



Soluções de Sinalização para VLT's

“Implementing a World Class Network”

*AEAMESP
Thomaz D'Agostini Aquino
Setembro 2016*

THALES

Alcance Global, Expertise Local

Colaboradores

 61.000

Presença global

 56 países

Thales - Operações em todo o mundo



Vendas em 2015

 15 Bilhões de Euros

Pesquisa e desenvolvimento

 2,5 Bilhões de Euros

THALES

Mercados Militar & Civil



AEROESPAÇO



ESPAÇO



TRANSPORTES



DEFESA



SEGURANÇA



PARCEIRO CONFIÁVEL PARA UM MUNDO MAIS SEGURO

THALES

N°1
mundial



Comunicações
Metro-ferroviárias



Carga útil para
satélites de com's



Gerenciamento
de tráfego aéreo

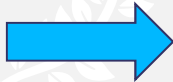


Sonares



Segurança para
transações bancárias

N°2
mundial



Sinalização
Metro-ferroviária



Entretenimento e
conectividade em voos

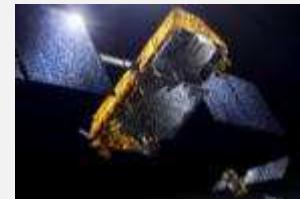


Radiocomunicações
táticas e militares

N°3
mundial



Aviônicos



Satélites civis



Radars de superfície

€15
bilhões
em vendas

Presença Local

- ◆ Mais de 45 anos de presença contínua no país
- ◆ Escritório Central da América Latina
- ◆ **250 colaboradores (98% brasileiros)**
- ◆ 5 bases: S. Paulo, Rio, Brasília S. José dos Campos (Centro de Integração) e S. Bernardo (Fábrica)
- ◆ Atuação nos 5 mercados: Espacial, Aeroespacial, **Transportes**, Defesa e Segurança
- ◆ Sólida relação com Forças Armadas e Clientes Civis (**CMSP, EMTU, CR Almeida**)
- ◆ Líder em radares de Gestão de Tráfego Aéreo



Thales nos Transportes – presença nos países

Centros de Integração e de Competência
Total de 6 800 Especialistas

EUROPA (5,054 p):

• Germany	1 374 p	• Romania	184 p
• France	1 090 p	• Italy	110 p
• UK	1 120 p	• Austria	212 p
• Spain	566 p	• Poland	87 p
• Portugal	207 p	• Switzerland	77 p
		• Latvia	27 p



Mais de 100 clientes, em mais de 50 países

Atividades

- ◆ Sinalização: redes urbanas, regionais e de longa distância (cargas e passageiros)
 - **CBTC** - Controle de trens para metrô e mon trilhos - com ou sem condutores (**Número 1 Mundial**)
 - **ETCS** - Soluções de controle de tráfego com interoperabilidade
 - **CTC** - Sistemas de Gerenciamento / Supervisão de Tráfego
 - **Sistemas de Sinalização e intertravamento** (incluindo soluções para VLT's)
 - Equipamentos de campo (Máquinas de chave, Contadores de eixo, Circuitos de via, Sinais, etc.)

- ◆ Sistemas de comunicações
 - Soluções para redes ferroviárias incluindo **Centros de Controle Operacional (CCO)**, pátios e estações: supervisão e controle da rede, sistemas de comunicações fixas e móveis (**Terra-Trem**), sistema de informação aos passageiros e multimídia, **sistemas de video-vigilância (Número 1 Mundial)**





**Sistemas de sinalização para redes de transporte urbano, com CBTC:
58 linhas de metrô em mais de 30 cidades
Transportando 3 bilhões de passageiros /ano**



**Centros de Controle Operacional, Comunicações integradas & supervisão para redes ferroviárias: 20.000 km em 28 países e
100 linhas de Metrôs e VLT's em 50 cidades**



**Sinalização para redes ferroviárias com ETCS: 17.000 km em 20 países,
Controlando mais de 220 mil elementos**



**Sistemas de bilhetagem:
50 milhões de transações em 100 cidades de mais de 15 países.**



Um Parceiro forte com atividade mundial

- N.º 2 em Sinalização
- N.º 1 em soluções CBTC e ETCS
- N.º 1 em Sistemas Integrados de Comunicações



Mais de 100 clientes, em mais de 50 países

Rail infrastructure project



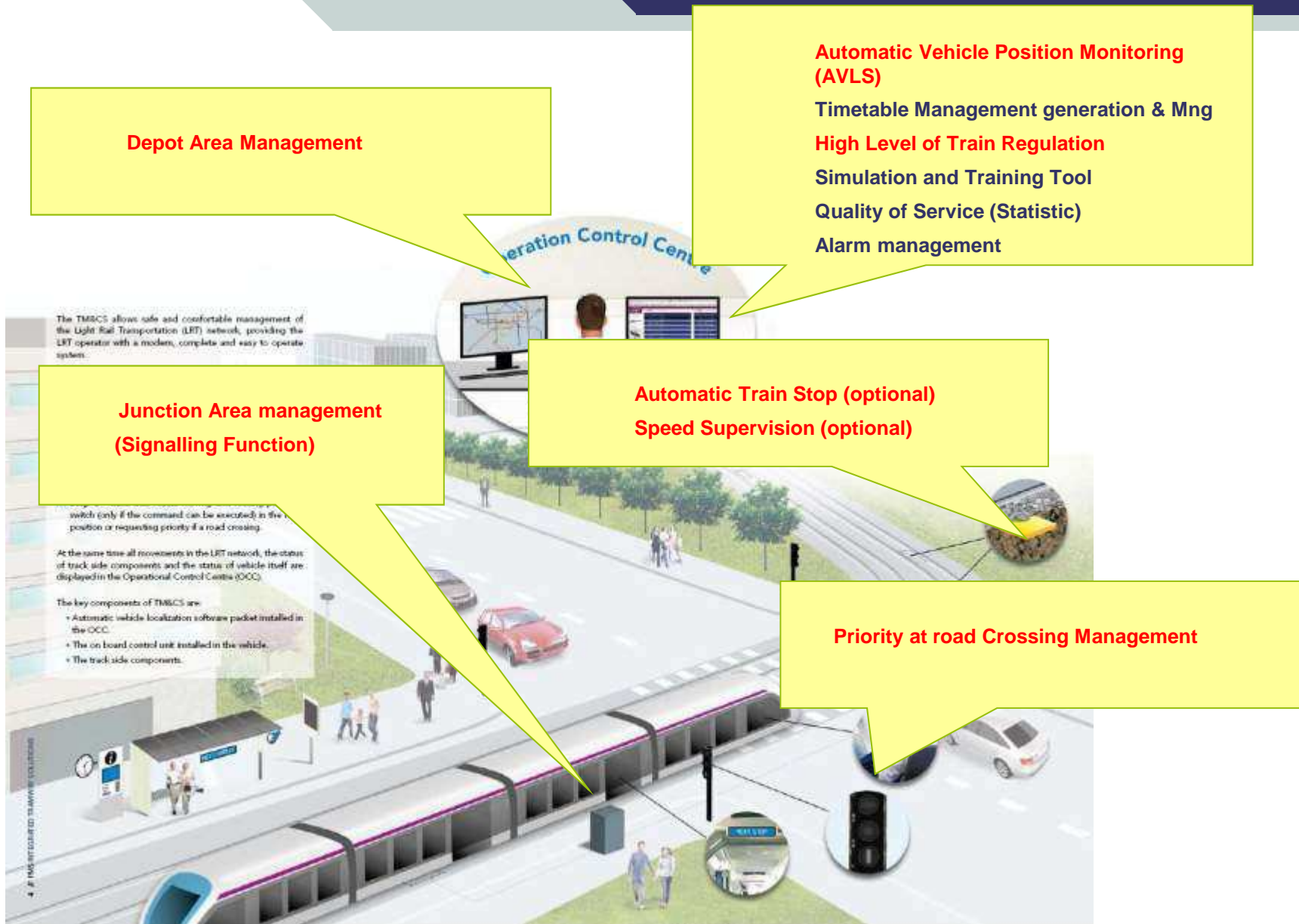
- Sinalização
- Supervisão (SCADA)
- Comunicações
- Monitoramento Eletrônico (CCTV)
- Multimedia
- Bilhetagem

- ◆ Light Rail Transit is becoming an **importante, eficiente e seguro meio de transporte**.
- ◆ LRT is an **opção atrativa** in terms of **investimento, capacidade, redução de poluição e estética**
- ◆ LRT provides **muito boa relação custo-benefício** transportation infrastructure for the public authorities
- ◆ LRT Operators need a solution to **optimise daily operations and maintenance** activities and to ensure **qualidade de serviço (confiabilidade)** by managing in the best way the **traffic light priority**
- ◆ Increase surrounding commerce activity



 Clean, green and quick, LRTs and Tramways are playing a key role in creating sustainable cities

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Get the most
out of the
LRT
infrastructure

- ◆ Otimizar a eficiência operacional
- ◆ Atender às expectativas dos Passageiros

○ Enabling transport network and infrastructure managers to **get the most out of their current and future investments** by increasing its global performance, offering an advanced solution and mastering the growing complexity of intelligent transport networks





