GenGED vs AToM^3

Presented by Denis Dubé

Feb 28, 2005

McGill

MSDL

Overview

- **Introduction**
- Generating visual languages
- Simulation & Animation
- Conclusion

Overview

- **Introduction**
  - Acronyms
  - Motivations
  - Philosophies
  - Implementations
- Generating visual languages
- Simulation & Animation
- Conclusion

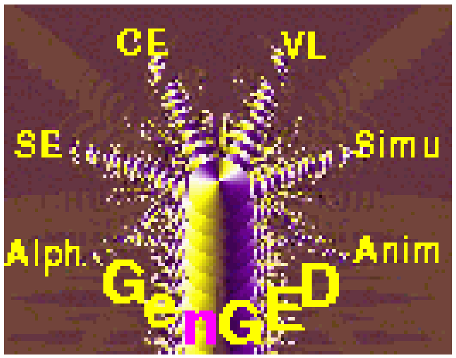
Acronyms

- Generation of Graphical Environments for Design
- A Tool for Multi-formalism and Meta-Modeling

Motivations

- Visual modeling and specification techniques are extremely useful for a host of domain specific applications
- Visual modeling environments are expensive to hand-code
  - Therefore it is highly desirable to automatically generate the environment from a meta-model

Philosophies



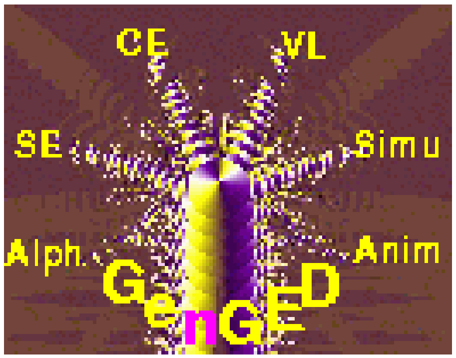
- *Visual* definition of visual languages and VL model manipulation

- Everything is a model
- Model everything explicitly

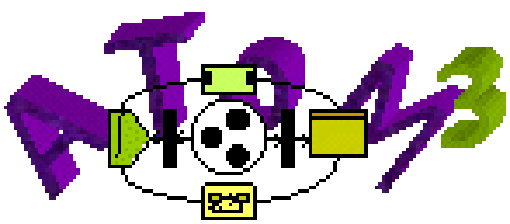
Philosophies Realization

- Emphasis on visuals results in integrated graphical constraints handler, PARCON package
- All model manipulation done using graph grammars, AGG package
- Explicit meta-model (ie. Entity Relationship) to create VL environments
- Graph grammars used to lesser extent, not as visual

Implementation



- Java but the PARCON constraints handler is in Objective C, thus GenGED works only on Linux & Solaris



- Python 2.3 and Tcl/Tk 8.3 (or better), completely platform independent (in theory)

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- Introduction
- **Generating visual languages**
  - The AToM^3 way
  - Alphabet editor
  - Alphabet rules
  - Visual language rules
  - Syntax and Parse Grammars
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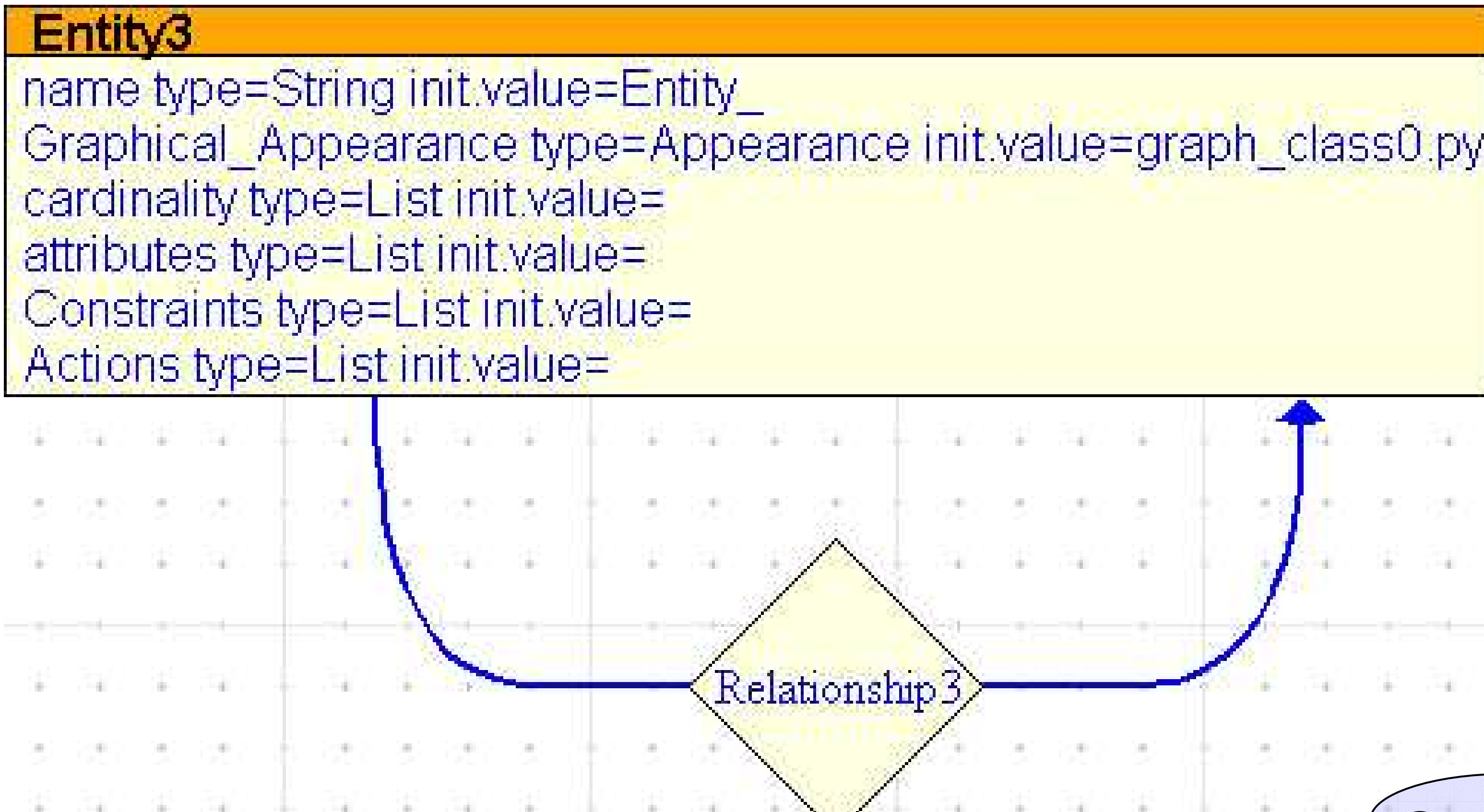
Generating VL's

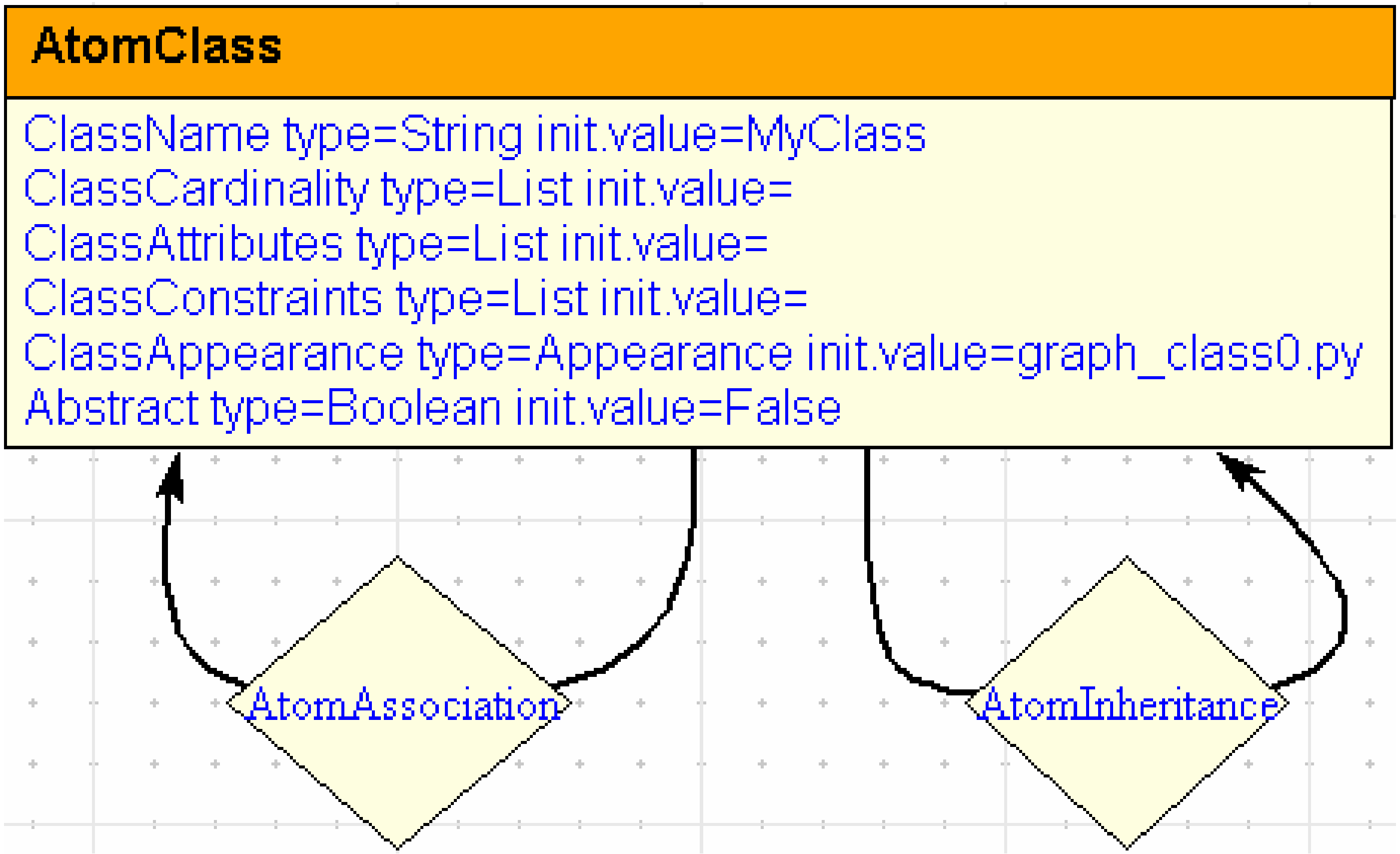
- Entity Relationship



See board

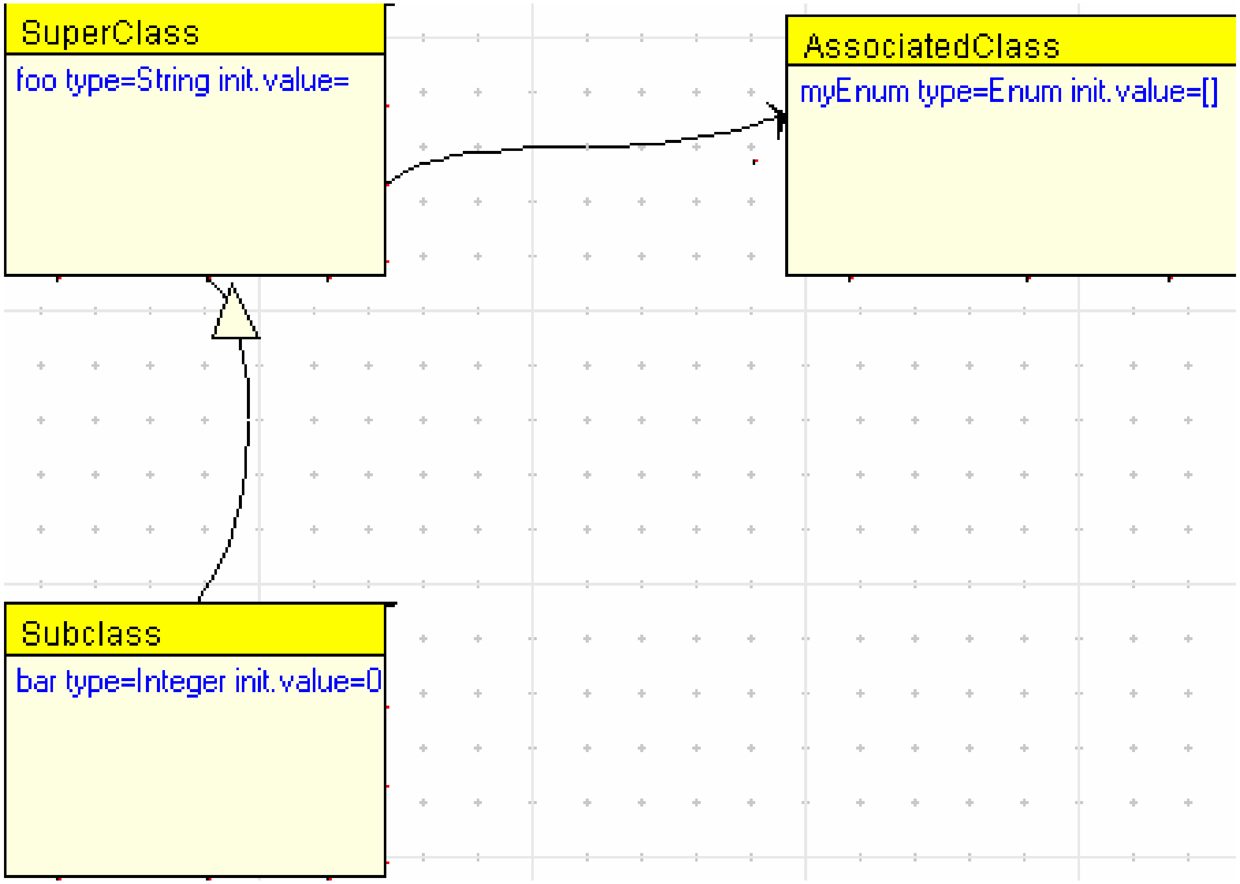
Generating VL's

- Class diagrams (Entity Relationship model)



