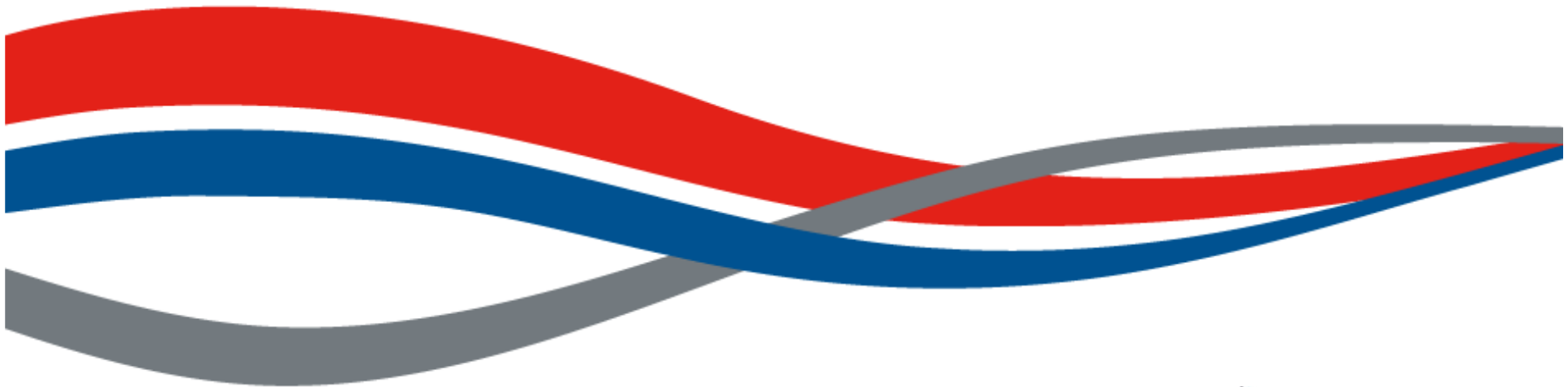


Use of Tcl/Tk in Railway signalling simulation and maintenance software

Eric Boudaillier
Adrien Peulvast



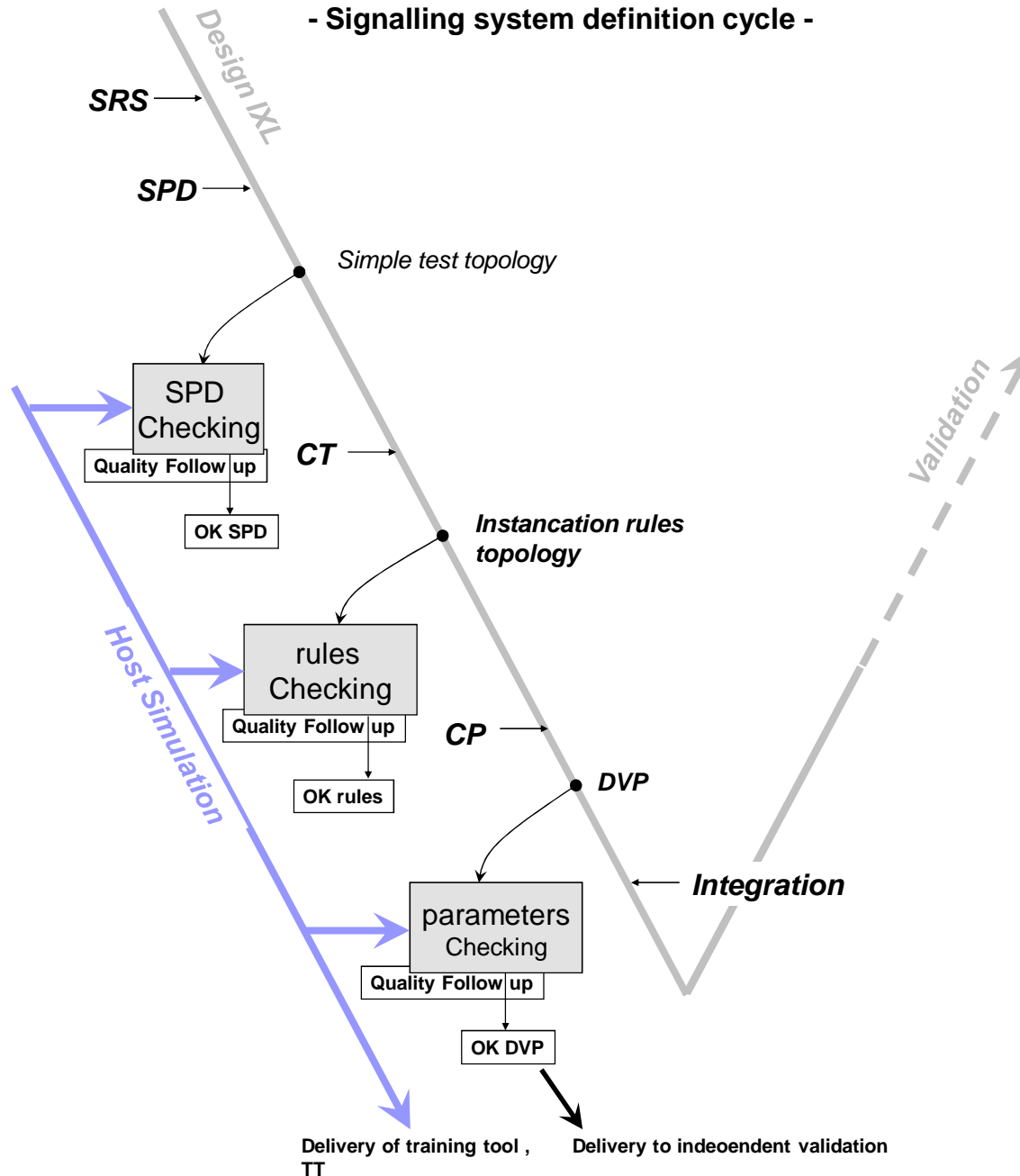
Sommaire

- Context
- User interface tools
- Tests tools
- Examples on current projects
- demos

Context

- Signalling design has to adapt to different clients
 - New markets with their own practice
 - New system functions
- Internal debugging is necessary :
 - Generic kernel (System functions)
 - Instanciation rules
 - Topology
- System level view of the signalling equipments
