Measurement Results from Wireless Battle Mesh Version 6

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Aalborg University. Aalborg, Denmark
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http://battlemesh.org/BattleMeshV6

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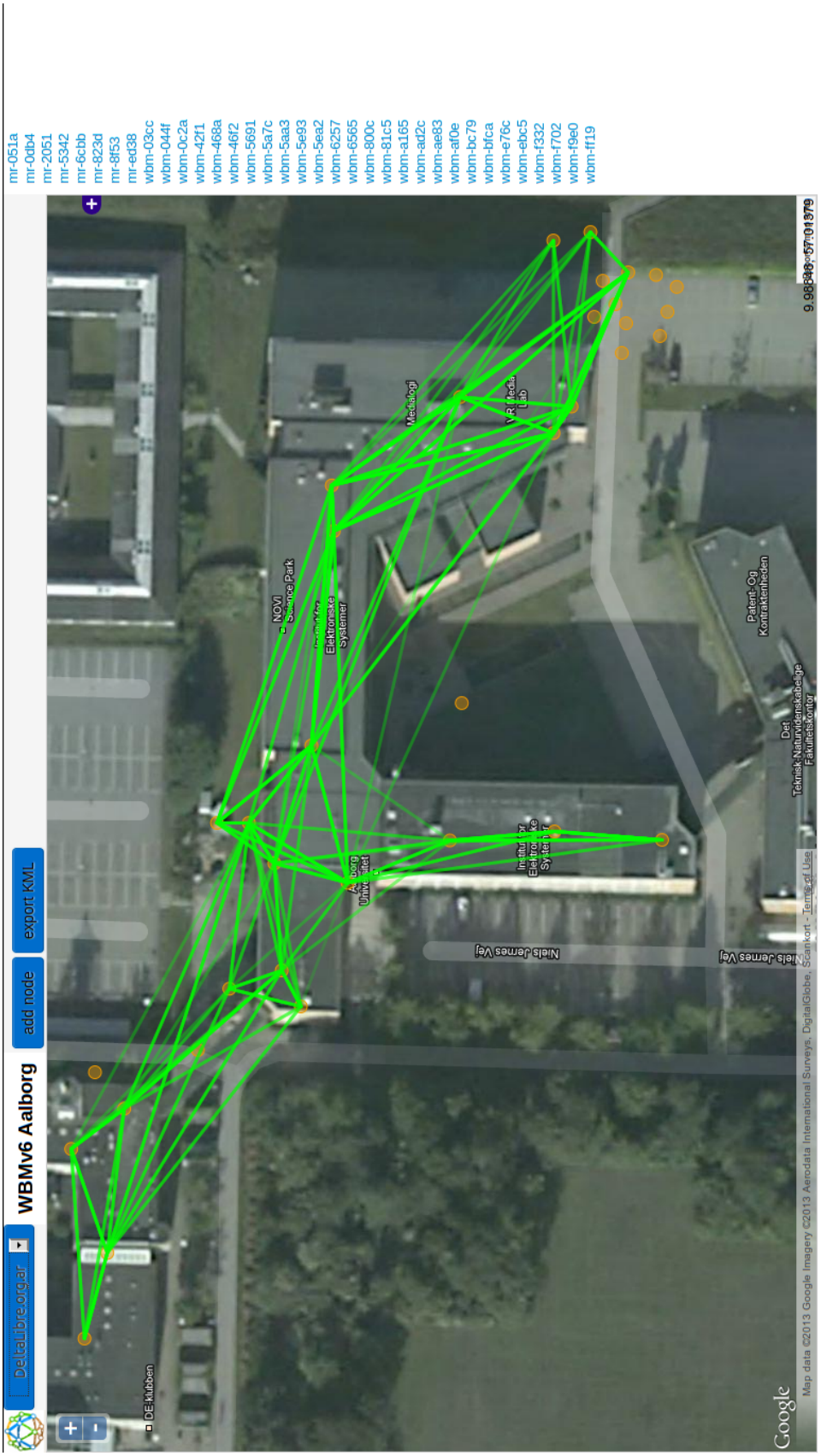

Figure 1: geographical map snapshot

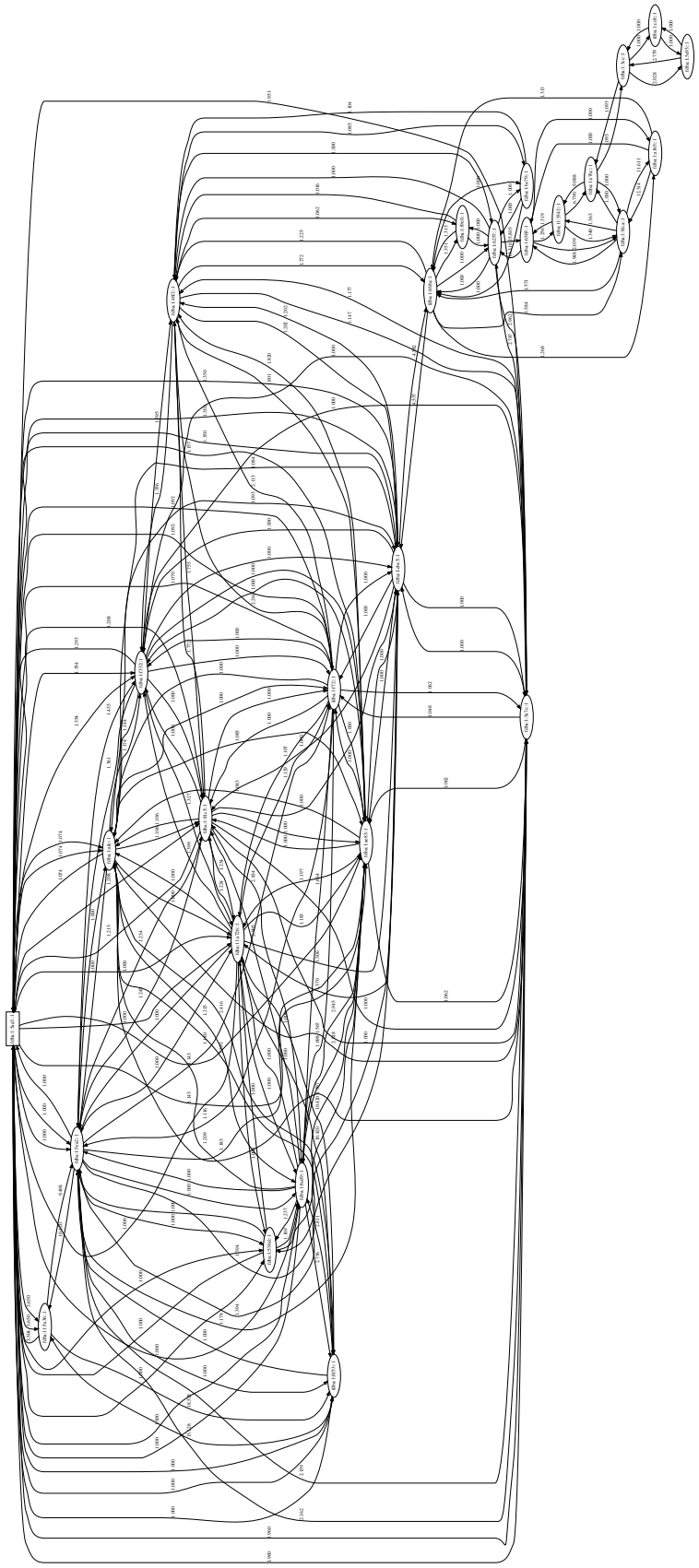

Figure 2: OLSR topology snapshot

3 Ping Measurements (hops, rtt, loss)

3.1 Assumptions

Like always, when post-processing the measurement data obtained during an event several weeks ago one notices that some particular information was not logged and may question the validity of the analysis.

The main problem identified from the WBMv6 measurement is the phenomenon that the ping program, although configured to send a fixed number of icmp probes at a given interval, does in-fact not complete the task in the expected time. For example one would expect that 100 pings send at an interval of 100ms would finish after 10s. But usually much longer periods have been observed. One reason for this effect is given by link-layer address resolution. It clearly seems that the time needed for resolving the link-layer address for forwarding a packet to the first hop (from layer 3 perspective) towards the destination is not counted for the overall round trip time. Instead, the whole process is delayed respectively. This claim can be confirmed with the experiment in Section 3.1.1.

The described behavior affects the measurements in the following ways:

For the stationary scenarios as analyzed in Sections **??**, ping has been configured to measure 1000 round-trip times at an interval of 100 ms. Some experiments indeed completed this task in the foreseen time of 10000ms (eg groups 17,18,19, see GRP and TIME column of Table **??** and Figures **??**). However, in other cases it happened that pings send using one or several protocols took much longer (eg groups 5, see GRP and TIME column of Table **??** and Figures **??**) where although all protocols showed zero packet loss, bmx6 took 30% more time to send the 1000 pings than babel.

I believe that the corresponding routing protocol can be accounted for the long delays and should be penalized as its the routing protocol's job to find a good next hops (with low arp-resolution delays). Also, if the ping command would have continued to count time during the resolution delays, all pings send within this period would got lost or at least show a significantly greater RTT. Further, as these delays are only ignored on the first hop (from layer 3 perspective) while arp-delays occurring beyond the first hop are indeed counted by the reported RTT, a layer-2 routing protocol would gain unfair benefits if ignoring these delays.

Therefore, simply comparing the successful ping replies would not be fair as the objective was to send them in the given time. To compensate this, the same fraction of icmp probes was considered as lost for the analysis as the total measurement time exceeded the foreseen time. As an example, if 8 pings send at an interval of 100ms took twice the expected time to complete (1600ms instead of 800ms) then 50% of the observed icmp probes are considered as lost for the analysis. So in case 1,3,5,8 (of 1-8) were received then 50% (using the greatest aware sequence numbers: 5,6,7,8) are discarded, resulting in a reduced total success rate of only 25% (instead of 50%).

Applying this kind of penalty was possible for the stationary (random) measurements as all traces included the finishing summary which includes the total time used for the measurement. For the mobile scenarios, a different assumption was made because the ping traces did not include this summary. Probably because ping was killed manually when the test-run was finished. Therefore it was assumed that all test-runs took roughly the same time (the persons moving the mobile node did not move significantly faster

when testing a particular protocol) and the maximum received sequence number of each experiment was considered unless this number differed significantly from the maximum received sequence number observed in all experiments.

Further, all Figures shown in this Section include only measurements where each participating protocol succeeded with a minimum amount of probes.

In contrast, the Appendix also includes measurements (groups) where only a subset of protocols succeeded.

3.1.1 Understanding uncounted ping delays

How arp/lladdr resolution affects ping interval

This section shows how failing (or long lasting) arp/lladdr resolution causes ping to emit icmp probes at a lower interval than specified, This can result in less total send pings during a given time. Therefore I set up a virtual network environment with a high broadcast/multicast packet loss but zero unicast packet loss. The following three experiments prove this strange ping behavior. IMHO, these "non-send" pings should be accounted as lost pings when comparing routing-protocols ping performance with each other.

```
1. Experiment: arp/lladr is resolved,
    As expected 100 pings at 0.1s interval take ~10 seconds!

root@mlc1001:~# ip neigh
fe80::a2cd:efff:fe10:201 dev eth1 lladdr a0:cd:ef:10:02:01 router REACHABLE

root@mlc1001:~# ping6 -q -c100 -i0.1 fd66:66:66:2c:a2cd:efff:fe10:201 &
PING fd66:66:66:2c:a2cd:efff:fe10:201(fd66:66:66:2c:a2cd:efff:fe10:201) 56 data byt
--- fd66:66:66:2c:a2cd:efff:fe10:201 ping statistics ---
100 packets transmitted, 100 received, 0% packet loss, time 10068ms
rtt min/avg/max/mdev = 800.119/800.231/800.331/0.717 ms, pipe 8



2. Experiment: arp/lladr still resolved but flushed three times during ping!
    Surprisingly 100 pings ‘‘at 0.1s interval’’ take ~15 seconds!

root@mlc1001:~# ping6 -q -c100 -i0.1 fd66:66:66:2c:a2cd:efff:fe10:201 &
PING fd66:66:66:2c:a2cd:efff:fe10:201(fd66:66:66:2c:a2cd:efff:fe10:201) 56 data byt
root@mlc1001:~# ip neigh flush dev eth1
root@mlc1001:~# ip neigh flush dev eth1
root@mlc1001:~# ip neigh flush dev eth1
--- fd66:66:66:2c:a2cd:efff:fe10:201 ping statistics ---
100 packets transmitted, 86 received, +14 errors, 14% packet loss, time 15878ms
rtt min/avg/max/mdev = 800.133/891.637/2203.781/299.134 ms, pipe 14



3. Experiment: arp/lladr flushed three times during ping and SIGINT send to ping af
    Only 69 pings ‘‘at 0.1s interval’’ send in ~10 seconds!
```

```
root@mlc1001:~# ping6 -q -c100 -i0.1 fd66:66:66:2c:a2cd:efff:fe10:201 & (sleep 11; killa
PING fd66:66:66:2c:a2cd:efff:fe10:201(fd66:66:66:2c:a2cd:efff:fe10:201) 56 data bytes
root@mlc1001:~# ip neigh flush dev eth1
root@mlc1001:~# ip neigh flush dev eth1
root@mlc1001:~# ip neigh flush dev eth1
--- fd66:66:66:2c:a2cd:efff:fe10:201 ping statistics ---
69 packets transmitted, 57 received, +6 errors, 17% packet loss, time 10919ms
rtt min/avg/max/mdev = 800.144/919.743/2202.364/353.556 ms, pipe 14
```

