

# OpenSignal

Feedback on BEREC Common  
Position on monitoring mobile  
coverage

July 19, 2018

## Introduction

OpenSignal understands BEREC has conducted a public consultation on a preliminary report in view of a Common Position (CP) on monitoring mobile coverage in 2017. As a result, BEREC has now created a draft set of recommendations for national regulators (NRAs) to adopt. The goal is to capture best practices, to create a standard set of methodologies which enable comparisons to be made between countries and operators. BEREC is now inviting comment on this draft set of Common Positions.

OpenSignal believes it is critically important with the many ongoing innovations in mobile technology to develop new, advanced, and rigorous methodologies to analyze and track the mobile experience in a standardized way.

OpenSignal is delighted that BEREC is researching how best to monitor mobile coverage and would like to offer comment and suggestions and on the draft recommendations. We believe it is important to ensure the standard approach matches the current state of the mobile industry and how mobile will evolve as we enter the era of 5G and other new mobile technologies.

## About OpenSignal

OpenSignal is a mobile analytics company that measures users' real-world experience on mobile networks by collecting and analyzing billions of smartphone measurements every day from more than 50 million users worldwide. We believe seeing how the network performs directly through users' eyes is the key to building better wireless networks. Our unique approach enables us to report on consumer mobile experience at the largest scale and frequency in the wireless industry: by operator and country, regionally and worldwide. As the recognized global standard for measuring real-world mobile network experience, our insights are used across the industry by mobile operators, telecoms regulators, equipment manufacturers and analysts.

OpenSignal's independent reports have been used or cited widely in financial analyst reports, by mobile operators across the world, by telecom regulators, as well as in papers from leading academic research institutions.

## Contacts

For further information, or to discuss any of the OpenSignal feedback, please contact:

Brendan Gill, CEO, [brendangill@opensignal.com](mailto:brendangill@opensignal.com)

Ian Fogg, VP Analysis, [ianfogg@opensignal.com](mailto:ianfogg@opensignal.com)

	BEREC Common Position on monitoring mobile coverage BoR (18) 115	OpenSignal comments
Introduction & objective, context for monitoring mobile coverage, p3	<p>As the BEREC preliminary report (BoR (17) 186)<sup>3</sup> already stated there are a number of reasons why mobile coverage monitoring would be necessary:</p> <ul style="list-style-type: none"> <li>- to provide highly-accessible independent and reliable information on the state of mobile coverage in their respective countries. Such information is often made available by the NRAs to consumers; respective policy makers and/or national governments; the European Commission; industry and wider public;</li> <li>- to assist in ensuring mobile network operators (MNOs) meet their coverage obligations. Some NRAs monitor the level of mobile coverage provided by operators to assess if they comply with any relevant coverage conditions and obligations set out in their licences. This can help ensure that mobile spectrum is used to deliver greater geographic and population coverage in particular in rural areas, which can have a positive impact on the reduction of the digital divide.</li> </ul>	<p>OpenSignal provides independent data and analysis of the mobile network experience provided by all leading operators.</p> <p>The OpenSignal methodology is standardized and enables comparisons between countries, as well as between operators in each country.</p> <p>OpenSignal's process begins with collecting over 2 billion individual measurements every day from consumer devices globally through our apps and our network of partner apps, totaling tens of millions of users worldwide. Next, we apply rigorous scientific analysis to arrive at the findings we share with our customers and with the industry.</p>

Introduction & objective, context for monitoring mobile coverage, p3	<p>In this context, two different aspects of monitoring mobile coverage can be considered:</p> <p>a) Estimating and predicting mobile coverage: this is normally based on theoretical calculations and the results are displayed in a specific map format (e.g. resolution, colour coding, etc.) taking into account predetermined assumptions (e.g. technology, propagation modelling, user specific parameters)</p> <p>b) Measuring mobile coverage through the field signal and/or the service availability in specific location and time taking into account equipment used to perform such measurement. This can be done for example by using calibrated equipment. The results of the measurements can also be represented in a specific map format.</p>	<p>Estimating and modelling is a conventional way to compensate for the paucity of real user data. By contrast, OpenSignal collects and analyzes billions of data points. OpenSignal provides direct measurements on the true experience.</p> <p>As BEREC's original scope document correctly explained, user equipment type and brand has an effect on actual signal experience because of differences in antenna/RF design, modem, brand etc. OpenSignal collects data from a wide range of smartphones reflecting most, if not all, of the devices in use by consumers.</p>
Introduction & objective, context for monitoring mobile coverage, p3	Such publications are often in the form of numerical data usually contained in report published by the NRAs on a regular basis (e.g. annually).	OpenSignal continuously collects mobile experience data. We choose to publish reports in major countries at six month intervals but the underlying data is available as frequently as needed.
Introduction & objective, context for monitoring mobile coverage, p3	"From consumer perspective, publishing easy-to-access, accurate, reliable and comparable information increases transparency and helps consumers to know if they receive the service they bought or to be empowered to make informed decisions before subscribing to a MNO – these have an overall effect of promoting competition. To date, the use of coverage maps has, for some NRA, been the preferred method of providing mobile coverage information."	<p>OpenSignal agrees that the availability of authoritative mobile experience data is important for a functioning competitive mobile market.</p> <p>However, we believe coverage data alone is not sufficient to enable consumers to make choices between operators. With the growth of smartphones, consumers also need to understand the underlying mobile data performance which is needed to use all popular mobile apps and services.</p>

