Mobile Access Bandwidth in Practice: Measurement, Analysis, and Implications – *Public Review*

Oliver Hohlfeld
Brandenburg University of Technology
Cottbus, Germany
oliver.hohlfeld@b-tu.de

Increasing mobile access bandwidth has been the key driving force behind innovations in mobile access technologies over the past decades. Higher access bandwidths (and lower latencies) are key to enabling new types of networked applications and to improving their user experience. Specification-wise, the continuously improved mobile access technologies led order-of-magnitude improvements in the bandwidth available to end-users within the last two decades. Yet, it remains unclear whether these theoretical improvements can also be experienced in practical deployments. In other words, do end-users actually benefit from improved access technology and to which extent?

To study this aspect, bandwidth probing applications (e.g., Speedtest) became popular in recent years. They are appealing to end-users since they enable to easily check the bandwidth provided by their ISP at their location and to compare and rank ISPs' by bandwidth. While probing methodologies have been established in recent years, they have seen little innovation and remain to use longer bulk downloads for bandwidth probing—a costly approach in metered mobile networks. Thus, large potential for innovation in bandwidth probing approaches remains. Beyond that, the data captured during bandwidth tests offers a rich potential to study the user experienced mobile access bandwidth at large. This experience track paper unlocks this potential and advances the state-of-the-art in mobile access bandwidth in two connected areas of high practical relevance.

First, it presents an empirical characterization of bandwidth of wireless deployments in China (both cellular and Wi-Fi) by analyzing a large speed test data set. In this regard, the paper presents a rather surprising fact that shows that the average 4G bandwidth has decreased between 2020 and 2021; similarly for 5G. The paper attributes this decrease to re-farming of the 4G spectrum for newer 5G deployments—a new trend whose study offers the potential for follow-up work. While prior work focuses on reporting the measured bandwidth, the paper stands out by the used app-based approach that enables to study how bandwidth varies depending on physical-layer factors (e.g., frequency bands or RSS level) that cannot be measured by typical web-based (instead of app-based) speed tests. This is a novel and long overdue perspective.

Second, it makes speed tests faster and more effective with a new probing approach that is referred to as Swiftest. The idea of Swiftest is intriguing and novel. It allows reducing the test time and load considerably (by a factor of 10). Having collaborated with a commercial speed test operator to realize the empirical study, the authors also took the unique chance to implement Swiftest in a commercial speed test application and evaluate its benefit by rolling it out to test users in a comparative study. To broaden its impact and to foster reproducibility, the client-side and server-side source code of Swiftest and all artifacts to reproduce the major results are openly released—a very welcome contribution.

The reviewers appreciated that the paper derives interesting insights from an impressive, large dataset collected in China. The reviewers commented favorably on the detailed speed test results that capture an entire country and all currently used wireless access technologies, including physical-layer properties that haven't been studied in this regard. The reviewers proposed to better show the potential of Swiftest by comparing it to state-of-the-art speed test approaches. The authors have addressed this proposal by benchmarking two representative state-of-the-art bandwidth testing services: FAST and FastBTS. To extend the depth of the evaluations, the authors added the spatial and temporal analysis of the bandwidth variation for different access technologies. In summary, this paper substantially advances our understanding of mobile bandwidth measurements and shows in a clever way how the test time and load can be decreased considerably.