

**For Discussion  
On 25 May 2021**

**LEGISLATIVE COUNCIL  
PANEL ON DEVELOPMENT**

**Development of  
Government-Wide Internet-of-Things Network (GWIN)  
to Enhance City Management**

**PURPOSE**

This paper briefs Members on the development of the Government-Wide Internet-of-Things Network (“GWIN”) by the Electrical and Mechanical Services Department (“EMSD”) to enhance the delivery of public services and support various smart city initiatives.

**BACKGROUND**

2. As one of the department’s core services, the EMSD has been providing quality engineering services to upkeep electrical and mechanical (E&M) systems and enhance energy efficiency in over 8 000 government buildings, facilities and infrastructures in the territory. With the advancement of the Internet-of-Things (“IoT”) technology in recent years, the EMSD has further improved the reliability of these E&M engineering services through development of wide area remote monitoring systems using the IoT technology to provide near real-time monitoring of the E&M systems concerned. This has in turn enabled relevant government departments to enhance their delivery of public services.

3. Having evaluated different IoT technologies, Long Range (“LoRa”) technology, being a Low Power Wide Area Network (“LPWAN”), is considered to be a more cost-effective means to implement wide area monitoring. In particular, as the sensor connectivity does not rely on public mobile networks, this can eliminate congestion problems that may be encountered during adverse

weather or other critical situations. The GWIN system makes use of in-situ battery powered IoT sensors (i.e. not requiring power supply connection) installed at E&M equipment under monitoring to communicate wirelessly with relevant gateways<sup>1</sup> using the LoRa technology. These gateways in turn communicate with the central server through high speed wired or wireless networks. The LoRa-based communication network between the IoT sensors and gateways is operated as a dedicated network with long range transmission capability, typically five to 10 kilometers (“km”) in rural areas and one to five km in urban areas where the wireless transmission is affected by high building density.

4. Although the 5G-based IoT communication technology has a clear edge on applications requiring high data transmission rate (e.g. for monitoring rapidly changing parameters or processing high data volume like video), it is relatively costly in the long run. In fact, much of the day-to-day monitoring of E&M equipment only requires a low data transmission rate, rendering the use of LoRa technology more cost-effective and sufficient for the department’s general applications. In addition, the LoRa technology has the advantages of having near real-time response, availability of abundant types of inexpensive sensing devices and avoidance of power supply connection for low power sensors. As such, the LoRa technology is particularly suitable for many territory-wide city management applications and E&M equipment monitoring.

## **GWIN**

5. In 2019, the EMSD deployed the LoRa technology to build its pilot IoT network, entitled the GWIN, in Shatin district. The system was completed within a short period of 10 months with a coverage of about 80%. Upon its successful application in Shatin, the GWIN was extended to Kowloon East in 2020, and is being extended to other districts over the territory in phases. As at the end of April 2021, about 200 fixed or mobile gateways have been installed at various government facilities, covering public transport interchanges, footbridges, government offices, municipal buildings, community halls, clinics, ambulance depots, fire stations, service reservoirs, promenades, etc.

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<sup>1</sup> LoRa gateways are installed at various government buildings and facilities like public transport interchanges and footbridges. These gateways collect data from nearby LoRa sensors and transmit the data to a central server for further processing.

## **APPLICATION OF GWIN**

6. With the GWIN, the EMSD makes use of various types of LoRa sensing devices to conduct remote monitoring and control of E&M equipment as well as to support smart city management, as elaborated in the ensuing paragraphs.

### Remote Monitoring and Control

7. We deploy the LoRa sensing devices to monitor the operation status of typical E&M equipment which includes air-conditioning systems of government buildings, filtration pump systems of swimming pools, ventilation fans in public transport interchanges, irrigation pumps at sports grounds, etc. Fault signals from the equipment under monitoring are promptly sent to maintenance staff for quick follow-up actions. The data so collected by the LoRa sensors can also be processed using data analytics and artificial intelligence tools to conduct performance trending of equipment. With the application of the GWIN, we can monitor the E&M facilities on a near real-time basis to enhance operation reliability, effectiveness and efficiency which is crucial to support various smart city initiatives.

