A Mapping from Shlaer-Mellor to UML

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1. Background

The purpose of this paper is to present a mapping between Shlaer-Mellor concepts and their representations in UML. The objectives of this mapping are to:

- bring executable and translatable models to the UML community
- enable interchange between Shlaer-Mellor tools and UML tools
- bring the terminology as close as possible to UML so that the models "look like" UML
- introduce as little dissonance as possible for native Shlaer-Mellor users

The ideas presented here are the results of work that builds on the ideas presented in earlier papers [M14,M15]. These earlier papers established the basis for using the UML notation to represent Shlaer-Mellor models but did not examine many aspects of the formalism in any detail. In particular the justification for the choices of mapping had not been fully established with respect to the UML meta-model. This issue is vitally important if it is to be possible to interchange models between tools while preserving their semantic content.

This latter issue is also becoming of greater importance to the wider UML community. In its current form UML is designed to support a wide variety of different modelling techniques and formalisms. This is evident, for example, in the state machine formalism which allows both Moore and Mealy formalism with hierarchical states including concurrent sub-states and both synchronous and asynchronous calling semantics. The result of this is not only that almost any state modelling style can be supported but also that many combinations of elements have no defined execution semantic[1]. It is now widely recognised within the UML community, however, that considerable benefit can be gained by forming subsets of the UML with well defined execution semantics. Such subsets can form an "executable UML" which would

[1] These are termed "Semantic Variation Points" in the UML specification

enable the simulation, execution, testing and ultimately translation of UML models into target code. As part of this movement, work is progressing under the auspices of the OMG towards the definition of "profiles" that define such subsets and towards the more detailed definition of the contents of "actions" including a more precise definition of the execution semantics of UML models.

This paper, then, describes an executable UML "profile".

This paper presents a combined approach encompasing the various different flavours of the Shlaer-Mellor method. Throughout this paper we will refer to the various flavours, which are described in more detail in section 11.

Finally, this work is not complete. Although all the elements of the Shlaer-Mellor method have been enumerated and tentative mappings identified (see section 12), we have not yet fully established all the implications. We welcome comments from the reader.

2. Principles

To make the mapping regular, we have to have a set of mapping principles that we can apply as uniformly as possible throughout. We discuss below the use of names, stereotypes, and tags.

On Names. One purpose of this paper is to present a mapping between Shlaer-Mellor *concepts* and their *representations* in UML. To maintain complete and clear domain separation between two, it would be best to maintain two entirely different vocabularies, which would yield statements of the form "Represent a (Shlaer-Mellor) object as a box with three compartments…." This mapping, then, is from the concept to its representation, an icon. However, the box-with-three-compartments represents a 'class' in UML, and users of UML will always refer to the box-with-three-compartments as a class, for that is what it is.

The approach to naming taken in this paper is therefore as follows.

The notational mappings are generally presented as:

"Represent <Shlaer-Mellor concept> as <notational element>"

We name each notational element using UML terminology; (i.e. a 'Box-with-several-compartments' is referred to as a 'Class'). This reduces dissonance when reading a UML model based on the notational elements under discussion. This also renders the use of this mapping in UML compliant tools more straight forward.

However, for certain notational mappings (for example those that use the Package Diagram[2]) refering to the UML representation simply by its representation type will be inadequate. For those situations we will use the Shlaer-Mellor terminology.

[2] We should not be surprised by this as the Package concept in UML is intended to be able to capture a wide variety of different packaging concepts. It is inevitable that any use of packages in UML will have to supply some method specific names.

On Stereotypes. A stereotype in UML is a way of introducing a new class of modelling element within a model. A stereotype can only specialize an existing class in the metamodel. A stereotype is shown between guillemets << and >>.

We use a stereotype to distinguish one use of a symbol from another, in a manner that extends the UML metamodel. For example, we shall use the package diagram to model both subsystems and domains. Because the UML makes no distinction between these two concepts and we use the same diagram for both, there must be a way to distinguish between them.

We also define a stereotype as high up in the model hierarchy as possible so that the stereotype appears as few times as possible. For example, we can stereotype the a UML Class Diagram as a (Shlaer-Mellor) Class Model so that all attributes on that model are required to be atomic.

On Tags. Tags are used to add arbitrary information to the models, but not to extend the meta-model. Tags are represented as a comma-delimited sequence of specifications, surrounded by braces {}. Each specification may be simply a keyword (a tag), or a keyword with a value (a property), expressed as keyword = value. Keywords and values are simply strings.

We use tags to add information about a model element in a manner that does not extend the metamodel of UML. For example, we shall use a tag to indicate mathematically dependent attributes.

Often, we use tags to represent Shlaer-Mellor concepts such as Numbers and Key Letters. These are present in Shlaer-Mellor to aid readability and to support model management. As such they are not central to the formalism itself and may be omitted from diagrams if desired. In this paper we will always show such tags in order to demonstrate what they look like if present.

3. The Domain Chart

Represent the Domain Chart using a Package Diagram.

The package diagram representing a domain chart is stereotyped to allow only packages with no contents, and no tags or other names on the dependencies.