Light Rail Transit

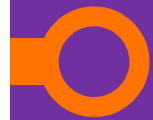
*Integrate advanced transport system
Improve urban design*

Marcha-à-Vista e Convencional

With:

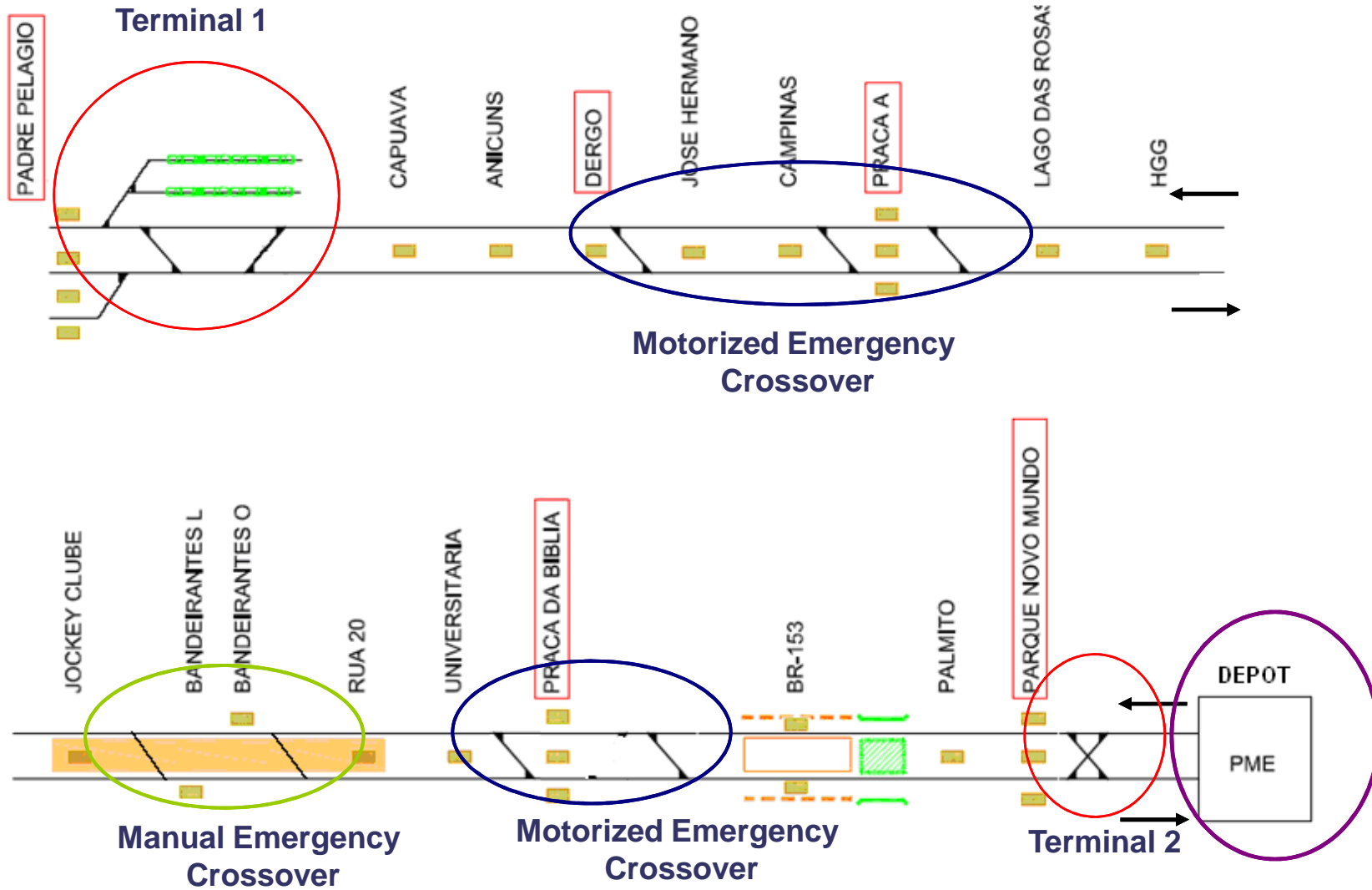
- **Via compartilhada ou segregada**
- **Estabelecimento da rota pelo piloto ou de forma centralizada**
- Até 70 km/h
- Headway de 3 minutos
- BOSTrab standard

CBTC
Automated and
driverless systems



Thales responds to all customer demands
from line of sight operating systems to fully automated systems

Definição das Áreas e Tipos de Sinalização



Where to install the Signalling System – possible signalling areas

◆ Conceitos Operacionais Básicos:

- The Tram Operating System (TOS) shall enable the operator to survey technically and operationally the light rail system. This includes **um sistema de rádio móvel de alta confiabilidade, um sistema de sinalização compatível com as necessidades operacionais e um sistema de gestão de prioridades Road/Rail**. This also implies a system that provides **sistema de informação operacional (Rail & Road) e informação ao Passageiro em tempo real**.
- **Movimento dos veículos controlado ou por uma sinalização tradicional (CTC e Intertravamento) ou via Marcha-à-vista (com mais responsabilidade no piloto**. That notwithstanding, a signalling (**SIL 4 or SIL 3**) system shall be provided in the required areas.
- **Marcha-à-vista** signaling system normally operates in a **modo local**:
 1. **A aproximação de um veículo a área sinalizada implica numa solicitação de rota** to the track side signaling equipment. **Como opção, o piloto pode ser o acionador das máquinas de chave**, from pushbuttons integrated in the vehicle driver console.
 2. Track side reacts by moving and locking powered switch (only if the command can be executed) in the right position or requesting priority if a road crossing.
 3. At the same time **todos os movimentos e status dos veículos sobre trilhos são supervisionados, pelo CCO**.

◆ **Conceitos Operacionais Básicos:**

- LRT network operations are based on a **Marcha-à-vista** basic principle. Drive on sight means that the tram driver must respect the traffic signs and ensure at all times that he can respect the safety distance with the other tramway vehicles, the road traffic and the pedestrian traffic.
- In addition, **os pilotos são os responsáveis por obedecer os limites de velocidade.**
- In the case that Drive on Sight is not applicable the driver will be assisted by additional safety system to allow him to drive at higher allowed speeds.
- **Os VLT's, normalmente, param em todas as estações/paradas.**
- **Cruzamentos rodoviários e de pedestres são sinalizadas**
- **Drive Direction:** On normal operations, driving takes place on right hand side. Except in terminus turn back situations, driving on left hand side is considered as exceptional.
- **Operating speed for each track section** has to be defined and in particular section is required as a reminder of maximum speed by static information Signboards.

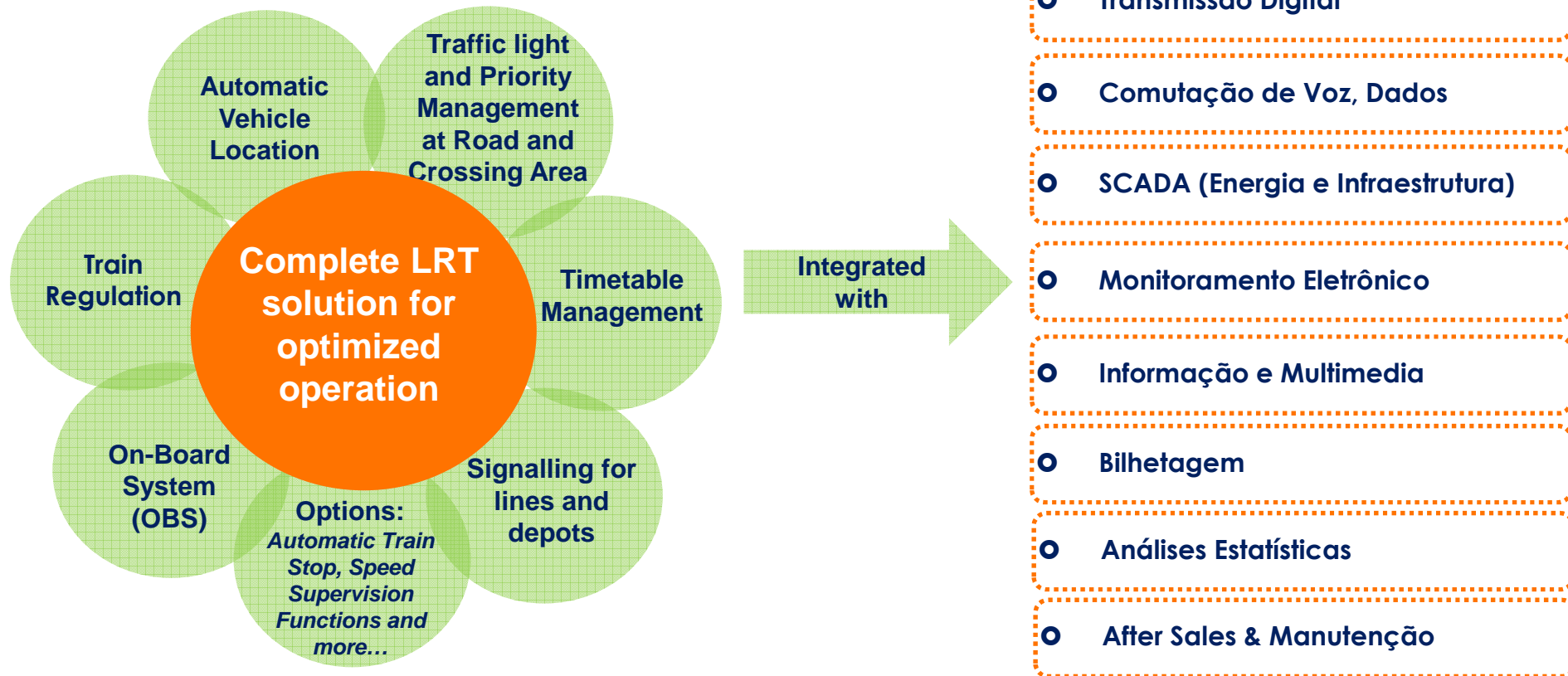
- **As Oficinas e áreas de estacionamento Centrais são controladas por sinalização tradicional (CCO e/ou PCL e Intertravamento).**
- The depot management system, installed in the Control Centre, shall allow at the least following main functions:
 - **Vehicles Tracking and visualization in the depot area:** Vehicle localization and tram movement in the depot area shall be available in real time on the depot operator workstation.
 - **Manual route setting:** Depot Operator work stations shall allow sending manual command to the depot interlocking in order to set/delete shunting route, exit route, entry route.


