Body of European Regulators for Electronic Communications

BEREC

BoR (17) 177

BEREC Report on the outcome of the consultation on the Draft Net Neutrality Regulatory Assessment Methodology

5 October 2017

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1. Executive summary

This report summarises the responses received to the consultation on BEREC's Draft Net Neutrality Regulatory Assessment Methodology.[1] The aim of the methodology is to provide guidance to National Regulatory Authorities (NRAs), following the provisions of Regulation (EU) 2015/2120 ("the Regulation")[2] and BEREC's net neutrality Guidelines ("BEREC Guidelines").

In response to the consultation, BEREC received 24 contributions:

1. Group of Dutch ISPs (CAIW Diensten, NL Connect, Tele2 (NL), T-Mobile (NL) and VodafoneZiggo)
2. ASSIA
3. Assoc. Prof. Jan Jerabek (of BRNO University of Technology)
4. AT&T
5. Cable Europe
6. Carina Panek
7. CASEonIT
8. Colt
9. Digital Europe
10. Eco
11. Epicenter.works
12. ETNO/GSMA
13. EBU
14. ECTA
15. Federation of German Consumer Organisations (Vzbv)
16. IXIA
17. KPN
18. Mark T
19. M-Lab
20. NOS
21. Telefonica
22. TIM
23. Vodafone
24. One other respondent (confidential)

The following section of this report covers comments that were of a general nature, while the subsequent sections (3-7) deal with the specific comments that were related to the corresponding sections of the draft Net Neutrality Regulatory Assessment Methodology.

The non-confidential responses to the consultation will also will be published on BEREC's website.

[1] BoR (17) 112, *Net Neutrality Regulatory Assessment Methodology*, 1 June 2017 http://berec.europa.eu/eng/document_register/subject_matter/berec/public_consultations/7093-draft-net-neutrality-regulatory-assessment-methodology

[2] REGULATION (EU) 2015/2120 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 November 2015 laying down measures concerning open internet access and amending Directive 2002/22/EC on universal service and users' rights relating to electronic communications networks and services and Regulation (EU) No 531/2012 on roaming on public mobile communications networks with the Union http://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32015R2120

2. General comments

A group of respondents suggested that the draft guidance provided by BEREC would not be sufficient to ensure that measurements produce sufficiently accurate results.

> BEREC considered how to use a sufficiently accurate methodology while using an approach that is both practical and widely implementable with ability to be operated by consumer. BEREC considers that the draft Regulatory Assessment Methodology struck an appropriate balance in this regard and does not consider that any superior approaches have been suggested. Therefore BEREC has decided not to update its overall approach.

Some respondents compared the regulatory implications that it considered could be derived from Articles 3 and 4 of the Regulation. It noted that Article 4 specifies certain details that should be included in contracts and specifies that non-compliance with such terms, "where the relevant facts are established by a monitoring mechanism certified by the national regulatory authority", may lead to remedies available to the consumer under national law. Therefore, in their view, it is clear that the Regulation requires NRAs to set criteria for monitoring mechanisms that can be certified and supported BEREC's intention to give guidance to NRAs for this purpose.

Two (2) respondents also highlighted the difference between monitoring customers' experience using an IAS and the contractual compliance of IAS providers. They suggested that these different perspectives should be taken into account and applied to different sets of methodologies.

> BEREC considers this suggestion and addresses the issues related to the certified monitoring mechanism in chapter 7 of the Regulatory Assessment Methodology.

The same group of respondents argued that Article 3 of the Regulation does not require NRAs to monitor the traffic management of ISPs and questions whether such monitoring would be proportionate or necessary to verify compliance with the obligations under Article 3. Due to the many factors that can influence results, they were concerned that monitoring will lead to operators being asked to clarify every detail of the findings, including factors that are beyond their control. They suggested that BEREC had not explained why compliance control, based on complaints and market information would not be sufficient and had ignored that such an approach would be more cost effective and proportionate.

Some respondents considered that the EU Regulation does not require NRAs to establish invasive measures in relation to potential priorities, bottlenecks or effects of specialised services, but rather to detect any anomalies, particularly those reported by end-users. They suggested that NRAs undertake ad hoc, case by case assessments to assess whether it is necessary to adopt measures in response.

One respondent argued that care should be taken to ensure that monitoring tools do not cause more congestion or reduce the optimal use of the network by preventing efficient and dynamic sharing of network resources.

Another respondent suggested that the proposed approach was intrusive and may limit the freedom and flexibility of market players to innovate in a highly dynamic and competitive environment. It considered that NRAs' involvement in ISPs' engineering and traffic

management practices would impact the efficient management of IAS traffic, stifling competition and harming end-users.

On the other hand, a respondent argued that NRAs are required under the Regulation to gather data about networks as a whole and potentially discriminating traffic management practices, as well as the general quality of the internet access service.

> With regard to the scope of the assessment methodology, in particular the reference to traffic management practices, BEREC has explained that, under the Regulation, NRAs may have several objectives in measuring IAS, including for detecting traffic management practices which may or may not be allowed. BEREC considers that such practices would be relevant for NRAs to consider when assessing performance. BEREC also notes that the Regulatory Assessment Methodology does not assess which traffic management practices are allowed and which are not.

One respondent further specified the importance of requirements being technology neutral, objective, transparent and proportionate.

> BEREC acknowledges the importance of the mentioned criteria's by the respondent.

The same respondent suggested that such monitoring could give rise to privacy or data protection concerns in relation to sensitive traffic data that would need to be analysed. With regard to this issue, it suggests it would not be logical for NRAs to apply methodologies that ISPs themselves would not be allowed to use under privacy and data protection rules.

> With regard to comments about privacy and data protection, BEREC agrees that these are important factors to take into account and has made reference to this in the Regulatory Assessment Methodology (for instance in Sections 5.3, 6.1 and 7.1). Further action related to these issues will be the responsibility of NRAs or other relevant authorities.

Another respondent also requested that BEREC explains how the methodology relates to the BEREC Report on IP-Interconnection Practices in the Context of Net Neutrality and explain how measurement results should take into account findings related to IP-interconnection issues.

> BEREC does not see a need to change the report with respect to the location of test servers which includes interconnection aspects. BEREC also notes that the purpose of these measurements is not primarily to investigate on interconnection issues.

One respondent suggested that a reference to crowd sourcing should be included in the document title.

> BEREC has not found any need to change the document title.

One respondent also suggested that crowd-sourcing tests could be improved through the input of ISPs, end-users and regulatory experts in order to identify and reduce flaws.

Another respondent suggested that NRAs should engage with ISPs to identify the root causes of any problems, also taking into account those causes that cannot be independently

controlled by the ISPs, and provide ISP with reasonable time to address any issues that are within their control.

> With regard to whether NRAs should check or discuss potential issues with ISPs before taking any action or further investigate issues, BEREC considers that the decision whether or not to do so is up to the individual NRAs to make when needed in light of their national administrative procedures. Therefore BEREC has decided not to add some additional text in the Regulatory Assessment Methodology in which it recommends that NRAs should discuss potential issues with ISPs.

Some respondents also noted that some monitoring systems had already been implemented and suggested that, where these deliver sufficient results, NRAs should refrain from changes that may burden industry and confuse consumers.

> BEREC acknowledges that there are existing monitoring systems and the NRA's are in charge of deciding which monitoring system to implement.

In accordance with one respondent's opinion it would be difficult, if not impossible, for the NRAs to keep up with industry changes due to the high pace of innovation and differences among providers in the marketplace. The same respondent was also concerned about the need for the market players to manage their inherently cross-border networks to varying NRA standards.

> BEREC is of the opinion that the Regulatory Assessment methodology actually fosters the harmonization of measurement practices between different member states.

Two (2) respondents raised doubts about the scope of BEREC's work, in particular relating to business or enterprise services. They suggested that the distinction between business/enterprise and consumer/best effort services should be recognised. One of those respondents also suggested that BEREC should encourage NRAs to create exceptions for business services providers, such as not being obliged to provide product information sheets before being requested by (business) customers.

> The regulation 2015/2120 doesn't distinguish between end-users and therefore BEREC has not done so either in the Regulatory Assessment methodology.

Two other respondents argued that measurement data should be openly published to increase transparency and that the certified measurement software should be open source.

> BEREC is generally in favour of open source and open data, but these topics are out of scope of this document.

