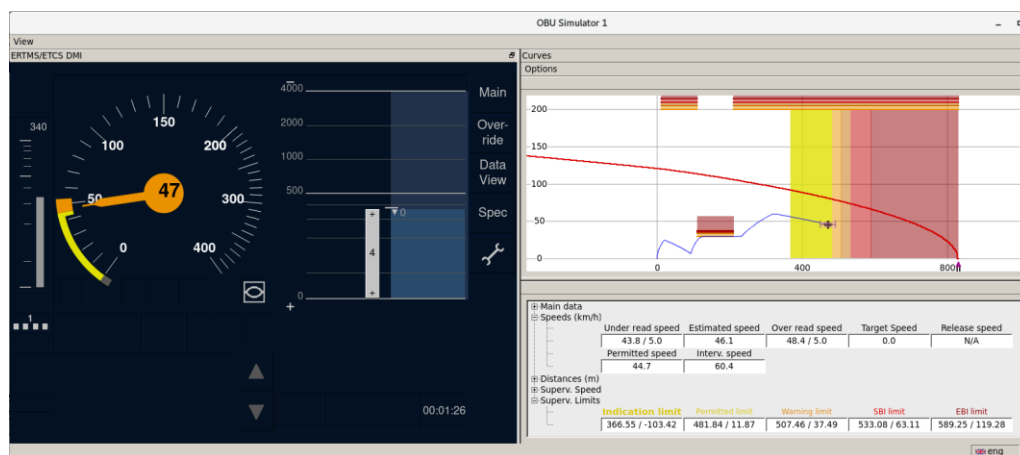




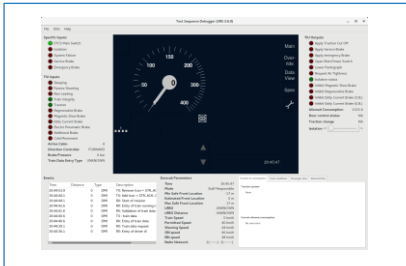
THE BENCHMARK FOR ERTMS & ETCS



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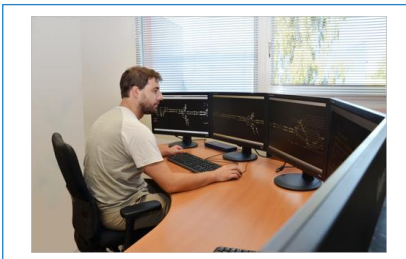
> ERTMS/ETCS ON-BOARD SIMULATOR

A functional implementation of the whole set of ETCS on-board functions which can be used as a neutral reference for testing of trackside configurations. It can be interfaced in different ways for laboratory testing or installed in a train. It is also used within the other products where the simulation of the ETCS on-board is requested. It is also named EVC Simulator.



> ERTMS/ETCS OPERATIONAL SIMULATOR

A visualisation of your train running under ERTMS/ETCS supervision which can be used for training, demonstration and testing purposes. The system can also be used in the development of operating rules and to investigate deployment issues.



> ERTMS/ETCS TRAFFIC SIMULATOR

An advanced real-time system which can be used for evaluating line capacity and improvements, validating RBCs, assessing conflict detection/resolution systems, signaller training and replicating real life events.



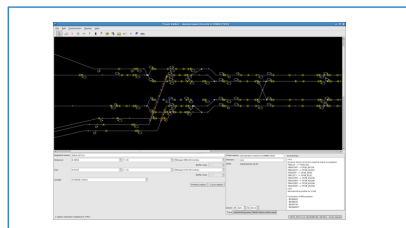
> ERTMS/ETCS OBU AND RBC TEST BENCHES

A range of advanced test benches which allow you to test your On-Board Units and Radio Block Centres, individually or in a cross-test combination.



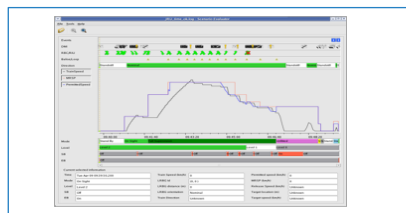
> ETCS DRIVER MACHINE INTERFACE

A DMI product providing a compliant interface to the ERTMS/ETCS system allowing driver identity and train data, to be entered, and displays of driving information, including speed, planning area, ETCS level, and mode.



