




ERJU SYSTEM PILLAR

T3-CMSRequirements



CMS Functional Requirements

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Abstract	The document contains the functional requirements in which the Capacity Management System (CMS) is responsible for. The chapters are divided by the CMS functional capabilities based on our understanding of chapter 5.1.2 in System Concept document. The capabilities and terminology can be found in System Concept.
Config Item	System Requirements Specification
Document ID	30 Deliverables/T3-CMSRequirements#714378  T3-CMSRequirements
Classification	Public
Status	Open (draft)
Version	1.0
Revision	714378
Last Change Date	24.09.2025
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1 History of Changes

Nr.	Changes	Leaders/authors
0.1	Initial Draft for Internal Review	Raghda Mohamed
	Comments	Matthias Krista
0.2	Draft for Internal Review	Raghda Mohamed
	Comments	Marco Nanni, Marcus Völcker, Mirko Gherzi, Ramon Oostveen
0.3	Contributors' Review Version	Raghda Mohamed
	Review	René Schönemann, Simona Di Loreto, Stefan Wegele, Simone Brezzi, Patrick Konix, Rolf Gooßmann
0.4	Worked on Contributors' Comments	Raghda Mohamed
0.5	First Delivery Version	Raghda Mohamed confirmed by Marco Nanni and Marcus Völcker
	Review	Mirko Gherzi, Marco Nanni, Raghda Mohamed
0.6		

2 Capacity Planning

The CMS shall plan the infrastructure usage for trains. [SPT3TMS-13015]

The CMS shall import railway infrastructure master data from the Asset Management. [SPT3TMS-13017]

For each railway infrastructure import, the CMS shall verify the [consistency] AND [relevance] of the data to make it valid. [SPT3TMS-13019]

The CMS shall verify the topology version number. [SPT3TMS-13018]

The CMS shall verify the topology datetime interval. [SPT3TMS-13016]

The CMS shall verify the [consistency] AND [relevance] of track topology. [SPT3TMS-13025]

The CMS shall verify the [consistency] AND [relevance] of functional topology. [SPT3TMS-13024]

The CMS shall verify the [consistency] AND [relevance] of topology properties. [SPT3TMS-13027]

For each railway infrastructure, the CMS shall integrate the data with additional information. [SPT3TMS-13026]

The CMS shall integrate the infrastructure data with the business rules. [SPT3TMS-13021]

The CMS shall integrate the infrastructure data with necessary linguistic translations. [SPT3TMS-13020]

The CMS shall set a new version of railway infrastructure with additions. [SPT3TMS-13023]

For each unavailable resource, the CMS shall mark it unavailable. [SPT3TMS-13022]

The CMS shall import infrastructure unavailability from asset management systems (TCR). [SPT3TMS-13029]

The CMS shall handle an unavailability period for any infrastructure declared unavailable. [SPT3TMS-13037]

The CMS shall construct a path that consists of available infrastructure. [SPT3TMS-13035]

When the infrastructure is unavailable the CMS shall create a capacity plan without those resources. [SPT3TMS-13033]

The CMS shall detect planning conflicts. [SPT3TMS-13031]

When the conflict is unsolvable, the CMS shall create a capacity plan which is non-conflict free. [SPT3TMS-13045]

The CMS shall receive train path request from ROCs. [SPT3TMS-13043]

When CMS receives a path request, the CMS shall update the capacity plan containing the new path. [SPT3TMS-13041]

If new path request has conflicts, then the CMS shall modify the request to resolve conflicts. [SPT3TMS-13039]

The CMS shall consider the KPIs of energy optimisation, ability for [delay reduction] AND [connection quality] in construction train path. [SPT3TMS-13048]

The capacity plan shall contain time adjustment to fix train delays. [SPT3TMS-13047]

The capacity plan shall contain [arrival] AND [departure] times. [SPT3TMS-13049]

The capacity plan shall contain commercial stops in a spatiotemporal order. [SPT3TMS-13058]

The capacity plan shall contain the train dynamic data. [SPT3TMS-13056]

The capacity plan shall contain the days of validity for each train. [SPT3TMS-13054]

The capacity plan shall contain the transfer connections for each train. [SPT3TMS-13053]

The capacity plan shall contain the train links for each train. [SPT3TMS-13904]

The capacity plan shall contain the stopping pattern for each train. [SPT3TMS-13063]

When the capacity plan includes passenger services providing intervals between services, the capacity plan shall contain the intervals between services for each train. [SPT3TMS-13062]

