

Emerging Technologies for new generation EMUs

Technology for new generation AC/DC EMUs in Mumbai



What is an EMU?

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- It is an **Electrical Multiple Unit** used for main line, urban & suburban Traffic
- High acceleration & deceleration
- Generally fixed formation
- Distributed power concept
- Door width is more for quick exchange of passengers

The EMUs worldwide – From Suburban trains to solutions for Mainline and Mass transit

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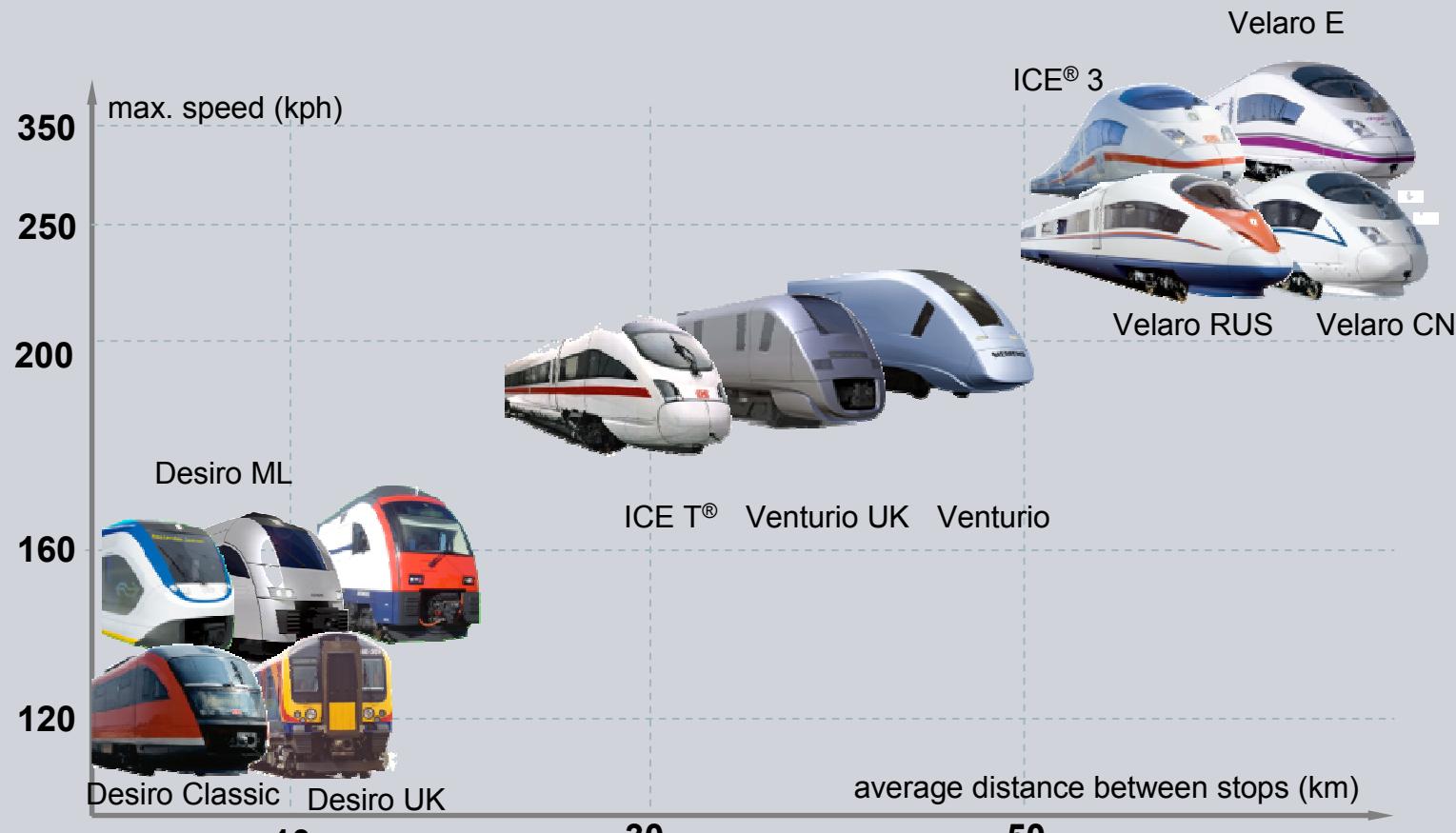
Main line Trains* - Velaro (High speed)	Mainline Regional*	Metro Trains	Light Rail (LRT)	Mono Rail
Long Distance	Suburban Travel	Urban Mass Transit	Urban Mass transit	Point to Point
Distributed Power	Distributed Power	Distributed Power	Distributed Power	Distributed Power
Speed 200 ~350 km/h >250 km/h – High Speed	Speed up to 160 km/h	High Acceleration Speed up to 100 km/h	High Acceleration Speed up to 100 km/h	High Acceleration Speed up to 100 km/h
Moderate No. of passengers	High number of passengers	Very high no. of passengers – up to 15,000-80,000 PPHPD	Moderate no. of passengers – up to 5,000-25,000 PPHPD	Moderate / Low no. of passengers – up to 5,000-16,000 PPHPD
Vehicles with high compressive strength	Vehicles with high compressive strength	Light weight vehicles	Light weight vehicles	Light weight vehicles

