

## Singapore

Singapore is a small densely-populated city-state, having a land area of only 719km<sup>2</sup>, and a population of 5.6m (2016). It has achieved strong economic growth over many years due to its role as a major financial/services hub and centre for high value manufacturing – the rising affluence bringing increased demand for available land and greater mobility. With finite space, the Singaporean Government is alleviating these pressures through the implementation of a long-term, overarching transport policy, led by the Land Transport Authority (LTA). The LTA is responsible for the planning, development and management of the entire land transport system in Singapore and so, with regard to the MRT, a broad overview and strategic policy direction has been implemented through a three-pronged integration approach:

**The integration of land use and transport planning.** The LTA has intensified land use across the island by decentralising commercial activities along rail corridors, integrating MRT stations into commercial facilities, and creating transport hubs which act as a focus of housing developments. Intensifying development around main MRT stations reduces the need for travel and increases the utilisation of the MRT, enabling the rail network to develop routes that serve the most densely populated areas and corridors, linking the population to the main commercial, business and industrial areas and trip generating points.

**Network integration.** The MRT is the backbone of the transport system in Singapore and has a hierarchical role, with LRT and bus services planned around MRT services. MRT and LRT stations are physically integrated to main bus stations which provide feeder routes. These routes are planned so that the duplication of services is limited and there is improved utilisation of transport resources and more effective coverage. The co-ordination of services also involves timetable integration, an integrated fare system (EZ-link card- distance-based contactless smart card), and integrated travel information via an impressive GPS/RTI electronic travel guide with full journey planning and fare information, or hard copy information (TransitLink guide). All this is achieved despite different ownership.

**Standard integration.** Service standards and performance are set and rigorously monitored by the LTA and the quality of provision is an essential ingredient. Supplementary provision such as pedestrian linkways to housing and adjacent commercial buildings, cycling and taxi facilities, intermediate and end-point commercial amenities, customer service centres, uniform station information and wayfinding, and safety (barriers/CCTV etc.) are all at forefront of design, construction and operation. Capturing performance is made easier because the government has managed transport competition. Essentially, two multi-modal operators exist – SMRT, which mainly operates trains and a small bus network and one LRT; whilst SBS mainly operates buses as well as two light metro lines and accompanying LRT lines. This structure provides the benefits of competition in terms of peer benchmarking in service standards and cost efficiencies, but enables easier service and policy integration.

This approach provides the population with high quality mobility options and a spectrum of seamless transport choices to accommodate varying travel needs. The harmonisation of services, brand and information makes travel by public transport efficient and effective. Whilst this approach is common in Europe, it is not the case in Asia, where mobility is often based on sheer volume than any planning protocols. This makes the Singapore experience all the more impressive and successful, supported in many ways by a dominant government and relatively obedient population.

## The System

The MRT is operated by two companies (SMRT-129.8km) / (SBS-40.1km) and is currently 169.9km in length with elevated (68.7km) and underground (101.2km) alignments. There is a total of 103 stations.

The original 1987 line now forms part of the arc shaped North-South Line (NS) which is 44.7km (12.3 Km underground) and has 26 stations (11 underground). It runs from the western industrial area of Jurong on viaduct, initially travelling north through less densely populated areas and connecting to the parallel Bukit Panjang LRT at Chao Chu Kang. At its northernmost, the line travels large satellite towns around Woodlands (where views of the city of Johore Bharu in Malaysia can be seen), and then moves south down the central north-south spine of the island. Here it runs past the huge stabling facilities at Bishan. The stations on the viaduct section are large, concrete, angular structures with island platforms, half screens and large ceiling fans. There are smart platform information boards with line maps and system maps, some seating and RTI information screens. South of Bishan (the only grade

station on the system), the line runs underground passing the main commercial corridors around Orchard Road and through the city centre. These stations have island platforms, with full platform screens and good quality passenger information. The infrastructure is clean and efficiently designed with ample stairs, lifts and bi-directional escalators, although the design is pretty standard, and the stations are very much of the 1980s. Services run from 0530 to 0030 with a base headway of 4/5mins and three of every four trains terminate at Marina Bay with only 4 services per hour heading onward to Marina South Pier. The entire journey takes 63mins.