Generating VL's

- Class diagrams (Class diagram model)



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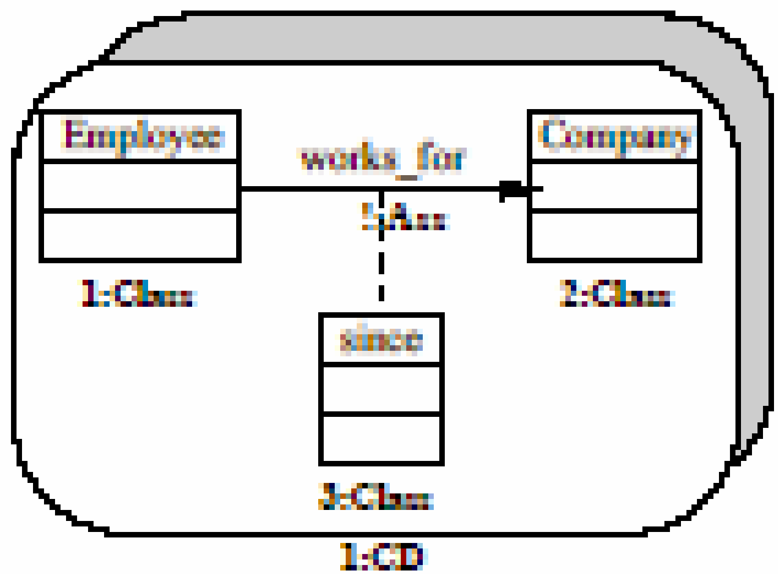
Running Example

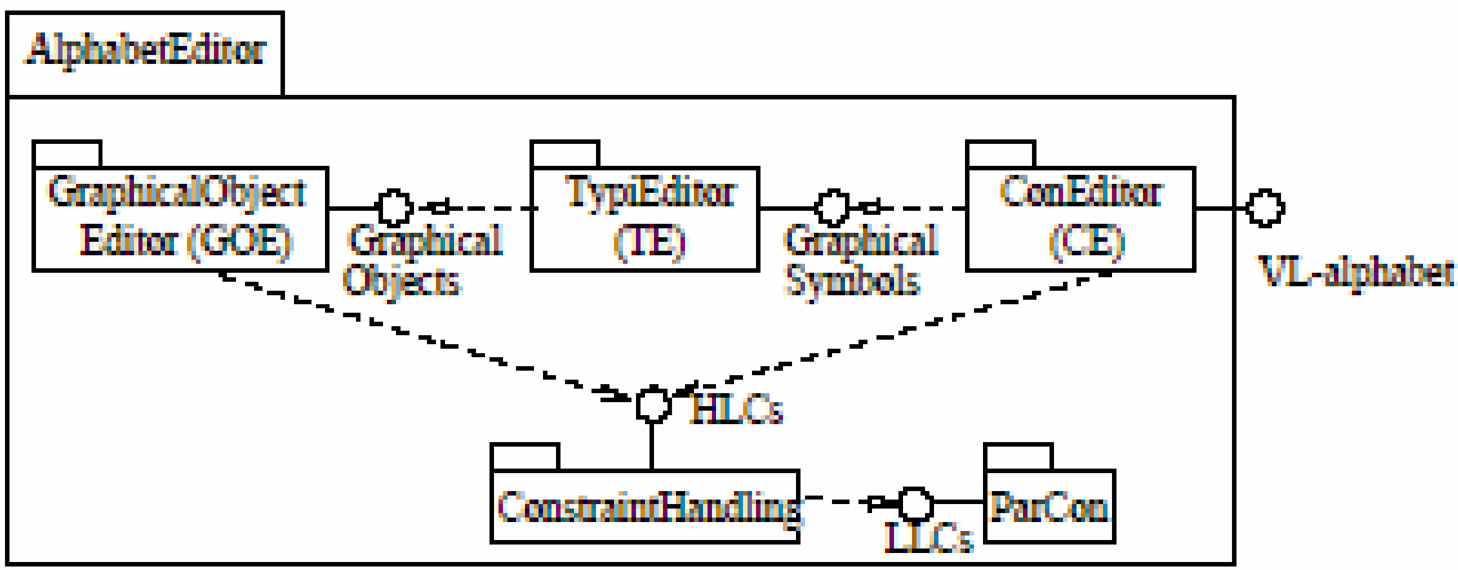
- Class diagrams VL

- Elements:
  - Class diagrams
  - Classes
  - Associations between classes
  - Association classes



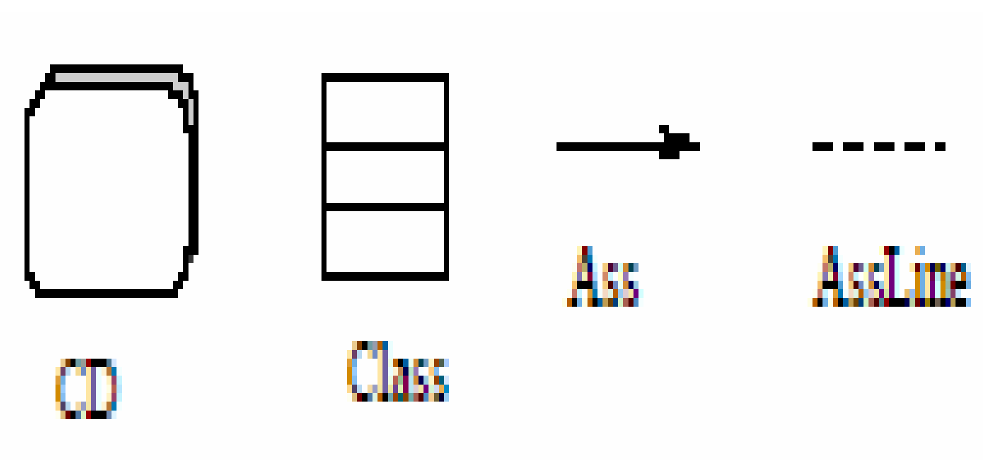
Alphabet editor

- Graphical Object Editor (draw visual icons)
- TypiEditor (map icons to semantic objects)
- ConEditor (connect semantic objects)



Alphabet editor: GOE

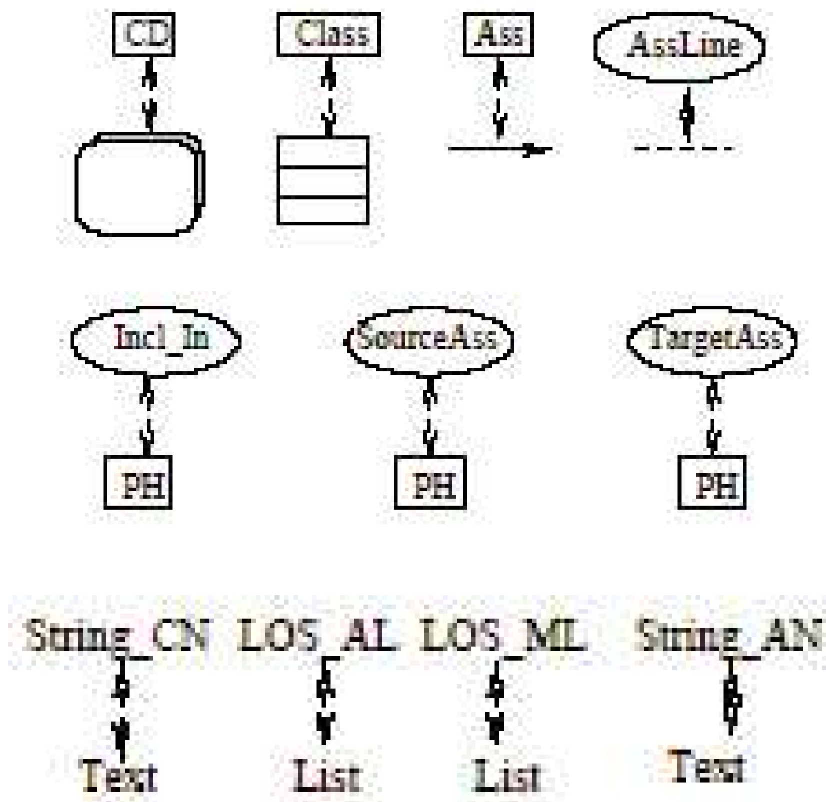
- Primitive objects: rectangles, circles, arrows, etc.
- Composite of primitive objects linked via graphical constraints



See board

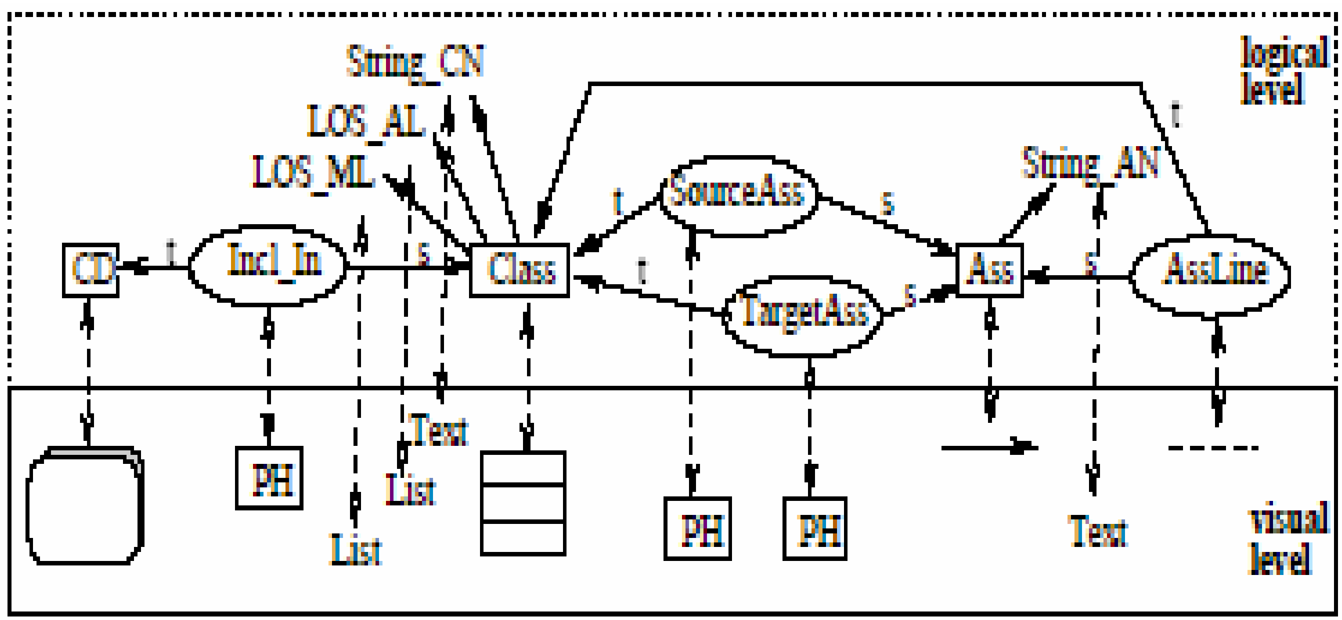
Alphabet editor: TypiEditor

- Mapping to graph nodes/edges of:
  - Graphical Objects
  - Place holders (non-visual)
- Creation of attribute data types by instantiating built-in data types



Alphabet editor: ConEditor

- Attribution mode: map nodes/edges with one or more data types
- Link mode: source and target definition for edges