Some respondents suggested that BEREC should review and update the assessment methodology over time in light of the evolving state of network technology, the importance of different parameters and taking into account IP interconnection practices.

In cases of uncertainty about the results of measurements, one respondent recommended that NRAs should consider adjusting the methodology.

> With regard to comments about the potential need to review or update the methodology, as is generally the case, BEREC may update its approach if market circumstances or technological advances suggest that this would be justified.

One respondent highlighted the importance of competition and transparency for net neutrality issues. Based on this, it recommended a strict enforcement of non-discrimination, EoI and cost orientation for regulated wholesale inputs.

It also considered it was important to take into account the quality of wholesale inputs when assessing the measurement results. It requested guidance on this issue to be included within the final Assessment Methodology. Related to this point, the respondent urged NRAs to carefully consider the consequences of capacity-related wholesale price structures that may force alternative operators to limit capacity.

Another respondent also requested BEREC to accelerate its work and also to publish a timeline according to which it will finalise its methodology and NRAs will implement their obligations relating to certification of a monitoring mechanism, as well as listing the countries in which obligations derived from the Regulation have not been fulfilled. It also made reference to a response co-written with another organisation in relation to earlier BEREC engagement with stakeholders on measurement methodologies in the context of net neutrality.

Another respondent suggested that BEREC should focus on core principles, rather than outline specific implementation requirements at this stage.

> A number of other comments were received that were beyond the scope of the current consultation. For instance, some comments would be more directly related to the Regulation itself or the BEREC Guidelines and some other comments called for further work by BEREC. Since BEREC must limit its consultations to a defined scope, it has not been possible to directly address all of these comments. However, BEREC's work on these issues is continuing and it encourages stakeholders to continue to participate in other relevant consultations.

3. Measuring Internet access service quality

Three (3) respondents supported BEREC's aim to maximise measurement accuracy, but whereas two (2) of those respondents stated that the aim of comparability between member states would bring little added value, the other respondent expressed support for harmonisation of methodologies among NRAs for comparability and sharing of results.

Another respondent suggested that, in order to compare results across countries, a number of common parameters would need to be set. It its view, these would be essential to compare differences in factors such as device market shares, contract offers, models of devices sold or versions of operating systems. It considered that this would not be possible under crowd-sourcing approaches.

> BEREC recognises that differences in individual measurement setups may result in minor differences, however when a large sample of controlled measurements is considered on a statistical basis, there is value in this approach

> BEREC acknowledges that different devices (including different operating systems) can have an impact on the measurement results. Measurement tools could gather and/or request from the user, selected information before test commencement. This metadata could be stored with the measurement results to enable a level of like for like comparison. Clearly this would bring questions around usability and confidentiality which would need to be considered. BEREC considers this level of implementation detail to be beyond the scope of the Regulatory Assessment Methodology.

Three (3) respondents questioned BEREC's suggestion that measurements could be used to confirm if IAS quality is "developing sufficiently over time", since measurements will be related to the subscribed IAS, not the deployed network. They argued that measurements of the former would not allow conclusions to be drawn about the latter.

> In response to the respondents question about the possibility to conform that the IAS quality is developing sufficiently over time, BEREC notes that IAS quality is not simply a question of the bitrate associated with a connection, and that other factors such as delay and packet loss can impact on users' effective connection speed. BEREC also considers that the effect of the IAS subscription will be mitigated in the statistical analysis of a large sample of measurements in a crowd sourced situation

More generally, one of those three (3) respondents reiterated its views about the need to separately consider measurements of the QoS of IAS and measurements of traffic management. It considered that the tools to measure IAS quality are not suitable for detection of prioritisation or the creation of interactive maps.

> BEREC agrees that measurements related to IAS quality and measurements related to traffic management are quite distinct, but consider that IAS quality measurements are indeed suitable for interactive maps when the data is presented with due consideration.

Those three (3) respondents also emphasised the importance that any data provided to end-users to increase transparency (e.g. interactive maps) are robust, up to date and representative.

> BEREC acknowledges the importance of maintaining a well-structured measurement data store.

Several respondents highlighted the risk of misleading test results and the potential influence of factors in the end-users' environment. Some of these suggested that the statement in the consultation that monitoring mechanisms "should mitigate, to the extent possible" such factors did not fully recognise the risks and the importance of robust mechanisms, whereas a group of respondents welcomed this caveat, while noting that it may be impossible to exclude such factors.

Other respondents raised concerns about crowd-sourcing tools and they suggested that these should be considered only as complementary to monitoring tools, taking into account their limitations.

In relation to the home environment – BEREC and the NRAs are fully aware of the effect of the home environment, and the benefits and drawbacks of crowd sourced data. The topic is discussed in chapter 5.

This methodology is limited to crowdsourced measurements only.

Some respondents also argued that the measurement parameters and methodologies should be based on technical standards, such as those developed by the European Telecommunications Standards Institute (ETSI), the International Telecommunication Union (ITU) and the Internet Engineering Task Force (IETF). They suggested that BEREC should collaborate with such organisations and aim to reach common agreement on industry standards for measurement methodologies and their implementation.

With regard to the use of technical standards or collaboration with standards bodies, BEREC has considered such suggestions. The use of such standards generally requires a particular, controlled environment. BEREC has adopted a practical approach that can be used in multiple different environments. The arguments made in the consultation have not changed this judgement. Therefore, there have not been any major changes in the approach other than clarifying certain aspects of the text.

One respondent suggested that, due to a trade-off between speed and protection of connectivity over DSL, the measurement tool should be able to register the number of disconnections over a period of time as well as their duration while the residential gateway is powered on.

BEREC notes that while the use case to register brief disconnections is not explicitly listed in the document, it could be satisfied by running a long duration, low bit rate packet loss test, which could be used to infer disconnections. Any direct measurement of modem status would be technology and modem specific and not suitable for a document of this nature. This use case could be considered for the implementation phase.

Some respondents questioned BEREC's recommendation that the measurement server should be located at the IXP, due to dependencies on factors outside of ISPs' control and due to uncertainty about the load of the path during tests. However, if this recommendation is retained, the respondents made some recommendations. For instance a group of respondents suggested that 'adequate connectivity' between the server and the IAS provider would need to be made more concrete. Two (2) respondents also suggested that it is important to ensure that the server is equipped with a 10GEnetwork card and that no packet drop will take place between the IXP and the ISP during the tests. One respondent also argued that such tests should not provide a basis to trigger contractual rights under Article 4 paragraph 4 of the Regulation. The same respondent reiterated this view with regard to measurements of delay, delay variation and packet loss.

Two respondents stated that measurements should preferably be done within ISPs' networks and considered that BEREC had not provided any justification for recommending that test servers should not be located within ISPs' networks. However, if the server is located outside of ISPs' networks, those respondents considered it is of utmost importance that conditions are alike and that there is sufficient capacity.

However, other respondents supported BEREC’s proposal of placing the measurement server in a (national) IXP.

One respondent supported BEREC's stance that where measurements are performed against a test server, this server should be located outside the IAS network. The same respondent also agreed with BEREC’s recommendation that the measuring server should be located at the national Internet exchange point (IXP). However, two respondents noted that there could be several IXPs available in one country. Therefore one recommended replacing the notion of "national Internet exchange point (IXP)" with "national Internet exchange point(s) (IXP(s)".

One respondent recommended deleting the exemption which states “unless there is specific reason for its placement elsewhere”, which it considered vague, and because, in its view, the connection to the open internet is not guaranteed with a mere connection to one local ISP.

> With regard to the location of servers, a range of views were expressed by stakeholders. BEREC has considered the arguments and, in general, considers the original approach proposed in the consultation remains appropriate. Therefore, the Regulatory Assessment Methodology continues to state that test servers should be located outside the IAS network. BEREC also maintains the recommendation that they should be located at national IXP, BEREC has decided to add some additional text to specify that they could be located at ‘one or more’ national IXPs to take account of the need in some cases to use more than one location. BEREC also notes that the qualifying statement ‘unless there is specific reason for its placement elsewhere’ would address some of the concerns expressed by stakeholders, while not trying to anticipate every possible reason. Furthermore, BEREC declines to make concrete recommendations as regards network connectivity or the hardware involved as these recommendations would be quickly out of date.
>
> BEREC considers that this approach is the most reasonable in order to maximise comparability, independence and fairness to all ISPs.

