Project Group "DynaSearch"
Intermediate Report: Results and Plans

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Introduction

Project Group

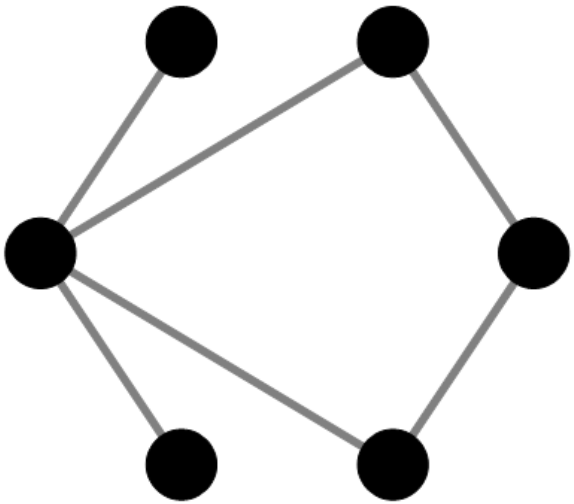
Our Work in the CRC 901

1. Big software from small pieces – Search for pieces that
   - Maximize some objective function or
   - Fulfill certain properties
2. Communicating entities with varying interests
   - Adapt network to these interests

Network Creation Games

Scenario

Scenario



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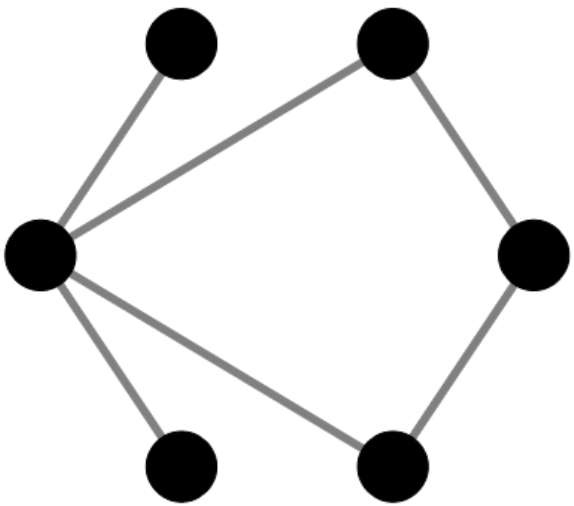

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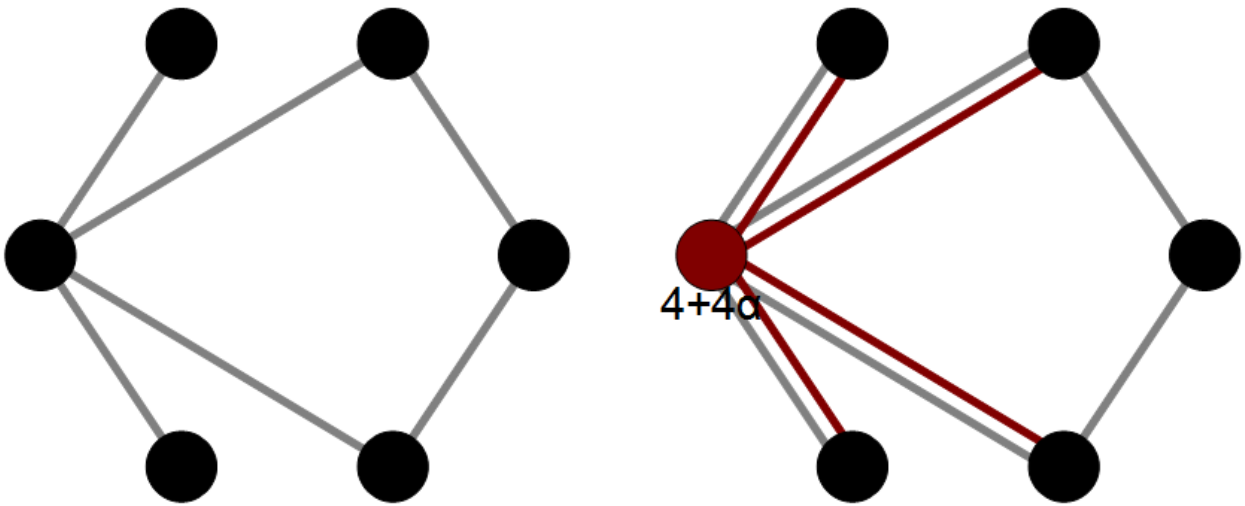

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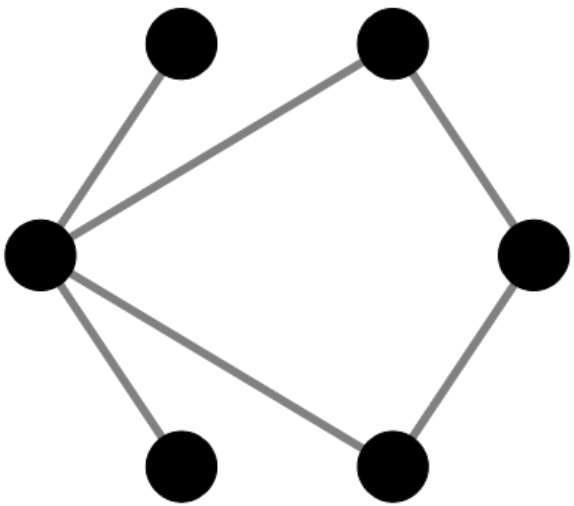

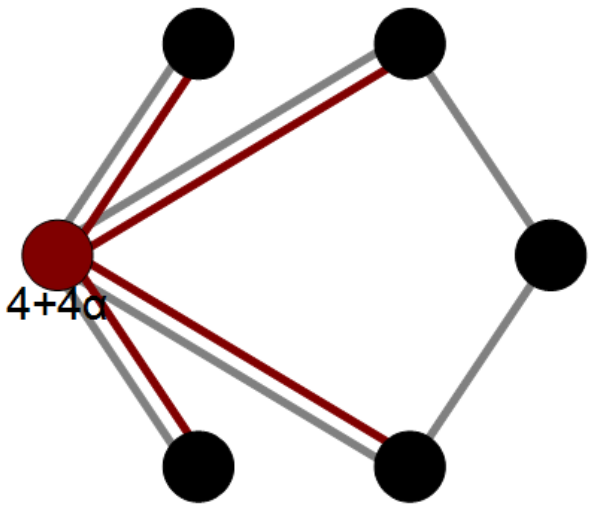

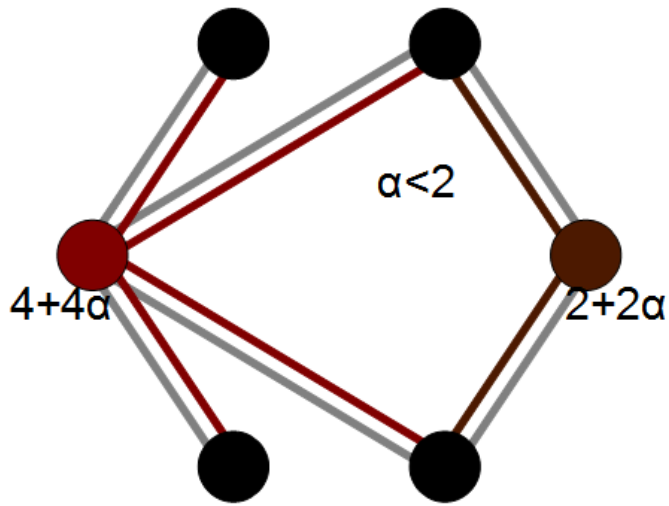

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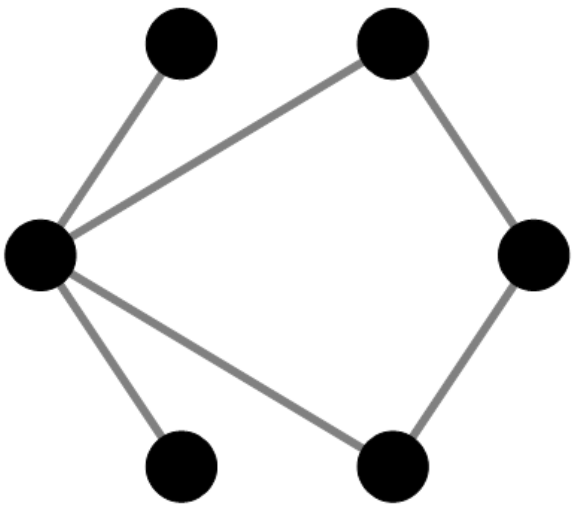

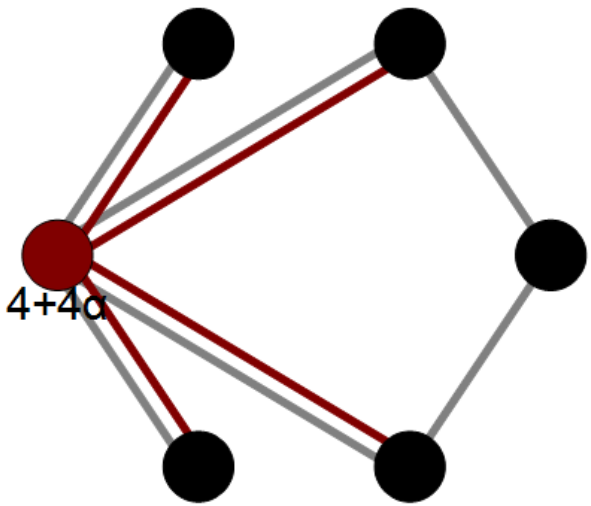

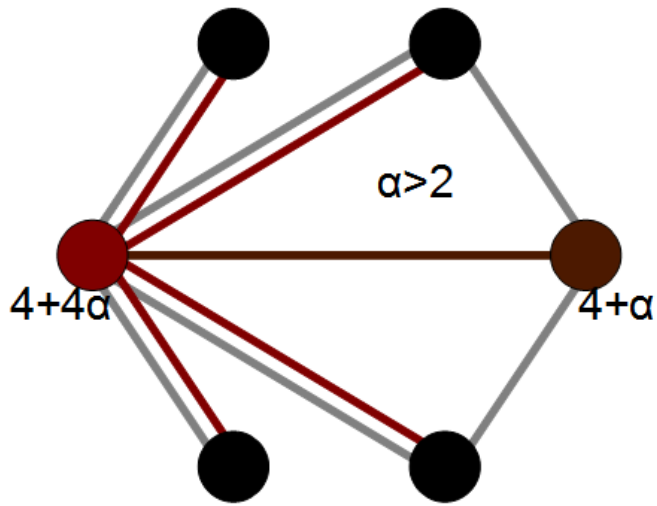

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Scenario
Research Focus

Definition (Nash equlibrium)

A state in which no node can improve its costs by choosing other neighbors.

- Focus of past work:
  - What do Nash equilibria look like?
  - How good are Nash equilibria compared to a global optimum?
- Our main focus: Under which circumstances are Nash equilibria reached?

Current Progress

Start Problem

Current Progress
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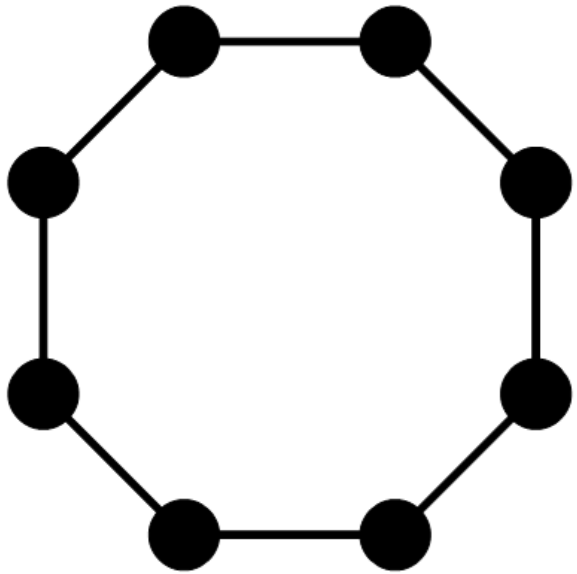

- Nodes on static ring topology

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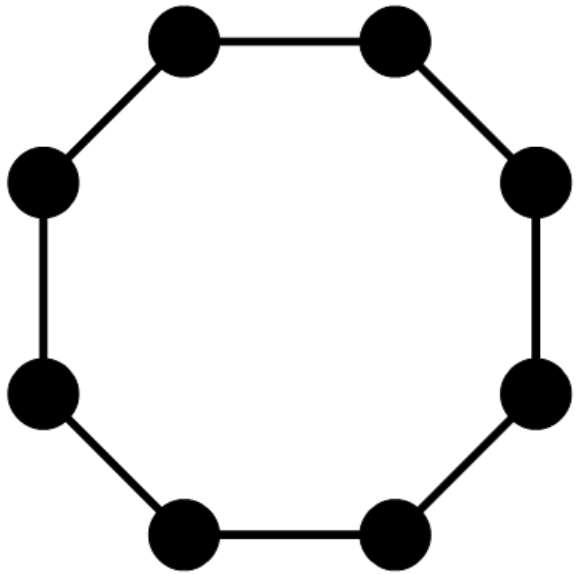

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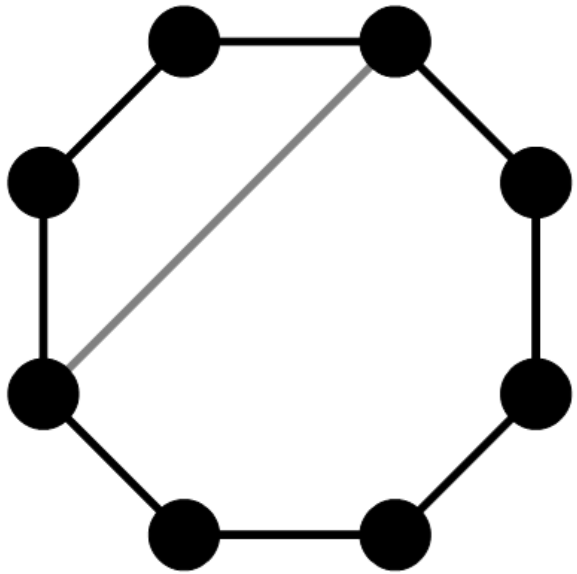

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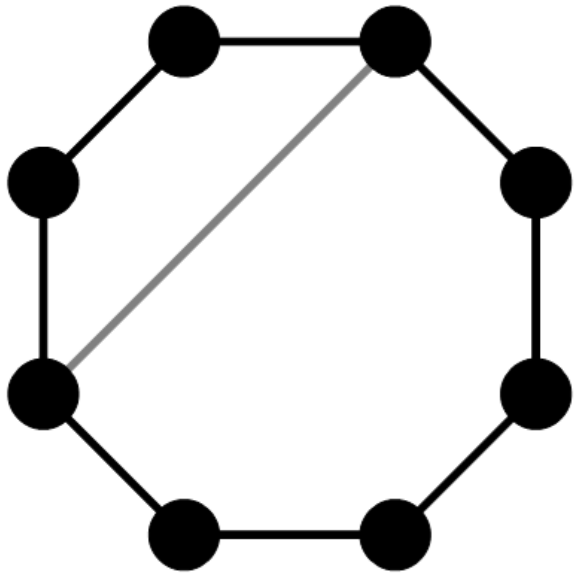

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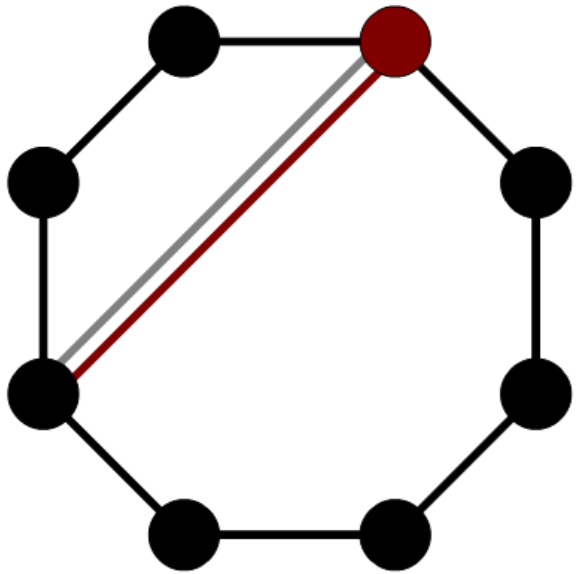

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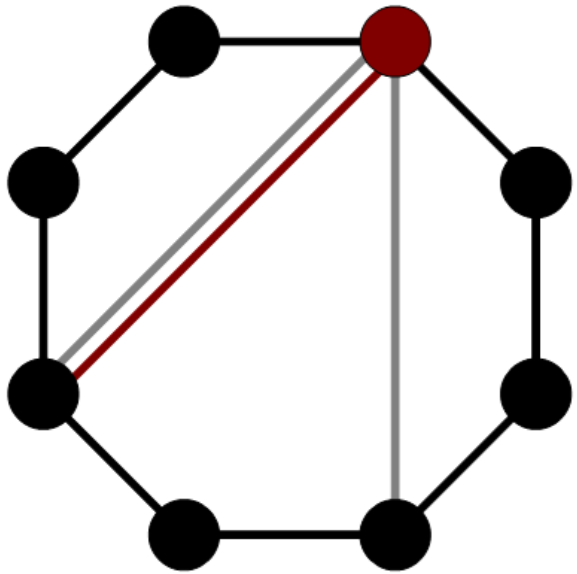

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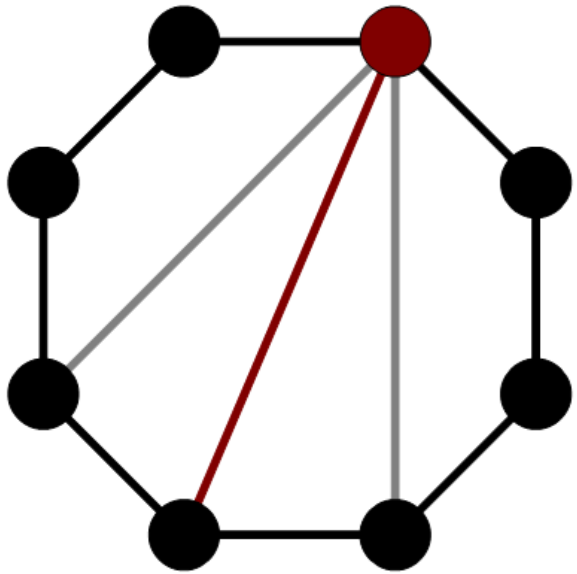

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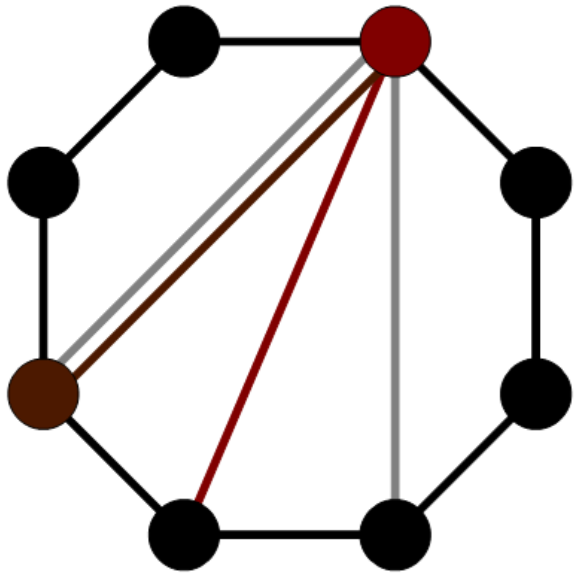

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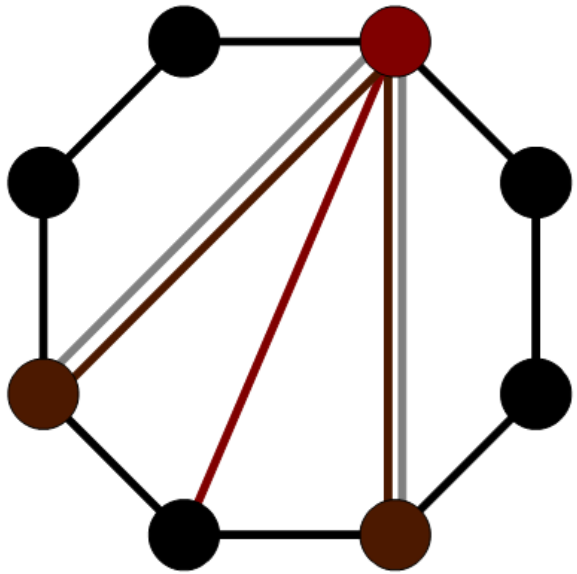

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Current Progress
Simulator

PeerfactSim.KOM

A simulation framework for large scale peer-to-peer systems.

