© 2017 IJSRSET | Volume 3 | Issue 2 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

End-to-End QoS Tool Development and Performance Analysis for Network Mobile

Edy Budiman[1], Ummul Hairah[2]

[1,2]Department of Computer Science and Information Technology, Mulawarman University, Samarinda, Indonesia

ABSTRACT

Quality of Service is an important thing in maintaining the performance of the service to the customer. Not only for marketing purposes, the quality of services can also bridge the gap between the promise given by the service provider and what the customers get. The main objective for developing this application is offers a system that can measure the performance of a mobile data communications network with to develop a measurement tool End-to-End QoS (client software) that is suitable for the mobile environment through traffic users, and to summarize the results of its performance test, determine the extent to which performance of QoS on ISP using each service pack featured mobile operator.

Keywords: End-to-End, QoS, Mobile Operator, Perfomance, ISP Network

I. INTRODUCTION

In Indonesia, Mobile cellular service developed rapidly because of strong customer demand [1, 2]. Indonesia's large and highly dynamic telecommunications sector represents the fourth largest mobile telecommunication market in the world, with 308 million mobile subscribers [2,3]. Data communication needs through cell phones continues to increase, for example the number of subscribers to data services Telkomsel 2014 as many as 21,782,672 subscribers, and by 2015 as many as 28,639,367 subscribers, there is a 31% rise [4]. XL 3G customers as many as 15.068 in year 2013 customers and 2014 as many as 16.006 customers [5]. But along with these developments, experiences and satisfaction of users of telecommunications services are still not fulfilled as expected due to the speed and services are still limited. still a lot of quality of service received is lower than expected [6]. To provide maximum service to the customer, the service provider should give special treatment to each of the characteristics of the service. It is in its implementation requires knowledge of the performance network of the mobile operator that is used in conjunction with various other network parameters.

Improving the energy efficiency and Quality of Experience (QoE) of mobile applications requires detailed knowledge of the cellular network performance. One approach is aggregating delay tolerant network requests to be executed at time periods and locations where the network quality is predicted to be high [7]. Therefore, detailed information on the Round-trip Time (RTT) and throughput of the available networks at the user's location are required. In the case of a larger measurement set, also the time of the day and periodically repeating traffic patterns are to be considered. Information on the coverage of the individual operator's networks can usually be found on their website, but lack the required accuracy.

Maps of the RTT or network throughput are not readily available. Hence, an Android application, termed Mobile End-to-End QoS Tool Network, we to developed. Many other network measurement services have been developed by independent developers to assist users to measure performance of wireless and cellular networks. Such applications include OpenSignal [8] and Sensorly [9], measuring the signal strength and to a limited extent also network latency (RTT) and throughput. An academic example is CobCel [10], measuring the signal strength only. SpeedSpot [11,12], NetRadar [13] includes the same metrics, and also creates network maps based on cellular throughput measurements. RootMetrics [13,14], NetworkCoverage [15], Internet Speed Test [16], Netradar [17] and Cisco Data Meter [18, 19] applications run latency and throughput experiments against servers deployed on the cloud/CDN servers and allows users to monitor traffic sent and received by applications installed on their devices, 4Gmark [20], and nPerf [21] are similar to each other.

Currently in Indonesia, standard mobile cellular telecommunications service quality parameters have not entered the mobile data so that an assessment of the data services are not based on standard QoS and QoE standards. so it is necessary to do field research to identify the parameters necessary with perform direct measurements to determine the quality standard of mobile data services. The End-to-End QoS Tool enable mobile application developers to characterize the data delivery performance of cellular data networks as delivered to mobile devices. Mobile application developers need to know a range of network performance characteristics, connection speed and availability.

A. Objective

The main objective for developing this application is offers a system that can measure the performance of a mobile data communications network with to develop a measurement tool End-to-End QoS (client software) that is suitable for the mobile environment through traffic users, and to summarize the results of its performance test, determine the extent to which performance of QoS on ISP using each service pack featured mobile operator. The system is expected to run transparently over the network access layer. The system also does not specifically into account the special characteristics of the content to be exchanged. However, the system is built is expected to remain able to provide an overview of the parameters of performance required by service providers to prepare kinds of satisfactory service to customers.

