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# Analyzing Throughput and Stability in Cellular Networks

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## key Objective :

The main objective is to test the factors that affect the stability and throughput of the cellular network based on the data set collected using netradar [2].

## terms and activities and quantitative measures used :

- **Data Collection Methodology :**

we use netradar [2], a measurement platform for crowdsourcing information about cellular network performance from mobile devices. The netradar measures and collects information including throughput (using TCP), signal quality and strength, radio technology type, round-trip time (using UDP)and time and location, information about the base station and network operators (like: Cell Id, Mobile Network Code (MNC), and Mobile Country Code (MCC)) and information related to the mobile devices (hard- ware, Operating Systems (OS).

## ◆ Performance Metrics :

Performance depends on several factors, all of which often sensitively affect network quality, network performance, and throughput. (Like: hardware and operating system (OS), wireless link characteristics, radio technology, time of day and location, device model, battery...etc)

NOTE : Machine learning approach) for understanding cellular network performance.

## ◆Statistical Methodology :

It is one of the most important steps in networks because one of its main tasks is to describe the characteristics of the network

(the type of network, how to generate models for it). may be useful in algorithms and applications. “Some network statistics may be used for algorithms or calculations on the graph. Or they might indicate which graph elements have certain properties regarding the application. To which degree a certain statistic fulfills one or more of these tasks obviously depends on the application and the network”[3].

## ◆ Stability and its modeling :

Stability of a given network link can be defined as the probability of having persistent connections over a given interval of time. We define the stability of a network in terms of the period of time t during which a given measurement session yields receive bit rates of zero in a row. We call this zero bit rate duration a sudden dropout. The longer the sudden dropout duration is, the more unstable the network is. The netradar[2], measurement server tests the download speed by sending a random data over TCP for 10 seconds. During the measurement session, both the client and the server record the number of bytes transferred every 50 ms.(the longer the sudden outage, the more unstable the network).

The me- anDecreaseAccuracy tests show how the classification model performs without each variable. The results show that TCP download and upload rate average, latency, signal strength starting network technology, mobile network operator, and device model type were among the top important predictive variables for classification.  we make different tests for select-ing a training model. We evaluate three prediction models

namely, bagging based classification [4], random forest, and conditional inference tree [5] using different features (i.e TCP downlink speed, latency, radio technology, time of the day, location, operator network, signal strength, base station information, OS platform, device information and battery level).

## **Design phase** :

If I have an existing network, the data collection process will be in the analysis phase more often and the scaling will be done in the architecture phase, in addition to the scaling Performance measures applied in the architecture phase Also, the statistical method, stability and modeling can be confirmed in the architecture phase.

## Our conclusions :

What we found is that by means of the netradar platform, it gives information about measuring the performance of the cellular network and that there are several factors that affect the performance of the network, such as the type of device, battery, location and time, all of this affects the cellular network.

Statistical analysis is very important because one of its functions is to measure network characteristics in addition to network stability (probability of having persistent connections over a given interval of time), Zero bitrate is a sudden leak and the longer the sudden dropout duration is, the more unstable the network is. also real-time applications using other transports would be affected. the models are useful to anticipate (near) future performance and to adjust application demands.

# Referencing :

**[1] Walelgne, Ermias & Manner, Jukka & Bajpai, Vaibhav & Ott, Jörg. (2018). Analyzing Throughput and Stability in Cellular Networks. 10.1109/NOMS.2018.8406261.**

**[2] "Netradar measurement platform," http://www.netradar.org/.**

***[3] Brinkmeier, M., & Schank, T. (2005). 11 Network Statistics[online].* Available: https://i11www.iti.kit.edu/_media/projects/spp1126/files/bs-ns-05.pdf**

**[4] A. Peters and T. Hothorn, "ipred: Improved predictors," 2017, r**

**package version 0.9-6. [Online]. Available: https://CRAN.R-project.org/package=ipred**

**[5] T. Hothorn, K. Hornik, and A. Zeileis, "Unbiased recursive partitioning:**

**A conditional inference framework," Journal of Computational and Graphical statistics, vol. 15, no. 3, pp. 651–674, 2006. [Online]. Avail-able: http://www.tandfonline.com/doi/abs/10.1198/106186006X133933**