CONSULTANCY SERVICES ON PILOT PROJECT FOR UBIQUITOUS POSITIONING INFRASTRUCTURE OF HONG KONG FOR SMART CITY DEVELOPMENT –
DESIGN AND CONSTRUCTION

Project Final Report -

Executive Summary

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Consultancy Services on Pilot Project for Ubiquitous Positioning Infrastructure
of Hong Kong for Smart City Development – Design and Construction
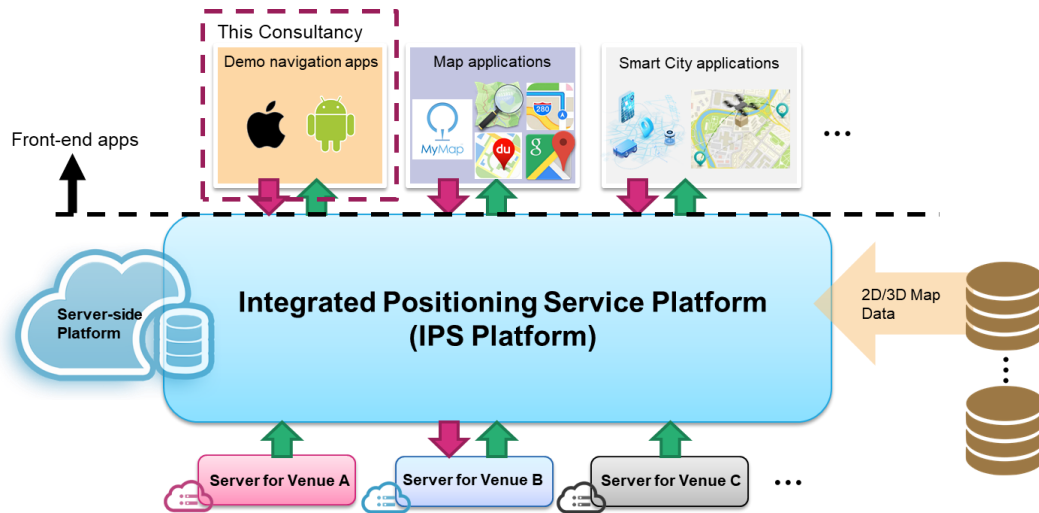Project Final Report

Executive Summary

A1   Background

A1.1   The current market for outdoor and indoor positioning solutions offers a wide variety of options, each with its unique methodologies, accuracy, reliability and availability. However, these technologies are usually designed to be optimal for specific indoor or outdoor environments, leading to inadequate performance and undesirable user experiences in other settings.

A1.2   It is common to use Global Navigation Satellite Systems (GNSS) for outdoor. While many indoor premises in Hong Kong have their own positioning facilities, there is currently no standard specification or protocol for service providers to follow, creating silos of individual positioning systems. As a result, users may need to acquire different applications or supporting software to enable positioning and navigation at various locations. The lack of interoperability among these systems obstructs the development and implementation of ubiquitous positioning on a territory-wide scale.

A1.3   Ubiquitous positioning ensures the seamless and uninterrupted provision of continuous positional information within and between both indoor and outdoor environments. It is a fundamental element of the digital infrastructure that supports Hong Kong's smart city initiatives. This project will contribute to various smart city initiatives outlined in the Hong Kong Smart City Blueprint 2.0. For example, the infrastructure will improve location determination, provide hassle-free travel experiences, and enable management from a spatial perspective through open standards. The developed standard can assist caregivers in locating their patients and supporting the economy by enhancing the tourist experience, facilitating tourism, and fostering innovation.

A2   The Pilot Infrastructure Solution

A2.1   A comprehensive review of various positioning approaches and technologies, with reference to international standards, practices, development cases and policies, for mapping and positioning in different countries and regions was conducted. After evaluating the current Positioning, Navigation and Timing (PNT) technologies, systems and standards in different places, the gaps that need to be addressed to develop a ubiquitous PNT infrastructure (the Infrastructure) in Hong Kong were identified.

A2.2   The goal of this project is to design and develop cost-effective deployable PNT technologies, systems, approaches, software interfaces and standards to support interoperability among diverse stakeholders involved in seamless indoor-outdoor PNT services. An infrastructure was designed to satisfy the goal based on the findings from the international research and review results. It consists of positioning devices installed on site, data, a centralised lookup server and a positioning standard. This project designed simple navigation

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application prototypes to demonstrate the practicability of the infrastructure.

A2.3   There are three key roles defined in this project to simulate simple collaboration scenarios between stakeholders:

- Site owners: These individuals or entities own indoor or outdoor venues and provide 2 types of data, namely site signal data and map data, to the Infrastructure.

- Platform operators: This role is responsible for daily operations and maintenance of the Infrastructure.

- End users: This role represents users who make use of functions and data provided by the Infrastructure. For example, application developers and the general public.

A2.4   The pilot project was implemented in Hong Kong Science Park, covering different floors, pedestrian footbridges, carparks and outdoor areas which can test for the challenging scenarios, such as change of zones and indoor-outdoor transition. Various positioning devices, including Bluetooth Low Energy (BLE) beacons, Wi-Fi access points (AP), Geo-QR Codes, and Ultra-wide Band (UWB) beacons were installed and placed in the pilot project area to demonstrate the fusion and interoperability of different positioning technologies. In the setting, three individual site owners and an independent platform operator were assigned. Two demo applications were developed to examine the performance of the Infrastructure solution.

