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TRACK DATA AUDITING SYSTEM (TDAS) – PHASE II

SUMMARY

Transportation Technology Center, Inc. (TTCI), through a program sponsored by the Federal Railroad Administration (FRA), developed the architecture and core requirements for a Positive Train Control (PTC) Track Database Auditing System (TDAS), including system, subsystem, and interface requirements that can be used to develop and test prototype solutions in future phases of the program. TDAS aims to support the development of specifications, in the form of standards and/or best practices, for subsystems of an auditing system designed to support flexible implementation and increased automation of auditing functions. The standards and/or best practices and capabilities defined by TDAS are intended to be available for all railroads. The deliverables produced in this phase included:

1. System Development and Implementation Plan
2. Update of TDAS Concept of Operations (ConOps)
3. TDAS System Requirements
4. TDAS Subsystem Requirements
5. TDAS Interface Requirements
6. Request for Proposal (RFP) and review of proposals received for evaluation in future phases

TDAS is a set of defined capabilities and standardized architecture intended to support the ongoing management of PTC track data to meet the requirements of the Interoperable Train Control (ITC) system. Key objectives of TDAS include flexibility of implementation, support for increased automation of auditing capabilities, and standardization or definition of best practices for audit management, audit prioritization and scheduling, and recordkeeping processes.

The TDAS concept is intended to support the ongoing management of PTC track data to meet the requirements of the ITC PTC system. The system manages the auditing of railroad track data for PTC systems that use the ITC PTC data model definition. TDAS manages the track data auditing functions for an organization's entire railway network, including audit data collection, audit data storage, audit data comparison, generation of audit reports, and audit prioritization and scheduling.

BACKGROUND

To function safely and effectively, PTC systems rely on accurate track data. PTC critical asset locations and attributes within PTC track databases can change because of various factors. Therefore, track databases require regular management and timely updates to support safe rail operations. Auditing PTC track databases can be a manual, time-consuming process. In some current track database auditing processes, PTC critical assets are visually inspected and surveyed, and documentation is submitted and verified.

The purpose of the TDAS program is to establish standards and/or best practices for requirements relating to the auditing of PTC critical assets from both the perspective of audit process management, data collection, and verification. The TDAS program also aims to support development of the technologies required to automate the auditing process. Development of technology to increase the level

of automation and support open standards and/or best practices is valuable to the industry in enhancing the accuracy and efficiency of the PTC track data audit process. This technology includes optical data collection systems such as LiDAR (Light Detection and Ranging) for scanning track infrastructure. Figure 1 illustrates a LiDAR point cloud of PTC infrastructure, containing data which can be used to accurately position PTC critical assets for an audit.

Phase I of the TDAS program established the initial framework for the system and goals for the program, based on stakeholder feedback. A ConOps document was developed in this phase as well as a system requirements specification. Additionally, a Request for Information was submitted to multiple vendors to establish capabilities of existing technologies and identify gaps between those capabilities and the system requirements.

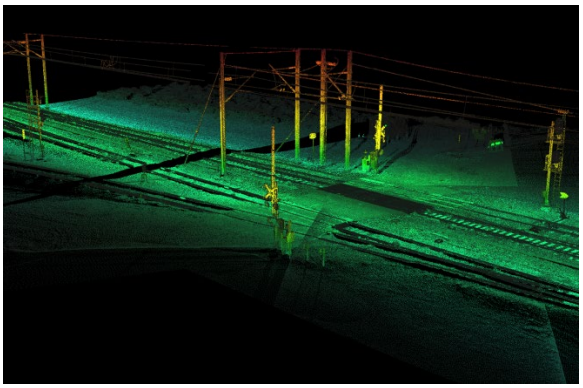

Figure 1. LiDAR Point Cloud Scan of PTC Critical Infrastructure

OBJECTIVES

Phase II of the TDAS program sought to produce a system development and implementation plan with a more comprehensive outline of the TDAS program approach and goals, as well as further refine the ConOps and system requirements developed in the first phase. The refined system requirements were then further decomposed into subsystem requirement documents that established functions and capabilities for each subsystem, as well as Interface Control Documents (ICDs) to define the interfaces between each subsystem, and between TDAS subsystems and other railroad subsystems. Finally, TTCI and the technical advisory group (TAG) generated an RFP that was submitted to vendors to establish candidates for development of testable prototypes for future program phases. Responses to this RFP were reviewed with the TAG to select vendors for developing prototypes to be evaluated.

