ICE

High-tech on rails

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Contents


ICE

Fig. 21: The high-speed sections, 440 km for 200 kph, and for 160 kph; summer 1985

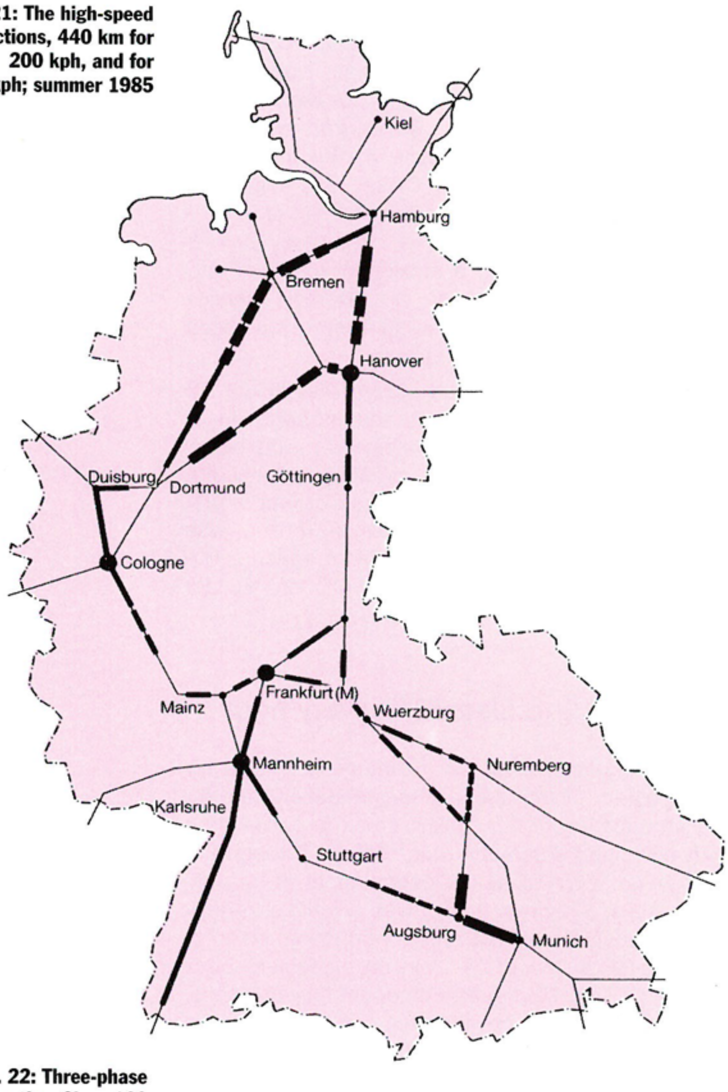


Fig. 22: Three-phase locomotive, Class 120

sengers, who had hitherto been confirmed to the slower trains, was much more important.

The significance of the German Intercity network to regional planning is generally underrated. The flagship trains of other railways may be faster, but there is no comparable system promoting a multicentric and sound regional planning structure nationwide as effectively as the IC system, with its regular and temporary end terminals as well as its connections at junction stations.

The advent of IC 79 has also brought the integrated long-distance timetable with 1-hour frequencies, making it easier to adjust feeder services to each section of the schedule.

In the anniversary year: IC 85

In the 150th anniversary year of the railway in Germany, IC 85 introduced further improvements in high-speed transportation, which largely exhaust the present-day potential of lines and of rolling stock. By extending the 200-kph sections (Fig. 21) to a total of 440 km and tightening the schedules, it has been possible for DB to raise the average service speed once again to 108 kph. The front runners are the IC 582, 680, and 682 trains in the Hanover—Hamburg line with a commercial speed of 115 kph.

But another aspect of IC 85 should perhaps be rated much higher: a new departure in passenger service. Guards in charge of the train and conductors, who used to change trains every so often, have been replaced by IC chiefs and IC attendants who assist and serve the passenger. At the same time, the number of train crews has been increased by almost one third.

