

# The AGV, a cutting-edge technology integrator

INNOTRANS-BERLIN September 2008

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*We are shaping the future* |

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## AGV

### The Concept



# The AGV concept

## Build on the TGV's benefits...

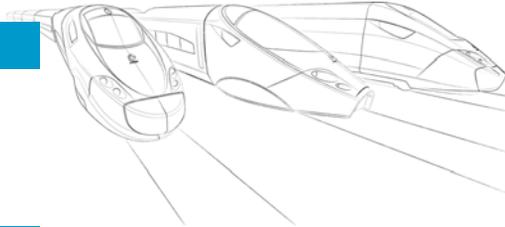
- Articulated train
- Weight optimisation

## To offer more...

- Modularity / Capacity
- Speed
- Comfort
- Reliability / Availability

## ...and less

- Operation cost
- Power consumption
- Investment per seat
- Environmental impact



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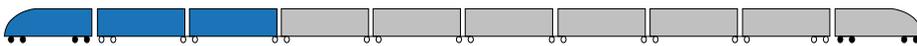
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# AGV – The first articulated train with distributed power From TGV to AGV

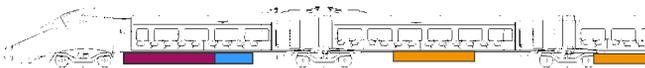
From single deck TGV (660 ft)



**TGV : 13 bogies**  
9600 kW 200 mph  
430 tons loaded  
777 passengers (TGV-F)



To AGV (660 ft)



**AGV 11 : 12 bogies**  
9000 kW 220 mph  
410 tons Loaded  
420 to 460 passengers



- Transformer
- Traction block
- Common block

- More capacity ( at same train length)
- Optimised operation costs (power, maintenance)
- Very high availability

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# Designed with environmental concerns in mind

## Reducing impact on the environment



98% of easily recyclable materials

Aluminium, steel, copper and glass



Able to produce its own electricity

Up to 8 MW of power feedback into the grid

Aero-acoustics to reduce noise

Same noise at 225 mph than competitors at 187 mph



70 tonnes less than competitor models

15% reduction in energy consumption

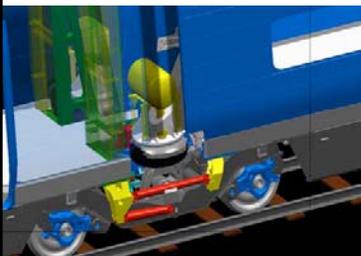
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## AGV - Based on an articulated architecture



### SAFETY AND RELIABILITY ARTICULATED TRAINSET



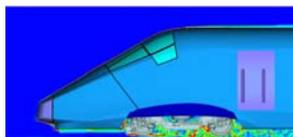
Position of bogies (powered & trailer) on the AGV