The capacity plan shall contain the required [service]s AND [facilities]. [SPT3TMS-13061]

The capacity plan shall plan train shunting movements between the line or station tracks and handover tracks of the yards or depot areas. [SPT3TMS-13060]

When alternative paths are possible the CMS shall provide alternative paths to be enabled. [SPT3TMS-13064]

When there is a change in the capacity request, the CMS shall update the capacity plan. [SPT3TMS-13030]

The CMS shall incorporate the ad-hoc request into an existing capacity plan. [SPT3TMS-13028]

When ROCs data are available, the CMS shall contain capacity strategy for 5 years before production. [SPT3TMS-13038]

When ROCs data are available, the CMS shall contain capacity strategy for 1 years before production. [SPT3TMS-13036]

When [ROCs] AND [other systems] like maintenance etc. data are available, the CMS shall consider them in the elaboration of the capacity planning for 24 hours before production. [SPT3TMS-13034]

When [ROCs] AND [other system] like maintenance etc. data are available, the CMS shall consider them in the elaboration for 1 to 6 hours before production. [SPT3TMS-13032]

When the long-term capacity planning is managed the CMS shall fill the [arrival date/time] AND [departure date/time] fields. [SPT3TMS-13046]

The CMS shall generate Capacity Plan versions until the planned starting of the train run. [SPT3TMS-13044]

The CMS shall fill the driving time reserves to produce the capacity plan. [SPT3TMS-13042]

The CMS shall fill [arrival date/time] AND [departure date/time], including minimal stopping times to produce the capacity plan. [SPT3TMS-13040]

The CMS shall fill commercial stops in a spatiotemporal order to produce the capacity plan. [SPT3TMS-13052]

The CMS shall fill the Train dynamic data to produce the capacity plan. [SPT3TMS-13051]

The CMS shall fill required [services] AND [facilities] to produce the capacity plan. [SPT3TMS-13050]

The CMS shall compile a detailed route for each train to produce the capacity plan. [SPT3TMS-13059]

When the capacity request contains only a sequence of locations, the CMS shall calculate the detailed route. [SPT3TMS-13057]

The CMS shall use the infrastructure data that are valid at time of execution. [SPT3TMS-13055]

3 Slot & Path Construction

The CMS shall consider business rules in slot construction, all rules related to infrastructure usage that have to be followed by the ROCs, e.g., [track usage] AND [directions], given by RIM. [SPT3TMS-13069]

The CMS shall contain [predefined] AND [customisable] business rules. [SPT3TMS-13072]

The business rules shall contain information on minimum average speed for a path. [SPT3TMS-13071]

The business rules shall contain information on predefined paths. [SPT3TMS-13066]

The business rules shall contain information on types of planning conflicts. [SPT3TMS-13065]

The business rules shall contain information on time thresholds depending on the type of conflict beyond which it is detected. [SPT3TMS-13068]

The CMS shall contain automatic train route assignment. [SPT3TMS-13067]

When the route is automatically set, the CMS shall consider the business rules. [SPT3TMS-13073]

The CMS shall detect transitional planning conflicts to detect the conflicts between areas managed by route managers. [SPT3TMS-13077]

The CMS shall detect capacity planning conflicts between any two capacity-consuming planning objects, independently of their type. [SPT3TMS-13076]

The CMS shall optimise energy consumption in path construction. [SPT3TMS-13075]

The CMS shall calculate the energy-optimised- sectional run time. [SPT3TMS-13074]

The CMS shall distribute the driving time margins across the path. [SPT3TMS-13081]

The CMS shall produce [balanced speed profiles] AND [minimise the number of speed changes]. [SPT3TMS-13080]

The CMS shall [add] OR [modify] OR [remove] individual stopping location on the train route. [SPT3TMS-13079]

The CMS shall build every train trip path without conflicting with another train trip path. [SPT3TMS-13078]

The CMS shall build a new train trip path resolving conflicts without changing existing train trip paths. [SPT3TMS-13083]

If a train path to be built cannot be conflict-free, the CMS shall build it minimizing the generated conflicts. [SPT3TMS-13082]

If a train path to be built cannot be conflict-free, the CMS shall build it highlighting the generated conflicts. [SPT3TMS-13084]

The CMS shall assign the path to a requestor (ROC). [SPT3TMS-13088]

The CMS shall consider the selected KPIs in the path construction. [SPT3TMS-13087]

If multiple KPIs are selected, the CMS shall consider the relative priority. [SPT3TMS-13086]

The CMS shall provide a KPI that maximise the capacity utilisation. [SPT3TMS-13085]

