

Semantic Web Processes and Ontologies for the Travel Industry

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Introduction

The emergence of e-commerce has changed the foundations of business, forcing managers to rethink their strategies. Organizations are increasingly faced with the challenge of managing e-business systems, e-commerce applications, Web services, Web processes, and workflows.

Web services and Web processes promise to ease several of nowadays infrastructure challenges, such as data, application, and process integration. With the emergence of Web services, workflow management system become essential to support, manage, and enact semantic Web processes, both between enterprises and within the enterprise (Sheth, Aalst, & Arpinar, 1999).

There is a growing consensus that Web services alone will not be sufficient to developed valuable and sophisticated Web processes due the degree of heterogeneity, autonomy, and distribution of the Web. Several researchers agree that it is essential for Web services to be machine understandable in order to allow the full deployment of efficient solutions supporting all the phases of the lifecycle of Web processes.

The idea and vision of the “Semantic Web” (Berners-Lee, Hendler, & Lassila, 2001) catches on and researchers as well as companies have already realized the benefits of this great vision. Ontologies (Uschold & Gruninger, 1996) are considered the basic building block of the semantic Web as they allow machine supported data interpretation reducing human involvement in data and process integration. For the tourism industry, the development of ontologies is fundamental to allow machine supported travel related data interpretation and integration.

Our research is dedicated to help the travel industry to take full advantage of the near universal access to the Internet. One of the fastest-growing categories of products in the travel industry is the creation of dynamic vacation travel packages. The objective of dynamic packaging is to pack all the components chosen by a traveler to create one reservation. Regardless of where the inventory originates, the package that is created is handled seamlessly as one transaction, and requires only one payment from the consumer.

This can be accomplished in an efficient, interoperable, and scalable manner through the development of a commonly accepted communication technology using Web services, Web processes and semantics. Semantics and ontologies provide an agreed understanding of data between and among travelers and travel-related businesses. Ontologies encourage the development of interoperable systems that can help create and support new collections of travel services to better meet the demands and expectations of travelers and the travel industry.

Travel Industry Trends

The travel industry, due to the long-distance interactions it requires, was one of the earliest electronic commerce adopters (Sabre (SABRE, 2004) system start operating in 1959). This industry is one of the most important kind of commerce through the Web, representing almost 40% of all global electronic commerce (Filho & Ramos, 2003) and one that most reflects the impact that this technology can have in the business process itself (Carroll, 2002).

With the Internet dissemination and the e-commerce growth there is a shift from the traditional off-line distribution process based on operators catalogs to an on-line promotion and reservation process. A shift that is marked by isolated initiatives guided by the B2C (business-to-customer) promise of increased profit margins and reduced commission values. This lead us to the present situation where we can find a diverse and numerous group of on-line reservation systems, most of them focused in one or in a few types of products without an integrated view of vacation planning, that is what the consumer looks for.

For this reason, the most recent trend for the travel industry is based on dynamic packaging. Dynamic packaging improves packaging revenues and packaging margins per transaction while offering travelers new opportunities to save by booking flights, hotels or rental cars together in a single transaction.

Research Objectives

Currently, the travel industry has concentrated their efforts on developing open specifications messages, based on eXtensible Markup Language (XML), to ensure that messages can flow between industry segments as easily as within. For example, the OpenTravel Alliance (OTA, 2004) is an organization pioneering the development and use of specifications that support e-business among all segments of the travel industry. The cumulative effort of various teams, individuals, associations, companies, and international organizations, including air, car, cruise, rail, hotel, travel agencies, tour operators and technology providers, has produced a fairly complete set of XML-based specifications for the travel industry (more than 140 XML specification files exist).

The Web has permanently changed the manner vacation packages can be created. Consumers can now acquire packages from a diversity of Web sites including online agencies and airlines. With the spread of Web travel, a new technology has surfaced for the leisure travel industry: dynamic packaging. For the development of dynamic packaging solutions it is necessary to look in detailed at the technology components needed to enhance the online vacation planning experience. By transitioning from a third-party service in most markets, dynamic packaging engines can better tailor its package offerings, pricing and merchandising to consumer demand.

Our research objective is to help the travel industry to take full advantage of the latest Internet technologies, such as Web services, Web processes, and semantics to develop dynamic packaging solutions. Semantics allow rich descriptions of Web services and Web processes that can be used by computers for automatic processing in various tourism related applications. The deployment of ontologies help articulate a well-defined set of common data elements or vocabulary that can support communication across multiple channels, expedite the flow of information, and meet travel industry and customer needs.

Semantic Web services will allow the automatic discovery, composition, integration, orchestration, and execution of inter-organization business logic, making the Internet become a global common platform where organizations and individuals communicate among each other to carry out various commercial activities and to provide value-added services. In the context of tourism, there is a great interest of such powerful capabilities. Major airlines, hoteliers, car rental companies, leisure suppliers, travel agencies and others are interested in creating and implementing industry-wide, open e-business specifications, tools and Web processes involving Web services.

