Comp 763 – Modeling and Simulation Based Design Presentation
April 30th, 2008

Presented by Riry Pheng

PROCEDURAL MODELING OF CITY GENERATION

Overview

- Introduction
- Meta-Model ~ Class Diagram
- Design Phases
  - Graph Transformation Rules
  - Simple Example
- Conclusion

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- Review
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Review

- **Problem**: Difficult to generate detailed and realistic content efficiently
- **Solution**: Use procedural techniques to create complex elements by iteratively applying simple rules

- **Project Goal**: Build on that idea, to use graph transformation to procedurally model city road network maps

Review: L-Systems Examples

>> *Thue-Morse System*

Input parameters:

V = {a,b}

w = a

P1 : a ⟶ ab

P2 : b ⟶ ba

Results:

w: a

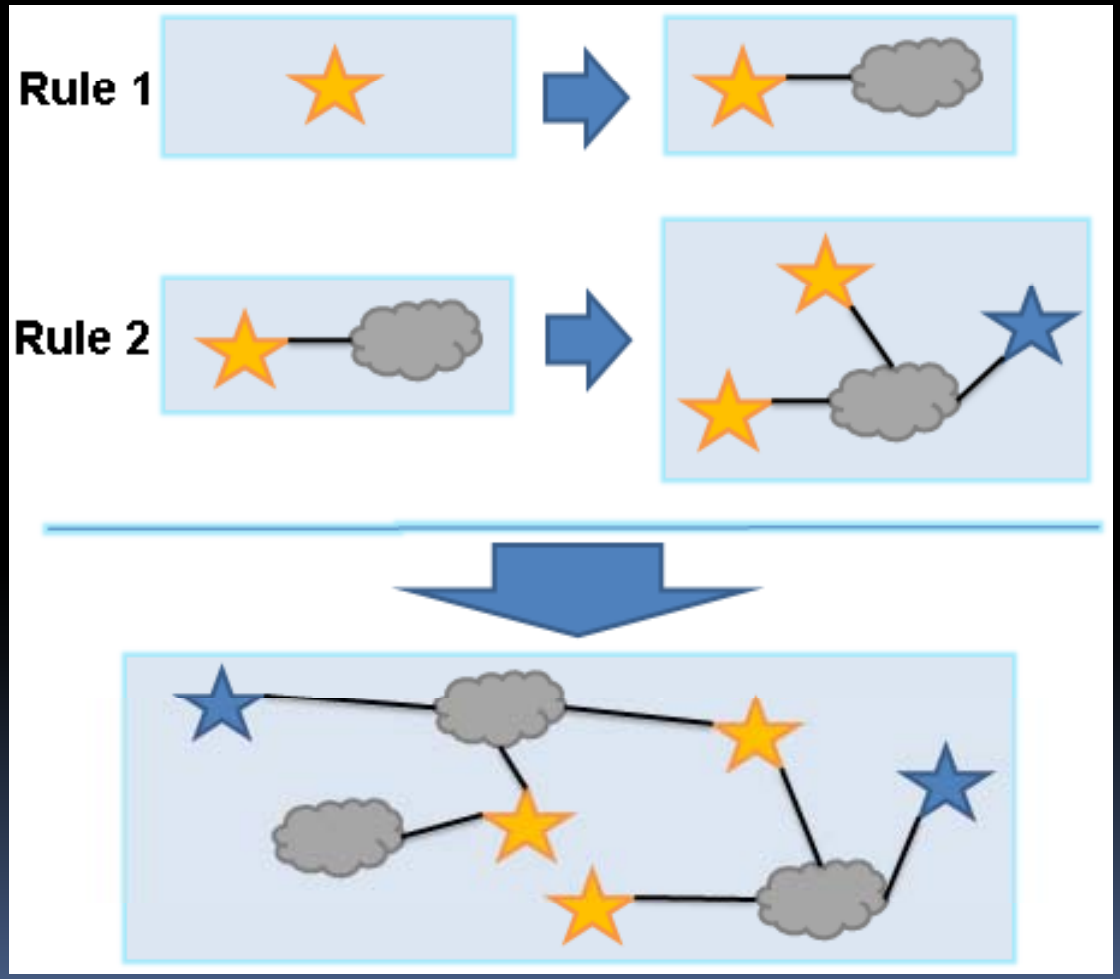
n = 1: ab

n = 2: abba

n = 3: abbabaab

n = 4: abbabaabbaababba

Similarly …



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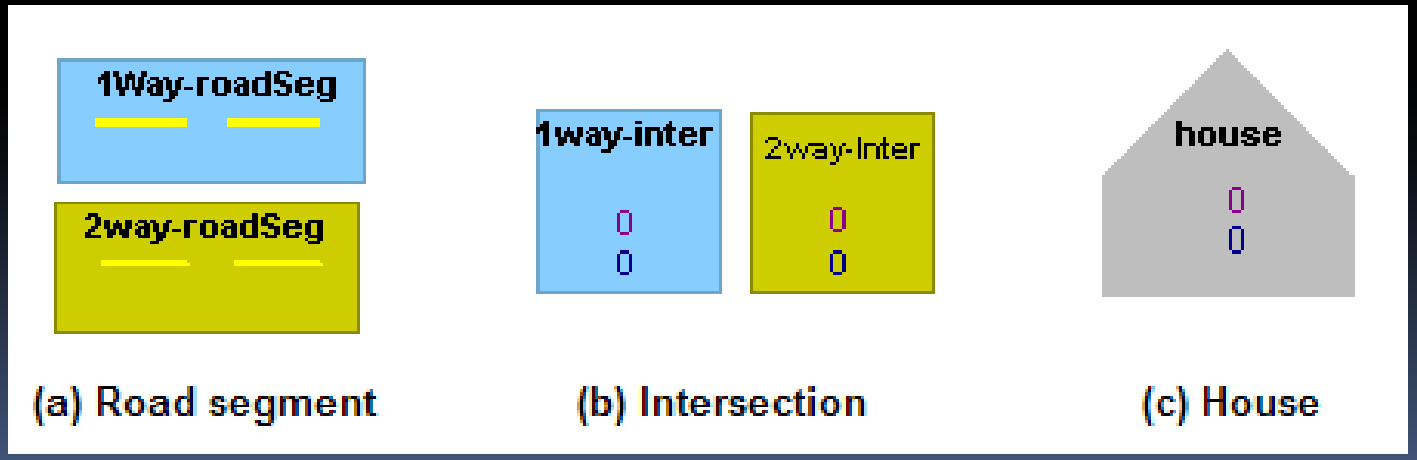
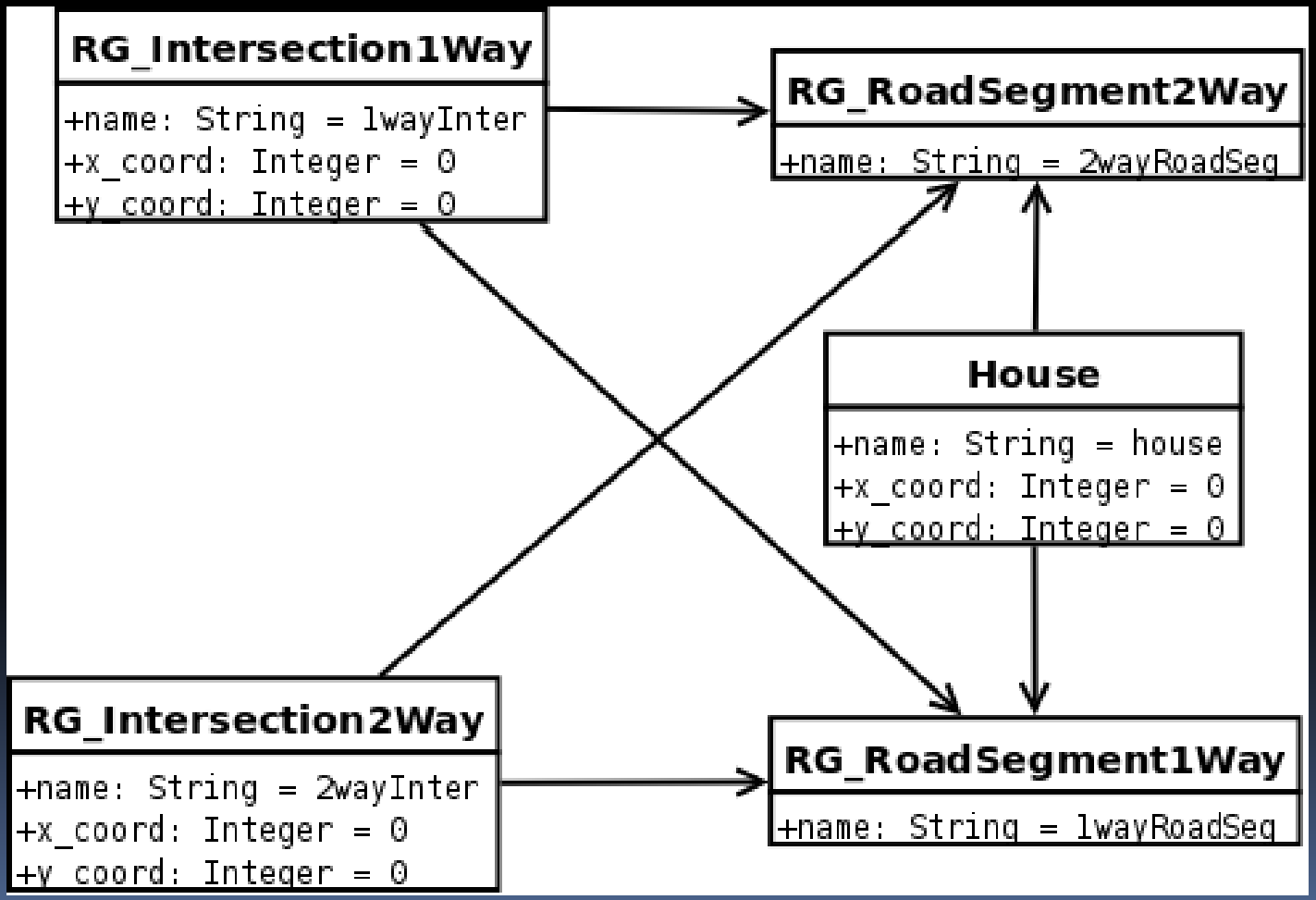
Meta-Model: Components

