

Project team:

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Harijan, Stephan;

Kraus, Andreas;

The following tests are structured in 3 different methods:

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1. Performance and functionality tests of the HttpServer (Tested with Postman)

Test name	Test object	Reference	Successful? YES/NO [Comments]
Tests of HTTP response for the current sensor data			
HttpResponse "PERFORMANCE TEST: Response time is less than 200ms"	HttpServer.java (http://localhost:8080/Sensorsdata/current/all)	see: Connected Cars.postman_test_run	YES
HttpResponse "FUNCTIONAL TEST: Status code is 200"	HttpServer.java (http://localhost:8080/Sensorsdata/current/all)	see: Connected Cars.postman_test_run	YES
HttpResponse FUNCTIONAL TEST: Should have four metrics	HttpServer.java (http://localhost:8080/Sensorsdata/current/all)	see: Connected Cars.postman_test_run	YES
HttpResponse "PERFORMANCE TEST: Response time is less than 200ms"	HttpServer.java (http://localhost:8080/Sensorsdata/current/traffic)	see: Connected Cars.postman_test_run	YES
HttpResponse "FUNCTIONAL TEST: Status code is 200"	HttpServer.java (http://localhost:8080/Sensorsdata/current/traffic)	see: Connected Cars.postman_test_run	YES
HttpResponse FUNCTIONAL TEST: Should have one metric	HttpServer.java (http://localhost:8080/Sensorsdata/current/traffic)	see: Connected Cars.postman_test_run	YES
HttpResponse "PERFORMANCE TEST: Response time is less than 200ms"	HttpServer.java (http://localhost:8080/Sensorsdata/current/speed)	see: Connected Cars.postman_test_run	YES

HttpResponse "FUNCTIONAL TEST: Status code is 200"	HttpServer.java (http://localhost:8080/Sensorsdata/current/speed)	see: Connected Cars.postman_test_run	YES
HttpResponse FUNCTIONAL TEST: Should have one metric	HttpServer.java (http://localhost:8080/Sensorsdata/current/speed)	see: Connected Cars.postman_test_run	YES
HttpResponse "PERFORMANCE TEST: Response time is less than 200ms"	HttpServer.java (http://localhost:8080/Sensorsdata/current/distance)	see: Connected Cars.postman_test_run	YES
HttpResponse "FUNCTIONAL TEST: Status code is 200"	HttpServer.java (http://localhost:8080/Sensorsdata/current/distance)	see: Connected Cars.postman_test_run	YES
HttpResponse FUNCTIONAL TEST: Should have one metric	HttpServer.java (http://localhost:8080/Sensorsdata/current/distance)	see: Connected Cars.postman_test_run	YES
HttpResponse "PERFORMANCE TEST: Response time is less than 200ms"	HttpServer.java (http://localhost:8080/Sensorsdata/current/fuel)	see: Connected Cars.postman_test_run	YES
HttpResponse "FUNCTIONAL TEST: Status code is 200"	HttpServer.java (http://localhost:8080/Sensorsdata/current/fuel)	see: Connected Cars.postman_test_run	YES
HttpResponse FUNCTIONAL TEST: Should have one metric	HttpServer.java (http://localhost:8080/Sensorsdata/current/fuel)	see: Connected Cars.postman_test_run	YES
Tests of HTTP response for the buffered sensor data			

HttpResponse "PERFORMANCE TEST: Response time is less than 200ms"	HttpServer.java (http://localhost:8080/Sensorsdata/history/all)	see: Connected Cars.postman_test_run	YES NO ¹
HttpResponse "PERFORMANCE TEST: Response time is less than 250ms"	HttpServer.java (http://localhost:8080/Sensorsdata/history/all)	see: Connected Cars.postman_test_run	YES NO
HttpResponse "Status code is 200"	HttpServer.java (http://localhost:8080/Sensorsdata/history/all)	see: Connected Cars.postman_test_run	YES
HttpResponse "PERFORMANCE TEST: Response time is less than 200ms"	HttpServer.java (http://localhost:8080/Sensorsdata/history/traffic)	see: Connected Cars.postman_test_run	YES NO
HttpResponse FUNCTIONAL TEST: Status code is 200	HttpServer.java (http://localhost:8080/Sensorsdata/history/traffic)	see: Connected Cars.postman_test_run	YES
HttpResponse PERFORMANCE TEST: Response time is less than 200ms	HttpServer.java "http://localhost:8080/SensorData/history/fuel"	see: Connected Cars.postman_test_run	YES NO
HttpResponse FUNCTIONAL TEST: Status code is 200	HttpServer.java "http://localhost:8080/SensorData/history/fuel"	see: Connected Cars.postman_test_run	YES
HttpResponse PERFORMANCE TEST: Response time is less than 200ms	HttpServer.java "http://localhost:8080/SensorData/history/distance"	see: Connected Cars.postman_test_run	YES NO
HttpResponse FUNCTIONAL TEST: Status code is 200	HttpServer.java "http://localhost:8080/SensorData/history/distance"	see: Connected Cars.postman_test_run	YES

