

Eurailspeed

Parallel Session D.3

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Zefiro: Bombardier's High Speed Train of the future



Eurailspeed

Milan – Italy, 7-9 November 2005

Ake Wennberg

Chief Technical Officer

BOMBARDIER

Introduction

- **I am Ake Wennberg the Chief Technical Officer of Bombardier Transportation, working out of our headquarter in Berlin, Germany.**
- **Bombardier Transportation (BT) is the global leader in the rail equipment manufacturing and servicing industry. Its wide range of products includes passenger rail vehicles and total transit systems. We also manufacture locomotives, bogies, propulsion & controls and provide rail control solutions. BT's revenues for the fiscal year ended Jan. 31, 2005 amounted to \$7.6 billion US.**
- **BT is a unit of Bombardier Inc., based in Canada, the world-leading manufacturer of innovative transportation solutions, from regional aircraft and business jets to rail transportation equipment.**

Bombardier is a Leader in VHS Railways

- **Bombardier is the only company having worldwide High-speed Rail experience and being a key supplier in all European Very High-Speed programs**

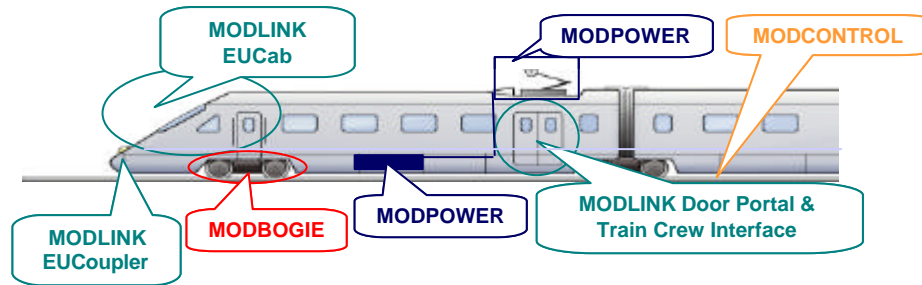
	ICE3	ICE 1+2	AVE102	ETR500	TGV Duplex	Eurostar
Alstom	0%	0%	0%	17%	82%	80%
Bombardier	48%	49%	42%	11%	18%	20%
Siemens	52%	51%	0%	0%	0%	0%
Others	0%	0%	58%	72%	0%	0%



BT is very engaged in European Projects and Standardisation Committees

European Projects Supporting HST Development

- EU MODTRAIN to develop up-to-date functional requirement specs (which fulfill all TSIs and European Standards) and to provide a new Industry Standard for Railways.

