BMIA

FORUM8 Design Festival 2010

G'Tun® & G'Road®

The know how : P.Marsaud

- 25 years of experience in IT industry
- 10 years serving Tunnel operations, mainly :
  - Project manager of Tunnel El Azhar SCADA (Cairo – Egypt)
  - Project Manager of Tunnel Duplex A86 SCADA (Paris – France)

In these 2 projects, implementation of a process of complete platform evaluation and validation of the software developments through simulation tools :
  - Equipment simulators (all projects since 1999)
  - Interactive visual simulation of a traffic section (A86)

The origin of the concept

The early proof of concept

First GUI

First traffic simulation

2004

What is involved ......

Mont-Blanc Tunnel - Fr
March 24th 1999
Truck in fire => 39 dead
2 Years of work – 500 M$

Gothard Tunnel - Sw
October 24th 2001
Truck in fire => 11 dead
3 Years of work – 650 M$

Tunnel du Frejus – Fr
June 5th 2005
Truck in fire => 2 dead

....

Training Requirement

- French circular No. 2000-63 on the safety of road tunnels asking that "*the staff assigned to the operation is to be trained ...* "

- European directive of April 29th 2004 relative to minimum requirements for the safety of trans-European network tunnels, requiring operations personnel and emergency services to receive appropriate initial and continuous training

Why using a simulator ?

« What we should learn to do, we learn by doing »
Aristote

The practice is necessary to form to :
- **Technologies and Systems (increasingly complex)**
- **Evolution of operating rules**

For a new design or improvement, the simulation is necessary, it:
- **Replaces the proposed technology**
- **Avoid the costs and delays of a prototype**
- **Limit the risks of testing while in operation**
- **Allows to test and compare several solutions**
- **Allows to reproduce any theoretical case ...**

The design concept

The product specification: real-time visual 3D traffic simulator for roads, bridges and tunnels run by the real SCADA and usable to :

| Conceive	Evaluate	Train
• 3D Visualization ➢ Use of standard formats ➢ Software package • Test support ➢ Connectable to SCADA • Communication tool ➢ Making videos in standard format	• Various traffic scénarios : fire, accident, ... ➢ Script editor. ➢ Scenario library • Impact Analysis ➢ Real time reporting ➢ Full recording • Operating rules validation ➢ Review of developments and changes. ➢ Road equipment library	• Immersion in context ➢ Replay of real case ➢ Scenario editor • Realistic environment ➢ Use of the real SCADA and the real tools. • Interactivity and reporting ➢ Online trainer actions. Reporting

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Tunnel Operation

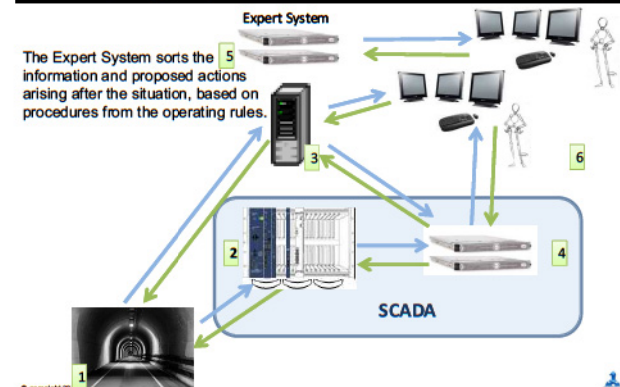## General SCADA architecture

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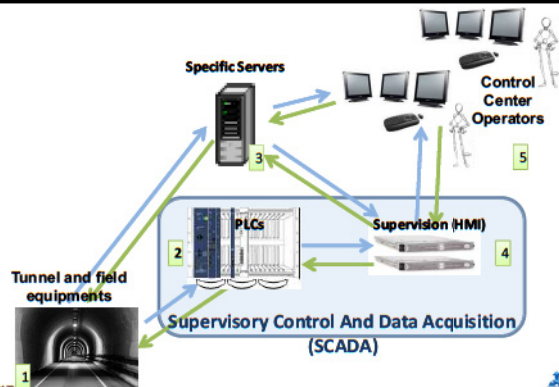
Content

1. All equipment in the tunnel (lane control systems, barriers, traffic counting stations ...) are either sensors (return data) or actuators (perform actions).
2. Some of these devices exchange technical information with SCADA for centralization (remote signals, telemetry, remote controls and remote settings).
3. Some equipment exchange data with their dedicated servers (ADI, EPS, PBX, ...)
4. Information are exchanged with the SCADA operators through the GUI of Supervision. These HMIs are graphical representations of all exchanged data, macros, and alarms.
5. The operator then manually sort these information and note the actions arising after the situation (fire, traffic jams, accidents ...). They rely on the procedures in their manual. The actions are then referred to the SCADA or to specific servers to be implemented.
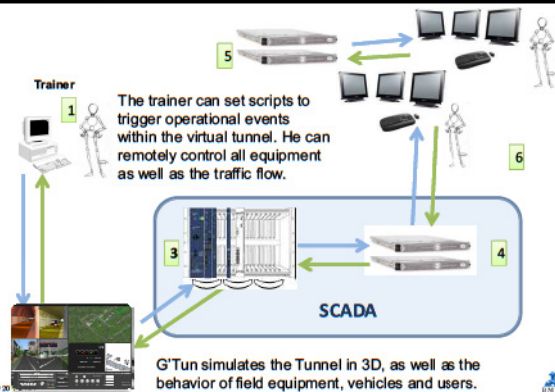

Helping Operators

The Expert System sorts the information and proposed actions arising after the situation, based on procedures from the operating rules.

