

# OpenSignal

## Comparison: On-Device and Drive Test Measurements

Methodology Background

*“The only thing that really matters when it comes to network performance is how it is experienced by users, which is best understood from actual user data.”*

*—Brendan Gill, CEO*

Measuring network performance has traditionally been characterized by operators reporting on how the network functions in an optimized test environment. In the absence of access to on-device measurements, the industry defaulted to conducting simulated tests to predict what mobile phone users *might* experience using the network, as opposed to measuring what users *actually* experience. Advances in mobile device technology have changed that. The power of today’s smartphones enables OpenSignal to record billions of on-device measurements every day, providing a rich source of data from which to accurately understand users’ true mobile network experience. Armed with this information, operators, regulators, analysts and other industry stakeholders can more accurately measure network performance from the source that matters most, actual users.

## Drive Test Measurements

*Predicts network performance based on simulated tests conducted in idealized conditions*

Historically, network coverage, quality and speed have been measured using drive tests. This is where carefully calibrated equipment is placed in a vehicle and driven over a specified route to collect measurements, using test equipment on a limited set of mobile devices. Drive tests can be useful for engineering teams as an internal diagnostic tool to troubleshoot specific network problems and identify geographic areas to pinpoint areas for improvement. Competitive drive tests are primarily used by operators to benchmark themselves against competitors and to make public claims about their network performance.

Both types of drive tests are typically conducted on major routes only, a few times a year at most, as they are very expensive for operators to carry out. A key limitation is that no measurements are collected from inside buildings, where people spend most of their time. In cases of enclosed outdoor locations, such as stadiums, walk testing is sometimes performed.

## On-Device Measurements

*Measures how the network performs in real-world conditions based on actual user experience*

Within the last decade, on-device measurements have emerged as both a complementary and competitive approach to drive testing — complementary to engineering drive testing and an alternative to competitive drive testing. Companies like OpenSignal eliminated the complexity of collecting on-device measurements by harnessing the momentum of the app revolution. The OpenSignal team created a free-to-use app that helped consumers identify the best networks and signal locations and gave operators easy access to real-world smartphone measurements. Today, OpenSignal collects 2 billion individual measurements every day from tens of millions of smartphones worldwide.

OpenSignal's focus is on understanding users’ mobile experience under typical network usage conditions. The company collects measurements from tens of billions of smartphones around the world every day — accounting for the fact that user devices may or may not be new, that operators may be throttling users’ data speeds, and that a user may be inside a building. The key thing that the on-device measurements approach does not do is take measurements in idealized network conditions.

## Key Benefits of On-device Measurements for Operators

The breadth of measurements collected from tens of millions of mobile devices enable operators to make key business decisions based on the certainty of actual subscriber measurements vs. predictive simulations. This enables operators to:

- Fully understand the performance of the network under all conditions, including when it is busy or under strain;
- Optimize networks for buildings, especially large or complicated ones;
- Identify problem areas more quickly, as the network highs and lows are better captured through on-device measurements;
- Validate internal network measurements and inform infrastructure investment decisions;
- Objectively benchmark against the network experience delivered by competitors; and
- Compare the mobile experience of different types of phones models and identify specific problem models or manufacturers

## Key Differences

### Real-world measurements

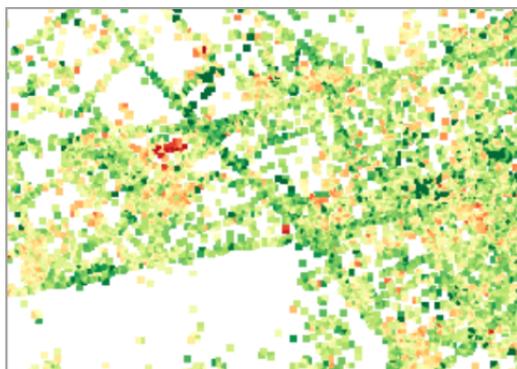
OpenSignal tests are specifically designed to capture common behaviors of users. We do this by running tests on the most common Content Delivery Networks (CDNs), such as Google, Amazon and Akamai, used by consumers. This combination represents the majority of all global internet traffic, so they are the best choice of testing end point to represent typical user experience. Mobile operators will register an OpenSignal test as normal user behavior and the network will handle the interface as it normally does for all other connections to those servers. This approach is key in order to understand the real end-to-end experience of users. Drive testing tests, in contrast, connect to a FTP test server. As a result, the results captured do not reflect users' real-world experience.

