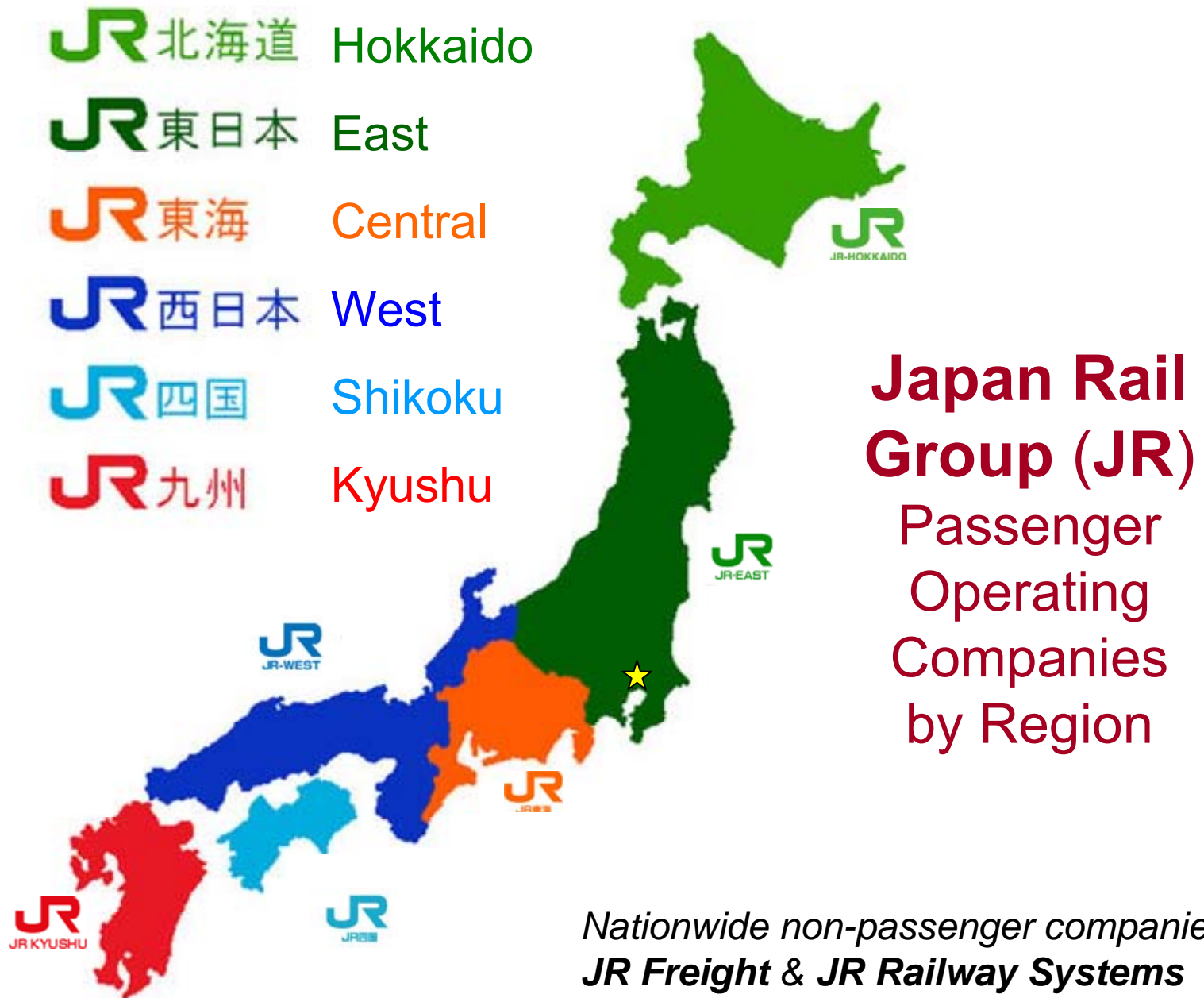


“Mini-Shinkansen”

How East Japan Railway Co.
extended high-speed rail without
huge infrastructure expenditures