PPHPD – Passenger per hour per direction

* Includes passenger amenities

Types of EMUs

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Types of EMUs

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DESIRO UK



DESIRO Classic, Slovenia



DESIRO O&E, Greece



DESIRO ET ERL, Malaysia

Types of EMUs

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ICE 1



ICE 2



ICE TD



ICE 3



Types of EMUs

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Velaro CN
China



Velaro RUS
Russia

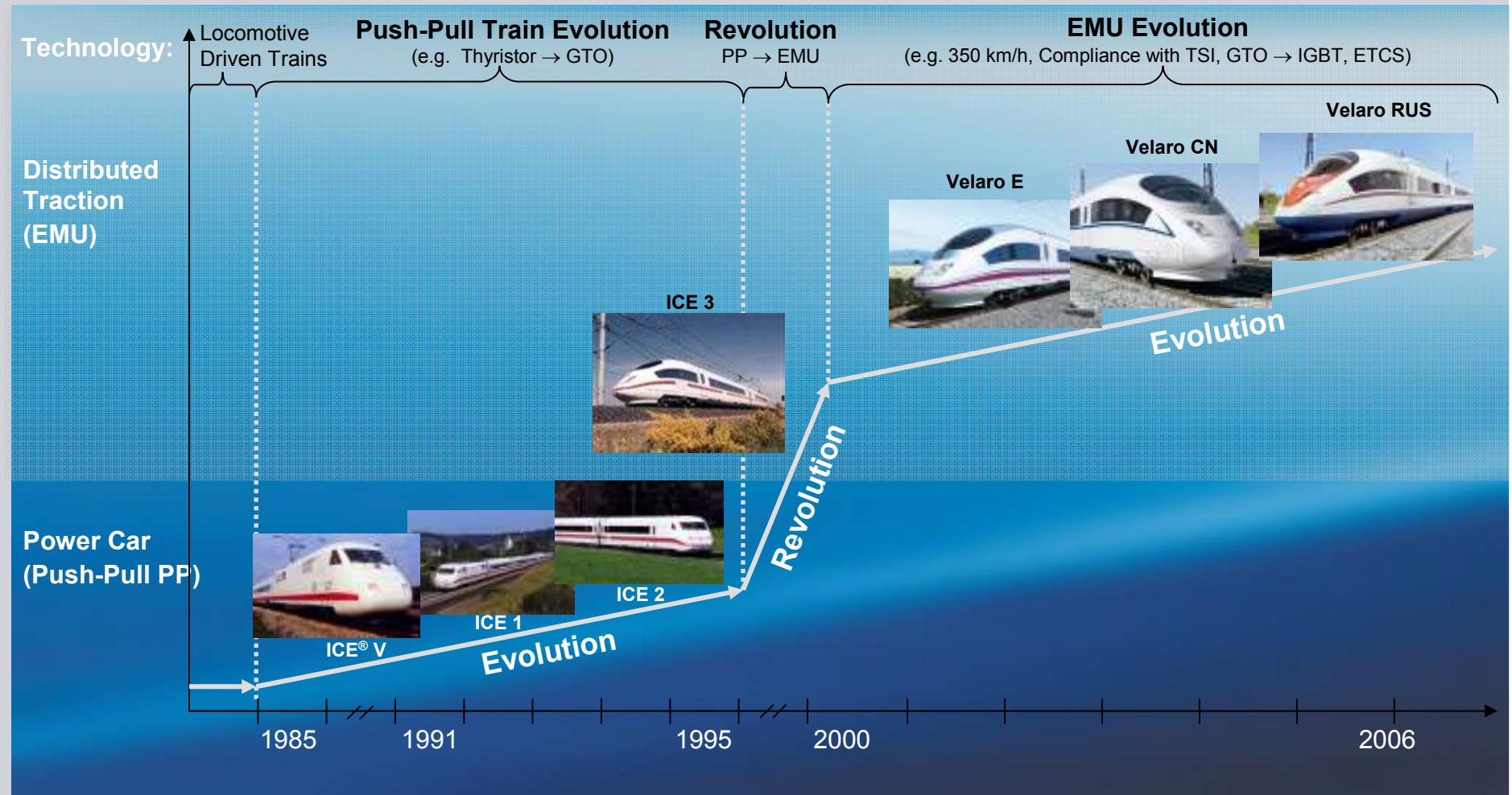


Velaro E
Spain



EMU – a revolution for main line as well

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Propulsion Equipment

- Transformer
- Traction Converter
- Traction Motor
- Micro Processor Control

Auxiliary Power Supply Equipment

- Auxiliary Converter
- Battery
- Battery Charger

Roof Equipment

- Pantograph
- Breaker (VCB or HSCB)
- Lightning Arrestor, CT, PT

Train Integrated Management System

- Central Control Unit
- Compact I/Os, SIBAS KLIPs etc.
- Brake Electronic Control Unit

Passenger Information & Cab Equipment

- Master Controller, Driver's display
- Passenger Information & communication system

Carbody

- Carbody Shell
- Seats, Windows
- Automatic & Semi Automatic Couplers
- Gangways etc.

Doors

- Door Leaves
- Door Drives.

Bogie Complete & Brake Equipment

- Bogie Frame, Wheels & Axles
- Primary & Secondary Suspension etc.
- Parking Brake
- Brake Shoe
- Air Compressor

Cab & Saloon Air-Conditioning Equipment

- Compressor
- Condenser & Evaporator Unit
- Parking Brake
- Ducting & Diffusers

Saloon Equipment

- Lights, fans
- HVAC Unit

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Industry Sector, Mobility Division

Equipment & Sub-systems of an EMU

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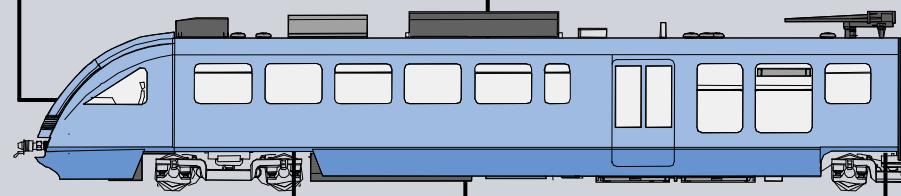
**Couplers,
driving cab**



