

BAB IV

HASIL DAN PEMBAHASAN

Hasil dari pengujian dan pembahasan pada bab 4 ini merupakan tahap kelanjutan dari proses perencanaan dan Perancangan WSN (*Wireless Sensor Network*) untuk monitoring kandang ayam. Hasil dan pembahasan pada penelitian ini yang diharapkan adalah berupa hasil data yang nantinya akan digunakan sebagai hasil analisa dan pengujian ini berbasis *Internet of Things*.

4.1 Hasil Pengujian Sistem Parameter QOS (*Quality of Service*)

Pada tahap ini merupakan hasil data pengukuran *quality of service* dari perangkat yang telah dibuat dengan melakukan pengamatan dan pengujian menggunakan *software wireshark* untuk pengujian parameter pada pengiriman antar *node sensor gateway* dan *firebase* serta menggunakan *serial monitor* untuk menampilkan waktu guna menguji langsung parameter untuk antar *node sensornya*, parameter yang digunakan untuk dilakukan pengujian yaitu parameter *delay*. Semua parameter diuji dengan menggunakan dua jenis skema komunikasi yaitu skema komunikasi *point to point* dan skema komunikasi *multipoint* dengan menggunakan 5 *node sensor* dan 1 *node sensor gateway*. Setiap *node sensor* memiliki jarak 5 meter dan 1 *node sensor gateway* diletakan pada titik tengah *node sensor*. Dengan rata – rata pengujian sebelumnya yang mengambil data sebanyak minimal 20 *sample* sehingga pengujian dilakukan dengan mengambil 35 *sample* data untuk pengujian *software wireshark* dan 30 *sample* pada *serial monitor* untuk pengujian parameter antar *node sensor*.

4.2.1 Pengujian Point to Point

4.2.1.1 Pengujian Delay dengan Menggunakan Aplikasi Wireshark

Pengujian *delay* pada skema komunikasi *point to point* dilakukan dengan menggunakan aplikasi *wireshark* dengan jarak antar *node sensornya* memiliki jarak sepanjang 7 meter. Pengujian *delay* ini dilakukan dengan melakukan 5 kali percobaan dengan 35 *sample* data setiap percobaannya. Pada pengukurannya digunakan 5 *node sensor* dan 1 *node sensor gateway* sebagai penerima data antar *node sensornya*. Dalam pengujian ini, penulis mengambil sebuah standar QOS

yaitu MQTT (*Message Queueing Telemetry Transport*). Hasil dari pengujian *delay point to point* dilihat pada Tabel 4.1 sampai tabel 4.5.

Tabel 4.1 Percobaan Pertama *Sample Delay Point to Point*

No	<i>Time 1</i>	<i>Time 2</i>	<i>Delay (s)</i>
1	0,032359	0,037189	0,004830
2	0,037189	0,082454	0,045265
3	0,082454	0,090128	0,007674
4	0,090128	0,090816	0,000688
5	0,090816	0,119634	0,028818
6	0,119634	0,887323	0,767689
7	0,887323	0,892626	0,005303
8	0,892626	0,892626	0,000000
9	0,892626	0,892626	0,000000
10	0,892626	0,892626	0,000000
11	0,892626	0,895509	0,002883
12	0,895509	0,895819	0,000310
13	0,895819	0,897644	0,001825
14	0,897644	0,934124	0,036480
15	0,934124	1,136982	0,202858
16	1,136982	1,153140	0,016158
17	1,153140	1,153257	0,000117
18	1,153257	1,170834	0,017577
19	1,170834	3,903314	2,732480
20	3,903314	3,909976	0,006662
21	3,909976	3,909976	0,000000
22	3,909976	3,909976	0,000000
23	3,909976	3,910068	0,000092
24	3,910068	3,910151	0,000083
25	3,910151	3,910181	0,000030
26	3,910181	3,935289	0,025108
27	3,935289	3,940386	0,005097
28	3,940386	3,970946	0,030560
29	3,970946	3,975069	0,004123
30	3,975069	4,000024	0,024955
31	4,000024	5,148892	1,148868
32	5,148892	5,148892	0,000000
33	5,148892	5,148892	0,000000
34	5,148892	5,148892	0,000000
35	5,148892	5,149163	0,000271
Total Delay			5,116804
Jumlah Paket			35
Rata - Rata Delay			0,1461944

Tabel 4.2 Percobaan Kedua *Sample Delay Point to Point*

No	<i>Time 1</i>	<i>Time 2</i>	<i>Delay (s)</i>
1	0,004496	0,004496	0,000000
2	0,004496	0,004689	0,000193
3	0,004689	0,005413	0,000724
4	0,005413	0,009084	0,003671
5	0,009084	0,009371	0,000287
6	0,009371	0,033474	0,024103
7	0,033474	0,033567	0,000093
8	0,033567	0,033655	0,000088
9	0,033655	0,033759	0,000104
10	0,033759	0,034207	0,000448
11	0,034207	0,034303	0,000096
12	0,034303	0,034365	0,000062
13	0,034365	0,034417	0,000052
14	0,034417	0,047343	0,012926
15	0,047343	0,059395	0,012052
16	0,059395	0,059879	0,000484
17	0,059879	0,060386	0,000507
18	0,060386	0,061122	0,000736
19	0,061122	0,061359	0,000237
20	0,061359	0,064311	0,002952
21	0,064311	0,064614	0,000303
22	0,064614	0,079161	0,014547
23	0,079161	0,079763	0,000602
24	0,079763	0,079841	0,000078
25	0,079841	0,092098	0,012257
26	0,092098	0,092614	0,000516
27	0,092614	0,092703	0,000089
28	0,092703	0,106270	0,013567
29	0,106270	0,107559	0,001289
30	0,107559	0,107717	0,000158
31	0,107717	0,108136	0,000419
32	0,108136	0,108207	0,000071
33	0,108207	0,108228	0,000021
34	0,108228	0,138009	0,029781
35	0,138009	0,138221	0,000212
Total Delay			0,133725
Jumlah Paket			35
Rata - Rata Delay			0,003820714

Tabel 4.3 Percobaan Ketiga *Sample Delay Point to Point*

No	<i>Time 1</i>	<i>Time 2</i>	<i>Delay (s)</i>
1	0,009810	0,009810	0,000000
2	0,009810	0,009907	0,000097
3	0,009907	0,062042	0,052135
4	0,062042	1,536495	1,474453
5	1,536495	1,562362	0,025867
6	1,562362	1,565880	0,003518
7	1,565880	1,590156	0,024276
8	1,590156	2,095078	0,504922
9	2,095078	2,095078	0,000000
10	2,095078	2,097909	0,002831
11	2,097909	2,099677	0,001768
12	2,099677	2,100029	0,000352
13	2,100029	2,102279	0,002250
14	2,102279	2,224059	0,121780
15	2,224059	2,230424	0,006365
16	2,230424	2,286249	0,055825
17	2,286249	4,084474	1,798225
18	4,084474	4,114321	0,029847
19	4,114321	4,239984	0,125663
20	4,239984	4,268751	0,028767
21	4,268751	4,349631	0,080880
22	4,349631	4,400536	0,050905
23	4,400536	4,400623	0,000087
24	4,400623	4,412094	0,011471
25	4,412094	4,960470	0,548376
26	4,960470	4,960607	0,000137
27	4,960607	4,976582	0,015975
28	4,976582	4,976582	0,000000
29	4,976582	5,010803	0,034221
30	5,010803	5,013908	0,003105
31	5,013908	5,069085	0,055177
32	5,069085	5,144250	0,075165
33	5,144250	5,172789	0,028539
34	5,172789	5,176588	0,003799
35	5,176588	5,202677	0,026089
Total Delay			5,192867
Jumlah Paket			35
Rata - Rata Delay			0,148367629

Tabel 4.4 Percobaan Keempat *Sample Delay Point to Point*

No	<i>Time 1</i>	<i>Time 2</i>	<i>Delay (s)</i>
1	0,001401	0,002216	0,000815
2	0,002216	0,003892	0,001676
3	0,003892	0,004164	0,000272
4	0,004164	0,005252	0,001088
5	0,005252	0,187487	0,182235
6	0,187487	0,280111	0,092624
7	0,280111	0,312780	0,032669
8	0,312780	0,337162	0,024382
9	0,337162	0,341348	0,004186
10	0,341348	0,367739	0,026391
11	0,367739	0,947145	0,579406
12	0,947145	0,950309	0,003164
13	0,950309	0,951921	0,001612
14	0,951921	0,951921	0,000000
15	0,951921	0,952177	0,000256
16	0,952177	0,960522	0,008345
17	0,960522	0,963248	0,002726
18	0,963248	0,965505	0,002257
19	0,965505	0,967615	0,002110
20	0,967615	1,003025	0,035410
21	1,003025	1,009614	0,006589
22	1,009614	1,724277	0,714663
23	1,724277	1,753080	0,028803
24	1,753080	1,753308	0,000228
25	1,753308	1,754597	0,001289
26	1,754597	1,782560	0,027963
27	1,782560	1,783832	0,001272
28	1,783832	1,784536	0,000704
29	1,784536	1,784623	0,000087
30	1,784623	1,785197	0,000574
31	1,785197	1,785759	0,000562
32	1,785759	1,785846	0,000087
33	1,785846	1,786027	0,000181
34	1,786027	1,791432	0,005405
35	1,791432	1,817137	0,025705
Total Delay			1,815736
Jumlah Paket			35
Rata - Rata Delay			0,051878171

Tabel 4.5 Percobaan Kelima *Sample Delay Point to Point*

No	<i>Time 1</i>	<i>Time 2</i>	<i>Delay (s)</i>
1	0,007264	0,062090	0,054826
2	0,062090	0,119206	0,057116
3	0,119206	0,119293	0,000087
4	0,119293	0,170597	0,051304
5	0,170597	0,171119	0,000522
6	0,171119	0,181944	0,010825
7	0,181944	0,211293	0,029349
8	0,211293	0,211387	0,000094
9	0,211387	0,667531	0,456144
10	0,667531	0,668238	0,000707
11	0,668238	0,694758	0,026520
12	0,694758	0,984283	0,289525
13	0,984283	0,992169	0,007886
14	0,992169	1,045357	0,053188
15	1,045357	1,669151	0,623794
16	1,669151	1,697402	0,028251
17	1,697402	1,701063	0,003661
18	1,701063	1,724926	0,023863
19	1,724926	2,740932	1,016006
20	2,740932	2,740932	0,000000
21	2,740932	2,740932	0,000000
22	2,740932	2,740932	0,000000
23	2,740932	2,740932	0,000000
24	2,740932	2,741217	0,000285
25	2,741217	2,741257	0,000040
26	2,741257	2,741466	0,000209
27	2,741466	2,742098	0,000632
28	2,742098	2,743454	0,001356
29	2,743454	2,744472	0,001018
30	2,744472	2,745828	0,001356
31	2,745828	3,507255	0,761427
32	3,507255	3,513136	0,005881
33	3,513136	3,513136	0,000000
34	3,513136	4,169999	0,656863
35	4,169999	5,015377	0,845378
Total Delay			5,008113
Jumlah Paket			35
Rata - Rata Delay			0,143088943

Tabel 4.6 Delay Point to Point

No	Besar Paket (<i>Bytes</i>)	<i>Time Span</i> (s)	<i>Delay</i> (ms)
1	46492	9,872	0,147116
2	307439	9,007	0,003820
3	17712	10,622	0,148367
4	88403	9,679	0,051878
5	13432	9,877	0,143088
Rata - Rata <i>Delay</i>			0,098854

Pada tabel 4.6 didapatkan hasil dari rata – rata *delay* dari 5 kali percobaan yang diambil mendapatkan nilai dari *delay* sebesar 0,098854 ms. Dapat disimpulkan bahwa dari nilai *Delay* yang diperoleh masuk kedalam kategori Sangat Baik dengan nilai yang didapatkan kurang dari 150 ms. Pengujian *delay* mendapatkan hasil dari minimum *delay* sebesar 0,003820 ms dan maksimum *delay* sebesar 0,148367 ms. Hasil dari *delay* dipengaruhi dari beberapa faktor seperti kondisi sinyal, keadaan dan lingkungan.

4.2.1.2 Pengujian Delay antar Node Sensor dengan Tampilan Serial Monitor

Pengujian *delay* pada skema komunikasi *point to point* dilakukan dengan menggunakan *serial monitor* untuk menampilkan waktu pengiriman antar *node sensor* dan waktu menerima pada *node sensor gateway*. Dengan jarak antar *node sensor*nya sepanjang 7 meter. Pengujian *delay* dilakukan dengan mengambil 30 *sample* pengiriman dengan melakukan request pengiriman data sebesar 5 detik.

```
16:00:53.922 -> 93
16:00:58.964 -> 93
16:01:04.001 -> 93
16:01:09.076 -> 93
16:01:14.109 -> 93
16:01:19.133 -> 93
16:01:24.170 -> 93
16:01:29.202 -> 93
16:01:34.279 -> 93
16:01:39.307 -> 93
16:01:44.340 -> 93
16:01:49.378 -> 93
16:01:54.457 -> 93
16:01:59.482 -> 93
16:02:04.514 -> 93
16:02:09.583 -> 93
16:02:14.617 -> 93
16:02:19.638 -> 93
16:02:24.684 -> 93
16:02:29.703 -> 93
16:02:34.783 -> 93
16:02:39.814 -> 93
16:02:44.850 -> 93
16:02:49.884 -> 93
16:02:54.915 -> 93
16:02:59.996 -> 93
16:03:05.029 -> 93
16:03:10.054 -> 93
16:03:15.084 -> 93
16:03:20.156 -> 93
```

