

Air-Rail Links in Japan

35 Years Old and Healthier than Ever

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Air-Rail Links in Japan Today

During 1998, in many different parts of the world, getting to the airport became easier due to construction of new air-rail links (ARLs). Three airports: Hong Kong International Airport at Chek Lap Kok, Copenhagen Airport at Kastrup, and Oslo International Airport at Gardermoen, opened their first ARLs, while two other airports: London Heathrow and Haneda Airport in Tokyo each gained a second rail link. 1998 was one of the best years ever for ARL construction and 47 airports worldwide now offer rail access to the cities they serve.

Tokyo's Haneda Airport (HND) was built on Tokyo Bay, 14 km south of the heart of the metropolis. When the Alweg-type (straddle-beam) monorail began linking the airport to downtown in September 1964, Haneda was Japan's gateway for international passengers. The Tokyo Monorail, Japan's first ARL, symbolized the start of the nation's high-growth period, after the post-war chaos and long process of recovery. The timing of the monorail's inauguration was opportune because the 1964 Tokyo Olympic Games started 1 month later. The Alweg-type of monorail had been developed by a Swede, Dr Axel Leonard Wenner-Gren in West Germany in 1952, but its first practical application was in Tokyo. Straddling a single beam, the train took advantage of a unique system never seen before in railway history.

The Tokyo Monorail was the world's fourth major ARL, and the first built outside Europe. The first three, all conventional railways, were built to serve Brussels (1955), London's Gatwick (1958) and Berlin's Schönefeld (1962).

Before the monorail started running, and for some years afterward, Haneda was Tokyo's only airport. In 1965, the year after the monorail was opened, the airport was used by about 3 million domes-

tic and 860,000 international passengers. In the same year, the monorail carried about 2.74 million people, including some non-flying passengers who used it as a transit system. In 1978, airline traffic in Japan grew to such an extent that a new airport serving Tokyo was opened for international flights. This was the New Tokyo International Airport at Narita. Haneda basically became Tokyo's domestic airport, but passenger traffic for both the airport and monorail continued to grow. According to the ACI (Airports Council International) Report, Haneda served about 49.3 million airline passengers in 1997, while the Tokyo Monorail carried even more people—about 65.2 million.

On 18 November last year—a little more than 34 years after the first monorail services began—Haneda gained a second ARL. This second link is a 3.2-km extension of the Kuko Line operated by Keihin Electric Express Railway Co., Ltd. (generally known as Keikyu). This company has long operated a railway linking Tokyo and Yokohama, with trains also providing through services on Tokyo's metropolitan Asakusa subway line. In fact, Keikyu's trains even carry passengers to Narita, using the Keisei Line operated by the Keisei Electric Railway co., Ltd. Keikyu's rail link to Haneda Airport is projected to carry 50,000 people daily, and will surely cut into the market long enjoyed by the monorail.

At present, Japan has seven airports boasting ARLs (Table 1). In order of ARL construction, they are: Haneda Airport (HND) in Tokyo; Narita Airport (NRT) serving Tokyo; Shin-Chitose Airport (CTS) serving Sapporo; Fukuoka Airport (FUK); Kansai International Airport (KIX) serving Osaka; Miyazaki Airport (KMI); and Itami Airport (OSA) serving Osaka. Only two airports, Narita and Kansai International, were designed from the beginning with an ARL in mind—lines were laid to the other five airports after airline passenger loads had

grown. Three airports: Haneda, Narita, and Kansai International, each have two ARLs, using mostly conventional tracks (urban/suburban heavy rail, subways, or main line railways), while Haneda and Itami use monorails as one of their ARLs. Japan was the first country to build a high-speed train (the shinkansen), but the honour of having the first high-speed train serving an airport went to France when its TGV began linking Charles de Gaulle Airport to Paris. Unlike Frankfurt Airport in Germany, Japan has no plans to bring similar high-speed services to any of its airports. When Narita Airport was still on the drawing board, the Japanese government gave approval to a project to link the airport to the shinkansen network, but the line was never finished. In my opinion, the decision to abandon construction was a mistake.

This article examines the ARLs joining Tokyo's two airports to the metropolis, and discusses their early and later developments. I will also discuss ridership on these and other ARLs in Japan, and then focus on public assistance for construction of costly ARL infrastructure, and plans for the development of future links. I will also look briefly at factors to consider when planning ARLs.

Air-Rail Links to Tokyo's Airport at Haneda

Japan is in the Far East—an apt term considering that the country is close to the eastern extremity of Asia, facing the Pacific Ocean. The four main islands of Japan stretch about 2000 km in a generally north-south direction (2800 km if smaller Okinawa islands in the southwest of Japan are included). Tokyo is in central Honshu and close to the nation's geographic centre. Its central position in the archipelago, plus of course its importance and size, have made it the largest transportation hub in Japan and a gateway for flights from all over the world.

After several years of confusion follow-

Table 1 Japanese Airports with Air-Rail Links

(March 1999)

City/Airport	No. of airline passengers per year (ACI Report, 1997)				World rank (1997)	Airport location (from city centre)	ARL type	ARL operator	Minutes from city centre	Wide area service
	Total	International	Domestic	In transit						
1. Tokyo/Haneda (HND)	49,300,000	840,000	48,430,000	20,000	6	14 km south	1. Monorail 2. Urban/suburban heavy rail	Tokyo Monorail ^P Keikyu ^P	30 30	No No
2. Tokyo/Narita (NRT)	25,670,000	22,940,000	800,000	1,920,000	26	55 km east	1. Urban/suburban heavy rail** 2. Urban/suburban heavy rail	Keisei ^P JR East	60 60	No Yes
3. Osaka/Kansai (KIX)	19,750,000	10,800,000	8,290,000	660,000	42	35 km southwest	1. Urban/suburban heavy rail 2. Urban/suburban heavy rail	JR West Nankai ^P	30 30	Yes No
4. Fukuoka (FUK)	17,290,000	2,490,000	14,800,000	—	46	4 km east	Subway	Fukuoka Municipal Government	10	No
5. Sapporo/ Shin-Chitose (CTS)	16,840,000	380,000	16,460,000	—	48	38 km southeast	Main line	JR Hokkaido	35	Yes
6. Osaka/Itami (OSA)	13,740,000	—	13,740,000	—	67	14 km north	Monorail	Osaka Kosoku ^S	Approx. 25	No
7. Miyazaki (KMI)	3,400,000*	10,000	3,390,000	—	—	5 km south	Main line	JR Kyushu	10	Yes