Extended by:

- Network creation games
- Content adressable network (CAN)

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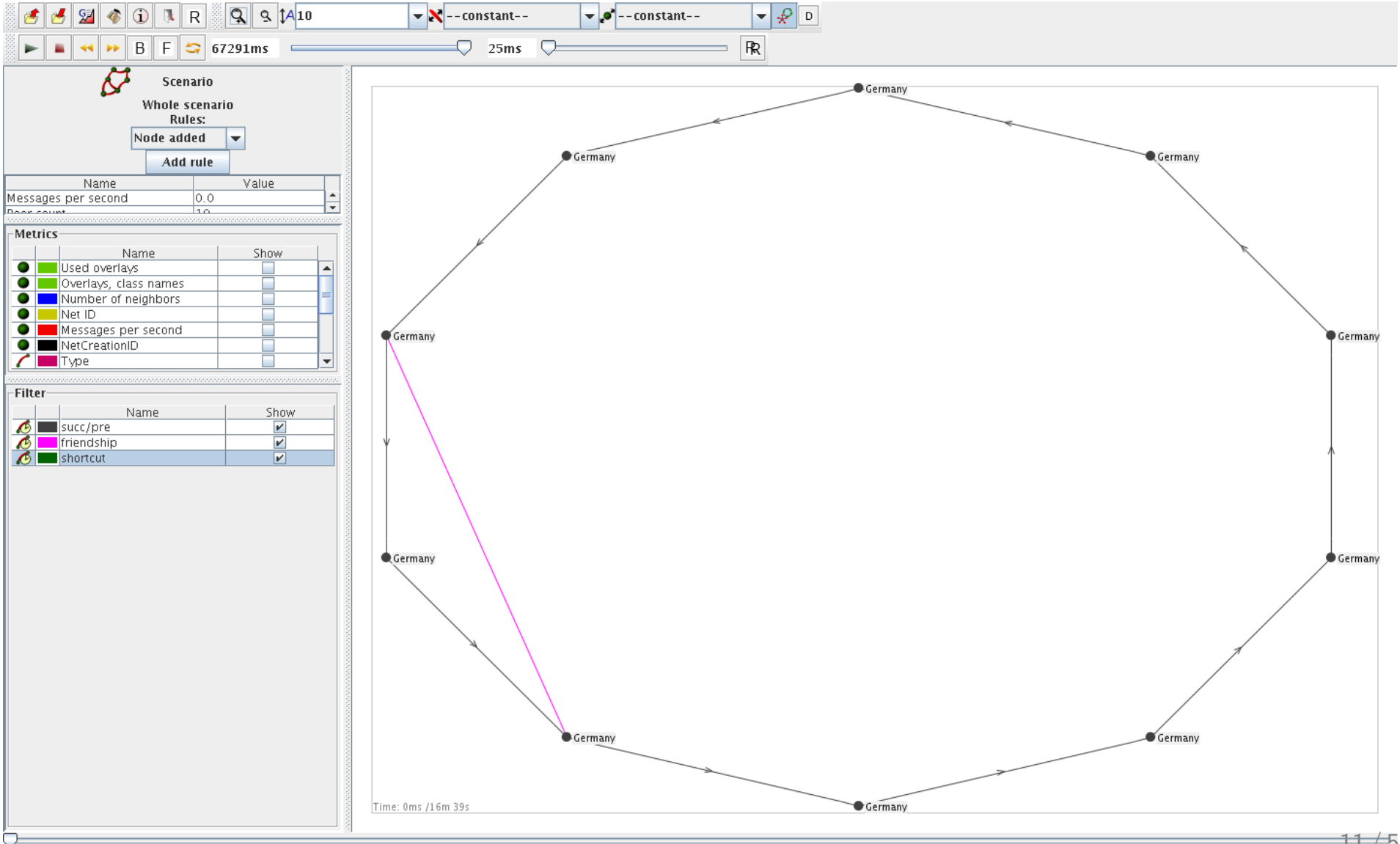
Simulator



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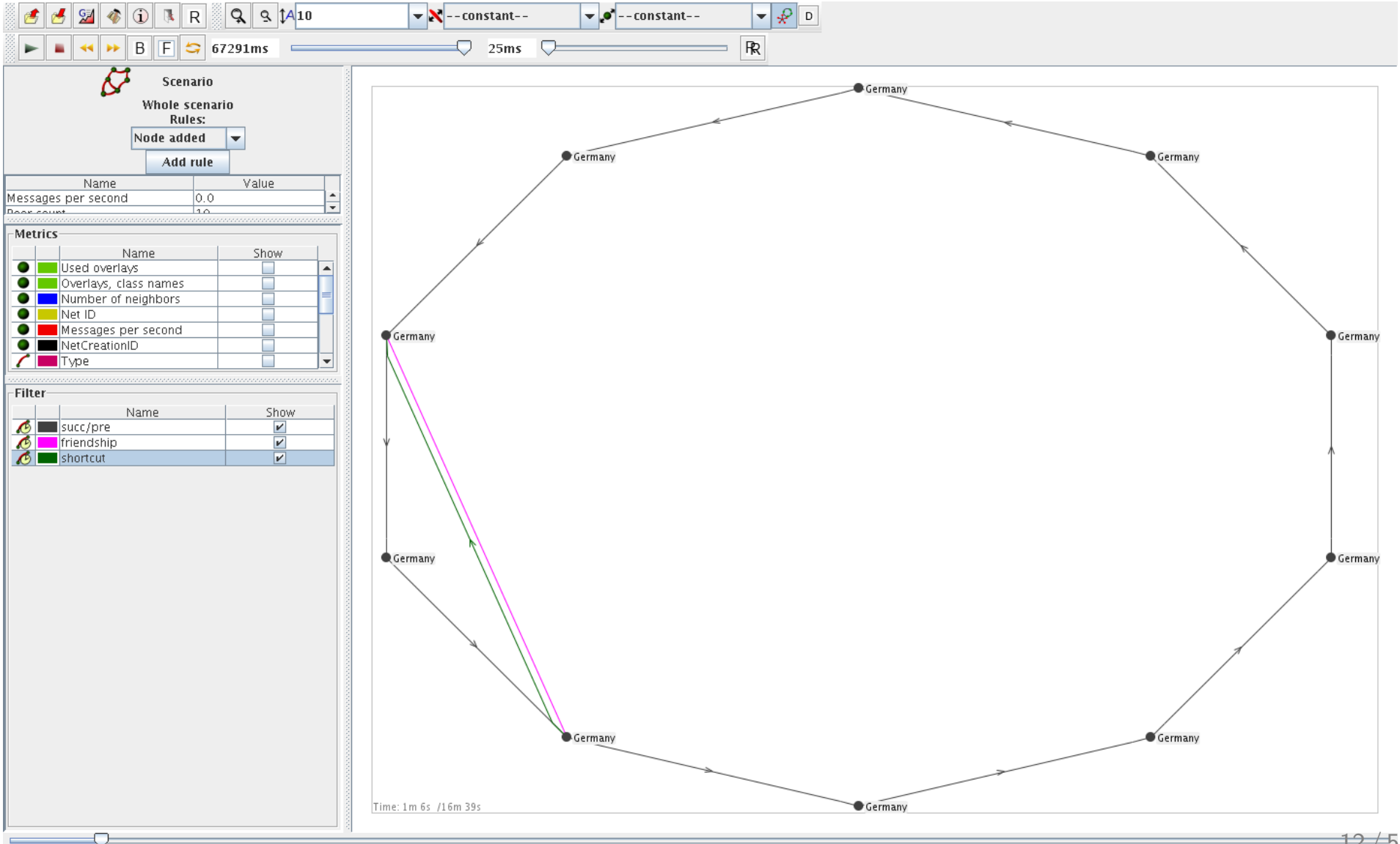

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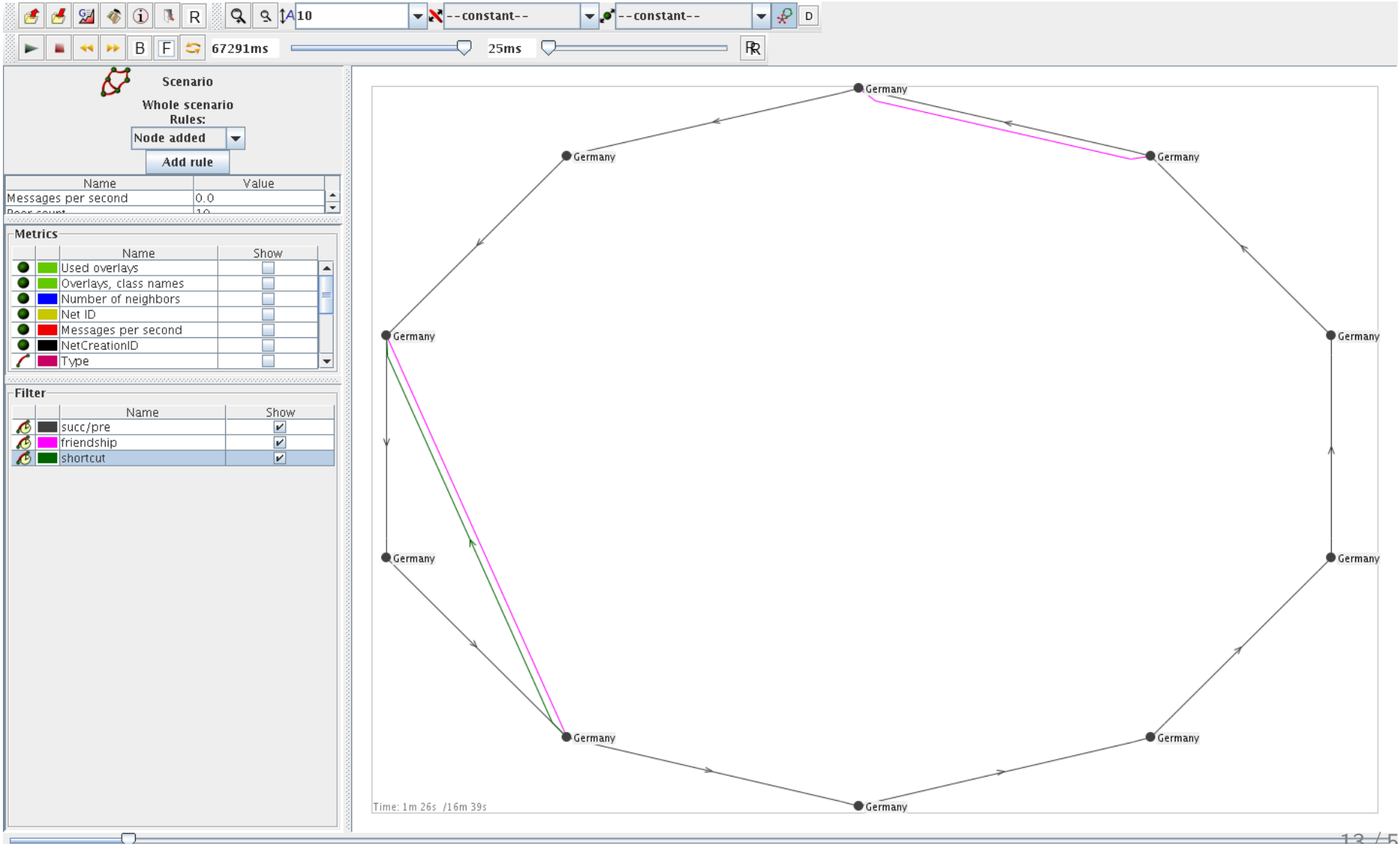

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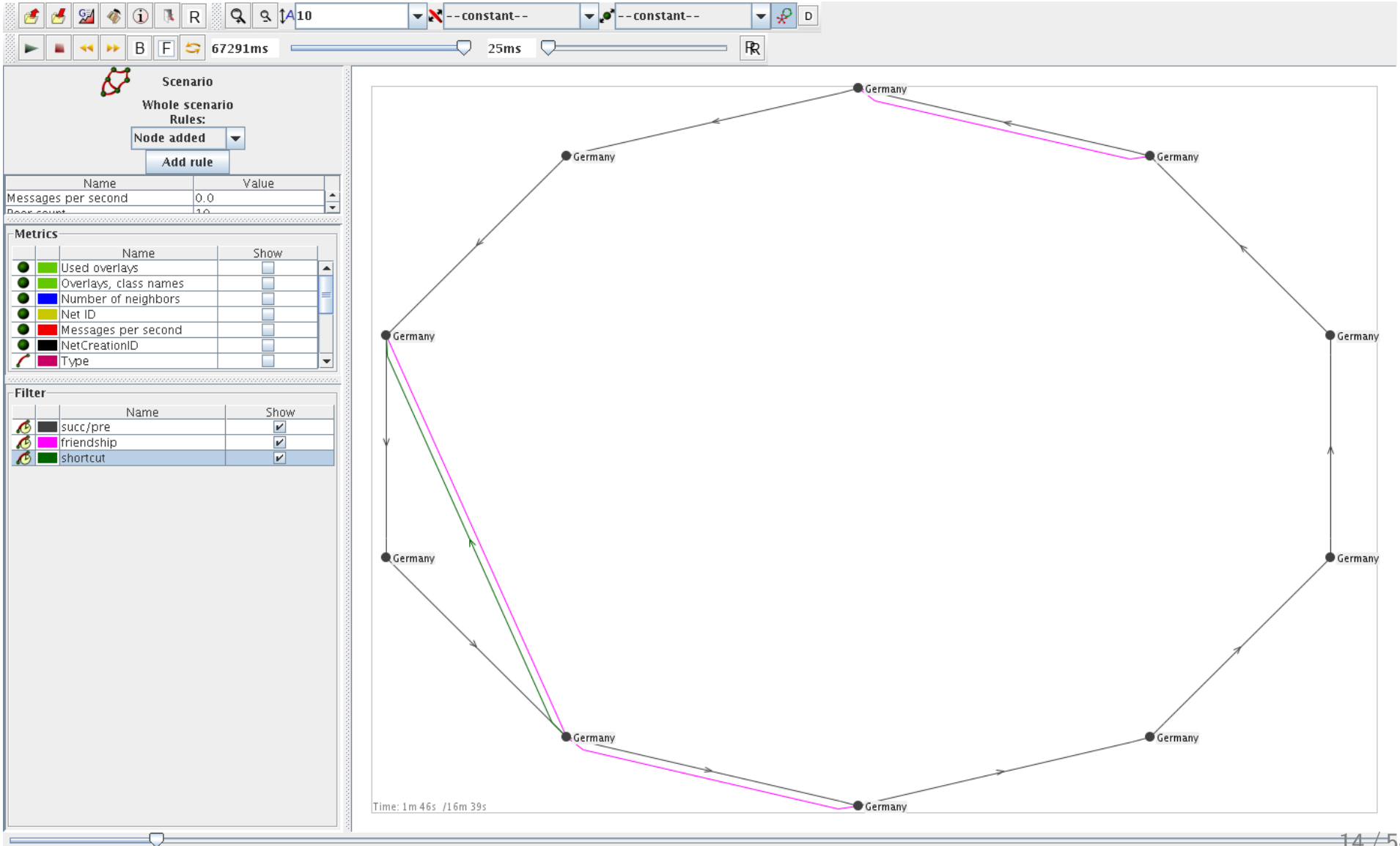

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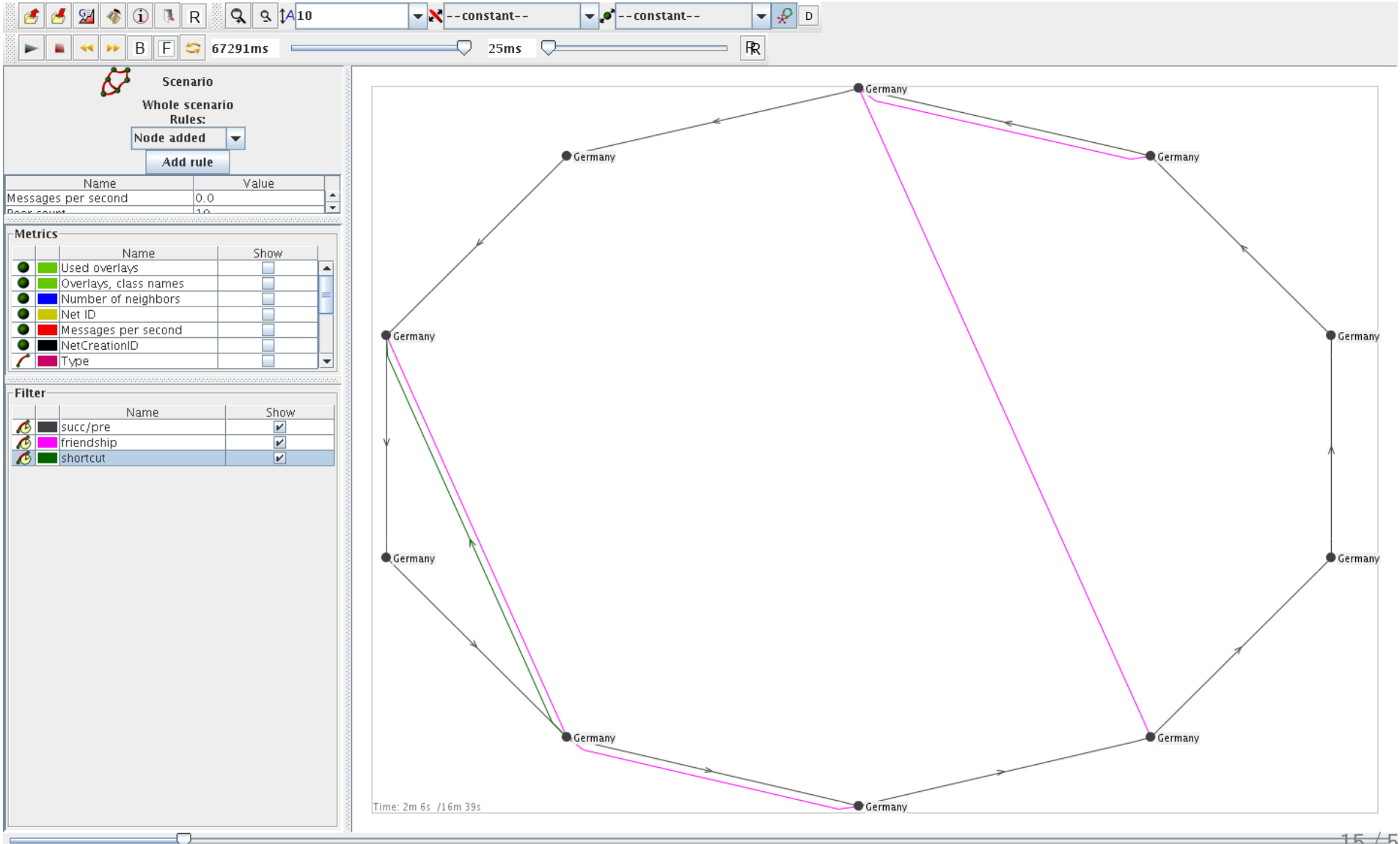

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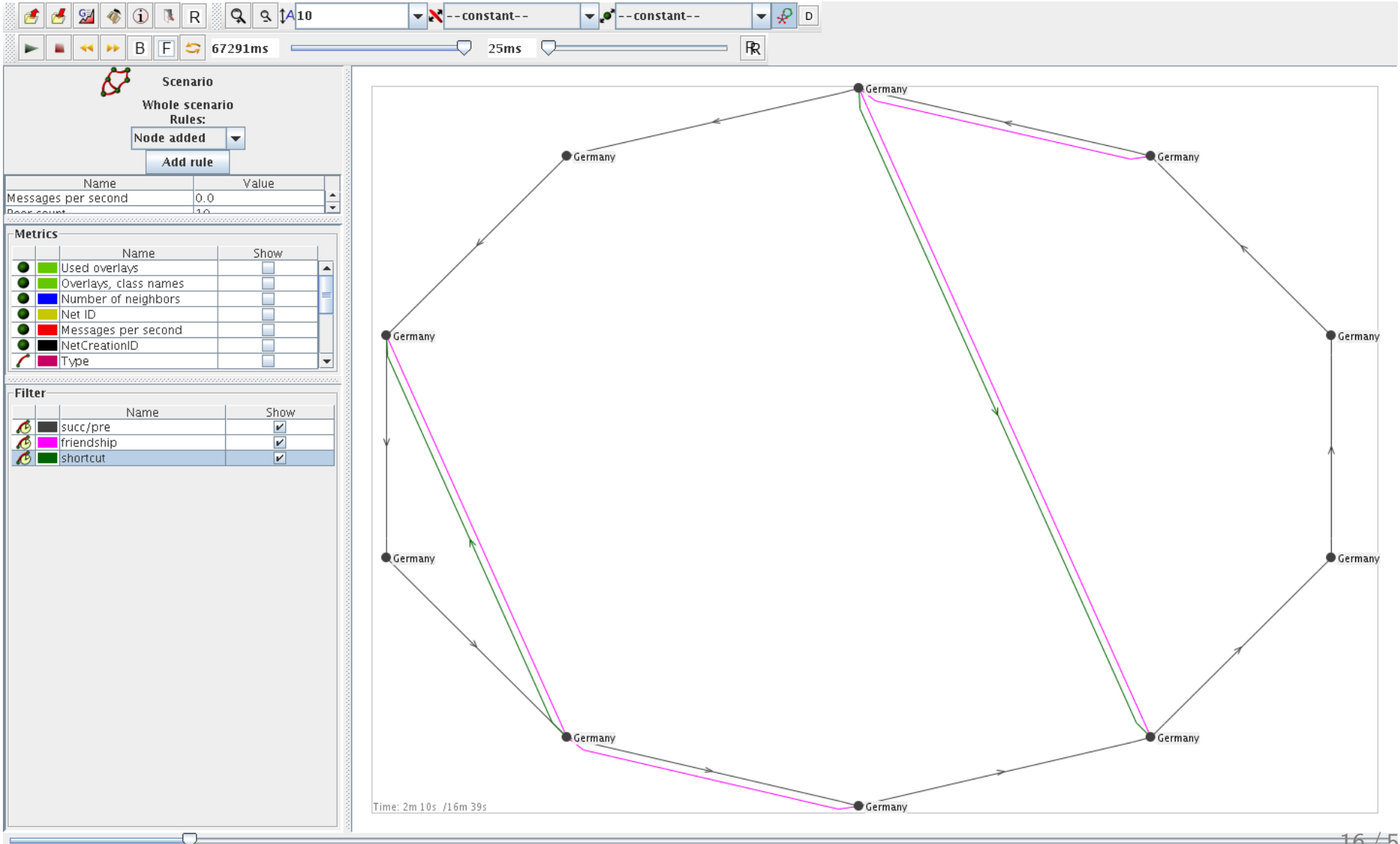

