Sustainable and intelligent management of energy for smarter railway systems in Europe: an integrated optimization approach

D8.4 – Newsletter "MERLIN – Making Railway's Energy smart"

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Project co-funded by the European Commission within the Seven Framework Programme (2007-2013)		
Dissemination Level		
PU	Public	x
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Start date of project: 01/10/2012 Duration: 36 months

EXECUTIVE SUMMARY

This document describes D8.4 which has been delivered in the form of a project newsletter summarizing the main technical results achieved during the first two years of MERLIN.

The purpose of the newsletter is to raise awareness of the main activities undertaken by the MERLIN partners and increase the interest of the railway stakeholders towards the goals of the project. In this regard, the different articles cover all the active technical Work Packages in order to provide a global overview of the project. The choice of the pictures has been done by taking into account the content of the newsletter, while the colors and the layout have been selected on the basis of the project website in order to create a continuity between these two dissemination/communication tools.

The 1st MERLIN newsletter consist of ten pages which covers all the activities carried out during the first two years of the project. Background information and a short introduction to the project have been included in the front page to help the reader understand the context in which MERLIN was created.

MERLIN will release a second and final newsletter which will be released in time for the Final Conference which will take place on the 10th of December 2015 in Madrid. This document will contain the main final results which need to be disseminated among the wide spectrum of European stakeholders.

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1. INTRODUCTION

The purpose of the 1st MERLIN newsletter is to raise awareness of the main activities undertaken by the MERLIN partners and increase the interest of the railway stakeholders towards the goals of the project. In this regard, the different articles cover all active technical Work Packages in order to provide a global overview of the project. The choice of the pictures has been done by taking into account the content of the newsletter, while the colors and the layout have been selected on the basis of the project website in order to create continuity between these two dissemination/communication tools.

Several partners have been involved in the realization of this publication but the most relevant contribution has been delivered by UNIFE and UIC (as author and co-author of the document) and by all the technical Work Package leaders, namely Ansaldo STS, D'Appolonia, ADIF, University of Newcastle, CAF and FFE.

2. STRUCTURE OF THE NEWSLETTER

The 1st MERLIN newsletter consist of ten pages which covers all the activities carried out during the first two years of the project. Background information and a short introduction to the project have been included in the front page to help the reader understand the context in which MERLIN was created.

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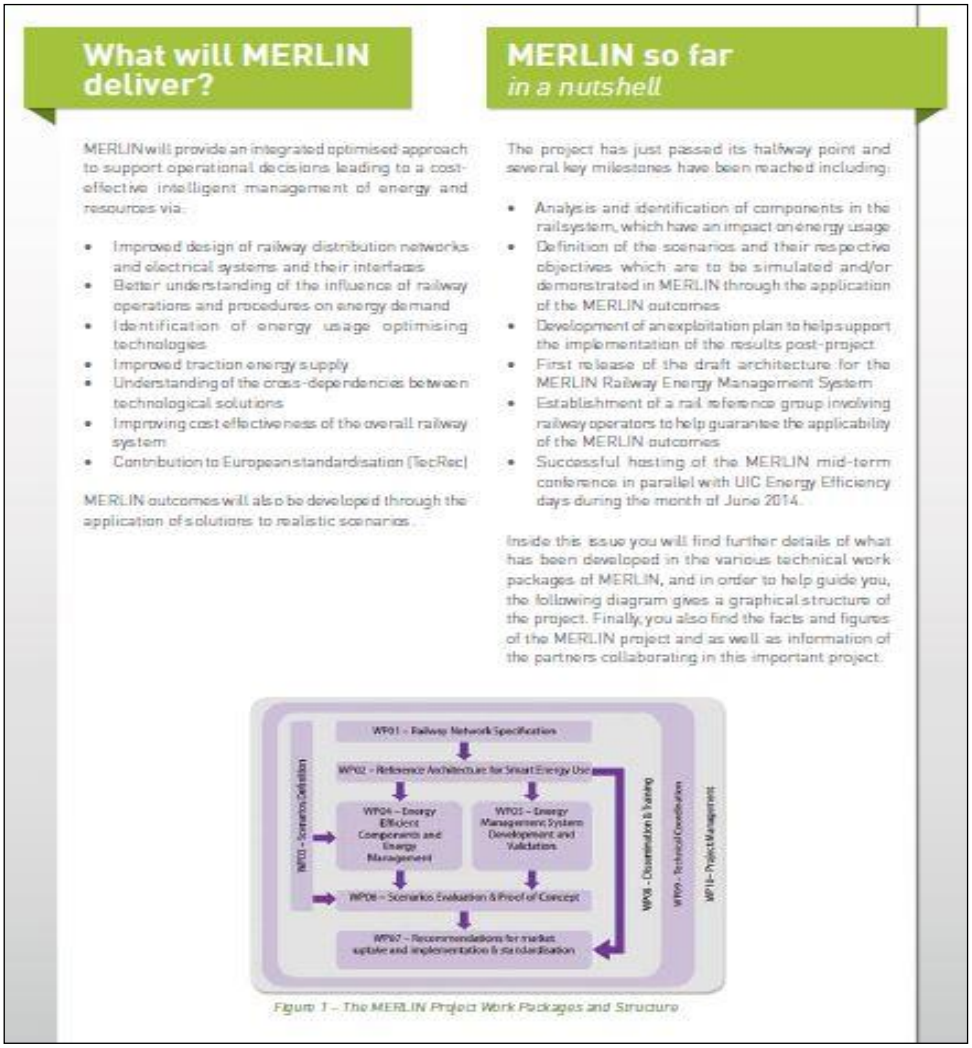
Table 1 – MERLIN objectives on Page 3