II. METHODS AND MATERIAL

This research was conducted with a quantitative approach, i.e. measuring the quality of Internet network using the card service package featured mobile operator IM3, AON3 and Flash. QoS parameters to be measured is the End-to-End delay, jitter, packet loss probability and throughput.

The scope of the study focused on the state and geographic region as the provincial capital Samarinda East Kalimantan with a total population of 10 districts. In the study selected 7 districts sampled by area calculation factor, population density, public or business area, a school, and community center internet network users.

A. QoS Parameters

QoS parameters that affect the performance of mobile internet network to be measured is characteristics, connection speed, and availability. Perfomance network analysis using approaches to measuring Broadband Quality of Service Experience (QoSE) standard LIRNEAsia [22] shown in “Table 1”, an organization of one regional organization initiated by the World Bank to inventory a variety of data and information related to ICT in the Asia Pacific.

TABLE I
PARAMETER QOS of LIRNEASIA

Parameter	Definisions	Method	Bench marks
Download speed (kbps)	The rate at which data is receive from a server	Min. file size 1 mb;Max time 3 mins.	-
Upload Speed(kbps)	The rate at which data is sent to a server	2 mb file	-
Latency: Round TripTime	The time taken for a packet to reach its destination and back	The average of 10 pings (each ping provides 3 sets of results	<300 ms
Jitter (milli-sec)	The variation of latency (RTT)		<50 ms
Packet-Loss (in %)	The fraction of packet that fail to reach its destination		<3%
Availability (in %)	The number of time the broadband link can be accessed within a given time frame = (1-F/T) x 100% (where T = total number of attemps; F = number of failed attemps)		>98%

B. Synchronization Time

The basic problem faced in all multi-point measurements are: measuring points should have the same knowledge of the same events, in this case, knowledge is needed is time information. A multi-point measurements are accurate requires accurate time synchronization as well. Problems arise because the computer clock is a source of very inaccurate. In many cases, it is not sufficient for the accuracy required to milli-seconds. Some handling techniques do is use NTP (Network Time Protocol) as well as the reference GPS (Global Positioning System). In [23] and [24] used a mathematical approach to synchronize. We calculate the offset between the client and server clocks using:

$$Offset = \frac{(Server\_rx - Client\_tx) + (Server\_tx - Client\_rx)}{2} \quad \text{(F1)}$$

- server_rx: receive time server side
- client_tx: send time client side
- server_tx: the send side server
- client_rx: time receive side clent

The resulting offset value is the difference between the time on one side relative to the time on the other side. This equation assumes that a package is used to measure the latency offset has the same uplink and downlink.

C. System Architecture

The diagram in "Fig. 1" illustrates the major components of system and the steps in mobile tool communication protocol. The measurement application operating on the mobile device first collects information about the mobile device, service provider, and test location. The database server communicates with the phone application to gather user input data and accumulate the results after a test run has been completed. The database server also manages a connection to the web site database where the user data, test results, and application configuration information are stored. The web site enables users to maintain accounts to review the tests run by their devices. The web site also provides tools for data visualization. Finally, the connectivity server is responsible for communicating with the mobile device to measure network performance. This model is divided into three subsystems: client, ISP network, and server.

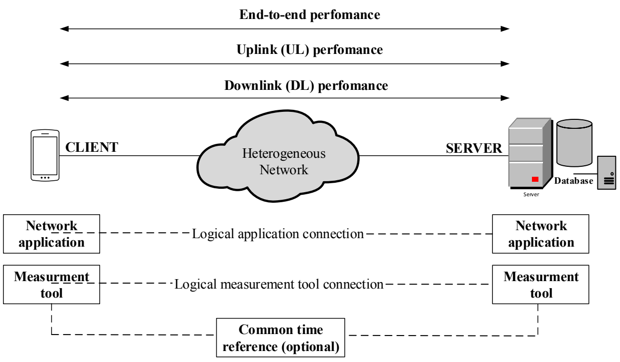

Figure 1: Measurement architecture

The explanation of each section in the measurement model according to "Fig. 1**Error! No bookmark name given.**" is as follows:

1) Client Mobile Device (Smartphone): The mobile device using a card that supports packet data service communications networks such as GPRS, EDGE, UMTS, HSDPA, or others and has a GPS feature. Measurement application using a specially designed mobile applications, android-based interface with input in the form of QoS parameters show in "Fig. 2" such as Server's IP address, the size of data packets to be sent, mobility status, and location of measurement. The point of the GPS coordinates (latitude and longitude), the technology used (TCP/UDP), the information of mobile operators, mobile device (brand and type), date and time, by default is obtained from measurements of the mobile device.

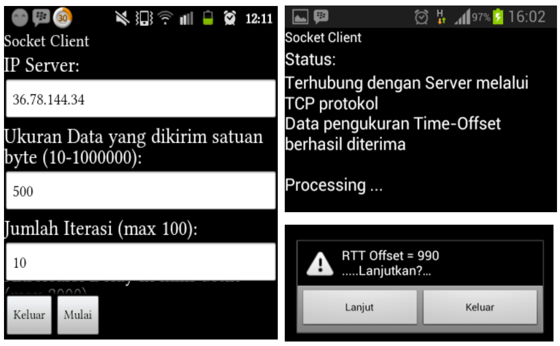

Figure 2: GUI mobile tool in client side

2) Internet Service Provider: Internet service providers use the services of some mobile operators that exist in the study area. The application will test some superior packages of each operator with the same standard of access speed (3.5G or above).

3) Server: The server has one public IP that is used to serve clients in the reception and delivery of data packets. Input data from the client in the form of parameters will be received and stored in the database server. The output parameters on the server side in "Fig.3" will manage data time offset (the time between the client and server), downlink delay (time data transmission from the server to client), uplink delay (time delivery of data from the client to server), and round time trip (RTT).

Figure 3: GUI computer PC tool in server side

Application on the server side is built using web-based applications with MySQL database connection. Monitoring interfaces on the server side will display the results of delivery of the client in the form of tables and graphs based on the existing input parameters.

D. Timeout Interval Test

The timeout interval test, measured round trip delay amount small package with transmission intervals are increased. With this test will be known round trip delay between packets associated with transmission distance. This test illustrates the cost performance to revive a component that time out (the reallocation of resources) to the synchronization process, use the formula offset (F1). After getting the offset value, the value of time on the client side will be adjusted by the formula:

$$client_u = Client_{\hat{a}} + offset \qquad (F2)$$

$Client_u$ are approximate values relative time on the client side according to the time on the server side.

E. Database Connection Model

To accurately measure the send and receive time of packets, we have developed Moping with Android based test tools, the architecture of which is shown in "Fig. 4". The main function of the tools is to time-stamp the packets at both client and server side, store it in the database and retrieve the trace file after completing the experiment.

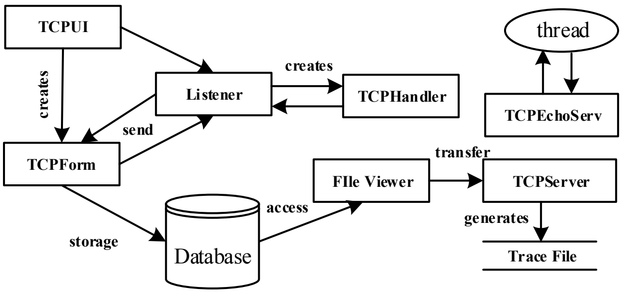

Figure 4: Database connection model and communication protocol

Description:

- TCPUI: It runs in mobile client to provide the user interface.
- TCPForm: This application is developed to store the actual trace file into the phone database (using RMS).
- TCPEchoServ: This is the server application based on TCP to send the Echo reply to the client.
- TCPHandler: The actual UDP mechanism is developed in this module.
- FileViewerMidlet: It retrieves the trace file from the database and transfers to the TCPServerFile (described below) using socket mechanism.
- TCPServerFile: It runs in the server to collect the trace file

III. RESULTS AND DISCUSSION

This section describes the process of implementation Mobile ping for testing the QoS internet services. To demonstrate Mobile ping app capabilities of providing insight into the performance of cellular data services as experienced by a particular device, we present the analysis of a small data set collected in the Samarinda City. Primary goal in this analysis is to show that application can obtain useful data, which can be analyzed to characterize the performance of data networks as experienced by individual wireless devices. The data presented in the following sections has been collected using a Samsung Galaxy Grand Duos SM-G7102 models that support android version 4.4.2.