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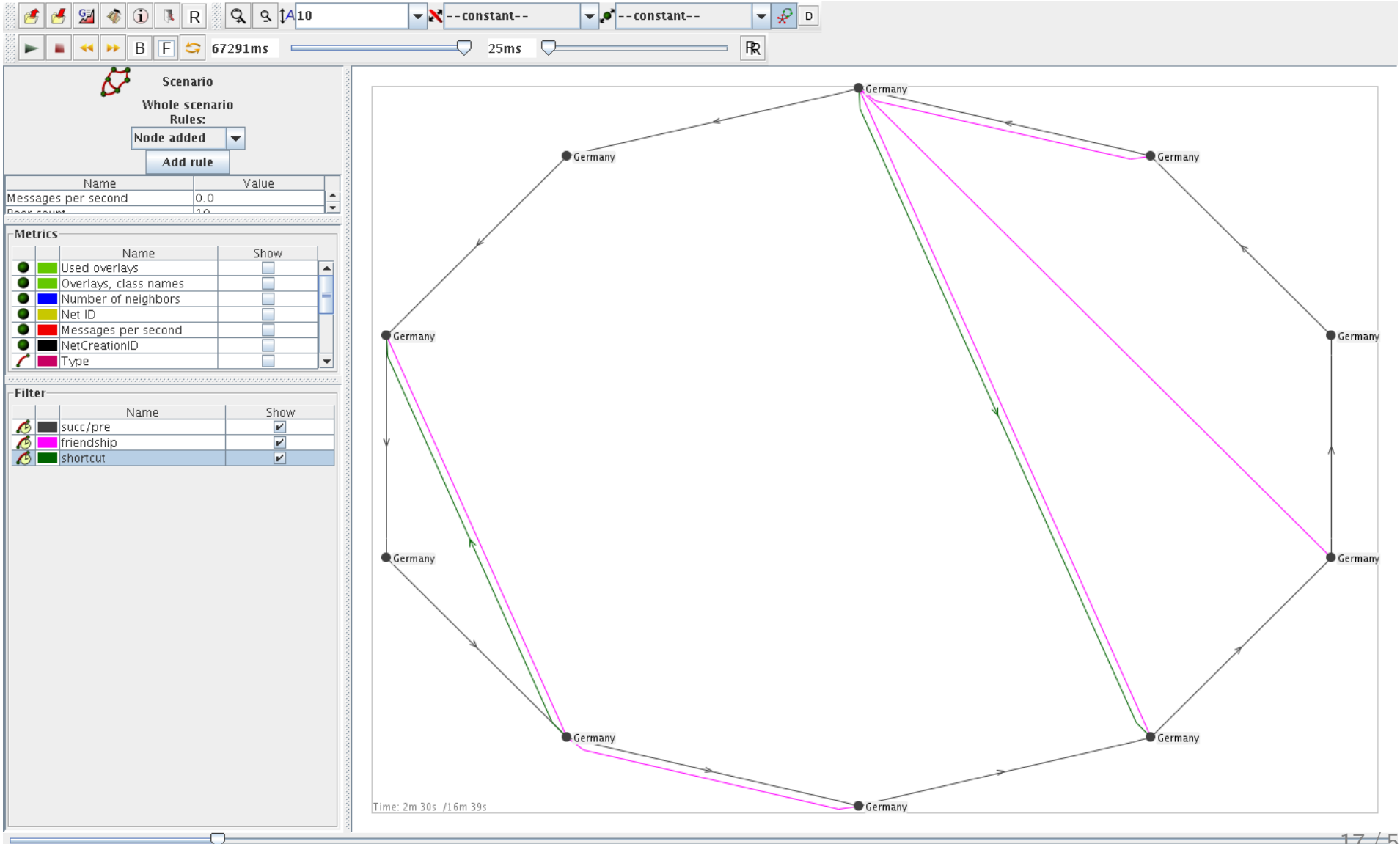

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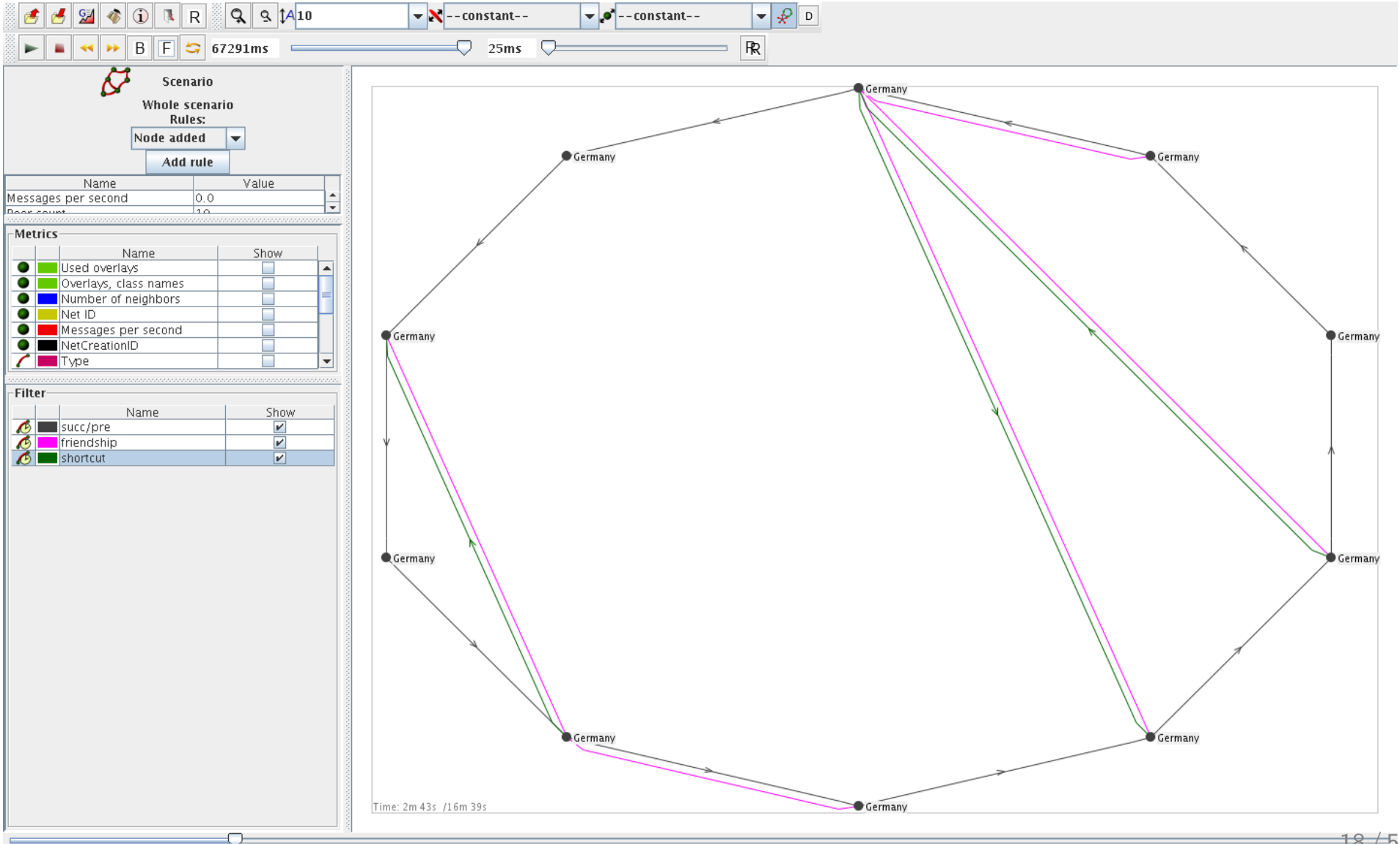

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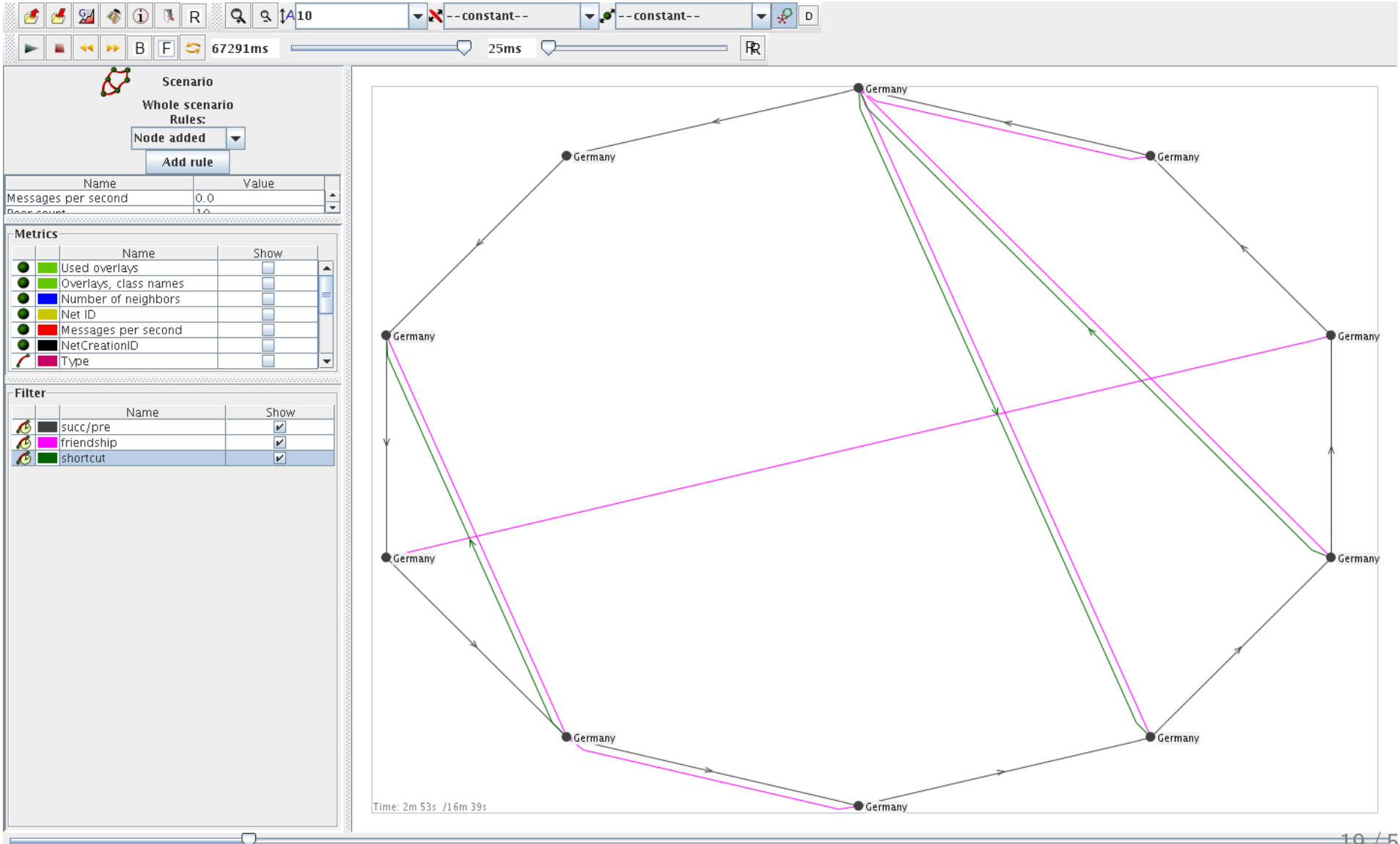

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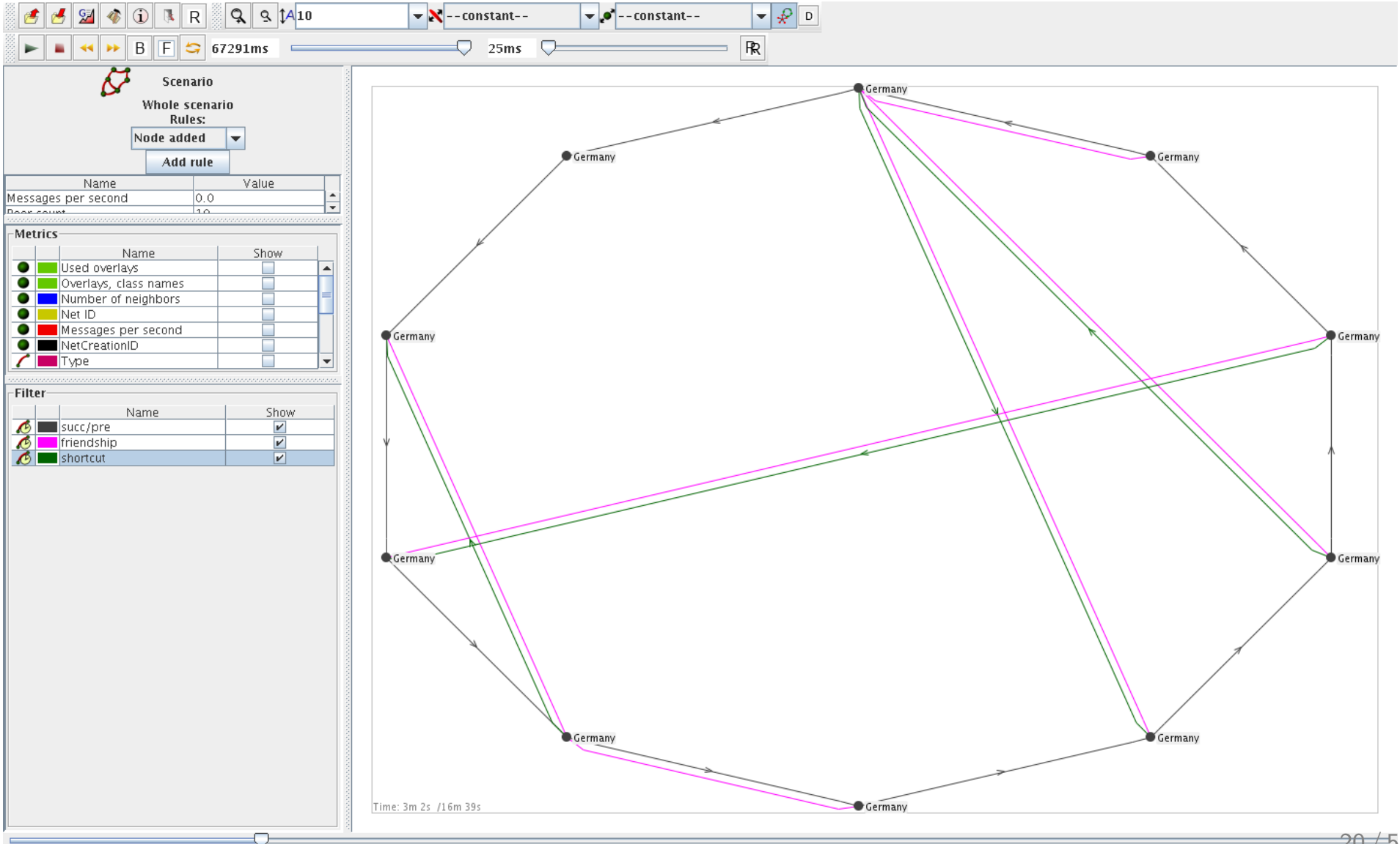

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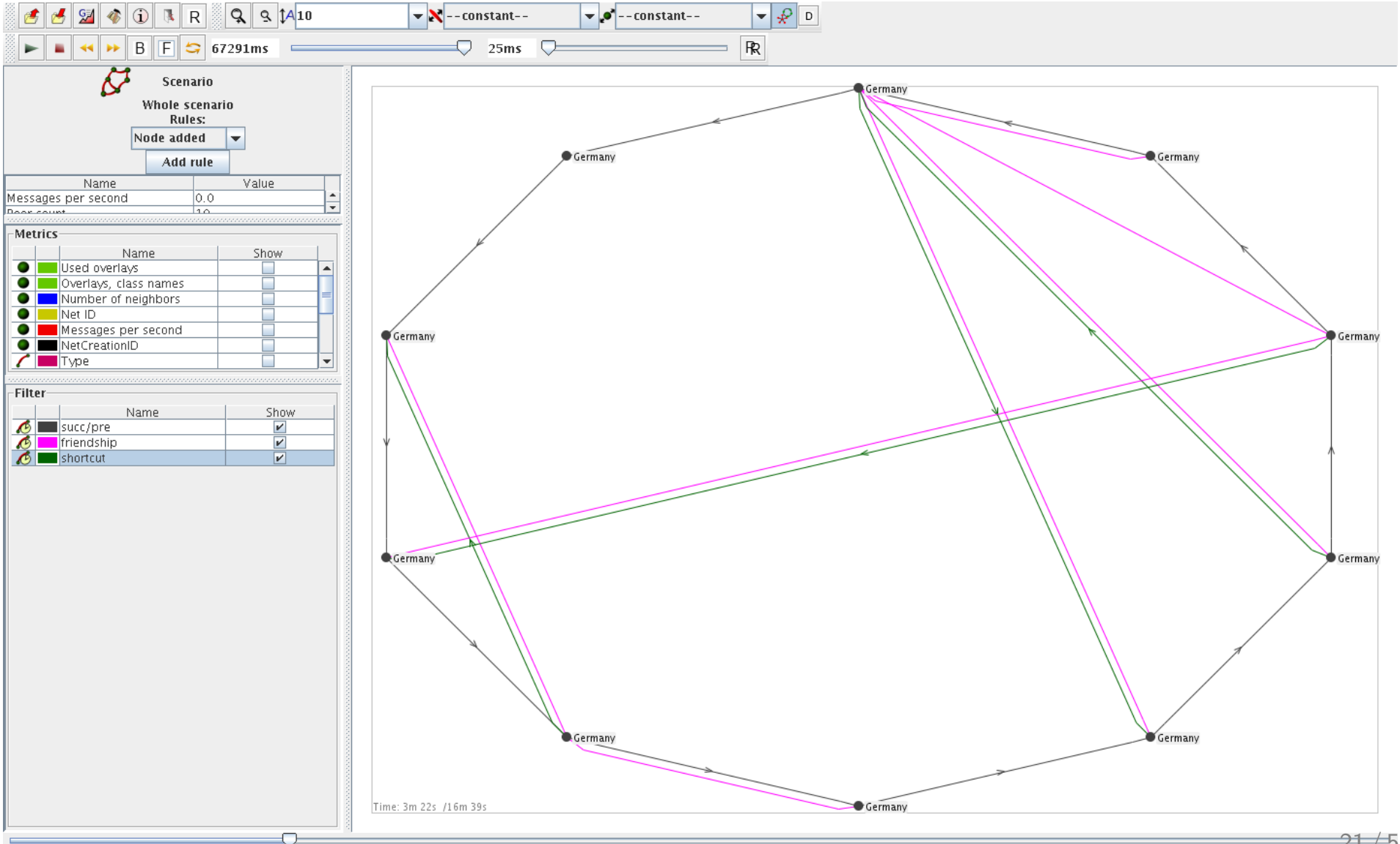

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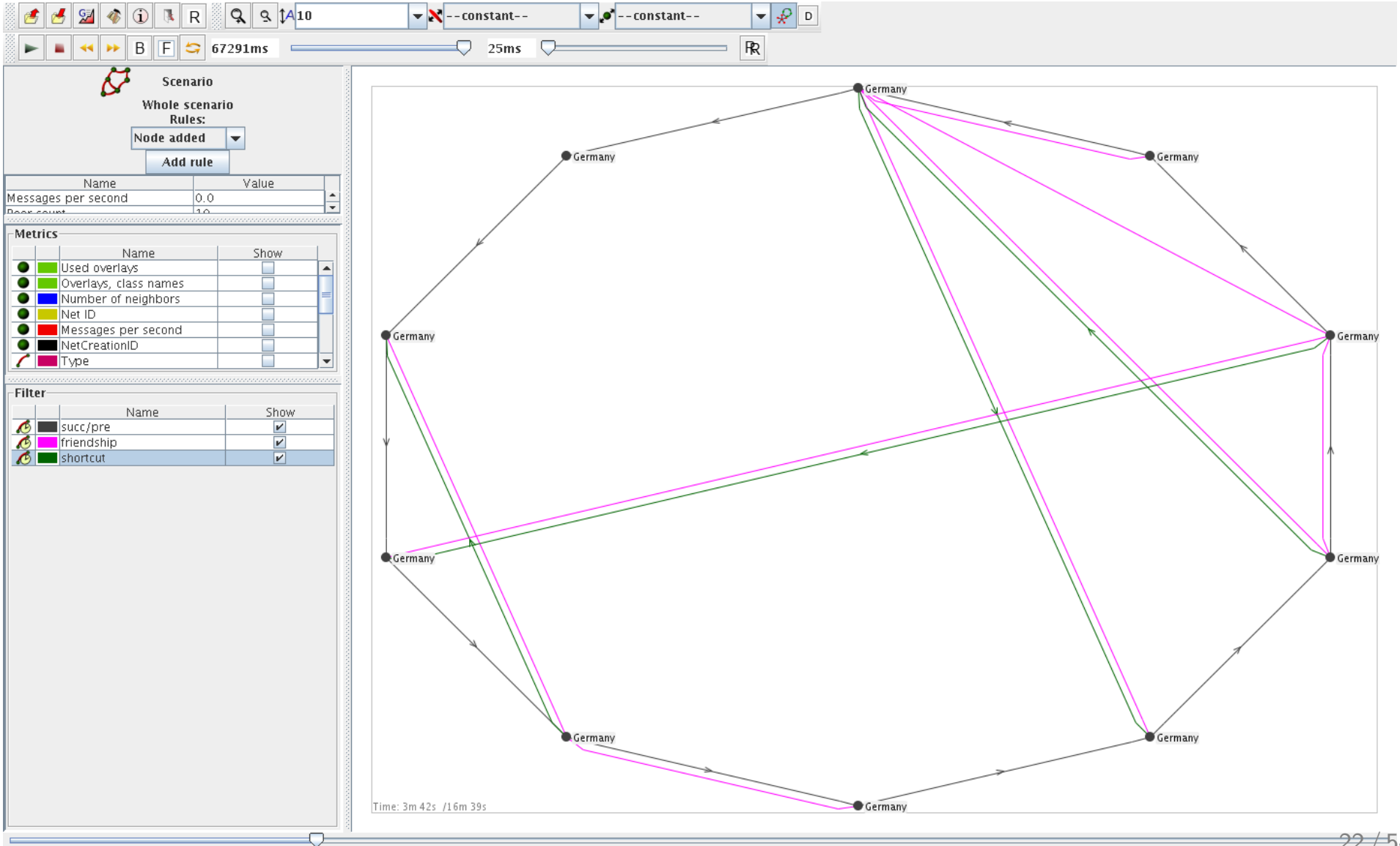

