Big Data in the city: analysing data for making transport systems smarter

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***Abstract*—This chapter focuses on Big Data management issues for making transport systems smarter: analysing real-time continuous data for providing comprehensive models and views of transport in cities; and for supporting decision making of civilians and practitioners for better providing and adapting transport services according to the characteristics of cities.**

***Index Terms*—IEEEtran, journal, LaTeX, paper, template.**

I. Introduction

Big data management and analysis on the cloud for Intelligent Transport Systems is important for supporting life quality and pollution reduction as a social collective objective. Road traffic jams at rush hours are a huge problem, namely in Lyon urban agglomeration, increasing pollution, decreases citizens life quality and makes it difficult to deliver urgent freight. Nowadays, different types of real-time stream data and information are available, such as traffic flow sensors from vehicles and road infrastructures and information from social cloud (i.e. a social network as a dynamic virtual organization with inherent trust relationships between citizens sharing information), social events (concerts, performances and sport games) and weather forecasts. The challenge for transportation industry is deal with Smart Data (i.e. the information that actually makes sense. It is data from which signals and patterns have been extracted by intelligent algorithms), rather than just Big Data. Therefore, it will be necessary to cope with data stemming from smart mobility environments including technical observations but also accessing other social data by building panels of consumers to capture day-by-day activity that impacts traffic flow behaviour. This will ease the emergence of agreements to build a comprehensive picture of traffic flow that can be improved when combined with other types of information such as social jam events. Efficient data integration and analysis can help to improve and optimize traffic management actions under intelligent and adaptable business models. This could become the most profitable way for mobility systems actors to unlock the value held in their data assets.

During the last five years, the problem of providing intelligent real time data management using cloud computing technologies has attracted more and more attention from both academic researchers (e.g. P. Valduriez team in France, Freddy Lecues work at Ireland IBM Research Lab, Big Data Initiative CSAIL Laboratory in MIT, USA, Cyrus Shahabis team University of Southern California in USA) and industrial practitioners (e.g. Google Big Query, IBM, Thales). They mostly concentrate on modelling stream traffic flow but not on combine it with other big data types to provide new services. Integration, storage and analysis of huge data collections will be adapted to support Intelligent Transport Systems (ITS) for providing effective solutions improving citizens lifestyle and safety. ITS apply ICT for integrating computers, electronics, satellites and sensors for making every transport mode (road, rail, air, water) more efficient, safe, and energy saving. The effectiveness of ITS relies on the prompt processing of the acquired transport-related information for reacting to congestion, dangerous situations, and, in general, optimizing the circulation of people and goods.

Big data are high volume, high velocity, and/or high variety information assets that require new forms of processing to enable enhanced decision making, insight discovery and process optimization. Real-time big data analytics introduces new challenges when data collections must be integrated, stored, and processed. Important computing, storage and memory resources must be efficiently managed and provided to exploit and analyse big data collections and thereby support critical tasks: namely to help smart cities managers to benefit from bulky mobility and transportation data analysis, decision making for piloting smart cities, financial markets, adapting transport infrastructure according to traffic and environmental constraints, providing alternative strategies for transporting people in the presence of disasters or exceptional situations.

However, providing continuous data collection and analysis capabilities involve handling considerable amounts of raw data that need to be processed, analysed and stored. Moving data aggregation and analysis to the cloud can be interesting for at least two reasons. First, it allows process of huge amounts of produced data in an efficient way with the existence of unlimited and adaptable computation and storage resources. Second, it can provide an ad hoc real-time personalized energy consumption analysis to different types of users.

Our work exploits cloud services characteristics (IaaS and PaaS) for proposing data integration, storage and processing strategies adapted to heterogeneous big data collections delivered for supporting the innovation real-time analysis, particularly in the context of intelligent transport systems. The originality of our work resides in analysing and combining real-time stream information to provide analysis, monitoring tools and alert services enabling to increase flow efficiency in urban road transportation by improving and optimizing traf-

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fic management, delivery areas management, and itineraries. Local and regional planning authorities can follow the real-time behaviour and traffic trends to provide new traffic plans, business travels and itineraries to passengers and vehicles drivers.

This chapter focuses on Big Data management issues for making transport systems smarter: analysing real-time continuous data for providing comprehensive models and views of transport in cities; and for supporting decision making of civilians and practitioners for better providing and adapting transport services according to the characteristics of cities.

II. Managing data for intelligent transport systems

A. Urban computing frameworks

B. Urban data

C. Urban data management techniques

D. Applications in urban computing

III. Urban data analytics: mining knowledge

A. Collecting and cleaning Urban data

B. Understanding Urban big data

C. Visualizing Big Urban data

IV. Integrating and curating Urban Big Data for making transport systems smarter

A. Providing scalable Big Data storage as services

B. Intelligent and integrated views of Urban Data

C. Real-time Decision making and recommendation for ITS

V. Conclusion

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