3.2 Stationary Scenarios

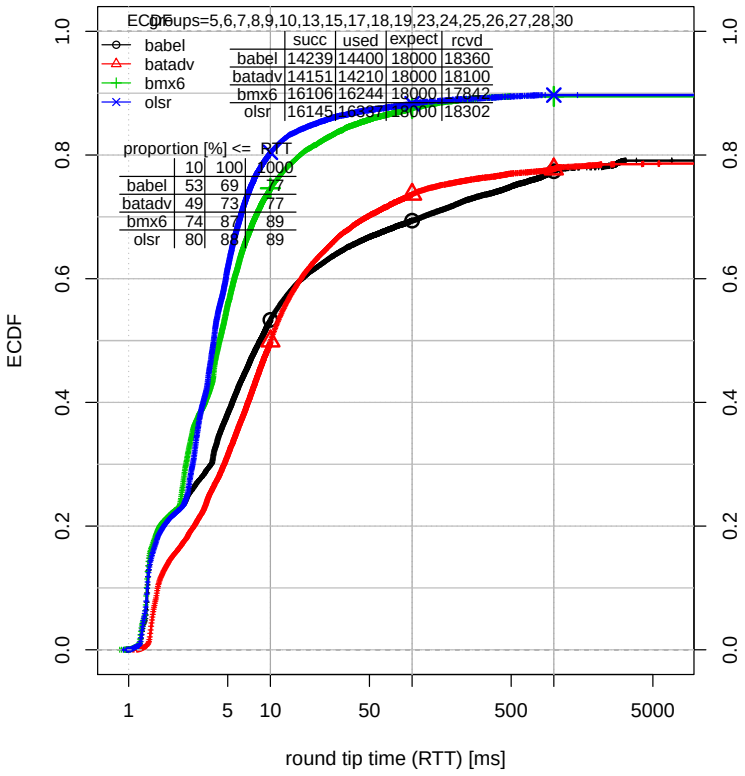

Figure 3: Random node test 1

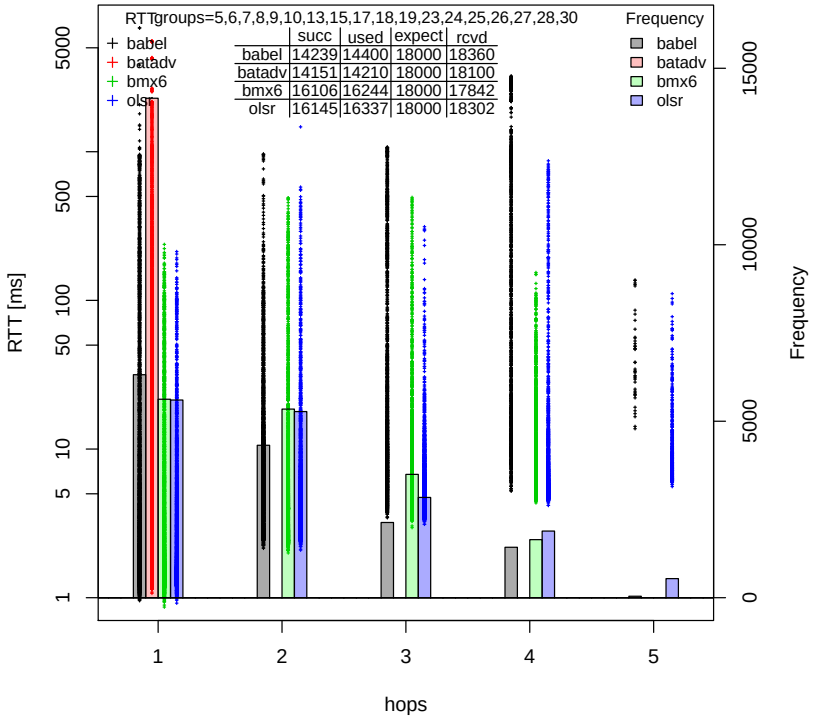

Figure 4: Random node test 1

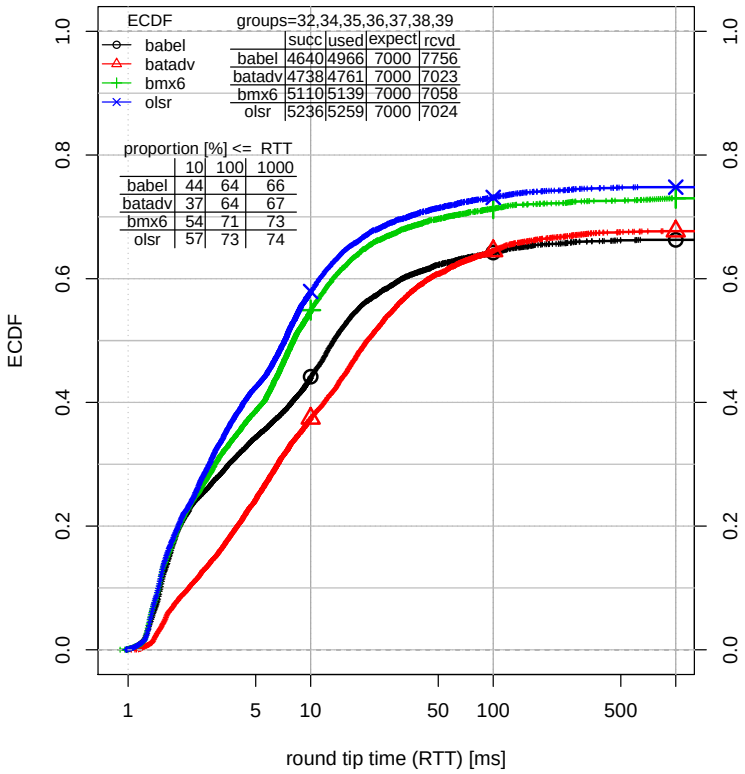

Figure 5: Random node test 2

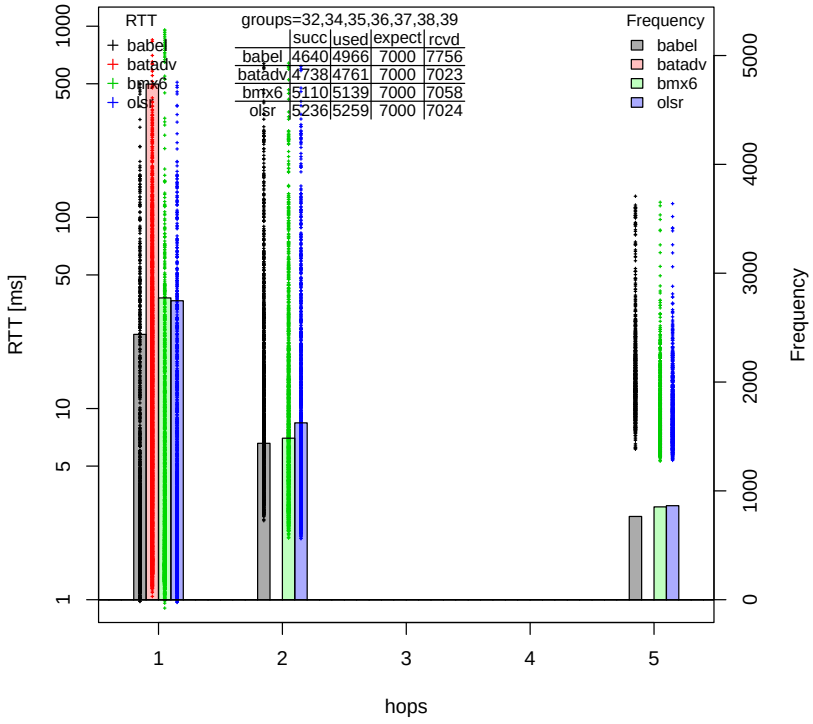

Figure 6: Random node test 2

3.3 Mobile Scenarios

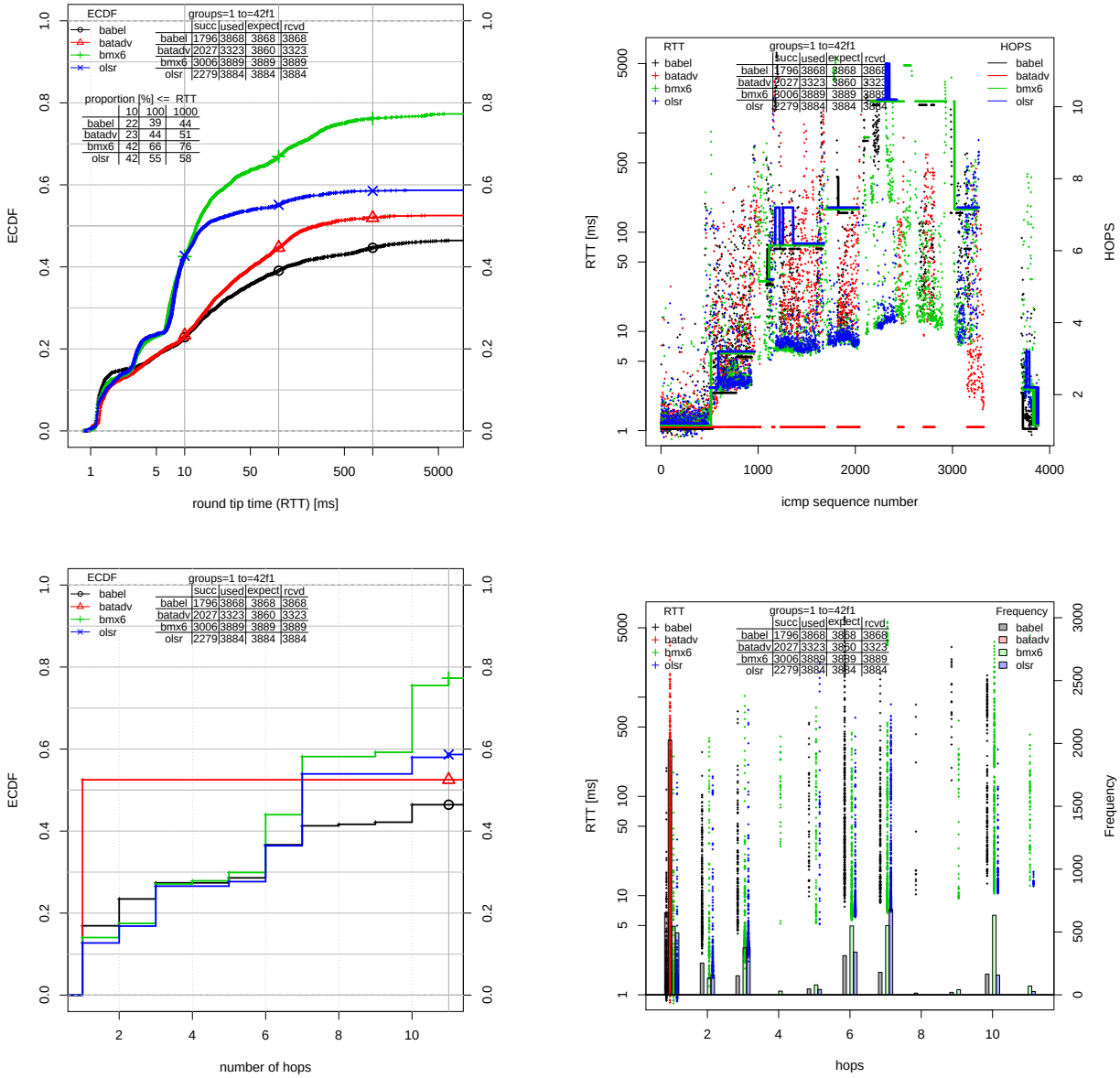

Table 1: Mobile test 0 (group 1)

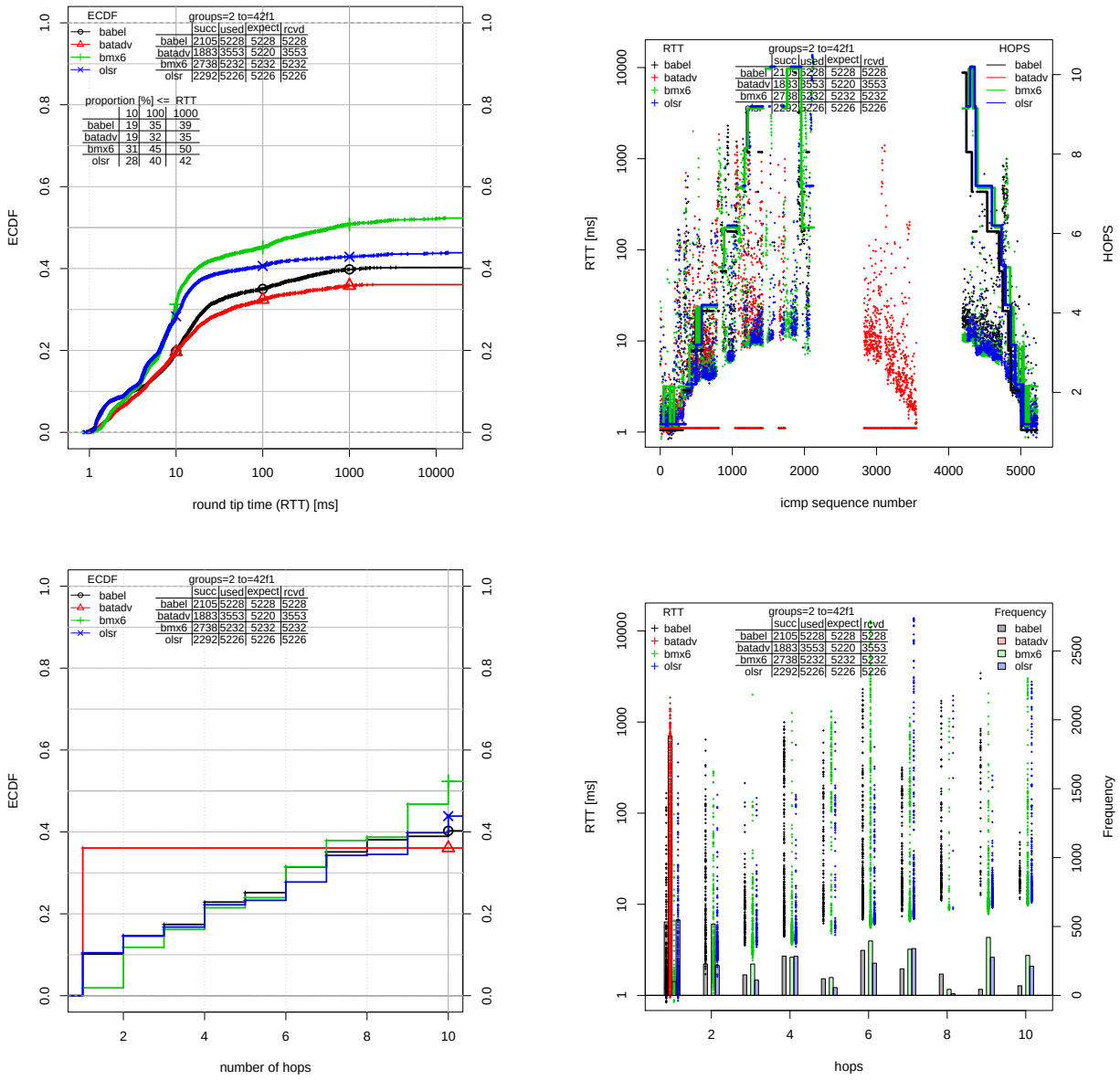

Table 2: Mobile node test 1 (group 2)

