FINAL REPORT

from the preliminary market consultation

TRAFFIC MANAGEMENT SYSTEM CONTROL LEVEL FOR HIGH-SPEED LINES (HSL)

Prague, 14. 11. 2025

Table of contents

Introduction

Správa železnic, státní organizace, in accordance with the provisions of Section 33 of Act No. 134/2016 Coll., on Public Procurement, as amended, conducted preliminary market consultations for the public procurement 'Traffic Management System (TMS) Control Level for High-Speed Lines (HSL)' (hereinafter also referred to as the 'public procurement').

The aim of the preliminary market consultations was to obtain information and suggestions from relevant suppliers and experts regarding the planned public procurement, particularly in the areas of technical solutions, operational provision and long-term sustainability of the traffic management system on high-speed lines in the Czech Republic. The consultations were conducted in the form of a written questionnaire.

The public procurement 'TMS Control Level for HSL' is a key project within the framework of the construction of high-speed lines in the Czech Republic. The HSL network will have a length of approximately 700 km upon completion and its construction is planned for the period 2028–2050. This scope requires the introduction of a new traffic management system that will ensure coordination between high-speed and conventional lines, scalability and the possibility of gradual connection of new sections.

The purpose of the preliminary market consultations was to verify the technical, organisational and economic aspects of the planned procurement, identify risks and ensure that the tender conditions corresponded to the needs of the Contracting Authority and were simultaneously in accordance with the principles of the Public Procurement Act. The outputs from the preliminary consultations will be used in the preparation of the tender documentation for the public procurement.

The possibility of participating in the preliminary consultations was open to all experts and suppliers regarding the public procurement. To participate in the preliminary consultations, experts and suppliers were required to confirm their interest in participation by sending a completed and signed Registration Form for the Preliminary Market Consultations – TMS Control Level for HSL (hereinafter referred to as the 'Registration Form'), by e-mail addressed to the Contracting Authority's contact person within the specified deadline stated in the invitation to participate in the preliminary market consultations.

17 participants registered for the first round of the preliminary market consultations, who confirmed their participation in the preliminary market consultations by sending the completed and signed Registration Form within the specified deadline. Within the first round of the preliminary market consultations, a written questionnaire was sent to the registered participants on 14 April 2025, with the deadline for submission of the completed questionnaire being no later than 12 May 2025; subsequently, this deadline was extended to 16 May 2025 upon the request of one of the participants. Správa železnic received 10 completed questionnaires within the extended deadline; 1 questionnaire was delivered only after the expiry of the specified deadline and was not evaluated, as the participant failed to meet the conditions set forth within the preliminary consultations by submitting it late.

1 Questions raised to participants

Participants in the first phase of the preliminary market consultations responded to the following questions:

A) General

1) What approximate costs do you expect for the implementation of the TMS system for high-speed lines in the Czech Republic, including costs for hardware, software, integration with existing systems, staff training and other related activities? Please indicate the range of these costs and the factors that may affect their amount.
2) Do you agree with the proposed schedule (Appendix 4) for the TMS project implementation, including the deadlines for completing individual milestones? If not, please provide comments and suggestions for schedule modifications that, in your opinion, would better reflect the realistic possibilities and optimal procedures for TMS implementation. Furthermore, please indicate whether you are able to suggest an approximate percentage distribution of the total project amount across individual milestones.
3) Based on your experience with similar projects, we would like to ask you to submit an indicative schedule for the implementation of our project. This schedule should include the milestones from Appendix 4. In addition to these milestones, we are also interested in other significant milestones that you consider key to the successful completion of the project. We are particularly interested in the estimated duration of individual stages and the dependencies between them.
4) Do you agree with the architecture shown in Figure 3 Procurement: TMS Control Level for HSL (Appendix 2)? If not, do you propose another more suitable option for building the TMS Control Level? At the same time, do you see any potential limitations or problems in the proposed architecture that could affect the functionality of TMS?
5) With reference to the architecture shown in Figure 3 Procurement: TMS Control Level for HSL (Appendix 2), please specify which subsystems from this figure are part of your TMS solution and will be delivered as part of this procurement. Please also indicate whether your solution includes other subsystems that are not shown in this figure, and if so, which ones specifically.
6) What technical solutions do you propose for building the interface between the TMS and future signalling systems from various manufacturers, what standards and protocols would you recommend to ensure smooth communication and data exchange between these systems?
7) What is your approach to adapting the EULYNX SCI-CC specification for the Správa železnic / HSL environment and what are your proposals for using the interface within this project?
8) With regard to the division of the Správa železnic architecture according to Figure 2 (HSL automatic operation concept, Appendix 2), it is necessary to define a communication protocol between the TMS Control Level and the Executive Level (RBC, interlocking) for high-speed lines. Are you able to define this protocol in cooperation with Správa železnic and with regard to the first HSL launch date? Does your company have the necessary competence to develop this protocol? If you believe that defining this communication protocol is not necessary, what alternative do you propose?

9) Alternatively, how will you ensure that the system you deliver to us is open for integration with signalling equipment from various suppliers? What specific steps will you take to ensure that the TMS will be compatible with different types of signalling equipment and allow us to easily connect new HSL sections to the TMS, regardless of the signalling equipment manufacturer?
10) Do you guarantee the compatibility of your system with at least three different signalling system suppliers without the need to use EULYNX-type solutions? If so, please list the specific names of all manufacturers whose signalling systems your TMS system is compatible with.
11) If we were to require complete TMS development, what is your estimated time frame for the development and implementation of the TMS solution, including all necessary modifications and integrations?
12) If you were to recommend a ready-made solution (without development), how could it be adapted to our requirements?
13) Regarding paragraph 3. Minimum requirements for TMS (Appendix 2, page 4): Do you have any difficulties implementing any of these requirements, do you consider them difficult to meet, or do you have any feedback on them?
14) Will the entire final product be delivered by a single contractor as part of the project implementation, or will it contain components or parts from other suppliers? If the product will contain parts from multiple suppliers, please specify which parts will be developed/delivered internally and which externally.
15) Do you have experience with implementing TWS (Track Warning System) level SCWS (Signal Controlled Warning System) on an operating railway infrastructure (line section) in the EU or in non-EU countries?
16) What experience do you have with similar contracts and specifically which contracts have you worked on over the past 7 years? Given the nature of the contract, is a 7-year period acceptable to you for assessing your experience or would you recommend considering a different period?
17) Is it possible to supplement your TMS with SCWS-I, or what are the limiting conditions of the system?
18) How do you estimate the financial and time requirements for connecting another HSL section to an already functioning TMS system? Does the format of data provided for implementing another section have an impact on this? Do you prefer any data format?
19) Is it possible to connect your TMS with a TMS from another manufacturer, if it were appropriate for a certain cross-border HSL connection?
20) As part of the requirements for long-term sustainability and flexibility of the TMS solution, what is your approach to providing the system source codes? Are you open to discussing the terms and scope of providing or potentially selling the source codes, and what are your potential concerns or conditions associated with this aspect?
21) In addition to providing the source code itself, what specific steps are you willing to take to ensure the transfer of ownership rights to this code, so that we have full control over its further possible development and modifications? Is this a feasible requirement for your company?
22) What support and system development period would you anticipate to be included in the contract?

23) What factors do you think determine the lifetime of the system (technical, moral) and what is your experience with long-term support for similar systems?
24) What exit strategy do you propose? In the event that the supplier would not be able to continue fulfilling the terms of the service contract or in the event of termination of system support, what mechanisms for transferring the management and operation of the system do you propose? How would the continuation of operation without a negative impact on the system be ensured?
25) What technical solutions do you propose for building the interface between the TMS system and future communication systems from various manufacturers (operation applications, CCTV systems, information systems, etc.), what standards and protocols would you recommend to ensure smooth communication and data exchange between these systems?
26) Requirements for ensuring the cyber security of ICT Infrastructure, cable routes and facilities (technological rooms and server rooms), including distribution cabinets in which supporting assets are operated and used, must comply with the Cyber Security Act (Act No. 181/2014 Coll.) and the Cyber Security Decree (Decree No. 82/2018 Coll.), which implement the relevant EU regulations (Directive (EU) 2022/2555 of the European Parliament and of the Council of 14 December 2022 concerning measures for a high common level of security of network and information systems across the Union and Regulation (EU) 2019/881 of the European Parliament and of the Council of 17 April 2019 on ENISA and on information and communications technology cybersecurity certification and repealing Regulation (EU) No 526/2013). Are you able to meet the requirements of these legal regulations with your solution?
27) From your perspective, is it feasible for the proposed system to support access control by connecting to Active Directory and at the same time secure communication using an SSL certificate issued by an internal certification authority (CA) with the ECDSA algorithm? If any of these parts is not feasible, please state the reason and propose an alternative if possible.
28) From your perspective, is it feasible to require that the proposed system, specifically its ability to connect to a central system for collecting logs (currently SPLUNK), is ensured? If this requirement is not feasible, please state the reason and, if an alternative exists, indicate whether it is possible.