Vehicle body



Interiors



Bogie



Traction converter



Control Unit



Traction motor

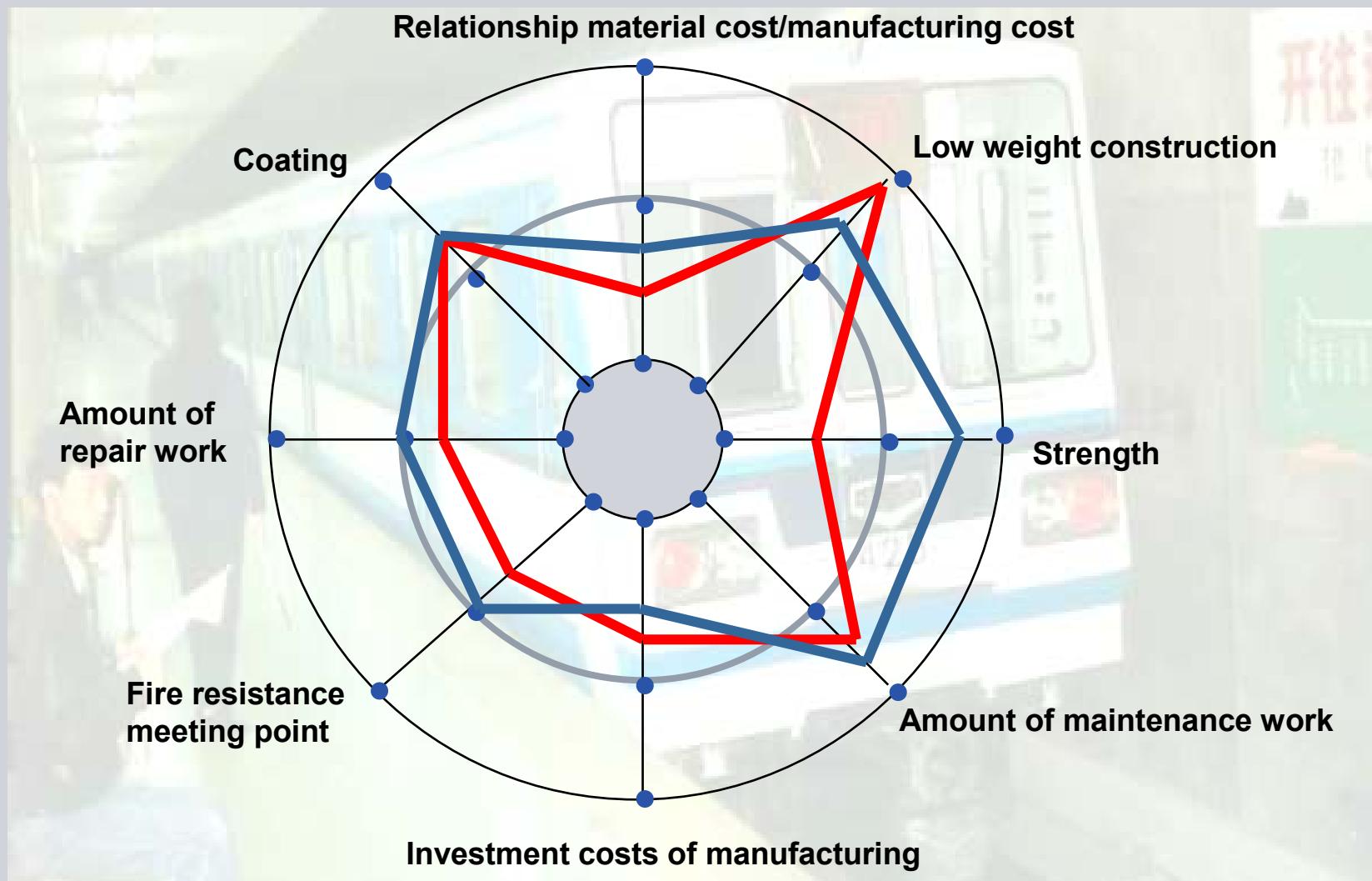
Current International Technology of Car Body Material – **SIEMENS**

Comparison from Customer's Point of View

	Steel	Stainless Steel	Aluminium*)
Cost of Material	++	●	-
Labour Cost	+	-	--
Integration of Interfaces for fastening	-	-	+
Weight of Carbody Structure	-	●	+
Corrosion Resistance	-	+	+
Maintenance	+	●	-
Industrial Design/Complex Shapes	-	-	+
Surface Coating/Painting	-	+	●
Fire Resistance w/o additional Insulation	+	+	-
Heat Insulation	+	+	-

