



High speed from Siemens

Two systems, one goal: Mobility for the 21st century

SIEMENS

efficient rail solutions

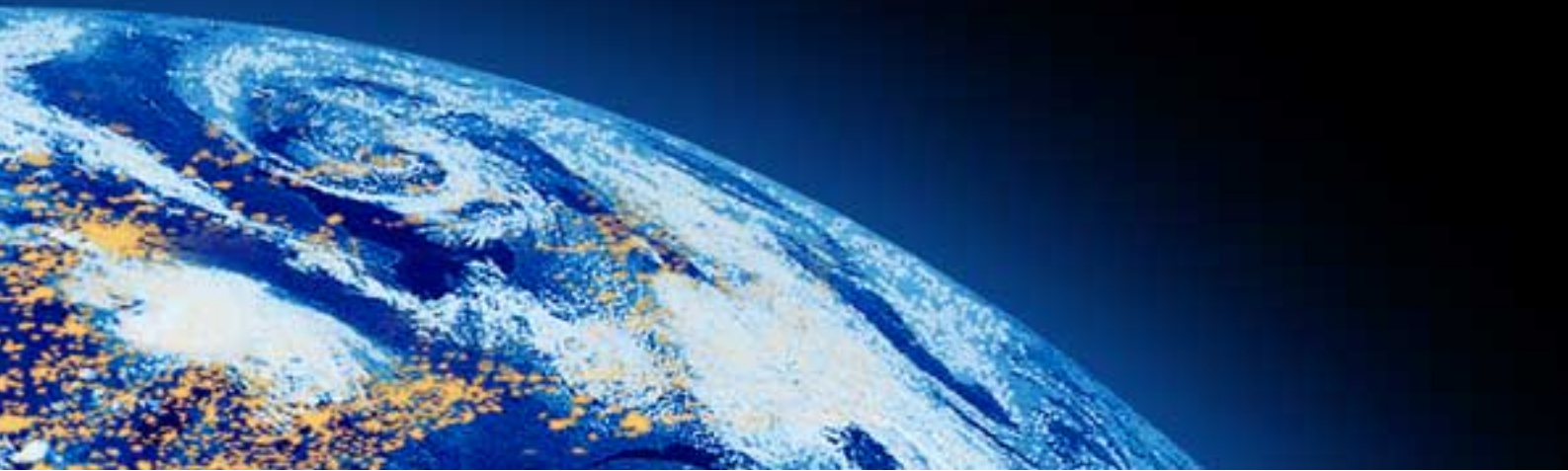


The same passion that inspires people to explore new realms of space also drives us
onward to develop technologies for high speed transportation.

The decision to use wheel-on-rail or magnetic levitation technology may be based on rational reasons,
but it will always be driven by that same fascination for space and speed.

