

**Legislative Council Panel on
Information Technology and Broadcasting**

**Information Note on the
Development of Global Positioning System in Hong Kong**

PURPOSE

At the meeting of the Panel on Information Technology and Broadcasting held on 12 January 2004, the Administration undertook to report on the development of Global Positioning Systems (GPS) in Hong Kong. The purpose of this paper is to update Members on this topic.

ABOUT GPS

2. GPS is a tool for positioning objects. When sufficient satellite signals are received, a GPS user can locate him or herself anywhere on earth. At present, there are two “public” GPSs being used around the world. The first system is called the NAVSTAR which was designed for and is operated by, the United States military. The second system is called GLONASS - managed by the Russian Space Forces for the Russian Federation Government. The NAVSTAR system is commonly referred to as the GPS as it is more widely used.

3. The GPS constellation consists of satellites that transmit specially coded signals that can be processed by GPS receivers to compute position. Users do not have to transmit anything to the satellites and there is no limit to the number of users at any one time. When building specific location-based applications such as car navigation, fleet management and personal information services, GPS needs to be used in conjunction with other hardware, software, digital maps and mobile devices to provide the necessary functionalities.

4. For example, in setting up a car navigation and tracking system for road users the following components are involved that will affect the business case for the system :

- (a) GPS receiver and other hardware such as milometer and gyroscope in the vehicle for determining the position of the vehicle at an accuracy of within 20 meters.
- (b) GPS reference stations to improve the accuracy of position determination with Differential GPS (DGPS) to within 3 meters.
- (c) Digital maps showing roads, house blocks, estates and other geo-community information of interest to vehicle users such as restaurants, hotels, car parks, etc.
- (d) Transport information on road-use restrictions, travelling directions and traffic conditions.
- (e) Software for processing the map information, traffic information and geo-community information.
- (f) Wireless devices and a communication network such as mobile phone for sending information between the information sources and the road users.

5. In the urban areas of Hong Kong, where there are typically clusters of high-rise buildings in close proximity, GPS alone may not provide a satisfactory solution for position fixing since satellite signals are blocked and often other technologies such as tracking beacon,¹ dead reckoning², mobile location estimation³ and map matching⁴ have to be used to supplement the positioning of a vehicle.

¹ Tracking Beacons are usually installed along the road where satellite visibility is low or no satellite signals can be received. The beacon's position will be sent to the receiver installed on vehicles. The vehicle's position can be updated as soon as the transmitted message from the beacons is received.

² The Dead Reckoning (DR) device usually includes a gyroscope or digital compass to measure the direction and a milometer to measure the distance. The position determined by the DR is not very accurate after a certain period of time and it would show a large drift rate. Therefore it can only be used for a short time period to provide the missing positional information in case the GPS signals are not received.

³ Mobile Location Estimation is the technology to position a mobile phone using techniques of Cell ID and networked triangulation based on the wireless communication network of mobile phone.

⁴ Map Matching is a computer program to enable the resulting vehicle path, which may be determined by GPS / DR, to be matched to the digital road map for display purposes.

DEVELOPMENT OF GPS IN THE PUBLIC SECTOR

6. The Lands Department (LandsD) has established a network of GPS reference stations for land surveying and position fixing. The reference station data can be used for road users to improve the accuracy of their on-board GPS receiver. The GPS data can be delivered to users via 2.5G or 3G mobile phones, SMS and the Internet.

7. LandsD has already made available a series of digital maps of various scales showing roads and ground features. For road applications, these digital maps have to be further enhanced by the GPS application solution provider for storage optimization and performance for integration with the individual GPS applications.

8. The Transport Department (TD) is developing a Transport Information System (TIS) that will provide a central database for the collection, processing and dissemination of transport information to maintain Hong Kong's competitiveness and to enhance the transport system. Under the TIS, an Intelligent Road Network (IRN) will be built. The IRN is a comprehensive traffic database that contains traffic-related information such as travelling directions, turning restrictions, etc. This database will open up commercial opportunities for service providers to develop value-added services such as navigation, fleet management, etc., for individual motorists and transport-related operators. Implementation of the TIS is scheduled to be completed in mid-2005.

9. The Highways Department (HyD) has earlier conducted a small-scale trial in using GPS as a means of recording positional information along roads. HyD found that GPS is useful in open areas where the GPS receiver has good lines of sight to the overhead satellites. However, in dense urban areas with congested high-rise buildings, the satellite signals to the receiver are often blocked and the accuracy of the results adversely affected. GPS is not usable when the receiver is inside tunnels.

10. In the Fire Services Department (FSD), the Third Generation Mobilizing System makes use of GPS for in-car navigation. LandsD has

assisted FSD to develop an Intelligent Electronic Road Network (IERN) for managing its fire engines and ambulances in the Automatic Vehicle Location System. Other measures including dead reckoning, tracking beacons and map matching are also used to supplement the precision in positioning the vehicles. A list of GPS deployment in the Government is in Annex A.

DEVELOPMENT OF GPS IN THE COMMERCIAL SECTOR

11. GPS raw data is now available for use by the public with the GPS reference stations network introduced by the LandsD. A handful of service providers for GPS solutions and applications development are available in Hong Kong. A number of research studies and projects on GPS and location based related services have also been undertaken by local academics. The Innovation and Technology Fund has also granted funding for a number of GPS projects in the past. A sample of these studies and projects is listed in Annex B. The more common solutions include vehicle tracking/positioning and fleet management. Some companies in the market offer fleet management services or provide theft alert service to car owners. In addition, we understand that a car navigation solution with in-vehicle GPS receiver will be launched in Hong Kong at the end of 2004.

