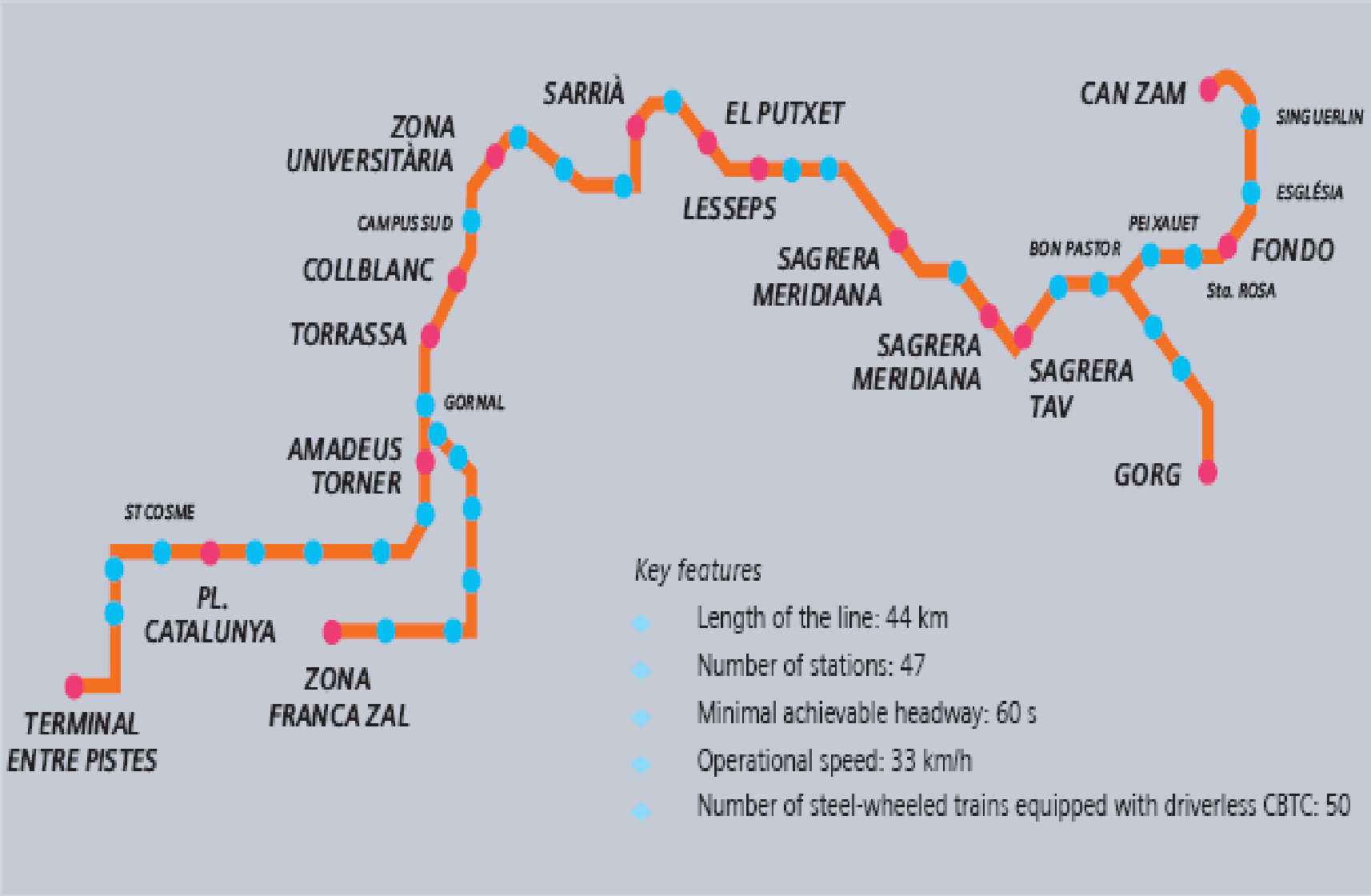
AEAMESP 2008

Barcelona Line 9
Driverless Test Track

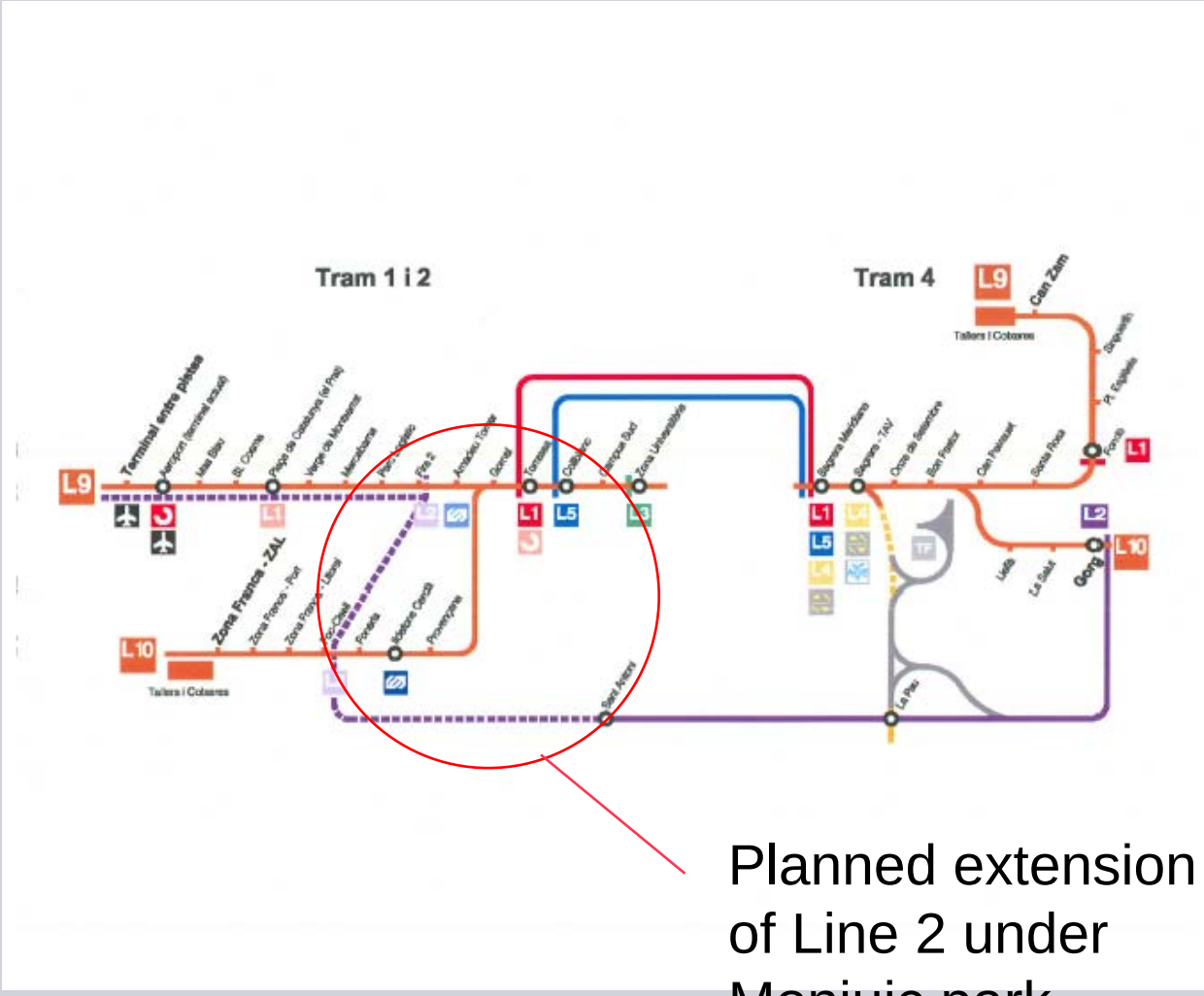
Salient Facts

Dr Gerard Yelloz
Siemens Transportation Systems

SIEMENS



Barcelona Line Plan project



AEAMESP

14ª Semana de Tecnologia Metroferroviária 2008

SIEMENS

L9 Turnkey system scope of work

Siemens:

- ATC Trainguard MT CBTC
- Signaling (point machines, signals, track-circuit)
- OCC (ATS, SCADA)
- Technical rooms equipment (light, UPS, air conditioning and fire protection)
- OPM

Dimetronic:

- Westrace Solid State Interlockings

Third Party:

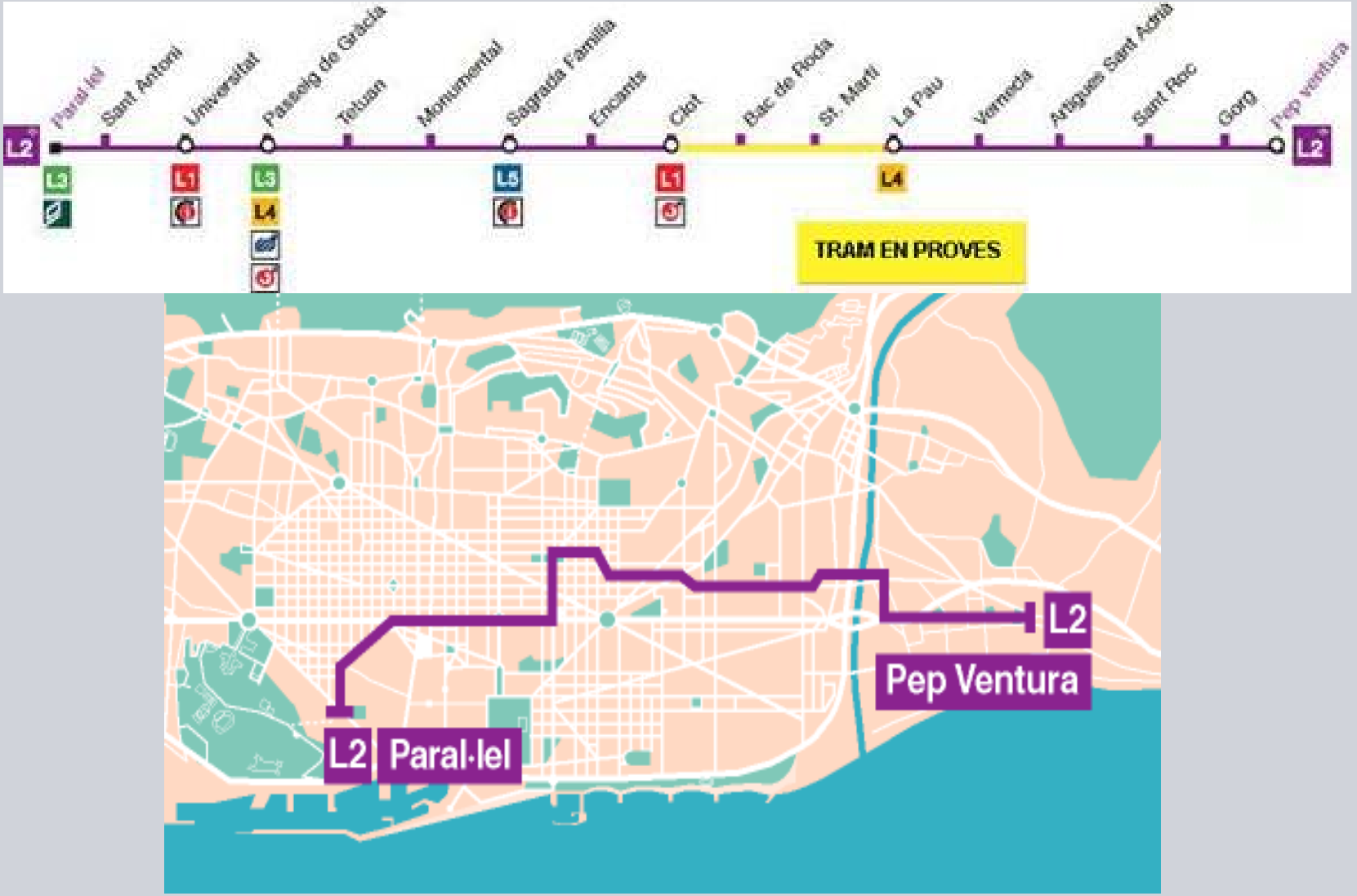
- Wireless LAN (for video transmission): wayside

