JiST:
Java in Simulation Time

for

Scalable Simulation of Mobile Ad hoc Networks

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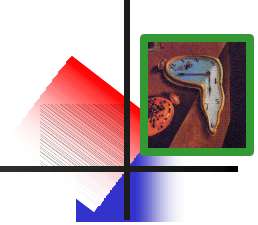
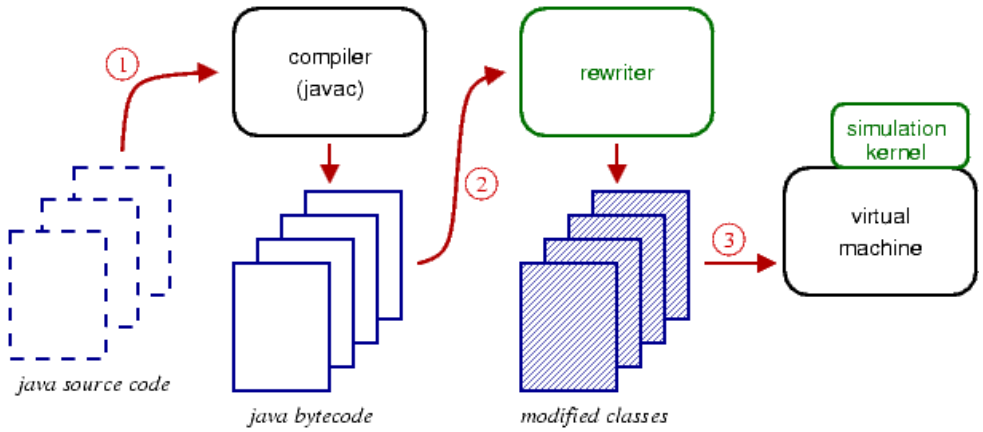
JiST – Java in Simulation Time



- **Simulation scalability is important**
- **JiST is a new approach to building simulators: it extends the Java object model and execution semantics, and leverages the Java virtual machine to run simulations efficiently and transparently.**
- **Bring simulation semantics to modern, popular language**
  - **run plain-Java programs in simulation time**
  - **merges systems and languages approaches to simulator construction**



Simulation throughput

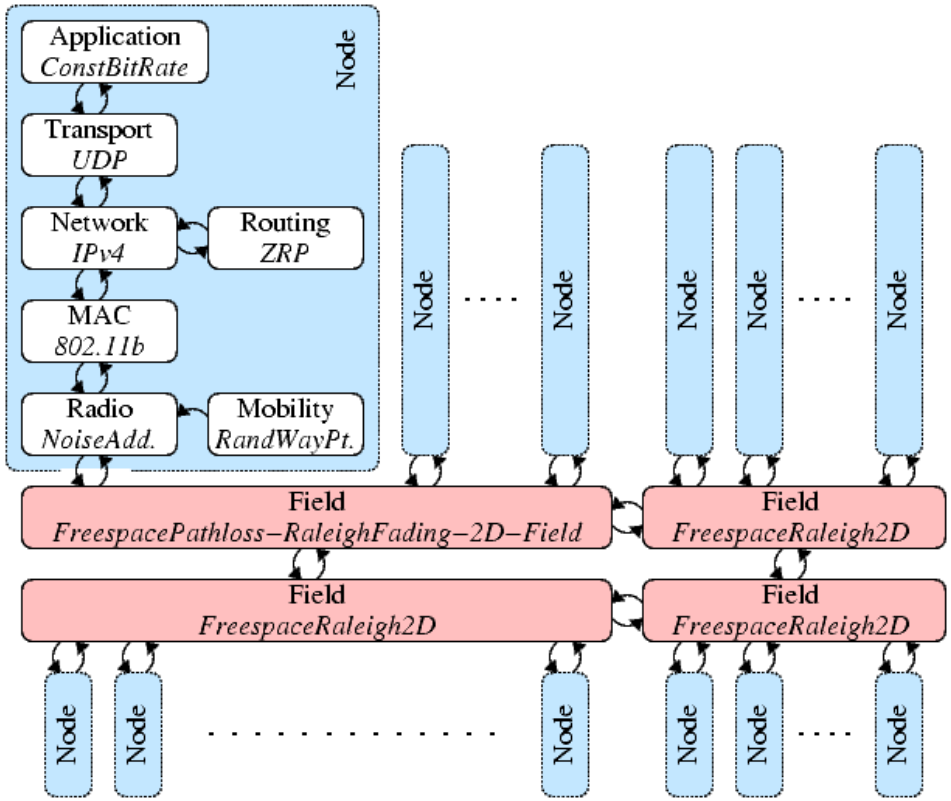
5x10^6 events	time (sec)	vs. JiST
JiST	**0.97**	**-**
Parsec	1.91	**2.0x**
ns2-C	3.26	**3.4x**
GloMoSim	9.54	**9.8x**
ns2-Tcl	76.56	**79.0x**