Route shall be setting by selecting geographically the start and end route symbol, or by selecting the route code in the route list.
 - **AMV's motorizados:** operator shall be able to verify the status and position of the powered switch and shall be able to command the powered switch directly by the synoptic view.
- **Emergency local panel** shall be foreseen at the depot entrance and at the depot storage area to allow the driver request the route (entry/exit) **in case of depot centralised operation is not available.**

Thales LRT offer

A complete portfolio tailored to fit your environment





 Thales integrated approach for LRT
is the right way to take advantage of today's state-of-the-art systems
From delivery up to full customer services (training, support, maintenance,...)

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Alto nível de Integração nos CCO e a Bordo dos VLT's

Conjunto avançado de funcionalidades:

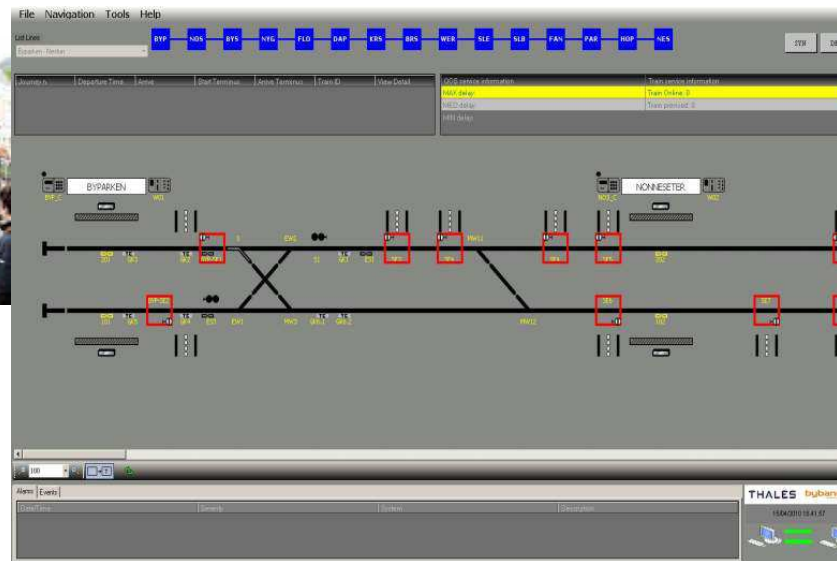
- ◆ Gerenciamento Inteligente da Regulação
- ◆ Plataforma de Simulação e Treinamento
- ◆ Gerenciamento Flexível de Prioridades (Road/Rail)
- ◆ Gerenciamento Estatístico da Qualidade de Serviço

THALES INTEGRATED
AND
ADVANCED APPROACH

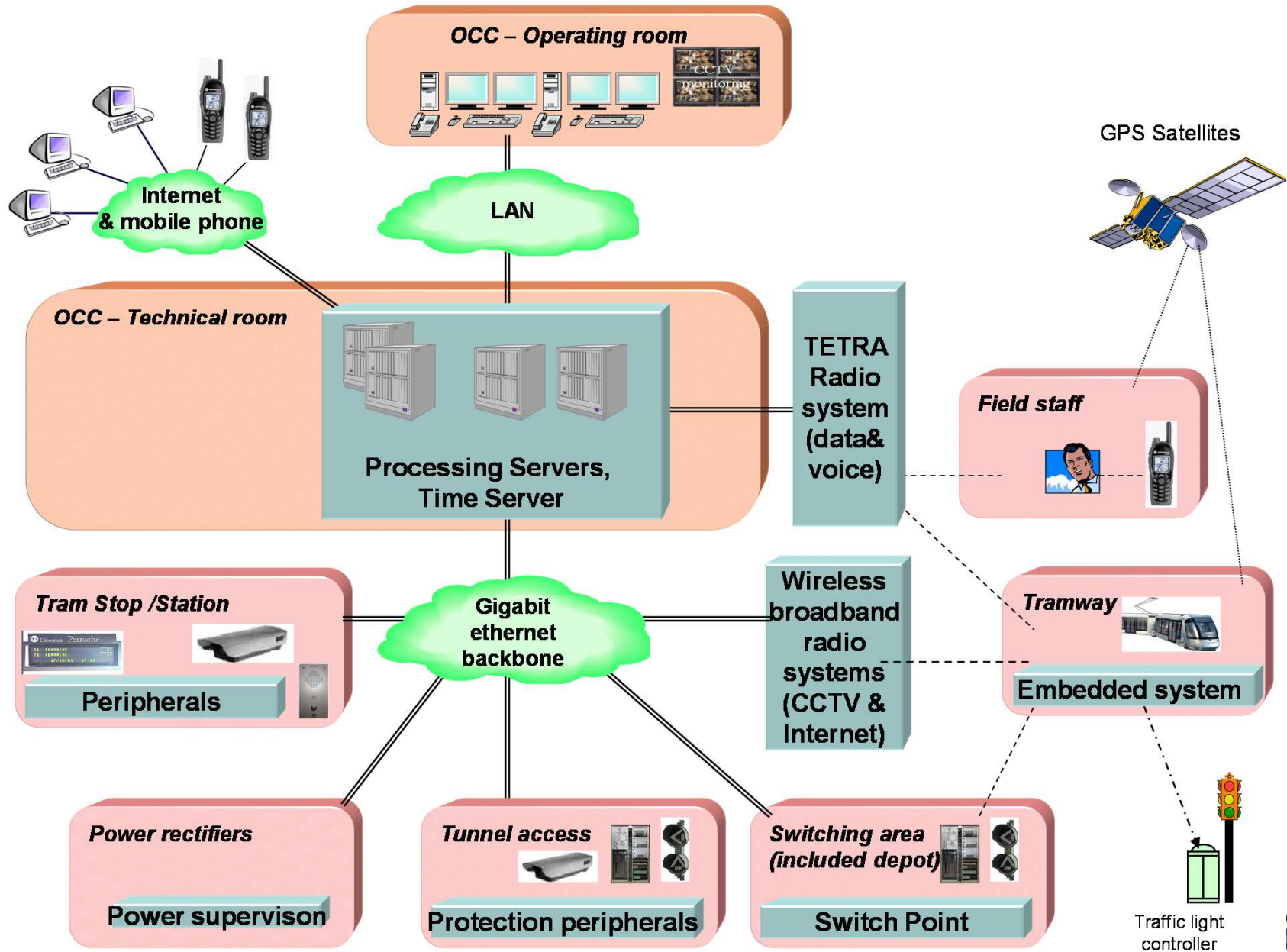
Sistema Inovativo de Comunicações Móveis

Thales Solution designed for the management of normal operational scenarios, degraded scenarios and special events

- The LRT solution shall comprise four main components:
 - Sistema de Supervisão (CTC/CCO)
 - Equipamento de Bordo
 - Equipamento de via
 - Sistema de Comunicações Fixas e Móveis