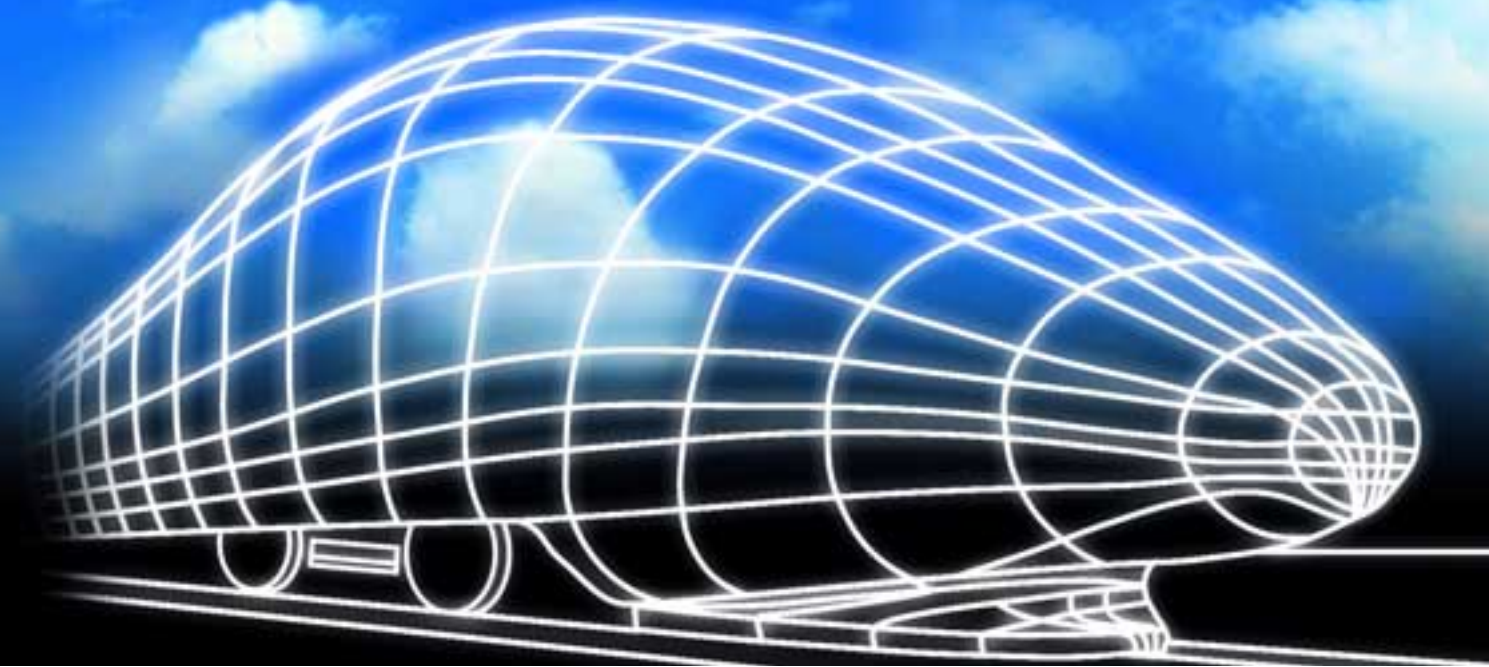
About making dreams come true

The desire to overcome great distances is an age-old human dream – and also the basis of our modern way of life. Today, it's no longer a question of whether we can reach remote destinations, but how we can reach them. Today, we want fast, direct and safe means of transportation that take us to those destinations almost without our noticing it, but in the knowledge we're not burdening the Earth's environment and its natural resources.



Come with us and discover concepts and technologies for overcoming distance and space faster and more comfortably than ever before. The system ultimately used – high speed rail or magnetic levitation technology – depends on the general conditions in each case: on the topography, the route length, the passenger and material flows, the existing infrastructures, and many other factors.

The systems are already available today in the form of: the Velaro®, a high-end development of the service-proven wheel-on-rail system; and the Transrapid, the first maglev train to operate in daily service. Both meet the high demands of market-oriented operators. Both provide everything to literally carry passengers away. And both are the result of the high speed competence offered by Siemens Transportation Systems.



The Velaro.

A successful idea redefined.

The **Velaro**, the new high speed platform from Siemens, sets new standards in the almost 40-year history of high speed rail-based transportation in terms of passenger comfort, product design and technical maturity.

New findings and new materials have been channeled into virtually every component area – from the traction system and the vehicle design to the furnishings in the passenger compartment and the optimization of the diagnostic and maintenance functions.

The biggest innovation, however, has been the evolution of train configuration: namely, the change from power car with coupled coaches to multiple-unit train. Unlike traditional high speed trains, every second axle on the Velaro is driven. This ensures excellent acceleration performance and the ability to climb grades as steep as 4 % – redefining the system limits for high speed rail traffic.



The Transrapid.

Innovation from top to bottom.