Gambar 4.1 Tampilan Serial Monitor pada Node Sensor Gateway

Pada gambar 4.1 dapat dilihat terdapat 30 sampel data suhu dan kelembaban yang dikirimkan oleh *node sensor* 1. Dengan waktu penerimaan dimulai dari pukul 16:00:53 berakhir pada pukul 16:03:20.

```
16:00:53.922 -> Url :
16:00:53.922 -> /get?templ=29.3&humdl=93
16:00:53.922 -> Closing connection
16:00:58.964 -> Url :
16:00:58.964 -> /get?templ=29.3&humdl=93
16:00:58.964 -> Closing connection
16:01:04.001 -> Url :
16:01:04.001 -> /get?templ=29.3&humdl=93
16:01:04.001 -> Closing connection
16:01:09.076 -> Url :
16:01:09.076 -> /get?templ=29.3&humdl=93
16:01:09.076 -> Closing connection
16:01:14.109 -> Url :
16:01:14.109 -> /get?templ=29.3&humdl=93
16:01:14.109 -> Closing connection
16:01:19.133 -> Url :
16:01:19.133 -> /get?templ=29.3&humdl=93
16:01:19.133 -> Closing connection
16:01:24.170 -> Url :
16:01:24.170 -> /get?templ=29.3&humdl=93
16:01:24.170 -> Closing connection
16:01:29.202 -> Url :
16:01:29.202 -> /get?templ=29.3&humdl=93
16:01:29.249 -> Closing connection
16:01:34.279 -> Url :
16:01:34.279 -> /get?templ=29.3&humdl=93
16:01:34.279 -> Closing connection
16:01:39.307 -> Url :
16:01:39.307 -> /get?templ=29.3&humdl=93
16:01:39.307 -> Closing connection
16:01:44.340 -> Url :
16:01:44.340 -> /get?templ=29.3&humdl=93
16:01:44.387 -> Closing connection
16:01:49.378 -> Url :
16:01:49.378 -> /get?templ=29.3&humdl=93
16:01:49.425 -> Closing connection

16:01:54.457 -> Url :
16:01:54.457 -> /get?templ=29.3&humdl=93
16:01:54.457 -> Closing connection
16:01:59.482 -> Url :
16:01:59.482 -> /get?templ=29.3&humdl=93
16:01:59.482 -> Closing connection
16:02:04.514 -> Url :
16:02:04.514 -> /get?templ=29.3&humdl=93
16:02:04.514 -> Closing connection
16:02:09.583 -> Url :
16:02:09.583 -> /get?templ=29.3&humdl=93
16:02:09.583 -> Closing connection
16:02:14.617 -> Url :
16:02:14.617 -> /get?templ=29.3&humdl=93
16:02:14.617 -> Closing connection
16:02:19.638 -> Url :
16:02:19.638 -> /get?templ=29.3&humdl=93
16:02:19.638 -> Closing connection
16:02:24.684 -> Url :
16:02:24.684 -> /get?templ=29.3&humdl=93
16:02:24.684 -> Closing connection
16:02:29.749 -> Url :
16:02:29.749 -> /get?templ=29.3&humdl=93
16:02:29.749 -> Closing connection
16:02:34.783 -> Url :
16:02:34.783 -> /get?templ=29.3&humdl=93
16:02:34.783 -> Closing connection
16:02:39.814 -> Url :
16:02:39.814 -> /get?templ=29.3&humdl=93
16:02:39.814 -> Closing connection
16:02:44.850 -> Url :
16:02:44.850 -> /get?templ=29.3&humdl=93
16:02:44.850 -> Closing connection
16:02:49.915 -> Url :
16:02:49.915 -> /get?templ=29.3&humdl=93
16:02:49.915 -> Closing connection
```



```

16:02:54.947 -> Url :
16:02:54.947 -> /get?templ=29.3shumdl=93
16:02:54.947 -> Closing connection
16:02:59.980 -> Url :
16:02:59.980 -> /get?templ=29.3shumdl=93
16:02:59.980 -> Closing connection
16:03:05.014 -> Url :
16:03:05.014 -> /get?templ=29.3shumdl=93
16:03:05.014 -> Closing connection
16:03:10.038 -> Url :
16:03:10.038 -> /get?templ=29.3shumdl=93
16:03:10.038 -> Closing connection
16:03:15.116 -> Url :
16:03:15.116 -> /get?templ=29.3shumdl=93
16:03:15.116 -> Closing connection
16:03:20.141 -> Url :
16:03:20.141 -> /get?templ=29.3shumdl=93
16:03:20.141 -> Closing connection

```

Gambar 4.2 Tampilan Serial Monitor pada Node Sensor 1

Pada gambar 4.2 merupakan tampilan pengiriman data suhu dan kelembaban yang dilakukan oleh *node sensor 1*. Dari hasil pengujian tersebut, nilai *serial monitor* hasil kondisi monitoring suhu dan kelembaban kandang ayam suhu memiliki nilai 29,3 derajat celcius dan kelembaban memiliki nilai 93%. Untuk pengujian *delay*nya dilakukan dengan menghitung selisih dari waktu pengiriman yang dilakukan *node sensor 1* dan waktu penerimaan pada *node sensor gateway*.

Tabel 4.7 Delay antara Node Sensor 1 dan Gateway

No	Waktu Dikirim	Waktu Diterima	Delay
1	16:00:53,922	16:00:53,922	00:00:00,000
2	16:00:58,964	16:00:58,964	00:00:00,000
3	16:01:04,001	16:01:04,001	00:00:00,000
4	16:01:09,076	16:01:09,076	00:00:00,000
5	16:01:14,109	16:01:14,109	00:00:00,000
6	16:01:19,133	16:01:19,133	00:00:00,000
7	16:01:24,170	16:01:24,170	00:00:00,000
8	16:01:29,202	16:01:29,202	00:00:00,000
9	16:01:34,279	16:01:34,279	00:00:00,000
10	16:01:39,307	16:01:39,307	00:00:00,000
11	16:01:44,340	16:01:44,340	00:00:00,000
12	16:01:49,378	16:01:49,378	00:00:00,000
13	16:01:54,457	16:01:54,457	00:00:00,000

No	Waktu Dikirim	Waktu Diterima	<i>Delay</i>
14	16:01:59,482	16:01:59,482	00:00:00,000
15	16:02:04,514	16:02:04,514	00:00:00,000
16	16:02:09,583	16:02:09,583	00:00:00,000
17	16:02:14,617	16:02:14,617	00:00:00,000
18	16:02:19,638	16:02:19,638	00:00:00,000
19	16:02:24,684	16:02:24,684	00:00:00,000
20	16:02:29,749	16:02:29,795	00:00:00,046
21	16:02:34,783	16:02:34,783	00:00:00,000
22	16:02:39,814	16:02:39,814	00:00:00,000
23	16:02:44,850	16:02:44,850	00:00:00,000
24	16:02:49,915	16:02:49,946	00:00:00,031
25	16:02:54,947	16:02:54,979	00:00:00,032
26	16:02:59,980	16:02:59,996	00:00:00,016
27	16:03:05,014	16:03:05,029	00:00:00,015
28	16:03:10,038	16:03:10,054	00:00:00,016
29	16:03:15,116	16:03:15,148	00:00:00,032
30	16:03:20,141	16:03:20,156	00:00:00,015
Rata - Rata <i>Delay</i>			00:00:00,007

Pada tabel 4.7 dari hasil pengujian perhitungan parameter *delay* dari waktu dikirim hingga waktu diterima memiliki hasil yang dapat dilihat yaitu memiliki nilai rata – rata *delay* sebesar 0,007 ms. Sehingga dapat disimpulkan bahwa nilai dari parameter *delay* yang diperoleh masuk kedalam kategori Sangat Baik karena nilai *delay* yang diperoleh dibawah dari 150 ms. Nilai dari parameter *delay* sangat dipengaruhi oleh beberapa faktor seperti kondisi sinyal, keadaan dan lingkungan.

```

16:18:16.775 -> 87
16:18:21.850 -> 86
16:18:26.844 -> 86
16:18:31.917 -> 86
16:18:36.947 -> 86
16:18:42.015 -> 86
16:18:47.053 -> 86
16:18:52.083 -> 86
16:18:57.118 -> 86
16:19:02.174 -> 86
16:19:07.200 -> 86
16:19:12.221 -> 86
16:19:17.305 -> 86
16:19:22.336 -> 86
16:19:27.355 -> 86
16:19:32.432 -> 86
16:19:37.469 -> 86
16:19:42.497 -> 85
16:19:47.522 -> 85
16:19:52.590 -> 85
16:19:57.605 -> 85
16:20:02.670 -> 85
16:20:07.701 -> 85
16:20:12.733 -> 85
16:20:17.769 -> 85
16:20:22.799 -> 85
16:20:27.879 -> 85
16:20:32.899 -> 85
16:20:37.923 -> 85
16:20:43.003 -> 85

```

Gambar 4.3 Tampilan *Serial Monitor* pada *Node Sensor Gateway*

Pada gambar 4.3 dapat dilihat terdapat 30 sampel data suhu dan kelembaban yang dikirimkan oleh *node sensor 2*. Dengan waktu penerimaan dimulai dari pukul 16:18:16 berakhir pada pukul 16:20:43.

```

16:18:16.775 -> Url :
16:18:16.775 -> /get?temp2=29.3&humd2=87
16:18:16.775 -> Closing connection
16:18:21.850 -> Url :
16:18:21.850 -> /get?temp2=29.3&humd2=86
16:18:21.850 -> Closing connection
16:18:26.891 -> Url :
16:18:26.891 -> /get?temp2=29.3&humd2=86
16:18:26.891 -> Closing connection
16:18:31.917 -> Url :
16:18:31.917 -> /get?temp2=29.3&humd2=86
16:18:31.917 -> Closing connection
16:18:36.947 -> Url :
16:18:36.947 -> /get?temp2=29.3&humd2=86
16:18:36.947 -> Closing connection
16:18:42.015 -> Url :
16:18:42.015 -> /get?temp2=29.3&humd2=86
16:18:42.015 -> Closing connection
16:18:47.053 -> Url :
16:18:47.053 -> /get?temp2=29.3&humd2=86
16:18:47.053 -> Closing connection
16:18:52.083 -> Url :
16:18:52.083 -> /get?temp2=29.3&humd2=86
16:18:52.083 -> Closing connection
16:18:57.118 -> Url :
16:18:57.118 -> /get?temp2=29.3&humd2=86
16:18:57.118 -> Closing connection
16:19:02.174 -> Url :
16:19:02.174 -> /get?temp2=29.3&humd2=86
16:19:02.174 -> Closing connection
16:19:07.200 -> Url :
16:19:07.200 -> /get?temp2=29.3&humd2=86
16:19:07.200 -> Closing connection
16:19:12.221 -> Url :
16:19:12.221 -> /get?temp2=29.3&humd2=86
16:19:12.266 -> Closing connection

```

```

16:19:17.305 -> Url :
16:19:17.305 -> /get?temp2=29.3&humd2=86
16:19:17.305 -> Closing connection
16:19:22.336 -> Url :
16:19:22.336 -> /get?temp2=29.3&humd2=86
16:19:22.336 -> Closing connection
16:19:27.355 -> Url :
16:19:27.355 -> /get?temp2=29.3&humd2=86
16:19:27.355 -> Closing connection
16:19:32.432 -> Url :
16:19:32.432 -> /get?temp2=29.3&humd2=86
16:19:32.432 -> Closing connection
16:19:37.469 -> Url :
16:19:37.469 -> /get?temp2=29.3&humd2=86
16:19:37.469 -> Closing connection
16:19:42.497 -> Url :
16:19:42.497 -> /get?temp2=29.3&humd2=85
16:19:42.497 -> Closing connection
16:19:47.522 -> Url :
16:19:47.522 -> /get?temp2=29.3&humd2=85
16:19:47.522 -> Closing connection
16:19:52.590 -> Url :
16:19:52.590 -> /get?temp2=29.3&humd2=85
16:19:52.590 -> Closing connection
16:19:57.635 -> Url :
16:19:57.635 -> /get?temp2=29.3&humd2=85
16:19:57.635 -> Closing connection
16:20:02.655 -> Url :
16:20:02.655 -> /get?temp2=29.3&humd2=85
16:20:02.655 -> Closing connection
16:20:07.685 -> Url :
16:20:07.685 -> /get?temp2=29.3&humd2=85
16:20:07.685 -> Closing connection
16:20:12.748 -> Url :
16:20:12.748 -> /get?temp2=29.3&humd2=85
16:20:12.748 -> Closing connection

16:20:17.785 -> Url :
16:20:17.785 -> /get?temp2=29.3&humd2=85
16:20:17.785 -> Closing connection
16:20:22.815 -> Url :
16:20:22.815 -> /get?temp2=29.3&humd2=85
16:20:22.815 -> Closing connection
16:20:27.849 -> Url :
16:20:27.849 -> /get?temp2=29.3&humd2=85
16:20:27.849 -> Closing connection
16:20:32.914 -> Url :
16:20:32.914 -> /get?temp2=29.3&humd2=85
16:20:32.914 -> Closing connection
16:20:37.939 -> Url :
16:20:37.939 -> /get?temp2=29.3&humd2=85
16:20:37.939 -> Closing connection
16:20:42.972 -> Url :
16:20:42.972 -> /get?temp2=29.3&humd2=85
16:20:42.972 -> Closing connection

```

Gambar 4.4 Tampilan *Serial Monitor* pada *Node Sensor 2*

Pada gambar 4.4 merupakan tampilan pengiriman data suhu dan kelembaban yang dilakukan oleh *node sensor 2*. Dari hasil pengujian tersebut, nilai *serial monitor* hasil kondisi monitoring suhu dan kelembaban kandang ayam suhu memiliki nilai 29,3 derajat celcius dan kelembaban memiliki nilai 85%. Untuk pengujian *delay*nya dilakukan dengan menghitung selisih dari waktu pengiriman yang dilakukan *node sensor 2* dan waktu penerimaan pada *node sensor gateway*.