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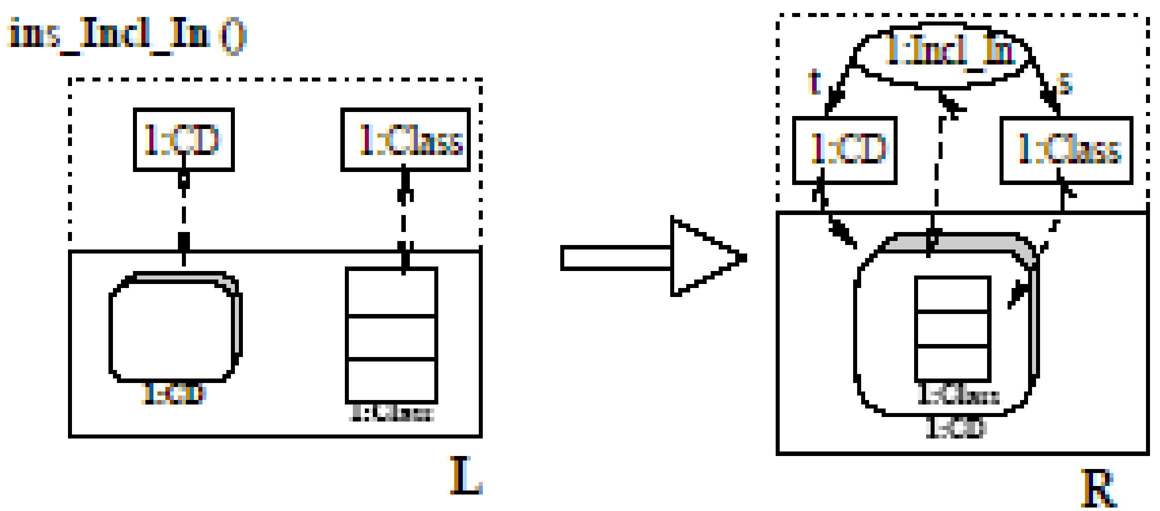
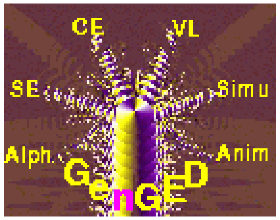
Alphabet rules

- Automatically generated for insertion & deletion
  - Node insertion: LHS = empty → RHS = new node
  - Edge insertion: LHS = 1+ nodes → RHS = new edge



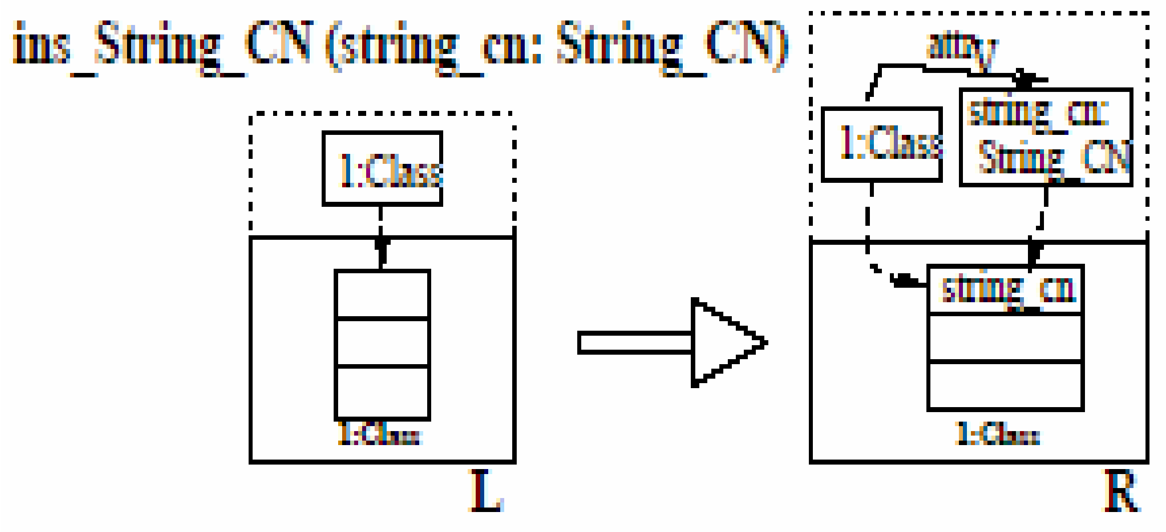
Example: Edge Insertion

Alphabet rules



- Automatically generated for insertion & deletion
  - Data types:

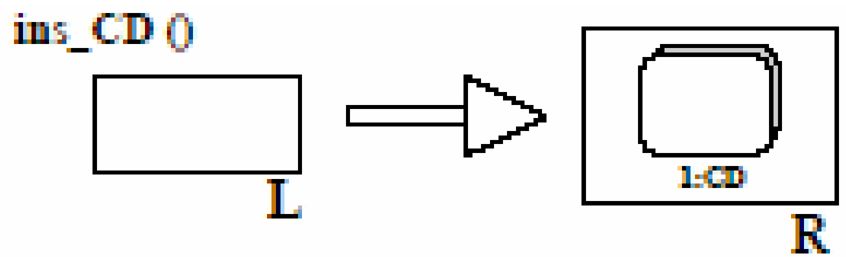
    LHS = Node/edge → RHS = Attributed Node/edge



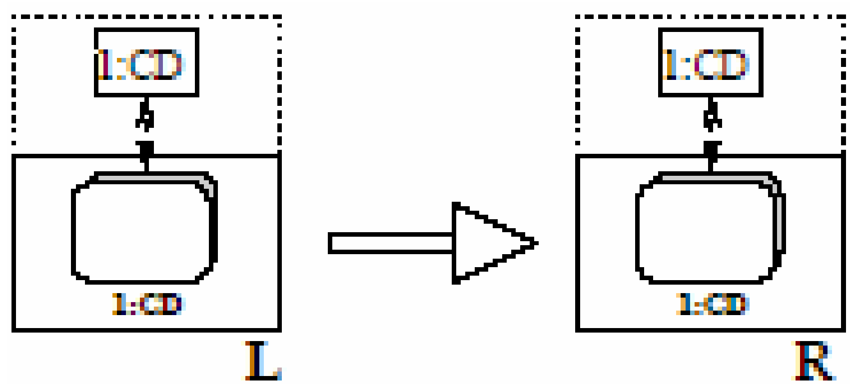
Example: String attribute insertion

VL Rule Editor

- Idea: use the basic alphabet rules to create more powerful ‘VL Rules’
  - Example: insertion of a class



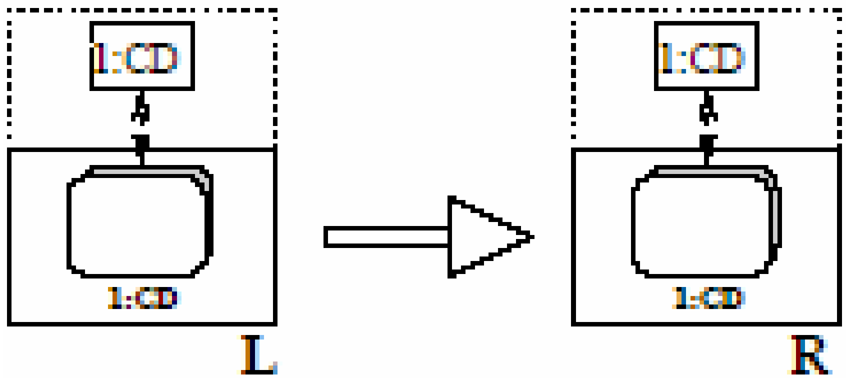
Alphabet rule:
Class diagram insertion



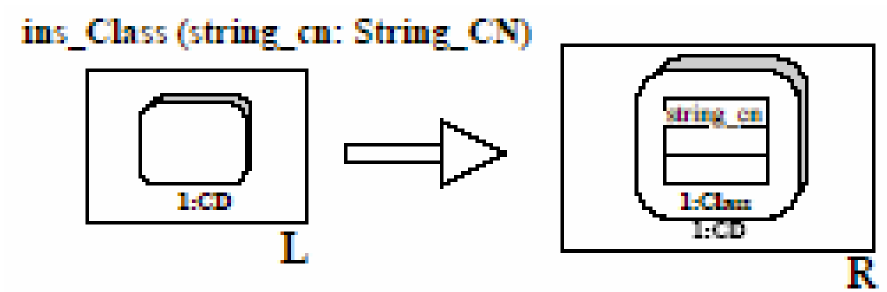
VL rule (not finished):
Class insertion

VL Rule Editor

- End result: VL Rule replaces the automatically generated alphabet rule
  - Example: insertion of a class



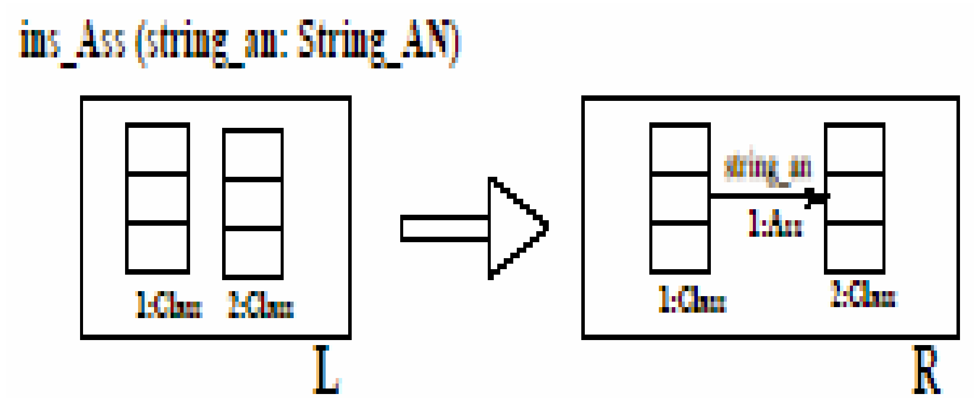
VL rule (not finished):
Class insertion



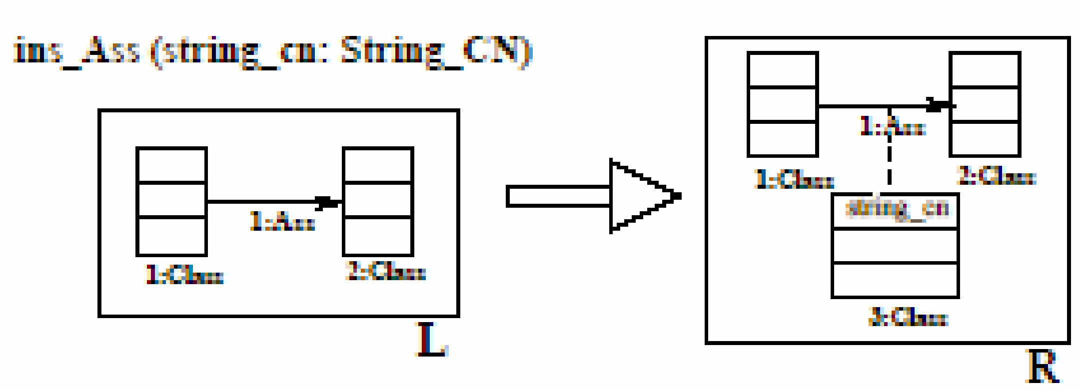
VL rule (finished):
Class insertion

VL Rule Editor

- More VL rules examples:



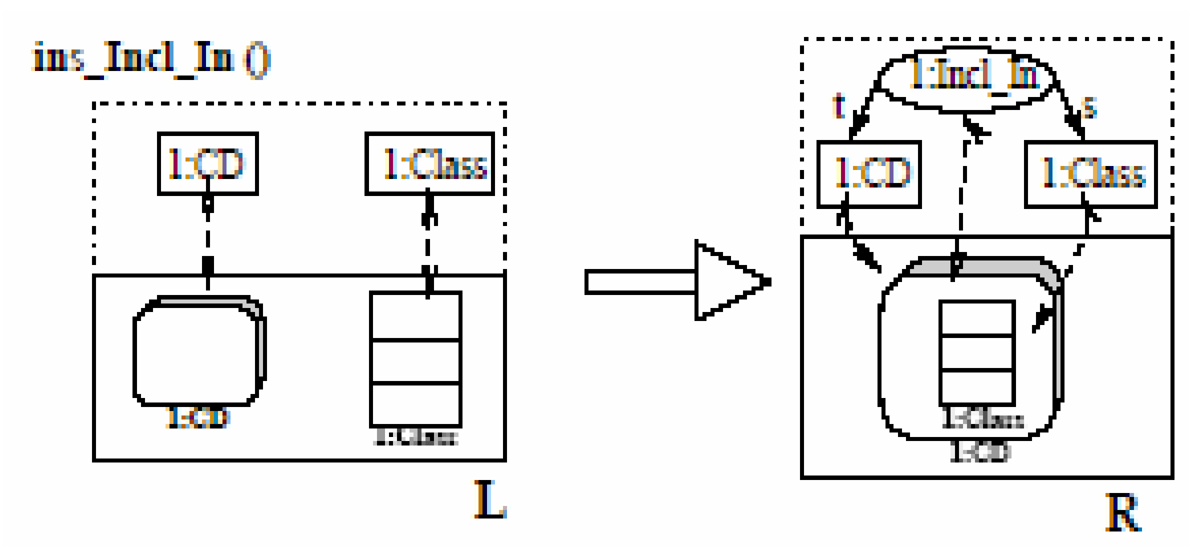
VL rule:
Insert association



VL rule:
Insert association class

VL Rule Application

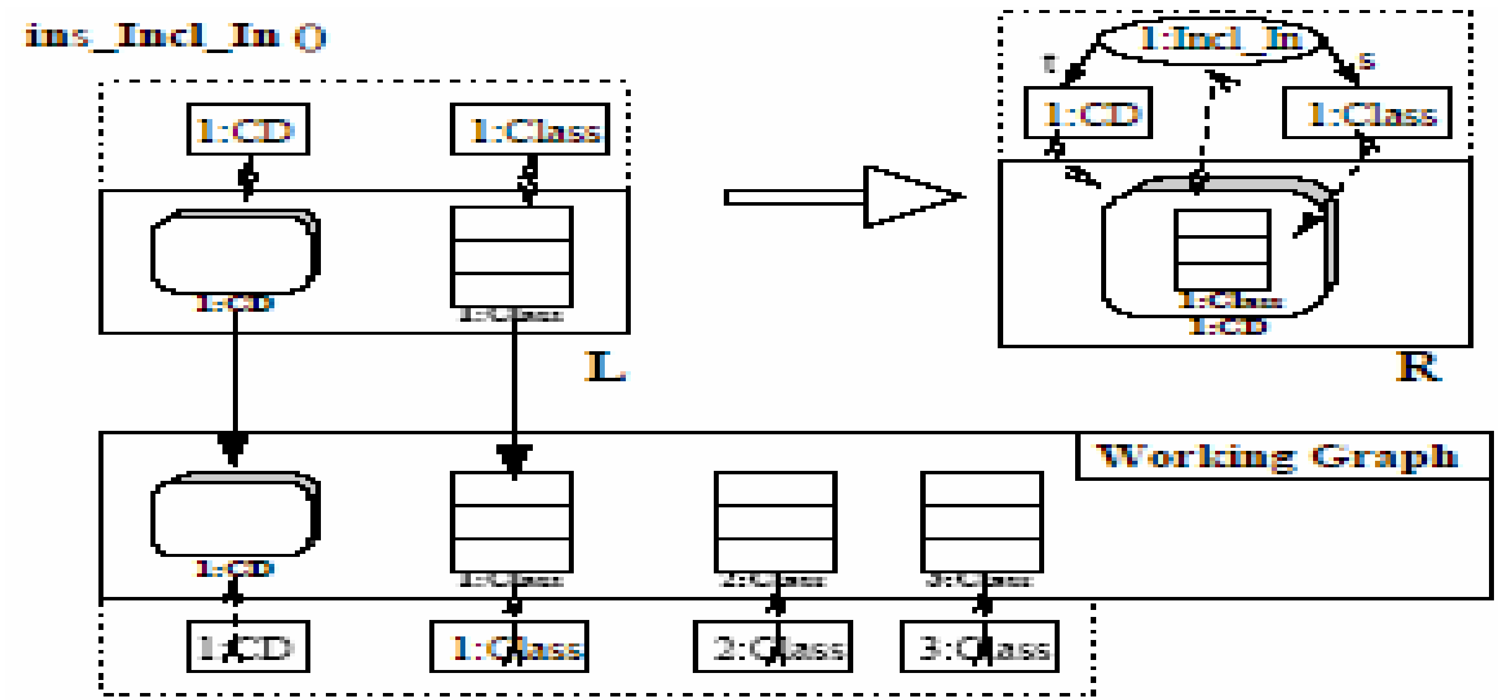
- How are these rules applied?
  - Example: automatically generated alphabet rule



Example: Edge Insertion

VL Rule Application

- Illustration of one match morphism for the previous rule



Rule

Host Graph

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Syntax Grammar

- Of what benefit are the VL rules?
  - The VL rules form a syntax grammar that ensure that a diagram being constructed or modified is always correct with respect to the VL model
  - Definition: A VL model is the set of all possible diagrams in a given visual language

Syntax Grammar

- AToM^3 emulates a syntax grammar (in some sense) with preconditions and postconditions

- Caveat: it is nonetheless possible to construct incorrect diagrams

See board

Parse Grammar

- What if the syntax grammar is too restrictive for interactive diagram editing?

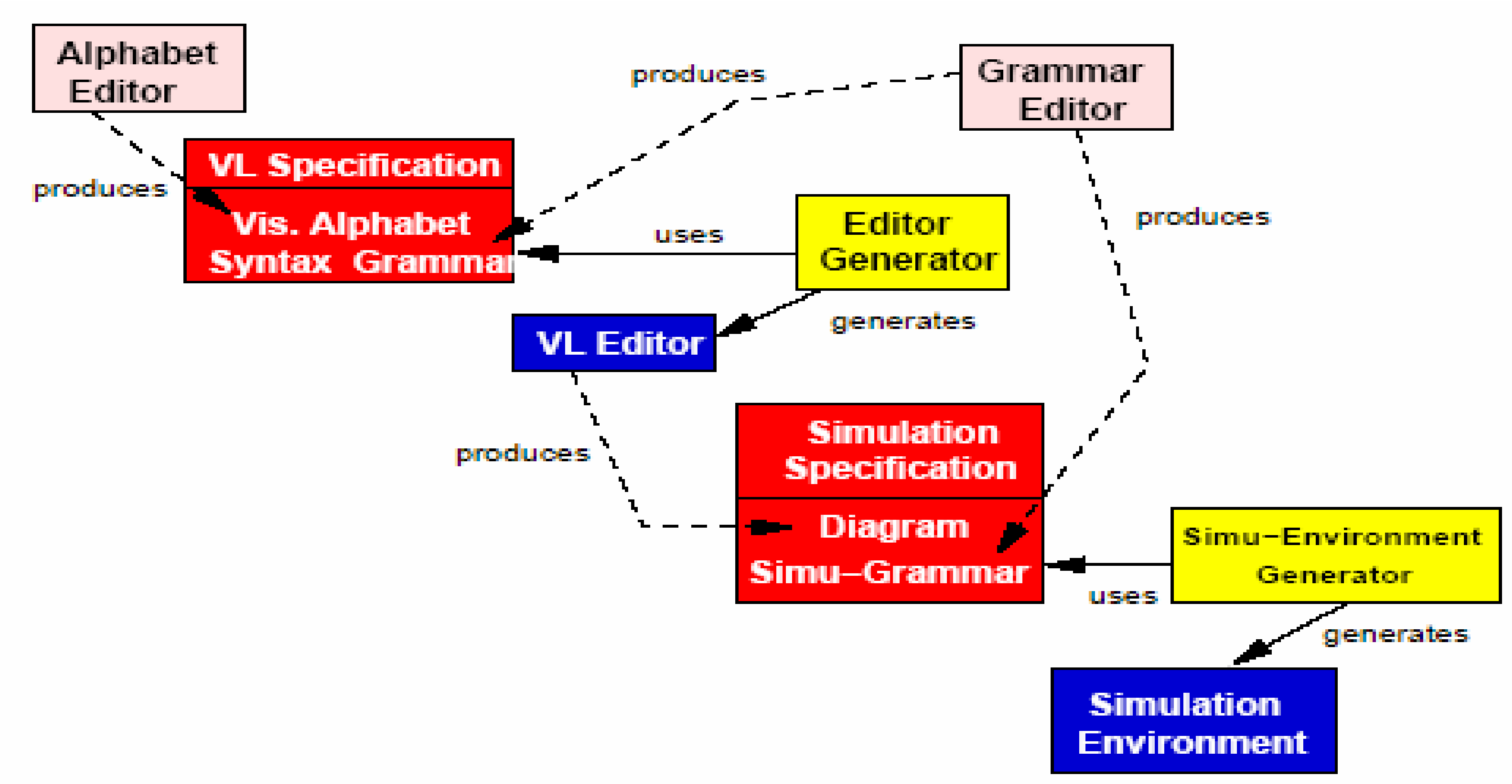
  - Create a set of rules that work from a simple start diagram and tries to build the current working diagram

  Or

  - Create a set of rules that removes components of the current working diagram until it reaches a simple end diagram

See board

GenGED Overview



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- **Simulation & Animation**
  - Motivation
  - The $AToM^3$ way
  - Simulation grammar
  - Simulation VS Animation
  - Animation & View transformation
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Motivation for simulation

- Simulation rules give the operational semantics of the underlying system represented by the visual model
  - Example: Petri-nets for the Traffic model

Motivation for animation

- Intuitive understanding of system behavior (especially for *non-experts*) cannot be expected in a (semi-) formal modeling language (ie: Petri-nets, Automatons)

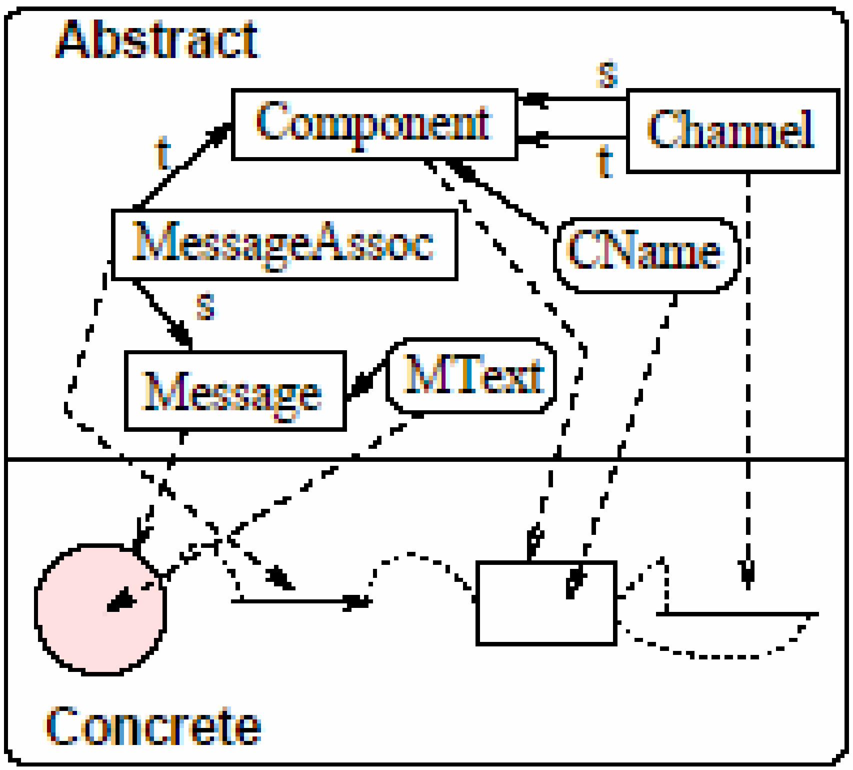
- Desirable to visualize model & behavior in the application domain (ie: want to work with Traffic models not Petri-nets)

Simulation & Animation

- AToM^3 handles model simulation by:
  - Graph grammars (lack of negative application conditions means some coding is required)
  - Hard-coded simulator
- AToM^3 handles model animation by:
  - Graph grammars (currently broken in version 0.3)
  - Hard-coded animation

Running example

- Producer Consumer VL



Legend:

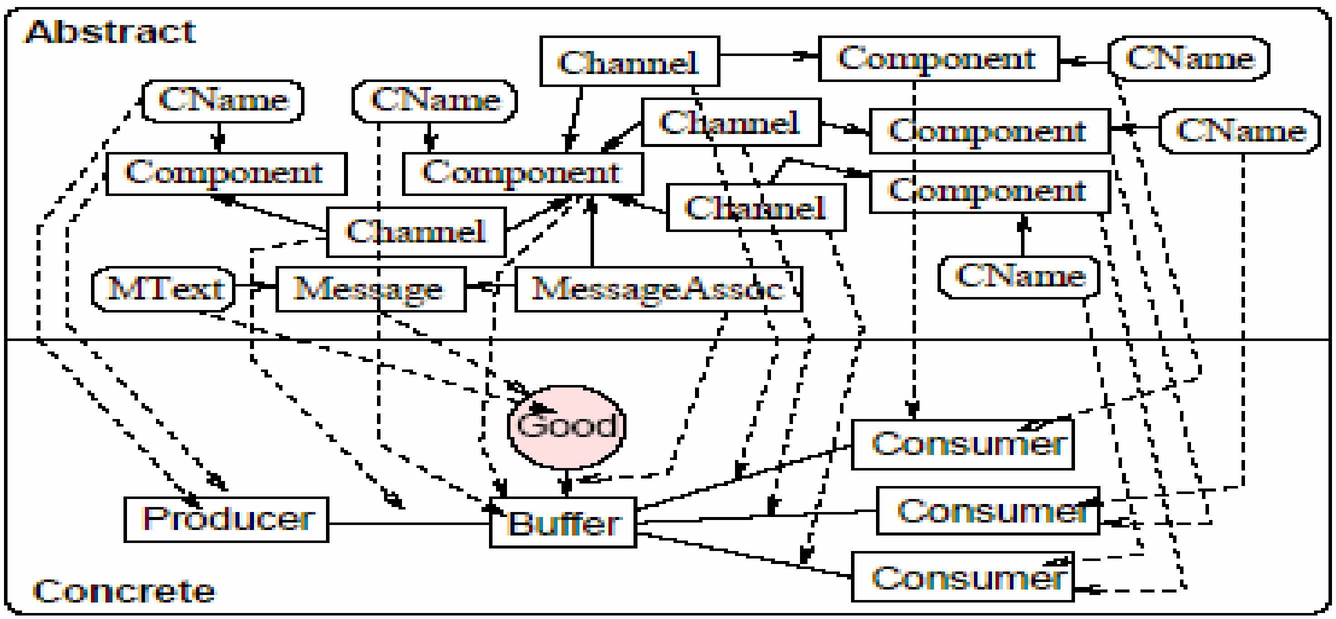
Edges/Nodes

Data types

Alphabet for producer consumer VL

Running example

- Producer Consumer VL



Legend:

Edges/Nodes

Data types

Example visual model

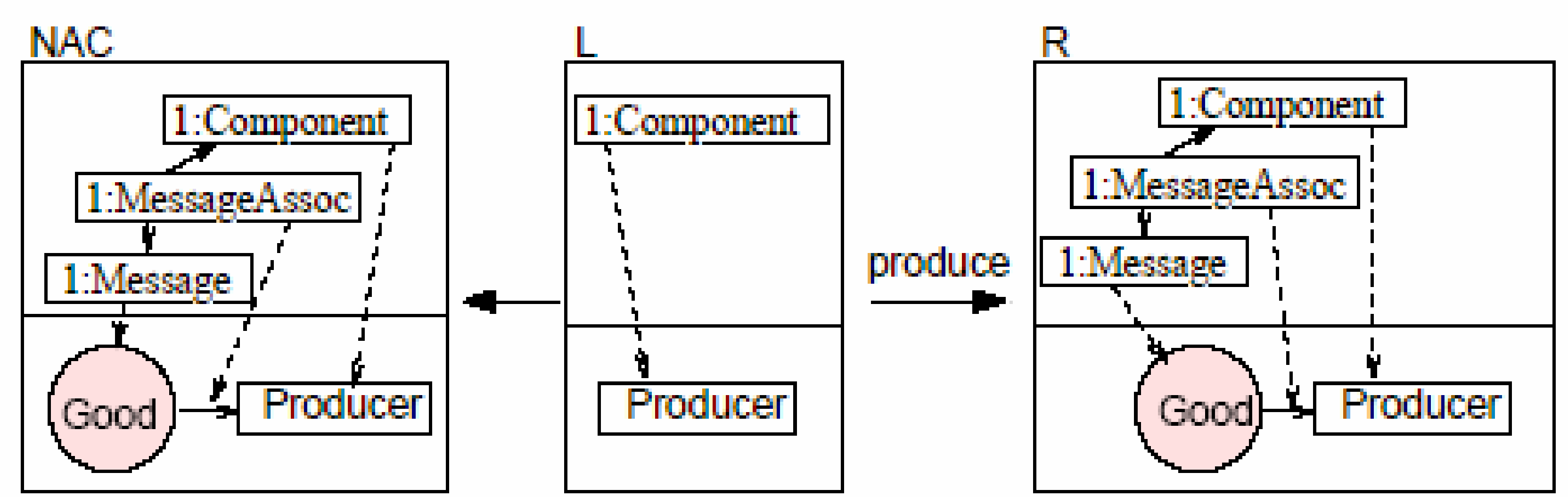
Simulation

- Describe behavior of the VL model using graph grammars (aka: a simulation grammar)
  - Rules represent model modification steps

- Rules = !NAC + LHS → RHS
  - Definition: a NAC is a negative application condition, if an LHS of a rule matches, but the NAC also matches, the rule is not applied

Simulation

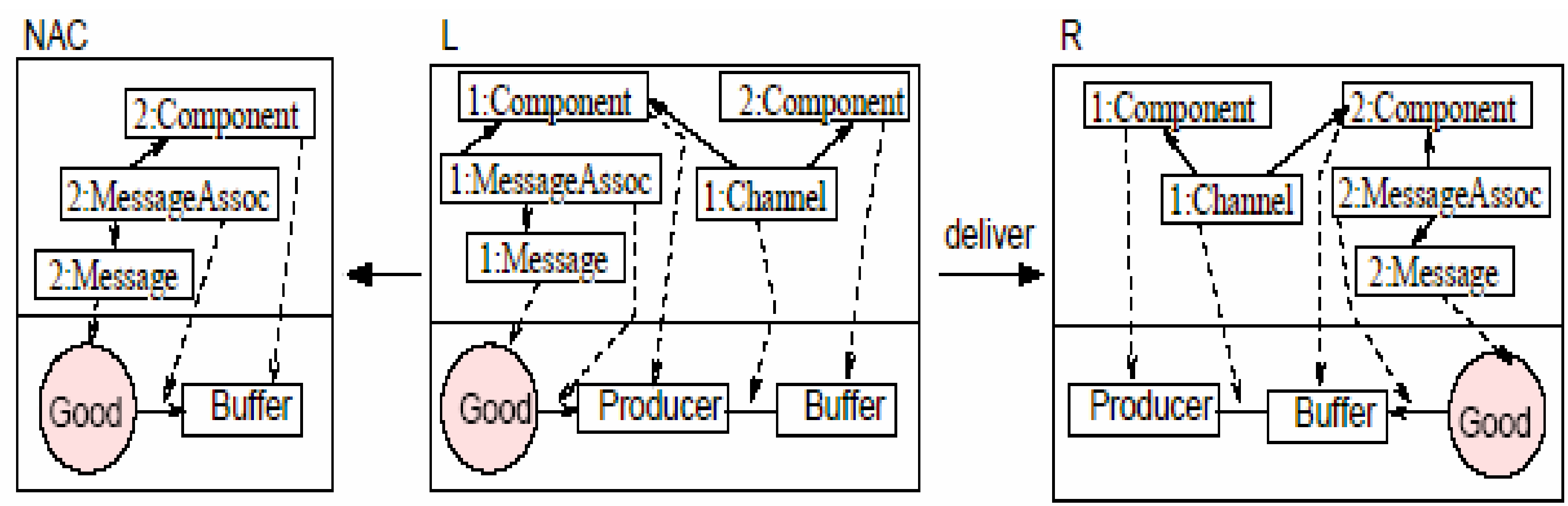
- Simulation Rule 1:
  - Production of a good at a 'Producer' component



Note: Data types not shown explicitly in the abstract layer

Simulation

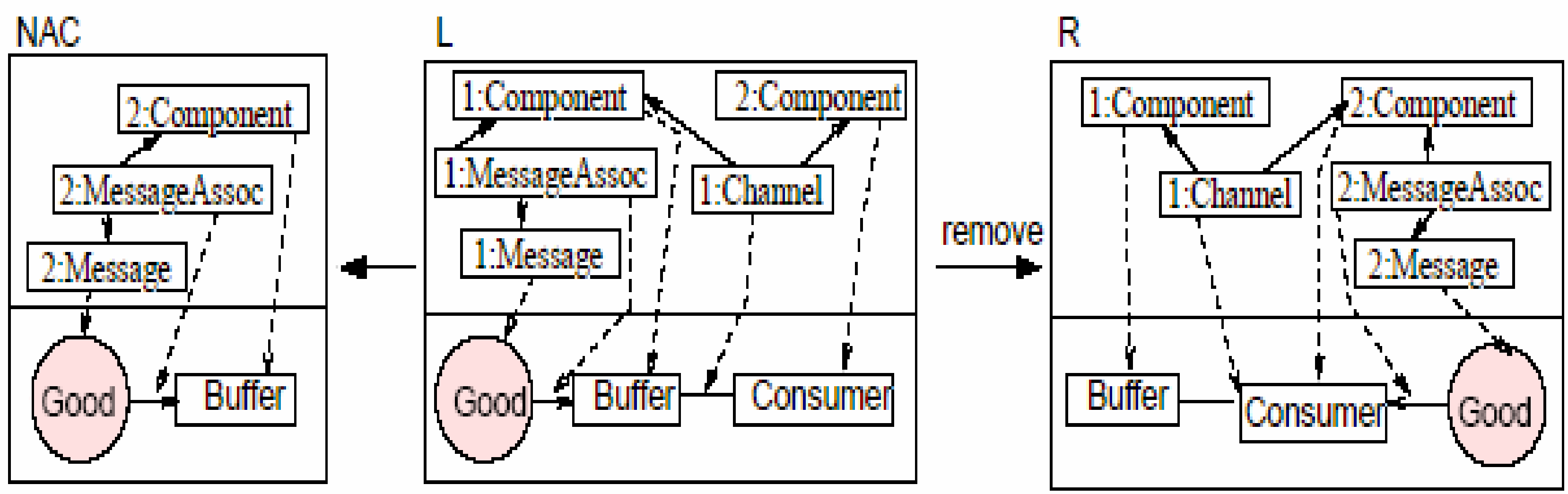
- Simulation Rule 2:
  - Delivery of a good from a Producer to a Buffer



Note: Data types not shown explicitly in the abstract layer

Simulation

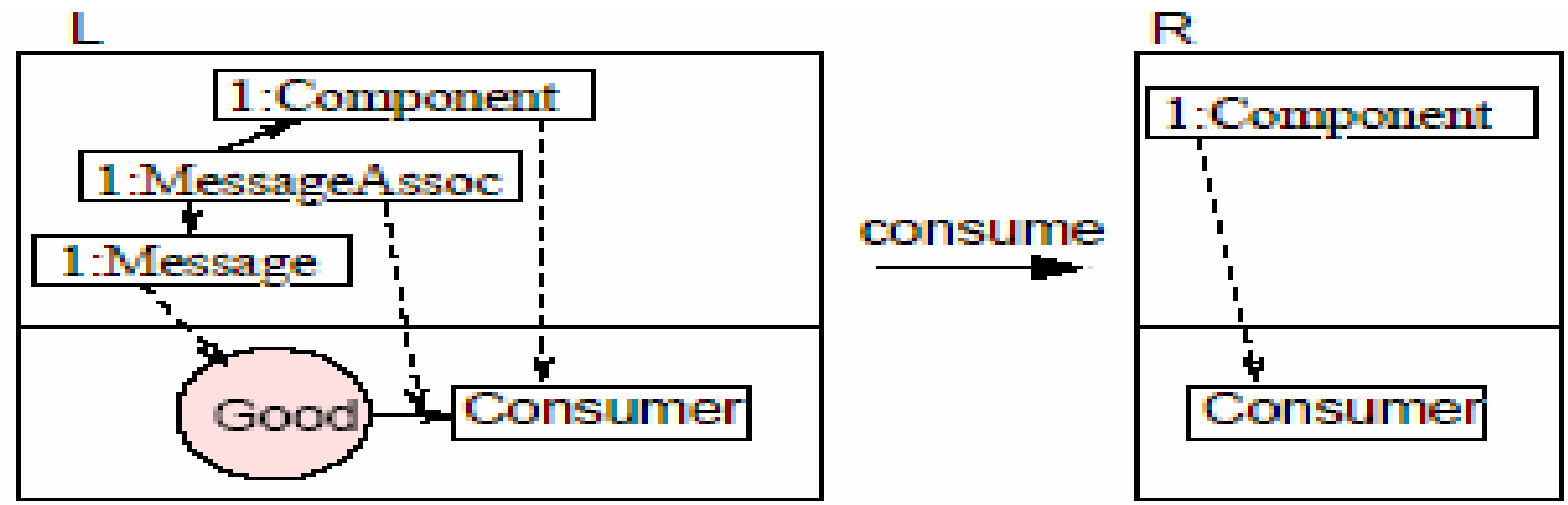
- Simulation Rule 3:
  - Removal of a good from the Buffer to the Consumer