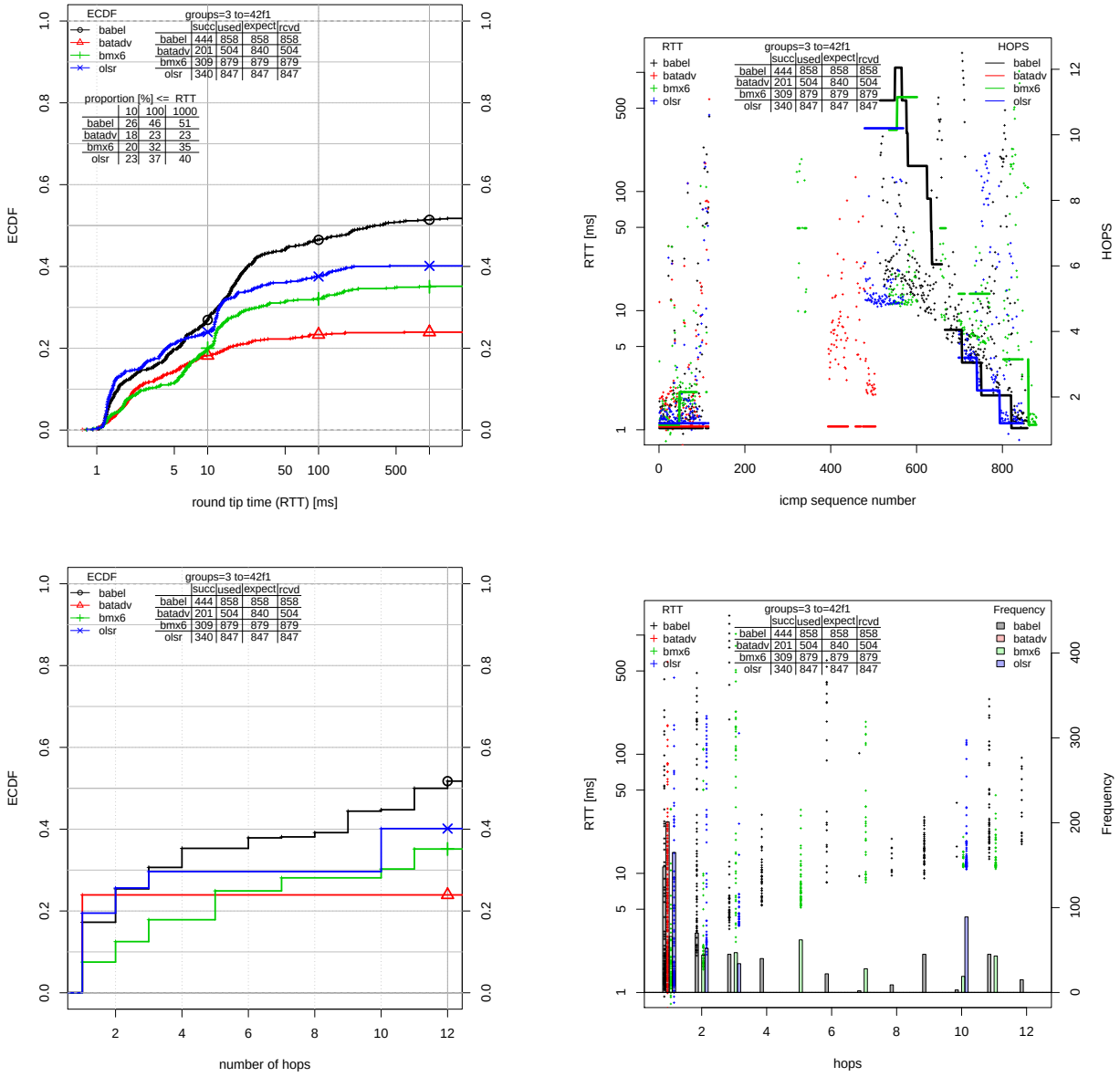

Table 3: Running node test 2 (group 3)

4 TCP Throughput Measurements

5 Appendix

5.1 Ping Results Table

The folloing verbatim table lists statistics per experiment (EXP) and group (GRP) as calculated by the lua-based evaluation script based on the raw ping-measurements data and outputted to the file ping.stat. Event based results are given for each received icmp response in ping.data.

ping.stat

PROTO	EXP	NODE	GRP	SIZE	SEND	RCVD	LOSS	TIME	maxTime	minSeq	maxSeq	SEQMAX	UNIQ	DUP	REOR	HOPMAX	HOPAVG	RTTMIN	RTTMAX	RTTAVG	LOGFILE
bmx6	1	42f1	1	1008	NA	NA	NA	NA	NA	3860	3889	3889	3006	0	4	11	5.68	0.82	5766	86.1	test_data/screenlog.ping_bmx6
babel	1	42f1	1	1008	NA	NA	NA	NA	NA	3860	3868	3868	1796	0	0	10	3.85	0.874	6428	143.7	test_data/screenlog.ping_babel
olsr	1	42f1	1	1008	NA	NA	NA	NA	NA	3860	3884	3884	2279	0	2	11	4.75	0.858	2259	26.5	test_data/screenlog.ping_olsr
batadv	1	42f1	1	1008	NA	NA	NA	NA	NA	3860	3323	3323	2027	0	0	1	1.00	0.836	3573	64.6	test_data/screenlog.ping_batadv
bmx6	2	42f1	2	1008	NA	NA	NA	NA	NA	5220	5232	5232	2738	0	9	10	5.60	0.844	12862	158.5	test_data/mobile_test1/screenlog.ping_bmx6
babel	2	42f1	2	1008	NA	NA	NA	NA	NA	5220	5228	5228	2105	0	1	10	4.19	0.838	3428	68.2	test_data/mobile_test1/screenlog.ping_babe
olsr	2	42f1	2	1008	NA	NA	NA	NA	NA	5220	5226	5226	2292	0	2	10	4.90	0.874	13823	124.2	test_data/mobile_test1/screenlog.ping_olsr
batadv	2	42f1	2	1008	NA	NA	NA	NA	NA	5220	3553	3553	1883	0	0	1	1.00	0.948	1857	54.1	test_data/mobile_test1/screenlog.ping_bata
bmx6	3	42f1	3	1008	NA	NA	NA	NA	NA	840	879	879	309	0	0	11	4.74	0.802	1023	30.8	test_data/mobile_running_test0/screenlog.p
babel	3	42f1	3	1008	NA	NA	NA	NA	NA	840	858	858	444	0	0	12	4.30	0.924	1457	47.3	test_data/mobile_running_test0/screenlog.p
olsr	3	42f1	3	1008	NA	NA	NA	NA	NA	840	847	847	340	0	0	10	3.71	0.821	439	19.5	test_data/mobile_running_test0/screenlog.p
batadv	3	42f1	3	1008	NA	NA	NA	NA	NA	840	504	504	201	0	0	1	1.00	0.741	595	14.7	test_data/mobile_running_test0/screenlog.p
bmx6	4	f9e0	4	1008	1484	1000	32	25224	10000	1000	580	1465	1000	0	37	5	4.35	8.15	13164	2716.5	test_data/random_ping_test/screenlog.0
batadv	4	f9e0	4	1008	654	171	73	29999	10000	1000	85	257	171	0	1	1	1.00	452	24402	5076.5	test_data/random_ping_test/screenlog.0
olsr	4	f9e0	4	1008	1141	1000	12	19157	10000	1000	547	1049	1000	0	0	5	5.00	8.14	2359	1150.4	test_data/random_ping_test/screenlog.0
bmx6	4	5691	5	1008	1001	1000	0	13790	10000	1000	725	1001	1000	0	0	1	1.00	1.16	330	40.1	test_data/random_ping_test/screenlog.0
batadv	4	5691	5	1008	1000	1000	0	12009	10000	1000	832	1000	1000	0	0	1	1.00	1.21	182	10.7	test_data/random_ping_test/screenlog.0
babel	4	5691	5	1008	1000	1000	0	10778	10000	1000	927	1000	1000	0	0	1	1.00	1.07	212	7.5	test_data/random_ping_test/screenlog.0
olsr	4	5691	5	1008	1000	1000	0	11067	10000	1000	903	1000	1000	0	0	1	1.00	1.08	178	8.1	test_data/random_ping_test/screenlog.0
bmx6	4	af0e	6	1008	1000	1000	0	10546	10000	1000	948	1000	1000	0	0	1	1.00	1	82.3	5.0	test_data/random_ping_test/screenlog.0
batadv	4	af0e	6	1008	1019	1000	1	14800	10000	1000	687	1017	1000	0	0	1	1.00	1.09	243	18.5	test_data/random_ping_test/screenlog.0
babel	4	af0e	6	1008	1001	1000	0	11632	10000	1000	859	1000	1000	0	0	1	1.00	1.12	84.4	9.2	test_data/random_ping_test/screenlog.0
olsr	4	af0e	6	1008	1007	1000	0	12969	10000	1000	776	1007	1000	0	0	1	1.00	0.996	213	12.1	test_data/random_ping_test/screenlog.0
bmx6	4	db4	7	1008	1003	1000	0	11007	10000	1000	911	1003	1000	0	0	3	3.00	3.85	241	15.7	test_data/random_ping_test/screenlog.0
batadv	4	db4	7	1008	1018	1000	1	14404	10000	1000	706	1017	1000	0	0	1	1.00	4.77	2172	178.1	test_data/random_ping_test/screenlog.0
babel	4	db4	7	1008	1075	1000	6	16821	10000	1000	638	1074	1000	0	33	4	4.00	7.02	3227	827.8	test_data/random_ping_test/screenlog.0
olsr	4	db4	7	1008	1032	1000	3	12232	10000	1000	843	1032	1000	0	0	4	4.00	4.35	450	21.9	test_data/random_ping_test/screenlog.0
bmx6	4	81c5	8	1008	1090	1000	8	12110	10000	1000	900	1090	1000	0	0	3	3.00	3.54	483	13.7	test_data/random_ping_test/screenlog.0
batadv	4	81c5	8	1008	1000	1000	0	13174	10000	1000	759	1000	1000	0	0	1	1.00	4.94	195	20.0	test_data/random_ping_test/screenlog.0
babel	4	81c5	8	1008	1024	1007	1	13322	10000	1000	756	1008	1007	0	2	3	3.00	3.5	982	104.6	test_data/random_ping_test/screenlog.0
olsr	4	81c5	8	1008	1001	1000	0	10190	10000	1000	982	1001	1000	0	0	3	3.00	3.24	113	5.2	test_data/random_ping_test/screenlog.0
bmx6	4	5e93	9	1008	1001	1000	0	13838	10000	1000	722	1000	1000	0	0	5	4.01	5.68	154	22.6	test_data/random_ping_test/screenlog.0
batadv	4	5e93	9	1008	1003	1000	0	13251	10000	1000	756	1002	1000	0	0	1	1.00	5.85	234	19.0	test_data/random_ping_test/screenlog.0
babel	4	5e93	9	1008	1052	1000	4	16204	10000	1000	647	1050	1000	0	5	5	4.09	6.2	1105	239.0	test_data/random_ping_test/screenlog.0
olsr	4	5e93	9	1008	1057	1000	5	15101	10000	1000	698	1055	1000	0	0	5	4.54	5.52	869	47.6	test_data/random_ping_test/screenlog.0
bmx6	4	468a	10	1008	1000	1000	0	10056	10000	1000	994	1000	1000	0	0	2	2.00	2	13.4	3.0	test_data/random_ping_test/screenlog.0
batadv	4	468a	10	1008	1000	1000	0	13271	10000	1000	753	1000	1000	0	0	1	1.00	1.98	666	42.6	test_data/random_ping_test/screenlog.0
babel	4	468a	10	1008	1007	1000	0	10707	10000	1000	940	1007	1000	0	0	2	1.71	1.91	120	6.7	test_data/random_ping_test/screenlog.0
olsr	4	468a	10	1008	1000	1000	0	10306	10000	1000	970	1000	1000	0	0	2	2.00	2.09	204	6.4	test_data/random_ping_test/screenlog.0
bmx6	4	ad2c	11	1008	1004	1000	0	15324	10000	1000	655	1004	1000	0	1	6	4.46	5.36	907	80.6	test_data/random_ping_test/screenlog.0
batadv	4	ad2c	11	1008	1031	1000	3	18811	10000	1000	545	1027	1000	0	15	1	1.00	7.54	2379	218.1	test_data/random_ping_test/screenlog.0
bmx6	4	534c	12	1008	1147	1000	12	18103	10000	1000	631	1143	1000	0	30	5	4.97	6.19	10960	1751.0	test_data/random_ping_test/screenlog.0
batadv	4	534c	12	1008	847	807	4	29984	10000	1000	280	841	807	0	22	1	1.00	31.9	4365	892.2	test_data/random_ping_test/screenlog.0
olsr	4	534c	12	1008	1830	863	52	29984	10000	1000	558	1675	863	0	35	5	4.16	514	7553	3122.2	test_data/random_ping_test/screenlog.0
bmx6	4	af0e	13	1008	716	697	2	13488	10000	1000	530	715	697	0	0	2	2.00	2.55	489	71.4	test_data/random_ping_test/screenlog.0
batadv	4	af0e	13	1008	1000	1000	0	10750	10000	1000	930	1000	1000	0	0	1	1.00	3.26	271	9.7	test_data/random_ping_test/screenlog.0
babel	4	af0e	13	1008	1011	1000	1	14840	10000	1000	681	1011	1000	0	0	2	2.00	3.09	966	49.8	test_data/random_ping_test/screenlog.0
olsr	4	af0e	13	1008	1001	1000	0	10397	10000	1000	962	1001	1000	0	0	2	2.00	2.37	183	4.2	test_data/random_ping_test/screenlog.0
bmx6	4	534c	14	1008	1738	1000	42	28774	10000	1000	585	1684	1000	0	18	4	3.67	5.18	7032	1232.1	test_data/random_ping_test/screenlog.0
batadv	4	534c	14	1008	1660	786	52	29957	10000	1000	422	1266	786	0	3	1	1.00	5.69	9047	4769.8	test_data/random_ping_test/screenlog.0
olsr	4	534c	14	1008	1711	521	69	29990	10000	1000	405	1215	521	0	43	4	3.89	20	15448	4145.2	test_data/random_ping_test/screenlog.0
bmx6	4	a165	15	1008	1000	1000	0	10044	10000	1000	995	1000	1000	0	0	2	2.00	2.36	17.5	3.7	test_data/random_ping_test/screenlog.0
batadv	4	a165	15	1008	1005	1000	0	20248	10000	1000	496	1005	1000	0	0	1	1.00	3.49	1043	129.5	test_data/random_ping_test/screenlog.0
babel	4	a165	15	1008	1021	1000	2	20066	10000	1000	508	1021	1000	0	2	2	1.62	2.77	1068	91.4	test_data/random_ping_test/screenlog.0
olsr	4	a165	15	1008	1000	1000	0	10250	10000	1000	975	1000	1000	0	0	2	2.00	2.27	109	4.7	test_data/random_ping_test/screenlog.0
batadv	4	ed38	16	1008	1581	970	38	29991	10000	1000	489	1468	970	0	6	1	1.00	5.93	5273	1910.7	test_data/random_ping_test/screenlog.0
bmx6	4	cc08	17	1008	1000	1000	0	10064	10000	1000	993	1000	1000	0	0	2	2.00	2.07	10	2.7	test_data/random_ping_test/screenlog.0
batadv	4	cc08	17	1008	1000	1000	0	10881	10000	1000	919	1000	1000	0	0	1	1.00	2.2	109	8.6	test_data/random_ping_test/screenlog.0
babel	4	cc08	17	1008	1000	1000	0	11205	10000	1000	892	1000	1000	0	0	2	2.00	2.25	163	9.3	test_data/random_ping_test/screenlog.0
olsr	4	cc08	17	1008	1006	1000	0	10254	10000	1000	981	1006	1000	0	0	2	2.00	2.57	193	5.0	test_data/random_ping_test/screenlog.0
bmx6	4	81c5	18	1008	1000	1000	0	10090	10000	1000	991	1000	1000	0	0	1	1.00	0.865	19.3	1.8	test_data/random_ping_test/screenlog.0
batadv	4	81c5	18	1008	1002	1000	0	10311	10000	1000	969	1000	1000	0	0	1	1.00	1.28	97.3	3.4	test_data/random_ping_test/screenlog.0
babel	4	81c5	18	1008	1000	1000	0	10101	10000	1000	990	1000	1000	0	0	1	1.00	1.06	74.4	2.0	test_data/random_ping_test/screenlog.0
olsr	4	81c5	18	1008	1000	1000	0	10112	10000	1000	988	1000	1000	0	0	1	1.00	1.06	9.25	1.7	test_data/random_ping_test/screenlog.0
bmx6	4	bfca	19	1008	1000	1000	0	10148	10000	1000	985	1000	1000	0	0	1	1.00	0.892	6.07	1.3	test_data/random_ping_test/screenlog.0
batadv	4	bfca	19	1008	1000	1000	0	10364	10000	1000	964	1000	1000	0	0	1	1.00	1.16	103	4.3	test_data/random_ping_test/screenlog.0
babel	4	bfca	19	1008	1000	1000	0	10050	10000	1000	995	1000	1000	0	0	1	1.00	0.955	5.49	1.4	test_data/random_ping_test/screenlog.0
olsr	4	bfca	19	1008	1000	1000	0	10157	10000	1000	984	1000	1000	0	0	1	1.00	0.961	5.67	1.4	test_data/random_ping_test/screenlog.0
bmx6	4	a165	20	1008	1000	1000	0	11216	10000	1000	891	1000	1000	0	0	4	4.00	4.16	106	10.4	test_data/random_ping_test/screenlog.0
batadv	4	a165	20	1008	1362	1004	26	23369	10000	1000	485	1135	1004	0	0	1	1.00	18.3	4067	1507.0	test_data/random_ping_test/screenlog.0
olsr	4	a165	20	1008	1010	1000	0	14651	10000	1000	687	1007	1000	0	0	4	3.23	4.49	799	63.2	test_data/random_ping_test/screenlog.0
bmx6	4	800c	21	1008	1145	1000	12	18672	10000	1000	607	1134	1000	0	71	5	4.78	6.48	4637	1186.5	test_data/random_ping_test/screenlog.0
batadv	4	800c	21	1008	910	701	22	29998	10000	1000	257	772	701	0	0	1	1.00	46.6	3527	1074.3	test_data/random_ping_test/screenlog.0

