

Accelerating Large-Scale Wireless Simulations in ns-3 using Spatial Indexing and Clipping

WNS3
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TEAM

Candace Diaz, Joseph Dickinson, Victor T. Echeverria, Jacob Fenger, Anand Ganti,
Vincent Hietala, Benjamin Newton, Uzoma Onunkwo, Michael Scoggin

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Problem

It takes a prohibitive amount of time to simulate practical large-scale wireless networks (1,000+ nodes for multiple hours) in ns-3, making it extremely difficult to study multiple what-if scenarios.

Why the Problem

- Wireless communications are generally broadcast in nature.
- Wireless mediums are shared, thus communication signals theoretically reach all nodes in the same channel.
- This results in significantly large counts of simulated events in wireless networks. However, many of these events are inconsequential and need not be simulated.

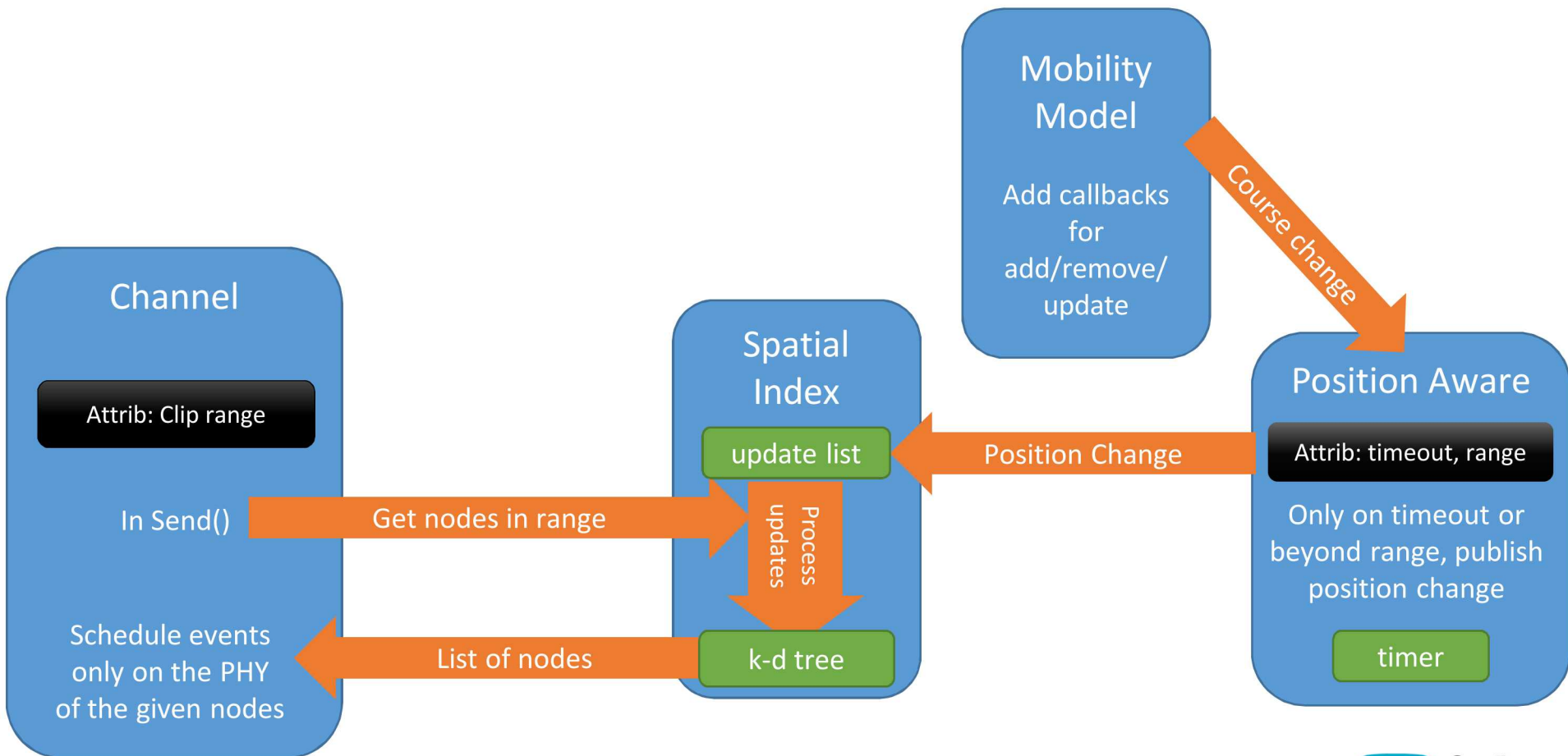
Solution

- Ignore wireless communication events at distances where strength is negligible.
- But this is costly to do by brute force.
- Use spatial indexing to optimally determine nodes in play during simulation of communication events. ***We call this KMSim and it has been implemented in ns-3.***

Relevance

- Practical problems of interest in industry revolve around protocol and architecture impact on larger scales of networks and at longer durations.
- Research in wireless studies of this scale will hugely benefit from much faster ns-3 simulations.