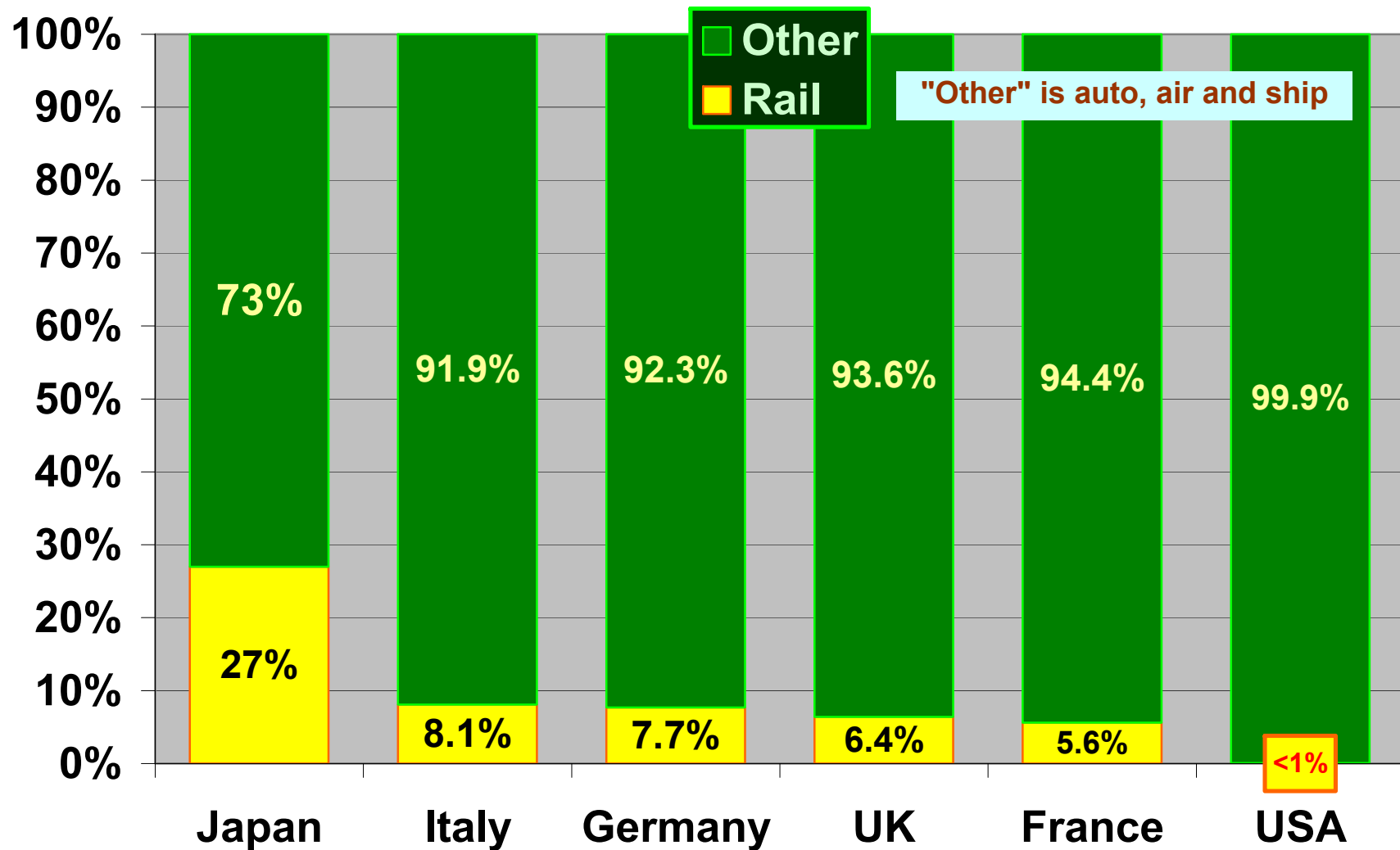


Presented to BayRail Alliance July 20, 2006 by
Ryan Hoover, with assistance from Yu Hanakura