B) System availability (redundancy between CDPs (TCCs))

1) Can you generally describe how you ensure high availability of the TMS system? What do you consider to be a suitable/achievable/necessary value for TMS system availability? Please also provide a specific value for system availability during HSL operation.
2) In the event of a system failure at one workplace, the system must allow immediate takeover of activities by another workplace, i.e. between workplaces in Prague and Přerov. What solution do you propose to ensure immediate workplace takeover in the event of a failure?
3) What solution do you use to ensure the fault tolerance of the system?

C) Traffic control rooms

1) Are you able to design and implement traffic control rooms that will be fully compatible with our Traffic Management Concept (Appendix 3) and our functional requirements? Are you able to fulfil these requirements in full?
2) Based on your experience with building traffic control workplaces for other high-speed lines, we would like to know your opinion on the proposed division of workplaces in CDP Praha (TCC Prague) and CDP Přerov (TCC Přerov). With regard to the HSL Section Description Tables (Appendix 5), we are interested in whether this arrangement is suitable in your opinion in terms of the efficiency of the controllers' work.
3) Efficiency of workplace division and smoothness of traffic management:
    a) Efficiency of workplace division: What is your view on the current structure of control positions, including the distribution of line, traffic and electrical control workplaces? Does this division correspond, based on your experience, to proven models for other high-speed lines?
    b) Smoothness of traffic management: Do you believe that the current division of sections between individual CDPs (TCCs) is suitable for ensuring the smoothness of operation on the controlled lines? Where and what possible optimisation opportunities do you see for the proposed solution?
4) Is the currently proposed staffing of workplaces for HSL control sufficient to ensure all necessary activities, or is there a lack of personnel in some areas of activities? If you see any alternative arrangement options that might be more suitable for HSL control, please indicate them.
5) Do you consider the questions from chapters: 1, 2, 3 sufficient to understand our intention and the future procurement? If not, what essential requirements should be clearly defined in the future procurement from your perspective? Would you recommend another form of consultation to clarify the procurement?

2 Categorisation of participants

For the evaluation of responses from participants of the preliminary market consultations, a structure of participants was proposed according to the following categories:

- Manufacturers with their own TMS system
- System Integrators / Consultancy companies (without their own TMS system)

All 10 participants who sent the completed questionnaire within the specified deadline fall into the category ‘Manufacturers with their own TMS system’.

3 Summary overview of responses

3.1 General

3.1.1 Question No. 1

What approximate costs do you expect for the implementation of the Traffic Management System (TMS) for high-speed lines in the Czech Republic, including hardware, software, integration with existing systems, staff training and other related activities? Please indicate the range of these costs and the factors that may affect their amount.

Companies in the category of manufacturers/suppliers with their own TMS systems provide various cost estimates for the implementation of TMS for high-speed lines in the Czech Republic with significant dispersion. Two of them have estimates in the range of 11.5–15 million EUR. One company anticipates higher costs in the range of 20–35 million EUR. Others did not provide specific numerical data but emphasised that the price will depend on many factors.

Most companies emphasise that a more precise estimate would be possible only after more detailed definition of exact requirements, network topology and required system architecture.

Some companies provide similar views on the price structure of the project. They emphasise the importance of the level of required integration with existing systems, degree of redundancy, cyber security requirements and scope of training. These companies also state that the final price will depend on detailed project specifications and are prepared to provide a more precise financial structure once more detailed information about project requirements and expectations is available.

A company from the group of system integrators is based on experience with a previous project, which includes the implementation of TMS with estimated costs of around 80 million EUR. Based on this comparison, they estimate costs for the Czech HSL project in the range of 15 to 25 million EUR. Furthermore, the company mentions that their estimate takes into account the implementation of OCC (Operations Control Centre) and backup OCC. A unique aspect of their response is the consideration of ATO (automatic train operation) as part of the TMS solution.

3.1.2 Question No. 2

Do you agree with the proposed schedule (Appendix 4) for the TMS project implementation, including the deadlines for completing individual milestones? If not, please provide comments and suggestions for schedule modifications that, in your opinion, would better reflect the realistic possibilities and optimal procedures for TMS implementation. Furthermore, please indicate whether you are able to suggest an approximate percentage distribution of the total project amount across individual milestones?

Most companies in the category of manufacturers/suppliers with their own TMS systems generally consider the proposed schedule to be feasible, but with certain reservations. Several of them explicitly confirm that the milestones are achievable. Some companies point out that milestone No. 1 could require more time, particularly for complete understanding and specification of requirements, which may take 12 to 24 months.

Several companies also emphasise that the schedule is realistic only when using an existing solution with minimal modifications, whilst new development would require a longer period. One company provided a link to a document with a detailed breakdown of project costs across individual milestones.

Some companies agree with the overall framework of the proposed schedule but point out the need for a longer period for milestone No. 1 and recommend adding risk reserves, particularly between milestones No. 3 and No. 4 in case of delays during integration and certification. One company submitted a detailed percentage distribution of the budget across milestones, with the largest share allocated to milestone No. 3 (25%) and milestones No. 1 and No. 4 (each 20%). This distribution balances the initial development effort with subsequent deployment and support.

A company from the group of system integrators considers the overall schedule to be reasonable and the commissioning date in 2033 to be feasible. However, it points out that the duration of milestone No. 1 is probably too short, with similar projects typically experiencing delays of 1 year or more due to the need for thorough understanding of local operational rules.

Instead of percentage distribution by milestones, it provides a distribution by types of costs: design (15%), equipment (45%), construction/installation (20%) and testing (20%).

3.1.3 Question No. 3

Based on your experience with similar projects, we would like to ask you to submit an indicative schedule for the implementation of our project. This schedule should include the milestones from Appendix 4. In addition to these milestones, we are also interested in other significant milestones that you consider key to the successful completion of the project. We are particularly interested in the estimated duration of individual stages and the dependencies between them.

Most companies in the category of manufacturers/suppliers with their own TMS systems propose either additional milestones to the existing schedule or accept the schedule in Appendix 4 as sufficient. Some companies propose adding milestones for design, specifications and safety certification.

Another of the companies recommends extending the framework of milestones between phases 1 to 4 with system design, testing, verification and approval. One then describes in detail the process of Customer Approval (CA) as a key approval process involving various phases of review and approval.

Some companies do not provide a detailed schedule, only referring to ‘the above considerations’. In contrast, others provided a very elaborate indicative schedule for the implementation of TMS Control Level for high-speed lines in the Czech Republic, which not only integrates the milestones from Appendix 4 but supplements them with other key activities. These companies emphasise the importance of overlapping phases, Factory Acceptance Test (FAT) as a critical quality gate before on-site deployment, dependence of pilot operation on stable installations and completed training, and dependence of post-go-live milestones on the national deployment schedule and maintenance agreements. This is a structured and flexible plan with an emphasis on risk management through early testing and gradual deployment.

A company from the group of system integrators did not provide a detailed schedule with the justification that the question is too complex. Such a brief response without further explanation suggests either limited experience with similar projects or reluctance to reveal their know-how regarding implementation schedules at this stage.

3.1.4 Question No. 4

Do you agree with the architecture shown in Figure 3 Procurement: TMS Control Level for HSL (Appendix 2)? If not, do you propose another more suitable option for building the TMS Control Level? At the same time, do you see any potential limitations or problems in the proposed architecture that could affect the functionality of TMS?

Companies in the category of manufacturers/suppliers with their own TMS systems provide diverse views on the proposed architecture. Several of them identify missing interfaces and potential limitations. Some companies emphasise the absence of interfaces for FRMCS, passenger information system, Power BI and centralised control of detectors. Others point out unclear communication links between subsystems and propose adjustments regarding the hierarchical relationship between TMS and ATO.

Another recommends a clearer presentation of roles (electrical system, line management, etc.) and their interactions with various systems. Another proposes the introduction of a digital integration layer and the use of thin clients for workplaces. Most companies agree that the architecture is generally feasible but requires clarification and improvement.

Some companies provided more extensive responses with specific proposals for improvement. Some companies provided more extensive responses with specific proposals for improvement. One agrees with the architecture but points out that some systems (ATO, PED, DOSTI, PDŽDC) should be external entities with which TMS communicates, rather than integral TMS modules. It also notes that the trackside ATO function should be at a similar level to the Radio Block Centre (RBC).