In order to enable measuring interconnection to other main European IXPs, the respondent suggested using open interfaces that allow NRAs from different member states to use each other’s servers and testing the interconnection speed provided by a given ISP to other large IXPs in Europe.

> BEREC supports such a use case, but this is an implementation issue.

The same respondent in particular drew attention to the technique of “IP spoofing” as a way to detect potentially discriminatory practices.

> With regard to the suggestion that “IP spoofing” may be used as a way to detect potentially discriminatory practices, BEREC is aware of the technique, but does not consider that it is necessary to make a reference to this in the Regulatory Assessment Methodology. As is generally the case, BEREC may revisit the Regulatory Assessment Methodology in due course.

Two respondents suggested that it was important to ensure that traffic was not prioritised towards testing servers.

> BEREC acknowledges this issue and has updated the Regulatory Assessment Methodology accordingly

Some respondents also recommended that multiple measurement servers should be used. One respondent suggested that other servers should be located with providers of common services.

Two respondents suggested that their location should correspond to the traffic patterns and traffic destinations of end users, in order to detect possible net neutrality violations that may occur as a consequence of interconnection agreements.

> BEREC notes that the measurement methodology already covers measurements covers cross-border measurements and measurements beyond the ISP leg, thereby interconnection issues are covered to some extent.

Some respondents also appeared to believe that the scope of the methodology should include measuring the quality of interconnection. However, BEREC would like to clarify that this is not the case and the intention is the measure the quality of the IAS.

One respondent considered that BEREC should specify that server-based data should take precedence over self-reported results. It also suggested that a wider set of properties should be tested.

> BEREC acknowledges this issue and has updated the Regulatory Assessment Methodology accordingly

Another respondent suggested that measurements should be submitted to both customer and provider in order to verify the results in a fair manner.

> This is an implementation issue, if desired the results can be submitted to the provider also.

A respondent stated that the quality of the local loop should also be taken into account. For instance, in order to have comparable results, it considered that all end-users of different IASs in an area should have LLUs of the same quality type.

> Given that the effective speed experienced by the end user is a result of all (or in some cases many) aspects of IAS quality (e.g. delay, packet loss and even local loop quality) BEREC considers all IAS quality aspects to be relevant to contractual rights referred to in Article 4 Paragraph 4,

3.1 IAS speed measurements

Two respondents highlighted the importance of measurement accuracy and questioned BEREC's proposal for a "best compromise" between accuracy, platform agnosticism, ease of implementation and transparency. They suggested that this was inappropriate and misleading, given that the monitoring systems may have direct legal relevance. They reiterated their concerns about interference from the end-user environment, including the performance limitations of the terminal equipment.

> BEREC accepts that the term ‘best compromise’ is not the most suitable term to use, and has reworded this statement in the methodology document.

On the other hand, a group of respondents welcomed BEREC’s acknowledgement that the methodology will always be a compromise, while also requesting that BEREC further clarifies what kind of weight should be given to the various demands in order to reach this compromise.

> With regard to comments about a ‘compromise’ between accuracy and other factors or about the ‘weight’ applied to different factors, BEREC notes that this is not a question about sacrificing accuracy, but rather about adopting a practical approach using a sufficiently accurate methodology. Put simply, BEREC has taken into account the various factors in choosing *what* to measure, but is fully confident that the accuracy of that methodology is not in doubt.

One other respondent requested a detailed description of recommended end-to-end test set-up, environment, conditions and exact procedures, which it considered necessary due to the impact that different approaches could have on the outcome of tests. This respondent and Vodafone suggested that the proposal to use different options (TCP payload or IP packet payload) for measuring IAS speed may lead to uncertainty and a lack of comparability.

> The wide range of customer environments makes such a description impossible as not all setups can be foreseen. The inclusion of TCP and IP payload options is the result of the NN Guidelines which allow for speed to be measured on either basis.

Two respondents suggested that a reasonable limitation of measurements would be necessary to avoid overload of networks and of the measurement server.

> BEREC is aware of the need to ensure adequate capacity on the links to the measurement server, and so BEREC anticipates a limited number of simultaneous tests to be executed. This would also mitigate any hypothetical risk of measurement traffic overloading networks,

Some respondents expressed doubts that TCP is the best choice of protocol for speed measurements, notwithstanding the suggestions BEREC made to work with the properties of TCP in this regard. One respondent therefore suggested reconsidering the choice of the protocol for testing download speed and listed several factors that it considered important for the test to fulfil. It also suggested that such an approach should be applied when considering the factors to take into account in the end-user environment and for the certification of a monitoring mechanism. The other respondent suggested that UDP should be used, since it is less influenced by external factors.

> BEREC considers that the use of TCP as the choice of protocol for speed measurements to be justified, since the measurements in question will be browser-based and most connections are based on TCP. For these reasons, BEREC does not consider that UDP would be a suitable alternative. BEREC has not found any evidence that it would not be possible to implement measurements based on TCP. A minor change has been made to the first paragraph of section 3.1.1 to clarify that the methodology is referring to TCP.

BEREC takes the view that since TCP is the dominant protocol for the services utilized by end users and that measuring TCP throughput is the closest possible direct measurement of the throughput experienced by end users. In the event that a QoS issue (e.g. packet loss) results of a drop in throughput, a normal characteristic of TCP, BEREC considers the inclusion of this effect in the measurements to be fully valid. Put simply, BEREC recognises that the TCP throughput is an indirect measurement of multiple aspects of IAS QoS, and considers this to be a supporting factor for the use of TCP.

BEREC does not consider UDP to be a superior alternative and notes that no respondent presented any detailed proposals of how a UDP based throughput measurement might be implemented in practice, or evidence of its superiority. BEREC believes that any UDP based measurement technique would be complex to specify and implement and would itself involve compromises, resulting in an inferior methodology. Conversely, BEREC has not found any evidence that it would not be possible to implement measurements based on TCP. A minor change has been made to the first paragraph of section 3.1.1 to clarify that the methodology is referring to TCP.

However, a group of respondents suggested that the fact that calculating IP packet payload from TCP payload leads to a significant margin of error justifies either measuring the IP packet payload directly or to fall back on the more reliable speed measurement based on the TCP payload.

With regard to the concern that there would be a significant margin of error in the proposed approach of calculating speed based on IP packet payload, BEREC notes that IP packet payload is mentioned in the BEREC Guidelines, so must be included in the Regulatory Assessment Methodology. It should be noted that the methodology includes a simple way to infer the IP Payload volume from the TCP payload volume in cases where it is required but not directly measurable, while noting that this is an approximation. In cases where IP Payload volume is required and can be directly measured, the directly measured volume should of course be used.

Several respondents questioned BEREC's approach to conversion factors (i.e. 1KB = 1000 Bytes rather than 1024 bytes). They argued that this kind of approach had generated confusion when used in a Recital of the Regulation on Wholesale Roaming, but had been subsequently resolved by a letter from the EC clarifying that the traditional use of base-2 conversion should prevail. They suggested that further consideration of this issue would be necessary among industry participants, with a transition period being potentially necessary.

With regard to the terms used for download and upload speeds and the use of base-10 or base-2 conversion factors, BEREC clarified the issue raised by some stakeholders by referring to bits/s rather than bytes in the conversions.

One respondent stated that use of multiple HTTP connections may less likely to show congestion issues in the path of a connection and argued that, at least as a complimentary measure, single HTTP connection measurements should be included.

Another respondent also suggested reporting the maximum throughput of a single stream.

A third respondent questioned whether it was necessary to control file transfer over HTTP and suggested that only the TCP protocol could be mentioned, with the reference to HTTP serving as an example of a web/desktop based approach. Also disagreed with the reasons suggested for HTTP use, which he did not consider valid, and suggested they should be deleted. If the references to HTTP are kept, he suggested highlighting the difference between HTTP1.1, HTTPS1.1, HTTP2 and HTTPS2 or specifying a version. This respondent also suggested having separate connections, one for a control and one or more for tests, with HTTP only being used for the control.

The same respondent also suggested that 3-5 HTTP connections may not be sufficient and suggested this recommendation should be changed to 'at least 3 TCP connections'. Also suggested that more details were needed in this paragraph of the text, in particular suggesting that the test can be evaluated in a given time scale and values can subsequently be evaluated to verify the minimal throughput, minimal throughput, maximal throughput, etc. The respondent also requested further details or explanation regarding the impact of packet loss and packet retransmission on IAS speed.