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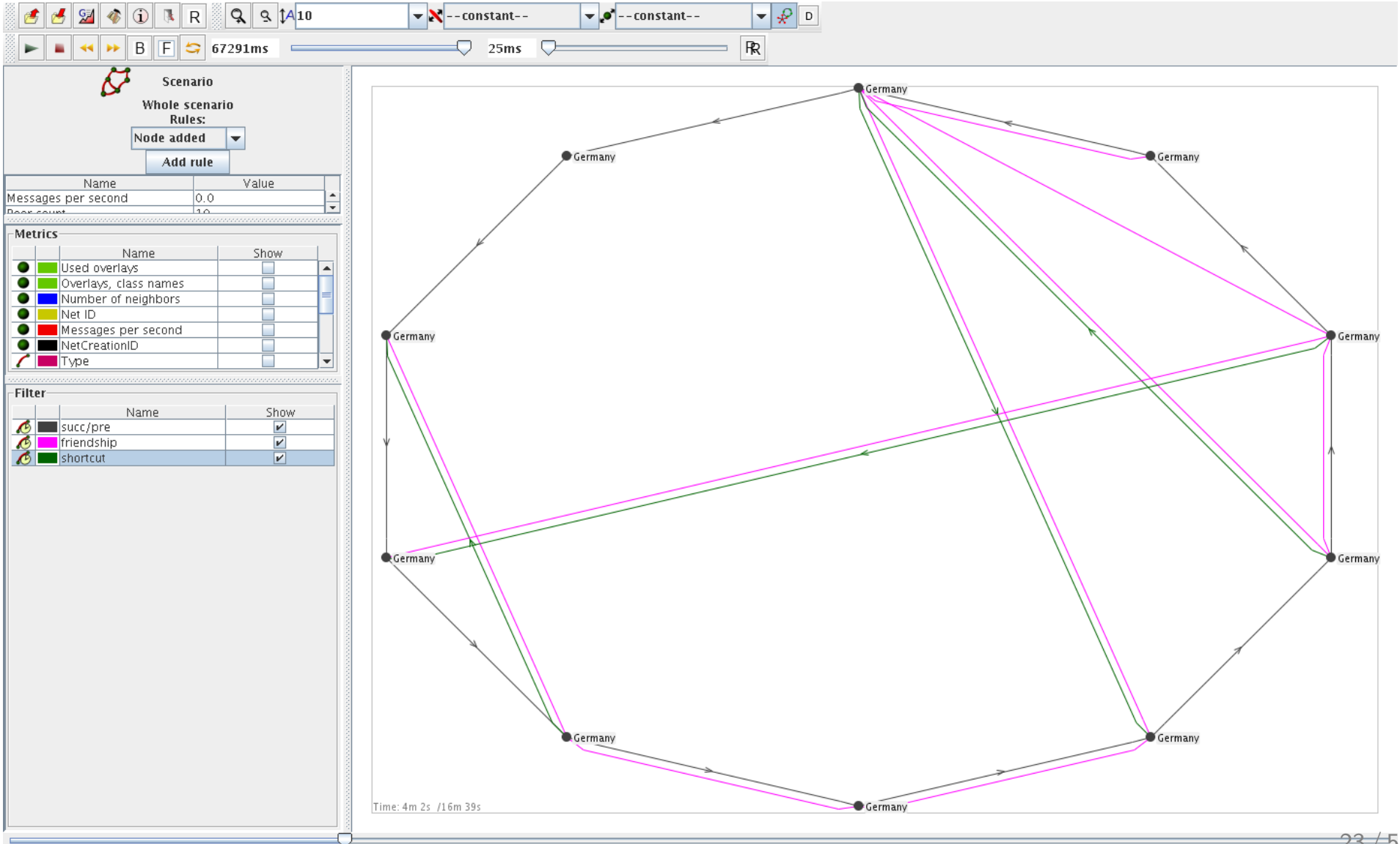

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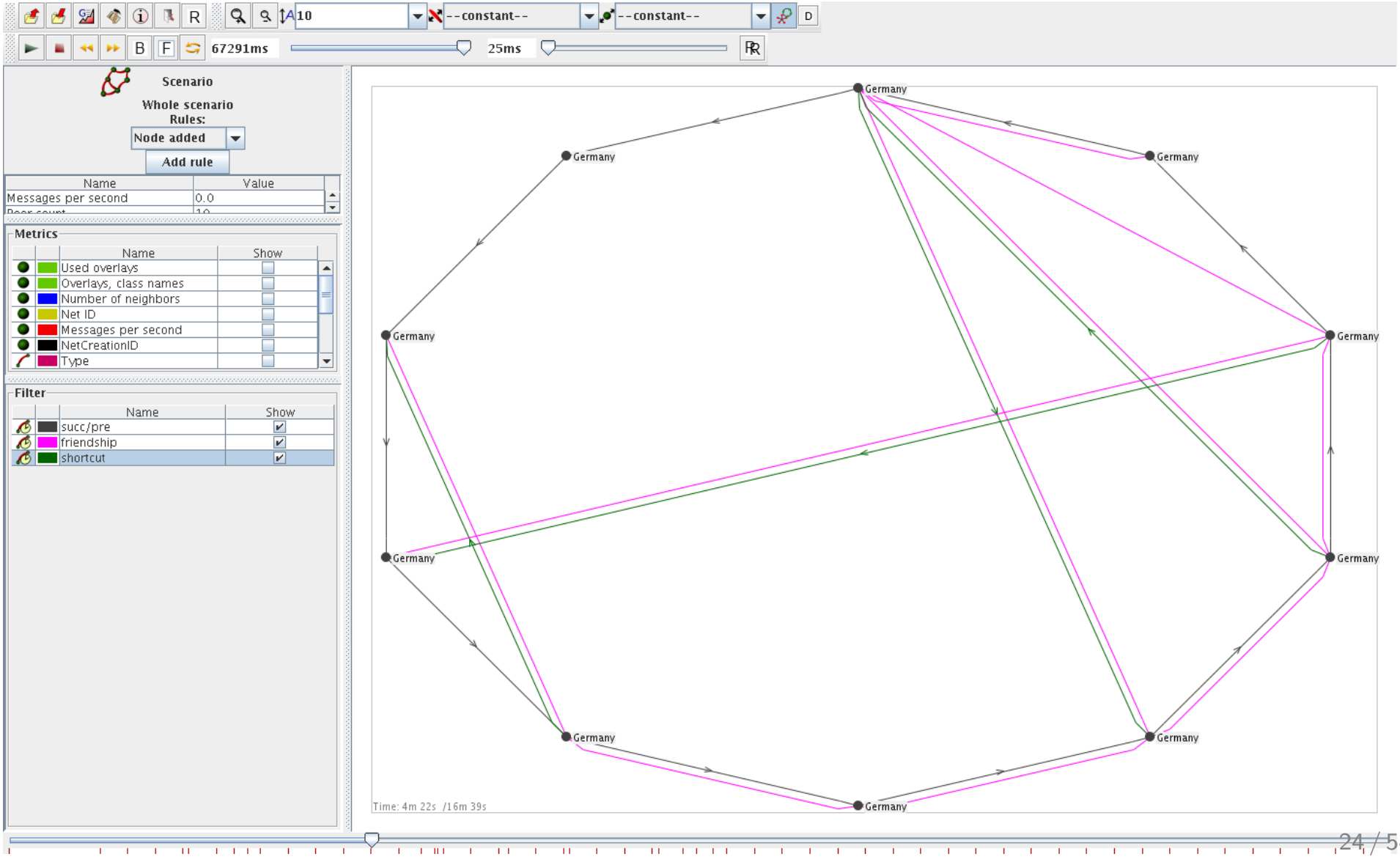

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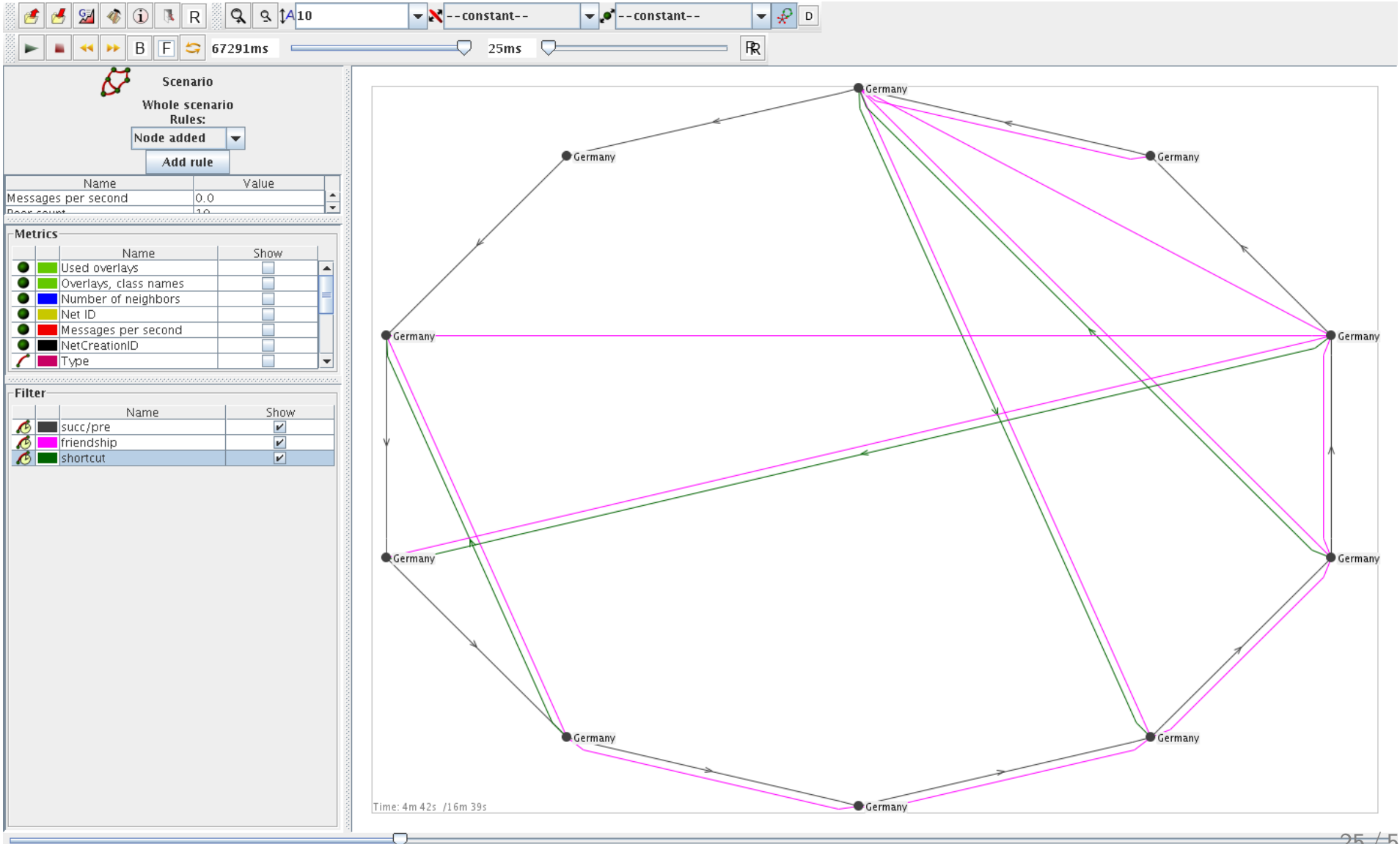

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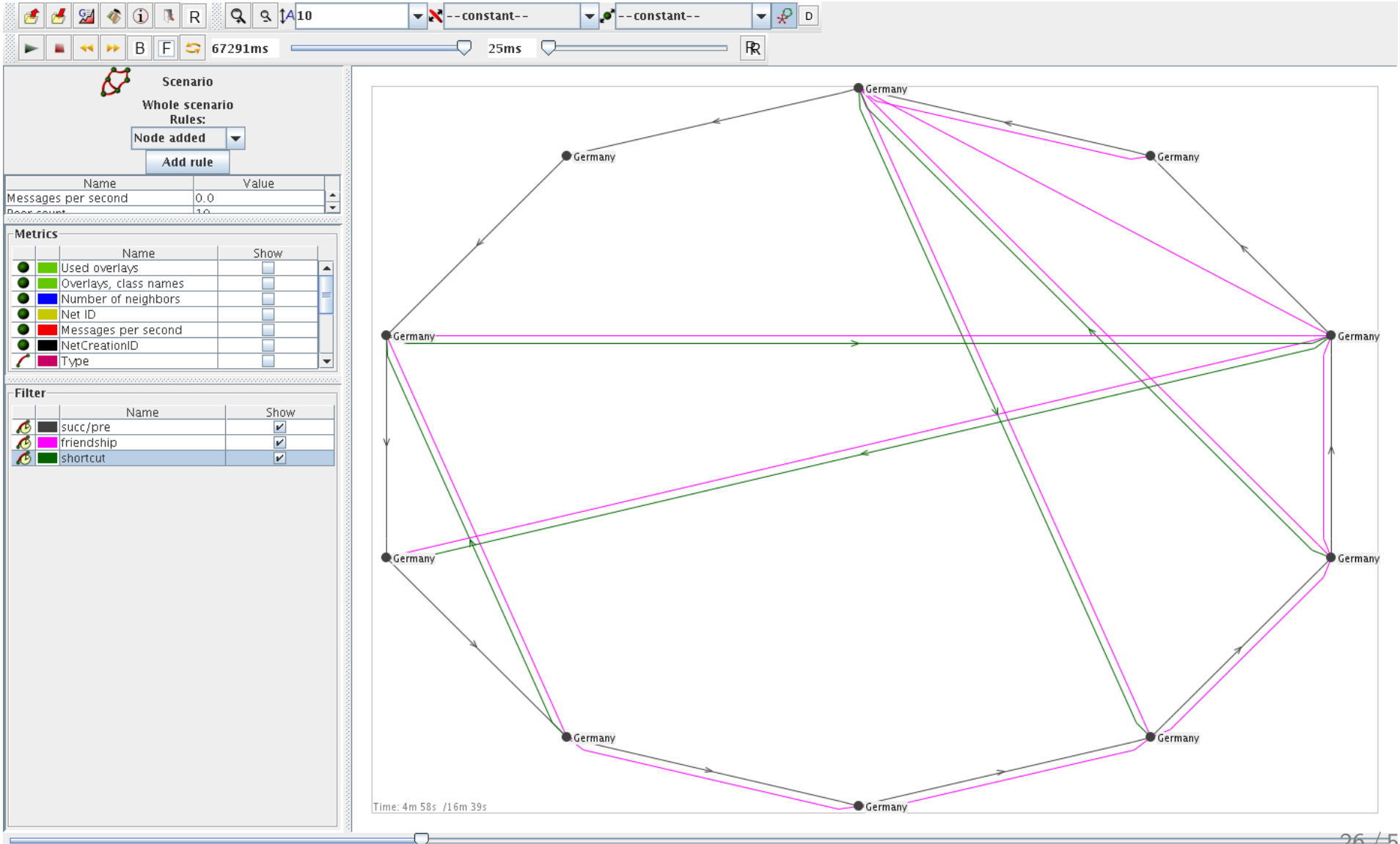

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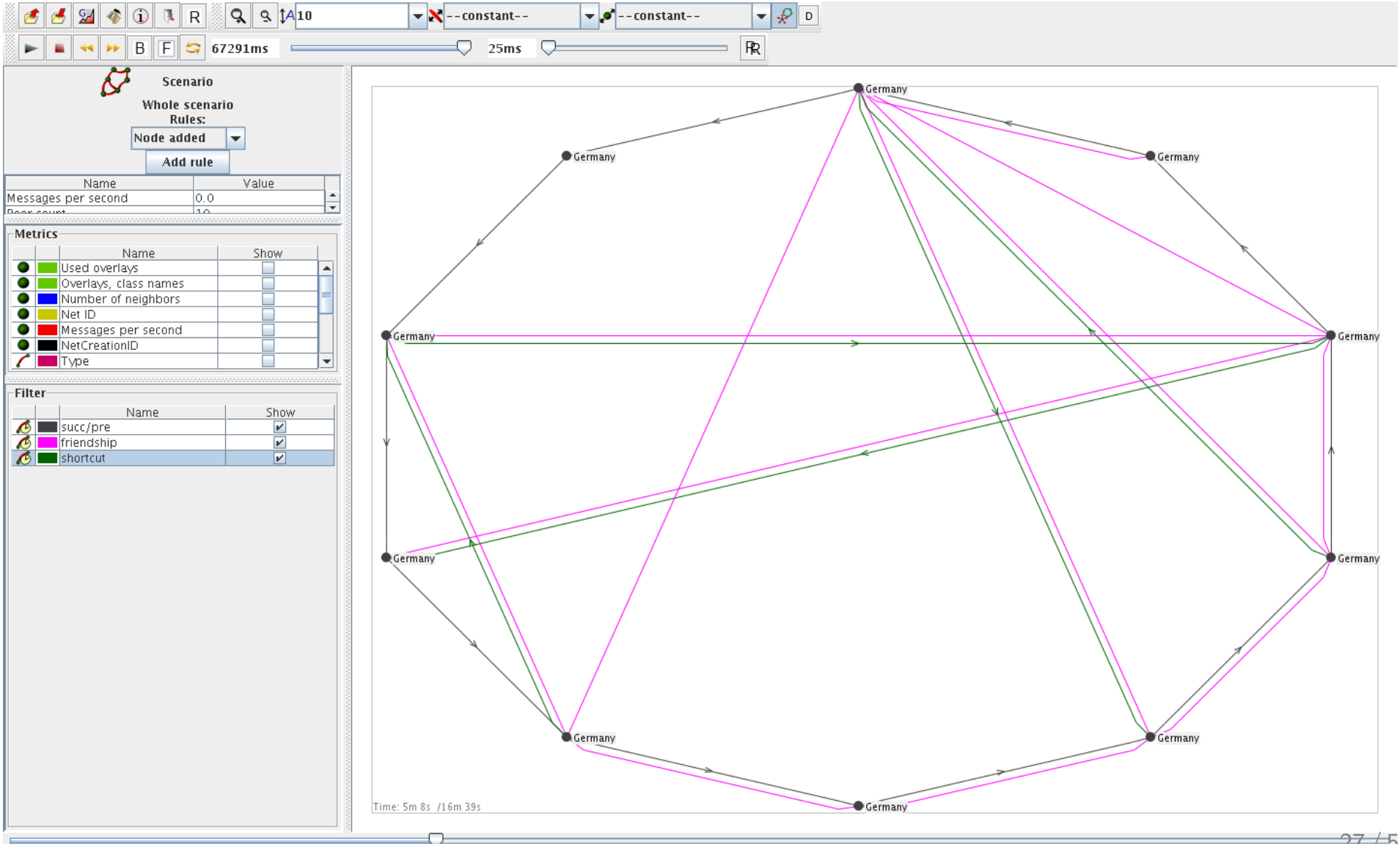

