





# Efficient and Realistic Simulation of VANETs with JiST/SWANS

Elmar Schoch | C2C-CC Simulation Workshop | 29.03.2006

# **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 ( >> 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 Simulation Time  $\rightarrow$  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 Wireless Ad Hoc Network Simulator

- → 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

$5 \times 10^6$ 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	1
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

Home Projects Publica	vanet info
Topics	Haven
Projects     Publications     Simulation	HOMIR Welcome to vanet.nfo - a site about research on vehicular ad hoc networks (VANETs). It is intended as an open platform for researchers in the field of inter-vehicle communication, so everyone is invider to add information on projects, activities, workshops, conferences, recent results etc. Moreover,
User login	simulation of VANETs is a major topic.
Isemame: •	What we currently have:
	<ul> <li>Links to related projects and proups</li> </ul>
Password: *	List of conferences and CIPs
	Relevant publications
Login	Portal on simulation
Create new account     Request new password	New Website launched
	By weingawitner - Protect on January 2005, 2007
	vanet info has been launched!

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

# **Extensions by Ulm University**

**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



Position

## **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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