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EXTENSIBLE LANGUAGE FOR DATA DESCRIPTION IN DIAGNOSTIC OF TRAFFIC CONTROL SYSTEMS

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Abstract: Modern railway traffic control systems commonly use Information Technology (IT) in order to perform processing and logging diagnostics data in diagnostic centres. The lack of standards for diagnostic data structures and the lack of common mechanisms of acquiring data causes, that the producers of systems use their own solutions in this domain. Thus, in spite of using modern technologies, there is a great difficulty in obtaining consistent diagnostic data and makes its further analysis difficult. In the article the using of the specialised XML-based markup language was proposed. This language can be used to unify structures of diagnostic data obtained from the different railway traffic control systems. The unification of diagnostic data structures would allow not only for building interfaces between railway traffic control systems and diagnostic centres, but also for developing the unified diagnostic system.

Keywords: railway traffic control systems, diagnostics, XML

1. INTRODUCTION

The railway traffic control systems are responsible for the safety and efficiency of trains movement on the rail network. Therefore, it is essential to ensure high reliability of these systems [7, 8]. Extremely helpful in achieving this objective may be centralized diagnostic systems, which, through acquisition of diagnostic data and usage of inference methods can help detect failures and minimize service and maintenance costs. Modern railway traffic control systems commonly use Information Technology (IT) in order to perform processing and logging diagnostics data in diagnostic centres [5, 6]. However, there is a lack of acquiring and structuring data standards what causes that the producers of the railway traffic control systems use their own solutions in this domain [9]. Therefore, despite the lack of technological barriers, there is a great difficulty in obtaining consistent diagnostic data and analysing them. The issue of unifying form of railway traffic control system diagnostic data and its structures is very important. Unified data structure, which is application-independent and vendor-independent, should simplify data exchange between railway systems and should allow to use various railway IT applications for data
acquisition, processing, visualisation and archiving. In this paper XML-based, specialized for railway traffic control system diagnostic data markup language was proposed.

2. XML

XML, or extensible markup language was originally used to store and exchange data between heterogeneous systems. Currently, as a set of simple rules, XML is often used to design other custom markup languages. Based on the XML specification many new markup languages were developed and acknowledged as standards, for example xHTML, RSS, MathML, CML, FpML, ebXML, GML, SVG, MusicML, SMIL, RDF, OWL [12]. XML was also used to develop standards for use in road transport – TransXML and rail transport – RailML [13, 14]. XML application comprehensiveness it is a result of its numerous advantages:

- openness – XML is open W3C standard supported by software industry market leaders, and based on international standards,
- strict syntax and parsing requirements – make the necessary parsing algorithms extremely simple, efficient, and consistent, allows validation using schema languages such as XSD,
- comprehensiveness – the hierarchical structure is suitable for most types of data, even in the case of the complex data structure; XML is commonly used as a format for online and offline document storage and processing,
- flexibility and extensibility – data structure is easy to extend and modify,
- separates content from presentation – the look and feel of an XML document can be controlled by stylesheets, allowing change the look of a document without editing its content,
- simplicity – simple and regular syntax that makes information coded in XML easy to read and understand,
- readability – it is a simultaneously human- and machine-readable format,
- internationalization – XML support multilingual documents and Unicode standard,
- wide availability of tools – XML is supported by many software vendors, so there are numerous and readily available parsers and editing tools,
- usability across the Internet.

Each custom markup language created using XML specification should satisfy a list of syntax rules provided in the specification. Well-formed document conforms to the rules:

- XML documents should begin with an XML declaration (XML prolog) which specifies the version of XML being used,
- a single "root" element contains all the other elements (tags),
- content must be properly nested (parents within roots, children within parents),
- elements can contain attributes, attribute values must always be quoted; either single or double quotes can be used,
- all XML elements must have a closing tag,
– element names must start with a letter or underscore; can contain letters, digits, hyphens, underscores, and periods; cannot contain spaces,
– the element tags are case-sensitive.

A "well formed" XML document is not the same as a "valid" XML document. A "valid" XML document must be well-formed, but in addition, it must comply with the restraints stated in document type definitions. This requirement only makes sense for the documents with defined schema. W3C XML Schema is currently the most popular standard to formal describing constraints on the structure of an XML document [10]. The purpose of an XML Schema is to define the elements and attributes that can appear in a document, the number of child element and data types and default values for elements and attributes. XML Schema standard allow to define new markup languages. Therefore, the authors used it for this purpose. In the following sections of the article the new defined markup language intended to describe data acquired from railway traffic control system was presented.