¹ Success depends on length of server runtime. Fail runtime for all sensors at once: Identifier reached 70 counts (3min 41sec); Fail runtime for one sensor at once: Identifier reached 157 counts(8min 06sec)

HttpResponse PERFORMANCE TEST: Response time is less than 200ms	HttpServer.java "http://localhost:8080/SensorData/history/speed"	see: Connected Cars.postman_test_run	YES NO
HttpResponse FUNCTIONAL TEST: Status code is 200	HttpServer.java "http://localhost:8080/SensorData/history/speed"	see: Connected Cars.postman_test_run	YES

Tests of HTTP response for all currently active sensors

HttpResponse PERFORMANCE TEST: Response time is less than 200ms	HttpServer.java "http://localhost:8080/"	see: Connected Cars.postman_test_run	YES
HttpResponse FUNCTIONAL TEST: Status code is 200	HttpServer.java "http://localhost:8080/"	see: Connected Cars.postman_test_run	YES
HttpResponse FUNCTIONAL TEST: Should have four metrics	HttpServer.java "http://localhost:8080/"	see: Connected Cars.postman_test_run	YES

Test of HTTP response for empty buffered due to wrong path

HttpResponse FUNCTIONAL TEST: Status code is 404	HttpServer.java http://localhost:8080/SensorData/	see: Connected Cars.postman_test_run	YES
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Test of HTTP response for 501 response due to wrong parameter in request

HttpResponse FUNCTIONAL TEST: Status code is 501	http://localhost:8080/SensorData/current/all	see: Connected Cars.postman_test_run	YES
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2. Performance and functionality tests of Sensor.sendData() and UDPListenerThread.receiveMessage. Comparison of send and received messages (Tested manually)

1. Functionality Tests: Sending data and receiving data with low frequency

Method: This test analyses if the sent data corresponds with the received data. For this test all sensors sent data constantly (observed for 3 min.) in low frequency (time between sending: 3000 ms.). By printing the sent and received values to the terminal both values can be compared.