As well as measuring upload/download speeds based on the time to execute a set of controlled file transfers over HTTP, one respondent suggested that other applications, such as FTP, HTTPS, Torrent, voice, video, as well as plain TCP or UDP throughput testing for establishing service baseline are also useful since they measure more parameters of service quality than HTTP alone. It stated that dedicated testing endpoints, either hardware or software, can be used for automating such validation and that, while this raises the complexity by one level, it provides more accurate KPIs and insight on perceived real user experience.

> BEREC has changed the reference to using '3-5 HTTP connections' to 'at least 3 HTTP connections' to take account of the point made by stakeholders that 3-5 may not be sufficient.
>
> BEREC considers the assertion that a single HTTP connection would be more likely to show congestion issues, to be unproven. Noting that the objective in using multiple connections is to maximise the throughput measured and reflect as closely as possible the total throughput available to the user along that path. With regard to the request for clarification on the use of chunked transfer encoding, the document has been updated to clarify the intent.
>
> With regard to the request to highlight the difference between HTTP versions, the methodology has been updated to clarify.

In relation to mitigating the effect of TCP slow-start, one respondent stated that it was not necessary to have a special .dat file and that this can be simplified by evaluating measured values after one second of test run.

In this respondent's view, it does not matter if the network is capable of compressing and decompressing the data, but if the point relates to end-point compression, he suggested that this should be clarified.

The same respondent requested clarification on the way to fulfil the recommendation that HTTP transfers are made using chunked transfer encoding, how the completion of a slow-

start would be detected and whether the 500 byte value is meant as the size of all HTTP headers.

With regard to the presence of TCP options introducing a possibility that the TCP header size is not fixed, the respondent argued that this is only the case for 'TCP handshake'.

With regard to the tables on example overheads, the respondent suggests adding the value of 576 B (the minimum datagram size for an IPv4 host) and clarifying the difference between MTU and minimum datagram size.

> With regard to the suggestion about using a 'slowstartX.dat' file in order to mitigate the effect of TCP slow-start, BEREC considers that the originally proposed approach in the draft is an example only, so BEREC has clarified this in the updated methodology document and decided that there is not a strong reason to modify the approach.
>
> BEREC believes that compression on the link could affect the accuracy of measurements, depending on how it is implemented.
>
> With regard to the request for further clarification about the addition of a 500 byte value to the total file size as an approximation when the exact size of HTTP headers is not known, the methodology has been updated to say that the exact HTTP header size should be used if known.
>
> With regard to the potential complication introduced by the presence of TCP options, BEREC notes that the Regulatory Assessment Methodology also states that the average TCP header size is likely be close to 20 bytes. There are some clarifications on TCP options included in the updated document.
>
> With regard to the suggestion to specify the minimum datagram size for an IPv4 host and clarify the difference between MTU and minimum datagram size, BEREC did not consider that this was necessary for the Regulatory Assessment Methodology since the majority of packets (likely all but the final one) used to transfer the file in a speed measurement will be as large as they are allowed to be.
>
> BERECs recognition of the effect of packet loss was not to suggest that these effects be omitted or taken into account, in fact the opposite is the case – BEREC are aware that packet loss has a detrimental effect on TCP throughput, and so one reason for the recommendation to measure speed based on TCP payload is to factor this real effect into the speed measurements.
>
> With regard to the suggestion to specify the minimum datagram size for an IPv4 host and clarify the difference between MTU and minimum datagram size, BEREC did not consider that this was necessary for the Regulatory Assessment Methodology.

Two respondents also suggested it would be preferable to consistently refer to HTTPS rather than HTTP.

> BEREC clarified that the use of Transport Layer Security in the form of HTTPS is optional, but provides e.g. the advantage of preventing any manipulation from intermediate proxy servers.

One respondent suggested that the methods described under 3.1.2 and 3.1.3 have limitations since they saturate the connection during the test and can therefore only run periodically or when end-users do not use the broadband link. The respondent proposes ways to provide a less invasive and more continuous view of performance, such as packet pairing, which requires the transmission of only a few packets. Whilst these techniques may be less accurate in measuring throughput, the respondent suggested that they are very accurate in detecting short broadband disconnection events, which have a high correlation with user experience.

> BEREC believes that it is only possible to accurately measure the maximum possible bitrate of a link by saturating it, and recognises that this means the test must be run when little or no other traffic is being transferred on that link. The matter of short disconnection events is discussed elsewhere in this document.
>
> As is generally the case, BEREC may update its methodology if market circumstances suggest that this would be justified.

3.2 Delay and delay variation measurements

One respondent argued in favour of computing various wide confidence intervals (e.g. 95%, 99% and 99.9%) for measurement data, in particular for delay and delay variation, since it considered that it is the occasional occurrence of large delays that particularly impacts the service quality of most applications.

> With regard to the computing various wide confidence intervals, BEREC considers that this may be confusing for end-users and has therefore decided not to adopt the suggestion.
>
> However, it is still possible for individual implementations to provide confidence intervals as output to the end user with the data gathered in a delay and delay variation measurement, even if this is not mandatory.

One other respondent argued that there was a lack of detail and a lack of a precise methodology for measuring delay and delay variations. It suggested engagement with standards bodies, such as ETSI, the European Commission and NRAs to develop this.

> As stated in previous responses, BEREC has considered such suggestions. However, as BEREC is following a crowd-sourcing, practical approach that can be used on different environments, while standards generally require a particular, controlled environment, BEREC has decided not to change the text.

One respondent stated that BEREC should provide evidence that 10 measurements for delay and delay variation would be sufficient.

> With regard to the number of measurements for delay and delay variation, BEREC notes that many tests use 10 measurements and multiple NRAs have had experience with using this number when conducting tests. BEREC considers that specifying ‘at least 10’ should be a sufficient lower bound for guaranteeing a minimum accuracy, while also providing some flexibility to conduct more measurements in the specific implementations.

With regard to the recommendation that delay is measured using UDP with TCP as a fall back option, one respondent suggests adding ICMP as an alternative.

Another respondent suggested that the basis for favouring UDP for measuring delay did not take into account that the TCP 3-way handshake using SYN, SYN-ACK, and ACK are not subject to flow control and thus can be reliably used to measure the link delay. Moreover, the respondent stated that UDP protocol does not by itself have an acknowledgement scheme, so that the delay measurement using UDP protocol requires a transmitting and receiving agent. The respondent suggested BEREC should modify the proposal to say that UDP or TCP protocols could be used.

> With regard to the point made about flow control and the suggestion to modify the recommendation to say that UDP or TCP protocols could be used, BEREC has added some text to the second bullet in the first list of Section 3.2 which further explains that 'the timing of the 3-way handshake is not visible to many platforms' and therefore cannot be used for delay measurements in practice on many crowdsourced platforms. Furthermore, it is not guaranteed that timing on the TCP handshake will never be modified by the network. Following these reasons, BEREC did not consider that further modifications to the approach would be necessary. The methodology is also amended regarding the option to use ICMP.

3.3 Packet loss measurements

A group of respondents noted the recommendation to send a large number of packets when conducting packet loss measurements and the reference to the appropriate number of packets in such cases being dependent on 'access technology characteristics'. With regard to this reference, the respondents requested further guidance on how the technology characteristics should be taken into account.

> With regard to the reference to 'access technology characteristics', BEREC notes that the methodology is valid for all access technologies and that the measurement client may not be aware of which technology is used. Taking this into account, BEREC has decided to delete the reference to access technology characteristics that was at the end of the second paragraph of this section.

One respondent stated that the proposed number of IP packets (at least 1000) was not enough and that the number should depend on the length of the test. The respondent also requested that some general principles regarding how to evaluate pack loss should be provided.

> With regard to the concern that the proposed number of IP packets (at least 1000) was not enough, BEREC acknowledges the comment, but considers that there is not an objective reason to state another number. Also, since the recommendation is a suggested minimum, there would be flexibility to select a higher number if necessary while providing a sufficient lower bound at guarantee a minimum accuracy of the measurement.

Three (3) respondents agreed that samples of measurements need to be sufficiently high, but also specified that data packages of different sizes should be included and that reasonable time periods should be used in order to be representative and comparable.

With regard to the reference to ‘long measurement intervals’ and the ‘stability of the IAS’, one respondent stated that longer measurements will only give an indication of the stability of a connection if the statistical distribution (including standard deviation) of latency etc. are captured and the network performance exhibits statistical stationarity.

