HyperVerse

Simulation and Testbed Reconciled

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Motivation

	Simulations	Test Deployment
Determinism	Yes	No
Scale	Large	Usually small
Development/Deployment	Simple	Complex
Flexibility	High	Low
Assessment	Synthetic	Realistic / Subjective
Usable	No	Yes
...		
HyperVerse	TopGen	HyperVerse Browser

A Hybrid Approach
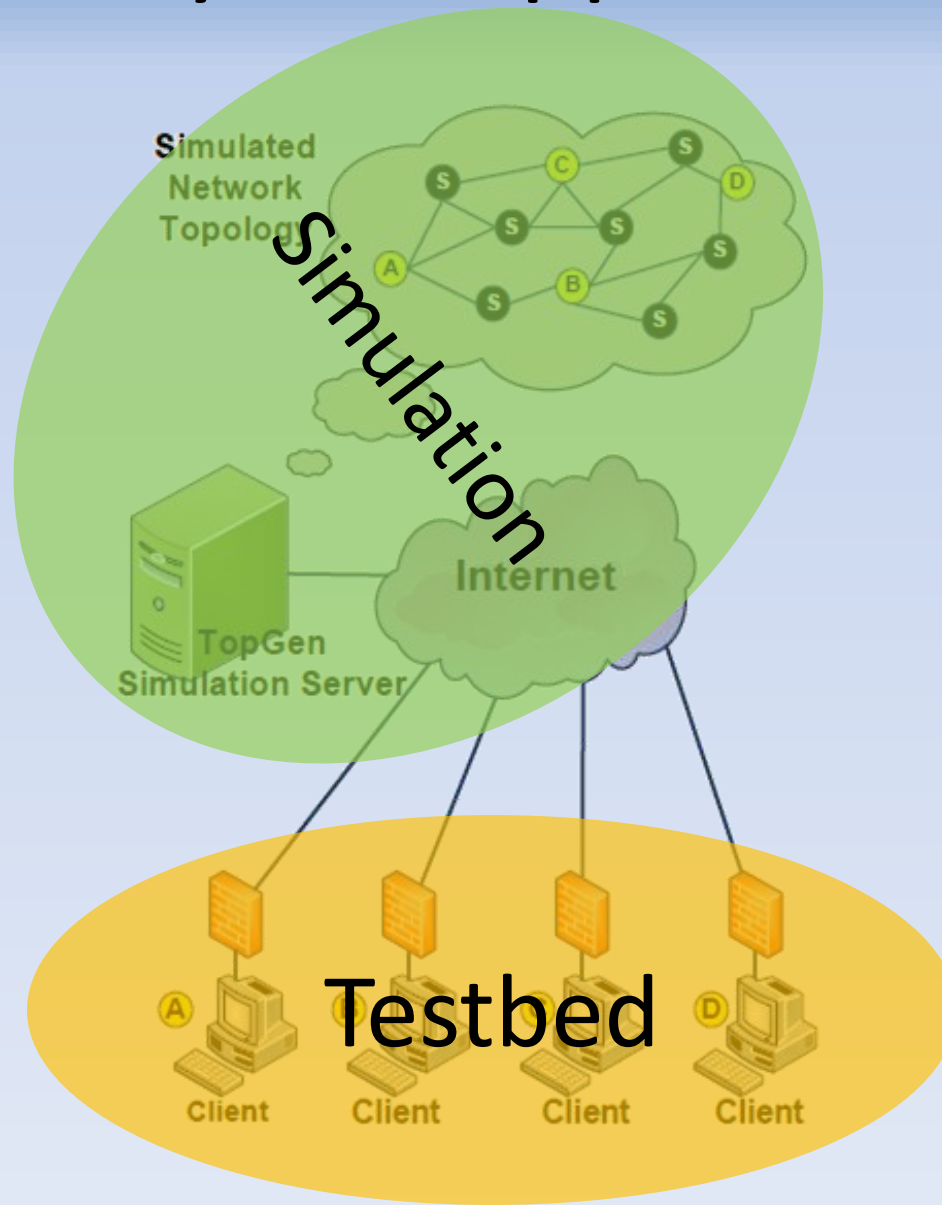
TopGen

- Simulation Environment for **Complex Systems**

  - Network Topologies

  - Cellular Automata