Results:

```
Sensor_DISTANCE | SENSOR sending: {"identifier":"57","type":"DISTANCE","value":"197752 km","timestamp":"14.12.2020 - 13:42:02"} to Central
Central         | CENTRAL receiving: {"identifier":"56","type":"FUEL","value":"82 %","timestamp":"14.12.2020 - 13:42:00"} on Port: 9870, Ip: /172.19.0.4
Central         | CENTRAL receiving: {"identifier":"57","type":"DISTANCE","value":"197752 km","timestamp":"14.12.2020 - 13:42:02"} on Port: 9873, Ip: /172.19.0.3
Sensor_TRAFFIC | SENSOR sending: {"identifier":"57","type":"TRAFFIC","value":"starker Verkehr","timestamp":"14.12.2020 - 13:42:02"} to Central
Central         | CENTRAL receiving: {"identifier":"57","type":"TRAFFIC","value":"starker Verkehr","timestamp":"14.12.2020 - 13:42:02"} on Port: 9872, Ip: /172.19.0.2
Sensor_SPEED   | SENSOR sending: {"identifier":"57","type":"SPEED","value":"10 km/h","timestamp":"14.12.2020 - 13:42:02"} to Central
Sensor_FUEL     | SENSOR sending: {"identifier":"57","type":"FUEL","value":"11 %","timestamp":"14.12.2020 - 13:42:03"} to Central
Central         | CENTRAL receiving: {"identifier":"57","type":"SPEED","value":"10 km/h","timestamp":"14.12.2020 - 13:42:02"} on Port: 9871, Ip: /172.19.0.5
Sensor_DISTANCE | SENSOR sending: {"identifier":"58","type":"DISTANCE","value":"18875 km","timestamp":"14.12.2020 - 13:42:05"} to Central
Central         | CENTRAL receiving: {"identifier":"57","type":"FUEL","value":"11 %","timestamp":"14.12.2020 - 13:42:03"} on Port: 9870, Ip: /172.19.0.4
Sensor_TRAFFIC | SENSOR sending: {"identifier":"58","type":"TRAFFIC","value":"mäßiger Verkehr","timestamp":"14.12.2020 - 13:42:05"} to Central
Central         | CENTRAL receiving: {"identifier":"58","type":"DISTANCE","value":"18875 km","timestamp":"14.12.2020 - 13:42:05"} on Port: 9873, Ip: /172.19.0.3
Sensor_SPEED   | SENSOR sending: {"identifier":"58","type":"SPEED","value":"2 km/h","timestamp":"14.12.2020 - 13:42:05"} to Central
Central         | CENTRAL receiving: {"identifier":"58","type":"TRAFFIC","value":"mäßiger Verkehr","timestamp":"14.12.2020 - 13:42:05"} on Port: 9872, Ip: /172.19.0.2
Central         | CENTRAL receiving: {"identifier":"58","type":"SPEED","value":"2 km/h","timestamp":"14.12.2020 - 13:42:05"} on Port: 9871, Ip: /172.19.0.5
Sensor_FUEL     | SENSOR sending: {"identifier":"58","type":"FUEL","value":"72 %","timestamp":"14.12.2020 - 13:42:06"} to Central
Sensor_DISTANCE | SENSOR sending: {"identifier":"59","type":"DISTANCE","value":"247178 km","timestamp":"14.12.2020 - 13:42:08"} to Central
Central         | CENTRAL receiving: {"identifier":"58","type":"FUEL","value":"72 %","timestamp":"14.12.2020 - 13:42:06"} on Port: 9870, Ip: /172.19.0.4
Sensor_TRAFFIC | SENSOR sending: {"identifier":"59","type":"TRAFFIC","value":"mäßiger Verkehr","timestamp":"14.12.2020 - 13:42:08"} to Central
Central         | CENTRAL receiving: {"identifier":"59","type":"DISTANCE","value":"247178 km","timestamp":"14.12.2020 - 13:42:08"} on Port: 9873, Ip: /172.19.0.3
Sensor_SPEED   | SENSOR sending: {"identifier":"59","type":"SPEED","value":"174 km/h","timestamp":"14.12.2020 - 13:42:08"} to Central
Central         | CENTRAL receiving: {"identifier":"59","type":"TRAFFIC","value":"mäßiger Verkehr","timestamp":"14.12.2020 - 13:42:08"} on Port: 9872, Ip: /172.19.0.2
Sensor_FUEL     | SENSOR sending: {"identifier":"59","type":"FUEL","value":"41 %","timestamp":"14.12.2020 - 13:42:09"} to Central
Central         | CENTRAL receiving: {"identifier":"59","type":"SPEED","value":"174 km/h","timestamp":"14.12.2020 - 13:42:08"} on Port: 9871, Ip: /172.19.0.5
Sensor_DISTANCE | SENSOR sending: {"identifier":"60","type":"DISTANCE","value":"187198 km","timestamp":"14.12.2020 - 13:42:11"} to Central
Central         | CENTRAL receiving: {"identifier":"59","type":"FUEL","value":"41 %","timestamp":"14.12.2020 - 13:42:09"} on Port: 9870, Ip: /172.19.0.4
Sensor_TRAFFIC | SENSOR sending: {"identifier":"60","type":"TRAFFIC","value":"starker Verkehr","timestamp":"14.12.2020 - 13:42:11"} to Central
Central         | CENTRAL receiving: {"identifier":"60","type":"DISTANCE","value":"187198 km","timestamp":"14.12.2020 - 13:42:11"} on Port: 9873, Ip: /172.19.0.3
Sensor_SPEED   | SENSOR sending: {"identifier":"60","type":"SPEED","value":"149 km/h","timestamp":"14.12.2020 - 13:42:11"} to Central
Central         | CENTRAL receiving: {"identifier":"60","type":"TRAFFIC","value":"starker Verkehr","timestamp":"14.12.2020 - 13:42:11"} on Port: 9872, Ip: /172.19.0.2
Sensor_FUEL     | SENSOR sending: {"identifier":"60","type":"FUEL","value":"13 %","timestamp":"14.12.2020 - 13:42:12"} to Central
Central         | CENTRAL receiving: {"identifier":"60","type":"SPEED","value":"149 km/h","timestamp":"14.12.2020 - 13:42:11"} on Port: 9871, Ip: /172.19.0.5
Sensor_DISTANCE | SENSOR sending: {"identifier":"61","type":"DISTANCE","value":"53690 km","timestamp":"14.12.2020 - 13:42:14"} to Central
Central         | CENTRAL receiving: {"identifier":"60","type":"FUEL","value":"13 %","timestamp":"14.12.2020 - 13:42:12"} on Port: 9870, Ip: /172.19.0.4
Sensor_TRAFFIC | SENSOR sending: {"identifier":"61","type":"TRAFFIC","value":"mäßiger Verkehr","timestamp":"14.12.2020 - 13:42:14"} to Central
Central         | CENTRAL receiving: {"identifier":"61","type":"DISTANCE","value":"53690 km","timestamp":"14.12.2020 - 13:42:14"} on Port: 9873, Ip: /172.19.0.3
Sensor_SPEED   | SENSOR sending: {"identifier":"61","type":"SPEED","value":"115 km/h","timestamp":"14.12.2020 - 13:42:14"} to Central
Central         | CENTRAL receiving: {"identifier":"61","type":"TRAFFIC","value":"mäßiger Verkehr","timestamp":"14.12.2020 - 13:42:14"} on Port: 9872, Ip: /172.19.0.2
Sensor_FUEL     | SENSOR sending: {"identifier":"61","type":"FUEL","value":"50 %","timestamp":"14.12.2020 - 13:42:15"} to Central
Sensor_DISTANCE | SENSOR sending: {"identifier":"62","type":"DISTANCE","value":"129371 km","timestamp":"14.12.2020 - 13:42:17"} to Central
Central         | CENTRAL receiving: {"identifier":"61","type":"FUEL","value":"50 %","timestamp":"14.12.2020 - 13:42:15"} on Port: 9870, Ip: /172.19.0.4
Sensor_TRAFFIC | SENSOR sending: {"identifier":"62","type":"TRAFFIC","value":"mäßiger Verkehr","timestamp":"14.12.2020 - 13:42:17"} to Central
```