olsr	4	800c	21	1008	596	331	44	22325	10000	1000	157	352	331	0	1	6	5.45	50.4	2752	398.5	test_data/random_ping_test/screen
bmx6	4	5e93	22	1008	1048	1000	4	16742	10000	1000	624	1046	1000	0	0	4	3.21	5.31	834	263.7	test_data/random_ping_test/screen
olsr	4	5e93	22	1008	1012	1002	0	13451	10000	1000	746	1004	1002	0	0	4	4.00	4.41	785	67.9	test_data/random_ping_test/screen
babel	4	5e93	22	1008	212	206	2	3539	10000	1000	209	209	206	0	1	4	3.30	7.23	1176	302.8	test_data/random_ping_test/screen
bmx6	4	81c5	23	1008	1000	1000	0	11088	10000	1000	901	1000	1000	0	0	3	3.00	2.96	72	9.4	test_data/random_ping_test/screen
batadv	4	81c5	23	1008	1075	1002	6	16634	10000	1000	608	1013	1002	0	0	1	1.00	4.51	1823	656.0	test_data/random_ping_test/screen
babel	4	81c5	23	1008	1000	1000	0	11174	10000	1000	894	1000	1000	0	0	3	2.24	3.45	101	10.4	test_data/random_ping_test/screen
olsr	4	81c5	23	1008	1000	1000	0	11341	10000	1000	881	1000	1000	0	0	3	3.00	3.25	313	12.7	test_data/random_ping_test/screen
bmx6	4	44f	24	1008	1000	1000	0	10052	10000	1000	994	1000	1000	0	0	1	1.00	1.08	10.2	1.6	test_data/random_ping_test/screen
batadv	4	44f	24	1008	1000	1000	0	11078	10000	1000	902	1000	1000	0	0	1	1.00	1.25	310	7.0	test_data/random_ping_test/screen
babel	4	44f	24	1008	1000	1000	0	10043	10000	1000	995	1000	1000	0	0	1	1.00	1.08	5.83	1.5	test_data/random_ping_test/screen
olsr	4	44f	24	1008	1000	1000	0	10338	10000	1000	967	1000	1000	0	0	1	1.00	1.08	99.8	4.4	test_data/random_ping_test/screen
bmx6	4	81c5	25	1008	1000	1000	0	10197	10000	1000	980	1000	1000	0	0	1	1.00	1.02	33.3	1.7	test_data/random_ping_test/screen
batadv	4	81c5	25	1008	1000	1000	0	10593	10000	1000	944	1000	1000	0	0	1	1.00	1.07	11.2	1.8	test_data/random_ping_test/screen
babel	4	81c5	25	1008	1001	1000	0	16067	10000	1000	623	1001	1000	0	1	1	1.00	1.04	6809	36.3	test_data/random_ping_test/screen
olsr	4	81c5	25	1008	1000	1000	0	10113	10000	1000	988	1000	1000	0	0	1	1.00	0.919	9.09	1.6	test_data/random_ping_test/screen
bmx6	4	bc79	26	1008	1033	1000	3	11374	10000	1000	908	1033	1000	0	0	3	3.00	3.21	493	14.3	test_data/random_ping_test/screen
batadv	4	bc79	26	1008	1025	1000	2	14195	10000	1000	718	1020	1000	0	6	1	1.00	3.56	5569	237.8	test_data/random_ping_test/screen
babel	4	bc79	26	1008	1002	1000	0	12249	10000	1000	817	1001	1000	0	0	3	3.00	3.8	348	22.8	test_data/random_ping_test/screen
olsr	4	bc79	26	1008	1000	1000	0	10211	10000	1000	979	1000	1000	0	0	3	3.00	3.12	24.6	4.5	test_data/random_ping_test/screen
bmx6	4	800c	27	1008	1000	1000	0	10834	10000	1000	923	1000	1000	0	0	4	4.00	4.34	112	10.2	test_data/random_ping_test/screen
batadv	4	800c	27	1008	1000	1000	0	12888	10000	1000	775	1000	1000	0	0	1	1.00	4.52	215	17.9	test_data/random_ping_test/screen
babel	4	800c	27	1008	1179	1000	15	18398	10000	1000	640	1179	1000	0	2	4	3.55	4.38	824	84.3	test_data/random_ping_test/screen
olsr	4	800c	27	1008	1000	1000	0	10256	10000	1000	975	1000	1000	0	0	4	4.00	4.18	54.2	6.6	test_data/random_ping_test/screen
bmx6	4	3cc	28	1008	1000	1000	0	10152	10000	1000	985	1000	1000	0	0	2	2.00	3.73	40.8	5.0	test_data/random_ping_test/screen
batadv	4	3cc	28	1008	1002	1000	0	11967	10000	1000	837	1002	1000	0	0	1	1.00	3.9	312	18.2	test_data/random_ping_test/screen
babel	4	3cc	28	1008	1000	1000	0	10183	10000	1000	982	1000	1000	0	0	2	2.00	3.49	49.5	5.3	test_data/random_ping_test/screen
olsr	4	3cc	28	1008	1090	1000	8	11822	10000	1000	922	1090	1000	0	0	2	2.00	2.84	476	12.2	test_data/random_ping_test/screen
olsr	4	8c7a	29	1008	1000	1000	0	11928	10000	1000	838	1000	1000	0	0	1	1.00	1.07	198	11.6	test_data/random_ping_test/screen
bmx6	4	81c5	30	1008	1001	1000	0	11629	10000	1000	859	1000	1000	0	0	2	2.00	2.28	124	11.2	test_data/random_ping_test/screen
batadv	4	81c5	30	1008	1041	1020	2	15612	10000	1000	655	1024	1020	0	0	1	1.00	2.28	2386	66.2	test_data/random_ping_test/screen
babel	4	81c5	30	1008	1053	1000	5	16342	10000	1000	616	1008	1000	0	0	2	1.35	2.15	960	145.5	test_data/random_ping_test/screen
olsr	4	81c5	30	1008	1111	1000	9	19686	10000	1000	563	1110	1000	0	0	2	2.00	2.42	3958	92.9	test_data/random_ping_test/screen
bmx6	4	60f0	31	1008	1008	1000	0	12490	10000	1000	806	1007	1000	0	0	4	4.00	4.52	1049	55.2	test_data/random_ping_test/screen
batadv	4	60f0	31	1008	1010	1000	0	12844	10000	1000	786	1010	1000	0	0	1	1.00	5.13	245	26.4	test_data/random_ping_test/screen
olsr	4	60f0	31	1008	1001	1000	0	11043	10000	1000	906	1001	1000	0	0	4	4.00	4.59	199	11.8	test_data/random_ping_test/screen
bmx6	4	e76c	32	1008	1001	1000	0	11710	10000	1000	853	1000	1000	0	0	5	5.00	5.32	120	11.5	test_data/random_ping_test1/scree
babel	4	e76c	32	1008	1000	1000	0	13071	10000	1000	765	1000	1000	0	0	5	5.00	6.13	129	19.0	test_data/random_ping_test1/scree
olsr	4	e76c	32	1008	1001	1000	0	11569	10000	1000	865	1001	1000	0	0	5	5.00	5.34	118	11.3	test_data/random_ping_test1/scree
batadv	4	e76c	32	1008	1000	1000	0	14060	10000	1000	711	1000	1000	0	0	1	1.00	7.21	225	29.9	test_data/random_ping_test1/scree
bmx6	4	ff19	33	1008	1004	1000	0	11304	10000	1000	888	1004	1000	0	0	4	4.00	4.65	378	13.3	test_data/random_ping_test1/scree
batadv	4	ff19	33	1008	1004	1000	0	13390	10000	1000	749	1004	1000	0	0	1	1.00	5.77	367	28.7	test_data/random_ping_test1/scree
olsr	4	ff19	33	1008	1005	1002	0	11100	10000	1000	904	1004	1002	0	0	4	4.00	4.93	387	14.1	test_data/random_ping_test1/scree
bmx6	4	ae83	34	1008	1000	1000	0	12807	10000	1000	780	1000	1000	0	0	1	1.00	1.03	16.5	2.7	test_data/random_ping_test1/scree
babel	4	ae83	34	1008	1000	1000	0	12856	10000	1000	777	1000	1000	0	0	1	1.00	1.17	17.6	2.7	test_data/random_ping_test1/scree
olsr	4	ae83	34	1008	1000	1000	0	12813	10000	1000	780	1000	1000	0	0	1	1.00	1.23	14.2	2.7	test_data/random_ping_test1/scree
batadv	4	ae83	34	1008	1000	1000	0	13982	10000	1000	715	1000	1000	0	0	1	1.00	2.18	367	11.7	test_data/random_ping_test1/scree
bmx6	4	af0e	35	1008	1056	1000	5	16357	10000	1000	645	1056	1000	0	0	2	1.11	1.64	957	40.9	test_data/random_ping_test1/scree
babel	4	af0e	35	1008	1753	677	61	29998	10000	1000	584	1752	677	0	0	2	1.38	1.46	499	29.2	test_data/random_ping_test1/scree
olsr	4	af0e	35	1008	1018	1000	1	15487	10000	1000	657	1018	1000	0	0	2	1.49	1.79	509	25.9	test_data/random_ping_test1/scree
batadv	4	af0e	35	1008	1021	1000	2	15812	10000	1000	645	1021	1000	0	0	1	1.00	1.77	494	24.4	test_data/random_ping_test1/scree
bmx6	4	ebc5	36	1008	1001	1000	0	14706	10000	1000	680	1001	1000	0	0	3	2.02	2.52	641	29.5	test_data/random_ping_test1/scree
babel	4	ebc5	36	1008	1000	1000	0	15105	10000	1000	662	1000	1000	0	0	2	2.00	2.63	639	30.8	test_data/random_ping_test1/scree
olsr	4	ebc5	36	1008	1003	1000	0	15405	10000	1000	651	1003	1000	0	0	2	2.00	2.75	617	28.5	test_data/random_ping_test1/scree
batadv	4	ebc5	36	1008	1002	1000	0	15718	10000	1000	636	1001	1000	0	0	1	1.00	2.64	849	50.4	test_data/random_ping_test1/scree
bmx6	4	ae83	37	1008	1001	1000	0	12411	10000	1000	806	1001	1000	0	0	2	2.00	2.1	145	12.5	test_data/random_ping_test1/scree
babel	4	ae83	37	1008	1004	1000	0	12878	10000	1000	779	1004	1000	0	0	2	2.00	2.55	267	17.6	test_data/random_ping_test1/scree
olsr	4	ae83	37	1008	1002	1000	0	11735	10000	1000	853	1002	1000	0	0	2	2.00	2.08	146	8.3	test_data/random_ping_test1/scree
batadv	4	ae83	37	1008	1001	1000	0	13092	10000	1000	764	1001	1000	0	0	1	1.00	2.33	346	24.1	test_data/random_ping_test1/scree
bmx6	4	ebc5	38	1008	1000	1000	0	13918	10000	1000	718	1000	1000	0	0	1	1.00	0.904	11.3	1.6	test_data/random_ping_test1/scree
babel	4	ebc5	38	1008	1000	1000	0	14803	10000	1000	675	1000	1000	0	0	1	1.00	0.948	8.59	1.6	test_data/random_ping_test1/scree
olsr	4	ebc5	38	1008	1000	1000	0	13563	10000	1000	737	1000	1000	0	0	1	1.00	0.967	10.2	1.6	test_data/random_ping_test1/scree
batadv	4	ebc5	38	1008	1000	1000	0	15842	10000	1000	631	1000	1000	0	0	1	1.00	1.04	105	5.7	test_data/random_ping_test1/scree
bmx6	4	bc79	39	1008	1000	1000	0	15204	10000	1000	657	1000	1000	0	0	1	1.00	0.98	23.7	2.0	test_data/random_ping_test1/scree
babel	4	bc79	39	1008	1000	1000	0	13810	10000	1000	724	1000	1000	0	0	1	1.00	1.01	13.5	1.9	test_data/random_ping_test1/scree
olsr	4	bc79	39	1008	1000	1000	0	13954	10000	1000	716	1000	1000	0	0	1	1.00	0.989	45.9	2.0	test_data/random_ping_test1/scree
batadv	4	bc79	39	1008	1000	1000	0	15159	10000	1000	659	1000	1000	0	0	1	1.00	1.05	28.8	2.1	test_data/random_ping_test1/scree
batadv	4	f332	40	1008	1000	1000	0	10501	10000	1000	952	1000	1000	0	0	1	1.00	2.34	104	5.9	test_data/random_ping_test1/scree
bmx6	4	5aa3	41	1008	1000	1000	0	10980	10000	1000	910	1000	1000	0	0	2	2.00	1.86	8.63	2.7	test_data/random_ping_test1/scree
batadv	4	5aa3	41	1008	1000	1000	0	11598	10000	1000	862	1000	1000	0	0	1	1.00	2.29	106	6.3	test_data/random_ping_test1/scree
olsr	4	5aa3	41	1008	1000	1000	0	10516	10000	1000	950	1000	1000	0	0	2	2.00	1.95	11.6	2.7	test_data/random_ping_test1/scree
bmx6	4	ed38	42	1008	1000	1000	0	12466	10000	1000	802	1000	1000	0	0	1	1.00	1.25	245	7.5	test_data/random_ping_test1/scree
batadv	4	ed38	42	1008	1000	1000	0	12519	10000	1000	798	1000	1000	0	0	1	1.00	1.34	250	7.9	test_data/random_ping_test1/scree
olsr	4	ed38	42	1008	1000	1000	0	12507	10000	1000	799	1000	1000	0	0	1	1.00	1.24	245	7.5	test_data/random_ping_test1/scree
bmx6	4	bc79	43	1008	1160	1000	13	20127	10000	1000	576	1160	1000	0	0	6	5.56	7.08	1599	147.2	test_data/random_ping_test1/scree
batadv	4	bc79	43	1008	1660	937	43	29993	10000	1000	320	962	937	0	6	1	1.00	10.1	1767	327.7	test_data/random_ping_test1/scree
olsr	4	bc79	43	1008	1052	1005	4	18445	10000	1000	564	1041	1005	0	0	5	5.00	6.91	1439	291.2	test_data/random_ping_test1/scree
bmx6	4	8f53	44	1008	1000	1000	0	12014	10000	1000	832	1000	1000	0	0	1	1.00	0.975	46	6.0	test_data/random_ping_test1/scree
batadv	4	8f53	44	1008	1000	1000	0	12394	10000	1000	806	1000	1000	0	0	1	1.00	1.2	113	7.0	test_data/random_ping_test1/scree
olsr	4	8f53	44	1008	1000	1000	0	12037	10000	1000	830	1000	1000	0	0	1	1.00	1.15	113	6.8	test_data/random_ping_test1/scree
bmx6	4	60f0	45	1008	1056	1000	5	19850	10000	1000	529	1052	1000	0	5	2	1.08	4.71	849	197.7	test_data/random_ping_test1/scree
batadv	4	60f0	45	1008	1083	1000	7	19211	10000	1000	555	1068	1000	0	0	1	1.00	8.93	839	225.3	test_data/random_ping_test1/scree
olsr	4	60f0	45	1008	1064	1000	6	20001	10000	1000	531	1064	1000	0	0	2	1.17	2.53	839	196.0	test_data/random_ping_test1/scree
batadv	4	c2a	46	1008	1002	1000	0	10632	10000	1000	942	1002	1000	0	0	1	1.00	3.31	70	6.6	test_data/random_ping_test1/scree
batadv	4	a165	47	1008	1012	1000	1	13316	10000	1000	759	1012	1000	0	0	1	1.00	5.56	444	27.5	test_data/random_ping_test1/scree
bmx6	4	6257	48	1008	1000	1000	0	11048	10000	1000	905	1000	1000	0	0	3	3.00	3.76	199	9.1	test_data/random_ping_test1/scree
olsr	4	6257	48	1008	1090	1000	8	12735	10000	1000	855	1090	1000	0	0	3	3.00	3.85	421	14.5	test_data/random_ping_test1/scree
batadv	4	a165	49	1008	1000	1000	0	10017	10000	1000	998	1000	1000	0	0	1	1.00	0.989	8.51	1.4	test_data/random_ping_test2/scree
bmx6	4	50e5	50	1008	1001	1000	0	13306	10000	1000	751	1000	1000	0	0	4	4.00	5.82	377	27.6	test_data/random_ping_test2/scree
olsr	4	50e5	50	1008	1001	1000	0	13357	10000	1000	748	1000	1000	0	0	5	4.44	5.67	359	27.8	test_data/random_ping_test2/scree