Since its invention 170 years ago, the railway as a system has been continuously optimized. However, the **Transrapid** – a joint project of Siemens, ThyssenKrupp and Transrapid International – marks the breakthrough of a truly brand-new idea and the successful break with wheel-on-rail technology. Levitating instead of rolling, powered electronically instead of mechanically, a vehicle is able to move for the first time without touching the track – without wheels, axles, gears and overhead contact lines.

Maglev technology opens up a new dimension in high speed transportation where even the most advanced wheel-on-rail systems reach their topographic or economic limits. Combined, both systems fulfill nearly all the requirements for guided ground transportation – from high speed drawdown traffic into the heart of the cities to long-distance service over 1,500 km, previously the exclusive domain of air transportation.

The world's fastest series-produced train

The Velaro trainset reaches regular operating speeds of up to 350 km/h, making it the world's fastest series-produced train in revenue service.

The underfloor arrangement of the traction system not only ensures an excellent acceleration performance and grade climbing ability, it also offers benefits to the passengers. Unlike traditional high speed trains, the full length of this multiple-unit train is available for seating, catering and luggage storage. In other words, the space available to passengers has been increased by 20 percent from the same length of train.

Throughout, the concept focus is on the passenger. Spacious travel ambiances in all categories, top-class materials, and a high degree of sophistication in every detail of the furnishings define a new level of quality in rail travel.

Besides its appeal to passengers, the value of a train to railway operators is judged by its ability to adapt to different operating requirements quickly and flexibly. Thanks to its modular design and multi-system capability to operate on all European line voltages, the Velaro guarantees high flexibility for every application. As a logical consequence, it will become a real "global player" that can provide direct, seamless connections to cities all across the continent.

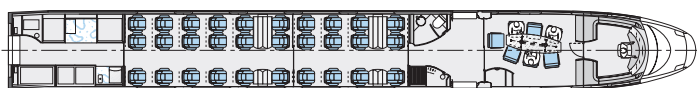


High speed in action: as ICE 3® operated by DB AG on the new line between Cologne and Frankfurt and as Velaro E starting in 2004 between Madrid and Barcelona. The train will run this 640-km line in less than two and a half hours – the fastest scheduled rail connection in Europe.





Velaro



End car, Club



Transformer car, Preferente



Converter car, Turista

Example: **Velaro E** for the Spanish operator RENFE: Comfortable travel with maximum freedom of movement – end to end in all three car classes Turista, Preferente and Club.

Technical Data

Train length (8 cars)	200 m
Configuration	2 end cars, 6 intermediate cars
Capacity	up to 458 seats
Power system (multi-system version)	AC 15 kV, 16.7 Hz AC 25 kV, 50 Hz DC 1.5 kV DC 3 kV
Maximum speed (in AC networks)	up to 350 km/h
Acceleration (loaded)	0 – 100 km/h: 44 s/626 m 0 – 200 km/h: 120 s/3,920 m 0 – 300 km/h: 318 s/17,900 m
Noise emission (train passing on open track at a distance of 25 m, without a protection wall)	at 300 km/h: 91 dB(A)
Power consumption (running at constant speed, with the HVAC systems on)	200 km/h: 24 Wh/pkm 250 km/h: 34 Wh/pkm 300 km/h: 46 Wh/pkm

Integration into existing transportation networks:

Service in existing railway infrastructures has been tested and is possible without additional measures.



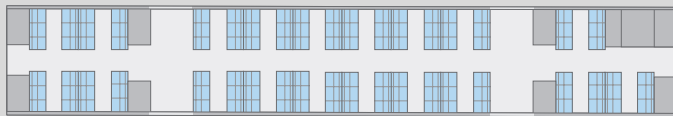
Welcome aboard: Seats styled according to latest ergonomic findings, a generous multi-media selection with music, video and travel information – all in an ambience using high-class materials. And the communication interfaces for business travelers make the Velaro the world's fastest office.