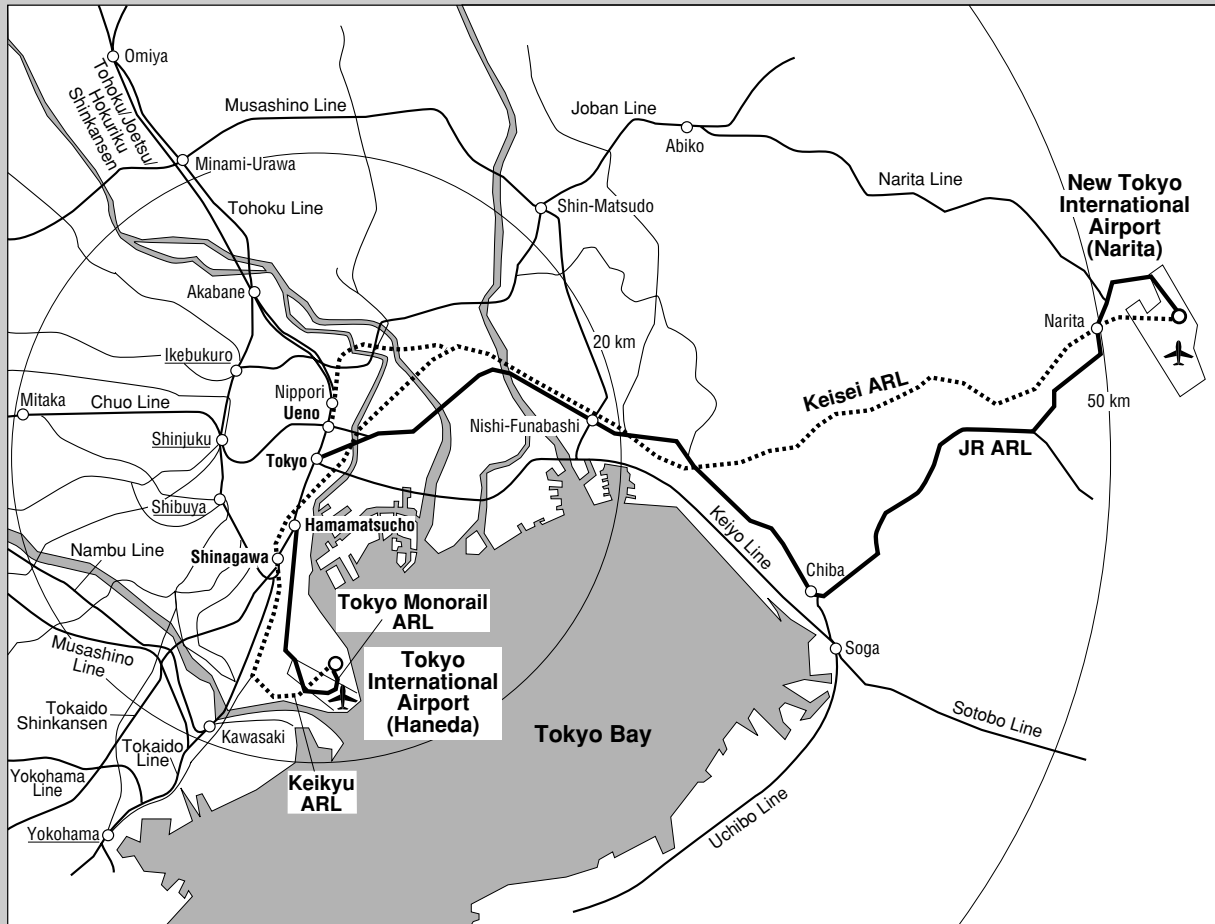
Notes: *: 1996 figures
 **: Plus subway
 P: Private railway
 S: Public/private corporation
 JR: Railway companies formed by privatization of JNR

ing World War II, the nation's private airlines began flying again in the early 1950s. As the country's economy expanded year by year, air passengers, both domestic and international, increased in number. In 1959, when the plan to develop an ARL for Haneda Airport was unveiled, about 540,000 domestic and 370,000 international passengers were using the airport. This totals only about 910,000 people, but there was every reason to believe that the figure would increase dramatically in 1964, the year of the Tokyo Olympic Games. Some people proposed extending the Tokyo Expressway to the airport instead, but it was obvious that this would only worsen road congestion as it took more than 1 hour to drive the 14 km from downtown Tokyo to the Airport even then. After some false starts, Japan Elevated Electric Railway Co. was established in 1960 to push through a rail link to Haneda. This company boldly chose an Alweg-type monorail, which Hitachi, Ltd. was eager to build in Japan under a technical cooperation arrangement. The

Alweg-type straddle-beam monorail was chosen for a number of reasons. First, the president of the new company, Tetsuzo Inumaru (who was also President of the Imperial Hotel, one of Japan's best hotels), was an old friend of the monorail developer, Dr Wenner-Gren, and had long been keen to introduce the technology to Japan. Second, Hitachi, Ltd., one of Japan's most important manufacturers of heavy electrical equipment, was very interested in the new system and saw great potential in developing its technology. The Tokyo Monorail became Japan's first ARL but one problem immediately became evident to passengers—since the trains could not run on conventional track, they could travel no further than the ends of the track, forcing passengers to disembark after a comparatively short ride. Furthermore, the monorail track from the airport ended at Hamamatsucho Station on the Yamanote Line, a loop line surrounding central Tokyo. The station, however, is still 3 km south of the business centre and Tokyo Station, the nation's

most important railway terminal (Fig. 1). The 13-km line running south to the airport on Tokyo Bay is a double-track line, except for 1-km stretches at each end. The only stations were the two terminals. (Four intermediate stations were built between 1965 and 1985 as urban development spread to the monorail corridor.) The two-level station at the airport was constructed under the parking lot in front of the airport terminal building. The construction proceeded rapidly—approval was obtained from the Minister of Transport in December 1961, construction began in May 1963, and the line was in operation by September 1964. The journey time from Hamamatsucho Station to the airport was 15 minutes, with departures every 7 minutes and the fare was ¥250. Total construction costs were ¥20 billion for infrastructure and ¥1.1 billion for rolling stock, totalling ¥21.1 billion or ¥1.6 billion per km. Incidentally, the total cost for building the 515-km Tokaido Shinkansen was about ¥400 billion or about ¥0.8 billion per km, half that of the

Figure 1 Tokyo's Major Railways and Airports



Tokyo Monorail ARL approaching Haneda

(Author)

Tokyo Monorail. The Tokaido Shinkansen began operations on 1 October 1964, just 2 weeks after the monorail.