<p>Introduction &amp; objective, key elements of mobile coverage information from consumer perspective, p4</p>	<p>The services:</p> <ul style="list-style-type: none"> <li>a) Data services, which are split into two subcategories, namely <ul style="list-style-type: none"> <li>o Basic quality service sufficient to carry out web browsing, email, satnav, Internet banking, audio download and social networks (excl. videos).</li> <li>o Good quality service sufficient to carry out most data functions, video content in social networks, video streaming and high-quality audio streaming.</li> </ul> </li> <li>b) Voice service (noting that voice is provided over data in some technologies)</li> </ul>	<p>An example of OpenSignal's innovation is the "Meteor" app which translates technical details on download speed, upload speed and latency into an easy way to understand how well popular mobile apps will work.</p> <p>Also, OpenSignal notes that most third party communication services, including IP-based voice services (e.g., Facetime, WhatsApp, Viber, etc.) use the mobile data connection where low latency is critical. OpenSignal collects latency as well as LTE/3G availability and mobile speed.</p>
<p>Technical specifications for monitoring mobile coverage in Europe, p5</p>	<p>2.1. The Common Position (CP1)</p> <p>From the perspective of giving information about mobile coverage, NRAs should choose either of the following criteria:</p> <ul style="list-style-type: none"> <li>1. Specifications based on the strength of the signal received: a given area is declared in- coverage if the average received signal power in that area is greater than a pre-specified minimum, which is chosen by the NRA to achieve a high probability of successful service reception, or</li> <li>2. Specifications based on the minimum probability of successful service (e.g. voice or data) reception: a given area is declared in-coverage if the service in that area is available with a pre-specified minimum rate of success.</li> </ul>	<p>OpenSignal believes it is preferable to measure actual mobile experience of consumers by city, region and country as the primary methodology because of rising network complexity as devices routinely connect to a mixture of network carriers at once.</p> <p>Such carrier aggregation makes signal estimation complicated because each spectrum band has widely different propagation properties and to deliver a high-speed mobile data connection will increasingly require more than one band.</p> <p>OpenSignal recommends that the proposed use of probability-based modelling should be as a secondary approach to supplement true mobile experience data.</p>

<p>Technical specifications for monitoring mobile coverage in Europe, p5</p>	<p>Considering the first case above, although other factors may affect the service quality, the available received mobile signal power is an indicative measure towards the definition of the level of coverage. Such a metric will also facilitate the display of mobile coverage on a map. The metrics for measuring signal power are dependent on the mobile technology. NRAs should use the following metrics for different mobile technologies:</p> <ul style="list-style-type: none"> <li>- RxLev (Received Signal Level) for GSM (also referred as 2G),</li> <li>- RSCP (Received Signal Code Power) for UMTS (also referred as 3G), and</li> <li>- RSRP (Reference Signal Received Power) for LTE (also referred as 4G).</li> </ul>	<p>OpenSignal captures a range of signal quality metrics as well as measures of the experience of using a mobile network such as download speed, upload speed and latency. Signal measures OpenSignal captures include RSRP, RSRQ, RSSNR, and many other parameters.</p> <p>OpenSignal has analyzed its many billions of data points to investigate the extent of correlation between measures of signal and service quality. We have found a correlation between some, but not all, measures of signal and service quality. OpenSignal would be delighted to share more information with BEREC on this area.</p> <p>However, OpenSignal also advises that there are many other factors which affect service quality, e.g. mobile data speeds, which are not captured by measures of mobile network signal. These factors include, among others: quality and capacity of site backhaul links; spectrum amount and capacity; number of users; quantity of data consumed and core network performance.</p> <p>By testing the actual mobile experience, OpenSignal is able to analyze actual service quality directly which overcomes these limitations (although OpenSignal also measures signal quality).</p>
--	---	--