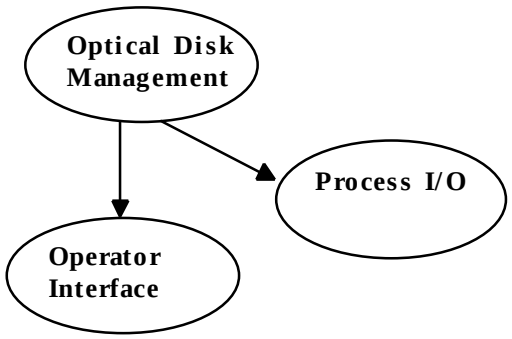

Figure 1 - Example Domain Chart with Shlaer-Mellor Notation

Figure 1 shows an example domain chart with the equivalent UML package diagram in Figure 2 below.

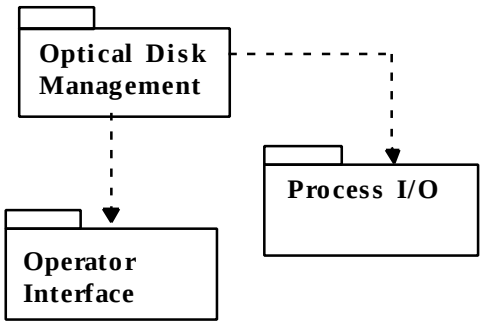

Figure 2 - Example Domain Chart as a Package Diagram

4. Subsystem Models

Subsystem Relationship Model. Represent the Subsystem Relationship Model as a Package Diagram.

The package diagram representing the subsystem relationship model is stereotyped to allow only packages with no contents.

Name each package as a triple comprising the subsystem name, the prefix, and the object number range.

Name each dependency between packages with the relationship identifiers expressed as tags. For example, express the relationships R10 and R182 as the tags { R10, R182 }.

Use a single dependency arrow in an arbitrary direction.

Subsystem Communication Model. Represent the Subsystem Communication Model as a Package Diagram.

The package diagram representing the subsystem communication model is stereotyped to allow only packages with no contents.

Name each package as a triple comprising the subsystem name, the prefix, and the object number range.

Name each dependency between packages with the event identifier and name expressed as property specifications. For example, express the events DTN21: Reschedule on disruption and TOM8: Switch to new schedule as { DTN21 = Reschedule on disruption, TOM8 = Switch to new schedule }.

Use the dependency arrow to point in the direction that the events are being sent.

Subsystem Access Model. Represent the Subsystem Access Model as a Package Diagram.

The package diagram representing the subsystem access model is stereotyped to allow only packages with no contents.

Name each package as a triple comprising the subsystem name, the prefix, and the object number range.

Name each dependency between packages with the process identifier expressed as tags. For example, express accesses to the processes DTC.2, DTZ.4 as { DTC.2, DTC.4 }.

Use the dependency arrow to point in the direction of the access.

5. Object Information Model

Represent the Shlaer-Mellor Information Model using a UML Class Diagram.

The class diagram representing the object information model has several stereotypes that apply to the model as a whole and apply to each of the kinds of elements that may appear on the model. We describe each stereotype below when we describe each kind of model element.

Objects. Represent a Shlaer-Mellor object using a UML Class. The class has three compartments:

- the name compartment, which contains the name comprising three parts, the object number, object name, and key letter
- the attribute compartment (see section below) and
- the operation compartment (see section below)

Represent an imported object using italics for the name, with a note reading "(from <subsystem name>)"

Attribute. Represent an attribute with its name, a colon, and its type. (See the subsection on typing below.)

We stereotype the class diagram that represents an object information model to require attributes to be single valued.

Represent an identifying attribute with a tag { I=2 }, { I=2 }, { I=33 }… If an attribute participates in multiple identifiers, the tags may be strung together as { I=1,2 } etc.

Represent a referential attribute with a tag corresponding to the relationship number(s) , i.e. { R=2,4 }

Represent a constrained referential attribute by extending the tag to have the letter 'c,' i.e. { R=2c }

Represent mathematically dependent attributes with a tag { M }.

Types. Represent the domain-specific data type as a string.

Separately, define the domain-specific data type in terms of its base types as defined in *Data Types in OOA* [M4] or the ASL Reference Manual [M10]

Operations. Shlaer-Mellor does not show operations on the object information model. However, the UML class diagram does allow operations, and there are potential uses for them in Shlaer-Mellor OOA, such as data accessors, transformers or syncronous services[3]. Whether or not these are shown is optional.

Represent a read accessor as an operation with isQuery = true. Use the standard UML syntax for the operation, i.e. OperationName(ParameterName : ParameterType = DefaultValue, …) : ReturnType. Do not include the instance identifier.

Represent a write accessor as an operation.

Represent a (publicly accessible) transformer as an operation with the tag { Transform }

Represent a synchronous service as an operation with the OperatioName being the name of the synchronous service. Do not include the key letter and service number as part of the name. These are modelled as tags on the operation.

Relationships. Represent a relationship as a class association, with the multiplicity and conditionality using numbers as in UML (i.e. 1c → 0..1, M → 1..*)

Represent the relationship identifier (i.e. R2 or R4) as an association name. Use the same approach for relationships constructed by composition: R3 = R2 + R4.

Represent the relationship roles names as association roles, such as 'owns' and 'is owned by.'[4]

Associative Objects. Represent an associative object as an association class. Note that in the UML meta-models, the association and the association class are indistiguishable entities. This has the effect that Shlaer-Mellor "many-associative" relationships (e.g. M-(M:M) or M-(1:M) etc.) cannot be modelled directly in UML. Instead, for such situations analysts must create an additional class with a M:1 association with the original association class.