A2.5   Key achievements of the pilot project include:

- Pioneering the design, implementation and evaluation of a positioning standard;

- Setting up a ubiquitous positioning infrastructure across multiple sites covering both indoor and outdoor;

- Achieving 5m accuracy for 90% of the testing time while employing the Infrastructure;

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- Achieving seamless indoor and outdoor positioning and navigation across multiple sites employing different PNT technologies;

- Providing over 95% overall uptime and supporting 1000 concurrent users.
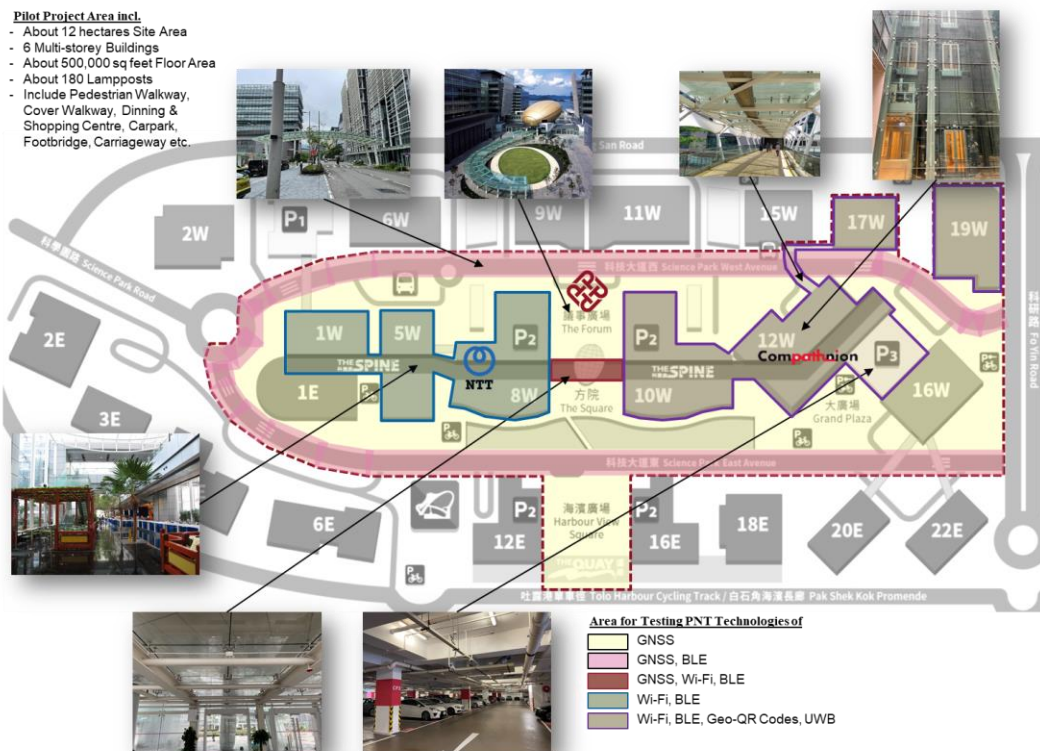
A2.6   In addition, Privacy Impact Assessments (PIA) and Security Risk Assessments (SRAA) were performed to assess the privacy impact and security level of the Infrastructure. This ensured the design and implementation of the Infrastructure adhered to local and international practices, standards and guidelines. Based on the experience gained from this project, future scaling up should follow the best practices and measures. These include implementing strong data governance practices, utilising privacy controls and technologies, establishing oversight and regulatory mechanisms, and providing public education. In addition, future site owners and application developers should adopt security practices that align with the existing policies and regulations, specifically addressing privacy impacts and security risks.

A3   Way forward

A3.1   As the standard created in this project is relatively novel, it is imperative to provide more support in the short-term to aid in its successful implementation. The Lands Department (LandsD) is likely to take up a supportive role to maintain and promote the standard. LandsD may also facilitate the skills and knowledge exchange, such as providing technical support on implementing the standard, promoting the standardisation of accessory components (e.g., API and data), and advising on data collection and sharing.

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A3.2   Based on the observations and findings of this project, recommendations were provided for consideration.

Future Improvement and Work		
Implementation Roadmap	• Scale-up implementation by phase and sector • Demonstrate impact of the Infrastructure through a Minimal Viable Product (MVP) Location-based Services (LBS) application • Leverage off the existing projects where practicable	
Advanced Features	• Explore different region switching techniques (e.g., GNSS, lighting intensity sensing, etc.) • Deploy fingerprint maintenance system that enables detection of fingerprints changes (e.g., via crowdsourcing application for non-technical and general people) • Survey-less localisation algorithms, such as Service Set Identifier (SSID) localisation, as potentially viable solution for identifying alternative locations for sites without fingerprints	
Privacy and Security Considerations	*Data Governance Practice and Regulatory Mechanisms*	• Develop appropriate data management, storage and retention protocols to protect against unauthorised access or disclosure • Clear procedures / policies for data collection, use, storage and sharing • Establish auditing and monitoring protocols / processes • Assigning responsibilities to enforce policies
	Public Education	• Promote transparency and privacy rights. • Build trust and credibility • Educating the responsible and ethical use and collection of data
	Privacy Control	• Requiring user's explicit consent before releasing data • Transparency on data collection • Encryption and anonymisation • Authentication

A3.3   The report includes an analysis of the implementation approaches, benefits and costs for scaling up the infrastructure if resources are available.