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# The Implementation and Use of Conceptual Standards - The Case of the RDS-TMC Service

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# THE IMPLEMENTATION AND USE OF CONCEPTUAL STANDARDS – THE CASE OF THE RDS-TMC SERVICE

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*Abstract. The topic of the paper concerns the implementation and use of standards. The standards which are in focus in the paper include conceptual models and descriptions of the functionality and information exchange which should be provided in order to deliver ICT-services. This implies that these conceptual standards are specifications and guidelines for the information systems used to provide ICT-services, and the intended users of these standards are the service providers. In order to investigate the implementation and use of these standards a case study has been performed at the Swedish National Road Administration (the SNRA) with a focus on the RDS-TMC service. The SNRA is the service provider for the RDS-TMC service in Sweden, and the RDS-TMC service is a mobile traffic information service based on radio communication, i.e. the RDS-channel. The implementation of the RDS-TMC service is based on two conceptual standards, the ALERT-C and Location Code standards. One goal with the case study has been to investigate how these standards have been implemented in the systems used to provide the service. Another goal has been to investigate how the standards affect the development, maintenance and usability of these systems, and the information exchange in the service delivering process.*

*Keywords: Standards, Implementation, IT-service, Intelligent Transport Systems and Services, RDS-TMC service*

# 1 BACKGROUND

The transport sector is an example of an area where there is fast development of new ICT-services. The concept used in the transport sector to talk about these services is Intelligent Transport Systems and Services (ITS). ITS is “any system or service that makes the movement of people or goods more efficient and economical, thus more "intelligent"”. In cars, ITS is used to help drivers navigate, avoid traffic hold-ups and collisions. On trains and buses ITS is used to manage and optimise fleet operations and to offer travellers automatic ticketing and real-time traffic information. At the roadside ITS is used to co-coordinate traffic signals, detect and manage incidents and to display information for drivers and travellers.

In the ITS-sector the use and implementation of standards are important, because there is a need for standards which promote high quality and effective communication between actors, companies and information systems. This is also the reason why a lot of money and work has been spent to develop standards in the ITS-sector (Bossom, et. al. 1999, CEN ENV 1377:2000). The aim with the standardisation process in the ITS-sector is to create interoperability between systems and services and to promote industrial development. In this paper two of these standards, ALERT-C and Location Code, are in focus (ISO 14819-1:2003, ISO 14819-2:2003, ISO/TS 14819-3:2000). These standards have been developed to provide the RDS-TMC service. RDS-TMC is an abbreviation for **R**adio **D**ata **S**ystem-**T**raffic **M**essage **C**hannel. This service is a mobile traffic information service distributed with the help of the RDS radio channel. The aim with the RDS-TMC service is to provide drivers and travellers with dynamic information about congestions, accidents and road conditions in order to make better and more informed decisions during the trip (TMC-Forum 2003).

One reason why the RDS-TMC service is of interest is that it is the only mobile national language independent mobile traffic information service in Europe. The RDS-TMC is in operation in Belgium (Flanders region), Denmark, Finland, France, Germany, Italy, The Netherlands, Spain, Sweden, Switzerland and the United Kingdom. Countries planning to provide the RDS-TMC service soon are Austria, Belgium (Wallonia region), the Czech Republic, Hungary, Norway and Portugal (TMC-Forum 2003).

ISO[1] which is a well established international standardisation organisation defines the concept of standard like this (ISO/IEC Guide 2:1996):

*”document, established by **consensus** and approved by a recognized **body,** that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context”*

This definition shows that standards are rules and guidelines for activities or results specified in a document approved by a recognised body. According to Brunsson and Jacobsson (Brunsson, et. al. 2000) and ISO/IEC (ISO/IEC Guide 2:1996) standards are rules or guidelines for the users of the standards.

The standards Alert-C and Location Code (ISO 14819-1:2003, ISO 14819-2:2003, ISO/TS 14819-3:2000) which are in focus in this paper describe and give guidelines on how service providers, who are the users of the standards, should provide the RDS-TMC service. This implies that the standards are conceptual specifications for the service and the IS used to provide the service. In the paper we also use the term conceptual standards to refer to these types of standards because they include conceptual models and descriptions of the functionality and information exchange which should be provided in order to deliver the service. This implies that it is of interest to investigate how these standards are implemented and used. In order to investigate this issue a case study has been performed

[1] International Organization for Standardization

at the Swedish National Road Administration (Vägverket in Swedish, abbreviated SNRA in English), who is the service provider responsible for the RDS-TMC service in Sweden.

