The Euro-Interlocking Project:

Status of work on Open Standards for Railway Interlocking Systems in Europe

Niklaus H. König
Dip El.-Ing. ETH
Euro-Interlocking Project Manager
SBB Infrastructure Extended Process
Hohlstrasse 532
8048 Zürich
koening@eurolock.org

and

Crispin Bayley
B.A. (Hons), M.A., D. Phil.
Euro-Interlocking Business Manager
Hohlstrasse 532
8048 Zürich

On 1 January 1999, eighteen European railways launched the EURO-INTERLOCKING project under the auspices of the UIC with the aim of significantly reducing life cycle costs of future interlockings. This objective is to be achieved by the development of open standards for signalling interfaces and a common European basis for describing railway requirements. To date, seven signalling suppliers have also joined the work in the project, which is being co-ordinated by the Euro-Interlocking Core Team of engineers in Zurich, Switzerland.

The project vision of uniting the efforts of European railways and signalling suppliers to create open standards to the benefit of all stakeholders was originally considered a necessary, but almost impossible task by some experts in the field. With some seventy deliverables defined in the project to date, including an array of requirements and possible interface specifications, there is no question that the project is complex. However, it has enjoyed tremendous support from its stakeholders, and highly qualified engineers and experts from various fields have helped turn the project vision into reality.
But what is the status of the key deliverables of the project and the focus of project work at present? As well, what is the Euro-Interlocking project’s relationship to the ERTMS/ETCS work across Europe?

The Organisational Diagram below shows the structure of the various bodies and people working in the project.
As originally envisioned, the focus of the signalling companies’ work in the project lies in the development of open interface specification standards. As with much of the project work, the philosophy is not to create new specifications but to adopt “best solution” specifications from project stakeholders and implement these as European Standards as quickly as possible. To this end, for example, Austrian Railways, who have made a tremendous effort in the past to standardise their signalling interfaces, have contributed their interface specifications for possible adoption by the project. In addition, several suppliers have, “opened” various interface specifications for possible standardisation.

Moreover three crucial interfaces have been identified by suppliers as being top priority for standardisation:
The interlocking to Traffic Control, MMI and Remote Control Systems interface (interlocking – TCS interface)

– The interlocking to interlocking interface

– The interlocking to RBC interface, needed for future ERTMS related systems

To date the FIS for the interlocking – TCS interface have been drafted. This work is of particular importance since it not only builds the basis for other FIS work in the project, but the FIS are also a crucial input for the development of the Functional Requirements for future interlockings. Work packages covering the seven ISO layers have been defined, including parties responsible for the work.

Requirements Language Standards for Signalling

Most railways in the project are faced with the difficult task of having to procure a new generation of interlocking systems for their network. This is primarily because first generation electronic interlocking systems are reaching the end of the production phase of their life cycle. Additionally, new functional requirements are needed to enable future interlocking systems to meet the special functional needs of ERTMS/ETCS systems.

To this end, one of the most crucial tasks in the project was to develop and adopt a set of methodologies and tools as a European platform to enable railways to develop their requirements for the procurement of future interlocking systems.

It is important to note that it is the aim of all involved in the project to develop requirements for future interlockings and that no technical specifications are to be included in these requirements. It is the intention of the railways that any interlocking system or technology shall be able to fulfil the given requirements, thereby leaving maximal room for suppliers to either offer existing systems and technologies to the railways and/or to offer innovative solutions, technologies and systems to meet the future needs of the railways. The exception, of course, to the “no technical specification” rule is the work being done on interface specifications, but this is anyway in the hands of industry.

The REVEAL® Requirements Engineering Methodology was adopted as a standard for this work early on in the project. To support the work of requirements capturing and change control management, the DOORS Requirements Management Tool was implemented, perfectly complementing the REVEAL methodology.

Given the high number of project stakeholders and their international backgrounds, it was found necessary to create a rigid definition of the use of English for plain text.

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requirements in the project. With this in mind, the SELRED Guideline (Structured English Language for Requirements Development) was developed by the project team, based in part on pioneer work already done in this area by NASA.

A highly structured Glossary of Terms, which is based on SELRED has also been developed. As far as possible, the term definitions have been taken from CENELEC, IEC, ERTMS and ITU, even though these terms do contain some inconsistencies and ambiguities. In many cases, however, , it was necessary to create new terms for project work.

As is explained below, the approach adopted for the development of the Functional Requirements led to the use of both an Object Oriented Method as well as the State Event and Transition Method. As the Statemate Tool is based on these two methods, it has been implemented in the project for this work.

This very powerful set of methodologies and tools, grouped under the name Requirements Language Standards for Signalling and is quickly becoming a de facto standard for project stakeholders across Europe.

High Level Requirements

The first major task completed last year in the area of requirements development were the High Level Requirements for future interlocking systems. In accordance with REVEAL and in line with the CENELEC norms EN 50126 to EN 50129, these requirements form the basis for all further requirements development. An example of a High Level Requirement is: “A main safety objective of an interlocking system is to prevent collision between trains”.

Although the High Level Requirements were completed last year, the very nature of the work means that additions and improvements are being made on an ongoing basis.