  - Spatialized Entities

  - Autonomous Agents

  - Geometric Graphs

  - Router Networks

    ...
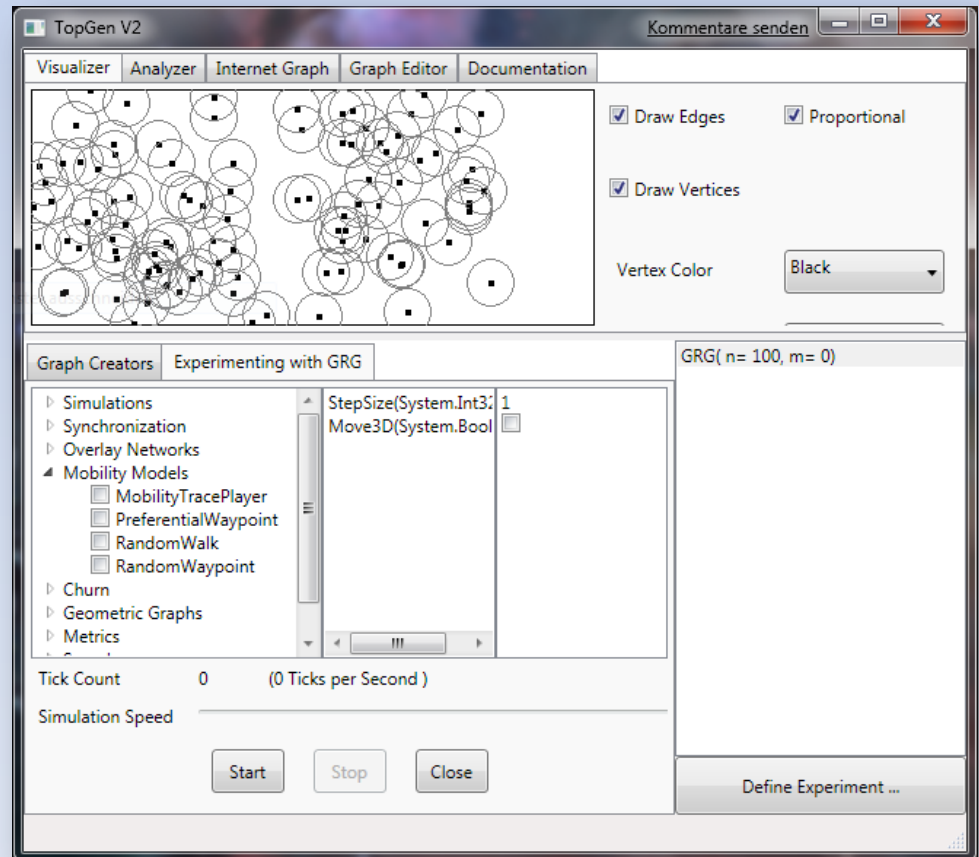
Key Features (1/2)

- **Modular Design**
  - Arbitrary Simulati...
  - Composable Simu...
  - Modern Paradigm...
- **Powerful Framew...**
  - Graphs, N...
  - Thread-s...
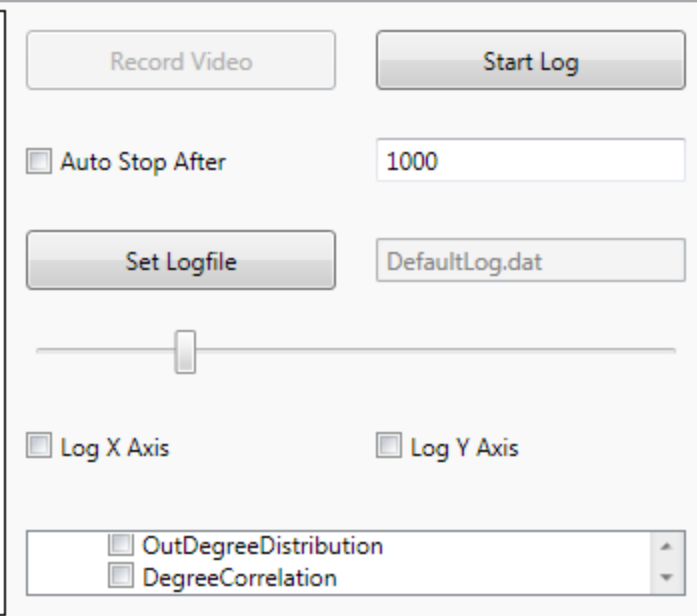 - Full in-co...
  - Extendab...
- **Real-time 2...**
  - Recordab...

Key Features (2/2)

- **Multi Core Scala...**
  - Automatic paral...
  - Retaining deter...
    Memory