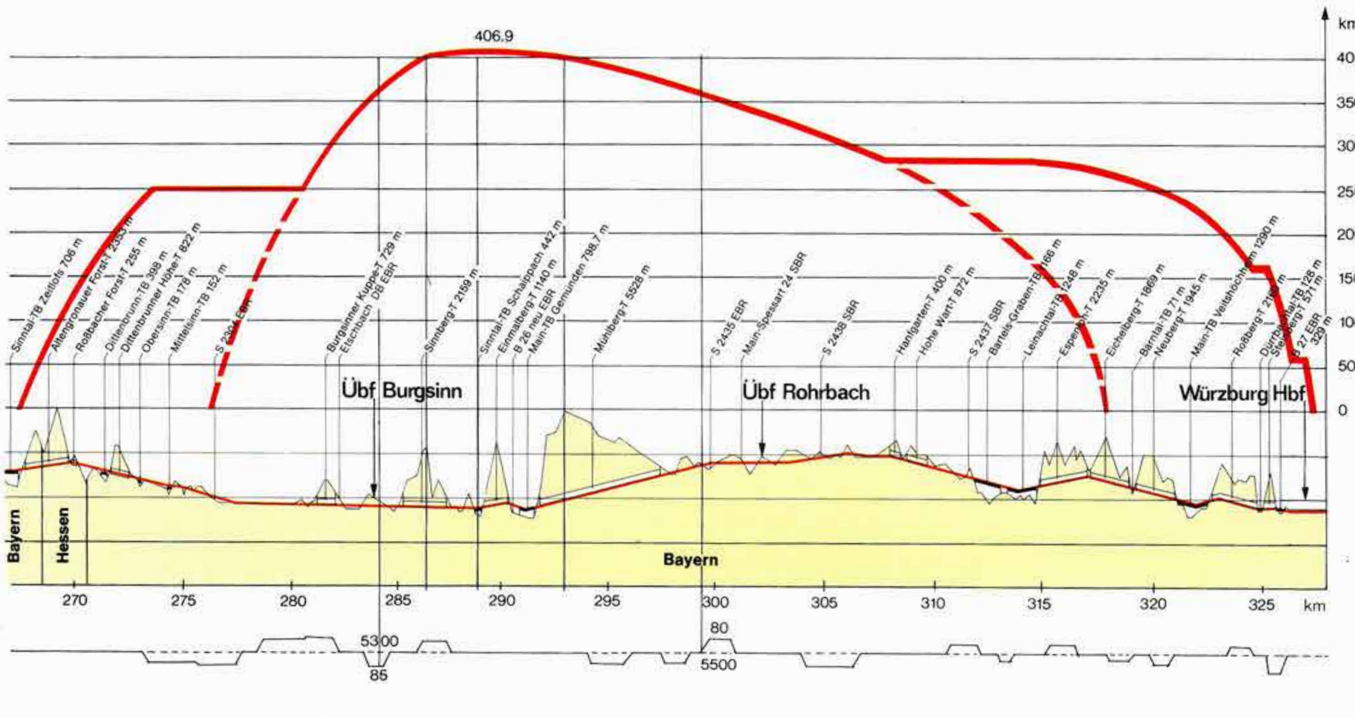
Records on the threshold of ultrahigh-speed transportation

The average scheduled speed in the IC 85 network was always influenced to a great extent by the low values in the pre-alpine mountain ranges. The new track sections from Mannheim to Stuttgart and from Hanover to Würzburg were under construction from August 1976 and May 1981 respectively subsequent to completion of a short section from Hanover to Rethen in 1979.

In 1955, Dr.-Ing. Edmund Frohne, first Chairman of the Board of German Federal Railway, stated that: "The advantages achieved through innovations in the field of locomotive and car construction can be realized only on railway lines which are abreast with the state of the art" [14]. And, in 1963, Dr.-Ing. E.h. Hans Geitmann, Chairman of the Board at that time, proclaimed the goal of introducing high-speed rail transportation demanded that federal planning of investment in routes through Germany's low mountain ranges be based on national economic considerations, "as had already been done in the Federal Republic of Germany in the case of investments for other transport routes, e.g. for the con-

Fig. 23: On 1st May 1988, the InterCity Experimental (ICE/V) "breached" the "sound barrier" of speed on rail (400 kph) for the first time. At 11:12 a.m. the speedometer in the train pointed at 406 kph. Subsequent evaluation produced the precise value of 406.9 kph