 - Identical as the signaller view
 - High level (commands, controls, graphical animation)
- Simplicity to be used by projects team (not software engineers)

- Signalling system definition cycle -



CT = control tables

CP = Production Tool –
(chaîne de production)

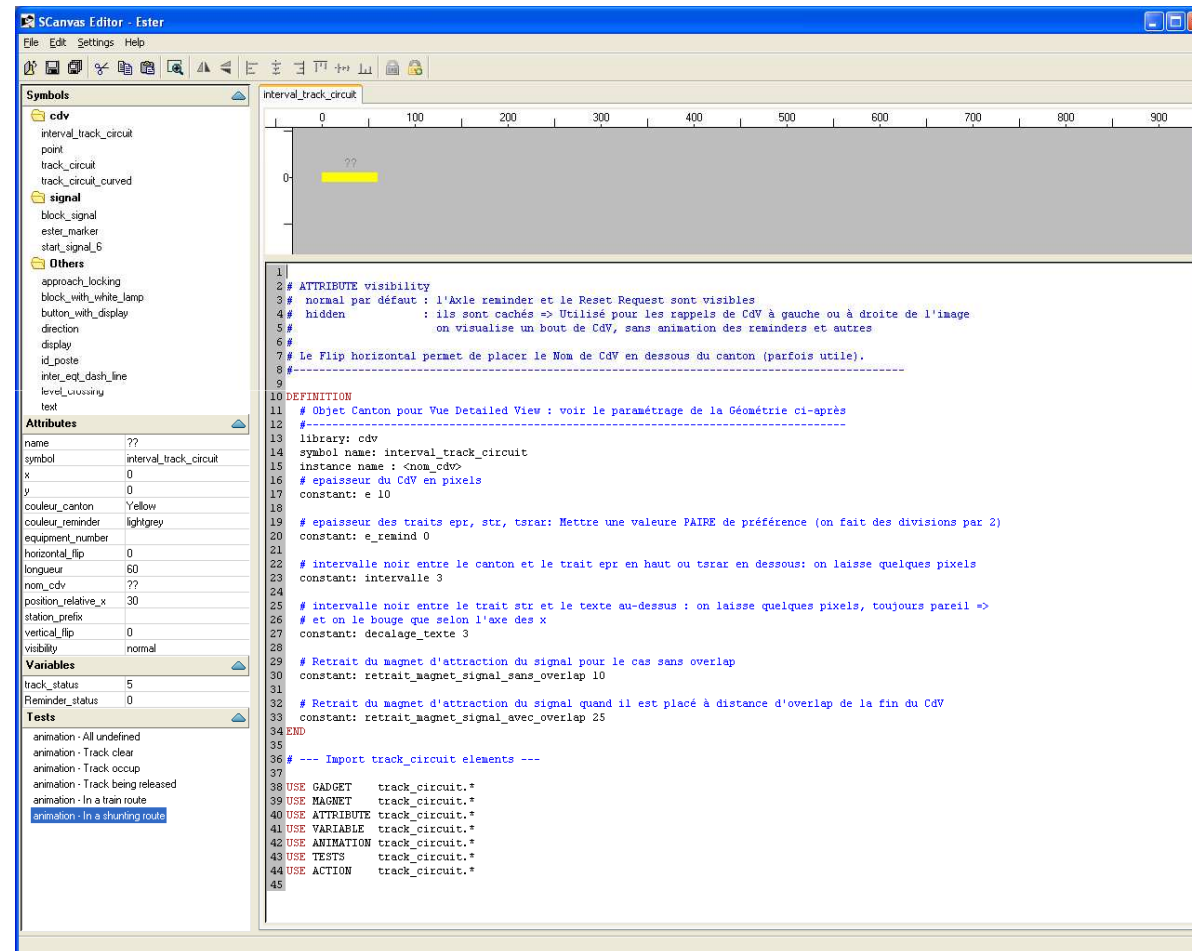
Goals :

- Process guidelines
- Automatisation of topology data.
- System functions verified and agreed.
- Instanciation rules tested.
- Good quality parameters.
- GUI mutualisation : views are integrated in the TT.

