Measurement Results from Wireless Battle Mesh Version 7

Type: Measurement Analysis (work in progress)
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Event:
Sublab. Leipzig, Germany
12th to 18th of May 2014
http://battlemesh.org/BattleMeshV7

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WBM...

2 Data and System Repositories

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http://wibed.confine-project.eu

https://github.com/battlemesh/wibed (buildroot)
https://github.com/battlemesh/wibed-battlemesh-experiment (package)
http://wiki.confine-project.eu/wibed:start
https://github.com/axn/wbm2pdf  (this stuff, branch wbmv7 in future)

Raw measurement data:
http://wibed.confine-project.eu/resultsdir/wbmv7-axn-16_2014-05-16_19-28-43 (stationary scenar
http://wibed.confine-project.eu/resultsdir/wbmv7-axn-17_2014-05-16_20-13-20 (broken crossed st
http://wibed.confine-project.eu/resultsdir/wbmv7-axn-19_2014-05-16_21-35-33 (mobile scenarios)
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Table 1: Testbed and experiment related code and data repositories

3 Testbed ad Experiment Descripiton

3.1 Deployment

During the first days of the event a total of 20 wibed nodes have been deployed. 16 wibed-nodes have beend spread over 3 different floors in the main event building. About 10 of these 16 nodes were located in the main event hall (approximately 300 sqare-meters workshop room) with highest node density in a particular corner of this room (deathroom in Table 2) and the 6 in the below and above floor of the event hall. Three more nodes have been placed in a neighboring building with wireless connectivity. One node was battery powerded for allowing mobile-node scenarios. In fact not all node positions were always exactly known as nodes were sometimes moved to fullfill specific experimentation-scenario requirements. In each building 1 of the wibed-nodes were configured as GW nodes and blocked for experimental usage. The remaining 18 nodes were shared between three different experimentation groups for running tests and different scenarios (each node was used by at most one experimentation group at any time).

All experiments were performed in a single 5Ghz channel. However, due to the presence of around 50 participans with wireless laptops and several other actively used wireless equipment, also the used 5GHz channel was likely affected by non-testbed related interference.

The experiment presented in this work was lead by one of these groups and used the following 16 nodes:

NodeID	Location	exp:axn-16 (stationary)	exp:axn-19 (mobile)
164a7a	deathroom		
3b3a90	workshopRoom		
3b3d70	????		
3e9db0	deathroom??	9db0->1ab0	9db0->4174
51aac8	halleAnfang		aac8->4174
8a417e	deathroom	417e->4174	
c24174	HalleEnde (mobile)		
c2427a	deathroom??		427a->4174
ce3360	EloiTable		
e4b63a	mustiTable		
e60a62	halleMitte		
e60aac	deathroom		
e60ad6	deathroom		
e61936	axelsTable	1936->4174	1936->4174
f41ab0	kloschi (building B)	1ab0->4174	1ab0->4174

Table 2: Node locations and experiment usage

3.2 Protocol Configurations and Assumptions

The highly dynamic and uncontrollable interference in the measurement environment made it inpossible to ensure equal conditions for sequential experiment executions. Therefore, to ensure equal (fair) environment conditions for all tested protocols, all routing protocols were running and observed in parallel on all nodes, thus all being always exposed to the exactly same environmental conditions.

The accepted downside of this approach is of course that protocol overhead introduced by one protocol or by protocol-observing tools like ping (causing total overhead in the order of few KB/s, as can be seen from later measurements) slightly affects the maximum achievable end-to-end throughput of other protocols (in the order of seveal MB/s).

Only netperf-tcp-based throughput probes, seeking to measure the achievable tcp performance of the end-to-end routing paths established by the individual protocols, were performed sequentially. This decision has been made because each netperf test trys to load the capacity of a given end-to-end path with a maximum of traffic, thus introducing maximum probing-traffic overhead and interference while on the other hand (given the tcp-inherent exponential backoff approach) drastically lowering the currently offered load in the presence of packet loss, leading to highly randomized results when running in parallel and making the comparatin of parallel executions difficult.

All protocols were configured for routing IPv6 traffic using an individual ULA address prefix per protocol.

All protocols were configured with default parametrizations, thus no environment specific customizations have been made apart from ensuring the routing of the given IPv6 address range. The exact configuration can be accessed via [**?**].

To avoid protocol-bootstrapping effects (eg unfinished neighbor-, path- or topology-discovery), all routing protocol deamons were started at least 200 seconds before any measurement.

3.3 Measurement Configuration and Assumptions

Followup measurements were executed from a singe selected node (src-node) by launching a pre-deployed test script [**?**] and given the id of a single other node (dst-node) for probing

end-to-end path characteristics. Src-node and dst-node IDs for each measurement are given in Table 2.

Each followup measurement last 200 seconds during which the following additional tools were used to observe protocol performance and overhead:

- ping6 (unix) command to dst-node ipv6 address with one-second interval and 1000 bytes icmp user data. The output of the ping6 command got logged for later end-to-end packet loss, hop-count, and round-trip time (RTT) over time analysis.
- top (unix) command for logging protocol-specific CPU and memory consumption at 1 second intervals.
- mtr (my trace route, unix) command at 1 second interval for tracing full src-to-dst protocol-established path information. Due to the difficulty to correlate or graphically represent these traces, the obtained log files were not processed further.
- netperf, executed in repeating rounds (4 rounds), each probing sequentially the maximum achievable end-to-end throughput to always the same destination node for 10 seconds via each routing protocol.
- tcpdump, passively capturing the present routing-protocol overhead of each protocol as reveived on the wireless channel by the src node.