Technical specifications for monitoring mobile coverage in Europe, p6	<p>Out of the 22 NRAs defining thresholds, 18 NRAs define thresholds for RSRP, 18 for RSCP and 17 for RxLev. Among those defining thresholds for RSRP are some that also define thresholds for RSCP but not for RxLev. On the other hand, there are some NRAs that only define thresholds for RxLev or which take into account other parameters, such as the level of interference (<math>E_c/I_o</math>).</p> <p>This different practice may be explained by the fact that Member States have imposed different coverage obligations to resolve the specific coverage issues they deal with, or due to the requirements they have specified to do measurements in the field. Different coverage obligations may require different measurement metrics and measurement methods to best assess MNO's compliance with those obligations (BoR (17) 186).</p>	OpenSignal uses a standard methodology which enables reliable and easy comparison between countries, as well as between operators in each country.
Technical specifications for monitoring mobile coverage in Europe, p7	<p>In order to improve the information on mobile coverage given to the public, there would seem to be merit in NRAs consider specifying at least three levels of mobile coverage (for example: basic / good / excellent). With regards to the publication of coverage maps this may enable end-users to come to well-founded decisions when choosing their MNO. It may also help identify areas where mobile coverage is available, but could still be improved, which would be of interest for MNOs as well as for the governments.</p>	OpenSignal is able to help with identification of areas with either weak 3G/LTE signal and/or those areas with slow mobile data performance. In some locations mobile signal strength is good, but mobile speeds are still low because of other factors.

<p>The use of signal predictions for mobile coverage estimation, p7</p>	<p>The Common Position (CP2)</p> <p>BEREC recognizes that mobile signal prediction enables the estimation of mobile coverage over the whole of the geographic surface of a given country. The NRAs should note that signal predictions are a statistical representation of the coverage achieved in practice.</p> <p>NRAs should base coverage estimation (numerical data or maps) on coverage calculations/predictions, whenever it is not economically or technically possible to carry out field measurements of the whole country. Such predictions may be generated from modelling a number of relevant input parameters<sup>6</sup> to predict the level of available mobile signal power or service accessible in any given area.</p> <p>An NRA may elect to:</p> <ol style="list-style-type: none"> <li>1. generate coverage predictions and publish information themselves (maps and/or metrics about mobile coverage);</li> <li>2. obtain the results of predictions from the operators and publish information themselves (maps and/or metrics about mobile coverage); or</li> <li>3. use a third party to generate the coverage predictions and publish information (maps and/or metrics about mobile coverage).</li> </ol> <p>In all cases, the NRA should be confident of the accuracy of the mobile signal predictions they use – see CP3.</p>	<p>OpenSignal's process begins with collecting over 2 billion individual measurements every day from consumer devices globally through our apps and our network of partner apps, totaling tens of millions of users worldwide.</p> <p>We collect measurements throughout the day, in both indoor and outdoor locations. Indeed, most of our measurements come from indoor locations (not surprising since that's where typical users spend the most time).</p> <p>OpenSignal calculates a '4G Availability' metric that shows the proportion of time that OpenSignal users with a 4G device and subscribed to a 4G service plan have a 4G connection available to them on each operator's network.</p>
<p>The use of signal predictions for mobile coverage estimation, p8</p>	<p>These are mainly used to verify whether coverage obligations are being fulfilled by the operator. More generally, this approach allows the verification of national population or geographic area being covered by a pre-defined service parameter.</p>	<p>OpenSignal provides independent third-party data and insights which is an extremely valuable way to check against data provided by operators.</p>



<p>The use of signal predictions for mobile coverage estimation, p8</p>	<p>It is worth noting that theoretical/predication-based mobile coverage information is the only known methodology that enables NRAs to derive an estimate of mobile coverage over 100% of their country land mass. Thus, theoretical/predication-based mobile coverage information should be used unless field measurements are feasible over 100% of the geography.</p>	<p>OpenSignal would value the opportunity to demonstrate the reach of its data to meet such a requirement.</p> <p>OpenSignal believes the depth of its data on the true mobile experience provides enormous value to provide more detailed insight than an exclusively modelled approach.</p> <p>An estimate of coverage based solely on theoretical / predication when used to evaluate license requirements is at risk of challenge from operators because it is estimated, and as BEREK explains the modelling process requires assumptions across many factors including terrain, software, choice of propagation model, antenna, link budget, penetration loss, etc.</p>
<p>Ensuring the accuracy of coverage information provided to the public, p9</p>	<p>The Common Position (CP3) NRAs should verify the reliability of mobile coverage information using, where appropriate, field measurements, noting that for technical and resourcing reasons it may not be possible to make widespread measurements<sup>7</sup>. Measurements by drive-testing offer an effective method of testing the accuracy of mobile signal predictions. NRAs should ensure statistical robustness of the measurement methodology and of the measurement processing and analysis.</p>	<p>Measuring mobile experience data from consumer devices directly provides extensive data across many locations, not just a small number of tests. This data provides an independent view of mobile experience.</p> <p>OpenSignal's data science team has developed robust statistical models to validate data on many important metrics including: 3G/4G availability; download and upload speed; and latency. We publish data alongside confidence intervals to ensure that users of the data are able to draw statistically valid conclusions from the data.</p>