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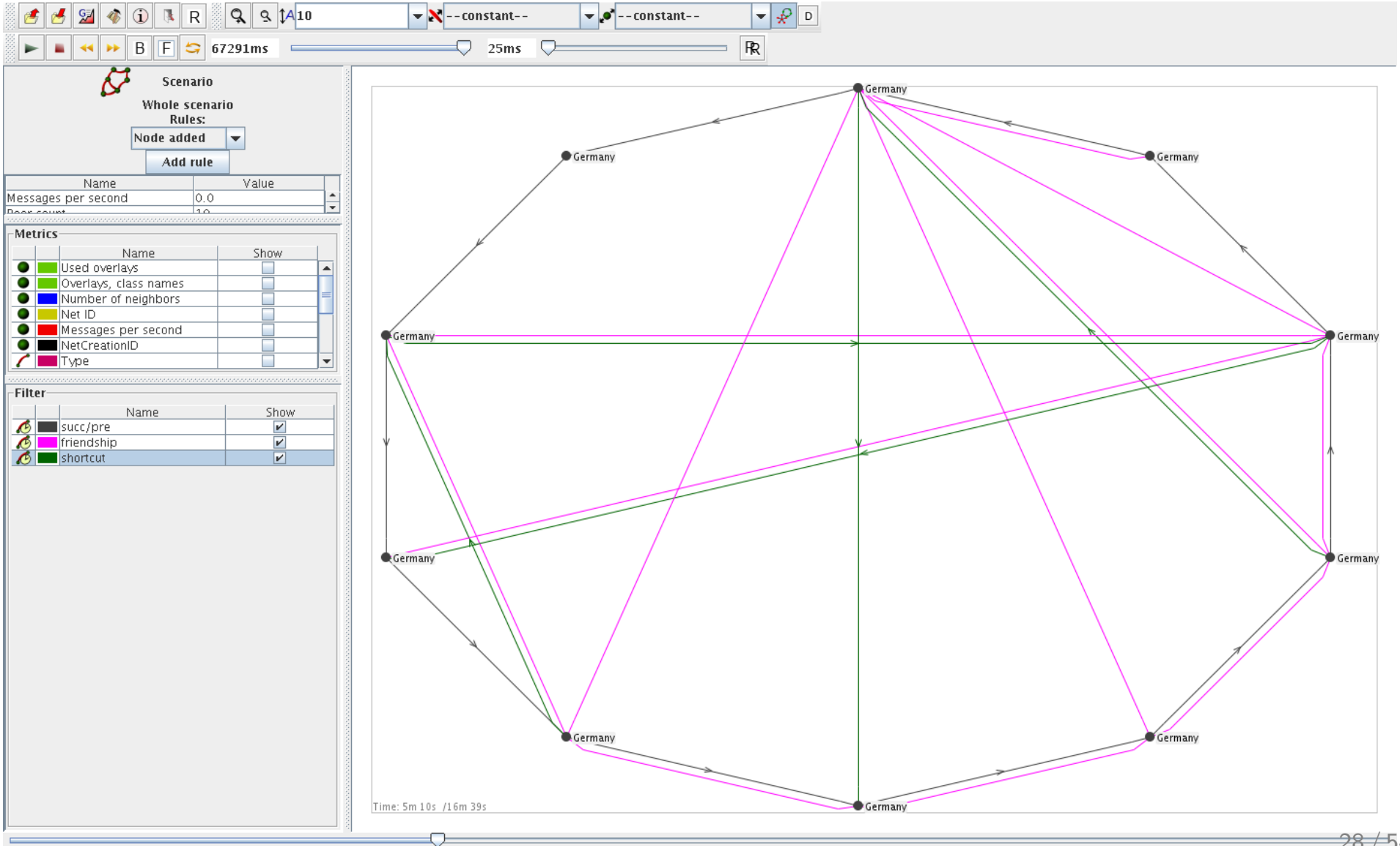

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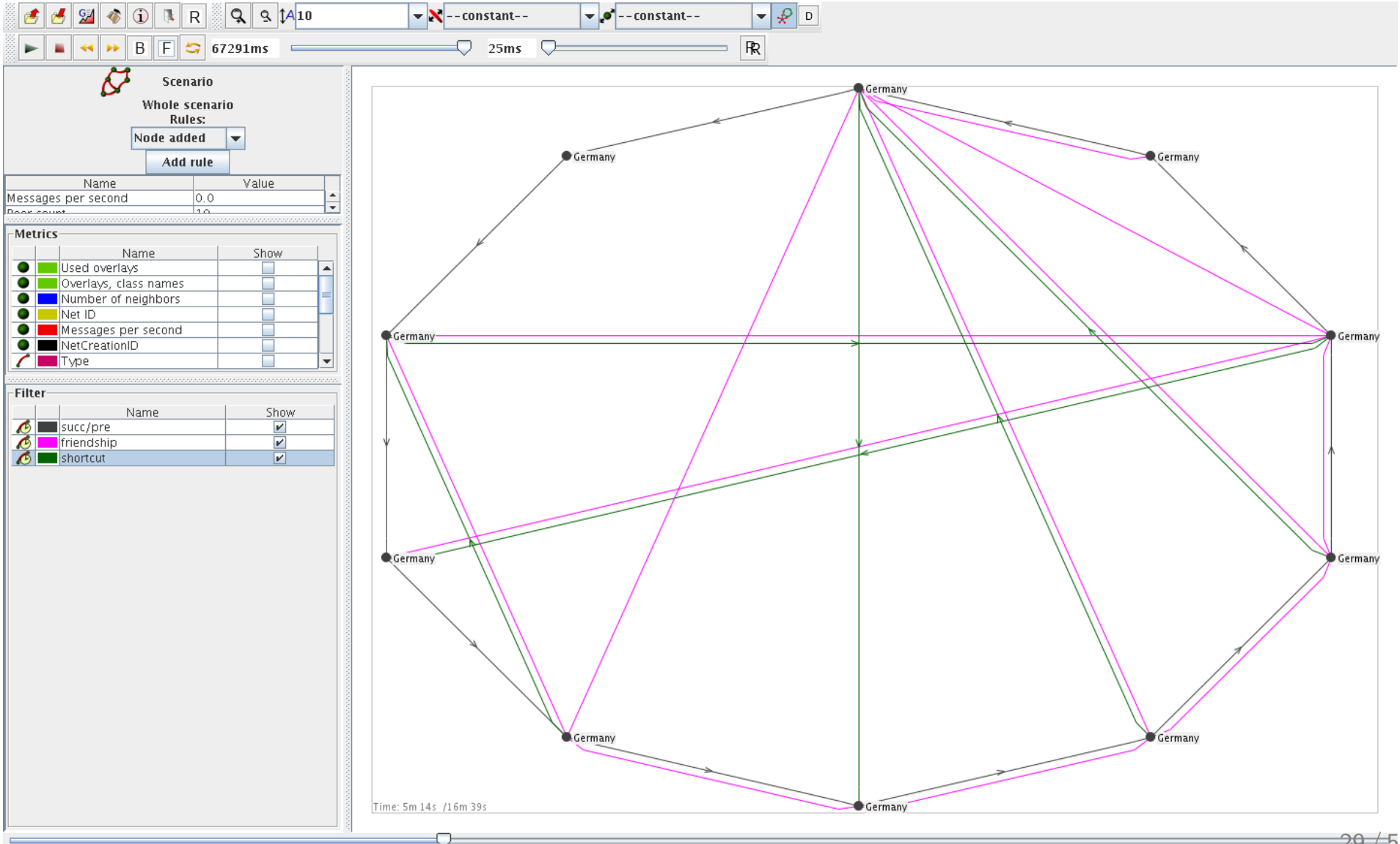

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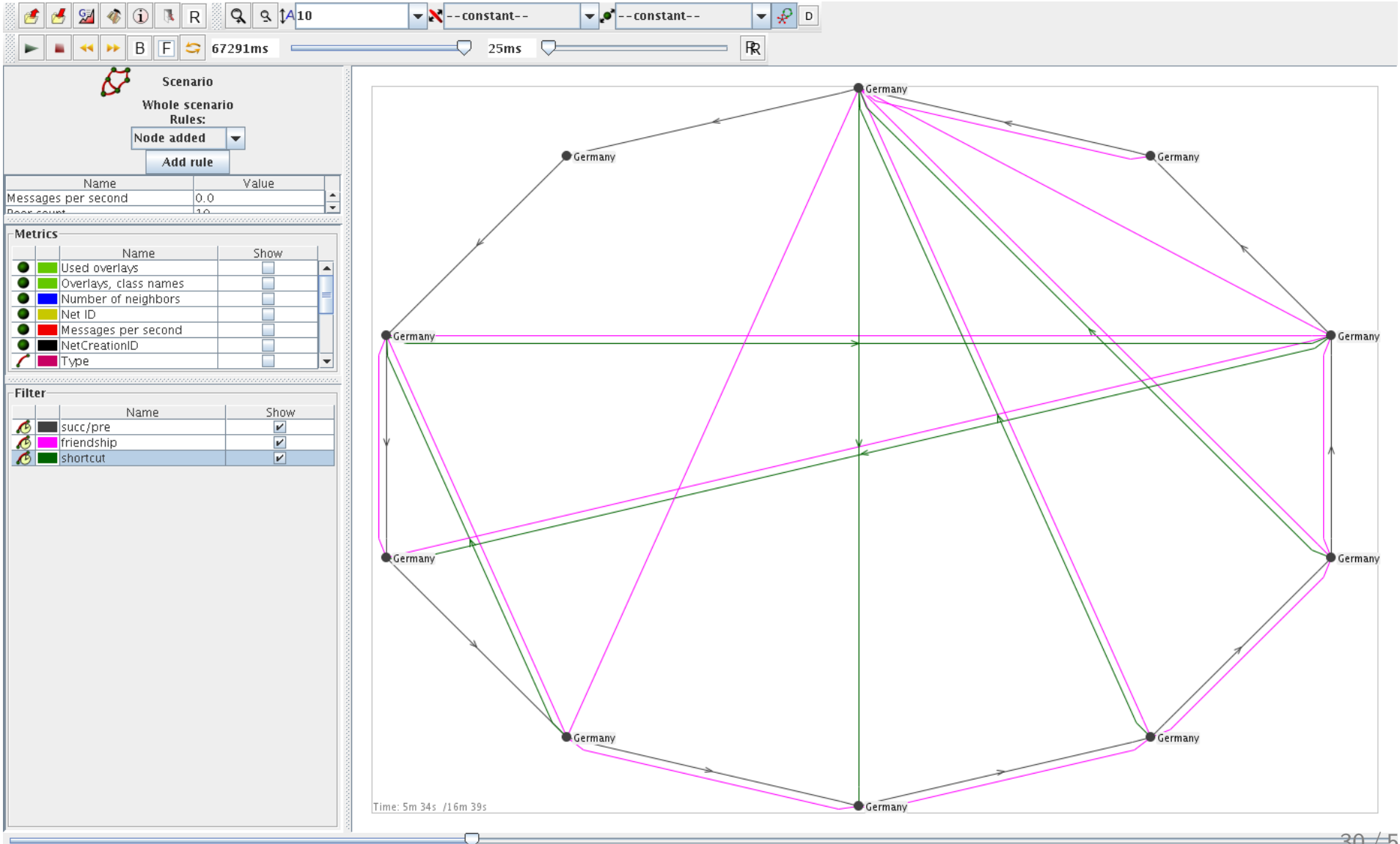

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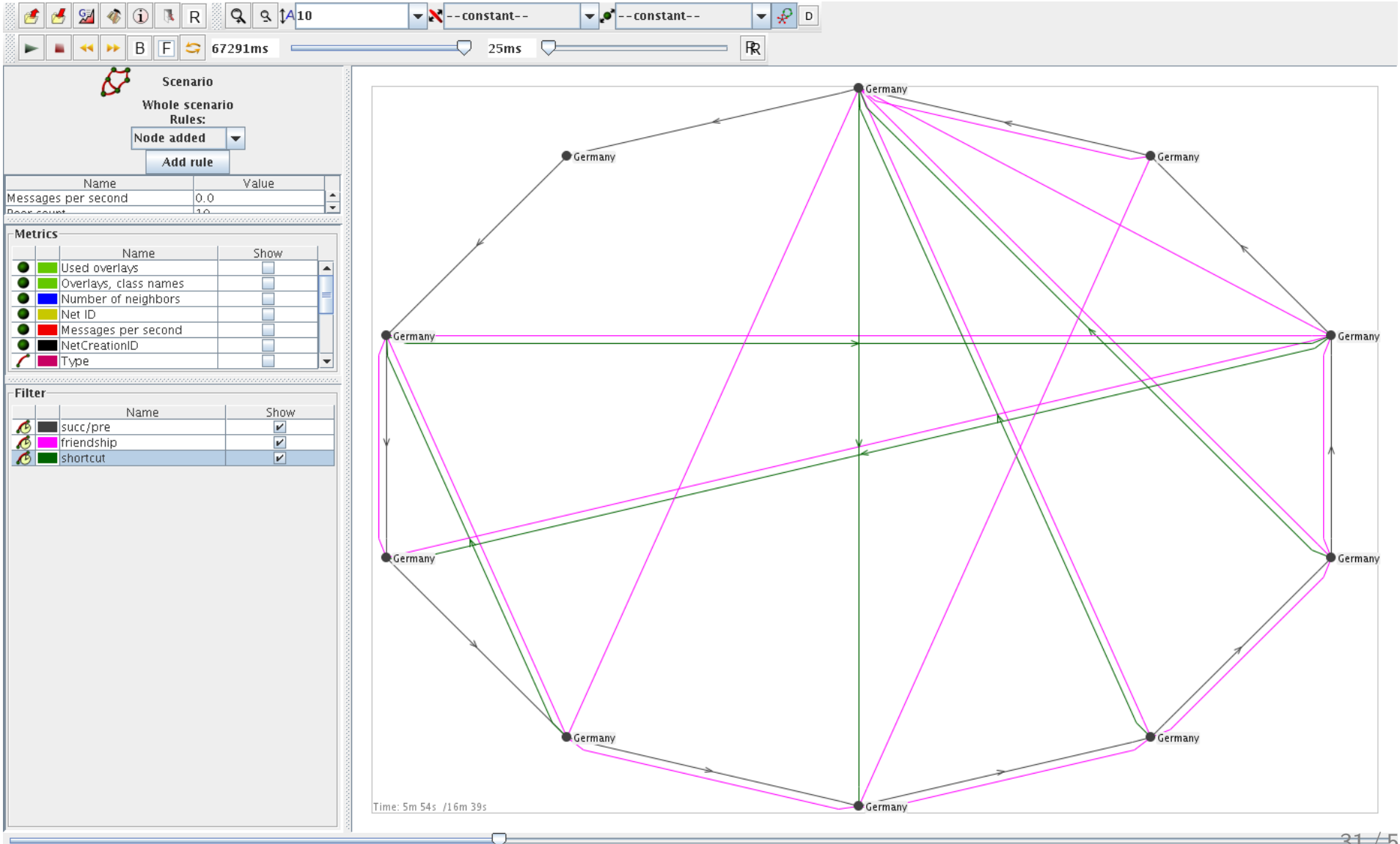

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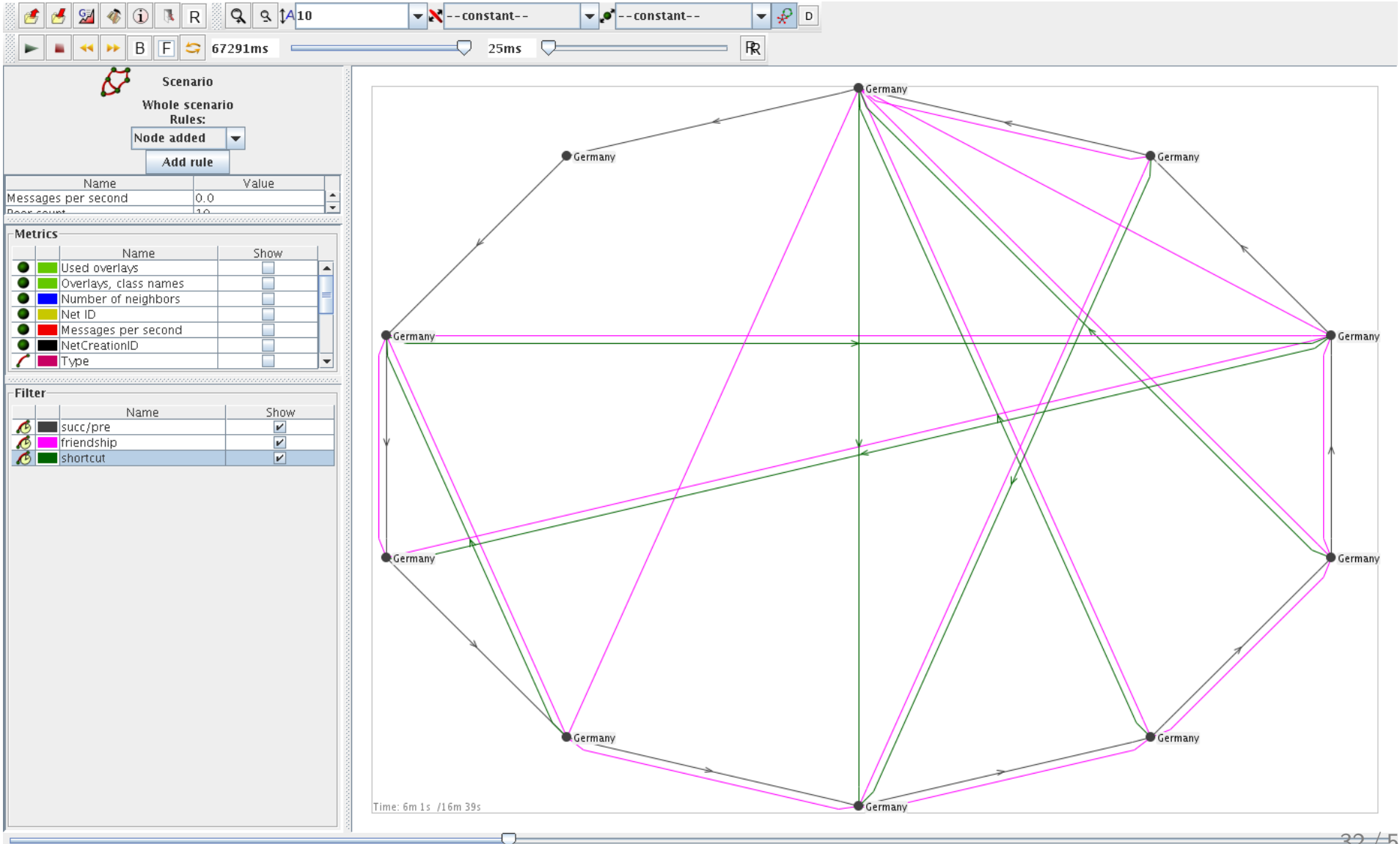

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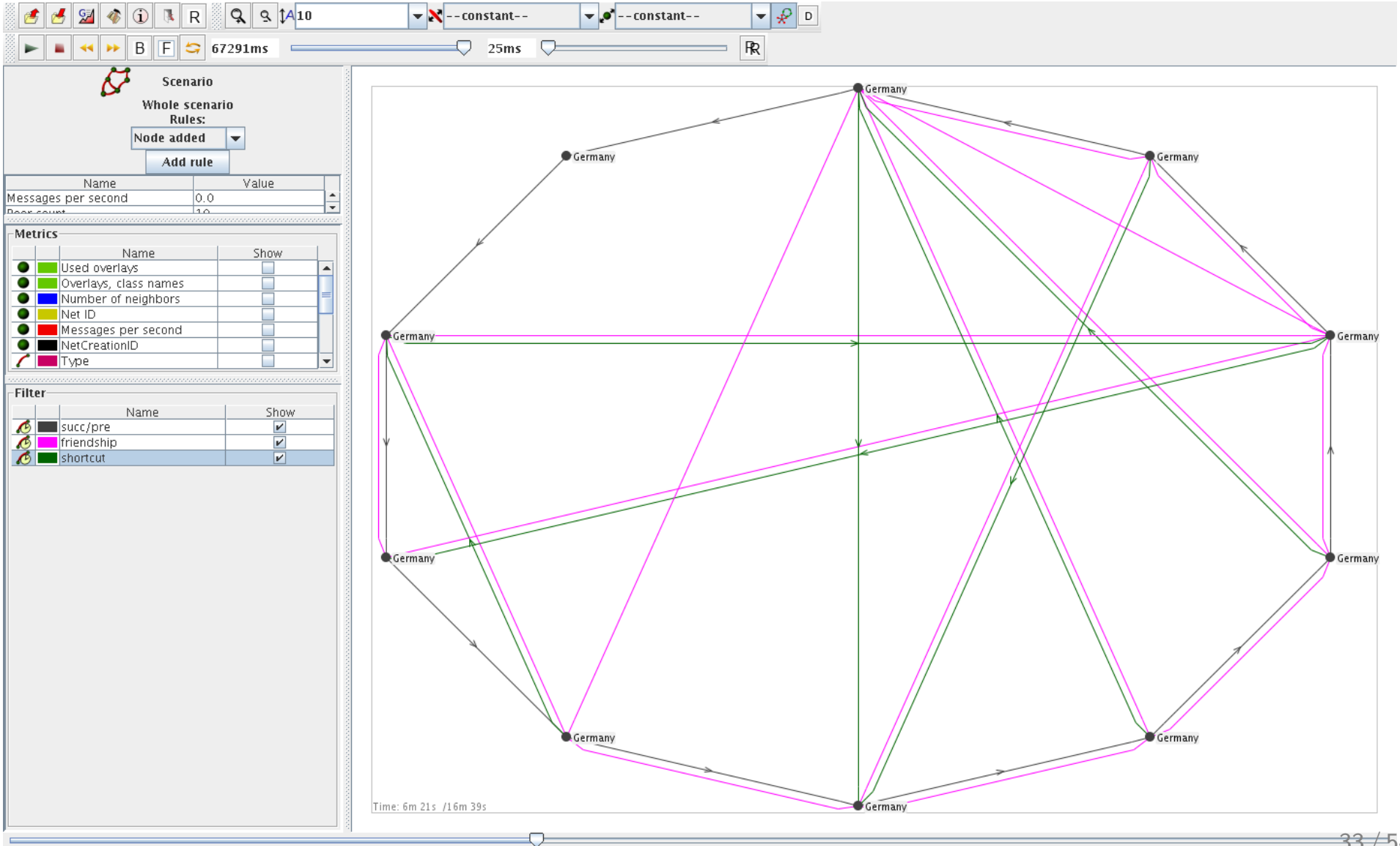