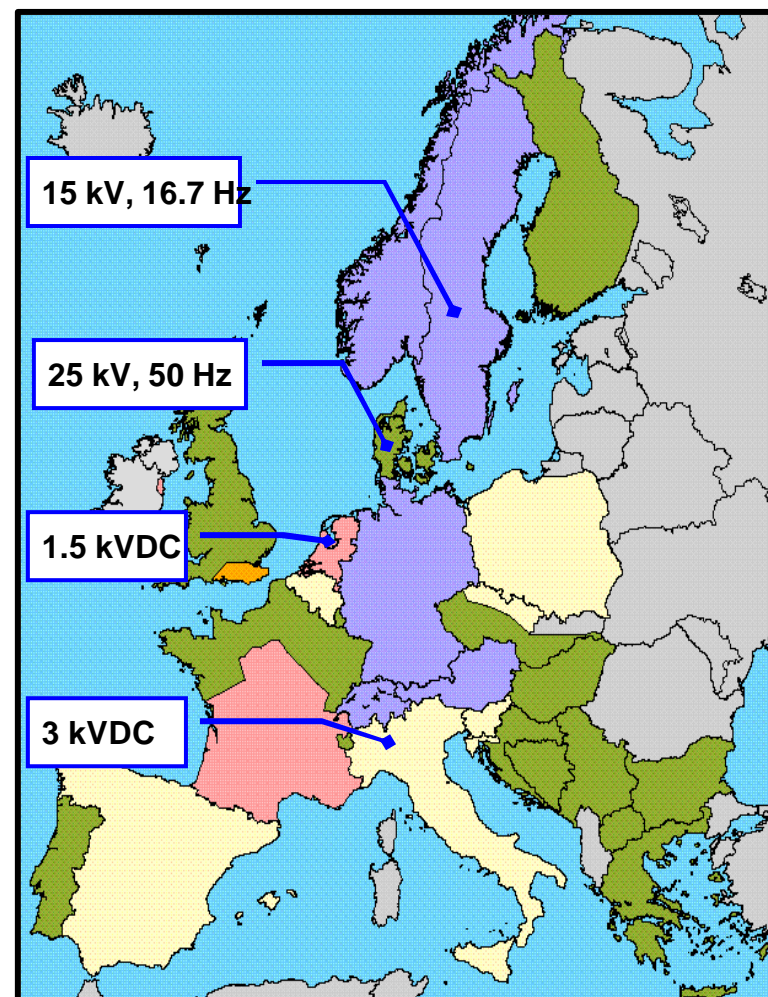
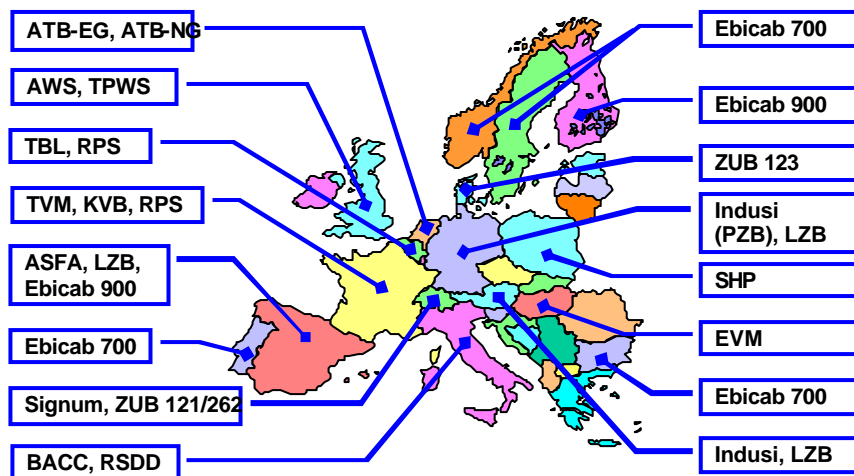


BT builds Mock-ups for Cab and Passenger Entrance Section



- EU InteGRail to develop intelligent procedures and integrated information systems in order to achieve higher levels of performance of the railway system in terms of capacity, average speed, punctuality, safety and optimized use of resources.
- EU Silence and EU InMAR to develop advanced solutions for noise reduction in trains (Bogie, Powertrain, HVAC and Ventilation).
- International Project 'Aerodynamics in Open Air' (AOA) focusing on high speed aerodynamics phenomena (incl. underfloor aerodynamics) and Cross Wind Safety.
- National Project 'Safe Journey' to develop advanced levels of passive safety for Drivers and Passengers of Rail Vehicles.

European Rail Network is still very fragmented



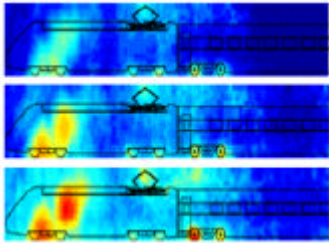
Key interoperability requirements

- Catenary voltages and pantos
- National train protection systems with migration to ETCS
- Loading gauges, Train radio
- Country specific equipment
- Homologation, cross acceptance

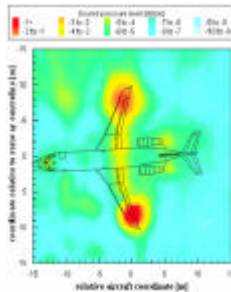
BT has a lot of hands-on experience on how to homologate railway equipment for European Cross border operation.

