

## **E-Tourism: Creating Dynamic Packages using Semantic Web Processes**

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**Abstract.** One important type of e-tourism applications that has surfaced in recent years is dynamic packaging systems. Dynamic packaging is critical to today's travel industry, such as airlines, hotels, tour operators and travel agencies, to create custom packages to consumers. Our objective is to develop a platform to enable dynamic packaging using the latest Internet technologies, such as semantic Web, Ontologies, Web services, and Web processes.

*Keywords:* e-tourism, dynamic packaging systems, semantic Web, ontologies, Web services, Web processes, information systems integration.

### **1 Introduction**

Tourism has become the world's largest industry and its growth shows a consistent year to year increase. The World Tourism Organization [1] predicts that by 2020 tourist arrivals around the world would increase over 200%. Tourism has become a highly competitive business for tourism destination over the world. Competitive advantage is no longer natural, but increasingly driven by science, information technology and innovation.

The Internet is already the primary source of tourist destination information for travelers. About 95% of Web users use the Internet to gather travel related information and about 93% indicate that they visited tourism Web sites when planning for vacations [2]. The number of people turning to the Internet for vacation and travel planning has increased more than 300% over the past five years.

Tourism Information Systems (TIS) are a new type of business systems that serve and support e-tourism and e-travel organizations, such as airlines, hoteliers, car rental companies, leisure suppliers, and travel agencies. One class of these systems relies on travel related information sources, such as Web sites, to create tourism products and services. The information extracted from these sources can serve as the springboard for a variety of tasks, including dynamic packaging, travel planning, and price comparison.

We are particularly interested in studying the development of dynamic packaging applications. Dynamic packaging can be defined as the combining of different travel components, bundled and priced in real time, in response to the request of the consumer or booking agent.

Our approach to the development of a dynamic packaging platform encompasses the use of the latest information technologies such as semantic Web, Web services, and Web processes. E-tourism is a perfect application area for semantic Web technologies, since information dissemination and exchange are the key backbones of the travel industry.

## 2 Dynamic Packaging Applications

Currently travelers must visit manually multiple independent Web sites to plan their trip, register their personal information multiple times, spend hours or days waiting for response or confirmation, and make multiple payments by credit card. Consumers are discouraged with the lack of functionality. They are demanding the ability to create, manage and update itineraries. With dynamic packaging technology, travelers can build customized trips that combine customer preferences with flights, car rentals, hotel, and leisure activities in a single price.

A dynamic packaging application allows consumers or travel agents to bundle trip components. These systems permit the customer to specify a set of preferences for a vacation, for example a five-day stay at the Madeira island, and dynamically access and query a set of information sources to find component such as air fairs, car rental, and leisure activities in real time

## 3 Dynamic Packaging System Architecture

Our architecture to develop a dynamic packaging infrastructure has four major phases: integration of e-Tourism information sources, semantic mediator generation, dynamic packaging process generation, and dynamic packaging final products. All the components that are used in each phase are illustrated in Figure 1. Due to space limitation, we will only briefly describe each phase.

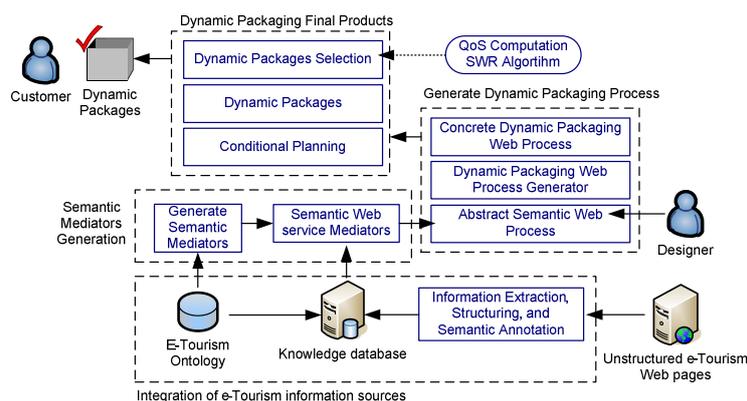


Figure 1. Overall system architecture

### **3.1 Integration of e-Tourism information sources**

One big challenge to develop dynamic packaging applications is to find a solution to cope and integrate the non-standard way of defining e-tourism products and services. There are no standards or common criteria to express transportation vehicles, leisure activities, and weather conditions when planning for a vacation package, several ways can be found among all the existing Web sites. To deal with the lack of standard and enable data integration we rely on the use of ontologies and semantic annotation. As it has been recognized, the semantic Web can considerably improve e-Tourism [3].