3.4 Experiments

The experiment focused on measuring the overhead and performance of 5 different mesh routing protocol implementations in static and mobile scenarios. The five tested protocols were batman-advanced (batadv), bmx6, olsr, olsr2, and babel. Unfortunately, we just discovered after the measurements that the babel protocol daemon was not configured correctly, leading to broken routing decisions for multi-hop path. Therefore all babel-protocol related measurements were discareded in the following discussion.

Experiments are grouped in two different scenarios (wibed experiments with results accessible via corresponding wibed-data repositories as given in Table1), each scenario consisted of about 4 measurement executions by using different source-destination combinatinos (measurement results were stored on the source-node of the measurement as given by Table2).

3.5 Stationary Nodes Measurements

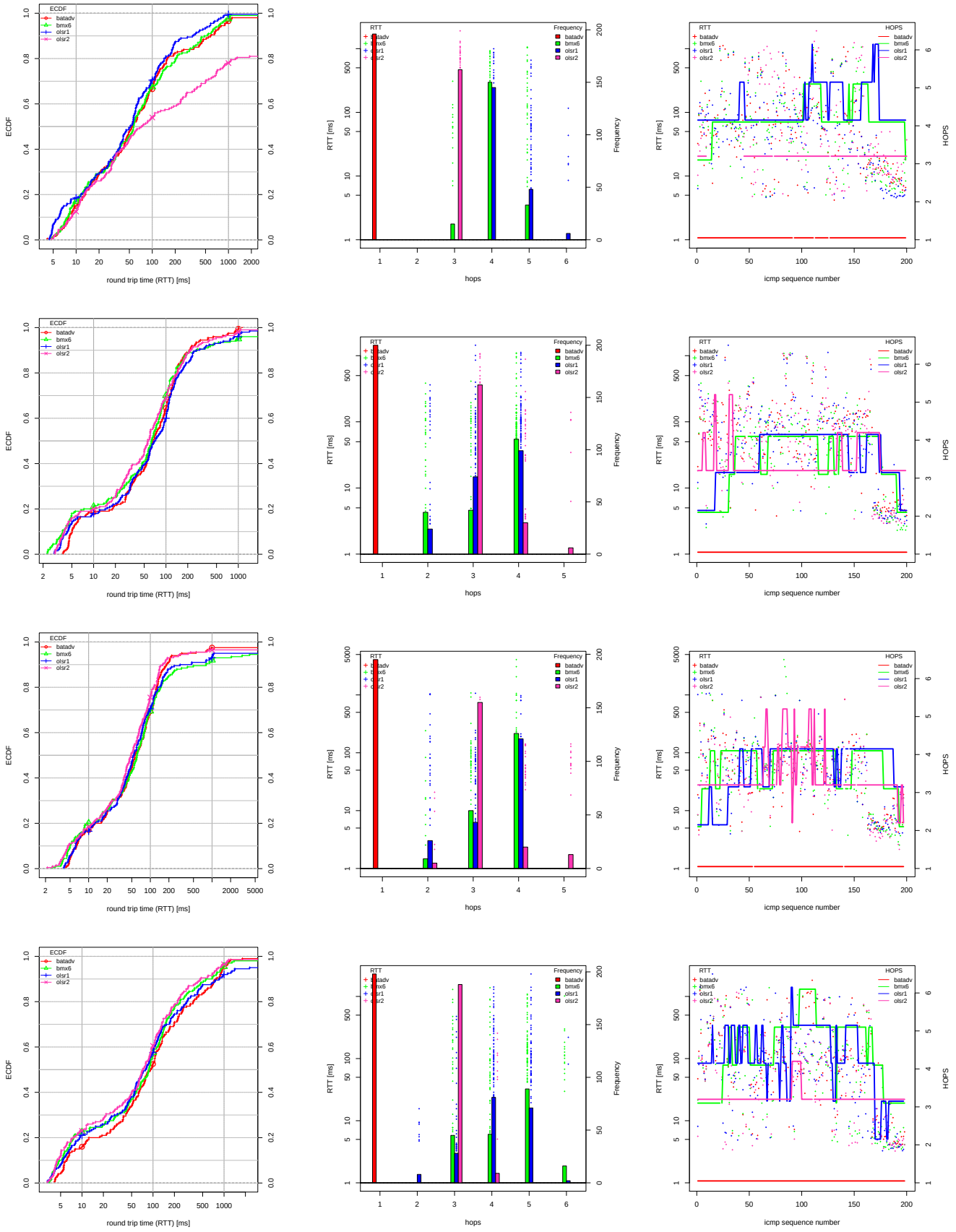

Table 1: End-to-end ping6 performance between two stationary nodes: 9db0-1ab0, 417e-4174, 1936-4174, 1ab0-4174