Transrapid



End section



Intermediate section

Transrapid: In the "Shanghai configuration" the trains consist of two end sections and three intermediate sections, but the system is designed to accommodate up to eight intermediate sections.

Technical Data

Train length (5 sections)	200 m
Configuration	2 end sections, 3 intermediate sections (up to 8 intermediate sections possible)
Capacity	453 seats
Power system	Public power network (e.g. 110 kV/50/60 Hz)
Maximum speed	up to 500 km/h
Acceleration (loaded)	0 – 100 km/h: 35 s/482 m 0 – 200 km/h: 69 s/1,930 m 0 – 300 km/h: 109 s/4,720 m 0 – 400 km/h: 176 s/11,300 m
Noise emission (train passing on open track at a distance of 25 m, without a protection wall)	at 400 km/h: 91 dB(A)
Power consumption (running at constant speed, with the HVAC systems on)	200 km/h: 22 Wh/pkm 250 km/h: 29 Wh/pkm 300 km/h: 34 Wh/pkm 400 km/h: 52 Wh/pkm

Integration into existing transportation networks:

Interconnection with existing transportation infrastructures (for intermodal transfer to railway, automobile, airline services at interchange stations).



Flying at ground level: The Transrapid connects the city of Shanghai with the new Pudong International Airport in only 7.5 minutes – high speed service at commuter rail intervals on the 30-km line.

In addition to such airport connections, the Transrapid also plays its strengths on mainline routes or as a regional system in conurbations, thus offering an extreme degree of service flexibility.

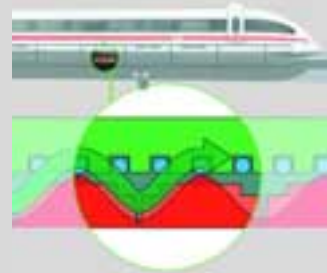
Levitation at 500 km/h

Based on actual travel time from city center to city center, the Transrapid can link metropolises that are up to 1,500 km apart faster than any other mode of transportation – even air travel.

The basis for this performance is the principle of non-contact electromagnetic levitation. It permits the Transrapid to accelerate to 400 km/h in less than three minutes, to run at extremely short service intervals and – due to its low noise emission – to achieve high speed even in densely populated areas.

Another aspect is the economy of operation. At 400 km/h, the Transrapid – not being slowed down by rolling resistance – contents itself with an energy consumption of 52 watt-hours per passenger kilometer. Due to non-contact electromagnetic propulsion, the guideway as well as the guidance and drive systems are virtually free of mechanical wear and provide an extremely long life at low maintenance costs.

The track routing also revolutionizes traditional concepts. Small curve radii and grades of up to 10 % are no longer a problem, land absorption is extremely low at 2 m² per running track meter (with an elevated guideway). This virtually eliminates the need for costly tunnel and bridge constructions.



Only that section of the guideway where the train is currently located is supplied with power. This eliminates the need for an onboard motor and further reduces the power consumption.



Contrary to the traditional electric motor, the stator in this case is "sliced open" and arranged underneath the outer edges of the guideway where it generates a gliding magnetic field. The levitation magnets on the vehicle act as the rotor. The interaction of both components moves the train forward.

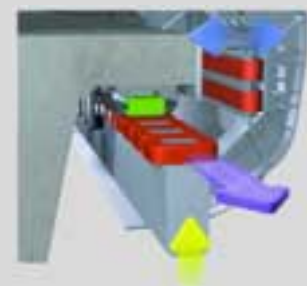


Supply components of the Transrapid project partners

Siemens: Propulsion system, power supply, operations control and communication systems, conductor rail

ThyssenKrupp: Maglev vehicles, drive components, guideway equipment

Transrapid International: System engineering and integration, marketing, sales



Electromagnetic levitation: Levitation magnets draw the vehicle up to the guideway, guiding magnets maintain its lateral position relative to the track.



High speed.