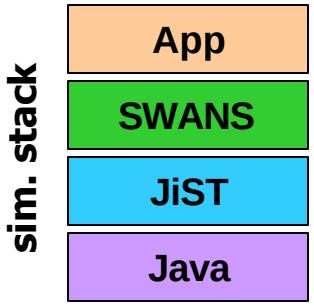
Simulation footprint

memory	per entity	per event
JiST	**36 B**	**36 B**
GloMoSim	36 B	64 B
ns2 *	544 B	40 B
Parsec	28536 B	64 B

SWANS

- **Scalable Wireless Ad hoc Network Simulator**
  - **runs standard Java network applications over simulated networks**
  - **uses hierarchical binning for efficient signal propagation**

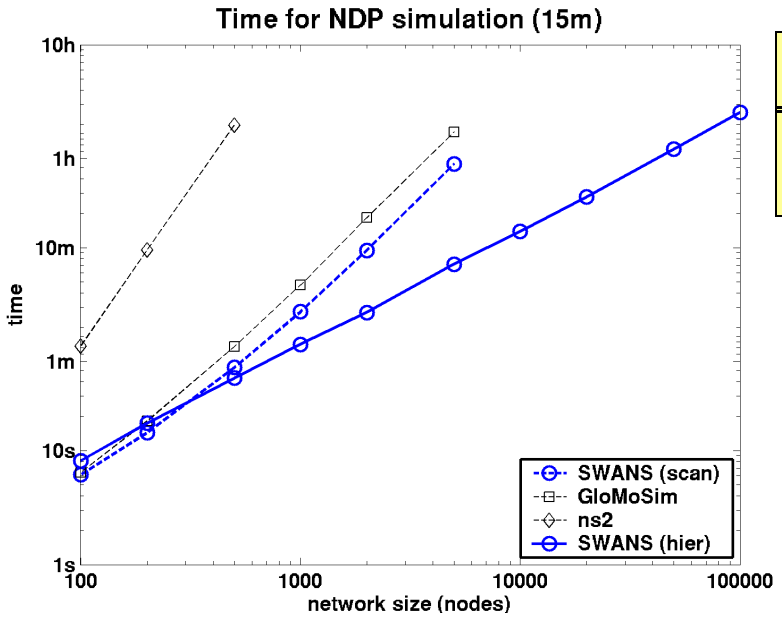




	files	classes	lines
JiST	25	92	11019
SWANS	65	145	17087
Other	25	52	3808
	115	**289**	**31914**

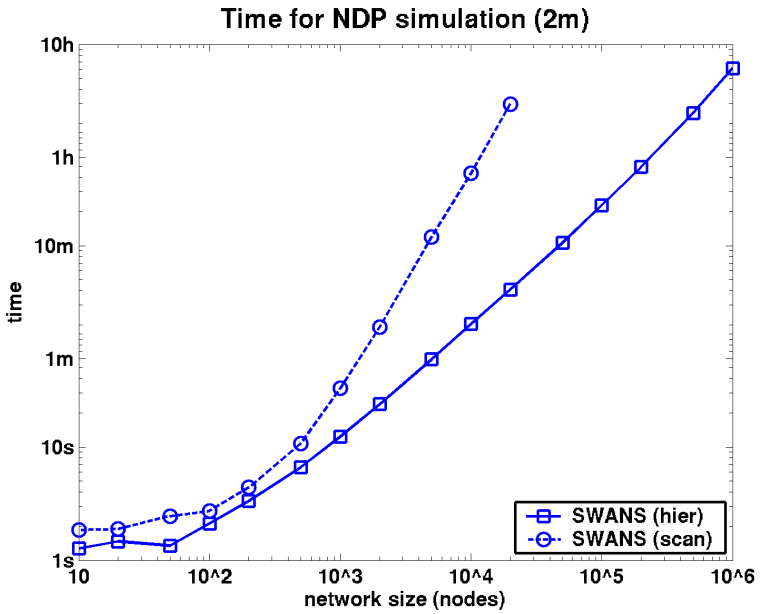
function	implementation
application	***heartbeat*** ; ***any Java network application***
transport	***UDP*** ; ***TCP*** [Tamtoro]
network	***IPv4***
routing	***ZRP*** ; ***DSR*** [Viglietta]; ***AODV*** [Lin]
link	***802.11b*** ; ***naïve*** ; ***wired***
placement	***random*** ; ***input file***
mobility	***static*** ; ***random waypoint*** ; ***input file***
interference	***independent*** , ns2; ***additive*** , GloMoSim
fading	***zero*** ; ***Raleigh*** ; ***Rician***
pathloss	***free-space*** ; ***two-ray***
propagation	***linear scan*** , ns2;
algorithm	***flat binning*** , GloMoSim; ***hierarchical binning***

