Conceptual Design of DrgML based on Object-Oriented ITS Application

여행자정보제공 통합시스템 구축을 위한 객체기술에 대한 연구

정 종 모 (청석엔지니어링, 연구원)

박 범 진 (한국건설기술연구원, 연구원)

문 병 섭 (한국건설기술연구원, 선임연구원)

Key Word: Object-Oriented, DrgML, ITS Application

목 차

I. Introduction

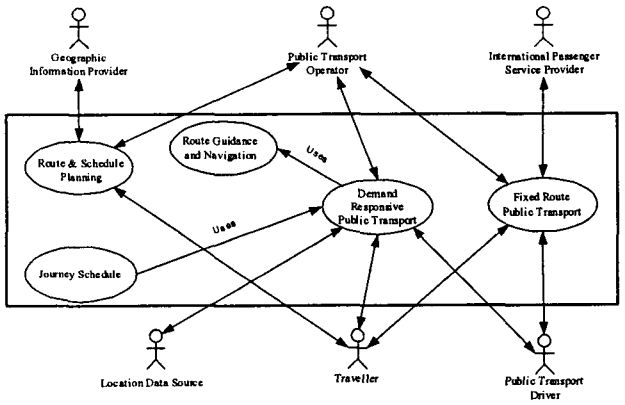
Modern society is becoming increasingly web-oriented to use information at the global level, and the road traffic is no exception. Also in South Korea, IT technologies on roads, traffic and vehicles are being promoted in order to solve such problems as traffic accident, congestion and the environmental deterioration, as well as to meet the market-expansion needs of the automobile industry, the information and communication industry and other industries. To promote information services through an advanced transportation information technology on roads, traffic and vehicles, the Ministry of Construction & Transportation (MOCT) initiated the National Intelligent Transportation Systems (NITS) Architecture project in 1999(1), which is based on the 64 user services. There are 64 transportation services defined in the Korean ITS. However, The Prime Question is whether to connect with NITS to meet structure of NITS based upon object-oriented in short-term and long-term future transportation conditions as the basis for ITS services. Therefore ITS application should be developed in its method to maintainof consistency, reuse, and expansion, especially when the system is to connect with web. There have been studies that developed ITS architecture. Jongmo Jeong(1) presented that object-oriented method is suitable for ITS application. However, he didn't present how to connect with web for ITS application in Korea. In our view, for ITS application, such as traveler information systems, we focused on how to connect between web services and distributed ITS application for traveler information system over ubiquitously available web service while conforming to the emerging Korean ITS application. We suggested to conceptual design for integration system between web and ITS application as a primary information delivery medium to traveler information system is that this system has shown a dramatic penetration rate with respect to the public communication service sector until current years in Korea.

The purpose of this study is to present conceptual design of DrgML based on web-oriented ITS Application using object-oriented methodology. We expect to achieve and maintain in aspect of interoperability and compatibility for connection and expansion of systems what is more to transmission transportation information between web and systems based upon object-oriented of the other ITS

1. Confirming to Emerging International ITS Architecture

As we know, the International ITS architecture defined the system architecture as a high level abstraction. The system

architecture is subdivided into the following categories: Reference architecture, Logical architecture, and Physical architecture (1999). ISO 14813(2), (3), (4), (5) is a multi-part Technical Report detailing the Reference Architecture and its associated documentation for the Transport Information and Control System (TICS) (1999). Its core TICS reference architecture, one of the Reference Model Architecture for the TICS sector, is completely redesigned by applying object-oriented method (1999). This TICS Model have a total of 32 services in TICS fundamental services and 9 conceptual packages and their abstract classes in Core TICS Reference architecture; that is Roadway, Transport, Vehicles, Events, Payments, Roadside Peripherals, Operating Interfaces, Travel Terminals and Vehicle Interfaces.

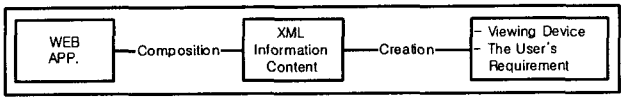


<Figure 1> Use Case Model in TICS

National ITS architecture in Korea also defined reference architecture, logical architecture, and physical architecture like the International Standard. Logical architecture(6) is divided into 62 user services under 7 major service categories. However, it appears that up until now, the logical architecture was designed based upon the so-called process-oriented which looks the system in terms of function and data structure. Recently, The Korea Research Institute for Human Settlements (KRIHS), one of the research agencies of MOCT, is under consideration ITS architecture that based upon object-oriented system that is to be applied by international ITS architecture. Besides, a number of Koreas research institutes actively participate in international standardization actively joined the international stream as one of ISO (the International Organization for Standardization) TC(Technical Committee) 204s WG (WorkingGroup).

