For discussion
on 7 June 2017

TFKT/13/2017

Stage 1 of Detailed Feasibility Study for Environmentally Friendly Linkage System for Kowloon East

PURPOSE

This paper serves to update Members on the findings of the Stage 1 of the Detailed Feasibility Study (DFS) for the Environmentally Friendly Linkage System (EFLS) for Kowloon East[1] **(Enclosure 1**).

BACKGROUND

2. The Kai Tak Outline Zoning Plan (OZP) approved in 2007 has incorporated the indicative alignment of an EFLS running within KTD[2]. In 2009, the Civil Engineering and Development Department (CEDD) conducted a preliminary feasibility study (PFS) on a rail-based EFLS. In the 2011-12 Policy Address, the Chief Executive announced the Energizing Kowloon East initiative to transform Kowloon East (KE) into another Core Business District (CBD) to sustain Hong Kong's economic development. Under this initiative, the proposed EFLS is considered essential to strengthen connectivity for the transformation of KE into CBD.

3. The PFS proposed the EFLS to take the form of a 9-kilometre long elevated monorail system with 12 stations and a link bridge across Kwun Tong Typhoon Shelter (KTTS), namely Kwun Tong Transportation Link (KTTL), linking the former runway tip and Kwun Tong (**Enclosure 2**). A two-stage public consultation (PC) exercise on the preliminary EFLS proposal was

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[1] Kowloon East comprises the Kai Tak Development, and the existing business areas of Kowloon Bay and Kwun Tong.

[2] The EFLS alignment indicated on the latest Kai Tak OZP generally follows that incorporated in the plan since 2007.

conducted between 2012 and 2014. While there were general support to enhance the connectivity for KE and requests for early implementation of the EFLS, diversified views were received on the proposed elevated monorail system which can largely be categorised into three key issues, i.e. (i) the need for an elevated rail-based EFLS; (ii) the preferred EFLS alignment and coverage; and (iii) the impact on the KTTS arising from KTTL. Regarding the need for an elevated rail-based EFLS, there were concerns about the high capital cost and weak financial performance of the proposed elevated monorail. A proposal for adopting modern tramway (**Enclosure 3**) at a lower construction cost as an alternative to elevated monorail was received during the PC. As the PFS did not have the level of details to address the public concerns, we recommended to conduct a DFS to address various public concerns and to draw up a scheme which would be developed to meet the relevant statutory and government requirements and would be generally accepted by the stakeholders.

4. During the funding application for the DFS in mid-2015, some Legislative Council Members questioned the financial viability of the proposed monorail system. The scope of the DFS was thus expanded and modified to be carried out in two stages. Stage 1 of the DFS would assess various green transport (GT) modes, including Personal Rapid Transit, Cable Car, Electric / Supercapacitor / Hybrid Bus, Travellator, Automated People Mover (APM), Monorail, Modern Tramway (MT) and Bus Rapid Transit (BRT), on equal basis in order to identify the most suitable GT mode for the EFLS and to conduct an interim PC on the findings of the assessment. Based on the recommended GT mode, Stage 2 of the DFS would further develop the EFLS scheme including its alignment coverage, station and depot locations, financial evaluation and procurement and implementation strategy. Upon completion of Stage 2 detailed assessment, another PC will be conducted to further collect public views.

5. The DFS commenced in October 2015 and we have

now completed Stage 1 of the DFS which includes assessment on system performance, impacts on other road users, capital cost and economic viability of the different GT mode(s) when implementing in KE. The key findings are set out in the ensuing paragraphs, and details can be found in the website of the DFS (www.ktd.gov.hk/efls).

KEY FINDINGS OF STAGE 1 OF THE DFS

6. The total commercial gross floor area (GFA) in KE was about 2.3 million square metres (m^2) in 2016. With the gradual transformation of KE into a CBD and the proposed increase in the development intensity of KTD, it is anticipated that the total commercial GFA in KE has the potential to reach about 7 million m^2. Together with the growth in residential population in KTD, the daily public transport (PT) passenger trips within KE are forecasted to rise by more than one fold in 2036.