- **Analysis Comp...**
  - Rea...
  - Log...
  - Fitt...
  - Fas...
  - ...
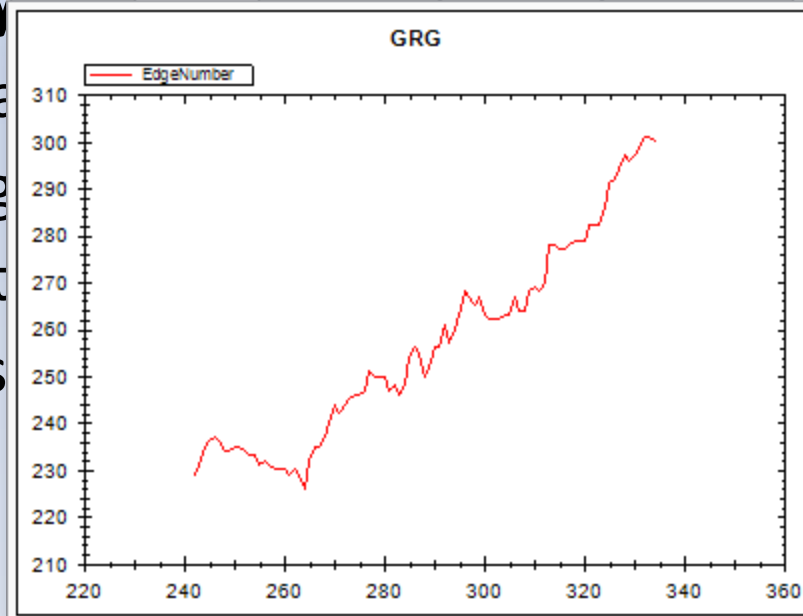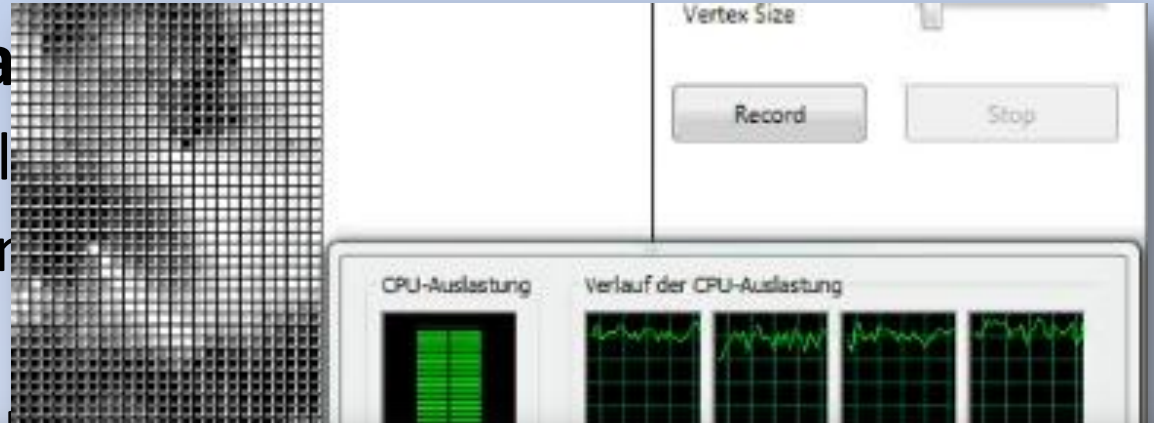
Programming Model
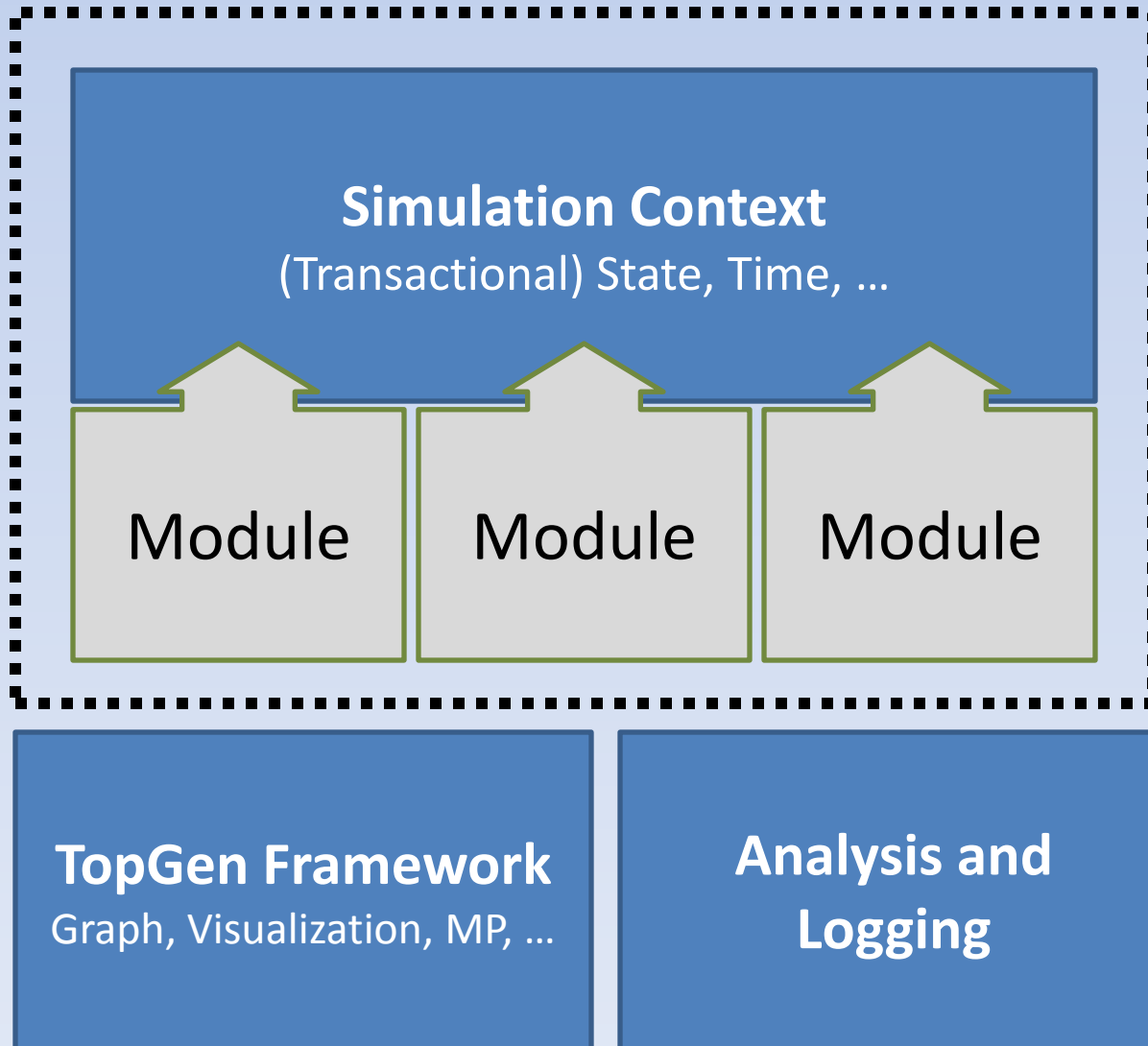
Technicalities