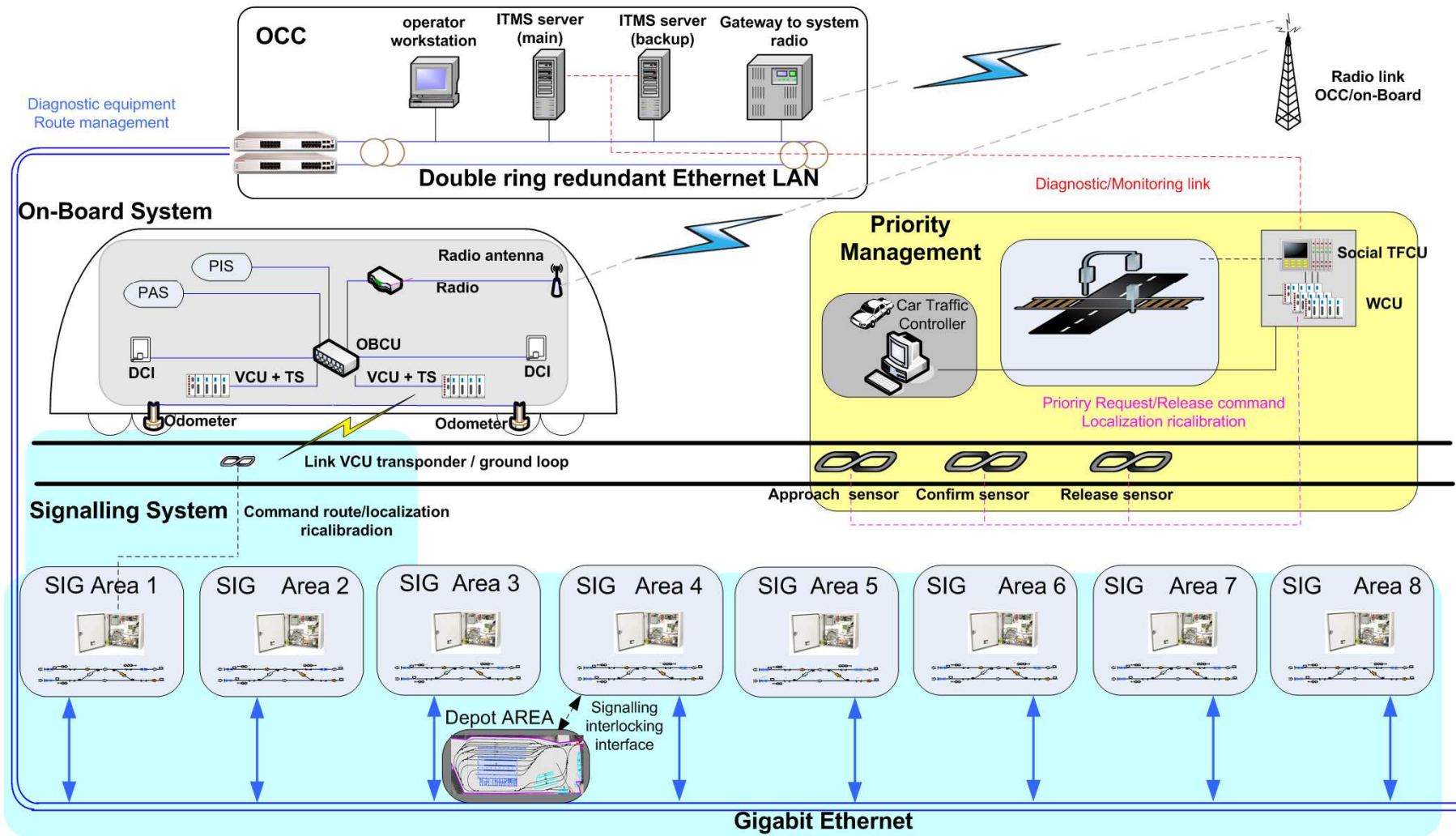


LRT M&CS Solution –Arquitetura Básica



- In the LRT Solution the Signalling package ensures the following **Funções Principais**:
 - **Sinalização ao longo da linha e nas Oficinas e Estacionamentos**
 - **Monitoramento da Posição de Veículos**
 - **Gerenciamento de Prioridades Road/Rail**
- **Dependendo das características físicas e operacionais da Linha e das vias o sistema poderá necessitar de sistemas centralizados e/ou descentralizados, tradicionais ou Marcha-à-vista.**

LRT M&CS Solution – Arquitetura do Sistema de Sinalização



- The Signalling System shall ensure tram transit across all critical point of the line and of the depot in a safe way by means of the management and control of the powered switch machines, the signals and the LRV detectors.
- The switches shall be interlocked so that they cannot be operated by other vehicles.
- Information on rail switch position shall be given to the driver by wayside signals according to Applicable Standard
- The signalling system consists of:
 - **Comunicações** unit in order to receive the route request from the on board
 - **CCO (CTC)**
 - Track Side (and/or Central) **Intertravamento**
 - Safety **Detetores (Contadores de Eixo)**
 - LRT **Sinais** (STOP and GO)
 - **Máquinas de Chave**
 - **Painel de Controle Local**, to set the route locally in case of emergency. The local control panel, installed in the interlocking track side, shall be easy to access and operate (**opcional**)

◆ Missão:

- The mission of tramway **Interlocking (or Point Controller)** is to **gerenciar, de forma segura, os elementos de campo, ao longo da via ou nas Oficinas/Estacionamentos**

Example of depot Configuration →



◆ Características:

- Computer system with high availability
- **Safety: SIL3 ou SIL 4: safety concept based on 2oo2 or 2x(2oo2) CPUs**
- **Placas I/O fail safe**; watchdog; power breaker
- Local Control Panel with keyboard for manual route requests
- Failure-free SW start-up process
- Modular system, with configurable number of safe I/O cards
- Possibility of **configuração Master-Master** (for single track route management)
- Possibility of **configuração Master-Slave** configuration (for more safe I/O cards)



◆ Benefício:

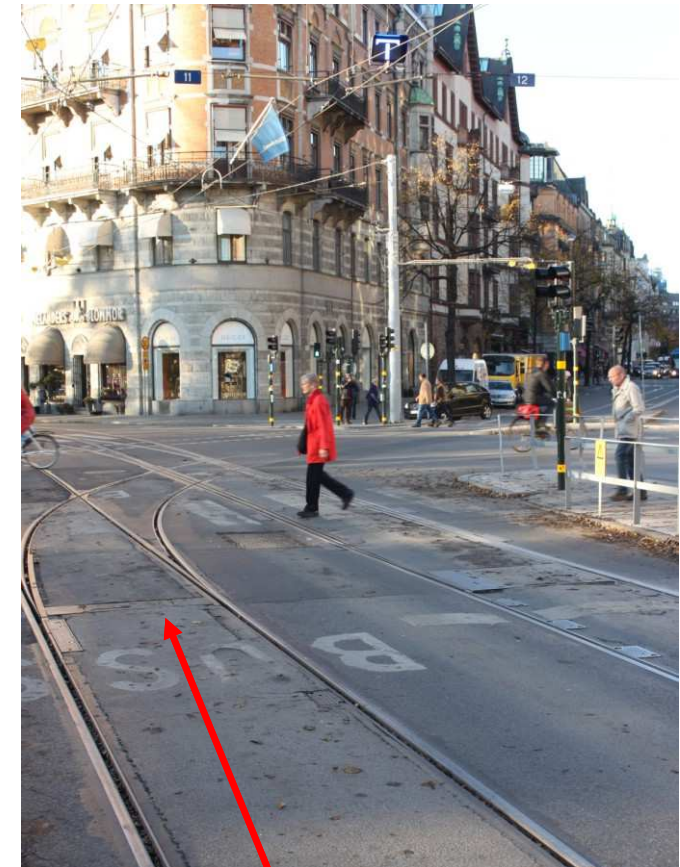
- **Estabelecimento de Rotas e Proteção**; Simple and complex switching; Depot Management System; Tracking/Queuing of route requests; Monitoring of field elements; Easy configuration