Another generally agrees with the presented layered and modular structure but proposes the integration of a diagnostic and monitoring layer, a dedicated safety management module, support for dynamic scaling and emphasis on standardised interfaces (EULYNX SCI-CC, FRMCS) to ensure long-term interoperability. These companies emphasise the need to reflect evolving European standards and specifications, particularly with regard to the System Pillar.

A company from the group of system integrators recommends dividing the network into areas of responsibility, where each area is assigned to one signaller workplace during normal operation. It emphasises the need for separation of TMS and ATO trackside servers and notes that TMS servers are of different types (archiving, simulation) with the necessity of redundancy for operational servers.

Furthermore, it considers it important to have an interface with the electrical system for controlling train movements in the event of powerless sections. As a key recommendation, it states the connection of TMS with Interlocking through the SCI-CC protocol, which offers modularity and flexibility.

3.1.5 Question No. 5

With reference to the architecture shown in Figure 3 Procurement: TMS Control Level for HSL (Appendix 2), please specify which subsystems from this figure are part of your TMS solution and will be delivered as part of this procurement. Please also indicate whether your solution includes other subsystems that are not shown in this figure, and if so, which ones specifically.

All companies in the category of manufacturers/suppliers with their own TMS systems confirm the ability to deliver key subsystems in the architecture in Figure 3. Some of them offer comprehensive solutions with a wide range of modules including simulation, train control, automatic route setting and several other modules that are not explicitly required (e.g. timetable generation). Others emphasise the ability to deliver TMS, ATO and SCADA systems including commercial hardware and equipment for operator workplaces.

Some companies point out that certain components (ATO, JDKnet, JDK Proxy and DOSTI server) are usually not part of the TMS solution. Other companies cover all subsystems and note that the electrical power control system is usually not part of the TMS solution but a separate system, although its importance is growing with the implementation of ATO technology. They also emphasise the importance of the planning system and ask whether it should be part of TMS or an external system.

Some companies have a comprehensive approach to TMS. Some of them consider the TMS server and line controller workplace (PTD) to be basic components of their solution, but are able to deliver other subsystems including diagnostic and maintenance subsystems. Others emphasise full support for the architecture with all key subsystems. In addition, they offer several advanced modules beyond the basic architecture – decision support system, dashboard with KPI and analytical functions, alarm management and a flexible workflow system.

A company from the group of system integrators proposes that TMS servers, ATO and workstations should be part of the TMS delivery together with internal network components (telecommunication cables, switches). As the only one, it explicitly mentions the possibility of delivering furniture (tables, chairs) as part of the TMS delivery and emphasises the need to consider the human factor and ergonomic studies. It recommends separating the ATO server from the TMS server to enable phased implementation, where it would be possible to first deploy commercial operation without ATO and only later add ATO functionality.

3.1.6 Question No. 6

What technical solutions do you propose for building the interface between the TMS and future signalling systems from various manufacturers, what standards and protocols would you recommend to ensure smooth communication and data exchange between these systems?

Most companies in the category of manufacturers/suppliers with their own TMS systems clearly recommend the EULYNX SCI-CC protocol as a standardised solution for communication between TMS and signalling systems. They cite standardisation, openness and interoperability between systems from different suppliers as advantages. Companies also mention the RaSTA layer as a security protocol under EULYNX SCI-CC. For communication between neighbouring TMS systems, some companies also mention TSI-TAF/TAP protocols.

Some companies offer a comprehensive multi-layered approach to integration based on standards. Some of them emphasise compliance with European directives and System Pillar requirements. They propose the use of basic IT standards (TCP/IP, HTTP/HTTPS), open formats for data exchange (XML, JSON), standardised RESTful API and publish/subscribe services for efficient event-driven communication.

Other companies similarly propose a multi-layered approach, where they state the EULYNX SCI-CC standard as a basis, supplemented by OPC UA and RESTful API for legacy systems. In addition, they offer middleware for adapting systems without direct SCI-CC support and emphasise the readiness of their architecture for future integration with FRMCS (successor to GSM-R). These companies emphasise the importance of open standards, modularity and scalability of their solution to ensure minimal disruption during future network expansion.

A company from the group of system integrators clearly recommends the EULYNX SCI-CC protocol (Baseline 4 R3) for the TMS-IXL and TMS-RBC interfaces, based on the open RaSTA communication protocol. It explains in detail the advantages of this solution, which include the possibility for Správa železnic to control the interface using an open standardised protocol, interface neutrality, the possibility of selecting different suppliers for IXL and TMS (which reduces integration problems), the possibility of future replacement of individual equipment without changing the entire system due to different IXL and TMS life cycles, and the offering of proven secure communication for safety functions.

3.1.7 Question No. 7

What is your approach to adapting the EULYNX SCI-CC specification for the Správa železnic/HSL environment and what are your proposals for using the interface within this project?

Companies in the category of manufacturers/suppliers with their own TMS systems generally agree on the suitability of using the EULYNX SCI-CC specification for the interface between TMS and signalling systems. Some of the companies propose implementing all mandatory elements of the protocol and analysing optional ones, whilst emphasising the need for agreement on identifiers and a command catalogue.

Another recommends the implementation of the standard RaSTA protocol as a security layer and possible joint definition of a custom application layer with the client. Another of the companies suggests that no adaptation may be necessary, depending on the maturity of external systems. Some companies agree with the proposal of Správa železnic to use EULYNX SCI-CC as the main interface and offer to identify technical challenges and necessary adjustments to specifications. Other companies state that the adaptation strongly depends on the operational concept of Správa železnic.

Some companies offer a comprehensive approach to adapting EULYNX SCI-CC. Some of them emphasise the need to monitor the development of SCI-OP protocols and thorough verification of compliance with specifications by all suppliers. Other companies present a three-stage adaptation strategy comprising adaptation of SCI-CC profiles to Czech infrastructure, collaborative testing and validation, and open interface documentation. They propose the use of SCI-CC as the primary protocol for signalling control, exchange of safety data and gradual implementation starting with testing during milestone No. 2. These companies emphasise interoperability and compliance with European standards.

A company from the group of system integrators proposes the use of SCI-CC from EULYNX baseline 4 R3 including the Rasta protocol for the communication layer. It states experience with defining control and indication messages between TMS and CBI from various suppliers. Their approach includes a two-stage analysis: first identifying operational needs (bottom-up analysis) and mapping them to EULYNX messages, and subsequently designing new functions based on EULYNX SCI-CC that would benefit operations.

3.1.8 Question No. 8

With regard to the division of the Správa železnic architecture according to Figure 2 (HSL automatic operation concept, Appendix 2), it is necessary to define a communication protocol between the TMS Control Level and the Executive Level (RBC, interlocking) for high-speed lines. Are you able to define this protocol in cooperation with Správa železnic and with regard to the first HSL launch date? Does your company have the necessary competence to develop this protocol? If you believe that defining this communication protocol is not necessary, what alternative do you propose?

More than half of the companies in the category of manufacturers/suppliers with their own TMS systems explicitly state that they are able to define the communication protocol in cooperation with Správa železnic. Some of them emphasise their experience with EULYNX SCI-CC, which they have already implemented in other projects.

Other companies propose the implementation of the standard RaSTA protocol and the possibility of cooperation on defining the application layer. Other companies in their response focused more on the track worker warning system (TWS/SCWS), which does not correspond directly to the question asked. Some companies emphasise their capabilities in the area of communication protocol development. Others propose that some parts will be covered by SCI-CC and others will be added as extensions.

Some companies declare that they are fully capable of defining the required communication protocol in cooperation with Správa železnic. Some of them offer a very comprehensive approach with a proposal to create a joint working group that would develop a well-documented, secure and standardised communication protocol. They describe specific areas that the protocol would cover (command formats, feedback loops, synchronisation with ETCS Level 2, performance feedback). Furthermore, they also offer an alternative approach if Správa železnic were to consider the definition of a new protocol unnecessary.

A company from the group of system integrators proposes the use of EULYNX SCI-CC from baseline 4 R3, including the Rasta protocol for the communication layer. It describes its methodical approach to defining the protocol, which combines bottom-up analysis (capturing needs from existing operation) and top-down analysis (designing new functions based on EULYNX SCI-CC capabilities). At the same time, it has experience with defining control and indication messages between TMS and CBI from various suppliers.

3.1.9 Question No. 9

Alternatively, how will you ensure that the system you deliver to us is open for integration with signalling system from various suppliers? What specific steps will you take to ensure that the TMS will be compatible with different types of signalling equipment and allow us to easily connect new HSL sections to the TMS, regardless of the signalling equipment manufacturer?

Companies in the category of manufacturers/suppliers with their own TMS systems agree on the necessity of using standardised protocols and integration layers to ensure TMS compatibility with various signalling system suppliers. Most of them emphasise the use of EULYNX SCI-CC as a suitable standard.