> With regard to point made about ‘long measurement intervals’ and the ‘stability of the IAS’, BEREC acknowledges the comment, but does not consider that it justifies modifying the methodology. As stated, there is a trade-off between the extent of the measurement and usability of the resulting product, which is important to consider, especially when taking the crowd-sourcing aspect into account. Although it is understandable that a larger number of packet loss measurements will give a more holistic picture over the tested network, it would lead to very long measurement tasks and less user interaction.

Two (2) respondents also suggested that some short data transfers should be performed before conducting the actual measurements in order to minimise issues related to the way in which devices save power by releasing radio resources after some time of not sending or receiving data. They suggested that this could otherwise result in elevated end-to-end RTTs.

> With regard to the concern about additional latency that may be visible in elevated end-to-end RTTs due to the way in which devices may save power, BEREC has added some text in Section 3 of the Regulatory Assessment Methodology to acknowledge this point (in particular noting that the first few seconds of measurement could be discarded if this appears to be a relevant concern), since the issue is more relevant here than for packet loss.

One respondent suggested that users should be given a free choice between performing quick or thorough measurements of their IAS.

> With regard to giving users a free choice of the measurement duration, BEREC notes that this is considered an implementation detail and not mandatory to all implementations.

Another respondent described some benefits of background or dedicated testing software compared to a one-time test, such as the generation of historical data, indication of times when a quality issue occurs and automated testing.

> With regards to background testing, BEREC notes that, as stated in the comments above, longer measurement intervals may lead to a more holistic picture of a network, but lead to a degradation of user experience.
>
> As stated in the footnote, modern FTTH networks experience a packet loss between 0.001 % and 0.21 %, so if it is possible for a measurement client to calculate packet loss on more than 1.000 packets with no degradation of user experience, this would be preferred.
>
> Background testing or dedicated measuring software would be one possibility to achieve this, but BEREC decided not to include this, as it will in many cases not be available when applying a crowdsourcing approach.

4. Detecting traffic management practices that impact individual applications

Other respondents raised concerns about BEREC's assessment on ad-blocking and parental controls that are network based. They suggested clarification is needed with regard to customer opt-in to traffic being blocked.

Some other respondents were also concerned about the risks of legitimate practices (e.g. NAT) or other technical solutions to the scarcity of IPv4 addresses being erroneously interpreted as non-compliance. They were also concerned that, despite acknowledging that many different factors could explain test results and despite it being impossible in some cases to assess the influence of each factor, the results may still be considered to evaluate ISPs.

> BEREC notes that the document focuses on a measurement methodology and does not give indications about which traffic management practices are allowed and which are not; or which may be considered a violation of the Regulation. This was also clarified in the document.

Three (3) respondents suggested that it was important to avoid associating issues at a higher level of the network, such as blocking of TCP/UDP ports, with features of IP connectivity provided by the IAS.

> BEREC disagrees with the statement that blocked TCP/UDP ports should not be considered as a part of IP connectivity provided by the IAS. BEREC also understands that the measurement metrics will be specified further by the NRAs when implementing the measurements.

Other respondents also suggested that NRAs should take into account the use of certain software, such as virus checkers parental controls and firewalls when assessing traffic management practices.

> As this topic is discussed in Chapter 5, BEREC consider that no changes are required in this chapter.

One respondent suggested that the scalable detection of prioritisation and discrimination was particularly challenging and that BEREC should initially encourage monitoring systems to focus on the detection of traffic management practices related to standardised and common protocols, in line with the proposals relating to HTTP and DNS manipulation.

> BEREC sympathises with the comment and believes that the NRAs are focusing on this kind of topics in the supervision. However, methodology is targeted to provide tools for different use cases and its scope is broader. BEREC also notes the evolving nature of protocols and hence makes it necessary to update the methodology at a later stage according to technological changes.

Two (2) respondents raised concerns about making the results of assessments public, in particular before ISPs had an opportunity to provide their views or input to compare results.

> BEREC is generally in favour of open source and open data, but these topics are out of scope of this document.

One other respondent also considered that the section on detecting traffic management practices that impact individual applications lacked detail or a precise description of a methodology, which may result in divergent practices.

> BEREC notes the comments and acknowledges that many details have to be further specified when implementing the measurements.

In relation to security, one respondent suggested there may be a risk that tools to detect traffic management practices could interfere with cybersecurity measures taken by ISPs. It suggested BEREC should take into account such security issues.

> BEREC does not consider that the measurements affect cybersecurity.

4.1 Connectivity measurements

Several respondents reiterated concerns about potential problems being outside the control of ISPs or affected by the end-user environment, even when a large number of measurements indicate that there is a problem on a particular network. Two (2) respondents also suggested that clarification is needed regarding the compatibility of NAT with the Regulation.

One respondent disagreed with the inclusion of 'DNS manipulation' in the list of problematic connectivity practices to consider, since it argued that this was outside the scope of the Regulation and does not concern traffic management issues and may be outside the control of ISPs.

One other respondent disagreed with the inclusion of "detection of an HTTP proxy" in the list of problematic connectivity practices and stated that HTTP proxies are not only used by ISPs, but also by other agents to enhance customer experience. They suggested that BEREC had not explained how specific actions by proxies may have a negative impact according to Net Neutrality legislation.

One other respondent requested clarification on whether the list in this section was exhaustive or not.

> BEREC notes that the document focuses on a measurement methodology and does not give indications about which traffic management practices are allowed and which are not; or which may be considered a violation of the Regulation.
>
> BEREC acknowledges the need to develop measurements for different use cases where appropriate and the list is not intended to be exhaustive.
>
> With regard to concerns about potential problems being outside the control of ISPs, BEREC acknowledges this point and considers that the Regulatory Assessment Methodology is sufficiently clear on this issue.

One respondent disagreed with the assertion that a port can normally be considered as being open if the 3-way handshake completes. Instead, it stated that firewalls may let you establish the basic handshake and cut your connection based on detection of particular content or applications after the handshake. Following this, it is suggested that BEREC should rephrase the text 'it is recommended to send some data and verify the integrity of the received data' to state that it is 'necessary' to do so.

With regard to the concern that a 3-way handshake could be completed but the connection is subsequently cut, BEREC acknowledges this point BEREC has accordingly modified the text of the first paragraph under Section 4.1.1 to refer to whether 'communication is possible', rather than referring to the completion of a 3-way handshake.

With regard to IP address blocking, one respondent requested clarification regarding how to recognise the blocked IP addresses. It was also argued that the frequent use of HTTP proxies in an office environment should be taken into account and that the problem of providing fake web pages should be covered.

In response to the request for clarification on how to recognise blocked IP addresses, BEREC has added some explanatory text to the first paragraph of Section 4.1.2.

4.2 Detecting practices that impact QoS of individual applications

One respondent disagreed with the statement (section 4.2.2 of the consultation) that "a mobile network providing IAS to predominantly small screen terminals would typically show lower bitrates, regardless of the performance of the network itself". It is referred to the provisions of the Regulation that end users have the freedom to use devices of their choice and therefore considered that this sentence should be deleted.

With regard to the comments about small screen terminals and bitrates, BEREC has updated the text to reflect the comment.

Another respondent is expressing support for the listing of measurement variations for particular KPIs in section 4.2 of the consultation. However, it is suggested that NRAs should allow users to recommend websites which should be tested (section 4.2.1 of the consultation) and that a specific sub-section on testing VoIP applications should be added.

With regard to the suggestion that NRAs should allow users to recommend websites which should be tested, BEREC notes that this is related to how the tool is used rather than the methodology itself, such that it is something that NRAs may consider subsequently. BEREC acknowledges the importance of the VoIP use case and do not see a need for a specific section to take it into account.

A respondent considered that it may be difficult or impossible to identify the location of a problem, since traffic may be affected by the ISP, the terminal used by the end-user and the content server.

It is also suggested that in order to compare different countries, a common list of services or applications would need to be set, since the use of applications and services may differ from one country to another.

Another respondent suggests that, due to the difficulty in establishing the underlying or main cause of a problem, NRAs could respond to complaints or indications of the presence of anomalies and explore potential issues present on single applications.

According to one respondent, there are many limitations to the available techniques. For instance, it is stated that most techniques operate at layer 3, so would not detect traffic management at layer 2. Furthermore it is noted that several of the technical approaches used

currently are also not scalable. It is stated that there was no coverage of such approaches in the consultation and therefore is suggested further consideration was necessary.

