A Multi-scale and Multi-modal Transportation GIS for the City of Guangzhou

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Abstract. The search for better urban living has significantly increased the demand for efficient and sustainable multi-modal transportation systems in large urban areas. This should favor emergence of balanced transportation systems that use each mode for what it does best. However, the development of urban transportation policies partly relies on the availability of appropriate data and then information. The research introduced in this paper proposes a multi-modal and multi-scale data model oriented to the representation of the urban transportation system of the city of Guangzhou in China. The model introduced takes into account different transportation modes and integrates them within a federated data model designed using an object-oriented approach. Such a model allows the development of specialized services designed after a survey and study of users’ and planners’ requirements. The approach is experimented in a district of the city of Guangzhou and validated by a prototype development. This experimental system enables transportation planners and decision-makers to take better decisions effectively, and provides high-quality geospatial information-based services to final end-users.

Keywords: Transportation GIS; Multi-modal transportation network; Object-oriented data modeling
1 Introduction

Nowadays, the concept of sustainable development becomes a key factor in the planning of modern cities. This trend is closely related to the improvement of the quality of life in a city, including ecological, cultural, political, institutional, social, and economic components without leaving a burden on the future generations [16]. Sustainability influences public policies, and favors the development of better urban environments and improving quality of life. This is crucial as the continuous growth of the world population leads to the emergence of modern megalopoles where urban decision-makers face extremely complex challenges. By 2007, more than 50% of the world’s population lived in urban areas, and most of these dwellers are relying heavily on public transportation modes to meet their mobility needs [18]. Urban transportation is a fundamental means to allow access to jobs, markets, education, health care, and other primary services and leisure; it is a vital asset for the development of modern cities. Urban transportation has been long oriented to individual commuters, as cities were viewed as locations of utmost human interactions with intricate traffic patterns linked to commuting, commercial transactions, and leisure/cultural activities [17]. Sustainable transportation looks forwards to the efficient transportation of passenger and goods, and to sustainable freight and delivery systems.

Transportation planners and decision-makers are increasingly considering multi-modal urban transportation strategies to support sustainable transportation associated with urban development [10]. A multi-modal or inter-modal urban transportation system can be defined as the use of two or more modes involved in the movement of people or goods from origin to destination [5]. It appears that quality of multi-modal urban transportation networks is determined not only by availability of main transportation modes, but also by accessibility to and between these modes and services. Nowadays, the main objective of urban transportation organizations is not only to design, build, manage, and extend transit networks but also to maintain high-quality accessibility to these transportation systems taking into account the value and quality of the services provided to dwellers. This implies reconsidering the methods and approaches that support the development and planning of urban transportation systems. In particular, this brings forward the role of federated information systems, as a resource to provide decision-makers, planners, and end-users with the appropriate information at the right time.