Some companies describe in detail their approach based on an intermediate layer (FEC), which translates between the native protocols of signalling systems and a unified CTC protocol. Some companies emphasise their experience with the integration of different systems. Overall, these are various approaches to achieving the same goal: to ensure that TMS can communicate with different types of signalling systems using a standardised interface.

Some companies emphasise the modularity and openness of the architecture of their solutions. Some of them propose a dedicated integration and communication layer within the TMS architecture, which will be flexible towards various protocols and formats. They also emphasise compliance with European directives and System Pillar requirements. Other companies build on the principles of open standards, modularity and scalability to ensure the integration of various signalling systems without dependence on a single supplier, which should facilitate future expansion of the high-speed network.

A company from the group of system integrators recommends EULYNX as an open and established protocol and proposes a thorough testing process to ensure seamless integration. Their approach includes a five-step strategy:

(1) homologation of each system in an independent laboratory,

(2) testing the Rasta protocol between systems,

(3) testing the application layer with a 'test station',

(4) testing various track configurations,

(5) final tests on site.

This methodology, according to the company, ensures gradual and thorough integration, whilst a similar approach can be used even if EULYNX were not adopted.

3.1.10 Question No. 10

Do you guarantee the compatibility of your system with at least three different signalling system suppliers without the need to use EULYNX-type solutions? If so, please list the specific names of all manufacturers whose signalling systems your TMS system is compatible with.

Most companies in the category of manufacturers/suppliers with their own TMS systems confirm the compatibility of their TMS systems with at least three different signalling system suppliers without the need to use EULYNX-type solutions. Some of the companies provided a more detailed response with a table showing their experience with the integration of various protocols for clients. Some companies named specific entities that have mutual support with their Core TMS. One company did not provide any response.

Some companies confirm the compatibility of their systems with several signalling system suppliers. Some of them state that their TMS can communicate with RBC and signalling systems through standard protocols set by a specific infrastructure manager. They already have integration with systems from a number of manufacturers in commercial operation.

Other companies guarantee that their platform is compatible with signalling system manufacturers even without relying on EULYNX-type solutions. Their system has been successfully integrated with various signalling systems using both standardised and proprietary protocols. Furthermore, they emphasise that their approach ensures supplier independence, which would enable Správa železnic to scale the TMS environment without architectural or contractual lock-in.

A company from the group of system integrators did not provide any specific information on this question and only responded that this part will be completed by the product owner.

3.1.11 Question No. 11

If we were to require complete TMS development, what is your estimated time frame for the development and implementation of the TMS solution, including all necessary modifications and integrations?

The estimated time frames for complete development and implementation of TMS vary among companies in the category of manufacturers/suppliers with their own TMS systems, ranging from 24 months to 4 years. Some of the companies rather recommend using an existing solution instead of complete development.

Other companies emphasise rapid development thanks to modular architecture but do not specify a precise time frame. The longest implementation time, which counts on a typical development and commissioning period of around 4 years, is commented on dependence on external factors such as construction work and signalling systems.

Some companies estimate a maximum time frame of 3 years depending on the required functionalities. Others offer the most detailed time plan of all companies and at the same time the longest total duration – 48 to 60 months. The schedule includes several phases described in detail: design and specification (6–9 months), development of the basic system (12–18 months), integration with signalling systems (6–12 months), testing, installation, pilot operation and other steps.

A company from the group of system integrators briefly states that based on its experience, the minimum time frame from notice to proceed to commissioning is 3 years. This response is similar to the estimates of several other companies from other categories, but it lacks more detailed information about individual phases or factors that could affect the schedule.

3.1.12 Question No. 12

If you were to recommend a ready-made solution (without development), how could it be adapted to our requirements?

Most companies in the category of manufacturers/suppliers with their own TMS systems offer flexible, configurable solutions that can be adapted without extensive development. They state various approaches to adaptation:

- configuration without development
- modular approach
- portfolio adaptability
- open source solution
- separate application areas
- requirements definition
- open architectures

Companies generally agree that some adaptations will always be necessary, particularly in the area of interfaces and specific operational procedures.

Some of the companies offer a solution based on an environment already familiar to them with an emphasis on four key areas of adaptation: compatibility of signalling systems, integration with existing systems, operational procedures and localisation. They acknowledge that adaptation will be necessary but emphasise the advantages of faster deployment.

Other companies present their own platform as a mature, modular solution with a comprehensive adaptation strategy including functional parameterisation, interface adaptation, localisation, training environment and compliance. They promise significant reduction of the development time plan whilst maintaining flexibility.

A company from the group of system integrators takes a realistic stance when it describes the idea of a ready-made solution without development as 'rather unrealistic'. It emphasises that each country has its specific operational requirements, rules and procedures that require a certain level of development and testing. It proposes using the core and architecture from a ready-made solution to minimise the scope of development.

3.1.13 Question No. 13

Regarding paragraph 3. Minimum requirements for TMS (Appendix 3): Do you have any difficulties implementing any of these requirements, do you consider them difficult to meet, or do you have any feedback on them?

Most companies in the category of manufacturers/suppliers with their own TMS systems consider the requirements to be fully realisable. Some of them provided the most detailed response with specific requirements for clarification (timetable optimisation, ETCS Level 2 with hybrid detection, ATO protocols, FRMCS implementation) and technical questions regarding redundancy between data centres.

Other companies emphasise the need for clear definition of specific functionalities and cooperation with the client. Others explain their capabilities in the area of innovation and safety.

Some companies consider the requirements to be realisable. Some of them point out that some requirements may exceed typical TMS boundaries and recommend distinguishing between inherent TMS requirements and interface requirements. Other companies provided constructive observations concerning redundancy, cyber security, diagnostic tools and data ownership, whilst confirming compatibility with their platform.

A company from the group of system integrators does not expect any problems with the implementation of common functions such as automatic routing or timetable management. It describes the requirements concerning ATO as the most demanding, as ATO via ETCS is still in the development and deployment phase.

3.1.14 Question No. 14

Will the entire final product be delivered by a single contractor as part of the project implementation, or will it contain components or parts from other suppliers? If the product contains parts from multiple suppliers, please specify which parts will be developed/delivered internally and which externally.

Most companies in the category of manufacturers/suppliers with their own TMS systems offer delivery as the main contractor with the use of external components. Whilst some deliver all software and hardware but use external libraries, databases and COTS hardware, other companies develop everything internally or deliver as a single supplier.

Other companies develop TMS and CCS internally but cooperate with local suppliers for knowledge of local conditions. Some of them offer a complete solution with three main parts including COTS hardware and can cooperate with the customer on the division of responsibilities. Other companies, for example, develop the TMS system internally but use external COTS hardware components.

Some companies offer delivery under a single contractual relationship but with the use of specialised partners. Some of them focus on the basic TMS solution with the use of COTS components for hardware and the possibility of integrating solutions from specialised suppliers. Other companies deliver a complete product in partnership for hardware supply and internally ensure platform development and system integration.

A company from the group of system integrators presents itself as an integrator that will combine components from various suppliers whilst maintaining quality in accordance with railway safety requirements. It has not yet made specific decisions about suppliers and plans to store equipment close to delivery locations.

3.1.15 Question No. 15

Do you have experience with implementing TWS (Track Warning System) level SCWS (Signal Controlled Warning System) on an operating railway infrastructure (line section) in the EU or in non-EU countries?

The experience of companies in the category of manufacturers/suppliers with their own TMS systems with the implementation of TWS/SCWS systems is very diverse. Some of the companies are developing their own Track Warning System based on IoT technologies for creating safety zones on the line, which should be compatible with various communication protocols.

Other companies state that they do not have direct experience with implementation but can integrate their TMS systems with SCWS systems provided that well-defined communication protocols exist. Other companies have extensive experience with the most advanced TWS systems implemented in several projects, including functions such as possession management, temporary speed restrictions and operator geolocation.

Some companies state briefly only a positive response without further details. Other companies have a technical solution based on a portable device in their portfolio, but not yet installed.

Some companies have certain experience with TWS/SCWS systems, but in various roles. Some companies cooperated with TWS suppliers primarily as a turnkey supplier of trackside equipment and were involved in feasibility studies for interfaces of TWS systems with signalling systems. Whilst other companies have indirect experience with the integration of SCWS systems in live railway environments in the EU and outside the EU.

A company from the group of system integrators provided a very brief response referring only to its own project without further details about the nature or scope of experience with TWS/SCWS systems.

3.1.16 Question No. 16

What experience do you have with similar contracts and specifically which contracts have you worked on over the past 7 years? Given the nature of the contract, is a 7-year period acceptable to you for assessing your experience or would you recommend considering a different period?

Most companies in the category of manufacturers/suppliers with their own TMS systems consider the seven-year period to be acceptable, whilst some emphasise that it should be counted from commissioning rather than from contract signing. Some companies propose extending it to 10 to 15 years for better reflection of the installed base. Companies submitted an impressive portfolio of references comprising projects in more than 20 countries.