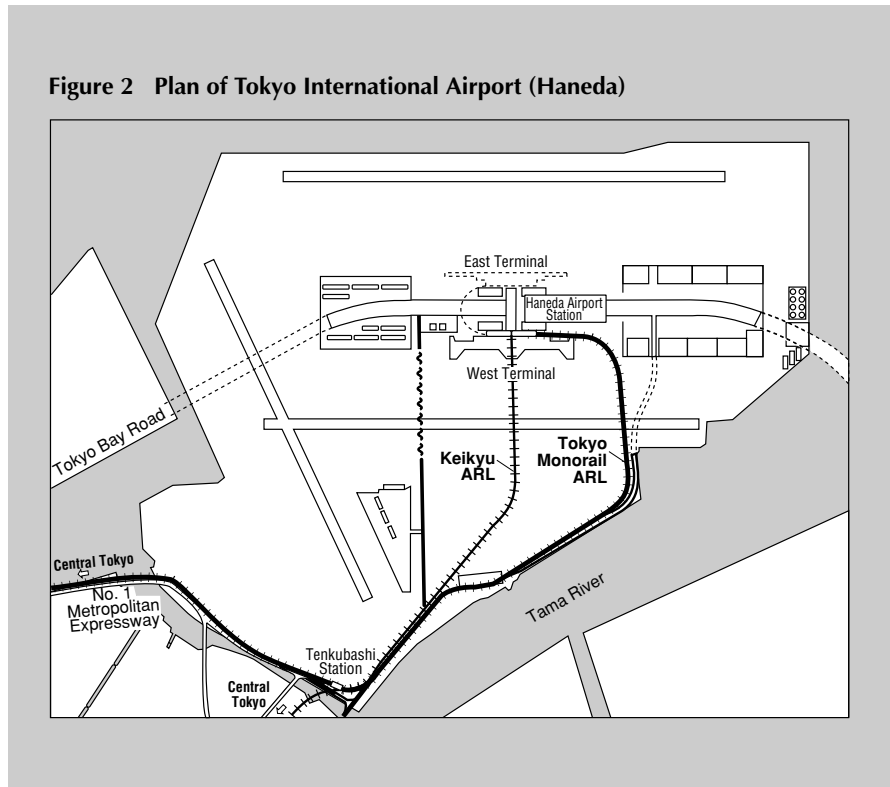
It is worth noting that the monorail was developed and constructed solely by the private sector, without any financial assistance from the government, airport authorities, or the aviation industry. Operations first became profitable in 1972 and have been in the black ever since. Monorail ridership surged in the following years as air travel became more popular. Then, in 1978, Tokyo's second airport opened at Narita for international traffic, and Haneda was relegated to serving domestic air travel. As a result, both Haneda and the monorail experienced a drop in passengers for some time, but domestic

flights to Haneda continued to increase to such an extent that, in February 1983, the Ministry of Transport (MOT) began an expansion project to boost Haneda's annual passenger handling capacity from 22 million to 85 million. This expansion involves increasing the airport area from 408 to 1100 hectares, and constructing two new terminal buildings (West and East terminals situated between two parallel 3000-m class runways).

Because the site for the new Haneda terminal buildings was moved about 2.5 km east, the road and rail links had to be extended. A plan to extend the existing monorail line to the new terminals was accepted, as was the request from Keikyu to extend its own line, which had terminated west of the airport.

While 2 km of the existing track serving the old terminal was closed, the monorail was extended 6 km to the new Haneda Airport Station adjacent and parallel to the West Terminal (Fig. 2). Two kilometers of this extension are elevated, with the remaining 4 km underground. The 6-km extension is entirely double-tracked, and has one new intermediate station. The line from Hamamatsuchō Station to the airport terminal is now 4 km longer and it takes 22 minutes to travel the 17 kilometers. This extension and the West Terminal Building were both opened on 27 September 1993.

On the same day, the Kuko Line owned by Keikyu, was extended as far as Haneda Station (now Tenkubashi Station) (Fig. 2). This arrangement was obviously of a provisional nature, because Haneda Station was not adjacent to the airport terminal and passengers had to transfer to the monorail. This inconvenience ended last year on 18 November when Keikyu opened its extended line to the new West Terminal, permitting passengers to travel directly between the airport and downtown Tokyo. The extension involved moving 0.8 km of existing track underground, and tunnelling an additional 3.2



km to the new terminal. The extension is double-track and has one intermediate station (Tenkubashi Station). The Keikyu rail terminal, called Haneda Airport Station, is located conveniently between both terminal buildings. (The East Terminal is still under construction, so passengers only have access to the West Terminal.) The 15-km journey from the airport to Shinagawa, 6 km south of the city centre, now takes 16 minutes (Fig. 1). The Keikyu trains offer more convenience because they also provide through services to the city centre and beyond on the Asakusa subway line and the Keisei Line. This latter through operation has made it possible for passengers to travel directly by express trains from Haneda Airport to Narita Airport in 1 hour 42 minutes (although there are only four trains each day). Or, by transferring onto the Yamanote Line at Shinagawa Station, Keikyu passengers have ready access to other major centres