a) Road Segments: 1-way and 2-way
b) Intersections: 1-way and 2-way
c) Houses



Meta-Model: Class Diagram



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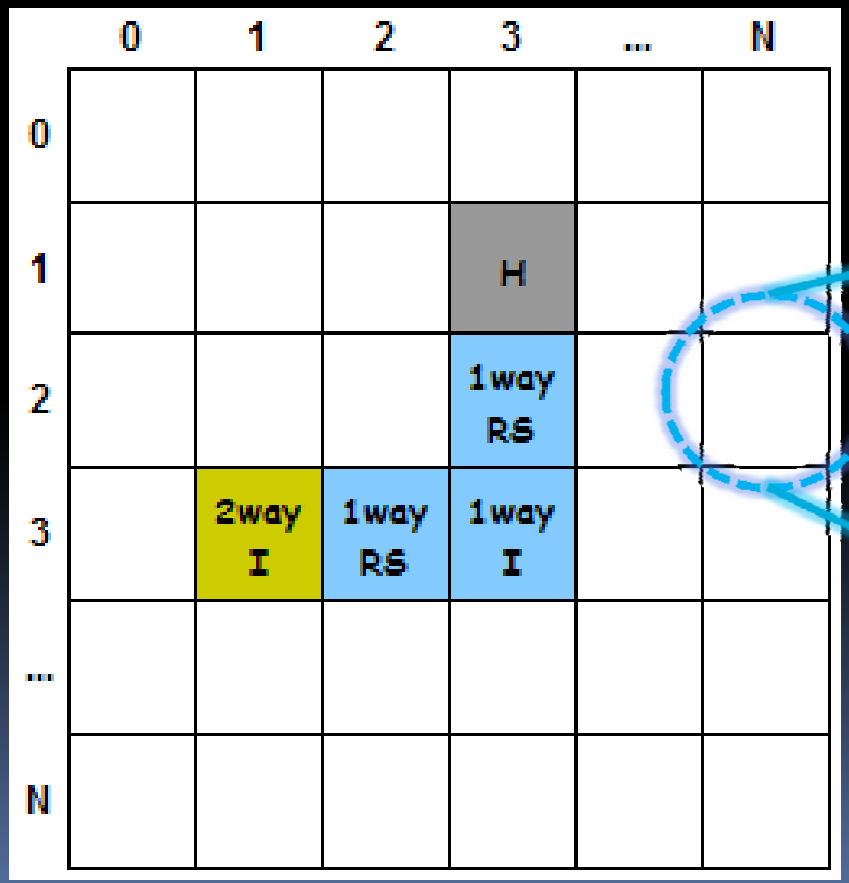
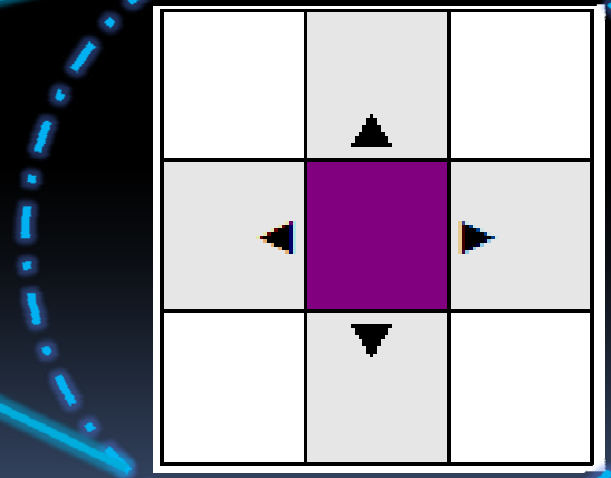
Design: Grid Pattern