### Smart City Management

8. We also develop different systems for smart city management applications by using the GWIN to maximise the value of public services for the community. Examples include:

(i) Smart Drainage System

Water level sensors have been installed in over 50 sites to monitor changes in river/sea water level for speedy alert of potential flooding risks. The system was in operation in 2020 and collected water level readings in a prompt manner during the passage of typhoons through connection with the LoRa network.

(ii) Provision of Parking Vacancy Information

We have completed the testing of the wireless sensors installed at the parking area near the Energizing Kowloon East Office of the Development

Bureau (“DEVB”). We are collaborating with relevant government departments to conduct trials of installing wireless sensors in other suitable non-metered on-street parking spaces so as to provide real-time information to facilitate the motorists for finding vacant parking spaces.

(iii) People Counting System

We installed a People Counting System for 15 flower markets over the territory for a period of seven days during this year’s Lunar New Year Fair for counting the number of visitors entering and exiting these venues in order to control the flow of people, thereby ensuring adequate social distancing amid the COVID-19 pandemic. The system also served to provide crowdedness indicators on the web to facilitate Hong Kong citizens to plan for their visits. According to our record, a total of about 877 000 persons visited the 15 flower markets during the Lunar New Year Fair safely.

## **LATEST DEVELOPMENT**

9. Upon successful trials of the GWIN as mentioned above, the application of the GWIN is being deployed on more fronts, as follows:

### Smart Toilet Pilot Programme

10. The general public raises concern from time to time about the availability, hygienic conditions and comfortability of public toilets in the territory. With the use of the GWIN sensing devices, “smart toilets” are being devised to collect useful information and data such that toilet management and attendants can better plan, adjust and manage the cleansing and housekeeping work as well as the maintenance of facilities and equipment. On the other hand, the system will also provide members of the public with useful information on the occupancy status of nearby toilets and the locations of toilets in their proximity. Through the “smart toilets”, we expect that user experience will be enhanced. On this front, we are coordinating with the Food and Environmental Hygiene Department and the Leisure and Cultural Services Department for implementation of a Smart Toilet Pilot Programme covering 17 public toilets.

## Location Tracking of Hikers at Remote Areas

11. Hiking is a popular outdoor activity but sometimes, hikers may wander off-trail and encounter accidents. In Hong Kong, some remote country parks and hiking trails are not covered by mobile signals, making the search and rescue of injured or lost hikers rather difficult. If hikers are equipped with GWIN-enabled wearables, the rescue team can carry out location tracking of their wearables even when there is weak or no mobile signals, thus speeding up the search and rescue work.

## Tree Monitoring Pilot Programme

12. The Tree Management Office (TMO) of the DEVB is committed to continuously improving tree risk management to protect public safety. In this connection, the TMO will commence a territory-wide pilot project in the third quarter of 2021 that uses tilting sensors to monitor the falling risks of some 8 000 trees over the territory. In this pilot project, the TMO will collaborate with the EMSD to make trial use of the GWIN to collect data from some of the tilting sensors.

## **WAY FORWARD**

13. To meet the rising demand, the EMSD will continue to enhance the GWIN's agility, reliability and versatility through expanding its coverage and capacity. To enable satisfactory coverage of the GWIN for more scenarios, we are exploring various deployment configurations, including applications at tunnel sites and in search and rescue operations with mobile gateways carried by drones.

14. Leveraging on the development of the GWIN, the EMSD will further collaborate with other Government bureaux and departments, research institutes, start-ups and universities to explore innovative IoT applications based on the GWIN for enhancing the delivery of public services and supporting various smart city initiatives.

**Development Bureau**

**Electrical and Mechanical Services Department**

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