Chapter 5

Agent Oriented Analysis and Design

5.1 Introduction

Previous chapter presented an agent oriented approach to solve business process complexity in tour operation with details on inputs, outputs, process, users and features. This chapter presents starting from a set of high level requirements identified, an analysis, and very high level design diagrams, going in to agent level indentifying, ontological modules, components and algorithmic parts of the system.

5.2 Functional Requirements

During the initial stages of the research, following were identified as the high level requirements.

- Setup system configurations. Those configurations include how many units to sell, period of selling, cost of each unit, default markup.
- Perform bargaining. System should be able to analyze and respond to bargain requests received from customers.
- Perform forecasting. System should be able to perform forecasts for price changes and no of units that will be requested in the future.
- Calculate demand fluctuations. When sales are ongoing, demand changes on daily basis and system should be able to calculate the shift in the demand curve.
- Perform autonomous price adjustments. Based on the demand adjustments and with the assistance of forecasted data, system should perform price adjustments to the inventory on daily basis so that the system earns maximum revenue.
- The autonomous entities in the system should only be created and be available when there is a need or job for them to perform. Otherwise, created agents should be removed from the system releasing any resources they are holding.

- Each group of entities should have a representing manager entity who handles the creation and deletion of other entities in the system. All the groups need to be monitored and controlled by another separate entity which also should act as the mediator between buying and selling side. The mediator entity should also act as directory service facilitator which provides the details of selling groups to buying entities.

5.3 Agent oriented analysis

Since the technological basis for the approach is multi agent technology and with the requirements discussed in section 5.2 in hand, it is first required to perform an analysis to identify what and where different components are. First the ontology and agent roles separated out. There are two levels of ontology, namely, global travel ontology which is common to any tour operator and local ontology, which is specific to individual tour operator depending on the nature of the business done. Then, different agents are defined identifying different roles to be played. Those roles, as mentioned in the approach, are Managing, Sales, Pricing, Inventory management and Demand forecasting. For each of the role, there can be more than one agent. However, agents in different roles do not compete where multiple agents in the same role compete with each other. With this analysis in hand several levels of designs for the proposed system can be highlighted as follows.

5.4 Architecture of agent oriented market place for tour operation

Figure 5.1 shows the main components of the multi agent assisted travel business market place. Message Space (Market place) is where the requests from customers coming in for various reservations. This message space is assisted with global travel business ontology.

Upon a booking request or price inquiry to this market place, individual tour operators who are also connected to that, offer prices for the request or provide a negotiated price for the request. Customer agents then evaluate proposals received from different tour operators and proceed with booking with the request which matches the criteria which can be either lowest price or some other. Manager Agent performs the following roles.

- Tour operator registration service
- Directory service (Similar to yellow pages service, for the customer agents look up available service providers)
- Simulation controlling (When running in simulation mode, initiates customer agents)

The global travel ontology contains, the following

- Business rules, for every agent to operate
- Various statistical models which can be used by agents to analyze trends and perform forecasts
- Mathematical equations to calculate and simulate demand

Upon creation, individual tour operators can access global ontology while having one of their own locally. This is further explained in next section.

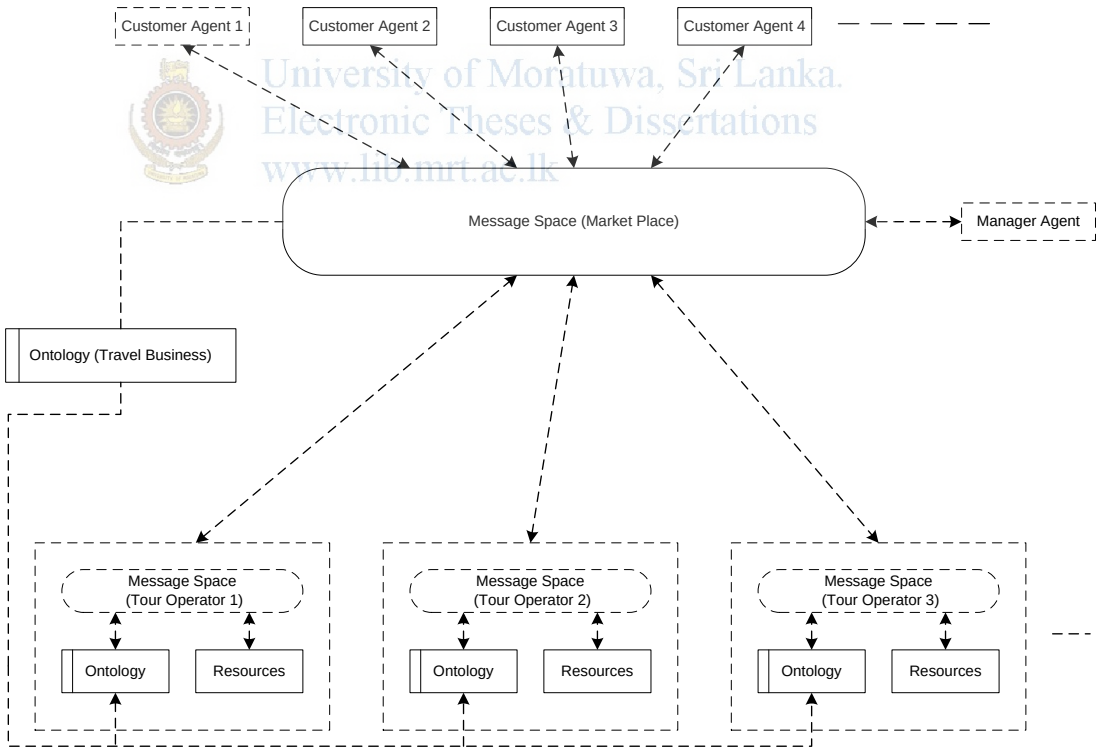

Figure 5.1: Agent Oriented Marketplace for tour operation – Architecture

5.5 Architecture inside Tour Operator

Inside architecture of tour operator is shown in Figure 5.2. Global purchase requests/bids are received by the sales agents, and upon receipt of such a request, internal multi agent system starts to work offering the best possible price, in a way it maximizes the revenue.

