



ICAO

The Fifth Meeting of the Aerodromes Operations and
Planning Sub-Group (AOP/SG/5)

Video Teleconference, 29 June to 2 July 2021

Agenda Item 4: Provision of AOP in the Asia/Pacific Region

**AIRPORT AUTONOMOUS TRANSPORT SYSTEM
AT HONG KONG INTERNATIONAL AIRPORT**

(Presented by Hong Kong, China)

SUMMARY

This paper presents the development and vision of the Hong Kong International Airport in implementing the Airport Autonomous Transport System by adopting driverless technology for airside transportation. After being the first airport with live operations of autonomous electric tractors deployed for baggage conveyance since December 2019, the Hong Kong International Airport has scheduled to commence trials on deploying autonomous electric tractors for cargo conveyance and autonomous buses for staff shuttle services in mid-2021 and early 2022 respectively.

1. INTRODUCTION

1.1 The Hong Kong International Airport (HKIA) is constantly in pursuit of innovative solutions for safe and efficient airport operations. With the advancement of driverless technology, HKIA has been progressively adopting autonomous vehicles for airside transportation. After being the first airport in the world to deploy autonomous electric tractors (AETs) into live operations for baggage conveyance, HKIA will expand the adoption of autonomous vehicles into other applications, with the eventual aim to establish the Airport Autonomous Transport System (AATS), which will be a backbone of airside transportation under the Three-Runway System (3RS) operations of HKIA.

1.2 This paper shares HKIA's experience in putting driverless technology for baggage conveyance into live operations through a multi-phased and collaborative approach, as well as ongoing plans of the AATS in expanding the technology's application to cargo conveyance and staff shuttle services. Benefits and opportunities brought forward by the adoption of driverless technology to airport operations are also highlighted in this paper.

2. DISCUSSION

AETs for Baggage Conveyance

2.1 The SkyPier at HKIA provides ferry services to sea-to-air and air-to-sea transit passengers, connecting multiple ports in the Mainland China and Macao. Baggage of passengers using these ferry transfer services are currently being transported by AETs through a 2-kilometre road between the Baggage Halls at Terminal 1 of HKIA and the SkyPier, as illustrated in Figure 1.