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Training with a Simulator

Trainer

The trainer can set scripts to trigger operational events within the virtual tunnel. He can remotely control all equipment as well as the traffic flow.

SCADA

G'Tun simulates the Tunnel in 3D, as well as the behavior of field equipment, vehicles and users.

© copyright 20...

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Tools and resources

- Information
  - Sensors data and alarms : traffic loops, ADI, temperature, …
  - Inbound communications : emergency calls, radio (patrol man), ….
  - CCTV System
- Action
  - Actuators : traffic light, barriers, VMS, ….
  - Outgoing communications : phone, fax, email, SMS radio,…

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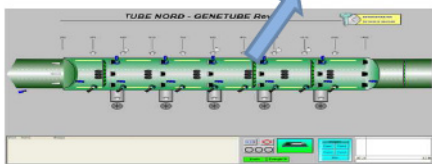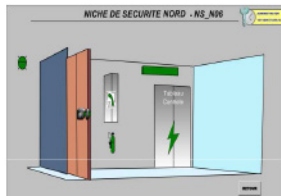# Example of SCADA HMI

© copyright 2010 BMIA

Slide 17
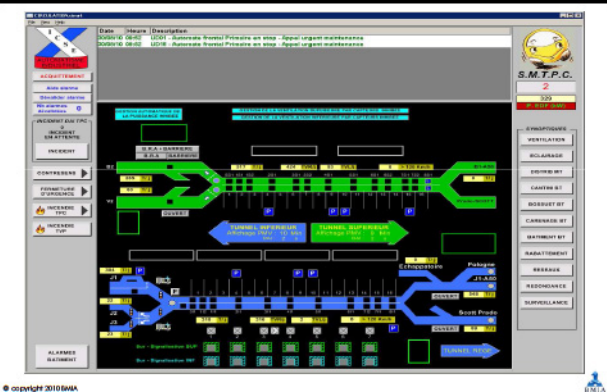
A safety niche

- Door position and safety
- External Flashing light
- Safety light
- Extinguisher
- Emergency Phone
- Ventilation
- LV and HV cabinets …….

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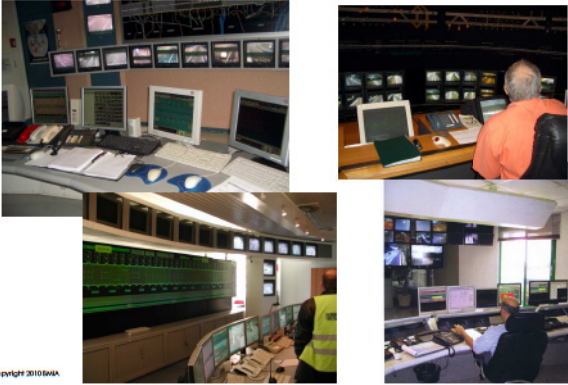
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Example of Expert System GUI

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Event Detection with CCTV

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Samples of Control Center

The 'ideal' CC
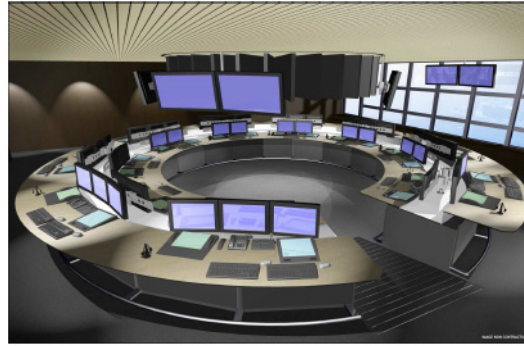
Some figures

Infrastructure :
- 2 Tunnels (1.5 km & 1 km)
- 10 km Highway
- 2 km Road

Simulator :
- 600 Equipments of 36 kinds
- 3,350 data points to CC

Previous conception = 1.5 data points / m
Modern conception = 5 data points / m

A86 Duplex => 5 km double deck = 70,000 DP !!