Classical architecture

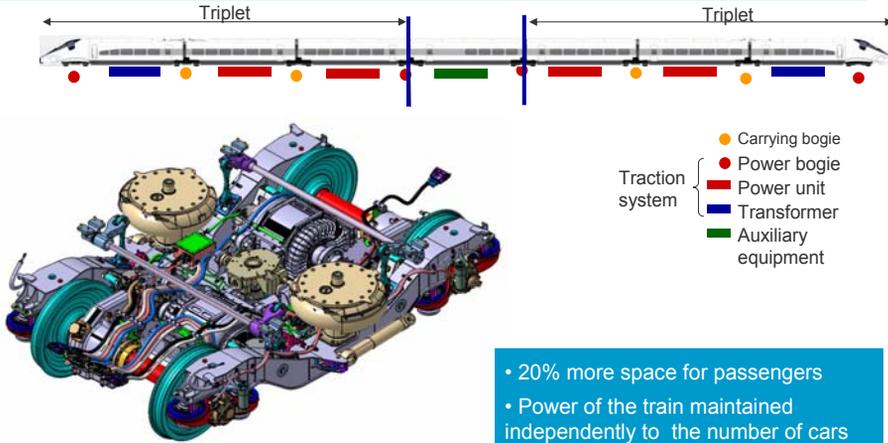


Articulated architecture



# AGV - Based on distributed power

## Traction systems distributed below floors of cars



Motor bogie on the AGV

# Flexible Interior design



# AGV

Cutting-Edge  
Technology

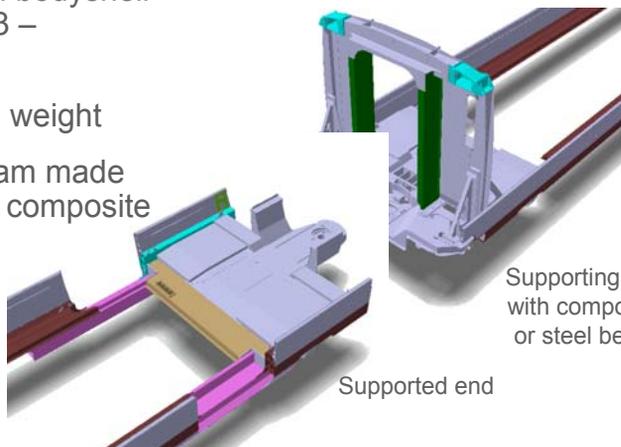
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## AGV - Technical Innovative Highlights - Bodyshell

- Aluminium bodyshell (EN 12633 – 1500KN)
- Optimised weight
- Bolted beam made of steel or composite



Supporting end  
with composite  
or steel beam

Supported end

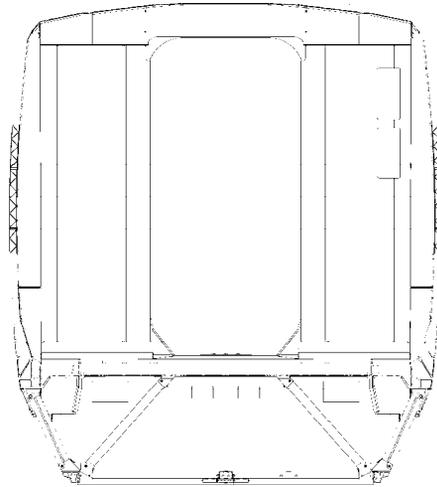
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## AGV - Technical Innovative Highlights - Bodyshell

- Distance between pivot
  - Intermediate car 17,3 m
  - Extremity car 17,1 m
- Curve face (radius 10 m)
- Bodyshell width 2985 mm (2904 mm for a previous TGV 1N)
- Floor height 1155 mm (easy accessibility)



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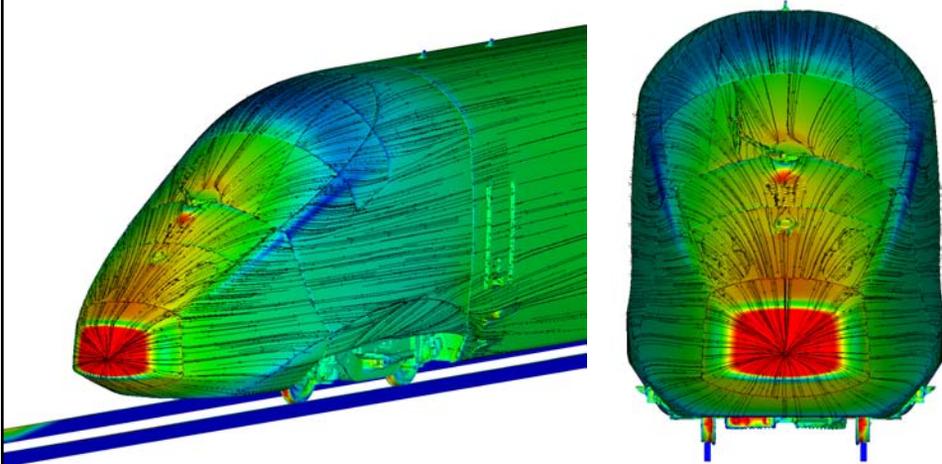
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## AGV - Technical Innovative Highlights - Safety



