that is not meeting its requirements/use case(s) and behaves differently than expected. A major defect occurs when the functionality is functioning grossly away from the expectations or not doing what it shall be doing.

- S3: Minor
  Any feature implemented that is not meeting its requirements/use case(s) and behaves differently than expected but the impact is negligible to some extent or it doesn't have a major impact on the application. A minor defect occurs when the product or application doesn't meet certain criteria or still exhibits some unnatural behavior, however, the functionality as a whole is not impacted.

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- S4: Low
  Any cosmetic defects including spelling mistakes or alignment issues or font casing can be classified under Low Severity. A minor low severity bug occurs when there is almost no impact on the functionality but it is still a valid defect that shall be corrected.

Defect priority, set by Product Owner (platform, use case)

- Priority 1: Immediate
  Has to be fixed immediately within 24 hours. Cases when an entire functionality is blocked and no testing can proceed as a result of this, meaning the platform/ feature is unusable in the current state

- P2: High
  Has to be fixed for any test activity to match the acceptance criteria. Normally when a feature is not usable as it's supposed to be, due to a program defect, or that new code has to be written or sometimes even because some environmental problem has to be handled through the code.

- P3: Medium
  A defect with this priority must be in contention to be fixed as it could also deal with functionality issues which are not as per expectation. Sometimes even cosmetic errors such as expecting the right error message during the failure could qualify to be a priority 3 defect.

- P4: Low
  A defect with low priority indicates that there is definitely an issue, but it doesn't have to be fixed to match the acceptance criteria. However, this must be fixed before the acceptance test is done. Typically, some typing errors or even cosmetic errors as discussed previously could be categorized here.

Any defect will be documented (e.g. in Jira) with a description, information regarding occurrence, severity and priority.

### 5.7.3 Test Environments and Procedures

Apart from local DEV environment for platform development the platform shall provide a dedicated test environment (TEST) reflecting the productive setup for the platform including all connections to partners. The TEST-environment shall be accessible via public URL and enable to test both functional as well as non-functional requirements listed in this document based on test data generated from the use cases and real world examples.

*Prototype*: Platform shall allow for all test levels test in distinct environments (developer and integration environment). A provision of a productive environment is not required due to nature of prototype.

## 5.8 Documentation

### 5.8.1 User Documentation

The platform shall provide user guides, manuals, and documentation to all users, based on their roles. The exact content and form of providing information will be determined in the course of the prototype.

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*Prototype*: Materials based on existing documentation must be provided plus general user documentation including short user guides and change-logs.

### 5.8.2 Technical Documentation

The platform shall provide technical documentation for system administrators and developers (e.g. OpenAPI spec for APIs) to ensure proper platform operations. Moreover the technical architecture needs to be documented to allow for an overview of all components of the platform and how they work together. User/system interactions, data and message flows need to be documented in a standardised format.

## 5.9 Usability and User Experience

### 5.9.1 User Interface Design and Navigation

The platform shall have a user-friendly interface that is easy to navigate and understand.

The interface shall be intuitive and require minimal training for users to use effectively.

The platform shall provide multi-platform support and be accessible on multiple devices, such as desktops, laptops, tablets, and smartphones.

The platform shall support accessibility features, such as screen readers and keyboard navigation, to accommodate users with disabilities.

*Prototype*: not relevant, no DP-RAIL specific frontend will be provided

### 5.9.2 User Guidance and Support

The platform shall provide a means for users to seek support or contact the platform administrators for assistance.

Users shall have access to a help desk or knowledge base to find answers to common questions or issues.

The platform shall support notifications or announcements to keep users informed about updates, new features, or system maintenance (windows).

*Prototype*: not relevant

### 5.9.3 Accessibility and Localization

The platform shall provide support for multiple languages and regions.

*Prototype*: provide support for English only

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