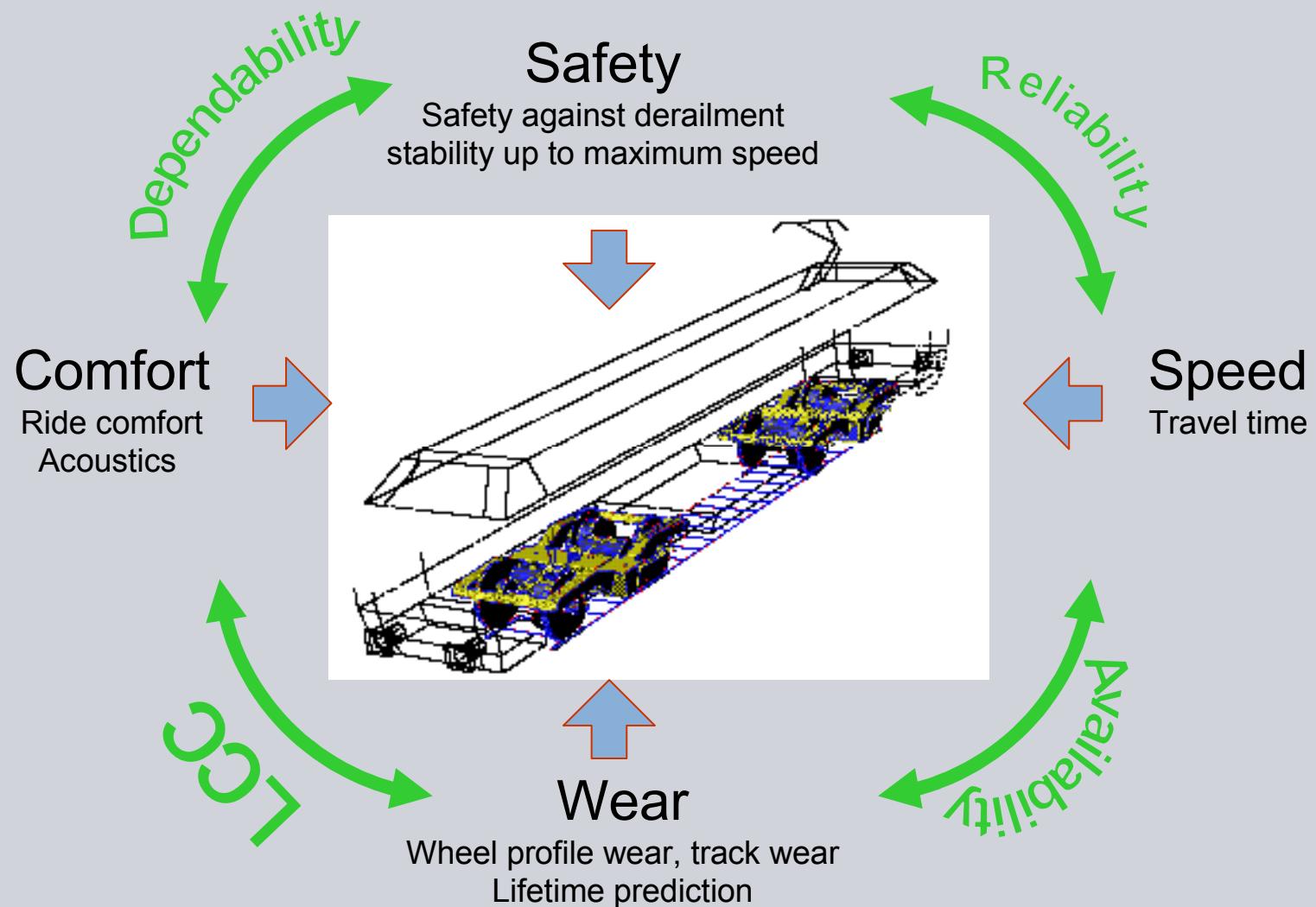
*) Large Extrusions

Current International Technology of Car Body Material – **SIEMENS** Comparison **Stainless Steel, Aluminium**



Current International Technology of Bogies – Bogie – Key Decision factor of operators

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Current International Technology of Bogies – Bogie – Cost in operation

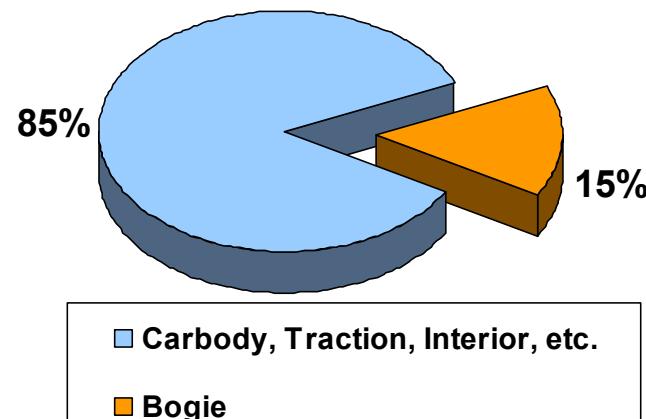
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low portion of
original equipment

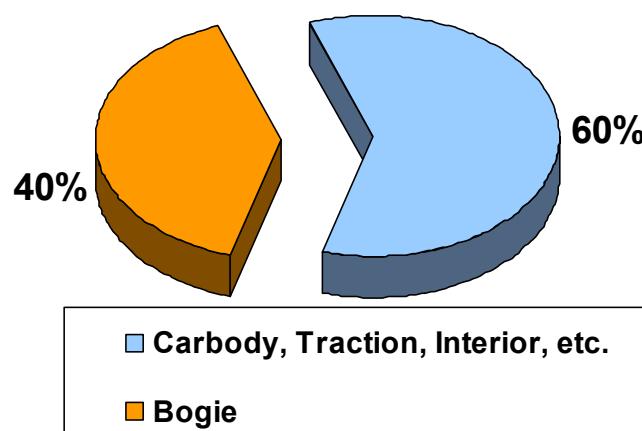
OPERATOR

high portion in total
cost of operation

Bogies account for 15 % of
railway vehicle value !



Roughly 40 % of LCC Costs of
railway vehicles are caused by
Bogies !



Current International Technology – Electrical components

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Auxiliary converter



Sibac traction converter



Sibas 32



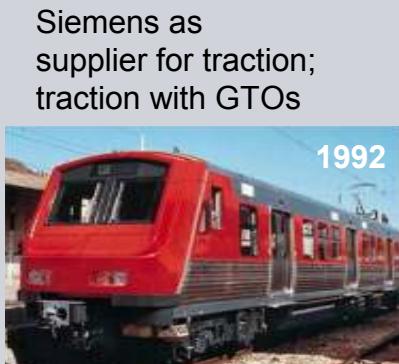
Traction Motor 1TB2016

- IGBT Based Traction Converter and Auxiliary Converter
- Microprocessor based traction, braking and train control system (sensor less operation, no speed or temperature sensor)
- Regenerative braking for energy recovery
- Extensive diagnostic memory for failure analysis
- State-of-the-art microprocessor based Train Management Systems
- Self ventilated 3 phase asynchronous traction motors
- Extensive audio visual Passenger Information systems
- HVAC Units