Screenshot_1

Interpretation of the results:

- The sending of data functions according to the set parameter of 3000 ms which can be observed by comparing the timestamps of the same sensor types.
- Sending and receiving functions flawlessly within the limits of the UDP-Protocol: The received messages are the same as the sent ones but are not always in the correct order. This can be observed by comparing if sending and receiving alternate.

2. Performance Tests: Sending data and receiving data with high frequency

a) Frequency 1/100ms

Method: This test analyses if the sent data corresponds with the received data if the frequency is high. For this test all sensors sent data constantly (observed for **30 sec.**) in a high frequency (time between sending: **100 ms.**). By printing the sent and received values to the terminal both values can be compared.

Results:


```

Central | CENTRAL receiving: {"identifier":"288","type":"FUEL","value":"37 %","timestamp":"14.12.2020 - 14:31:06"} on Port: 9870, Ip: /172.21.0.2
Sensor_SPEED | SENSOR sending: {"identifier":"286","type":"SPEED","value":"8 km/h","timestamp":"14.12.2020 - 14:31:06"} to Central
Central | CENTRAL receiving: {"identifier":"288","type":"DISTANCE","value":"132914 km","timestamp":"14.12.2020 - 14:31:06"} on Port: 9873, Ip: /172.21.0.4
Sensor_TRAFFIC | SENSOR sending: {"identifier":"290","type":"TRAFFIC","value":"frei","timestamp":"14.12.2020 - 14:31:06"} to Central
Central | CENTRAL receiving: {"identifier":"286","type":"SPEED","value":"8 km/h","timestamp":"14.12.2020 - 14:31:06"} on Port: 9871, Ip: /172.21.0.6
Sensor_FUEL | SENSOR sending: {"identifier":"289","type":"FUEL","value":"90 %","timestamp":"14.12.2020 - 14:31:06"} to Central
Central | CENTRAL receiving: {"identifier":"290","type":"TRAFFIC","value":"frei","timestamp":"14.12.2020 - 14:31:06"} on Port: 9872, Ip: /172.21.0.3
Sensor_DISTANCE | SENSOR sending: {"identifier":"289","type":"DISTANCE","value":"233570 km","timestamp":"14.12.2020 - 14:31:06"} to Central
Central | CENTRAL receiving: {"identifier":"289","type":"FUEL","value":"90 %","timestamp":"14.12.2020 - 14:31:06"} on Port: 9870, Ip: /172.21.0.2
Sensor_SPEED | SENSOR sending: {"identifier":"287","type":"SPEED","value":"123 km/h","timestamp":"14.12.2020 - 14:31:06"} to Central
Central | CENTRAL receiving: {"identifier":"289","type":"DISTANCE","value":"233570 km","timestamp":"14.12.2020 - 14:31:06"} on Port: 9873, Ip: /172.21.0.4
Sensor_TRAFFIC | SENSOR sending: {"identifier":"291","type":"TRAFFIC","value":"starker Verkehr","timestamp":"14.12.2020 - 14:31:06"} to Central
Central | CENTRAL receiving: {"identifier":"287","type":"SPEED","value":"123 km/h","timestamp":"14.12.2020 - 14:31:06"} on Port: 9871, Ip: /172.21.0.6
Sensor_FUEL | SENSOR sending: {"identifier":"290","type":"FUEL","value":"79 %","timestamp":"14.12.2020 - 14:31:06"} to Central
Central | CENTRAL receiving: {"identifier":"291","type":"TRAFFIC","value":"starker Verkehr","timestamp":"14.12.2020 - 14:31:06"} on Port: 9872, Ip: /172.21.0.3
Central | CENTRAL receiving: {"identifier":"290","type":"FUEL","value":"79 %","timestamp":"14.12.2020 - 14:31:06"} on Port: 9870, Ip: /172.21.0.2
Sensor_DISTANCE | SENSOR sending: {"identifier":"290","type":"DISTANCE","value":"62044 km","timestamp":"14.12.2020 - 14:31:06"} to Central
Sensor_SPEED | SENSOR sending: {"identifier":"288","type":"SPEED","value":"45 km/h","timestamp":"14.12.2020 - 14:31:06"} to Central
Central | CENTRAL receiving: {"identifier":"290","type":"DISTANCE","value":"62044 km","timestamp":"14.12.2020 - 14:31:06"} on Port: 9873, Ip: /172.21.0.4
Sensor_TRAFFIC | SENSOR sending: {"identifier":"292","type":"TRAFFIC","value":"frei","timestamp":"14.12.2020 - 14:31:06"} to Central
Central | CENTRAL receiving: {"identifier":"292","type":"SPEED","value":"45 km/h","timestamp":"14.12.2020 - 14:31:06"} on Port: 9871, Ip: /172.21.0.6
Sensor_FUEL | SENSOR sending: {"identifier":"291","type":"FUEL","value":"72 %","timestamp":"14.12.2020 - 14:31:07"} to Central
Central | CENTRAL receiving: {"identifier":"292","type":"TRAFFIC","value":"frei","timestamp":"14.12.2020 - 14:31:06"} on Port: 9872, Ip: /172.21.0.3