Underlying Grid

Valid Element Connections





Design Phases & Graph Transformation Rules

1. Road Network Growth
2. Local Expansion
3. Local Population
4. Road Fragmentations

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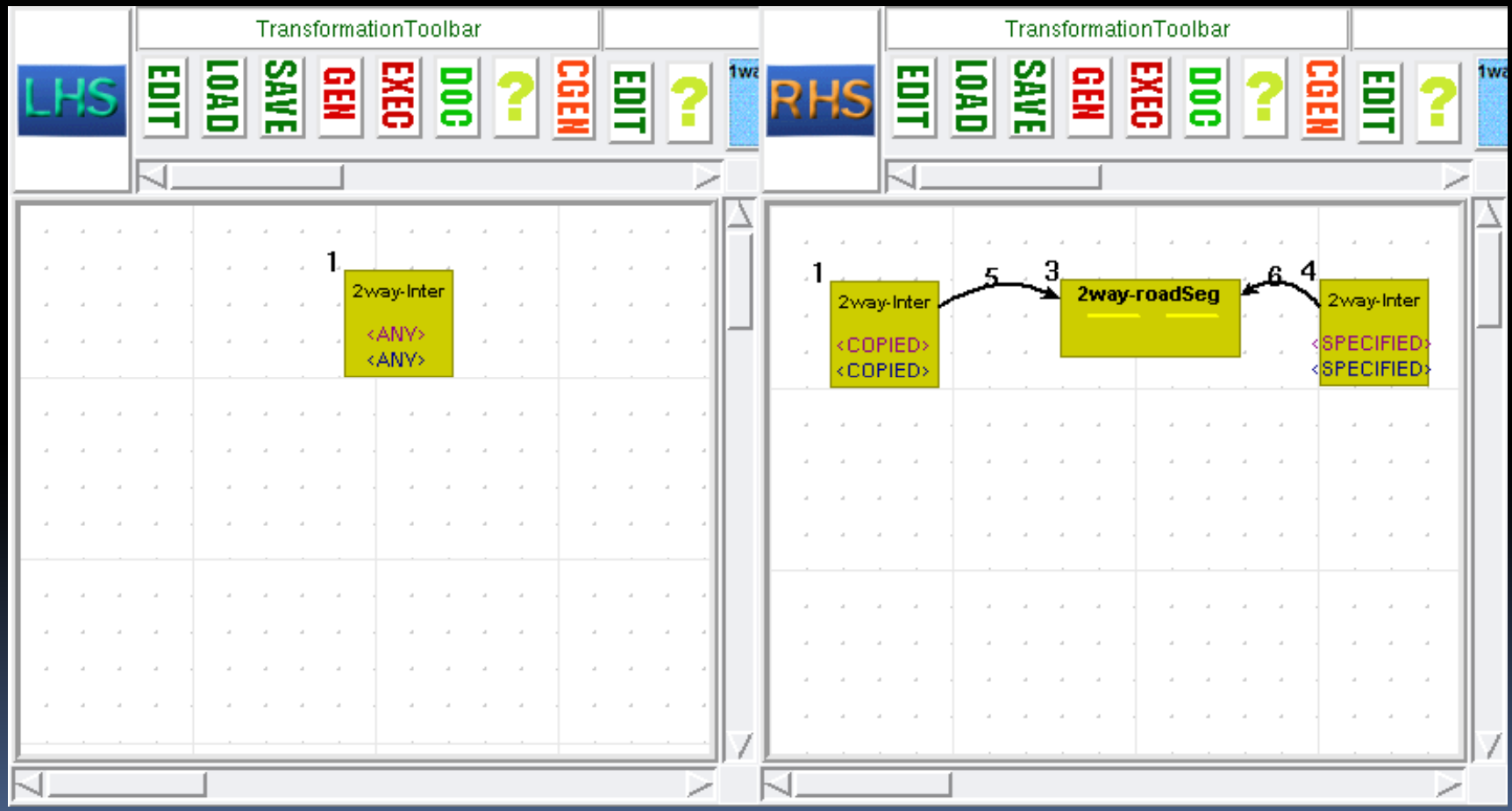
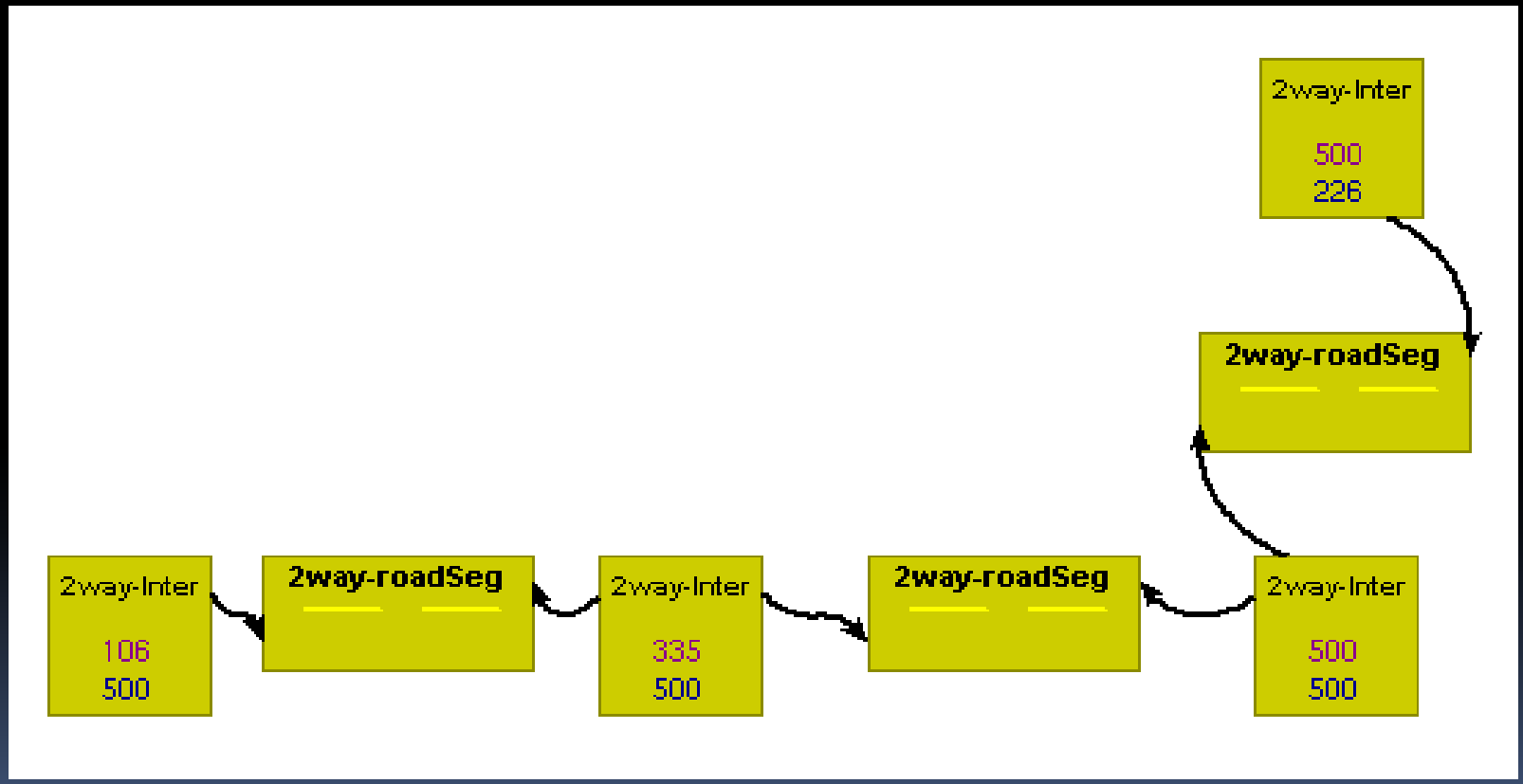
Phase I – Road Network Growth