Siemens Contribution in EMUs – Development and evolution in recent years

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Experience
+ Innovation
= Desiro ML Vehicle Platform



CP 2300 / 2400
Portugal



Desiro ET
Malaysia

Full Siemens vehicle;
traction with high voltage GTOs



Desiro EMG 312
Slovenia

Siemens builds
partially under licence;
traction with GTOs

2000

Full Siemens vehicle;
traction with IGBTs



Desiro OSE
Greece



2008

Desiro
ML
Platform

- various types of traction:
Diesel or electrical
- various train configurations:
2 to 4 cars
- various entrance heights:
600, 800, 1000 mm

Mumbai EMUs – Current Stock with DC technology

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Brief Details of Network

Length – Route km over 302
Number of stations – More than 100
3 lines – Western, Central & Harbour
Caters to 6.1 Mio commuters every day
Only network in India with 1.5 kV DC
(conversion to 25kV in progress)
Number of trains – 2200 (approx.)

Brief Details of existing DC Stock

9 car rakes – 200 (approx.)

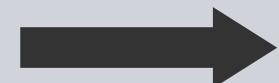
Conversion from 1.5 kV DC to 25 kV AC system voltage

Changeover from DC traction to AC traction technology

Existing



Intermediate



Future

1.5 kV DC

- DC Motors
- high Maintenance – resistor switch bank, DC motors
- no regeneration
- jerky
- low adhesion
- no slip/slide control
- high power loss in starting

1.5 kV DC and 25 kV AC

- 3 phase AC motors
- low maintenance – converter controlled AC motors
- regeneration
- jerk free
- improved adhesion
- slip/slide control
- ease of diagnostics

25 kV AC power supply

- 3 phase AC motors
- low maintenance – converter controlled AC motors
- regeneration
- jerk free
- improved adhesion
- slip/slide control
- ease of diagnostics

EMU Mumbai – Scope of supply – Major items

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Propulsion Equipment

- Transformer
- Traction Converter
- Traction Motor
- Micro Processor Control

Auxiliary Power Supply Equipment

- Auxiliary Converter
- Battery Charger

Roof Equipment

- Pantograph
- Breaker (VCB & HSCB)
- Lightning Arrestor,
- Current Transformer
- Voltage transformer
- Brake resistor
- AC DC changeover switch

Train Integrated Management System

- Central Control Unit (CCU)
- SIBAS KLIPs etc.
- Brake Electronic Control Unit (BECU)

Brake Equipment

- Parking brake
- Air Compressor
- Main compressor, air dryer, air filter

Cab & Saloon Air-Conditioning Equipment

- Ventilation system (only in MRVC)

Saloon Equipment

- Lights
- Fans

Passenger Information & Cab Equipment

- Master Controller, Driver's display
- Passenger Information & communication system
- Driver's desk, Head light, tail light

Cables & accessories

- Power cables
- Control cables
- Intervehicle jumpers & couplers

Fire detection and extinguishing system

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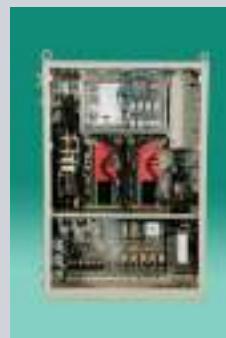
Mumbai EMUs – Solution by Siemens – Entire Propulsion and Electrical Package

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Transformers



Auxiliary converter



Traction motors



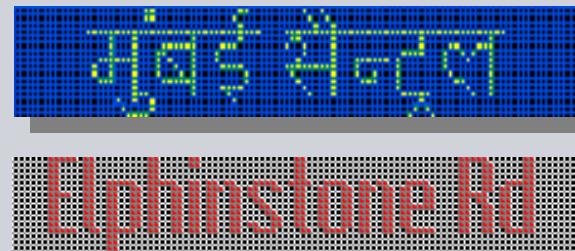
Traction Converter



Driver Desk



Roof Equipment



Passenger Information System

(Example pictures)

EMU Mumbai – Critical Requirements of Order



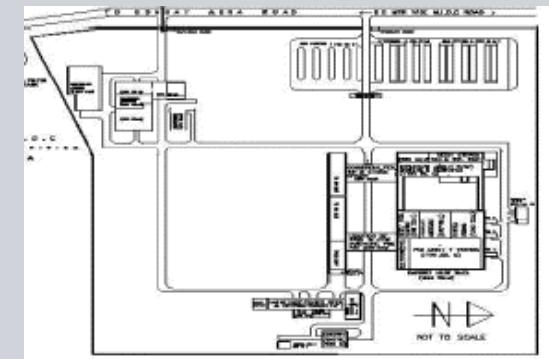
- Design to consider super dense crush load of 16 people/m²
- Equipments to withstand humid and salty environment with excessive vibrations
- Flood proofing of underslung equipment up to 760 mm of height above rail level.
- Design to consider 25% choking of air filters and radiator fins.
- Introduction of fresh air in cars to minimise Carbon-dioxide levels
- Regeneration of approx 30% energy
- Reduced specific energy consumption

Siemens fulfils all these requirements

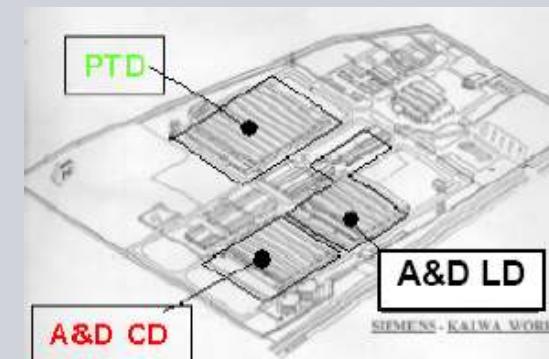
Siemens Local presence in India – For EMUs

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Nashik:
Local Engineering
and Manufacturing
of Traction Converters
and Auxiliary Converters