Page 3 contains a very schematic and effective summary of the main goals of MERLIN on one side and, on the other, the results already achieved. Below the text, a figure showing the structure of the project has been included to guide the reader through the following articles focusing on each technical WP.



What will MERLIN deliver?

MERLIN will provide an integrated optimised approach to support operational decisions leading to a cost-effective intelligent management of energy and resources via:

- Improved design of railway distribution networks and electrical systems and their interfaces
- Better understanding of the influence of railway operations and procedures on energy demand
- Identification of energy usage optimising technologies
- Improved traction energy supply
- Understanding of the cross-dependencies between technological solutions
- Improving cost effectiveness of the overall railway system
- Contribution to European standardisation (TecRec)

MERLIN outcomes will also be developed through the application of solutions to realistic scenarios.

MERLIN so far *in a nutshell*

The project has just passed its halfway point and several key milestones have been reached including:

- Analysis and identification of components in the railsystem, which have an impact on energy usage
- Definition of the scenarios and their respective objectives which are to be simulated and/or demonstrated in MERLIN through the application of the MERLIN outcomes
- Development of an exploitation plan to help support the implementation of the results post-project
- First release of the draft architecture for the MERLIN Railway Energy Management System
- Establishment of a rail reference group involving railway operators to help guarantee the applicability of the MERLIN outcomes
- Successful hosting of the MERLIN mid-term conference in parallel with UIC Energy Efficiency days during the month of June 2014.

Inside this issue you will find further details of what has been developed in the various technical work packages of MERLIN, and in order to help guide you, the following diagram gives a graphical structure of the project. Finally, you also find the facts and figures of the MERLIN project and as well as information of the partners collaborating in this important project.

Figure 1 – The MERLIN Project Work Packages and Structure

Fig 2 – MERLIN objectives on Page 3

Pages 4 to 9 are focused on the main results achieved in the technical Work Packages 1 to 7 and the headings also display the Work Package Leader.

The main purpose of the articles is to give a clear vision, both written and visual, of the activities carried out and the main achievements.

Reference Architecture for Smart Energy Use (WP2)

led by D'Appolonia

The main objective of this work package is the definition and development of the reference architecture for the integrated Railway Energy Management System, which will be one of the main outputs of the MERLIN project. The architecture defined here will be the basis for the development of a system and technological solutions, which will contribute to the optimisation of energy usage in the railway domain. This is in line with the overall objective of the MERLIN project.

The reference architecture includes both an operational energy management application (REM-S) and a strategic decision making tool (SDMT). A preliminary version of the architectures, one for the strategic and one for the operational application, has been released.

The architecture for the REM-S has been prepared according to the Smart Grid Architecture Model (SGAM), a reference model of smart grid architectures for different sectors of application issued by the CEN-CENELEC-ETSI Smart Grid Coordination Group. According to the SGAM, the REM-S architecture is implemented through different interoperability layers:

- Business layer - representing the missions of the system;
- Function layer - relating to the function to perform the optimisation;
- Information layer - describing the information exchange between functions, services and components;
- Communication layer - representing the protocols for exchange of information;
- Component layer – relating to the system implementation.

Energy optimisation is performed by the REM-S at different levels. The first level is on a daily basis, to calculate the optimum behaviour of the network for the next 24 hours; then a "minute ahead optimisation" is performed, and finally a real time operation generates indicactions to be fulfilled by the different actors and/or components.