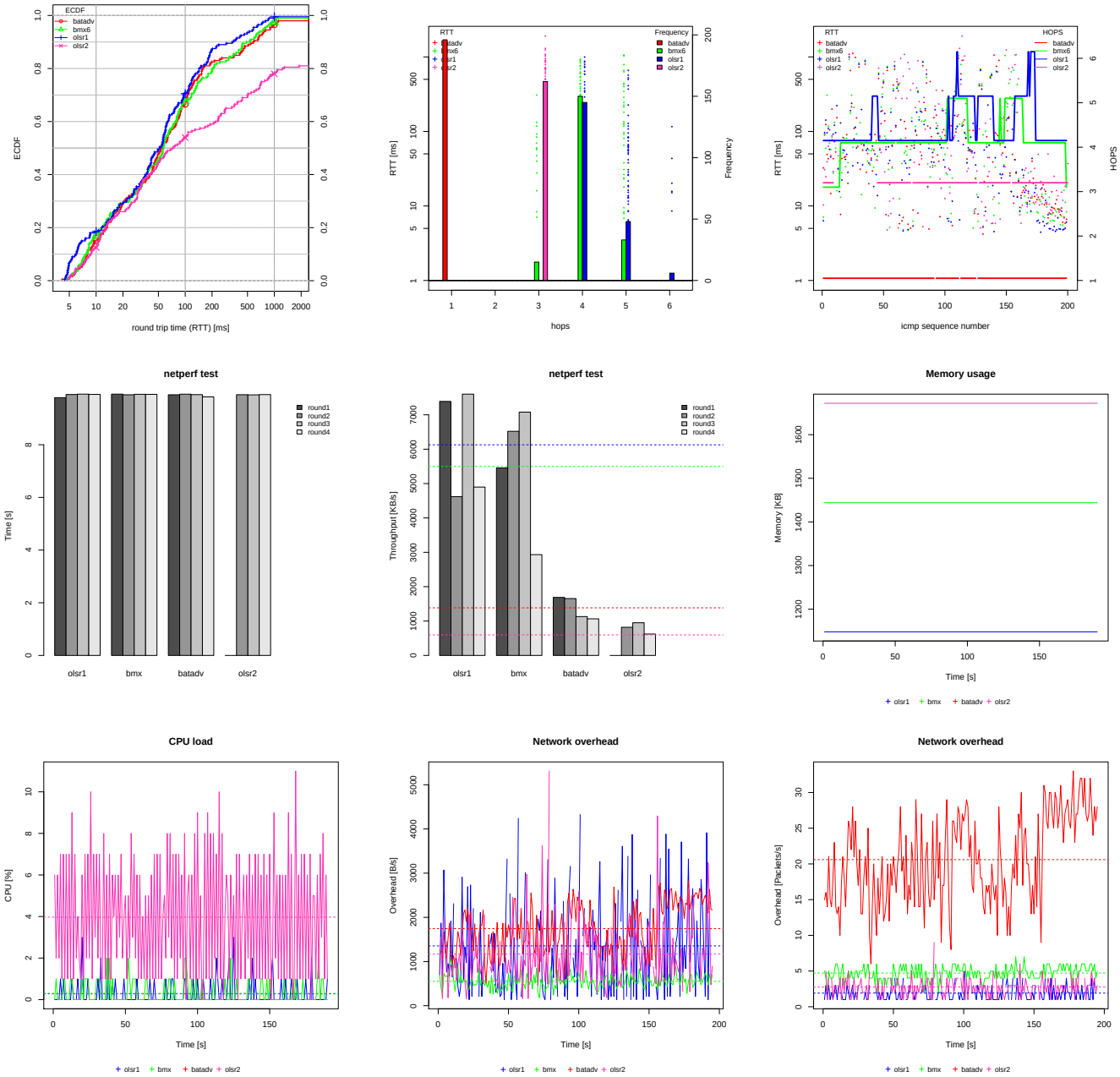

Table 2: Overhead and end-to-end performance between two stationary nodes: 3e9db0 and 1ab0