The most significant projects include national traffic management systems, high-speed lines, metro systems and extensive modernisations of existing infrastructure. Companies emphasise their experience with EULYNX standards, ETCS integration, automated train operation (ATO) and complex control centres.

Some companies from this group consider the seven-year period to be acceptable. One company emphasises its continuous work on more than 100 stations over the past 7 years and significant high-speed line projects. Another company presents specific reference projects worth tens of millions of euros including work for national and regional projects, whilst emphasising its experience with EULYNX and ETCS integration.

A company from the group of system integrators is working on several similar projects abroad. In this connection, it considers seven years to be the minimum and would ideally recommend a period of ten years for assessing experience.

3.1.17 Question No. 17

Is it possible to supplement your TMS with SCWS-I, or what are the limiting conditions of the system?

The approaches of companies in the category of manufacturers/suppliers with their own TMS systems to the possibility of supplementing TMS with SCWS-I differ considerably. Some companies are currently working on this integration but do not yet have it implemented.

Other companies do not supply SCWS systems but are able to integrate them through well-defined open interfaces and protocols. Other companies only confirm the possibility of this integration. The most detailed response offers a comprehensive solution. The system also allows connection to an external SCWS through a secure communication protocol.

Some companies confirm the possibility of integrating SCWS-I into their TMS systems. Some of them emphasise an open and interoperable architecture that enables the integration of data from various railway subsystems. Received information about track warnings and safety states can be visualised in the TMS interface. However, it is important to distinguish responsibilities – TMS can display information, but safety-critical functions should remain in the interlocking system.

Other companies offer integration through a dedicated track management subsystem with possibilities of activating warning signals in real time, centralised monitoring of maintenance zones and safe coordination between train movements and track access.

A company from the group of system integrators did not provide a specific response and refers to the product owner for the completion of information.

3.1.18 Question No. 18

How do you estimate the financial and time requirements for connecting another HSL section to an already functioning TMS system? Does the format of data provided for implementing another section have an impact on this? Do you prefer any data format?

Most companies in the category of manufacturers/suppliers with their own TMS systems state that the financial and time requirements for connecting another HSL section depend primarily on the size and complexity of the new section, including the number of interlockings, track elements and trains. Companies further agree that connecting another section is significantly less expensive than the implementation of the basic system, as it primarily concerns configuration, not new development.

All companies emphasise the significant impact of data format on time and financial requirements. They prefer standardised formats (EULYNX, XML / JSON) and consistency with the original sections to minimise effort and errors. Modular architecture enables the addition of sections with minimal impact on live operation.

Some companies provide more specific estimates – connecting a section takes 3 to 9 months with costs of 500,000 – 1,000,000 € per section. They emphasise the importance of minimising disruption to existing operation through gradual implementation and parallel testing. They strongly support standardised data formats according to EULYNX and European directives to ensure interoperability. Quality, standardised data significantly accelerate configuration and enable the parallelisation of engineering tasks.

A company from the group of system integrators provided a brief response suggesting the use of a data aggregator with a repeating rule. It commits to adapting to customer standards but does not provide specific estimates of costs or time frame for connecting additional sections.

3.1.19 Question No. 19

Is it possible to connect your TMS with a TMS from another manufacturer, if it were appropriate for a certain cross-border HSL connection?

All companies in the category of manufacturers/suppliers with their own TMS systems confirm that their TMS systems can be connected with TMS from other manufacturers. Companies rely on various technical approaches: they use standardised protocols such as TAF TAP TSI, ESB buses with MIE protocols, flexible 'Bridge components' and Enterprise System Bus (ESB) or Digital Integration Layer (DIL).

Some of the companies already have practical experience with such integrations on existing projects. It generally emerges that the success of the connection depends on clearly defined protocols and communication interfaces between manufacturers.

Some companies provide detailed and positive responses regarding the possibility of connection with TMS from other manufacturers. Some of the companies have practical experience with interoperability and are actively participating in a project that is devoted to this issue. Other companies offer a comprehensive solution using their own platform with support for many communication protocols including EULYNX SCI-TMS/SCI-CC, RESTful API and message brokers. These companies further emphasise the importance of standardised interfaces and already have an implemented solution for international corridors.

A company from the group of system integrators provided a very brief and pragmatic response, which suggests that connection with TMS from another manufacturer is not technically demanding. It states that it is primarily an exchange of basic information about train designation and that sharing operational data with a neighbouring TMS usually does not present a challenge.

3.1.20 Question No. 20

As part of the requirements for long-term sustainability and flexibility of the TMS solution, what is your approach to providing the system source codes? Are you open to discussing the terms and scope of providing or potentially selling the source codes, and what are your potential concerns or conditions associated with this aspect?

Companies in the category of manufacturers/suppliers with their own TMS systems show diverse approaches to providing source code. Most of them do not provide source code as standard due to intellectual property protection, but are open to discussing alternative solutions.

The prevailing model is the provision of perpetual licences with the possibility of escrow agreements that would release the source code only under specific conditions (bankruptcy, inability to provide support). Some of the companies are open to selling the source code for internal use with the aim of ensuring long-term control and reducing dependence on the supplier. Several companies emphasise the advantages of retaining control over the source code for future development and support.

Some companies stated fairly consistent responses. They do not provide or sell complete system source codes as standard due to intellectual property protection, which represents a significant investment in research and development.

They consider source code to be a key asset ensuring unique functionality and competitive advantage. However, they understand the need for long-term sustainability and are open to discussing an escrow agreement, where the source code would be deposited with a neutral third agent and released only under predefined conditions, such as termination of business operations or inability to provide maintenance and support.

A company from the group of system integrators did not respond to the question and only stated a note that the response should be completed by the product owner.

3.1.21 Question No. 21

In addition to providing the source code itself, what specific steps are you willing to take to ensure the transfer of ownership rights to this code, so that we have full control over its further possible development and modifications? Is this a feasible requirement for your company?

Companies in the category of manufacturers/suppliers with their own TMS systems show very different approaches to the transfer of ownership rights to source code. Some of them are willing to discuss partial transfer under certain conditions and offer training or workshops for the customer's technicians, whilst others refuse any transfer of ownership and designate this information as confidential.

Several companies emphasise that full transfer of ownership would have a negative impact on the quality of support and system maintenance, as expert knowledge and experience would be lost. Alternatives to full transfer that are offered are licensing agreements for the use of engineering tools or source code escrow agreements. Generally, companies consider complete transfer of ownership to be problematic in terms of maintaining the quality and safety of TMS.

Some companies referred to their previous responses concerning source code. Some of the companies are significantly more open and offer a comprehensive solution including modular separation of intellectual property, where components developed specifically for the customer could be fully transferred, whilst basic components would remain under licence.

They also propose a structured knowledge transfer programme, full access to documentation and extended escrow agreements with emergency development rights. This approach is designated as feasible under clearly defined conditions.

A company from the group of system integrators referred in its response to the need for completion by the product owner.

3.1.22 Question No. 23

What factors do you think determine the lifetime of the system (technical, moral) and what is your experience with long-term support for similar systems?

Companies in the category of manufacturers/suppliers with their own TMS systems agree that the lifetime of TMS systems is determined primarily by technological factors – particularly hardware obsolescence (typically 5 to 10 years), software and operating systems, evolution of cyber security and the need for adaptation to new standards.

Most companies state a typical lifetime of 7 to 20 years before the need for significant technological renewal. Key factors are modular architecture, use of standard components (COTS), configurability and the possibility of gradual upgrades. A number of companies offer long-term support and maintenance contracts, typically for 5 to 20 years with the possibility of renewal. Proper maintenance, regular updates and proactive obsolescence management are considered the foundation for extending system lifetime.

Some companies provide a detailed analysis of factors affecting TMS lifetime. They emphasise a combination of technical aspects (modular architecture, COTS hardware, cyber security) and 'moral' factors (adaptability to new technologies, regulatory changes, evolution of user interfaces). They state a typical lifetime of 15 to 20 years and have practical experience with long-term support for systems for a period of 10 to 20 years and more. Companies focus on proactive maintenance, regular updates and continuous support as key factors for extending system lifetime.

A company from the group of system integrators only stated that it should be completed by the product owner.

3.1.23 Question No. 22

What support and system development period would you anticipate to be included in the contract?

The duration of support differs significantly between companies in the category of manufacturers/suppliers with their own TMS systems. Some of them propose only 6 months of support during the launch phase, whilst others recommend significantly longer periods. The shortest recommended long-term support is 10 years for technical support and maintenance, whilst the most ambitious offer is 15 years or more.