5.2 Individual Random-node Test Measurements

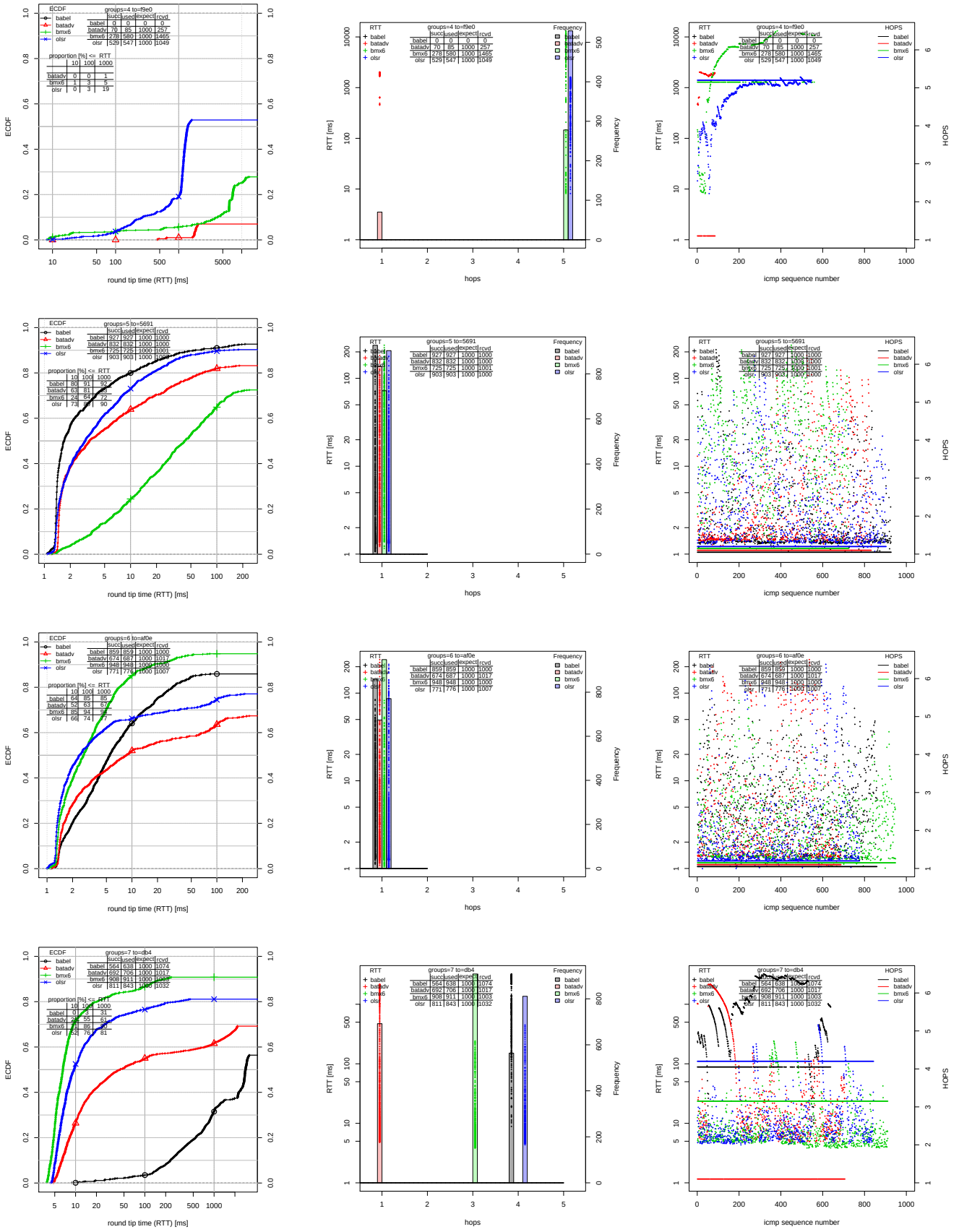

Table 4: Individual Random node tests (groups 4-6)