Fig. 24: Graphic record of the world record run on 1st May 1988 and line profile



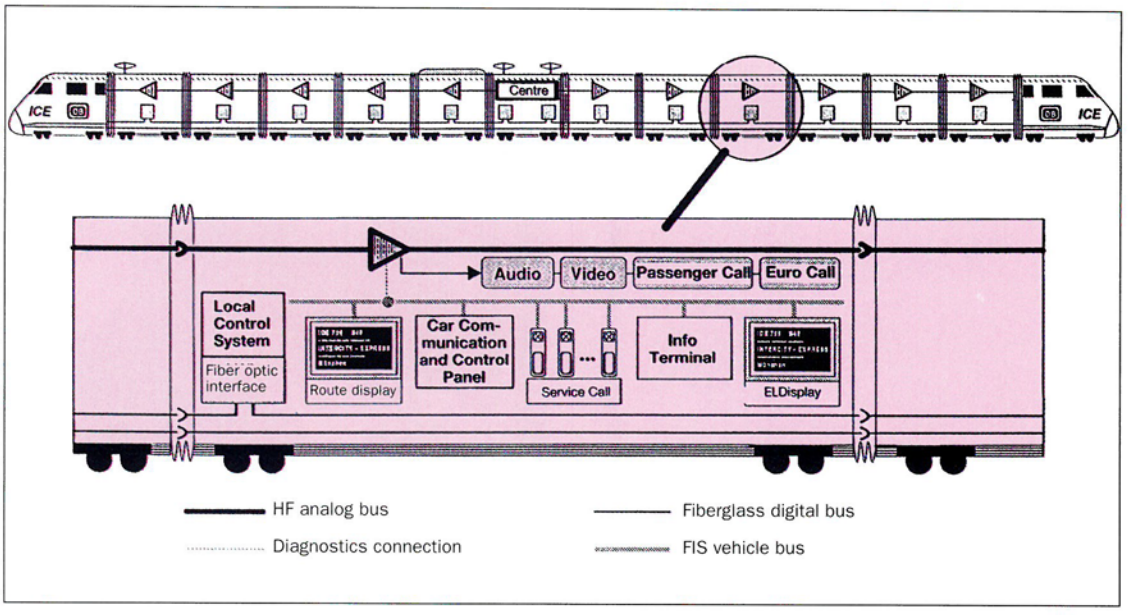


Fig. 83: Passenger information system (FIS) in the trailer car

FIS is a modular system with a hierarchical structure. It consists of:

▷ a control center;
▷ subcenters;
▷ terminals.

FIS exploits state-of-the-art CMOS microprocessor technology for the construction of electronic assemblies that are suitable for use in vehicles. Such advanced technologies include, for example, color LCD and EL (electroluminescence) for displays.

The use of FIS in DB's InterCityExpress train illustrates the system's wide range of possibilities. Its modular structure allows for a configuration tailored to the specific requirements of various transport systems.

Fig. 84: Some seats are additionally equipped with video monitors

FIS for the ICE is based on a central control system to which subcenters one per car, are linked. These car control systems, in turn, communicate with the FIS terminal devices. This basic structure for signal transmission uses separate paths for data and for wideband RF transmission.

Fig. 83 gives an overview of the FIS installation in the car.

8.5.1 Information

The public-address system in the passenger area transmits not only automatic announcements in synthetic speech but also those by the attendant crew. Lockable control panels are located in every car from which the attendants can communicate with each other or with the driver.

8.5.2 Entertainment (Fig. 84)

Each seat has a headphone outlet to give the passenger a choice of three radio channels and three stereo music channels.

8.5.3 Communication

An important means of communication on the moving train is the train telephone.

It is possible to make international calls on the car telephone network C or D, which is available throughout Europe today. Cashless payment for calls also facilitates the use of the train telephone.

8.5.4 Service

The wireless paging system is used for the following services:

▷ service call;
▷ official call:

An attendant can be paged to contact his colleague or the driver via the car communication panel.

▷ Euro-call:

transmission of the European Radio Call.

▷ emergency braking:

All attendants are immediately informed of emergency braking and the location from which it was triggered.

8.6 Comfort elements

The comfort requirements for the ICE as currently series-produced for DB were very stringent in view of competition from the automobile and airplane.

By "comfort" we mean not merely the interior furnishings and generous spacing, but also the services offered, air conditioning and a low noise level.

The interior design is closely related to the concept of space and service described above.

Three service categories are catered to in the ICE: the restaurant, the bistro as well as the at-seat snack and beverage service.

At-seat service in 1st Class offers a selection from that available in the service car. There is a new version of the minibar for the 2nd class.

Apart from the restaurant car (Fig. 85), called the service car, a 2nd class car with special facilities is available to passengers. Services include a conference room, facilities for the handicapped, and a baby's changing unit for mothers with small children.

