Good afternoon, Ladies & Gentlemen.
I am deeply honoured to be addressing you today.
I am especially honoured because I have been asked to talk about high speed trains in the country where the high speed train was born.
I shall begin by looking briefly at some key events in the history of high speed railways.
I shall then invite you to join me on a tour of Europe to review recent progress with high speed railway developments. I will also touch on plans and projects outside Europe.
Finally, I shall look ahead to future plans and briefly discuss the challenges that face high speed train operators in the years to come.
The theme of today’s symposium is "Aiming for Further Progress for the Shinkansen". I shall not say a great deal about the Shinkansen, as you all know far more than I do about the world’s premier high speed railway, but the Shinkansen will be the starting point of my presentation.
When the Tokaido Shinkansen opened in 1964, it sparked a fresh interest in railways across the world. At the time, in Europe and North America, there was a school of thought that held railways to be old-fashioned and doomed to extinction. The future, they thought, lay exclusively with jet aircraft and private cars. How wrong they were! That famous opening of the Shinkansen in October 1964 was a milestone in world railway history – and indeed world history.
Since then the concept of high speed train travel has spread to at least 15 countries, with many others building, planning or proposing high speed railways.
At this point, it is important to define high speed. High speed is a relative term, but generally, this is taken to mean 200 km/h or more. That speed is practised on historic infrastructure in many countries, with Portugal touching 220 km/h and Amtrak in the USA 240 km/h – although only on short sections of route. But in most cases speeds higher than 200 km/h demand their own dedicated tracks.

There are at least 12 countries where purpose-built high speed railways are under construction. Today, the benchmark speed for high speed lines is 300 km/h. But one railway already touches 320 km/h, and over the next 10 years we shall see at least two more operators exceed the 300 km/h threshold. And one of them, of course, will be JR East.

I would ask you now to travel back in time to look at some early speed records. Our time machine will land over a century ago in Germany, just south of Berlin, where engineers were exploring what was then a new technology. It was called electric traction. Using a 23 km military railway, they were investigating the potential for speed, and in 1901 they accelerated an electric locomotive up to 162.5 km/h. These early trials were followed by tests with two electric railcars, during which the 200 km/h barrier was breached for the first time.

On October 27, 1903, one of the railcars set a world rail speed record of 210.2 km/h. That momentous feat was over 100 years ago.

Today we take it for granted that we can simulate what happens if engineering is pushed beyond accepted limits. But back in the early 1900s, that was entirely impossible. And because the engineers did not know what would happen, the trials came close to disaster. During one test, a bogie on one of the railcars actually lifted off the rails. But fortunately, it landed back on the track in the same alignment, avoiding tragedy.

We’ll fast forward now for 50 years or so towards the present day to an event that was even more daring. In March 1955, the French Railways, SNCF, staged a series of tests on the main line south of Bordeaux. Two locomotives were regeared, given new pantographs and fitted with monobloc wheels, and 2 trains were prepared by attaching passenger coaches. Every component was checked to ensure that it was in perfect working order for what was to follow. The objective was simply to see how fast the locomotives could go. The test site featured a long straight section – although there was a curve at the far end. This curve was a critical limiting factor, and to ensure the train would slow down in time for the curve, staff were on board just to lower the windows to assist with braking.

Word of the trials had spread to the surrounding area, and when the tests started there was quite a crowd at the line side. These observers were rewarded with a stunning display of what we would today term as raw railway research.

In a whirlwind of noise and dust, the trains flashed past, flinging ballast into the air and trailing clouds of smoke as the pantographs dissolved into shards of red-hot metal. One of the locomotives touched 326 km/h, and the other recorded 331 km/h. This was a truly astounding achievement.

But this exploit also came within a hair’s breadth of catastrophe. Look carefully at the picture on the right, and you will see that the track was seriously bent by the hunting of the bogies (trains). The lesson was that the dynamic forces exerted on the track by high speed trains had to be fully controlled.

This critical factor was fully understood here in Japan when the Tokaido Shinkansen opened between Tokyo and Osaka just nine
years later. The trains were lightweight with low axle loads. This policy has been followed to this day in successive generations of Shinkansen rolling stock. This has also been true for other high speed trains besides the Shinkansen.

Let us stay in France for the moment and move on again to 1981. This was a landmark year for France and for Europe. Not only did SNCF open the first section of Europe’s first high speed line between Paris and Lyon, but its engineers proved to the rest of the world that they had truly mastered high speed technology. Their creation was the TGV or Train à Grande Vitesse, developed after a long programme of research begun in the early 1970s. TGV was a trend-setting train, and the letters TGV have become a household name in France and across Europe.