## 2 THE CASE STUDY

The SNRA is an important actor in the ITS-sector in Sweden, and the SNRA provides a number of traffic information services. One of these services is the RDS-TMC service, and this service has been in operation since 1997 in Sweden. The RDS-TMC service is based on a number of standards (ISO 14819-1:2003, ISO 14819-2:2003, ISO/TS 14819-3:2000), and the intended users of these standards are the service providers. Being the service provider for the RDS-TMC service in Sweden implies that the SNRA has the responsiblity to see that the service complies with these standards (guidelines).

### 2.1 Purpose

The main purpose of the case study has been to investigate how the SNRA have implemented and used the standards behind the RDS-TMC service in order to provide the service. The use of the standards can be described on two levels:

1. The standards are conceptual specifications (guidelines) which have been used to implement the systems used to provide the service. This implies that the system developers and the system owners have directly used these standards when they developed the databases, the information systems and the interfaces between these systems. At present they also use these specifications when they maintain the systems.

2. The standards govern how information should be created, stored, coded and exchanged when the systems are in use. This means that the users of these systems use the standards directly and indirectly when they perform these activities with the help of the systems.

### 2.2 Method

A qualitative research approach (Alvesson, et. al. 1994) has been chosen and the data used in the analysis have been collected with the help of:

1. Written documents which describe the standards and the information systems. The documentation analyzed is produced by the SNRA, by the European Committee For Standardization (CEN) and by the TMC Forum.

2. Observing how the functionality of the systems is used, and examining the information content of databases.

3. Guided interviews have been performed with people who are working with the maintenance of the systems and the standards, and the users of the systems.

Five interviews have been conducted with people at the headquarter of the SNRA who are responsible for the RDS-TMC service, and the systems used at the SNRA which provide the service. These are both systems developers and system owners. We have also interviewed the operators and co-ordinator at three Traffic Information Centers (TIC) who operate the service and use the systems which the service is based upon. The interviews have also included observations and demonstrations of these systems.

The data gathered has been analysed and the result of this analysis is presented as follows:

Description of the standards used. This is a description of the standards used based on the standard's documentation. This is presented in section 3 of the paper.

Implementation. This is a description of how the standards have been implemented and used in a number of information systems used to provide the RDS-TMC in Sweden. This is presented in section 4 of the paper.

Evaluation. This is an evaluation of the standards used. At first a problem analysis is presented describing negative results and effects concerning the implementation and use of the standards. Secondly a strength analysis is presented describing the positive results and effects. This is presented in section 5 of the paper.

## 3 THE STANDARDS

The RDS-TMC service is based on the ALERT-C and Location Code standards which specify how the traffic message should be coded and distributed to the customer.

### 3.1 Alert-C

The European standardization organisation CEN has created the ALERT-C standard (ISO 14819-1:2003). The standard describes how traffic messages should be coded, distributed and translated to drivers and travellers with the help of the RDS-TMC service (TMC 1999a). An important part of the standard is the event list (ISO 14819-2:2003). The standard describes both the information structure of the event list and a number of pre-defined traffic events which are approved by CEN. This implies that the entries in the event list are the same for all the countries in Europe. However the event list is translated into different national languages. In figure 1 below we can see how the event list is used to translate the coded RDS-TMC message sent.

The standard also gives guidelines on how the message should be transmitted through the distribution channel (i.e. the RDS-channel). This includes guidelines for the grouping of messages. The guidelines for grouping means that the message has to be adjusted to the sending groups of the channel. One group contains a maximum of 37 bits which corresponds to a basic (single-group) message. Figure 1 below illustrates the structure and content of a single-group message sent, how it is decoded in the receiver of the car which is the device used to present the message to the driver.