8.6.1 Air conditioning

Good air conditioning is of importance to passenger well-being in the trailer cars. Apart from the guarantee that no external pressure waves are propagated inside the cars, for instance when trains pass each other or during tunnel passage the setting and maintenance of optimum temperature conditions had to be ensured in the cars for the climatically very different seasons of the year.

Fig. 86 shows the air supply.

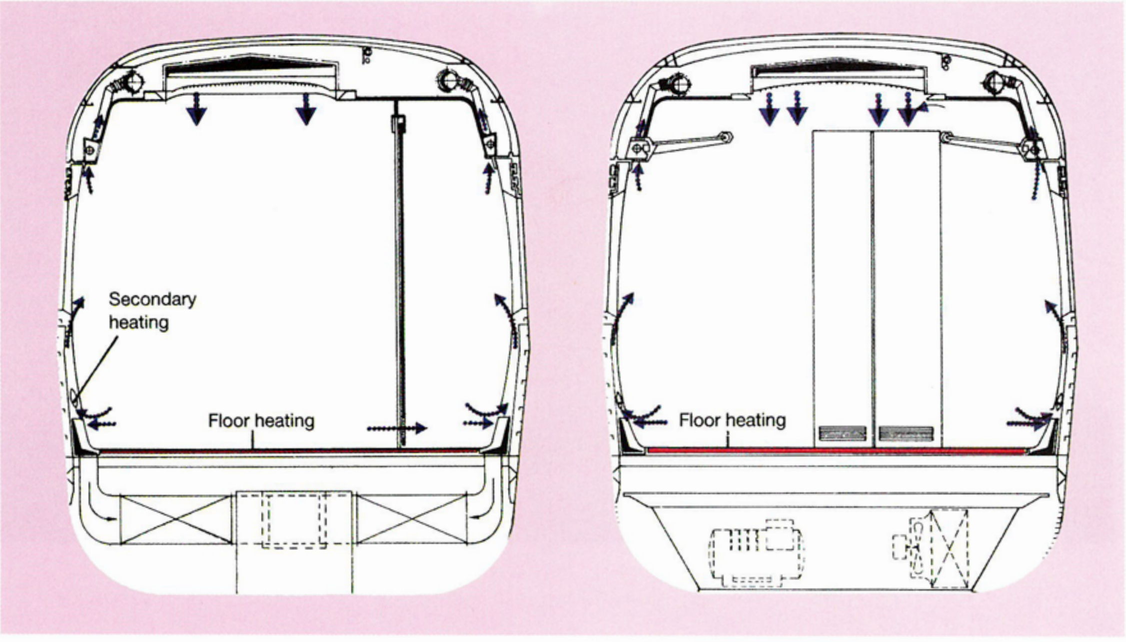


Fig. 85 (up): Restaurant car interior

Fig. 86 (left): Circulation of air by the air-conditioning system

Siemens finished work on the first two ICE 2 power cars

Aubert Martin, Alois Weschta, Herbert Landwehr

ICE 2.2 The latest design for an European high-speed train

1 Introduction

The European high-speed rail (HSR) lines are linking up to form a compatible transportation network (Fig. 1). To ensure that high-speed trains have free access to these international routes, both railway management and industry are striving for the harmonization of major requirements and technical specifications. ICE 2.2 is the latest addition to the successful high-speed ICE family and meets the demands for such pan-European operation (Fig. 2).

In 1994, German Rail (DB AG) placed an order with the Siemens-led project group Siemens-AEG for fifty ICE 2.2 trainsets. Thirteen of these trainsets are to be equipped for cross-border service and thus for multisystem operation, i.e. 4 trainsets for 3 voltage systems, 9 for 4 systems.

In 1995 Netherlands Railways (NS) signed a declaration of intent to purchase six ICE 2.2 high speed trainsets with multisystem capability for the Amsterdam—Cologne—Frankfurt route.

The second-generation ICE version, ICE 2.2 is slat-

Fig. 1: The plan of European high-speed train network

NEW LINES (NL) > 250 km/h
UPGRATED LINES (UL) + 200 km/h
INTERCONNECTION LINES
PRIORITY CORRIDORS IN CENTRAL AND EASTERN EUROPE
KEY LINKS