Central | CENTRAL receiving: {"identifier":"291","type":"FUEL","value":"72 %","timestamp":"14.12.2020 - 14:31:07"} on Port: 9870, Ip: /172.21.0.2
Sensor_DISTANCE | SENSOR sending: {"identifier":"291","type":"DISTANCE","value":"23020 km","timestamp":"14.12.2020 - 14:31:07"} to Central
Sensor_SPEED | SENSOR sending: {"identifier":"289","type":"SPEED","value":"30 km/h","timestamp":"14.12.2020 - 14:31:07"} to Central
Central | CENTRAL receiving: {"identifier":"291","type":"DISTANCE","value":"23020 km","timestamp":"14.12.2020 - 14:31:07"} on Port: 9873, Ip: /172.21.0.4
Sensor_TRAFFIC | SENSOR sending: {"identifier":"293","type":"TRAFFIC","value":"Stau","timestamp":"14.12.2020 - 14:31:07"} to Central
Central | CENTRAL receiving: {"identifier":"289","type":"SPEED","value":"30 km/h","timestamp":"14.12.2020 - 14:31:07"} on Port: 9871, Ip: /172.21.0.6
Sensor_FUEL | SENSOR sending: {"identifier":"292","type":"FUEL","value":"67 %","timestamp":"14.12.2020 - 14:31:07"} to Central
Central | CENTRAL receiving: {"identifier":"293","type":"TRAFFIC","value":"Stau","timestamp":"14.12.2020 - 14:31:07"} on Port: 9872, Ip: /172.21.0.3
Central | CENTRAL receiving: {"identifier":"292","type":"FUEL","value":"67 %","timestamp":"14.12.2020 - 14:31:07"} on Port: 9870, Ip: /172.21.0.2
Sensor_DISTANCE | SENSOR sending: {"identifier":"292","type":"DISTANCE","value":"234878 km","timestamp":"14.12.2020 - 14:31:07"} to Central
Sensor_SPEED | SENSOR sending: {"identifier":"290","type":"SPEED","value":"52 km/h","timestamp":"14.12.2020 - 14:31:07"} to Central
Central | CENTRAL receiving: {"identifier":"292","type":"DISTANCE","value":"234878 km","timestamp":"14.12.2020 - 14:31:07"} on Port: 9873, Ip: /172.21.0.4
Sensor_TRAFFIC | SENSOR sending: {"identifier":"294","type":"TRAFFIC","value":"starker Verkehr","timestamp":"14.12.2020 - 14:31:07"} to Central
Central | CENTRAL receiving: {"identifier":"290","type":"SPEED","value":"52 km/h","timestamp":"14.12.2020 - 14:31:07"} on Port: 9871, Ip: /172.21.0.6
Central | CENTRAL receiving: {"identifier":"294","type":"TRAFFIC","value":"starker Verkehr","timestamp":"14.12.2020 - 14:31:07"} on Port: 9872, Ip: /172.21.0.3
Sensor_FUEL | SENSOR sending: {"identifier":"293","type":"FUEL","value":"66 %","timestamp":"14.12.2020 - 14:31:07"} to Central
Sensor_DISTANCE | SENSOR sending: {"identifier":"293","type":"DISTANCE","value":"146296 km","timestamp":"14.12.2020 - 14:31:07"} to Central
Central | CENTRAL receiving: {"identifier":"293","type":"FUEL","value":"66 %","timestamp":"14.12.2020 - 14:31:07"} on Port: 9870, Ip: /172.21.0.2
Sensor_SPEED | SENSOR sending: {"identifier":"291","type":"SPEED","value":"86 km/h","timestamp":"14.12.2020 - 14:31:07"} to Central
Central | CENTRAL receiving: {"identifier":"293","type":"DISTANCE","value":"146296 km","timestamp":"14.12.2020 - 14:31:07"} on Port: 9873, Ip: /172.21.0.4
Central | CENTRAL receiving: {"identifier":"291","type":"SPEED","value":"86 km/h","timestamp":"14.12.2020 - 14:31:07"} on Port: 9871, Ip: /172.21.0.6
Sensor_TRAFFIC | SENSOR sending: {"identifier":"295","type":"TRAFFIC","value":"mäßiger Verkehr","timestamp":"14.12.2020 - 14:31:07"} to Central
Central | CENTRAL receiving: {"identifier":"295","type":"TRAFFIC","value":"mäßiger Verkehr","timestamp":"14.12.2020 - 14:31:07"} on Port: 9872, Ip: /172.21.0.3
Sensor_FUEL | SENSOR sending: {"identifier":"294","type":"FUEL","value":"24 %","timestamp":"14.12.2020 - 14:31:07"} to Central
Sensor_DISTANCE | SENSOR sending: {"identifier":"294","type":"DISTANCE","value":"86536 km","timestamp":"14.12.2020 - 14:31:07"} to Central
Central | CENTRAL receiving: {"identifier":"294","type":"FUEL","value":"24 %","timestamp":"14.12.2020 - 14:31:07"} on Port: 9870, Ip: /172.21.0.2
Sensor_SPEED | SENSOR sending: {"identifier":"292","type":"SPEED","value":"116 km/h","timestamp":"14.12.2020 - 14:31:07"} to Central
Central | CENTRAL receiving: {"identifier":"294","type":"DISTANCE","value":"86536 km","timestamp":"14.12.2020 - 14:31:07"} on Port: 9873, Ip: /172.21.0.4