Phase I – Result



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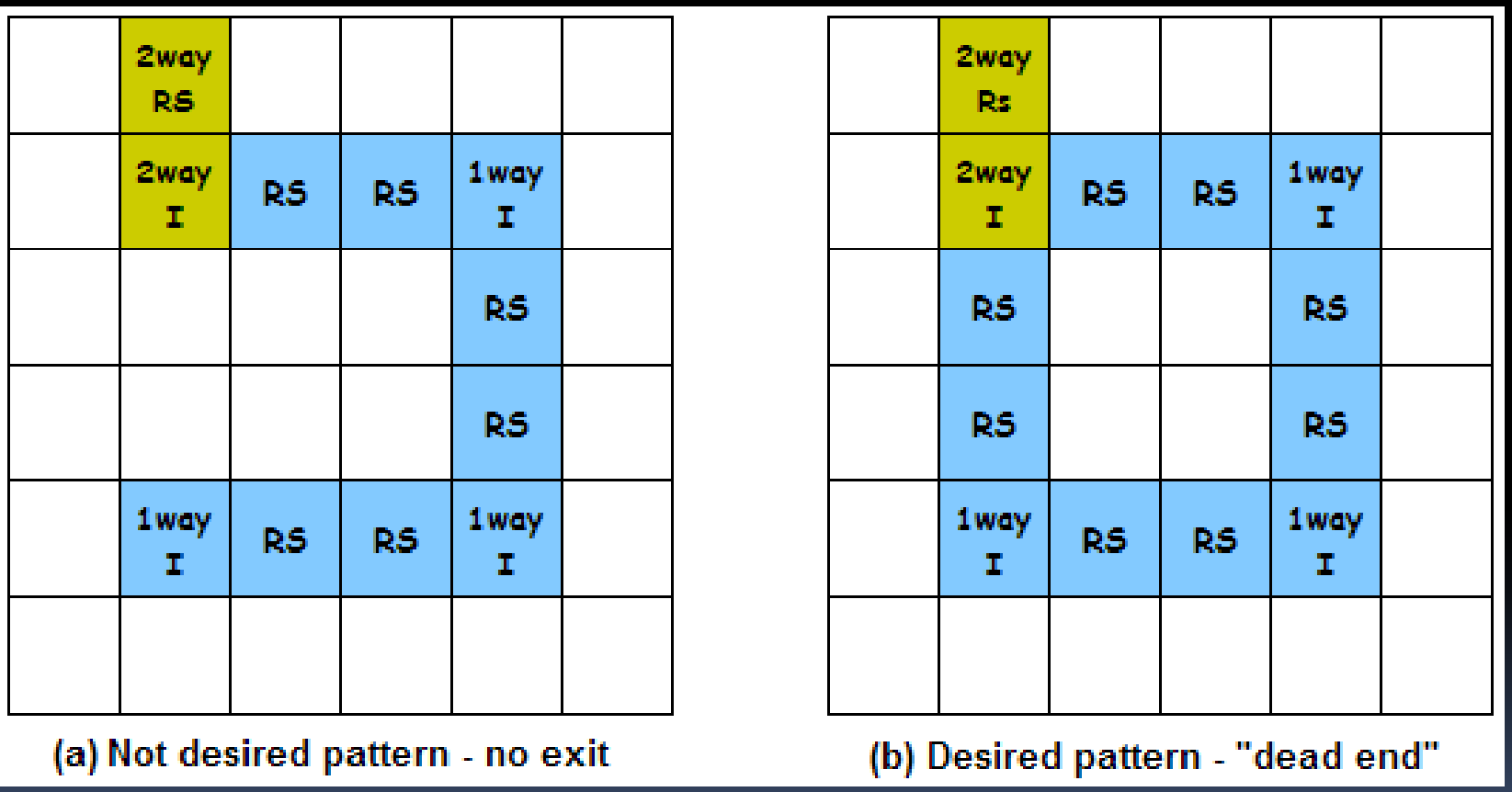
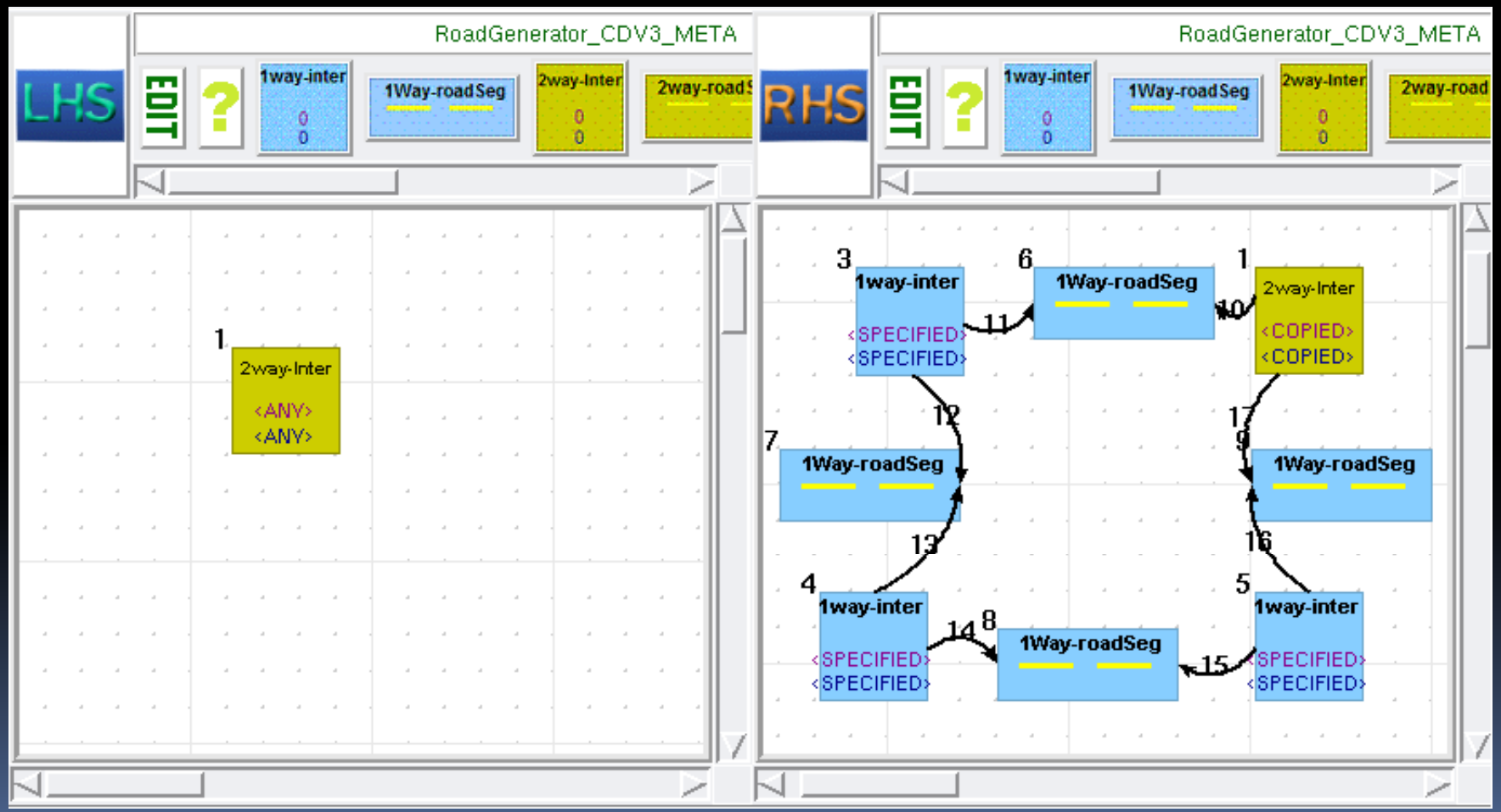
Phase II – “Dead End”



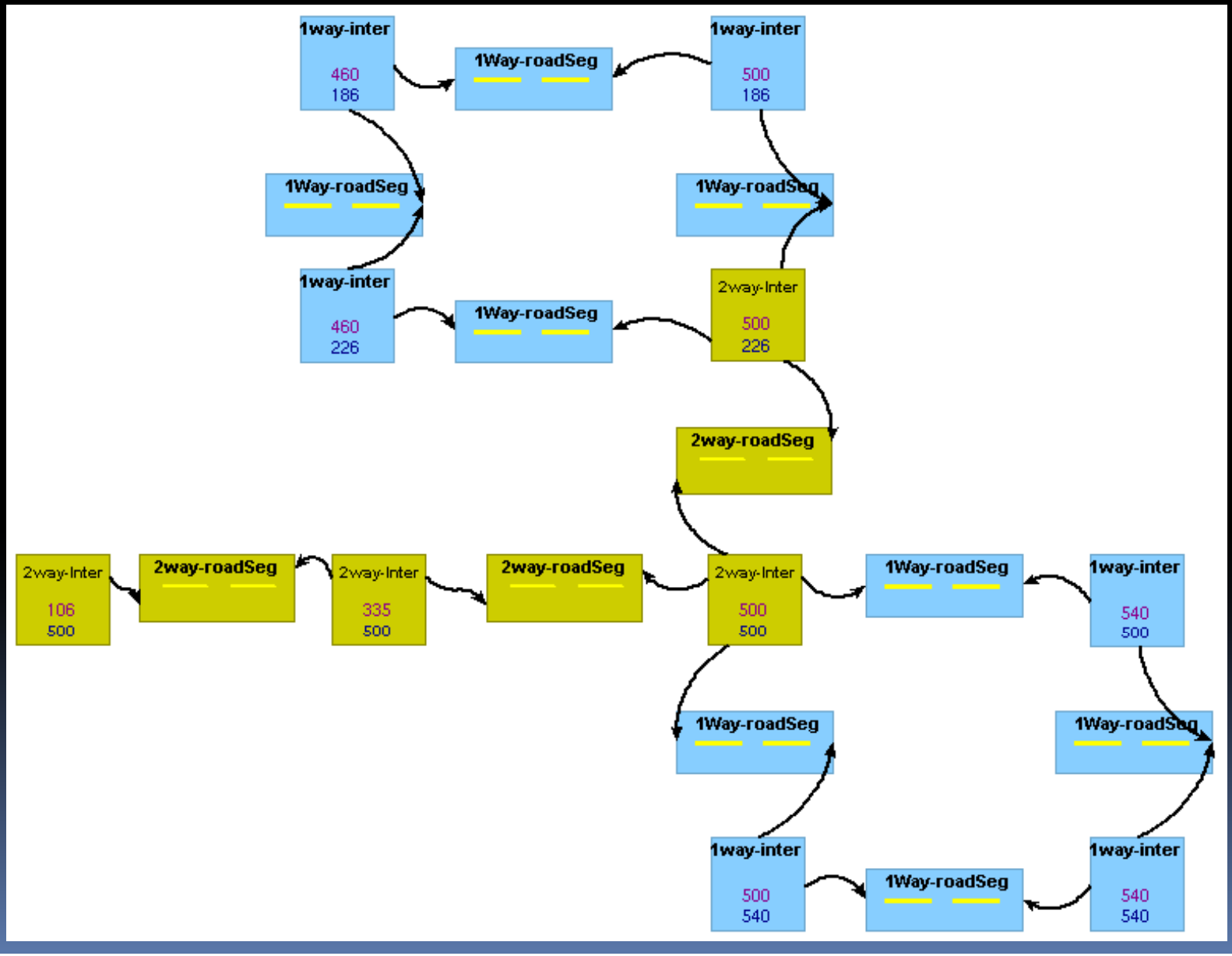
(a) Not desired pattern - no exit

(b) Desired pattern - "dead end"