Graphical objects editor

- Scanvas: layer over the Tk canvas with tkpath
- Graphical symbols are described in text file. A symbol is:
 - A group of atomic gadgets (polyline, oval, ...)
 - Parameterized by attributes
 - Animated through an set of variables
- Graphical symbols are generated in Tcl code.

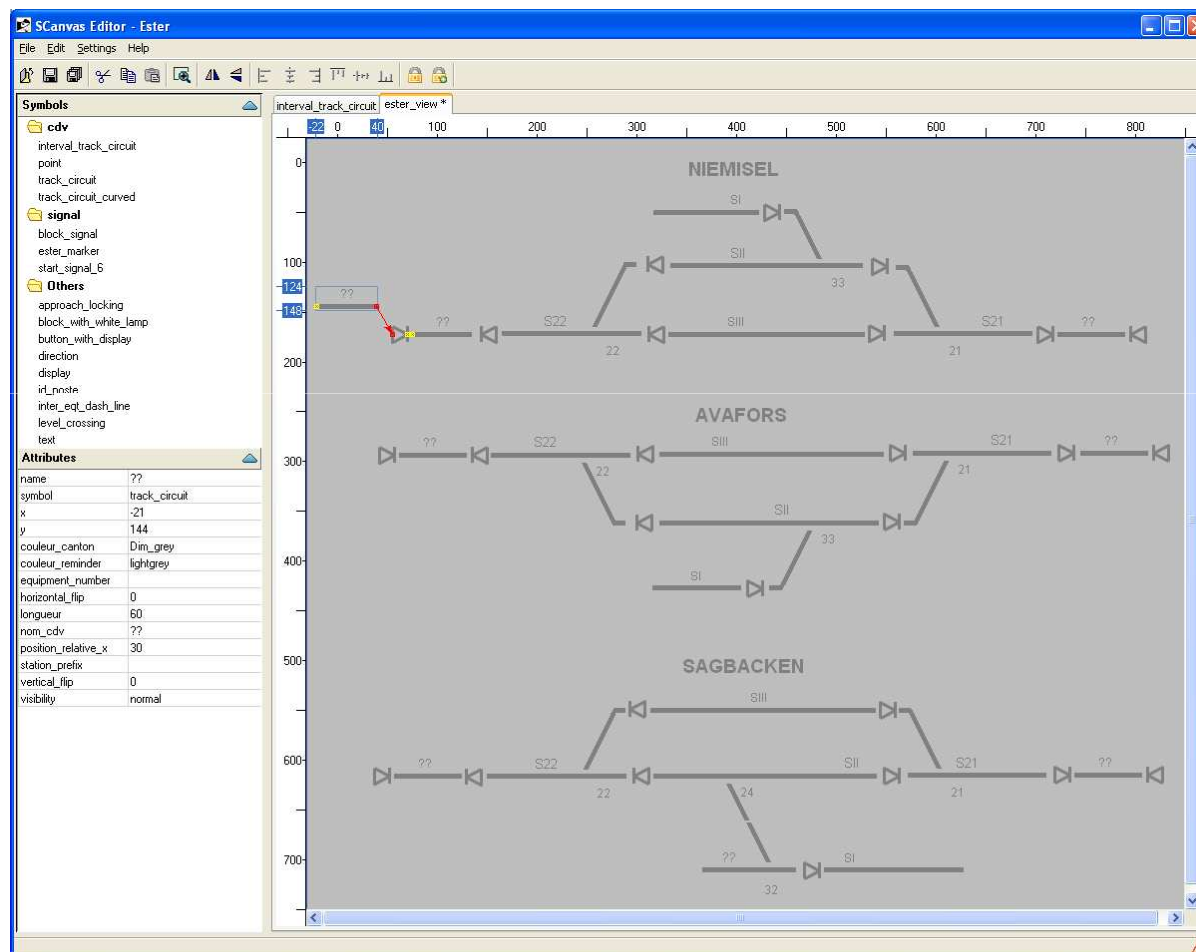
Graphical objects editor



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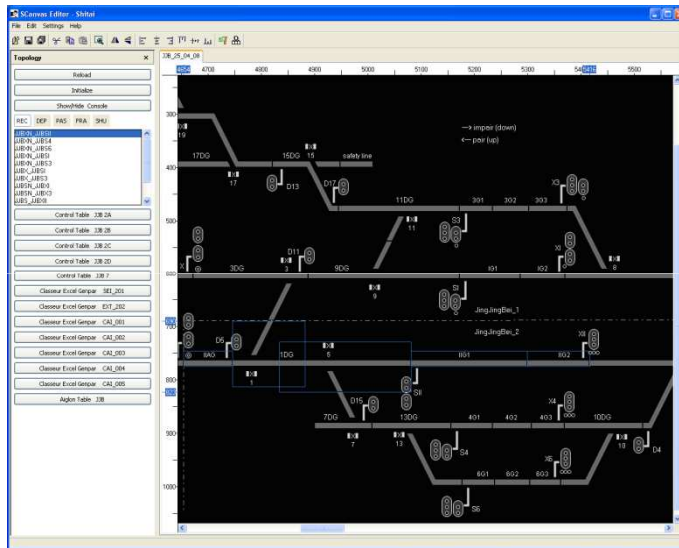
View edition