12. Major franchised bus operators, including KMB and Citybus, are undertaking trials to test the applicability and reliability of the GPS and associated technology in vehicle tracking/positioning, data transmission, and dissemination of information on vehicles and bus stops.

13. In the general business sector, large scale deployment of GPS has yet to be developed. According to industry sources⁵, SMEs in Hong Kong seldom use GPS in their day-to-day operations.

OUTLOOK

14. Some private companies have plans to introduce in-car navigation solutions with GPS service and related technologies. In this

⁵ Hong Kong Computer Society and Hong Kong Productivity Council

regard, the Transport Department's Intelligent Road Network will facilitate the development of GPS applications in Hong Kong.

15. There are a variety of hardware and software GPS products available in the market. To encourage and facilitate development, the industry and the Government can work together to address interoperability issues. In this regard, the Hong Kong Wireless Development Centre, recently set up at the Cyberport with government funding, can help identify the most imminent interoperability issues and seek support from relevant government agencies, and help to promote the awareness of GPS in HK.

16. To support the use of digital maps in GPS applications, the map formats need to be standardized. It would be beneficial for the industry and the Government to work together to develop an open standard for map information exchange.

17. There is potential for the private sector to work with the Government on research and developmental activities associated with GPS applications using the Intelligent Road Network, digital maps, GPS reference services and other relevant services. Identification of the right user segment is crucial in the deployment of GPS. Enterprises will be able to ascertain the potential demand for GPS and navigational systems through the market mechanism.

**Information Technology Services Department
April 2004**

Adoption of GPS in Government

(i) Existing Applications

B/Ds	Type of Application	Brief description of functions
CAS	Vehicles Tracking	The system uses GPS and cellular phone network for sending vehicle location information.
CED	Acquisition of Mobile Computing Devices for Geotechnical Field Mapping	Geological and geotechnical field mapping, ground investigation, landslide investigation and assessments of natural terrain hazards.
GFS	Used in Aircrafts	It is used for navigation in planes and helicopters to show the location of aircrafts (in the Avionic system) and will also transmit location information of aircrafts to Control Room using High Frequency (HF).
HKO	Delivery of Weather Information to PDA Users	Testing of the system
HKO	Automatic Survey Data Ingestion System	GSM 9.6K Dialing
HKO	Automatic Survey Data Input System	Transmission of survey data from field to Headquarters
HyD	Satellite surveillance system	GPS installed in 15 cleaning cars for high speed roads
HyD	"Winfleet" System	Tracking of works vehicles including mechanical road sweeper and pick up trucks using GIS and GPS technologies.
HyD	GPS Reference Station at TMCA	This system provides RTK and post-processing GPS data to users

HyD	GPS Equipment	Equipment are used by Survey Division to supply 3-D positions of points
TD	Journey Time Information System	Transmission of road traffic data and journey time information between the field equipment and the central computer

(ii) Applications Being Implemented / Planned

B/Ds	Type of Application	Brief description of functions
EPD	Mobile Computing System for Local Control Enforcement Operation	Use of handheld devices to facilitate field data capturing and information look-up
FSD	Automatic vehicle location system (AVLS) in FSD Third Generation Mobilizing System (TGMS)	By means of GPS receivers coupled with Differential GPS (DGPS), Dead Reckoning, Map Matching and Tracking Beacons, the positions of about 700 FS vehicles and over 10 fireboats can be provided up to an accuracy of 20 m.
HKO	Mobile Survey Data Transmission Unit	Transmission of mobile survey data
HKPF	Third Generation Command & Control Communication System (CCIII)	Mobile communication for vehicles
MD	Government Fleet Operation Management Information System (Wireless transfer of government fleet and crew information)	Data transmission device will be installed on government fleet for the transmission of the fleet position and the crew's duty information.
WSD	Slope Maintenance System	Record of slope management works

List of GPS and Location Based Initiatives raised in the Academia or funded by the Innovation and Technology Fund

Title	Raised in the Academia or Funded by the ITF	Parties Involved
Integrated vehicle navigation system	Academic research studies	<ul style="list-style-type: none"> • Hong Kong Polytechnic University
A Dual-Channel Location Estimation System for Providing Location Services Based on the GPS and GSM Networks	Academic research studies	<ul style="list-style-type: none"> • Hong Kong Baptist University • HK Institute of Vocational Education
GPS/GSM Position Location System	Academic research project	<ul style="list-style-type: none"> • Hong Kong Polytechnic University – Department of Electronic and Information Engineering
GPS Fleet Management System	Project funded under Innovation and Technology Fund (Ref: S/P322/01)	<ul style="list-style-type: none"> • Key Technology System Limited
Improved Positioning of Land Vehicle in ITS Using Digital Map and Other Accessory Information	Project funded under Innovation and Technology Fund (Ref: UIT/014)	<ul style="list-style-type: none"> • Brilliant Technology Development Limited • Hong Kong Polytechnic University

<p>Develop an Accurate low-cost Mobile Location Estimation System (MLES) for Fleet Management Applications using existing mobile phone infrastructure</p>	<p>Project funded under Innovation and Technology Fund (Ref: ITS/022/02)</p>	<ul style="list-style-type: none"> • Hong Kong Wireless Technology Industry Association Limited • Hong Kong Productivity Council • Hong Kong Institution of Engineers
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