Enterprise Interoperability

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INTRODUCTION

EC (Electronic Commerce) represents one of the major driving forces to build an electronic society. In the past enterprises faced with interoperability problems, first in the era of closed systems, later on in the infant era of open systems and ACME (A Company that Make Everything) -like vendor's solutions (Kajan, 2014). Since then, many interoperable frameworks have been suggested, developed and implemented; most of them are based on Web services and Semantic Web technologies. With the advent of globalization many organizations look for new partners to reach common goals to improve, for example, production rate, increase market share, refine supply chain, etc. Such new networked organizations are known as Virtual Enterprises (VEs). In a VE it is unlikely that any single partner will decide on the infrastructure, applications, and/or processes to be used. Instead, knowledge sharing around common goals and retaining the autonomy of each partner is crucial (Kajan, et. al., 2016).

In recent days enterprises are facing with a new challenge: everything is connected or it is going to be connected in the near future. In that movement social networking, networked things, smart objects, social communities of Web services, etc., are taking place as stated by Tan et al. "Currently, most social networks connect people or groups who expose similar interests or features. In the near future, we expect that such networks will connect other entities, such as software components, Web-based services, data resources, and workflows" (Tan et al., 2013).

As a consequence the new engineering discipline driven by the torrents of data available today has born: the data science. Data is collected about anything, at any time and any place (van der Aalst, 2014). In such circumstances there is a lot of new heterogeneity issues between business processes, supported applications, data sources, events, and associated data on one side and different hardware, operating systems, database systems, network infrastructure, etc. on the other side, that make huge difficulties and barriers in achieving the full potential of EC. This article gives an overview of main challenges, obstacles, approaches and recent research efforts, and forecasts in order to overcome recent interoperability problems.

THE ISSUES AND CHALLENGES OF ENTERPSISE INTEROPERABILITY

The Web is the backbone of a new social era -a more open, global, ubiquitous, and pervasive platform. People, software, and things are part of a new era in which almost "everything" will be socially connected as shown in Figure 1. We refer to it as the *Social World*. The complexity of social world calls for mutual understanding of all entities involved. Besides many initiatives, ideas, and particular platform-to-platform solutions, connecting all by mutual understanding and self-learning capabilities is yet a big challenge (Dorloff & Kajan, 2012).

Interoperability is the ability of two or more systems or components to exchange information and use the information that has been exchanged in a useful way.[1] In the context of social enterprises (i.e., those that explore data from social world), interoperability is the ability of interactions (exchange of information and services) between

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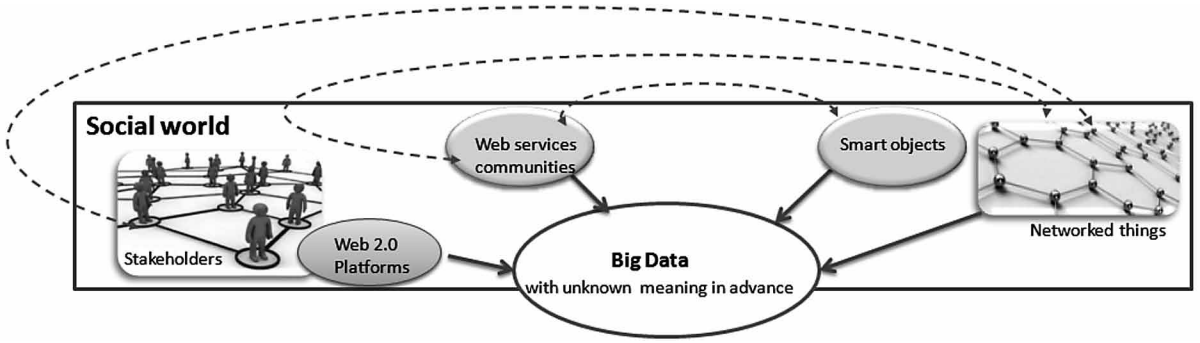
Figure 1. The social world



enterprise systems (Verginadis, 2011), but also to explore and exchange information of mutual interest gathered from social world. It has triggered the need of capturing the intrinsic characteristics of the business world (enterprises, their applications and stakeholders that may run various business processes) on the one side, and social and ubiquitous worlds on the other side, for bridging the gap between them. These goals have emphasized by (Romero and Vernadat, 2016) as "Enterprise Interoperability and Networking services will need to become a 'commodity' in order to support the building of a hyper-connected world and the seizing of its opportunities for industry (e.g. Industry 4.0)…".

Most organizations are now modeled according to the principles of Service Oriented Architecture (SOA) for the sake of improving efficiency, agility, and response to changing market needs. SOA supports the integration of several enterprises into an entity usually known as a VE by exposing these organizations' capabilities as services (Huhns & Singh, 2005). A VE possesses the following characteristics (Narendra, et al., 2013): (i) it is formed for a specific service-oriented process execution (for short- or long-term), and may dissolve once that execution is done; (ii) it is dependent on the nature of the interactions among the participating organizations; (iii) it is typically formed via a joint alignment of strategies among the participating organizations; and (iv) since the participating organizations are autonomous, conflicts would definitely arise.

The main goal of the VE is to provide business entities (BEs) with the ability to establish business collaborations in a way that their public business processes can interact with each other to exchange data. In a business scenario, BEs are usually loosely coupled; that means business processes require ad hoc integration from time to time. Such on-demand integration may experience many conflicts. Problems arise due to the heterogeneity between business processes and data involved, which are both different by nature on the one side and on the other side between underlying IT technologies, which are different by default. In EC, we re-characterize interoperability into A2A and B2B. They have much in common, but they are also different. Business processes inside an enterprise have their private and public parts, as shown in Figure 2. The private part is visible only inside a business entity interacting with other internal business processes whilst the public part acts inside the business entity but also takes place in B2B processes interacting with the public parts of business processes that belong to the other BE. A2A is an important mechanism for BEs in order to achieve business goals, but also serves as a flywheel of B2B efforts of that BE. As much as a BE reaches full A2A, i.e., it becomes a Zero Latency Enterprise (ZLE), i.e., its chances to have successful B2B relationships with other BEs increases (Kajan, 2010). Both A2A and B2B interoperability are victims of this heterogeneity. From that point of view, the main difference between them is the ability to control