Associative Objects with Assigners. Show an associative object with an assigner with a stereotype <<assigner>>.

Note that this stereotype can designate *two* classes expressed as one on the graphic. The name of the "base" class is as given by the user "5, Dog Adoption, DA" and the assigner is name "<null>, Dog Adoption-A, DA-A". This will allow us to build two state models in a UML repository.

Sub/Supertype Relationships. Represent a sub/supertype relation using the UML generalization relation.

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[3] According to method flavour. Note that we would not normally show "Event Taker" operations on the class since these represent only one style of implementation of state machines. Other, different styles are possible. We consider the State Machine to be a separate part of the formalism from the operations shown on the class diagram.

[4] Note that the classic UML "style" (as used in the many books) is to use nouns as roles on associations. However, the UML standard does not dictate this and allows for the Shlaer-Mellor style verb phrases. We maintain that such verb phrases have many advantages over the noun style.

We stereotype the class diagram to require the tag {complete, disjoint}. This information may be expressed visually on a model at the tool vendor's option.

Represent sub/supertype relationship numbers as tags {Rn}.

Note that in the UML, generalisation is *not* the same thing as inheritance. Rather, inheritance is a set of mechanisms that can be applied to a generalisation hierarchy. Such an application is not, however, compulsory. Indeed, the UML specification makes it clear that using inheritance makes it difficult to model multiple classification and indicates that other approaches might be more appropriate in this context. We suggest that the Shlaer-Mellor sub/supertype concept is such an approach. In the Shlaer-Mellor view of generalisation then, we think of the superclass as having instances (objects) that are distinct from, but associated with the subclass instances.

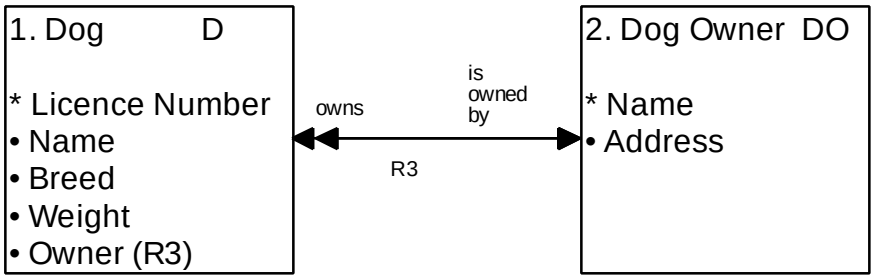

Figure 3 - A section of a Shlaer-Mellor Information Model

The example information model fragment shown in Figure 3 will become the UML class diagram fragment shown in Figure 4.

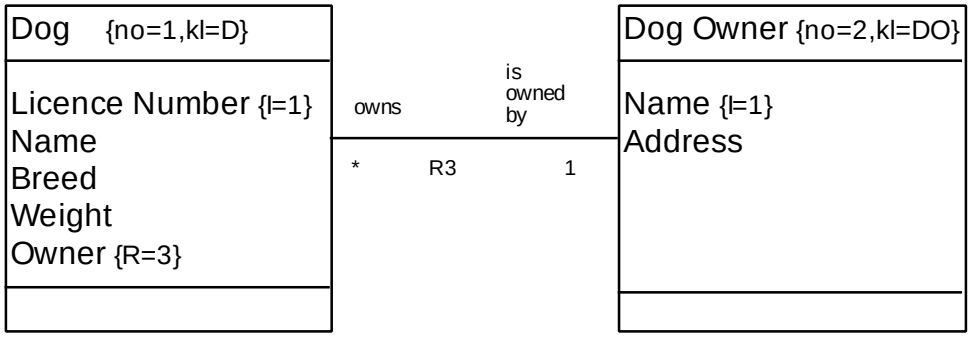

Figure 4 - UML Class Diagram Fragment

6. Object Communication Model

Represent the Shlaer-Mellor Object Communication Model (OCM) using a UML specification level collaboration diagram.

Objects Represent the Shlaer-Mellor object's state model (OOA91) or the object (OOA97) by a role on the collaboration diagram. Name the role with the name of the object. Draw a line between those objects that communicate with each other.

Event Transmissions Represent asynchronous communications (event transmissions in OOA92 and

OOA97) by arrows with a half arrow head in the style of UML asynchronous message. Label the message with the *event meaning* (*name*) from Shlaer-Mellor. Indicate the key letter and event number with tags.

Syncronous Invocations Represent synchronous service invocations (from OOA97) by a arrow with full arrow head in the style of a UML synchronous message. Label the message with the *service name* from Shlaer-Mellor. Indicate the key letter and service number with tags.

Terminators Represent terminators as interfaces classes with a role on the collaboration diagram. Name the role with the name of the terminator. Stereotype type the role as <<interface>>.

Domain Based Services To represent invocations/transmissions from OOA97 domain based services, place a role on the collaboration diagram to represent the class corresponding to the domain itself. Name the role with the Key Letter of the domain.

Options The key letter and event/service number tags may be omitted if required.