- Open source

- Implemented in C# 3.0 (.NET 3.5/MONO 2.0)
  - Compiles and runs on MONO (except WPF-GUI)
  - ECMA-standardized OpenSource CLR

- TopGen Framework
  - OS-independent
  - Architecture-independent
  - Language-independent

- Module-development
  - In any CLR-language (C#, J#, C++, Boo, F#, …)

Showcases ...
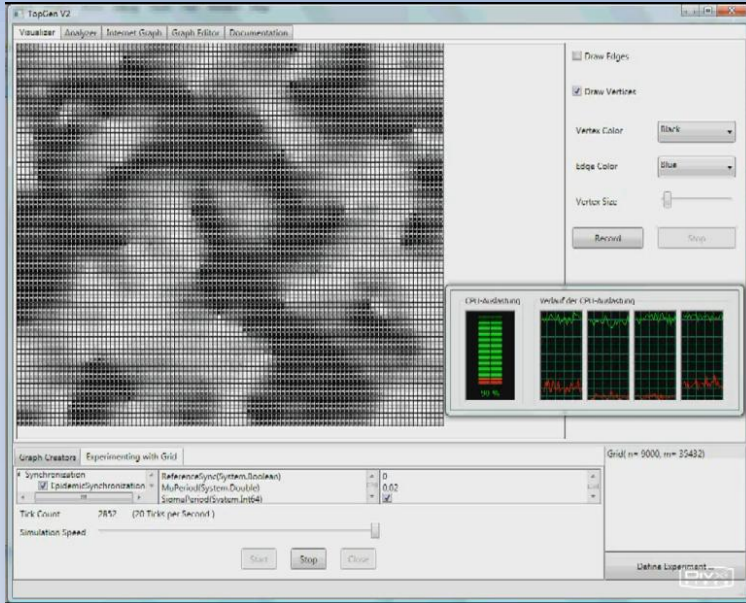
(for details see Complex'09)
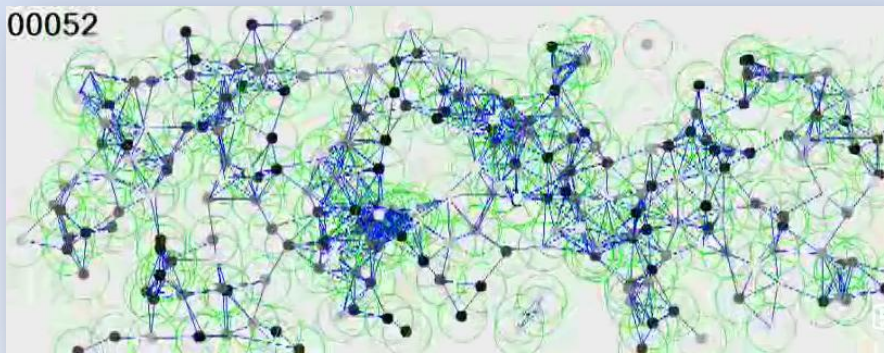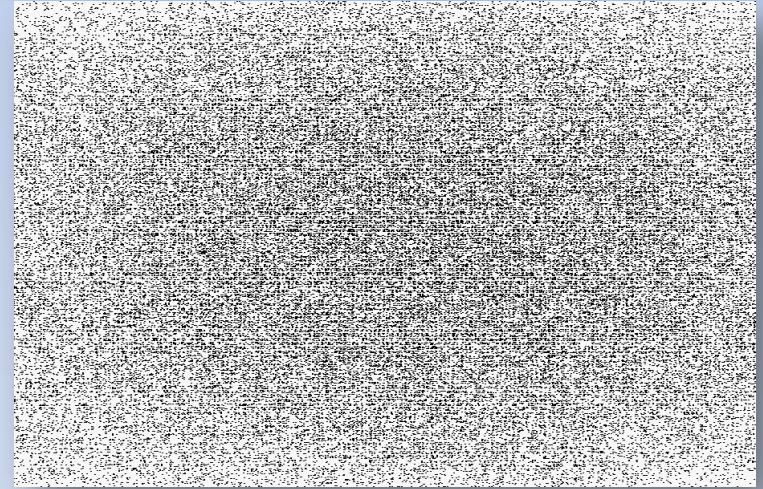
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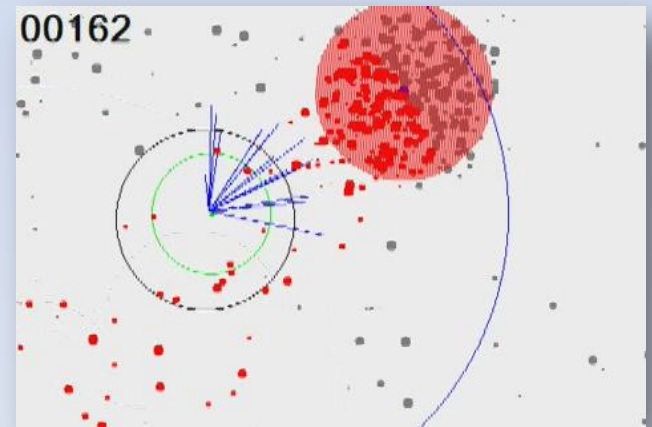
(for details see CollaborateCom 2008)