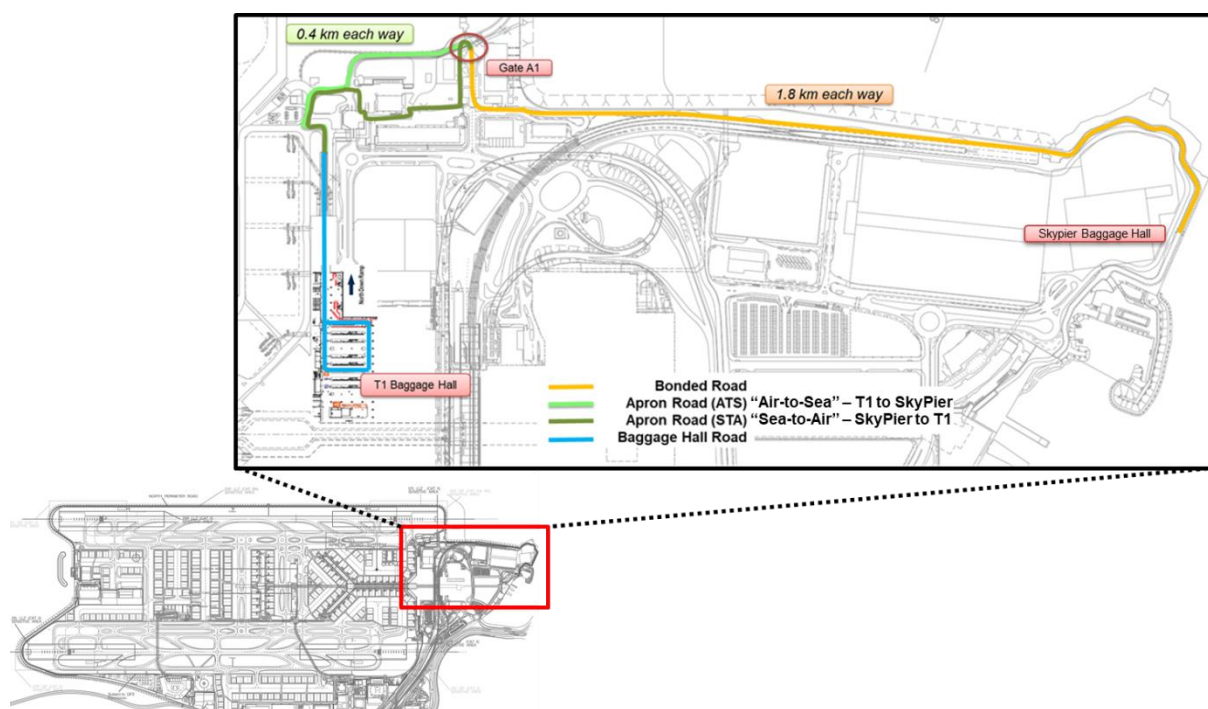


Figure 1
AET Routing Between Baggage Halls at Terminal 1 and SkyPier

2.2 Since 2018, the Airport Authority Hong Kong (AA), airport operator of HKIA, had been endeavouring to explore technical feasibility to develop AETs for baggage conveyance. The current AET is equipped with High-Definition cameras, LiDAR and radar sets, as well as a differential Global Positioning System (dGPS). It is capable of maintaining AET's positioning accuracy within 15cm at a travelling speed of 20km/h in autonomous mode. Real-time monitoring of the AETs is conducted through a Remote Monitoring Unit (RMU), where live images, operational data and alerts of the AET are obtained, and emergency stop commands can be given immediately, whenever necessary.

2.3 After completing stages of rigorous factory and on-airport testing on the AET's obstacle detection capability, positioning accuracy and system durability, the AET was deployed to a non-apron road section of the SkyPier-Terminal 1 baggage conveyance route for the first phase of operational trial in June 2019. Over 150 test trips were conducted with a record of zero AET-caused accidents. Being the first airport in the world, HKIA launched AET live operations at the non-apron road section in December 2019.

2.4 The second phase of AET trial was conducted in the apron road section of the SkyPier-Terminal 1 baggage conveyance route, which involves manoeuvring through a T-junction. With a comprehensive test plan in place, the reaction of the AET under different traffic conditions at the T-junction was tested satisfactorily. The end-to-end SkyPier-Terminal 1 baggage conveyance by a fleet of AETs was eventually put into live operations in September 2020.

2.5 Throughout the process of AET development, AA had maintained close collaboration with regulatory authorities and stakeholders to resolve concerns including aerodrome safety, aviation security



Figure 2
AET departing from the Baggage Hall at SkyPier

and use of radio frequency channels. The Hong Kong Civil Aviation Department (CAD) conducted thorough assessment on the AET implementation and test plans, observed trials of various operational modes and test scenarios, and vetted the standard operating procedures, contingency plan and test reports before the live operations of AET. Future applications of AET will be implemented by AA in close consultation with CAD.

2.6 Operations at HKIA had long been challenged by a low availability of labour, including tractor drivers. The replacement of manually driven tractors by AETs, not only being a relief for HKIA from such challenge in the long run but has also provided a more effective and efficient baggage conveyance service by operating around-the-clock under all-weather conditions.