The CMS shall provide a KPI that minimise energy consumption. [SPT3TMS-13091]

The CMS shall provide a KPI that maximise the capacity efficiency via maintenance infrastructure interruption scheduling accuracy. [SPT3TMS-13090]

The CMS shall provide a KPI that minimise the scheduled maintenance infrastructure interruptions based on the request of infrastructure allocation. [SPT3TMS-13089]

The CMS shall provide a KPI that keeping planning conflicts at minimal. [SPT3TMS-13070]

4 Technical & Sectional Run Time

The CMS shall calculate the sectional run time for each train. [SPT3TMS-13094]

The CMS shall consider the path data in the calculation of capacity plan. [SPT3TMS-13093]

The CMS shall consider the train dynamics in the calculation of capacity plan. [SPT3TMS-13096]

The CMS shall consider the infrastructure restrictions (TCR) in the calculation of capacity plan. [SPT3TMS-13095]

When the calculation parameters change, the CMS shall update the minimal sectional run time. [SPT3TMS-13092]

5 Margins

The CMS shall contain customised reserve parameters (margins) to perform a correct time calculation for each train. [SPT3TMS-13098]

The CMS shall define margins in [percentages] OR [absolute] values. [SPT3TMS-13097]

The CMS shall add [spatial] and [temporal] margins to every location relevant for evaluating the train forecast which the train is planned to cross. [SPT3TMS-13099]

6 Planning Conflicts

The CMS shall contain planning conflict threshold to define the minimum rules to identify a conflict. [SPT3TMS-13105]

The CMS shall detect planning conflicts for each train route. [SPT3TMS-13104]

The CMS shall detect crossing conflicts. (See T3-SystemConcept-Crossing conflict) [SPT3TMS-13107]

The CMS shall detect overtaking conflicts. (See T3-SystemConcept-Overtaking conflict) [SPT3TMS-13106]

The CMS shall detect headway conflicts. (See T3-SystemConcept-Headway conflict) [SPT3TMS-13100]

The CMS shall detect junction conflicts. (See T3-SystemConcept-Junction conflict) [SPT3TMS-13101]

The CMS shall detect joining conflicts. (See T3-SystemConcept-Joining conflict) [SPT3TMS-13103]

The CMS shall detect [station entry] AND [station exit] conflicts. (See T3-SystemConcept-Station entry and exit conflicts) [SPT3TMS-13102]

The CMS shall detect train capability conflicts. (See T3-SystemConcept-Train capability conflicts) [SPT3TMS-13108]

The CMS shall detect 'violation of track occupancy requirements' conflicts. (See T3-SystemConcept-Violation of track occupancy requirements) [SPT3TMS-13112]

The CMS shall detect 'insufficient length of stay' conflicts. (See T3-SystemConcept-Insufficient length of stay) [SPT3TMS-13111]

The CMS shall detect 'insufficient platform length' conflicts. (See T3-SystemConcept-Insufficient platform length) [SPT3TMS-13110]

The CMS shall detect 'Level access' conflicts. (See T3-SystemConcept-Level access) [SPT3TMS-13109]

The CMS shall detect 'unsuitable stopping place' conflicts. (See T3-SystemConcept-Unsuitable stopping place) [SPT3TMS-13116]

The CMS shall detect 'violation of order requirements' conflicts. (See T3-SystemConcept-Violation of order requirements) [SPT3TMS-13115]

The CMS shall detect 'timing deviations' conflicts. (See T3-SystemConcept-Timing Deviations) [SPT3TMS-13114]

The CMS shall detect 'connection conflicts'. (See T3-SystemConcept-Connection conflicts) [SPT3TMS-13113]

The CMS shall detect 'circulation conflicts'. (See T3-SystemConcept-Circulation conflicts) [SPT3TMS-13118]

The CMS shall detect other types of violations agreed with the ordering ROC. (See T3-SystemConcept-Violation of other specifications) [SPT3TMS-13117]

The CMS shall retrieve non-standard shipment data made by the requestor through the order management system. (See T3-SystemConcept-Check on Non-Standard Shipments) [SPT3TMS-13119]

When trains carry non-standard shipment, the CMS shall consider the track prohibitions. [SPT3TMS-13123]

When trains carry non-standard shipment, the CMS shall consider the speed restrictions. [SPT3TMS-13122]

When trains carry non-standard shipment, the CMS shall consider the meeting restrictions. [SPT3TMS-13121]

When trains carry non-standard shipment, the CMS shall consider the required stops. [SPT3TMS-13120]