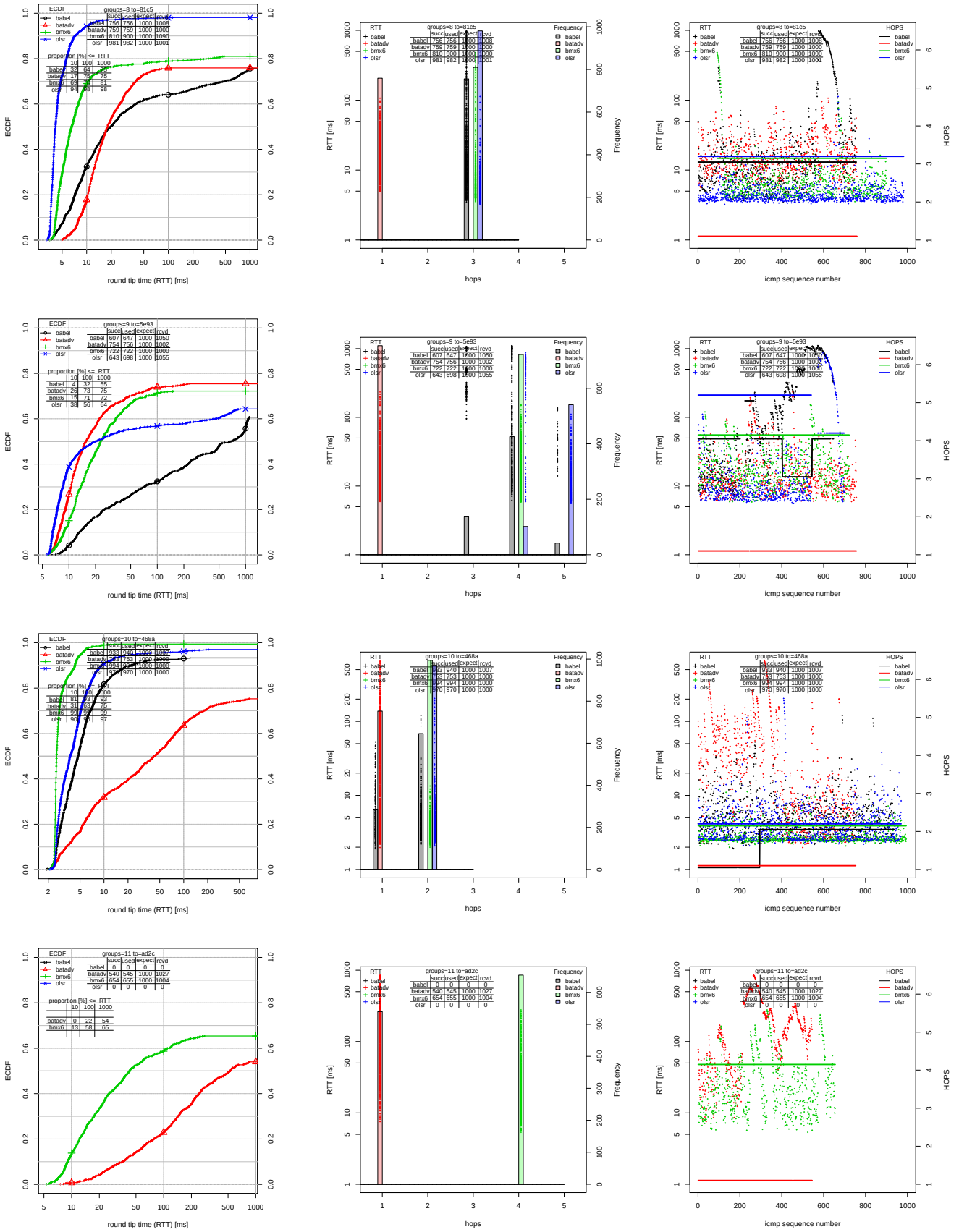

Table 5: Individual Random node tests (groups 8-11)

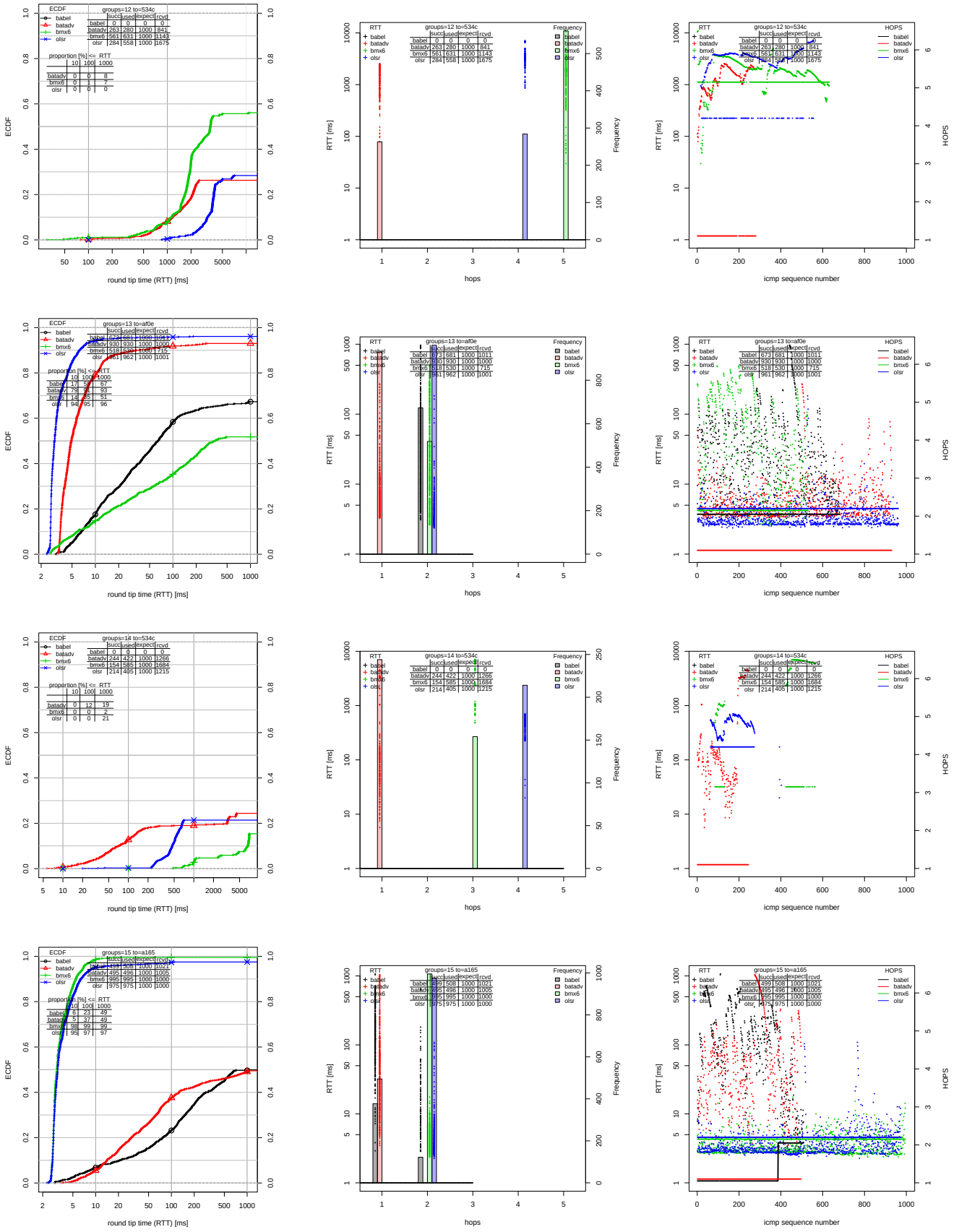

Table 6: Individual Random node tests (groups 12-15)

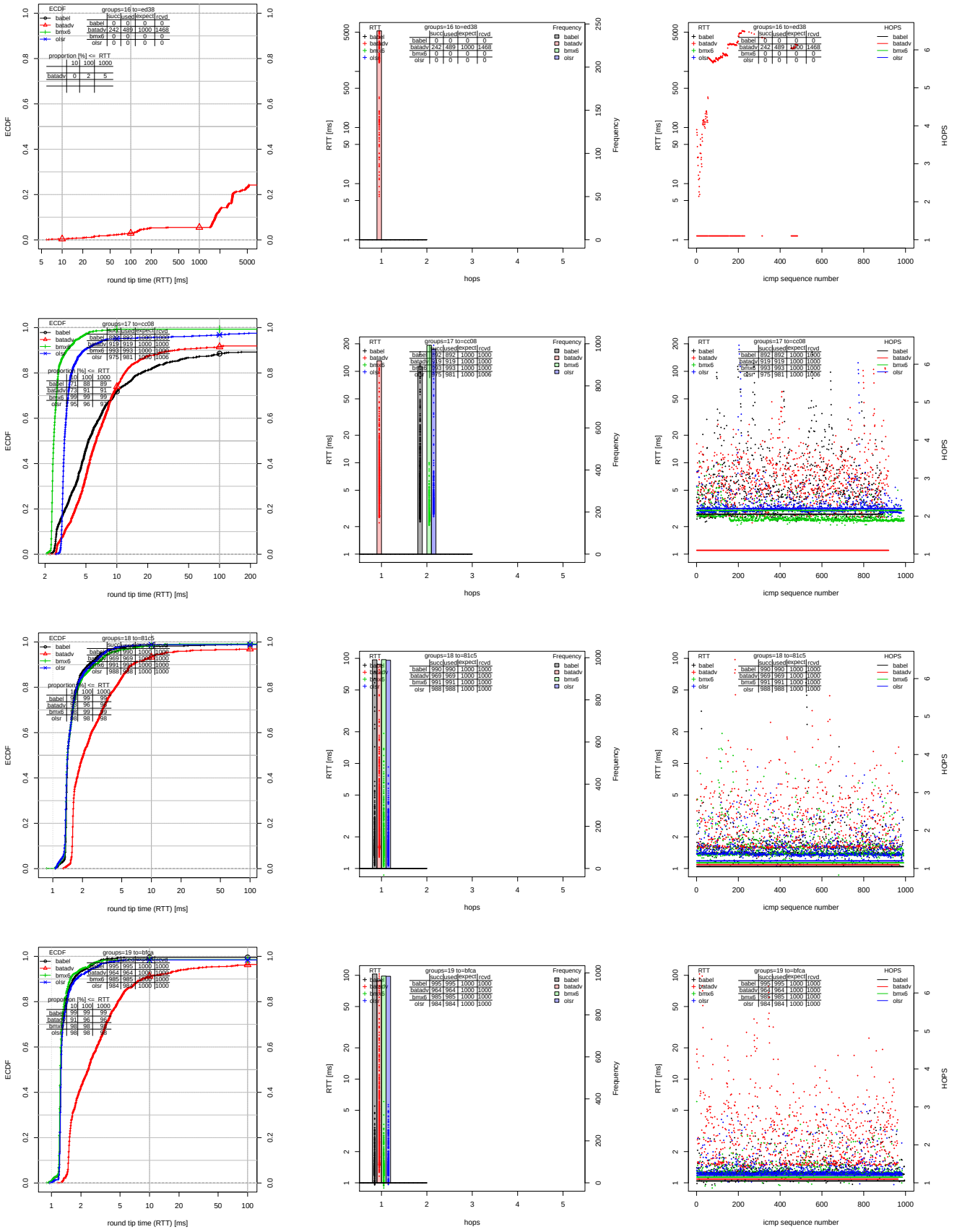

Table 7: Individual Random node tests (groups 16-19)

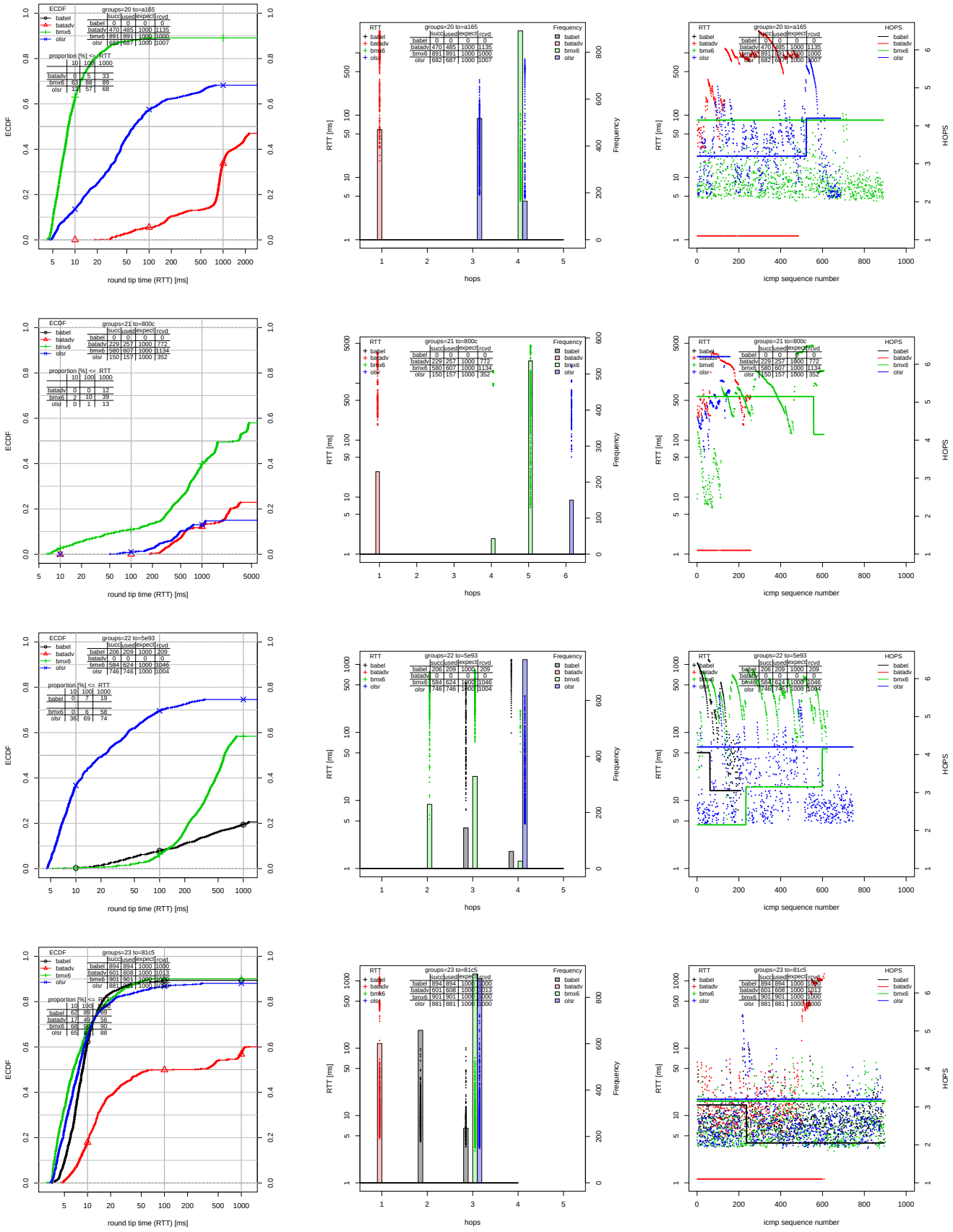

Table 8: Individual Random node tests (groups 20-23)