3. DESCRIPTION OF DIAGNOSTIC DATA FOR THE RAILWAY TRAFFIC CONTROL SYSTEMS

Based on XML syntax an exemplary specification of document structure in the form of XML Schema file was developed. This specification can be a simple version of the markup language specialized for acquisition diagnostic data which are gathered from railway traffic control systems. In the specification the "faults" type was defined, which is a complex type and contains the declaration of the element "fault".

```xml
<xs:element name="faults">
  <xs:complexType>
    <xs:sequence>
      <xs:element ref="fault"/>
    </xs:sequence>
  </xs:complexType>
</xs:element>

<xs:simpleType name="ID">
  <xs:restriction base="xs:integer">
    <xs:minInclusive value="1"/>
  </xs:restriction>
</xs:simpleType>

<xs:element name="fault">
  <xs:complexType>
    <xs:sequence>
      <xs:element ref="location"/>
      <xs:element ref="system"/>
      <xs:element ref="faultType"/>
      <xs:element ref="startTime"/>
      <xs:element ref="endTime"/>
    </xs:sequence>
  </xs:complexType>
</xs:element>
```
This element is composed of sub-elements:
- "location" with details about the railway object, in which the railway traffic control system was located,
- "system" with details about the railway traffic control system,
- "faultType" with details about the failure
- "startTime" and "endTime" with time stamps of the appearance of the failure.

Attribute of the element "fault" is the "ID" number which is defined on the basis of a simple integer. The element "location" is a complex type having sub-elements: "stationName", "lineNumber" and "position" which are also simple types, respectively: string, integer, integer and sub-element "geoCoord", which indicates the geographic location of the railway traffic control system.

In order to specify the latitude/longitude the element "geoCoord" type "posGPS" was defined. This element includes two sub-elements "latGPS" and "lonGPS" respectively "latitudeType" and "longitudeType".
Next element, which is the "system" has a string type attribute. The elements "startTime" and "endTime" are declared as dateTime. "FaultType" (complex type) with the attribute “alarmType” (string) and sub-elements: "code", "confirmState", "description" is the last element. The "Code" element is the simple type hexBinary. The "confirmState" is the type of confirmation defined on the basis of string, while "description" is a simply string.
When an abstract structure design documents (XML Schema) the graphic notation is often used [15]. The article visualise the created schema (Fig. 1).

Validation of the sample XML document containing information about a single failure was performed with the use of the XML parser. For this purpose previously defined XML Schema was used.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<faults xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:noNamespaceSchemaLocation="diagsrk.xsd">
  <fault id="1">
    <location>
      <stationName>Radom</stationName>
      <lineNumber>8</lineNumber>
      <position>103</position>
      <geoCoord>
        <latGPS>51.391773</latGPS>
        <lonGPS>21.156334</lonGPS>
      </geoCoord>
    </location>
    <faultType></faultType>
    <confirmState></confirmState>
    <description></description>
    <startTime></startTime>
    <endTime></endTime>
  </fault>
</faults>
```
4. CONCLUSIONS

XML language is constantly evolving and finding new applications. In accordance with XML specification the new standards are formed, while the others are still being developed and expanded. The authors of the article inspired with this technology suggested using of XML in the diagnostics of the railway traffic control systems. Nowadays each of the producers offer their own solutions, which are not coherent both in scope of acquired diagnostic data as well as the method of its representation. Developing the common standard based on XML would allow to standardise the diagnostic data structures gathered from the railway traffic control systems. Such an approach would ensure not only to design interfaces between railway traffic controls systems and diagnostic centres, but also allow to develop a unified diagnostic system [1, 2, 7]. It would be undoubtedly very helpful in building centralized diagnostic systems [3, 4]. As a result, this may lead to minimizing the costs of maintenance and servicing of the railway traffic control systems.

References

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ROZSzerzALNY JęZyK OPisu DATYCH W DIAGNOSTYCE SYstEMÓW STEROWANIA RUCHEM KOLEJOWYM


Słowa kluczowe: systemy sterowania ruchem kolejowym, diagnostyka, XML

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