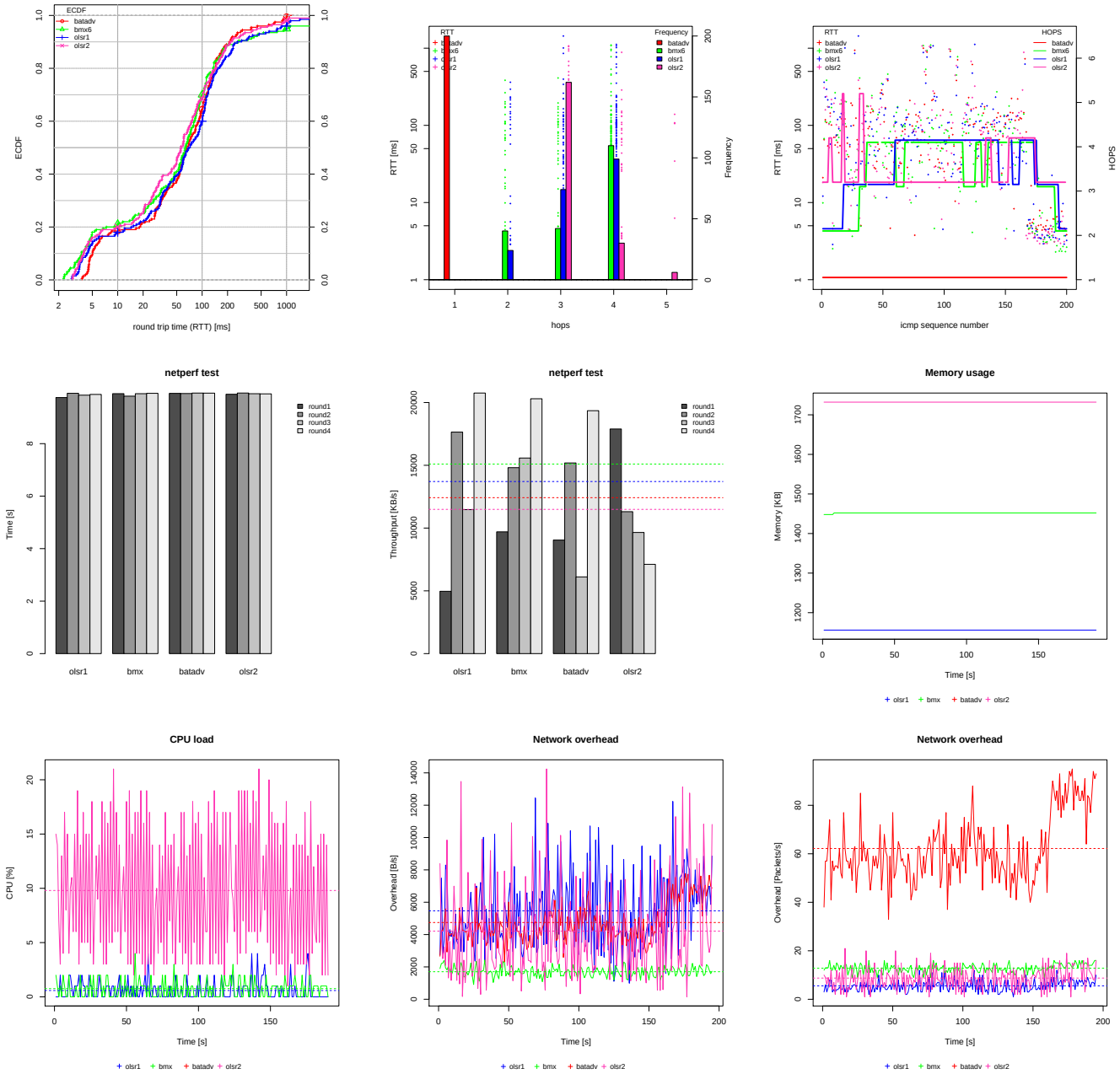

Table 3: Overhead and end-to-end performance between two stationary nodes: 8e417e and c24174

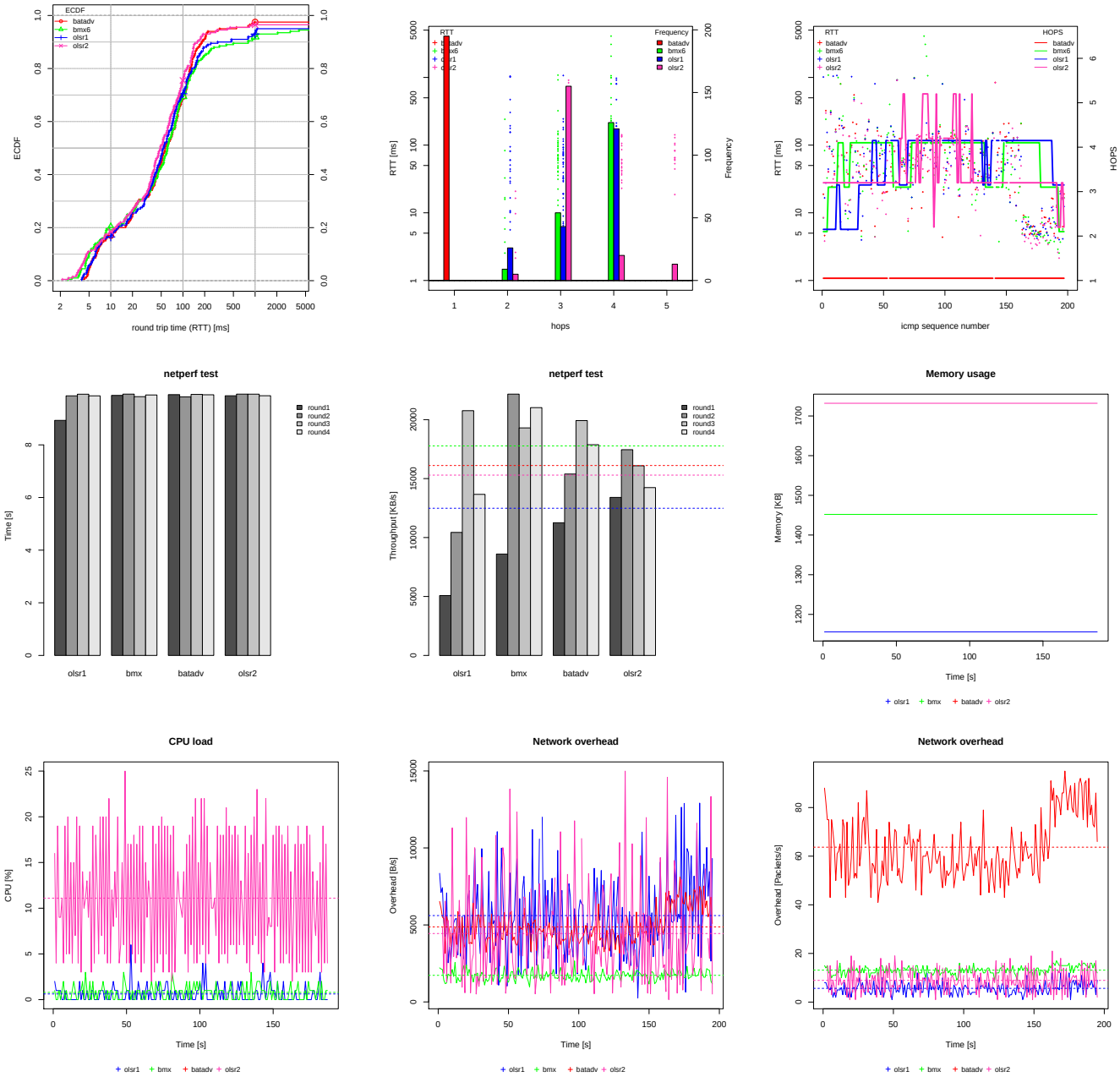

Table 4: Overhead and end-to-end performance between two stationary nodes: e61936 and c24174