A Hybrid Approach
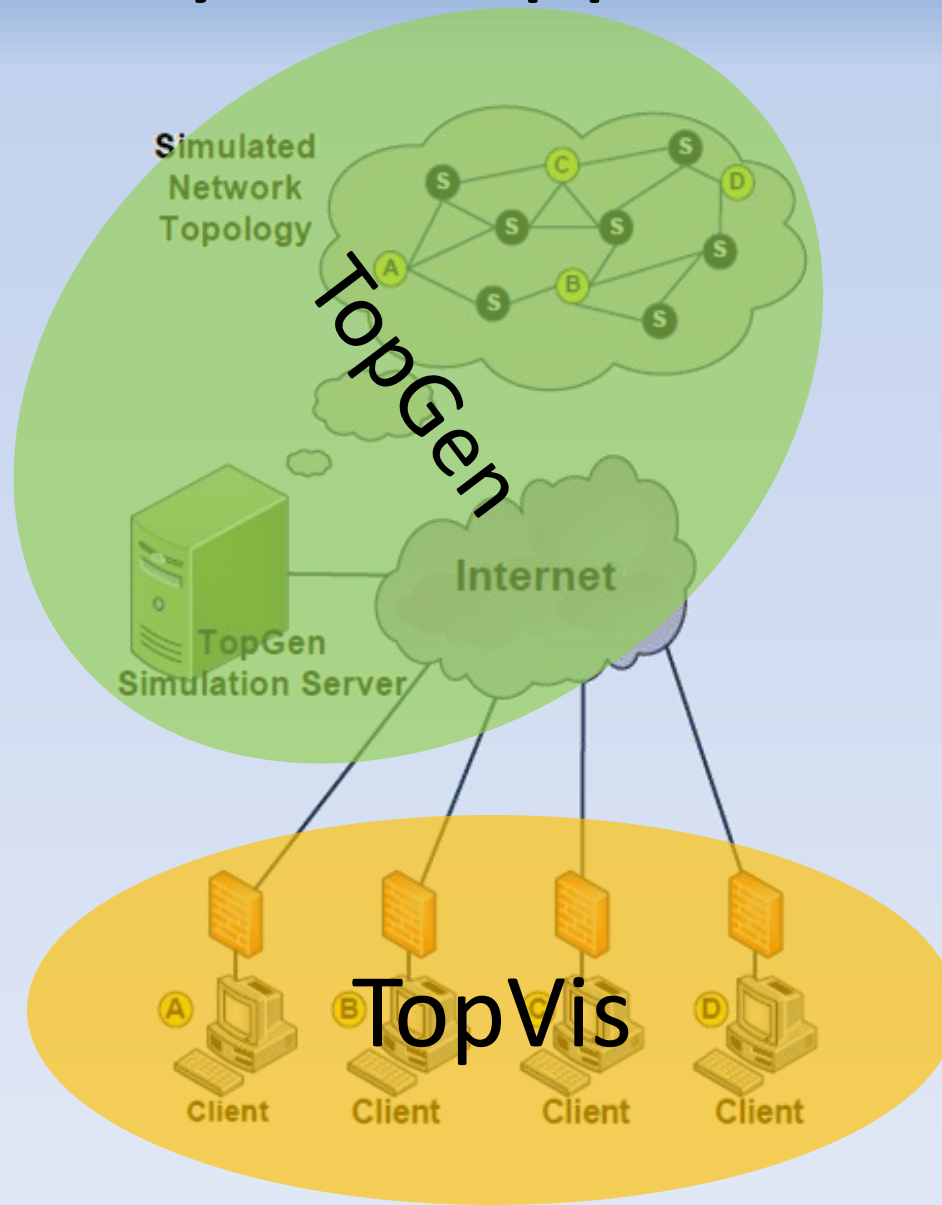
Client Considerations

- ## Generic and modular
  - Basic rendering facilities (any XNA-compatible content)
  - Client-logic customizable via dynamically-loadable plugins

- ## Ease-of-Implementation
  - High-level networking abstraction
  - Consistent communication model
  - „Message Bus"

- ## „Firewall-neutral"
  - No complex traversal required
  - All traffic via client-initiated TCP connection