Note: Data types not shown explicitly in the abstract layer

Simulation

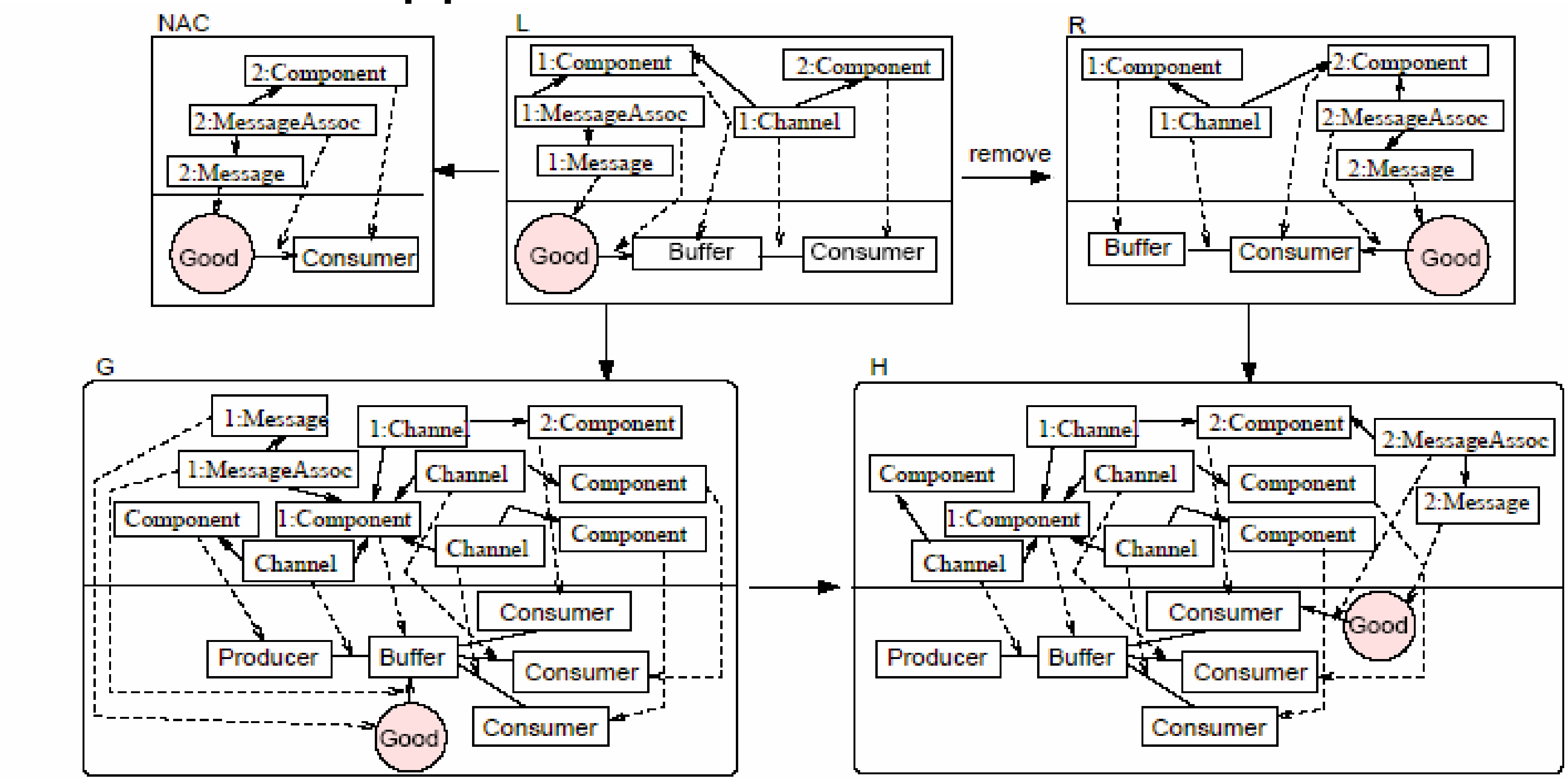
- Simulation Rule 4:
  - Consumption of a good by the Consumer



Note: Data types not shown explicitly in the abstract layer

Simulation

- Each rule application/derivation is a simulation step



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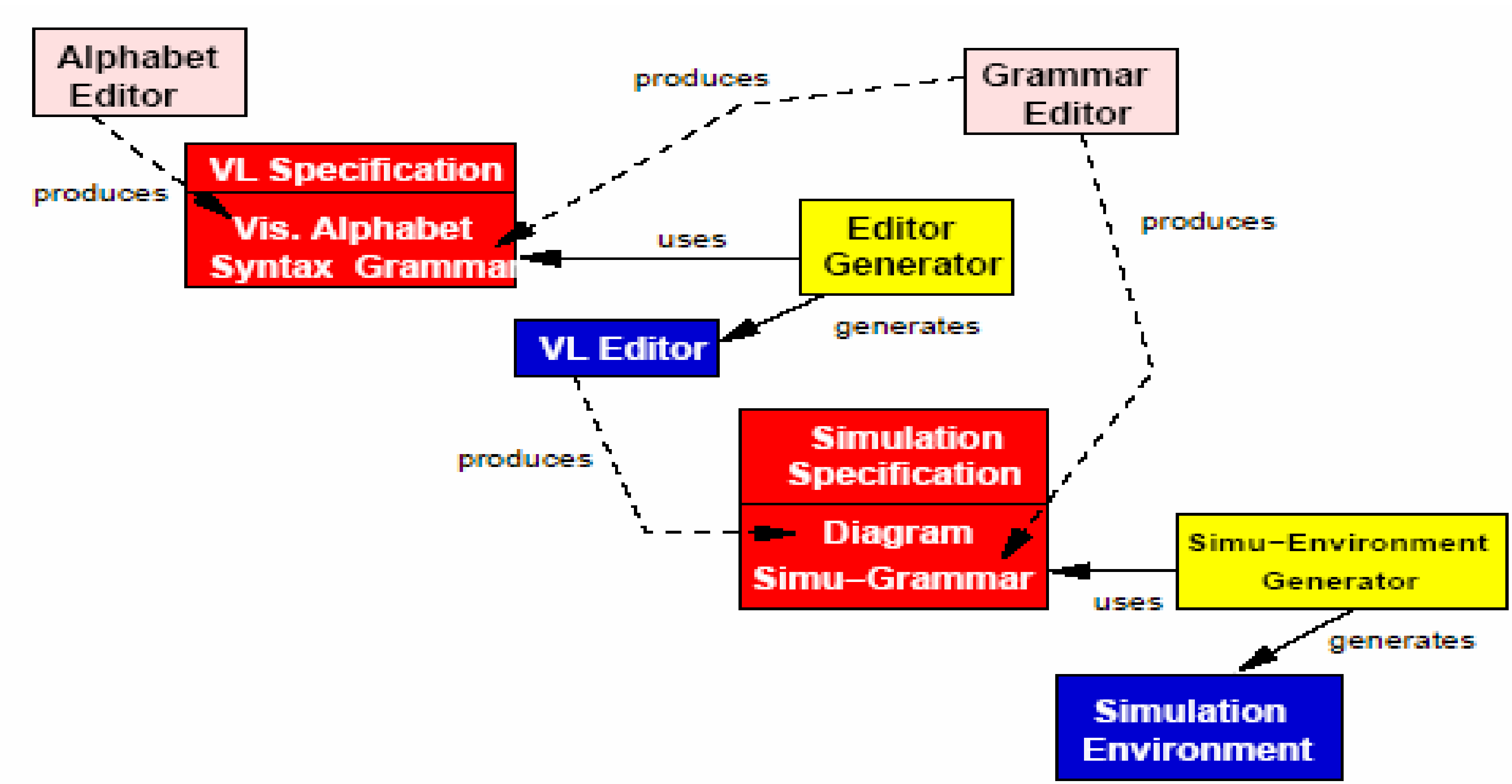
GenGED Overview



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Simulation VS Animation

- Simulation visualizes discrete state changes within the VL model itself

- Animation visualizes continuous state changes in a domain-oriented layout
  - Example: A traffic system with cars that move along a road and traffic lights that change colors

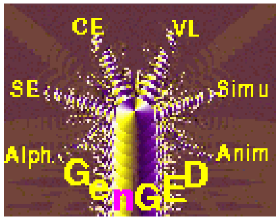
Animation

- Transformation from VL model and the associated simulation rules to an animation view must be done with care
  - Must avoid deviations between the two or worse, contradictions!
  - In particular: we want to preserve the precision of the (semi-) formal model in the animation view
- Therefore: generate the animation view systematically from the VL model with a formal view transformation grammar

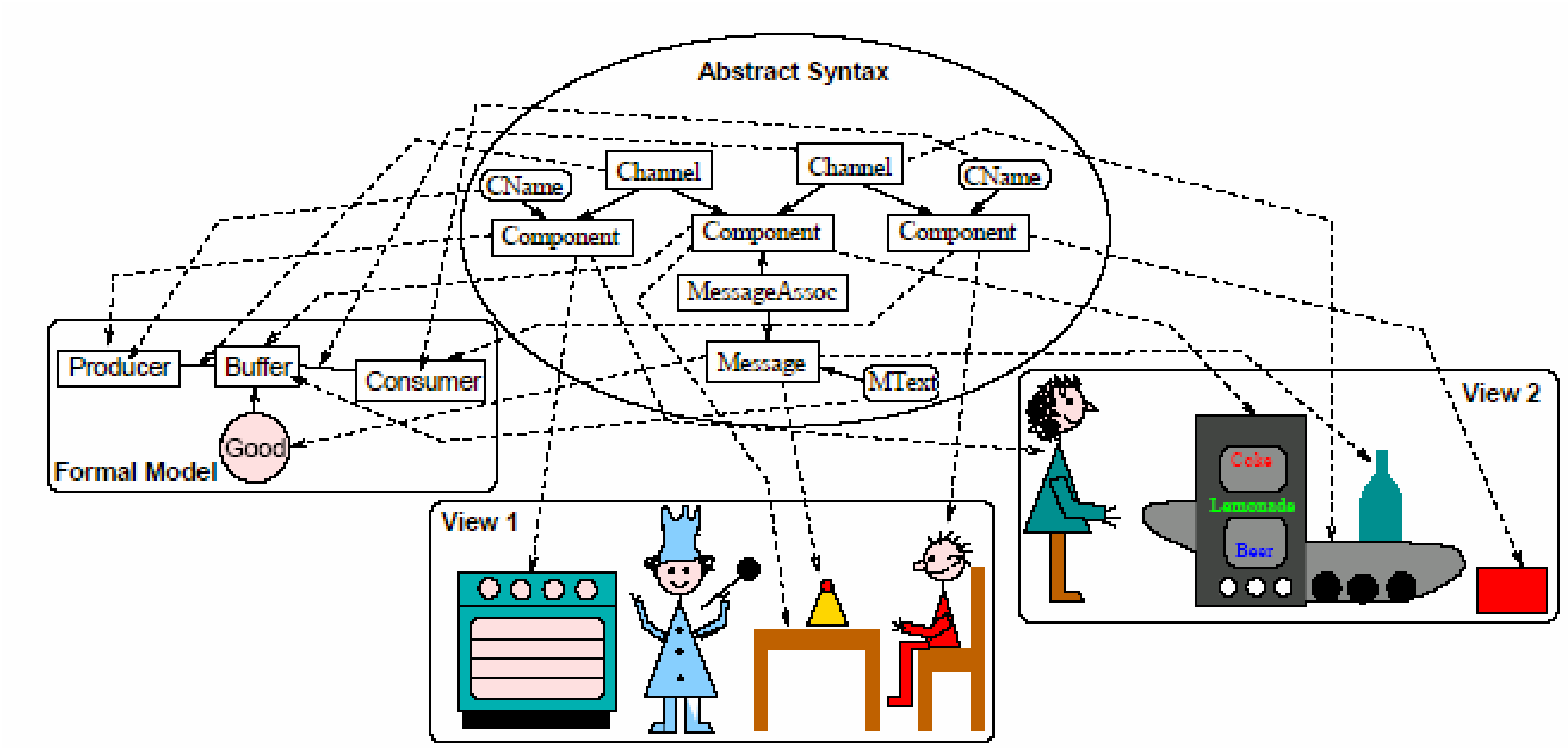
View Transformation

- The view transformation grammar:
  - Transforms the VL model to a domain specific layout
  - Transforms the simulation grammar into an animation grammar
  - Permits the addition of attributes to the simulation grammar that allow for continuously changing objects (ie: position, size, color, of objects can change continuously between specified time intervals)

