

INFORMATION NOTE

Rail network systems in Singapore, Kuala Lumpur and Sydney

1. Introduction

1.1 At its meeting on 25 March 2014, the Panel on Transport requested the Research Office to study (a) the fully automatic, driverless mass rapid transit ("MRT") system in Singapore; (b) the monorail system in Kuala Lumpur of Malaysia; and (c) the now defunct monorail system in Sydney of Australia that closed in 2013 after 25 years of operation. As such, the purpose of this information note is to provide the Panel with background information on the operation of the above three rail network systems.

2. Automatically operated mass rapid transit system in Singapore

2.1 In metro systems, automation refers to the process by which responsibility for operation management of the trains is transferred from the driver to the train control system. Technical progress has rendered metro automation possible by making train control system capable of supervising, operating and controlling the entire operational process automatically without the need for a driver. At present, an automatically operated train is usually equipped with:

- (a) Automatic Train Protection system – a safety system for avoiding collisions, red signal over-running and exceeding train speed by applying brakes automatically;
- (b) Automatic Train Operation system – performing all the functions of the driver to allow full automation of trains. For example, the system can adjust the operating parameters such as the speed of the train and station dwell time to bring the train back to the timetable slot set for it; and
- (c) Train Data Management system – transmitting the necessary train data (including the operation of the train doors and platform screen doors) to the Automatic Train Protection and Automatic Train Operation systems.

2.2 An automatically operated metro system benefits train operators and passengers in that:

- (a) human error can be reduced to a minimum, thereby contributing to greater efficiency and safer operations;
- (b) more effective response can be made to system disturbances and emergencies under the automated failure detection system;
- (c) driverless trains accelerate and brake at a consistent rate and travel between stations at precisely the optimal energy-efficient operating speed; and
- (d) passengers can enjoy more frequent and reliable train services.

2.3 Singapore's Land Transport Authority¹ rode the trend of metro automation in 1997 to construct one of the world's first fully automatic underground rail systems, the North East Line. At present, Singapore has three automatically operated MRT lines, namely the North East Line, the Circle Line and the Downtown Line. Profiles of these three MRT lines are highlighted in the **Table** below.

Table – Profiles of the three automatically operated mass rapid transit lines

	North East Line	Circle Line	Downtown Line
Development of the rail line	<ul style="list-style-type: none"> • Commenced operation by stages from June 2003, and fully operated in June 2011. 	<ul style="list-style-type: none"> • Commenced operation by stages from May 2009, and fully operated in October 2011. 	<ul style="list-style-type: none"> • Commenced operation by stages from December 2013, and scheduled to be fully operated by 2017.
Construction costs	<ul style="list-style-type: none"> • S\$4.6 billion (HK\$28.5 billion). 	<ul style="list-style-type: none"> • S\$10 billion (HK\$62.0 billion). 	<ul style="list-style-type: none"> • Estimated S\$12 billion (HK\$74.4 billion).

¹ The Land Transport Authority is responsible for planning, operating, and maintaining land transport infrastructure and systems in Singapore.

Table – Profiles of the three automatically operated mass rapid transit lines (cont'd)

	North East Line	Circle Line	Downtown Line
Length of the rail line	<ul style="list-style-type: none"> 20 km long with 16 stations. 	<ul style="list-style-type: none"> 35.7 km long with 28 stations. 	<ul style="list-style-type: none"> 4.3 km long with six stations already opened for service. 42 km long with 34 stations, when fully operational.
Number of compartments per train	<ul style="list-style-type: none"> Heavy capacity line, with six compartments per train.⁽¹⁾ 	<ul style="list-style-type: none"> Medium capacity line with three compartments per train. 	<ul style="list-style-type: none"> Medium capacity line with three compartments per train.
Total journey time	<ul style="list-style-type: none"> About 33 minutes. 	<ul style="list-style-type: none"> About 45 minutes. 	<ul style="list-style-type: none"> About 65 minutes when fully operational.
Train frequency during peak hours	<ul style="list-style-type: none"> Every two to four minutes per train. 	<ul style="list-style-type: none"> About every five minutes per train. 	<ul style="list-style-type: none"> About every four minutes per train.
Enhancement plan	<ul style="list-style-type: none"> 18 additional trains will be progressively added to the Line from 2015 onwards. It is also planned to extend the Line northwards by one station to serve Punggol North, in tandem with the development in northern Singapore. If implemented, the project is scheduled to be completed by 2030. 	<ul style="list-style-type: none"> 24 additional trains will be progressively added to the Line from 2015 onwards. It is also planned to build a new 4-km extension line running between Marina Bay and Harbour Front. If implemented, the project is scheduled to be completed by 2025. 	<ul style="list-style-type: none"> It is planned to build a new southern extension running from the Singapore Expo through the East Coast area. If implemented, the project is scheduled to be completed by 2025.

Note: (1) See **Appendix** for the design of new train and its compartment.