Several companies emphasise the need for 24/7 technical support and helpdesk. One company proposes that the development period will depend on specifications and will typically last 1 to 2 years. All companies agree that the specific conditions of support should be the subject of negotiations during contractual discussions.

Some companies propose a structured approach to support with several levels. Some of them recommend initial technical assistance during the first months of operation, followed by multi-level maintenance where the customer has the first level and the supplier higher levels. They propose 2–3 years in the main contract with the possibility of renewable contracts.

Other companies recommend 7 years of basic support with the possibility of extension to 10 years, including corrective maintenance, technical support and cyber security updates. These companies emphasise a structured approach with various types of support including evolutionary maintenance and life cycle management.

A company from the group of system integrators did not provide any specific response, only noting that the information should be completed by the product owner.

3.1.24 Question No. 24

What exit strategy do you propose? In the event that the supplier would not be able to continue fulfilling the terms of the service contract or in the event of termination of system support, what mechanisms for transferring the management and operation of the system do you propose? How would the continuation of operation without a negative impact on the system be ensured?

Companies in the category of manufacturers/suppliers with their own TMS systems offer similar approaches to exit strategy based primarily on escrow agreements. Most suppliers propose placing the source code in an escrow account with clearly defined conditions for its release (e.g. supplier insolvency, termination of support).

Some emphasise structured handover procedures including training and documentation. Some companies take a sceptical stance towards exit strategy and prefer long-term partnership. Other companies did not specify specific mechanisms or postponed the discussion to the second phase.

Some companies provide the most comprehensive and most detailed exit strategies. In both cases, they emphasise their long-term commitment to supporting clients but at the same time offer robust mechanisms for operational continuity. Their proposals include escrow agreements, comprehensive documentation, structured knowledge transfer plans, technical packages for continuation, standardised interfaces and the possibility of training local teams. These companies guarantee the continuation of operation without disruption thanks to a combination of perpetual licensing, full documentation and trained stakeholders.

A company from the group of system integrators did not provide any specific information about exit strategy and referred to the product owner for future completion of this part.

3.1.25 Question No. 25

What technical solutions do you propose for building the interface between the TMS system and future communication systems from various manufacturers (operation applications, CCTV systems, information systems, etc.), what standards and protocols would you recommend to ensure smooth communication and data exchange between these systems?

Companies in the category of manufacturers/suppliers with their own TMS systems agree on the importance of using open standards and protocols to ensure interoperability with future communication systems. Most propose the use of European standards such as TAF TAP TSI, Rail ML and System Pillars protocols.

Technical approaches differ – some companies propose the NAOS platform with ESB using the JMS standard and XML messaging. Other companies present a solution with a configurable 'Bridge' component for communication with the external world, which works with Enterprise Service Bus and XML formats.

Modern approaches include the use of a digital integration layer (DIL) with the KAFKA event streaming platform as the main message broker, which enables a publish/subscribe model of communication. RESTful API, TCP/IP, HTTP/HTTPS protocols and JSON/XML formats for flexible data exchange also appear.

Some companies present advanced, comprehensive approaches to the integration of communication systems. They emphasise compliance with European directives and System Pillar requirements. Some of them propose a technical solution based on basic IT standards (TCP/IP, HTTP/HTTPS), open formats (XML, JSON), RESTful API and publish/subscribe messaging patterns for optimising network traffic.

Other companies bring their own platform with an emphasis on interoperability, offering API-driven architecture, 'message broker/event bus' solution and protocol adapters for legacy systems. They recommend specific standards for various areas – ONVIF for CCTV, GTFS-RT for passenger information, OPC UA for SCADA systems. These companies propose a sandbox environment for testing integration without impact on live operation.

A company from the group of system integrators provides a brief but practical response focused on two key principles. It recommends maximum use of open protocols to ensure flexibility and vendor neutrality.

The main architectural proposal is an Enterprise Service Bus (ESB), which serves as a central integration layer capable of transforming data models, managing connectivity, routing messages, converting communication protocols and composing multiple requests. ESB makes these functions available as service interfaces for reuse by new applications, which ensures system modularity and extensibility.

3.1.26 Question No. 26

Requirements for ensuring the cyber security of ICT Infrastructure, cable routes and facilities (technological rooms and server rooms), including distribution cabinets in which supporting assets are operated and used, must comply with the Cyber Security Act (Act No. 181/2014 Coll.) and the Cyber Security Decree (Decree No. 82/2018 Coll.), which implement the relevant EU regulations (Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union and Regulation (EU) 2019/881 of the European Parliament and of the Council of 17 April 2019 on ENISA and on information and communications technology cybersecurity certification and repealing Regulation (EU) No 526/2013). Are you able to meet the requirements of these legal regulations with your solution?

Most companies in the category of manufacturers/suppliers with their own TMS systems confirm their ability to meet the requirements of Czech and European cyber security regulations. Some of them elaborated in detail the entire cyber security framework including risk management, physical security, ICT system protection, asset management, incident response, personnel training, supply chain security and continuous monitoring.

Other companies specifically stated compliance with several European regulations including the Cyber Resilience Act and the IEC 62443 standard. Other companies admitted that they have not yet fully evaluated all the consequences of the legislation but commit to cooperation in ensuring compliance.

Some companies from this group provided comprehensive and detailed responses confirming the ability to meet all required cyber security standards. Some of them described in detail their multi-layered approach including principles of secure design, verification of compliance, risk assessment, security hardening, incident response planning and personnel training.

Other companies specifically named all relevant legal regulations and presented a compliance strategy based on security from design, secured physical infrastructure, logical and network security, readiness for audits and continuous security life cycle management. These companies emphasise their readiness to cooperate with the client in ensuring full compliance with requirements.

A company from the group of system integrators did not provide a response to this question and only stated that the response should be completed by the product owner.

3.1.27 Question No. 27

From your perspective, is it feasible for the proposed system to support access control by connecting to Active Directory and at the same time secure communication using an SSL certificate issued by an internal certification authority (CA) with the ECDSA algorithm? If any of these parts is not feasible, please state the reason and propose an alternative if possible.

Most companies in the category of manufacturers/suppliers with their own TMS systems confirm that the requested functionality is technically feasible. Likewise, all confirm the possibility of integration with Active Directory for access control. Regarding SSL certificates with the ECDSA algorithm, most support them without problems.

Some suppliers specifically point out that they have already implemented this combination in previous projects. Other suppliers recommend flexibility in the selection of encryption algorithms in view of the rapid development in this area. Some companies emphasise that ECDSA keys are even recommended compared to older RSA keys and propose regular updating of supported algorithms within cyber security management.

Other companies provide detailed technical explanations of the feasibility of requirements. They confirm that integration with Active Directory is standard and well-established practice for centralised user management. They agree in supporting the use of SSL certificates with the ECDSA algorithm, with one company emphasising its better performance and cryptographic strength.

Furthermore, they also offer backup solutions for older components that may not support ECDSA, including hybrid certificates or reversion to RSA. These companies confirm full compatibility with European and Czech regulations in the area of cyber security.

A company from the group of system integrators did not provide a specific response, referring to completion by the product owner.

3.1.28 Question No. 28

From your perspective, is it feasible to require that the proposed system, specifically its ability to connect to a central system for collecting logs (currently SPLUNK), is ensured? If this requirement is not feasible, please state the reason and, if an alternative exists, indicate whether it is possible.

All companies in the category of manufacturers/suppliers with their own TMS systems confirm that it is technically feasible to connect the proposed TMS system to a central log collection system (SPLUNK). Furthermore, they mention support for standard protocols such as Syslog (RFC 5424, RFC 5425, RFC 5426), HTTP/HTTPS, and the possibility of exporting standard log files.

Some companies emphasise the need for cooperation with the client for correct configuration and evaluation of implementation requirements. Others also specifically mention support for SPLUNK protocols within their TMS system.

Some companies provide very detailed and comprehensive responses confirming the feasibility of integration with central log collection systems. They emphasise that centralised log management is a standard function of their architectures and is essential for cyber security and operational transparency.

Companies describe various integration mechanisms including Syslog, RESTful API, HTTP/HTTPS with structured data, file export and compatibility with SPLUNK Forwarders. They also specify the types of supported logs (system, application, security) and state that they have experience with the integration of various monitoring and logging solutions.

A company from the group of system integrators states that the response should be completed by the product owner.

3.2 System availability (redundancy between CDPs (TCCs))

3.2.1 Question No. 1

Can you generally describe how you ensure high availability of the TMS system? What do you consider to be a suitable/achievable/necessary value for TMS system availability? Please also provide a specific value for system availability during HSL operation.

Companies in the category of manufacturers/suppliers with their own TMS systems present various approaches to ensuring high availability of TMS systems with an emphasis on redundancy and geographical separation.