```

Screenshot_2

Interpretation of the results:

- The sending of data functions according to the set parameter of **100 ms** which can be observed by comparing the timestamps of the same sensor types.
- Sending and receiving functions flawlessly within the limits of the UDP-Protocol: The received messages are the same as the sent ones but are not always in the correct order. This can be observed by comparing if sending and receiving alternate. Compared to the lower sending frequency of 1/3000ms the order of sent and received values differs more often.

b) Frequency 1/10ms

Method: This test analyses if the sent data corresponds with the received data if the frequency is high. For this test all sensors sent data constantly (observed for **30 sec.**) in a high frequency (time between sending: **10 ms.**). By printing the sent and received values to the terminal both values can be compared.

Results:


```

Sensor_FUEL | SENSOR sending: {"identifier":"2731","type":"FUEL","value":"68 %","timestamp":"14.12.2020 - 14:42:38"} to Central
Central | CENTRAL receiving: {"identifier":"2788","type":"TRAFFIC","value":"frei","timestamp":"14.12.2020 - 14:42:38"} on Port: 9872, Ip: /172.22.0.2
Central | CENTRAL receiving: {"identifier":"2731","type":"FUEL","value":"68 %","timestamp":"14.12.2020 - 14:42:38"} on Port: 9870, Ip: /172.22.0.4
Central | CENTRAL receiving: {"identifier":"2753","type":"SPEED","value":"154 km/h","timestamp":"14.12.2020 - 14:42:38"} on Port: 9871, Ip: /172.22.0.6
Sensor_SPEED | SENSOR sending: {"identifier":"2753","type":"SPEED","value":"154 km/h","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_FUEL | SENSOR sending: {"identifier":"2732","type":"FUEL","value":"26 %","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_SPEED | SENSOR sending: {"identifier":"2754","type":"SPEED","value":"107 km/h","timestamp":"14.12.2020 - 14:42:38"} to Central
Central | CENTRAL receiving: {"identifier":"2789","type":"TRAFFIC","value":"Stau","timestamp":"14.12.2020 - 14:42:38"} on Port: 9872, Ip: /172.22.0.2
Central | CENTRAL receiving: {"identifier":"2732","type":"FUEL","value":"26 %","timestamp":"14.12.2020 - 14:42:38"} on Port: 9870, Ip: /172.22.0.4
Central | CENTRAL receiving: {"identifier":"2754","type":"SPEED","value":"107 km/h","timestamp":"14.12.2020 - 14:42:38"} on Port: 9871, Ip: /172.22.0.6
Sensor_DISTANCE | SENSOR sending: {"identifier":"2786","type":"DISTANCE","value":"364 km","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_DISTANCE | SENSOR sending: {"identifier":"2787","type":"DISTANCE","value":"131723 km","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_DISTANCE | SENSOR sending: {"identifier":"2788","type":"DISTANCE","value":"136117 km","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_TRAFFIC | SENSOR sending: {"identifier":"2788","type":"TRAFFIC","value":"frei","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_TRAFFIC | SENSOR sending: {"identifier":"2789","type":"TRAFFIC","value":"Stau","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_TRAFFIC | SENSOR sending: {"identifier":"2790","type":"TRAFFIC","value":"starker Verkehr","timestamp":"14.12.2020 - 14:42:38"} to Central
Central | CENTRAL receiving: {"identifier":"2790","type":"TRAFFIC","value":"starker Verkehr","timestamp":"14.12.2020 - 14:42:38"} on Port: 9872, Ip: /172.22.0.2
Central | CENTRAL receiving: {"identifier":"2786","type":"DISTANCE","value":"364 km","timestamp":"14.12.2020 - 14:42:38"} on Port: 9873, Ip: /172.22.0.3
Central | CENTRAL receiving: {"identifier":"2787","type":"DISTANCE","value":"131723 km","timestamp":"14.12.2020 - 14:42:38"} on Port: 9873, Ip: /172.22.0.3
Sensor_FUEL | SENSOR sending: {"identifier":"2733","type":"FUEL","value":"48 %","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_SPEED | SENSOR sending: {"identifier":"2755","type":"SPEED","value":"136 km/h","timestamp":"14.12.2020 - 14:42:38"} to Central
Central | CENTRAL receiving: {"identifier":"2788","type":"DISTANCE","value":"136117 km","timestamp":"14.12.2020 - 14:42:38"} on Port: 9873, Ip: /172.22.0.3
Central | CENTRAL receiving: {"identifier":"2733","type":"FUEL","value":"48 %","timestamp":"14.12.2020 - 14:42:38"} on Port: 9873, Ip: /172.22.0.4