A. Session Testing and Measurements

Test using Packet Internet Groper will be done before sending data packets to the server to confirm or check the network connection has been connected to the server. Sessions will be created in the server so that the server can calculate the elapsed time during the session. "0 illustrates the workflow Mobile Ping.

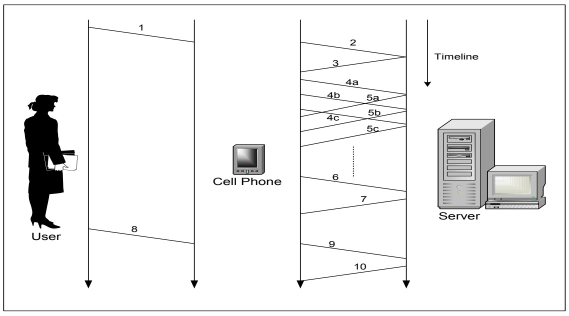

Figure 5: Mobile Ping Session Workflow

The data packets are used for measuring the time offset is made as small as possible, i.e. 1 byte, to reduce

Round Trip Time (RTT) of the test. Offset data packets transmitted two times, but the timestamp that is processed is the second. It is made because the second RTT offset data package is smaller than the first due to the offset data package will no longer pass through the opening process of connections.

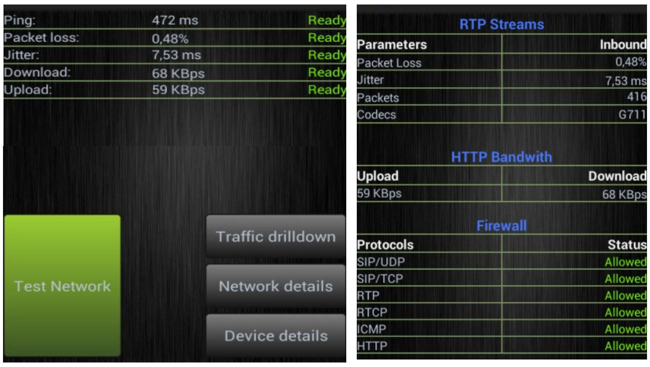

Figure 6: Interface network testing

Having regard to the "Fig. 5", inputting of data is done through measurement applications on smartphone devices. These data include the type of test to be performed, the data packet size, the number of test iterations, the time interval between tests, mobility status, test locations as in "Fig. 6".

1) Measurement of packet loss

The results of measurements of packet loss at every point locations are generally in the range of grades 0-3%, except in Samarinda city to reach a value of 3-5%. The amount of packet loss in the district occurred in the center of very dense commercial activity. The following "Table 2" shows the average packet of data loss.

TABLE 2
MEASUREMENT OF PACKET LOSS

Districts	Average Packet Loss			Category
	Mobile Operator			
	A	B	C	
Samarinda Ulu	2.4%	2.73%	1%	Good
Samarinda Kota	2.1%	1.19%	0%	Good
Samarinda Ilir	2.17%	1.58%	0%	Good
Samarinda Utara	0%	0.86%	0%	Good
Sambutan	0%	0%	0%	Excellent
Sungai Pinang	0%	0.74%	0%	Excellent
Sungai Kunjang	0.48%	1.37%	0%	Good

2) Delay Measurement (Latency)

Things to note in "07" is the latency values that tapers at 10000 and 5000 byte packets compared to the 500 byte packets. To find out the cause of this phenomenon, further testing is done to the internal components of the network provider. For reasons of testing limits, the authors could only take the assumption that there is a buffering mechanism that occurs in the service provider. This mechanism causes the packet data in a smaller size than the size of the buffer must wait for a certain time until the buffer is full before it is sent to the network, resulting in increased value of the overall latency.

