



Efficient and Realistic Simulation of VANETs with JiST/SWANS

Requirements on Realistic Simulation of VANETs

- Realistic node mobility models
 - Highways with quasi 1D movement pattern, high node speed
 - Urban scenarios with complex road structure
 - Mutual influence of communication and node mobility
- Large number of nodes ($\gg 100$)
- Realistic radio propagation in urban environments
 - with lots of buildings and obstacles
- Medium access mechanisms (802.11p, DSRC)
- Multi-hop message dissemination schemes
- Dedicated applications

JiST/SWANS - Overview

JiST

Java in **S**imulation **T**ime

→ entirely Java-based simulator engine

- Developed at Cornell University
- Basic ideas:
 - Introduce virtual time semantics of simulations into JVM
 - Use Java's reflection capabilities and bytecode rewriting to decouple method calls
- Totally in Java
 - Type safety, garbage collection, platform independence

SWANS

Scalable **W**ireless **A**d Hoc **N**etwork **S**imulator

→ component library for ad hoc network simulations

- Runs atop of JiST
- Various implementations of radio propagation, node mobility, medium access, routing, transport and application
- Allows for integration of legacy Java networking apps

JiST/SWANS - Performance

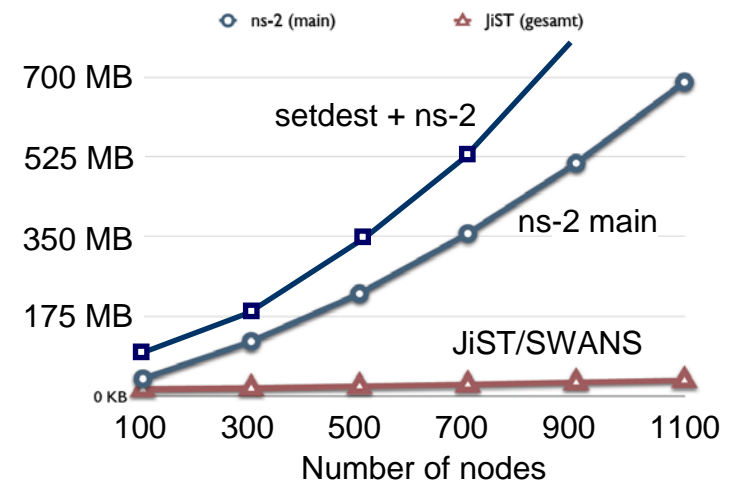
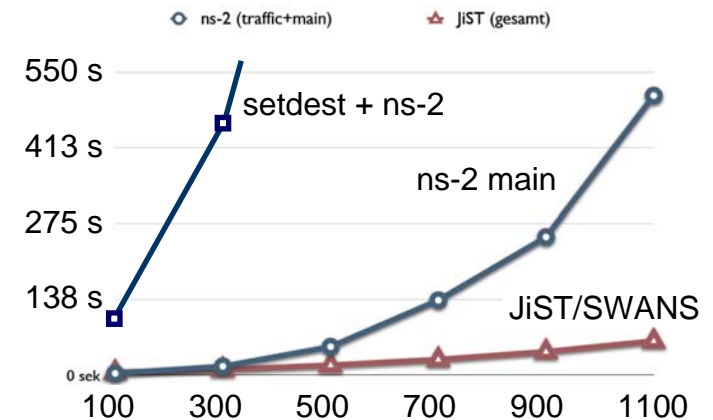
- Comparison to well-known simulators
- Processing time

5×10^6 events	time (sec)	vs. baseline	vs. JiST	*
baseline	1.640	1.0x	0.8x	
JiST	1.957	1.2x	1.0x	
Parsec	3.705	2.3x	1.9x	
ns2-C	5.151	3.1x	2.6x	
GloMoSim	23.720	14.5x	12.1x	
ns2-Tcl	160.514	97.9x	82.0x	