Example

The following Shlaer-Mellor diagram:

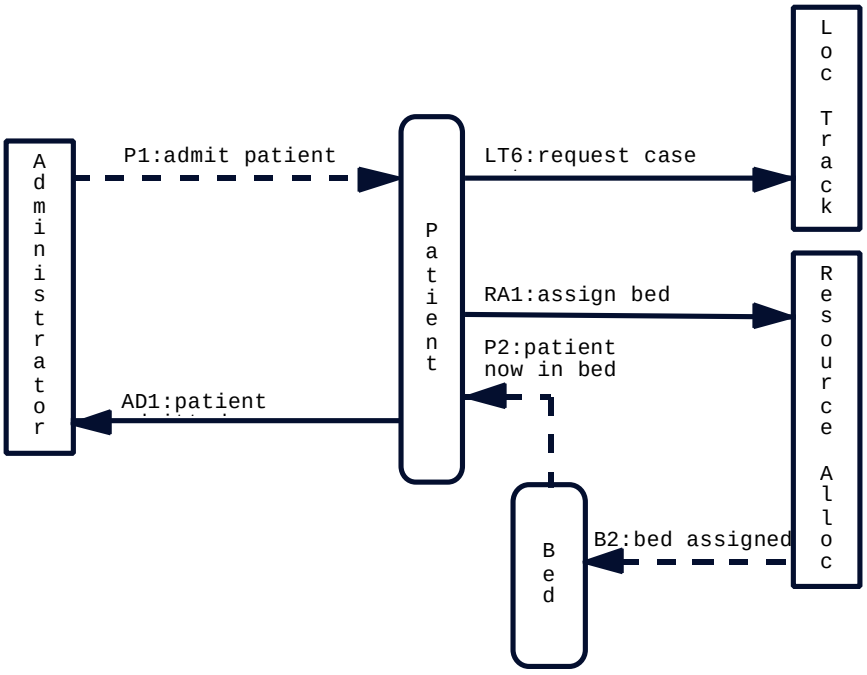

Figure 5 - An example Shlaer-Mellor OCM

(where dotted lines represent asynchronous communication and solid lines represent sychronous invocations), becomes:

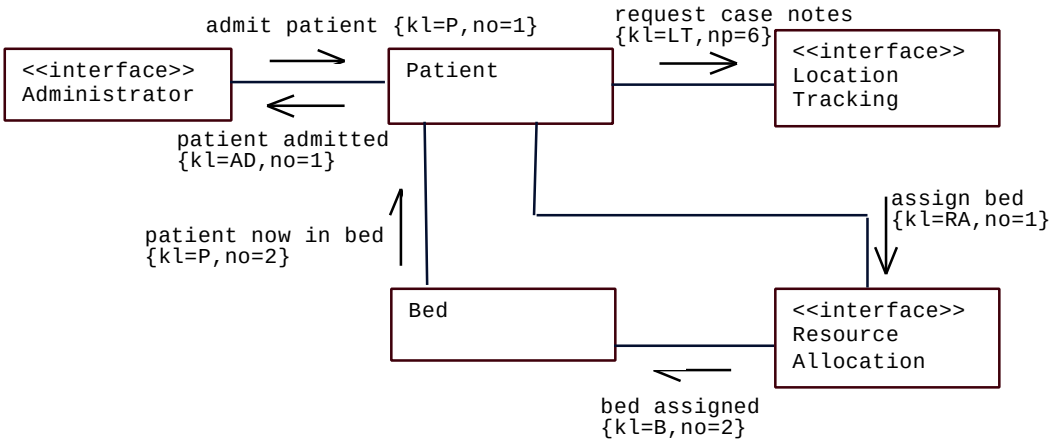

Figure 6 - The OCM as a Collaboration Diagram

7. State Models

In Shlaer-Mellor a state model has two representations; The State Transition Diagram (STD) and The State Transition Table. We detail the mapping of these representations and the components of the underlying state model that they represent.

Representations

State Transition Diagram Represent the Shlaer-Mellor STD using a UML stereotyped UML state chart. The stereotyping constrains the chart not to use heirarchical states.

State Transition Table Represent a Shlaer-Mellor STT as a sterotyped tabular representation. Label the OOA92 "Non-existent" state as "Initial State".

States

States Represent Shlaer-Mellor states as states on the state chart. Name the states using the name from the Shlaer-Mellor state. Number the states using tags.

Deletion State Represent a Shlaer-Mellor deletion state (i.e one in which self deletion occurs and the box is shown as dotted) by a UML state with an unlabeled (completion) transition to the final state vertex. If there are multiple deletion states then create multiple transitions to the single final state vertex.

Quiescent State Represent a quiescent state (i.e. one in which self delection does not occur, but has no outgoing transitions) as a state on the UML state chart with no outgoing transitions.

State Action Model the Shlaer-Mellor state action as a UML entry action on the corresponding state

Events

Event Represent Shlaer-Mellor events as signal events on the state chart. Label the signal event with the *event meaning* (*name*) from Shlaer-Mellor. Indicate the key letter and event number with tags.

Self Directed Event Represent a Shlaer-Mellor self directed event as a UML "completion transition". This guarantees the correct semantics for the transition. However, to avoid confusion for those used to Shlaer-Mellor models, label the transition with the appropriate event.

Event Parameter Represent Shlaer-Mellor *supplementary event data* (*event parameters*) as signal event parameters.

Polymorphic Event Represent OOA92 style polymorphic events as signal events with a key letter appropriate to the superclass to which they are directed. Such events should be placed used to label transitions as appropriate on subclass state charts. To allow for key letters not being shown on the OCM or the state chart, event names must be unique across the entire heirarchy.

Represent OOA96 style polymorphic events by creating a Polymorphic Event Table providing a mapping from the superclass signal events to the appropriate subclass events. In this case even names need only be unique within a particular class.

