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Response to public consultation on draft BEREC Guidelines on Very High Capacity Networks

Introductory remarks

The digital revolution towards real-time, any-time connectivity is transforming the world and is creating many opportunities both for operators and end users. As stated in the European Commission's communication "Shaping Europe's Digital Future", **gigabit connectivity powered by secure fiber and 5G infrastructure is vital if we are to tap into Europe's digital growth potential**. Therefore, promoting the widespread deployment of competitive and technology neutral very high capacity networks is a key factor in the consolidation of the European gigabit society.

Digitales welcome therefore the BEREC Guidelines that will contribute to a harmonized interpretation and understanding of what may constitute as a "very high capacity network" (VHCN) in the EU in line with the EECC's provisions. As currently drafted, the Guidelines provide National Regulatory Authorities (NRAs) with useful clarification in certain areas and can be improved and amended in other areas.

Key Recommendations for draft BEREC Guidelines on Very High Capacity Networks

1. **Ensure Technology Neutral Criteria for the definition of Very High Capacity Networks**

Nowadays, there are different fixed line connectivity and backhauling technologies used, combined in network deployments, some of which are fiber-based and some of which are wireless, but are equal in terms of capability. These types of alternatives should be acknowledged and recognized by the Guidelines in a more inclusive and explicit language.

Guidelines referenced in recommendations: Paragraph 16

2. **The Guidelines should enable NRAs to be inclusive to embrace evolution of current, as well as new technologies**

BEREC Guidelines ought to reflect the dynamics of the industry, by offering a flexible framework for NRAs to include upgrades implemented to existing technologies as well as improvements obtained by network design. The Guidelines must avoid to explicitly exclude any current technologies or evolution thereof as alternative to implement VHCN.

Current text indicates that 4G and some earlier generations are not able to meet performance thresholds– this statement is not accurate, and we suggest its removal.

Criterion 3 states some parameters thresholds that even DCOSIS 3.1 technology and even some FTTH network cannot actually meet, therefore, seriously limiting possible upgrade of other technologies as HFC.

Guidelines referenced in recommendations: Paragraphs 35, 36.

3. **Performance assessment should consider the specificities of the wireless networks design, and not only the network capacity per se**

Compliance with the "capacity" requirement is as much about proper network dimensioning through dynamic resource management as about network capacity to support different services. The Guidelines and the methodologies used for networks assessment should be adjusted to reflect all relevant factors.

Guidelines referenced in recommendations: Paragraphs 69, 75.

4. **These Guidelines have the potential to accelerate Europe's journey in achieving its Gigabit connectivity**

The importance of these Guidelines is well acknowledged by all stakeholders. We understand and agree with BEREC's acknowledgement that matters of state aid go beyond the scope of the Guidelines as outlined in paragraph 24.

Guidelines referenced in recommendations: Paragraph 24.

Key Recommendations: technical context, policy considerations and specific Guidelines

1. **Ensure Technology Neutral Criteria for the definition of Very High Capacity Networks**

Technical Context

To ensure flexibility, operators can deploy a combination of fiber and microwave transport technologies: fiber where multiplexing of different services offers cost- efficient and low-latency transmission for fronthaul; microwave where fast, flexible deployment is needed, but still with 5G-ready capacity with low latency over the air. Due to the cost efficiency of microwave products, this technology is also increasingly used in areas where optical fiber technically can be an option, but the deployment of fiber is more expensive.

The major network and technology driver in this area continues to be evolving capacity needs. With the buildout of LTE, the appetite for mobile broadband backhaul capacity has increased as expected, a trend that will continue with the arrival of 5G. Forecast shows that by 2022, the typical backhaul capacity for a high-capacity radio site will be in the 1Gbps range, rising to 3–5Gbps by 2025. We also predict that 80 percent of sites in an advanced wireless broadband network will still be operating under 350Mbps in 2022, however by 2025 this will have increased to 600Mbps.

Technology evolution is enabling new alternatives of classic backhauling technologies to emerge. One example of this trend is the 3GPP work in the Integrated Access Backhauling (IAB) standardization. This technology will use part of the wireless spectrum as backhaul connection of base stations instead of fiber. A diverse range of deployment scenarios can be envisioned, including support for outdoor small cell deployments, coverage extension, indoor deployments, and fixed wireless access (FWA). IAB is currently being standardized for 3GPP rel-16, which is expected to be completed by Q3 2020.