In terms of railway technology, the TGV broke with tradition. This train had articulated trailer coaches, long wheelbase bogies and the lineside signals were moved into the cab. Maximum speed in commercial service was initially 260 km/h. As part of the preparations for opening the new line between Paris and Lyon, tests were carried out with a specially-modified TGV. SNCF’s tests culminated on February 26 1981 when SNCF grabbed the attention of the world’s media. The TGV test train crushed the 1955 world speed record with a spectacular dash that peaked at 380 km/h. It was proof that high speed rail travel was safe and that the engineers were in full control. Not only that, but there were suggestions that even higher speeds were attainable.

Nine years later, in 1990, French railway engineers hit the headlines once again. By now they had amassed plenty of experience with high speed rail, and they again set out to test the limits of wheel-on-rail technology. This time they were much more confident, they had made extremely thorough preparations, and they had calculated what would happen.

On May 18 1990, TGV Set 325 roared into railway history with a record-breaking speed for a passenger-carrying train of 515.3 km/h. Excluding magnetic levitation vehicles, that record still stands today. But achieving one-off world records is comparatively easy. It is less easy to do it every day in commercial service with real passengers on board. Let’s glance at the history of world speed records in relation to the highest average speeds attained in day-to-day service.

The individual speed exploits are shown above the line. In many cases, these were standard trains that had been specially prepared for the occasion, but some were experimental vehicles that were never going to carry fare-paying passengers. The red line on the graph shows the highest average point-to-point speed in a public timetable from the earliest days of railways to the present day. In 2005 the fastest scheduled service in the world is a TGV between Lyon and Aix-en-Provence, attaining a start-to-stop average speed of 263.3 km/h.

Since its debut on the railway stage in 1981, the TGV has set the pace of high speed railway development in Europe. The second part of the Paris – Lyon high speed line opened in 1983, and in May of that year, the maximum speed was increased from 260 km/h to 270 km/h. By now there were plans for a second high speed line which would serve western France. This project rapidly went ahead, and the TGV Atlantique line became the first in the world where trains ran every day in commercial service at 300 km/h. And so France became the first country in Europe to develop a true high speed network. The following table presents the construction of various routes, and the date of opening.
TGV has been developed over several generations. With each generation came technical advances designed to cut capital and operating costs. SNCF’s standard TGV is now the Duplex, a double-deck design offering a blend of comfort and capacity. SNCF is about to order another 120 Duplex train sets in the next few months.

At the end of last year, Alstom decided to construct a seven-car demonstration AGV at its own financial risk. The AGV demonstrator will be rolled out in 2007. It will have permanent magnet traction motors, 3 metre wide bodies, and the same capital and operating cost per seat as a double-deck TGV. Tomorrow’s AGV will operate at 350 km/h, but it will still be slower than the Fastech 360 of East Japan Railway.

Let us now look at what happened elsewhere in Europe after the launch of the TGV. In Britain, British Rail managers and engineers had their own vision of high speed rail travel. But they knew that they would receive little support from politicians for building a new high speed line.

They concluded that something comparable was possible with new trains on old track. Their brainchild was the Advanced Passenger Train or APT.

The APT had tilting bodies to permit faster running through curves, lightweight aluminium bodyshells, hydrokinetic brakes and a host of other innovations. So many, in fact, that they proved to be its
downfall - there were simply too many types of new equipment on one train. That, combined with design, engineering and industrial relations problems, meant that the train was doomed to failure. APT only ran in passenger service on three occasions. After that, in the early 1980s, the project was abandoned.

In Britain we have a saying that every cloud has a silver lining. This means that something good is always hidden behind something bad. With APT, the silver lining was a train called the HST. This had been developed in case the APT failed to deliver its promise. Based on the best of available proven technology, this 200 km/h diesel train was launched in commercial service in 1976. It still performs frontline duties 30 years later in 2006. It may well do so for another 10 years as contracts have just been placed to re-engine part of the fleet. Its successor, the HST2 is still in the discussion stage, and firm plans have not actually been made.

On the other side of the Atlantic in the USA as well, attempts were made to copy the Shinkansen, but the US politicians did not want Shinkansen costs. As in Britain, the aim was to run new trains on old track. The chosen route was the busy Northeast Corridor linking New York and Washington. High power EMUs, similar in concept to the Shinkansen trains with distributed power, took to the rails in 1967. They were named the Metroliners, and were operated by the famous Penn Central company, which unfortunately went bankrupt shortly afterwards.

The Metroliners were heavy, hurriedly-built and a source of technical headaches. They entered service in 1969, and in 1971 Amtrak took over from Penn Central. Amtrak made the Metroliners work, but they were never the success that the Americans had hoped for.