Bombardier High Speed Trains includes the Synergies from Bombardier Aerospace

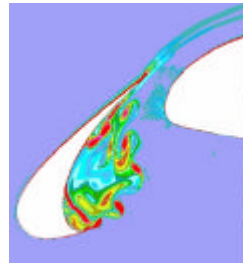
▪ Aeroacoustic Sources



Bogie



Wing Tips

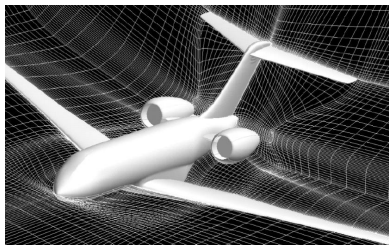


Local Turbulences

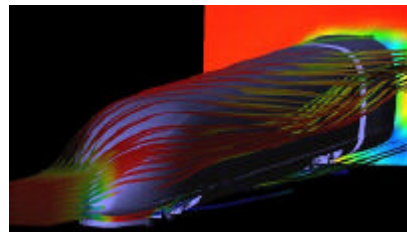
▪ Side Wind Loads



▪ Aerodynamic Drag

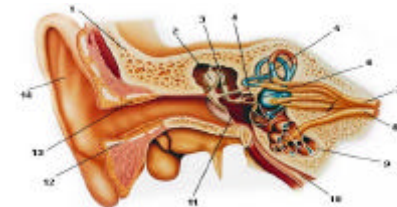
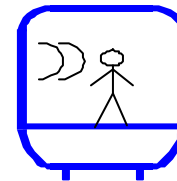
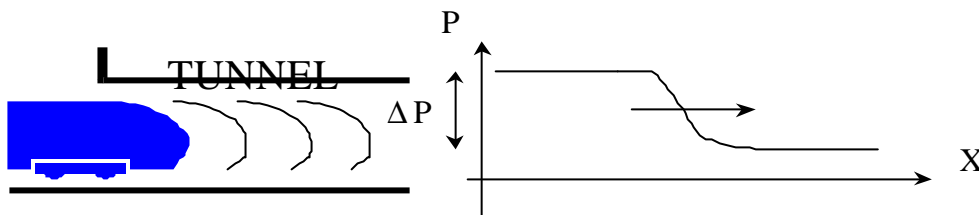


Global Express



High Speed Train

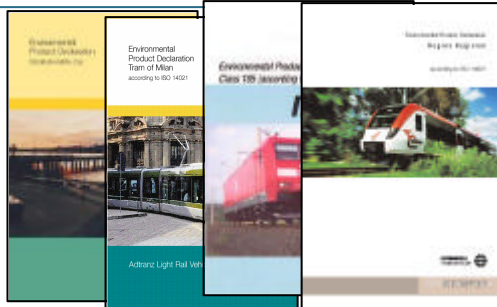
Bombardier Transportation and Aerospace have together put a lot of efforts in developing sophisticated tools to optimize acoustic and aerodynamic behavior of the trains/planes. BT has proven that those tools correctly predict the reality of the trains in service. This means that, we can now really optimize the trains in the design phase when we are introducing new or modified design.



Bombardier High Speed Products have Superior Environmental Performance

■ Environmental Product Declarations (EPD)

- Product environmental performance is documented in a reliable way according to ISO standard 14021 / 14025
- Based on a Life Cycle Assessment (LCA) according to ISO standard 14040
- Other environmental documentation: Recycling manual, Environmental assessment report etc.



■ Low energy consumption - thus low emissions of CO_x, NO_x, SO_x

- Reduced running resistance, dominated by aerodynamic drag
- Reduced weight
- Reduced energy losses in e.g. propulsion and auxiliary systems and also in the catenary and feeding system
- Reduced energy consumption of comfort equipment, e.g. auxiliary equipment
- Use of energy regeneration
- Energy efficient driving and “eco-driving”
- Run the train fewer number of stops

■ Environmentally sound materials

- All materials in the vehicles are known and listed
- Bombardier has developed a list of Prohibited & Restricted Substances to ensure that no harmful materials are used in the vehicles

■ High recyclability > 90% (by weight)

- The vehicles are produced with a high fraction of recycled and recyclable materials
- Polymers over 100 grams are marked, according to ISO standards to facilitate recycling

■ Increased load factor (passenger-km / offered seat-km)

- High speed lines are more attractive and thus have a higher load factor
- Improved space utilisation maximised in terms of seats per length of train

■ Low noise emissions – TSI for high-speed

■ Low particle emissions – minimised wear and tear

■ Efficient mode of transport – in terms of land use

Design Input for BT's new *Zefiro*

Zefiro is an Evolution of solutions from existing trains combined with many of BTs new standard sub-systems such as Propulsion, Interior Systems, TCMS etc.