The CMS shall aim for solving all planning conflicts. [SPT3TMS-13127]

The CMS shall determine a physical part of the infrastructure for each operating location. [SPT3TMS-13126]

The CMS shall perform a [planning conflict detection] AND a [feasibility check] for each path. [SPT3TMS-13125]

When feasible, the CMS shall approve the plan. [SPT3TMS-13124]

When not feasible, the CMS shall reject the plan. [SPT3TMS-13128]

7 Variants

The CMS shall contain the [creation] AND [management] of different slot variants. [SPT3TMS-13129]

8 Interfaces

When a new slot request arrives from slot ordering system, the CMS shall import requested slots. [SPT3TMS-13135]

When an ad-hoc request arrives from slot ordering system, the CMS shall import requested slots. [SPT3TMS-13134]

The CMS shall connect to order management system via TAF/TAP TSI. [SPT3TMS-13137]

The CMS shall import the topology data. [SPT3TMS-13136]

The CMS shall import the ROC data. [SPT3TMS-13131]

The CMS shall import the Vehicle data. [SPT3TMS-13130]

The CMS shall import the Planning data. [SPT3TMS-13133]

The CMS shall export the capacity plan to the TMS. [SPT3TMS-13132]

The CMS shall export the capacity plan to the ROC Via TSI. [SPT3TMS-13138]

The CMS shall export the capacity plan to the DAS Via ROC. [SPT3TMS-13142]

The CMS shall export the Short-Term and Very Short-Term capacity plan to TMS. [SPT3TMS-13141]

The CMS shall export the slot modifications to the billing system* (Note: The billing system is connected to TMS). [SPT3TMS-13140]

The CMS shall Interface an external secure Identity and Access Management system for managing digital identities (human users and assets) and roles for authorisation and single-sign on (see SSI-IAM - Identity and Access Management Interface). [SPT3TMS-13139]

The CMS shall interface an external secure Public Key Infrastructure system for receiving certificates and their status and thus ensure secure communication (see SSI-PKI - Public Key Infrastructure Interface). [SPT3TMS-13146]

The CMS shall interface an external Secure Time Synchronisation system, to guarantee a secure time synchronisation necessary to validate certificates. (see SSI-STS - Secure Time Synchronisation). [SPT3TMS-13145]

The CMS shall interface an external Domain Name System, for name resolution to map domain names to IP addresses. [SPT3TMS-13144]

The CMS shall interface an external Network Access Control system, for identifying, authenticating, and authorizing network access. [SPT3TMS-13143]

9 Human-Machine Interface

The CMS shall contain a Human Machine Interface (HMI). [SPT3TMS-13169]

The CMS shall include a Train Graph (TG) representation view of capacity plan. [SPT3TMS-13173]

The CMS shall include a view with detailed information on each train run. [SPT3TMS-13183]

The CMS shall include a view with detailed information on each conflict. [SPT3TMS-13181]

The CMS shall include a view with detailed information on Temporary Capacity Restriction. [SPT3TMS-13179]

The CMS shall include a view with the different parameters of configuration. [SPT3TMS-13177]

The CMS shall display the imported Temporary Capacity Restrictions (TCR) to the user. [SPT3TMS-13189]

The CMS shall display the topology data with additions to the user. [SPT3TMS-13187]

The CMS shall display the train composition to the user. [SPT3TMS-13186]

The CMS shall display the train properties to the user. [SPT3TMS-13150]

The CMS shall display the train's driving time reserves to the user. [SPT3TMS-13149]

The CMS shall display the train arrival date/times to the user. [SPT3TMS-13156]

The CMS shall display the train departure date/times to the user. [SPT3TMS-13155]

The CMS shall display the train stop stations to the user. [SPT3TMS-13154]

The CMS shall display the start stations of the train to the user. [SPT3TMS-13153]

The CMS shall display the end stations of the train to the user. [SPT3TMS-13159]

The CMS shall display the [Routes] AND [track] usage of the train to the user. [SPT3TMS-13158]

The CMS shall display the train stopping patterns to the user. [SPT3TMS-13157]

The CMS shall display the [Required services] AND [facilities] of the train to the user. [SPT3TMS-13163]

The CMS shall display the unsolved planning conflicts to the user. [SPT3TMS-13162]

The CMS shall display the type of the train conflict to the user. [SPT3TMS-13160]

The CMS shall display the ROC request data to the user. [SPT3TMS-13166]

The CMS shall distinguish available from unavailable capacity. [SPT3TMS-13165]