Example of Configuration for terminus

Point Machine in Tramway Scenario



Powered Point Machine
ballast Track



Manual Point machine
Embedd Track



Powered Point Machine
Embedd Track



Signalling Cabinet
For Line Application



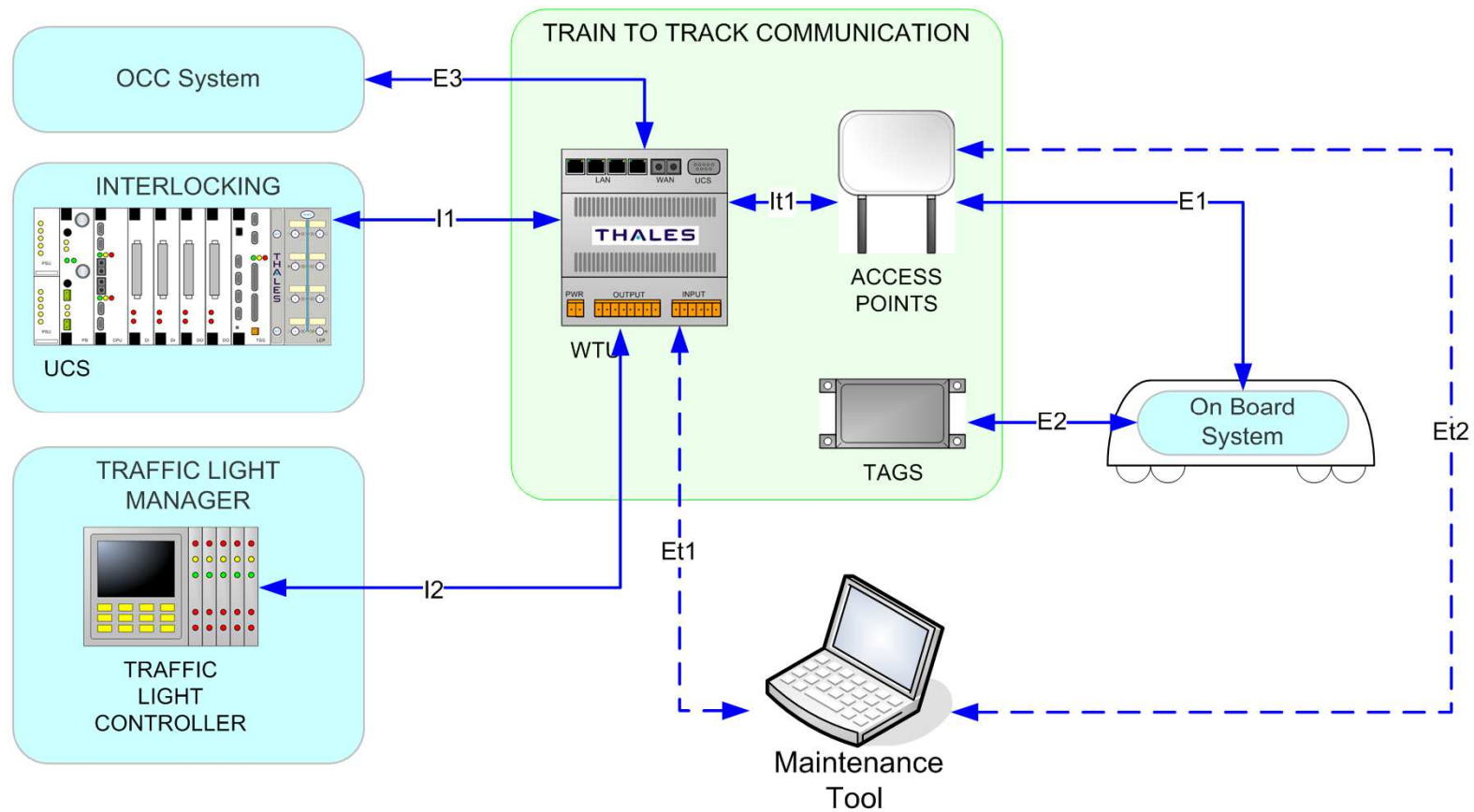
Track side
Local Panel



Signalling Cabinet
For Depot Application

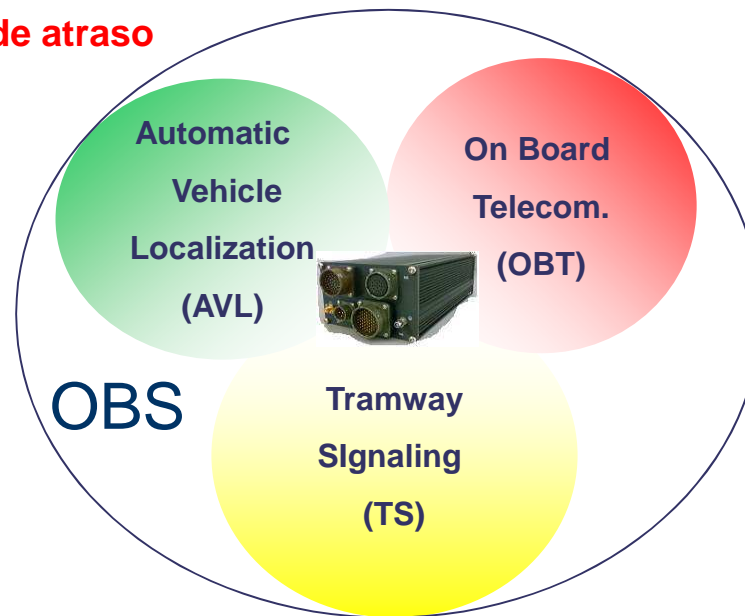
This subsystem is in charge of the **funções non safety-related**:

- ◆ **Comunicações Terra-Trem**
- ◆ **Localização de veículos sobre trilhos**
- ◆ **Ajuda na Gestão de Prioridades Road/Rail**
- ◆ **Elementos do Sistema:**
 - **Rede Wireless:** Communication with on-board system is performed through UDP/IP connection over wireless network, using a proprietary protocol.
 - **Balizas Passivas RFID:** passive tags are installed on the tracks nearby to stations or road crossings or Junction Areas. They are used by the on-board system to detect the train position and to retrieve the configured actions to be performed within the area that is going to be approached.
 - **Estações-Base ao longo da via**



Monitoramento de Localização Automática de Veículo

- Automatic Vehicle Position Monitoring
- **Informação antecipada de atraso**
- Time table management
- Virtual Loop
- Doors enabling
- **Modo Headway**
- **Modo Tempo de Parada**
- GPS



On Board Telecom.

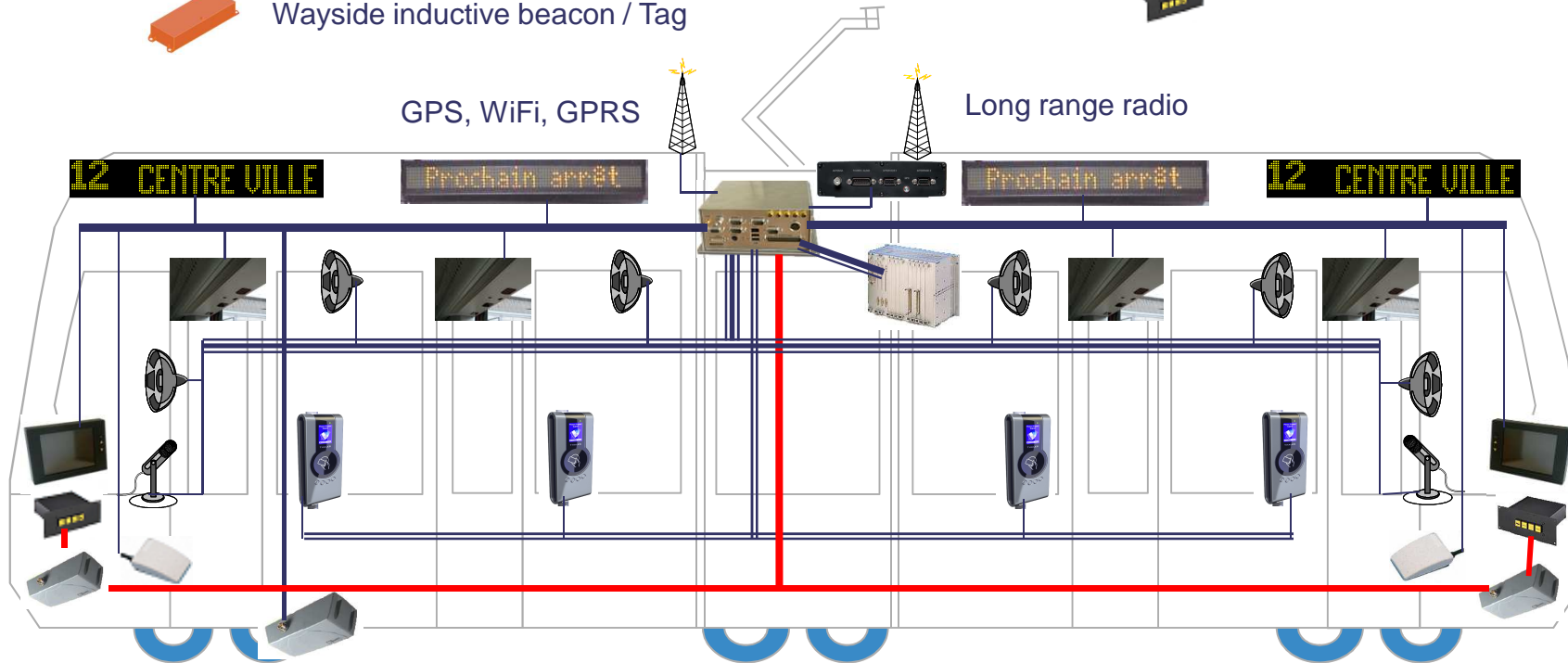
- Panel Information Display
- Public Announcements
- Emergency Call Panel
- **TETRA**
- Ticketing system
- TVCC
- Infotainment
- Data Video Recorder
- Passenger counter
- **Wireless communication** (802.11)
- **Transponder** (inductive, RFID)

LRT Sinalização

- Controle Manual das Maq. Ch.
- Solicit de Rota
- Solicit de Prioridade Road/Rail

Cenario a Bordo – Alto grau de Integração

- 
 External display
- 
 Information display
- 
 Passengers counting
- 
 Ticket Validator
- 
 Beacon reader
- 
 Wayside inductive beacon / Tag
- 
 MBC platform (GPS, Gyroscope, WiFi, integrated vocal functions)
- 
 Long range radio (Data - Voice)
- 
 Rolling Stock Controller (doors, odometer...)
- 
 Driver console
- 
 Microphone
- 
 High speaker (Voice –Public Address)
- 
 Distress Pedal
- 
 Switch Panel





