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Control and safety technology

Operational and technical objectives for “Digitale Schiene Deutschland“

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The digitalisation of the German railway system was a key theme in discussions within our industry last year. With the stated goal of a nationwide rollout of digital control and safety technology for the system’s digital signal boxes, and the introduction of the European Train Control System (ETCS), DB Netz AG has taken a leading role in driving this strategic project. The ‘Digitale Schiene Deutschland’ (Digital Rail Germany: DSD) programme serves as a streamlined organisation managing both the conception and implementation of this rollout, and the involvement of all relevant stakeholders within the German railway sector.

A core foundation for DSD is the 'Operational and Technical Objectives' document (Betrieblich-Technisches Zielbild: BTZ). This describes the functional requirements of both operations (dispatching and operational implementation of rail operations) and the technical systems required. To create the BTZ, a catalogue of operational scenarios and requirements for the rollout was first created from an operational perspective, with the strategic goal of optimising the capacity of the existing network, and simplifying current operational procedures. One scenario, for example, describes the faster and simpler turning of a train at an operating point or on a track under the guidance of the ETCS.

Management requirements: technology follows process

The second step was to use these scenarios as a basis for formulating technical requirements for the technical systems required (including digital signal boxes (Digitaler Stellwerke: DSTW), ETCS, integrated control and operating system (integrierte Leit- und Bediensystem: iLBS) and telecommunications) and to compare them with the requirements of the ETCS process linked to each operational scenario. Thus, with stringent management requirements, it is always clear which technical requirement is needed for each operational requirement. This makes the commonly used 'reverse approach' (that a technical system requires concrete operational processes due to its fixed operating specifications) obsolete.

With this approach, DB Netz AG must provide manufacturers with complete requirements in the form of tender specifications for procuring technical systems for digital control and safety technology (Digital Leite- und Sicherungstechnik: DLST). This will ensure that developed products conform to the BTZ operational and technical requirements. For this purpose, a Technology Development Plan (Technologie-Entwicklungsplan: TEP) was developed based on the BTZ – to transfer its requirements into tender specifications and requirement documents according to a release plan coordinated across all systems. The primary release planning ensures that tender specifications, for example for a defined release of DSTW and ETCS, are based on a uniformly functional scope and will be compatible with each other.

Technologie-Entwicklungsplan und Starterpaket-Projekte

The TEP was developed to help create tender specifications for the surface rollout before 2030. Until then, 'starter package projects' are to be commissioned as a basis for further rollout. This project portfolio includes:

1. The 'Digital Node Stuttgart' (Digitale Knoten Stuttgart: DKS) project for equipping the Stuttgart rail junction with DLST (see p.18)

2. The renewal of the LST on the Cologne-Rhine/Main high-speed line

3. The entire Trans-European Network's (TEN) Scandinavia-Mediterranean corridor (ScanMed), including all DB Netz AG network districts on this corridor.

The process and results of the BTZ and TEP can first be tested through these projects and adjusted if necessary. To hand over the tender specifications to manufacturers in good time as a basis for development, the TEP initially comprises these three main releases, which are to be completed in the periods up to 2021, 2023 and 2025 respectively. The manufacturers will be commissioned to first develop generic products, such as the DSTW central unit or the ETCS control centre (RBC), until their approval. Then, they will carry out the project-specific configuration and project planning for the requirements of the individual starter package projects.

It is important in this context that tender specifications (even if initially drawn up for concrete starter package projects) should always be designed for a generic product and not be specific to individual projects. Otherwise, they may not be suitable for the wider rollout.

Early involvement of manufacturers

To keep to the tight schedule for commissioning starter package projects, it's not just the time taken to prepare specifications that must be significantly reduced, but the time taken by manufacturers to develop and approve products. Through early and transparent participation of all manufacturers active in the German DLST market, both now and in the future, manufacturing specifications (Pflichtenheft) can be created by manufacturers even before release of the tender specifications (Lastenheft).

This form of collaboration has already been successfully carried out in tender specifications for the 2016 DSTW pre-series projects, which were drawn up with regular expert working groups. The specifications were successively created by DB Netz AG in close iterations and reviewed by the manufacturing companies each time. This way, all questions and drafts could be circulated with all manufacturers and the outcomes transferred easily to the respective specifications. This quasi-parallel creation of specifications and requirements must also be the aim for the implementation of the TEP.

The first test of the BTZ and TEP is the Digital Node Stuttgart project. In this project, the uniform operation of DSTW and ETCS with Level 2 without signals is to be used for the first time via the integrated control and operating system (iLBS). For this purpose, the corresponding tender specifications are to be drawn up according to the described method based on requirements from the BTZ, and the corresponding products will be developed and approved by the manufacturers. To avoid jeopardising the 2025 commissioning date, the tender specifications are to be completed in cooperation with manufacturers by mid-2023 in accordance with the TEP, with the manufacturing specifications and product development being carried out in parallel.

Europe-wide harmonisation of system architecture

With a 2030 timeframe, the current versions of BTZ and TEP, do not, of course, complete the further operational and technological development of DLST. Projects for this already exist today at a European level (EULYNX and Reference Command and Control System Architecture (RCA)). Under the leadership of European infrastructure operators, with constant participation of manufacturers here, these projects are driving forward the long-term development of the DLST – with the ultimate goal of a uniform system architecture throughout Europe. For example, the current tender specifications for the DSTW are already fully harmonised with the EULYNX specifications for signalling systems.

Foto: DB AG/JET-Foto Kranert

Warnemünde Station at the Baltic Sea (May 2020): after extensive modernisation, the new digital signal box takes complete control of rail traffic on the line

Due to historically evolved specifics of individual national rail networks, it is the stated common goal of European infrastructure managers and the railway industry to harmonise both operational and technical requirements for the DLST through uniform specifications. On one hand, this simplifies interoperability in international railway operations. On the other, it enables manufacturers to develop and use a system platform for all DLST systems that can be used throughout Europe.

The BTZ has already taken this into account and currently requires compliance with EULYNX specifications in the DB Netz AG operating area. In addition, the BTZ, together with the TEP, will be updated by 2030 to specify operational and technical requirements for the future DLST in Germany – such that they will permanently conform to the goal of European target architecture being developed in the RCA project. In the Digital Rail System (Digitales Bahnsystem: DBS) project, DB Netz AG is already a key contributor to the design of the RCA target architecture, in coordination with other European infrastructure operators.

Conclusion

With the Digitale Schiene Deutschland programme, DB Netz AG has already made a concrete start on further development of today's rail operations, including existing control and safety systems, towards a consistent simplification and standardisation of technical systems and operational regulations.

This is accompanied by a fundamental change in the process of defining requirements for technical systems and operational processes. Whereas, in the past it was primarily the technology that was the source of requirements, with the operational and technical vision that is now available, future operational processes have been consistently defined as the source of all requirements for technical systems (in particular DSTW, ETCS and iLBS). This methodology will now be tested and, if necessary, adjusted within the framework of the starter package projects, together with all relevant actors in the railway sector, to serve as a basis for the subsequent rollout of the DLST throughout the German rail network.