ICE 2

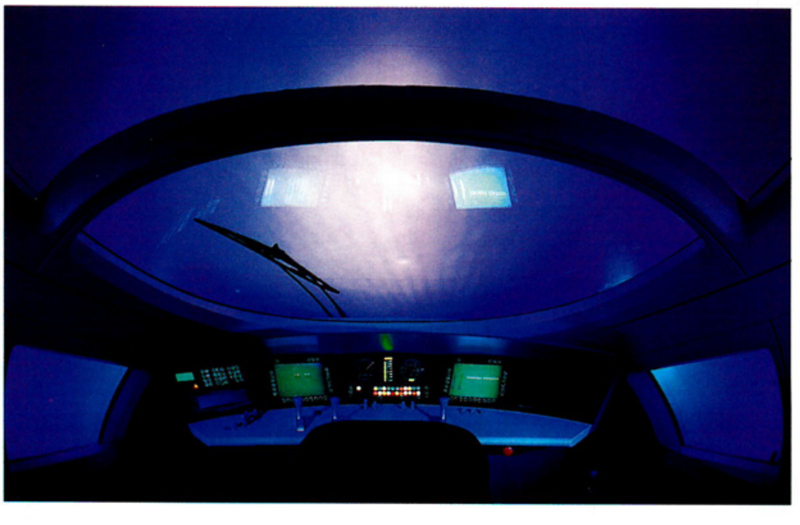
Studies of the traffic density in the expanded high-speed railway network have revealed that shorter trainsets can improve loading factors on certain routes as well as reduce the required number of vehicles.

The specifications for development work were as follows:

▷ Half-train configuration, with coupling capability, consisting of 1 power car + 6 trailer cars + 1 driving trailer, capable of forming an extended train configuration with 1 power car + max. 14 trailer cars + 1 power car,
▷ Automatic coupler, installed in a hatch at each end of the train, to permit the coupling of two half trains,
▷ Uniform carbody shell with identical window spacing and defined fastening points for interior fittings,
▷ Air-spring bogies to improve the vertical ride quality, to change the characteristic of the transverse suspension and to further decouple structure-borne noise,
▷ Modified maintenance concept.

One of the key demands in the development of ICE 2 called for the reduction of weight by at least 5 metric tons per trailer car compared to ICE 1.

Forty-four ICE 2 half trains have been ordered. Production of the first batch started in the middle of 1995.



ICE 2.2

Ongoing development of the ICE trains is based on design requirements which stem from expansion of the German high-speed routes and the European HSR network. The demands having the greatest influence on ICE design are:

▷ More traction power for a maximum running speed of 330 kph and a maximum grade of 40 ‰, and
▷ Maximum static axleload of 17 t.

Despite the limitation of axleloads to 17 t, simultaneous increase in traction power for a top speed of 330 kph and continued successes in the field of lightweight vehicle construction, the concept of a power car-hauled train which concentrates its tractive effort among a few driving axles soon came under technical scrutiny. A comparison of power car-hauled and multiple-unit train formations drew attention to the following advantages, which tipped the scales in favor of the multiple-unit concept:

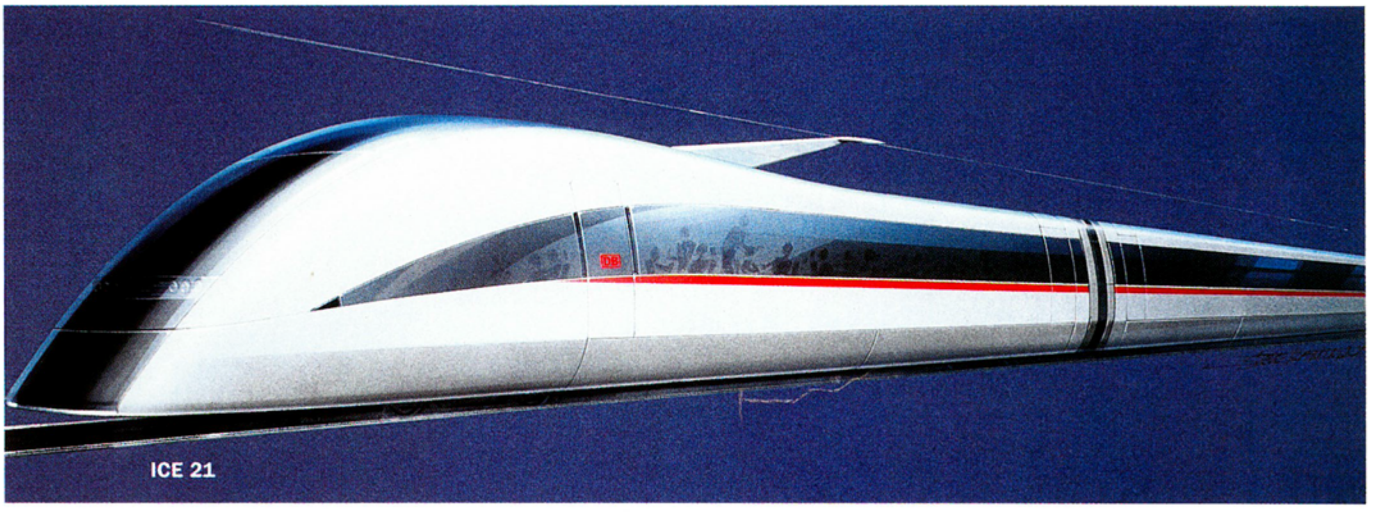
▷ Greater seating capacity per length of train,
▷ More uniform distribution of weight in the train,
▷ Lower weight per seat
▷ Better traction response with lower adhesion stress,
▷ Higher proportion of dynamically braked axles and
▷ Lower static axleload.