TopVis Architecture
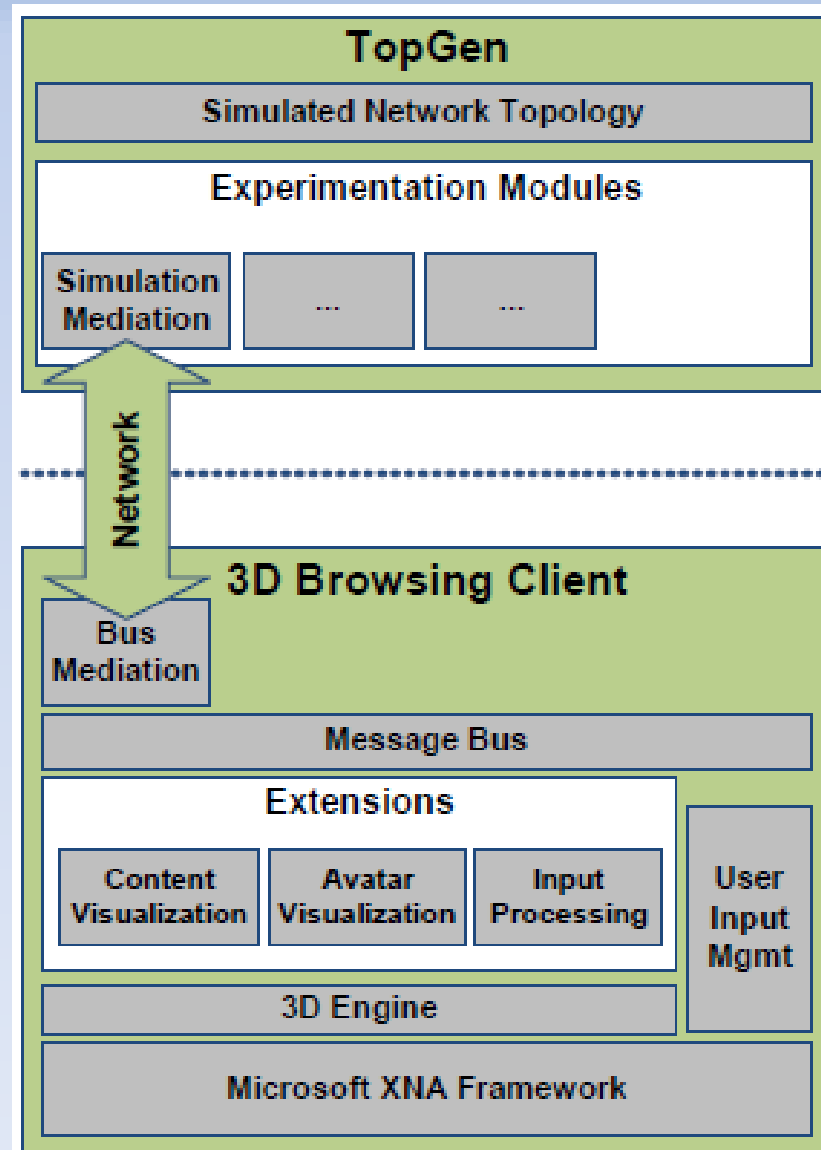
TopVis Programming Model
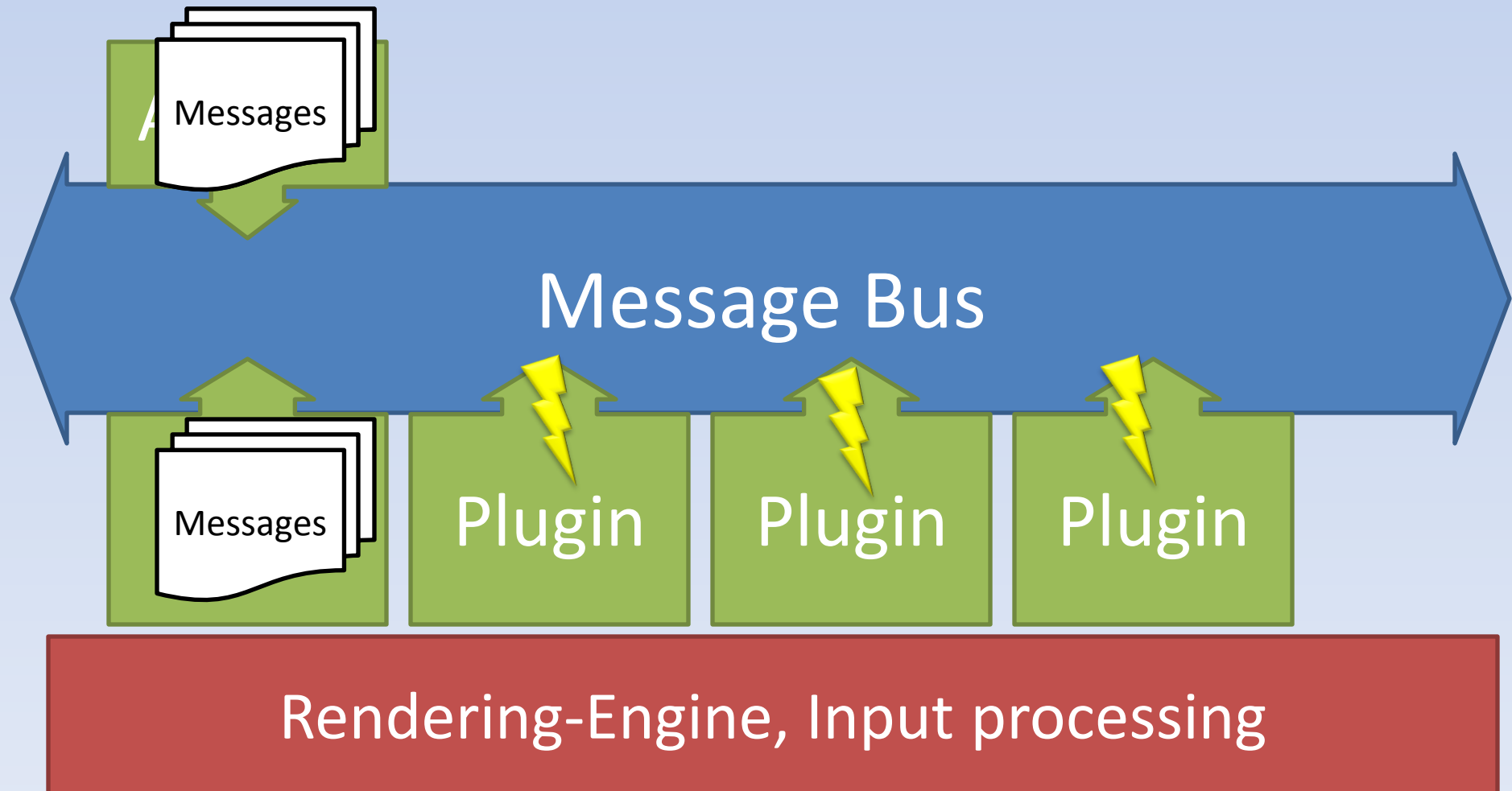