Effects

Transition Represent a Shlaer-Mellor state transition as a transition on the UML state chart. Label the transition with the signal event corresponding to the appropriate Shlaer-Mellor event

Creation Transition Show a Shlaer-Mellor creation transition on the UML state chart as a transition from the intial state vertex to the creation state. If there was more than one creation state/transition, then this should be shown as multiple transitions from the single initial state vertex.

Ignore Represent the Shlaer-Mellor "ignore" response on the UML state chart by showing an internal transition on the appropriate state labeled with the signal event which is ignored. Show no action for the transition.

Cannot Happen Represent the Shlaer-Mellor "cannot happen" response on the UML state chart by showing an internal transition on the appropriate state labeled with the signal event which "cannot happen". Show a stereotyped action <<cannot happen[5]>> for the internal transition.

Shouldn't Happen Represent the OOA97 "shouldn't happen" response on the UML state chart by showing an internal transition on the appropriate state labeled with the signal event which "shouldn'thappen". Show a stereotyped action <<shouldn't happen[6]>> for the internal transition.

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[5] <<cannot happen>> is a UML "raise" action that causes raising of an exception.

[6] <<shouldn't happen>> is a UML "raise" action that causes raising of an exception.

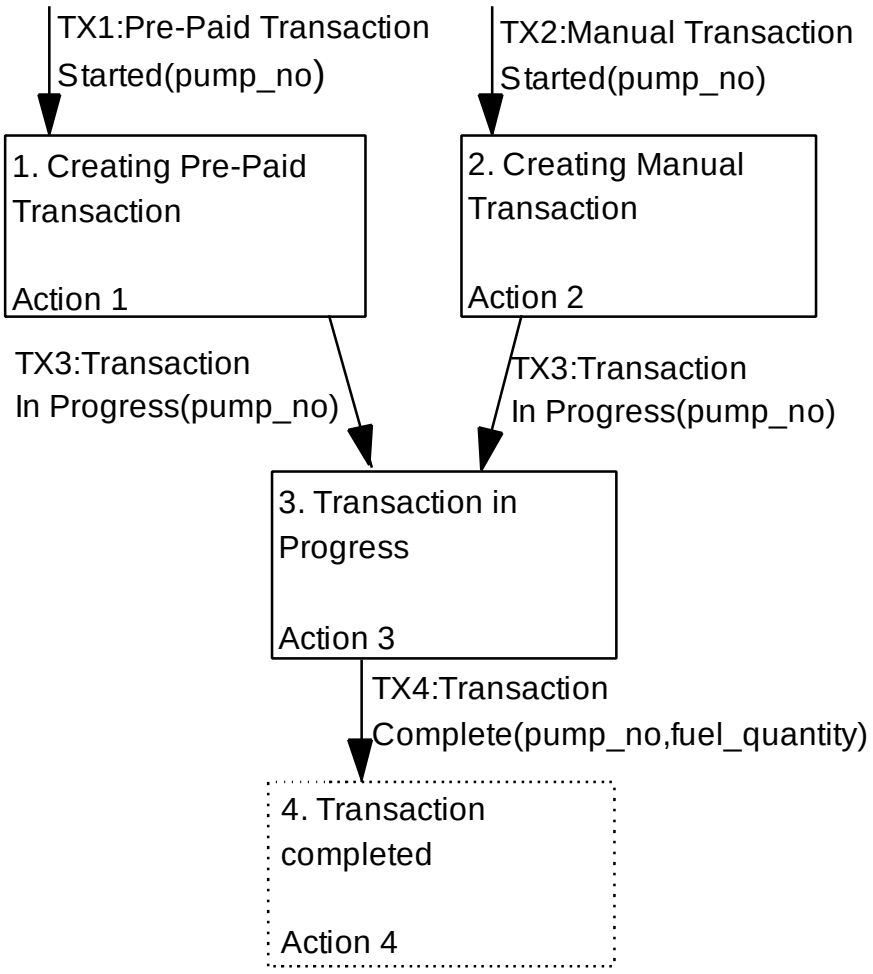
Hold Represent the OOA97 "hold" response on the UML state chart by showing an internal transition on the appropriate state labeled with the signal event which is to be held. Show a UML "defer" action for the transition.