All of these design factors culminated in a further model — the ICE 2.2 multiple-unit train.

Thirty-seven such trainsets have meanwhile been ordered for operation on the German railway network.

ICE 2.2 (M)

Compliance with the "Technical Specifications for Interoperability (TSI)" is imperative in order to give high-speed trains free access to the growing Euro-


ICE 21

pean HSR network. Therefore, the following essential requirements must be met:

▷ Multiple unit or similar configuration designed for autonomous bi-directional operation,
▷ Maximum train length of 400 m,
▷ Built for platform heights of 76 and 55 cm,
▷ Maximum static axleload of 17 t,
▷ Maximum design speed of 330 kph,
▷ European vehicle profile (basis: UIC),
▷ Suitable for the voltage, ATC and communication systems of the assigned cross-border routes and
▷ Pressure-protected passenger compartments and driver's cabs.

Basing its design on the ICE 2.2 concept, ICE 2.2 (M) will be able to meet all of these demands.

Thirteen units of this multisystem ICE model have been ordered for a variety of railway applications by DB and six by NS.

ICE 21

To safeguard DB's competitive edge, it is necessary not only to pursue the further development of rolling stock but also to take new approaches for greater innovation. Such a policy, however, means examining every vehicle sector and every innovation potential for better performance and economy.

The major task areas of development are focusing on:

▷ Vehicle weight,
▷ Energy consumption,
▷ Running performance and vibration characteristics,
▷ Noise emission
▷ Wear characteristics
▷ Reliability and availability, and
▷ Maintenance.

Designed to carry HSR technology into the next century, ICE 21 is a joint project of the railway industry and DB. Commissioning is planned for the year 2000.

IC multiple unit with tilting technology (ICT)

The current fleet of InterCity (IC) trains will be due for replacement in the next few years and DB intends to take the opportunity to enhance the appeal of this market segment. A corresponding market survey undertaken by DB revealed that only vehicles with tilting technology and higher tractive effort could stimulate the desired increase in ridership. So the technical choice has fallen on an electric multiple unit (EMU) with active body tilting mechanism — a design which is based on the tilting diesel-multiple-unit VT 610 "Pendolino" successfully introduced by DB for its regional service. The active tilting system has been developed further and is now completely integrated in the bogie. The traction motors are arranged in the carbody, each motor transmitting its torque via cardan shafts and an axle drive to the inner axle of the bogie. This tilting and propulsion system is already being used in the Class ETR 460 tilting trains of the Italian State Railways (FS). The new long-distance EMU is distinguished by a strictly modular design, which can be readily adapted to meet the individual demands of different routes. Furthermore this new system is to be used in operation with multi-section trains, thus offering a greater number of transfer-free connections in a bid to win over new passengers.

Thirty-two 7-car and eleven 5-car tilting EMUs were ordered by DB.

The high-speed InterCityExpress (ICE) train has to be counted among the innovations at the top end of today's technology spectrum. Apart from making an undeniably economical and ecological contribution to the interaction of all high-capacity modes of transportation, it underscores the technological leadership of the German railway industry.

After opening with a review of the history of high-speed rail travel in Germany, this completely revised and supplemented 3rd edition covers all steps in the development of the ICE system. The authors and ICE designers describe details of the very first InterCity Experimental vehicle, experiences gained during operation of the first ICE generation, and conceptualization of a technically completely new ICE generation which will also feature multisystem versions suitable for operation all across Europe.

The reader is given a literally firsthand account as well as plenty of photographs, diagrams and tables about all of the technical innovations that make high-speed rail travel so appealing today.

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