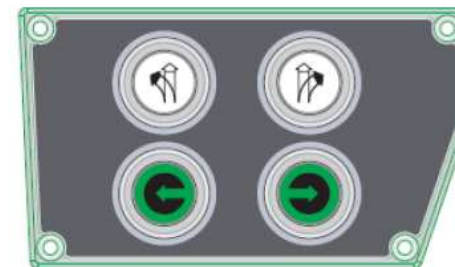
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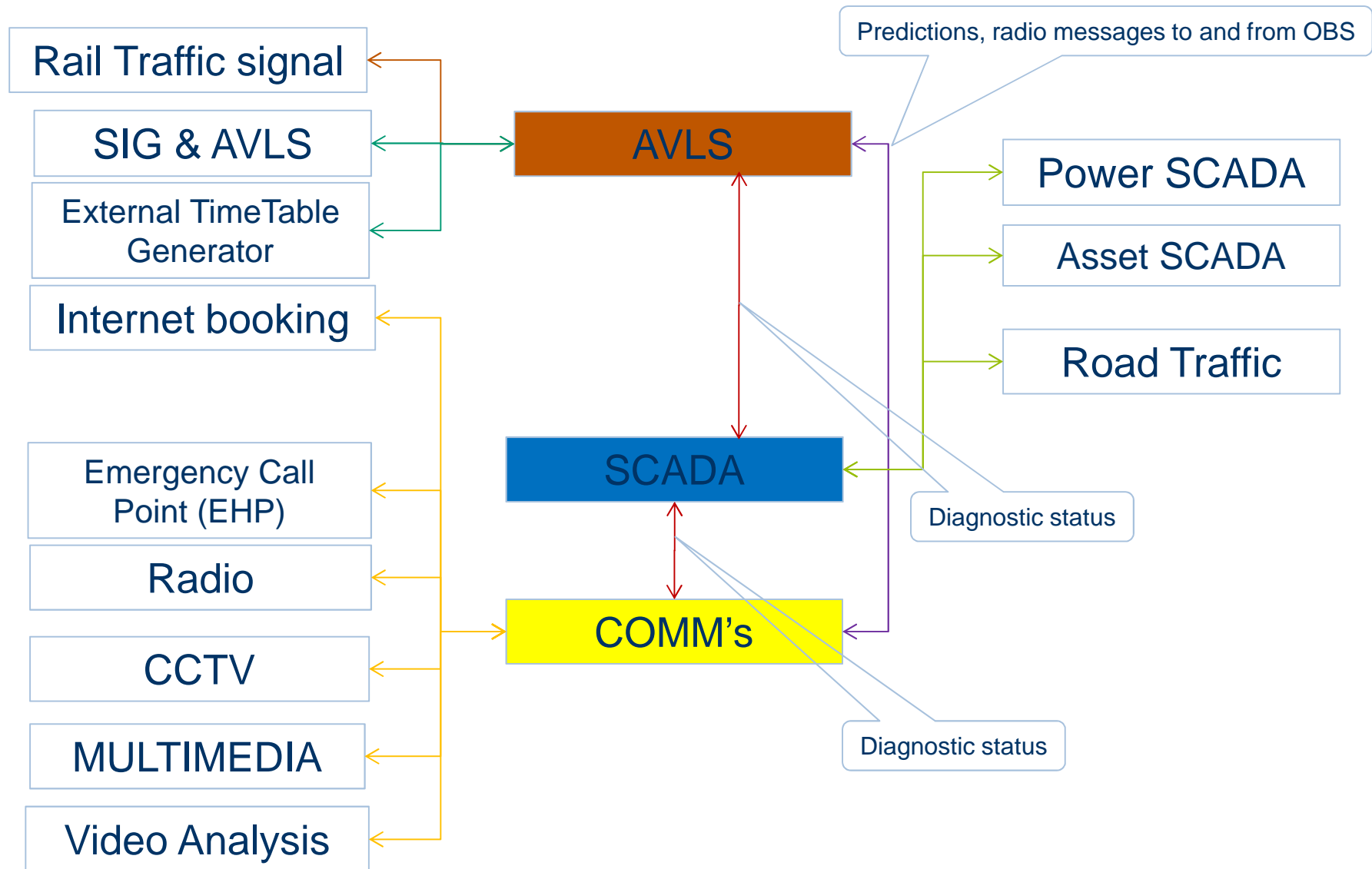


Push Button to manage the point/Route in the Tramway Solution are normally duplicated:
One set provided by Rolling Stock provider (2);
One Set provided by Signalling Provider (1)
The route command will be generated automatically by the On Board Computer according to Vehicle Destination. Driver can override the command generally using the push button (2) which could be more comfortable; or if not working can use push button on the driver panel

THE ON BOARD CONTROL UNIT SHALL BE ABLE TO MANAGE BOTH

2





◆ Missão:

- Fornecer um conjunto de ferramentas para possibilitar a supervisão e comando das operações do LRT

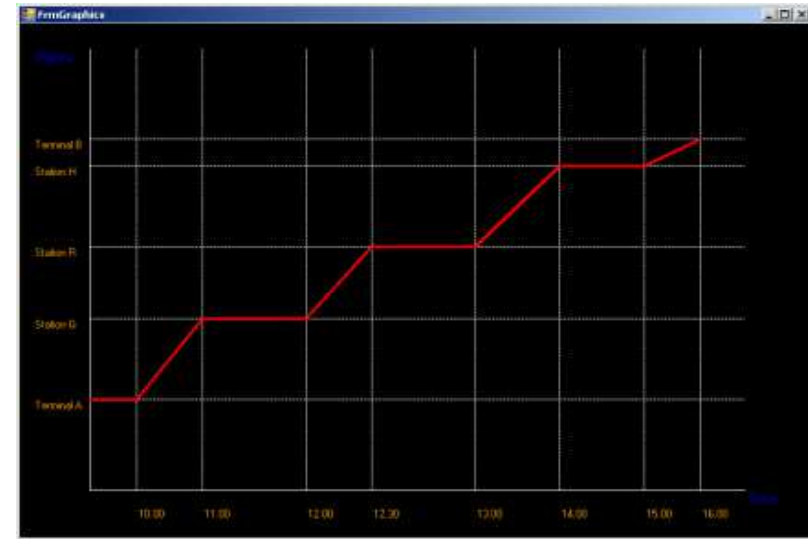
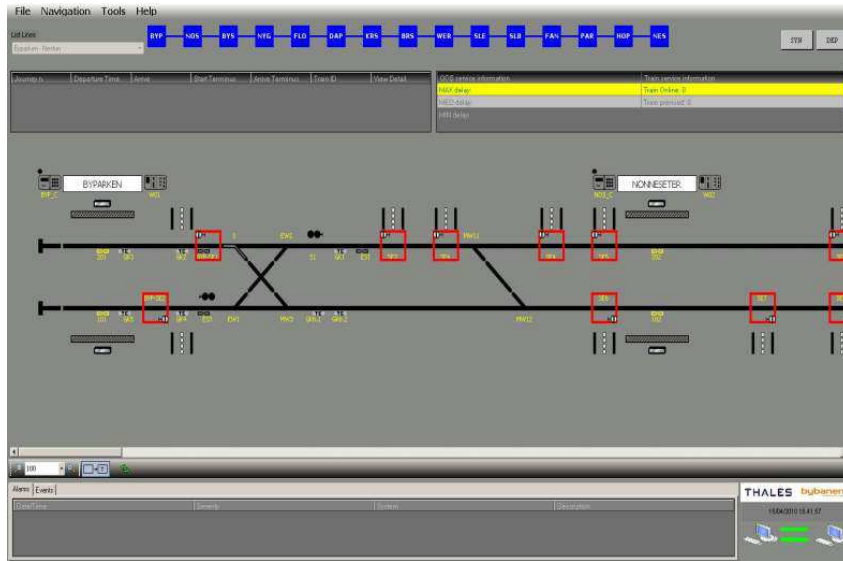
◆ Características:

- Central Server-Client software at OCC
- Built-in communication gateway
- **Servidores em hot standby**
- **Gerenciamento dos Perfis de Operador**
- Synoptic visualization
- Input data on vehicle location: ground loops, + odometer + GPS): via radio from vehicles; via RFID
- ground wired LAN from wayside devices
- **Output to vehicles and stops via radio & LAN**
- **Non-standards services (management of disruptions)**

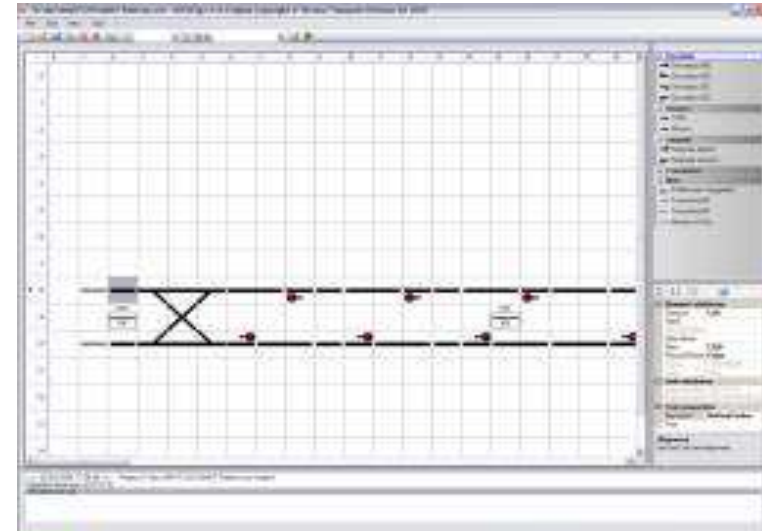
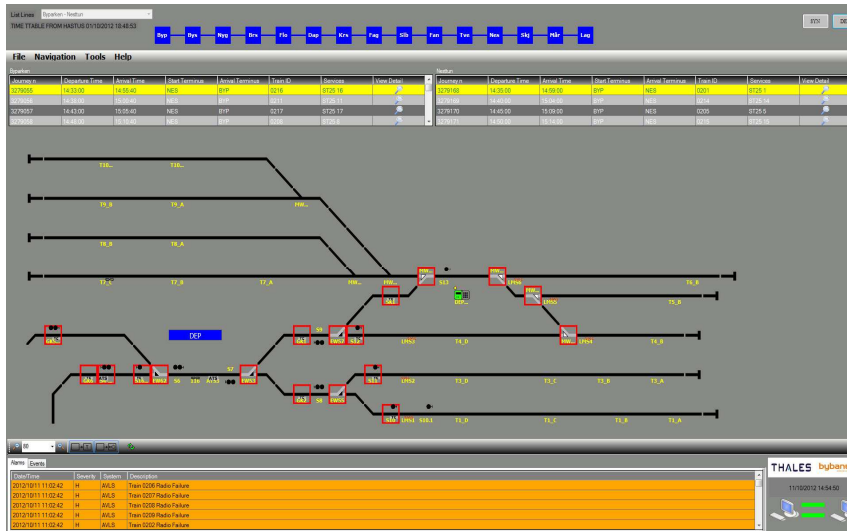


