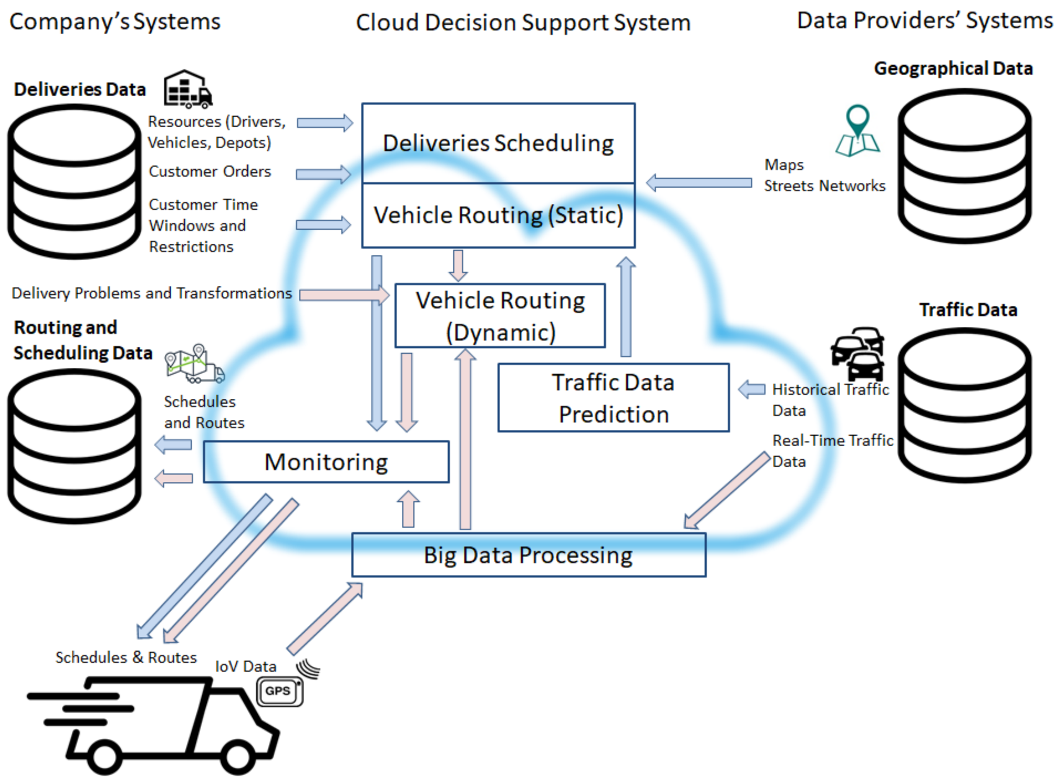

Figure 1: Smart Transportation System's Architecture

Figure 1 depicts the Cloud System and its modules described above (main-central part of the architectural scheme), as well as the interfaces with the systems of its users (left part), as well as third-party systems (right part). The arrows depict the data flow acting as an input in the system or as an output of it, plus the data flow between the modules. Blue arrows refer to the first level of routing and scheduling (static), while the red arrows characterize the data flow for the second level, that is the dynamic routing and rerouting of the trucks.
For every part of the system's architecture, various technologies have been explored and several of them have already been selected and are going to be implemented for the development of the cloud system. These technologies are described in the next section of the paper.

4. Technologies for System Development

The cloud decision support system is the core element of the proposed system's architecture. It will be implemented in a state-of-the-art cloud technology offered by the big providers of cloud computing (like Microsoft, Oracle or Amazon) and it will be using the approach of Infrastructure-as-a-Service or the approach of Platform-as-a-Service, depending on the final selection of the cloud computing technology. The applications (modules) of the transportation system will be developed over these platforms and infrastructures and will be offered to end users as Software-as-a-Service. Zhang et al. in their paper "Cloud computing: state-of-the-art and research challenges"(Zhang, Cheng, & Boutaba, 2010) describe the aforementioned architectural layers of cloud computing comprehensively. This cloud computing system can easily host and deliver services over the Internet, but it needs reliable and easily applied interfaces with user's systems and third-party data providers' systems to achieve this. The most challenging interfaces are the ones with the companies' systems in order to send and receive the data presented in the left part of Figure 1.
Input data to the cloud system will be transferred through Application Programming Interface (API) services, and the communication of the APIs will be made through the Representational State Transfer (REST) protocol or Simple Object Access (SOAP) protocol. This approach needs the user company to extend its systems and prepare an infrastructure to communicate with the transportation system's APIs. Alternatively, it could be developed a web interface in ASPx.net.2 technology for no IT expert companies in order to upload data files of their deliveries, vehicles, depots and so on. In this case, Angular platform will be used for dynamic HTML pages to build mobile and desktop

web applications for data input. Output data from the cloud system can be sent through APIs and REST or SOAP protocols, using the same or different ID API number with the input data.

Cartographical data from geographical systems will be retrieved using APIs created by their providers. The geocoding of the end point of delivery will be succeeded through REST protocol and through JavaScript Library which has many capabilities of interaction on the maps.

Vehicle routing and scheduling algorithms, as well as the traffic forecasting algorithms, will be developed in python or .net programming languages, but C++ is still an option, due to its extended available numerical libraries.

The big data processing technology integrates IoV data from vehicles devices and online traffic data from data providers. This technology will use various techniques and processing methods like NoSQL databases for unstructured data, knowledge discovery tools, data virtualization, data integration, stream processing, parallel processing. Yue and Jiang (Yue & Jiang, n.d.) present an overview of the recent methods in supporting big data management and analysis for the geospatial and mapping domain. The objective of big data management needs virtualization into cloud architectures using the cloud management platforms for Infrastructure-as-a-Service, exploiting the cloud architecture in which the transportation system will be built. The development of the cloud computing infrastructure is the next phase of the research project while the final selection of the technologies is going to materialize soon.

5. Conclusions and Further Research

The proposed architecture of the transportation system incorporates the current trends in the application of industry 4 in supply chain and logistics. It integrates static data for vehicle routing and scheduling and real-time data for monitoring and rescheduling of routes, avoiding inconsistences in the schedules. It is a decision support system that can offer efficiency in the delivery of goods and keep in a high level the customer satisfaction of its users. Cloud computing is used in order to build and provide the system for decision making in routing and scheduling operations of logistics companies or generally of companies that need to prepare their distribution plans in urban areas. The development of the designed system is part of an ongoing research project carried out by the Industrial Engineering Laboratory of the National Technical University of Athens in partnership with a software company.

Acknowledgment

The present work is co-funded by the European Union and Greek national funds through the Operational Program "Competitiveness, Entrepreneurship and Innovation" (EPAnEK), under the call “RESEARCH-CREATE-INNOVATE” (project code: T1EDK-00527 and Acronym: SMARTRANS).

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