At the most central stations of City Hall and Raffles Place, there is cross platform transfer with the East-West Line (EW) depending on which direction you wish to travel; the tunnels here dive, rise and twist between the two stations to ensure all transfer possibilities are met effectively. The EW line is of a similar standard to the NS line. It is 49.7km (13.4km underground) and includes a branch from Tanah Merah to Changi Airport (6.4km). Including the branch there are 31 stations (8 underground). From the large eastern satellite towns around Tampines, the line runs above the busy New Changi Road/Sims Avenue where there are some nice views of the dense urban environment. The stations on this section have vaulted ceilings, supported by arch pillars. The island platform areas are very similar to those on the NS line. The airport branch involves a change of service at Tanah Merah, a two island/three-line station, with the middle line for the airport line shuttle supporting cross platform transfer, regardless of direction. This branch runs at 5min base headways on its 9min journey and after the modern Expo station, it heads underground to the large and architecturally stylish station at the airport. Continuing on the main line, after Kallang the line heads below ground through the centre (cross-platform transfer with the NS line) in a south westerly direction before a sharp bend north-westward (and lots of flange noise) at Tanjong Pagor. After Tiong Bahru, the line again emerges to viaduct above Commonwealth Avenue. These stations are more angular and have elevated walkways from the pavement areas - these are, perhaps, the least impressive on the system. Cross-Platform transfer to the NS line is also possible at Jurong East station, a multi-platform large station with an impressive flying junction and some intensive train movements from the east. Beyond Jurong East the line continues on a viaduct through less dense areas to the western terminus at Joo Koon, from where a 7.5km extension to TUAS West/4 stations will open in 2017. As with the NS line, there are good headways and a peak hour service level of 2min frequencies really pushes the system to capacity, with many trains stopping between stations due to train congestion and bringing some irregularity to headways. This is the longest line on the Singapore system and takes 64mins to traverse.

The two lines share 6 car stock. These have been built at various times by Siemens (Wien), Kawasaki and a Kawasaki/CSR partnership. There are some differences in external and internal appearance between the various constructions, but all have high levels of cleanliness, information provision (strip maps/audio information), and side seating. In some cases, seats in the middle part of the carriage have been removed and more grab poles added to increase capacity. Strip maps above the door have electric lights to show progression and there is written information provision in English, Simplified Chinese, Bahasa and Hindi (Sanskrit), although audio information on station stops is in English only.

Although these two MRT lines are the backbone of the system, they are more than ably supported by three fully automated lines. The SMRT operated Circle Line (CC) is 35.4km long with 28 stations and takes 62min to travel. Services run from 0545-0030 and operate at 5min base headways. The fully underground line is currently the longest underground automated line in the world (soon to be surpassed by the Downtown Line) and it covers some of the more peripheral areas of the built up part of Singapore. Running from the centre at Dhoby Ghaut, the line heads in a semi-circle via Paya Labar and Bishan to the Dover area and down toward the Harbour. At Promenade station (see Downtown Line), the line splits toward Marina Bay (2.1km branch/7mins) with 1 in 4 services operating this leg. It is a medium capacity line using 3 car Alstom Metropolis sets. This line has several architecturally distinct stations with high atrium style platform areas providing a very airy environment and space for large art pieces. Platforms have seating, smart information boards, full platform screens and RTI. The highlights on this line, against much competition, are 'Stadium' and 'Bras Basah', two of the most stylish stations in South East Asia.