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Topology data extraction



Control Tables
generation

Raw Parameters
generation

ROUTE :	JJB56_JJBXN
Route with Automatic Route Release (RA) and automatic passing (TP) by passing route	
Control mode for scheduled routes	Automatic
SETTING UP CONDITIONS	
Control and Monitoring	
of point equipments	JJB130, JJB170, JJB50, JJB10
(points, movable frog)	
devices associated to	JJB50
partial route	
Destination track blocking	
ROUTE PROVING CONDITIONS	
	Origin Signal
	JJB56
	Intermediary Signal
Route set up	X
Main manual release inactive	X
Points or movable frog Left position (G)	
(HAG)	
Points or movable frog Right position (G)	JJB13, JJB7, JJB5, JJB1
	JJB31
Track circuits (Z)	
cleared	automatic spacing (except if Call On)
	JJB50
Automatic route closing (LOC)	
Track circuit (Z) occupied	JJB13, JJB7
Intermediary signal open	
Routes towards... cancelled	JJB56, HUIS
Bi-directional working (BA)	
Opposite direction	Subroute locking (TR)
locking	inactive
Stabling locking (VST)	
locking	Subroute locking (TR) inactive
Direction locking (BS)	
locking	Subroute locking (TR) inactive
Track circuit (Z) cleared	

Route Properties	hasFractTotal	hasFractPart	fracf	fracp	listAlqD	listAlqG
JJBXN_JJB52					JJB1, JJB3	JJB5, JJB7
JJBXN_JJB54					JJB1, JJB5, JJB7, JJB3	JJB2, JJB4
JJBXN_JJB56					JJB1, JJB5, JJB7, JJB3	NONE
JJBXN_JJB58					JJB1, JJB5, JJB7, JJB3	NONE
JJBXN_JJB60					NONE	JJB1, JJB3
JJBXN_JJB62					NONE	JJB1, JJB3, JJB5, JJB7, JJB3
JJBXN_JJB64					NONE	JJB1, JJB3, JJB5, JJB7, JJB3
JJBXN_JJB66					NONE	JJB1, JJB3, JJB5, JJB7, JJB3
JJBXN_JJB68					NONE	JJB1, JJB3, JJB5, JJB7, JJB3
JJBXN_JJB70					NONE	JJB1, JJB3, JJB5, JJB7, JJB3
JJBXN_JJB72					NONE	JJB1, JJB3, JJB5, JJB7, JJB3
JJBXN_JJB74					NONE	JJB1, JJB3, JJB5, JJB7, JJB3
JJBXN_JJB76					NONE	JJB1, JJB3, JJB5, JJB7, JJB3
JJBXN_JJB78					NONE	JJB1, JJB3, JJB5, JJB7, JJB3
JJBXN_JJB80					NONE	JJB1, JJB3, JJB5, JJB7, JJB3
JJBXN_JJB82					NONE	JJB1, JJB3, JJB5, JJB7, JJB3
JJBXN_JJB84					NONE	JJB1, JJB3, JJB5, JJB7, JJB3
JJBXN_JJB86					NONE	JJB1, JJB3, JJB5, JJB7, JJB3
JJBXN_JJB88					NONE	JJB1, JJB3, JJB5, JJB7, JJB3
JJBXN_JJB90					NONE	JJB1, JJB3, JJB5, JJB7, JJB3
JJBXN_JJB92					NONE	JJB1, JJB3, JJB5, JJB7, JJB3
JJBXN_JJB94					NONE	JJB1, JJB3, JJB5, JJB7, JJB3
JJBXN_JJB96					NONE	JJB1, JJB3, JJB5, JJB7, JJB3
JJBXN_JJB98					NONE	JJB1, JJB3, JJB5, JJB7, JJB3
JJBXN_JJB100					NONE	JJB1, JJB3, JJB5, JJB7, JJB3