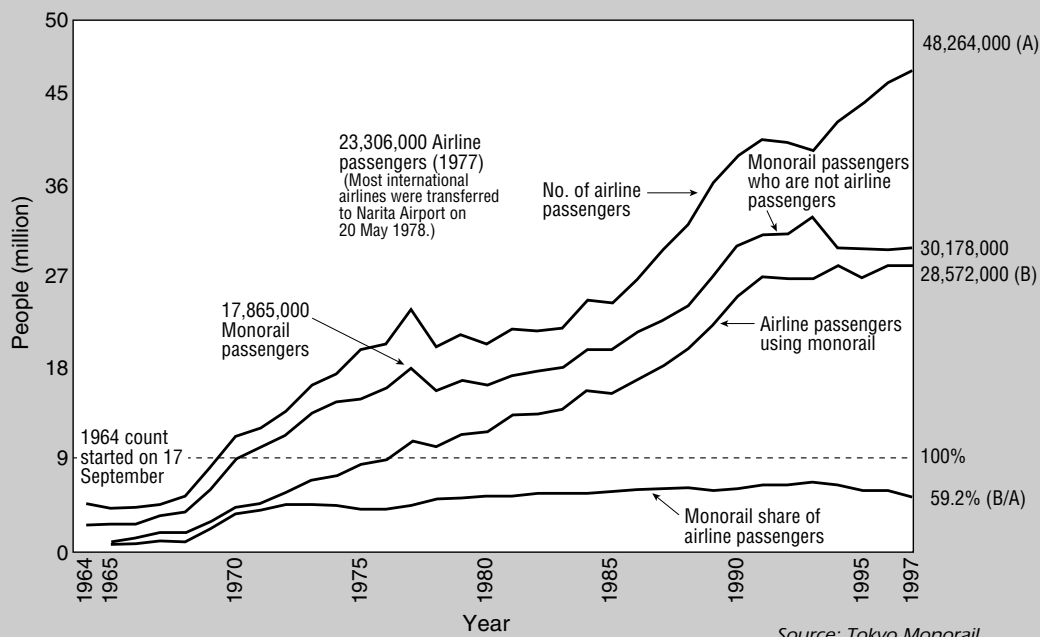
in the metropolis, such as Shibuya, Shinjuku, and Ikebukuro. These new and convenient connections pose an obvious threat to the monorail.

Incidentally, the construction costs for extending the monorail and the Kuko Line were both approximately ¥80 billion. Figure 3 shows how the monorail has



Keisei train at Haneda Airport Station, served by trains from four companies (Author)

Figure 3 Number of Airline Passengers (inc. International) at Haneda and Tokyo Monorail Users



Source: Tokyo Monorail

fares since its inception. Of the approximately 48 million people who flew into or out of Haneda in 1997, about 28 million used the monorail, giving a ridership share of 59.2%. The share has remained stable at around 60% for many years, but Keikyu's new Kuko Line will surely reduce the share. This is a matter of obvious interest for all parties concerned.

Air-Rail Links to Tokyo's International Airport at Narita

Narita Airport (known officially as New Tokyo International Airport) opened in 1978. Located some 55 km east of the metropolis, it is Tokyo's second airport and the country's largest international gateway. The large majority of flights are international, except for a few connecting domestic flights. Compared to Haneda's location close to central Tokyo, Narita Air-

port is inconveniently situated from central Tokyo, so ARLs were naturally part of the overall plan from the beginning. In 1966, when the First Sato Cabinet approved construction of Narita, it also approved a policy promoting construction of railway lines from Tokyo to the new airport. Planners projected construction of two ARLs, one operated by JNR (now JR), the other by the Keisei Electric Railway Company, Ltd. Neither plan had reached fruition when the airport opened; JNR had plans to build a shinkansen to the airport but the plan ran into tremendous opposition from municipal governments and people located near the proposed line as soon as they realized there would be no benefit to them and that their environment would suffer. When construction was suspended in 1982, the only part of the line constructed was a 9-km stretch of roadbed from the

airport, and the airport station shell. Later, when JNR was privatized and split into the JRs in 1987, the government passed a law that officially halted the Narita Shinkansen project. The debt and unfinished facilities passed into the hands of the JNR Settlement Corporation. But this did not mean that the MOT had forgotten the issue after Narita Airport opened. In May 1981, the Ministry established the Committee to Study High-speed Rail Access to New Tokyo International Airport, making it a consultative body to the Head of the Railway Supervision Bureau with power to recommend a substitute for the cancelled Narita Shinkansen. The Committee examined proposals that the existing rail network be linked to the airport using parts of other lines that had already been constructed or were still in the planning stages. The Committee announced its findings in May

1982, making three alternative proposals that it labelled A, B and C.

Proposals A and B each promoted construction of a conventional narrow-gauge line instead of a shinkansen line, while Proposal C was only an interim plan. Proposal A envisaged a 72-km route running partly on JNR's Keiyo Line, that the Japan Railway Construction Public Corporation (JRCC) was constructing at the head of Tokyo Bay. The line would be operated by JNR. Proposal B suggested a 65-km route over lines owned by a number of different companies: the Keisei Line, the metropolitan Asakusa subway line, the Hokusō Line (under construction at the time), and a railway line built and operated by the Housing and Urban Development Public Corporation (also under construction at the time). The route would be operated jointly by the owners of each of these lines, meaning the involvement of both the public and private sectors. In November 1984, the MOT announced that it would proceed with Proposal B, but once again the momentum collapsed and met the same fate as the Narita Shinkansen.

Keisei Electric Railway Company, Ltd. already had trains running on the Keisei Line from Ueno, near the city centre, to Narita City (about 8 km from the airport) and sensing an excellent return on the investment, decided to extend the line to the airport. The plan was approved by the Minister of Transport in November 1969. Construction began in November 1970 and the line was finished in November 1972. The extension was double-tracked over its entire length of 7.2 km, and had no intermediate stations. Unfortunately, the station serving the airport was constructed halfway between Terminal 1 and Terminal 2 (Terminal 2 was in the planning stages at the time), so passengers had to board a bus between the station and terminals. The change took only a few minutes but was a source of great annoyance.

This extension cost about ¥10 billion. Keisei spent another ¥12 billion to upgrade its terminal at Ueno, as well as additional money to permit faster speeds on existing tracks. This enormous investment, and the company's zeal in pushing through construction as fast as possible, brought no fruit for several years because the airport opening was delayed until May 1978. Needless to say, Keisei found itself in financial difficulties during the delay. Furthermore, once the trains started running, passengers immediately began complaining about the airport station's location and the need to change to a bus. Keisei's special *Skyliner* express train took 60 minutes to travel the 68 km between Ueno and Narita Airport, but the inconvenience at the airport kept Keisei's ridership share low.