7. To facilitate successful transformation of the KE into a CBD, it would be of utmost importance to enhance the accessibility of KE and its connectivity with all major destinations in the territory. Since the MTR Kwun Tong Line and Shatin-to-Central Link run along the periphery of KE, the connectivity within KE mainly relies on road-based PT services and walkway system. It is therefore necessary to introduce EFLS as an additional transport mode in linking up the key activity nodes within KE and connecting with rail stations as well as nearby PT and pedestrian facilities. It will not only meet the newly generated traffic need with enhanced road environment, but also improve the accessibility of KE to facilitate its development to become a premium business district.

8. To address the increase in travel demand and to provide a high level service required for the CBD, the EFLS should have sufficient capacity to meet future travel demand in KE, and be reliable, comfortable and on-time so as to provide a quick and time-competitive journey as compared with other PT services.

Being a green transport mode, EFLS has to be environmentally and socially sustainable with minimal impact during both construction and operation stages. On this basis, the EFLS has to achieve four basic visionary criteria including (i) capacity; (ii) reliability; (iii) efficiency; and (iv) sustainability in order to serve as a PT backbone within KE.

9. In carrying out Stage 1 of the DFS, a two-phase evaluation approach has been used in identifying the most suitable GT mode(s) for the proposed EFLS. A high level screening was conducted to assess all the GT modes against the four visionary criteria based on their system characteristics as summarized at **Enclosure 4**. It has revealed that Personal Rapid Transit and Cable Car are of lower and inadequate carrying capacity. Being environmentally friendly in using green energy, Electric / Supercapacitor / Hybrid Bus has similar operating speed as the conventional bus. Travellator is considered as a supplement to pedestrian facility for enhancing walking comfort for a short distance travel. Amongst all the GT modes assessed, the performance of Monorail, APM, MT and BRT in terms of capacity, reliability, efficiency and sustainability have to be further evaluated for comparison.

10. Based on the operating and infrastructure characteristics, the four selected transport modes have been grouped as follows:

(i) At-grade Dedicated Corridor Modes (using MT or BRT) - requiring occupation of road space of 2 to 3 traffic lanes for exclusive use;

(ii) At-grade Shared Corridor Mode (using MT) - sharing the road space with general traffic; and

(iii) Elevated Modes (using Monorail or APM).

11. Detailed assessments in terms of system performance,

impacts on other road users, capital cost and economic viability for the above three groups have been carried out.

At-grade Modes

12. For the dedicated corridor modes, apart from taking up road space currently largely used by vehicles **(Enclosure 5)**, all junctions along the corridor have to be signalized with priority given to EFLS to enhance its travelling speed. It would thus cause serious traffic congestion along and in the vicinity of their proposed routes. For example, the assessment indicated that in Kowloon Bay, the speed of road traffic could be reduced to as slow as the walking speed. The community as a whole has to spend more time in daily travel due to the introduction of the dedicated corridor modes. Furthermore, to avoid disruption to the service, it is necessary to realign all underground utilities away from the dedicated corridor. As a result, the economic return[3] for these modes are negative.

13. For the At-grade Shared Corridor Mode, as its service would be interrupted by other vehicles sharing the same road space **(Enclosure 5)**, its operating speed or reliability performance would not be better than other road-based PT. Furthermore, to avoid disruption to the service, it is necessary to realign all underground utilities away from the shared corridor. Taken into account the extra costs on establishing and operating the MT system, the economic return for this mode is also negative.

Elevated Modes

14. On the other hand, an elevated system segregating from road traffic **(Enclosure 5)** provides reliable service, offers better overall system performance and attracts higher daily ridership. Through maintaining the existing traffic lanes, the

[3] Economic return is measured in terms of Economic Internal Rate of Return. It is the discount rate that equates the present value of the economic costs stream (including the capital and operation costs during construction and the subsequent 50 years of operation) to that the economic benefits stream (including travel time savings of passengers, vehicle operating cost savings, and accident cost savings), as a measure of the overall cost-effectiveness of the project to the community.

presence of the elevated system would have negligible impact on the operation of road traffic. Despite the capital investment cost is comparatively higher than those of the at-grade modes, the elevated system would still generate a positive economic return through considerable saving in the travelling time of PT users.