Options

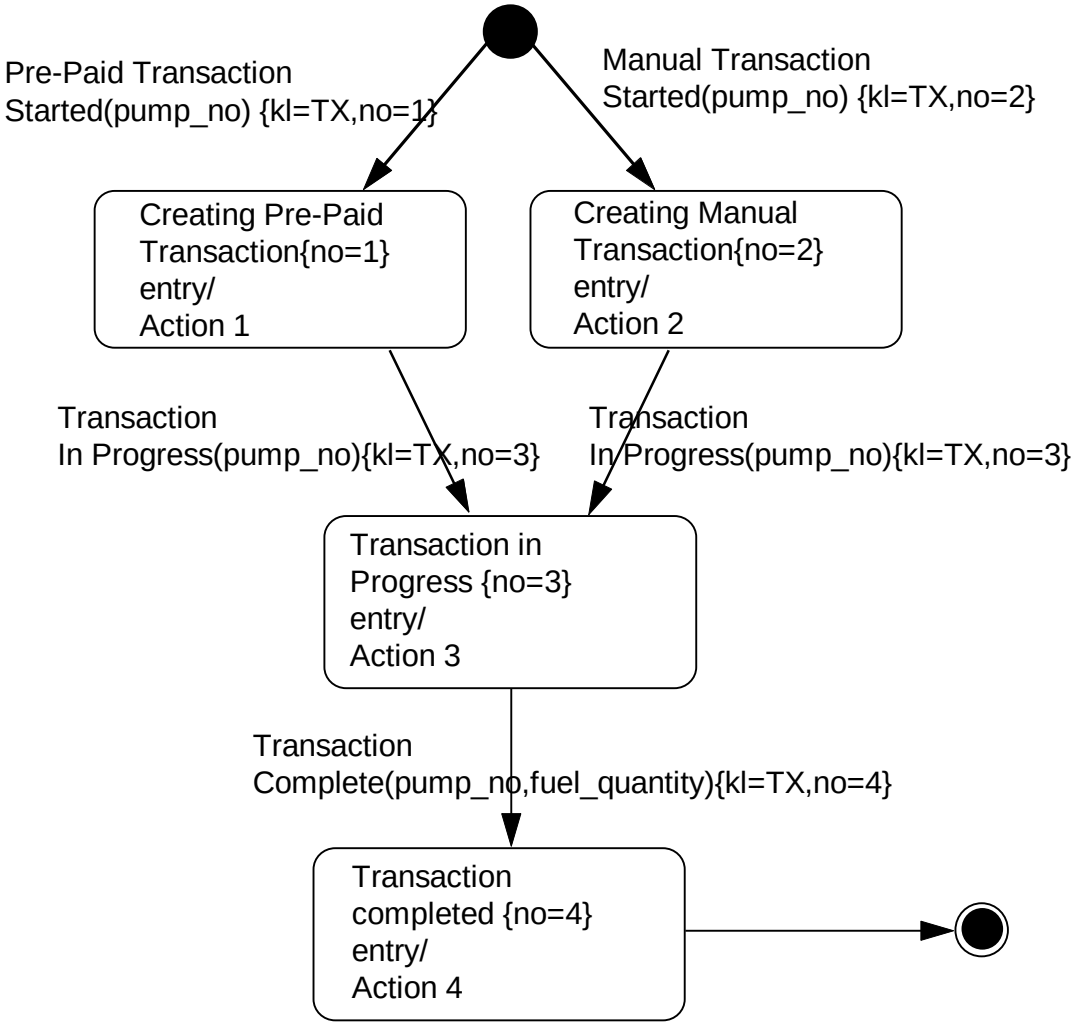
The keyletter, state number and efvent number tags may be ommitted if required. Internal transitions will not normally be shown if the STT notation is also employed.

Example

The following Shlaer-Mellor state transition diagram:



becomes a UML state chart as follows:



8. Assigner State Models

Represent an OOA91 assigner state model by a state chart sterotyped as <<assigner>> attached to the associative class. The streotyping prehibits creation states, deletion states and polymorphism. Label events with a key letter in the form "<class kl>-A".

Represent an OOA96 assigner state model by a state chart sterotyped as <<assigner>> attached to the partititioning association. The streotyping prehibits creation states, deletion states and polymorphism. Label events with a key letter in the form "R<association number>-A".

9. Synchronous Operations

Represent OOA92 and OOA97 style synchronous services as UML operations with the corresponding service actions as UML methods[7]. The invocation of such operations is shown on the OCM as described previously. Optionally, the services can also be shown in the Class Diagram.

10. Acknowledgements

Both authors are indebted to the many people who have contributed ideas over the years.

In particular, SJM would like to thank....

ITW would like to thank all the consultants and developers at Kennedy Carter. In particular for the specific issue of the UML mapping, he has benefited from many useful conversations with Colin Carter and Paul Francis. Andy Land deserves special praise for the painstaking care with which he picked his way through the 300+ pages on the UML specification in order to ensure the correctness of the mappings.

[7] Note that UML 1.3 does not allow methods to have "actions". This is certain to be changed in the "Precise Action Semantics" enhancement to UML currently being defined under the auspices of the OMG.

11. Method Baselines

Since the publication of the first book on OOA by Shlaer and Mellor various clarifications and extensions have been issued. In addition, others have contributed ideas, many of which are in active use. The intention of this section is to summarise these so that the discussion of the mapping to UML may be seen in context. It is not intended that this in any way replaces the published definitions of these extensions and in case of doubt the original publications should be consulted.

A complication in defining clear versions of the method is that there have often been a continuous series of minor improvements that have been incorporated into, for example, training material or consulting work on real projects without there having been an "official" and published release. Nevertheless, it is useful and convenient to attempt to define such versions.

11.1 OOA 88

This method, described in [M1] is confined mainly to Information Modelling with a minimal treatment of dynamic modelling and “design by translation”.

11.2 OOA 91

The method as published in “Object Lifecycles: Modelling the World in States” [M2], represents the first virtually complete description of OOA as we might recognise today. It differs from OOA 88 in the following respects:

- Minor Improvements to the Information Modelling formalism and notation such as Numbered Relationships.
- Substantial definition of dynamic behaviour in terms of interacting state machines executing models represented by State Transition Diagrams and State Transition Tables. Included with this was a treatment of the rules of synchronisation and concurrency within an OOA model.
- Introduction of the idea of domain partitioning with an outline treatment of bridges.
- A discussion of the Software Architecture that emphasised the idea of translation as system construction approach.