Prototype

Normasim

SIMVIZ 2006 - 2009

The first GUI

Problems / Admission of failure

- Very difficult to reach a level of quality close to a real product
- Very far to a standard, very close to custom software
- 3D took too much place compare to technical objectives
- Price of development, follow-up and updates

=> UC-win/ROAD (Jan-2010)

Updated specifications

Needs

- The software is designed to simulate the behavior of different components (traffic, equipment, speakers, human, environmental, ..) of a road network, to provide an operator training support for its operation .
- Linked to the SCADA via OPC, the simulator is a training in the use of Control Center tools.
- It will validate the operation of software modules as well as traffic management principles or new operating rules.
- A specific Instructor PC can generate different events in the simulator but also unitarily drive all components of the simulator

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Dynamic

- Basic human animations (users, rescue teams, …)
- Special effects (fog, smoke generator, …)
- Realistic simulation of traffic behavior and flow
- Handling of road equipments (OPC dialog)
- Variable flow of vehicles
- Obstruction, speed regulation, diversion of Traffic
- Traffic loops data
- Video recording
- Controllable field cameras
- ……….

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UC win/Road 5

G'Tun® & G'Road® principles

Architecture

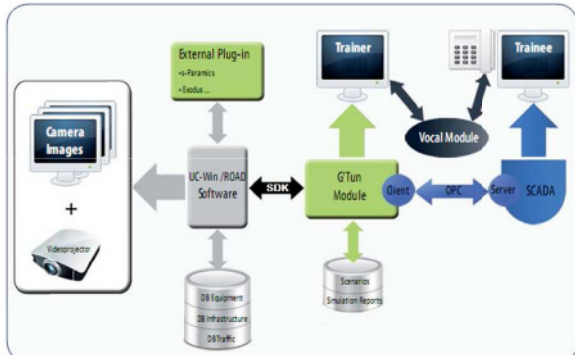**G'Tun® & G'Road® consists of 3 separate modules:**

- **The visual simulator:** simulates the traffic in a realistic and interactive 3D environment. It generates traffic incidents, visually simulates the behavior of multiple types of field equipment, modifies their implementation and / or characteristics and can provide images from fixed or mobile cameras into the virtual 3D space.

- **The trainer (instructor) module:** permits the user to 'pilot' the simulator in parallel to operating tools used through the HMI. It can activate a whole series of scenarios and incidents as well as generating a variety of reports. This module enables the trainer to control the different parameters of the simulator.

- **The SCADA interface:** this allows the simulator to exchange data with the SCADA Data Base through an OPC protocol. This data comes from the different sensors simulated within the project (LCS, ADI, door, …) as well as the control orders from the SCADA or Trainer HMI (started accelerator, closed barriers, VMS, …)

Software architecture

Hardware architecture
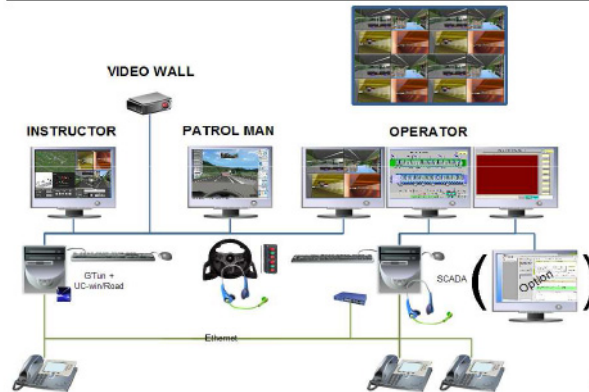

Video Wall

G'Tun® Instructor HMI

Ineractive map

manuel selection and equipments driving

Tunnel parameters (statics and dynamics) Scénario handling Training report

Video choice, showing and recording

Training report

Expected actions column

Trainer action column

SCADA data column (trainee action)

Scenarisation

- Generation of a slow moving vehicle at any KP
- Generation of an accident between a 2 LV, any KP
- Generation of a disabled vehicle, any KP
- Generating a fire scenario, any KP
- Object on roadway (packages, wheel
- Rescue arrival, repairman, police…
- Simulation of drive in the VR (patrol man)
- Ground marking
- Contra flow vehicle
- Wandering animal
- ….

Visible Equipments

- Free VMS messages display
- Display symbols on LCS
- Traffic lights
- Gates opening & closing
- Barriers deployment & drawdown
- Camera (CCTV)
- Automatic Detection of Incident
- Tolls opening, closing lanes, temporization
- Flash Lights On, Off
- Lighting On, Off
- ....

Unvisible equipments

- Jet fans and ventilation system efficiency
- Fire extinguisher removal in safety niche
- Opening doors of safety niche
- Pollution sensors (CO, NO, Opacity, ...)
- Increase of Temperature alarm
- Smoke detection
- ADI (Automatic Detection of Incident)
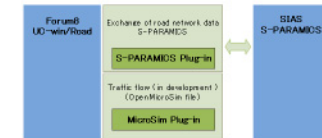- Emergency Phone calls
- ....

Traffic simulation

S-PARAMICS Plug-in Option enables data exchange between UC-win/Road and S-PARAMICS to provide a great combination of traffic analysis and 3D virtual reality by linking one of the leading traffic microsimulation solutions with UC-win/Road.

Thank you for your attention

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