Showcases …
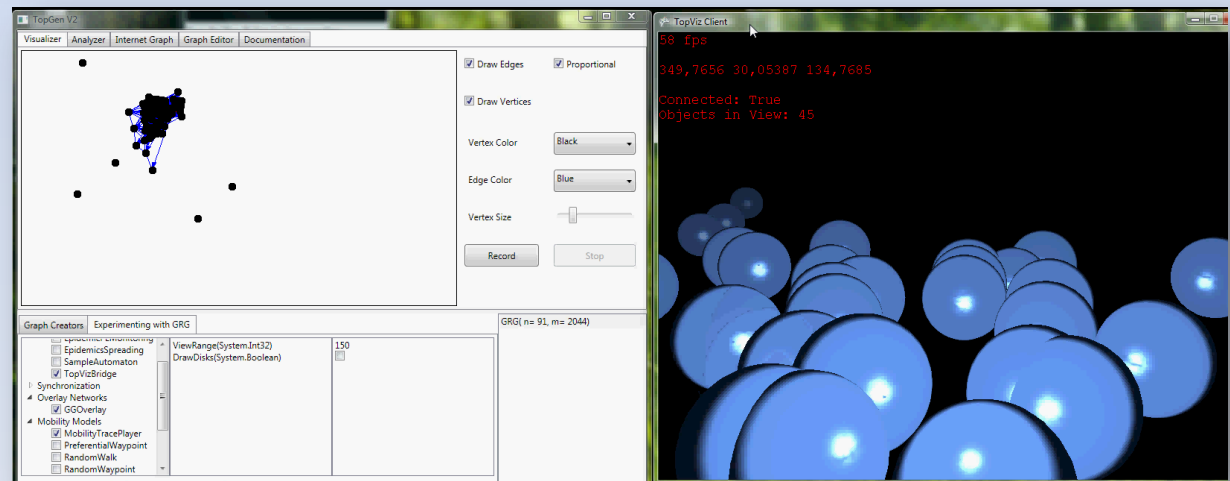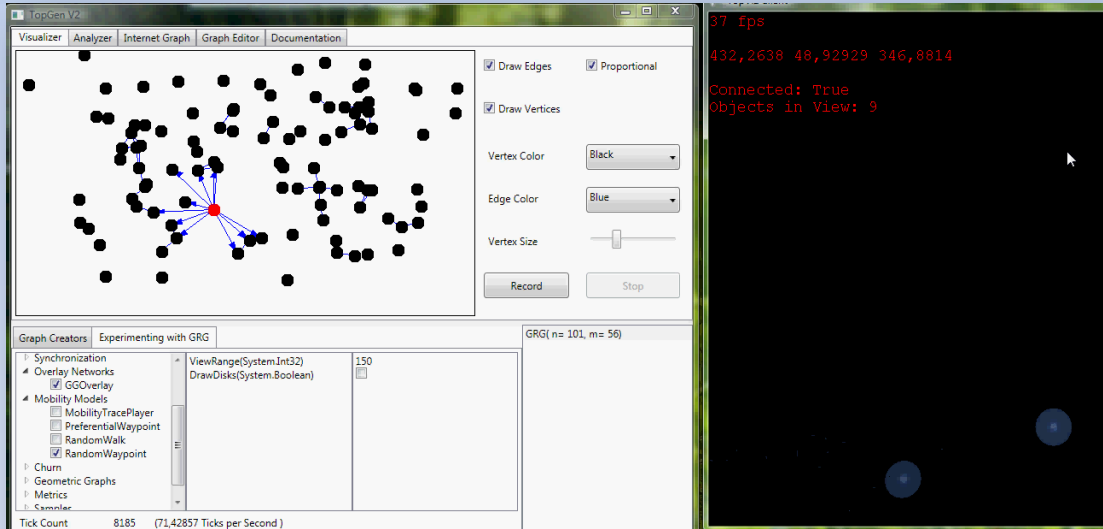
Usage Scenarios