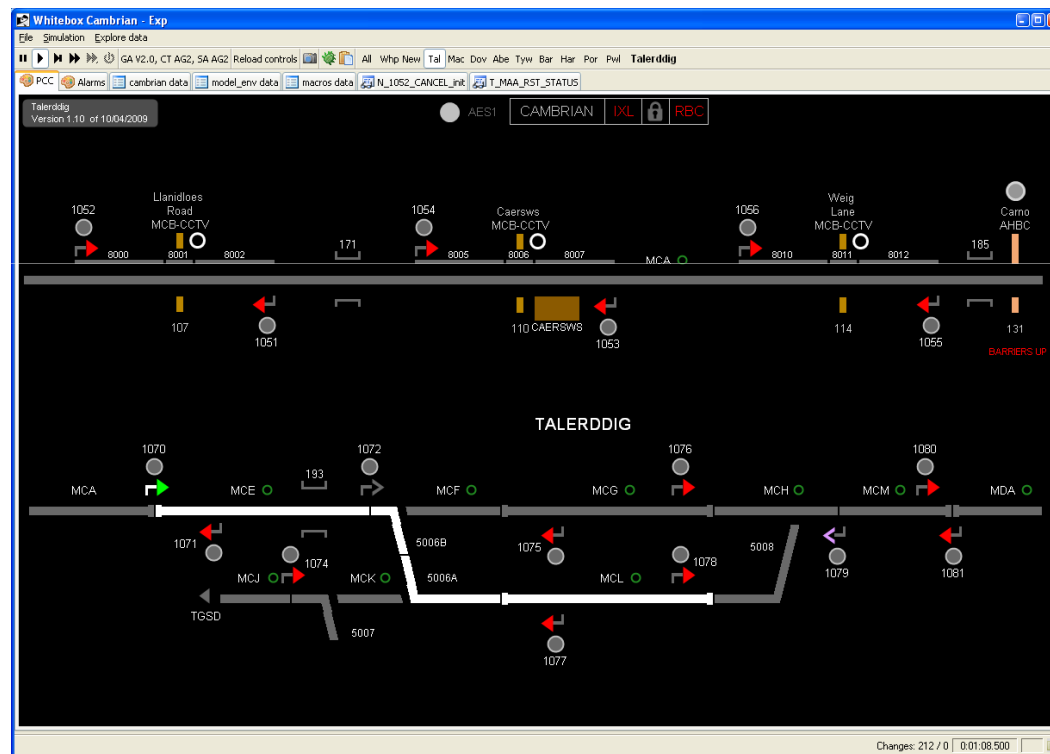
Topology data extraction

- Tcl scripts loaded as plugin of the editor
- Use the Scanvas API and the magnets to build topology
- Use of Tcom for Excel management

WhiteBox Simulator

- Import of production tool data
- Loading of simulation models
 - Automatic links between models
 - Defined or automatic links between models and graphical object
 - Models management with enhanced view (inputs/outputs, filters, graphs, model browser)
- Simulation management
 - Inputs setting / outputs getting.
 - Initialisation phase, environment simulation.
 - Running management (play, step-by-step, pause, fast forward, reset)

Simulation GUI – Graphical view



- Interactivity,
- Overview,
- Graphical objects finding tool

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Simulation GUI – Data view

Use TkTable: thousands of variables in the table without any response time issue

Whitebox Cambrian - Exp

Simulation Explore data

GA V2.0, CT AG2, SA AG2 Reload controls All Whp New Tal Mac Dev Abe Tyw Bar Har Por Pwl Talerddig

PCG Alarms cambrian data model_env data macros data N_1052_CANCEL_Ink T_MAA_RST_STATUS