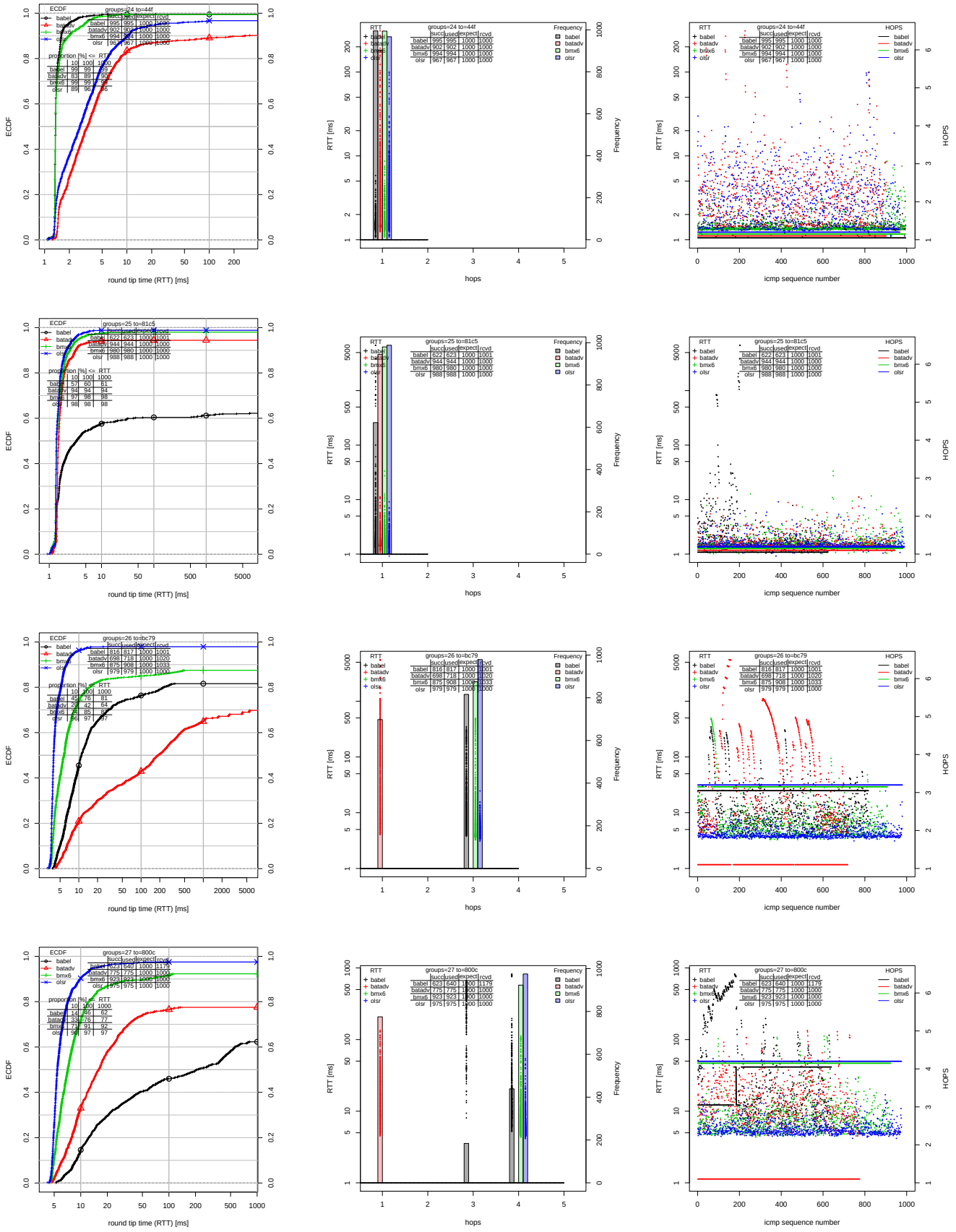

Table 9: Individual Random node tests (groups 24-27)

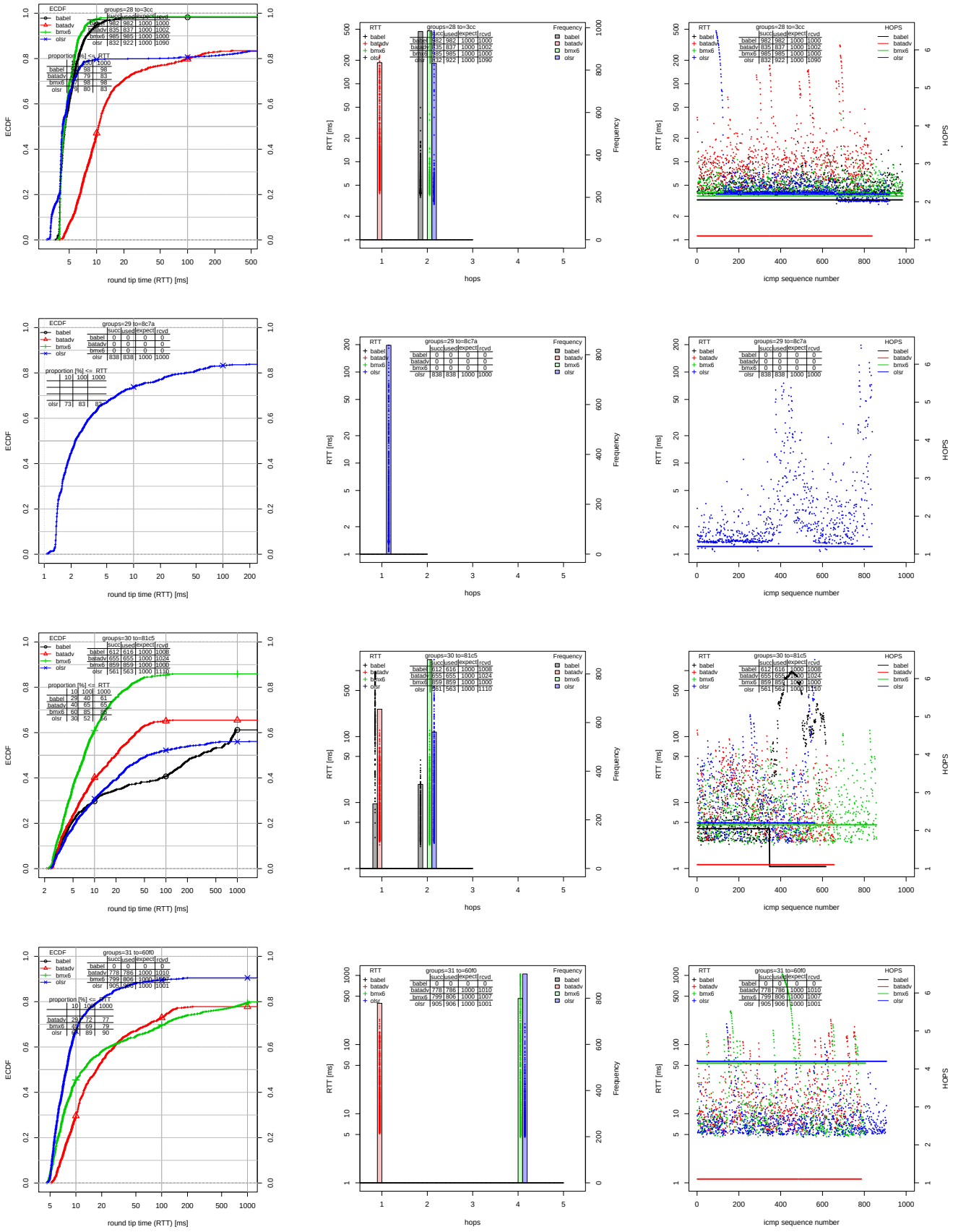

Table 10: Individual Random node tests (groups 28-31)

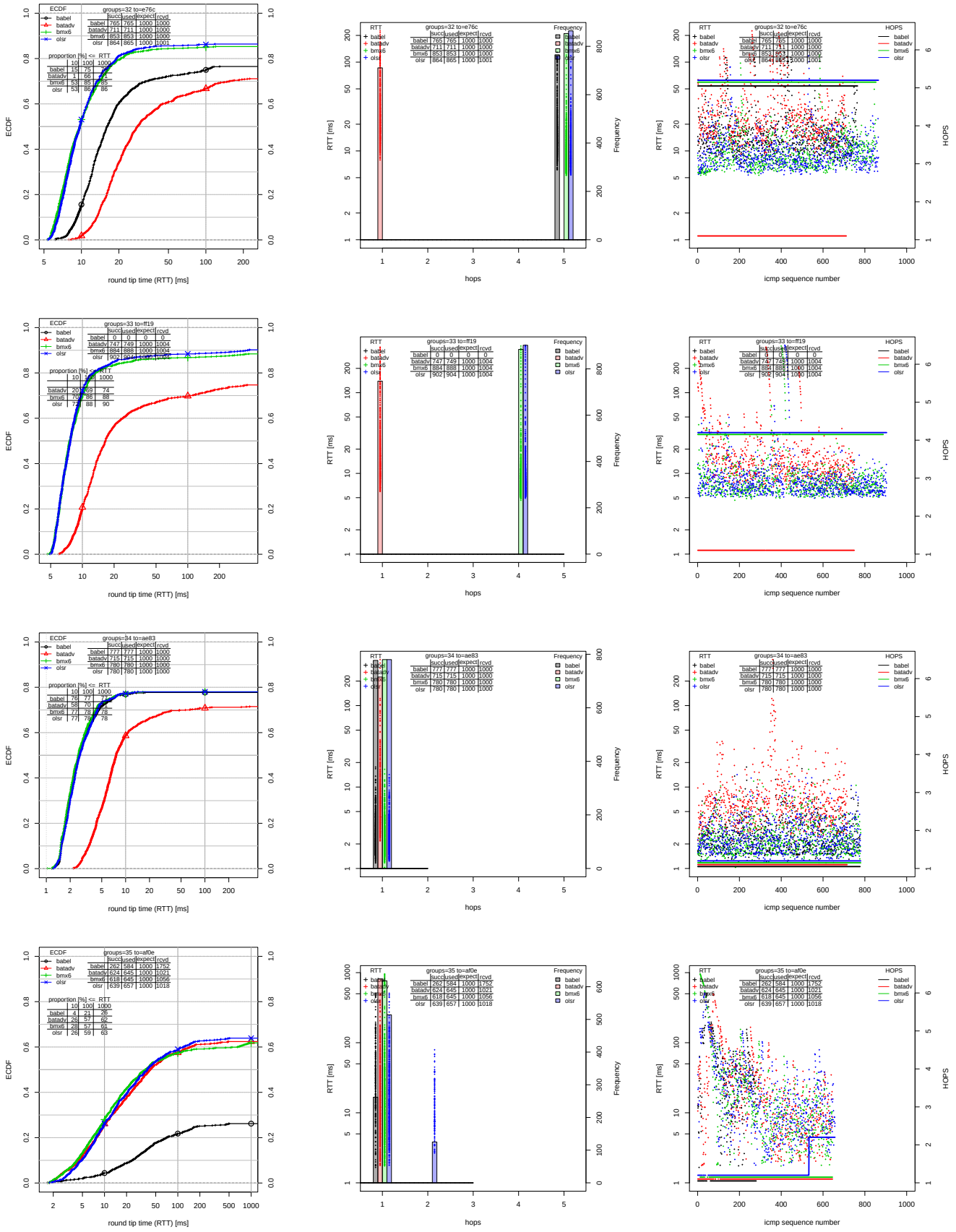

Table 11: Individual Random node tests (groups 32-35)