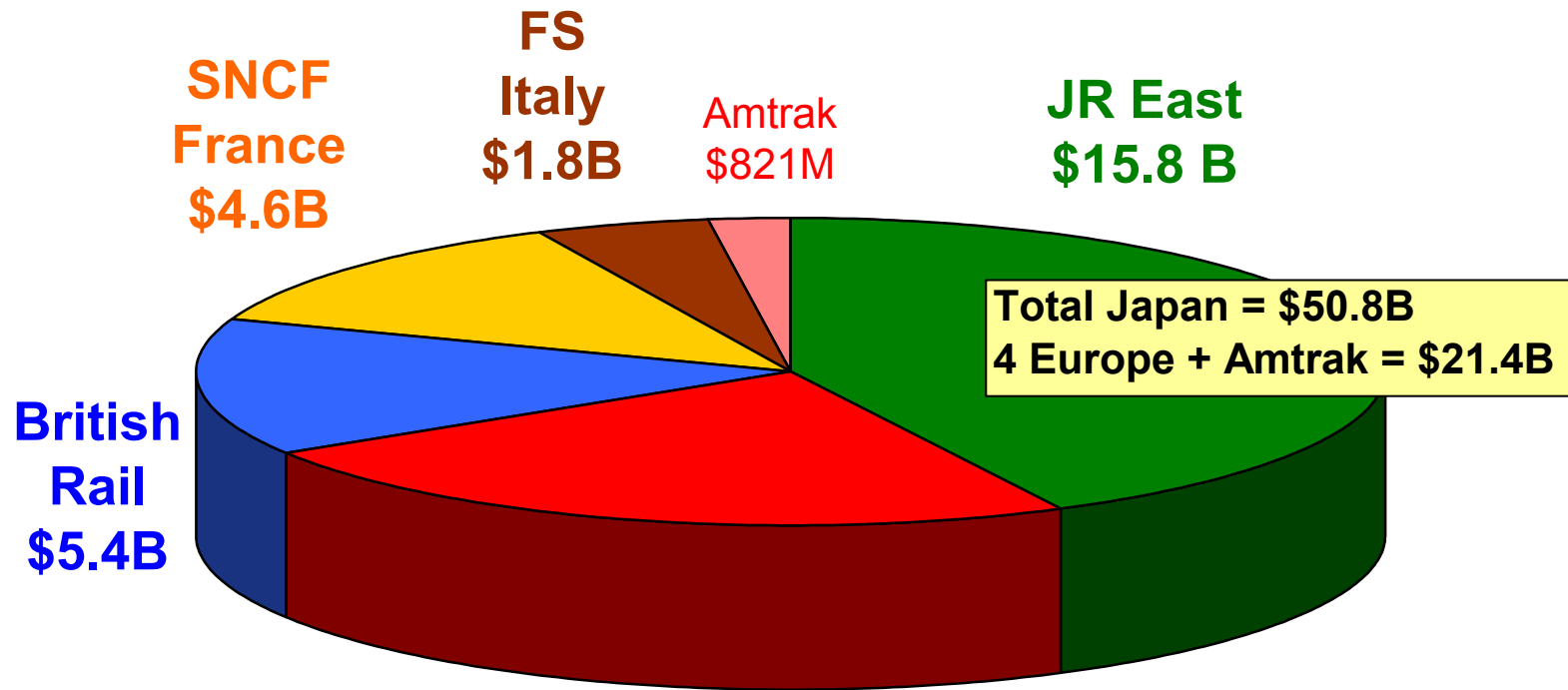
Source: Japan Railways Group

Rail Share of Total Passenger Travel