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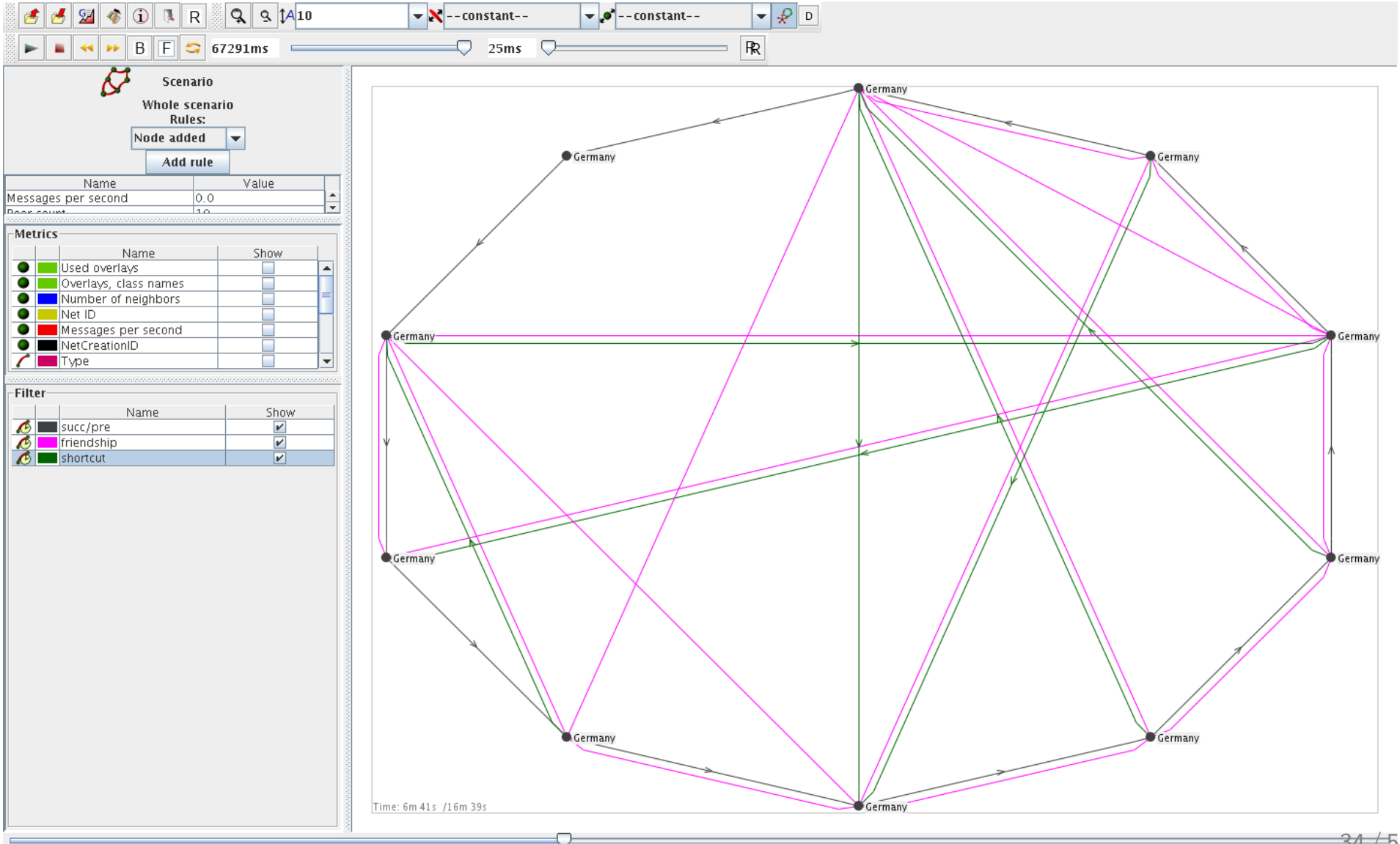

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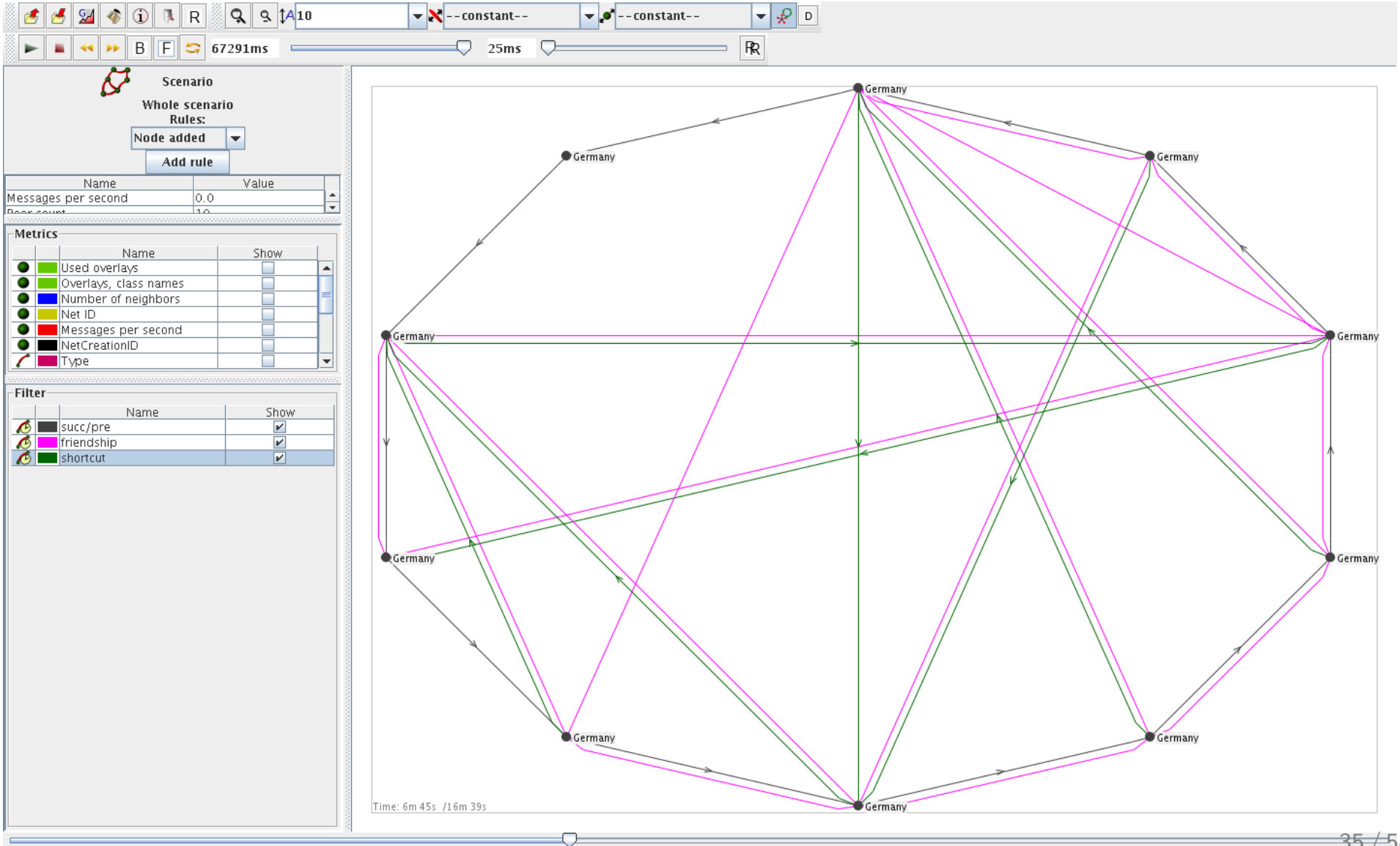

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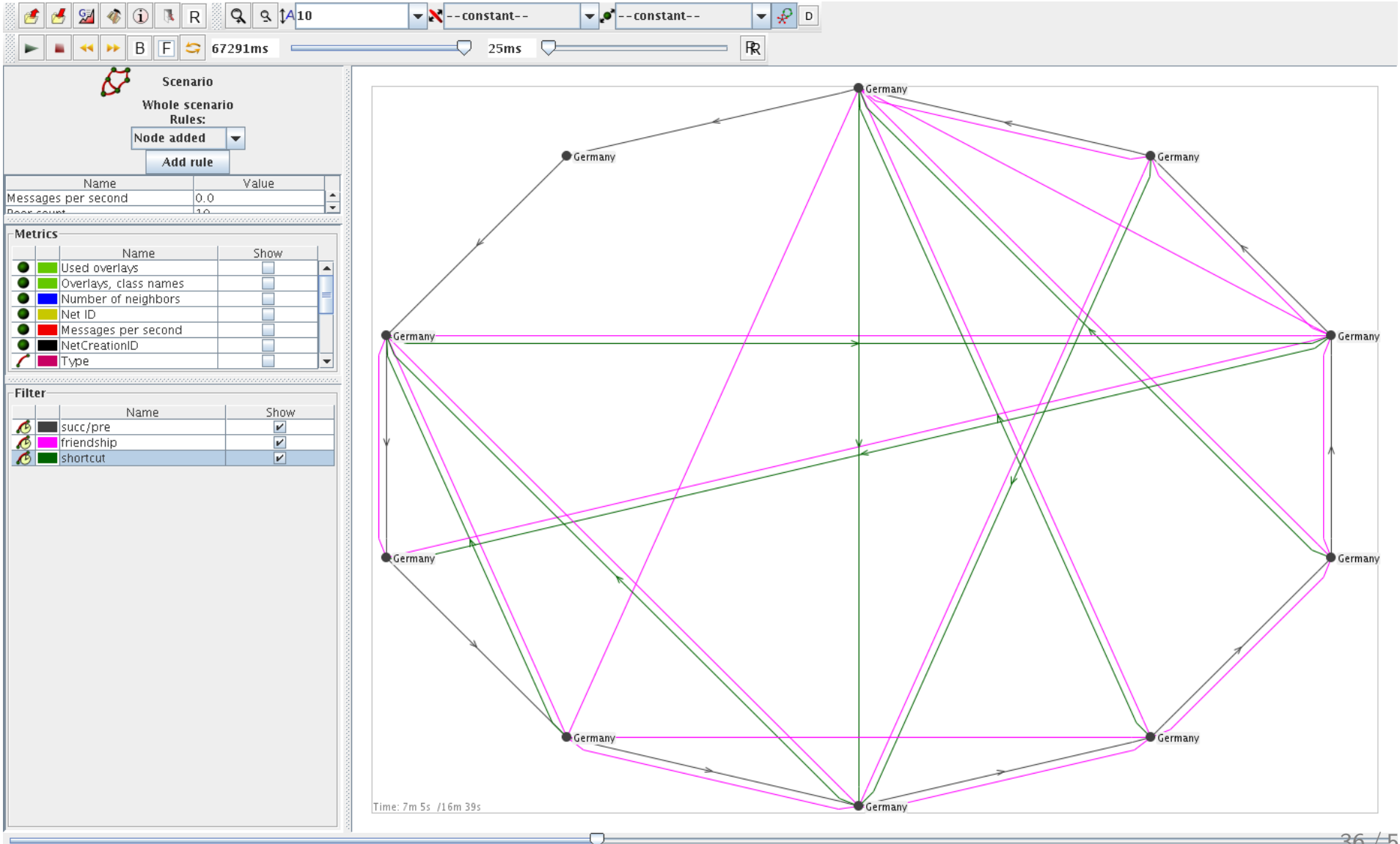

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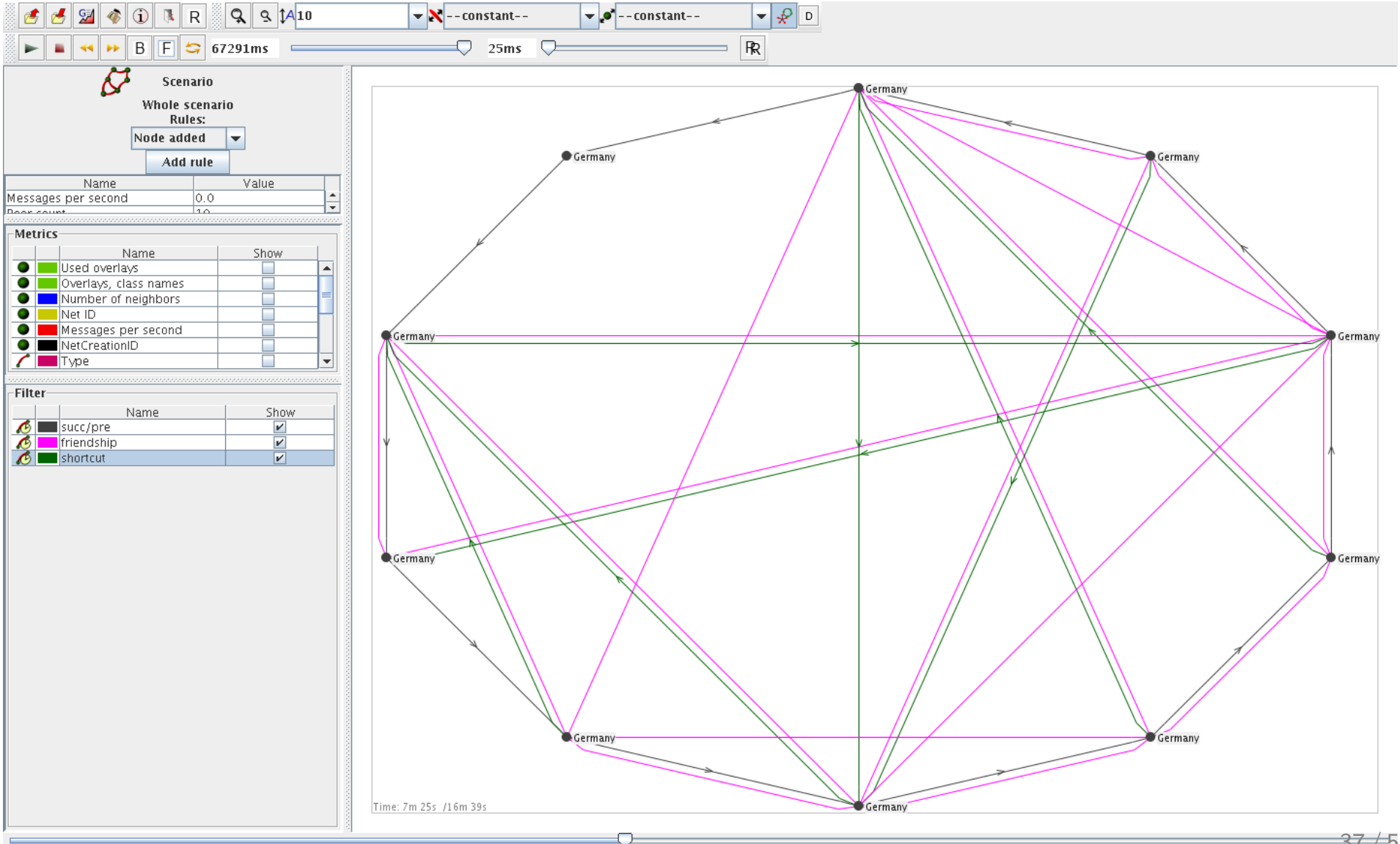

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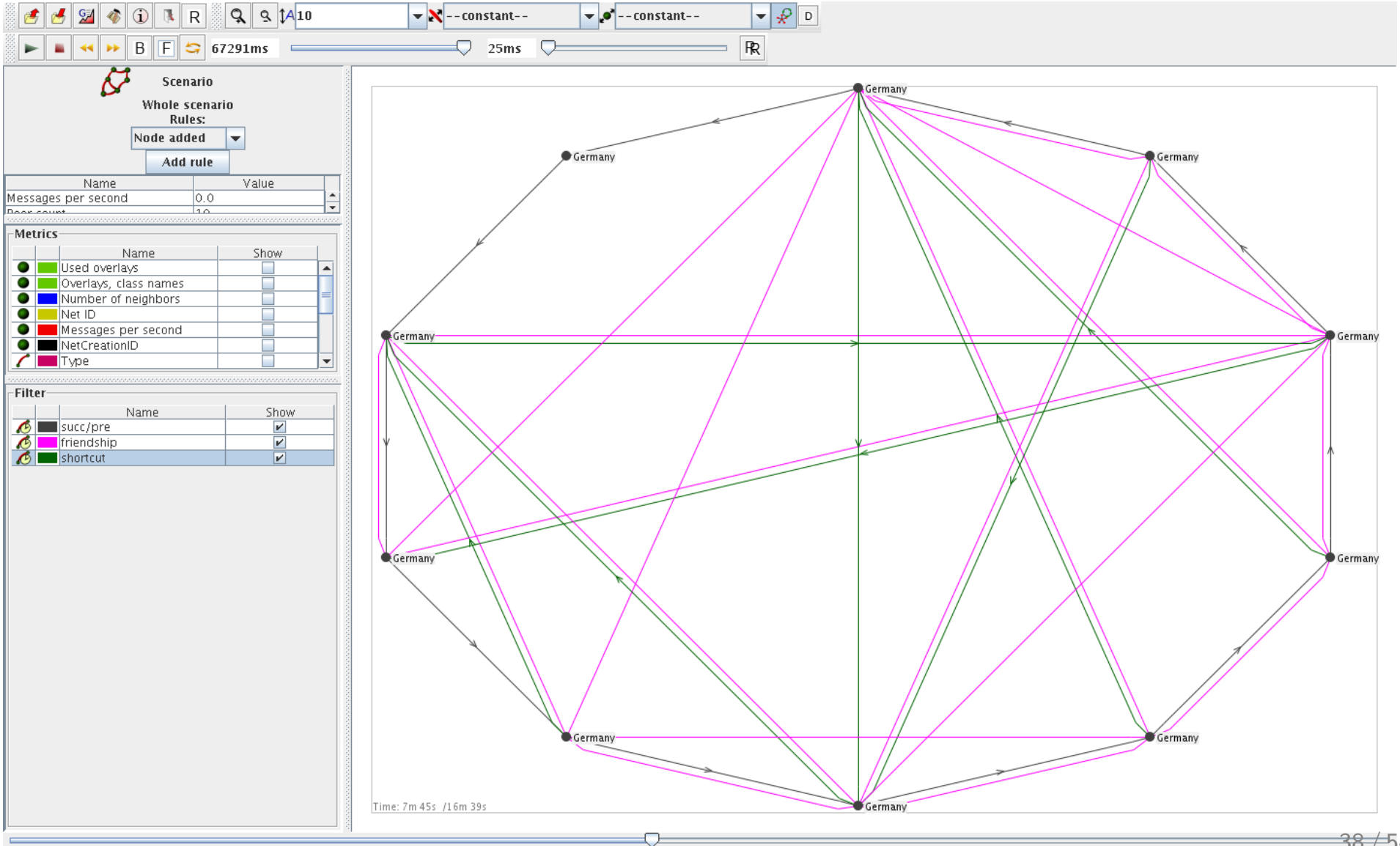

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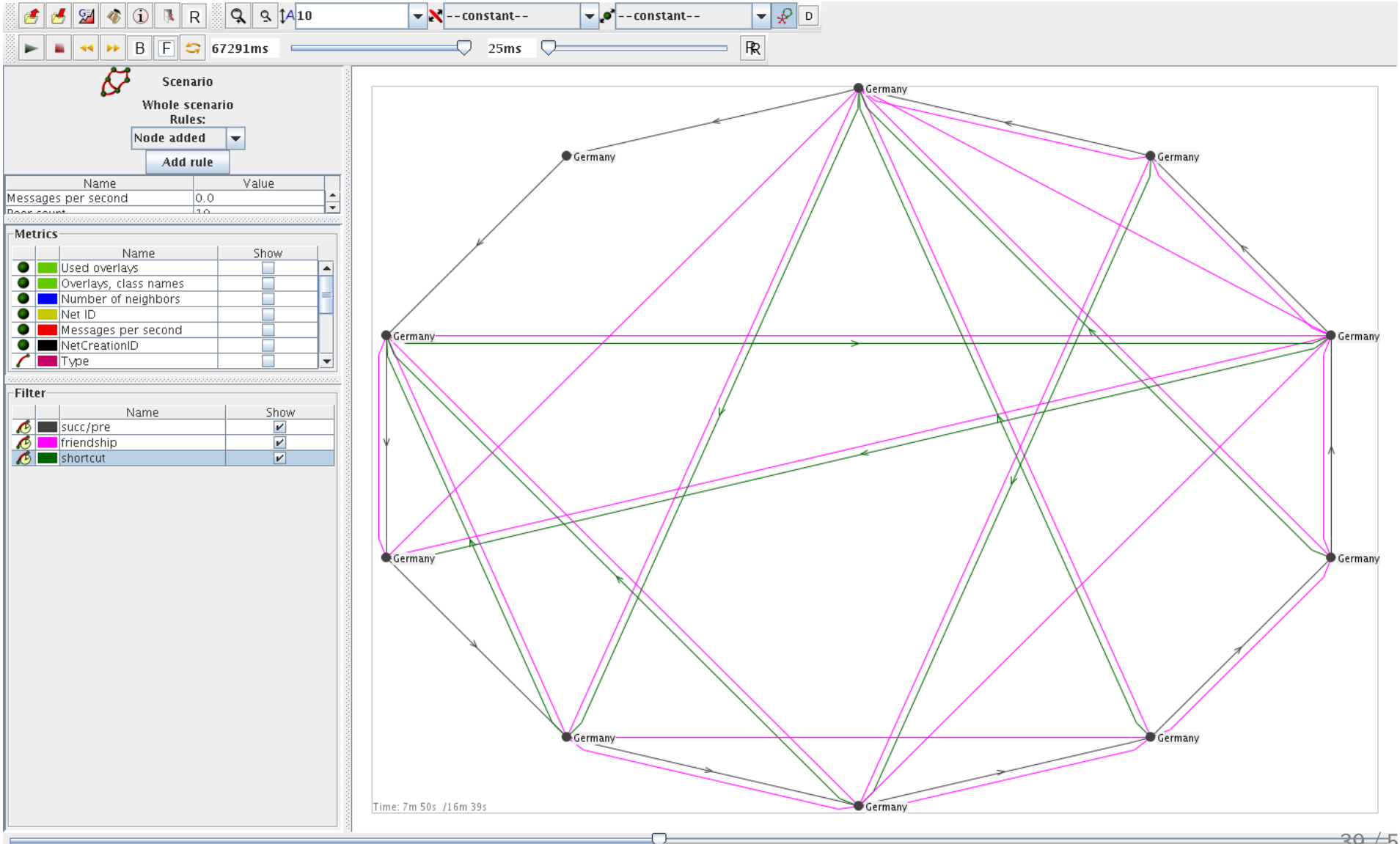

