The AGV, a cutting-edge technology integrator

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

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-R)

To AGV (660 ft)
- AGV 11: 12 bogies
- 9000 kW
- 220 mph
- 410 tons Loaded
- 420 to 460 passengers

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

Transformer
Traction block
Common block
Designed with environmental concerns in mind

Reducing impact on the environment

- 98% of easily recyclable materials
- Able to produce its own electricity
- Aero-acoustics to reduce noise
- 70 tonnes less than competitor models

- Aluminium, steel, copper and glass
- Up to 8 MW of power feedback into the grid
- Same noise at 225 mph than competitors at 187 mph
- 15% reduction in energy consumption

AGV - Based on an articulated architecture

Position of bogies (powered & trailer) on the AGV
AGV - Based on distributed power

Traction systems distributed below floors of cars

Motor bogie on the AGV

- 20% more space for passengers
- Power of the train maintained independently to the number of cars

Flexible Interior design

Open for New Concepts
AGV - Technical Innovative Highlights - Bodyshell

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

AGV - Technical Innovative Highlights - Safety

![AGV Safety Features]
Surface pressure simulation

Turbulent flow cinematic energy calculation for noise simulation
**AGV - Technical Innovative Highlights – Aerodynamics simulation**

Turbulent flow lines
Around the bogie cavity

**AGV - Technical Innovative Highlights – Motor bogie**

- One tread brake per wheel (TGV)
- TGV T type body link
- Tooth coupling
- TGV type primary suspension
- TGV type secondary suspension
- High tensile steel bogie structure
- Traction motor mounted on bogie structure
- One single reducer per axle
AGV - Technical Innovative Highlights – Motor bogie

AGV prototype reducer used on V150 (World Record)

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
AGV - Technical Innovative Highlights – Permanent magnet motors

- 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..)

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
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

Main results: Acoustics-interior noise

\[ L = K \times \log \left( \frac{f}{f_0} \right) + L_a(V_c) \]

K ~60 for P150 vs K ~80 for TGV

\[ Niveaux sonore des microphones intérieurs en fonction de la vitesse \]

\[
\begin{align*}
  y &= 0.052x + 60.419 & R^2 &= 0.993 \\
  y &= 0.136x + 53.286 & R^2 &= 0.965 \\
  y &= 0.0416x + 53.91 & R^2 &= 0.9868 \\
  y &= 0.046x + 52.708 & R^2 &= 0.988 \\
  y &= 0.046x + 52.447 & R^2 &= 0.991
\end{align*}
\]
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

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

- Internal LED display
- External LED display
- LCD Display
**AGV - Technical Innovative Highlights – Intranet Communication System**

- Provides Intranet server access to the passenger using the WiFi network (possibility 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

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

- Broadcast Music.
- Broadcast soundtrack (audio-film).
- Broadcast Background Music to Public Address (PA) Loudspeakers.
eTrain is an integrated system. The Train...equivalent... to a web-site.

AGV - Technical Innovative Highlights – Diagnostics

Bound for a commercial success
25 AGV sold to NTV (+ 10 options)
Commercial Operations starting in early 2011

Daily operating speed:
300-360 kph

Thank you!