◆ Benefício

- **Regulação do Tráfego**; Smart Timetables Management; Real time Vehicle Location; Monitoring of status & alarms; Provide location info to Passenger Information system for Information at tramway stops; Information for On-Board passengers and driver; Depot management; Global Quality management



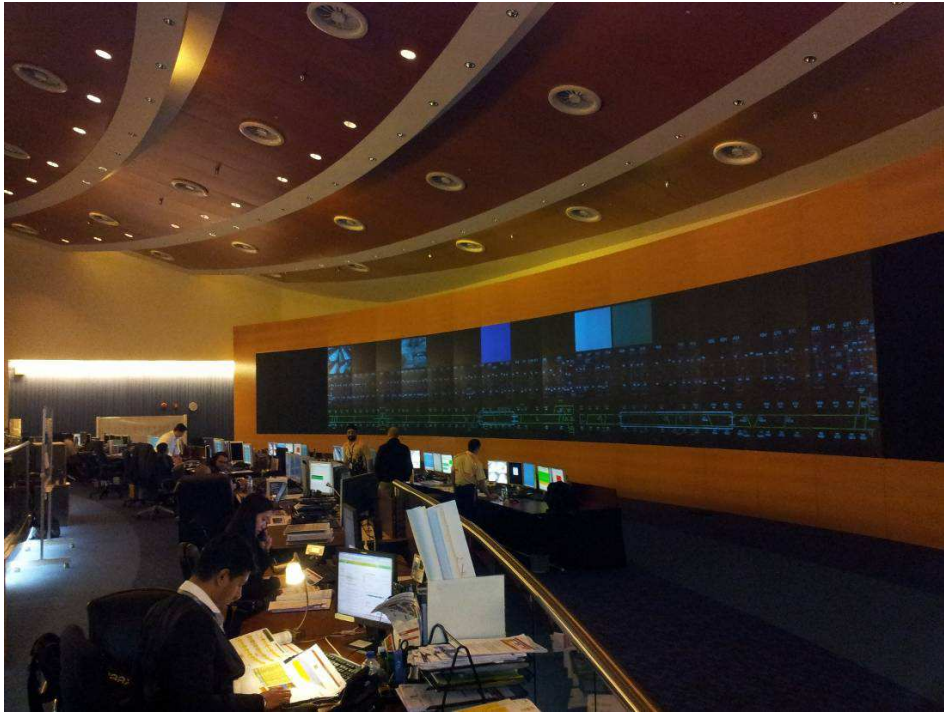
Configuration Tool









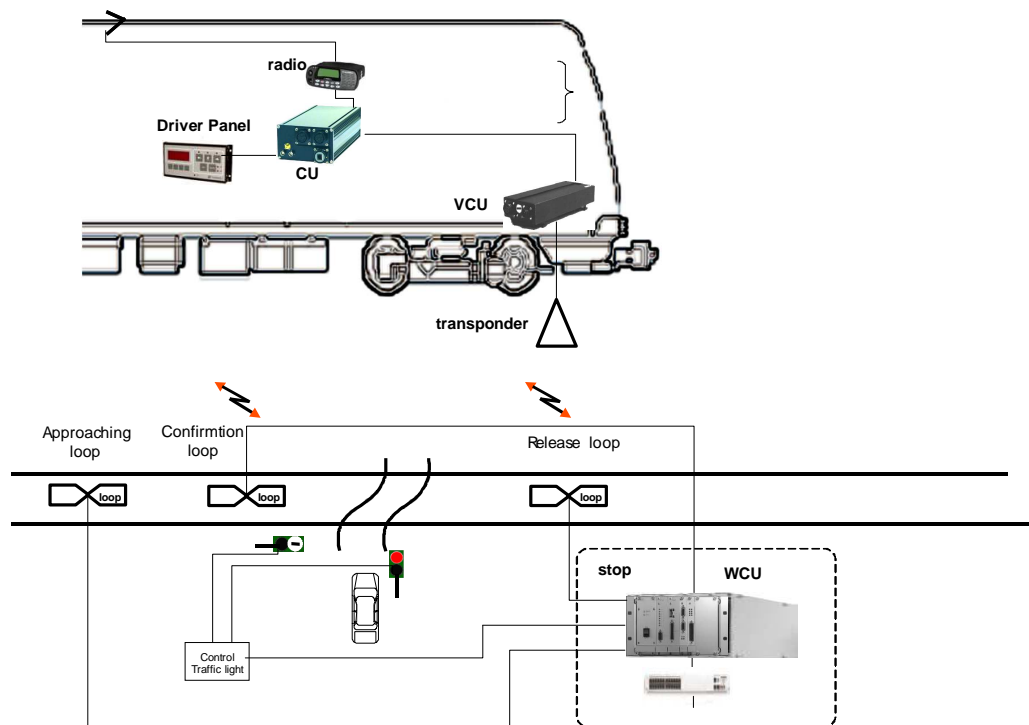


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- **A posição do veículo é calculada pelo the On Board Control Unit (OBCU)**
- **The OBCU to compute the position as distance from the last identified physical sensor**
- The OBCU uses the passive tags installed along the line (as sensor) and the odometer pulse to evaluate the distance from the sensor; **informação GPS usada como Backup** in case of odometer or RFID not working. When the vehicle passes over the tags along the line, the OBCU is able to calculate the exact position of the train and reset the odometer
- **A OBU envia a mensagem de localização ao CCO, via Tetra ou via WiFi, no máximo a cada 10 segundos (configurável)**
- **Balizas RFID** will be installed generally at each station (one for each direction) and / or **máximo a cada 1000 m.**
- AVLS information will include: track –ID, Train Number, Direction, Position

◆ Missão:

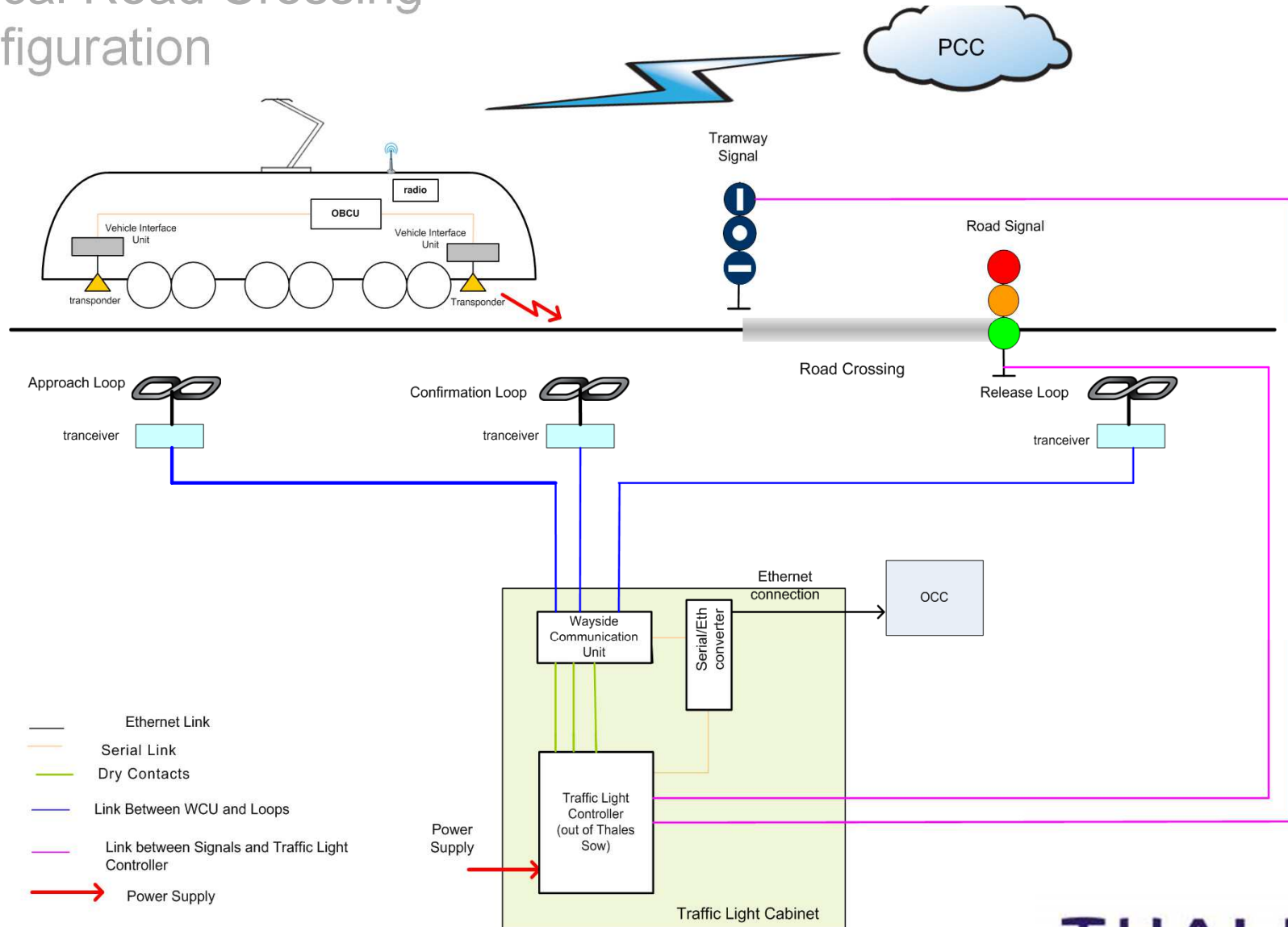
- Solicitar a Prioridade para o VLT at the Road or pedestrian Crossing
- Permitir uma regulação otimizada do tráfego do LRT so as to avoid over-crowding of passenger in the station/stop