During the year after regular flights started at Narita, about 8 million passengers used the airport. The figure climbed steadily each year, reaching 15 million in 1987 and 20 million in 1990. A survey in November 1987 showed that only 19.3% of all passengers at Narita Airport used the Keisei *Skyliner*—the vast majority opted to go by road instead. At that time, the *Skyliner* took 70 minutes from Ueno to the airport, including the bus connection.

This was exactly the same time as scheduled runs by Airport Limousine buses serving Tokyo City Terminal (TCAT) in downtown Hakozaeki. However, the buses were not always on schedule because they frequently encountered traffic congestion.

Act I in this sorry tale was the start of airport traffic on the Keisei Line in 1978. Act II was the abandonment of construction of the Narita Shinkansen in 1987. Act III starred Shintaro Ishihara, the Minister of Transport who was also a well-known novelist. After reviewing the situation, in June 1988, Ishihara announced that his Ministry would ensure that the underground station built for the abandoned Narita Shinkansen adjacent to the airport terminal (now Terminal 1) would be made available to Keisei and JR trains. His plan was similar to the earlier Proposal C. Under the plan, *Skyliner* passengers would benefit because they would no longer have to make a bus connection to the airport. The new JR East would also benefit because it would be able to offer a direct connection from central Tokyo to the airport terminal.

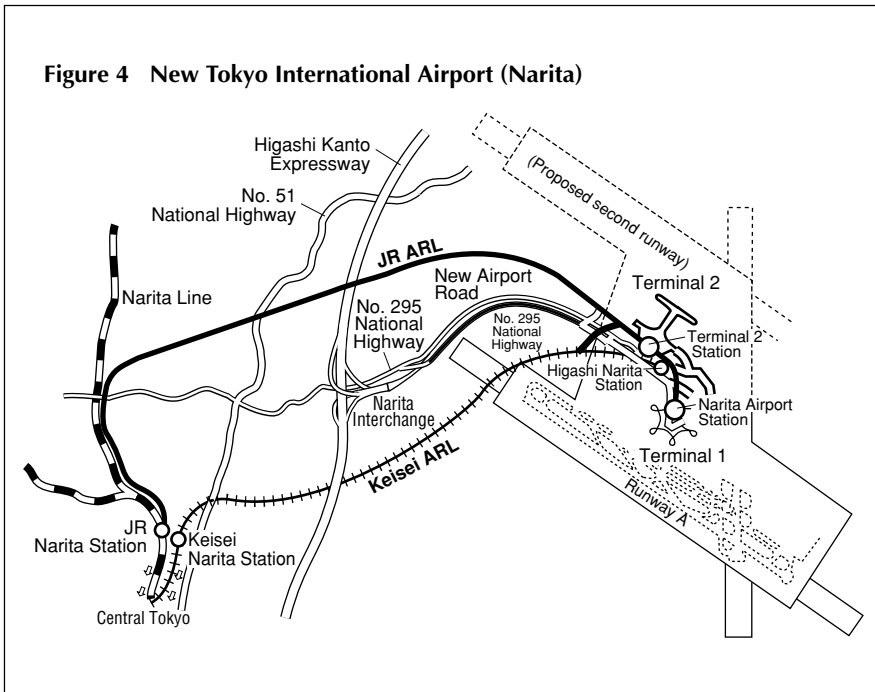
Ishihara's decision broke new ground in another sense as well. The construction of the elevated railway infrastructure and



Keisei Skyliner at Ueno Terminal

(Author)

Figure 4 New Tokyo International Airport (Narita)



the provision of loans to JR and Keisei would be entrusted to a new company using investments from both the public and the private sectors. In accordance with the 1986 Railway Enterprise Law (enacted as part of the JNR privatization process), the company was classified as

a Category-III railway business that provides rail infrastructure. Accordingly, on this particular section, JR East and Keisei were named as Category-II railway enterprises, which run trains on leased tracks. Prior to this law, both the 1922 Railway Construction Act (regulating the construc-

tion of national railway lines) and the 1919 Local Railway Act (controlling private railway businesses) had assumed that each railway enterprise should be responsible for building lines, maintaining tracks, and running trains. However, the Railway Enterprise Law opened a new era by classifying railway businesses into three categories—Category-I responsible for both infrastructure and operations, Category-II engaged only in operations, and Category-III in charge of infrastructure. As a result, the Narita Airport Rapid Railway Co., Ltd. was established to construct a Category-III project. In very little time, the company has completed all the bureaucratic procedures and was ready for action. Construction began in March 1989 and JR and Keisei trains began pulling into the new airport station on 19 March 1991 (Figs. 1 and 4). Other improvements soon followed, with the opening of Terminal 2 on 3 December 1992, and the opening of Terminal 2 Station adjacent to Terminal 2, 1 km from the end of the line.

As Fig. 4 shows, the JR East and Keisei lines take slightly different routes. The new JR East line to the airport branches from its Narita Line in the Tsuchiya district of Narita City. The 8.7-km spur is a single track laid on one of the two roadbeds built for the now-cancelled Narita Shinkansen. Keisei's line to the airport branches off in the Komaino district of Narita City, 1.1 km before its old terminus, then extends 2.1 km to the two airport stations. This spur is double-tracked to the Keisei station at Terminal 2, beyond which, the track is laid on the other roadbed built for the shinkansen. In other words, JR East uses part of the double-track built for the Narita Shinkansen, which had been laid from Tsuchiya on the Narita Line, and JR and Keisei both use the underground station built for the shinkansen adjacent to the airport terminal. With the completion of JR's single track on one of the shinkansen roadbeds, an additional



JR East Narita Express (NEX) at Ikebukuro Station

(Author)



Coupling NEX cars at Tokyo Central Station

(Author)

7.7 km of bed is still unused, a possible candidate for future expansion. The last part from the newly constructed Terminal 2 to the end of the line at Terminal 1, has two tracks, one for JR East and the other for Keisei, with both companies using the same station facilities.