2. The Basic Activities of a Business Model and Information System in ITS Application

As a means to design architecture guideline, we adopted combination of object-oriented and web-oriented method, which is used in ISO/TC204 and W3C.More specifically, we chose an traveler information system a subsystem of ATIS, for modeling Web Service (7) with the Unified Modeling Language (UML) notation (8), (9), to apply conceptual design for a relationship between Traveler Information Language, so called DrgML, which is used to provide traveler information to user, and ITS application based on object-oriented.



<Figure 2> Example for recombination of ITS application & XML information for Web Service

Fig. 2 shows the recombination of ITS application and XML information for web service that is appropriate for the viewing device and the user's requirement. To integrate ITS application and XML based upon object-oriented, we suppose two primary component of the ITS application. The reason for this is that at phase of ITS architecture. It offers us how to analyze and design ITS application. Since these requires with the object-oriented paradigm, we designed framework that develops the ITS application for in-vehicle dynamic guidance system. Figure3 shows the basic activities of a business model and information system in Web and ITS application. The outline of this condition is shown as following.

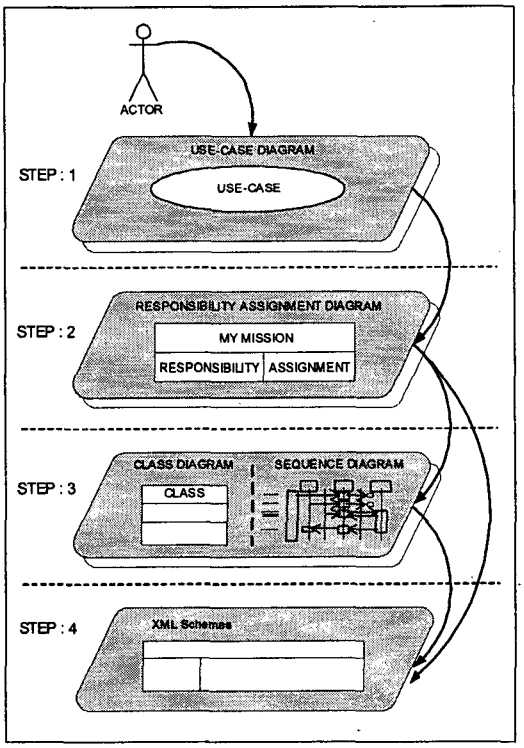
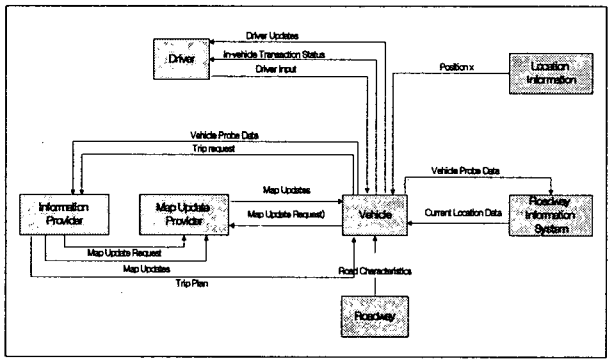


Figure 3. The Basic Activities of a Business Mode and Information System in ITS

1) Requirements Capturing

In order to construct a more effective and stable ITS application, it is necessary to capture user needs, system functional requirement and define the services required to fulfill these needs. The purpose of requirements capturing is to capture a good picture of what requirement are imposed on the information system, built on which users want and what user oneself can accomplish. From the viewpoint applying the object-oriented for ITS application to connect DrgML, we grouped subject users and system into *system operation status, vehicle operation status, vehicle guidance; surveyed user needs and systems functional requirement. To capture user needs and system functional requirement to traveler information, we, as shown schematically shown in Figure 4, defined the limit of application about systems that based upon the data flow diagram.*



<Figure 4> Example for Information Flow in In-vehicle Guidance System

2) The Use Case Model in ITS Application

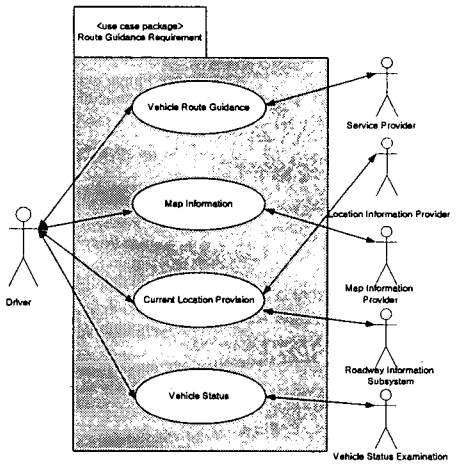
To analyze and design ITS LSA more faithfully, our approach to ITS LSA using the use case model is to capture the part of the business in which we are interested by using the use case model. We will describe the business and its environment.