> With regard to the comments made about limitations to the available techniques, BEREC acknowledges the limitations inherent in any practical measurement methodology and takes it into the consideration during the implementation. As a minimum the results from such testing could be taken by NRAs as indicative.

One other respondent disagreed with the two examples in this section (web browsing and video streaming) as ways of measuring the performance of the IAS, since it is considered these applications and their performance fall outside the scope of the Regulation. It is also suggested that the tests described in this section should only be used to give an initial impression and not for compliance.

> BEREC respond that the performance of IAS is discussed in Chapter 3.

In relation to video streaming, one respondent stated that simulating a service had limitations compared to using a real service and suggested that it would be preferable to request ETSI to create a reference or launch a video streaming session on an existing public streaming platform.

Also with regard to video streaming, another respondent stated that most video streaming today is TCP with adaptive bitrate and that while this is easily tested by the user by running videos directly inside the browser, this method yields subjective results. For objective KPIs, it is suggested that solutions exist to automate variable bitrate video testing with simulated traffic, or connections to real internet video servers.

> With regard to the assessment of video streaming quality of service simulating traffic or using a real service, BEREC acknowledges that each methodology has pros and cons and accordingly modified the text. Some of aspects are specified further during the implementation of the measurement system by NRAs.

5. End user dependent factors that may impact the measurement results

One respondent is highlighting the importance of transparency with regard to the information provided to end users and also suggested that NRAs and ISPs should act to educate end users with regard to identifying potential causes of problems in their own environment (e.g. terminal equipment).

> With regard to the suggestion of educating end users about setting up proper environment, BEREC agrees that this would be beneficial but is out of the scope of that recommendation.

Another respondent is welcoming BEREC's acknowledgement of end-user dependent factors. However, it was concerned that NRAs may nevertheless use the results generated without fully recognising the lack of reliability. It also emphasised the need to carefully analyse the results obtained from crowdsourcing.

With regard to the remark concerning measurements reliability, BEREC recommends to NRAs to gather as much metadata as possible in order to analyse the measurement context and discard results if biased (refer to chapter 6.1).

A respondent argued that NRAs should gather as many measurements as possible and only then filter and weigh the data according to the additional information on the measurement environment that is acquired. It is also suggested that, if it is not possible to collect environmental information before the test, an optional questionnaire could be used after the measurement has been performed. It also suggested that measurement software suites in customer premises equipment could take account of most environmental factors.

With regard to the remark and suggestion about the number of measurements advocated and an optional questionnaire, BEREC agrees on those but reminds that both items are already integrated in the report (refer to chapter 5.1). Considering the suggestion concerning the integration of the measurement client directly into the end user equipment, BEREC reminds that the cost effective crowdsourcing approach is based on browser (fixed device) or on application (mobile devices) solutions.

According to another respondent, if the objective is to measure the ISP's network connectivity then measurements should be made directly from the broadband router or a device plugged into a wired Ethernet port on the router. However, if the objective is to measure the end-to-end user experience of their applications, it stated that the Wi-Fi connection to the end-user device should also be included. It is emphasised that any NRA regime that compares performance should be clear on what it is attempting to measure and ensure consistency.

With regard to the position mentioning the final objective of the measurements, BEREC explains that the report is intended to support NRA in the monitoring and supervision of the net neutrality provisions of the Regulation (refer to chapter 2).

One other respondent welcomed the discussion of factors that could influence results, but requested that BEREC makes the list of factors exhaustive and that BEREC provides a detailed method for end users to avoid these factors.

With regard to the request for delivering a complete list of end user environment degrading factors, BEREC has clarified that only the main issues are listed in the report.

It also requested clarification on the scope of this section, since it appeared to the respondent that it provides guidance to end-users, whereas the scope of the document was to provide guidance to NRAs.

With regard to the request for clarification about whether the guidance in this section was provided for end-users or NRAs, BEREC has clarified that it is intended for NRAs.

5.1 End user initiated measurements

Some respondents suggested that, due to uncertainties about end-user measurements, such tests should only be considered indicative before NRAs conduct in-depth investigations. They also stated that it was important to avoid any bottlenecks with regard to the measurement server.

With regard to the suggestions about in-depth investigations and server bottlenecks, BEREC recalls that these issues are well explained in the report (refer to chapters 6 and 5.1).

Another respondent is highlighting the need for end-users to be sufficiently informed and trained to make measurements correctly. The respondent further described available systems for taking measurements.

With regard to the suggestion concerning the end-users training, BEREC thinks that this is not the purpose of the report, which is focusing only on giving NRAs guidance with the implementation of the net neutrality provisions of the Regulation 2015.

5.2 End user environment

A number of respondents questioned the idea that the measurement client could retrieve required data from the local hardware and operating system and from the IAS provider, due to doubts about the availability of data needed to ensure exclusion of disturbances in the end-user domain, as well as technical difficulties in retrieving the data even if it exists and legal questions about providing the data to third parties (such as the NRA).

With regard to the questions concerning data retrieval and legal issues about the end-user environment, BEREC recommends NRAs to try to retrieve data in order to be able to analyse accurately the measurement results and to ask for permission before the measurement start (refer to chapter 5.2).

Two respondents welcomed BEREC's distinction between fixed and mobile environments, but also suggested that there were several factors that were relevant for both cases, such as:

- terminal equipment;
- parallel run software or generally, internet traffic (e.g. updates);
- turning off a device's energy saving options;
- running on measurement tool application (e.g. browser, java, flash, dedicated app).

With regard to the distinction between fixed and mobile environments, BEREC specifies that the report gives advice of the main issues that impact both environments. However, BEREC has clarified in the updated report that software updates of end-users terminals are considered as cross traffic cases.

Another respondent noted that in many cases user experience is limited by Wi-Fi connections in the home as opposed to access networks to the home. The respondent suggested putting the test client in the customer premise gateway to allows for testing of the access network directly. The respondent also stated that a test client on CPE which also serves as a Wi-Fi access point can test Wi-Fi throughput to subscriber devices and determine whether or not the subscriber is limited by access or in-home network performance, which may be important if subscribers are assessing their internet speed and using this as a basis to file a complaint about the IAS.

With regard to the suggestion concerning the implementation of the measurement client directly into a CPE (e.g. modem router), BEREC would like to call to mind that NRA have the choice to run both systems, crowdsourced or dedicated measurements

client. However, in order to keep the system costs low, BEREC recommends using a crowdsourcing approach.

One another respondent requested that BEREC provides some advice about how to tackle the issues identified for the fixed and mobile environments.

With regard to the request concerning how to tackle each and every end-user environment limiting factors, BEREC believes that this very technical exercise doesn't fit into this report. This issue is however generally described in chapter 5.3. Each NRA should develop and also share their own experiences about identifying end-user environment limiting factors.

5.2.1 Fixed environment

Two (2) respondents listed some additional factors that it considered relevant in a fixed environment:

- In-house cabling (to the extent that it is not subject to the IAS contract);
- Ethernet usage as opposed to Wi-Fi;

With regard to the additional factors BEREC acknowledges that measurements should reflect user experience and these factors may have to be taken into account when evaluating results.

It has been also suggested by another respondent that adding 'software updates' as a factor that may influence the measurements. In its view, whilst software updates were usually seen as an issue affecting the mobile scenarios, they are becoming more relevant in fixed scenarios.

With regard to the suggestion about software updates, BEREC has clarified that software updates of end-users terminals are considered as cross traffic cases.

5.2.2 Mobile environment

Two (2) respondents listed some additional factors that it considered relevant in a mobile environment, such as location (e.g. in buildings or outside), number of users in the cell as well as the hardware that is used.

With regard to the additional factors to consider in a mobile environment, BEREC considers that neither NRAs nor end-users could influence these factors by any way and therefore not relevant for the report.

A respondent also listed several other factors, such as the reached server, network connectivity and handset type and settings. It considered that the impact of such factors can be much greater than the impact of traffic management.

With regard to the additional factors that were suggested to consider, BEREC notes that these may be relevant pieces of information. However, in general, all factors relating to the quality of the radio connection may be relevant and BEREC considers that this is sufficiently recognised in the methodology.

Another respondent also suggested adding 'software updates' as a factor that may influence the measurements. It explained that backups running in the background or any other traffic

flows using mobile access are controlled by app developers and therefore are out of ISPs' control.

