Measures Taken by JR East to Expand Shinkansen Network and Increase Train Speeds

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Introduction

The Tohoku Shinkansen extension from Hachinohe to Shin-Aomori commenced service on 4 December 2012, completing construction of the full Tohoku Shinkansen, which had started just over 40 years earlier in 1971. Moreover, there is much anticipation of the further expansion of the shinkansen network prior to the opening of the Hokuriku Shinkansen through to Kanazawa in late FY2014. (JR East's section of this new line is between Nagano and Joetsumyoko.) This article describes the expansion of the shinkansen network, its current status, and JR East's measures to increase train speeds.

Current Status of Shinkansen Network in JR East Area

JR East's current shinkansen network consists of five lines—the Tohoku Shinkansen (Tokyo–Shin-Aomori), Joetsu Shinkansen (Omiya–Niigata), Hokuriku Shinkansen (Takasaki–Nagano, more commonly known as the 'Nagano Shinkansen'), as well as the Yamagata Shinkansen (Fukushima–Shinjo) and Akita Shinkansen (Morioka–Akita), which both use a dual-gauge method for run through-services on both shinkansen and conventional tracks (mini-shinkansen).

The lines extend to about 1135 km (or 1411 km, if including the dual-gauge through-service tracks) carrying 328 trains every day. The annual transport figure is approximately 18.4 billion passenger-km with about 87 million passengers each year (Fig. 1).

Development of Shinkansen Network in JR East Area

Table 1 lists the details of the JR East shinkansen network development.

The Ueno–Morioka section of the Tohoku Shinkansen and the Omiya–Niigata section of the Joetsu Shinkansen were inaugurated during the Japanese National Railways (JNR) era. Upon the 1987 creation of the JR group of railway operators, ownership of the shinkansen lines was transferred to the Shinkansen Holding Corporation (hereafter SHC, dissolved in 1991), which leased the tracks to JR East and the other JR operators. (The Tokyo–Ueno section of the Tohoku Shinkansen, which was built by the SHC after the creation of JR East, was handled in the same manner.)

However, after the October 1991 abolition of the shinkansen track lease system, JR East purchased the Tohoku Shinkansen (Tokyo–Morioka) and Joetsu Shinkansen (Omiya–Niigata) tracks, which remain company assets today.

The Yamagata and Akita shinkansen lines were not shinkansen as defined by the Nationwide Shinkansen Railway Development Act, but were existing narrow-gauge lines that were widened with dual-gauge tracks to allow through-services for both shinkansen and conventional trains (mini-shinkansen). To reduce dual-gauging work in tunnels and on bridges which would have been necessary if the standard shinkansen loading gauge had been used, special mini-shinkansen carriages with conventional-train carriage loading gauge were used to provide through-services.

The Japan Railway Construction, Transport and Technology Agency (JRTT) was the body responsible for construction of the Takasaki–Nagano section of the Hokuriku Shinkansen and the Morioka–Shin-Aomori section of the Tohoku Shinkansen in accordance with the projected shinkansen development scheme. These shinkansen were constructed as public works and then leased to JR East as the operator.

Lines and sections called 'projected shinkansen' (Aomori-Sapporo on Hokkaido Shinkansen, Morioka-Aomori on Tohoku Shinkansen, Tokyo-Omiya on Hokuriku Shinkansen (using Joetsu Shinkansen tracks between Tokyo-Takasaki), Fukuoka-Kagoshima and Fukuoka Nagasaki on Kyushu Shinkansen) had been designated in the November 1973 development plan based on the Nationwide Shinkansen Railway Development Act. Although development of these projected lines were put on hold in 1982, the plan was reinstated in 1987.