Tabel 4.8 Delay antara Node Sensor 2 dan Gateway

No	Waktu Dikirim	Waktu Diterima	Delay
1	16:18:16,775	16:18:16,775	00:00:00,000
2	16:18:21,850	16:18:21,850	00:00:00,000
3	16:18:26,891	16:18:26,938	00:00:00,047
4	16:18:31,917	16:18:31,917	00:00:00,000
5	16:18:36,947	16:18:36,947	00:00:00,000
6	16:18:42,015	16:18:42,015	00:00:00,000
7	16:18:47,053	16:18:47,053	00:00:00,000
8	16:18:52,083	16:18:52,083	00:00:00,000
9	16:18:57,118	16:18:57,118	00:00:00,000
10	16:19:02,174	16:19:02,174	00:00:00,000
11	16:19:07,200	16:19:07,200	00:00:00,000
12	16:19:12,221	16:19:12,221	00:00:00,000
13	16:19:17,305	16:19:17,305	00:00:00,000
14	16:19:22,336	16:19:22,336	00:00:00,000
15	16:19:27,355	16:19:27,355	00:00:00,000
16	16:19:32,432	16:19:32,432	00:00:00,000
17	16:19:37,469	16:19:37,469	00:00:00,000
18	16:19:42,497	16:19:42,497	00:00:00,000
19	16:19:47,522	16:19:47,522	00:00:00,000
20	16:19:52,590	16:19:52,590	00:00:00,000
21	16:19:57,635	16:19:57,665	00:00:00,030
22	16:20:02,655	16:20:02,670	00:00:00,015
23	16:20:07,685	16:20:07,701	00:00:00,016
24	16:20:12,748	16:20:12,763	00:00:00,015
25	16:20:17,785	16:20:17,801	00:00:00,016
26	16:20:22,815	16:20:22,831	00:00:00,016
27	16:20:27,849	16:20:27,879	00:00:00,030
28	16:20:32,914	16:20:32,929	00:00:00,015
29	16:20:37,939	16:20:37,955	00:00:00,016
30	16:20:43,972	16:20:43,975	00:00:00,003
Rata - Rata Delay			00:00:00,007

Pada tabel 4.8 dari hasil pengujian perhitungan parameter *delay* dari waktu dikirim hingga waktu diterima memiliki hasil yang dapat dilihat yaitu memiliki nilai rata – rata *delay* sebesar 0,007 ms. Sehingga dapat disimpulkan bahwa nilai dari parameter *delay* yang diperoleh masuk kedalam kategori Sangat Baik karena nilai *delay* yang diperoleh dibawah dari 150 ms. Nilai dari parameter *delay* sangat dipengaruhi oleh beberapa faktor seperti kondisi sinyal, keadaan dan lingkungan.

```

16:32:13.496 -> 76
16:32:18.539 -> 76
16:32:23.554 -> 76
16:32:28.599 -> 76
16:32:33.625 -> 76
16:32:38.663 -> 76
16:32:43.721 -> 76
16:32:48.750 -> 76
16:32:53.826 -> 76
16:32:58.851 -> 76
16:33:03.866 -> 76
16:33:08.905 -> 76
16:33:13.983 -> 76
16:33:19.015 -> 76
16:33:24.045 -> 76
16:33:29.085 -> 76
16:33:34.150 -> 76
16:33:39.150 -> 76
16:33:44.224 -> 76
16:33:49.259 -> 76
16:33:54.283 -> 76
16:33:59.320 -> 76
16:34:04.356 -> 76
16:34:09.441 -> 76
16:34:14.474 -> 76
16:34:19.490 -> 76
16:34:24.561 -> 76
16:34:29.601 -> 76
16:34:34.627 -> 76
16:34:39.648 -> 76

```

Gambar 4.5 Tampilan Serial Monitor pada Node Sensor Gateway

Pada gambar 4.5 dapat dilihat terdapat 30 sampel data suhu dan kelembaban yang dikirimkan oleh *node sensor 2*. Dengan waktu penerimaan dimulai dari pukul 16:32:13 berakhir pada pukul 16:34:29.

```

16:32:13.496 -> Url :
16:32:13.496 -> /get?temp3=28.7&humd3=76
16:32:13.496 -> Closing connection
16:32:18.523 -> Url :
16:32:18.523 -> /get?temp3=28.9&humd3=76
16:32:18.523 -> Closing connection
16:32:23.554 -> Url :
16:32:23.554 -> /get?temp3=28.9&humd3=76
16:32:23.554 -> Closing connection
16:32:28.599 -> Url :
16:32:28.599 -> /get?temp3=28.9&humd3=76
16:32:28.599 -> Closing connection
16:32:33.625 -> Url :
16:32:33.625 -> /get?temp3=28.9&humd3=76
16:32:33.672 -> Closing connection
16:32:38.694 -> Url :
16:32:38.694 -> /get?temp3=28.9&humd3=76
16:32:38.694 -> Closing connection
16:32:43.705 -> Url :
16:32:43.705 -> /get?temp3=28.9&humd3=76
16:32:43.752 -> Closing connection
16:32:48.781 -> Url :
16:32:48.781 -> /get?temp3=28.9&humd3=76
16:32:48.781 -> Closing connection
16:32:53.810 -> Url :
16:32:53.810 -> /get?temp3=28.9&humd3=76
16:32:53.810 -> Closing connection
16:32:58.851 -> Url :
16:32:58.851 -> /get?temp3=28.9&humd3=76
16:32:58.851 -> Closing connection
16:33:03.866 -> Url :
16:33:03.866 -> /get?temp3=28.9&humd3=76
16:33:03.916 -> Closing connection
16:33:08.905 -> Url :
16:33:08.905 -> /get?temp3=28.9&humd3=76
16:33:08.952 -> Closing connection

```

```

16:33:13.980 -> Url :
16:33:13.980 -> /get?temp3=28.9&humd3=76
16:33:13.980 -> Closing connection
16:33:19.015 -> Url :
16:33:19.015 -> /get?temp3=28.9&humd3=76
16:33:19.015 -> Closing connection
16:33:24.045 -> Url :
16:33:24.045 -> /get?temp3=28.9&humd3=76
16:33:24.045 -> Closing connection
16:33:29.085 -> Url :
16:33:29.085 -> /get?temp3=28.9&humd3=76
16:33:29.085 -> Closing connection
16:33:34.150 -> Url :
16:33:34.150 -> /get?temp3=28.9&humd3=76
16:33:34.150 -> Closing connection
16:33:39.197 -> Url :
16:33:39.197 -> /get?temp3=28.9&humd3=76
16:33:39.197 -> Closing connection
16:33:44.224 -> Url :
16:33:44.224 -> /get?temp3=28.9&humd3=76
16:33:44.224 -> Closing connection
16:33:49.259 -> Url :
16:33:49.259 -> /get?temp3=28.9&humd3=76
16:33:49.259 -> Closing connection
16:33:54.298 -> Url :
16:33:54.298 -> /get?temp3=28.9&humd3=76
16:33:54.298 -> Closing connection
16:33:59.336 -> Url :
16:33:59.336 -> /get?temp3=28.9&humd3=76
16:33:59.336 -> Closing connection
16:34:04.371 -> Url :
16:34:04.371 -> /get?temp3=28.9&humd3=76
16:34:04.371 -> Closing connection
16:34:09.409 -> Url :
16:34:09.409 -> /get?temp3=28.9&humd3=76
16:34:09.409 -> Closing connection

16:34:14.443 -> Url :
16:34:14.443 -> /get?temp3=28.9&humd3=76
16:34:14.443 -> Closing connection
16:34:19.522 -> Url :
16:34:19.522 -> /get?temp3=28.9&humd3=76
16:34:19.522 -> Closing connection
16:34:24.546 -> Url :
16:34:24.546 -> /get?temp3=28.9&humd3=76
16:34:24.546 -> Closing connection
16:34:29.586 -> Url :
16:34:29.586 -> /get?temp3=28.9&humd3=76
16:34:29.586 -> Closing connection
16:34:34.611 -> Url :
16:34:34.611 -> /get?temp3=28.9&humd3=76
16:34:34.611 -> Closing connection
16:34:39.663 -> Url :
16:34:39.663 -> /get?temp3=28.9&humd3=76
16:34:39.663 -> Closing connection

```

Gambar 4.6 Tampilan Serial Monitor pada Node Sensor 3

Pada gambar 4.6 merupakan tampilan pengiriman data suhu dan kelembaban yang dilakukan oleh *node sensor 3*. Dari hasil pengujian tersebut, nilai *serial monitor* hasil kondisi monitoring suhu dan kelembaban kandang ayam suhu memiliki nilai 28,9 derajat celcius dan kelembaban memiliki nilai 76%. Untuk pengujian *delay*nya dilakukan dengan menghitung selisih dari waktu pengiriman yang dilakukan *node sensor 3* dan waktu penerimaan pada *node sensor gateway*.

Tabel 4.9 Delay antara Node Sensor 3 dan Gateway

No	Waktu Dikirim	Waktu Diterima	Delay
1	16:32:13,496	16:32:13,496	00:00:00,000
2	16:32:18,523	16:32:18,539	00:00:00,016
3	16:32:23,554	16:32:23,554	00:00:00,000

No	Waktu Dikirim	Waktu Diterima	Delay
4	16:32:28,599	16:32:28,599	00:00:00,000
5	16:32:33,625	16:32:33,625	00:00:00,000
6	16:32:38,694	16:32:38,725	00:00:00,031
7	16:32:43,705	16:32:43,721	00:00:00,016
8	16:32:48,781	16:32:48,812	00:00:00,031
9	16:32:53,810	16:32:53,826	00:00:00,016
10	16:32:58,851	16:32:58,851	00:00:00,000
11	16:33:03,866	16:33:03,866	00:00:00,000
12	16:33:08,905	16:33:08,905	00:00:00,000
13	16:33:13,980	16:33:13,983	00:00:00,003
14	16:33:19,015	16:33:19,015	00:00:00,000
15	16:33:24,045	16:33:24,045	00:00:00,000
16	16:33:29,085	16:33:29,085	00:00:00,000
17	16:33:34,150	16:33:34,150	00:00:00,000
18	16:33:39,197	16:33:39,244	00:00:00,047
19	16:33:44,224	16:33:44,224	00:00:00,000
20	16:33:49,259	16:33:49,259	00:00:00,000
21	16:33:54,298	16:33:54,313	00:00:00,015
22	16:33:59,336	16:33:59,352	00:00:00,016
23	16:34:04,371	16:34:04,386	00:00:00,015
24	16:34:09,409	16:34:09,441	00:00:00,032
25	16:34:14,443	16:34:14,474	00:00:00,031
26	16:34:19,522	16:34:19,554	00:00:00,032
27	16:34:24,546	16:34:24,561	00:00:00,015
28	16:34:29,586	16:34:29,601	00:00:00,015
29	16:34:34,611	16:34:34,627	00:00:00,016
30	16:34:39,663	16:34:39,678	00:00:00,015
Rata - Rata Delay			00:00:00,012

Pada tabel 9 dari hasil pengujian perhitungan parameter *delay* dari waktu dikirim hingga waktu diterima memiliki hasil yang dapat dilihat yaitu memiliki nilai rata – rata *delay* sebesar 0,012 ms. Sehingga dapat disimpulkan bahwa nilai dari parameter *delay* yang diperoleh masuk kedalam kategori Sangat Baik karena nilai *delay* yang diperoleh dibawah dari 150 ms. Nilai dari parameter *delay* sangat dipengaruhi oleh beberapa faktor seperti kondisi sinyal, keadaan dan lingkungan.


```

16:49:18.654 -> 75
16:49:23.686 -> 75
16:49:28.718 -> 75
16:49:33.796 -> 75
16:49:38.828 -> 75
16:49:43.900 -> 75
16:49:48.928 -> 75
16:49:53.959 -> 75
16:49:58.989 -> 75
16:50:04.069 -> 75
16:50:09.073 -> 75
16:50:14.131 -> 75
16:50:19.175 -> 75
16:50:24.237 -> 75
16:50:29.282 -> 75
16:50:34.306 -> 75
16:50:39.340 -> 75
16:50:44.401 -> 75
16:50:49.433 -> 75
16:50:54.460 -> 75
16:50:59.494 -> 75
16:51:04.566 -> 75
16:51:09.594 -> 75
16:51:14.668 -> 75
16:51:19.691 -> 75
16:51:24.762 -> 74
16:51:29.785 -> 74
16:51:34.808 -> 74
16:51:39.884 -> 74
16:51:44.905 -> 74

```

Gambar 4.7 Tampilan Serial Monitor pada Node Sensor Gateway

Pada gambar 4.7 dapat dilihat terdapat 30 sampel data suhu dan kelembaban yang dikirimkan oleh *node sensor 2*. Dengan waktu penerimaan dimulai dari pukul 16:49:18 berakhir pada pukul 16:51:44.

```

16:49:18.639 -> Url :
16:49:18.639 -> /get?temp4=29.3&humd4=75
16:49:18.639 -> Closing connection
16:49:23.716 -> Url :
16:49:23.716 -> /get?temp4=29.3&humd4=75
16:49:23.716 -> Closing connection
16:49:28.748 -> Url :
16:49:28.748 -> /get?temp4=29.3&humd4=75
16:49:28.748 -> Closing connection
16:49:33.780 -> Url :
16:49:33.780 -> /get?temp4=29.3&humd4=75
16:49:33.780 -> Closing connection
16:49:38.859 -> Url :
16:49:38.859 -> /get?temp4=29.3&humd4=75
16:49:38.859 -> Closing connection
16:49:43.884 -> Url :
16:49:43.884 -> /get?temp4=29.3&humd4=75
16:49:43.884 -> Closing connection
16:49:48.912 -> Url :
16:49:48.912 -> /get?temp4=29.3&humd4=75
16:49:48.912 -> Closing connection
16:49:53.990 -> Url :
16:49:53.990 -> /get?temp4=29.3&humd4=75
16:49:53.990 -> Closing connection
16:49:59.020 -> Url :
16:49:59.020 -> /get?temp4=29.3&humd4=75
16:49:59.020 -> Closing connection
16:50:04.054 -> Url :
16:50:04.054 -> /get?temp4=29.3&humd4=75
16:50:04.054 -> Closing connection
16:50:09.088 -> Url :
16:50:09.088 -> /get?temp4=29.3&humd4=75
16:50:09.088 -> Closing connection
16:50:14.115 -> Url :
16:50:14.115 -> /get?temp4=29.3&humd4=75
16:50:14.115 -> Closing connection

```

```

16:50:19.190 -> Url :
16:50:19.190 -> /get?temp4=29.3&humd4=75
16:50:19.190 -> Closing connection
16:50:24.205 -> Url :
16:50:24.205 -> /get?temp4=29.3&humd4=75
16:50:24.205 -> Closing connection
16:50:29.250 -> Url :
16:50:29.250 -> /get?temp4=29.3&humd4=75
16:50:29.250 -> Closing connection
16:50:34.320 -> Url :
16:50:34.320 -> /get?temp4=29.3&humd4=75
16:50:34.320 -> Closing connection
16:50:39.355 -> Url :
16:50:39.355 -> /get?temp4=29.3&humd4=75
16:50:39.355 -> Closing connection
16:50:44.386 -> Url :
16:50:44.386 -> /get?temp4=29.3&humd4=75
16:50:44.386 -> Closing connection
16:50:49.417 -> Url :
16:50:49.417 -> /get?temp4=29.3&humd4=75
16:50:49.417 -> Closing connection
16:50:54.491 -> Url :
16:50:54.491 -> /get?temp4=29.3&humd4=75
16:50:54.491 -> Closing connection
16:50:59.524 -> Url :
16:50:59.524 -> /get?temp4=29.3&humd4=75
16:50:59.524 -> Closing connection
16:51:04.551 -> Url :
16:51:04.551 -> /get?temp4=29.3&humd4=75
16:51:04.551 -> Closing connection
16:51:09.579 -> Url :
16:51:09.579 -> /get?temp4=29.3&humd4=75
16:51:09.625 -> Closing connection
16:51:14.652 -> Url :
16:51:14.652 -> /get?temp4=29.3&humd4=75
16:51:14.652 -> Closing connection

16:51:19.723 -> Url :
16:51:19.723 -> /get?temp4=29.3&humd4=75
16:51:19.723 -> Closing connection
16:51:24.746 -> Url :
16:51:24.746 -> /get?temp4=29.3&humd4=74
16:51:24.746 -> Closing connection
16:51:29.770 -> Url :
16:51:29.770 -> /get?temp4=29.3&humd4=74
16:51:29.770 -> Closing connection
16:51:34.839 -> Url :
16:51:34.839 -> /get?temp4=29.3&humd4=74
16:51:34.839 -> Closing connection
16:51:39.868 -> Url :
16:51:39.868 -> /get?temp4=29.3&humd4=74
16:51:39.868 -> Closing connection
16:51:44.890 -> Url :
16:51:44.890 -> /get?temp4=29.3&humd4=74
16:51:44.936 -> Closing connection

```

Gambar 4.8 Tampilan Serial Monitor pada Node Sensor 4

Pada gambar 4.8 merupakan tampilan pengiriman data suhu dan kelembaban yang dilakukan oleh *node sensor 4*. Dari hasil pengujian tersebut, nilai *serial monitor* hasil kondisi monitoring suhu dan kelembaban kandang ayam suhu memiliki nilai 29,3 derajat celcius dan kelembaban memiliki nilai 74%. Untuk pengujian *delay*nya dilakukan dengan menghitung selisih dari waktu pengiriman yang dilakukan *node sensor 3* dan waktu penerimaan pada *node sensor gateway*.