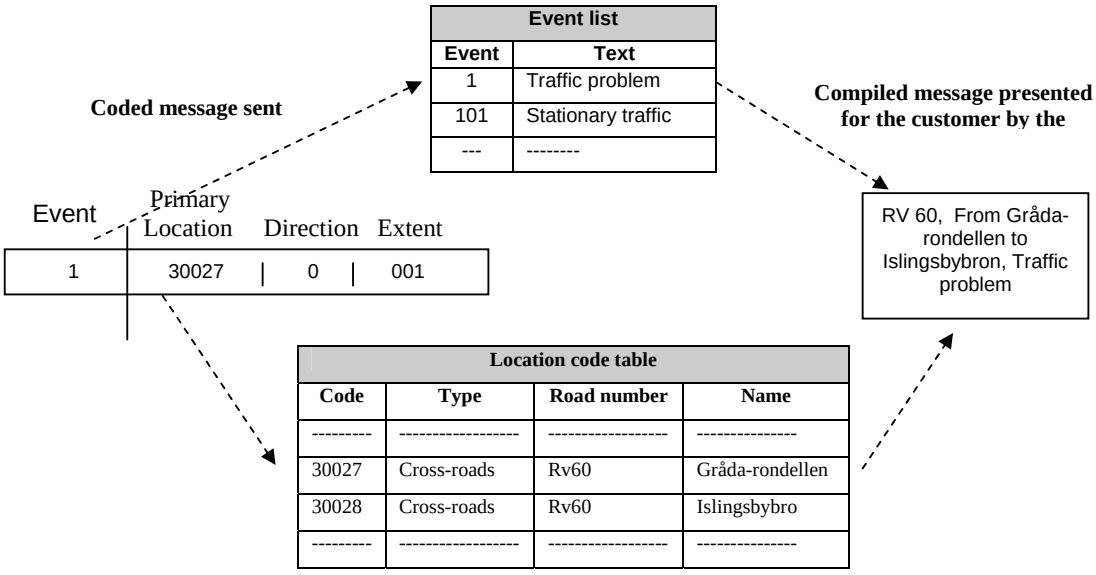


*Figure. 1. The structure of a sent coded RDS-TMC message and how it is compiled*

The coded message sent is described on the left of the figure. The event is traffic problem (Event Code = 1). The primary location is Grådarondellen (Location Code = 30027). The extent of the event is to the next Location Code, 30028 (i.e. Islingsbybron) in the direction of the road. This is coded by the 0

in the direction field and the 001 in the extent field. In order to able to present the message, both the event list and the location code table has to be installed in the receiver of the car.

### 3.2 Location code

Information about locations is a very important part of a traffic message, and the Location Code is a European standard designed by CEN (ISO/TS 14819-3:2000) to support the definition of locations used in traffic messages. The standard was originally developed for the RDS-TMC service but has later on been adopted in other traffic information services and standards too, see e.g. the DATEX-standard [4]. The standard describes the basic information structure of the location code database and how places, which are related to the road network, can be coded and named (ISO/TS 14819-3:2000). These places are stored in a location code database consisting of a number of tables which is described in "the recommended location data model" (TMC 1999b); this is a document which supports the standard. One of the tables in that database is the location code table which is also defined in the standard document (ISO/TS 14819-3:2000). An extract of the table is shown in the figure 1 above.

In the location code table the codes and names of the places are stored. For example, figure 1, shows that a place with the code "30027" and the name "Grådarondellen" has been created and stored in the location code table.

Every country in Europe has its own Location Code Database which is identified with a location Code ID-number. Today the ID-number for the Location Database in Sweden is 33. SNRA is responsible for the maintenance of the database in Sweden. The standard specifies the basic information structure of the database (ISO/TS 14819-3:2000), and detailed guidelines on how Location Codes should be created in the database are described in the supporting document (TMC 1999a). Every Location Code Database can contain a maximum of 65535 codes. Location codes cannot be reused because of the risk that some receivers contain an old version of the location table, which could imply that the location of the traffic event would not be compiled in the right way in that case.

## 4 THE SYSTEMS USED

In this section the systems which are used to provide the RDS-TMC service in Sweden will be presented and described (see figure 2 below).

White boxes are systems controlled and managed by the SNRA. TRISS is the system where the traffic information is stored at the SNRA and it is the basic system for a number of traffic information services, one of them is the RDS-TMC service. TRISS is used by the operators at the Traffic Information Centers to code RDS-TMC messages. The Location Code Manager System contains information about codes and names of pre-defined places, these places are used in traffic messages to describe the location of the events. The system is used by the operators at the Traffic Information Centers who use the system to create, code and name locations which are stored in the Location Code database. The RDS-TMC Editor is a system used to decide which RDS-TMC messages should be transmitted. The coded RDS-TMC messages are imported from the TRISS system. The RDS-TMC Editor quality controls the imported messages.

The grey boxes indicate systems managed by other actors. The TMC Forum is the organization responsible for supporting the implementation, operation and development of TMC products and services in Europe, and they have a web-site where the different national event lists can be retrieved. The compiler application used in the RDS-TMC receivers is developed by a number of system vendors who deliver the RDS-TMC receivers and associated software and information.