KMSim in ns-3: Details



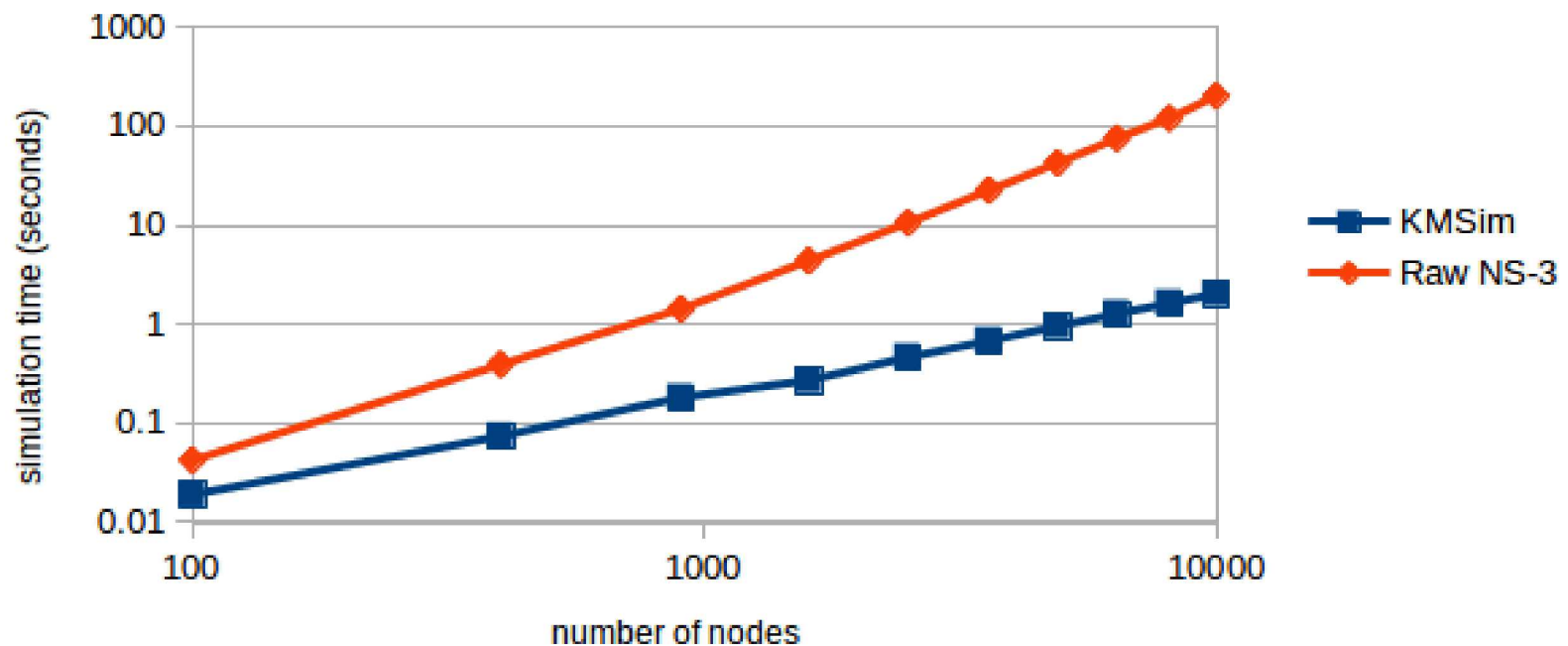
Ns-3 Wireless Simulations: *KMSim vs. Traditional*

Simulation Setup:

- YansWifi
- Distance-based
- Static network in grid layout
- Simulation fidelity preserved