- Memory requirements

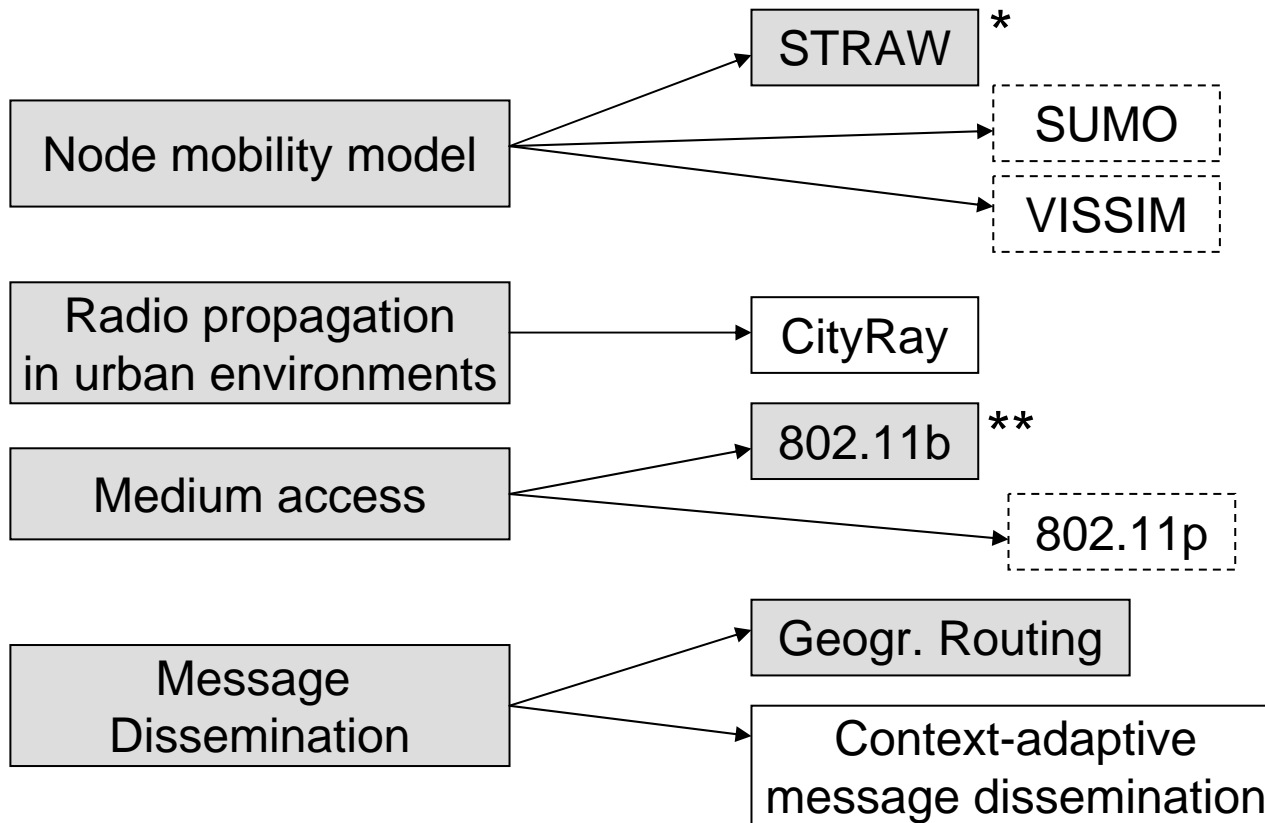
memory	entity	event	10K nodes sim.	*
JiST	36 B	36 B	21 MB	
GloMoSim	36 B	64 E	35 ME**	
ns2	544 B	36 B*	72 MB*	
Parsec	28536 B	64 B	2885 MB	