When a capacity plan containing conflicts is created, the CMS shall notify and highlight the conflicts to the user. [SPT3TMS-13164]

The CMS shall give the possibility to distinguish among capacity plans that are conflicts free or that contains conflicts. [SPT3TMS-13176]

The CMS shall provide the current number of detected conflicts to the user at any time. [SPT3TMS-13911]

The CMS shall allow for drag&drop operations where useful. [SPT3TMS-13175]

The CMS shall perform the chart editing HMI function. [SPT3TMS-13174]

The CMS shall perform the graphics scaling HMI function. [SPT3TMS-13172]

The CMS shall perform the train [selection] AND [unselection] HMI function. [SPT3TMS-13180]

When the train is selected, the CMS shall show its details. [SPT3TMS-13184]

The CMS shall perform the train editing HMI function. [SPT3TMS-13182]

The CMS shall perform the train creation HMI function. [SPT3TMS-13178]

The CMS shall perform the train export HMI function. [SPT3TMS-13190]

The CMS shall perform the train import HMI function. [SPT3TMS-13188]

The CMS shall perform the train marking HMI function. [SPT3TMS-13193]

The CMS shall show the connections among trains. [SPT3TMS-13197]

The CMS shall perform the train compatibility checks HMI function. [SPT3TMS-13196]

The CMS shall perform the train sections movement HMI function. [SPT3TMS-13195]

The CMS shall perform the trains comparison HMI function. [SPT3TMS-13151]

The CMS shall perform the train stops management HMI function. [SPT3TMS-13152]

The CMS shall perform the [Train classes] management HMI function. [SPT3TMS-13147]

The CMS shall perform the moving train trip path HMI function by shifting the [arrival] AND [departure] date/time of the timetable. [SPT3TMS-13148]

The CMS shall perform the copying train trip path HMI function by coping the timetable and shifting the [arrival] AND [departure] date/time. [SPT3TMS-13206]

The CMS shall perform the managing reserves HMI function. [SPT3TMS-13202]

The CMS shall perform the [arrival date/time] AND [departure date/time] editing HMI function. [SPT3TMS-13203]

The CMS shall display the schematic track representation of a station. [SPT3TMS-13204]

The CMS shall display the track occupancy plan of a station. [SPT3TMS-13205]

The CMS shall display the [arrival] AND [departure] timetable of a station. [SPT3TMS-13198]

The CMS shall [display] AND [allow editing] the data in graphical form. [SPT3TMS-13199]

The CMS shall [display] AND [allow editing] the data in tabular form. [SPT3TMS-13200]

The CMS shall allow data filtration by station. [SPT3TMS-13201]

The CMS shall allow data filtration by arrival date/time. [SPT3TMS-13194]

The CMS shall allow data filtration by departure date/time. [SPT3TMS-13191]

The CMS shall allow data filtration by train categories. [SPT3TMS-13192]

The CMS shall allow data filtration by specific train. [SPT3TMS-13185]

The CMS shall allow data filtration by planning conflict type. [SPT3TMS-13167]

The CMS shall allow data filtration by TCR. [SPT3TMS-13168]

The CMS shall allow data filtration by train run date. [SPT3TMS-13170]

The CMS shall have an authentication system. [SPT3TMS-13171]

10 Appendix A

10.1 Glossary

Track Topology

The 'Track Topology' is part of the railway infrastructure and defines the tracks and connections that allow trains to travel from one track to the next. [SPT3TMS-12462]

Functional Topology

The 'Functional Topology' is part of railway infrastructure and defines different functional elements like Signals, Points, etc. [SPT3TMS-12464]

Properties Topology

The 'Properties Topology' is part of railway infrastructure and defines different properties for a section of track like speed limit, traction system etc. [SPT3TMS-12463]

Train dynamic data

Train axles, train length, train size and train wagons are considered train dynamic data. [SPT3TMS-12530]

11 Appendix B

11.1 Abbreviations

CMS Capacity Management system [SPT3TMS-12984]

HMI Human Machine Interface [SPT3TMS-12994]

KPI Key Performance Indicator [SPT3TMS-12953]

RIS Railway Infrastructure System [SPT3TMS-13006]

ROC Rail Operating Company [SPT3TMS-12956]

TAF/TAP Telematics Applications for Freight/Passenger Services [SPT3TMS-13004]

TCR Temporary Capacity Restriction [SPT3TMS-12963]

TG Train Graph [SPT3TMS-12968]

TSI Technical Specifications for Interoperability [SPT3TMS-13010]

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