# AGV - Technical Innovative Highlights – Aerodynamics simulation



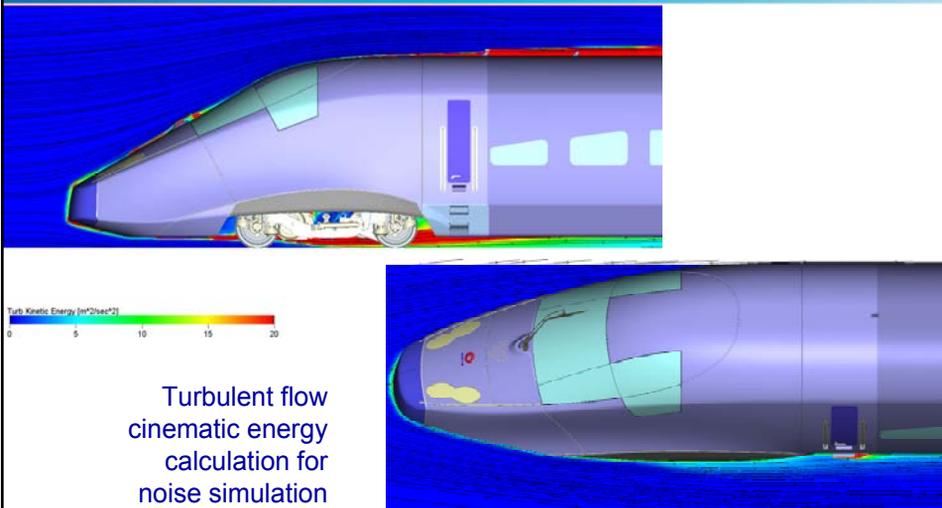
Surface pressure simulation

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# AGV - Technical Innovative Highlights – Aeroacoustics simulation