Sensor_DISTANCE | SENSOR sending: {"identifier":"2789","type":"DISTANCE","value":"153754 km","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_TRAFFIC | SENSOR sending: {"identifier":"2791","type":"TRAFFIC","value":"frei","timestamp":"14.12.2020 - 14:42:38"} to Central
Central | CENTRAL receiving: {"identifier":"2755","type":"SPEED","value":"136 km/h","timestamp":"14.12.2020 - 14:42:38"} on Port: 9871, Ip: /172.22.0.6
Central | CENTRAL receiving: {"identifier":"2789","type":"DISTANCE","value":"153754 km","timestamp":"14.12.2020 - 14:42:38"} on Port: 9873, Ip: /172.22.0.3
Central | CENTRAL receiving: {"identifier":"2791","type":"TRAFFIC","value":"frei","timestamp":"14.12.2020 - 14:42:38"} on Port: 9872, Ip: /172.22.0.2
Central | CENTRAL receiving: {"identifier":"2734","type":"FUEL","value":"33 %","timestamp":"14.12.2020 - 14:42:38"} on Port: 9870, Ip: /172.22.0.4
Sensor_SPEED | SENSOR sending: {"identifier":"2756","type":"SPEED","value":"46 km/h","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_FUEL | SENSOR sending: {"identifier":"2734","type":"FUEL","value":"33 %","timestamp":"14.12.2020 - 14:42:38"} to Central
Central | CENTRAL receiving: {"identifier":"2756","type":"SPEED","value":"46 km/h","timestamp":"14.12.2020 - 14:42:38"} on Port: 9871, Ip: /172.22.0.6
Central | CENTRAL receiving: {"identifier":"2792","type":"TRAFFIC","value":"starker Verkehr","timestamp":"14.12.2020 - 14:42:38"} on Port: 9872, Ip: /172.22.0.2
Sensor_DISTANCE | SENSOR sending: {"identifier":"2790","type":"DISTANCE","value":"138525 km","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_TRAFFIC | SENSOR sending: {"identifier":"2792","type":"TRAFFIC","value":"starker Verkehr","timestamp":"14.12.2020 - 14:42:38"} to Central
Central | CENTRAL receiving: {"identifier":"2790","type":"DISTANCE","value":"138525 km","timestamp":"14.12.2020 - 14:42:38"} on Port: 9873, Ip: /172.22.0.3
Central | CENTRAL receiving: {"identifier":"2757","type":"SPEED","value":"27 km/h","timestamp":"14.12.2020 - 14:42:38"} on Port: 9871, Ip: /172.22.0.6
Sensor_FUEL | SENSOR sending: {"identifier":"2735","type":"FUEL","value":"48 %","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_SPEED | SENSOR sending: {"identifier":"2757","type":"SPEED","value":"27 km/h","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_TRAFFIC | SENSOR sending: {"identifier":"2793","type":"TRAFFIC","value":"mäßiger Verkehr","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_DISTANCE | SENSOR sending: {"identifier":"2791","type":"DISTANCE","value":"230001 km","timestamp":"14.12.2020 - 14:42:38"} to Central
Central | CENTRAL receiving: {"identifier":"2735","type":"FUEL","value":"48 %","timestamp":"14.12.2020 - 14:42:38"} on Port: 9870, Ip: /172.22.0.4
Central | CENTRAL receiving: {"identifier":"2793","type":"TRAFFIC","value":"mäßiger Verkehr","timestamp":"14.12.2020 - 14:42:38"} on Port: 9872, Ip: /172.22.0.2
Sensor_SPEED | SENSOR sending: {"identifier":"2758","type":"SPEED","value":"147 km/h","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_FUEL | SENSOR sending: {"identifier":"2736","type":"FUEL","value":"92 %","timestamp":"14.12.2020 - 14:42:38"} to Central
Central | CENTRAL receiving: {"identifier":"2791","type":"DISTANCE","value":"230001 km","timestamp":"14.12.2020 - 14:42:38"} on Port: 9873, Ip: /172.22.0.3
Central | CENTRAL receiving: {"identifier":"2758","type":"SPEED","value":"147 km/h","timestamp":"14.12.2020 - 14:42:38"} on Port: 9871, Ip: /172.22.0.6
Sensor_DISTANCE | SENSOR sending: {"identifier":"2792","type":"DISTANCE","value":"70910 km","timestamp":"14.12.2020 - 14:42:38"} to Central
Central | CENTRAL receiving: {"identifier":"2736","type":"FUEL","value":"92 %","timestamp":"14.12.2020 - 14:42:38"} on Port: 9870, Ip: /172.22.0.4
Central | CENTRAL receiving: {"identifier":"2794","type":"TRAFFIC","value":"mäßiger Verkehr","timestamp":"14.12.2020 - 14:42:38"} on Port: 9872, Ip: /172.22.0.2
Sensor_TRAFFIC | SENSOR sending: {"identifier":"2794","type":"TRAFFIC","value":"mäßiger Verkehr","timestamp":"14.12.2020 - 14:42:38"} to Central