After this improvement in Narita ARLs in 1991, competition between the two carriers has ensured even greater levels of convenience. Both companies offer special express services in new, comfortable cars departing once or twice every hour (with 23 shuttle runs each way daily). JR East's fastest train takes 53 minutes on the 79.2-km run between Tokyo Station and the airport. This is nearly matched by Keisei, at 57 minutes for its 69.3-km run from Ueno. JR East's trains from the airport do not terminate at Tokyo Station but continue on, providing direct (and well-used) services to other major stations in the Tokyo area, terminating in Shinjuku, Ikebukuro, and Ofuna (trains formerly terminated in Yokohama). Many of the express trains running on the Tokyo-Narita Airport track are composed of cars that originate and return to different lines, so JR East has developed simple and rapid techniques to couple and uncouple trains

at underground platforms in Tokyo Station. Riding JR East's *Narita Express* (affectionately called *NEX*) or Keisei's *Skyliner* requires a surcharge in addition to the regular fare, but this can be avoided by taking one of many rapid, though slower, commuter trains. These services do take a little longer—about 80 minutes for JR East and 70 minutes for Keisei (which operates 35 shuttles per day).

The construction of the infrastructure for these extensions cost the Narita Airport Rapid Railway Co., Ltd. a total of ¥50 bil-

lion (including interest on money borrowed during the construction phase). The company's capital resources totalled only ¥9 billion so the remaining funds were provided by loans from city banks. In other words, the project was completed without public assistance.

Air-Rail Link Usage in Japan

Haneda Airport

The ACI Report states that 49.3 million passengers used Haneda in 1997, making it the world's sixth busiest airport (the fifth is London Heathrow). However, Haneda now caters to very few international passengers—in 1997, only 850,000 were on international flights and only 20,000 were international passengers in transit.

An MOT survey at airports throughout Japan on 25 October 1995 showed that 86,000 domestic passengers used Haneda. Of these, 62% used ARLs, while 25% went by road. (The remaining 13% either did not respond or went by other means.) The ARL-to-road ratio is 62:25, or 71:29 if the remaining 13% is apportioned between the two groups (Table 2). Other figures supplied by Tokyo Monorail show the relationship between the

Table 2 Land Transport used by Domestic Airline Passengers and Estimated Shares (25 October 1995)

Unit: People/day

Airport	No. of airline passengers	Rail	Road	No answer/Other	Rail : road ratio
Haneda (HND)	86,226 (100)	52,972 (62)	21,864 (25)	11,390 (13)	71 : 29
Shin-Chitose (CTS)	29,152 (100)	10,346 (35)	15,635 (54)	3,171 (11)	40 : 60
Fukuoka (FUK)	27,768 (100)	11,386 (41)	13,164 (47)	3,218 (12)	46 : 53
Kansai International (KIX)	17,093 (100)	7,524 (44)	6,662 (39)	2,907 (17)	53 : 47

Source: MOT

number of airline passengers using Haneda Airport and the number of people using the monorail (Fig. 3). Of all airline passengers using Haneda Airport in 1997, 59.2% took the monorail. As Fig. 3 also shows, 58.7 million took the monorail in the same year, although 30.2 million—more than half—were not airline passengers. The monorail corridor has seen considerable urban development over the last few years, so it is being used increasingly both as an ARL and a form of urban transit. From the company's point of view, this trend is certainly favourable, but when a transportation mode serves two very different types of passengers, problems can arise at certain times of the day. Putting such potential disadvantages aside, the Tokyo Monorail carries more airline passengers than any other ARL in the world (60,000 to 80,000 daily, approximately 60% to 70% share of its total ridership).

Narita Airport

I have explained how Narita Airport had inadequate ARLs until 1991 (years after the airport opened in 1978), although its inconvenient location called for a high standard of rail service. However, over the past 8 years, passengers have been able to choose between two well-travelled rail routes to downtown Tokyo.

A total of 25.7 million airline passengers used Narita Airport in 1997, making it the 26th busiest airport in the world. Of these, 22.9 million (89%) were on international flights. Domestic passengers numbered only 800,000, with an additional 1.9 million in transit.

A survey by the New Tokyo International Airport Authority on people coming to the airport on one day in March 1997 from places within Japan (including departing airline passengers) showed that of the 36,300 departing passengers, 14,500 (39.9%) had come to the airport by rail, while 20,900 (57.5%) had come by road. The remaining 900 (2.6%) had arrived on

domestic flights.

Of the 14,500 arriving at the airport by rail, approximately 7500 used JR East's services, while about 6900 used Keisei's. Twice as many of these rail travellers chose express services over cheaper (but slower and less comfortable) commuter services; 5700 took JR's *Narita Express* and 3600 took Keisei's *Skyliner*. The advantages offered by JR East's *NEX* are evident. A total of 83,300 people, including the 36,300 airline passengers, arrived at the airport by land on the day of the survey. (Note that the figures do not include passengers flying into the airport then taking some form of land transport.) Of these 83,000, only 22,500 (27.2%) came by rail. This shows that the actual rail share is lower when people other than departing airline passengers are included.

A similar survey was conducted previously in 1991 (the year the airport gained its second ARL and improved its first). On that day, of the 25,000 departing airline passengers, 10,500 (42%) arrived at the airport by rail. Comparing these 1991 figures with those for 1997, there has been a 145% increase in the number of passenger departures, but almost no change (from 42% to 39.9%) in rail's share.

Other Japanese Airports

In addition to Haneda and Narita, five other Japanese airports are linked by rail to nearby cities. They are Shin-Chitose (CTS) serving Sapporo; Fukuoka (FUK); Kansai International Airport (KIX) serving Osaka; Miyazaki Airport (KMI); and Itami Airport (OSA) serving Osaka.

The last two were connected by rail only recently, and no ridership data have been released yet for them. Data for the other three airports are given in Table 2 using the results of the MOT survey mentioned above. Air-rail links at each airport have an estimated share of at least 40%. However, actual levels may be somewhat different because passengers on international flights were excluded from the survey.

Shin-Chitose is served by a railway line operated by JR Hokkaido, Fukuoka Airport by the Fukuoka Municipal Government subway line, and Kansai International Airport by JR West and Nankai Electric Railway Co., Ltd.

Higher Levels of Public Assistance for ARL Infrastructure Development

Financing for construction at Haneda and Narita

As explained, no government assistance was provided for the construction of Japan's first two ARLs (Haneda's Tokyo Monorail, and Narita's Keisei Line).

With increasing numbers of airline passengers, both airports were forced to expand their capacity. This involved relocating Haneda's terminal and constructing a second terminal at Narita. In both cases, existing ARLs had to be extended and upgraded.