SBS operate the majority of bus services in Singapore and also operate two fully automated metro lines and two LRT lines. The North East Line (NE) is a 19.2km fully underground line heading from the harbour through the western areas of the centre toward the north east satellite towns around Punggol (33mins). It has 16 stations and is the only line in Singapore to use overhead power supply for its Alstom Metropolis stock with its quite ugly interior frontages. This is a very speedy and smooth ride, operating from 0545-0000 with 4min base headways. The platforms, like those of the CC line have a large atrium style which are located below smart ticket halls, all are island platforms and at certain stations some liberties have been taken with the design to allow for art/individuality to be presented (Kovan/Houghang are good examples). The last two stations in the north east connect with the SBS LRT lines and this is where most of the footfall in the north east lies, because of this, Sengkang and Punggol are designed more for capacity than style although they are still impressive. SBS also operates the Downtown Line (DT). This is the latest addition to Singapore's urban rail system and, once it reaches its full length out by the airport area, it will be the longest line on the system. Currently, the 20.9km fully underground line (17 stations) runs at 4min frequencies from

Panjang Hill in the north west, where there is lengthy, barriered transfer to the Bukit Panjang LRT line via a bridge and ramp, and heads in a south easterly direction toward the city centre at 4min intervals. There are some examples of fine stations on this line both internally (mainly island platforms) and in the immediate external environment. Stevens has separate side platforms with barriered transfer to the other platform. At Newton the line connects to the NS line and is the only 'metro to metro' interchange to involve a barriered transfer (free if re-entering the system within 15mins). In the centre, the DT Line serves the newer tourist/corporate developments around Bayfront (cross-platform transfer to the CC Line) and Downtown, and at Promenade station (CC/DT) there are four separate single platforms located on four different levels with separate escalator access to each platform. The line takes 35mins to traverse and uses Bombardier Movia stock which offers station information in all four languages and not just English.

Like the Full Metro, LRT services in Singapore are operated by both SMRT and SBS (note that, although branded as LRTs, these can be considered People Movers). The SMRT Bukit Panjang Line (BPLRT) connects to the NS line at Choa Chu Kang where both stations lie parallel to each other. Here, the LRT arrives at a single line/two side platform halt with passengers alighting at one side and boarding from the other platform. It is 7.8km (14 stations) long and runs at a 5min base headway (although the ten-mile junction branch is served only three times per hour), utilising two types of quite ugly Bombardier Innovia stock with rubber tyres. These trains have misted windows so that passengers cannot see into the apartments located next to the elevated line. It takes approximately 30mins to complete the loop with quite basic arch-roofed stations, short side platform and perfunctory barriers with gaps where the train doors open. The line is not that well used at non-peak periods except for the joint stretch between the two metro stations it serves, but the infrastructure is impressive and the views of the dense housing areas is interesting.

The remaining two LRTs are operated by SBS and are run perpendicular to the last two stations on the NE line. The Sengkang LRT (SKLRT) comprises an east and west loop converging at Sengkang. This is a large station located directly above the NE line station. Both loops have a combined length of 10.7km with 14 stations. Sengkang has an island platform with both loops served on either side, dependent on the direction. Trains are single Mitsubishi Crystal Movers although two car sets operate at some peak times. They have no direction boards on trains but their service is identified by the platform screen which stipulate the next train as 'East' or 'West' Loop. The service on each loop takes approx. 15mins and there are some great views with long straight avenues of dense housing and commercial buildings. The loop stations have island platforms (no platform screens) and quite basic seating and information provision. Like the Sengkang LRT, the two Punggol LRT (PGLRT) loops (10.3km/13 stations) operate independently, although the western loop only operates anti-clockwise at the moment. This particular loop has two unopened stations, although the automated trains stop at these stations momentarily. At the northernmost station, Punggol Point, there are some interesting views across the narrow stretch of water to Malaysia. Punggol itself is a large station with angular roof, housed directly above the NE Line station mezzanine. Services on each platform are identified as 'East' or 'West' Loop and there are signs to tell you to make sure to get the correct train. The stock is identical to the Sengkang LRT, with busy services at the initial stations of each loop. Both these LRTs have quite short distances between stations and some impressive track infrastructure. They are used for intra town provision but mainly act as feeders to the NE line services.