Practical Results

Results from our research will lead to the spearhead and foster the cross-industry consensus needed to establish and maintain the most effective and widely used specifications designed to electronically exchange business data and information among all sectors of the travel industry using ontologies.

The development of a suitable ontology for the tourism industry will serve as a common language for travel-related terminology and a mechanism for promoting the seamless exchange of information across all travel industry segments. The current development of open specifications messages based on XML, such as OTA schema, to ensure the interoperability between trading partners and working groups is not sufficiently expressive to guaranty an automatic exchange and processing of information.

The major result of our research will be the development of a comprehensive and precise reference ontology named COTRIN (Comprehensive Ontology for the Travel Industry). Major airlines, hoteliers, car rental companies, leisure suppliers, travel agencies and others can use it to bring together autonomous and heterogeneous Web services, Web processes, applications, data, and components residing in distributed environments. The objective of COTRIN is to be deep and complex, implementing rich semantic interrelationships between the nodes of its taxonomies retrieved from the data and terminology presents in the XML-based OTA specifications (Figure 1). COTRIN will be developed using the Web Ontology Language (OWL, 2004) designed by the World Wide Web Consortium (W3C).

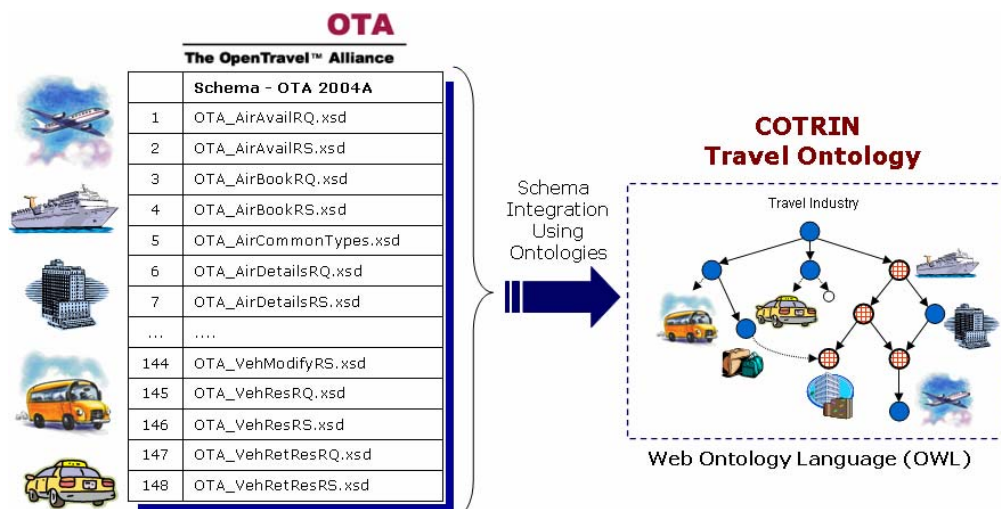


Figure 1. COTRIN Ontology for the Travel Industry

With COTRIN, semantic Web processes, managing dynamic package determine which Web services are used, what combinations of Web services are allowed or required and specific rules determine how the final retail price is computed (Cardoso, Miller, Sheth, Arnold, & Kochut, 2004).

This work represents what can be achieved by the symbiotic synthesis of two of the hottest R&D and technology application areas: Web services and the semantic Web, as recognized at the Twelfth International World Wide Conference (2003) and in the industry press. The intelligent combination of Web services and the semantic Web can start off a technological revolution with the development of semantic Web processes (Cardoso & Sheth, 2003). These technological advances can ultimately lead to a new breed of Web-based applications.

Impact on the Portuguese Tourism Industry

Our research has a direct impact on the Portuguese tourism industry, as well as the worldwide tourism industry. Portugal is well known for its tourism. In fact, in 2002 alone, this market has generated a revenue of more than \$7200 millions (INE, 2004).

The deployment of ontologies, Web services, and Web processes for the tourism industry will enable the construction of sophisticated infrastructures to support e-commerce and e-business activities. These ontologies encourage the development of interoperable systems that can help create and support new collections of travel Web services to better meet the demands and expectations of travelers through dynamic packaging.

The main sectors of the industry affected include airlines, car rental agencies, hotel corporations, leisure suppliers, tour operators, railways, ferry operators, cruise operators and any other area of travel and tourism.

Conclusions

New trends in the travel industry require the ability to dynamically compose travel packages from the aggregation and orchestration of distributed Web services. With the growth of demand for customized travel itineraries, agencies seek technology that provides their clients the flexibility to build unique packages from a selection of choices. Dynamic packages can be created and booked effortlessly with private and published air, car hire, hotels, attractions and insurance rates.

Current approaches, using XML-based specification messages, are not sufficient to enable the creation of dynamic travel packages. One solution is the use of ontologies to overcome semantic problems that arise from the autonomy, heterogeneity, and distribution of Web services. Our research targets the development of a comprehensive and functional ontology, named COTRIN, relating the terms commonly used by the tourism industry when exchanging data and information to deploy and manage Web processes to dynamically compose travel packages.

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