View Transformation

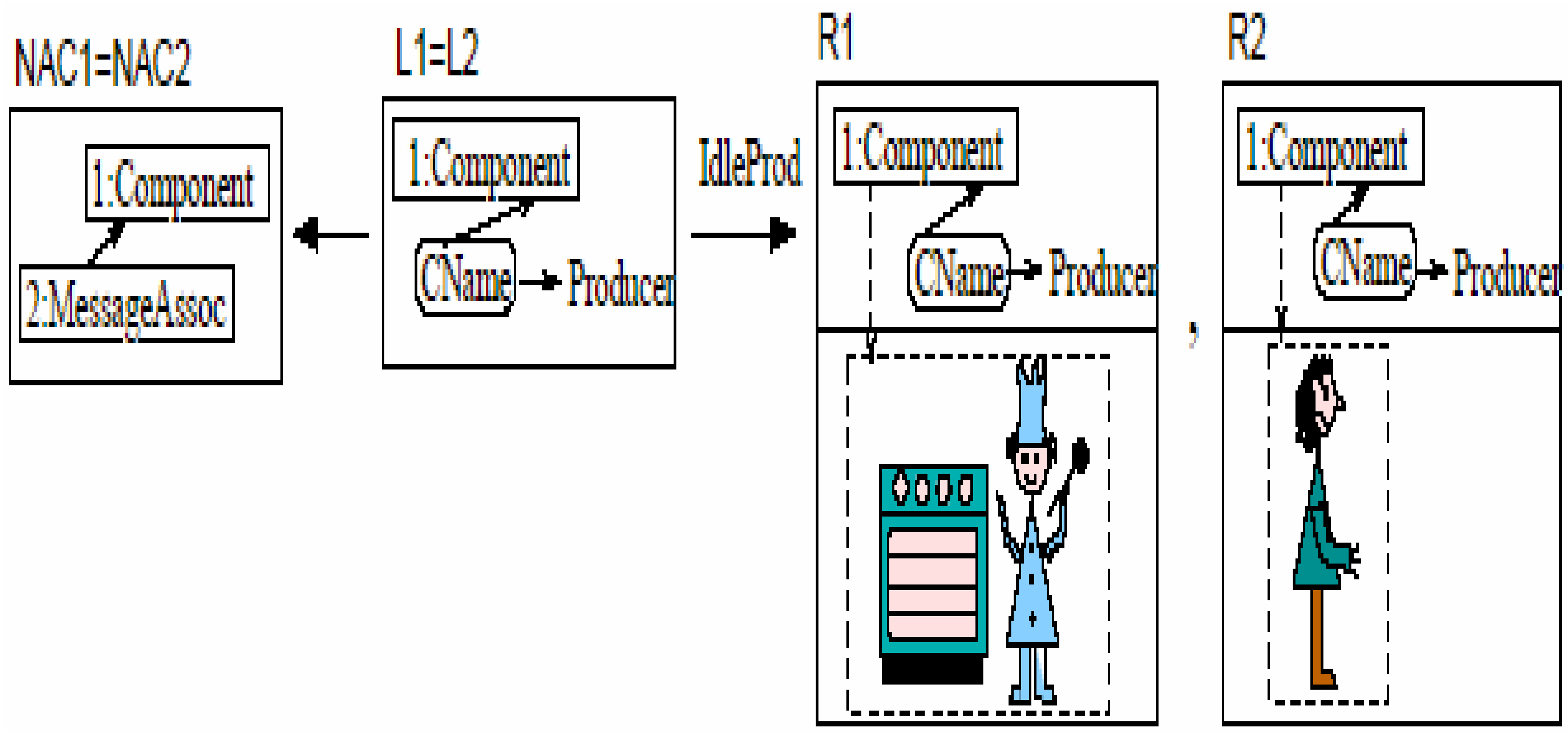


- Producer consumer model & two animation views

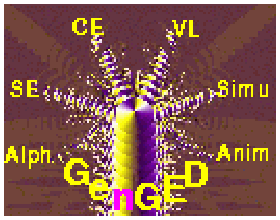


Transformation Grammar

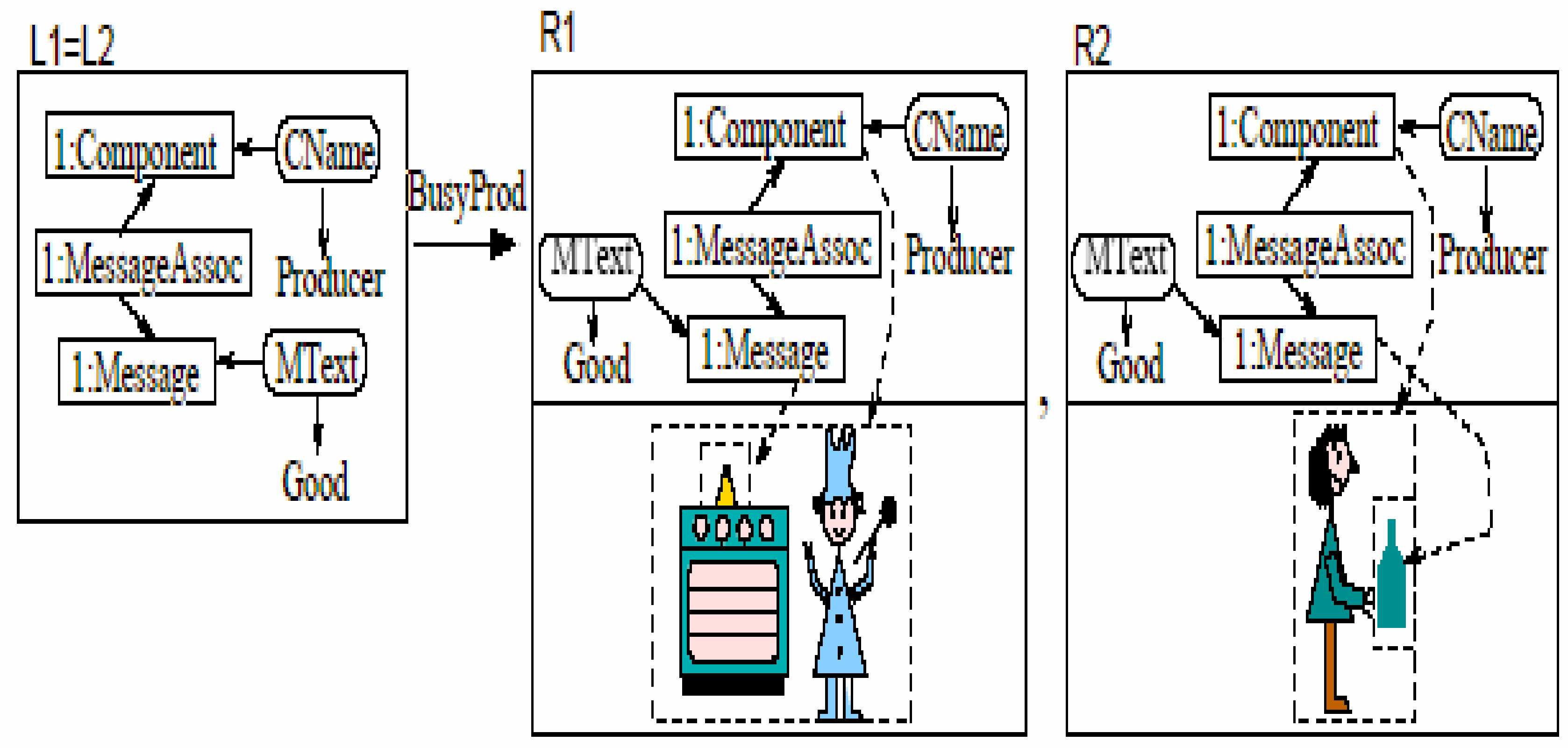
- Idle Producer transformation



Transformation Grammar

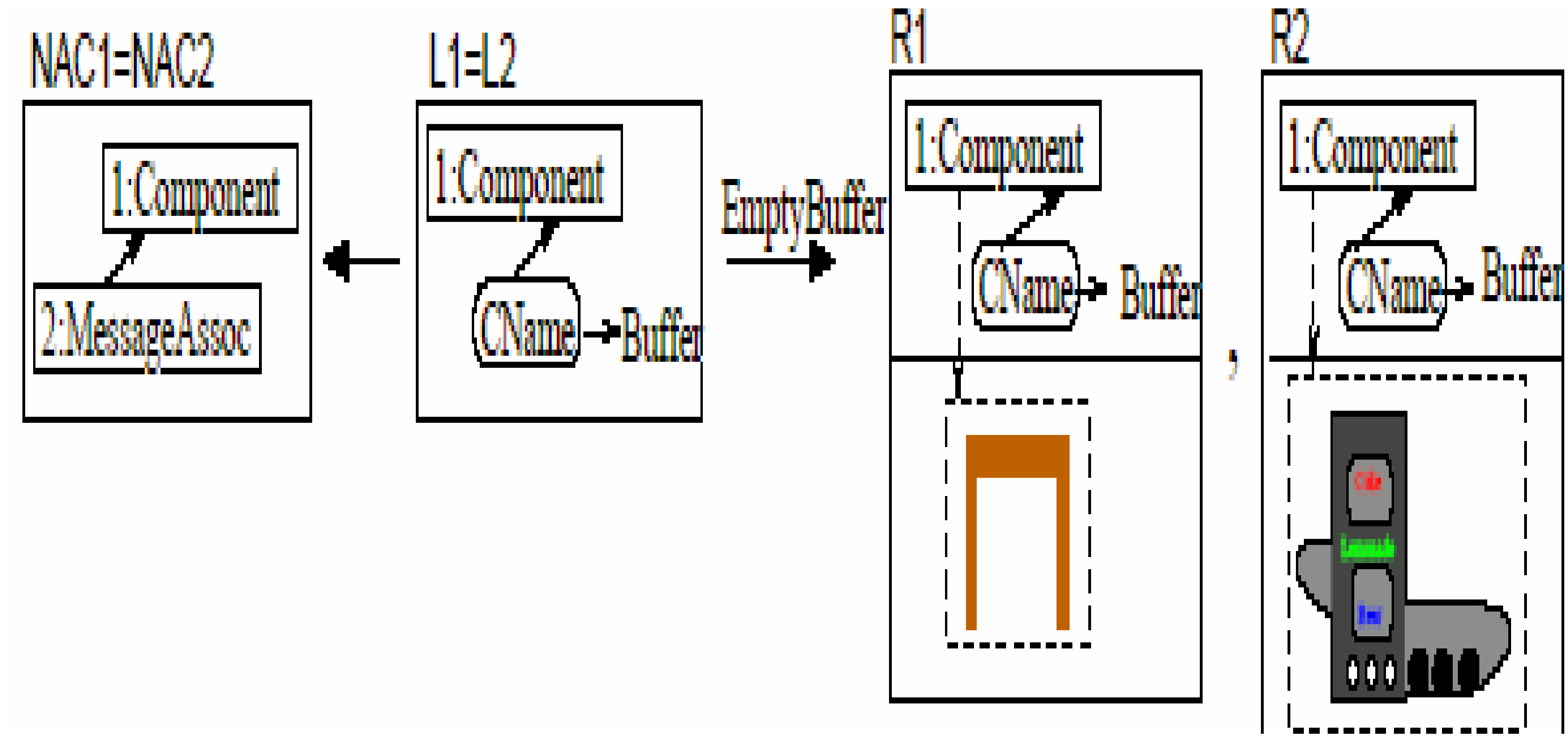


- Busy Producer transformation



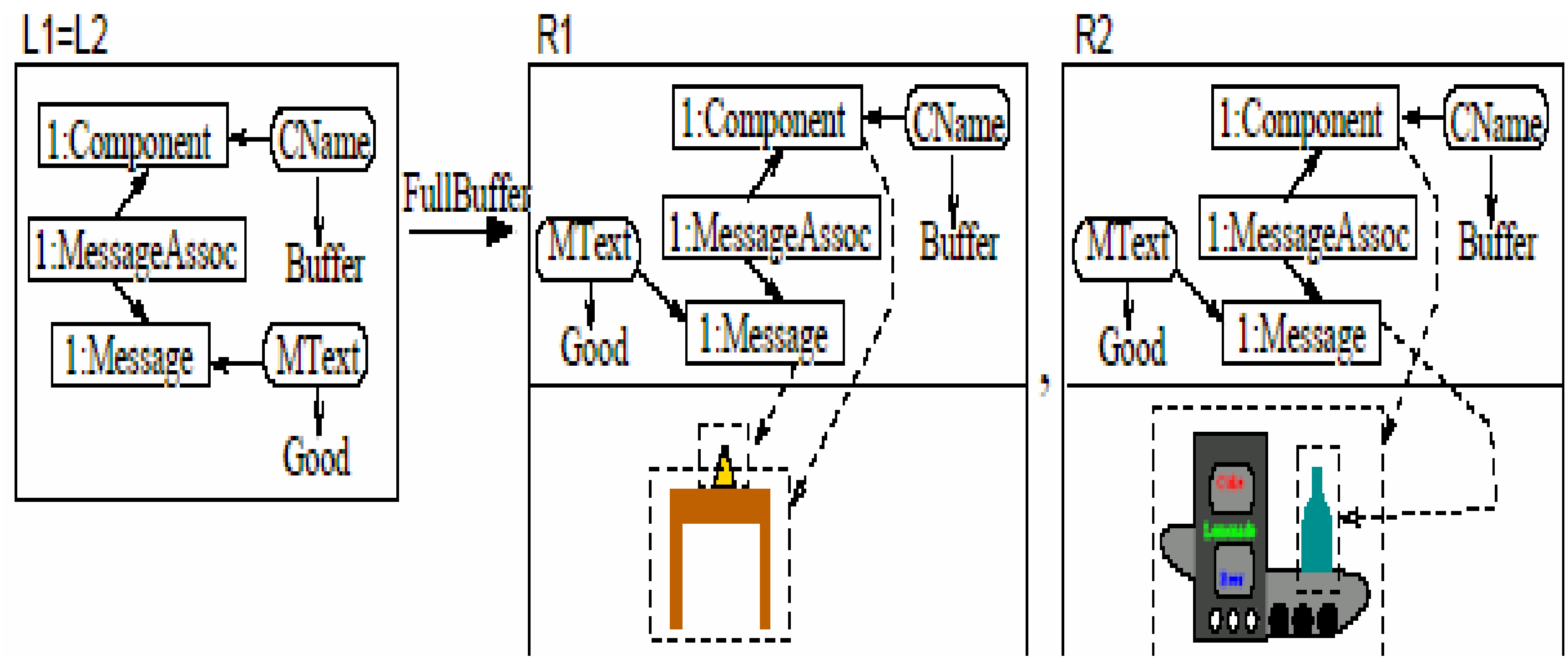
Transformation Grammar

- Empty Buffer transformation



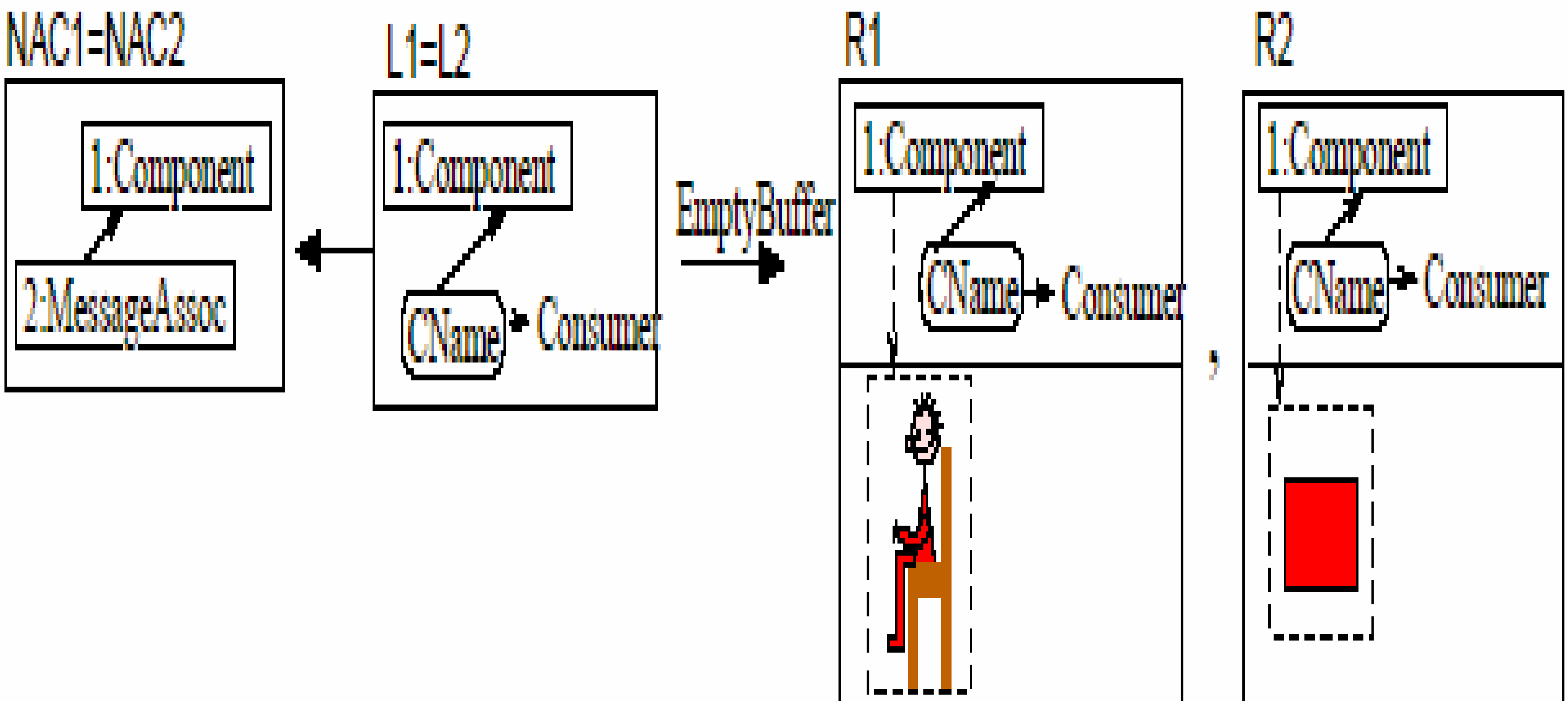
Transformation Grammar

- Full Buffer transformation



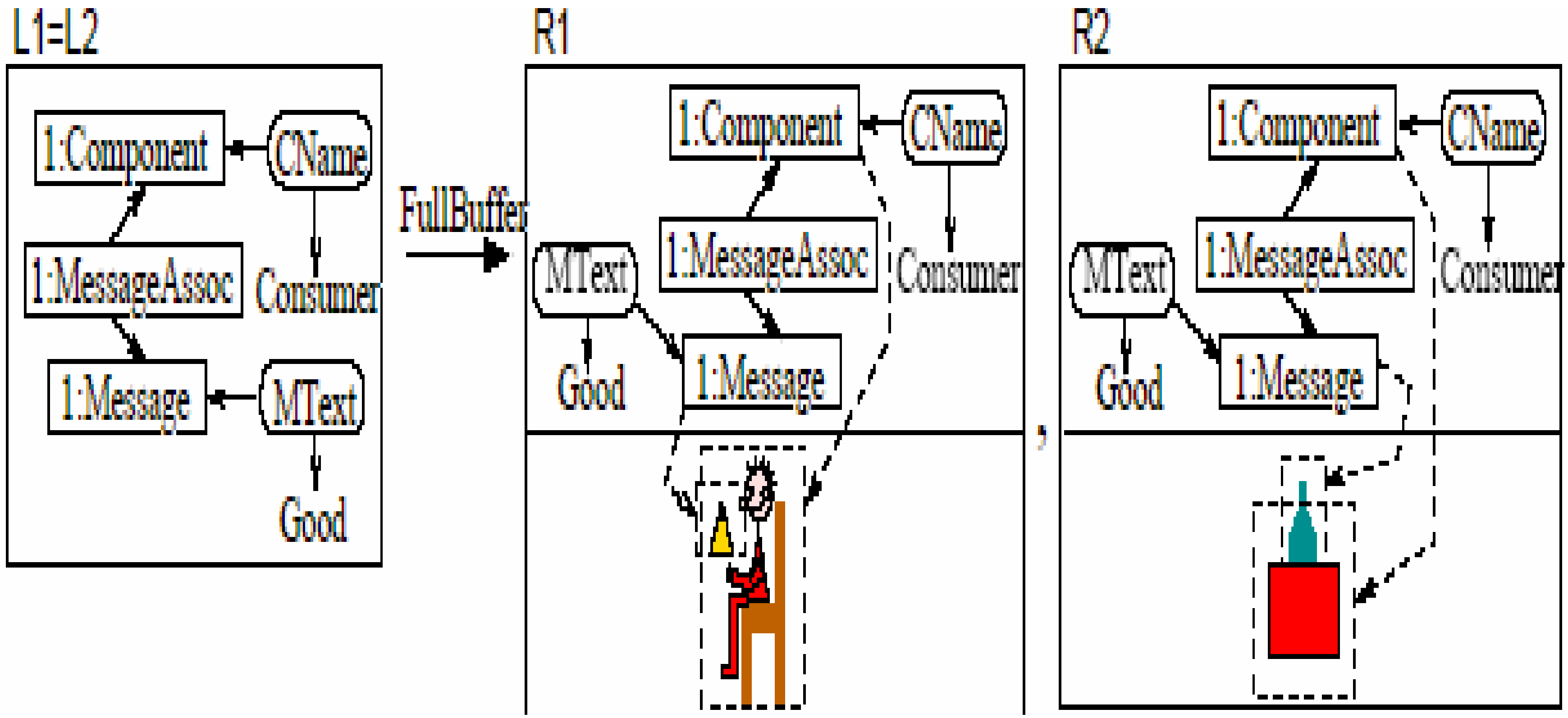
Transformation Grammar

- Empty Consumer transformation



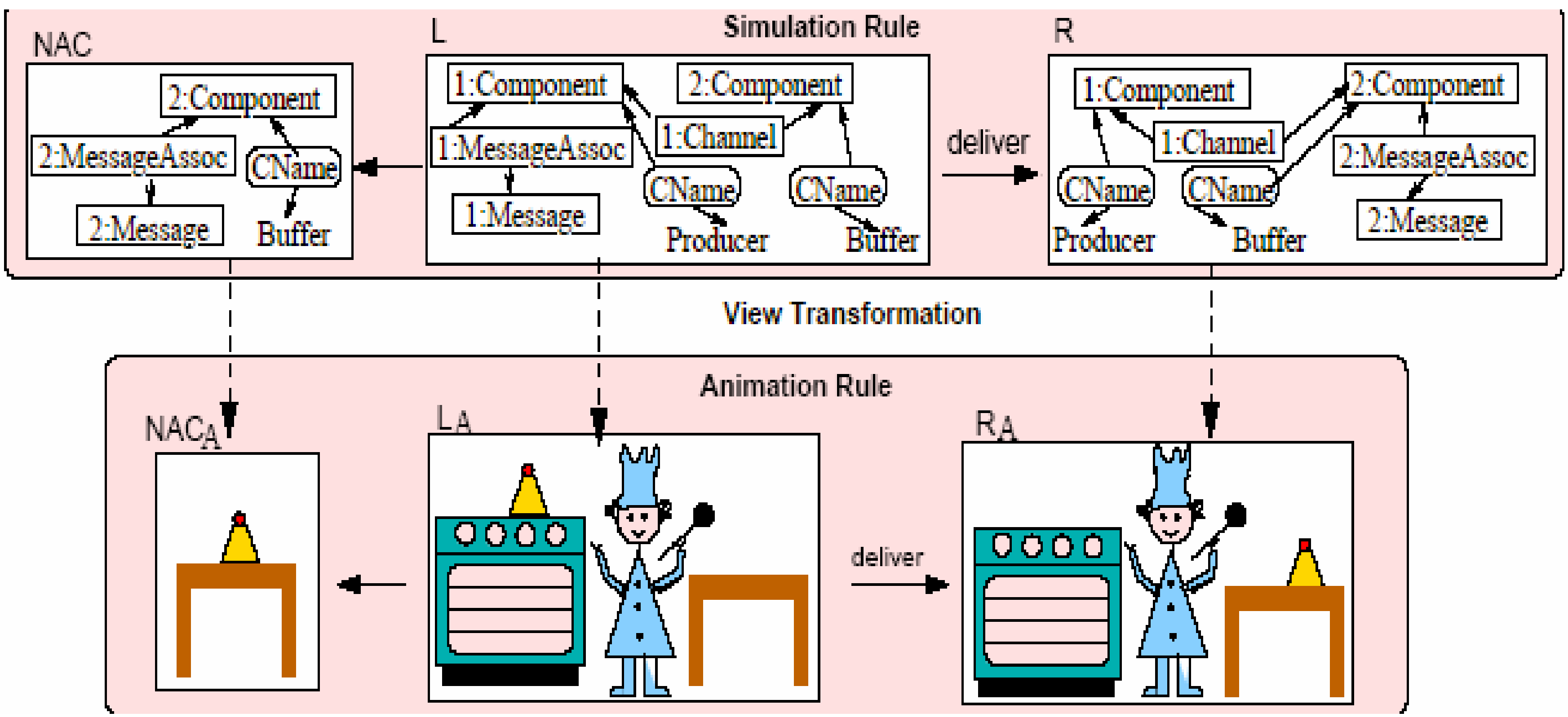
Transformation Grammar

- Full Consumer transformation



Animation Grammar

- Automatic transformation of Simulation rule to Animation rule



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Conclusion

- GenGED and AToM^3 are similar
  - Generate visual language environments
  - Allow simulation & animation
  - Rely on graph grammar transformations extensively
- The visual emphasis of GenGED, at least on the surface, makes it a far more accessible tool
  - No/less hand-coding
  - Systematic animation system

Conclusion

- Graphical Constraints
  - GenGED provides high level constraints
    - Example: rectangle1 sameBorderwidth rectangle2
  - These constraints are mapped to one or more low level constraints that PARCON understands

Conclusion

- Graphical Constraints
  - Graphical constraints are a key component in GenGED since they are used to:
    - Create composite graphical objects with multiple primitives
    - Anchor arrow points at object borders
    - Enforce insideness relations between objects

Sources

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