### Identifying dead zones: Sample size matters

The solution for identifying areas with low coverage or weak signal, often referred to as dead zones, on a granular level is to take as many measurements in as many locations as possible, which on-device measurements easily accommodate. Mobile operators typically limit the number of locations and frequency at which they conduct drive tests (often due to cost considerations). Rural areas are rarely covered, if at all. Consequently, the sample of data is very limited. This is highlighted in the coverage maps below showing data for the same area. It is clear that OpenSignal 's approach is far more effective at identifying dead zones.



Drive test data



OpenSignal data

## Continuous vs. periodic measurements

OpenSignal collects data 24/7, continuously in the background of our apps, providing operators with up to date insights, enabling them to:

- Identify patterns by looking at day vs. night, weekday vs. weekend or commuting vs. not commuting times, and data on the impact of specific network upgrades;
- Spot problem areas faster; and
- Understand changes in user behavior over time.

Drive tests are conducted monthly, sometimes only bi-annually or annually. It is, therefore, not possible to determine if the conditions at the point-in-time measurement are typical or represent a one-off fluctuation. Additionally, drive tests are often conducted at night when the network is under-utilized, so the snapshot in no way reflects the performance of the network under normal conditions when it is busy or under strain.

## Indoor measurement collection

With 80% of all mobile traffic originating or terminating indoors, it is essential for any testing to include in-building measurements within its scope. OpenSignal has developed a sophisticated methodology for capturing data from users wherever they are, indoors or outdoors. It is an insight that is not available through any other means. As a result of tests being carried out by driving along roads, traditional drive test methods have no way of measuring network coverage inside buildings.

## Diversity of operators and mobile device models

OpenSignal has captured measurements from tens of thousands of different models of mobile devices. Drive testing is conducted using specialized test equipment and a small number of mobile devices. These tend to be the latest models and so they have all the features to enable them to get the best network speeds.

Also, the ground up approach of on-device measurements means that data for all operators is captured, large or small. Only a limited amount of drive testing is focused on capturing performance of competitors' networks. This is largely due to the expense involved in conducting these specific drive tests. As a result, operators only concentrate their efforts on their larger competitors and will almost certainly ignore smaller players and regional-only operators.

## Summary of Differences

| OpenSignal's On-device Measurements  | Drive Test Measurements <sup>1</sup>   |
|--|--|
| Independent testing to represent typical user experience   | Generally, operator-initiated testing representing simulated or "best-case-scenario" conditions  |
| Measurements are taken from consumer smartphones; no special test equipment or servers are used                          | Uses specific test equipment and dedicated FTP test servers  |
| Measurements are collected 24/7 continuously in the background of our network of apps                                    | Measurement collection timeframes vary from monthly to bi-annually or annually and are conducted by driving around test equipment in vans            |
| Measurements collected everywhere users live, work and travel, including rural areas and inside and outside of buildings | Measurements are only collected along the driving route, in outdoor (outside of buildings) locations; rural areas are rarely covered, if at all      |
| Measurements collected across all operators and thousands of device types  | Measurements conducted on a small number of adapted mobile devices; limited focus on capturing performance of competitor networks (cost-prohibitive) |

## About OpenSignal

OpenSignal, a mobile analytics company, is the global standard for measuring real-world mobile network experience. Using billions of measurements collected 24/7 from tens of millions of smartphones, OpenSignal analyzes real-world mobile network experience at the largest scale and frequency in the wireless industry: by operator and country, regionally and worldwide. OpenSignal believes measuring how the network performs directly through users' eyes is key to building better wireless networks. Network operators, telecoms regulators, equipment makers and analysts use OpenSignal's mobile analytics insights to inform industry analysis and make key business decisions.

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<sup>1</sup> Conducted for competitive comparisons