

Network Provisioning for High Speed Vehicles Moving along Predictable Routes Part 1: Spiderman Handover

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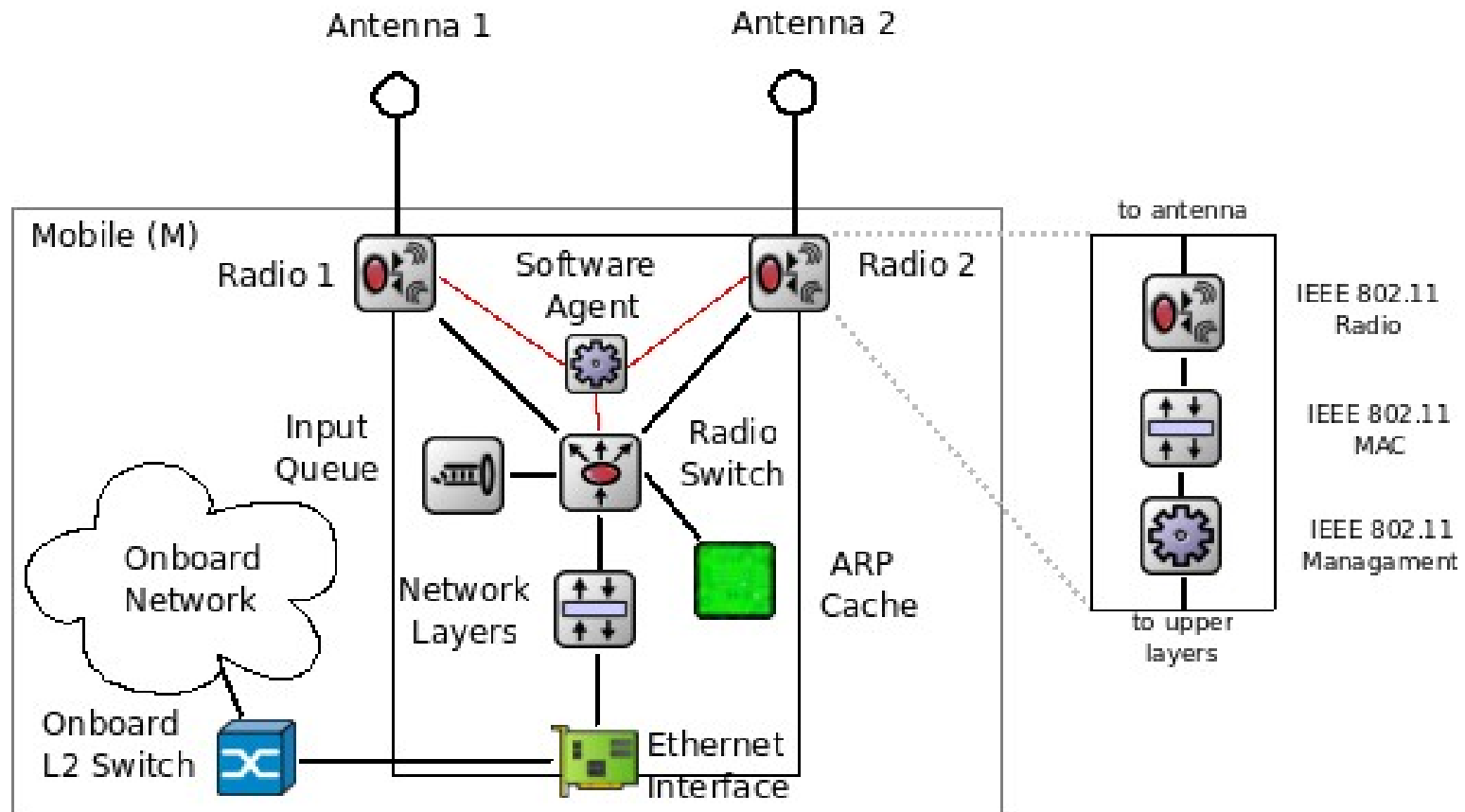
Motivation

- Provide continuous network connectivity to high-speed mobiles ($>150\text{km/h}$)
 - Avoid disruptions in connectivity when handover from one AP to another.
 - Hide the handover time.
 - Simple and non-intrusive.
 - All done in layer 2.
 - Transparent for in-motion devices and the infrastructure network.
 - Fail-Tolerant and self-configured
 - Easy to manage (at least from the configuration point of view)
 - AP failures.