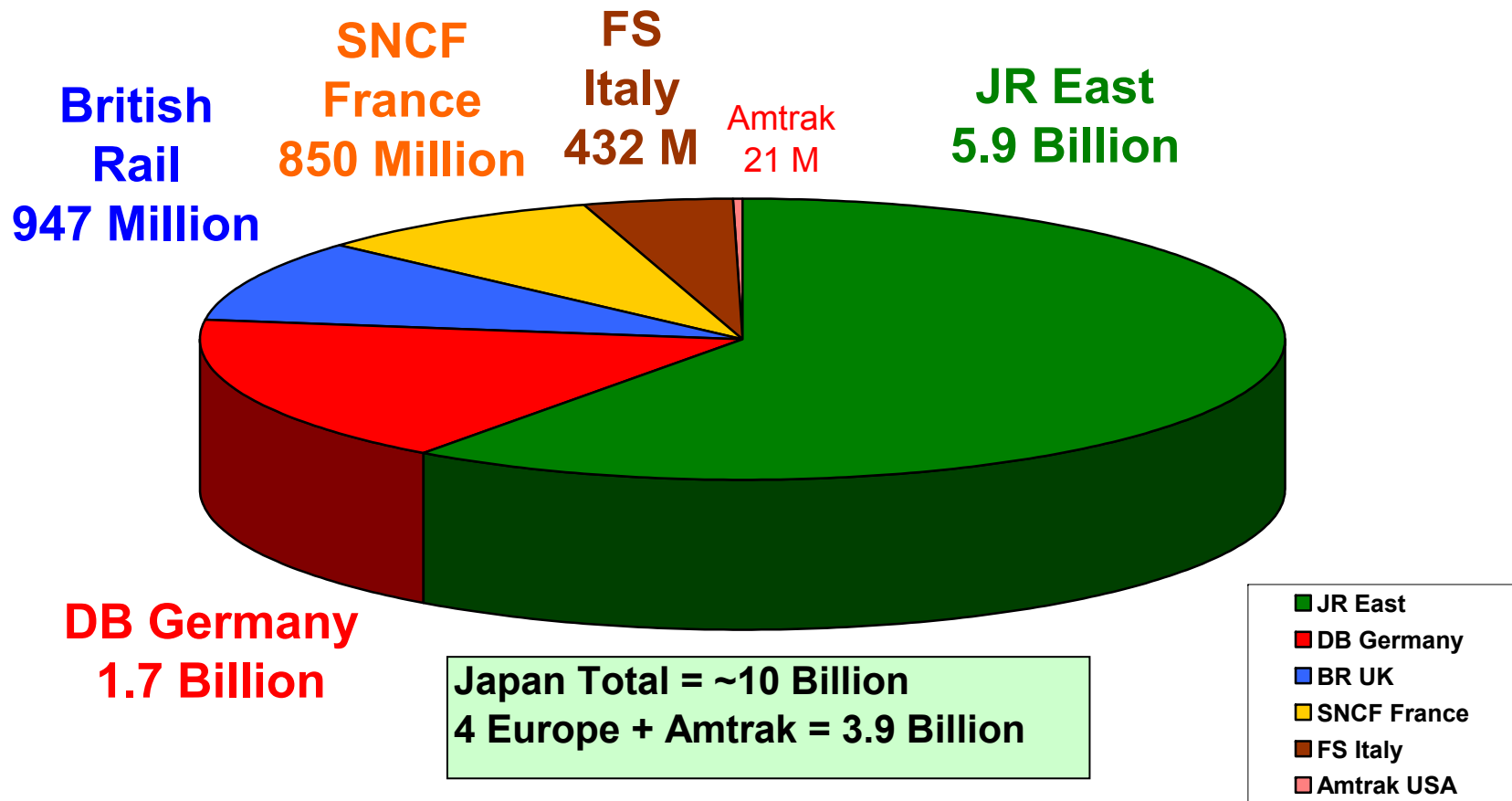
Source: International Railway Statistics, International Union of Railways, fiscal 1999