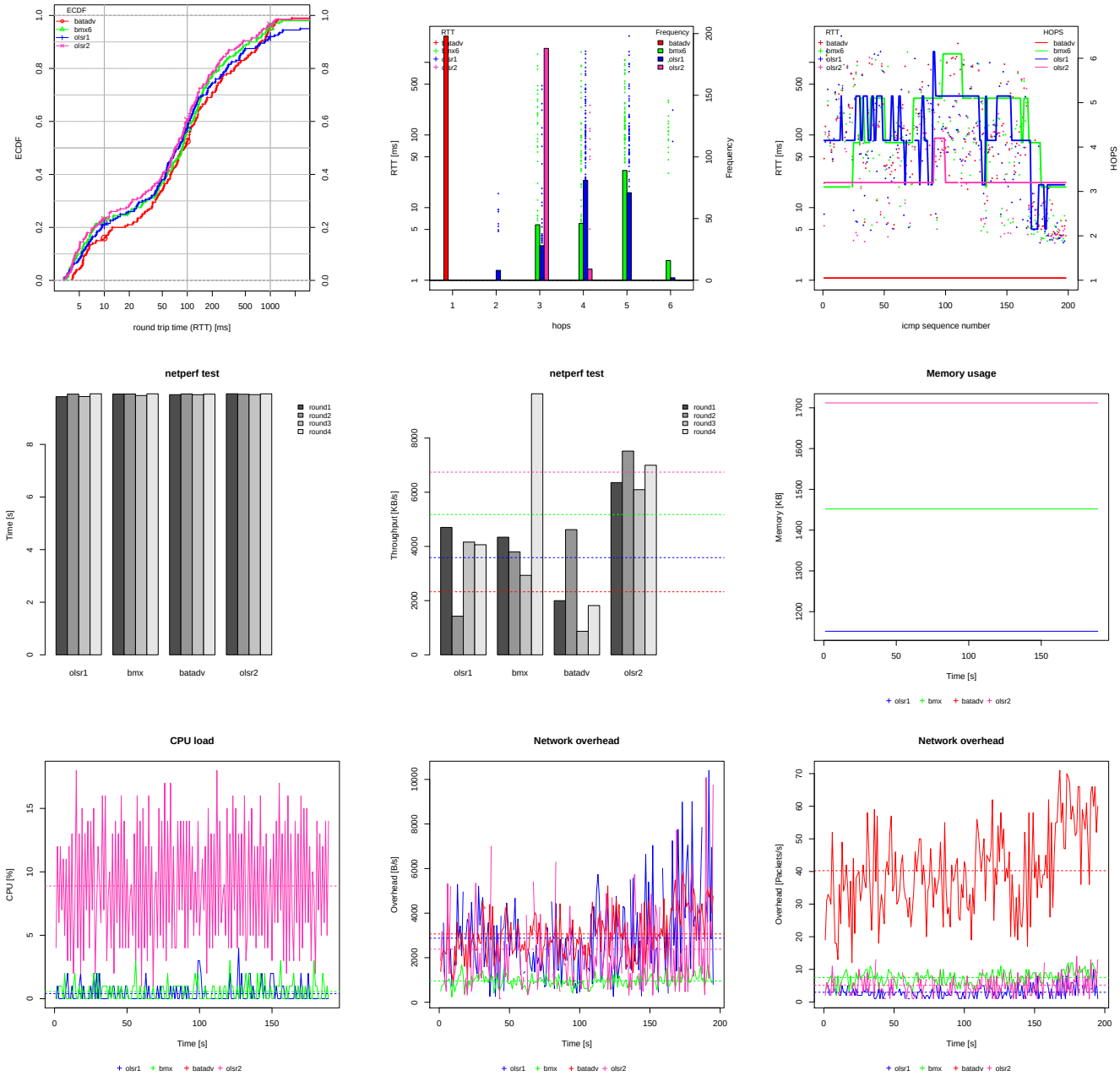

Table 5: Overhead and end-to-end performance between two stationary nodes: f41ab0 and c24174