> With regard to the suggestion about software updates, BEREC has clarified that software updates of end-users terminals are considered as cross traffic cases.

It is also stated that terminal equipment may have further effects on measurements if a wireless network adapts the radio path according to the least capable device it is serving, which would mean that the results of an inferior performance may be influenced by any device connected in the same sector or radio band.

> With regard to the point made about additional potential effects of terminal equipment, BEREC notes the comment, but does not consider that the Regulatory Assessment Methodology would need to specify such issues.

5.3 Hardware and software information retrieval methods

Several respondents agreed with BEREC's comments regarding privacy and the relevance of the General Data Protection Regulation, and they also suggested that reference should be made to the ePrivacy Directive.

> With regard to making a reference to the ePrivacy Directives, BEREC has instead updated the text to refer to 'the applicable privacy rules', which it considers sufficient.

One other respondent suggested that BEREC should not just present the different options, but should recommend a specific approach. It also advised BEREC to remain technology neutral.

> With regard to the request concerning how to tackle each and every end-user environment limiting factors, BEREC believes that this very technical exercise doesn't fit into this report and that each NRA should develop and also share their own experiences.

It is stated by another respondent that the reference to Broadband Forum TR-064 is incorrect and that the correct reference should be TR-069. However, it also noted that the ability to retrieve data from CPEs through TR-069 is valid only for CPEs provided from the IAS provider.

> With regard to the references to broadband forum technical reports, BEREC disagrees with the comment and has therefore not changed the reference.

5.4 Measurements data filtering

Two (2) respondents specified that only accurate measurement results should be stored and processed and suggested that ISPs should have the possibility to assess these data, in close cooperation with authorities.

> BEREC is targeting an accurate measurement methodology. This is not related to storage of measurement results. Sharing of data is out of scope of the document. Generally BEREC is in favour of open data.

Another respondent raised doubts about the technical feasibility of achieving the objective stated in section 5.4 of the consultation.

BEREC recommends retrieving and storing data according to availability in compliance with privacy rules.

6. Measurement results assessment

One respondent suggested that NRAs may involve a third party organisation in verifying the performance of ISPs.

BEREC notes that NRAs may involve third parties when assessing ISPs, but there is no obligation to do so.

6.1 Data validation

Several respondents highlighted concerns about crowd sourced measurement, such as factors in the end-user environment, selection bias (participants may not be representative) and manipulation.

One respondent suggested that installing the capability to run tests on customer premise equipment under the control of a cloud based-server could resolve the issue of bias due to reliance on end-users to initiate tests.

Another respondent also emphasised that samples should be sufficiently large and up to date.

Three (3) respondents also stated that NRAs should carefully consider whether to make details about ISPs' performance public, due to the risk of misleading information, particularly before consultation with the ISPs and when there is still some uncertainty about the cause of results, since the effects on ISPs' reputations could be long-lasting.

One other respondent argued that crowd sourcing approaches should not focus on specific IAS providers.

With regard to the comments about the use of crowd sourced measurements, i.e. end-user environment, selection bias and risk of misleading information, BEREC notes the comments but does not see the need to modify the report. End-user environment issues are handled in detail in chapter 5.2. In Chapter 6.3 there is a reference given to the BEREC Report on Monitoring QoS of Internet access services in the context of net neutrality where the effect of selection bias and the need to carefully analyse crowd sourced data is addressed. This also covers concerns on focusing on individual ISPs. Publication is out of scope of this document.

A respondent suggested that the reference to parallel active applications should be removed due to privacy considerations and problems with the evaluation of such information.

With regard to the suggestion to remove reference to parallel active applications, BEREC notes the concerns about privacy may be valid. However, the concerns may not be limited to parallel active application, so a footnote has been added at the end of this section which refers to these issues.

6.2 Speed assessment for end users

One respondent suggested that, under the Regulation, it is sufficient for ISPs to communicate speeds (minimum, maximum, normal, advertised) in a way that best meets its offered service

and compliance should be in line with the contracted QoS. It suggested that, if NRAs wish to decide on more standardised approaches, they would need to define such approaches appropriately through consultation.

One other respondent suggested that BEREC should simply refer to the types of speeds previously defined in the BEREC Guidelines and provide a methodology that facilitates testing them.

Two (2) respondents made reference to a response they made previously to BEREC's Guidelines in addition to comments that are listed under the following sub-sections.

> BEREC notes that according to the BEREC Guidelines Recital 143 "In principle, the actual speed should not be lower than the minimum speed, except in cases of interruption of the IAS." Therefore it is important to compare contractual minimum speed individually for results of each measurement. BEREC does not see necessary to give further guidance in this report.

6.2.2 Maximum speed and estimated maximum speed

Two (2) respondents stated that the most reliable information on maximum speed of mobile networks is provided through Drive Tests and that BEREC's consultation had not taken account of the problems with in-house measurements, which it considered significantly impair mobile network performance.

Another respondent disagreed with the stance adopted in the final sentence of section 6.2.2 of the consultation, which it considered contradicted and undermined the stance adopted in the first sentence of this section of the consultation and that taken in paragraph 145 of the BEREC Guidelines regarding the frequency or duration of achieving the "maximum speed".

> BEREC notes the comments, but sees that further specifications on the assessment and frequency and duration of achieving the speed levels may be carried by individual NRAs while taking into account EU 2015/2120 and the BEREC Guidelines.

One respondent stated that the maximum speed can only be differentiated on a technological basis and not for single end-users. Therefore, it considered that the maximum speed must coincide with the advertised speed.

> BEREC notes that according to the NN Guidelines para 145 the maximum speed is the speed that an end user could expect to receive at least some of the time (e.g. at least once a day).

Two (2) respondents were also concerned that the consultation suggested that the maximum speed in the fixed environment could be assessed by comparing it to only one measurement, whereas they considered that maximum speed should be compared against individual samples (and that this would be consistent with the Regulation).

It is also stated by another respondent that the intention of the sentence "It is important to compare the maximum speed value against a measurement result and not individual samples within the measurement task or within multiple measurement tasks" is not clear.

BEREC disagrees with the suggestion that maximum speed should be compared against a sample rather than against only one individual measurement, since it is important for the comparison to be against a stable speed rather than a sample.

6.2.3 Normally available speed

Two (2) respondents emphasised its view that ISPs can only indicate speed ranges and no single speed parameter can be constantly guaranteed to the customer.

It is suggested by another respondent that a more sustainable definition of normally available speed would depend on the maximum speed, combined with a factor to take account of the geographic location of a customer and a factor to take account of network load.

A third stakeholder suggested that the proposal in this section may cause congestion/slow down for other users at aggregation points, and therefore argued that this needs to be clarified to avoid being overly onerous.

BEREC notes the comments, but sees that further definitions of the normally available speed should be carried by individual NRAs while taking into account EU 2015/2120 and the BEREC Guidelines. BEREC disagrees with the comment on the proposal being overly onerous and has therefore not changed the text. The measurements are initiated by the end-user and thus represent a normal use scenario and the network should be designed to handle that load.

6.2.4 Advertised speed

Two (2) respondents supported BEREC's approach to advertised speeds in the mobile environment, but suggested that this approach should also apply to the fixed environment.

BEREC disagrees that a market level evaluation rather than individually for each end user should be applied to speeds in the fixed environment. The speeds for the fixed environment are contracted for each individual subscriber access and thus should be measured individually.

6.3 Market level aggregation

Two (2) respondents stated that interactive maps that are based on crowd-sourcing should only provide an overview of measurements and not of deployed networks. They also highlighted the importance of protecting customers' privacy when publishing such maps.

BEREC agrees with the importance of protecting customers' privacy when publishing results in any form and has acknowledged this issue in several ways throughout the Regulatory Assessment Methodology (for instance in Sections 5.3, 6.1 and 7.1).

Another respondent also questioned the purposes of using aggregated data. It considered that the factors to consider would depend on whether the purpose was to produce overall anonymised results, or results on specific ISPs, or if the results were used to judge compliance with the Regulation. It suggested that NRAs would need to further consult on such measures before introducing them.

With regard of the use of aggregated data based on crowd-sourcing for interactive maps or presenting results on specific ISPs, BEREC considers that it is for the NRAs to decide on the way aggregated data is used and published. The referenced BEREC

> Report on Monitoring QoS of Internet access services in the context of net neutrality contains detailed information on the implications when using aggregated crow-sourced data.