30059 rows AHBC_084_PO_K 1 Set Toggle Command Clear

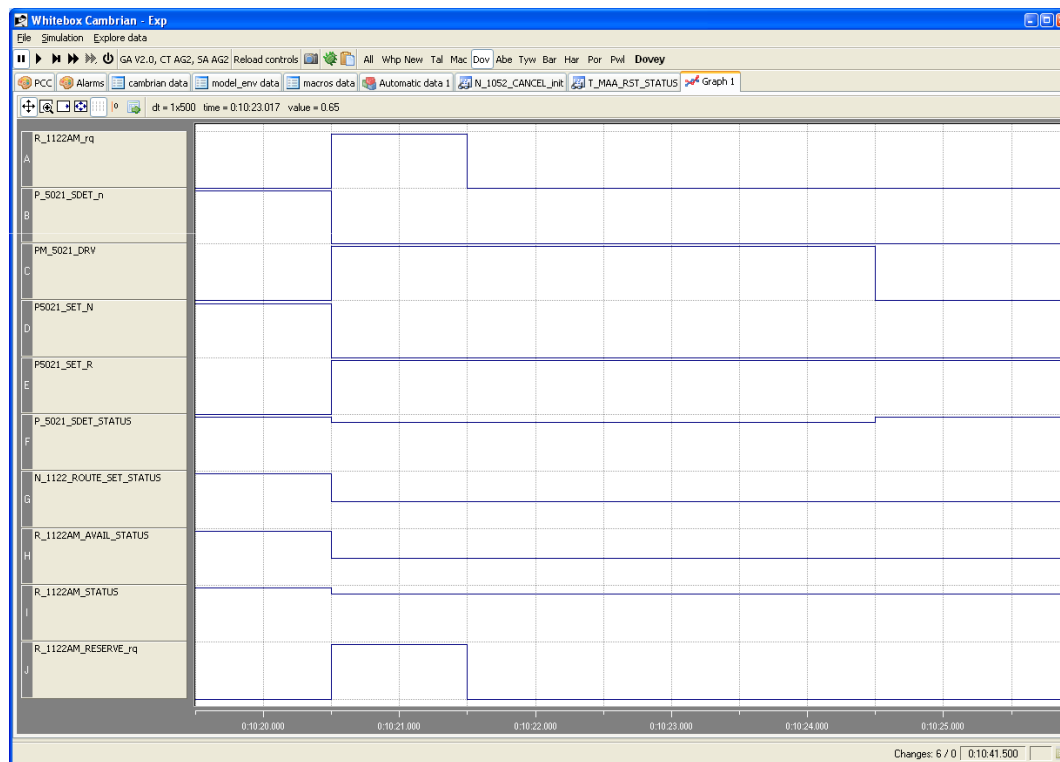
Model	Nature	Term	Value
cambrian	input	AHBC_042_ALARM_ACK_rq	0.QAHBC_NULL
cambrian	input	AHBC_042_ES_RD_rq	0.QRD_NULL
cambrian	input	AHBC_042_ES_rq	0.QE_NULL
cambrian	input	AHBC_042_PO_K	1
cambrian	input	AHBC_042_XING_K1	1
cambrian	input	AHBC_042_XING_K2	0
cambrian	input	AHBC_056_ALARM_ACK_rq	0.QAHBC_NULL
cambrian	input	AHBC_056_ES_RD_rq	0.QRD_NULL
cambrian	input	AHBC_056_ES_rq	0.QE_NULL
cambrian	input	AHBC_056_PO_K	1
cambrian	input	AHBC_056_XING_K1	1
cambrian	input	AHBC_056_XING_K2	0
cambrian	input	AHBC_084_ALARM_ACK_rq	0.QAHBC_NULL
cambrian	input	AHBC_084_ES_RD_rq	0.QRD_NULL
cambrian	input	AHBC_084_ES_rq	0.QE_NULL
cambrian	input	AHBC_084_PO_K	1
cambrian	input	AHBC_084_XING_K1	1
cambrian	input	AHBC_084_XING_K2	0
cambrian	input	AHBC_131_ALARM_ACK_rq	0.QAHBC_NULL
cambrian	input	AHBC_131_ES_RD_rq	0.QRD_NULL
cambrian	input	AHBC_131_ES_rq	0.QE_NULL
cambrian	input	AHBC_131_PO_K	1
cambrian	input	AHBC_131_XING_K1	1
cambrian	input	AHBC_131_XING_K2	0
cambrian	input	AHBC_206_ALARM_ACK_rq	0.QAHBC_NULL
cambrian	input	AHBC_206_ES_RD_rq	0.QRD_NULL
cambrian	input	AHBC_206_ES_rq	0.QE_NULL
cambrian	input	AHBC_206_PO_K	1
cambrian	input	AHBC_206_XING_K1	1
cambrian	input	AHBC_206_XING_K2	0
cambrian	input	AHBC_209_ALARM_ACK_rq	0.QAHBC_NULL
cambrian	input	AHBC_209_ES_RD_rq	0.QRD_NULL
cambrian	input	AHBC_209_ES_rq	0.QE_NULL
cambrian	input	AHBC_209_PO_K	1
cambrian	input	AHBC_209_XING_K1	1
cambrian	input	AHBC_209_XING_K2	0
cambrian	input	AREA_1_ES_RD_rq	0.QRD_NULL
cambrian	input	AREA_1_ES_rq	0.QE_NULL
cambrian	input	AREA_2_ES_RD_rq	0.QRD_NULL
cambrian	input	AREA_2_ES_rq	0.QE_NULL
cambrian	input	AREA_3_ES_RD_rq	0.QRD_NULL
cambrian	input	AREA_3_ES_rq	0.QE_NULL

Changes: 0 / 0 0.05:28.000

- Filters and data selection
- Custom tables
- Change simulation inputs

Simulation GUI – Strip chart

- Custom set of variables,
- Enhanced controls: zoom, value display, etc.



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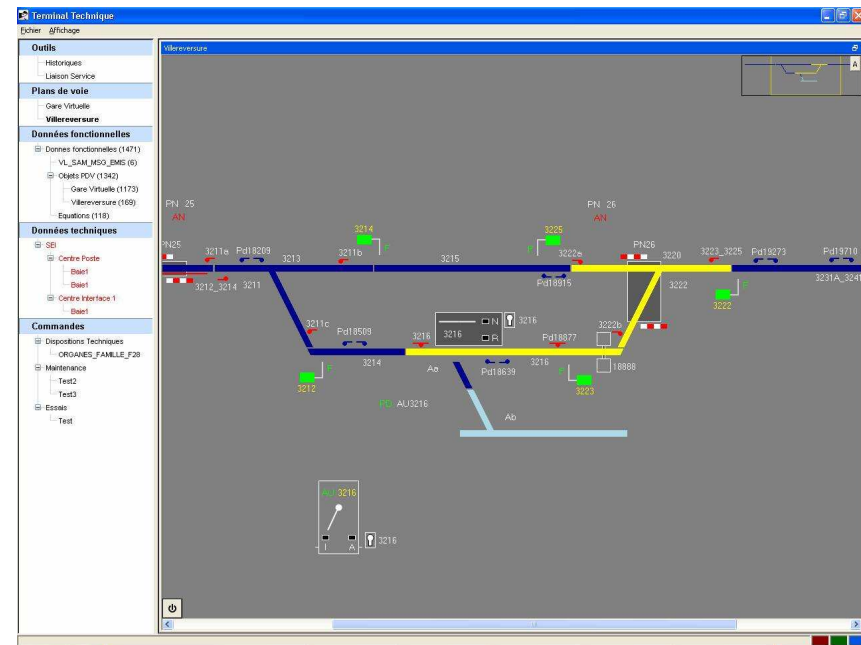
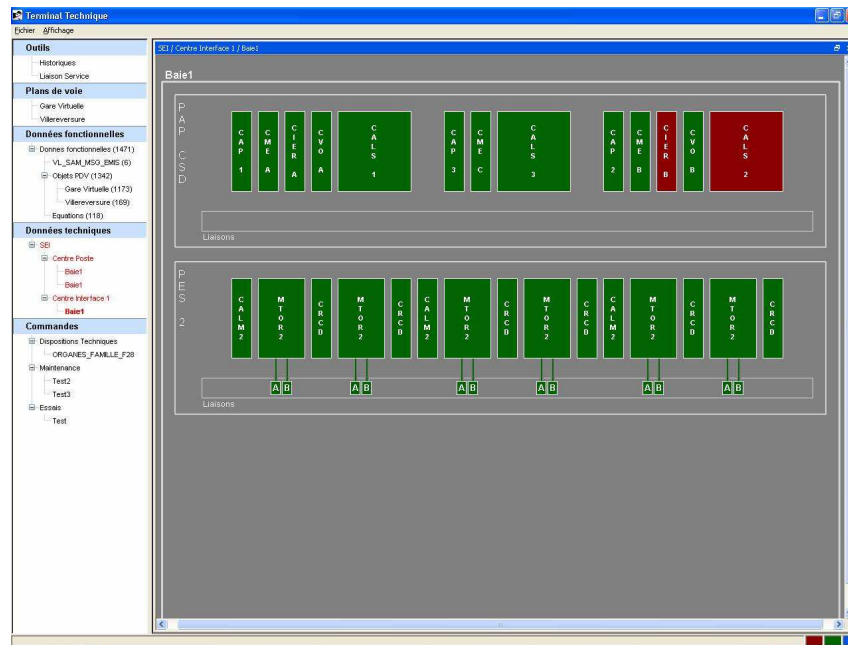
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Tests and validation use