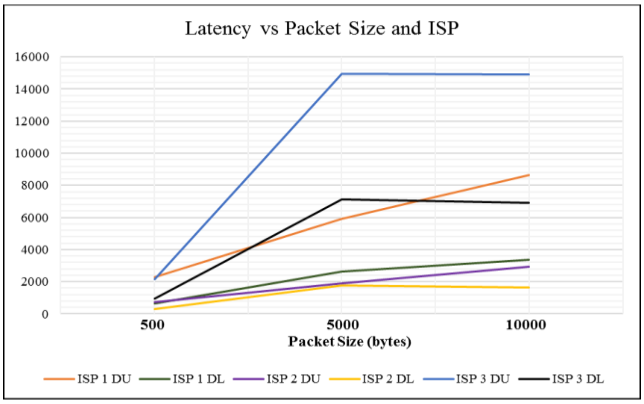

Figure 7: Latency vs Packet size and ISP

Measurement delay (latency) in the delivery of data packets set by ten times iteration, in "Fig. 8" shows the variation of bundling different data from each ISP to reduce the value of latency caused by the buffering process.

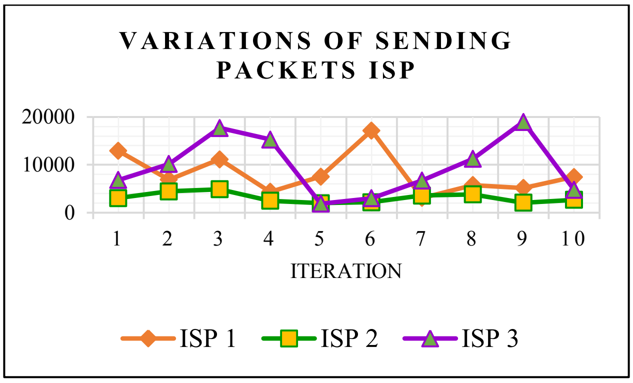

Figure 8: The Variant of Sending Packets by ISP

3) Throughput Measurement

In "Fig. 9" is the result of the measurement throughput at one location in the district of North Samarinda shows the throughput. The size of the package used in this test is 10000 bytes. Each test session uses 10 iterations. Test carried out on three mobile network provider initials ISP

1, ISP 2 and ISP 3 are each performed three times a session. Throughput value of ISP 2 is higher than the ISP 1 and 3.

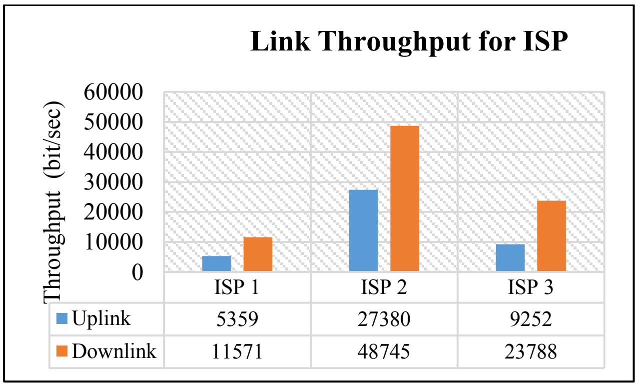

Figure 9: The comparison throughput of each ISP

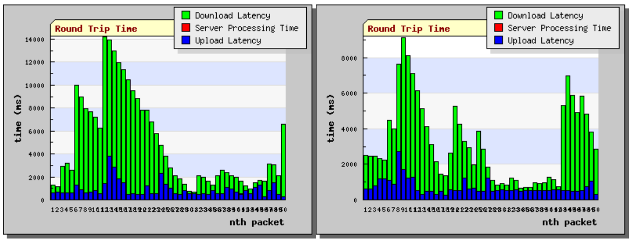

Figure 10: Uplink and downlink throughput

The interesting things to note in the measurement results shown in "Fig. 10"0 is the value of the downlink compared to the uplink value of each ISP, it seems it is more influenced by the factors of time and location of measurement for other such locations are the downlink value greater than the value of the uplink.