Most of them propose multi-layered architecture including hardware redundancy, virtualisation and geographical distribution between Prague and Přerov. A common element is the use of active-standby or active-active configurations with automatic function takeover.

Companies further state various target availability values – from 99.99% up to 99.99999%. Technical solutions often include cluster deployment, continuous monitoring, automatic failover mechanisms and robust backup systems. Several of them emphasise the use of virtualisation platforms and container orchestration to increase system resilience.

Some companies state a comprehensive approach to high availability with elaborated strategies in detail. They emphasise multi-layered redundancy, including automatic failover mechanisms, continuous monitoring and proactive notification systems. One of the companies states target availability of 99.99987%, whilst another aims at 99.995% (less than 26 minutes of annual outages). A common element is emphasis on geographical redundancy between Prague and Přerov with real-time data synchronisation, zero data loss and minimal service interruption.

A company from the group of system integrators proposes a hot standby configuration with redundant servers in each technical room (two in Prague, two in Přerov). It strongly recommends disaster recovery functions in the event of operations control centre unavailability. It specifies specific availability targets – servers minimum 99.50% with MTBF ≥ 50,000 hours and workstations minimum 99.00% with MTBF ≥ 40,000 hours. All communication interfaces must be redundant (Link A and Link B). The approach is technically conservative with clearly defined reliability metrics.

3.2.2 Question No. 2

In the event of a system failure at one workplace, the system must allow immediate takeover of activities by another workplace, i.e. between workplaces in Prague and Přerov. What solution do you propose to ensure immediate workplace takeover in the event of a failure?

Companies in the category of manufacturers/suppliers with their own TMS systems offer various approaches to immediate takeover of activities between CDP Praha (TCC Prague) and CDP Přerov (TCC Přerov) workplaces. Basic principles include geographical redundancy, dynamic redistribution of control areas and various redundancy models.

Most of the companies propose a system with connection of both CDPs (TCCs), where workstations can be connected to both locations simultaneously. Some companies prefer an 'active-active' architecture with two independent nodes, where each node can function as a backup for the other. Others propose control role concepts where operators can quickly take over areas of responsibility using sectorisation. Most solutions count on redundant workstations at both locations and the possibility of remote connection between centres.

Some companies propose an identical solution based on active-standby redundancy with automated takeover. Their approach includes the deployment of identical, fully synchronised TMS systems at both locations. During normal operation, one location functions as the active primary and the other as hot standby with continuous mirroring of all critical data in real time. In the event of failure, an automated mechanism immediately detects the problem and smoothly switches operations to the backup location with almost zero outage and minimal manual intervention.

A company from the group of system integrators proposes a comprehensive disaster recovery strategy with TMS workstations in both control rooms and main servers in Prague with backup servers in Přerov. The solution enables mutual takeover of operation – Prague can control southern and northern sections in the event of an outage in Přerov and vice versa.

The system requires that all servers have a database of the entire network and enable remote connection. The company emphasises the necessity of an appropriate strategy for training operators on all HSL sections.

3.2.3 Question No. 3

What solution do you use to ensure the fault tolerance of the system?

Most companies in the category of manufacturers/suppliers with their own TMS systems use similar approaches to ensuring system fault tolerance. Key elements are redundant hardware architecture with geographical division between Prague and Přerov, use of virtualisation technologies for high availability, and implementation of Active-Standby configurations.

Companies also focus on the elimination of single points of failure through redundant servers, storage and network components. At the application level, they use micro-services and modular architecture for fault isolation. Systems are designed to enable automatic service takeover and continuous monitoring of component status with the possibility of transparent switching for operators.

Some companies implement similar concepts with a focus on hot standby models within operations control centres. One of the companies in particular provides a very detailed description of a multi-layered approach that combines hardware redundancy (servers, network equipment, RAID configuration) with software measures including modular architecture, robust fault detection mechanisms, automatic restarts and data replication.

Companies emphasise geographical redundancy and the ability of the system to maintain continuous operation even during component failures or unexpected errors.

A company from the group of system integrators offers a different approach focused primarily on the implementation of a maintenance support system. Their solution concentrates on corrective, preventive and predictive maintenance with monitoring of specific indicators (FDMS, MTR, MTBF) and use of their proprietary SNG product. This approach is more oriented towards proactive system management than traditional hardware redundancy.

3.3 Traffic control rooms

3.3.1 Question No. 1

Are you able to design and implement traffic control rooms that will be fully compatible with our Traffic Management Concept (Appendix 3) and our functional requirements? Are you able to fulfil these requirements in full?

Most companies in the category of manufacturers/suppliers with their own TMS systems confirm the ability to design and implement traffic control centres compatible with requirements. Some companies describe it as a routine task, whilst others require more specific details about functionality, as they consider the requirements in the documentation to be too general. Several companies express a high probability of meeting requirements.

Some companies point out that fully equipped control centres are not part of their standard delivery but can advise on technical integration and recommend the acquisition of physical infrastructure from local suppliers. Other companies confirm full capabilities and commitment to deliver approved solutions or briefly confirm the ability to design and implement. One company states that the design of control centres is not among its main competencies and recommends hiring a local designer.

Some companies provide detailed and positive responses, stating that they have the design of control centres within their competencies and emphasise thorough understanding of operational procedures, ergonomic design and optimisation of operator performance. They point out the need for an ergonomic study and distinguish between requirements directly related to TMS and requirements for physical infrastructure. Others are fully capable of delivering turnkey control centres with their own layout, technological integration, role-based functional zones and support for future improvements including Czech localisation.

A company from the group of system integrators did not provide a response and stated a note '*To be completed by the product owner*'.

3.3.2 Question No. 2

Based on your experience with building traffic control workplaces for other high-speed lines, we would like to know your opinion on the proposed division of workplaces in CDP Praha (TCC Prague) and CDP Přerov (TCC Přerov). With regard to the tabular overview of the description of HSL sections (Appendix 5), we are interested in whether this arrangement is suitable in your opinion in terms of the efficiency of the controllers' work and smoothness of operation, or whether you would recommend any adjustments.

Companies in the category of manufacturers/suppliers with their own TMS systems generally consider the proposed division of workplaces between CDP Praha (TCC Prague) and CDP Přerov (TCC Přerov) to be acceptable but point out the need for further analyses. Several of them emphasise the necessity of more detailed workload analysis and level of automation. Some companies propose a possible reduction in the number of workstations due to higher automation.

Other companies point out uneven workload – Prague has almost double the length of the controlled section compared to Přerov, which could cause problems during operation takeover. Some of the companies consider the distribution to be balanced and consistent with their experience from similar projects. One company proposes a significant reduction in the number of operators thanks to smooth operation of their system.

One of the companies provides a very detailed analysis of the proposed division, specifically specifying the numbers of controllers for individual sections and their justification. For CDP Praha (TCC Prague), it proposes 2 controllers for the western section (with additional supervision over tunnel ventilation) and 3 controllers for the eastern section.

For CDP Přerov (TCC Přerov), it recommends 1 controller for the southern section and 2 for the northern section. It also mentions the need for additional operators for timetable creation and specifies requirements for infrastructure and electrical system controllers.

Another company considers the division to be logical but recommends considering the frequency of train services and the use of track vehicles for optimising allocation, particularly for timetable management and delay regulation.

A company from the group of system integrators considers the geographical division between Prague and Přerov to be a typical approach for high-speed lines that is also used in other projects. It points out that this model (north HSL operated from one location, south from another with the possibility of recovery) will require communication at the boundary between the two areas.

3.3.3 Question No. 3

3.3.3.1 Part a)

Efficiency of workplace division: What is your view on the current structure of control positions, including the distribution of line, traffic and electrical control workplaces? Does this division correspond, based on your experience, to proven models for other high-speed lines?

Most of the participating companies in the category of manufacturers/suppliers with their own TMS systems consider the proposed division of control positions to be suitable and corresponding to proven practices on high-speed lines. Several companies emphasise the flexibility of their systems – the possibility of combining or dividing line and traffic control functions according to specific needs.

Some companies propose the addition of an ETCS / telecommunications monitoring workplace and recommend verification of the optimal number of workplaces during simulation training. Other companies point out the possibility of optimising and reducing the number of workplaces based on experience.

Generally, however, all companies confirm that the structure is feasible but depends on the specific method of operation by Správa železnic.

Some companies provide a detailed view of the structure of control positions with an emphasis on practical experience from realised projects. One company presents specific references from its projects, where similar organisational models with various numbers of operators were successfully implemented. It also emphasises dynamic redistribution of control zones according to the current situation. Another company provides a comparative analysis with European models and highlights the advantages of functional segmentation – specialisation, reduced cognitive load and coordination between roles.

These companies consider the proposed division to correspond to best practices and to be suitable for the Czech context.