Japan's Rail Passenger Revenue vs. Europe & USA

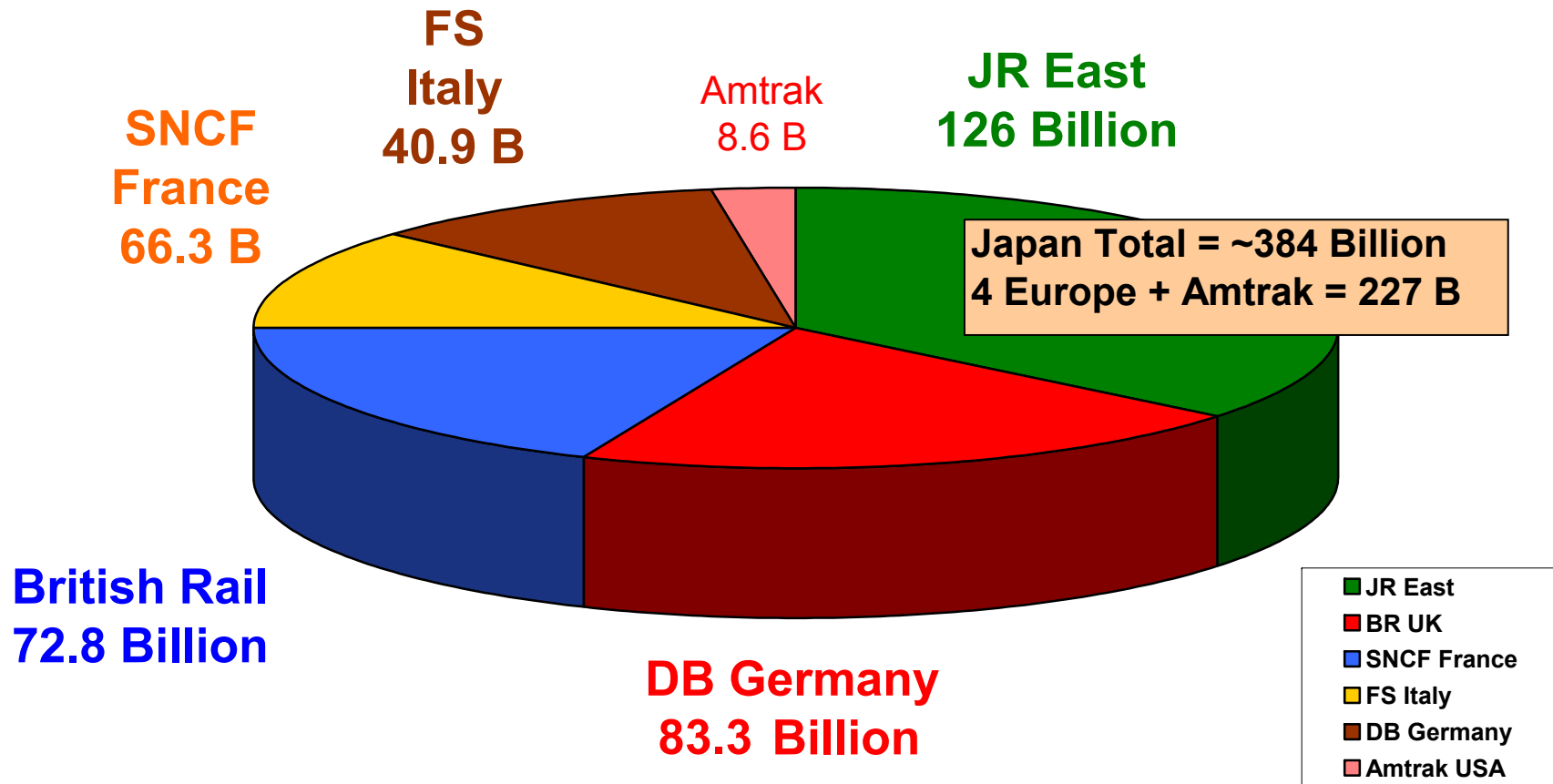


| SIX MAJOR PASSENGER RAIL SYSTEMS COMPARED | |
|---|---|
| ■ Total Japan | JR six operating cos. plus ~130 private railway cos. |
| ■ JR East | East Japan Railway Co. (one of 6 JR passenger rail cos.) |
| ■ DB | <i>Deutsche Bahn</i> / German National Railways |
| ■ BR | National Rail (UK total of private passenger operating cos.) |
| ■ SNCF | <i>Société National des Chemins de Fer</i> / French National Rys. |
| ■ FS | <i>Ferrovie dello Stato Trenitalia</i> / Italian State Passenger Rys. |
| ■ Amtrak | US national network only — no heavy, light or commuter rail |