- Real time simulation mode: the user controls the running and actions.
- Record/replay mode: scenarii can be recorded and play again.
- Validation Scenarii mode: high level scenario (include macros) run with the help of the simulator.

Maintenance Use: TT GUI

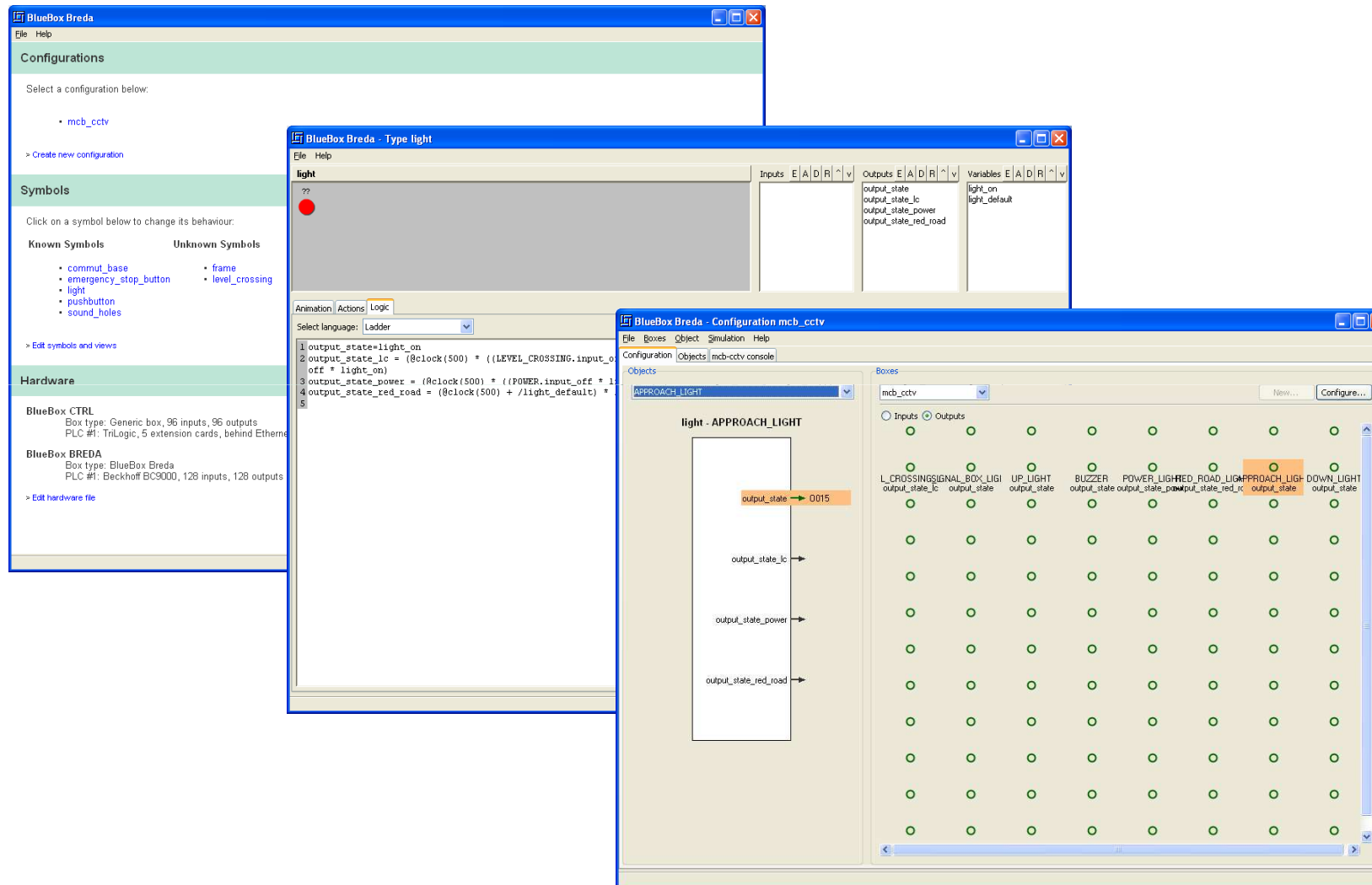
- Track views reused for the maintenance application
- First use TclOO