> TRACK EDITOR

Allowing you to create and modify track models for use with our operational and traffic simulation tools and test benches. The track models can be used in all ERTMS/ETCS application levels.



> SIMULATION AND TEST EVALUATION TOOLS

Simplifying the task of analysing, displaying and reporting the data generated using our operational and traffic simulation tools, or by third party on-board or trackside systems.

ERTMS/ETCS ON-BOARD SIMULATOR

Our ERTMS/ETCS on-board simulator (also named EVC simulator) is implementing all functions described in SUBSET-026 concerning the on-board parts, including also the DMI functions in compliance with the ERA specification. It is a functional but non safe implementation installed on its hardware or delivered in a virtual machine.

BENEFITS

Using our On-board Simulator will allow you to:

- own a light ETCS on-board product which is independent from any industrial supplier
- prepare test cases/ scenarios and run them in real time against the simulator in a lab environment compliant with SUBSET-094 or SUBSET-111-2
- collect the juridical data generated by the simulator and analyse them
- when the simulator is installed in a train, interface it with train and trackside equipment and acquire data generated by the trackside components of a track for the purpose of measurements.

THE ERTMS/ETCS ON-BOARD SIMULATOR

Its architecture is fully compliant with the description provided in SUBSET-026. It is a state machine which is reading its inputs through standardised interfaces, performing supervision functions and generating outputs through standardised interfaces.

The main interfaces are with: ETCS DMI (internal or external), train (odometry, TIU and on-board recorder), trackside (balise, loop, radio), national train control systems (STM control function).

Three versions of the Simulator are available: Baseline 2, Baseline 3 MR1, Baseline 3 R2.

The main functions are:

- read the configuration default state and initial values
- manage all interfaces with all peripheral and external equipment
- decode and process balise telegrams and loop messages
- manage radio communication (decode and process input messages, generate and encode output messages)
- determine travelled distance, speed and acceleration
- calculate braking curves and supervision limits
- supervise train movement and trigger DMI information and interventions (TCO, SBI, EBI)
- supervise technical modes and ETCS level and their transitions
- control and supervise the STMs (option)

- generate and transmit juridical data

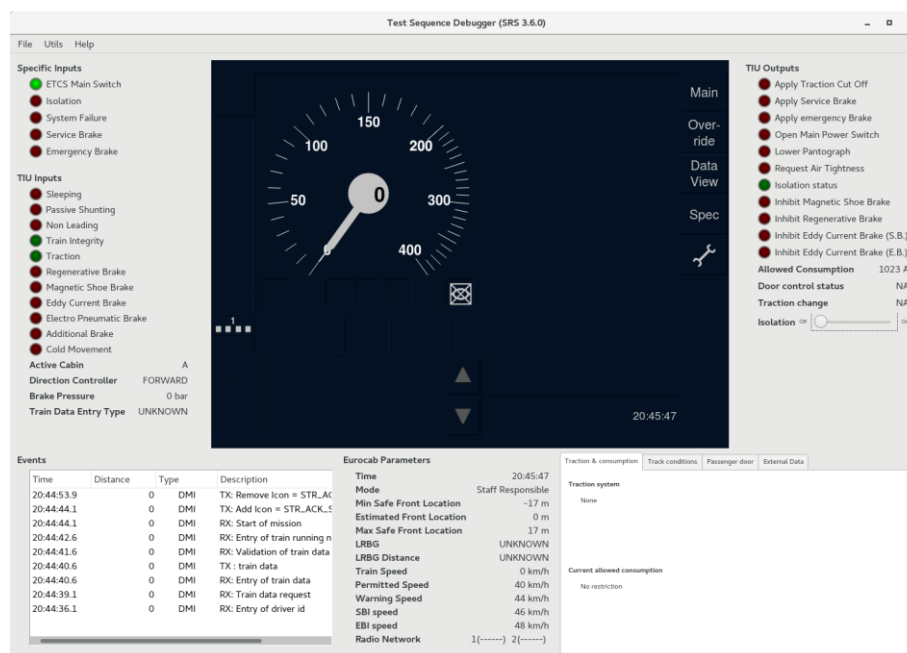
OPTIONS

For the exchange of information with trackside components, the simulator is basically using the data in the format described in chapters 7 and 8 of SUBSET-026. The value of our system can be further enhanced by extending it to include:

- the Euroradio layers as described in SUBSET-037
- balise telegrams encoded according to SUBSET-036.