Tabel 4.10 Delay antara Node Sensor 4 dan Gateway

No	Waktu Dikirim	Waktu Diterima	Delay
1	16:49:18,639	16:49:18,654	00:00:00,015
2	16:49:23,716	16:49:23,746	00:00:00,030
3	16:49:28,748	16:49:28,778	00:00:00,030
4	16:49:33,780	16:49:33,796	00:00:00,016
5	16:49:38,859	16:49:38,890	00:00:00,031
6	16:49:43,884	16:49:43,900	00:00:00,016
7	16:49:48,912	16:49:48,928	00:00:00,016
8	16:49:53,990	16:49:54,021	00:00:00,031
9	16:49:59,020	16:49:59,051	00:00:00,031
10	16:50:04,054	16:50:04,069	00:00:00,015
11	16:50:09,088	16:50:09,103	00:00:00,015
12	16:50:14,115	16:50:14,131	00:00:00,016
13	16:50:19,190	16:50:19,205	00:00:00,015
14	16:50:24,205	16:50:24,237	00:00:00,032
15	16:50:29,250	16:50:29,282	00:00:00,032
16	16:50:34,320	16:50:34,334	00:00:00,014
17	16:50:39,355	16:50:39,370	00:00:00,015
18	16:50:44,386	16:50:44,401	00:00:00,015
19	16:50:49,417	16:50:49,433	00:00:00,016
20	16:50:54,491	16:50:54,522	00:00:00,031
21	16:50:59,524	16:50:59,554	00:00:00,030
22	16:51:04,551	16:51:04,566	00:00:00,015
23	16:51:09,579	16:51:09,594	00:00:00,015
24	16:51:14,652	16:51:14,668	00:00:00,016
25	16:51:19,723	16:51:19,755	00:00:00,032
26	16:51:24,746	16:51:24,762	00:00:00,016
27	16:51:29,770	16:51:29,785	00:00:00,015
28	16:51:34,839	16:51:34,870	00:00:00,031
29	16:51:39,868	16:51:39,884	00:00:00,016
30	16:51:44,890	16:51:44,905	00:00:00,015
Rata - Rata Delay			00:00:00,021

Pada tabel 4.10 dari hasil pengujian perhitungan parameter *delay* dari waktu dikirim hingga waktu diterima memiliki hasil yang dapat dilihat yaitu memiliki nilai rata – rata *delay* sebesar 0,021 ms. Sehingga dapat disimpulkan bahwa nilai dari parameter *delay* yang diperoleh masuk kedalam kategori Sangat Baik karena nilai *delay* yang diperoleh dibawah dari 150 ms. Nilai dari parameter *delay* sangat dipengaruhi oleh beberapa faktor seperti kondisi sinyal, keadaan dan lingkungan.

```

16:58:35.763 -> 92
16:58:40.795 -> 92
16:58:45.830 -> 92
16:58:50.889 -> 92
16:58:55.926 -> 92
16:59:00.973 -> 92
16:59:06.007 -> 92
16:59:11.038 -> 92
16:59:16.078 -> 92
16:59:21.106 -> 92
16:59:26.180 -> 92
16:59:31.201 -> 92
16:59:36.236 -> 92
16:59:41.262 -> 92
16:59:46.334 -> 92
16:59:51.363 -> 92
16:59:56.393 -> 92
17:00:01.475 -> 92
17:00:06.505 -> 92
17:00:11.575 -> 92
17:00:16.612 -> 92
17:00:21.686 -> 92
17:00:26.726 -> 92
17:00:31.830 -> 92
17:00:36.862 -> 92
17:00:41.894 -> 92
17:00:46.972 -> 92
17:00:51.977 -> 92
17:00:57.060 -> 92
17:01:02.091 -> 92

```

Gambar 4.9 Tampilan Serial Monitor pada Node Sensor Gateway

Pada gambar 4.9 dapat dilihat terdapat 30 sampel data suhu dan kelembaban yang dikirimkan oleh *node sensor 5*. Dengan waktu penerimaan dimulai dari pukul 16:58:35 berakhir pada pukul 17:01:02.

```

16:58:35.747 -> Url :
16:58:35.747 -> /get?temp5=28.9&humd5=92
16:58:35.747 -> Closing connection
16:58:40.780 -> Url :
16:58:40.780 -> /get?temp5=28.9&humd5=92
16:58:40.780 -> Closing connection
16:58:45.815 -> Url :
16:58:45.815 -> /get?temp5=28.9&humd5=92
16:58:45.861 -> Closing connection
16:58:50.889 -> Url :
16:58:50.889 -> /get?temp5=28.9&humd5=92
16:58:50.889 -> Closing connection
16:58:55.926 -> Url :
16:58:55.926 -> /get?temp5=28.9&humd5=92
16:58:55.926 -> Closing connection
16:59:00.958 -> Url :
16:59:00.958 -> /get?temp5=28.9&humd5=92
16:59:00.958 -> Closing connection
16:59:05.991 -> Url :
16:59:05.991 -> /get?temp5=28.9&humd5=92
16:59:05.991 -> Closing connection
16:59:11.023 -> Url :
16:59:11.023 -> /get?temp5=28.9&humd5=92
16:59:11.023 -> Closing connection
16:59:16.062 -> Url :
16:59:16.062 -> /get?temp5=28.9&humd5=92
16:59:16.109 -> Closing connection
16:59:21.137 -> Url :
16:59:21.137 -> /get?temp5=28.9&humd5=92
16:59:21.137 -> Closing connection
16:59:26.164 -> Url :
16:59:26.164 -> /get?temp5=28.9&humd5=92
16:59:26.164 -> Closing connection
16:59:31.186 -> Url :
16:59:31.186 -> /get?temp5=28.9&humd5=92
16:59:31.233 -> Closing connection

```

```

16:59:36.267 -> Url :
16:59:36.267 -> /get?temp5=28.9&humd5=92
16:59:36.267 -> Closing connection
16:59:41.292 -> Url :
16:59:41.292 -> /get?temp5=28.9&humd5=92
16:59:41.292 -> Closing connection
16:59:46.318 -> Url :
16:59:46.318 -> /get?temp5=29.0&humd5=92
16:59:46.318 -> Closing connection
16:59:51.348 -> Url :
16:59:51.348 -> /get?temp5=29.0&humd5=92
16:59:51.394 -> Closing connection
16:59:56.424 -> Url :
16:59:56.424 -> /get?temp5=29.0&humd5=92
16:59:56.424 -> Closing connection
17:00:01.460 -> Url :
17:00:01.460 -> /get?temp5=29.0&humd5=92
17:00:01.460 -> Closing connection
17:00:06.537 -> Url :
17:00:06.537 -> /get?temp5=29.0&humd5=92
17:00:06.537 -> Closing connection
17:00:11.606 -> Url :
17:00:11.606 -> /get?temp5=29.0&humd5=92
17:00:11.606 -> Closing connection
17:00:16.643 -> Url :
17:00:16.643 -> /get?temp5=29.0&humd5=92
17:00:16.643 -> Closing connection
17:00:21.671 -> Url :
17:00:21.671 -> /get?temp5=29.0&humd5=92
17:00:21.671 -> Closing connection
17:00:26.756 -> Url :
17:00:26.756 -> /get?temp5=29.1&humd5=92
17:00:26.756 -> Closing connection
17:00:31.830 -> Url :
17:00:31.830 -> /get?temp5=29.2&humd5=92
17:00:31.830 -> Closing connection

17:00:36.862 -> Url :
17:00:36.862 -> /get?temp5=29.3&humd5=92
17:00:36.862 -> Closing connection
17:00:41.941 -> Url :
17:00:41.941 -> /get?temp5=29.3&humd5=92
17:00:41.941 -> Closing connection
17:00:46.972 -> Url :
17:00:46.972 -> /get?temp5=29.3&humd5=92
17:00:46.972 -> Closing connection
17:00:52.025 -> Url :
17:00:52.025 -> /get?temp5=29.3&humd5=92
17:00:52.025 -> Closing connection
17:00:57.060 -> Url :
17:00:57.060 -> /get?temp5=29.3&humd5=92
17:00:57.060 -> Closing connection
17:01:02.091 -> Url :
17:01:02.091 -> /get?temp5=29.3&humd5=92
17:01:02.091 -> Closing connection

```

Gambar 4.10 Tampilan *Serial Monitor* pada *Node Sensor 5*

Pada gambar 4.10 merupakan tampilan pengiriman data suhu dan kelembaban yang dilakukan oleh *node sensor 5*. Dari hasil pengujian tersebut, nilai *serial monitor* hasil kondisi monitoring suhu dan kelembaban kandang ayam suhu memiliki nilai 29,3 derajat celcius dan kelembaban memiliki nilai 92%. Untuk pengujian *delay*nya dilakukan dengan menghitung selisih dari waktu pengiriman yang dilakukan *node sensor 3* dan waktu penerimaan pada *node sensor gateway*.

Tabel 4.11 *Delay* antara *Node Sensor 5* dan *Gateway*

No	Waktu Dikirim	Waktu Diterima	<i>Delay</i>
1	16:58:35,747	16:58:35,763	00:00:00,016
2	16:58:40,780	16:58:40,795	00:00:00,015
3	16:58:45,815	16:58:45,830	00:00:00,015

No	Waktu Dikirim	Waktu Diterima	Delay
4	16:58:50,889	16:58:50,889	00:00:00,000
5	16:58:55,926	16:58:55,926	00:00:00,000
6	16:59:00,958	16:59:00,973	00:00:00,015
7	16:59:05,991	16:59:06,007	00:00:00,016
8	16:59:11,023	16:59:11,038	00:00:00,015
9	16:59:16,062	16:59:16,078	00:00:00,016
10	16:59:21,137	16:59:21,168	00:00:00,031
11	16:59:26,164	16:59:26,180	00:00:00,016
12	16:59:31,186	16:59:31,201	00:00:00,015
13	16:59:36,267	16:59:36,298	00:00:00,031
14	16:59:41,292	16:59:41,322	00:00:00,030
15	16:59:46,318	16:59:46,334	00:00:00,016
16	16:59:51,348	16:59:51,363	00:00:00,015
17	16:59:56,424	16:59:56,455	00:00:00,031
18	17:00:01,460	17:00:01,475	00:00:00,015
19	17:00:06,537	17:00:06,569	00:00:00,032
20	17:00:11,606	17:00:11,637	00:00:00,031
21	17:00:16,643	17:00:16,674	00:00:00,031
22	17:00:21,671	17:00:21,686	00:00:00,015
23	17:00:26,756	17:00:26,786	00:00:00,030
24	17:00:31,830	17:00:31,830	00:00:00,000
25	17:00:36,862	17:00:36,862	00:00:00,000
26	17:00:41,941	17:00:41,988	00:00:00,047
27	17:00:46,972	17:00:46,972	00:00:00,000
28	17:00:52,025	17:00:52,073	00:00:00,048
29	17:00:57,060	17:00:57,060	00:00:00,000
30	17:01:02,091	17:01:02,091	00:00:00,000
Rata - Rata Delay			00:00:00,018

Pada tabel 4.11 dari hasil pengujian perhitungan parameter *delay* dari waktu dikirim hingga waktu diterima memiliki hasil yang dapat dilihat yaitu memiliki nilai rata – rata *delay* sebesar 0,018 ms. Sehingga dapat disimpulkan bahwa nilai dari parameter *delay* yang diperoleh masuk kedalam kategori Sangat Baik karena nilai *delay* yang diperoleh dibawah dari 150 ms. Nilai dari parameter *delay* sangat dipengaruhi oleh beberapa faktor seperti kondisi sinyal, keadaan dan lingkungan.