A segment where we feel at home – embedded in a total competence, from airport connections and regional transportation to 1,500-km distances, from propulsion to service.

With the Velaro and the Transrapid, we can offer two high speed systems that do not compete but harmonize with each other to form an intelligent alternative to travel by private motor vehicle and by plane.

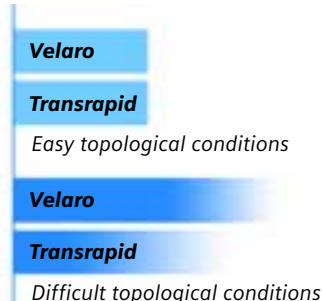
Committed to mobility

A common feature of both technologies – wheel-on-rail and magnetic levitation – is cost-effectiveness. Your choice of system will depend on a number of specific operating conditions.

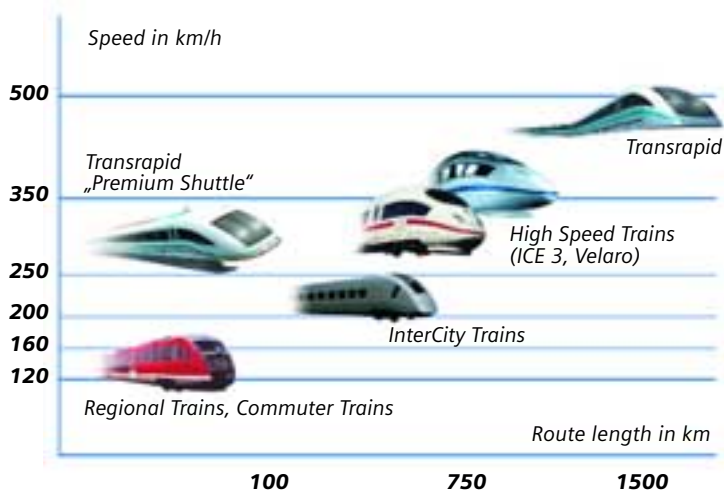
But whatever you choose, each solution is backed up by the system competence of Siemens Transportation Systems. We are the only supplier in the world who has experience with both systems, assuring you that you will always get the best solution for your particular application.



Comparison of investment: Vehicles
Considering the investment for vehicles, the wheel-on-rail system provides advantages owing to the economy of scale and a production that has been optimized over many years.



Comparison of investment: Track/Guideway
For normal route topologies, the investments for the track/guideway are almost equal. Magnetic levitation provides advantages in more demanding terrain.



The "Trains" product portfolio from Siemens Transportation Systems

The Velaro runs on new or existing lines (typical distances up to 750 km) at speeds up to 350 km/h. The Transrapid provides a high speed, high-frequency premium connection between the city center and the airport and is also a means of mainline transportation for distances up to 1,500 km and at top speeds of 500 km/h.



Comparison of cost: Life cycle

With regard to life cycle costs, the magnetic levitation system offers advantages which are essentially due to the absence of mechanical wear (running gear, brakes).

Welcome to the "Global Network of Innovation"

Siemens Transportation Systems is your partner for the entire world of rail-based transportation. Our product portfolio, which ranges from components to complete turnkey solutions including financing, enables every project to become reality – whether for mass transit, regional or mainline service, for freight or passenger traffic.

The name Siemens is synonymous with innovative strength in every respect. There is hardly any other company that makes more extensive use of information technology (IT) to make railway systems more cost-effective and efficient. And hardly any other company has been more successful in advancing modular designs in all areas – whether in rolling stock or in infrastructure. And no other company, as a market and technology leader, provides the same level of competence in operations control systems for wheel-on-rail and maglev systems.

We combine competencies and technologies from the unique network of Siemens activities to make greater progress in rail-based transportation. And we do this worldwide – as a partner you can rely on today and tomorrow.



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The information in this document contains general descriptions of the technical options available, which do not always have to be present in individual cases. The required features should therefore be specified in each individual case at the time of closing the contract.