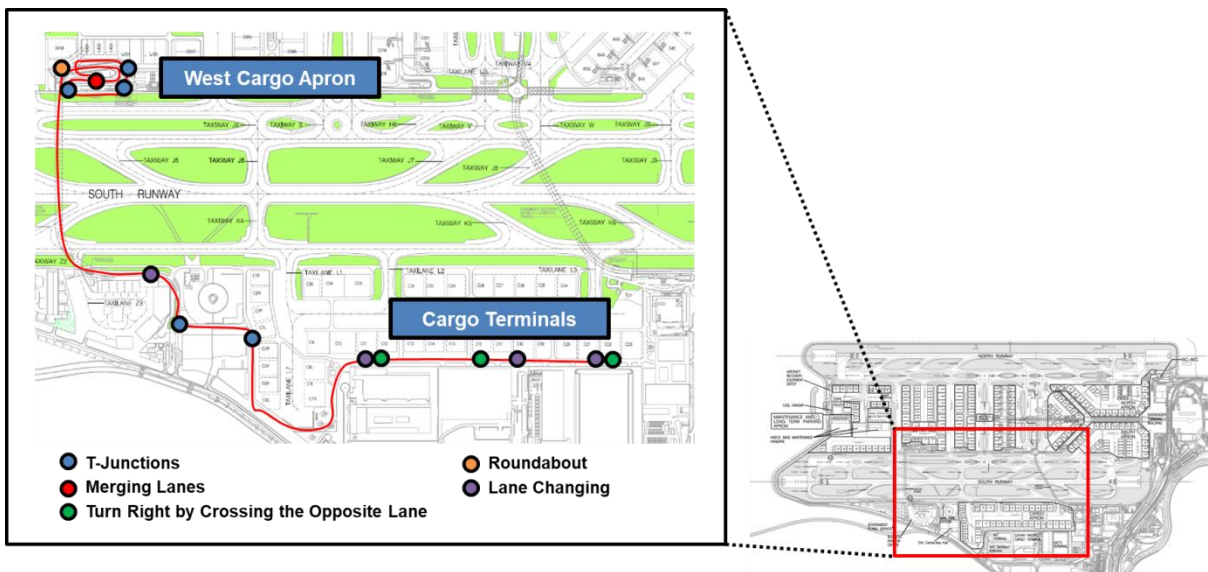
AETs for Cargo Conveyance in 3RS

2.7 With over 50% increase of operation footprint at HKIA upon the commencement of the 3RS in 2024, the maximum cargo towing distance between parking stands and cargo terminals is expected to be doubled. Building from the success of AETs application on baggage conveyance, AA had commenced feasibility studies and ramp community engagement on deploying AETs for cargo conveyance between cargo terminals and the newly developed 3RS apron.



*Figure 3
Preliminary testing on AET for cargo conveyance*

2.8 Trials involving AETs conveying cargo is scheduled to commence in mid-2021. The AET routing for cargo conveyance trial is illustrated in Figure 4. Expected challenges include going through tunnel and around roundabout, lane merging, obstacle avoidance, the requirement for a larger sensing range for the AET operating with a longer chain of cargo pallets, and the durability of the electric tractor in towing heavy-loads. The successful deployment of AETs for cargo conveyance in 3RS will significantly increase the cost-effectiveness of operations, and will contribute to AA’s commitment on Ground Service Equipment electrification at HKIA.



*Figure 4
AET Routing for Trial on Cargo Conveyance*

Autonomous Bus for Staff Shuttle Services

2.9 In addition to tractors, apron buses are another planned application of driverless technology under the AATS. AA currently provides the airport community with a staff shuttle service travelling between various locations within HKIA aprons along apron roads. Providing the shuttle service with autonomous buses will allow greater flexibility in its operating hours and frequencies to bring further convenience to the airport community. As a passenger-carrying service, technical solutions for deploying autonomous buses are being explored while maintaining passenger safety standards. To ensure a smooth transition, a phased approach in implementation similar to that of the AET will be adopted. Initial trials are currently planned at segregated apron areas in early 2022.

Future Development

2.10 Combining the needs arising from AETs deployment for cargo conveyance in 3RS and the autonomous bus for staff shuttle services, AA is also assessing the infrastructure requirement for supporting Vehicle-to-Everything (V2X) communication, a technology that allows autonomous vehicles to communicate with the surrounding environment within HKIA airfield. The establishment of a fleet management system is also being explored for facilitating informed decisions through an integrated management system.

2.11 Subject to further development of driverless technology and local regulatory framework, it is envisioned that applications of autonomous buses could possibly be expanded to passenger conveyance at the landside, earliest in 2024, for shuttle services within the airport area, and further to the neighboring town of Tung Chung.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) note the development and vision of HKIA in adopting driverless technology for airside transport;
- b) share experience and lesson-learnt of different airports in the application of driverless technology and other innovative solutions for transportation in the airport environment; and
- c) discuss any relevant matters as appropriate.

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