Customer Specific Requirements

European Standardization projects, TSI

BT Experience and Expertise

Evolution of Proven Solutions

Synergies with other Projects

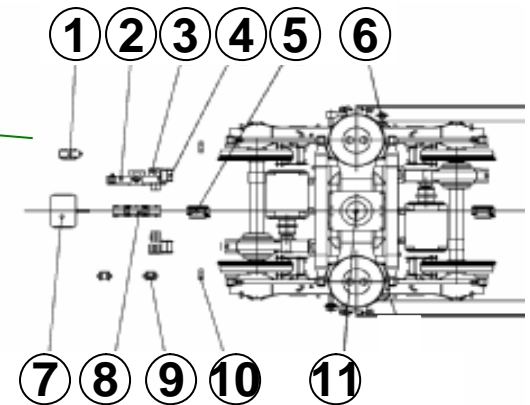
Cost Efficiency



Zefiro's
Product Definition

Zefiro is a multi-system interoperable train

Zefiro is equipped with **multiple pantographs**, **signaling systems** and **auxiliary systems** enabling cross border operation on all AC and DC lines

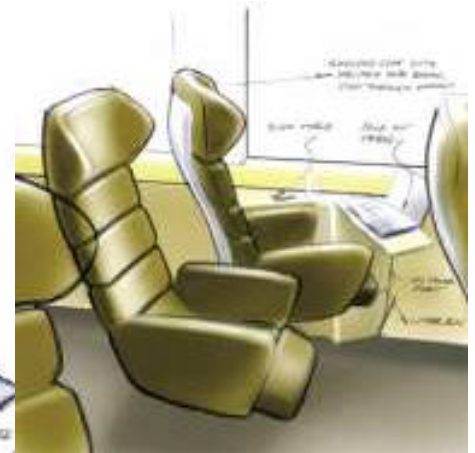
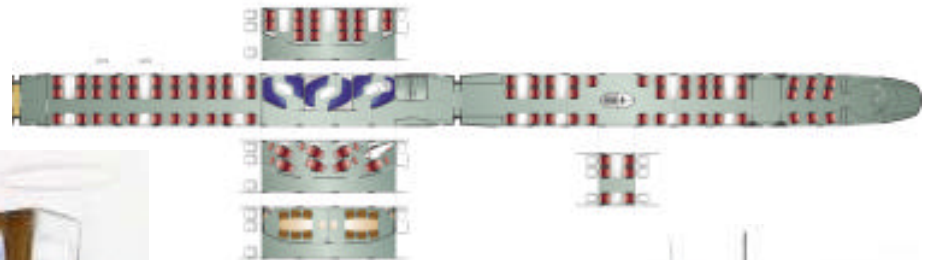


Zefiro has Modular Train Configuration and Interior

Zefiro is built up using three types of cars, DMC's, TC's and MC's






Train consists of a 4-car units possible to extend by adding 2-car units up to 400 m length.



Car bodies are open tubes with possibilities to fit with exiting or very pragmatic solutions.

Train Control and Management System (TCMS)

Zefiro's on-board systems are uniformly integrated and divided into three sections

<p>Safety section</p> <p>System Integrity Level >2 Includes safety systems (cfr ATP, ERTMS, ...)</p>	<p>Provides safe and reliable journey</p>	 <p>ERTMS</p>
<p>Operational section</p> <p>Reliable redundant computer systems, communication and displays</p>	<p>Provides excellent driver assistance in case of system failure</p>	 <p>EUDD</p>
<p>Comfort section</p> <p>Advanced technology which follows IT market</p> <p>High performance communication backbone based on Internet Protocol Technology</p>	<p>Provides Unique features in real-time train to wayside facilities (eg. Internet; fleet management)</p>	

Conclusion

- **BT the largest railway supplier in the world will bring innovative but proven solutions of systems from our pool of experience.**
- **BT brings the experience from participation in all European HST projects into the design of *Zefiro*.**
- **BT offers smart evolution of already proven systems into *Zefiro*.**
- **BT is leading or participating in all EU supported railway projects for new technology or new Interoperability requirements.**
- **BT has solutions for Interoperable high-speed trains as well as hands- on experiences how to achieve Homologation across Europe.**