

# Chapter 56

## Sensor Based Ubiquitous Application Modeling Using Process Definition Language

Sang-Young Lee

**Abstract** The Unified Modeling Language (UML) is a language for specifying, visualizing, constructing, and documenting the artifacts of software systems. It provides rich notations for representing, analyzing architecture and behaviors of systems. Business Process Definition Languages such as XPDL, BPML, and BPEL4WS have been so far specified with different basis and goals. Among them, XPDL proposed by WfMC is considered as an XML-based language for process definition exchange. RFID application domain is an especial environment that requires precise measurement and precision calculation of real-world factor. Therefore in the paper new extended iconic stereotypes for better modeling RFID application in the UML Diagram are proposed, and the Implementation of a program called Stereotype Creator, which is able to create iconic stereotypes used in one of the most popular visual modeling tools for software development, Rational Rose, will be also proposed.

**Keywords** Unified modeling language · Extension · RFID

### 56.1 Introduction

The Unified Modeling Language (UML) is a language for specifying, visualizing, constructing, and documenting the artifacts of software systems. It provides rich notations for representing, analyzing architecture and behaviors of systems [1]. Because among these notations, the UML activity diagram is well-known for describing systems' dynamic behaviors, it is useful to model business process and workflow [2]. RFID application domain is an especial environment that requires

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S.-Y. Lee (✉)

Department of Health Administration Namseoul University, 21 Maeju-ri, Seongwan-eup, Cheonan, South Korea  
e-mail: Sylee@nsu.ac.kr

precise measurement and precision calculation of real-world factor. The conventional modeling element of class in UML is not powerful enough to present the spatial feature and temporal feature that RFID objects embody. Therefore, new modeling elements of class for RFID application with UML are needed [3]. This paper will propose several new iconic stereotypes formulating modeling elements for RFID application. Also in this paper the implementation of a program called Stereotype Creator, which is able to create iconic stereotypes used in Rational Rose, will be proposed.

## 56.2 Iconic Stereotypes for Class Meta-Model Element

In Fig. 56.1, the visual notations are used to represent georeferenced classes which are distinguished from conventional classes. Main elements of georeferenced classes are:

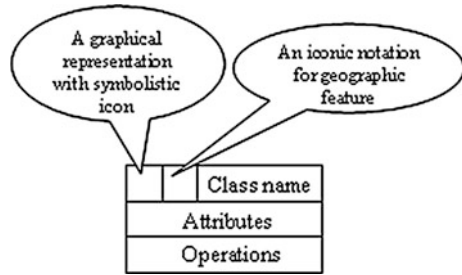
- a graphical representation with a symbolistic icon,
- an iconic notation for geographic types (points, lines and polygons),
- the class name,
- attributes,
- operations.

For example, the Fig. 56.2 depicts the visual representation of a class named “Building” with a symbolistic icon and an iconic notation for geographic types (corresponding to a polygon) on the left side of the class name, Building. The polygon symbol means that each object “Building” is associated to a polygon. Attributes are “address” and “inhabiting\_area”. The only operation associated to the class is “build”.

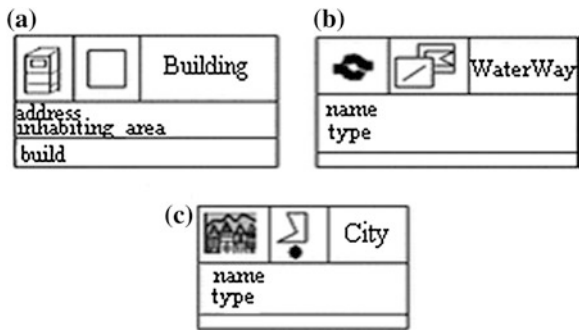
The georeferenced classes allow the representation of complex objects and composed objects. Each complex object is related to several points, lines or polygons. For example, a waterway may be considered as a lake (a polygon) connected to a river (a line). Graphically speaking, overlapped iconic figures express complex objects. An example of a complex object class is given in Fig. 56.2b. Composed objects have several representations in function of scale’s point of view. Figure 56.2c presents the graphical notation of a composed class “City”. We do not consider composed-complex objects in this paper.

In many cases the value of an attribute of an object varies during all the life cycle of the object [4, 5]. It is possible to associate a temporality to an attribute  $x$  of an object  $a$ . In that case, during all the life cycle of  $a$ , the object is able to “know” all previous values of  $x$ . Graphically, an icon representing a clock is placed on the right side of the attribute in the class (Fig. 56.3a). In the same way, a temporality may be associated to the geometry of an object. In that case, an icon representing a clock is placed on the right side of the iconic notation for geographic types (Fig. 56.3b). The Fig. 56.4 depicts the implementation of Class Mobile Station presented in Fig. 56.3a.