NEW FUNCTIONS

The ERTMS/ETCS Onboard Simulator is currently extended to include the latest functions related to TSI 2023 (Baseline 4 including ATO and FRMCS).



ERTMS/ETCS OPERATIONAL SIMULATOR

Our Operational Simulator provides a real-time visualisation of your train running under ERTMS/ETCS supervision.

BENEFITS

Using our Operational Simulator will allow you to:

- identify scheme options and assess them quickly and easily so that good engineering design and configuration decisions can be made at the earliest stages of your project thereby reducing the risk of, and avoiding the high cost of rework during project implementation
- develop and assess the effects of new or changed operating rules arising from regulatory changes or changes to the infrastructure before they are implemented
- visualise and demonstrate train running on the new or proposed infrastructure under current or new operating rules giving stakeholders the confidence they require
- train and assess your staff to work under ERTMS/ETCS supervision without the need to expose them to the hazards of the operational railway and avoiding the costs of track access and trains.

THE ERTMS/ETCS OPERATIONAL SIMULATOR

The true complexity of the railway system is embedded in our ERTMS/ETCS Simulation System which can be used with several built-in predefined simulation scenarios, or to give you the flexibility to define and explore your own scenarios: ETCS telegrams and messages, signal aspect and point position changes required to run trains with interactive train control. We provide a set of user configurable modules:

A track and scenario editor which is used to define the train and set default data for the EVC, and to set event driven messages

A train dynamics module which calculates train movements based on track voltage, gradient and adhesion and inputs from the EVC or driver inputs through the keyboard (or optionally) the desk or joystick

An EVC simulator interfaces to the driver, train, positional data and trackside elements of ERTMS (baseline 2 and 3). Other national train control system standards (class B systems) can also be implemented and interfaced with the EVC simulator

An ETCS Driver Machine Interface module; compliant with the ERA specification the DMI provides a cab display allowing the driver to see the track and to input information.

A Trackside simulator which transmits Baseline 2 and Baseline 3 packets and messages (balise, loop, and radio), and national ATP/ATC data

All simulation functions are installed on a single PC which displays the ETCS Driver Machine Interface, a simplified driver's desk with cab instruments; and the EVC supervision curves.

OPTIONS

The value of our system can be further enhanced by extending it to include:

- a second PC giving the operator a realistic real-time 3D view of the track, direction of the travel, speed, weather conditions, and trackside equipment
- radio communication according to SUBSET-037 through an ISDN board
- a joystick to control train movements, and a keyboard for operator inputs.



NEW FUNCTIONS

The ERTMS/ETCS Operational Simulator is available for rental through a cloud version. It is currently extended to include the latest functions related to TSI 2023 (Baseline 4 including ATO and FRMCS).

ERTMS/ETCS TRAFFIC SIMULATOR

Our ERTMS/ETCS Traffic Simulator is an advanced real-time system which can be used for evaluating line capacity and improvements, validating RBCs, assessing conflict detection/resolution systems, signaller training and replicating real life events.

BENEFITS

Using our Traffic Simulator will allow you to:

- build a detailed engineering model of a complete railway running under ERTMS/ETCS control
- investigate realistic timetable scenarios involving multiple trains interacting with RBC, interlocking and traffic management systems
- evaluate impact on line capacity and recovery from disruption for different track layouts, ERTMS/ETCS levels and traffic management options.