Passengers Carried by Rail 1999: Japan vs Europe & USA



Rail Passenger-Kilometers: Japan vs. Europe & USA



Japan's Solutions to Nationwide High-Speed Rail

1964-2010 – Shinkansen (i.e., “New Main Line”): All new, dedicated, grade separated standard gauge (1435mm) high-speed passenger rail infrastructures to accommodate planned speeds of up to 360 km/h (225 mph). \$\$\$\$\$\$\$\$ ¥¥¥¥¥¥¥¥

1992-1999 – Mini-Shinkansen: JR East Narrow gauge lines (1067mm) upgraded to standard gauge to allow through Shinkansen trains from Tokyo at speeds of up to 130 km/h (81 mph). \$\$\$ ¥¥¥

2013? – Super Limited Express: Narrow gauge lines heavily upgraded and grade-separated to Shinkansen standards to accommodate speeds of up to 200 km/h (125 mph). \$\$\$\$\$ ¥¥¥¥¥

新幹線



Mini-Shinkansen Chronology

July 1992 – Yamagata Shinkansen, Fukushima-Yamagata

March 1997 – Akita Shinkansen, Morioka – Akita

December 1999 – Yamagata Shinkansen, Shinjō extension

Japan's Shinkansen High-Speed Rail Lines

Tōkaidō

Sanyō

Tōhoku

Jōetsu

Nagano

Yamagata

Akita

Kyushu



Base map: <http://en.wikipedia.org/wiki/Image:Shinkansenmap.png>

Mini-Shinkansen Train Equipment & Services

| Company | Shinkansen | Service | Equipment | Begin | End | km/h | mph |
|---------|------------|-----------------|-------------|-----------|-----------|------|-----|
| JR East | Tōhoku | <i>Yamabiko</i> | 200, E1, E4 | Tokyo | Hachinohe | 240 | 150 |
| | Yamagata | <i>Tsubasa</i> | 400+E4 | Tokyo | Fukushima | 240 | 150 |
| | Yamagata | <i>Tsubasa</i> | 400, E3 | Fukushima | Shinjō | 130 | 81 |
| | Tōhoku | <i>Hayate</i> | 200, E2 | Tokyo | Hachinohe | 270 | 168 |
| | Akita | <i>Komachi</i> | E3+E2 | Tokyo | Morioka | 270 | 168 |
| | Akita | <i>Komachi</i> | E3 | Morioka | Akita | 130 | 81 |