SWANS using georouting



[*] Source: JiST Documentation [**] without any simulation data

Simulation of VANETs ... with SWANS



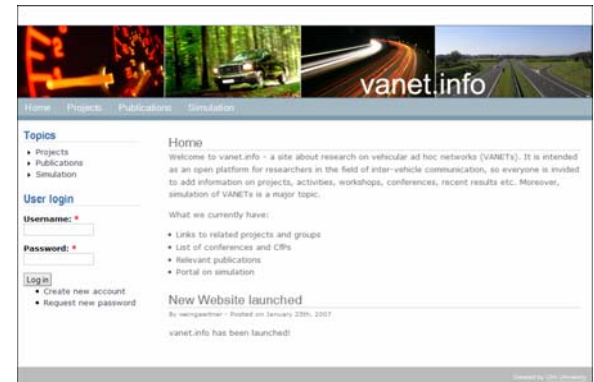
Extensions by Ulm University

DUCKS Execution Framework

- Supports simulation cycle:
 - setup simulations using config files
thousands of simulations with 1 config
 - execute in parallel on multiple
JiST servers
 - collect & evaluate results
using a relational database and GUI-tool

Extensions of SWANS

- Geographic routing
Geounicast, -broadcast, -anycast
- Various mobility support
(e.g. replay of GPS traces)
- Various helper classes & bugfixes



Soon available on
<http://www.vanet.info>

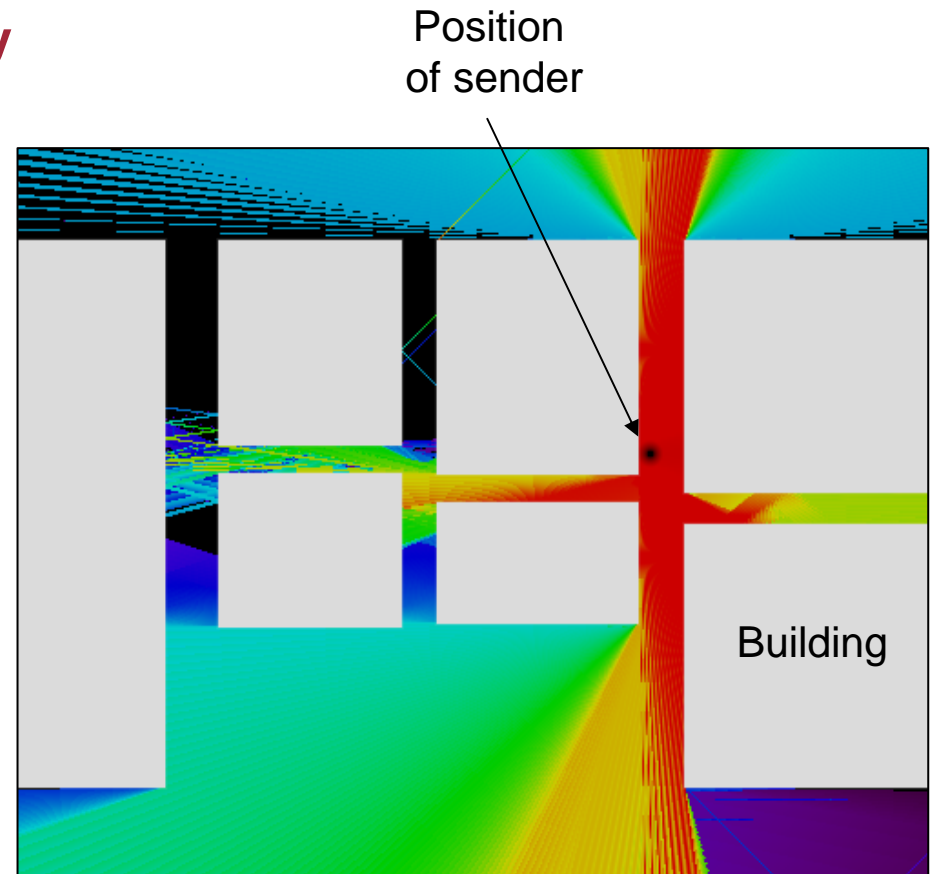
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Current activities

- Radio propagation model using raytracing
 - particularly relevant for evaluation of VANETs in urban scenarios
- Context-adaptive message dissemination
- Optimized geocast mechanisms

Plans

- Coupling with VISSIM (Micromobility)
- Integration & evaluation of security mechanisms



Outlook

Research topics to be addressed at our institute:

- Increase efficiency of radio model by high-performance real-time ray tracing methods developed at our institute
- Introduce security operations in simulation time semantics

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