Source: Land Transport Authority.

2.4 In Singapore, the development of automatically operated MRT lines offers time savings and a greater source of reliability for commuters. This is particularly important for Singapore as the country needs an efficient public transport system to enhance the movement of commuters amid a growing population within a limited land area.²

3. Kuala Lumpur Monorail

3.1 The Kuala Lumpur Monorail opened in August 2003 as an urban monorail system in Kuala Lumpur. It was built by a private company, the Kuala Lumpur Infrastructure Group, with a construction cost of 1.2 billion ringgit (HK\$3.0 billion). The monorail runs 8.6 km on two parallel elevated tracks with 11 stations connecting the Kuala Lumpur Sentral transport hub³ with Bukit Bintang, the prominent shopping and entertainment district of Kuala Lumpur.

3.2 The Kuala Lumpur Infrastructure Group had suffered losses from the start primarily due to heavy depreciation and interest expenses. The Group subsequently declared bankruptcy in May 2007 after repeatedly defaulting on its loan repayments. In response, the government-owned company Prasarana took over the Kuala Lumpur Monorail at a cost of 882 million ringgit (HK\$2.2 billion). The current operator of the monorail is the Rapid Kuala Lumpur Rail, a wholly-owned subsidiary of Prasarana.

3.3 At present, the Kuala Lumpur Monorail complements the metro and light rail lines. It is run with two-compartment trains each capable of carrying up to about 210 passengers. The Kuala Lumpur Monorail has reached its peak capacity with a daily ridership of about 70 000 passengers. The train frequency is about five minutes per train during peak hours.

² Singapore is one of the most densely populated countries in the world with a population density of 7 540 persons per sq km.

³ The hub is a transit-oriented development that houses the main railway station of Kuala Lumpur and the City Air Terminal.

Enhancement of the Kuala Lumpur Monorail

3.4 Faced with the over-crowding problem of the Kuala Lumpur Monorail, the Malaysian government announced in its Government Transformation Programme⁴ to use four-compartment trains starting from the third quarter of 2014 onwards. It has spent 494 million ringgit (HK\$1.2 billion) on the purchase of 12 new trains each with a carrying capacity of 430 passengers. Apart from a larger passenger capacity, the new trains are also equipped with better safety features such as on-board closed circuit televisions. In addition, the government also plans to upgrade the facilities of monorail stations and the project includes upgrading the signalling system, installing the platform automatic gates and constructing a new depot to cater for the larger train sets.

4. Sydney Monorail

4.1 The Sydney Monorail officially opened on 21 July 1988 and ceased operating on 30 June 2013. It was an elevated single-loop railway constructed by an Australian company, the TNT Group, in the late 1980s to provide a passenger link between Darling Harbour and the central business district in Sydney. The project was to fit with the development of Darling Harbour as a convention and tourist precinct. The monorail was subsequently sold to a private company named Metro Transport Sydney.

4.2 The Sydney Monorail attracted criticisms even before it came into operation in 1988. A key limitation of the monorail was that it only served a small area surrounding Darling Harbour and the central business district, rendering it more of a tourist attraction than an efficient public transport system.⁵ Indeed, a complete circuit of the route only took about 12 minutes. In addition, the local community considered that the monorail columns, pedestals and beams interrupted the streetscapes.

⁴ The Malaysian government has implemented the Government Transformation Programme in an effort to improve the livelihood of the people. The elements of the programme include (a) enhancing public transport services; (b) upgrading basic infrastructure in rural areas; and (c) raising living standards of low-income households.

⁵ The unpopularity of the monorail as a form of public transport was reflected by its low patronage. Before its cessation of operation, the Sydney Monorail had an average daily patronage of 6 000 passengers, compared with the corresponding figure of 525 000 passengers for the Sydney Buses.

4.3 The New South Wales ("NSW") government purchased Metro Transport Sydney in March 2012 and placed it under the control of the Transport for NSW. The deal allowed the NSW government to redevelop the Sydney Convention and Exhibition Centre by closing the monorail and remove the contractual restrictions on expanding the light rail network. The Sydney Monorail finally closed on 30 June 2013 and Metro Transport Sydney was shut down shortly thereafter.

4.4 The NSW government envisaged a number of long-term benefits brought by dismantling the monorail system. These include the saving from not having to upgrade the aging monorail system, enhancement of the streetscape views of Sydney, and improvement of the pedestrian and traffic flows through converting the land previously occupied by the monorail support columns and pedestals back to footpath or roadway.

Research Office
Information Services Division
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Tel: 2871 2129

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Appendix

Figure 1 – New generation of trains used in Singapore



Source: Land Transport Authority.

Figure 2 – Interior design of a new train compartment⁽¹⁾



Note: (1) New trains provide ample carriage space and a more comfortable journey for commuters. They have perch seats in the gangway area and extra wheelchair spaces in the centre of the compartment for greater accessibility.

Source: Land Transport Authority.

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