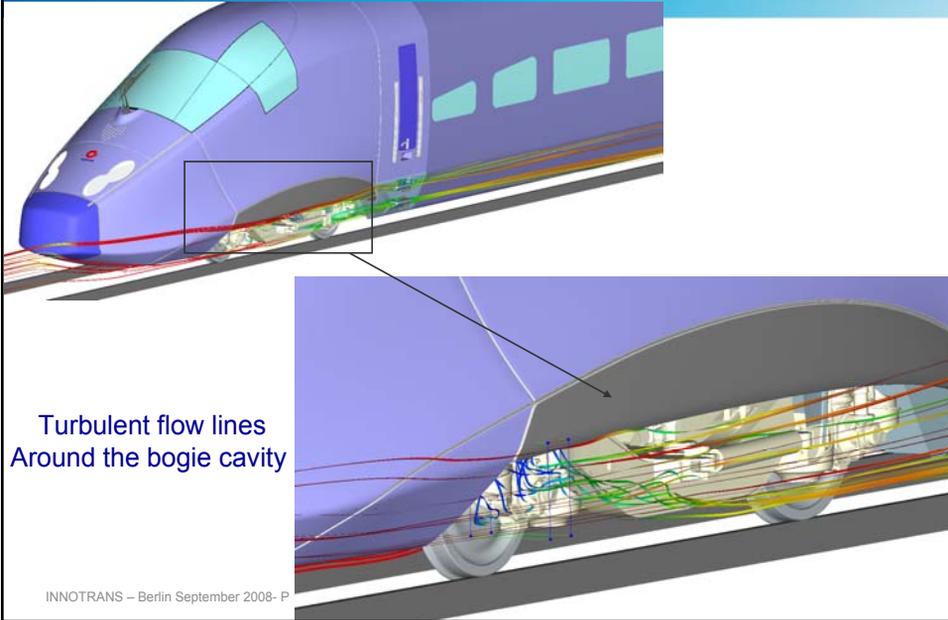


Turbulent flow cinematic energy calculation for noise simulation

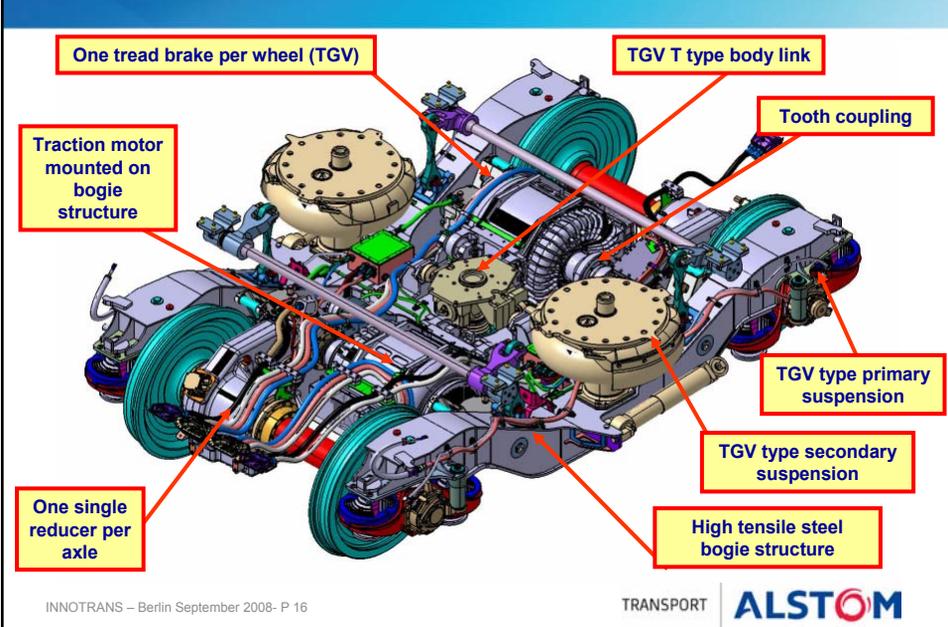
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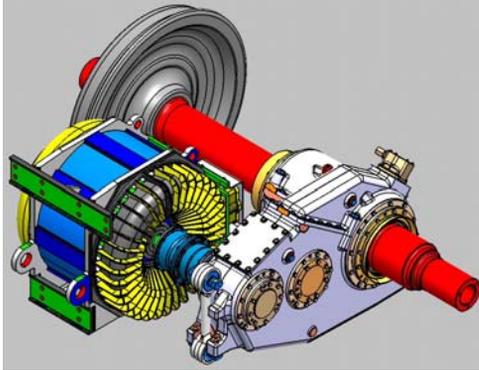
# AGV - Technical Innovative Highlights – Aerodynamics simulation



# AGV - Technical Innovative Highlights – Motor bogie



## AGV - Technical Innovative Highlights – Motor bogie



AGV prototype reducer  
used on V150 (World Record)

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## AGV - Technical Innovative Highlights – Traction system architecture

- Two motor blocks per main transformer, each motor block feeding 2 traction motors each with an independent converter
- Use of the latest IGBT 6,5 kV – 600 A technology
- Traction components are water cooled modules ONIX 233
- Auxiliary converter for the train integrated within each traction block
- All equipment located in the underframe
- Synchronous permanent magnet motors

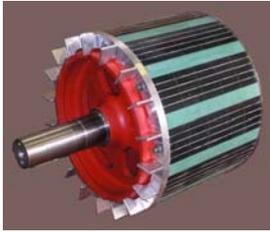


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# AGV - Technical Innovative Highlights – Permanent magnet motors



1



2



3



4

- First very high speed railway application for a high power (760 kW) permanent magnet traction motor (more than 1 kW / kg)
- Closed & self ventilated => Maintenance free motor
- Intensive test already performed (world record, test benches, prototype train..)

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# TGV 150 : The objectives

## ✓ Explore for the first time the speeds beyond 500 kph

- measure and validate under real-life conditions : Aerodynamic, Acoustic, Dynamic and Vibratory phenomena
- To continue to explore (modelisation & measurements) the field of very high speed



## ✓ Validate the critical components of Alstom's two train platforms : the TGV Duplex and the AGV

- To demonstrate ALSTOM's technical competence in very high speed based on 25 years of experience
- To promote and test in very extreme conditions our two very high speed Alstom platforms

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# TGV 150 : The Test Train

The test train  
(the two platforms tested on the test train)