Figure 1 JR East Shinkansen Network

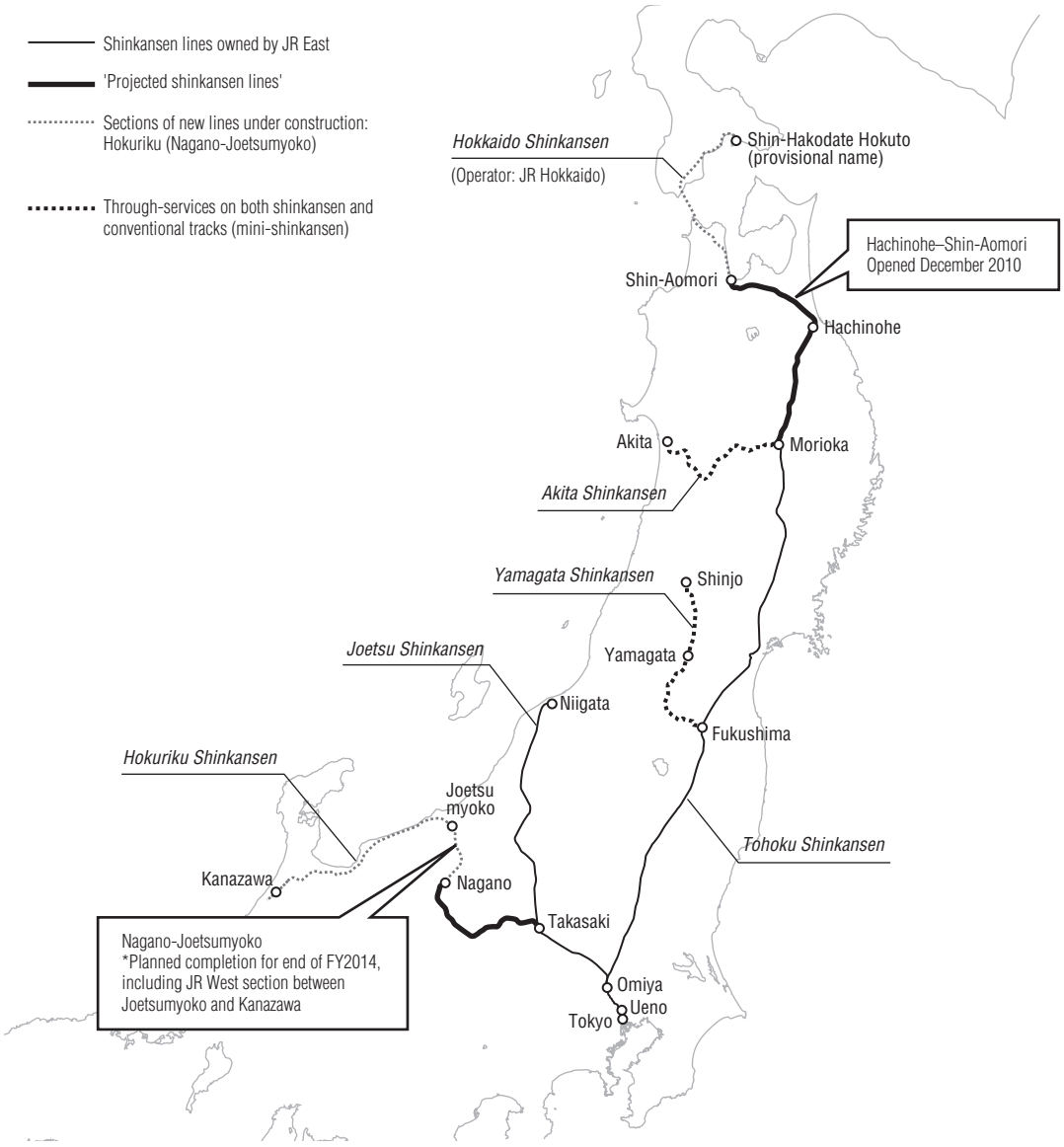
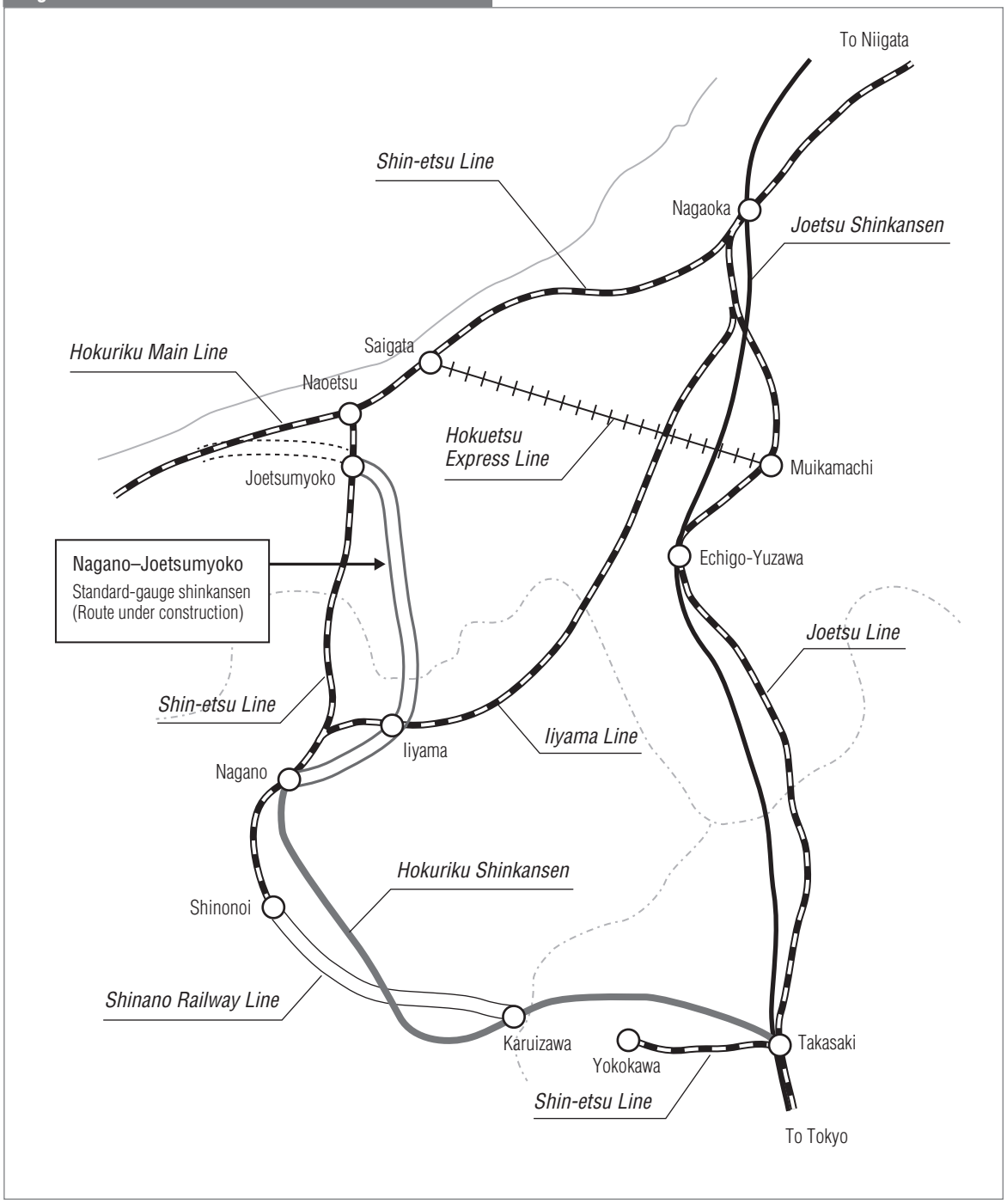