Let us now go back to Europe. While France was the first country in the world after Japan to launch high speed trains, another European country had tried to be next to the finishing line. Just four years after the Tokaido Shinkansen opened, Italy set out in 1968 to build the direttissima, a high speed line between Rome and Florence. It took much longer than expected. So long in fact, that 22 years elapsed before the 236 km line was finished. But the Italian Railways needed a fast train sooner than that. Yet again, it was a question of new trains on old track. Here the Italians took over the tilting train baton from the British APT. The Italian train was the Pendolino, a name now practically synonymous with tilting trains. An experimental vehicle was tested from 1971 through 1972. This was followed by a four-car prototype called ETR401 in 1975 through 1976.

But many more years passed before the first commercial fleet of ETR450 Pendolino trains entered service. That did not happen until 1988. But the Pendolino was a success, particularly in terms of exports. Derivatives have been built for service in Germany, Spain, Portugal, Slovenia, Switzerland, the Czech Republic and Great Britain. The Pendolino family has also blossomed in its native country.

The first generation trains are now relegated to second-tier services. The second generation trains, known as ETR460, are deployed on premium routes. Currently, the third generation Pendolino is on the production line.

It will enter service next year.

Although the Italian Railways took many years to finish the direttissima, they had ambitious plans for other new lines. The idea was to build a national network stretching from the head to the toe of Italy. For this they did not need a tilting train. They needed high power and high capacity.

The answer was a more conventional high speed train, the ETR500. This has end power cars flanking a set of conventional intermediate coaches.
The direttissima was completed in 1992. The second section of the national network has just been finished between Rome and Naples. The first passengers rode on the Rome – Naples high speed line in an ETR500 train on December 22 2005, although services on this route were limited to just two trains a day in each direction. This was because of delays in commissioning the train control system known as ETCS, European Train Control System, which one day will be widely used across Europe. In the meantime, the number of trains has been stepped up to four a day in each direction, and more trains will be added in June.

Another section of new high speed line has opened even more recently. This was on February 10 between Torino and Novara in Northern Italy. It carried traffic to and from the Winter Olympic Games, but again, the number of trains was limited. However, it was on this route that an ETR500 train set an Italian speed record of 350.7 km/h last October. The Italians are now making rapid progress with their high speed network, which should be completed in 2015.

I should now like to take you north across the Alps to Germany. It was Germany which pioneered operations at 200 km/h in Europe in 1965, but this was limited to a special service for the Munich Exhibition. With one exception, trains were only permitted to run at 200 km/h on a regular basis since 1977. Germany was a late starter in building high speed lines. It has a dense and widely-dispersed population, a strong culture of environmental protection, and a complicated political system. Taken together with the high costs, this meant that building new railways was off the political agenda until the mid-1980s. Compared to the success of France’s TGV at that time, the difference was obvious.

Germany’s first two lines were completed in 1991, one in the East between Hannover and Würzburg, and the second a much shorter line, 100 km long, between Mannheim and Stuttgart. Maximum speed was normally 250 km/h, but drivers were authorised to run at 280 km/h to make up lost time.

Germany’s high speed rolling stock contrasted dramatically with the conservatively designed long-distance trains common in Germany until then. It was distinctive, lavishly-designed – and expensive. Called ICE – InterCity Express, it was intended to woo German customers out of their BMWs and Mercedes, and it did. The original ICE1 design has since been refined and developed. There are now five different types of ICE, including a tilting version and a small fleet of diesel-powered sets which were less successful, but some will carry football teams and supporters during the World Cup this summer.

You will, I am sure, remember that an ICE1 was involved in a catastrophic accident at Eschede in North Germany in 1998. It is important to remember that this accident did not occur on a dedicated high speed line but on an old line that had been upgraded. This means that the safety record of purpose-built high speed lines in Germany, and indeed worldwide, remains superlative.

The newest German high speed train is the ICE3. It has distributed power, a luxurious interior and eddy-current rail brakes which are a revolutionary technology that acts on the rails without using friction. Developed for DB Germany by Siemens, it has since been sold to Spain, China, and possibly Russia. The ICE3 has been designed to operate on Germany’s most important high speed line between Cologne and Frankfurt. This line is of special interest. It has ballastless track which permits 300 km/h travel and has a unique feature, the grades are as steep as 4%, so only ICE3 can run on this track.
Another German high speed line will open in May 2006, linking Nuremburg with Ingolstadt in the south of the country in time to transport passengers for the World Cup.