4.2.2 Pengujian *Multipoint*

4.2.2.1 Pengujian *Delay* dengan Menggunakan Aplikasi *Wireshark*

Pengujian *delay* pada skema komunikasi *Multipoint* dilakukan dengan menggunakan aplikasi *wireshark* dengan jarak antar *node sensor*nya memiliki jarak sepanjang 7 meter. Pengujian *delay* ini dilakukan dengan melakukan 5 kali percobaan dengan 35 *sample* setiap percobaannya. Pada pengukurannya digunakan 5 *node sensor* dan 1 *node sensor gateway* sebagai penerima data antar *node sensor*nya. Dalam pengujian ini, penulis mengambil sebuah standar QOS yaitu MQTT (*Message Queueing Telemetry Transport*) . Hasil dari pengujian *delay* dilihat pada Tabel 4.10

Tabel 4.12 Percobaan Pertama *Sample Delay Multipoint*

No	<i>Time 1</i>	<i>Time 2</i>	<i>Delay (s)</i>
1	0,035496	0,038987	0,003491
2	0,038987	0,065624	0,026637
3	0,065624	1,037711	0,972087
4	1,037711	1,037711	0,000000
5	1,037711	1,037711	0,000000
6	1,037711	1,037711	0,000000
7	1,037711	1,037711	0,000000
8	1,037711	1,037711	0,000000
9	1,037711	1,037711	0,000000
10	1,037711	1,037711	0,000000
11	1,037711	1,037711	0,000000
12	1,037711	1,038068	0,000357
13	1,038068	1,038119	0,000051
14	1,038119	1,038190	0,000071
15	1,038190	1,038240	0,000050
16	1,038240	1,038990	0,000750
17	1,038990	1,043219	0,004229
18	1,043219	1,046719	0,003500
19	1,046719	1,062633	0,015914
20	1,062633	1,070571	0,007938
21	1,070571	1,073455	0,002884

No	<i>Time 1</i>	<i>Time 2</i>	<i>Delay (s)</i>
22	1,073455	2,142544	1,069089
23	2,142544	2,499713	0,357169
24	2,499713	2,505147	0,005434
25	2,505147	2,505147	0,000000
26	2,505147	2,505341	0,000194
27	2,505341	2,524229	0,018888
28	2,524229	2,524314	0,000085
29	2,524314	4,089627	1,565313
30	4,089627	4,115519	0,025892
31	4,115519	4,119417	0,003898
32	4,119417	4,146975	0,027558
33	4,146975	5,135524	0,988549
34	5,135524	5,135524	0,000000
35	5,135524	5,135524	0,000000
	Total Delay		5,100028
	Jumlah Paket		35
	Rata - Rata Delay		0,145715

Tabel 4.13 Percobaan Kedua *Sample Delay Multipoint*

No	<i>Time 1</i>	<i>Time 2</i>	<i>Delay (s)</i>
1	0,004071	0,004071	0,000000
2	0,004071	0,004071	0,000000
3	0,004071	0,004071	0,000000
4	0,004071	0,004195	0,000124
5	0,004195	0,004268	0,000073
6	0,004268	0,004317	0,000049
7	0,004317	0,004925	0,000608
8	0,004925	0,029122	0,024197
9	0,029122	0,032252	0,003130
10	0,032252	0,032897	0,000645
11	0,032897	0,057777	0,024880
12	0,057777	0,790181	0,732404
13	0,790181	0,790181	0,000000
14	0,790181	0,790181	0,000000
15	0,790181	0,793229	0,003048

No	<i>Time 1</i>	<i>Time 2</i>	<i>Delay (s)</i>
16	0,793229	0,798789	0,005560
17	0,798789	0,798914	0,000125
18	0,798914	1,691037	0,892123
19	1,691037	1,697853	0,006816
20	1,697853	1,752507	0,054654
21	1,752507	3,715566	1,963059
22	3,715566	3,715669	0,000103
23	3,715669	3,838068	0,122399
24	3,838068	3,866964	0,028896
25	3,866964	3,870622	0,003658
26	3,870622	3,897064	0,026442
27	3,897064	4,895083	0,998019
28	4,895083	4,895083	0,000000
29	4,895083	4,895083	0,000000
30	4,895083	4,895083	0,000000
31	4,895083	4,896142	0,001059
32	4,896142	4,903606	0,007464
33	4,903606	4,904820	0,001214
34	4,904820	4,904917	0,000097
35	4,904917	4,912080	0,007163
	Total Delay		4,908009
	Jumlah Paket		35
	Rata - Rata Delay		0,140229

Tabel 4.14 Percobaan Ketiga *Sample Delay Multipoint*

No	<i>Time 1</i>	<i>Time 2</i>	<i>Delay (s)</i>
1	0,009309	0,009309	0,000000
2	0,009309	0,009422	0,000113
3	0,009422	0,010040	0,000618
4	0,010040	0,025722	0,015682
5	0,025722	0,029643	0,003921
6	0,029643	0,035440	0,005797
7	0,035440	0,054494	0,019054
8	0,054494	0,289146	0,234652
9	0,289146	0,289286	0,000140
10	0,289286	0,298119	0,008833
11	0,298119	0,298119	0,000000
12	0,298119	0,300438	0,002319
13	0,300438	0,304210	0,003772
14	0,304210	0,309521	0,005311

No	<i>Time 1</i>	<i>Time 2</i>	<i>Delay (s)</i>
15	0,309521	0,309521	0,000000
16	0,309521	1,666691	1,357170
17	1,666691	1,677816	0,011125
18	1,677816	1,728067	0,050251
19	1,728067	2,417268	0,689201
20	2,417268	2,500354	0,083086
21	2,500354	2,536006	0,035652
22	2,536006	2,538506	0,002500
23	2,538506	2,538506	0,000000
24	2,538506	2,552350	0,013844
25	2,552350	2,636894	0,084544
26	2,636894	2,636985	0,000091
27	2,636985	2,722968	0,085983
28	2,722968	2,740763	0,017795
29	2,740763	2,740839	0,000076
30	2,740839	2,759134	0,018295
31	2,759134	2,759234	0,000100
32	2,759234	2,760286	0,001052
33	2,760286	2,760333	0,000047
34	2,760333	2,774688	0,014355
35	2,774688	3,347762	0,573074
	Total Delay		3,338453
	Jumlah Paket		35
	Rata - Rata Delay		0,095384

Tabel 4.15 Percobaan Keempat *Sample Delay Multipoint*

No	<i>Time 1</i>	<i>Time 2</i>	<i>Delay (s)</i>
1	0,000331	0,000370	0,000039
2	0,000370	0,003534	0,003164
3	0,003534	0,004116	0,000582
4	0,004116	0,004384	0,000268
5	0,004384	0,006177	0,001793
6	0,006177	2,363384	2,357207
7	2,363384	2,370211	0,006827
8	2,370211	2,425581	0,055370
9	2,425581	2,493122	0,067541
10	2,493122	2,493219	0,000097
11	2,493219	3,048102	0,554883
12	3,048102	3,052171	0,004069
13	3,052171	3,052999	0,000828

No	<i>Time 1</i>	<i>Time 2</i>	<i>Delay (s)</i>
14	3,052999	3,077380	0,024381
15	3,077380	3,077380	0,000000
16	3,077380	3,081587	0,004207
17	3,081587	3,108885	0,027298
18	3,108885	3,991919	0,883034
19	3,991919	3,996327	0,004408
20	3,996327	3,996327	0,000000
21	3,996327	3,996327	0,000000
22	3,996327	3,996327	0,000000
23	3,996327	3,999244	0,002917
24	3,999244	3,999244	0,000000
25	3,999244	3,999820	0,000576
26	3,999820	4,002257	0,002437
27	4,002257	4,002562	0,000305
28	4,002562	4,006658	0,004096
29	4,006658	4,025180	0,018522
30	4,025180	4,026337	0,001157
31	4,026337	4,085060	0,058723
32	4,085060	4,101134	0,016074
33	4,101134	5,114065	1,012931
34	5,114065	5,114065	0,000000
35	5,114065	5,114174	0,000109
	Total Delay		5,113843
	Jumlah Paket		35
	Rata - Rata Delay		0,146110

Tabel 4.16 Percobaan Kelima *Sample Delay Multipoint*

No	<i>Time 1</i>	<i>Time 2</i>	<i>Delay (s)</i>
1	0,000141	1,024721	1,024580
2	1,024721	1,024721	0,000000
3	1,024721	1,024877	0,000156
4	1,024877	1,024877	0,000000
5	1,024877	1,024877	0,000000
6	1,024877	1,024965	0,000088
7	1,024965	1,025081	0,000116
8	1,025081	1,025553	0,000472
9	1,025553	1,051816	0,026263
10	1,051816	1,057141	0,005325
11	1,057141	1,075203	0,018062
12	1,075203	1,130358	0,055155

No	<i>Time 1</i>	<i>Time 2</i>	<i>Delay (s)</i>
13	1,130358	1,133837	0,003479
14	1,133837	1,134127	0,000290
15	1,134127	1,158283	0,024156
16	1,158283	1,158426	0,000143
17	1,158426	1,158513	0,000087
18	1,158513	1,158634	0,000121
19	1,158634	1,160788	0,002154
20	1,160788	1,160846	0,000058
21	1,160846	1,160920	0,000074
22	1,160920	1,161024	0,000104
23	1,161024	1,182597	0,021573
24	1,182597	1,183160	0,000563
25	1,183160	1,184155	0,000995
26	1,184155	1,184177	0,000022
27	1,184177	1,185208	0,001031
28	1,185208	1,187442	0,002234
29	1,187442	1,187649	0,000207
30	1,187649	1,190242	0,002593
31	1,190242	1,190795	0,000553
32	1,190795	1,190875	0,000080
33	1,190875	1,204900	0,014025
34	1,204900	1,205018	0,000118
35	1,205018	1,205379	0,000361
	Total Delay		1,205238
	Jumlah Paket		35
	Rata - Rata Delay		0,034435

Tabel 4.17 Delay Multipoint

No	Besar Paket (Bytes)	<i>Time Span (s)</i>	<i>Delay (ms)</i>
1	46492	9,872	0,120144
2	307439	9,007	0,140228
3	17712	10,622	0,095384
4	88403	9,679	0,146109
5	13432	9,877	0,034435
	Rata - Rata Delay		0,10726

Pada tabel 4.17 didapatkan hasil dari rata – rata *delay* dari 5 kali percobaan yang diambil mendapatkan nilai dari *delay* sebesar 0,10726 ms. Dapat disimpulkan bahwa dari nilai *Delay* yang diperoleh masuk kedalam kategori Sangat Baik dengan

nilai yang didapatkan kurang dari 150 ms. Pengujian *delay* mendapatkan hasil dari minimum *delay* sebesar 0,034435 dan maksimum *delay* sebesar 0,146109. Hasil dari *delay* dipengaruhi dari beberapa faktor seperti kondisi sinyal, keadaan dan lingkungan.

4.2.2.2 Pengujian Delay antar Node Sensor dengan Tampilan Serial monitor

Pengujian *delay* pada skema komunikasi *point to point* dilakukan dengan menggunakan *serial monitor* untuk menampilkan waktu pengiriman antar *node sensor* dan waktu menerima pada *node sensor gateway*. Dengan jarak antar *node sensornya* sepanjang 7 meter. Pengujian *delay* dilakukan dengan mengambil 30 sampel pengiriman dengan melakukan request pengiriman data sebesar 5 detik.

```
19:06:27.259 -> Url :
19:06:27.259 -> /get?templ=29.3shumdl=98.0
19:06:27.259 -> Closing connection
19:06:32.249 -> Url :
19:06:32.249 -> /get?templ=29.3shumdl=98.0
19:06:32.296 -> Closing connection
19:06:37.315 -> Url :
19:06:37.315 -> /get?templ=29.3shumdl=98.0
19:06:37.315 -> Closing connection
19:06:42.355 -> Url :
19:06:42.355 -> /get?templ=29.3shumdl=98.0
19:06:42.355 -> Closing connection
19:06:47.377 -> Url :
19:06:47.377 -> /get?templ=29.3shumdl=98.0
19:06:47.377 -> Closing connection
19:06:52.415 -> Url :
19:06:52.415 -> /get?templ=29.3shumdl=98.0
19:06:52.415 -> Closing connection
19:06:57.434 -> Url :
19:06:57.434 -> /get?templ=29.3shumdl=98.0
19:06:57.434 -> Closing connection
19:07:02.504 -> Url :
19:07:02.504 -> /get?templ=29.3shumdl=98.0
19:07:02.504 -> Closing connection
19:07:07.530 -> Url :
19:07:07.530 -> /get?templ=29.3shumdl=98.0
19:07:07.530 -> Closing connection
19:07:12.531 -> Url :
19:07:12.531 -> /get?templ=29.3shumdl=98.0
19:07:12.577 -> Closing connection
19:07:17.569 -> Url :
19:07:17.569 -> /get?templ=29.4shumdl=98.0
19:07:17.615 -> Closing connection
19:07:22.643 -> Url :
19:07:22.643 -> /get?templ=29.4shumdl=98.0
19:07:22.643 -> Closing connection

19:07:27.674 -> Url :
19:07:27.674 -> /get?templ=29.4shumdl=98.0
19:07:27.674 -> Closing connection
19:07:32.705 -> Url :
19:07:32.705 -> /get?templ=29.5shumdl=98.0
19:07:32.705 -> Closing connection
19:07:37.726 -> Url :
19:07:37.726 -> /get?templ=29.7shumdl=98.0
19:07:37.726 -> Closing connection
19:07:42.756 -> Url :
19:07:42.756 -> /get?templ=29.8shumdl=98.0
19:07:42.756 -> Closing connection
19:07:47.779 -> Url :
19:07:47.779 -> /get?templ=29.8shumdl=98.0
19:07:47.825 -> Closing connection
19:07:52.816 -> Url :
19:07:52.816 -> /get?templ=29.8shumdl=98.0
19:07:52.863 -> Closing connection
19:07:57.880 -> Url :
19:07:57.880 -> /get?templ=29.8shumdl=98.0
19:07:57.880 -> Closing connection
19:08:02.904 -> Url :
19:08:02.904 -> /get?templ=29.8shumdl=98.0
19:08:02.904 -> Closing connection
19:08:07.922 -> Url :
19:08:07.922 -> /get?templ=29.8shumdl=98.0
19:08:07.968 -> Closing connection
19:08:12.991 -> Url :
19:08:12.991 -> /get?templ=29.8shumdl=98.0
19:08:12.991 -> Closing connection
19:08:18.007 -> Url :
19:08:18.007 -> /get?templ=29.8shumdl=98.0
19:08:18.007 -> Closing connection
19:08:23.031 -> Url :
19:08:23.031 -> /get?templ=29.8shumdl=98.0
19:08:23.031 -> Closing connection
```

```

19:08:28.089 -> Url :
19:08:28.089 -> /get?templ=29.8&humdl=98.0
19:08:28.089 -> Closing connection
19:08:33.114 -> Url :
19:08:33.114 -> /get?templ=29.8&humdl=98.0
19:08:33.114 -> Closing connection
19:08:38.132 -> Url :
19:08:38.132 -> /get?templ=29.8&humdl=98.0
19:08:38.179 -> Closing connection
19:08:43.200 -> Url :
19:08:43.200 -> /get?templ=29.8&humdl=98.0
19:08:43.200 -> Closing connection
19:08:48.213 -> Url :
19:08:48.213 -> /get?templ=29.8&humdl=98.0
19:08:48.213 -> Closing connection
19:08:53.242 -> Url :
19:08:53.242 -> /get?templ=29.8&humdl=98.0
19:08:53.288 -> Closing connection