Table 1 Chronology of Shinkansen Opening (JR East Area)

Date of Opening	Line	Section
23 June 1982	Tohoku Shinkansen	Omiya–Morioka
15 November 1982	Joetsu Shinkansen	Omiya–Niigata
14 March 1985	Tohoku Shinkansen	Ueno–Omiya
20 June 1991	Tohoku Shinkansen	Tokyo–Ueno
1 July 1992	Yamagata Shinkansen	Fukushima–Yamagata
22 March 1997	Akita Shinkansen	Morioka–Akita
1 October 1997	Hokuriku Shinkansen	Takasaki–Nagano
4 December 1999	Yamagata Shinkansen	Yamagata–Shinjo
1 December 2002	Tohoku Shinkansen	Morioka–Hachinohe
4 December 2010	Tohoku Shinkansen	Hachinohe–Shin-Aomori

Figure 2 Shinkansen Sections Under Construction



The JR East Hokuriku Shinkansen Nagano–Joetsumyoko section is currently under construction by JRTT, which is working to build a line to full (not mini) shinkansen specifications opening in spring 2015 (Fig. 2). In terms of progress, the track laying completion ceremony was held in May 2014 and test runs are currently underway using shinkansen cars to confirm the functions of the structures, tracks, overhead catenary and signals. Following opening, the plan is to run through-services in cooperation with JR West between Nagano and Joetsumyoko, and Joetsumyoko and Kanazawa (which will open at the same time). This will result in the addition of a new shinkansen line linking Greater Tokyo with the Hokuriku region. In addition, JR East and JR West are jointly developing a new Series E7 car (known as W7 in the JR West area) for the line. Following the March 2014 timetable revision, the new Series E7 started running on the Tokyo–Nagano section ahead of opening the through-section to Kanazawa.