3.6 Mobile Node Measurements

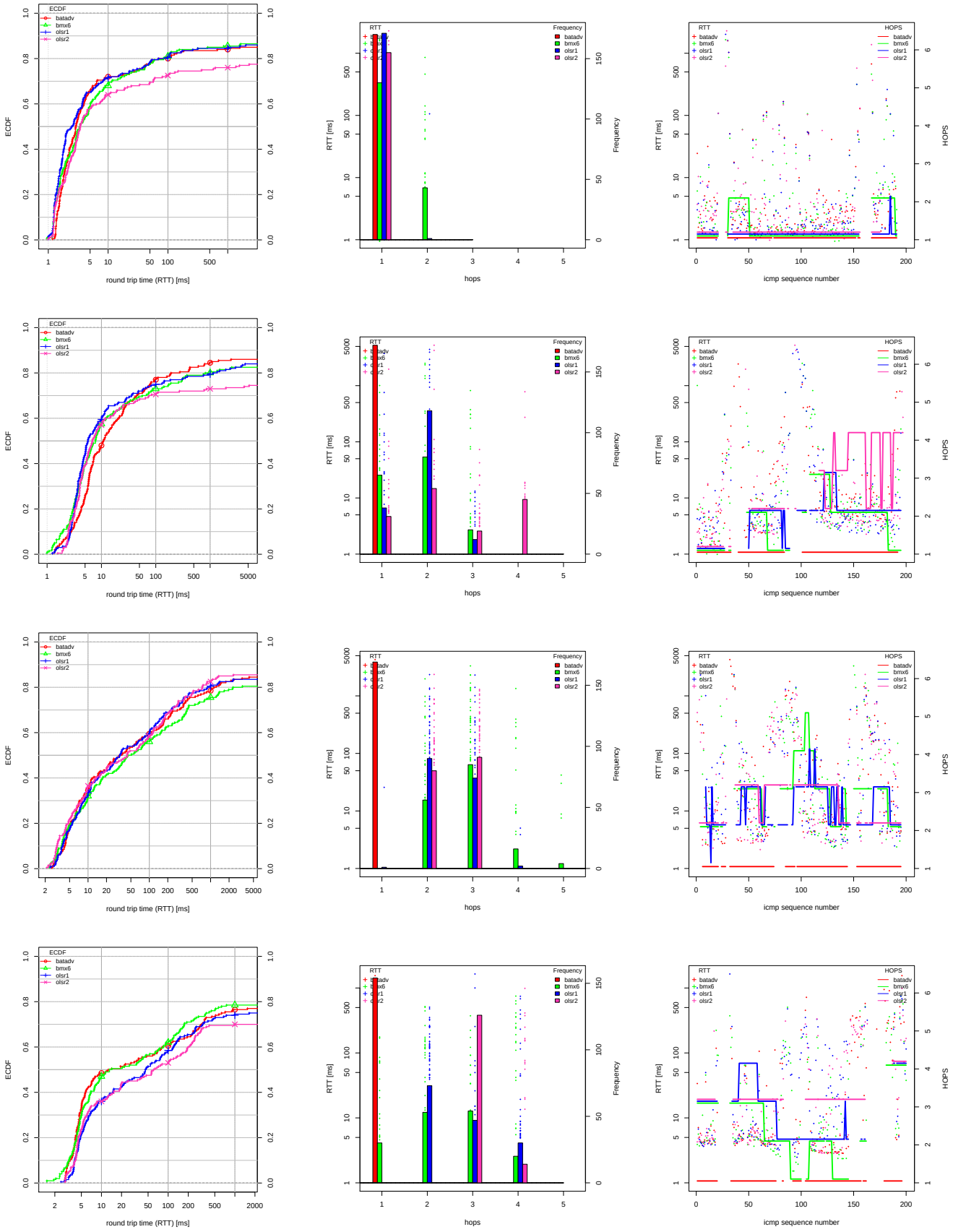

Table 6: End-to-end ping6 performance to mobile node 4174 from aac8, 1936, 1ab0

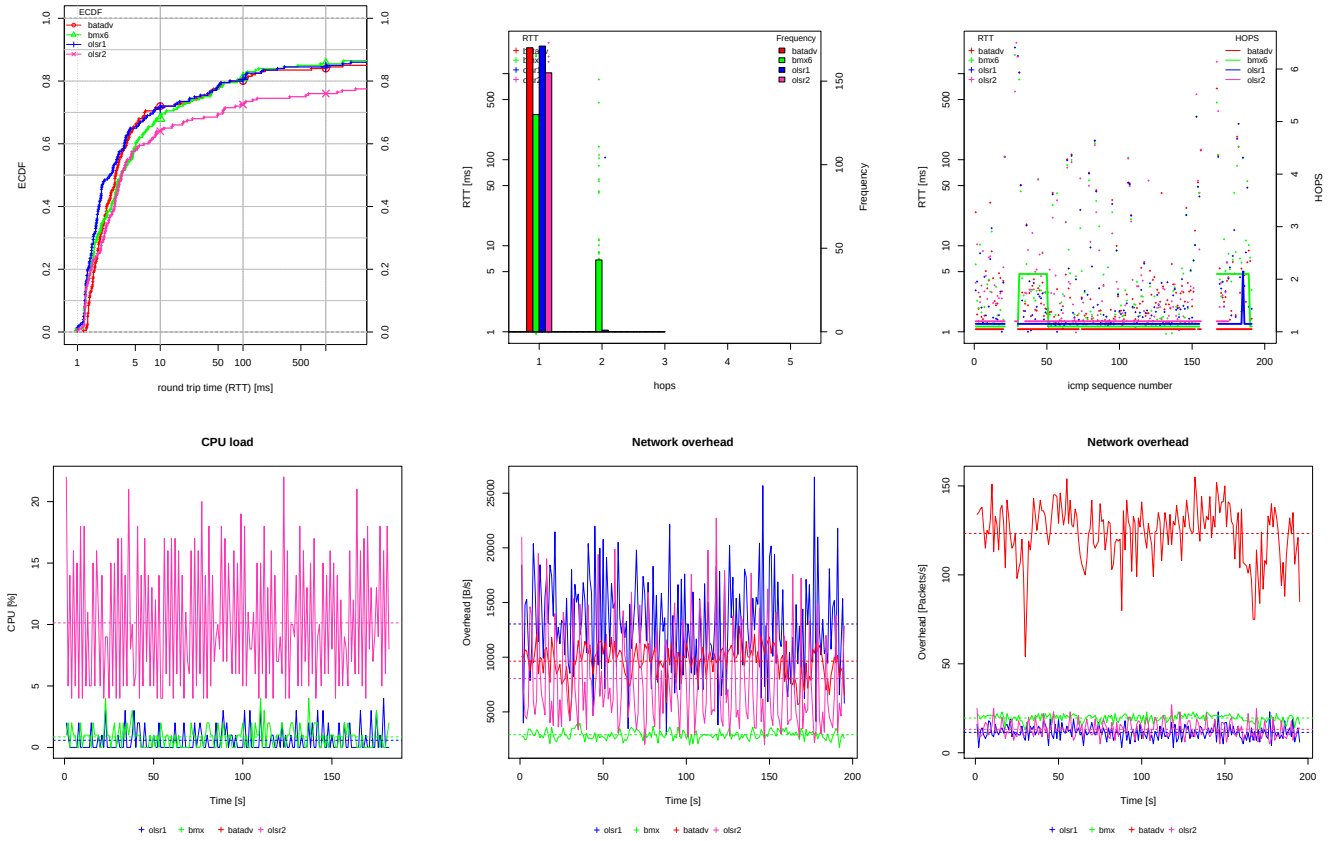

Table 7: Overhead and end-to-end performance to mobile node c24174 from stationary node 51aac8