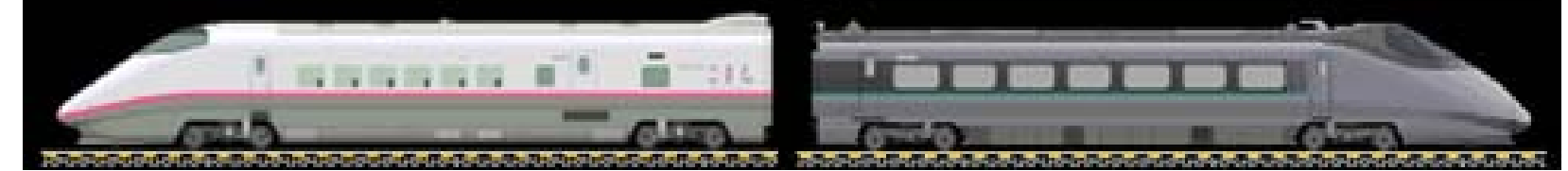
E2

E3



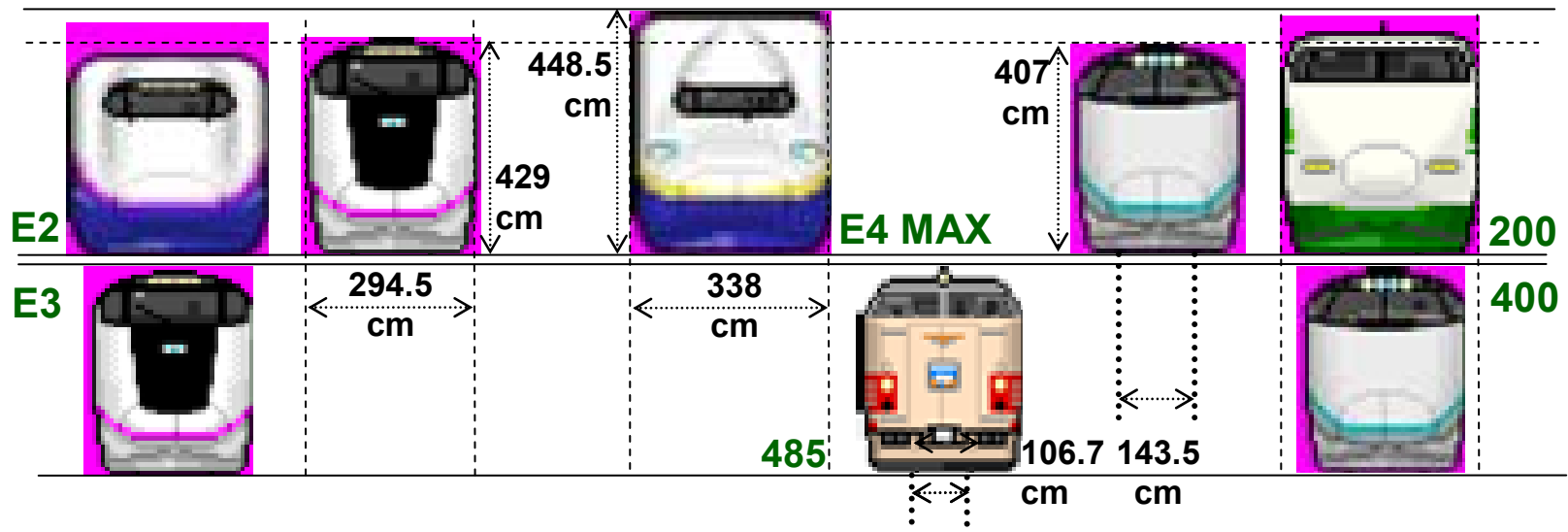
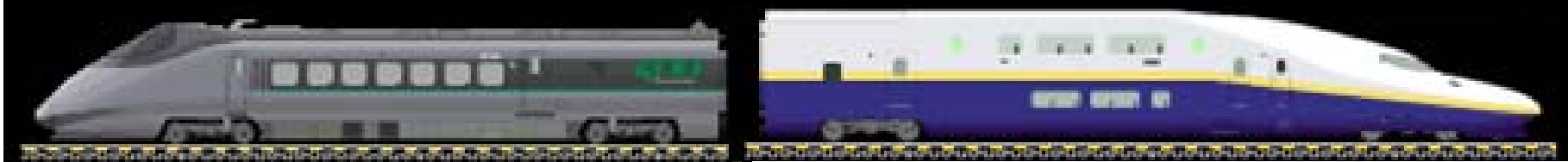
E3 Mini

400 Mini



400

E4 MAX



Sources: Sides: www.iit.bme.hu/traffic/stocke.htm ; Fronts: www.alpha-net.ne.jp/user2/curoka/ftv.htm



JR East **Shinkansen MAX E4 Yamabiko + Mini-Shinkansen 400 Tsubasa**

Double deck E4 MAX (maximum amenity express) *Yamabiko* E4, coupled to “mini” *Tsubasa* 400 series. The trains run coupled from Tokyo to Fukushima, where the *Yamabiko* continues up the Tōhoku Shinkansen to Hachinohe. The narrower, shorter *Tsubasa* mini-Shinkansen cuts off and continues through the mountains to Yamagata. E3 series “mini-trains” are also used in *Tsubasa* service.

Source: Sam Doshi Gallery, <http://www.pbase.com/image/60417114>



JR East **400 series *Tsubasa* Mini-Shinkansen** approaching Ōishida Station, on the Yamagata Line.

Source: <http://www.snowjapan.com/e/insider/photo.php?pgno=4&userid=soubriquet>



JR East narrow gauge **Super Azusa Limited Express** tilting EMU train at Matsumoto on the Chuo line to Tokyo.