Phase II – Local Expansion



Phase II - Result



Design Phases & Graph Transformation Rules

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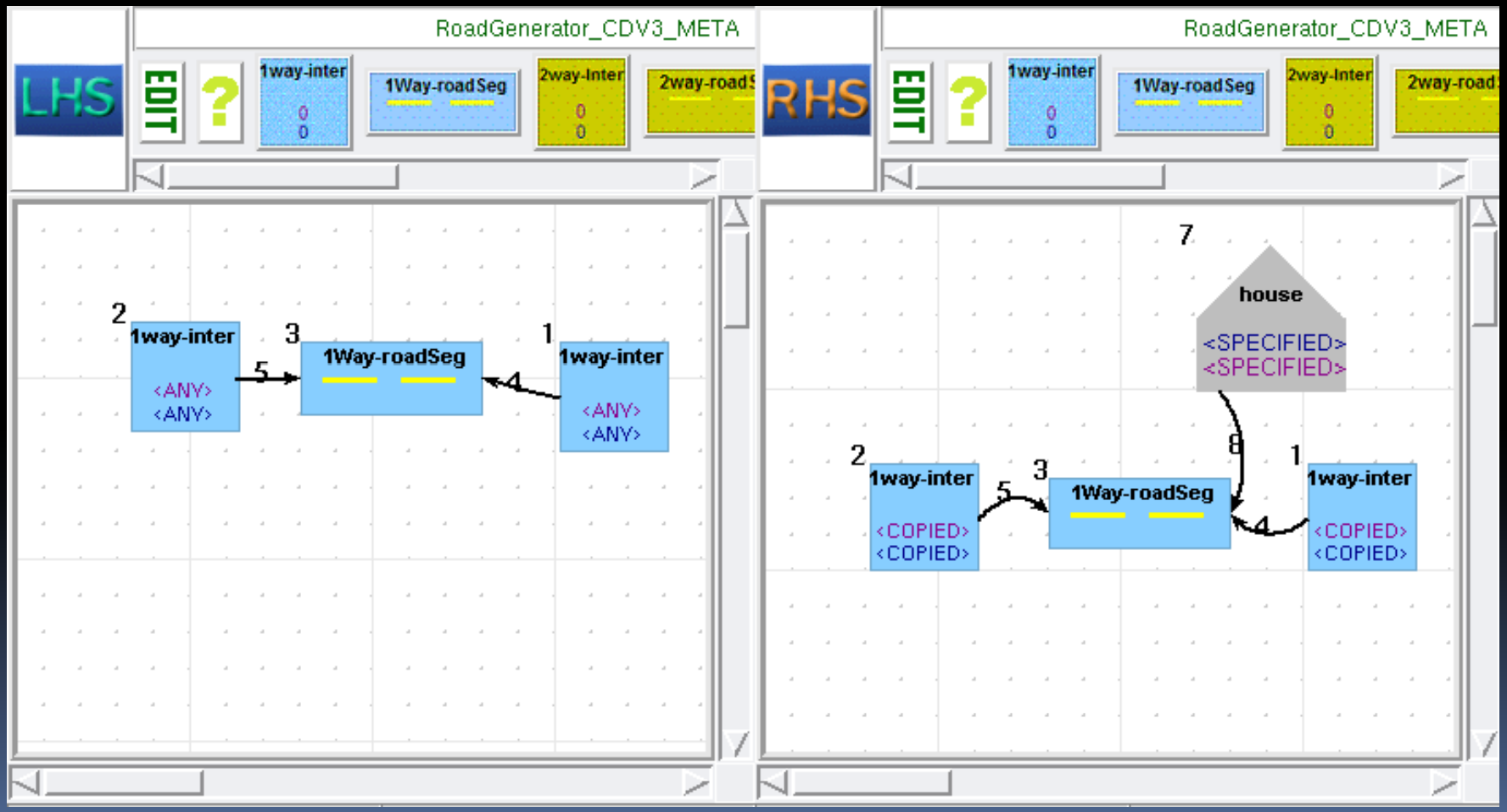
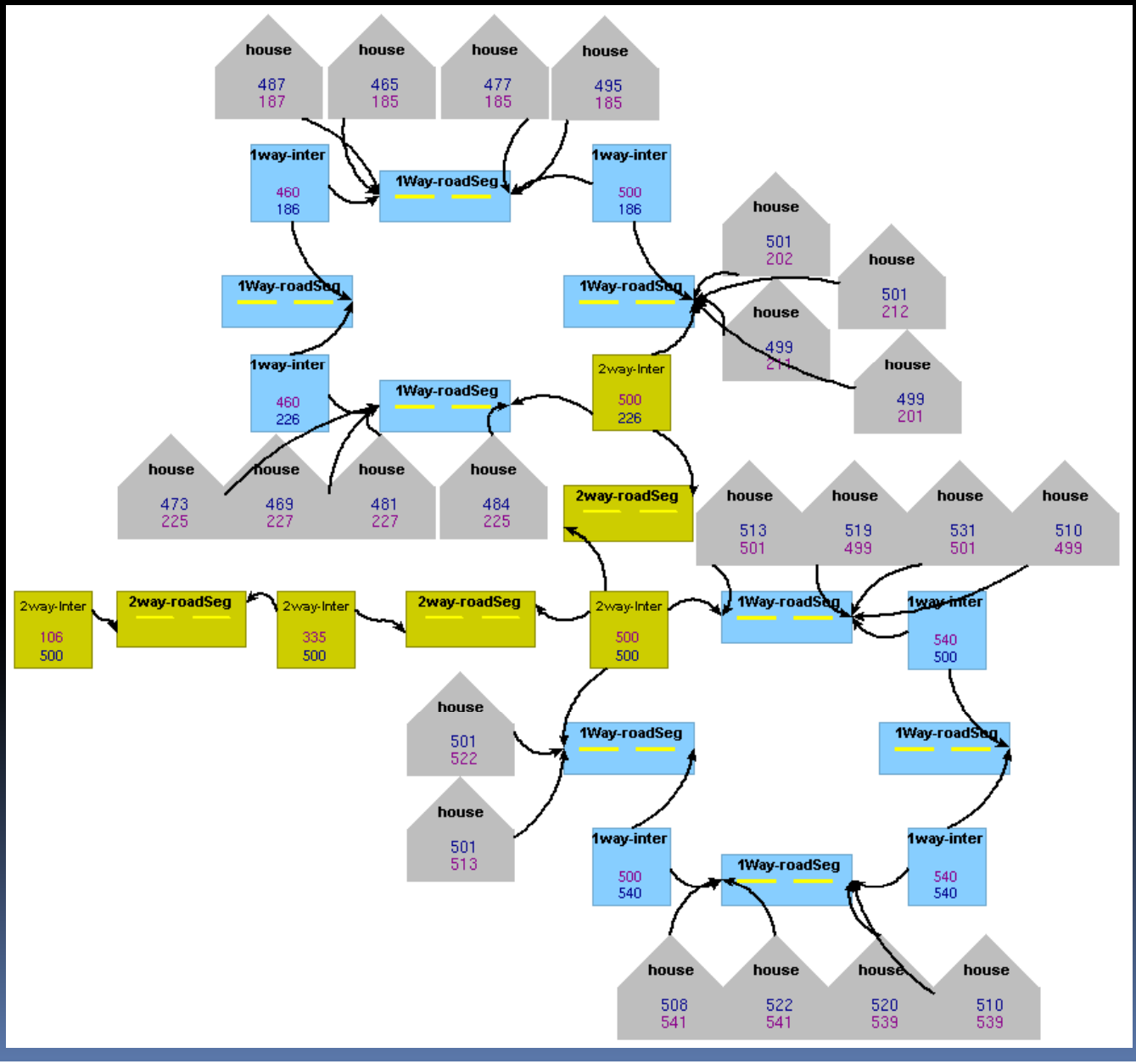
Phase III – Local Population