Let us now move on again, this time to Spain. The Spanish story of high speed is the most remarkable of all. Back in the 1980s, the Spanish railways were not in good condition, nor were they well regarded by the public. At that time, some far-sighted engineers convinced the politicians that a high speed railway should be built from Madrid to Cordoba and Seville. This rail line opened in 1992, marking a watershed in the development of Spanish railways.

The high speed service was known as the AVE, which means “Spanish High Speed” in the Spanish language. Passengers flocked to the new trains which were based on the French TGV, with German train control systems and electrification systems. The Spanish engineers’ faith in high speed trains proved justified. They had built a railway that could compete with the airlines and of course the airlines were duly shocked.

But the significance of the AVE is greater than that. It brought about a real transformation. It changed the way people thought about rail travel, it changed the level of political support for railways, and it changed the railways themselves. Since the early 1990s Spain’s railways have flourished as investment has poured in. For example, no less than 4.5 billion euros are being spent on new trains between 2005 and 2009, and more than one third of that will be invested in high speed trains.

The development of Spain’s network of high speed lines has been remarkable. In this map of Spain, the 2 red lines are lines in service. The orange lines are under construction, and the blue and yellow lines are currently in planning or under investigation. The long-term objective is to serve nearly all principal cities in Spain.

But Spain has a unique problem. This is a problem that people in Japan may be familiar with. The historic network was built to broad gauge (1668 mm), whereas the high speed lines are built to standard gauge (1435 mm). In other words, in order to serve cities off the high speed network, gauge convertible trains were needed. Here Spanish engineers were fortunate in being able to draw on the expertise and experience of the Talgo company, which back in the 1960s had developed a novel type of gauge-convertible train with single stub axles on the trailer cars.

This has since been refined and re-engineered, and the newest Talgo train, the Talgo 350 is designed for 330 km/h.

Another Spanish company, CAF, has developed a second type of gauge-changing high speed train. This is an EMU with gauge convertible powered axles, similar in concept to a prototype built in Japan. The first of these, the Class 120 EMU is now in service.
Furthermore, a gauge-convertible locomotive is being developed. This will be the forerunner of the 44 Talgo power cars that will run at 260 km/h on standard gauge and 220 km/h on broad gauge. This completes our discussion of gauge-changing trains.

Our final look at Spanish high speed trains will be the Velaro E. Depending on the results of the FASTECH 360, the Velaro E may soon be the fastest train in the world.

Built by Siemens for the Madrid – Barcelona service, it is designed to run at 350 km/h. Based on the German ICE3, it is designed for the hot Spanish climate and will have three classes of accommodation. The premium class includes a business lounge at one end with a view through the driver’s cab. This ends our tour of individual countries in Europe.

I would like to add just a few words about international high speed lines. These are the exception rather than the rule in Europe. In fact, there is just one cross-border high speed line in Europe, which links France and Belgium.

It uses TGV derivatives which run from France into Belgium, the Netherlands and Germany under the Thalys brand name. TGVs also link Paris with Italy and Switzerland, but these are not high speed lines across national borders. The most significant international link is between the French high speed network and Britain. This is the Channel Tunnel, used since 1994 by Eurostar trains operating between London and Paris and London and Brussels.

The Eurostar is another derivative of the TGV. This photograph of a Eurostar was taken on the occasion of the British speed record of 334.7 km/h in July 2003.

In the next part of my presentation, I shall look ahead to 2007. This will be a very important year in the history of Europe’s high speed railways. The reason is that several more high speed lines will open. In France the first part of TGV Est which runs through eastern France will be completed between Paris and Baudrecourt. Baudrecourt is located about two-thirds of the way to Strasbourg.

The line speed will be 320 km/h, slashing journey times between the French capital and eastern France. This line will continue on to parts of Germany, Switzerland and Luxembourg.

Most trains on this line will be TGVs, but there will also be 5 specially-modified German ICE3 trains invading French territory for the first time. It took around five years of tests and investigations for the ICE3 to be approved to run in France. This will only be possible after modifications costing 8 million euros per train. There are several reasons for this. To give one example, the ballast between the sleepers is higher in France than in Germany. During trials with the ICE3 in France, the airstreams under the train flung the ballast up, which struck the under floor equipment. Special shields had to
be fitted to protect the equipment. Another issue was the eddy-current rail brakes. These had the potential to cause electrical interference with lineside equipment.

What else will happen in 2007 In Britain we shall see the opening of the second part of the Channel Tunnel Rail Link. Eurostar trains will run at high speed right into the heart of London to terminate at the famous St Pancras station, which is being completely rebuilt for its new role. I am sure you know that from 2009 the line will carry high speed commuter trains that are being built here in Japan. We are looking forward to seeing these trains in England. Also in 2007, more sections of the Italian and Spanish high speed networks will be completed. Still in 2007, we shall see the first high speed line open in the Netherlands. Known as HSL-Zuid, it will join Amsterdam with the Belgian border.