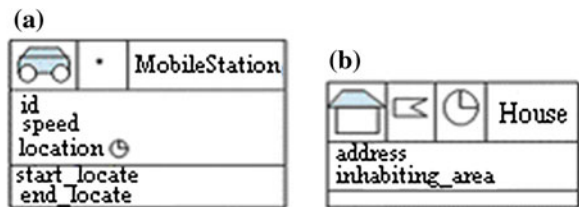
**Fig. 56.1** Graphical representation of class meta-model element



**Fig. 56.2** Examples of georeferenced class



**Fig. 56.3** Examples of georeferenced class with temporality

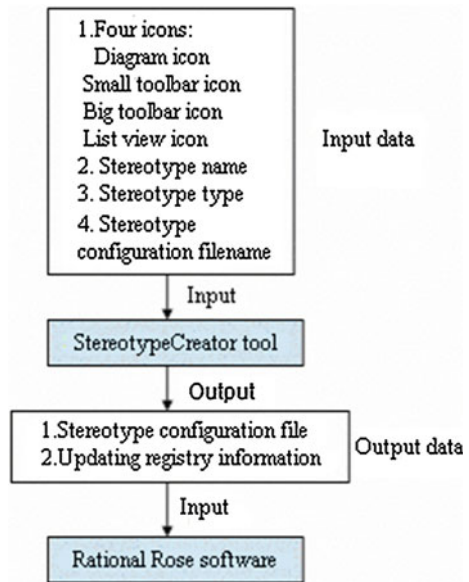


### 56.3 Implementation of Stereotype Creator

According to the specification of extended iconic stereotype of class meta-modeling element for a georeferenced class in UML class diagram, many kinds of the iconic stereotypes of class can be designed. Stereotype Creator is a software tool used to automatically create all kinds of user-defined iconic stereotypes that can be used in Rational Rose. It can be considered as an extended tool for Rational Rose [6]. The tool can create stereotypes for different modeling elements in Rational Rose that include class, attribute, association, dependency, use case etc. [7].

The whole process is that users input some simple information required to create stereotype, such as diagram icon, small/big toolbar icon, stereotype name

**Fig. 56.4** Whole process of stereotype creator



and so on, into Stereotype Creator program, and that Stereotype Creator program processes and converts these data information into output as stereotype configuration file and updating registry information which can be recognized and loaded when Rational Rose software initiates.

### 56.3.1 Stereotype Configuration File

The format of the stereotype configuration file must be known before the creation of stereotype configuration file. Stereotype configuration file is a text file with extension name of INI. A stereotype configuration file may include one or more stereotypes information.

The Fig. 56.5 presents the general format of stereotype configuration file. In the format of stereotype configuration file, the general section contains the information of specific setting (Fig 56.6).

### 56.3.2 Update Registry Information

After creating the stereotype configuration file, another task is to update the registry information for stereotype configuration file in order to make stereotype configuration file loaded correctly when Rational Rose software initiates.

```

[General]
ConfigurationName=Name
IsLanguageConfiguration=Yes or No

[Stereotyped Items]
REI item:Stereotype name
REI item:Stereotype name
...
[REI item:Stereotype name]
Item=REI item
Stereotype=Stereotype name
optional icon settings:
Metafile=&/model-element.wmf
SmallPaletteImages=&/palette_icons.bmp
SmallPaletteIndex=Index

MediumPaletteImages=&/palette_icons.bmp
MediumPaletteIndex=Index
ListImages=&/stereotypes.bmp
ListIndex=Index
...
[REI item:Stereotype name]
Item=REI item
Stereotype=Stereotype name
optional icon settings:
Metafile=&/model-element.wmf
SmallPaletteImages=&/palette_icons.bmp
SmallPaletteIndex=Index
MediumPaletteImages=&/palette_icons.bmp
MediumPaletteIndex=Index
ListImages=&/stereotype.bmp
ListIndex=Index
    
```

Fig. 56.5 The format of stereotype configuration file



Fig. 56.6 Relationship between stereotype set class and iconic stereotype class

### 56.4 Conclusion

This paper proposes extended iconic stereotypes of class meta-model element for GNSS application in the UML Diagram and provides its implementation as a tool of Stereotype Creator for Rational Rose. Current research is so little that a great deal of work remains and should be done in the future. Future research can be positioned in customizing iconic stereotypes for other modeling elements such as

association, generalization, attribute and so on, in GNSS application. Now the tool of Stereotype Creator just supports the creation of iconic stereotype for the modeling element of class in class diagram, but in the future Stereotype Creator for Rational Rose will support more kinds of iconic stereotype for different modeling element.

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## References

1. Leick A (1990) GPS satellite surveying. Wiley, New Jersey
2. Bajaj R, Ranaweera SL, Agrawal DP (2006) GPS: location-tracking technology. *Computer* 35(3):92–94
3. Pinet F, Lbath A (2010) Semantics of stereotypes for type specification in UML: theory and practice. *Electronic Edition*, pp 339–353
4. Borges KAV, Davis CA, Laender AHF (2011) OMT-G: an object-oriented data model for geographic applications. *GeoInformatics* 5(3):221–260
5. Parent C, Spaccapietra S, Zimanyi E (1999) Spatio-temporal conceptual models: data structure + space + time. In: *ACM GIS'99*
6. Rational (2011) Using rose, electronic document, VERSION: 2011A.04.00. <http://www.rational.com>
7. Pinet F, Lbath A (2012) An algorithm for stereotype deduction in UML-based formalism and its application in geographic information systems. In: *proceedings of the IEEE symposium on visual/multimedia approaches to programming and software engineering (Human Centric Computing'2012)*, pp 296–303
8. Booch G, Jacobson Y, Rumbaugh J (1999) *The unified modeling language user guide*. Addison-Wesley, Boston