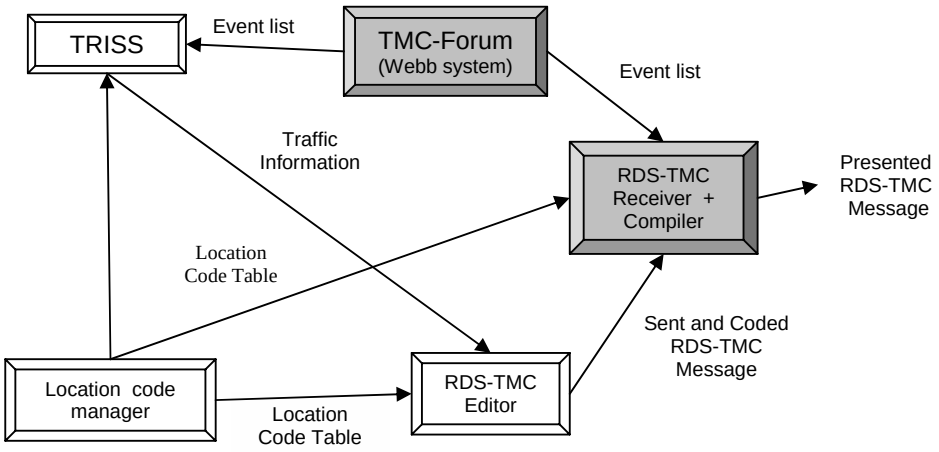


*Figure 2. The systems which are used for providing of traffic the RDS-TMC service.*

The standards described in the previous section have been used to implement these systems. This implies that the system developers and system owners have directly used these standards when they developed the systems and the databases. Presently they also use the standards when they are maintaining the systems. The fact that the standards are implemented in the systems implies that the standards are used when the systems are used and information is exchanged when the RDS-TMC service is provided.

The systems described above cross organisational boundaries and there is a lot of information exchange between different systems and actors when the service is provided. The architecture is also mobile and distributed. A rough estimate made by those responsible for the RDS-TMC service at the SNRA indicate that there are at least 50,000 installed receivers and associated software in vehicles in Sweden.

# 5 EVALUATION OF THE STANDARDS USED

From the description above we can see that the standards have been used by systems developers to implement the functionality, databases and information exchange between a numbers of systems. The standards also govern the use of these systems. The purpose with this section is to present some of the major problems and strengths which are related to the use of the standards. At the time the case study was performed the standards were used in two ways at the SNRA:

- By the operators at the TIC when information is created, stored, coded and exchanged with the help of the Location Code Manager and the TRISS system (see figure 2 above).
- By the systems developers and system owner at the headquarters when they maintain the Location Code Manager. The TRISS system and the RDS-TMC editor (see figure 2 above).

## 5.1 Alert-C

### *5.1.1 Problems*

A major problem with the use of the ALERT-C standard is that the message sent is coded which implies that it has a limited and fixed size which does not allow for a detailed and flexible textual description of the traffic event.

The following three problems were identified both from the interviews with the systems developers and system owners at the SNRA headquarter and the operators at the TICs.

The problem with the event part of the message is that the event list is predefined and that it is not possible to send information about an event which is not on the list approved by the standard. This implies that although an event really does not fit any of the entries in the event list, it has to be coded to fit a predefined event.

Another problem with the predefined event list is that it is too general which implies that it is hard to adjust it to the specific needs of a single country. For example in Sweden there is a great need to describe events related to winter road conditions which are not covered in the event list.

A third problem which is imposed by the standard is that only one event can be related to a location when a message is sent. This implies that although there can be a number of events which occur at a specified location, only one of these events can be transmitted.

A fourth problem was identified from the interviews with the systems developers and system owners at the SNRA headquarters. The problem is that it takes too much time and effort to propose changes to the standard, e.g. to propose additional events to the event list (which concern the information content of the systems) or to correct problems concerning data structures or functionality.

#### *5.1.2 Strengths*

The following strengths was identified in the interviews with people at the SNRA headquarters.

A strength is that the standard is well documented which implies that the standard gives support for how the RDS-TMC service should be developed, managed and maintained.

The predefined event lists which are distributed make it possible to translate the messages sent to the native language of the customer. The example in figure 1 shows that an Englishman driving in Sweden can get the traffic event translated into English although the message is sent by the SNRA.

The fact that an Alert C message is short and based on numeric codes means that the transmission costs are low.