Phase III - Result



Design Phases & Graph Transformation Rules

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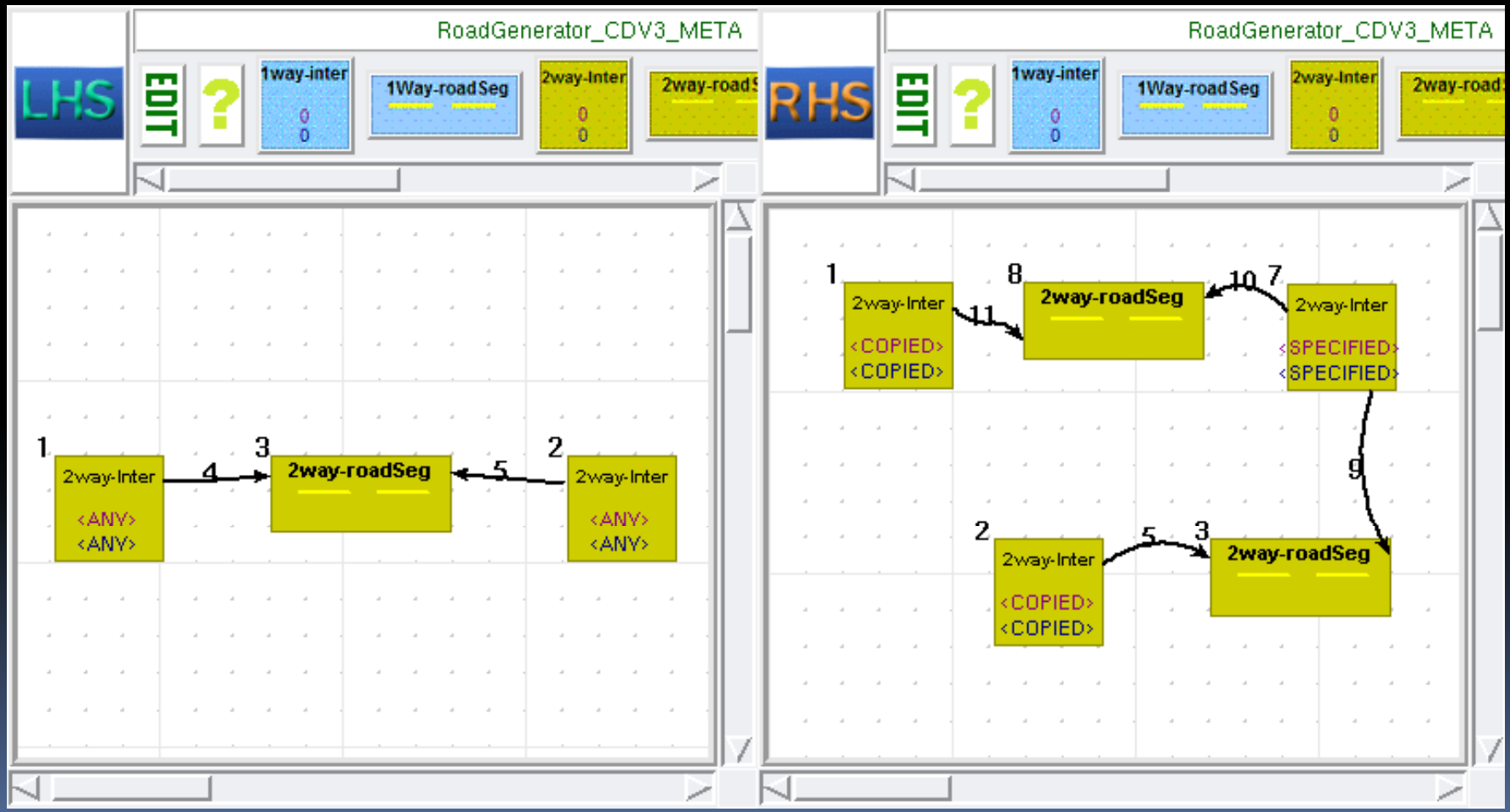
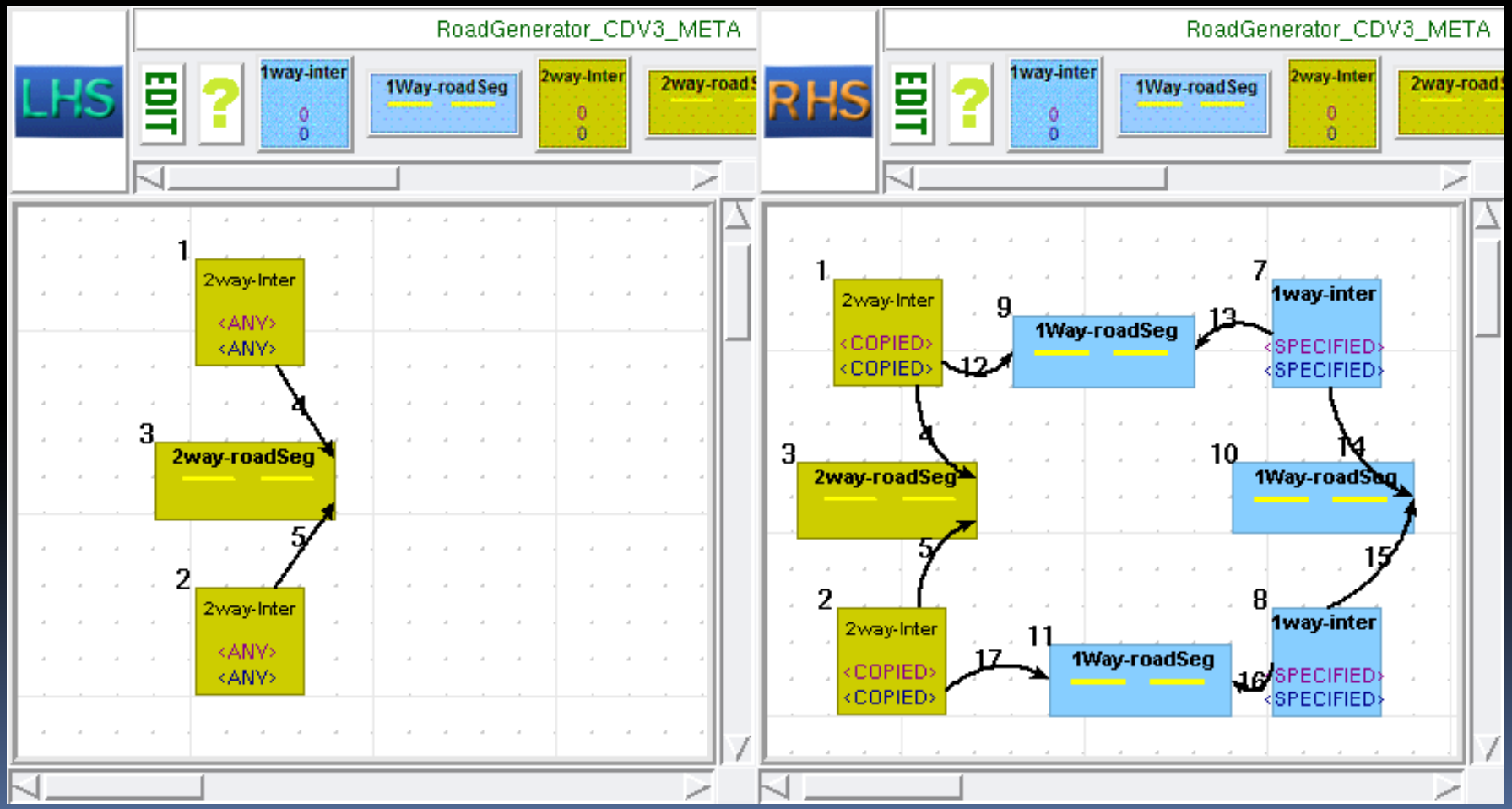
Phase IV – Road Fragmentation