Summary of Detailed Assessment

Items for Detailed Assessment	Occupation of Existing Road Space	Impact on Underground Utilities	Modifications of Junctions, Traffic Signals and Pedestrian Facilities	Construction Cost	Travelling Time of All Passengers	Visual Impact	Overall Benefit
At-grade (dedicated)	Considerable	Extensive	Large-scale	Low	Lengthened	Minor	Negative
At-grade (shared)	Moderate	Extensive	Localised	Low	Generally no change	Minor	Negative
Elevated	Moderate	Localised	Minor	High	Shortened	Considerable	Positive

WAY FORWARD FOR THE EFLS PROJECT

15. In response to the first key issue mentioned under paragraph 3, i.e. the need for an elevated rail-based EFLS, we have assessed various GT modes on equal basis under Stage 1 of the DFS. Stage 1 study concluded that the two elevated modes (Monorail or APM) should be selected as the most suitable GT modes as the EFLS for KE and be further examined in Stage 2 of the DFS.

16. Stage 2 of the DFS will examine in detail the proposed elevated EFLS alignment coverage, station and depot locations, capital and operating costs, procurement approach, its associated economic and financial performance and implementation programme.

Enclosures

Enclosure 1 – Coverage of Kowloon East

Enclosure 2 – Preliminary EFLS proposal under Preliminary Feasibility Study

Enclosure 3 – Modern Tramway Proposal as received under Preliminary Feasibility Study

Enclosure 4 – Characteristics of Green Transport Modes

Development Bureau
Civil Engineering Development Department
May 2017

圖例
LEGEND

啟德發展區
Kai Tak Development

九龍灣商貿區
Kowloon Bay
Business Area

觀塘商貿區
Kwun Tong
Business Area

註釋:
Note:

九龍東包含啟德發展區及現時的
九龍灣及觀塘商貿區
Kowloon East comprises of Kai Tak Development and existing business areas of Kowloon Bay and Kwun Tong

圖則名稱 Drawing title

九龍東涵蓋範圍
Coverage of Kowloon East

附件一
Enclosure 1

圖例
Legend :

- 已進行諮詢的環保連接系統初步建議 Preliminary EFLS Proposal - Alignment on which Public Consultation was conducted
- 環保連接系統初步建議 - 替代走線 Preliminary EFLS Proposal - Alternative Alignment
- 初步建議的環保連接系統車站 Preliminary EFLS Station
- 港鐵與環保連接系統的交匯站 MTR Station Interchange with EFLS
- 初步建議的環保連接系統車廠 Preliminary EFLS Depot
- 啟德發展區 Kai Tak Development