```

Gambar 4.11 Tampilan Serial Monitor pada Node Sensor 1

Pada gambar 4.11 dapat dilihat terdapat 30 sampel data suhu dan kelembaban pada *node sensor* 1. Pengiriman data dilakukan oleh *node sensor* 1 kepada *node sensor* 2 yang di dalam datanya berisi data dari *node sensor* 1. Dengan waktu pengiriman dimulai dari pukul 19:06:27,259 berakhir pada pukul 19:08:53,288

Tabel 4.18 Delay antara Node Sensor 1 dan Node Sensor 2

No	Waktu Dikirim	Waktu Diterima	Waktu Delay
1	19:06:27,259	19:06:27,274	00:00:00,015
2	19:06:32,249	19:06:32,249	00:00:00,000
3	19:06:37,315	19:06:37,315	00:00:00,000
4	19:06:42,355	19:06:42,376	00:00:00,021
5	19:06:47,377	19:06:47,393	00:00:00,016
6	19:06:52,415	19:06:52,416	00:00:00,001
7	19:06:57,434	19:06:57,435	00:00:00,001
8	19:07:02,504	19:07:02,534	00:00:00,030
9	19:07:07,530	19:07:07,564	00:00:00,034
10	19:07:12,531	19:07:12,546	00:00:00,015
11	19:07:17,569	19:07:17,569	00:00:00,000
12	19:07:22,643	19:07:22,689	00:00:00,046

No	Waktu Dikirim	Waktu Diterima	Waktu Delay
13	19:07:27,674	19:07:27,706	00:00:00,032
14	19:07:32,705	19:07:32,735	00:00:00,030
15	19:07:37,726	19:07:37,741	00:00:00,015
16	19:07:42,756	19:07:42,771	00:00:00,015
17	19:07:47,779	19:07:47,794	00:00:00,015
18	19:07:52,816	19:07:52,831	00:00:00,015
19	19:07:57,880	19:07:57,911	00:00:00,031
20	19:08:02,904	19:08:02,919	00:00:00,015
21	19:08:07,922	19:08:07,937	00:00:00,015
22	19:08:12,991	19:08:13,023	00:00:00,032
23	19:08:18,007	19:08:18,022	00:00:00,015
24	19:08:23,031	19:08:23,047	00:00:00,016
25	19:08:28,089	19:08:28,120	00:00:00,031
26	19:08:33,114	19:08:33,114	00:00:00,000
27	19:08:38,132	19:08:38,132	00:00:00,000
28	19:08:43,200	19:08:43,200	00:00:00,000
29	19:08:48,213	19:08:48,213	00:00:00,000
30	19:08:53,242	19:08:53,243	00:00:00,001
Rata - Rata Delay			00:00:00,016

Pada tabel 4.18 hasil pengujian perhitungan parameter *delay* antara *node sensor 1* dan *node sensor 2* dari waktu dikirim hingga waktu diterima memiliki hasil yang dapat dilihat yaitu memiliki nilai rata – rata *delay* sebesar 0,016 ms. Sehingga dapat disimpulkan bahwa nilai dari parameter *delay* yang diperoleh masuk kedalam kategori Sangat Baik karena nilai *delay* yang diperoleh dibawah dari 150 ms. Nilai dari parameter *delay* sangat dipengaruhi oleh beberapa faktor seperti kondisi sinyal, keadaan dan lingkungan.

19:06:27.244 -> 98.0
19:06:27.337 -> Url :
19:06:27.337 -> /get?templ=29.3shumdl=98.0&temp2=29.8shumd2=92.0
19:06:27.337 -> Closing connection
19:06:32.249 -> 98.0
19:06:32.389 -> Url :
19:06:32.389 -> /get?templ=29.3shumdl=98.0&temp2=29.8shumd2=92.0
19:06:32.389 -> Closing connection
19:06:37.315 -> 98.0
19:06:37.408 -> Url :
19:06:37.408 -> /get?templ=29.3shumdl=98.0&temp2=29.8shumd2=92.0
19:06:37.408 -> Closing connection
19:06:42.334 -> 98.0
19:06:42.429 -> Url :
19:06:42.429 -> /get?templ=29.3shumdl=98.0&temp2=29.8shumd2=92.0
19:06:42.429 -> Closing connection
19:06:47.361 -> 98.0
19:06:47.502 -> Url :
19:06:47.502 -> /get?templ=29.3shumdl=98.0&temp2=29.8shumd2=92.0
19:06:47.502 -> Closing connection
19:06:52.416 -> 98.0
19:06:52.509 -> Url :
19:06:52.509 -> /get?templ=29.3shumdl=98.0&temp2=29.8shumd2=92.0
19:06:52.509 -> Closing connection
19:06:57.433 -> 98.0
19:06:57.529 -> Url :
19:06:57.529 -> /get?templ=29.3shumdl=98.0&temp2=29.8shumd2=92.0
19:06:57.576 -> Closing connection
19:07:02.474 -> 98.0
19:07:02.566 -> Url :
19:07:02.566 -> /get?templ=29.3shumdl=98.0&temp2=29.8shumd2=92.0
19:07:02.612 -> Closing connection
19:07:07.500 -> 98.0
19:07:07.639 -> Url :
19:07:07.639 -> /get?templ=29.3shumdl=98.0&temp2=29.8shumd2=92.0
19:07:07.639 -> Closing connection

19:07:12.546 -> 98.0
19:07:12.639 -> Url :
19:07:12.639 -> /get?templ=29.3shumdl=98.0&temp2=29.8shumd2=92.0
19:07:12.685 -> Closing connection
19:07:17.569 -> 98.0
19:07:17.709 -> Url :
19:07:17.709 -> /get?templ=29.4shumdl=98.0&temp2=29.8shumd2=92.0
19:07:17.709 -> Closing connection
19:07:22.597 -> 98.0
19:07:22.737 -> Url :
19:07:22.737 -> /get?templ=29.4shumdl=98.0&temp2=29.8shumd2=92.0
19:07:22.737 -> Closing connection
19:07:27.642 -> 98.0
19:07:27.782 -> Url :
19:07:27.782 -> /get?templ=29.4shumdl=98.0&temp2=29.8shumd2=92.0
19:07:27.782 -> Closing connection
19:07:32.675 -> 98.0
19:07:32.814 -> Url :
19:07:32.814 -> /get?templ=29.5shumdl=98.0&temp2=29.8shumd2=92.0
19:07:32.814 -> Closing connection
19:07:37.741 -> 98.0
19:07:37.834 -> Url :
19:07:37.834 -> /get?templ=29.7shumdl=98.0&temp2=29.8shumd2=92.0
19:07:37.834 -> Closing connection
19:07:42.771 -> 98.0
19:07:42.864 -> Url :
19:07:42.864 -> /get?templ=29.8shumdl=98.0&temp2=29.8shumd2=91.0
19:07:42.864 -> Closing connection
19:07:47.794 -> 98.0
19:07:47.935 -> Url :
19:07:47.935 -> /get?templ=29.8shumdl=98.0&temp2=29.8shumd2=91.0
19:07:47.935 -> Closing connection
19:07:52.831 -> 98.0
19:07:52.970 -> Url :
19:07:52.970 -> /get?templ=29.8shumdl=98.0&temp2=29.8shumd2=92.0
19:07:52.970 -> Closing connection


```

19:07:57.849 -> 98.0
19:07:57.990 -> Url :
19:07:57.990 -> /get?temp1=29.8&humid1=98.0&temp2=29.8&humid2=91.0
19:07:57.990 -> Closing connection
19:08:02.919 -> 98.0
19:08:03.011 -> Url :
19:08:03.011 -> /get?temp1=29.8&humid1=98.0&temp2=29.8&humid2=91.0
19:08:03.011 -> Closing connection
19:08:07.937 -> 98.0
19:08:08.079 -> Url :
19:08:08.079 -> /get?temp1=29.8&humid1=98.0&temp2=29.8&humid2=91.0
19:08:08.079 -> Closing connection
19:08:12.959 -> 98.0
19:08:13.099 -> Url :
19:08:13.099 -> /get?temp1=29.8&humid1=98.0&temp2=29.8&humid2=91.0
19:08:13.099 -> Closing connection
19:08:18.022 -> 98.0
19:08:18.114 -> Url :
19:08:18.114 -> /get?temp1=29.8&humid1=98.0&temp2=29.8&humid2=91.0
19:08:18.114 -> Closing connection
19:08:23.047 -> 98.0
19:08:23.190 -> Url :
19:08:23.190 -> /get?temp1=29.8&humid1=98.0&temp2=29.8&humid2=91.0
19:08:23.190 -> Closing connection
19:08:28.058 -> 98.0
19:08:28.196 -> Url :
19:08:28.196 -> /get?temp1=29.8&humid1=98.0&temp2=29.8&humid2=91.0
19:08:28.196 -> Closing connection
19:08:33.114 -> 98.0
19:08:33.253 -> Url :
19:08:33.253 -> /get?temp1=29.8&humid1=98.0&temp2=29.9&humid2=91.0
19:08:33.253 -> Closing connection
19:08:38.132 -> 98.0
19:08:38.272 -> Url :
19:08:38.272 -> /get?temp1=29.8&humid1=98.0&temp2=30.0&humid2=90.0
19:08:38.272 -> Closing connection

19:08:43.200 -> 98.0
19:08:43.292 -> Url :
19:08:43.292 -> /get?temp1=29.8&humid1=98.0&temp2=30.2&humid2=90.0
19:08:43.292 -> Closing connection
19:08:48.213 -> 98.0
19:08:48.353 -> Url :
19:08:48.353 -> /get?temp1=29.8&humid1=98.0&temp2=30.2&humid2=90.0
19:08:48.353 -> Closing connection
19:08:53.243 -> 98.0
19:08:53.383 -> Url :
19:08:53.383 -> /get?temp1=29.8&humid1=98.0&temp2=30.2&humid2=90.0
19:08:53.383 -> Closing connection

```

Gambar 4.12 Tampilan Serial Monitor pada Node Sensor 2

Pada gambar 4.12 dapat dilihat terdapat 30 sampel data suhu dan kelembaban pada *node sensor 2* yang diterima dari *node sensor 1*. Pengiriman data dilakukan oleh *node sensor 2* kepada *node sensor 3* yang di dalam datanya berisi data dari *node sensor 2* dan *node sensor 1*. Dengan waktu penerimaan dimulai dari pukul 19:06:27,244 berakhir pada pukul 19:08:53,243 dan pengiriman dari pukul 19:06:27,377 sampai 19:08:53,383.

Tabel 4.19 Delay antara Node Sensor 2 dan Gateway

No	Waktu Dikirim	Waktu Diterima	Waktu Delay
1	19:06:27,337	19:06:27,352	00:00:00,015
2	19:06:32,389	19:06:32,405	00:00:00,016

No	Waktu Dikirim	Waktu Diterima	Waktu <i>Delay</i>
3	19:06:37,408	19:06:37,423	00:00:00,015
4	19:06:42,429	19:06:42,445	00:00:00,016
5	19:06:47,502	19:06:47,549	00:00:00,047
6	19:06:52,509	19:06:52,526	00:00:00,017
7	19:06:57,529	19:06:57,529	00:00:00,000
8	19:07:02,566	19:07:02,566	00:00:00,000
9	19:07:07,639	19:07:07,670	00:00:00,031
10	19:07:12,639	19:07:12,639	00:00:00,000
11	19:07:17,709	19:07:17,741	00:00:00,032
12	19:07:22,737	19:07:22,752	00:00:00,015
13	19:07:27,782	19:07:27,782	00:00:00,000
14	19:07:32,814	19:07:32,814	00:00:00,000
15	19:07:37,834	19:07:37,850	00:00:00,016
16	19:07:42,864	19:07:42,864	00:00:00,000
17	19:07:47,935	19:07:47,982	00:00:00,047
18	19:07:52,970	19:07:53,016	00:00:00,046
19	19:07:57,990	19:07:57,990	00:00:00,000
20	19:08:02,011	19:08:02,011	00:00:00,000
21	19:08:07,079	19:08:07,079	00:00:00,000
22	19:08:12,099	19:08:12,099	00:00:00,000
23	19:08:18,114	19:08:18,114	00:00:00,000
24	19:08:23,190	19:08:23,193	00:00:00,003
25	19:08:28,196	19:08:28,196	00:00:00,000
26	19:08:33,253	19:08:33,283	00:00:00,030
27	19:08:38,272	19:08:38,288	00:00:00,016
28	19:08:43,292	19:08:43,308	00:00:00,016
29	19:08:48,353	19:08:48,368	00:00:00,015
30	19:08:53,383	19:08:53,399	00:00:00,016
Rata - Rata <i>Delay</i>			00:00:00,014