Ensuring the accuracy of coverage information provided to the public, p9	The radio signal level and its quality do not guarantee that a mobile user can effectively access and use mobile services. Therefore, approximately half of the NRAs determine whether a location is covered, by measuring parameters that are more related to the QoS/QoE provided at that location. In few countries, NRAs aligned with MNOs on the exact set of parameters to be measured in the field, nonetheless these parameters differ across European states.	<p>OpenSignal's data supports the analysis that radio signal level and quality alone is not sufficient to gauge consumers' ability to use mobile services.</p> <p>For this reason, OpenSignal collects a range of data metrics. Additionally, OpenSignal has developed a means to communicate how these technical tests translate into the quality of experience consumers will enjoy with a range of popular apps, including Telegram, Instagram, SnapChat, WhatsApp, Skype, Netflix Spotify, etc. OpenSignal's Meteor app illustrates this communication approach.</p>
Ensuring the accuracy of coverage information provided to the public, p9	Drive testing is a standard method that should be used to monitor mobile coverage in the field – it may inform the level of mobile coverage (end/or service availability) along routes or at specific locations and may provide an opportunity to reflect the end users' perception and experience of the mobile networks. Drive testing refers to the outdoor measurements, performed as static or in-move measurements. They typically include vehicle(s) equipped with at least a RF scanning equipment. Besides, this method ensures that all MNNOs are measured at the same time in a same location and, thus, gives a comparable picture of MNOs.	<p>OpenSignal's methodology has a number of advantages over drive testing:</p> <ul style="list-style-type: none"> <li>- Uses real consumer devices which means the effect of different smartphone antenna designs, modems, SoCs are fully tested.</li> <li>- Is more scalable - Provides data on many locations, not just a small set where a drive test has happened.</li> <li>- Is more cost effective to cover the whole of a country.</li> <li>- Offers a standardized methodology which enables comparisons both between countries and between operators in a given country.</li> </ul> <p>OpenSignal believes a statistically robust methodology based on measuring real-world usage is a necessary complement to traditional network drive testing. This will become more important over time because of devices' ability to connect to multiple network carriers, including LTE carrier aggregation on licensed spectrum, unlicensed spectrum carriers, and soon 5G carriers which operate simultaneously with LTE carriers.</p>

<p>Availability and presentation of mobile coverage information, p10</p>	<p>The Common Position (CP4)</p> <p>To realize the benefit of dissemination of mobile coverage information, NRAs should strive to provide easy-to-access accurate mobile coverage information to the widest possible range of consumers. The information published would be in particular useful for end-users to be able to compare the coverage provided by the operators and therefore to compare their services.</p> <p>NRAs should consider a range of methods of access such as via their own and third-party website and apps, with the aim of maximization of coverage information accessibility by the widest range of consumers possible. Providing the information on mobile coverage in open data would be in particular beneficial as it can easily be widely reused by external parties. Third-party publication of NRAs' coverage information should reference the source and whether the information has been tested for accuracy.</p> <p>When NRAs publish coverage maps, they should consider the following:</p> <ol style="list-style-type: none"> <li>1. Provide for consumer confidence in the maps by: <ul style="list-style-type: none"> <li>- stating if the data used to create the maps were provided by the MNOs or by the NRA itself.</li> <li>- stating if the data used for the creation of the maps were tested for accuracy.</li> <li>- describing the method used to test the data for accuracy (theoretical calculation and/or drive tests etc.), as well as the extent to which the data were tested for accuracy.</li> </ul> </li> <li>2. Increase the effectiveness of information conveyed by the maps by: <ul style="list-style-type: none"> <li>- providing consumers with the choice to select/unselect the available services and/or technology.</li> </ul> </li> </ol>	<p>OpenSignal has eight years of expertise in displaying mobile experience data by geography. OpenSignal has developed both mobile apps and traditional websites to display mobile experience data.</p> <p>OpenSignal is available to advise regulators with the tricky task of communicating mobile experience data clearly and accurately.</p> <p>OpenSignal offers independent data on mobile experience with a standardized methodology across operators. This avoids issues which may arise with operator-provided data where one operator may provide data at a different level of detail or with a slightly different metric definition to others.</p>
--	---	---

	<p>10</p> <p>BoR (18) 115</p> <ul style="list-style-type: none"><li>- displaying layers for different levels of coverage by exploiting the notion of multi- thresholding.</li><li>- providing a coverage map resolution of 100m or lower.</li></ul>	
--	---	--