The chronology of shinkansen car changes is shown in Figure 3 (see Figure 4 for details of the Series E7).

Figure 3 Chronology of Car Changes (JR East Area)

	1980 ~	1990 ~	2000 ~	2010 ~
Tohoku Shinkansen	Series 200 (Jun 1982 ~) 	Series E2 (Mar 1997 ~)  Series E4 (Dec 1997 ~) 		Series E5 (Mar 2011 ~) 
Akita Shinkansen		Series E3 (Mar 1997 ~) 		Series E6 (Mar 2013 ~) 
Yamagata Shinkansen		Series 400 (Jul 1992 ~)  Series E3 (Dec 1999 ~) 		
Joetsu Shinkansen	Series 200 (Nov 1982 ~) 	Series E1 (Jul 1994 ~)  Series E4 (May 2001 ~) 		
Hokuriku Shinkansen		Series E2s (Oct 1997 ~) 		Series E7 (Mar 2014 ~) 

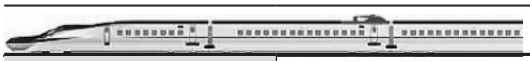
Figure 4 Overview of Series E7

	Series E7
No. of Cars	12 (10M2T)
Capacity (No. of Passengers)	*GranClass*: 18 *Green Car*: 63 Ordinary Cars: 853
Livery	Roof: Sky Blue Lower Side: Ivory White Band: Copper and Sky Blue
Interior	Keyword: *Wa* (Harmony/Japonesque) Concept: Future of *Wa*

Figure 5 Overview of Series E5 and E6

Series E5

No. of Cars	10 (8M2T)
Capacity (No. of Passengers)	*GranClass*: 18 *Green Car*: 55 Ordinary Cars: 658
Livery	Roof: *Tokiwa* Green Lower Side: *Hiun* White Central Band: *Hayate* Pink
Interior	Keywords: Comfort, Kindness, Yours Concept: Exclusive Dream – A Special Travel Moment for You



Series E6

No. of Cars	7 (5M2T)
Capacity (No. of Passengers)	*Green Car*: 23 Ordinary Cars: 315
Livery	Roof: Madder Red Side: *Hiun* White Central Band: Arrow Silver
Interior	Keywords: Comfort, Kindness, Yours Concept: Careful attention to detail

Table 2 Tohoku Shinkansen Speed Increases

Date.		March 2011	March 2013	March 2014
Top Speed	Omiya–Utsunomiya	275 km/h	275 km/h	275 km/h
	Utsunomiya–Morioka	300 km/h	320 km/h	320 km/h
Journey Time (Tokyo–Shin-Aomori, fastest train)		3 hours 10 minutes	2 hours 59 minutes	3 hours 37 minutes (Tokyo–Akita)
Series		Series E5 300 km/h	• Series E5 320 km/h • E5/E6 coupled 300 km/h	E5/E6 coupled 320 km/h

Measures Taken to Increase Speed

As explained above, the JR East shinkansen network is well developed, including through-services using shinkansen and conventional tracks and completion of projected shinkansen sections. However, in addition to these developments, it is essential to shorten travel times by implementing measures to increase speeds to gain a competitive advantage over air travel.

JR East has been actively developing technology to increase shinkansen speeds. Running tests using the 'FASTECH360' experimental high-speed shinkansen cars have been conducted since FY2005 to research speed, reliability, environmental friendliness, and comfort, both in terms of cars themselves and trackside facilities and equipment. Based on the technology research outcomes, we succeeded in accomplishing passenger services on the Series E5 *Hayabusa* running at a top speed of 300 km/h from March 2011. This was further increased to 320 km/h in March 2013, the fastest speed yet in Japan. These achievements have been highly praised by many customers.