In the SDMT, four missions have been identified, and components and interfaces of the architecture have also been defined. Similarly, four sets of functionalities have also been defined. The first set of functionalities concern the calculation of the energy flows within a given railway system configuration; the second set the visualisation of results; the third the optimisation process itself; the fourth tests the resilience of the system configuration to variations in day-to-day operation. Relevant stake holders for the strategic decision process have also been identified.

The architecture defined in this work package will serve as input to the work packages on: "Energy efficient components and energy management technological solutions" (WP4) and "Energy management system development and validation" (WP5), to feed the developments in regard to the technical elements. The definition of new business model and relevant algorithms for fair share of gains, which may eventually occur as a result of such a system, will be functional to the progression of the work.

Finally, the results concerning the reference architecture, including business models, and new methods, will provide an input to the activities of the work package "Recommendations for market uptake and implementation & Standardisation" (WP7) to ensure market uptake and to provide inputs for the TecRec (Technical Recommendations as industrial voluntary standards) standardisation activities.

Figure 3 - CEN-CENELEC-ETSI SGAM Model

traffic railway, in conjunction with the REM-S for energy management. (To manage the impact on the overall energy performance of a train which is delayed)

5. The last scenario, and the second British scenario has two aims. One is to to implement changes to the Line Voltage within the 750V areas and analyse their effect on energy consumption. This should also allow a greater current to be consumed by the traction rolling stock (this is presently limited by software). The second is to investigate the impact of new contractual arrangements to buy electrical energy, and whether this can offer significant cost savings when energy is managed by REM-S.

To support the validation of systems with different scenarios, the development of a common methodology that would allow a homogeneous description was conducted.

Energy efficient components and energy management technological solutions (WP4)

led by D'Appolonia

The activities in this work package aim to develop the component layer of a holistic Railway Energy Management System in terms of new smart grid structures and new controllable components, at infrastructure grid level or at vehicle level. The technological solutions tackle the system-wide energy management approach.

The Smart Grid Architecture Model (SGAM) framework is used in order to describe the Railway Energy Management System (REM-S) architecture, with 3 operational modes. Firstly, a Day Ahead Optimisation (DAO) will be carried out at network level, trying to fix the energy need for the whole network with the market prices. Once the energy is bought, a local optimisation will update the energy needs of each zone every 15 minutes, matching with detailed predictions from each actor (energy source, storage system...) and the energy bought at the DAO Operation. Finally, a real time control operation function will control the actors in order to suggest the best implementation mode to each controllable actor. The intelligence governing these functions will help at network level to find the best price for the energy.

In the second task, the study is based on optimising power peaks, which can cause energy usage to be sub-optimal. In this case the problem cannot be solved by conventional solutions (such as increasing substation power or adding a new substation) because of the upstream electrical network's weakness. Therefore, two different solutions are studied, which consist in getting a smooth power demand:

- traffic regulation using ATS (Automatic Train Supervision) avoiding unnecessary braking, stops, accelerating, etc. on specific parts of the railway network such as bifurcations;
- intelligent energy storage integration and/or alternative energy sources such as renewable sources.

In regard to optimisation for vehicles, auxiliary loads power evaluations have been completed for High Speed trains, Regional trains and Suburban trains. The remaining work will concentrate on new solutions and controlling algorithms for auxiliary loads on a suburban train. This study will be aimed at reducing the energy absorbed by some auxiliary on-board loads: air compressor, HVAC (heating ventilation and air conditioning) and lighting system.

Figure 5 – MERLIN Reference Architecture

Fig 3 – Examples of articles focused on the technical achievements

The articles have been drafted using a simple language that can be easily understood both by technical experts and by the general public. The selection of pictures, then, has been done in accordance with the content of the articles to create clear links between the text and the figures.

The MERLIN website address www.merlin-rail.eu is displayed in the page footer in order to invite the reader to visit it and be updated on the last developments of the project.

The back page features general information on the project's consortium including the partners' logos, the EU Countries represented, facts and figures and the main contact details allowing readers to obtain more information on MERLIN.

Fig 4 – Back page

3. DISTRIBUTION AND NEXT ISSUES

The MERLIN newsletter has been distributed during all major events attended/organised by UNIFE and UIC as dissemination partners and by other MERLIN partners when they participated in EU-level events relevant to the project.

The Newsletters can also be downloaded from the News&Event page of the MERLIN website.

The next and final newsletter will be delivered in time for the Final Conference of MERLIN which will be organised on the 10th of December 2015 at FFE premises in Madrid.