圖則名稱 Drawing title

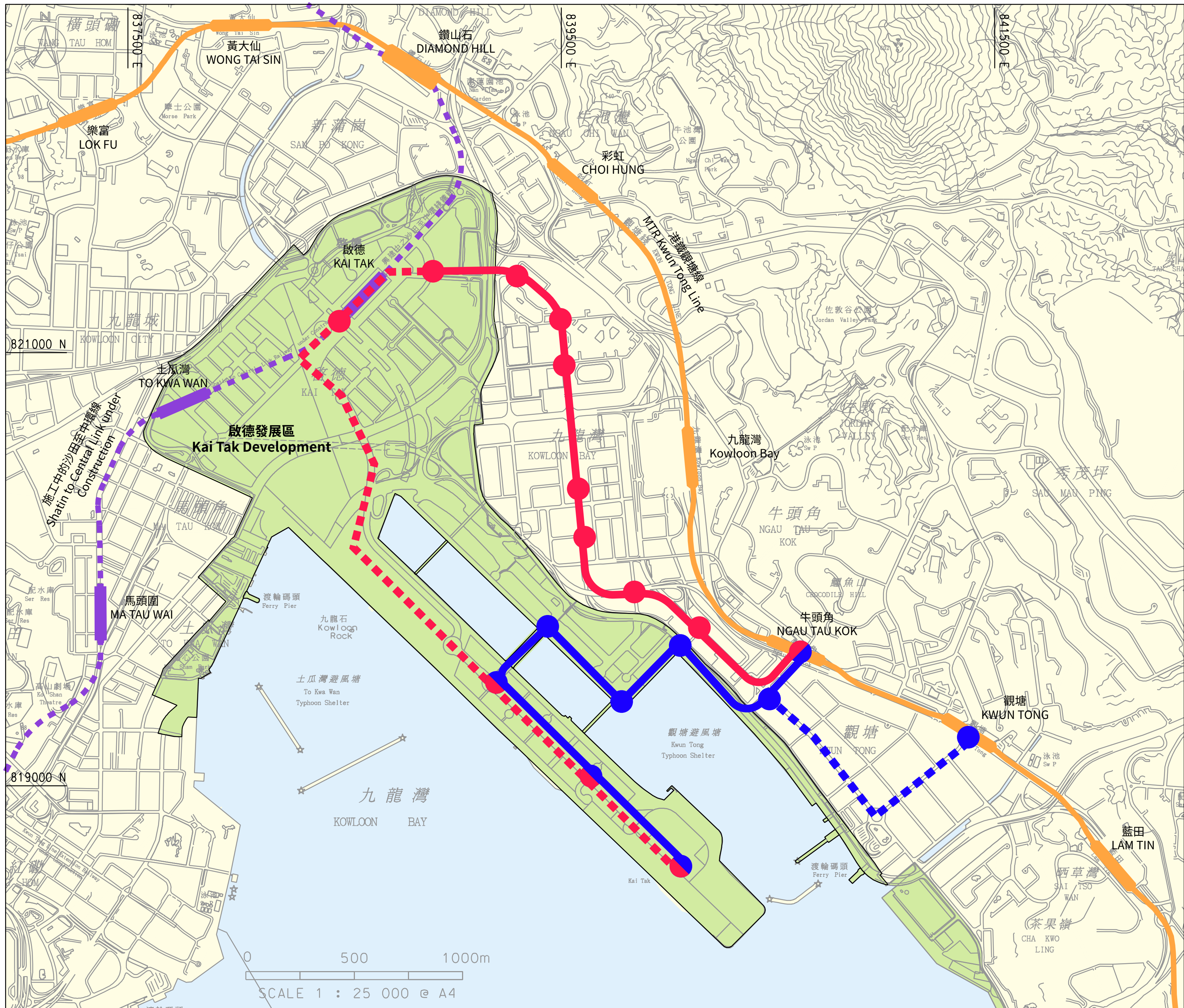
初步可行性研究的環保連接系統初步建議

Preliminary EFLS proposal under Preliminary Feasibility Study

附件 二

Enclosure 2

G:*KZ-Dgn*KZ933*KZ933.dgn



圖例
Legend :

路線1 第1期
Line 1 Phase 1

路線1 第2期
Line 1 Phase 2

路線2 第1期
Line 2 Phase 1

路線2 第2期
Line 2 Phase 2

圖則名稱 Drawing title

於初步可行性研究收到的現代電車之建議

Modern Tramway Proposal as received under Preliminary Feasibility Study

附件 三

Enclosure 3

G:*KZ-Dgn*KZ933*KZ933.dgn

BUS RAPID TRANSIT (BRT)

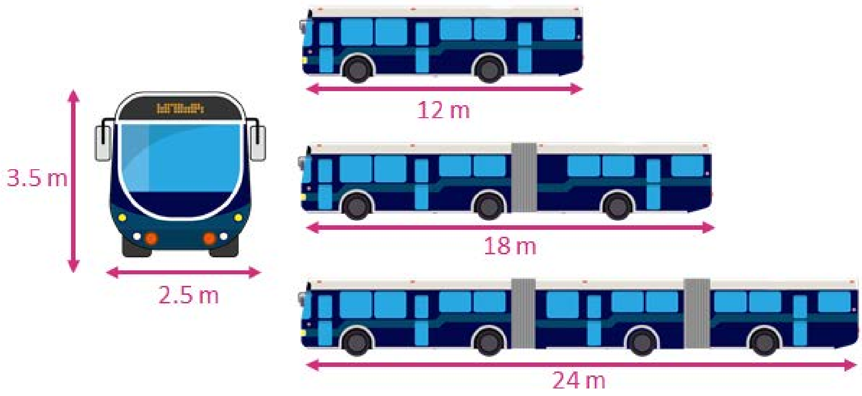
Description:

- A high quality bus-based system
- Typically operates in an at-grade dedicated corridor, segregated from other road users except at junctions
- Various strategies adopted to increase speeds/capacity such as signal priority, off-board payment, level boarding, passing lanes, and elongated stations

Typical Operating Characteristics:

- Runningway: Typically in at-grade bus-only lanes to ensure they are not delayed by other road traffic.
- Segregation: Bus-only lanes are segregated from other road traffic except at junctions, where priority can be provided to reduce delays
- Avg. Speed: Around 15-30 km/hour
- Max. Speed: Around 70 km/hour

Vehicle Dimension and Capacity:



- Capacity: Around 65 passengers (single deck bus) up to 270 passengers (bi-articulated bus)

Note: Actual vehicle dimensions and carrying capacity subject to manufacturers' design

System Characteristics:

- Manually operated by Driver
- Propulsion: Diesel, LPG, hybrid vehicles
- Typical Corridor Width: About 8-9 m for dual 3.5m bus lanes without passing lane; additional 3-4m for platform at station location.

MODERN TRAMWAY (MT)

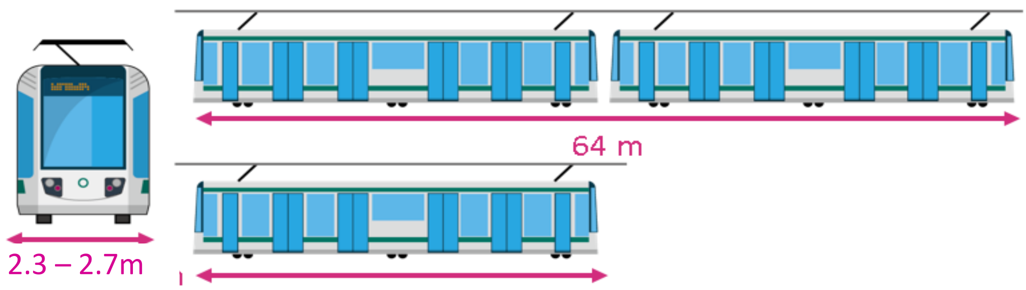
Description:

- Rail-based system typically operating on street in embedded track
- MT operates in both shared and dedicated corridors, although reliability and speed significantly reduced in shared operation
- Typically powered by overhead wires, but newer systems can be "overhead wire free" using embedded power supply systems

Typical Operating Characteristics:

- Runningway: Typically at-grade in embedded track
- Segregation: Shared corridors use track occupying the same traffic lanes as other vehicles. Dedicated corridors are segregated from other road traffic except at junctions, where priority can be provided to reduce delays.
- Avg. Speed: Around 20-30 km/hour
- Max. Speed: Around 80 km/hour

Vehicle Dimension and Capacity:



- Capacity (4 pax/m^2): Around 200-240 passengers (for 32m long tram)

Note: Actual vehicle dimensions and carrying capacity subject to manufacturers' design

System Characteristics:

- Manually operated by Driver
- Propulsion: Electricity
- Typical Corridor Width: About 7 m for dual track; additional 2.5-3m for platform at station location.

MONORAIL

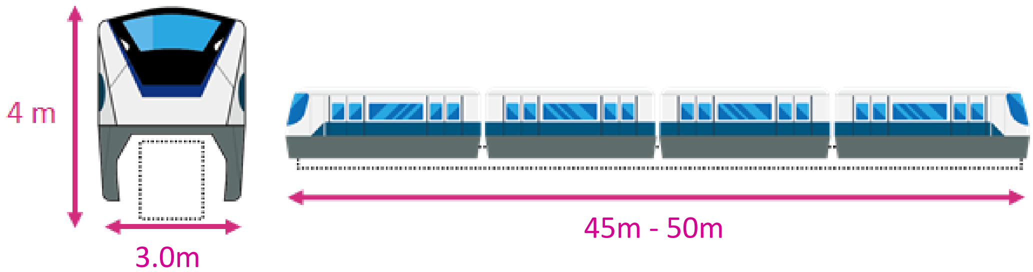
Description:

- Rail-based system with rubber tire vehicles straddling single beam
- Single beam is considered "slimmer" and less visually impactful than other elevated modes
- Operates in an elevated dedicated corridor, segregated from other road users
- Limited number of suppliers as technology is proprietary

Typical Operating Characteristics:

- Runningway: Elevated guide beam supported on columns
- Segregation: Fully segregated from ground-level traffic
- Avg. Speed: Around 20-30 km/hour
- Max. Speed: Around 80 km/hour