(1) Vertical/Horizontal Split

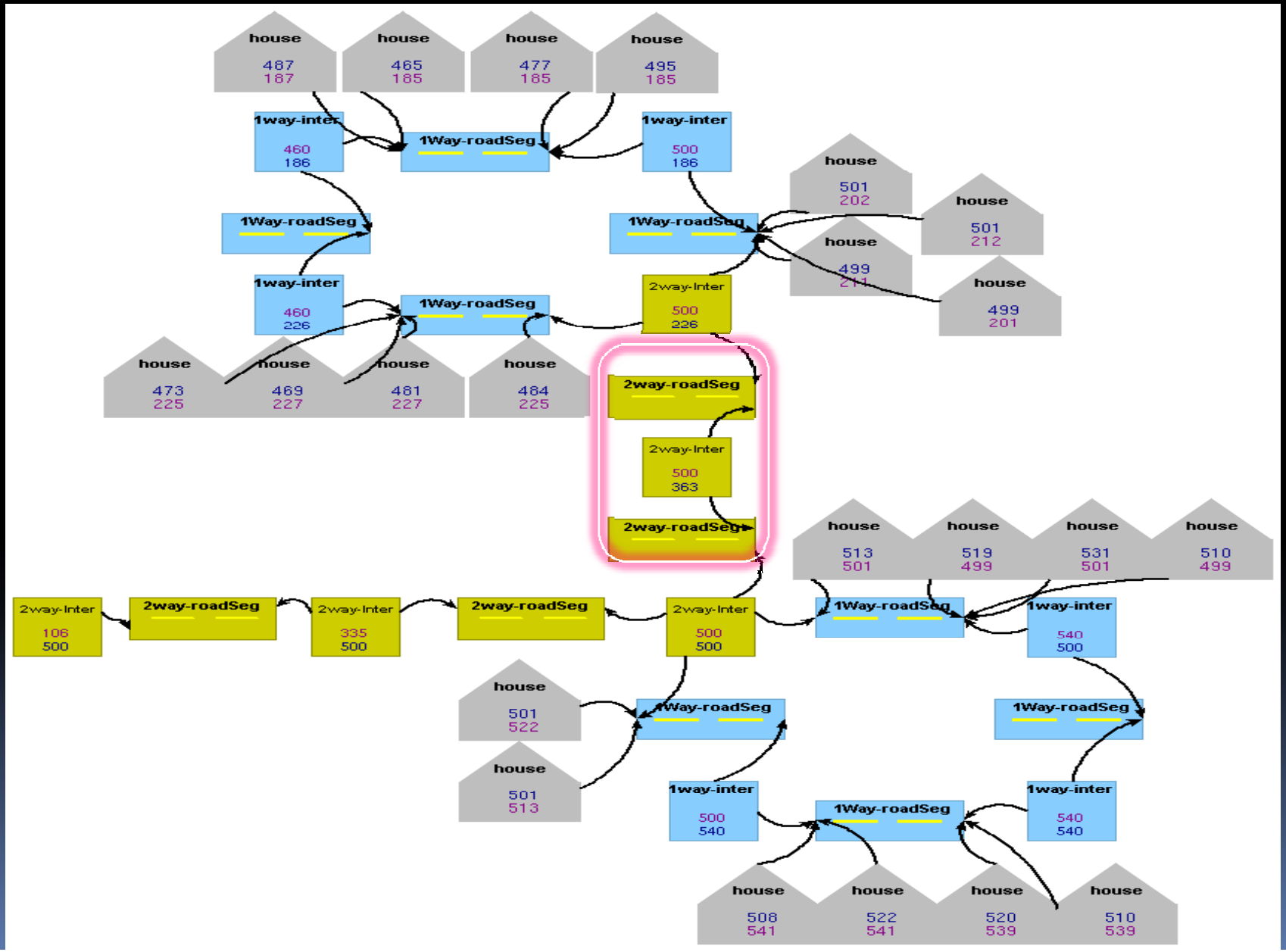


Phase IV – Road Fragmentation

(2) Split Horizontal + Add 1-way Cycle



Phase IV – Result



Design Phases & Graph Transformation Rules

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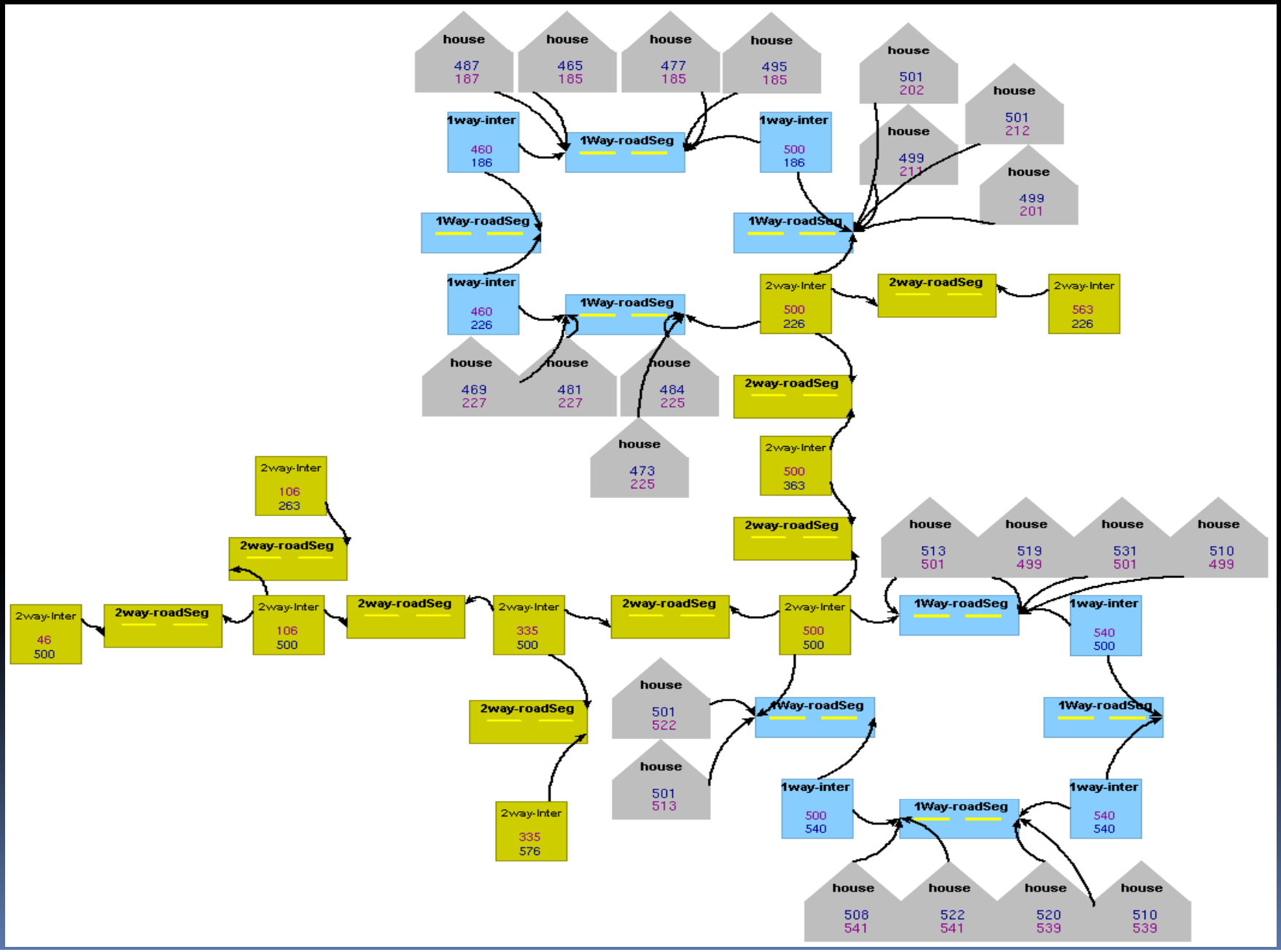
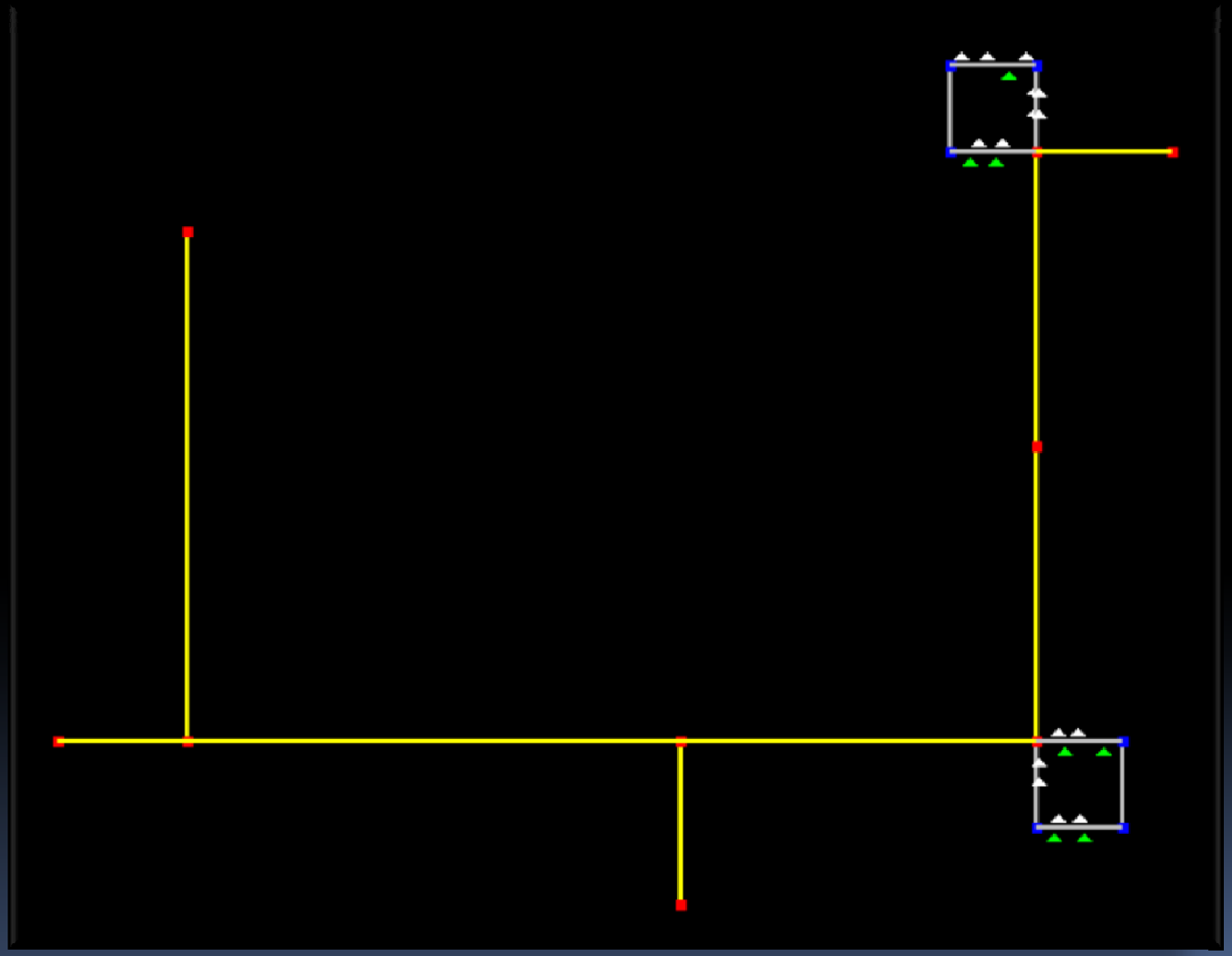
5. **>> ITERATE**