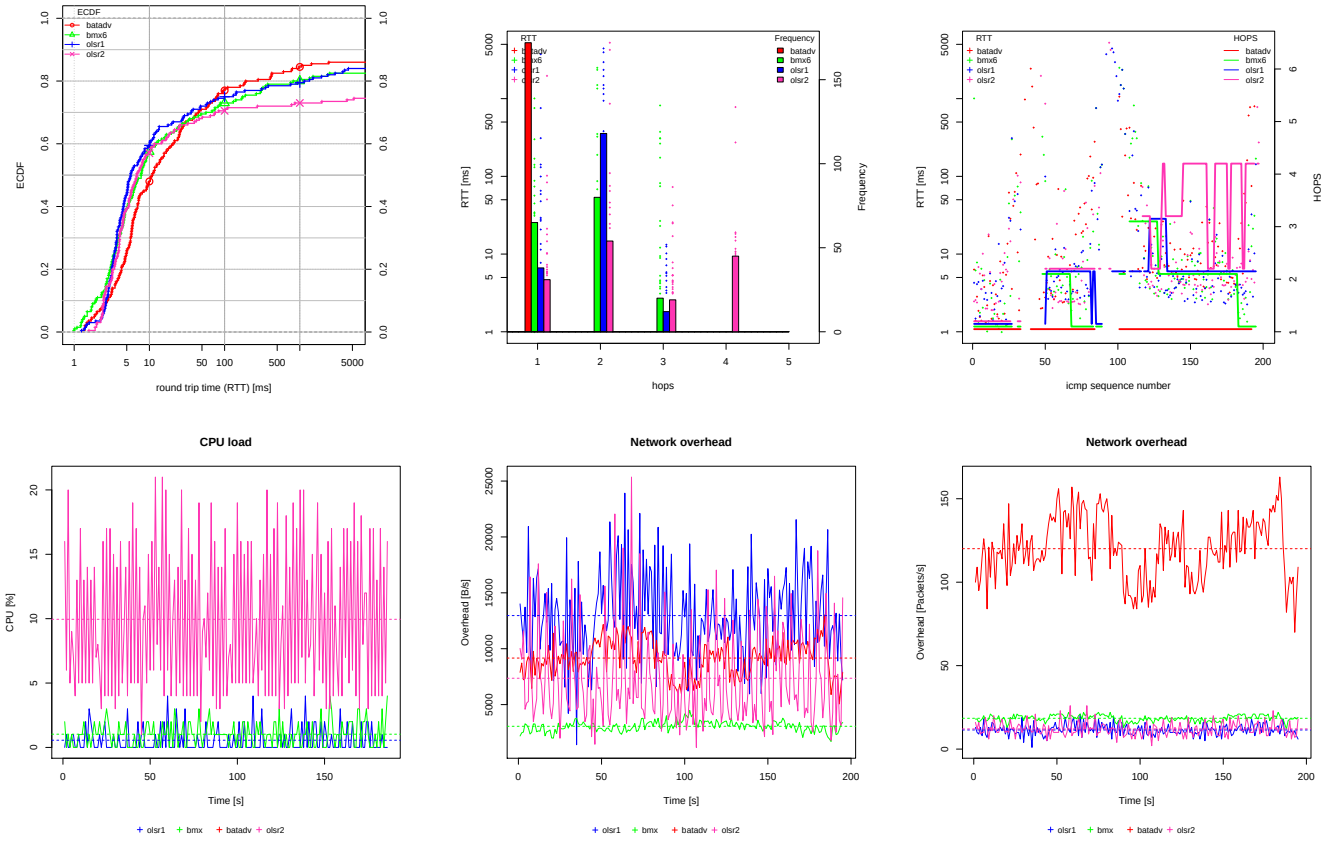

Table 8: Overhead and end-to-end performance to mobile node c24174 from stationary node e61936