11.3 OOA 92

While developing CASE tool support that *understood* the formalism Kennedy Carter extended the definition and notation some areas. Most of these issues were documented in the product’s User Guide, although some technical notes were written.

The following issues were addressed:

Information Models

The following changes were made:

- The case of a general n-way relationship that had briefly been mentioned in OOA 88 but omitted from OOA 91 was withdrawn completely from our support. Our experience was that such relationships are very hard to understand and the real-world issues that they represent are better described by a number of simpler relationships.

- The notion of an "attribute domain", which was informally described in OOA 91 was tightened to include the idea of a data type with optional constraint.

State Models

In order to make the STT representation a complete description of the state model the following were added:

- A row representing the state of an instance before its creation. This pseudo-state enables the STT to show creation transitions. In addition, it allows the analyst to distinguish between the arrival of an event targeted at a non-existent instance being an error ("Cannot Happen") and being expected ("Ignore").

- The addition of the effect "Meaningless" for events arriving for instances in a state where the instance is deleted.

Other changes were:

- The notion of a polymorphic event was formally introduced [M12,M13].

- The idea of "synchronous services" was introduced [M7]. Such services specify processing that is executed synchronously with respect to the invocation and can return data to the invoking state action. OOA 97 refined the ideas and introduces the formal association of such services with objects and with object instances.

- Self directed events go to the head of the event queue for an instance. (Previously this was a recommendation only).

Process Models

- The Action Specification Language (ASL) [M10] was introduced as an alternative to Action Data Flow Diagrams (ADFDs) for specifying process models.

Domains and Bridges

- Introduction of an "OOA of Bridges" describing all the possible bridges mappings that can exist between OOA domains [M8].

- Interaction with other domains captured through events being sent to[8]/from terminators. Guidelines were provided for the level of abstraction for the terminator (i.e. that the terminator

[8] In OOA 97 the idea of an event being sent to a terminator was replaced with a "terminator service invocation" akin to a wormhole [M6].

represents the "ultimate source or sink" of a structured analysis "essential model" rather than the domain that implements it).

11.4 OOA 96

The "OOA 96 Report" [M3] tidied up a number of a number of loose ends in the description of OOA 91 and introduced some additional concepts. Some of these concepts had previously been described in Project Technology training material, but not incorporated in an "official" description of the method.

In outline the areas addressed were:

Information Models

- Clarification of the ideas of mathematical and stochastic dependence of attributes. Introduction of the notation (M) for mathematically dependent attributes replacing the (D) notation used previously.
- Clarification of the idea of relationship loops and composed relationships.
- Clarification to the ideas of reflexive relationships and the introduction of a new special case of symmetric reflexive relationships.

State Models

- Notational distinction between identifying event parameters and supplemental data.
- Events can no longer be sent to terminators.
- Self directed events go to head of the event queue for an instance.
- Formal introduction of polymorphic events through the idea of a "Polymorphic Event Table"
- Clarification to the definition of the operation of the Finite State Machine mechanism.
- Occurrence of "Cannot Happen" at run time defined as an analyst error.
- Introduction of the new concept of "multiple assigners"
- Clarifications to the rules surrounding object instance creation and deletion

Process Models

- Process models are not longer allowed to access the "Current State" attribute of an active object (except in the special case of synchronous creation).

- Introduction of the "proper attribution" rule for transient data on ADFDs[9]

- Introduction into ADFDs of the ideas of "base processes" working on (possibly ordered) sets of data, thus formally supporting the idea of iteration.

- Changes to the allowable properties of different process types on ADFDs.

- Replacement of the "Timer" mechanism with a simpler "Delayed Event" mechanism.

- Introduction of the term "wormhole" to refer to the invocation of services provided by other domains.

11.5 OOA 97

OOA 97 was an accumulation of a number of issues that built up in the course of consultancy work. These issues were then gathered into a single OOA 97 document [M9].

- Refinement of the idea of synchronous services by formal association of services with domains, objects and instances of objects. In ASL this association was captured with a defined syntax for the service calls.

- Introduction of the additional FSM responses of "Hold" and "Shouldn't Happen". The first of these was to deal with a specific class of problem complexity, the second in response to the OOA 96 rules that classify "Cannot Happen" as an analysis error if it does happen.

- Introduction of exception handling mechanisms within the OOA formalism.

- Introduction of support from the formalism for both "Deferred" and "Dynamic" data types.

- Introduction of a comprehensive support for the definition of Bridges within OOA/ASL including the idea of "counterpart relationships".

In order to support these ideas, the definition of ASL was upgraded from ASL 2.4 to ASL 2.5.

11.6 OOA 96++

Since the OOA 96 report, Shlaer and Mellor issued further method documents [M5, M6, M7] on the subjects of Data Types, Bridges & Wormholes and Synchronous Services. For convenience we refer to these as OOA 96++.

- Introduction of formal notion of a Data Type with a base type, range and precision and units

[9] This rule has been subsequently refined to the idea that all transient flows should have a defined *type* [M4].

- Introduction of idea of wormholes with client-server associations managed through transfer vectors

- Introduction of idea of a synchronous service provided by a domain.

12. Shlaer-Mellor to UML Meta-Model Mapping

The following table outlines the mappings between Shlaer-Mellor modelling concepts and the UML meta-model. These mappings have been chosen to be strictly correct in terms of the definition of the semantics behind the meta-model.