Simulation Performance Comparison

using KMSim in NS-3.29

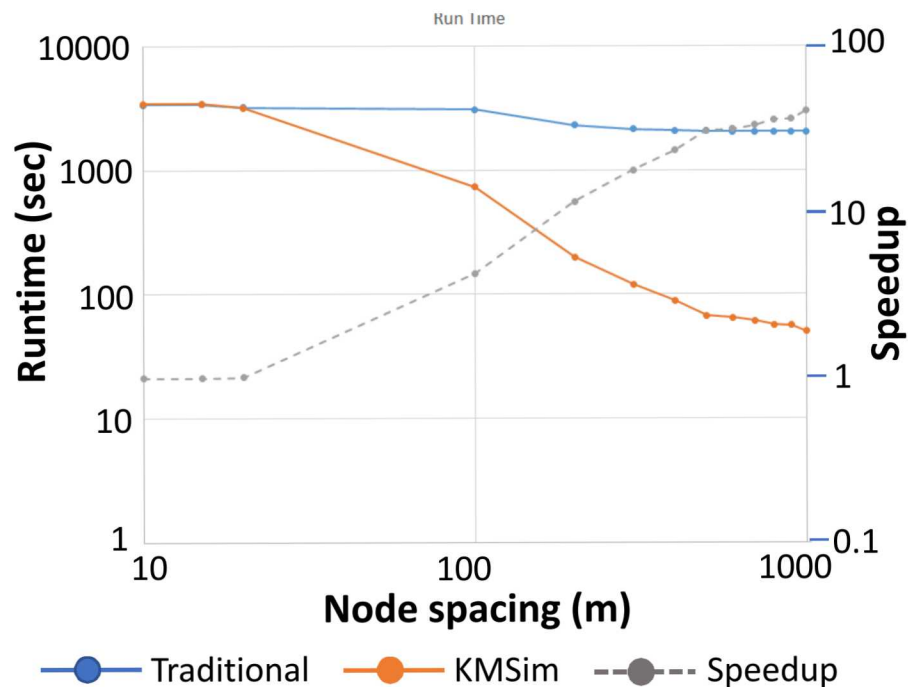


Simulation Setup:

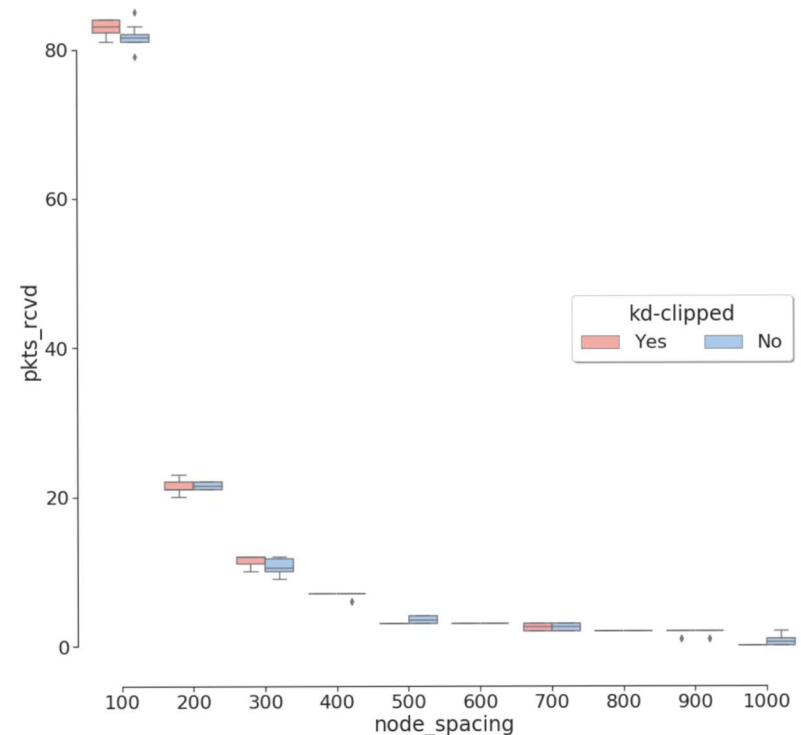
- YansWifi
- Friis transmission model
- Static network in grid layout

Ns-3 Wireless Simulation

Runtime



Fidelity/Accuracy





Future Work

- Release to community.
 - ☐ Getting approvals for open source.
 - ☐ Work with ns-3 community.
- Expand to parallel DES execution.
 - ☐ Each processing element has its own spatial indexing tree.
 - ☐ Define hypervisors that coordinate events amongst simulated nodes and controls their migrations between processes.