- 2 TGV East power cars
- 3 TGV Duplex coaches
- 2 AGV bogies + traction components

standard production components

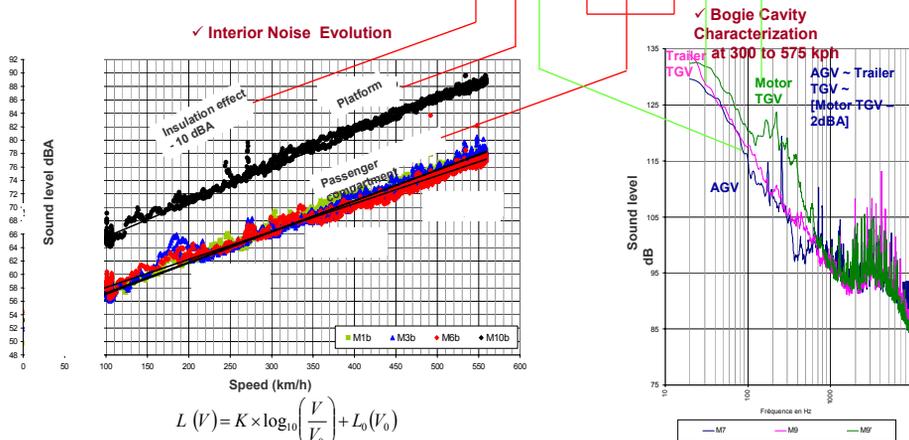
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# Main results : Acoustics-interior noise



$$L(V) = K \times \log_{10} \left( \frac{V}{V_0} \right) + L_0(V_0)$$

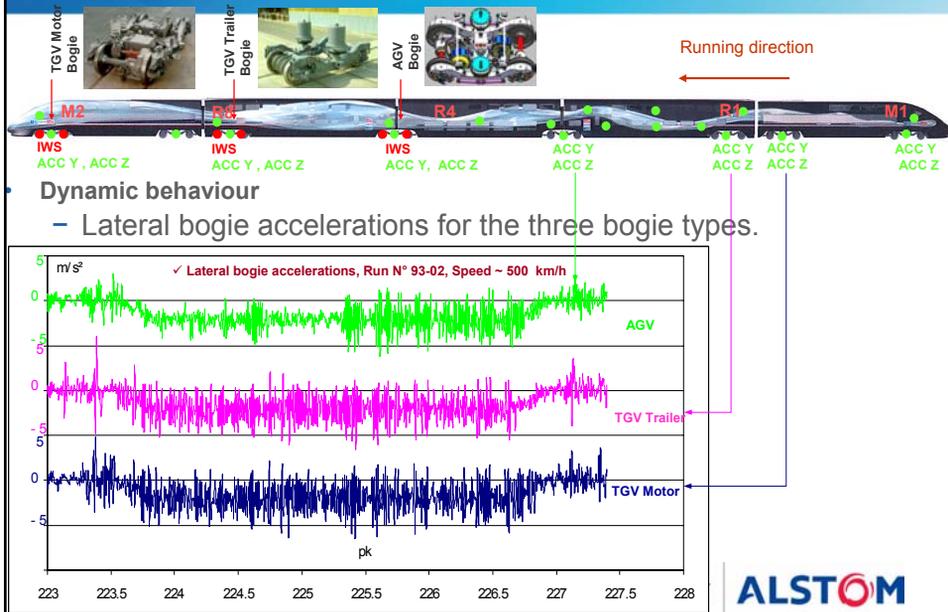
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## Main results : Railway dynamics (2/2)

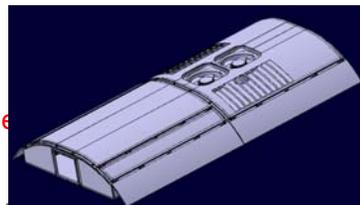
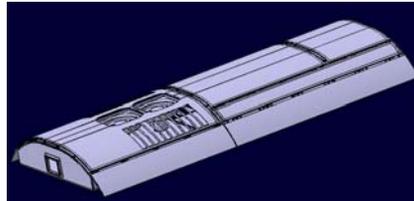


### Dynamic behaviour

- Lateral bogie accelerations for the three bogie types.