With regard to assessing the impact of specialised services on IAS quality, few respondents supported the approach outlined by BEREC whereby NRAs assess aggregated IAS QoS measurement results before and after the introduction of a specialised service. However, questioned the second “more direct approach taking into account network topography”, in particular regarding the extent to which locally specific effects are relevant to assessing the “general quality of IAS”.

Two (2) respondents suggested that this approach seemed to refer to an erroneous counterfactual. They suggested that the effect of Neighbour B’s usage of specialised services (an IP-TV service) should not be compared with a case in which Neighbour B uses nothing at all, but the case in which Neighbour B uses some other form of OTT video service.

Another respondent also suggested that BEREC should further specify the conditions for the neighbour comparison that is proposed, taking into account the many other relevant factors.

With regard to the proposed check between neighbouring network elements to determine potential abuse in favour of specialised services, another respondent suggested that this can only be one indicator for such abuse and that BEREC should consider adding further parameters to allow NRAs to unambiguously identify any form of abuse rather than drawing such conclusion on a too narrow basis.

One another respondent expressed concern with the proposed ways of measuring the effect of specialised services on IAS in the mobile environment. It stated that if there is an indication that the specialised service is impacting IAS, then the case should be further assessed because a marginal impact may not cause any practical detriment to perception of IAS quality.

A third respondent believed that the suggested approach of measuring performance with and without a specialised service is potentially flawed. It argued that results will depend on the time of day and traffic load on the network when the measurements are made. Furthermore, it considered that 20 seconds of video duration is not enough for the end points to reach the final bitrate on the negotiation, and that static videos should be used rather than live video streaming.

> With regard to the suggestion that an erroneous counterfactual was used in section 6.3.2, BEREC considers that this may be a practical issue, since facilitating coordination among neighbours may be difficult. BEREC considers that the approach presented in the draft methodology would be a practical way to gather information about whether a problem may be caused by the use of specialised services. Following this, more detailed investigation could be conducted.
>
> With regard to whether NRAs should check or discuss potential issues with ISPs before taking any action or further investigate issues, BEREC considers that the procedures implemented by NRAs lies within the jurisdiction of each individual NRA.

Two (2) other respondents provided comments relating to the justification for using specialised services.

This comment is beyond the scope of the current consultation and BEREC notes the comments.

6.4 Individual applications using IAS

One respondent noted the complexity of measuring the performance of individual applications and would need detailed investigation. Therefore, it questioned the proportionality and effectiveness of using complex tools to try to find questionable results and suggested it would be preferable for such tools to be complaint-driven. One other respondent expresses similar concerns and argued that use of testing of this kind for assessing compliance of the IAS should be avoided.

A third respondent doubted that a test over VPN services can be a strong indicator for traffic management and suggested that BEREC should add some more criteria to ensure the results are not misleading.

However, another respondent agreed with the suggested use of VPNs. It also suggested that a list is published for contact addresses of NRAs where end users can submit complaints.

A respondent stated that traffic management practices are not always harmful and may be necessary and that a distinction should be made accordingly.

BEREC notes the comments, but sees that the further analysis should be carried by individual NRAs during an investigation. The present text calls possible restrictions and implications when using measurements of individual applications and highlights that these measurements provide a first indication of inadmissible traffic management and that further interpretation of results is needed.

7. Certified monitoring mechanism

Some respondents noted that, according to the Regulation, end-users depend on a certified monitoring mechanism in order to support a claim that actual performance of the service significantly, continuously or regularly differs from the performance indicated in their contracts. Furthermore they suggested that, therefore, the implementation of a monitoring mechanism certified by national regulators is mandatory.

With regard to suggestions that implementation of a monitoring mechanism certified by national regulators should be mandatory, BEREC notes that according to the BEREC Guidelines Recital 161 “the Regulation does not require Member States or an NRA to establish or certify a monitoring mechanism”. Therefore, it would not be consistent with the Regulation, or within BEREC’s mandate, to assert that such implementation is mandatory.

Another respondent suggested that, if some NRAs do not have the capacity to certify monitoring software, then cooperation should be encouraged with other NRAs. It also suggested that BEREC should outline further supervisory work that would be expected of NRAs if a certified monitoring mechanism is not provided to end users.

Regarding the situation where the certified monitoring mechanism doesn’t exist, BEREC supports Member States in implementing of such mechanism through its various work streams (the document under present consultation and “Net Neutrality

measurement tool specification" are examples of BEREC's assistance aimed at providing guidelines which may be used by NRAs when monitoring ISPs compliance with the Regulation and BEREC Net Neutrality guidelines).

A respondent also disagreed with the conclusion that the final ruling over which "evidence" is sufficient for triggering legal consequences is still subject to court rulings. It suggests that this reneges on NRAs' mandate under the Regulation and that BEREC should provide guidance on the circumstances under which consumers can consider evidence sufficient to seek remedies.

Regarding legal consequences BEREC notes that this would be part of a process within the responsibility of NRAs and other relevant authorities.

Two (2) respondents outlined a number of points relating to the certification of a monitoring mechanism. For instance, they placed emphasis on the principles of reliability, accuracy, comparability and transparency. In particular, they suggested that any limitation in the quality of measurement should be acknowledged and incorrect results should not be used to assess contractual compliance. They also suggested that certification should be done through an independent third party and NRAs should also be required to get certification of their monitoring systems. In general, they suggested that certification should avoid costly or negative consequences for the ISPs' established good practices.

With regard to the suggestion that certification should be done through an independent third party and that NRAs should also be required to get certification for their own monitoring systems, BEREC disagrees and reaffirms that a monitoring mechanism provided by NRAs for the purpose of Article 4(4) should be considered as a certified monitoring mechanism.

One respondent suggested that not only the devices should be certified but also the conditions of the measurements (such as how many tools are used, the test cycle length, number of lines used for the test and frequency). It stressed that the replicability of the test is essential to ensure that the conclusions were correct. Furthermore it agreed with the assessment made by BEREC regarding the legal consequences of the quality measurements the document covers and the cautious approach to evidence that NRAs must have.

With regard to the suggestion to certify not only the test, but also the conditions of the measurements, BEREC considers that decisions regarding the details that were mentioned by the stakeholder may be relevant for NRAs when implementing the tool, rather than for the BEREC Regulatory Assessment Methodology.

With regard to the issue of replicability, BEREC notes that neither the conditions in the end-user environment nor the network conditions can be precisely replicable.

Several respondents referred to previous comments regarding the need for cooperation with industry, in particular with ETSI, in order build consensus on the appropriate methodologies.

With regard to the use of technical standards or collaboration with standards bodies, BEREC has considered such suggestions. However, the use of such standards generally requires a particular, controlled environment. BEREC has instead adopted a more practical approach that can be used in multiple different environments. The

arguments made in the consultation have not changed this judgement. Therefore, there have not been any major changes in the approach other than clarifying certain aspects of the text.

7.1 Guidance on criteria regarding certified monitoring mechanism

Three (3) respondents reiterated the importance of accuracy in the monitoring mechanism.

BEREC agrees that the accuracy of monitoring mechanisms is important and considers that the proposed methodology would result in sufficiently accurate results for its intended purposes.

Another respondent suggested tests should be certified by neutral scientific institutes.

BEREC notes that according to the BEREC Guidelines Recital 161 "the Regulation does not define how the certification must be done. If the NRA provides a monitoring mechanism implemented for this purpose it should be considered as a certified monitoring mechanism according to Article 4(4)."

One another respondent requested clarification regarding what is meant in practice by the reference to a “straightforward comparison” between measurement results and contractual speeds in section 7.1 c). It also considered it important not to confuse in general advertised speeds with individually agreed speeds. In relation to 7.1 d) it requested clarification on the meaning of “a single indicator” (against which, noncompliance would give users the right to legal recourse). It raised concerns about the risks of NRAs interpreting this detail in a disproportionate way.

BEREC considers that, by using a certified monitoring mechanism, end-users should be able to assess in a clear and simple way if measurement results meet all contractual speed values (minimum, normally available, maximum) assumed by ISPs.

According to the BEREC NN guidelines the advertised speed for a mobile IAS offer should reflect the speed that the ISP is realistically able to deliver to end users. NRAs could set requirements in accordance with Article 5(1) on how speeds defined in the contract relate to advertised speeds, for example that the advertised speed should not exceed the maximum speed defined in the contract.