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Review

# An overview of electromagnetic compatibility challenges in European Rail Traffic Management System

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**Abstract**

In Europe, the railway industry is rapidly getting transformed from traditional mode of public transportation to a very fast, more reliable, long distance and cross country operation. A new concept, called European Rail Traffic Management System (ERTMS) is originated to make this transition smooth, reliable and compatible among different countries. Electromagnetic interference and compatibility (EMC) issues play a major role on the overall system design and performance of this. In this paper, an overview of the operational principles and major components of ERTMS and other modern railway systems are discussed in detail with an emphasis on possible EMC issues. Radiated and conducted interferences originated from different sources and their consequences on different subsystems and components are discussed and analyzed.
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*Keywords:* Rail transportation; Rail transportation communication; European Rail Traffic Management System; Electromagnetic interference; Electromagnetic compatibility; Arc discharges

**Contents**



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## 1. Introduction

In the recent past, globalization on the European railroad transportation system had a great impact to the overall railway system and technology. Unlike the road transport or air transport, the technical specifications of railway transport in Europe were different in different countries for various historical and political reasons. There were differences in terms of track width, signaling system, traction feeding voltage and frequency, navigational standards, etc. So, the interoperability between different countries was difficult. With numerous mergers in the railway industry and the need to operate trains through different countries, a need for a railway system with cross country operability was building up. The ERTMS is the outcome of this. The main objective of this system as mentioned by de Tillere et al. (2003) was to set a standard for Europe in terms of onboard and trackside equipments like power feeding, signaling, communication, train control, complete certification process etc., to provide and improve the safety of the overall system for high speed trains with only few minutes headways between trains, enhancing the operational reliability and capability for carrying more traffic with same infrastructure, reducing the maintenance cost, making it more efficient and enabling the cross country functionality for both freight and passenger trains. Although ERTMS had started in Europe at the beginning, the overall technology and concept is adopted by many other countries across the world because of its superiority over the conventional railway system.

Electromagnetic noises, generated within the system or coming outside the system often hampers the overall system performance and sometimes create interference with the nearby civilian systems as well. Keeping in mind the huge size and complexity of the railway system, it is often difficult to identify the noise source and the coupling path by which it is affecting the victim. In this paper, operating principles of the critical components of the ERTMS are briefly described from the EMC point of view to have a better understanding of the overall operation of the system, which will help in identifying the source, victim and the coupling path. Another important challenge of ERTMS and modern railway is to ensure the availability of the different radio based services because of high speed and more traffic than the installed capacity. With increasing speed and capacity, it will get more and more challenging to ensure passage of all the required information through different subsystems and components within a very short time span.

Section 2 describes different types of railway signaling systems and important components associated with it, an overview of ERTMS, its major components and different levels in brief. Section 3 provides information about major EMC challenges to railway signaling and communication both at component as well as overall system level. Section 3 also describes the major problems faced by the railway engineers associated with the related standards, major components, the detail analysis about the nature and possible consequence of the important problems related to EMC.

## 2. Railway signaling systems: a brief overview

The main task of signaling system is basically to protect the train from collision with other trains, guide the train to maintain a desired speed, i.e., preventing it from undesired speeding or slowing, avoid derailing of the

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