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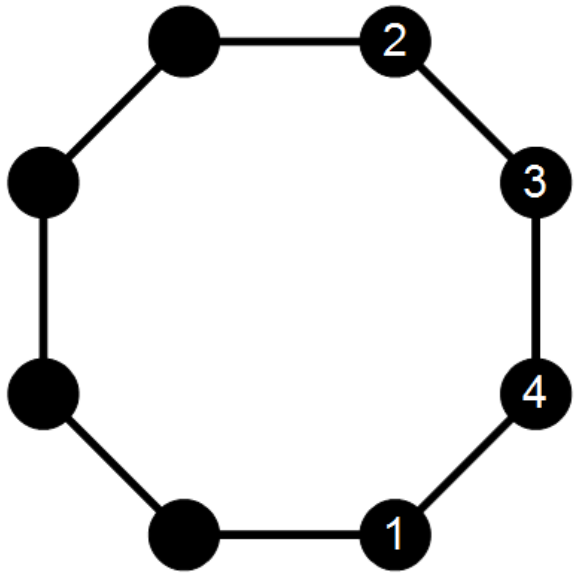

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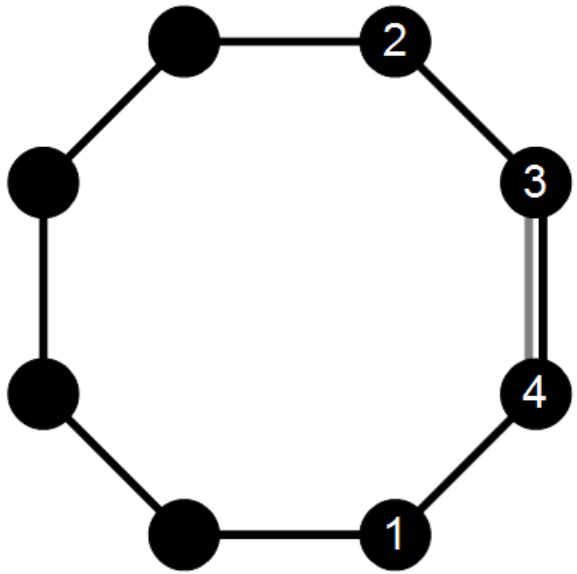

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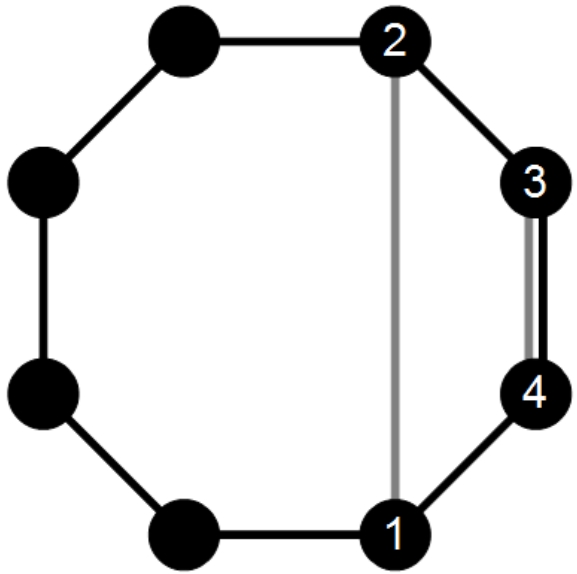

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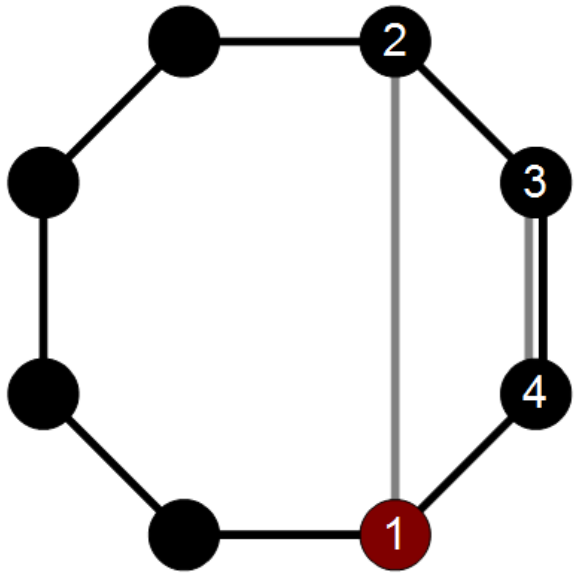
- $v \in V$ minimizes $\max_{u \in \mathcal{F}(v)} d(u, v)$

Current Progress

Looking for easier problems



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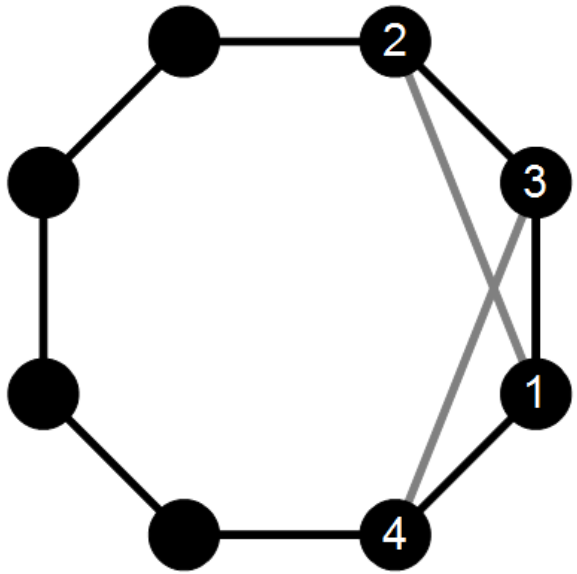

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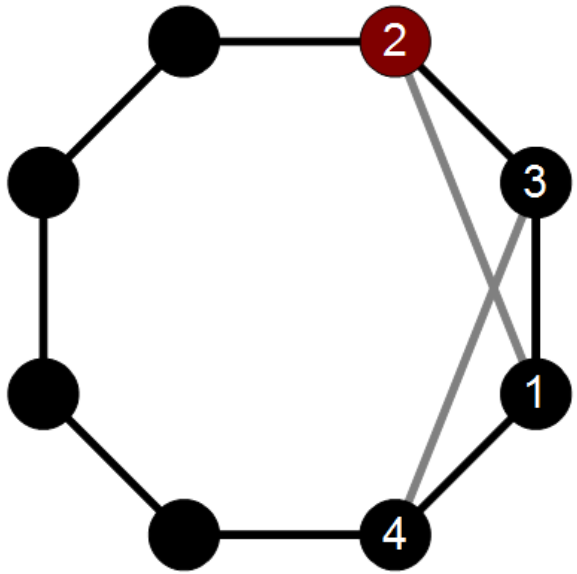

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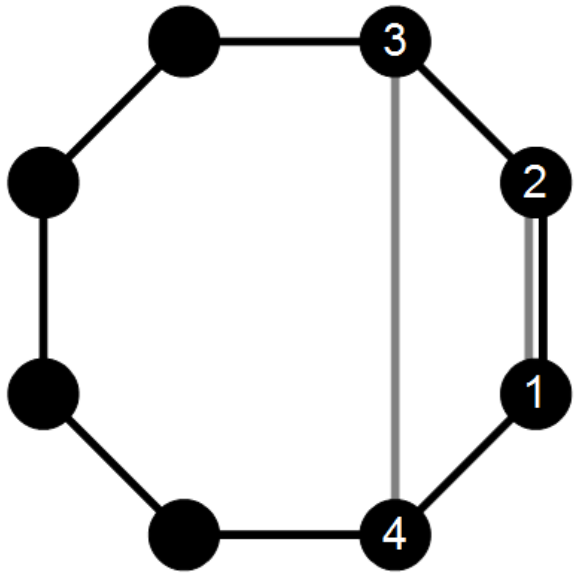

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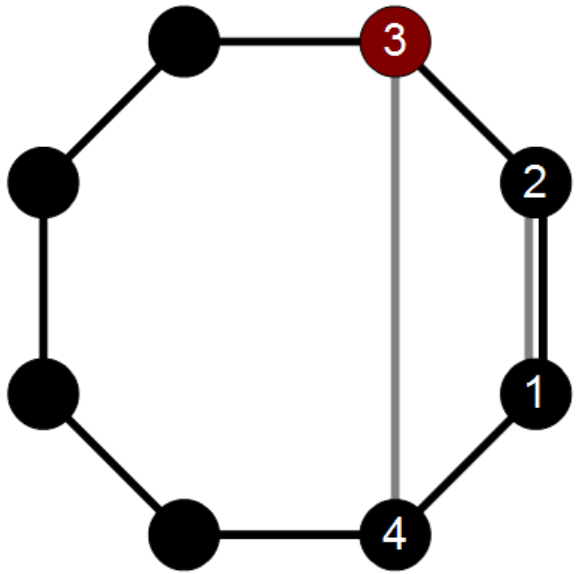

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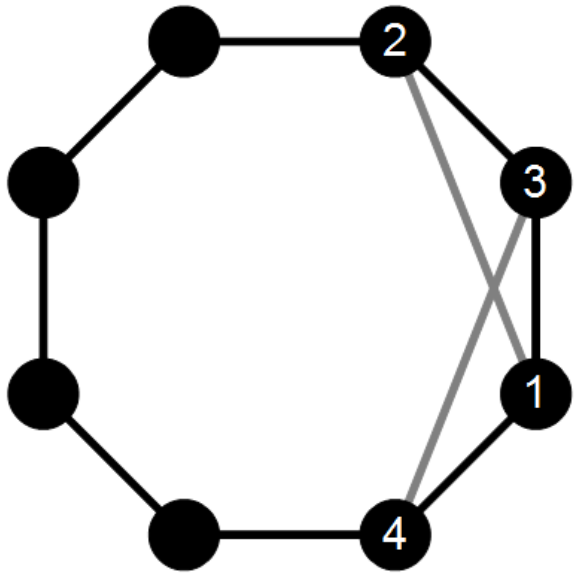

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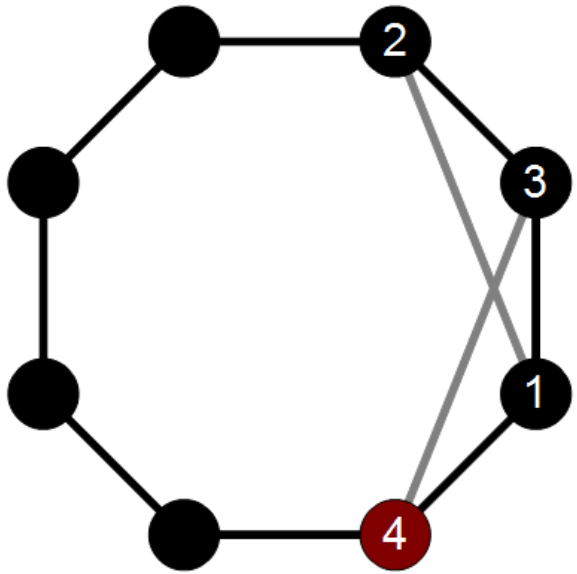

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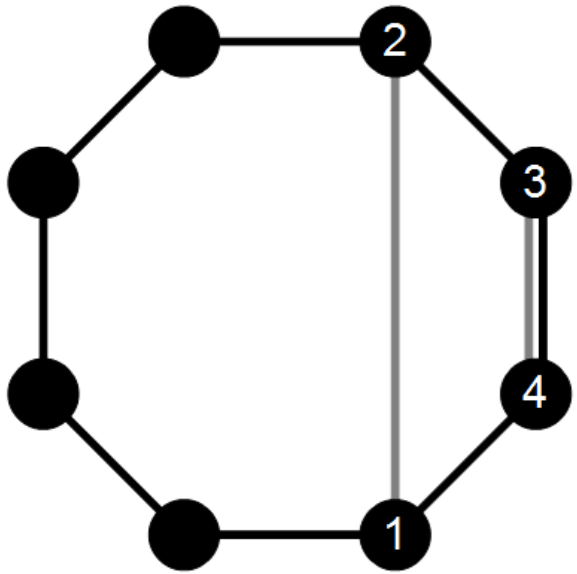

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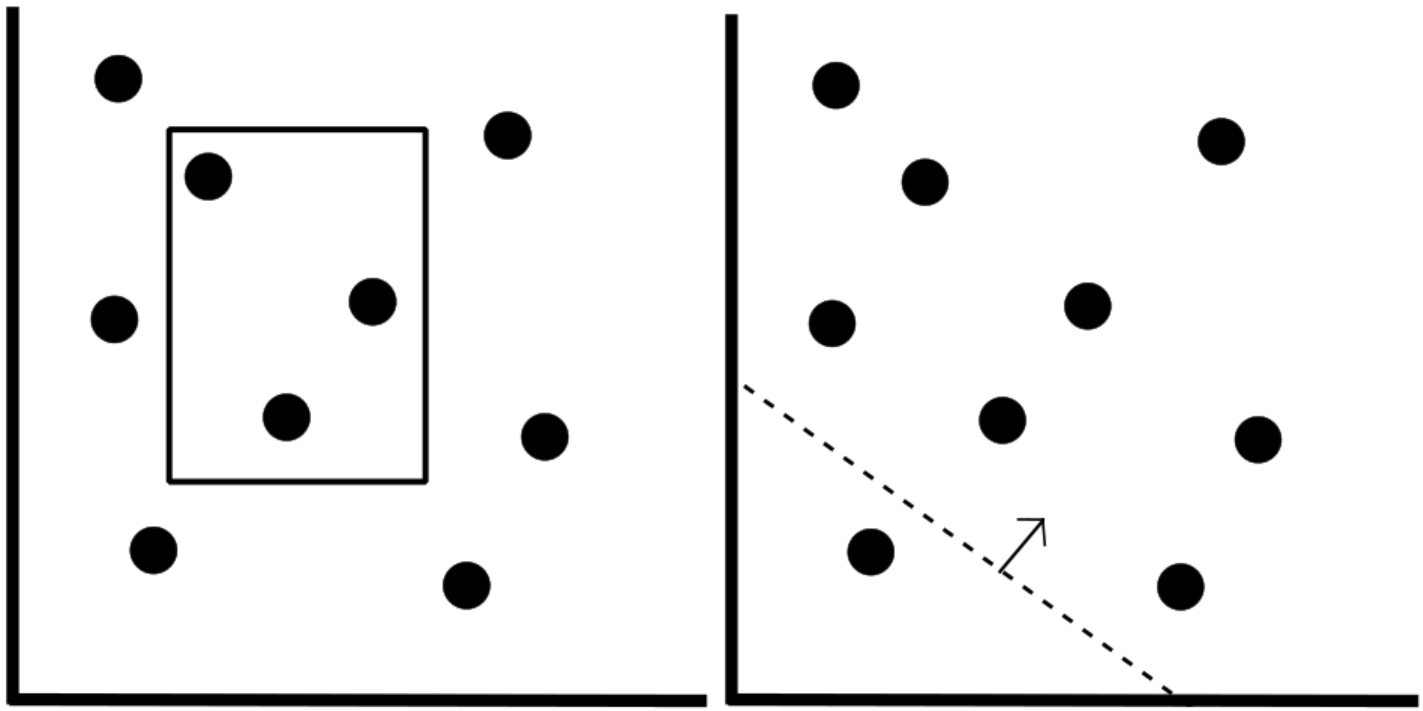
Future Plans

- Approach the start problem
  - Find more easy models and results
  - Generalize techniques
- Identify further reasonable models
  - Consider bandwidths / costs
  - Local view of nodes
- Compare adapting to non-adapting overlays

Range and Search Queries

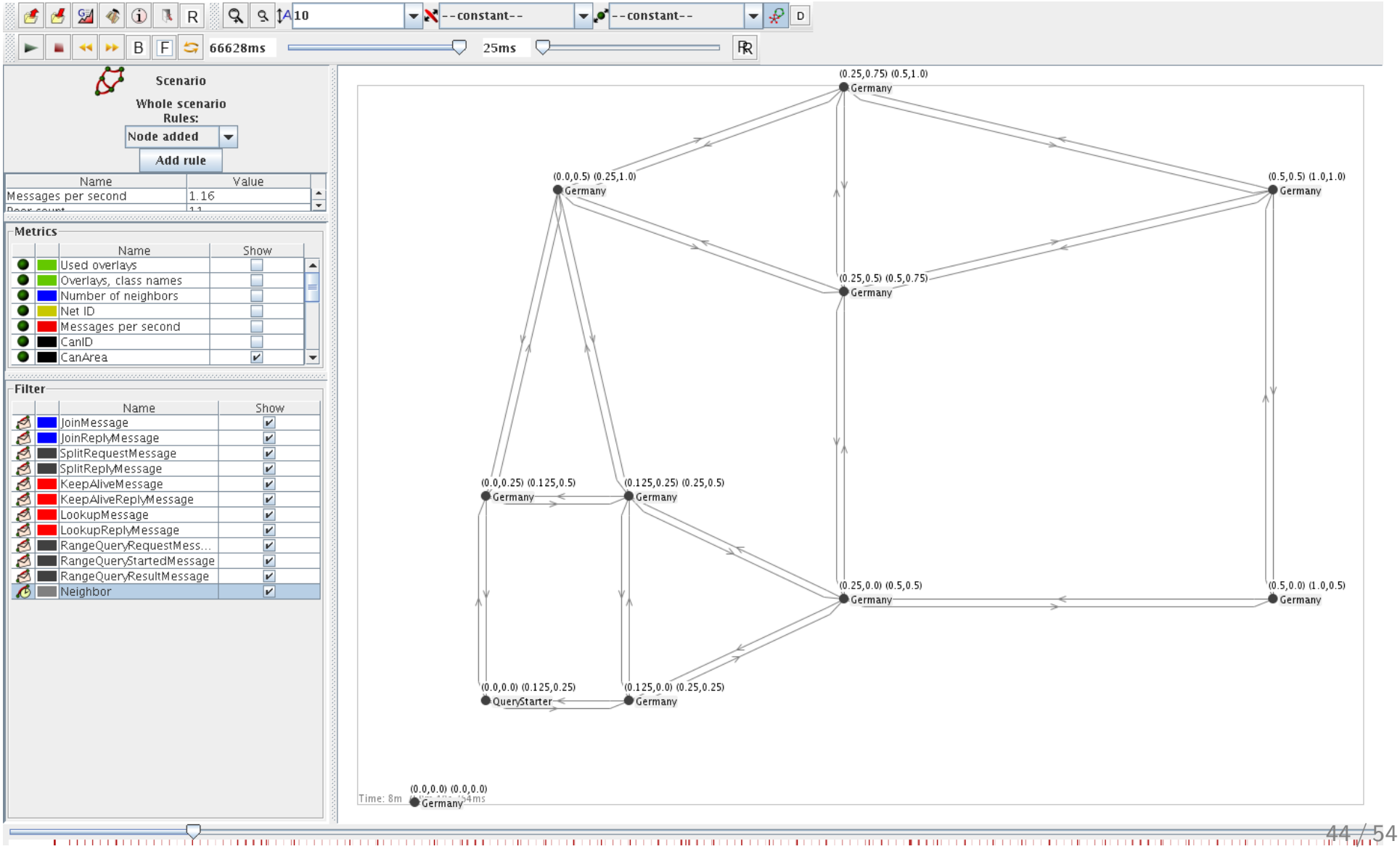
Scenario



- Data items are associated with coordinates in $[0,1]^d$. Tasks:
  - Find all data items in the given range $\mathcal{R} \subseteq [0,1]^d$ or
  - Find a data item $x^* \in [0,1]^d$ maximizing $f : [0,1]^d \to \mathbb{R}$.