```

Screenshot_3

```

Central | CENTRAL receiving: {"identifier":"2789","type":"TRAFFIC","value":"Stau","timestamp":"14.12.2020 - 14:42:38"} on Port: 9872, Ip: /172.22.0.2
Central | CENTRAL receiving: {"identifier":"2732","type":"FUEL","value":"26 %","timestamp":"14.12.2020 - 14:42:38"} on Port: 9870, Ip: /172.22.0.4
Central | CENTRAL receiving: {"identifier":"2754","type":"SPEED","value":"107 km/h","timestamp":"14.12.2020 - 14:42:38"} on Port: 9871, Ip: /172.22.0.6
Sensor_DISTANCE | SENSOR sending: {"identifier":"2786","type":"DISTANCE","value":"364 km","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_DISTANCE | SENSOR sending: {"identifier":"2787","type":"DISTANCE","value":"131723 km","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_DISTANCE | SENSOR sending: {"identifier":"2788","type":"DISTANCE","value":"136117 km","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_TRAFFIC | SENSOR sending: {"identifier":"2788","type":"TRAFFIC","value":"frei","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_TRAFFIC | SENSOR sending: {"identifier":"2789","type":"TRAFFIC","value":"Stau","timestamp":"14.12.2020 - 14:42:38"} to Central
Sensor_TRAFFIC | SENSOR sending: {"identifier":"2790","type":"TRAFFIC","value":"starker Verkehr","timestamp":"14.12.2020 - 14:42:38"} to Central
Central | CENTRAL receiving: {"identifier":"2790","type":"TRAFFIC","value":"starker Verkehr","timestamp":"14.12.2020 - 14:42:38"} on Port: 9872, Ip: /172.22.0.2

```

Screenshot_4

Interpretation of the results:

- The observation method is only poor for this kind of data flow. A good example for this is shown Screenshot_4: The logging of Sensor_Traffic_2789_Received occurred before the logging of Sensor_Traffic_2789_Sent. A better logging system is needed to observe and interpret the sending behaviour. For this we will implement logs4J before we proceed to the next milestone.
- As for the data that is logged:
 - it can be observed that the sensors differ in their speed of data creation and sending. For example: Fuel is at its 2730th packet while traffic is at its 2790th. Here it would be interesting to analyse if this is due to the thread and its data creation or the sending.
 - the sent and received data corresponds to each other. The transmission functions within the limits of the UDP protocol (see above regarding order of sent and received packets).

3. UNITTest of TrafficSituation

Test name	Test object	Reference	Successful? YES/NO [Comments]
TrafficSituationTest FUNCTIONAL TEST: It tests if the value for traffic-situation is correct.	TrafficSituation.java	TrafficSituationTest.java	YES