At Haneda, the lengthening of the monorail and extension of Keikyu's line were the first in Japan to obtain some degree of public assistance. In the case of the monorail, part of the new line had to be built under runways, taxiways, aprons and other airport facilities. The task of constructing the tunnel was assumed by the government because it owns the airport and the government now leases the tunnel to Tokyo Monorail. Construction of other parts qualified for public financial assistance under the Private Line (non-JR) regulations that permit public assistance for rail transit development projects. This was the first time the regulations were applied. Large construction projects in Japan are generally financed through non-subsidized loans procured by the builder, but under these regulations, the national and local governments pay any loan interest exceeding 5%.

The infrastructure for the monorail extension cost about ¥80 billion but the national government provided about ¥12 billion for

the tunnel construction under its own property. The remainder was procured through loans with JRCC as the builder. Keikyu received more public assistance because all the Keikyu Line extension was inside the airport and was built by the national government as the airport owner. Keikyu infrastructure costs were about ¥80 billion and the national government provided about ¥14 billion of this amount. Keikyu was not eligible for a Private Line subsidy so it borrowed part of the remainder at a low interest rate from the Japan Development Bank. Since the railway companies use facilities built and owned by the government, they pay the government an annual rent equivalent to 2.3% of the value of the facilities.

I have already explained how the Narita Airport Rapid Railway Co., Ltd. was made responsible for Category-III improvements to Narita Airport's ARL, and how JR East and Keisei began offering services as Category-II railway companies in an arrangement that was different from anything seen until then. The Narita Airport Rapid Railway Co., Ltd. spent ¥50 billion on infrastructure—¥28 billion of this was used to purchase the facilities of the cancelled Narita Shinkansen from the national government. Actually, the construction cost of the cancelled line was ¥94 billion including interest on loans, but the purchase price was set at the much lower figure of ¥28 billion to ensure that the new company remained financially viable. This lenient approach reflected the government's policy of encouraging construction by the company, JR East and Keisei, and was in effect, a form of public assistance. JR East and Keisei lease the completed facilities from Narita Airport Rapid Railway Co. Ltd. that uses the revenue for operation expenses and loan repayment. According to the company's long-term financial plan, it will start making an operating profit in 2005 (14 years after the opening) and will pay off its debts in 2019 (28 years after opening).

Financing at other airports

Sapporo's Shin-Chitose Airport became the third airport in Japan to gain rail service in October 1980. The line was operated by JNR, which constructed a new station on its intercity Chitose Line, at a location nearest to the terminal building (a similar choice was made for London Gatwick). Later, when the airport terminal was moved, a 2.6-km spur was built, part of which runs under the airport facilities. In this sense, the extension was similar to that of the monorail at Haneda, so the national government agreed to provide some public assistance. The new service opened in April 1992 operated by JR Hokkaido.

Fukuoka Airport was linked to the Fukuoka Municipal Government subway in March 1993, becoming the first Japanese airport to be served by subway. The line from downtown Fukuoka City was extended to the airport as part of a government programme to encourage development of municipal subways. This qualified the line for public assistance and about 70% of the construction costs were paid by the national and municipal governments.

Osaka's second airport, Kansai International Airport, opened in September 1994 and is Japan's second most important gateway for international travel. Partly be-

cause of this international status, ARLs to the airport were constructed under an arrangement similar to that for Tokyo's Narita Airport. Construction of Kansai International Airport occurred around the time of JNR's privatization and breakup into the JRs. This was opportune timing, since it affected the terms under which the new government-related entity, Kansai International Airport Co. Ltd. operated. The company built the airport and promoted Category-III construction of rail infrastructure on most of the route. JR West and Nankai Electric Railway were designated Category-II railway companies with the right to serve the airport. The airport was built on a man-made island in Osaka Bay, 35-km southwest of central Osaka, meaning that JR West and Nankai Railway had to build spur lines to the airport from their Hanwa and Nankai lines, respectively. Neither company received any public assistance for construction on the landward side of their spur lines between the branch-off points and the newly built Rinku Town Station facing the bay. However, the 6.9-km stretch between Rinku Town Station and the airport was built and paid for by Kansai International Airport Co., Ltd. that owns this part of the line and leases it to the railways. No public assistance was given for infrastructure construction, unlike the



Kansai International's Airport Station, offering express train services by Nankai Electric Railway and JR West (Nankai Electric Railway)

situation for other airports, but the companies did borrow some money at good rates from the Japan Development Bank. The company plans to use the revenue from rent paid by JR West and Nankai Railway to repay its construction loans. This lease-repay situation is similar to that adopted by Narita Airport Rapid Railway Co., Ltd.

Miyazaki Airport in south Japan gained an ARL in July 1996. The track to the airport, operated by JR Kyushu, is a 1-km spur from the existing Nichinan Line. The line's infrastructure on airport land was built and paid for by the national government in accordance with the principles described above. The cost for building those parts of the line not on airport property was divided equally between JR Kyushu and the Miyazaki prefectural government. In other words, much of the cost did not fall on the railway's shoulders.

Osaka's Itami Airport was the seventh airport in Japan to gain an ARL when the Osaka Monorail began services in April 1997. Like the Tokyo Monorail, the Osaka Monorail is a straddle-beam system. One difference is that it was built not so much as a downtown-to-airport link but as a form of urban transit to facilitate travel in the suburban loop corridor, with the airport at the westernmost part of the line. The line, which took many years to build, is not very convenient for airline passengers. However, because it was built as an urban transit system, the line qualified for financial assistance from the national and local governments that paid 60% of the costs. The builder, Osaka Monorail Corp., received investment funds from the public and private sectors.

Public Funding for Railway Projects—A Growing Trend

Government funds are increasingly being made available for ARL development in Japan. As we have seen, current policy now permits the national government,

as airport owner, to construct tunnels, bridges and other rail infrastructure on parts of the route within airport boundaries and to lease these facilities to the railways. Other public funds are available under the Private Line regulations and through local government assistance. Public assistance was not available in Japan until about 30 years after construction of the first ARL, the Tokyo Monorail to Haneda.