Our Proposal

- New Handover algorithm
 - Exploit two-radio hardware in order to hide handover.
 - Gratuitous ARP loop to ensure handover success.
- Wireless Bridge with Handover Capabilities
 - Keep the link and topology reconfigurations in layer 2.
- Wireless Switch Access Point.
 - The same as a regular layer 2 switch (L2 routing), but instead wired ports, we have wireless ports (associations).

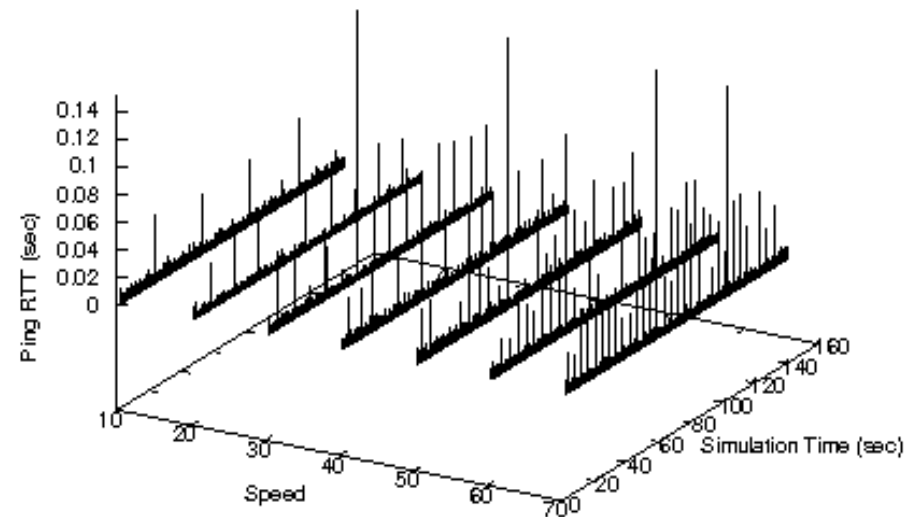
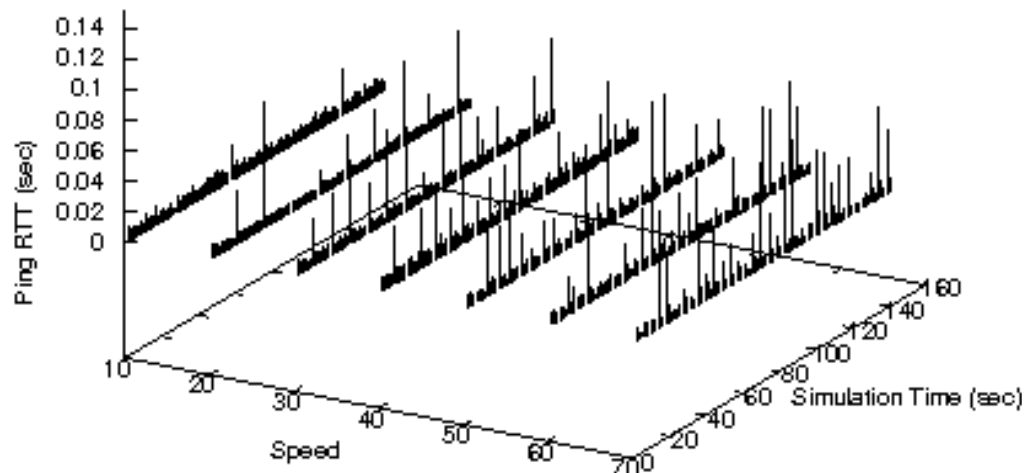
Spiderman Device



Spiderman Simulation's Results

Simulation scenario of train trip with 50 on-board and 50 on-ground stations. 100 flows (2 each one (ICMP and UDP CBR)). Train speed from 10 m/s up-to 70 m/s