The leasing of the Rolling Stock is a separate contract

Scope of work

- Preliminary and detailed design (projeto constructivo)
- Manufacturing
- Installation
- Test and commissioning
- Guarantee (own spare + repair + technical assistance in case of failure)

L2 Test track



Test Track

- GISA / TMB decided first to organize a test track of Line 9 vehicles on 4 stations of Line 2 that would be used at night during off-revenue service hours.
- Alstom's series 9000 trains are equipped with both the TBS100 and CBTC

L2 Project benefited from the Line 9 project:

Trains of driverless line 9 can be used on with driver line 2 .

Test Track Configuration

- 1 ATS,automatic train supervision
- 2 Zone Controllers,trackside ATC moving block CBTC
- 49 Digisafe balises
- 1 WCC 2 radio cells,train to track and train to track continous bi directionnal communication
- 10 WRE radio bases with antenneas
- 2 trains
- Wayside signalling is single direction, in this test configuration routes are not controlled by the CBTC
- PSDs are simulated via a separate computer

Test Track Project Roll Out

- Project started end of August 2007 ended Early March 2007
- Installation was made with 1 month ½
- Testing hours: 00:30 and 04:30 hours
- Tests could only be performed 3 nights a week,
  3 effective hours a night (approx 100 usefull hours of tests)
- Train characterization was performed in 3 days,
  - 50 scenarii were recorded
  - 2 measurement campaigns were necessary
- In October trains were already moving in UTO
- 2 Trains have operated in UTO, demonstrating the viability of the architecture and the CBTC system
- Next Step is now the roll out of the system on Line 9 section 4 (CYQ4/08)

AEAMESP

14ª Semana de Tecnologia Metroferroviária 2008

SIEMENS

Train Control

- **OBCU and CIU :on board ATC**
  - installed in the middle of the train
- **CRE**
  - installed in front and rear ends of the train(antennaes)
- **fully redundant hot swappable configurations**
- **+/- 25 cm stopping accuracy**

Line 9 System features

- **Same Trainguard MT CBTC System as in New York, but several innovations implemented in Barcelona SW:**
  - 2,4 Ghz ETSI DSSS radio
  - UTO functionalities + 4 Manual Driving Modes
  - Interface with 3rd party Solid State IXL
  - Serial Interface to PSDs

Line 9 System features

MTO
operation mode without driver, under the full ATP protection
ATO
operation mode assisted driver, under the full ATP protection
ATPM
operation mode manual driver, under the full ATP protection
ATPR
operation mode at sight, but max speed is supervised
BYPASS
fully manual at sight

Conclusion

Success factors:

- Rollout of a mature CBTC product:
- No problem with radio (proven technology) and interfacing with AWS
- Experienced team (seasoned engineers involved in previous CBTC projects)
  - Seamless cooperation between development team/Integration – FAT team/on-site test team
- New Rolling Stock, easier adaptation
- Cooperative operator and partners

Conclusion

Lessons learned:

- Focus on testing method design in the early stage of the project.
- Get an extensive test track with ATS ,IXL,PSD,…for integrated test.
- Performances,Operation modes,response time,architecture were verified and tuned intensively.
- As built Train characterization parameters , stopping accuracy , train control algorithms were tuned and demonstrated.
- Strictly negotiate the modifications of the train traction parameters
- Early transfer to the operationsstaff as much as possible of technical know how on the system in order to accelerate adoption of the technology and new operating modes

- **Long integrated test track with stations is recommended reducing risk and project implementation on the target line**