## AGV - Technical Innovative Highlights – HVAC system

- Ventilation through ceiling and no more through « éjecto-convecteurs »
- 2 HVAC systems:
  - One for the pilot car including both cab and passenger saloon groups
  - One for intermediate cars
- Each group comprises:
  - 2 new air fans,
  - 2 condenser fans,
  - 2 compressors,
  - 1 evaporator with 2 cooling circuits,
  - 1 roof mounted control unit.
- Very high level of passenger comfort
  - > XXX kw cooling capacity per passenger
  - Increased reliability level
  - Internal redundancy in each group
  - Maintain of air cond when passing trough neutral sections



# AGV - Technical Innovative Highlights – Driver cab



- Validated on a driving simulator
- Tested with international drivers



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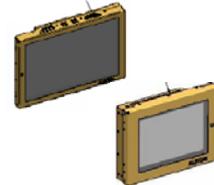
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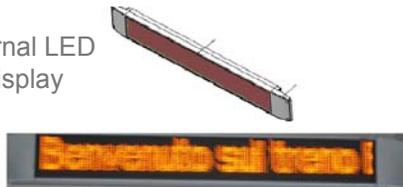
# AGV - Technical Innovative Highlights – PIS Information and Media Entertainment Displays



LCD Display



Internal LED display



External LED display

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## AGV - Technical Innovative Highlights – Intranet Communication System

- Provides Intranet server access to the passenger using the WiFi network (possibility to to interface with an Internet service provider)
- Provides WiFi user restricted access to devices on board train (maintenance crew)
- The doorway monitor allows Passengers to access the WEB Server with information such as: advertisement spots, welcome messages, train



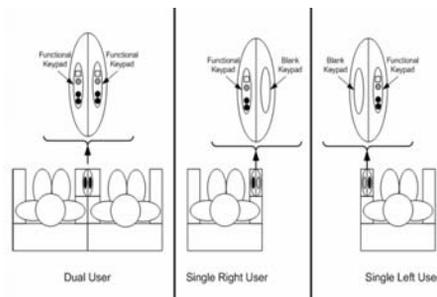
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## AGV - Technical Innovative Highlights – At-Seat Audio (ASA) System

- Broadcast Music.
- Broadcast soundtrack (audio-film).
- Broadcast Background Music to Public Address (PA) Loudspeakers.



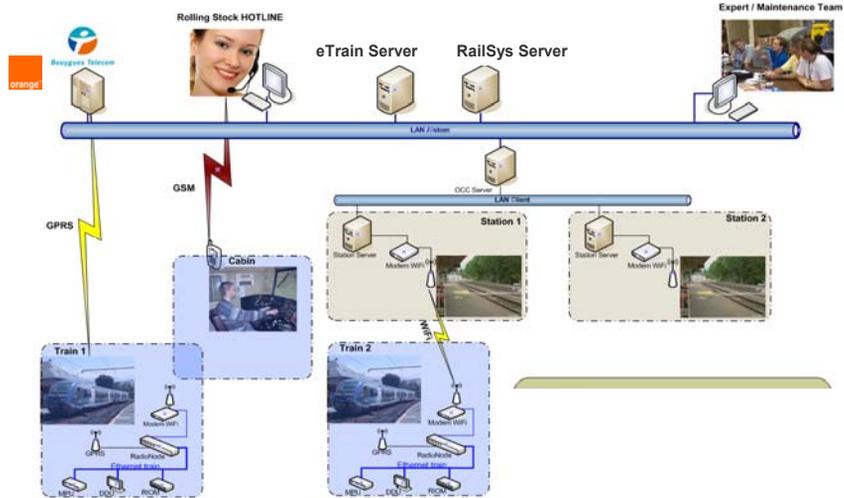
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# AGV - Technical Innovative Highlights – Diagnostics

eTrain is an integrated system The Train...equivalent... to a web-site



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## AGV

Bound for a  
commercial  
success

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25 AGV sold to NTV (+ 10 options)  
Commercial Operations starting in early 2011



Daily operating  
speed:  
300-360 kph

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A high-speed train (AGV) in motion on a track, with a speedometer showing 574.8 km/h. The train is white and blue, and the speedometer is black with red and white text. The background shows a grassy field and a crowd of people watching the train.

Thank you!

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