Kalwa:
Local Engineering
and Manufacturing
of Traction Motors



Local Service Support for Maintaining the fleet

Mumbai EMUs – Technical data

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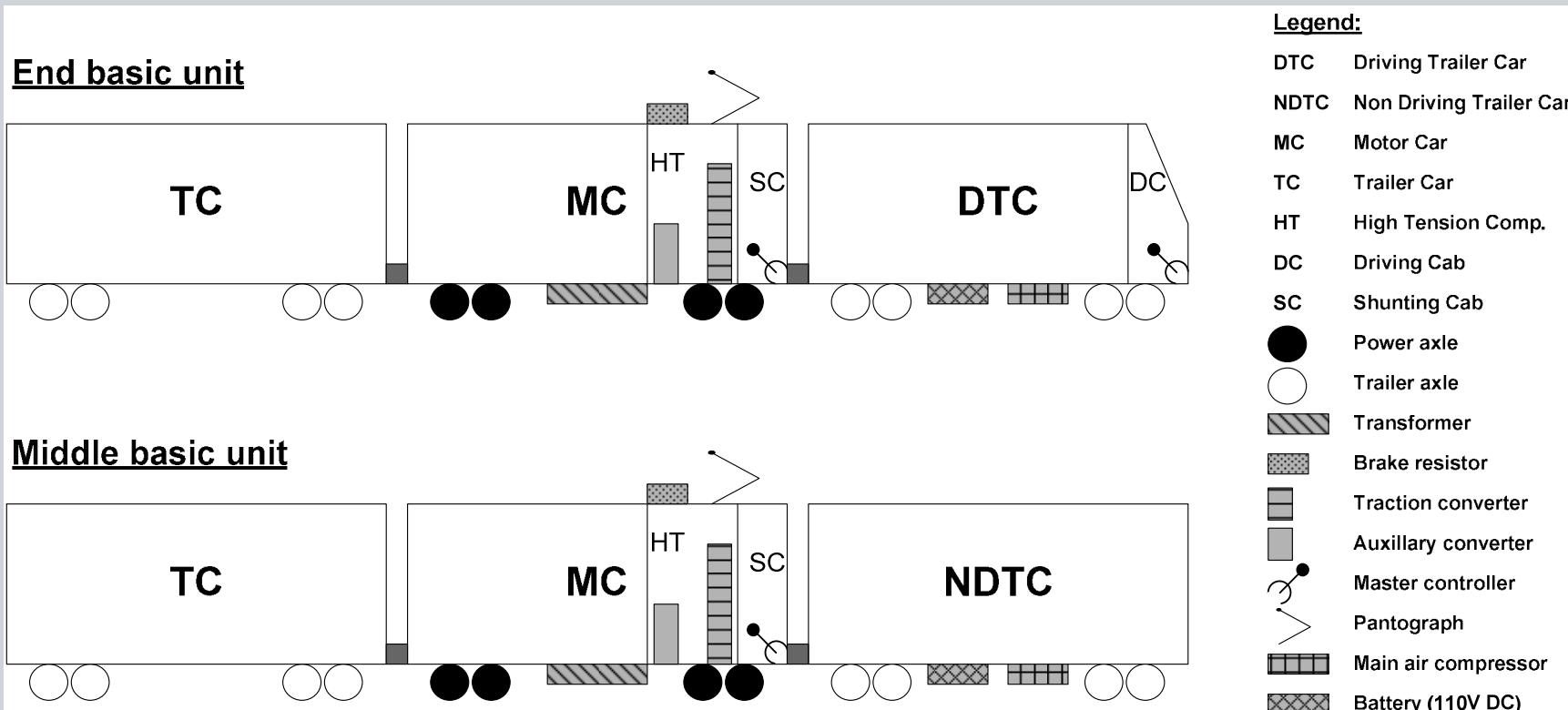


Technical Data

Year	2005 – 2010				
Number of cars	9	12	15	18	
Power system	AC 25/50 + DC 1.5			kV/Hz	
Maximum power at wheel	3300	4400	5500	6600	kW
Maximum speed	100	←	←	←	kmph
Weight	630	840	1050	1260	t
Track gauge	1676	←	←	←	mm
Seats	900	1200	1500	1800	
Numbers to be built	170 + 303 (3-car units)				