Vehicle Dimension and Capacity:



- Capacity (4 pax/m^2): 360 passengers (4-car train)

Note: Actual vehicle dimensions and carrying capacity subject to manufacturers' design

System Characteristics:

- Fully Automated Driverless operation
- Propulsion: Electricity
- Typical Corridor Width: About 9m for dual track section

AUTOMATED PEOPLE MOVER (APM)

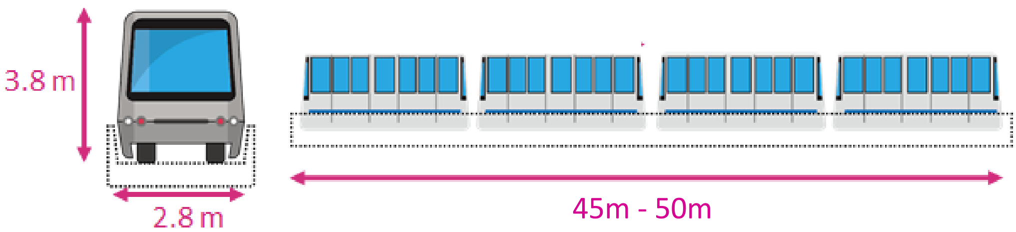
Description:

- Rail-based system with vehicles using rubber tires running on a flat guideway on viaduct
- Operates in an elevated dedicated corridor, segregated from other road users
- Limited number of suppliers as technology is proprietary

Typical Operating Characteristics:

- Runningway: Elevated guideway supported on columns
- Segregation: Fully segregated from ground-level traffic
- Avg. Speed: Around 20-30 km/hour
- Max. Speed: Around 80 km/hour

Vehicle Dimension and Capacity:



- Capacity (4 pax/m^2): 400 passengers (4-car train)

Note: Actual vehicle dimensions and carrying capacity subject to manufacturers' design

System Characteristics:

- Fully Automated Driverless operation
- Propulsion: Electricity
- Typical Corridor Width: About 9m for dual track section

PERSONAL RAPID TRANSIT (PRT)

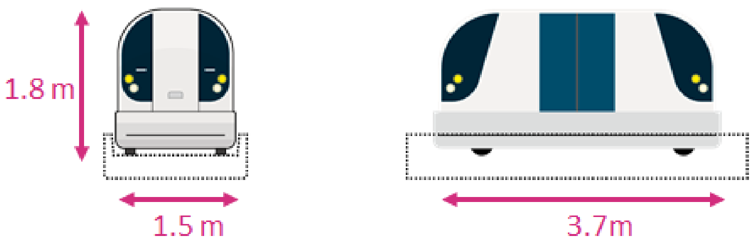
Description:

- On-demand system with automated pods operating in specially built guideways, segregated from other road users
- Passenger enjoy point-to-point, nonstop travel, bypassing all intermediate stations

Typical Operating Characteristics:

- Runningway: Elevated guideway supported on columns
- Segregation: Fully segregated from ground-level traffic
- Avg. Speed: Around 30-40 km/hour
- Max. Speed: Around 50 km/hour

Vehicle Dimension and Capacity:



- Capacity: 4-6 passengers per vehicle

Note: Actual vehicle dimensions and carrying capacity subject to manufacturers' design

System Characteristics:

- Fully Automated Driverless operation
- Propulsion: Electricity
- Typical Corridor Width: About 4m for dual track

CABLE CAR

Description:

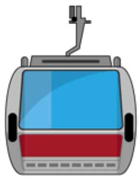
- Aerial system with cabins pulled by a suspended cable, completely segregated from road users
- Lower capacity compared to other systems as cable strength limits number of cabins operating
- System closes during heavy rain, high winds and low visibility and maintenance
- Turning towers necessary for change of direction

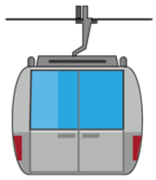
Typical Operating Characteristics:

- Runningway: Elevated system suspended from ropeway
- Segregation: Fully segregated from ground-level traffic
- Avg. Speed: Around 10-20 km/hour

Vehicle Capacity:

- Cabin size depends on design capacity
- Capacity per Cabins: Typically 10-17 passengers (ref: Ngong Ping 360's cabins seat 10 and hold up to 17 passengers)