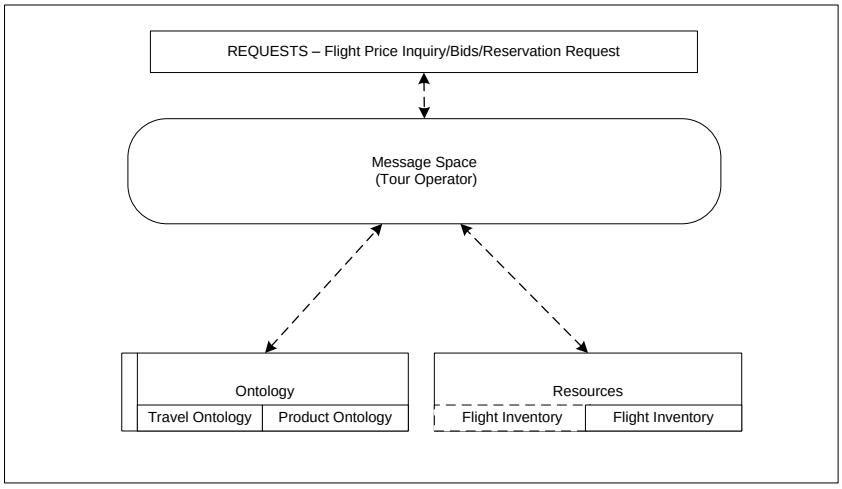

Figure 5.2: Architectural components inside a tour operator

Individual tour operator has its own message space for agents to communicate. So is the ontology. Tour operators get a copy of global ontology. This ontology is updated with knowledge gathered by agents but not visible to outside. Another main part of the tour operator is resources to be allocated.

5.6 Tour operator – Agents

Now it is time to look at individual agents interacting inside a tour operator. It is this level actually where implementation begins.

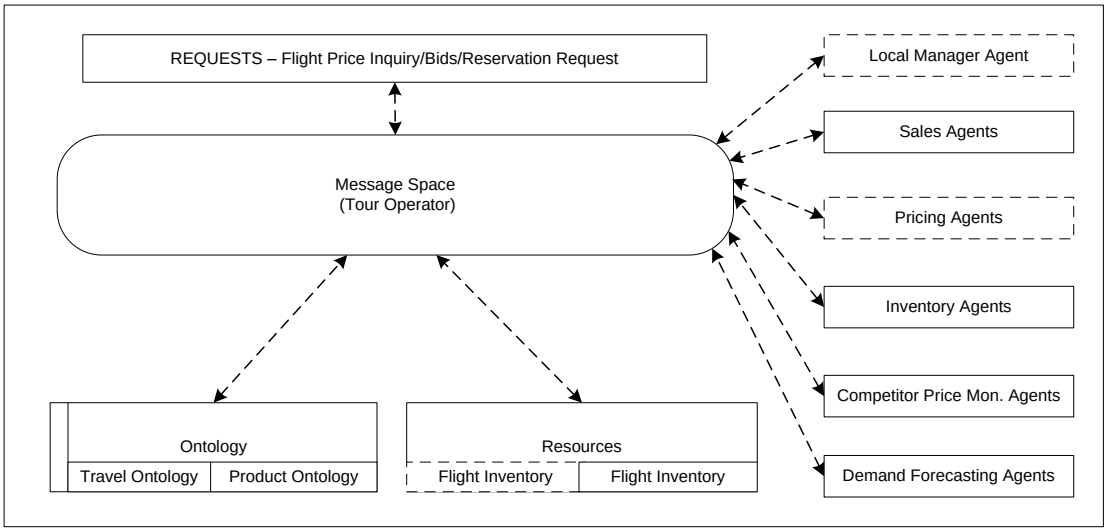

Figure 5.3: Agents inside a tour operator

Figure 5.3 shows, individual agents interacting with each other. Different agents have different tasks to perform.

5.6.1 Individual Component Details

Following is what each of the component in Figure 5-3 does.

- Local Manager Agent – does the management role of a tour operator. Agent creation and termination handled by this agent.
- Sales agents – acts as the hub between global market place and local system. Also does the *negotiation* with global internet market place, serving customer requests.
- Pricing agents – does the pricing of the raw inventory. Other than that, when the need arises, these agents do price adjustments to the already priced inventory.
- Inventory agents – does the inventory allocation for incoming booking requests.
- Competitor price monitoring agents – scans the global market place for competitor prices for the products offered by this tour operator.
- Demand forecasting agents – analyzes price and quantity aspects of demand of products of this tour operator and then provide the forecasts when required by other agents.

- Ontology – the knowledge for agents to operate in the form of rules and classes.
- Resources – the resources to be managed and allocated for incoming requests. In this case, resources are flight seats to be allocated over finite number of days of sales.

5.7 Detailed designs

The standard agent system design diagram for the system design can be found in Appendix A.

5.8 Summary

Starting from high level requirements, detail about the key modules in the proposed system and interaction between them in the proposed system presented in this chapter. After describing key components in the system, then, different agents in the system and their roles were presented. Next chapter presents, implementation details of the designs presented in this chapter along with choice of the toolkits …etc.