The ITEA 2 openETCS project has developed an integrated modelling, development, validation and testing framework to leverage the cost-efficient and reliable implementation of ETCS (European Train Control System). This thereby realizes the ‘Open Proofs’ concept for ETCS on-board systems and so signifies a considerable step towards the ambitious target of implementing a pan-European uniform train control command system.

Project origins
Several challenges exist in developing an ETCS, not least the lack of conformity of pre-existing standards in inherited networks that are not in line with the ETCS guidelines. While the diversity of technical standards of the different European railway lines may present a possibly insurmountable hurdle to a fully unified ETCS, it is nonetheless feasible for a high level of interoperability to be established. In this respect, software solutions are decisive when considering the real core of the global ETCS concept, its unified software. The key to creating unified software lies in an open source solution that is freely accessible to all participants. These were the premises that gave birth to the idea of openETCS.

Technology applied
The openETCS project made use of open standards on all levels, including hardware and software specification, interface definition, design tools, verification and validation (proofs) procedures, last but not least, embedded control software, and therefore called “open proofs”. These technologies and related business concepts provide the framework for the establishment of a holistic tool chain across the whole development process of ETCS software that supports the formal specification and verification of the ETCS system requirements, the automatic and ETCS compliant code generation and validation, and the model-based test case generation and execution. Furthermore, the open source concept provides for a ‘correct’ functioning reference device that helps to overcome interoperability problems, supporting manufacturers, infrastructure managers and railway companies alike. By transferring verification and validation activities from the track to the laboratory, scarce resources are preserved and finally the migration phase accelerated. This project is an innovation driver for business: the test phase is always very costly and never reaches guaranteed zero- bug implementation. By focusing on an open source version of the heart of the signaling software, developers can monitor the code and check for any bad implementation. Moreover, a formalised specification enables vendor-neutral reference implementation and, by making the core functionality software fully transparent, the market for software services in equipment, which tends to last between 20 and 40 years, is opened up.

Making the difference
openETCS has an impact on rail operators, manufacturers, software service and tool providers. First and foremost, the reduced system development costs due to
openETCS principles are already being exploited by DB and NS (the Dutch railway operator), for example, in vehicle tendering, and NS is even considering applications beyond ETCS for interference current monitoring, energy metering and STM. Open proofs enable not only a shift in testing from track to laboratory, but also more process control (no vendor lock-in) and in-house system (co)development. Finally, the ETCS equipped network is continuing to grow in Europe and overseas, with new players already having entered the ETCS equipment market – and the likelihood that this number will rise in the future. Which is good news from both a safety and economic perspective.

ITEA is the EUREKA Cluster programme supporting innovative, industry-driven, pre-competitive R&D projects in the area of Software-intensive Systems & Services (SiSS). ITEA stimulates projects in an open community of large industry, SMEs, universities, research institutes and user organisations. As ITEA is a EUREKA Cluster, the community is founded in Europe based on the EUREKA principles and is open to participants worldwide.