◆ Tipos de Prioridade:

- Always Off
- Always ON
- Temporary Disable
- Ready to Start
- Conditional

Typical Road Crossing Configuration



Thales LRT

Referências Seleccionadas



Worldwide References in LRT and Tramway



Customer challenges

- Streamline and modernise the densely urbanized Santos metropolitan area whose population is around 1.5 Million inhabitants.

Thales' answer

- **Integrated Light Rail Transit solution:**
 - **Signalling and Localization**
 - **Fixed and mobile communication systems,**
 - **Data transmission,**
 - **Passenger Information and Comfort**
 - **Passenger and Infrastructure Security**

Main benefits

- 70000 passengers to be carried every day
- Reduction of the bus fleet by 23% expected
- Optimized maintenance costs



Key dates :

- Award : 2013
- Revenue into Service: 2015
- Overall Public Investment: 170MBRL
- Customer: EMTU - Empresa Metropolitana de Transportes Urbanos

Customer challenges

- Original requirement for 3 new passenger lines to double the size of the Metrolink network in Manchester. Additional line added later taking total to 4 resulting in a tripling of the size of the network
- Contract expanded to incorporate further extensions to the network – overall scope covers over 60km of new track and provision of 60 new tram stops

Thales's answer

- An open and flexible approach to the client requirement, working in partnership to find a solution to meet the client need and budget
- Power, communications backbone, voice & data applications, tram operating system, SCADA field equipment, Passenger Security with CCTV and Help points, Passenger Information and Public Address and Signalling system based on SIL 3 point controller** to the extension of Manchester's Metrolink tram network

Main benefits

- Enables improved travel to the people living and working in Manchester
- Will bring benefits to the local economy



Key dates

- Award: June 2008
- Media City opened July 2011
- Implementation: Maintenance until 2018

Manchester network at a glance

- Almost 100Km of Track
- 100 Stops
- 95 Road Crossing
- 100 Vehicles

Prestigious industry accolades are received

- “The launch of the extension of the line to Ashton-under-Lyne follows a year of successful delivery by the Thales team which has included service extensions to, East Manchester, Rochdale, Manchester City Centre, Cornbrook, East Didsbury and the migration to the new Network Management Centre. This excellence delivery performance has been complemented by cost reductions and improvements in the final product quality.
- This excellence performance was recognised at the 2013 Light Rail Awards held at the Honourable Artillery Company in London on Wednesday 2 October. **Thales contribution to the Metrolink programme was recognised in three categories:-**
 - The Impact Thales consortium (MPT) was awarded the European Supplier of the Year award
 - Manchester Metrolink was awarded UK Light Rail Project of the Year
 - The Manchester Metrolink operator RAPT won operator of the year

Wednesday 09 October 2013

Customer challenges

- Implement a new transportation mode in the city to face the important growth of the population
- 29 road crossings
- Integrated signalling solution

Thales' answer

- **On board computers, communications units and transponders**
- **Detection loops**
- **Trackside wayside stations**
- **Tram signalling and routing controllers (SIL 3 Point Controller)**
- **Interfaces to traffic signal controllers (RFID Tag)**
- **Automatic Train Stop**
- **Operation Control Centre (including Automatic Vehicle Location)**
- **Communications system**

Main benefits

- 1st modern tramway line in Bergen
- Reduce car traffic
- Connect different communes

Worldwide winners at the 2011 Light Rail Awards
Bergen's Bybanen in Norway as Worldwide Project of the Year for its outstanding Brand new light rail system that opened in June 2010.



Key dates:

- **Award: 2008**
- **Implementation: 2010**

Customer challenges

- Integrated telecommunication system to support all the Light Rail operations
- Line Villa Costanza – Santa Maria Novella functional lot)
- 14 stations
- Length: 9km

Thales' answer

- **Tram Operation System**
- **On-board system**
- **TETRA**
- **IP network**
- **VoIP**
- **CCTVoIP**
- **PAoIP**

Main benefits

Operate a tramway line in a single control room with a high level of security



Key dates:

- Award: 2005
- Implementation: 2010

Thales Customer:

- Ansaldo STS

Customer challenges

- Open to the service in a short time the new line of Gondomar Line
- Ensure the interface with the existing system of Bombardier

Thales' answer

- Design, delivery and commissioning of a Signalling system to Gondomar Line – 6.5 Km / 10 stations, main figures:
 - **2 Thales Interlocking (SIL 4)**
 - **54 signals;14 motorized point machines;**
 - **98 Thales Axle Counters (SIL 4);**
 - **2 Control table (1 local and another remote);**
 - **8 Local point machine control panels;**
 - **Development of the Interface with Bombardier TMS**

Main benefits

- Partner with a company (Thales) able to extend an existing system in a short time
- Between 2008-2009 Thales provided Signaling system to Metro do Porto for Guifões Shunting Yard (capacity 105 Vehicles) with same approach



Key dates:

- **Award:** Feb 2010
- **Implementation:** Dec 2010

Customer challenges

- Extension of the North LRT Line of Edmonton
- More than 10 km of track and the entire ETS fleet of 94 LRT cars will be equipped with Thales' CBTC system, which will be integrated with the existing ETS signalling system.

Thales' answer

- **SelTrac® Communications-Based Train Control (CBTC)**

Main benefits

- Raise frequency of trains to increase capacity and respond to traffic demand
- Minimizes equipment requirements for the extension
- Provide overall safety to the system, operating efficiencies, and optimization of traffic interfaces
- Solution engineered to meet the long-term light-rail growth needs of the city
- *“The installation of this CBTC technology will provide Edmonton with the most advanced driver-operated Light Rail Transit system in Canada”*. Carl Wright, LRT Fleet and Electrical Systems Engineering Supervisor for the Edmonton Transit System (ETS)



Key dates:

- Award: July 2011
- Revenue service: April 2014?

Customer challenges

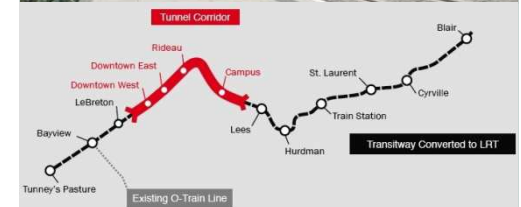
- Greenfield project: create a new LRT for Ottawa city, capital of Canada
- 12.5 km including 2.5 km of tunnel, 13 stations, 80 LRT vehicles reaching speeds of up to 100km/h

Thales' answer

- Design, build, maintain the systems and support its installation and commissioning:
 - **SelTrac® CBTC solution: automatic train supervision and protection**
 - **Semi-automated**
 - **Fully automated depot**

Main benefits

- Delivery of greater operational performance while improving safety and reliability
- Optimized life-cycle costs



Key dates:

- **Award:** Feb 2013
- **Revenue Service:** 2018

Implantação Segura

- Experienced supplier with extensive **project management** capabilities including delivery, integration and safety – expert in managing **complex environments**
- **Local presence** and right partnerships adapted to your needs

Inovação Comprovada

- Cutting-edge Thales solutions ensures **reliability and availability** for optimised **operations & maintenance** to respond to state-of-the art LRT & Tramways
- LRT& Tramways references in major cities all over the world

Portfolio Extenso

- **Complete Solution** meeting modern LRT requirements from Line of Sight operating systems to large capacities systems (Mainline, Metro, ...)

Investimento Flexível

- **Easy and fast to configure, install and extend**
- Thales independent systems fits with all rolling stock suppliers and interfaces with all third-party systems



To get the most out of your LRT infrastructure

Get the most out of your infrastructure

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