Current Progress

Simulator



Current Progress

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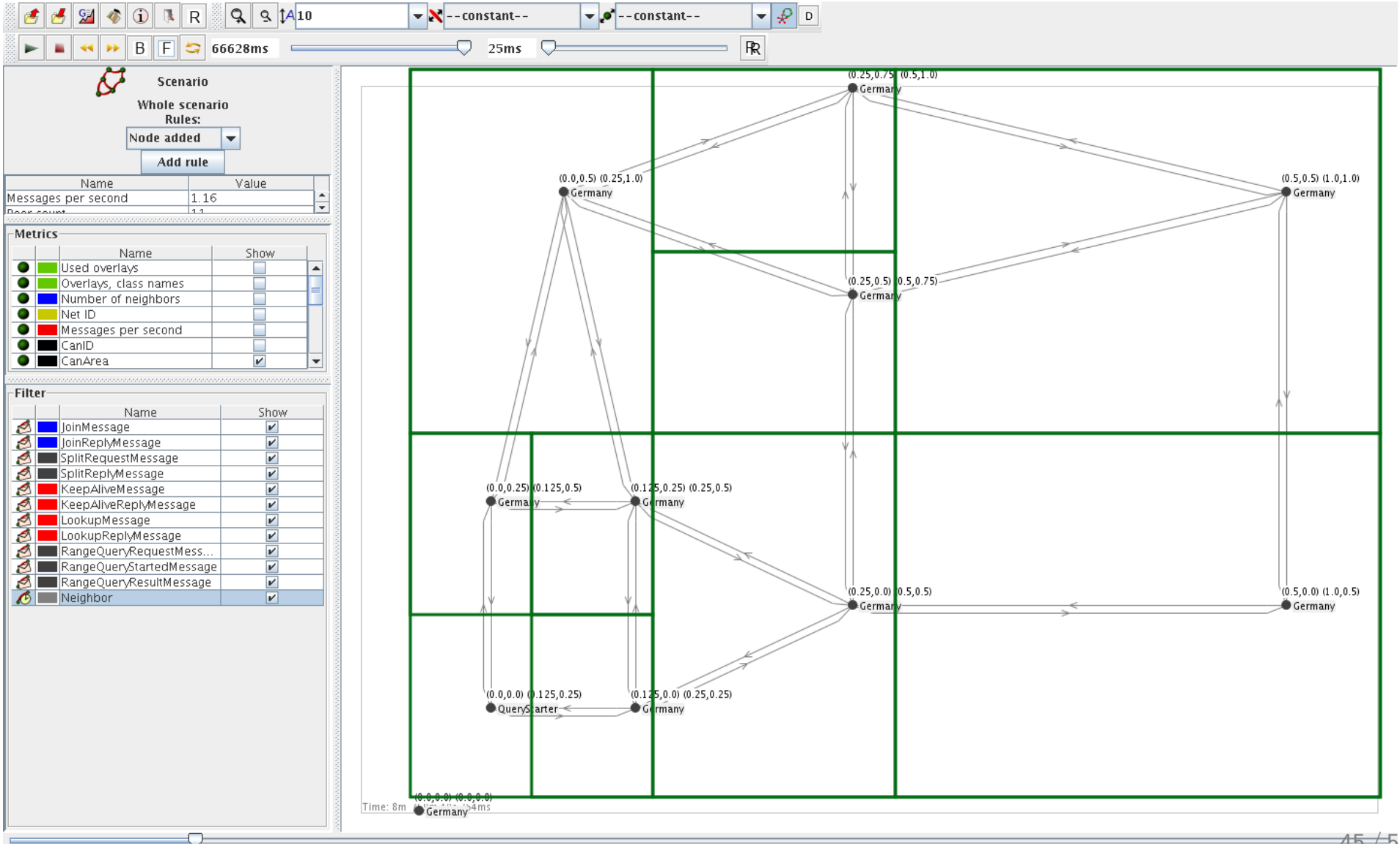
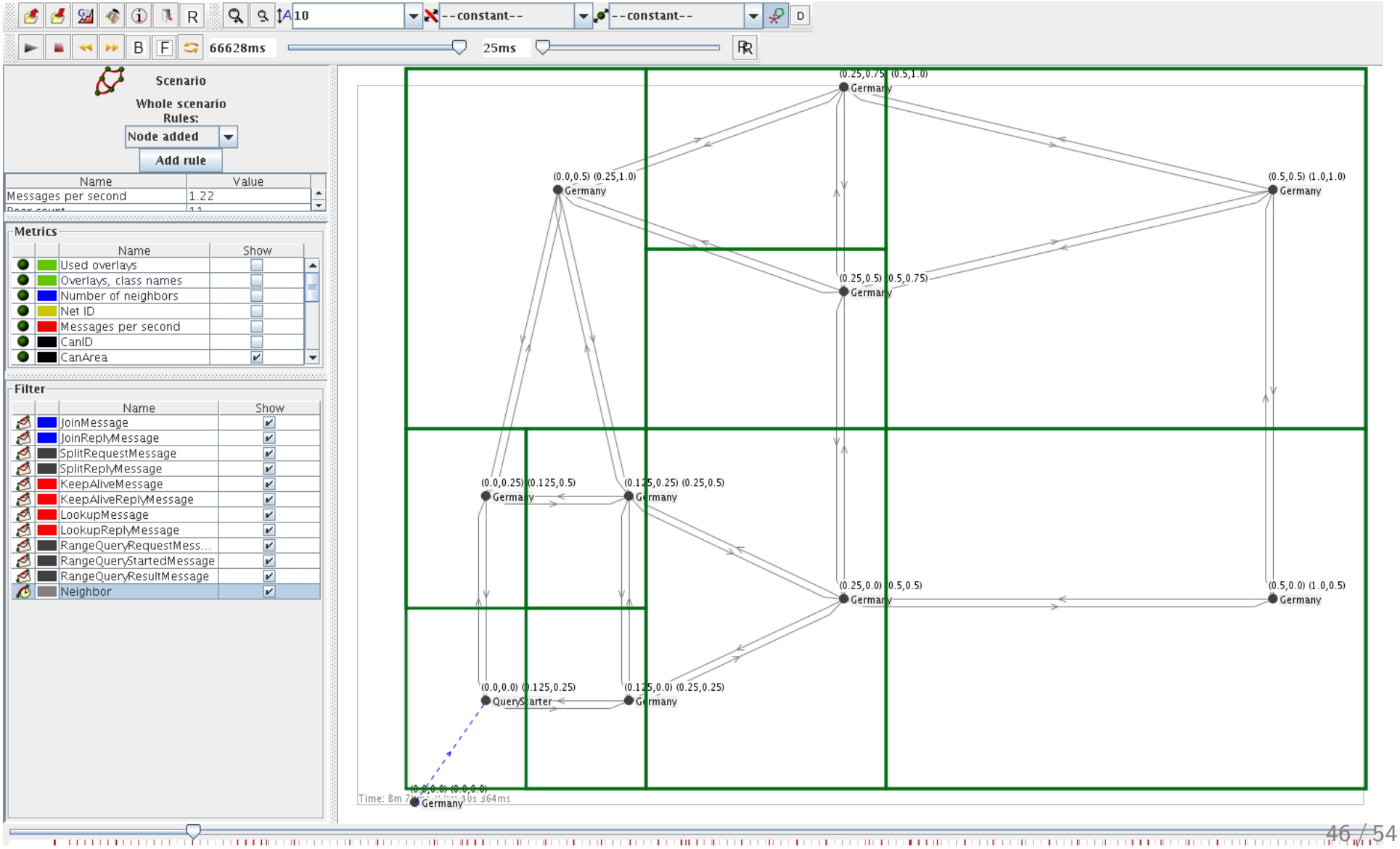


Current Progress

Simulator



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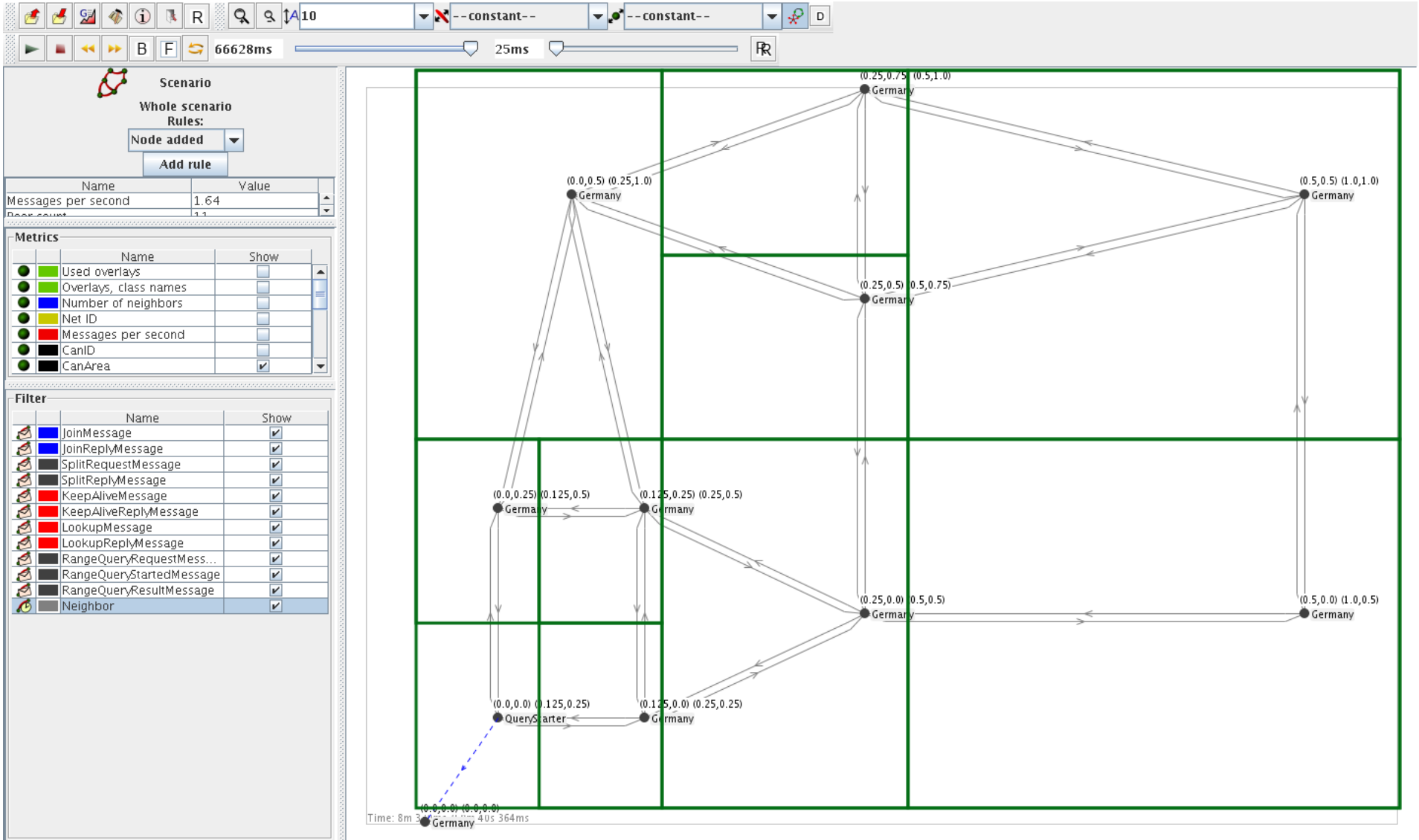

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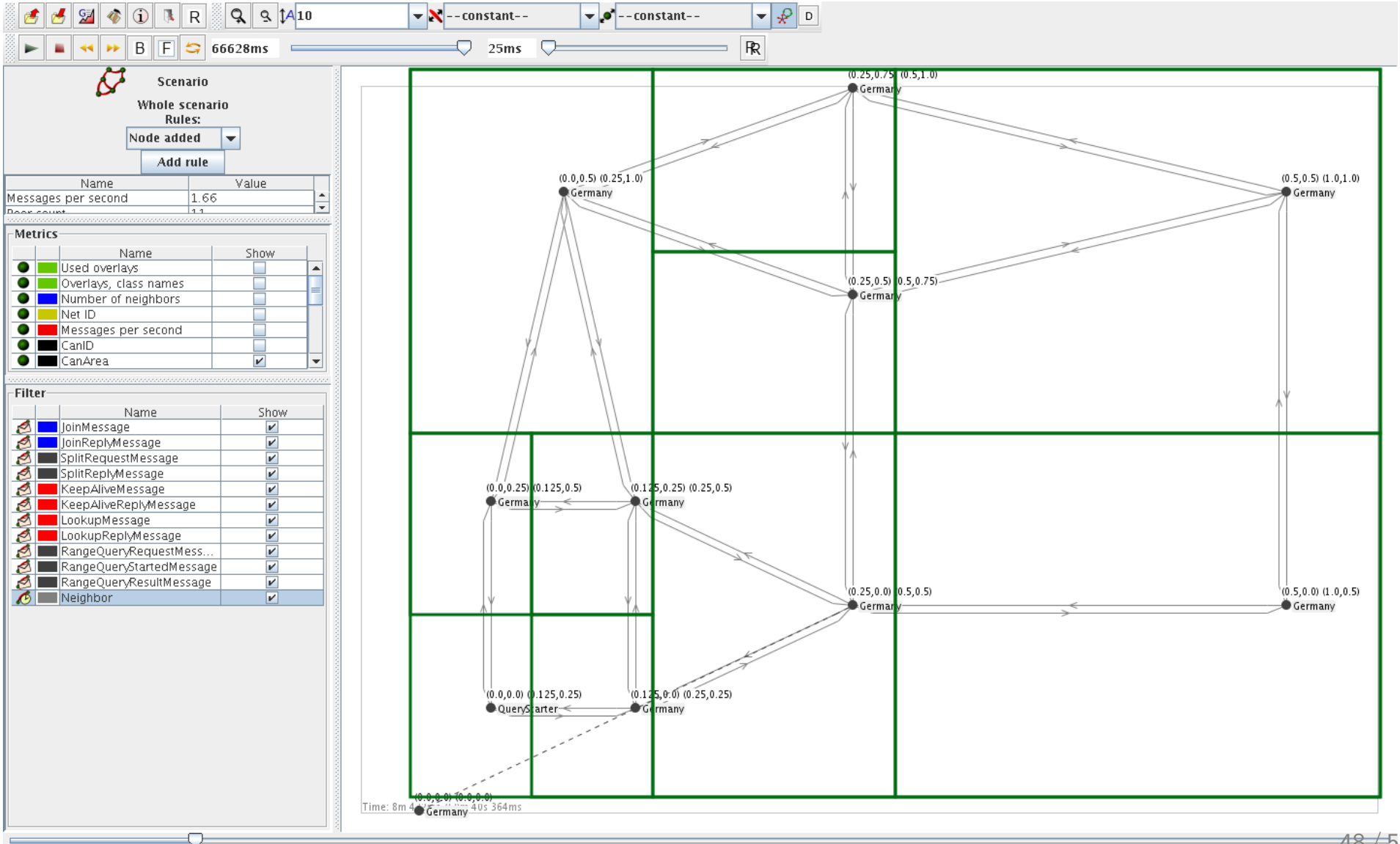

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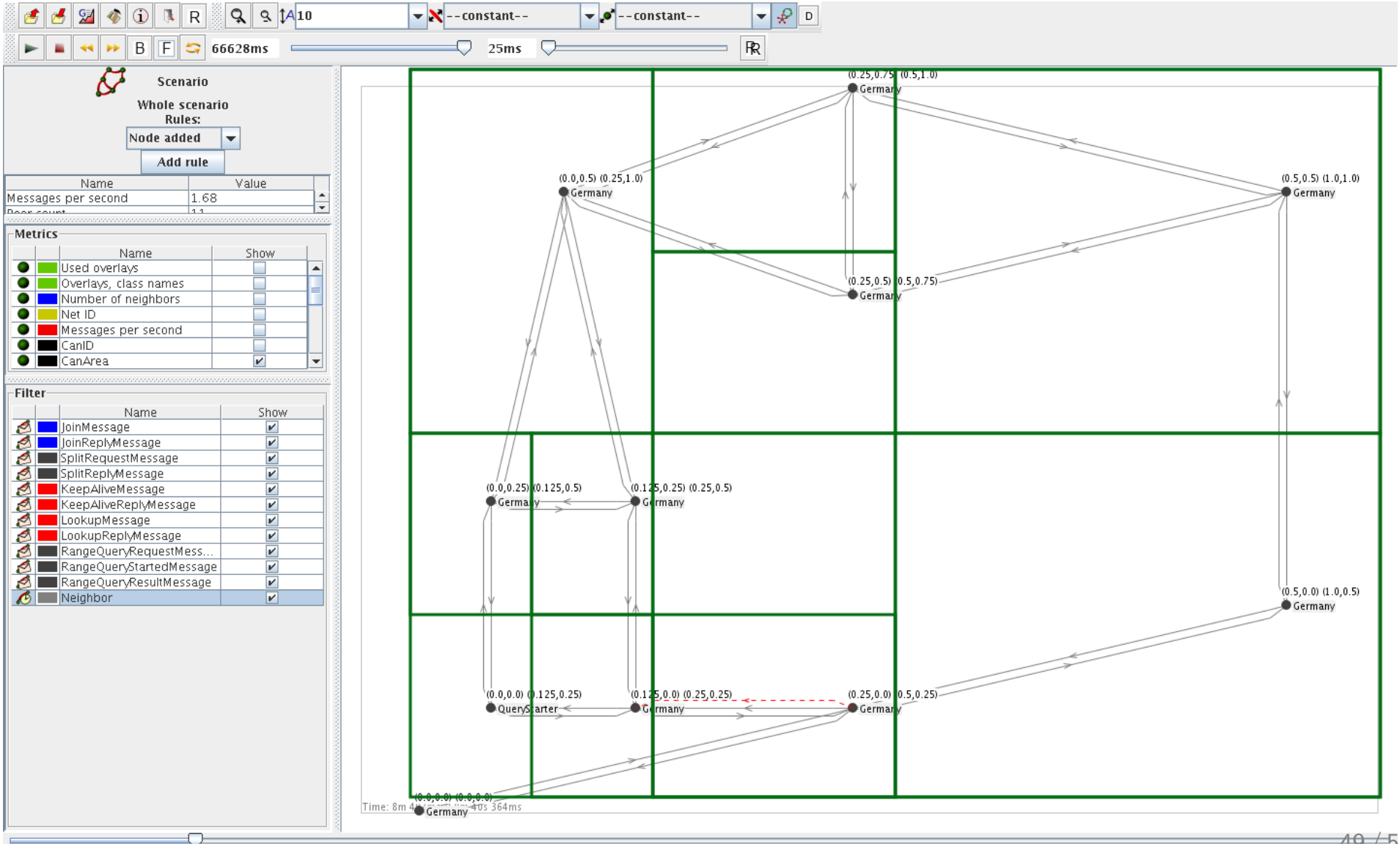

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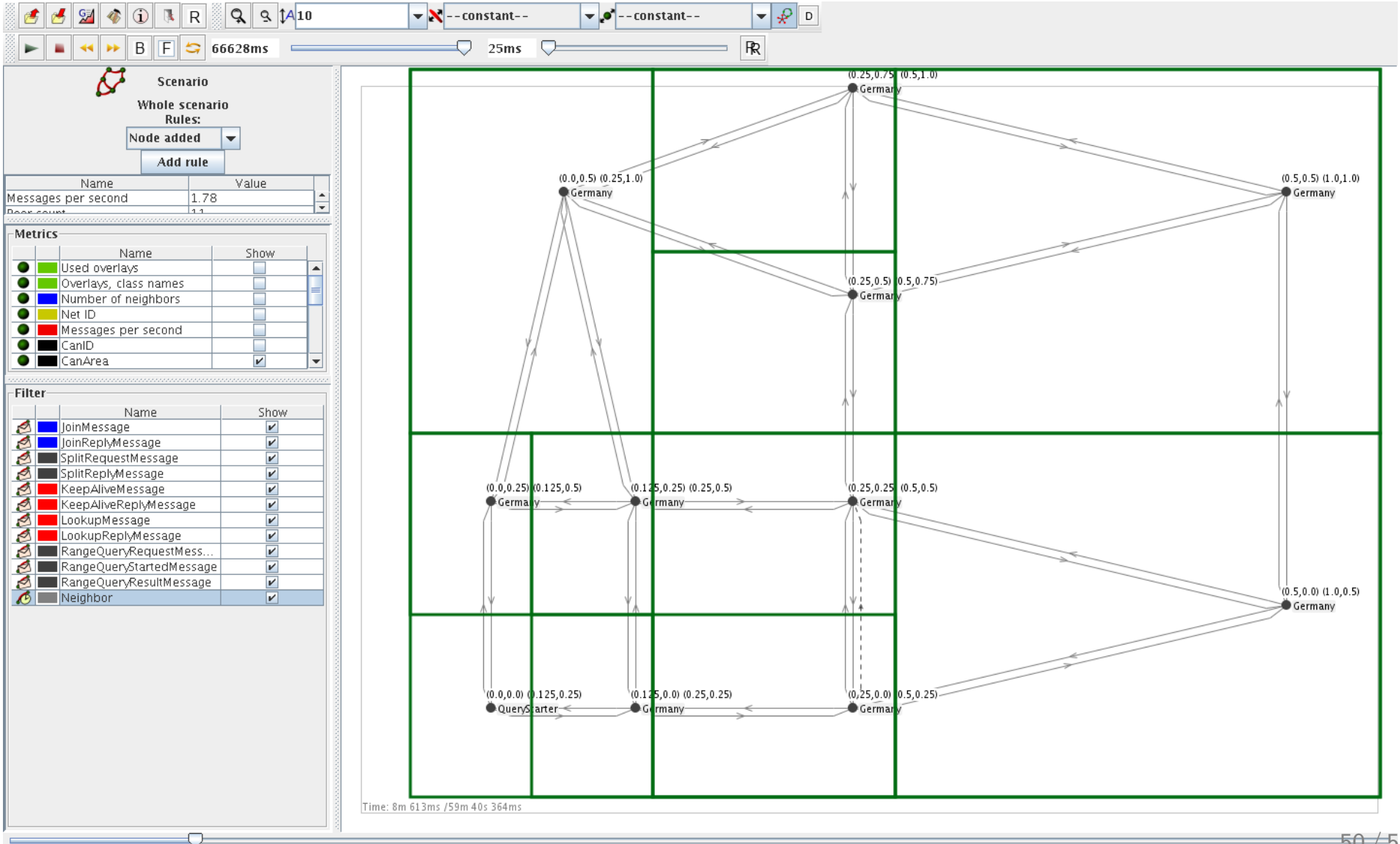

Current Progress

- Algorithm for objective function scenario
- Assumptions:
  - $n = 2^{2k}$ nodes, $k \in \mathbb{N}$
  - Nodes uniformly distributed
  - Areas of equal size
  - Linear function $f : \mathbb{R}^2 \to \mathbb{R}$, non-negative coefficients
- Result: Message complexity $\mathcal{O}(\sqrt{n})$ with overhead $\mathcal{O}(1)$ per node

Next Steps

- Extensions to non-uniform areas, negative coefficients
- Analyze and reduce message size
- Improve routing time
- Looking for more powerful metastructures

Future Plans

- Objective function search extensions
  - More dimensions
  - Broader classes of functions (e. g. convex functions)
- Range queries
  - Start our research

Thank you for your attention.