Other application: BlueBox Simulator

- A field simulator
 - Modbus standard communication with PLC (Triangle Research / Beckhoff)
 - Configuration management (inputs/outputs affectation + Ladder code generation)
 - Use graphical views to map objects in the PLC.

Other application: BlueBox Simulator

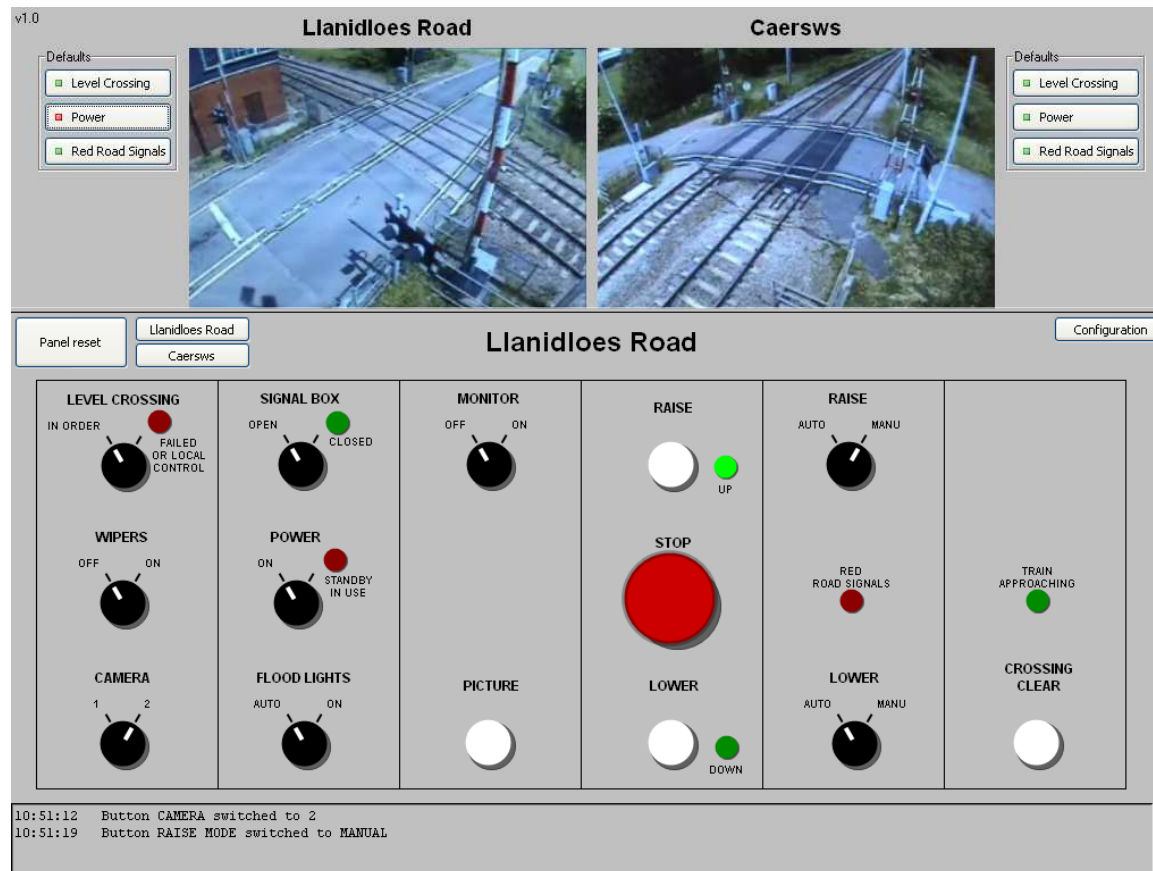


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Other application: BlueBox Simulator

- Use of TkVideo



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Tcl/Tk in the industry: advantages

- Modular development: from a simple software up to a complex one.
- Maintainability, glue language
- Easier to use with TclOO
- Tk scanvas power
- Use of C/Tcl API for C dlls
- Easy deployment thanks to TclKit

Current projects

- SNCF resignalling in France: simulation and TT.
- ERTMS in UK: modelling and simulation up to the training tool and TT. On-board data management tool.
- CTCS in China: modelling and simulation, topology data extraction from the track view, gateway with the production tools.

Demos

- Scanvas editor (objects + views)
- Cambrian simulator + Level crossing simulator + on-board data management tool
- Shitai topology + simulator