Pada tabel 4.19 hasil pengujian perhitungan parameter *delay* antara *node sensor 2* dan *gateway* dari waktu dikirim hingga waktu diterima memiliki hasil yang dapat dilihat yaitu memiliki nilai rata – rata *delay* sebesar 0,014 ms. Sehingga dapat disimpulkan bahwa nilai dari parameter *delay* yang diperoleh masuk kedalam

kategori Sangat Baik karena nilai *delay* yang diperoleh dibawah dari 150 ms. Nilai dari parameter *delay* sangat dipengaruhi oleh beberapa faktor seperti kondisi sinyal, keadaan dan lingkungan.

```
02:31:38.975 -> 93.0
02:31:41.928 -> 92.0
02:31:42.581 -> Url :
02:31:42.581 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=92.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=93.0
02:31:42.581 -> Closing connection
02:31:43.986 -> 93.0
02:31:46.977 -> 92.0
02:31:47.628 -> Url :
02:31:47.628 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=92.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=93.0
02:31:47.628 -> Closing connection
02:31:49.031 -> 93.0
02:31:52.026 -> 92.0
02:31:52.678 -> Url :
02:31:52.678 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=92.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=93.0
02:31:52.678 -> Closing connection
02:31:54.075 -> 93.0
02:31:57.053 -> 92.0
02:31:57.706 -> Url :
02:31:57.706 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=92.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=93.0
02:31:57.706 -> Closing connection
02:31:59.107 -> 93.0
02:32:02.099 -> 92.0
02:32:02.749 -> Url :
02:32:02.749 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=92.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=93.0
02:32:02.749 -> Closing connection
02:32:04.153 -> 93.0
02:32:07.133 -> 93.0
02:32:07.788 -> Url :
02:32:07.788 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=93.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=93.0
02:32:07.788 -> Closing connection
02:32:09.190 -> 93.0
02:32:12.139 -> 93.0
02:32:12.791 -> Url :
02:32:12.791 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=93.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=93.0
02:32:12.837 -> Closing connection

02:32:14.196 -> 94.0
02:32:17.191 -> 93.0
02:32:17.846 -> Url :
02:32:17.846 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=93.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=94.0
02:32:17.846 -> Closing connection
02:32:19.246 -> 94.0
02:32:22.245 -> 93.0
02:32:22.897 -> Url :
02:32:22.897 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=93.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=94.0
02:32:22.897 -> Closing connection
02:32:24.295 -> 94.0
02:32:27.281 -> 94.0
02:32:27.933 -> Url :
02:32:27.933 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=94.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=94.0
02:32:27.933 -> Closing connection
02:32:29.332 -> 94.0
02:32:32.318 -> 94.0
02:32:32.969 -> Url :
02:32:32.969 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=94.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=94.0
02:32:32.969 -> Closing connection
02:32:34.371 -> 95.0
02:32:37.319 -> 94.0
02:32:38.019 -> Url :
02:32:38.019 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=94.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=95.0
02:32:38.019 -> Closing connection
02:32:39.378 -> 95.0
02:32:42.369 -> 94.0
02:32:43.067 -> Url :
02:32:43.067 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=94.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=95.0
02:32:43.067 -> Closing connection
02:32:44.425 -> 95.0
02:32:47.414 -> 94.0
02:32:48.064 -> Url :
02:32:48.064 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=94.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=95.0
02:32:48.110 -> Closing connection
```

```

02:32:49.466 -> 95.0
02:32:52.459 -> 94.0
02:32:53.110 -> Url :
02:32:53.110 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=94.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=95.0
02:32:53.157 -> Closing connection
02:32:54.512 -> 95.0
02:32:57.497 -> 95.0
02:32:58.148 -> Url :
02:32:58.148 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=95.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=95.0
02:32:58.195 -> Closing connection
02:32:59.554 -> 95.0
02:33:02.502 -> 95.0
02:33:03.198 -> Url :
02:33:03.198 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=95.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=95.0
02:33:03.198 -> Closing connection
02:33:04.594 -> 95.0
02:33:07.539 -> 95.0
02:33:08.240 -> Url :
02:33:08.240 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=95.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=95.0
02:33:08.240 -> Closing connection
02:33:09.645 -> 95.0
02:33:12.588 -> 95.0
02:33:13.283 -> Url :
02:33:13.283 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=95.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=95.0
02:33:13.283 -> Closing connection
02:33:14.682 -> 95.0
02:33:17.624 -> 95.0
02:33:18.322 -> Url :
02:33:18.322 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=95.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=95.0
02:33:18.322 -> Closing connection
02:33:19.725 -> 95.0
02:33:22.666 -> 94.0
02:33:23.363 -> Url :
02:33:23.363 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=94.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=77.0&temp5=28.9&humd5=95.0
02:33:23.363 -> Closing connection

02:33:59.992 -> 95.0
02:34:02.978 -> 94.0
02:34:03.680 -> Url :
02:34:03.680 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=94.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=78.0&temp5=28.9&humd5=95.0
02:34:03.728 -> Closing connection
02:34:05.033 -> 95.0
02:34:08.017 -> 94.0
02:34:08.715 -> Url :
02:34:08.715 -> /get?temp1=28.9&humd1=98.0&temp2=28.9&humd2=94.0&temp3=28.0&humd3=80.0&temp4=28.9&humd4=78.0&temp5=28.9&humd5=95.0
02:34:08.762 -> Closing connection

```

Gambar 4.13 Tampilan Serial Monitor pada Node Sensor 3

Pada gambar 4.13 dapat dilihat terdapat 30 sampel data suhu dan kelembaban pada *node sensor 3* yang diterima dari *node sensor 2* dan *node sensor 4*. Pengiriman data dilakukan oleh *node sensor 3* kepada *gateway* yang di dalam datanya berisi data dari *node sensor 1* sampai *node sensor 5*, Dengan waktu penerimaan dimulai dari pukul 02:31:38,975 berakhir pada pukul 02:34:08,017 dan pengiriman dari pukul 02:31:42,581 sampai 02:34:08,715.

Tabel 4.20 Delay antara Node Sensor 3 dan Gateway

No	Waktu Dikirim	Waktu Diterima	Waktu Delay
1	02:31:42,581	02:31:42,581	00:00:00,000
2	02:31:47,628	02:31:47,643	00:00:00,015
3	02:31:52,678	02:31:52,726	00:00:00,048
4	02:31:57,706	02:31:57,706	00:00:00,000
5	02:32:02,749	02:32:02,779	00:00:00,030
6	02:32:07,788	02:32:07,788	00:00:00,000

No	Waktu Dikirim	Waktu Diterima	Waktu Delay
7	02:32:12,791	02:32:12,791	00:00:00,000
8	02:32:17,846	02:32:17,846	00:00:00,000
9	02:32:22,897	02:32:22,897	00:00:00,000
10	02:32:27,933	02:32:27,933	00:00:00,000
11	02:32:32,969	02:32:32,969	00:00:00,000
12	02:32:38,019	02:32:38,019	00:00:00,000
13	02:32:43,067	02:32:43,067	00:00:00,000
14	02:32:48,064	02:32:48,064	00:00:00,000
15	02:32:53,110	02:32:53,110	00:00:00,000
16	02:32:58,148	02:32:58,148	00:00:00,000
17	02:33:03,198	02:33:03,214	00:00:00,016
18	02:33:08,240	02:33:08,256	00:00:00,016
19	02:33:13,283	02:33:13,298	00:00:00,015
20	02:33:18,322	02:33:18,337	00:00:00,015
21	02:33:23,363	02:33:23,378	00:00:00,015
22	02:33:28,409	02:33:28,424	00:00:00,015
23	02:33:33,476	02:33:33,476	00:00:00,000
24	02:33:38,518	02:33:38,518	00:00:00,000
25	02:33:43,518	02:33:43,518	00:00:00,000
26	02:33:48,554	02:33:48,554	00:00:00,000
27	02:33:53,601	02:33:53,601	00:00:00,000
28	02:33:58,638	02:33:58,654	00:00:00,016
29	02:34:03,680	02:34:03,696	00:00:00,016
30	02:34:08,715	02:34:08,730	00:00:00,015
Rata - Rata Delay			00:00:00,007

Pada tabel 4.20 hasil pengujian perhitungan parameter *delay* antara *node sensor* 3 dan *gateway* dari waktu dikirim hingga waktu diterima memiliki hasil yang dapat dilihat yaitu memiliki nilai rata – rata *delay* sebesar 0,004 ms. Sehingga dapat disimpulkan bahwa nilai dari parameter *delay* yang diperoleh masuk kedalam kategori Sangat Baik karena nilai *delay* yang diperoleh dibawah dari 150 ms. Nilai dari parameter *delay* sangat dipengaruhi oleh beberapa faktor seperti kondisi sinyal, keadaan dan lingkungan.

00:49:25.154 -> 95.0
00:49:30.192 -> Url :
00:49:30.192 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:49:30.192 -> Closing connection
00:49:30.192 -> 95.0
00:49:35.210 -> Url :
00:49:35.210 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:49:35.210 -> Closing connection
00:49:35.234 -> 95.0
00:49:40.217 -> Url :
00:49:40.217 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:49:40.217 -> Closing connection
00:49:40.265 -> 95.0
00:49:45.284 -> Url :
00:49:45.284 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:49:45.284 -> Closing connection
00:49:45.284 -> 95.0
00:49:50.279 -> Url :
00:49:50.279 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:49:50.279 -> Closing connection
00:49:50.328 -> 95.0
00:49:55.325 -> Url :
00:49:55.325 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:49:55.325 -> Closing connection
00:49:55.372 -> 95.0
00:50:00.373 -> Url :
00:50:00.373 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:50:00.373 -> Closing connection
00:50:00.373 -> 95.0
00:50:05.422 -> Url :
00:50:05.422 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:50:05.422 -> Closing connection
00:50:05.422 -> 95.0
00:50:10.424 -> Url :
00:50:10.424 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:50:10.424 -> Closing connection

00:50:10.492 -> 95.0
00:50:15.484 -> Url :
00:50:15.484 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:50:15.484 -> Closing connection
00:50:15.484 -> 95.0
00:50:20.491 -> Url :
00:50:20.491 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:50:20.562 -> Closing connection
00:50:20.562 -> 95.0
00:50:25.550 -> Url :
00:50:25.550 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:50:25.550 -> Closing connection
00:50:25.550 -> 95.0
00:50:30.585 -> Url :
00:50:30.585 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:50:30.585 -> Closing connection
00:50:30.585 -> 95.0
00:50:35.647 -> Url :
00:50:35.647 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:50:35.647 -> Closing connection
00:50:35.647 -> 95.0
00:50:40.685 -> Url :
00:50:40.685 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:50:40.685 -> Closing connection
00:50:40.685 -> 95.0
00:50:45.703 -> Url :
00:50:45.703 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:50:45.703 -> Closing connection
00:50:45.703 -> 95.0
00:50:50.742 -> Url :
00:50:50.742 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:50:50.742 -> Closing connection
00:50:50.742 -> 95.0
00:50:55.749 -> Url :
00:50:55.749 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:50:55.794 -> Closing connection

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00:50:55.794 -> 95.0
00:51:00.789 -> Url :
00:51:00.789 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:51:00.789 -> Closing connection
00:51:00.835 -> 95.0
00:51:05.832 -> Url :
00:51:05.832 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:51:05.832 -> Closing connection
00:51:05.879 -> 95.0
00:51:10.869 -> Url :
00:51:10.869 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:51:10.869 -> Closing connection
00:51:10.915 -> 95.0
00:51:15.925 -> Url :
00:51:15.925 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:51:15.925 -> Closing connection
00:51:15.925 -> 95.0
00:51:20.963 -> Url :
00:51:20.963 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:51:20.963 -> Closing connection
00:51:20.963 -> 95.0
00:51:25.977 -> Url :
00:51:25.977 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:51:25.977 -> Closing connection
00:51:26.023 -> 95.0
00:51:31.019 -> Url :
00:51:31.019 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:51:31.019 -> Closing connection
00:51:31.019 -> 95.0
00:51:36.080 -> Url :
00:51:36.080 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:51:36.080 -> Closing connection
00:51:36.080 -> 95.0
00:51:41.117 -> Url :
00:51:41.117 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:51:41.117 -> Closing connection

00:51:41.117 -> 95.0
00:51:46.132 -> Url :
00:51:46.132 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:51:46.132 -> Closing connection
00:51:46.132 -> 95.0
00:51:51.179 -> Url :
00:51:51.179 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:51:51.179 -> Closing connection
00:51:51.179 -> 95.0
00:51:56.195 -> Url :
00:51:56.195 -> /get?temp4=29.3&humd4=79.0&temp5=29.3&humd5=95.0
00:51:56.195 -> Closing connection

```

Gambar 4.14 Tampilan Serial Monitor pada Node Sensor 4

Pada gambar 4.14 dapat dilihat terdapat 30 sampel data suhu dan kelembaban pada *node sensor 4* yang diterima dari *node sensor 5*. Pengiriman data dilakukan oleh *node sensor 4* kepada *node sensor 3* yang di dalam datanya berisi data dari *node sensor 5*. Dengan waktu penerimaan dimulai dari pukul 00:49:25,154 berakhir pada pukul 00:51:51,179 dan pengiriman dari pukul 00:49:30,192 sampai 00:51:56,195.

Tabel 4.21 Delay antara Node Sensor 4 dan Gateway

No	Waktu Dikirim	Waktu Diterima	Waktu Delay
1	00:49:30,192	00:49:30,218	00:00:00,026
2	00:49:35,210	00:49:35,234	00:00:00,024

No	Waktu Dikirim	Waktu Diterima	Waktu Delay
3	00:49:40,217	00:49:40,217	00:00:00,000
4	00:49:45,284	00:49:45,294	00:00:00,010
5	00:49:50,279	00:49:50,311	00:00:00,032
6	00:49:55,325	00:49:55,325	00:00:00,000
7	00:50:00,373	00:50:00,373	00:00:00,000
8	00:50:05,422	00:50:05,422	00:00:00,000
9	00:50:10,424	00:50:10,424	00:00:00,000
10	00:50:15,484	00:50:15,484	00:00:00,000
11	00:50:20,491	00:50:20,491	00:00:00,000
12	00:50:25,550	00:50:25,550	00:00:00,000
13	00:50:30,585	00:50:30,585	00:00:00,000
14	00:50:35,647	00:50:35,694	00:00:00,047
15	00:50:40,685	00:50:40,732	00:00:00,047
16	00:50:45,703	00:50:45,703	00:00:00,000
17	00:50:50,742	00:50:50,742	00:00:00,000
18	00:50:55,749	00:50:55,749	00:00:00,000
19	00:51:00,789	00:51:00,789	00:00:00,000
20	00:51:05,832	00:51:05,832	00:00:00,000
21	00:51:10,869	00:51:10,869	00:00:00,000
22	00:51:15,925	00:51:15,925	00:00:00,000
23	00:51:20,963	00:51:20,963	00:00:00,000
24	00:51:25,977	00:51:25,977	00:00:00,000
25	00:51:31,019	00:51:31,019	00:00:00,000
26	00:51:36,080	00:51:36,080	00:00:00,000
27	00:51:41,117	00:51:41,117	00:00:00,000
28	00:51:46,132	00:51:46,132	00:00:00,000
29	00:51:51,179	00:51:51,179	00:00:00,000
30	00:51:56,195	00:51:56,195	00:00:00,000
Rata - Rata Delay			00:00:00,006

Pada tabel 4.21 hasil pengujian perhitungan parameter *delay* antara *node sensor 4* dan *node sensor 3* dari waktu dikirim hingga waktu diterima memiliki hasil yang dapat dilihat yaitu memiliki nilai rata – rata *delay* sebesar 0,004 ms. Sehingga dapat disimpulkan bahwa nilai dari parameter *delay* yang diperoleh masuk kedalam kategori Sangat Baik karena nilai *delay* yang diperoleh dibawah dari 150 ms. Nilai dari parameter *delay* sangat dipengaruhi oleh beberapa faktor seperti kondisi sinyal, keadaan dan lingkungan.