Functional Requirements

Probably the most complex and difficult task in the project is the development of the railway Functional Requirements for interlocking systems. The main thrust of the work to date has been to develop Generic Functional Requirements. These requirements should cover all possible functions required by the participating railways both today and in the foreseeable future. This information is crucial not only for suppliers who would like to deliver generic products to various railways in Europe, but also because the Generic Functional Requirements are the basis for the definition of the National Functional Requirements of each railway. The basic concept is that a
railway can “tag” which of the Generic Functional Requirements are applicable for them and thus define their national requirements. With this method, it is possible for railways and suppliers to compare the various functional requirements of the railways. Based on this information, suppliers and railways are able to make key strategic market and purchasing decisions during the procurement of new interlocking systems.

A key task in this area was to decide upon which tools and methods were to be used as a basis for the development of the Functional Requirements. At a high level, it was decided to take the pioneering step of using Object Orientated Methodology in the development of requirements. This allows the breakdown of the complex task of functional requirements development for some fifteen railways in the project into manageable object classes and groups of work packages. As a basis for the detailed requirements development, it was decided that the project would use State Event and Transition Diagrams. This method is the basis of the Statemate tool already mentioned. To date the functionality of most of the track elements managed by an interlocking system has been defined. At present work is being focused on the approach, methodology and tool to be used at an intermediate level. This covers by and large the handling of commands and states of the various railways by an interlocking system. The methodology and tool chosen must not only guarantee that suppliers can meet the functional requirements with any interlocking system technology and architecture, but also that it must be possible to validate an interlocking system against these requirements.

**Qualitative Requirements**

Apart from Interface Standards and Functional Requirements, there is a large group of requirements needed for the procurement of new interlocking systems. These are called the Qualitative Requirements and cover such things as

- Reliability and Availability
- Maintenance
- Safety
- Performance
- Modification
- EMC
- Environmental Conditions
- Cross-acceptance
- Verification and validation

To date approximately 60% of the Qualitative Requirements have been drafted and they are currently under review by railways and suppliers.
It is important to note that wherever possible existing standards are used. In this case, it is still valuable information for railways and suppliers to know which standards or even which part of a standard applies in a specific area. In many cases, however, railways must make a decision about their requirements in a particular area that goes beyond what is stated in a specific standard. For example, in environmental standards several classes of temperature ranges are defined, but a railway must still choose which temperature class is required for a system installed on their network.

**Data Preparation**

The field of Data Preparation in the Euro-Interlocking project covers the promotion of tools which would primarily enable railways to automate the preparation of data needed for a specific interlocking system. Such tools would enable a more efficient planning and procurement process for the railways and in part for the suppliers, which would not only cut costs but also improve the time to implementation of a specific interlocking.

The scope and context of the Data Preparation work in the project has been defined. The tasks include creating two crucial “File Format Standards” for Data Preparation.

The first of these, the “Location File Format Standard” defines the form in which data from a specific location, primarily the track topology, is given as input to a data preparation tool. The second, the “Interlocking File Format Standard” defines the form in which data about track elements and interlocking dependencies is passed from a railway to a supplier. Some preliminary work has been done on these two standards but the specification of the File Format Standards is just now starting, with the aim that it should be completed by the end of the year.

Several suppliers have expressed their willingness to provide data preparation tools to railways and support the development of the above mentioned standards.

**ERTMS/ETCS**

The question is often raised, how does the Euro-Interlocking project fit into the broader field of ERTMS/ETCS? In general terms, the work in the Euro-Interlocking project runs parallel to the ERTMS/ETCS work but is closely co-ordinated with the specifications and system developments taking place within the ERTMS/ETCS framework.
A good example of this is the Interlocking to RBC interface presently being developed in various forms by several suppliers. Would be logical to develop a European standard for this interface as quickly as possible, but the work has been defined as lying outside the scope of ERTMS/ETCS. Thus the Euro-Interlocking project has taken on this task and it is currently under development by the participating suppliers.

Another key task of the project is to define the requirements of future interlocking systems to meet the advanced functionality required from interlockings connected with future ERTMS/ETCS systems. This task is under constant consideration by the Core Team members developing the functional requirements, but is made more difficult by the fact that the additional functionality required by ERTMS/ETCS systems is not yet clearly defined.

If and how ERTMS/ETCS-based requirements and specifications within the Euro-Interlocking project will be integrated into the TSI specifications and specifications for conventional lines still remains to be decided upon.

**Further project output**

In December 2000, a broad Business Case for European Railways for the project, covering the field of signalling and interlocking systems across Europe, was completed. As an annex to the Business Case, a Study of Standardisation in other Industries was also completed by the Business School of the University of Warwick, under contract with the Euro-Interlocking project.

This year we have also started publishing a project newsletter, the first issue of which was circulated in May. The Newsletter gives up-to-date information about the progress and status of the project as well as providing detailed information concerning special work and deliverables completed or in progress in the project. The first issue was such a success that a reprint was necessary to meet the demand after the first delivery had been completed.

The Euro-Interlocking website has also been on-line for more than a year now, providing not only information about the project and access to all the project work, but also giving key information and links from the field of signalling across Europe. Under “Links and Contacts” one can also find a signalling glossary, providing terms definitions and cross-references from Euro-Interlocking, CENELEC, ERTMS/ETCS, IEC, ITU and Railtrack. If you would like more detail about project work, would like to get in touch with project team or project stakeholders or would like to be on the mailing list for the project newsletter, the project website is

[www.euro-interlocking.org](http://www.euro-interlocking.org)