"Fig. 10" describe a chart pattern of uplink and downlink throughput. Measurement location was chosen in the area of education and business, that makes a great cause of large downlink data traffic. This can be seen in the pattern of downlink latency, which uplink latency is different from the patterns that tend static. This phenomenon itself, of course, require further research to determine the cause

4) Timeout Interval Analysis

Additional testing is done to measuring the time-out. The process of measuring the time-out is done by sending a series of the data size of 1000 bytes and increase the intervals between deliveries. These measurements were performed on two mobile network provider initial provider A and B to compare the time-out of both network providers. Each network provider gets two test sessions. Each session uses 20 iterations with the addition of a half-second interval between delivery (500 msec). The results of each session are shown in "Fig. 11" and "Fig. 12"

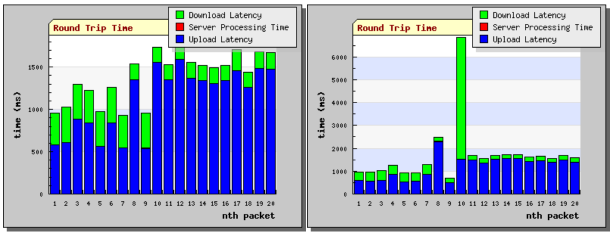

Figure 11: Timeout Provider A

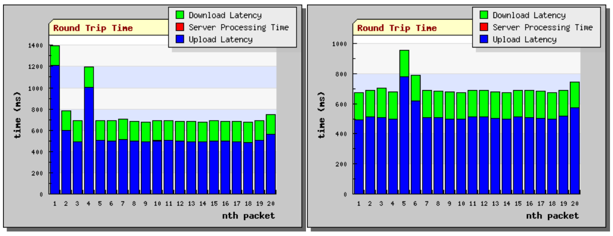

Figure 12: Timeout Provider B

Based on examination of the "Fig. 11" for provider A, the value of uplink consistently increased in the 10th iteration. This indicates that the value of the time-out for provider A is 5 seconds, which means if the client using the network for 5 seconds network resources will be diverted to other users. The same condition was not seen in testing provider B. Until the 20th iteration does not seem to have consistent changes in the uplink. It has been suggested that the time-out value for the provider B is not contained in the range of 1 to 10 seconds. To try further how to determine the time-out value of provider 2, conducted two additional sessions with the addition of an interval change the value of shipments into the second (1000 msec). It turned out that after adding the value of the interval between deliveries, nothing is changing in the value of a consistent latency uplink. It can be concluded that provider B does not apply the time-out method. During the communication process, network resources continue to be provided to the user.

IV.CONCLUSION

We have presented application End-to-End QoS Tool, a cellular data network measurement platform, focusing on the needs of mobile application developers, rather then network infrastructure optimization and provisioning. We have analyzed sample data collected with our tool, showing large variability in cellular data network characteristics. We have concluded, by motivating the need for further measurement efforts from the point-of-view of mobile application developers and network researchers. The mobile application End-to-End QoS Tool enables developers to characterize the data delivery performance of cellular data networks as delivered to mobile devices. Mobile application tool can to know a range of network performance characteristics, including latency, jitter, throughput, and network timeout delays.

During our data collection we identified a number of measurement directions for future work. First, there are numerous outstanding questions as to the behavior of cellular data networks from the point-of-view of mobile application developers. While we were able perform tests and obtain data for the cellular network using one mobile device, to make the study exhaustive we need to perform similar tests using other mobile device combinations. Results from these tests would allow application developers to make their applications robust to varying latency, packet size, and timeout values. Second, we would like to improve mobile application End-to-End QoS tool with the addition of geographically distributed measurement, as well as trace collection and emulation features. We believe that these functions will allow mobile developers to, not only characterize cellular data networks, but actively field test their traffic loads before application deployments. The improved understanding of the network is likely to positively impact application usability and adoption rate, ultimately resulting in value chains benefiting application developers, network providers, and customers.

V. REFERENCES

[1] APJII, PUSKAKOM UI. “Profil Pengguna Internet Indonesia 2014”. Asosiasi Penyelenggara Jasa Internet Indonesia. Jakarta. Indonesia. First edition, March 2015.