- Pure Simulation Scenario
  - TopGen as simulation environment
  - No active TopVis clients
  - TopVis usable for Realtime 3D Visualization
- Pure Testbed Scenario
  - TopGen as (centralized) DVE Server
  - Simulated overlay with controllable delays
  - No simulated entities
  - TopVis as DVE clients
- Hybrid Scenario
  - TopGen as simulation environment + DVE server
  - Active/Passive TopVis clients

Benefits and Open Issues

- Benefits
  - Overlay topologies can be tested with actual clients
  - Topologies can be changed in real-time
  - Simplified Development/Deployment
  - Controllable network delays based on router network
  - Flexible usage

- Open Issues
  - Number of supportable TopVis clients
  - Ready-to-use MONO version

TopGen(-powered) References

[SimuTools08] Scholtes et al.: *„TopGen - Internet Router-Level Topology Generation based on Technology Constraints"*, In Proceedings of SimuTools, March 2008, Marseille, France

[IJAMC08] Botev et al.: *„The HyperVerse: Concepts for a federated and Torrent-based 3D Web"*, In IJAMC, Vol.2, No. 4, June 2008

[SaSo08] Scholtes et al.: *„Awareness-driven Phase Transitions in Very Large Scale Distributed Systems"*, In Proceedings of IEEE SaSo, Oct. 2008, Venice, Italy

[CollaborateCom08] Scholtes et al.: *„Minimizing Load Delays in Distributed Virtual Environments using Epidemic Hoarding"*, In Proceedings of CollaborateCom, Nov. 2008, Orlando, FL, USA

[Complex09] Scholtes et al.: *„Epidemic Self-Synchronization in Complex Networks"*, In Proceedings of Complex'09, Feb. 2009, Shanghai, China

Thank you …

- Questions? Comments?

- Check it out!

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