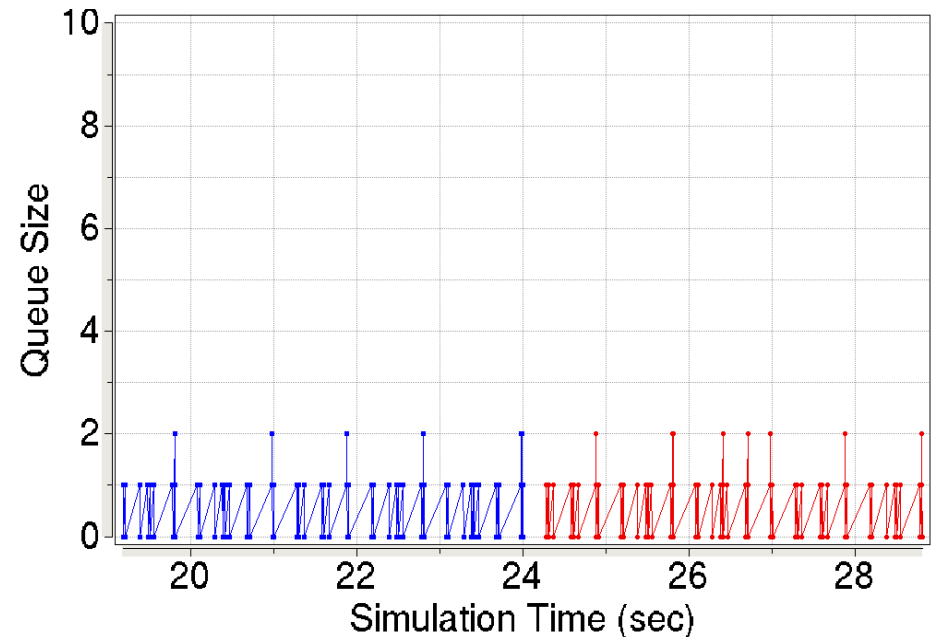
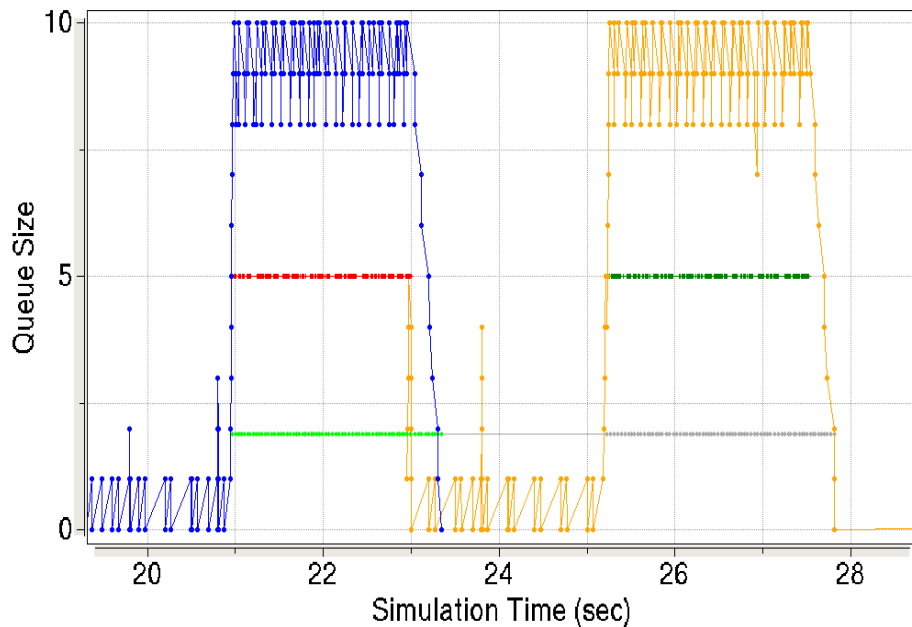
ICMP Ping between on-board and on-ground stations



Spiderman Simulation's Results

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Access Point Queues when Handover



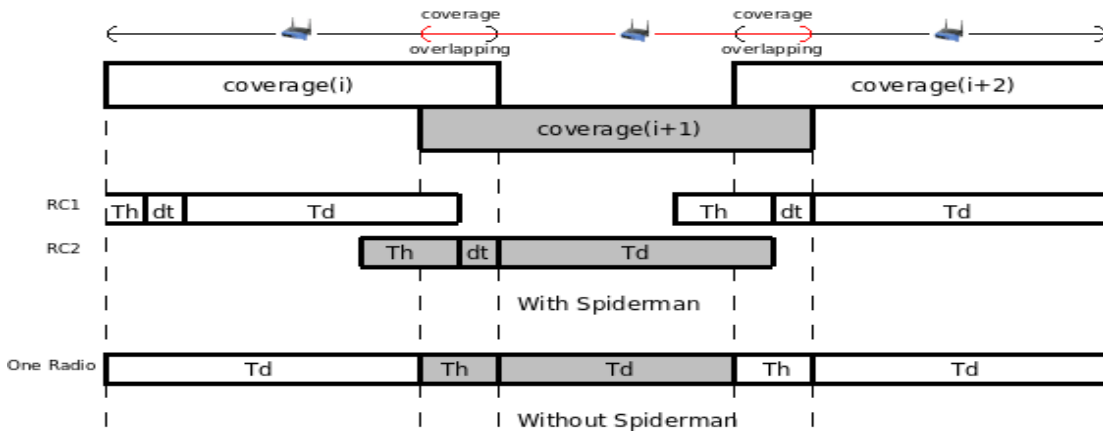
On going work

- Formalism
 - Found the maximal useful time (td).
 - Evaluate the *InputQueue* behavior.
- Simulation
 - Comparison against ways to do the same thing.
 - i.e. One radio simple client
 - Evaluate the handover algorithm with background traffic (inner city scenarios)
 - Generating realistic 802.11 interferences (background traffic) based on real measurements [DDM09]