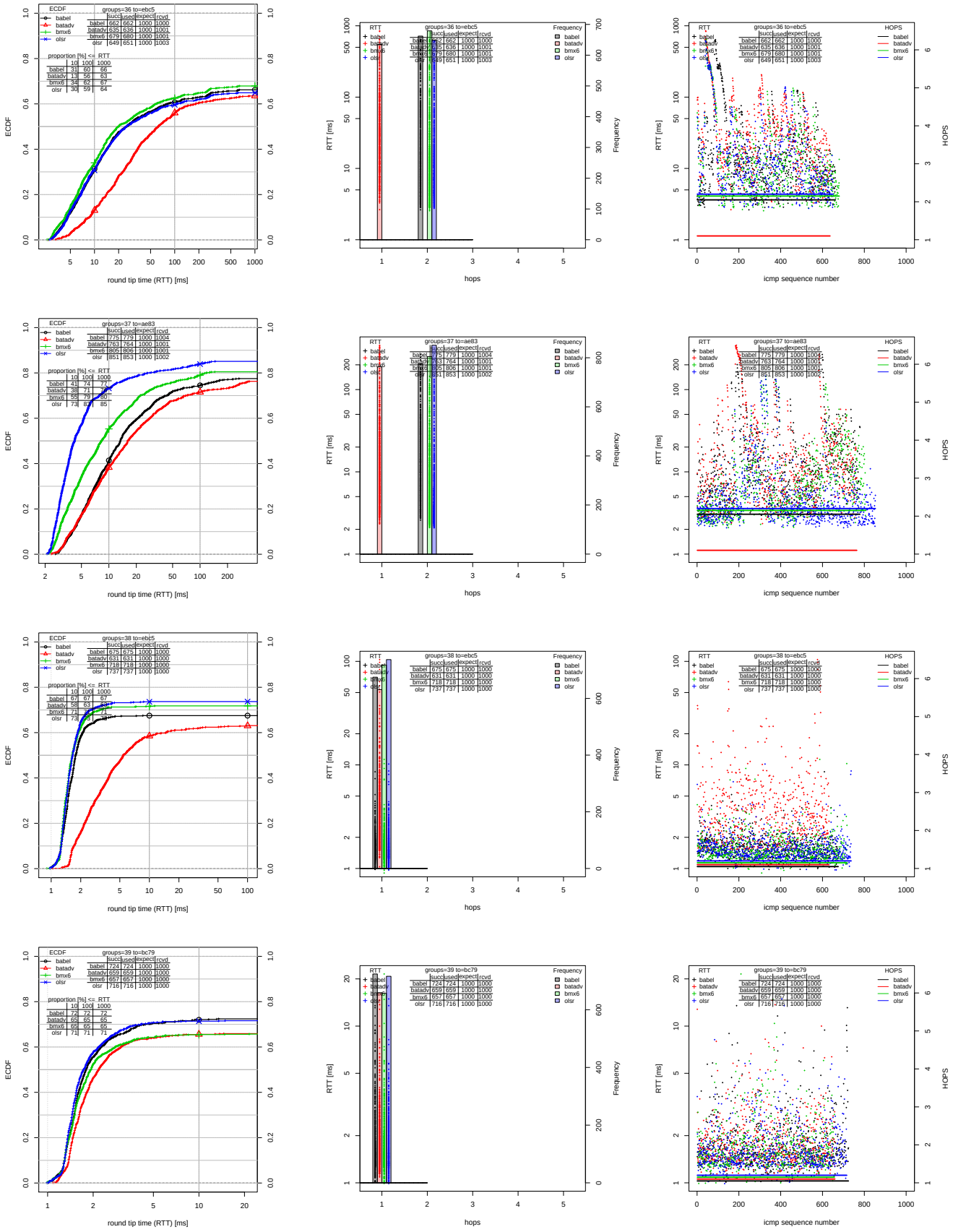

Table 12: Individual Random node tests (groups 36-39)

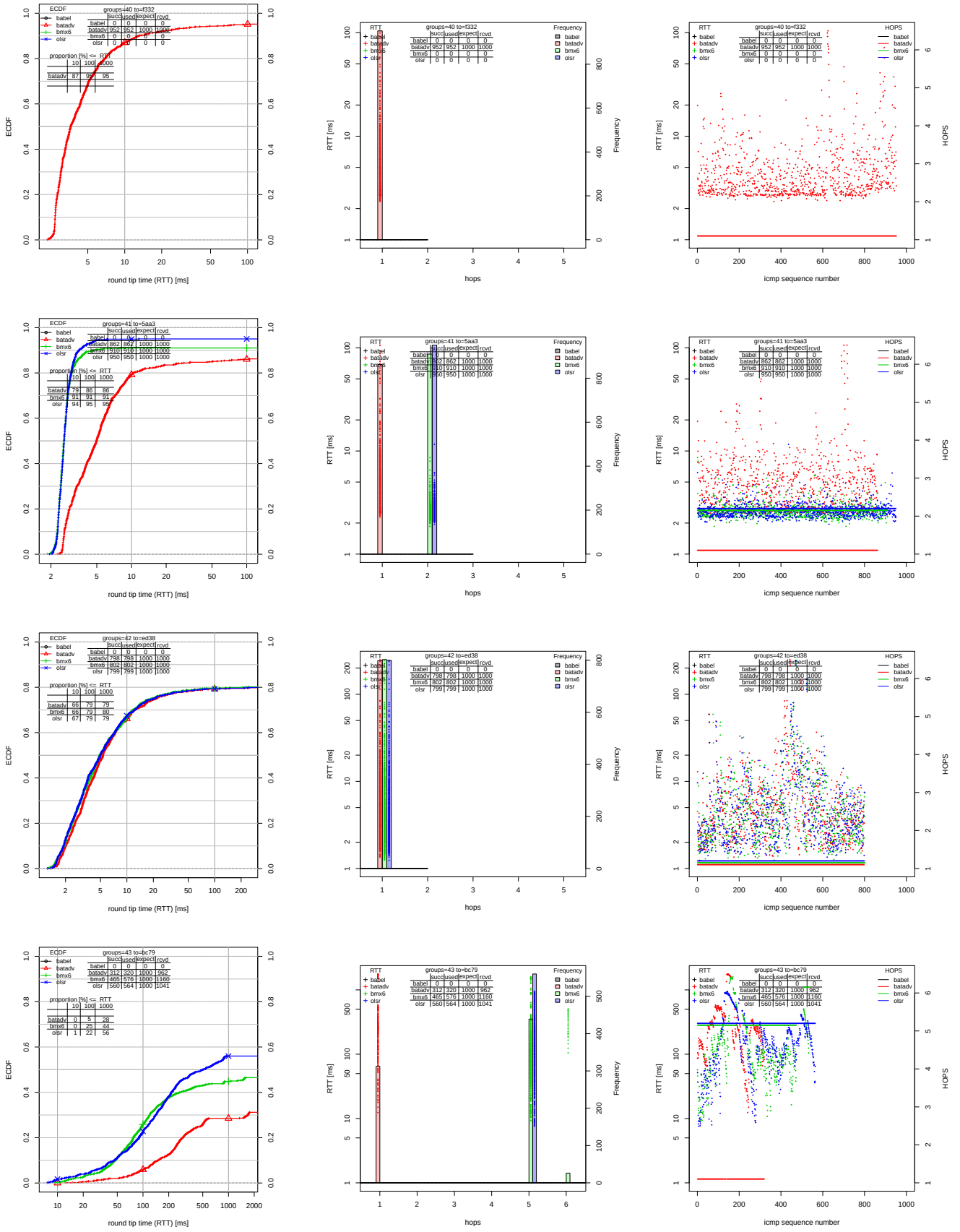

Table 13: Individual Random node tests (groups 40-43)

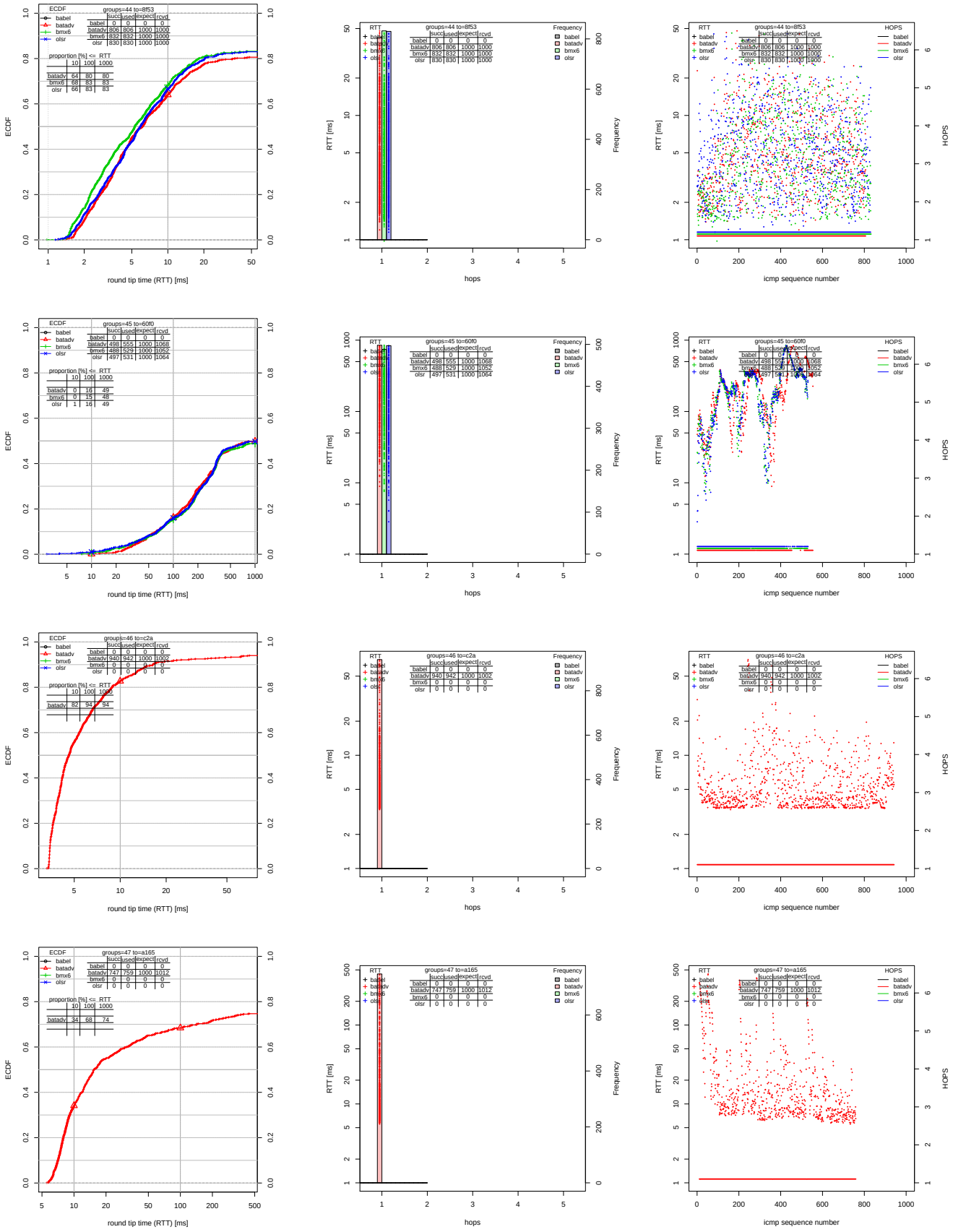

Table 14: Individual Random node tests (groups 44-47)

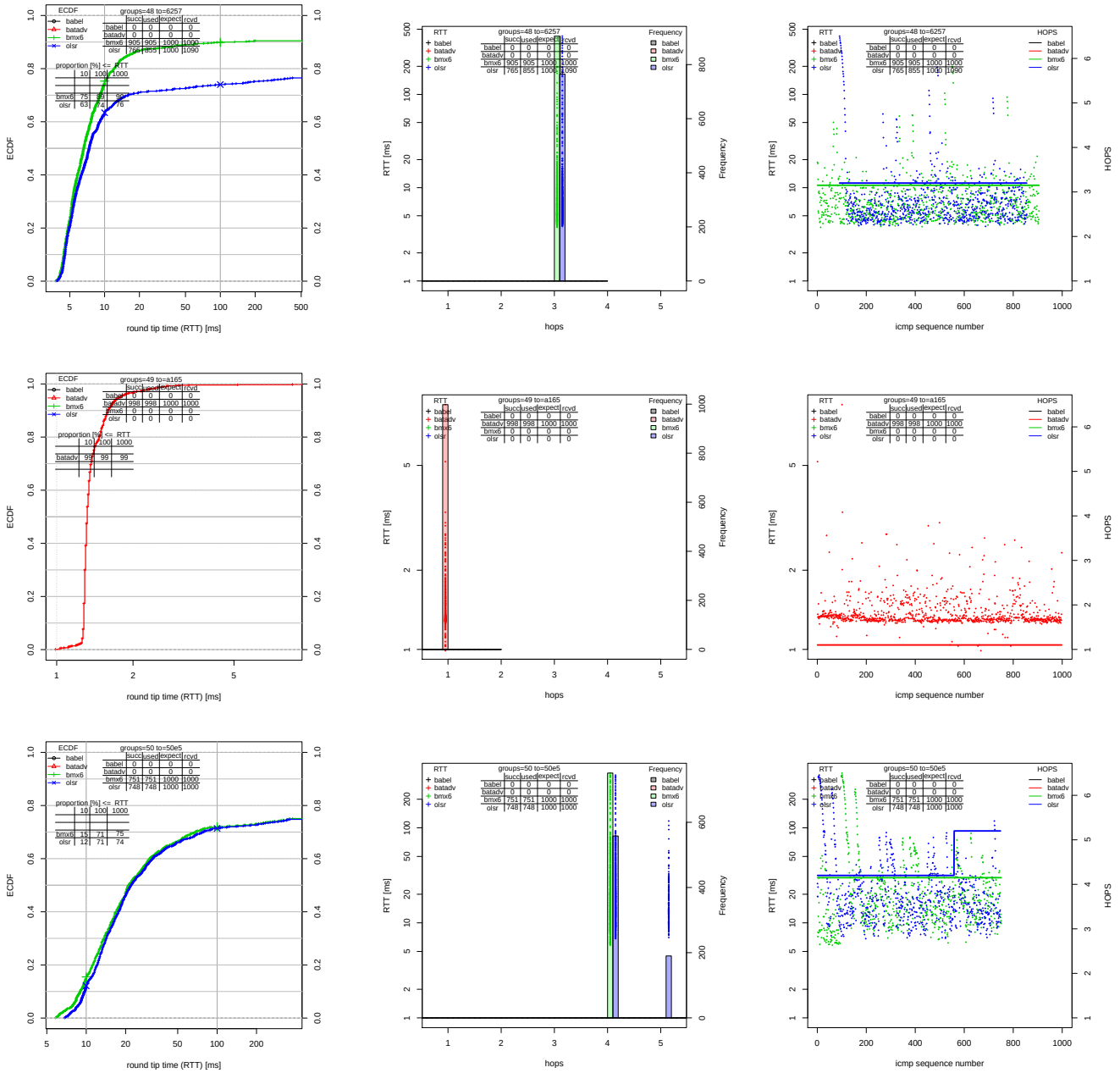

Table 15: Individual Random node tests (groups 48-50)