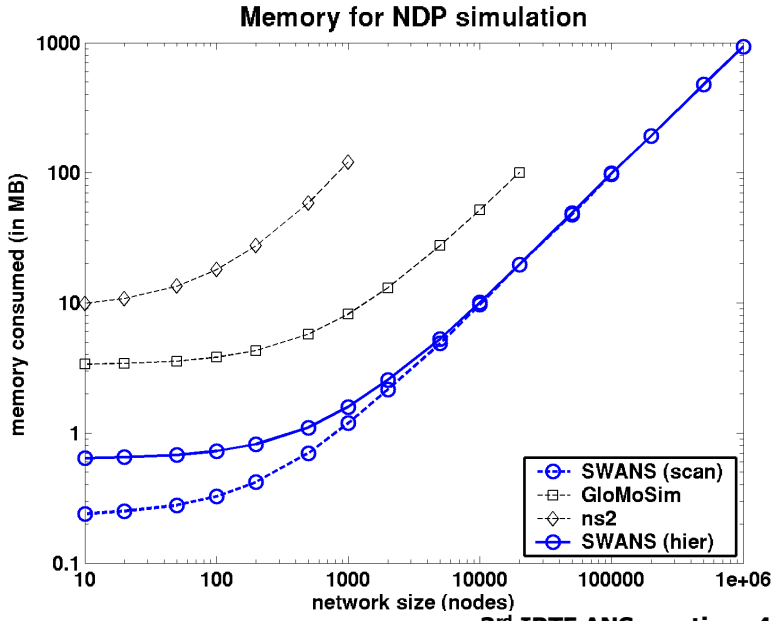
SWANS performance



15m	ns2		GloMoSim		SWANS		SWANS-hier	
nodes	time	memory	time	memory	time	memory	time	memory
500	7136.3 s	58761 KB	81.6 s	5759 KB	53.5 s	700 KB	43.1 s	1101 KB
5000			6191.4 s	27570 KB	3249.6 s	4887 KB	430.0 s	5284 KB
50000						47717 KB	**4377.0 s**	**49262 KB**

2m	SWANS-hier			
nodes	10,000	100,000	**1 million**	*1*
initial memory	13 MB	100 MB	**1000 MB**	*1.0 KB*
avg. memory	45 MB	160 MB	**1200 MB**	*1.2 KB*
time	2 min	25 min	**6 hours**	*20 ms*





benefits of the jist approach

- more than just performance…
- application-oriented benefits
  - type safety — source and target statically checked
  - event types — not required (implicit)
  - event structures — not required (implicit)
  - debugging — dispatch source location and state available
- language-oriented benefits
  - Java — standard language, compiler, runtime
  - garbage collection — cleaner code, memory savings
  - reflection — script-based simulation configuration
  - safety — fine grained isolation
  - robustness — no memory leaks, no crashes
- system-oriented benefits
  - IPC — no context switch, no serialization, zero-copy
  - Java kernel — cross-layer optimization
  - rewriting — no source-code access required
  - distribution — provides a single system image abstraction
  - concurrency — model supports parallel and speculative execution
- hardware-oriented benefits
  - cost — COTS hardware and clusters
  - portability — runs on everything
- simulation research platform