Source: Sam Doshi Gallery, <http://www.pbase.com/image/60417113>

MINI-SHINKANSEN: Faster, Better, Cheaper

After privatization of JNR (Japan National Railways) in 1987, the variety of high-speed Shinkansen train sets increased dramatically. This DVD groups together and recaps some of Vicom's *Rail Report* videos covering the various shinkansen trains. High-speed trains covered include the faster Series 500 and 700 *Nozomi* trains, series E2 for steeper lines, series E1 and E4 bilevel MAX (Maximum Amenity Express) trains for higher capacity, and smaller series 400 and E3 train sets for "Mini-Shinkansen" service.

New Mini-Shinkansen Lines

The Yamagata Mini-Shinkansen has been in service since July 1992. This segment covers the old Ōu line, showing the classic narrow-gauge *Tsubasa* Limited Express service before the line's conversion to standard gauge. The new standard gauge *Tsubasa* series 400 and E3 trains are shown coupled with 200 and E4 series *Yamabiko* trains at 240 km/h (150 mph) on the high-speed Tōhoku line from Tokyo to Fukushima, the uncoupling of the 400s at Fukushima Station, their continued operation to Yamagata, and, later, on the 1999 extension to Shinjo.

The Akita Mini-Shinkansen has been operational since March 1997. This segment shows video clips of series E3 *Komachi* rolling stock running on the high-speed Tōhoku Shinkansen coupled with Series E2 or 200 *Hayate* trains at up to 270 km/h (168 mph) to Morioka, uncoupling and continuing separately on the Akita line, their switchback at Omagari Station, and trains running in beautiful mountain scenery.

Mini-Shinkansens are not a part of the high-speed Shinkansen Network, technically or legally. JR East planned and built them as upgrade projects to better serve more remote areas of Northern Japan. They are not true Shinkansens -- new main lines -- as those are entirely new, totally separated double-tracked standard gauge lines built for speeds of up to 300 km/h or 186 mph. Minis are simply upgraded and regauged lines to permit through trains from Tokyo at top speeds of about 130 km/h or 81 mph.

The upgrading of the former Ōu line from Yamagata to Shinjo in 1997 was funded entirely by Yamagata Prefecture at about ¥35 billion or \$305 million. JR East did not spend any capital from their own budget for the upgrade. So far, the Shinjo extension of the Yamagata Mini-Shinkansen is the only existing case of a publicly-funded but privately-built railroad line in Japan.

The pros and cons of the Mini-Shinkansen concept:

Pros:

- Total travel times between major cities in Northern Japan and Tokyo are dramatically reduced by eliminating transfers and by providing slightly faster speeds on the regauged lines.
- Ridership figures clearly show that the two Mini-Shinkansens are now becoming competitive with air travel.
- New and rebuilt stations are designed to be the hubs of commercial, transit, social and cultural development with shops, restaurants and in some cases, museums or other attractions in cooperation with local communities.

Cons:

- New standard-gauged trainsets are needed for local service to replace existing narrow gauge cars.
- Trainsets are smaller than full-sized standard Shinkansens to fit original loading gauges.
- Safety is more of a concern since Mini lines are not entirely grade-separated and crossings of roads and other railways remain.
- Some dual-gauged portions must remain for essential regional freight traffic.

- Capacity is lower since much of the regauged lines are single-tracked and passing sidings must be provided.
- Services may be reduced or canceled during construction periods.

Super Limited Express -- an Alternative to the Mini-Shinkansen

Engineers are increasingly looking at a new kind of high-speed upgrading: "Super Limited Express" (SLE) or all new grade-separated narrow gauge lines built to full standard gauge Shinkansen specs. More costly than Mini-Shinkansens, but cheaper than standard gauge Shinkansens, trains can run in direct service on the new line between any points on the existing narrow-gauge network with existing rolling-stock while attaining top speeds of between 160- and 200 km/h.

The Hakutaka Limited Express between Kanazawa and Echigo Yuzawa Shinkansen Station is considered to be the first example of an SLE line. SLE is an effective interim upgrade step toward possible future joining of the full standard-gauged Shinkansen high-speed rail network.

- Translation from original Japanese sources courtesy of Yu Hanakura