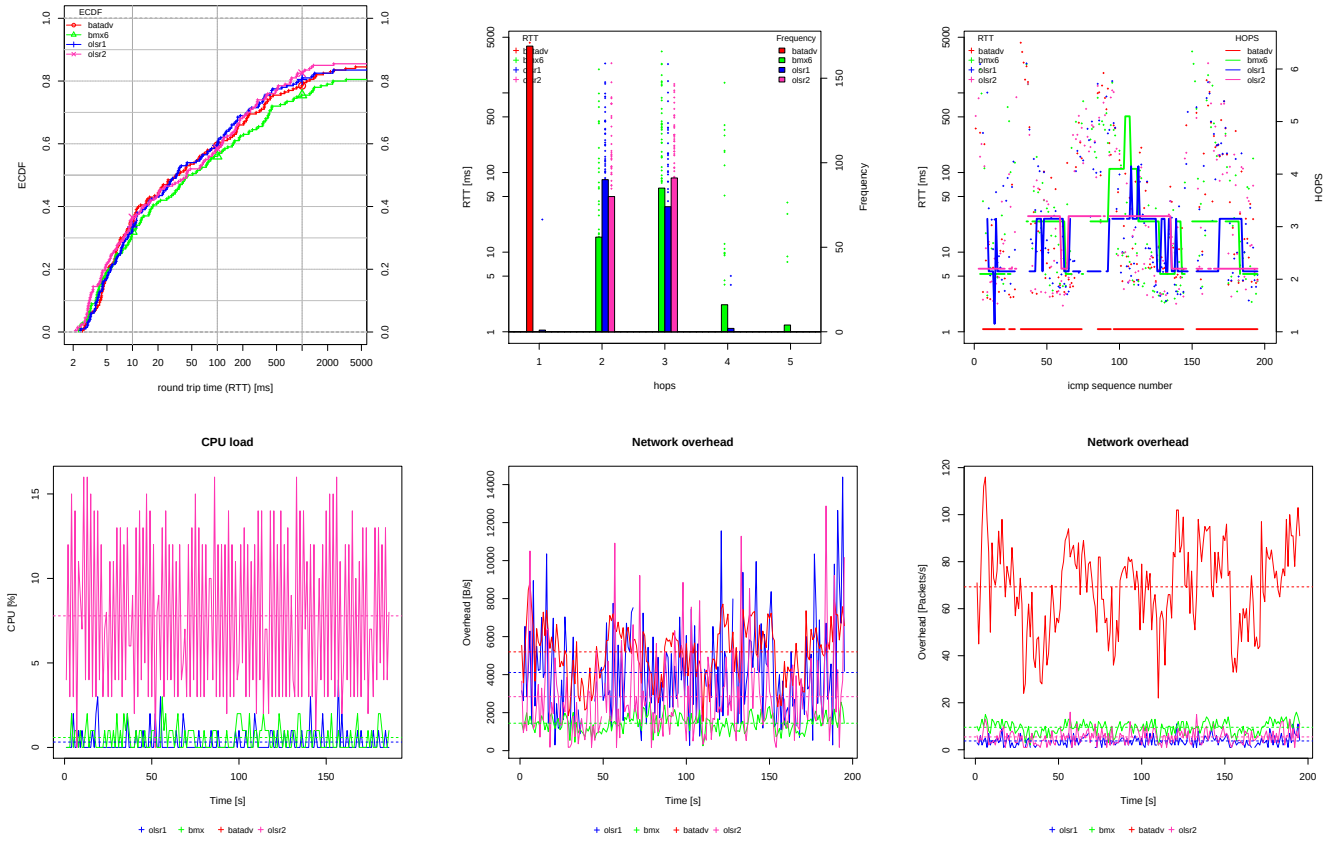

Table 9: Overhead and end-to-end performance to mobile node c24174 from stationary node f41ab0

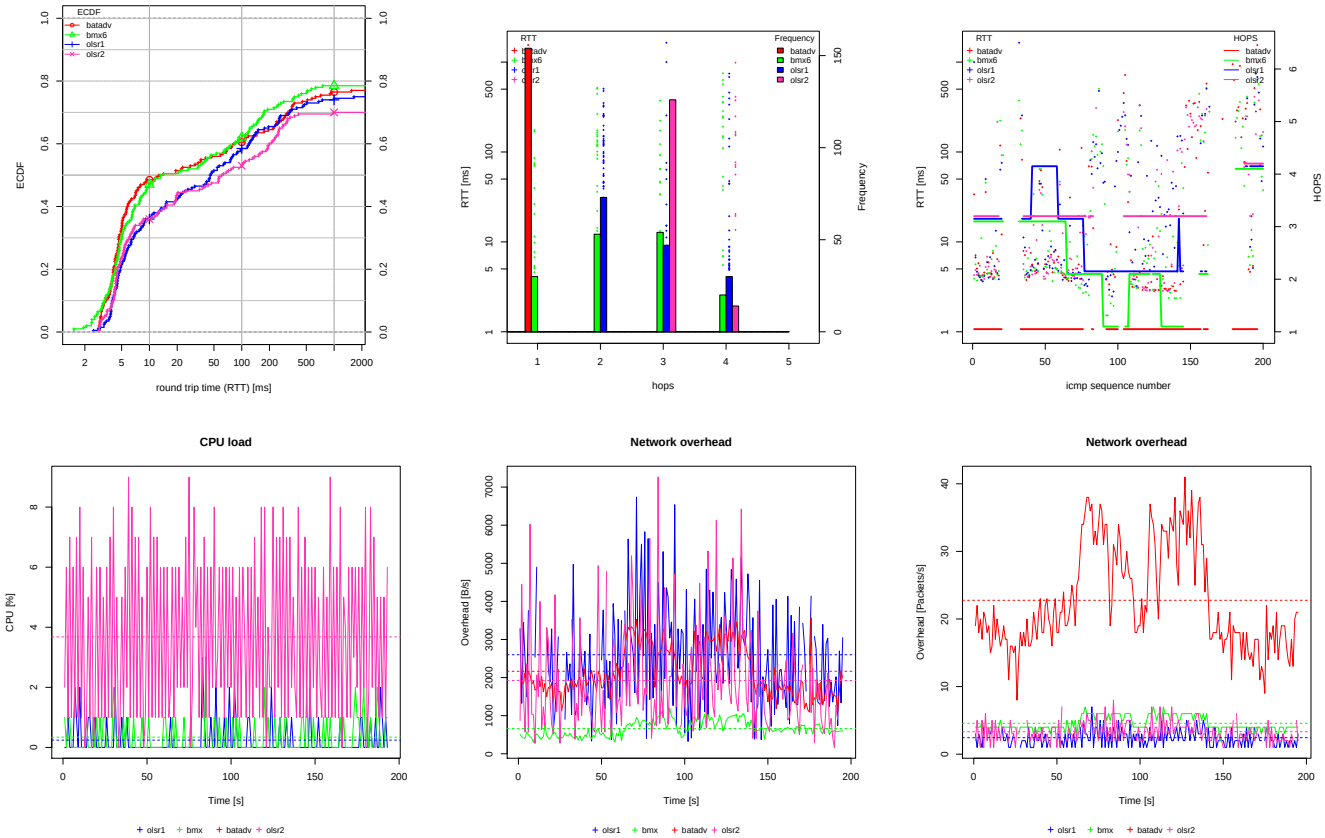

Table 10: Overhead and end-to-end performance to mobile node c24174 from stationary node c2427a

3.7 Mobile Scenarios

4 TCP Throughput Measurements

5 Recommendations for next battlemesh

- Traceroute and mrt often show high packet for intermediate nodes. This is due to a kind of denial-of-service mechanism enabled by default in Linux kernel. WIth this mechanism the kernel simply discards frequent icmp responses (eg due to exceeded TTL values). This behavior can be disabled by lowering the default net.ipv6.icmp.ratelimit=1000 setting, eg via: sysctl -w net.ipv6.icmp.ratelimit=10

6 Appendix