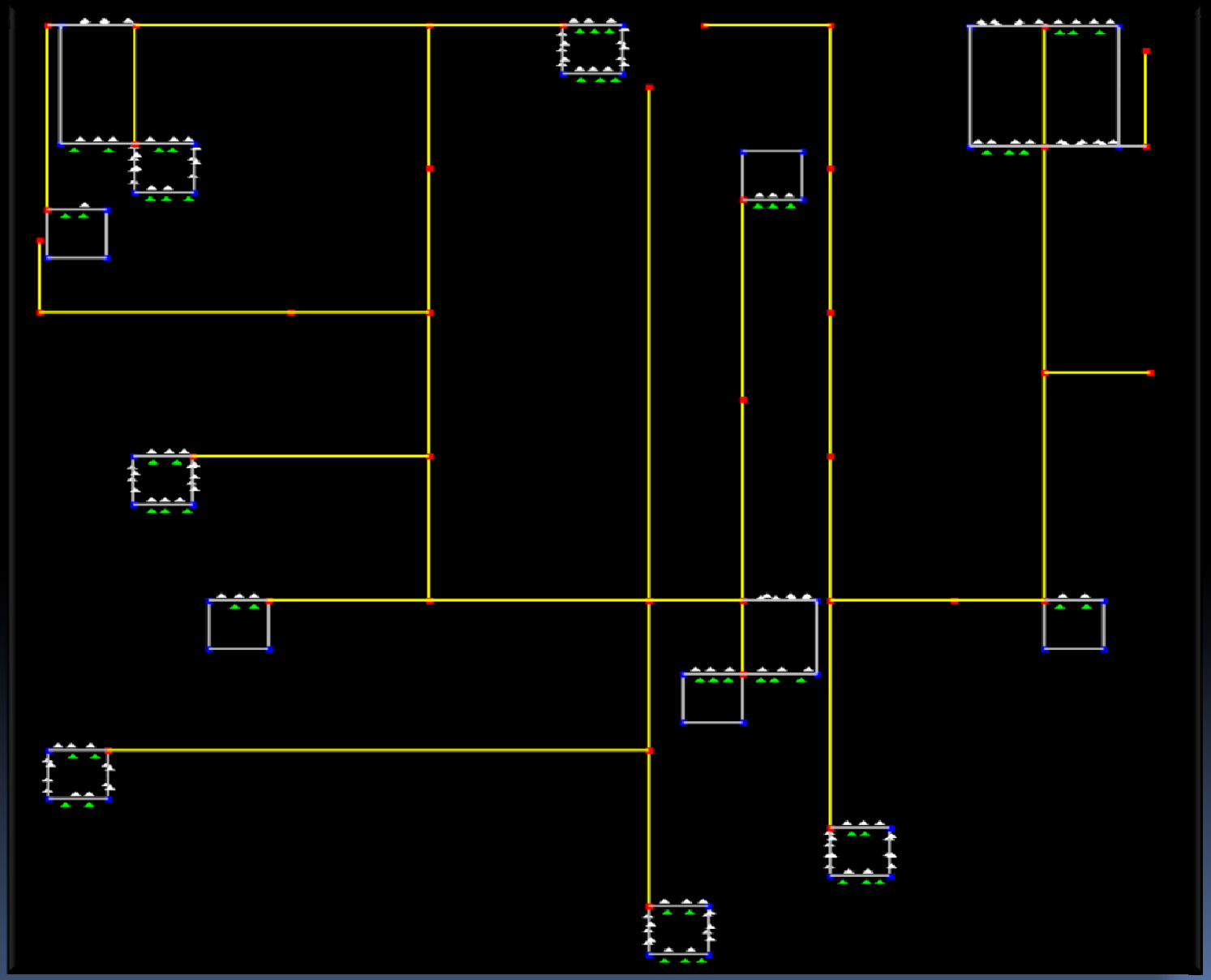
… Now Iterate …


house 487 187
house 465 185
house 477 185
house 495 185
1way-inter 460 186
1Way-roadSeg
1way-inter 500 186
house 501 202
house 501 212
house 499 211
house 499 201
1Way-roadSeg
1Way-roadSeg
1way-inter 460 226
1Way-roadSeg
2way-Inter 500 226
2way-roadSeg
2way-Inter 563 226
house 469 227
house 481 227
house 484 225
house 473 225
2way-roadSeg
2way-Inter 500 363
2way-Inter 106 263
2way-roadSeg
2way-roadSeg
house 513 501
house 519 499
house 531 501
house 510 499
2way-Inter 46 500
2way-roadSeg
2way-Inter 106 500
2way-roadSeg
2way-Inter 335 500
2way-roadSeg
2way-Inter 500 500
1Way-roadSeg
1way-inter 540 500
2way-roadSeg
house 501 522
1Way-roadSeg
1Way-roadSeg
house 501 513
1way-inter 500 540
1Way-roadSeg
1way-inter 540 540
2way-Inter 335 576
house 508 541
house 522 541
house 520 539
house 510 539

Generated Map



More Complex Map



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  - Graph grammars
  - Graph transformations
- Generated maps not very realistic
  - More input data needed

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Questions?!

Thank you