On going work

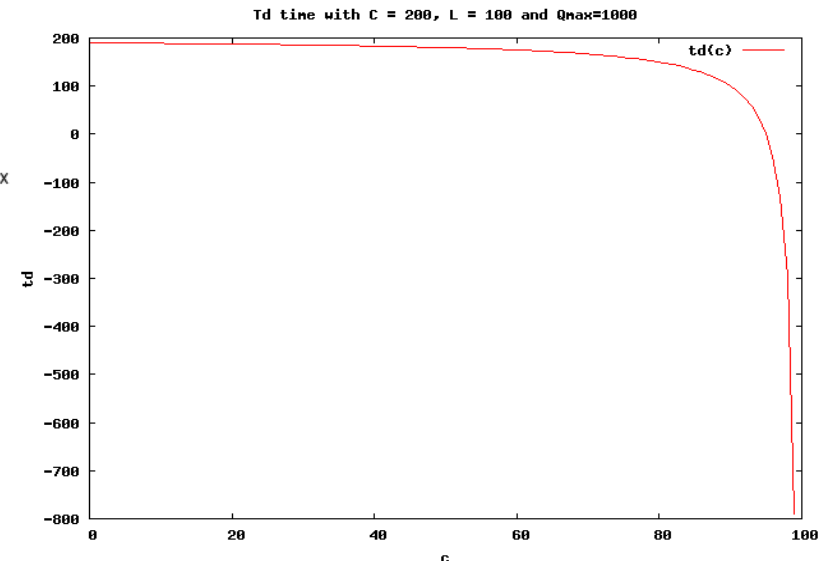
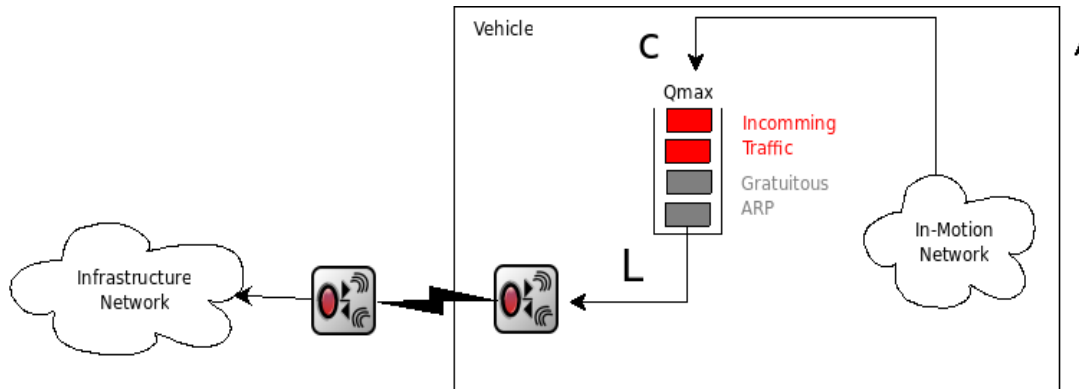
- Experimentation
 - Build a testbed for development
 - Record real traces of received signal strength to evaluate the algorithm in static testbed.
 - Evaluate handover and connectivity provisioning on low-speed scenario.
 - Up to 80 km/h
 - Evaluate handover and connectivity provisioning on high-speed scenario.
 - Up to 180 km/h
 - Dream about to test it at 300 km/h

Formalism



V_{max} = Mobile speed
 Q_{max} = Input Queue Size
 c = Ingress Traffic speed
 L = outgoing Traffic speed
 P = packet loss probability

$$td(c) = \frac{\text{coverage}(i)}{V_{max}} \cdot \frac{Q_{max}}{c - L}$$



$$p > 0 \Rightarrow c < L$$

**Network Provisioning for High
Speed Vehicles Moving along
Predictable Routes
Part 2: Infrastructure network**

Further work

- Evaluate a mesh protocol considering:
 - Lineal topology
 - Gateways (Sinks, whatever) each 50 or 100 mesh nodes.
- OSLR (Batman?)
- Develop a proprietary protocol designed for linear topologies?
- Simulation
 - Simulate huge mesh networks (up to 4000 mesh nodes)
 - Future Event Set improvements?
 - Parallel/Distributed Simulation?