The business is made up of all the relevant business processes, for example the processes that are appropriate for system application. The external environment is made up of, for example, user, partners and suppliers that take part in the process.

In our research, we represent that these processes are modelled with use cases, while the environment is modelled by using what we call actors.

In this way, we can propose use-case package of route guidance requirement. Besides, we can adopt the proposed use-case package that belongs to route guidance under Traveler Information in TICS reference architecture. In this top-level, there are four use-cases under use-case package that so-called Route Guidance Requirement: *vehicle route, map information, current location, and vehicle system status,* and six actors: *Driver, Service Provider, Location Information Provider, Map Information Provider, Roadway Information Subsystem, and Vehicle Status Examination*

The top-level use case diagram is shown in Fig. 5. It notes that proposed actors and use-cases in this diagram are in very abstract terms.



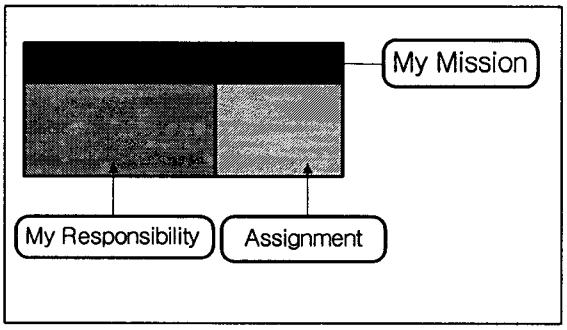
<Figure 5> A use case model for the in-vehicle dynamic route guidance system

Fig. 5 described the use case model for the in-vehicle dynamic route guidance system. In fig. 5, we proposed 4 use cases: vehicle route guidance, map information, current location provision and vehicle status. It is more logical that our system belongs to the in-vehicle system that connects outer systems since our users primarily want to know the current travel route. In Fig 5, we are trying to identify all the relevant use-cases about route guidance requirement from actors point of view.

II. The Conceptual Design of DrgML for ITS Application using Object Technology

In this Section, we should be very careful about existing object-oriented method. We know that there is a big conceptual analysis/design gap in how to transform the captured requirements into the appropriate attributes and methods of the suitable class/object. To reduce analysis/design gap, we suggested Responsibility Assignment Diagram (RAD) that will provide how to create business vocabulary model to the actor's viewing-point. Even though, it does not belong to UML. The RAD defines business vocabulary, determines the structure of XML documents, and creates as an application's content. This presents a

association between objects based on object-oriented and XML documents. In our view, we proposed to a relationship between use-case and XML document. In the context of an XML application, actors (consumers) are both sources and recipients of communication using messages. As a source, the actor requests service for route guidance and produces XML messages containing dynamic route queries for service request. Actor receives dynamic route information encoded in XML documents, which is then presented in a Web browser or imported into the recipient's business system. We presented that the business is made up of all the relevant business processes, for example the processes that are appropriate for ITS application. The external environment is made up of, for example, user, partners and suppliers that take part in the process. so, we represented that these processes are modeled with use cases, while the environment is modeled by using what we call actors. In our view, the use case has a flow of event to process ITS application we suggested RAD that express how to connect web and ITS application. RAD organized into three factors: My Mission, My Responsibility, and Assignment. Fig. 6 expressed composition for RAD. In Fig. 6, RAD represents what my mission should be able to do with Information System

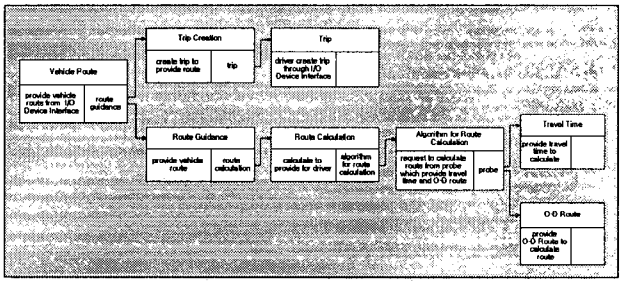


<Figure 6> Example for Responsibility Assignment Diagram

1. An illustrative Example

In our approach, we present that one view is drawn a flow of event for information-system use case, and for each view we present only those objects that participate through RAD. RAD will govern work with all of the other diagrams. It notes that each RAD can represent a flow of events for several use case. We should show RAD, which processes each use-case.