THE ERTMS/ETCS TRAFFIC SIMULATOR

The true complexity of the railway system is embedded in our Traffic Simulator which can be used with several generic trains, alternatively you can define your own train and use that alongside a set of user configurable modules:

Generic Train Modules which support all ERTMS/ETCS levels can be included in the simulation and can be fully customised by the user and simulate train dynamics and Baseline 2 or Baseline 3 on-board units. Train objects can be driven manually and start from any location on the track, and in automatic mode they can run according to the timetable and the driving information and data received over the balise, loop and radio interfaces.

The traffic simulation is managed by a **Scenario Controller** which initiates or stops the simulation and allows users to inject events or failures in the track or train modules.

A **Route Map Manager** shows the track topology and all train movements and allows users to show or hide other features; balises, track circuit status, track profiles, boards and signals.

The **Interlocking** allows users to set and lock routes; and provides block condition status required by the Radio Block Centre module to send movement authorities to the trains.

The **Radio Block Centre** (RBC) manages connection and disconnection to trains, issues movement authorities, TSRs and text messages; receives position reports, sends and revokes emergency stops; and displays the new position of trains as soon as a report is received. The RBC can also generate diagrams showing actual and predicted positions of all trains in the simulation.

OPTIONS

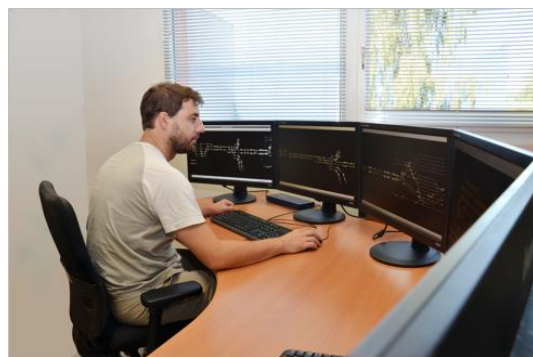
We have developed several optional modules which customers will find increase flexibility and scope of the core simulator and add value:

Automatic Route Setting is an optional module; based on a timetable and train path, ARS sets routes without the need for user input. This module can be disabled allowing users to set routes manually.

Our **OPSIMU train modules** provide users with the option to add a complete ERA ERTMS/ETCS DMI and a realistic train desk control to set up a demonstration and training environment.

Our **Traffic Evaluation Tool** will simplify the analysis of the various data collected during the simulation giving users an insight into:

- track occupation changes
- point settings and signal aspect changes
- radio connections/disconnections and radio holes
- RBC/Train and RBC/RBC messages
- positional data.



NEW FUNCTIONS

The ERTMS/ETCS Traffic Simulator is currently extended to include the latest functions related to TSI 2023 (Baseline 4 including ATO and FRMCS).

ERTMS/ETCS DRIVER MACHINE INTERFACE

Our Driver Machine Interface (DMI) software runs on customers or third-party hardware for installation on train, or in our simulation tools and provides a cab display allowing the driver to input information into the system; it allows driver identity and train data to be entered, and displays driving information, including speed, planning area, ETCS level, and mode. The DMI also prompts driver actions: selection of driving mode, confirmations and acknowledgements.

BENEFITS

Using our Driver Machine Interface will allow you to:

- avoid in-house development of this key component of an ERTMS/ETCS on-board system by buying in an existing proven component
- comply with ERA recommendations for standardisation of the driver interface
- easily configure the system for specific rolling stock types, optional features and languages.



SPECIFICATION

Our DMI satisfies ERA DMI specifications and supports ERA's recommendations on area design. ETCS levels 1 to 3 are all supported, as are all technical modes requiring an open driver's desk including Standby, Unfitted, Shunting, Staff Responsible, Full Supervision, On Sight, Trip, Post Trip, Reversing, Non-Leading, Limited Supervision, and System National.

Automatic testing and self-test functionality are built in.

In addition to the ERA specification some national system layouts are also optionally included: ATB EG, KVB/TVM, PZB, AWS/TPWS, ATC-2 and ZUB.

Baseline 2 and Baseline 3 are available. Baseline 4 (including ATO and FRMCS) are under development as part of TSI 2023.