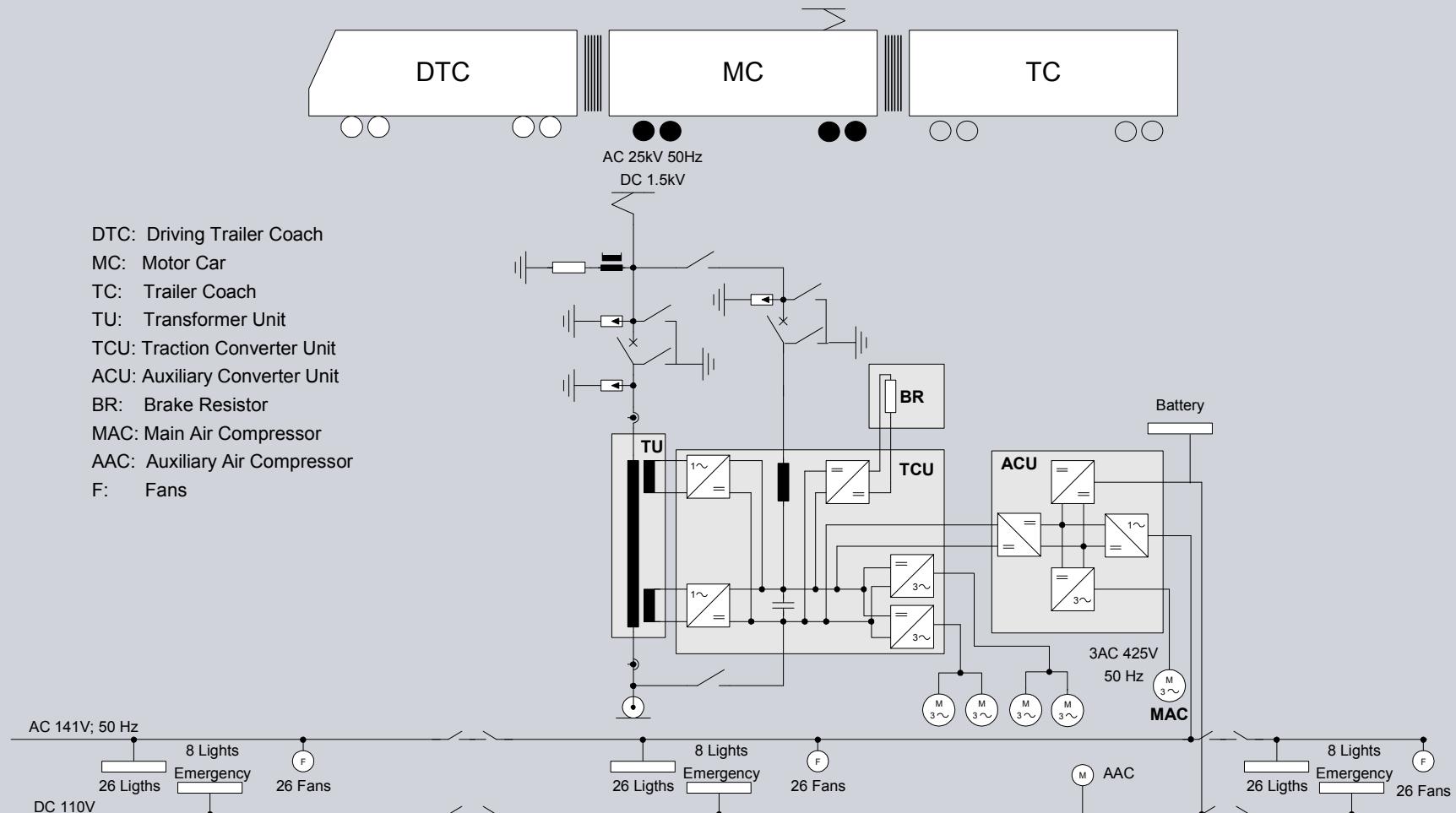
EMU Mumbai – Train Disposition

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Mumbai EMUs – Principal Circuit Diagram

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DTC: Driving Trailer Coach
 MC: Motor Car
 TC: Trailer Coach
 TU: Transformer Unit
 TCU: Traction Converter Unit
 ACU: Auxiliary Converter Unit
 BR: Brake Resistor
 MAC: Main Air Compressor
 AAC: Auxiliary Air Compressor
 F: Fans

Mumbai EMUs – Most Important Features



- Dual Voltage operation
- Force air cooled IGBT based Traction converter and Auxiliary converter.
- Improvement in passenger comfort by ventilation units.
- Low energy consumption and low life cycle costs.
- High reliability and service friendly.
- Self-ventilated three-phase asynchronous traction motors, low maintenance.
- Train and traction control system by microprocessor based Sibas® 32.
- Bus system and train communication network (TCN).
- Passenger information system.
- Up to 15 / 18 car formation.
- Load sensing to adjust braking.
- Fire detection and extinguishing system.
- Extensive diagnostic memory.
- Improved illumination for better visibility inside vehicles
- Ergonomic driver's desk

Mumbai EMUs – Current Status



- 3 Trains in passenger service in Western Railway
- 11 Trains in passenger service in Central Railway
- Production of series trains in progress at ICF

Installation at ICF

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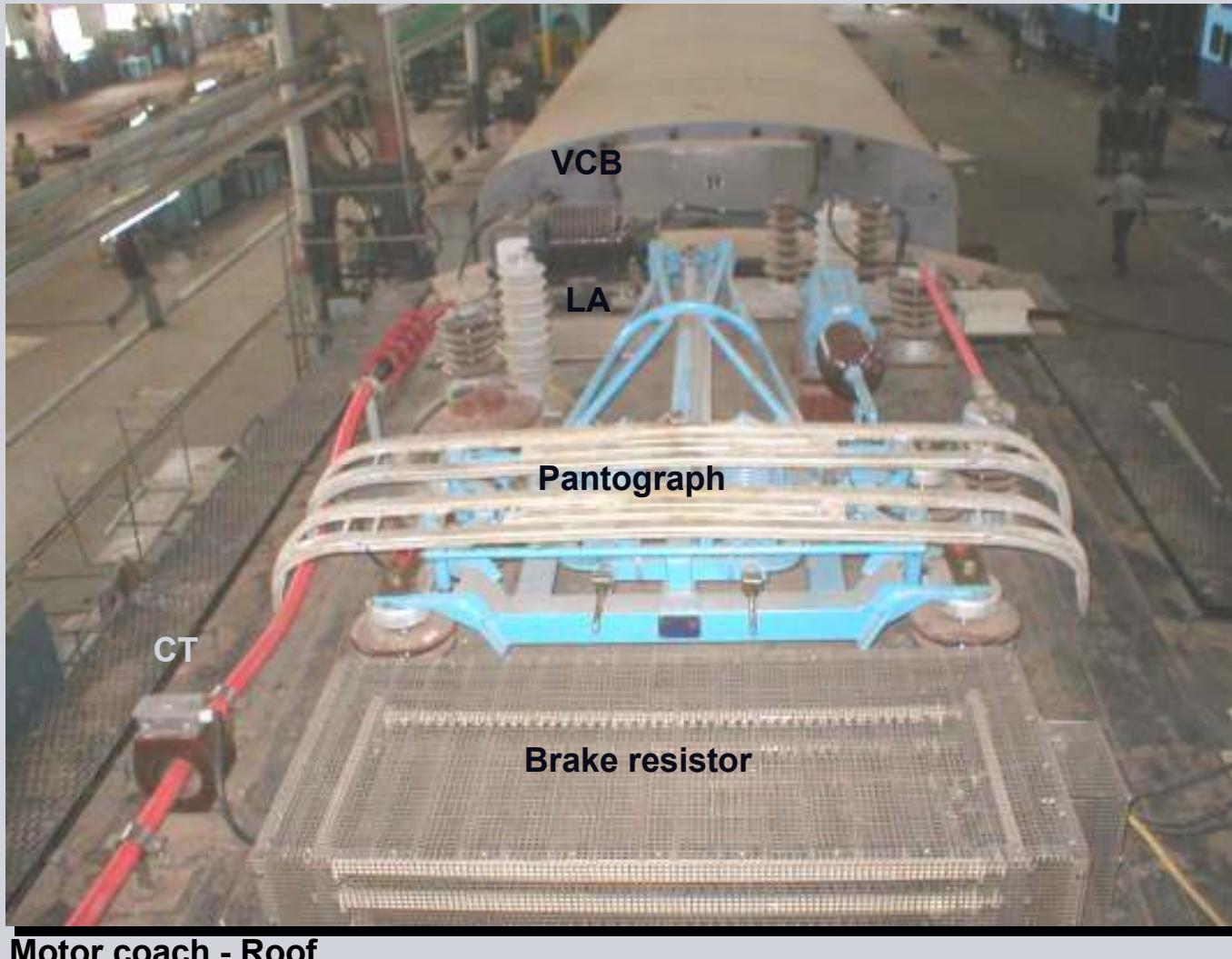
Car body – Driving Trailer Car (DTC)