```
00:49:25.124 -> Url :
00:49:25.124 -> /get?temp5=29.3&humd5=95.0
00:49:25.124 -> Closing connection
00:49:30.166 -> Url :
00:49:30.166 -> /get?temp5=29.3&humd5=95.0
00:49:30.166 -> Closing connection
00:49:35.234 -> Url :
00:49:35.234 -> /get?temp5=29.3&humd5=95.0
00:49:35.234 -> Closing connection
00:49:40.265 -> Url :
00:49:40.265 -> /get?temp5=29.3&humd5=95.0
00:49:40.265 -> Closing connection
00:49:45.276 -> Url :
00:49:45.276 -> /get?temp5=29.3&humd5=95.0
00:49:45.276 -> Closing connection
00:49:50.311 -> Url :
00:49:50.311 -> /get?temp5=29.3&humd5=95.0
00:49:50.311 -> Closing connection
00:49:55.372 -> Url :
00:49:55.372 -> /get?temp5=29.3&humd5=95.0
00:49:55.372 -> Closing connection
00:50:00.373 -> Url :
00:50:00.373 -> /get?temp5=29.3&humd5=95.0
00:50:00.373 -> Closing connection
00:50:05.422 -> Url :
00:50:05.422 -> /get?temp5=29.3&humd5=95.0
00:50:05.422 -> Closing connection
00:50:10.470 -> Url :
00:50:10.470 -> /get?temp5=29.3&humd5=95.0
00:50:10.470 -> Closing connection
00:50:15.484 -> Url :
00:50:15.484 -> /get?temp5=29.3&humd5=95.0
00:50:15.484 -> Closing connection
00:50:20.539 -> Url :
00:50:20.539 -> /get?temp5=29.3&humd5=95.0
00:50:20.539 -> Closing connection

00:50:25.550 -> Url :
00:50:25.550 -> /get?temp5=29.3&humd5=95.0
00:50:25.597 -> Closing connection
00:50:30.632 -> Url :
00:50:30.632 -> /get?temp5=29.3&humd5=95.0
00:50:30.632 -> Closing connection
00:50:35.647 -> Url :
00:50:35.647 -> /get?temp5=29.3&humd5=95.0
00:50:35.647 -> Closing connection
00:50:40.685 -> Url :
00:50:40.685 -> /get?temp5=29.3&humd5=95.0
00:50:40.685 -> Closing connection
00:50:45.703 -> Url :
00:50:45.703 -> /get?temp5=29.3&humd5=95.0
00:50:45.703 -> Closing connection
00:50:50.742 -> Url :
00:50:50.742 -> /get?temp5=29.3&humd5=95.0
00:50:50.742 -> Closing connection
00:50:55.794 -> Url :
00:50:55.794 -> /get?temp5=29.3&humd5=95.0
00:50:55.794 -> Closing connection
00:51:00.835 -> Url :
00:51:00.835 -> /get?temp5=29.3&humd5=95.0
00:51:00.835 -> Closing connection
00:51:05.879 -> Url :
00:51:05.879 -> /get?temp5=29.3&humd5=95.0
00:51:05.879 -> Closing connection
00:51:10.915 -> Url :
00:51:10.915 -> /get?temp5=29.3&humd5=95.0
00:51:10.915 -> Closing connection
00:51:15.925 -> Url :
00:51:15.925 -> /get?temp5=29.3&humd5=95.0
00:51:15.925 -> Closing connection
00:51:20.963 -> Url :
00:51:20.963 -> /get?temp5=29.3&humd5=95.0
00:51:20.963 -> Closing connection
```

```

00:51:26.023 -> Url :
00:51:26.023 -> /get?temp5=29.3&humd5=95.0
00:51:26.023 -> Closing connection
00:51:31.019 -> Url :
00:51:31.019 -> /get?temp5=29.3&humd5=95.0
00:51:31.067 -> Closing connection
00:51:36.080 -> Url :
00:51:36.080 -> /get?temp5=29.3&humd5=95.0
00:51:36.080 -> Closing connection
00:51:41.117 -> Url :
00:51:41.117 -> /get?temp5=29.3&humd5=95.0
00:51:41.117 -> Closing connection
00:51:46.132 -> Url :
00:51:46.132 -> /get?temp5=29.3&humd5=95.0
00:51:46.178 -> Closing connection
00:51:51.180 -> Url :
00:51:51.180 -> /get?temp5=29.3&humd5=95.0
00:51:51.180 -> Closing connection

```

Gambar 4.15 Tampilan Serial Monitor pada Node Sensor 5

Pada gambar 4.15 dapat dilihat terdapat 30 sampel data suhu dan kelembaban pada *node sensor 5*. Pengiriman data dilakukan oleh *node sensor 5* kepada *node sensor 4* yang di dalam datanya berisi data dari *node sensor 5*. Dengan waktu pengiriman dimulai dari pukul 00:49:25,124 berakhir pada pukul 00:51:51,180.

Tabel 4.22 Delay antara Node Sensor 4 dan Node Sensor 5

No	Waktu Dikirim	Waktu Diterima	Waktu Delay
1	00:49:25,124	00:49:25,154	00:00:00,030
2	00:49:30,166	00:49:30,192	00:00:00,026
3	00:49:35,234	00:49:35,234	00:00:00,000
4	00:49:40,265	00:49:40,265	00:00:00,000
5	00:49:45,276	00:49:45,284	00:00:00,008
6	00:49:50,311	00:49:50,328	00:00:00,017
7	00:49:55,372	00:49:55,372	00:00:00,000
8	00:50:00,373	00:50:00,373	00:00:00,000
9	00:50:05,422	00:50:05,422	00:00:00,000
10	00:50:10,470	00:50:10,492	00:00:00,022
11	00:50:15,484	00:50:15,484	00:00:00,000
12	00:50:20,539	00:50:20,562	00:00:00,023

No	Waktu Dikirim	Waktu Diterima	Waktu Delay
13	00:50:25,550	00:50:25,550	00:00:00,000
14	00:50:30,632	00:50:30,679	00:00:00,047
15	00:50:35,647	00:50:35,647	00:00:00,000
16	00:50:40,685	00:50:40,685	00:00:00,000
17	00:50:45,703	00:50:45,703	00:00:00,000
18	00:50:50,742	00:50:50,742	00:00:00,000
19	00:50:55,794	00:50:55,794	00:00:00,000
20	00:51:00,835	00:51:00,835	00:00:00,000
21	00:51:05,879	00:51:05,879	00:00:00,000
22	00:51:10,915	00:51:10,915	00:00:00,000
23	00:51:15,925	00:51:15,925	00:00:00,000
24	00:51:20,963	00:51:20,963	00:00:00,000
25	00:51:26,023	00:51:26,023	00:00:00,000
26	00:51:31,019	00:51:31,019	00:00:00,000
27	00:51:36,080	00:51:36,080	00:00:00,000
28	00:51:41,117	00:51:41,117	00:00:00,000
29	00:51:46,132	00:51:46,132	00:00:00,000
30	00:51:51,180	00:51:51,181	00:00:00,001
Rata - Rata Delay			00:00:00,006

Pada tabel 4.22 hasil pengujian perhitungan parameter *delay* antara *node sensor 5* dan *node sensor 4* dari waktu dikirim hingga waktu diterima memiliki hasil yang dapat dilihat yaitu memiliki nilai rata – rata *delay* sebesar 0,003 ms. Sehingga dapat disimpulkan bahwa nilai dari parameter *delay* yang diperoleh masuk kedalam kategori Sangat Baik karena nilai *delay* yang diperoleh dibawah dari 150 ms. Nilai dari parameter *delay* sangat dipengaruhi oleh beberapa faktor seperti kondisi sinyal, keadaan dan lingkungan.

```
02:31:42.581 -> 93.0
02:31:47.613 -> 93.0
02:31:52.630 -> 93.0
02:31:57.706 -> 93.0
02:32:02.719 -> 93.0
02:32:07.788 -> 93.0
02:32:12.791 -> 93.0
02:32:17.846 -> 94.0
02:32:22.897 -> 94.0
02:32:27.933 -> 94.0
02:32:32.969 -> 94.0
02:32:38.019 -> 95.0
02:32:43.067 -> 95.0
02:32:48.064 -> 95.0
02:32:53.110 -> 95.0
02:32:58.148 -> 95.0
02:33:03.182 -> 95.0
02:33:08.224 -> 95.0
02:33:13.268 -> 95.0
02:33:18.307 -> 95.0
02:33:23.348 -> 95.0
02:33:28.424 -> 95.0
02:33:33.476 -> 95.0
02:33:38.518 -> 95.0
02:33:43.518 -> 95.0
02:33:48.554 -> 95.0
02:33:53.601 -> 95.0
02:33:58.654 -> 95.0
02:34:03.696 -> 95.0
02:34:08.730 -> 95.0
```

Gambar 4.16 Tampilan *Serial Monitor* pada *Node Gateway*

Pada gambar 4.16 dapat dilihat terdapat 30 sampel data suhu dan kelembaban pada *node gateway*. Pengiriman data dilakukan oleh *node sensor 3* kepada *gateway* dengan waktu penerimaan dimulai dari pukul 02:31:42,581 berakhir pada pukul 02:34:08,730.

4.2.3 Perbandingan QOS *Point to Point* dan *Multipoint*

4.2.3.1 Pengujian *Delay*

Pada pengujian perbandingan QOS *delay* antara skema komunikasi *point to point* dan skema komunikasi *multipoint* yang dilakukan dengan mengambil nilai dari software wireshark dan nilai *delay* dari antar *nodenya* dapat dilakukan dengan mengambil rata – rata nilai *delay* dari beberapa pengambilan *sample* sebagai berikut:

Tabel 4.23 Delay Point to Point

No	Besar Paket (<i>Bytes</i>)	<i>Time Span</i> (s)	<i>Delay</i> (ms)
1	46492	9,872	0,147116
2	307439	9,007	0,003820
3	17712	10,622	0,148367
4	88403	9,679	0,051878
5	13432	9,877	0,143088
Rata - Rata Delay			0,098854

Tabel 4.24 Delay Multipoint

No	Besar Paket (<i>Bytes</i>)	<i>Time Span</i> (s)	<i>Delay</i> (ms)
1	46492	9,872	0,120144
2	307439	9,007	0,140228
3	17712	10,622	0,095384
4	88403	9,679	0,146109
5	13432	9,877	0,034435
Rata - Rata Delay			0,10726

Dari hasil tabel 4.23 dan tabel 4.24 dapat dilihat bahwa nilai dari suatu QOS *delay* dari skema komunikasi *point to point* memiliki nilai sebesar 0,098854 ms, dan nilai dari *delay* skema komunikasi *multipoint* memiliki nilai sebesar 0,10726 ms. Kedua nilai tersebut masuk kedalam kategori Sangat Bagus dengan nilai Indeks 4 karena kedua nilai *delay* dari kedua skema komunikasi tersebut berada pada angka <150 ms, sehingga apabila berpatok pada acuan standar MQTT kedua skema komunikasi tersebut dapat dibilang memiliki hasil yang Sangat Bagus. Akan tetapi apabila kita tidak mengacu pada standar MQTT dan memilih untuk mencari nilai terbaik dari nilai parameter *delay*, maka *delay* pada skema komunikasi *point to point* lebih unggul dari pada nilai *delay* pada skema komunikasi *multipoint*. Sehingga dapat kita simpulkan bahwa nilai *delay* dari skema komunikasi *point to point* lebih baik untuk digunakan dalam penelitian ini.

Tabel 4.25 Delay antar Node Point to Point

No	Nilai Delay Antar Node	
	<i>Point to point</i>	
1	Node 1	00:00:00,007
2	Node 2	00:00:00,007
3	Node 3	00:00:00,012

No	Nilai Delay Antar Node	
	<i>Point to point</i>	
4	Node 4	00:00:00,012
5	Node 5	00:00:00,018
Rata - rata delay		00:00:00,011

Tabel 4.26 Delay antar Node Multipoint

No	Nilai Delay Antar Node	
	<i>Multipoint</i>	
1	Node 1	00:00:00,016
2	Node 2	00:00:00,014
3	Node 3	00:00:00,007
4	Node 4	00:00:00,006
5	Node 5	00:00:00,006
Rata - rata delay		00:00:00,010

Dari hasil tabel 4.25 dan 4.26 dapat dilihat bahwa nilai dari suatu QOS *delay* antar *node* dari skema komunikasi *point to point* memiliki nilai sebesar 0,011 ms, dan nilai dari *delay* antar *node* skema komunikasi *multipoint* memiliki nilai sebesar 0,010 ms. Kedua nilai tersebut masuk kedalam kategori Sangat Bagus dengan nilai Indeks 4 karena kedua nilai *delay* dari kedua skema komunikasi tersebut berada pada angka <150 ms, sehingga apabila berpatok pada acuan standar MQTT kedua skema komunikasi tersebut dapat dibilang memiliki hasil yang Sangat Bagus. Akan tetapi apabila kita tidak mengacu pada standar MQTT dan memilih untuk mencari nilai terbaik dari nilai parameter *delay*, maka *delay* pada skema komunikasi *multipoint* lebih unggul dari pada nilai *delay* pada skema komunikasi *point to point*. Sehingga dapat kita simpulkan bahwa nilai *delay* dari skema komunikasi *multipoint* lebih baik untuk digunakan dalam penelitian ini.

4.2.4 Analisa Perbandingan QOS Point to Point dan Multipoint

Dari hasil perbandingan parameter QOS *delay* dapat disimpulkan bahwa hasil dari perbandingan tersebut dapat dibilang memiliki hasil yang seri. Kenapa dapat dibilang memiliki hasil yang seri? Karena pada masing-masing skema komunikasi memiliki keunggulannya. Seperti pada skema komunikasi *point to point* yang memiliki keunggulan nilai *delay* yang lebih rendah pada saat pengiriman dari *gateway* menuju *firebasenya*, sedangkan pada skema komunikasi *multipoint* memiliki keunggulan nilai *delay* lebih rendah pada pengiriman data antar *nodenya*.

Walaupun nilai perbedaannya terlihat sangat kecil diantara dua skema komunikasi tetapi memiliki pengaruh juga pada pengiriman datanya.

Dengan ini dapat dinyatakan bahwa skema komunikasi *multipoint* maupun skema komunikasi *point to point* sama-sama memiliki hasil yang baik pada penelitian ini. Dengan kategori *delay* yang sama sama memiliki kategori sangat baik, kedua skema komunikasi cocok digunakan.

Tetapi dengan catatan penulis memiliki catatan bahwa untuk hasil *real* perhitungan *delay* antar *nodenya* ada memiliki kendala, waktu penerimaan pada node penerima lebih cepat dari waktu pengiriman node pengirim yang hasil perhitungannya memiliki nilai minus (-) yang penulis belum mengetahui kendalanya ada dimana.