But it will not carry high speed trains to start with. Because of delays with the ETCS train control system, the new line will start out with locomotive drawn trains and conventional coaches at just 160 km/h. This photograph shows a test train, taken in February. Only in 2008 will the Dutch high speed trains take to the rails. These trains are being built in Italy. By the way, an unusual feature of HSL-Zuid is a derailment containment system. This consists of a concrete plinth between the rails of each track. This photograph shows the construction.

Now I shall briefly review progress with high speed railways outside Europe. South Korea has successfully launched its KTX service and is now developing its own design of high speed train. Japan is close to Korea and you all well aware of developments there. In Taiwan, Japanese Shinkansen technology has been adopted for the 345 km line from Taipei to Kaohsiung which is due to open towards the end of this year. China is building a 300 km/h line from Beijing to Tianjin, and it has many plans, including a 1300 km line between Beijing and Shanghai. In the USA, the Metroliners were gradually phased out and replaced by loco-hauled trains. These have also disappeared and have been replaced by the Acela Express.

This train developed by Alstom and its Canadian partner Bombardier, partly using European developed components from the TGV. However, it is still a new train on an old railway, and speed does not exceed 240 km/h.

During the 1970s, Russian Railways developed the ER200 high speed train, which for a time ran at up to 200 km/h between Moscow and St. Petersburg. At that time, St. Petersburg was still known as Leningrad. When I rode it in 1994, the speed was limited to 180 km/h. There was another curiosity; it ran only once a week in each direction.

More recently, a prototype high speed train called Sokol or Falcon was built for the same route between Moscow and St Petersburg. However, Russian industry had little experience with building sophisticated rolling stock, and the train was withdrawn from tests. The high speed line never progressed beyond a ceremonial development start in 1993, but there is a firm project to operate Pendolino trains in a joint venture with Finnish Railways between St Petersburg and the Finnish capital city, Helsinki. This should be established by June this year.
Finally, let us look at the three main challenges facing the operators of high speed railways: cost, competition and the environment.

I shall address these in the reverse order. I believe the main environmental concern is noise. Sound barriers are expensive and can be intrusive for passengers on the trains, hiding the view of the passing landscape. In extreme cases, tunnels have been built to ‘bury’ the noise of the trains, of course the most expensive option of all. Reducing noise emissions is a major technical challenge and I would like to express my respect for the pioneering work has been done here in Japan.

Competition is another area of concern. In Europe, low-cost airlines such as Ryanair and Easyjet have creamed off a slice of the rail market, both domestic and international. Apart from competing directly with rail, these low-cost airlines have driven down the fares of the traditional airlines, which then become a more serious threat to inter-city rail travel. The railways in Europe were slow to respond to this threat, but some are now altering their fare structures to be more competitive with airlines. In France, SNCF has launched iDTGV, a low-cost TGV service modelled on the airlines. Designed to appeal to a young clientele, it offers ultra-low prices, internet bookings, and special on-board attractions. A pilot service on one route proved successful, and SNCF is extending the concept to further routes in 2006. In Italy, a similar concept is called TrenOK, but so far this remains limited to two routes.

The discussion of fares brings me to the question of cost and its implications. Earlier, I mentioned the Channel Tunnel Rail Link. The new line is just 109 km long. It has a price tag of £5.4 billion, which is nearly £50 million or 70 million euros per km. There is talk of extending it north of London, but if the cost per km is the same as the line from the Tunnel to London, it will never be built.

In this chart, the bottom red line shows just how expensive Britain’s first high speed railway is. Fortunately, the situation is not so bad in other countries. But the point is that governments face other calls on their funds such as schools, hospitals and social services. Railways must demonstrate that they are giving good value for money if government funds are used for investment in high speed lines. This is another challenge to engineers. They must develop infrastructure and rolling stock that is cheaper to build and operate, without compromising safety, speed or capacity.

We live in a competitive world. Many arguments favour high speed railways, including their important role as a catalyst for economic development. But tomorrow’s railway engineers and managers must be conscious of the competition. As fuel prices rise, highway and aircraft engineers will develop more efficient cars and aeroplanes. They will be quieter and will generate fewer harmful emissions. So railway engineers must rise to the challenge. They must win the support of their customers and of politicians, who may be the same people. And in that way they can secure the future of high speed railway business and the railroad industry. And taking the example of Spain and Japan, there could soon be a second golden age of railways.

Thank you.