#### **3.1.1 Lack of standards**

After studying several travel, leisure, and transportation online sites, we found out the lack of standards in the tourism domain. Some of the differences founded among several sites are the following:

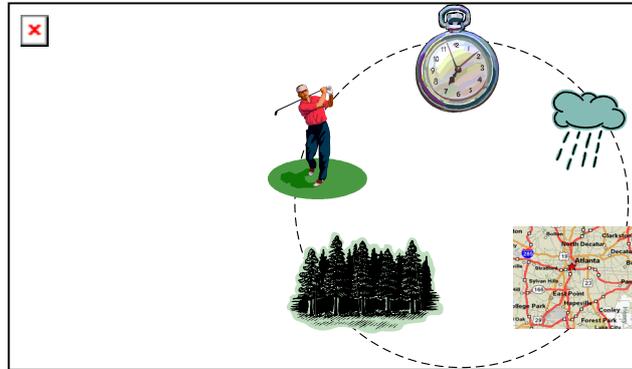
- The price of tourism related activities and services are expressed in many different currencies (euros, dollars, British pounds, etc.)
- The time units do not follow a standard. Some Web sites state time in hours, others in minutes, others in hours and minutes...etc. For example, 1 hour and 30 minutes, 1h and 30 min, 1:30 h, 90 min, one hour and thirty minutes, ninety minutes, 1:30 pm, etc.
- The keywords used to express a date are not expressed in a normalized way. Some Web sites express a day of the week using the words Monday, Tuesday, ..., Sunday, while other use the keywords M, T, ..., Su.
- The temperature unit scale is not standard. It can be expressed in degrees centigrade as well as in degrees Celsius.

Our objective is find a solution to surpass this lack of standards in the tourism field by automatically understanding the different ways of expressing tourism products and services, extracting its relevant information and structuring. We argue that sophisticated technologies, such as semantics and ontologies, are good candidates to enable the development of dynamic packaging information systems.

#### **3.1.2 E-Tourism Ontology**

The e-Tourism ontology [4] provides a way of viewing the world of tourism. It organizes tourism related information and concepts. The ontology will allow achieving interoperability through the use of a shared vocabulary and meanings for terms with respect to other terms.

In an early stage of our project, a partial ontology for the e-Tourism was created using Protégé [5] and the OWL [6] language. This was a very time-consuming task since it was necessary to find out information about real tourism activities and infrastructures on the Web and feed them into the knowledge base. A partial view of e-Tourism ontology developed using Protégé is illustrated in Figure 2. It should be noticed that this is a work in progress; the ontology is not complete yet. We are still gathering new concepts for its taxonomy and new axioms.



**Figure 2. E-Tourism ontology dimensions**

Parallel to our work, a working group at DERI [3] is also constructing an ontology for the tourism industry. Our approach differs – it is objective-oriented – the ontology is able to answer four types of questions (Figure 2) that can be asked when developing a dynamic package. These questions involve the predicates *What*, *Where*, *When*, and *How*. Examples of typical questions are:

- *What* can a tourist do while staying at the Madeira island.
- *Where* are located the interesting places to see and visit.
- *When* can the tourist visit a particular place?
- *How* can the tourist get to its destination to see or do an activity?

### 3.1.3 Semantic annotation

With the growth of the Web, all types of tourism information providers already have homepages for storing the description of tourism services and products. A dynamic packaging infrastructure requires integrating data in an automated way for querying in a uniform way and across multiple heterogeneous Web sites containing tourism related information.

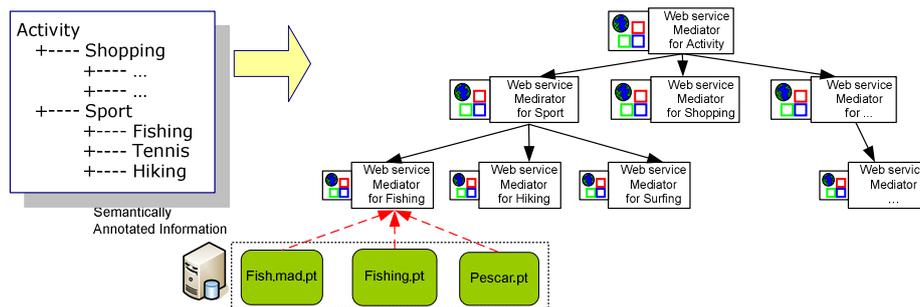
In our project, we rely on semantic annotation [7] to resolve the differences among the data present in distinct e-Tourism Web sites. Semantic annotation is the process of inserting tags in documents, whose purpose is to assign semantics to the text between the opening and closing tags. Unstructured Web pages are annotated using the e-Tourism ontology. The semantically annotated pages are then stored in a knowledge database.