FLEXIBILITY

Our standard DMI runs on a 10.4" display with a 800x600 screen resolution but is highly configurable; with modular software it is available in Linux and Windows versions depending on the hardware you want to host it on, and a range of and communications protocols are available for links to the EVC.

As the ERTMS specification continues to develop, we have minimised the disruption users might see in keeping their DMI up to date. Configuration and flexibility are built in; many parameters can be accessed outside the application itself, allowing some parameters to be configured without modifying the software, these include: driver language, train data, icons and text, the optional colour palette. Downloads or flash memory exchanges allow our DMI to be updated simply.

TRACK EDITOR

Our Track Editor tool allows you to create and modify track models for use with our operational and traffic simulation tools and test benches. The track models can be used in all ERTMS/ETCS application levels.

BENEFITS

Using our Track Editor will allow you to:

- apply your CLEARSY simulation tools and test benches to a wide range of projects and scenarios
- maximise the use of in-house staff to configure the systems
- minimise repeated data entry by exchanging data in formats such as RailML® or SUBSET-112.

SPECIFICATION

The Track Editor Tool presents a user-friendly interface allowing you to:

- define complex track sections quickly
- navigate around the track easily
- independently zoom horizontally and vertically
- compute distances
- rename elements automatically

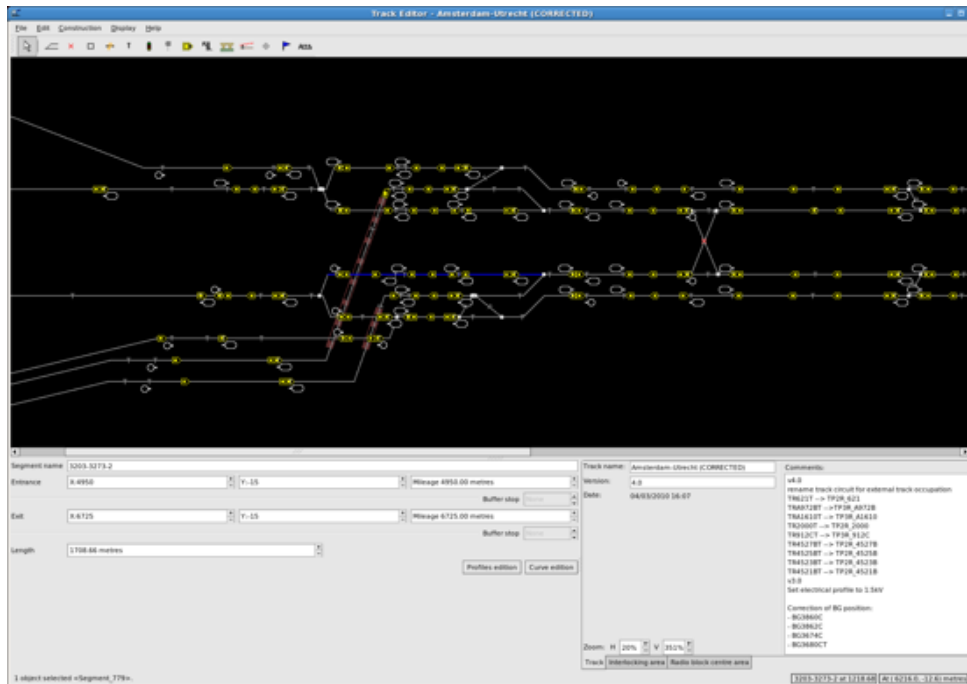
The track model can include:

- topology and physical data including points, gradient and curvature
- infrastructure data including tunnels, stations, bridges, and level crossings
- signalling information including signals, boards, marker boards, track circuits
- ERTMS/ETCS Baseline 2 and Baseline 3 compliant balise and infill device data
- national signalling equipment location and characteristics

These features give you a further refinement of details aimed at identifying scheme options and assessing them quickly and easily so that good engineering design and configuration decisions can be made at the earliest stages of your project thereby reducing the risk of and avoiding the high cost of rework during project implementation.