Car interiors – Ventilation system, fans, lights

Installation at ICF

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Motor coach - Roof



Motor coach – HT compartment

September 2008

Installation at ICF

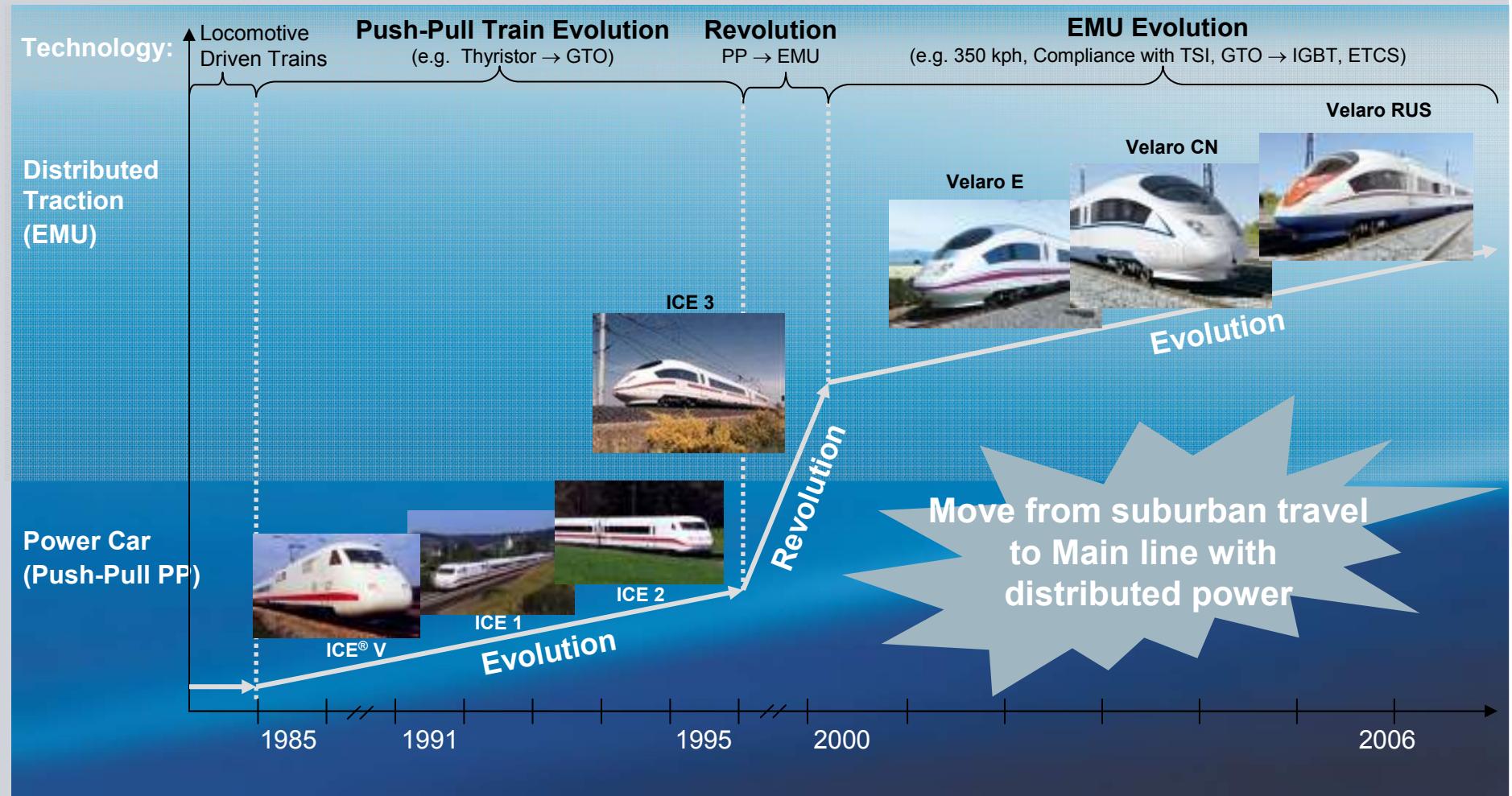
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Complete train

EMU – a revolution for main line as well

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Thank You for your attention