Fig. 7 describes the process by introducing the concept of RAD Pattern Vehicle Route , Trip Creation , Route Guidance , Trip , Route Calculation , Algorithm for Route Calculation , Travel Time , and O-D Route to provide and guide vehicles route. The vehicle route is subdivided into trip creation and route guidance. Trip Creation is created by trip that is provided to driver through I/O Device Interface We also depicted Route Guidance that provides vehicle route, which is calculated by using algorithm for route calculation. Algorithm for Route Calculation requests to calculate route from probe that provides travel time and O-D route.



<Figure 7> Example for Vehicle Route RAD

Based upon the proposed RAD, we can further identify which use-case defined in use-case diagram can be processed by RAD more faithfully. In our research, we can then carefully select the potential usages of each class in terms of entity, control, and interface class groups. We found that the appropriate classes can be selected easier with our proposed methodology. The proposed classes included I/O Device Interface , Vehicle Operation , Map Provider , Location , Route Guidance , Trip , Route Calculation , O-D Route , Probe , Travel Time , Roadway , Vehicle ITS-Component .

III. Physical Implementation Approach

To provide proof of the concept, we will implement the client-side-in-vehicle traveler information on web browser. Even though, most of the development work was performed by using demo in PC environment. We will use traveler information Markup Language(DrgML). The DrgML is used to user, store, process, and exchange product traveler information data in ITS application. It is also used to deliver traveler information content to a personalized Web portal, where the final selection and presentation are determined by the portal's personality rules and stylesheets .using XML Spy. The suggested our model, as a specification of the DrgML vocabulary, describes the business objects required for businesses to communication about dynamic route guidance content. DrgML is not an industry standard but was created for the purpose of examples in our research. Fig. 8 shows for example the Web services implementation

physical architecture based on object-oriented methodology which proposes our object technology. This example is submitted represented to the ISO TC 204 WG 10

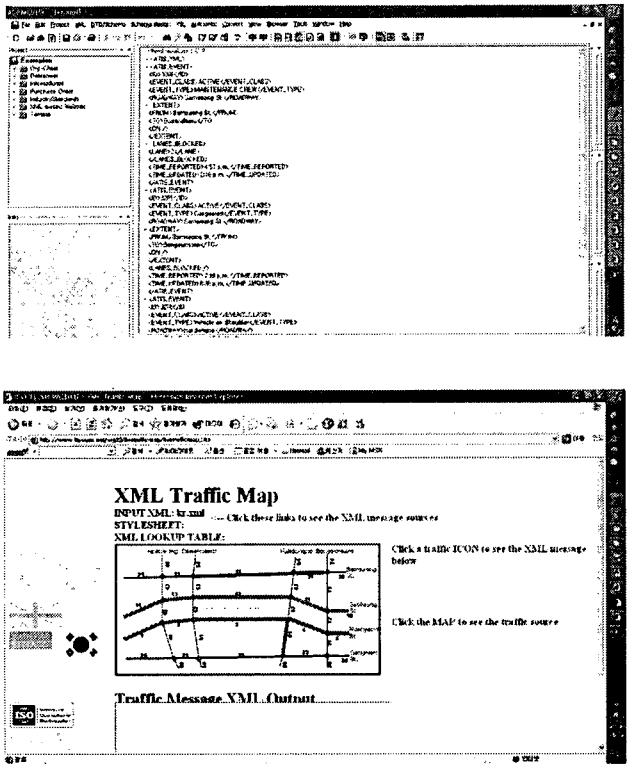


Figure 8 Example for the Web services implementation physical architecture based on object-oriented methodology

IV. Conclusion

The purpose of this study is to present conceptual design of DrgML based on web-oriented ITS Application. We expect to achieve and maintain in aspect of interoperability and compatibility for connection and expansion of systems what is more to present web and systems based upon object-oriented of the other ITS

To analyze/design DrgML more faithfully, our approaches to DrgML using the object-oriented method are to apply traveler information systemfor the quality of object-oriented design in our conceptual model. In this research work, we have shown that our proposed conceptual design method plays a vital role to develop DrgML based upon the object-oriented through an traveler information systemwhile confirming the upcoming Transport Information and Control System (TICS).

As we witnessed during the last few months, the newly emerging standardized web services will be utilized extensively in the coming future in order to implement the request/delivery on the Web service

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