Furthermore, we started operating Series E6 pre-mass production cars on the Akita Shinkansen from late FY2012; these trains have also been running at a top speed of 320 km/h since March 2014.

Overview of Tohoku Shinkansen Speed Increases

- High-speed operations implemented on Omiya–Morioka section
- High-speed operations implemented using new train cars (Series E5 and E6)
- Increased commercial speeds introduced gradually from March 2011 to late fiscal 2013

It is no exaggeration to say that the maximum speed is dictated by environmental performance, so environmental measures are an essential element in efforts to increase speed. To date, measures have been implemented both onboard, at trackside facilities, and on equipment to control noise. In specific terms, the nose and body shape of the new Series E5 was designed to reduce running noise, and a noise-reducing pantograph design was also used. In terms of track facilities, the height of noise barriers has been increased and tunnel portals have been fitted with hoods to reduce pressure waves and tunnel boom. Further technologies are being developed to achieve higher speeds without increasing environmental noise pollution.

Introduction of *GranClass* (Series E5)

In March 2011, the new Series E5 *Hayabusa* made its debut on the Tokyo–Shin-Aomori Tohoku Shinkansen. In addition to ordinary and *Green Cars*, *Hayabusa* features the first-

Series E5 *GranClass* car (JR East)

ever first-class car called *GranClass* on a shinkansen. The *GranClass* cars provide a travelling space and services with a level of luxury and comfort never seen before on Japanese railways, and customers have been extremely enthusiastic about this new class. The name *GranClass* is a neologism based on the French word for 'large' and the English word 'class'. It expresses the luxury feel of the cars as well as their spaciousness and comfort, which are the most notable characteristics.

The design concept is 'Exclusive Dream – A Special Travel Moment for You'. The interiors feature materials with a luxury texture and feel, as well as soothing lighting, all of which combine to create a refined and elegant space. With a long seat pitch and only three seats abreast, the *GranClass* cars achieve a sense of space and comfort, with a novel back shell design enhancing the feeling of privacy.

The in-car service concepts are 'a space just for you (personal)', 'the best of everything (quality time for customers)' and 'originality (unique appeal of Tohoku Shinkansen)'. Special *GranClass* attendants provide in-car service, offering lunch boxes consisting of seasonal local cuisine to express regional characteristics and a sense of the changing seasons. In terms of amenities, passengers are provided with blankets, slippers and eye masks, as well as a choice of newspapers. JR East is planning to introduce *GranClass* cars in cooperation with JR West on the Hokuriku Shinkansen when it opens in late FY2014.

Opening of Hokkaido Shinkansen to Shin-Hakodate Hokuto

The Hokkaido Shinkansen to Shin-Hakodate Hokuto is expected to open in late FY2015. Although the operator is JR Hokkaido, if through-services with the Tohoku Shinkansen are planned, preparations and coordination of various facilities are necessary, including operation plans and operation management systems.

Furthermore, joint through-services through the Seikan Tunnel, which currently serves conventional trains with a top speed of 140 km/h, will require confirmation of safety measures by all relevant parties, including the national government.

Table 3 Seats in *GranClass* and *Green Cars*

Item	*GranClass*	*Green Car*
Capacity (No. of Passengers)	18	55
Seat Pitch (mm)	1300	1160
Seat Width (mm)	520	475
Armrest Width (Sides and Center) (mm)	94/260	70/140
Partition	Yes	No
Reading Light	Adjustable	Adjustable
Table (mm)	500×250 (with forward/back slide)	420×250 (no forward/back slide)
Seatback (Reclining Angle)	Electric operation (45°)	Manual operation (31°)
Seat (Slide/Tilt)	Electric operation	No slide/tilt function
Leg Rest	Electric operation	Electric operation
Foot Rest	Electric operation	None
Head Rest	Manual up-down adjustment	Manual up-down adjustment
Operation from Seating Position	All seatback, seat, and leg controls can be operated together or adjusted separately	Seatback and leg controls are operated separately

Conclusion

Japan's shinkansen network is continuing to expand and JR East is committed to providing its passengers with comfortable and attractive services. The company will also work with trackside communities to achieve further development through various measures, including tourism promotion. ■

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