As for using the system, well this is very simple. Station entrances are conspicuous across the city, with many of the underground stations having several entrance points. All have stairs and escalators from street level, whether underground or elevated. Ticket machines are easy to use and individual tickets can be re-used. Tap barriers provide access to the system and all stations have information centres where a folded map is available. As most stations on the system have island platforms wayfinding is easy and location maps, beautiful schematic and geographic maps, along with RTI information are plentiful and stylishly designed on platforms and entrance halls. All of this is provided via a very smart brand with a typeface (LTA Identity) designed especially for the system. On the system, stations are identified by name, but also line initials and number (e.g. Khatib NS14) and in addition to staff in the ticket hall, there are smartly dressed staff on platforms to assist passengers. There is surprisingly little advertising on the system. Generally, in Asia, urban rail is used to its full potential for advertising purposes but it has been deliberately kept to decent levels here. Most promotions relate to the government and encouraging communal values and good citizenship. Tickets are distance based and are less expensive if you have an EZ-Card, moreover, to lessen crush loads at peak times and aid mobility for certain elements of society, MRT services are free before 0730 (you tap your EZ-Card but no fare is deducted). Day tickets are available but these are in the form of a Singapore Tourist Pass with 1,2 or 3 day validities. These can only be purchased from Transitlink Ticket offices (located at main stations only) only and not from SMRT machines (see below).

Beyond SMRT/SBS there are two other little bits of rail provision in the city-state. The Sentosa Express is a straddle

beam monorail running from the top of the Vivo Shopping Centre (HarbourFront CC/NE station is located in the basement of this shopping centre) to the tourist island of Sentosa. It is 2.1km long and has 4 stations. The monorail is owned and operated by SDC, and a day ticket costs \$4 (although EZ-Cards are valid). Hitachi trains run every 5/6mins as a base headway from 0700 to midnight on the 8mins journey. Secondly, at the airport there is a land side and airside people mover system which uses the same Mitsubishi Crystal Movers as the SBS LRTs in 1 and 2 car sets. Known as the Changi Airport Skytrain the series of short lines (air side and land side together accounts for 1.2km of track) connect the three terminals at 2min headways from 0500 to 0230 (outside of which a bus service is provided). The stations are recessed into the terminal building and are well signed, with full screens and RTI. The landside service between T2 and T3 has been closed as the walkway between the two terminals (which includes the MRT station) has made this part of the service redundant.

Overall, the urban rail system in Singapore is fantastic. It is integrated well between the two operators, and the system is pretty seamless with all MRT lines offering transfer to all others. It is a very stylish system in most parts and is well branded and has long been a system at the forefront of innovation and style. With a mix of alignments, high service levels, quality stations, different modes, ease of use and broad coverage this is one of the finest systems in the world. Yet despite this, there are some shortcomings and deficiencies. Firstly, the system is a victim of its own success. The government has produced a splendid system, but with it comes increased passenger demand and some real line capacity problems at peak hour where there can be delays and resulting irregular headways, much to the irritation of the demanding Singaporeans. The other flaw is that the day ticket is operated by EZ-Link and not the transport companies. As such its purchase is limited to specific (and very busy) ticket offices at only a few stations, it is valid from the day of purchase (if you arrive late in the day, as many do in Singapore, then it is of little value), purchase is by cash or Mastercard only (no Visa/Amex) and there is a \$10 deposit required. It really is quite an overcomplicated procedure and I wish a basic day ticket/24hr ticket could be offered by SMRT/SBS and be purchased from ticket machines. What makes this all the more frustrating is that it is not really like the rest of the system which operates so seamlessly.