OPTIONS

The Track Editor can be extended to include automatic track data import/ export from/to standardised formats such as RailML® or SUBSET-112. Custom import/export solutions can also be provided.



NEW FUNCTIONS

The Track Editor is currently extended to include the latest functions related to TSI 2023 (Baseline 4 including ATO and FRMCS).

TEST BENCHES FOR ERTMS/ETCS COMPONENTS

We have gained significant experience of ERTMS/ETCS through our involvement in many EU projects, and through our development of operational, traffic simulation and training tools, and have a range of advanced test benches which allow you to test your ERTMS/ETCS components.

Our test benches are used by a range of customers including:

- OEMs
- Notified Bodies and Independent Testing Providers
- Investigators

BENEFITS

Our Test Benches provide:

- a proven route to validating your On-Board Units and Radio Block Centre equipment against the ERTMS/ ETCS standards avoiding costly retesting at the product approval stage
- the tools to test and approve ERTMS/ETCS equipment independent of the OEMs, giving the Infrastructure Managers and Train Operators the confidence, they need.

TEST BENCH FOR ON BOARD SYSTEMS

ARCHITECTURE WITH SUBSET-094

Our OBU Test Bench is compliant with the Reference Architecture defined in SUBSET 094:

- Using our **off-line tool**, test sequences which are part of SUBSET-076, can be automatically imported and stored as scenarios. Users can also create testing information including train parameters, speed profile, messages compliant with Baseline 2 or Baseline 3.
- Our **on-line tool** is used to define and control a test environment which is connected to the on-board system to be tested using standard interfaces.

TEST ENVIRONMENT WITH SUBSET-094

The test environment in our OBU Test Bench is made up of several modules which work together to test customers' OBUs, these include:

- a **scenario controller** to start, manage and stop scenarios

- a **driver simulator** to automatically enter data on the DMI and perform actions on the desk
- a **train motion simulator** to perform the train dynamics
- a **speed sensor simulator** to deliver the odometric information to the EVC
- a **TIU simulator** to enable and stimulate the interfaces between EVC and train
- modules to simulate the transmission of data by balise, loop, radio, and national signalling equipment
- various modules to record and review all logged information.

TEST ENVIRONMENT WITH SUBSET-111-2

Our OBU Test Bench is also available in compliance with the architecture defined in SUBSET-111-2. The TCL (Test Control and Logging) are fully implemented to communicate directly with the OBU Adapter provided by the supplier of the OBU.

TEST BENCH FOR RADIO BLOCK CENTRE

The simulated RBC in our ERTMS/ETCS Traffic Simulator can be substituted by your RBC allowing you to test the RBC.