### 5.2 Location Code

#### *5.2.1 Problems*

One problem area which has been identified by the system developers and system owners at the SNRA headquarters, concerns how the Location Code standard is used when location codes are created in the Location Manager System. The problem is that location codes are coded and created in the wrong way compared to the intention of the standard. For example, the intention is that location codes should be coded from the travellers' point-of-view because the locations used in the messages should be places which the traveller can recognise and understand. However when analysing the content of the Location Manager we discovered that the better geographical knowledge a user (i.e. TIC-operator) has of a certain geographical area, the more location codes are created in that area. This implies that the creation of location codes is primarily based on the operator's point-of-view rather than the traveller's point-of-view.

Another problem, which was also identified by the people at the SNRA headquarters, concerns how the standard is used for a different purpose. The Location manager has e.g. been used for the creation of location codes which are used to describe the location of physical objects, e.g. road culverts, and not traffic events. This causes other problems further down the line because location codes which are useless for the purpose of communicating traffic messages have to be deleted, and deleted codes cannot be reused again. This implies that there is a risk the available domain of location codes will run out, because there is a limited domain of 65,000 codes available.

A third problem, identified both by the people at the headquarters and at the TIC, is due to the comprehensive documentation which makes it hard to read and understand how the standard should be used in such a way that it is not misused or misunderstood.

### *5.2.2 Strengths*

Despite the problems, which have been described above, the Location Code standard is a useful tool to describe locations used in traffic messages. The standard creates rules which can be used both in the process of creating and coding places. The rules can be used for evaluating the usefulness and quality of information about locations in traffic messages which is crucial for traffic information messages. It is also of interest to notice how the Location code standard which originally was developed for the RDS-TMC service has been adopted in other standards used for the exchange of traffic information (CEN ENV 1377:2000), because it is considered useful.

### *5.2.3 The use of the standards in the systems development process*

In section 4 we showed how the standards have been used to implement the systems which are used to provide the RDS-TMC service. However, in the case study we did not study the actual system development process because the information systems which are based on the ALERT-C and Location Code standards were already implemented at the time the case study was performed. However there are documents (TMC 1999b) which describe experiences from the implementation of the standards from several European countries which show that the systems developers have had difficulties in using and interpreting the standards in the systems development process. For example in (TMC 1999b) it says that:

”In March 1997 a survey was distributed to all countries with general questions concerning their National location database for ALERT-C locations. One of the main outcomes for this survey was that countries interpreted the Location Referencing Rules in different ways, which resulted in different database models.”.

To overcome these problems a number of documents have been developed which offer a more detailed description of the Location Referencing Rules. For example, there are now documents which in detail describe how the Location Code Database should be implemented (TMC 1999c, TMC 1999d). The purpose of these documents is to provide system developers with more detailed systems specifications compared to the original standard document (ISO/TS 14819-3:2000).

## 6 CONCLUSIONS

The standards described in the case study are conceptual specifications and guidelines for how service providers should provide the RDS-TMC service and develop the information systems which are used to deliver the service. This implies that these standards have a strong impact on the systems development process. Furthermore the standards also affect the maintenance of the systems. The standards affect the possibilities to make changes in the systems because the standards have to be changed initially which makes the systems maintenance process quite complicated. The standards also affect the usability of the systems. From the case study we have learned that the standards have imposed unwanted restrictions on what can be communicated because the standards implemented in the systems set the rules for what can be expressed. Another problem concerns the complexity of the standards which implies that it is not so easy to understand how the guidelines should be used. The case study has revealed a number of interesting research questions which should be elaborated in future research. In the case of the RDS-TMC service the next step would be to investigate how the standards affect the quality of the service from a customer point-of-view. It would also be of interest to investigate how new delivery channels which could carry TMC services including digital radio (DAB), mobile Internet, and mobile phone networks, will affect the standardisation process. On a more general level it would also be of interest to investigate how other conceptual standards are implemented and used, because the case study shows that standards like ALERT-C and Location Code have a considerable affect on the systems development and maintenance process. This is of general interest because the development and use of conceptual standards are not something unique to the RDS-TMC service. There are a number of standards in the ITS-sector (Bossom, et. al. 1999, CEN ENV 1377:2000) which describe information, functionality and messages on a conceptual level. This

is a trend in the whole ITS-sector, and also in other ICT-service sectors, e.g. in the area of Location Based Services (ISO/AWI 19132). There are already a number of conceptual standards and more are on the way, where it is expected that service providers and system developers should comply to these standards.

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