## 3.2 Semantic Mediators Generation

In our architecture, semantic mediators support a virtual view that integrates several e-Tourism information sources semantically annotated. Each mediator does not store any data and provide the system with uniform access to various e-Tourism information sources.

Mediators are automatically generated based on the e-Tourism ontology. Mediators are interrelated and form a hierarchical structure that is derived directly from the taxonomy of the e-Tourism ontology.

To better explain these concepts, let us consider the partial taxonomy retrieved from our e-Tourism ontology illustrated in Figure 3. From this particular taxonomy, the following set of semantic mediators is automatically generated:



**Figure 3. Hierarchical Structure of Semantic Mediators**

Each mediator gathers and integrates semantic information from its children. In this structure, the leaves are records of information coming from e-Tourism data sources which were semantically annotated.

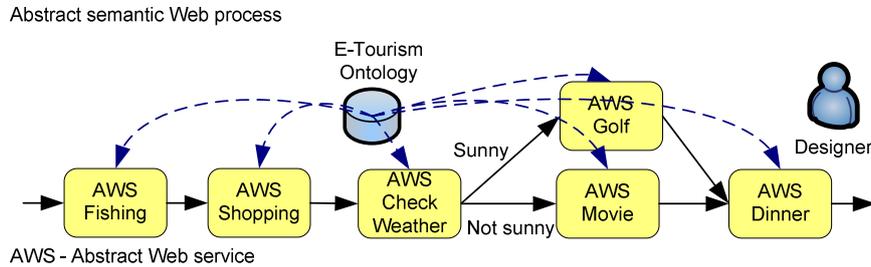
### 3.3 Generate Dynamic Package Processes

The objective of this phase is to construct a set of processes that are able to compose valid dynamic packaging solutions for customers. This phase includes the following elements:

1. Abstract semantic Web process
2. Dynamic Packaging Web Process Generator
3. Concrete Dynamic Packaging Web Process

**Abstract Web process.** An abstract Web process [8] specifies the control-flow and data-flow of an application, but does not define which Web services will be executed at runtime. Abstracting away the resource descriptions allows Web processes modeling dynamic packages to be portable and reused to generate different process instance at runtime.

For example, Figure 4 shows an abstract Web process designed to construct a dynamic package that includes a fishing experience in the morning, takes the tourist for shopping, schedules a golf game or a movie in the afternoon, and a dinner at night.



**Figure 4. Abstract semantic Web process**

**Dynamic Packaging Web Process Generator.** Concrete dynamic package Web processes are automatically created using a suitable generator. In this step, the generator may optimize the concrete process based on the availability of Web services. Each service in the abstract Web process is turned into an executable service by specifying the locations of the Web service implementation.

**Concrete Dynamic Packaging Web Process.** An abstract Web process typically originates several concrete processes. Each Web process invokes different Web services. At this point, the processes are valid from a functional point-of-view, but they may not generate valid dynamic package due, for example, to time or cost constraints.

### 3.4 Dynamic Packaging Products

Final dynamic package processes are created using conditional planning, ranking, and selection. We envisage using a conditional planning approach to allow the generation of correct dynamic packages. The main objective of the planning is to schedule an appropriate timeframe during which the tourist will realize a particular activity referenced by a dynamic package.

After using conditional planning, all the dynamic packages are valid. Nevertheless, some packages may take more time to execute than others or be more expensive for the tourist, i.e. they have a distinct QoS (Quality of Service)[9]. For these reasons the next phase is responsible for ranking and selecting the packages which have a set of characteristics that is more similar with the tourist requirements. To compute the QoS of each package process, we use the SWR algorithm [9, 10]. Once dynamic package processes are evaluated, they are presented to the tourist. Finally, the tourist can select the package that he finds more appealing or suitable according to his preferences.

## 4 Conclusions

Dynamic packaging is the key for the future of the tourism industry. Dynamic packaging can be defined as the combination of different travel components, bundled and priced in real time, in response to the requests of the consumer or booking agent.

In this paper we have describe an architecture that we will be developing in the next two years as part of a funded project (POSI/EIA/56164/2004) on e-Tourism. Our

approach encompasses the use of the latest information technologies such as semantic Web, ontologies, Web services, and Web processes to deploy a generic and reusable platform do construct and deploy dynamic packaging solutions. We believe that the construction of such a system will represent a significant step towards the semantic Web and the adoption of modern information systems in the tourism industry.

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