The objectives of Phase II of this project were to:

- Document a system development and implementation plan, based on findings from Phase I.
- Refine design documentation from Phase I.
- Develop open standard specifications for individual system subsystems.
- Develop open standard interfaces between individual system subsystems.
- Generate RFPs for development of the audit management software and proof-of-concept data collection system subsystems and develop recommendations for the next project phase.

METHODS

To achieve the stated objectives, TTCI began by documenting the industry strategic plan for development, implementation, testing, and expansion of the TDAS using the findings from Phase I and input and feedback from the industry TAG. During the development of this plan, face-to-face meetings were held with members of the TAG to evaluate project progress and deliverables in terms of applicability to the industry and alignment with individual railroad programs. These meetings resulted in refining project deliverables for the current phase of the program to remain applicable and provide the intended benefits sought by FRA and the industry.

The ConOps and system requirements documentation developed in the first Phase were updated using feedback received in collaboration with the TAG. TTCI facilitated consensus with the TAG on the subsystem-level requirements and ICDs for the TDAS subsystems. TTCI prepared RFPs for the audit management subsystem and data collection subsystem that included these documents and the updated ConOps and system requirements. The Data Collection subsystem RFP was distributed to vendors, and the responses were analyzed to select potential vendor(s) to develop and test proof-of-concept data collection subsystems in the next phase of the program.

RESULTS

The update of the ConOps focused on updating and removing concepts as appropriate to better align with the focus on high-level standards and/or best practices agreed upon with the railroads. Restrictive, detailed design concepts were abstracted to more generalized system goals. In addition to being more appropriate for lower-level specifications, these design concepts did not completely align with railroad technical approaches, and unnecessarily restricted the technological approach without specifying meaningful standards for system performance.

The system requirements document was updated to match the narrative of the revised ConOps with respect to TDAS capabilities. Additionally, organization of the document was improved to better distinguish between system-level and subsystem-level requirements, which were moved to the appropriate documents.

Subsystem-level requirements were developed for the process management and data collection subsystems. These documents were written with sufficient detail for development of working implementations in a follow-on phase.

ICDs were developed to provide a description of the messages between each subsystem and identify the content of those messages. Non-standard requirements such as messaging protocols and security requirements were left to be specified by individual railroads in an appendix for each ICD.

An RFP was prepared and distributed to several vendors selected by TTCI and the TAG, and responses were obtained for evaluation. Evaluation of the RFP responses highlighted several concerns regarding the testing approach and limitations it may create when developing the subsystem prototype. Many vendors already had commercial, off-the-shelf systems available capable of being evaluated against the data collection subsystem's core performance requirements. The TAG agreed that testing several existing systems and choosing a single vendor from that evaluation to develop a full prototype would be more effective. It was decided to update and redistribution of the RFP to account for these changes was necessary, and it was determined these tasks would be addressed in the next phase of the program.

CONCLUSIONS

The goal of the TDAS program is to support collaboration between the railroads for development of industry standards and/or best practices related to track data auditing and technology to support automation of these processes. The system development and implementation plan defines the proposed structure of the TDAS program as well as a roadmap to incrementally increase the level of automation of the audit process. The ConOps and system requirements document updated in this phase of the program provide a framework for fundamental capabilities that any implementation of the TDAS should include, and the subsystem requirements and ICDs detail requirements and specifications necessary to develop prototypes of two of the three subsystems.

Analysis of the RFP responses received in this phase highlighted the need to modify the envisioned test structure and vendor selection process in the next phase. The TAG sought to include more vendors and implement a multi-phase testing and development process for the

data collection subsystem prototype to produce a more robust implementation.

FUTURE ACTION

Goals for the next phase include updating the prototype development and testing process for the data collection subsystem and testing of a data collection subsystem prototype.

Future program goals include development of the data comparison subsystem requirements and PTC critical asset library, development and testing of a data comparison subsystem, and implementation of the TDAS capabilities by the railroads.

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