Note: Actual vehicle dimensions and carrying capacity subject to manufacturers' design

System Characteristics:

- Fully Automated System
- Propulsion: Electricity
- Hauling systems by cable spanning between towers

CABLE LINER

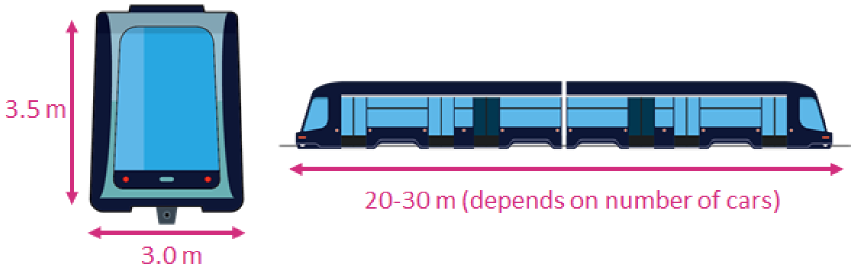
Description:

- System uses vehicles pulled by cables below the vehicle
- Operates in an elevated dedicated corridor. Vehicles have no motors and are lighter, allowing for less bulky support viaducts
- Typically used for feeder system or for airports
- Limited number of suppliers as technology is proprietary

Typical Operating Characteristics:

- Runningway: Elevated truss/guideway supported on columns
- Segregation: Fully segregated from ground-level traffic
- Avg. Speed: Around 35-40 km/hour

Vehicle Dimension and Capacity:



- Capacity: Around 110-115 passengers per three car train

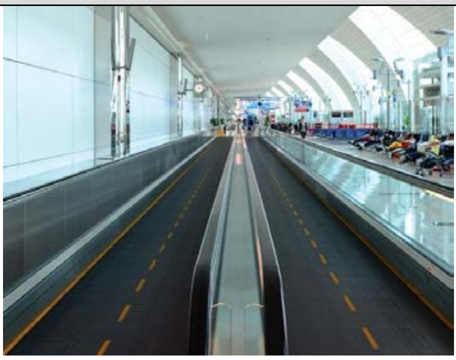
Note: Actual vehicle dimensions and carrying capacity subject to manufacturers' design

System Characteristics:

- Fully Automated Driverless System
- Propulsion: Electricity

TRAVELLATOR

Description:



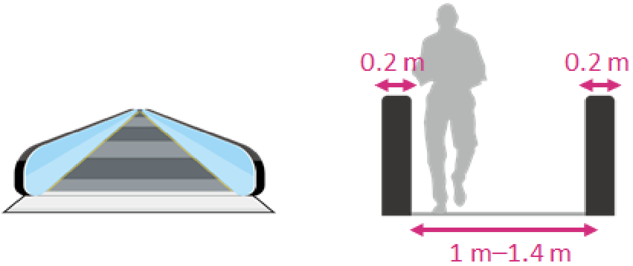
- Sometimes referred to as a moving sidewalk or walkway, travellators reduce effective walking distances and walk times
- Travellators may be provided indoor or outdoor (typically covered), underground, at-grade, or on a footbridge
- Targeted for short-distance walk trips, for instance in airports and between major transport hubs and nearby buildings
- Slow moving speed makes travellators unsuitable for longer distance trips

Typical Operating Characteristics:

- Runningway: Typically provided adjacent to conventional walkway either on footbridge/subway or within building as an additional pedestrian facility to enhance walking comfort
- Avg. Speed: Around 2.5 km/hour

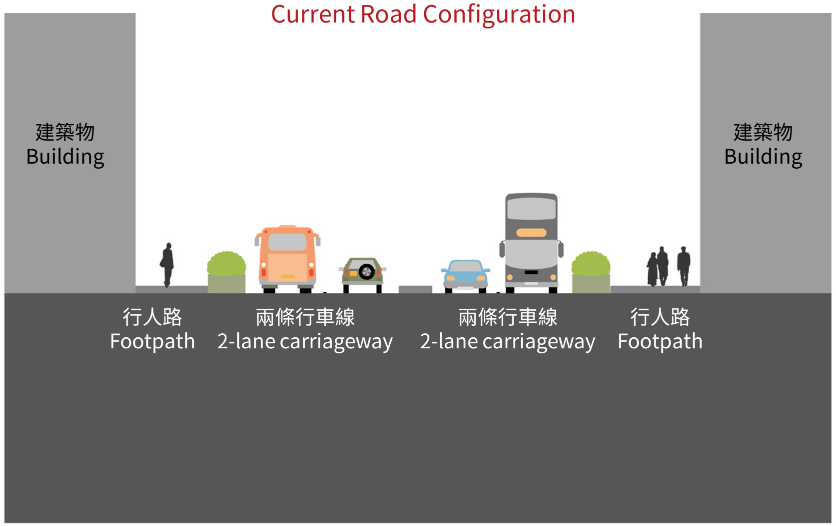
System Characteristics:

- Propulsion: Electricity
- Width depends on designed capacity and whether luggage and carts are allowed on the travellator
- Capacity can vary significantly according to whether pedestrians walk or stand, as well as the gap between pedestrians



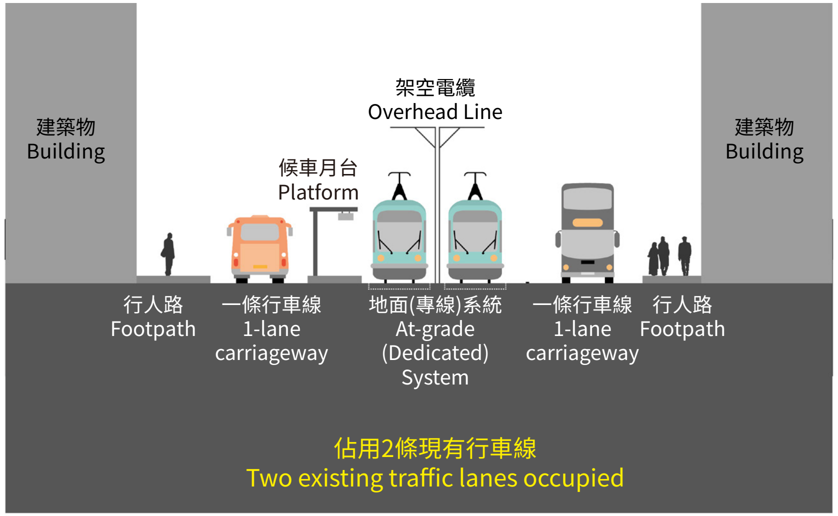
Note: Actual vehicle dimensions and carrying capacity subject to manufacturers' design

現時路面情況
Current Road Configuration

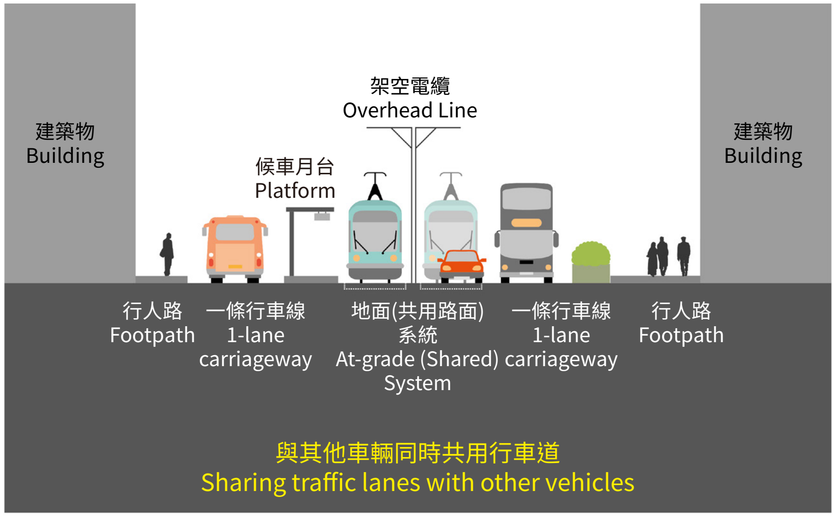


採用高架系統後
With Elevated System

採用地面(專線)系統後
With At-grade (Dedicated) System



採用地面(共用路面)系統後
With At-grade (Shared) System



圖則名稱 Drawing title

不同環保公共交通模式於宏光道的剖面圖
Cross Sections of Various Green Public Transport Modes at Wang Kwong Road

附件 五
Enclosure 5