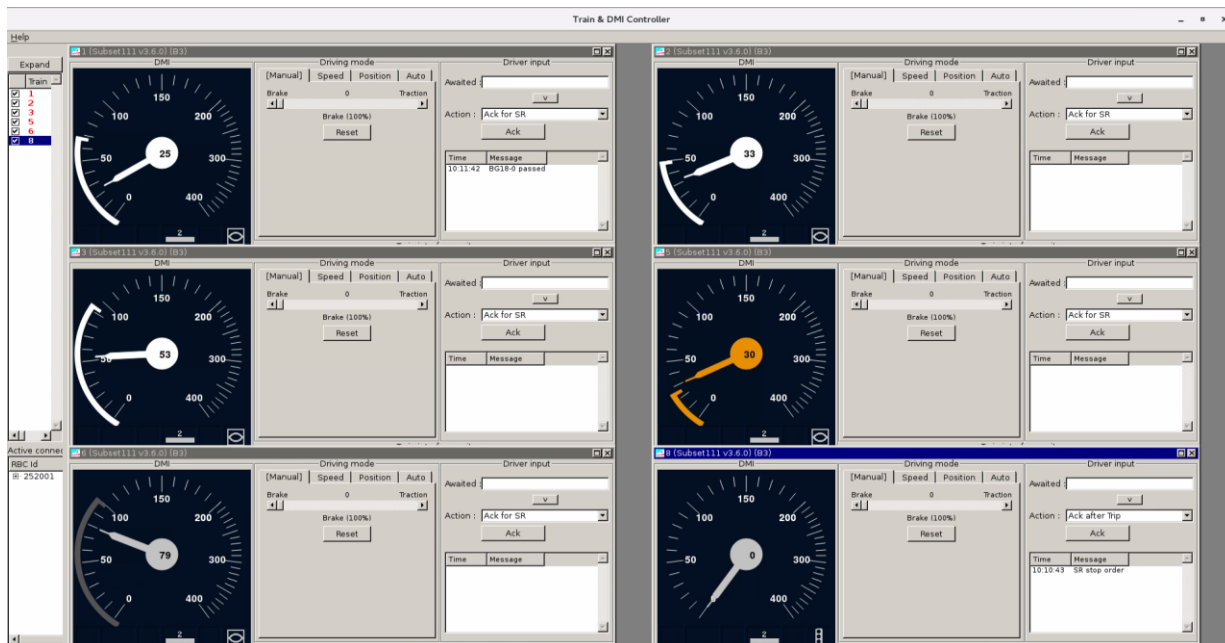
TEST ENVIRONMENT

Our RBC Test Bench test environment is made up of several modules:

- a **route map** showing static information including track topology and infrastructure elements, and dynamic information including train movements and changes of signal aspects and point positions
- **multiple train modules**, all independent from each other, running manually or automatically, and all equipped with train dynamics and EVC simulation compliant with Baseline 2 or Baseline 3
- a **generic interlocking** system regularly updated with track occupation information is used for setting, locking and release of routes
- a **recording unit** to log all information in real time and display the results
- a traffic management module which integrates train path and timetable information for automatic route setting is available.

TEST BENCH FOR CROSS TESTS

Our Cross Test bench which combines both OBU and RBC test benches can be used to test EVC and RBC simultaneously for components from the same OEM or different OEMs. A comprehensive test environment can be created with the optional addition of trains running in manual or automatic mode.



NEW FUNCTIONS

The ERTMS/ETCS Test Benches are currently extended to include the latest functions related to TSI 2023 (Baseline 4 including ATO and FRMCS).

SIMULATION AND TEST EVALUATION TOOLS

Our evaluation tools simplify the task of analysing, displaying and reporting the data generated using our operational and traffic simulation tools, or by third party on-board systems.

BENEFITS

Using our Evaluation Tools will allow you to:

- visualise in detail the results of simulation and testing to verify the outcome and investigate problems
- ensure recorded data and test outcomes are reported consistently and accurately
- minimise the time and effort taken to produce reports for individual tests and complete test campaigns.

THE SCENARIO ANALYSER

The Scenario Analyser is a highly configurable interface which allows users to review data and follow the train status and environment in fully synchronised views (text, track and train views):

- train location and direction of travel
- signal aspects, points positions and track profiles
- EVC information: speed, braking curves and supervision limits, current ERTMS/ETCS level and mode, train interface information, LRBG information, track conditions/gradient profiles, messages exchanged through balise/loop/radio.

By setting checkpoints, particular points in the test run can be selected for analysis, and search functionality allows users to identify specific messages, telegrams, packets and variables.

Two reporting modes, which can be customised by users, are provided:

- an overview reporting facility where the results of many tests are compiled into a single file to report a test campaign; and
- a detailed reporting facility where textual and graphical information for individual tests can be reported.

Textual log data can be exported to .XML files; test reports can be exported to PDF, MS Word and OpenOffice.

JURIDICAL DATA

Besides data logged by simulation modules or gathered at the interface with industrial equipment, the Scenario Analyser supports the importation and display of ERTMS/ETCS Baseline 2 and Baseline 3 juridical data; and is available as a stand-alone product used to evaluate data from third party on-board or trackside systems or with our own simulation tools. The Scenario Analyser allows users to:

- analyse EVC behaviour, including the study of braking curves and supervision limits, and driver reactions
- check the sequence of radio messages
- check balise telegrams and loop/radio messages for compliance and correctness
- validate simulation scenarios
- analyse real situations.