[2] ATSI, Summary Report: Building a Digital Indonesia a Snapshot of the Indonesian Telecommunication Industry 2015, ATSI, Jakarta. 2016.

[3] KEMP, Simon. “Digital, Social & Mobile in APAC in 2015”. We Are Social, vol 10, pp.145-155, March 2015.

[4] Telkomsel. 2015. Jumlah Pelanggan Layanan Data Telkomsel.

[5] PT. XL AXIATA tbk. Laporan Keberlanjutan (2014).

[6] Sanjaya, I., 2012. Analisis perbandingan kualitas pengalaman dengan standar kualitas layanan bagi pelanggan seluler. Buletin Pos dan Telekomunikasi, 10(1), pp.23-34.

[7] Kaup, F. and Hausheer, D., 2013, October. Optimizing energy consumption and qoe on mobile devices. In Network Protocols (ICNP), 2013 21st IEEE International Conference on (pp. 1-3). IEEE.

[8] OpenSignal, The Largest Global Survey of LTE The State of LTE. OpenSignal Ltd. State of LTE Report. January 2016. http://opensignal.com/

[9] Sensorly, “Unbiased Wireless Network Information. From people just like you.” http://sensorly.com/, 2016.

[10] Pino, Jonathan; Pezoa, Jorge E. CobCel: Distributed and Collaborative Sensing of Cellular Phone Coverage Using Google Android. In: ICSNC 2012, The Seventh International Conference on Systems and Networks Communications. pp. 228-230. 2012.

[11] SpeedSpot, SpeedSpot: Pioneering Hotel WiFi Speed Test, http://speedspot.org/, Juli 2016.

[12] Alsaadi, Fuad E.; Elmirghani, Jaafar MH. 2010. High-speed spot diffusing mobile optical wireless system employing beam angle and power adaptation and imaging receivers. Journal of Lightwave Technology, 28.16: 2191-2206.

[13] Sonntag, Sebastian; Schulte, Lennart; Manner, Jukka. 2013. Mobile network measurements It's not all about signal strength. In: 2013 IEEE Wireless Communications and Networking Conference (WCNC). IEEE, p. 4624-4629.

[14] RootMetrics, “The RootMetrics testing methodology,” http://www.rootmetrics.com /us/methodology, July. 2016.

[15] Martin, Michelle C., et al. 2014. Forecasting mobile transmission reliability using crowd-sourced cellular coverage data. In: Systems and Information Engineering Design Symposium (SIEDS), 2014. IEEE, p. 322-327.

[16] V-Speed, Cloud Managed Speed Test. https://www.v-speed.eu/about_cloud managed speedtest. July 2016

[17] Sonntag, Sebastian; Manner, Jukka; SCHULTE, Lennart. 2013. Netradar-Measuring the wireless world. In: Modeling & Optimization in Mobile, Ad Hoc & Wireless Networks (WiOpt), 2013 11th International Symposium on. IEEE, p. 29-34.

[18] Index, Cisco Visual Networking. Global mobile data traffic forecast update, 2012-2017. Cisco white paper, 2013.

[19] Index, Cisco Visual Networking. Forecast and methodology, 2015-2020 white paper. 2016.

[20] MAIA, José Miguel de Carvalho Branco. 2015. Collecting and processing geographic coverage information of mobile networks. PhD Thesis. Universidade do Porto.

[21] nPerf.com, “Whats nPerf? How does it work?” http://www.nperf.com/en/, Nov. 2014

[22] LIRNEasia. Broadband Quality of Service Experience(QoSE) Indicators. Annually in March 2014.

[23] Mills, D.L., 1995. Improved algorithms for synchronizing computer network clocks. IEEE/ACM Transactions on networking, 3(3), pp.245-254.

[24] Wittie, M.P., Stone-Gross, B., Almeroth, K.C. and Belding, E.M. 2007, September. MIST: Cellular data network measurement for mobile applications. In Broadband Communications, Networks and Systems, 2007. BROADNETS 2007. Fourth International Conference on (pp. 743-751). IEEE.