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Large Scale Train Detector Network ensures efficiency and safety in train operation

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Abstract

This paper describes the hurdles and benefits of implementing a large scale train detector network based on RFID technology for a european railway infrastructure operator. This system consists of so called "readpoints" located on specific locations within the railway network and keeps track on the vehicles of each train throughout their travel. The mobile segment of the system is represented by a small RFID transponder mounted on the railway vehicle transmitting its vehicle number when passing by. Challenges were to interconnect various IT "worlds" in a unique system, to cope with the circumstances of remote stations which are hard to reach for local service, to handle a large amount of information in time for further processing and to achieve a high 24/7 availability of the system. It will be shown how to develop an all over systems design for such a large scale traindetector network, which focus has to be set on applications on readpoints and hosts to "uniform" the messaging, how could it be ensured that the system can flexible be extended by size and functionality and the demands for browser and mobile device oriented user interfaces for the operation personnel. The system now handles 350+ detector stations.

Keywords: Train Operations, Efficiency, Big Data

Introduction

The travel of trains through the railway infrastructure net is always influenced by weather conditions and other unforeseen events like technical faults on vehicles, delays, rerouting, etc. Wayside train detector stations are able to detect each passing vehicle and train, check their speed, direction and sequence of wagons and generate various value added AS-IS-information describing the actual operation status. A train is always associated by a "train-number" and "described" by an electronic wagon list. This information is handled by the signalling system controlling the wayside signalling equipment. But this information does NOT contain the actual sequence nor the running orientation of a vehicle. The actual status of the wagons and

therefore train can change rapidly and during the movement e.g. by technical faults at brakes, failures on axles and bearings (extraction of wagons from the train) and/or by weather conditions (delays). Thus a monitoring system is needed to ensure the proper train operation by checking the train's status on various locations. As described above, there is some vital information NOT available in the electronic train papers. Train detector station – so called "AVI" (automatic vehicle identification)-systems or short spoken "readpoints" can achive this demand. This equipment can properly detect the actual sequence of vehicles in the train, their speed and can also exactly pinpoint each specific axle or wheel of a specific wagon. This information helps to improve the loading/unloading procedure and can give very valuable pre-maintenance information by longterm statistics analyses of accurate allocated measurements from wayside train monitoring equipment (WTMS): The concerned infrastructure operator plans to install about 300-400 train detector stations. The task was to develop and implement a software solution for efficient monitoring and handling of such big network.

Main Tasks to fullfill

Main tasks to fullfill were (a) to design a overall system structure which is flexible to handle different brands of RFID reader, (b) to implement software for each different RFID reader to uniform the messaging between the RFID reader respective the "readpoint" and the central Host, (c) ensure the detection and handling of communication and system faults and (d) develop and implement a software system to handling all information received by the readpoints, do 24/7 system monitoring and support the installation and maintenance of the detector network by using different web browser and mobile devices.

Hurdles and Challenges

The main challenge is that all readpoints are located in very remote location and it takes long time to go there for local maintenance. As the internal communication network is based on a high secured closed IP-Net with fixed IP addresses precautions have to be taken to avoid wrong settings to be transmitted to the readpoint when configuring them. Additional "fall-back" scenarios had to be implemented to re-establish communication even if the configuration went wrong. Another challenge is to handle the big amount of data which is generated in the field. Even if each trainreport takes only several 100kB, in sum there is a huge amount of information generated each day raising up to GB per day. On the host side the various demands of the monitoring personnel had to be taken into consideration. The implementation had to cope with the high secured and high available multi-host environment, with the different operation demands from the technical department, the installation group in the field, the monitoring department and last not least the production department using the received "train-reports" to produce customer oriented output.

The solution

The solution developed is (a) an all over systems design for the installation and operation of such a large scale traindetector network, (b) applications on readpoints and hosts running under various operating systems to "uniform" the messaging, (c) an system which can flexible be extended by readpoints and functionality, (d) a user interface using state of the art web technologies and (e) various value added output which leads at the end to an increased efficiency in the operation of the railway infrastructure and output offered to the user of the railway infrastructure to increase efficiency, profit and to reduce maintenance effort.

The Benefits seem from the user

The benefits of using the system is to get a detailed overview of the status of the detector network together with possibilities to troubleshoot any problems. With a couple of hundred installations and a 24/7 organisation an easy-to-use system which can be handled by our service desk is requested. Though we are using different type of equipment in the readpoints it is also vital that the user can compare relevant information from different types in the same interface. By collecting the information in a host before sending it to recipients makes it easier to integrate new functionality. If every supported system had to be adapted for new installations it would be unmanageable. This new generation of the system gives us good possibilities to achieve high availability in the system. It has been vital that we as end-users have been involved in the development so it covers the user's as well as the technical demands.

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