Shlaer-Mellor Concept	**Version Specific**	**UML Concept**
Information Modelling		
Object		Constrained Class
Attribute		Attribute
Identifier		Collaboration of Attributes
Binary Relationship		Association
Super/Sub Type Relationship		Constrained Generalisation
Associative Relationship		Association Class
Symmetric Reflexive Relationship		Stereotyped Association
Composed Relationship		Association with Constraint
Referential Attribute		Attribute with Tag
Mathematical Dependancy		Attribute with Constraint and Tag
Attribute Constraint		Constraint
Base Types		
Integer	OOA92	Type
Real/Numeric		Type
Boolean		Type
Extended Boolean	OOA96++	Type
Ordinal	OOA96++	Type
Duration	OOA96++	Type
Time-of-Day		Type
Date		Type
Text/Symbolic		Type
Arbitary	OOA96++	Type
Untyped Instance Handle	OOA92	Type
Domain Specific Types		
Constrained Base Type		Type

Enumeration		Type
Structure Set	OOA92	Type
Typed Instance Handle	OOA92	Type
Dynamic	OOA97	Type
Deferred	OOA97	Type
Units	OOA96++	Type
Default Value	OOA96++	Type
Range		Type
Precision		Type
Object Instance		Object
Relationship Instance		Link
Information Model Diagram		Stereotyped Class Diagram
State Modelling		
Instance State Model		Constrained State Machine asscociated with Class
Assigner State Model		
	OOA91	Constrained State Machine asscociated with Class
	OOA96	Constrained State Machine asscociated with Class and Association
State		State
Event		Constrained Signal/Reception Pair. "Event Direction" maps to Reception is BehaviouralFeature is Feature is owned by classifier is class(model element), Tied to event on state machine by association with Signal Event
Effects		
Transition		Transition
Cannot Happen		Transition associated with State by Internal Transition with Tag
Ignore		Transition associated with State by Internal Transition with Tag
Hold	OOA97	Event associated by "deferred event" to state
Shouldn't Happen	OOA97	Transition associated with State by Internal Transition with Tag
Non-existent State	OOA92	Initial Pseudo-State
Creation Event/State/Transition		Constrained Signal Event/State/Transition from Pseudo-State to the state
Terminal State		Constrained State that calls destroy event at end of entry action
Terminator		Sterotyped Class, visible outside the package
Event Parameter		Parameter on Signal Event
Polymorphic Events		
	OOA92	Each "event availability" is an additional signal reception ultimately owned by the class for which is is available
	OOA96	Each "OOA event" alias is an additonal signal & reception "raised" by the aliased signal/reception pair
Instance State Transition Diagram		Stereotyped State Chart

Assigner State Transition Diagram		Stereotyped State Chart
Instance State Transition Table		(Table)
Assigner State Transition Table		(Table)
Object Communication Model		Specification Level Collaboration Diagram
Thread of Control Chart		Sequence Diagram
Synchronous Services		
Domain Based Service	OOA92	Operation owed by an interface class owned by the (domain)package
Object Based Service	OOA97	Class based operation
Instance Based Service	OOA97	Instance based operation
Service Parameters	OOA92	
Input		In Parameters
Output		Return Parameters
Polymorphic Service	OOA97	IsPolymorhpic Operation with methods at each subclass
Object Access Model		TBD
Supplementary		
Scenario	OOA92	Operation/Method of class in an initialisation subpackage belonging to domain package
Scenario Schedule	OOA92	Operation/Method of class in an initialisation subpackage belonging to domain package
External	OOA92	Operation/Method of class in an initialisation subpackage belonging to domain package
External List	OOA92	Operation/Method of class in an initialisation subpackage belonging to domain package
Exception Handler	OOA97	TBD
Raising Exceptions	OOA97	TBD
RD & Bridges		
Domains etc		
Domain		Stereotyped Package
Dependency		Dependency
Build Set		Stereotyped Package with import dependencies on the domain

		packages that it uses
Domain Chart		Package Diagram
Contracts		
Contract		N/A
Contract Type		N/A
Closure Service		Signal or Operation
Bridges		
Terminator Service	OOA92	Operation on Stereotyped Class
Untyped IH/Transfer Vector	OOA96++/ OOA97	Parameters on the operation
ASL Mapping/Bridge Table	OOA97	Method provided by class in the build set package
Peer-to-Peer Counterpart Relationship	OOA97	association between terminator classes in imported domain packages
Specific/Generic Relationship	OOA97	generalisation between SCT and specific classes in imported domain packages
Explicit S/G CP Mapping	OOA97	Stereotyped method provided by the SCT class which raises the specific class operation
Implicit S/G CP Mappings		
Event Consumption	OOA97	Action on transition
Pre-State	OOA97	Addition to entry action
Post-State	OOA97	Addition to end of entry action
Pre-Service	OOA97	Additional method with pre-appendage
Post-Service	OOA97	Additional method with post-appendage
Attribute Access	OOA97	TBD
Architectures		
Tag Group		Tag
Tag(Colour)		Tag
Tag Attachment (Colourisation)		Application of Tag (Tag Value)
Miscellaneous		
Subsystems		
Subsystem		Package
Foreign Object		Imported Class
Foreign Relationship		Association belonging to imported class
Subsystem Relationship Model		Stereotyped Package Diagram
Subsystem Communication		Stereotyped Package Diagram

Subsystem Access Model		Stereotyped Package Diagram

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