Railway companies were seen as enterprises responsible for their own financial affairs, and MOT policy has encouraged the three transport modes—rail, road, and air—to compete freely, each sector taking advantage of its own unique strengths. However, over the last few years, governments have boosted public assistance to railways with a view to improving urban transit and facilitating high-speed travel between cities. Municipal governments and public/private corporations are increasingly funding development of urban transit systems, rather than depending entirely on the private sector. In addition, private companies now receive more public funds for the development of rail transit services, and the construction costs of inter-city shinkansen infrastructure are, in principle, now completely covered by public assistance plans (with the national government paying double the amount paid by local governments). Increased public financing for ARLs is part of this trend.

Future ARLs in Japan

For all its impressive advances in rail technology, Japan is not the country with the world's greatest number of ARLs. That honour goes to the USA. The first ARL built in the USA was for Cleveland Hopkins International. This was a transit rail extension to the airport, opened in November 1968, a few years after the Tokyo Monorail. Eight other US airports have

ARLs: Boston Logan International; Washington National; Philadelphia International; Chicago O'Hare International; Hartsfield Atlanta International; Chicago's Midway and South Bend Michiana Regional; and Lambert-St. Louis International. Japan ranks second after the USA, with one ARL under construction, and links to another five airports in various stages of planning or study. The line under construction is a monorail to link downtown Naha in Okinawa to its airport (OKA). When this straddle-beam monorail opens in 2003, it will be Okinawa's first rail-based urban transit system.

Two separate ARLs are in the planning stage: one for Sendai (SDJ), the other for the planned Chubu International Airport at Nagoya. Sendai's plans call for a spur line to be built from a JR East line to the airport with JR East offering direct services between the airport and downtown. Nagoya is Japan's fourth largest city, with a population of 2.1 million, and is the site of Expo 2005. The city's second airport is to be built on reclaimed land offshore with an ARL to be provided by Nagoya Railroad Co., Ltd., on an extension of its Tokoname Line. If the construction schedule is on time, the airport will open in 2005 for the Exposition.

Air-rail links are at the conceptual stage at three other airports: Hiroshima (HIJ), which is studying the feasibility of a High Speed Surface Transit system (HSST) using electromagnetic levitation technology developed in Japan; Niigata (KIJ), where shinkansen track could be extended to the airport; and Kochi (KCZ), where a spur line might be built from the narrow-gauge Asa-Sai Line under construction.

Ideal Conditions for Future ARLs

Planning of future ARLs must proceed carefully because each situation is unique. Variable conditions include the location, size, type, and *raison d'être* of each air-

port, as well as the size and type of the urban rail network. Having said this, I will venture to suggest three ideal conditions that should be considered when planning possible rail links.

First, the ARL should offer far greater convenience than the roads leading to the airport. Planners should reject out of hand any system that forces passengers to make train-bus connections. Indeed, they should make every attempt to avoid even a single transfer from one train to another. In the case of cities already possessing an advanced rail transit system, the line should link the airport to the existing rail network and permit direct connections with several major stations within the network. For this reason, an unconventional transport system, such as a monorail or electromagnetically levitated train, is not really suitable.

Second, ARLs should be able to carry passengers at about 100 km/h over the existing rail network to destinations 100 or even 200 km from the airport. JR trains fulfill these conditions to a certain extent for airports such as Narita, Kansai International, Shin-Chitose and Miyazaki. For example, passengers can take the *NEX* from Narita Airport to Yokohama and beyond, or a rapid commuter train even further to Yokosuka. The *NEX* takes only 90 minutes from the airport to Yokohama. (Yokohama and Yokosuka are respectively about 80 and 90 km southwest of the airport, as the crow flies). In another example, the *Haruka* special express takes only 85 minutes from Kansai International Airport to Kyoto (75 km northeast of the airport). The JR group of companies operates a nationwide rail network with many urban and inter-urban lines, and could provide even more convenient, extensive services within this network. The rail links to airports in Frankfurt and Zurich could perhaps serve as a model in this regard. Conversely, subways and small private railways cannot meet the objectives set out here.

The third ideal condition has been examined by some people, but only conjecturally. The focus of these studies is either a shinkansen or MAGLEV cars joining three of Japan's international gateway airports—Narita, Chubu International Airport (planned for Nagoya), and Kansai International. Narita serves as a global hub and is centrally located in Japan, so its role as a transit point for passengers travelling to and from different Japanese cities will surely increase. If Narita Airport were connected to a nationwide high-speed train network (for example, the shinkansen network), passengers would enjoy a far greater level of convenience. Trains to and from cities within 800-km radius of the airport would be superior to any other form of transport. As high-speed train development plans in Europe show, trains travelling at 300 km/h are well placed to serve long-distance passengers, and they can do so using less energy and with less environmental impact than planes. When we consider these points, the decision to cancel the Narita Shinkansen from downtown Tokyo to Narita Airport created problems that will have to be solved later.

The proposal to use JR's MAGLEV technology to link Narita to Chubu International Airport in Nagoya and Kansai International in Osaka (a total distance of 500 km) will raise the potential of these airports as international gateways. The cars would travel at more than 500 km/h. In effect, such a scenario envisages not three airports but one airport with three groups of terminals joined by magnetically levitated trains much like airport ground

transport systems and people movers. But even if magnetically levitated cars can carry people at 500 km/h, the scenario still faces considerable obstacles. Planners should first develop ways for their new system to link with airports and high-speed trains—this would offer passengers greater mobility. In the meantime, what type of rail link should be constructed for Nagoya's future international airport?

Air-rail links began as a way to offer road users another choice, but they are becoming the main form of transport to some large airports due to the increase in air travel, and because of the tendency to build airports far from city centres. There are many forms of ARLs, ranging from monorails to transit-system railways to high-speed trains. Planes used to be about five times faster than trains, but some trains have reduced the ratio to 3:1 or even close to 2:1. Motor vehicles, too, will one day travel faster through the introduction of the Intelligent Transportation System (ITS) and other technical advances. At a time when sustainable development is viewed as an essential goal for the entire world, what is the ideal way to move large numbers of people comfortably, quickly, and in an environmentally friendly manner? Further study is needed to identify the respective advantages and disadvantages of airplanes, railways and motor vehicles, and to develop systems that make best use of the advantages of each transportation mode in a complementary fashion. I believe that Japan has a duty to study these issues seriously and to develop ideal systems that the world will want to adopt. ■



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