A company from the group of system integrators very briefly confirms that the proposed layout corresponds to a typical arrangement used in the field, without providing further details or recommendations.

3.3.3.2 Part b)

Smoothness of traffic management: Do you believe that the current division of sections between individual CDPs (TCCs) is suitable for ensuring the smoothness of operation on the controlled lines? Where and what possible optimisation opportunities do you see for the proposed solution?

Most of the companies in the category of manufacturers/suppliers with their own TMS systems consider the proposed division of sections between CDPs (TCCs) to be suitable. Furthermore, they emphasise the flexibility of their systems – the ability to redistribute control areas between workplaces and the possibility of dynamic reassignment of zones.

Several of them point out the advantages of a centralised solution or the possibility of operating the entire system from one location in the event of an emergency. One company proposes the reassignment of 'HSL Vysočina I' to another section. Generally, all recommend detailed analysis of efficiency and ergonomics during the design phase.

Some companies consider the current division to be suitable but emphasise the necessity of considering further factors. One company highlights the flexibility of the system through control zone management and standardisation of workstations with the possibility of logging in from any workplace. Another company recommends considering the frequency of train services and the use of track vehicles for optimising allocation, particularly for timetable management and delays.

A company from the group of system integrators considers it premature to assess the suitability of the current division without conducting task analysis and human factors assessment, which would ensure that train dispatchers will not be overloaded.

3.3.4 Question No. 4

Is the currently proposed staffing of workplaces for HSL control sufficient to ensure all necessary activities, or is there a lack of personnel in some areas of activities? If you see any alternative arrangement options that might be more suitable for HSL control, please indicate them.

Opinions on the adequacy of the proposed staffing differ amongst companies in the category of manufacturers with their own TMS systems. One company identified several missing roles – passenger information manager, coordinator between infrastructure and carriers, shift supervisor and training and maintenance personnel.

Other companies consider the staffing to be fundamentally sufficient with regard to the size and operation of individual lines. Some of the companies emphasise the need to verify the design of workplaces in terms of efficiency and ergonomics in the design phase.

Other companies propose, based on a high degree of automation, the possibility of reducing the number of staff/workplaces. Companies proposing the most advanced solutions consider the current staffing to be sufficient and additionally propose roles for ETCS / telecommunications monitoring and crisis management.

Some companies refer to previous responses and point out two specific activities that are not assigned to any operator – supervision over tunnel ventilation and off-line creation and updating of timetables.

A company from the group of system integrators, instead of a specific position, emphasises the need to conduct task analysis and human factors assessment to ensure that train dispatchers will not be overloaded. It considers it premature to assess the adequacy of staffing at this stage of the project.

3.3.5 Question No. 5

Do you consider the questions from chapters: 1, 2, 3 sufficient to understand our intention and the future procurement? If not, what essential requirements should be clearly defined in the future procurement from your perspective? Would you recommend another form of consultation to clarify the procurement?

Most companies in the category of manufacturers/suppliers with their own TMS systems consider the provided questions to be a good basis but propose the need for further clarifications and more detailed requirements. They most frequently miss:

- Specific operational concepts (CONOPS) and operational scenarios
- Detailed technical specifications of functionalities (e.g. traffic regulation, ERTMS commands)
- Information about the relationship between passenger and freight transport
- Clarification of redundancy requirements between data centres in Prague and Přerov
- Specification of training environments and their infrastructure

Some of the companies recommend additional consultations or workshops before the final tender announcement for better alignment of technical assumptions.

Some companies provided more detailed recommendations for supplementing the tender. They emphasise the need to specify operational parameters (number of trains per hour, types of trains), definition of risks for backup workplaces and functionalities of automatic modules. One of them proposes a structured process of bilateral consultations with selected suppliers before the final tender.

A company from the group of system integrators considers the current level of information to be sufficient for this tender phase and does not require further clarifications.

4 Comprehensive summary of the preliminary market consultations

4.1 Key findings and differences in opinions

4.1.1 Implementation costs – significant dispersion

Observed differences:

- Manufacturers with their own TMS: **11.5–35 million EUR** (more than double dispersion)
- System integrators: **15–25 million EUR** (based on experience with an 80 million EUR project)

Implications for Správa železnic:

- Necessity of very careful definition of requirements before the actual tender
- Risk of large price differences in tenders
- Need for detailed analysis of what is included in the price

4.1.2 Schedule – critical point: milestone No. 1

Consensus across categories:

- Milestone No. 1 (specification and understanding of requirements) needs **12–24 months** instead of the proposed time frames
- Overall schedule realistic only when using existing solutions
- New development would require significantly longer periods

Implications for Správa železnic:

- Re-evaluate the time plan for the first milestone
- Prepare for possible delays in initial phases
- Consider risk reserves between milestones

4.1.3 Architecture – need for clarification

Agreement:

The proposed architecture is generally feasible.

Differences in recommendations:

- **Manufacturers:** point out missing interfaces (FRMCS, Power BI, centralised detector control); recommend reassessing the TMS vs. ATO hierarchy, digital integration layer
- **Integrators:** emphasis on separation of TMS and ATO servers, connection via SCI-CC

Implications for Správa železnic:

- Architecture requires further detailed elaboration
- Necessary to classify the roles of individual subsystems
- Define clear interface between TMS and ATO

4.1.4 Communication protocols – strong consensus

Clear agreement: **EULYNX SCI-CC** as the standard

- Both categories recommend this protocol
- They emphasise openness, interoperability, vendor neutrality

Implications for Správa železnic:

- Clearly define the requirement for EULYNX SCI-CC in the tender
- Prepare for adaptation of the specification for Czech conditions
- Require proven experience with this protocol

4.1.5 Compatibility with various suppliers

Advantage: Most confirm compatibility with suppliers even without EULYNX.

Differences in approaches:

- **Manufacturers:** often proprietary solutions with adapters; emphasis on standardised interfaces
- **Integrators:** systematic testing of various configurations

Implications for Správa železnic:

- Possibility of selecting various signalling system suppliers
- Necessity to define testing procedures for compatibility

4.1.6 Development time frames – large differences

Range of estimates:

- **24 months to 5 years** for complete development
- Most recommend the use of existing solutions

Implications for Správa železnic:

- Prefer suppliers with existing solutions
- When requiring new development, expect longer deadlines

4.1.7 Source codes and ownership rights – fundamental differences

Significantly different positions:

- **Most manufacturers:** refuse sale, offer escrow agreements; more open, offer modular solutions
- **Generally:** escrow agreements as a compromise

Implications for Správa železnic:

- Decide on the priority of code ownership vs. support quality
- Consider escrow agreements as an alternative
- Define clear conditions for knowledge transfer

4.1.8 Support and system lifetime

Consensus: 15–20 years typical lifetime, **5–20 years** support contracts

Critical factors: Hardware obsolescence, cyber security, regulatory changes

Implications for Správa železnic:

- Plan long-term support contracts
- Prepare strategy for gradual upgrades
- Define criteria for system replacement

4.2 Fundamental implications for Správa železnic

4.2.1 Immediate necessary actions:

1) **Detailed specification of requirements** – define before tender announcement:
    a) Precise functional requirements
    b) Operational concepts (CONOPS)
    c) Redundancy requirements between CDPs (TCCs)
    d) Specific Czech operational procedures
2) **Schedule reassessment** – extend milestone No. 1 to 18–24 months
3) **Elaborate the architecture** – classify:
    a) TMS vs. ATO relationship
    b) Missing interfaces and components
    c) System hierarchy

4.2.2 Strategic decisions:

1) **Ownership vs. support quality**
    a) Decide on the priority of code ownership rights
    b) Consider escrow agreements as a compromise
2) **New development vs. adaptation of existing**
    c) Existing solution = faster implementation, lower risk
    d) New development = greater control, higher costs and risks
3) **Vendor lock-in vs. integration**
    e) Require EULYNX SCI-CC for vendor neutrality
    f) Define compatibility tests with various suppliers

4.2.3 Risks to address:

1) **Price volatility** – large dispersions in cost estimates
2) **Time delays** – underestimated specification requirements
3) **Technical risks** – insufficiently defined architecture
4) **Supplier dependence** – various approaches to code ownership

4.2.4 Recommendations for next steps:

1) **Bilateral consultations** with selected suppliers before the final tender
2) **Ergonomic study** for traffic control rooms
3) **Pilot project** for requirements validation
4) **Detailed technical specification** based on findings

The consultations provided valuable insights but at the same time revealed the need for further clarification of requirements before announcing the public procurement.

5 Assumption of further procedure

The information obtained from participants in the first round of the preliminary market consultations proved to be sufficient for drawing conclusions. Therefore, holding a second round of the preliminary market consultations is not required.

6 Appendices

6.1 Appendix No. 1 – Table with individual responses