Furthermore, according to GSA, by the end of March 2020, 70 mobile operators in 40 countries had launched one or more 3GPP compliance 5G services. Of these, 34 operators had launched 3GPP compliant 5G FWA or broadband services (27 full launches and 7 limited availability launches)

Regarding criterion 2 thresholds for fixed networks, the guidelines consider DOCSIS 3.1 as the most advanced HFC technology so far. However, there are some inconsistencies when determining the corresponding parameters thresholds. Networks using DOCSIS 3.0 + 3.1 obtain better results than networks only using DOCSIS 3.1; some parameter's values are not even met by FTTH networks. Thus, the proposed thresholds would hardly let HFC updated to DOCSIS 3.1., be considered as VHCN. It is hard to believe that such thresholds reflect conveniently the access network performance between the last distribution node and the building. Values informed by the respondents differ extraordinarily, so the median values result too high. The median should calculate excluding the higher results that produce a distortion of the final result.

Policy Considerations

BEREC Guidelines determine that any network which fulfils one (or more) out of four criteria is a very high capacity network. Demand for 5G services is rising sharply across consumer and industry markets. To service this demand, service providers need purpose-built microwave and fiber mobile transport solutions – delivering ubiquitous, high-capacity 5G and 4G connectivity across cities, suburban areas and remote, rural spaces. The fact that networking industry is in constant evolution should be considered and articulated as an element in the definition of the VHCN criteria.

One of the guiding principles of the Guidelines, besides the equivalence of performance, is the consideration of two different topologies (i) fibre roll out (at least) up to a multidwelling building in the case of a fixed-line connection and (ii) fibre roll out up to the base station in the case of a wireless connection.

As currently drafted, the Guidelines circumscribe "wireless VHCN" to a specific configuration: base stations with fiber-based backhauling, which might lead to excluding, unintentionally, non-fiber based backhauling alternatives. Modern wireless networks architecture enables other backhauling alternatives, which offer equivalent capacity to fibre rollouts. A clear example of this type of solutions is the Microwave Backhaul Technology (MBT). MBT plays a significant role in providing reliable wireless network performance.

Similar considerations apply to some architectures of HFC networks. Advanced Docsis 3.0 enables offer equivalent capacity to networks included in Criterion 1 with fibre roll out up to the multi-dwelling building.

Section 3 of the draft BEREC Guidelines seem to suggest that wireless networks normally cannot offer services to end users that are the target of many fixed broadband networks, such as home broadband or broadband to enterprises. This might be misleading, and cause NRAs to issue policies and funding incentives based on a "fixed VHCN" paradigm, without considering Fixed Wireless Access (FWA), thereby compromising technology neutrality. Mobile networks are a multiservices network providing MBB, IoT, FWA, etc. at the same time on the same infrastructure

The Guidelines should reflect the reality of networks deployment and adapt the criteria definition to the dynamics and evolution of the industry. Due to major recent evolution in wireless backhauling, the Guidelines should be written in a way that does not imply differences between the fiber backhaul and other backhauling techniques. The objective is to enable innovation both in the network deployment and the services provision while ensuring a neutral definition of VHCN.

Guideline Recommendations

Revisit Guidelines Section 2 and 3 (paragraph 16) to better reflect the use of alternative network architectures and backhauling solutions different to fibre in Wireless/Mobile VHCN.

Revisit section 3 looking for a formulation that avoids a potential bias of NRAs on "fixed VHCN", and that NRAs decouple the service offered from the network by which the service is offered. NRAs should be encouraged to base policies on services and service levels rather than "fixed" and "wireless" networks.

2. **The Guidelines should enable NRAs to be inclusive to embrace current, as well as new technologies**

Technical Context

3GPP has developed the 5G standard, which is seen as the forefront technology in the wireless networks. Although 5G is a natural step in the telecommunications evolution, LTE constitutes an essential piece of the 5G puzzle. As such, Rel-15 and Rel-16 are intended to meet as many 5G requirements as possible and address the relevant use cases expected in the 5G era.

The process of making LTE 5G-ready involves a variety of enhancements and new features. The most significant ones are enhancements to user data rates and system capacity with FD-MIMO, improved support for unlicensed operations, and latency reduction in both control and user planes (UPs). The enhancements in Rel-14 and Rel15 also aimed to provide better support for use cases such as massive MTC, critical communications and ITS.

LTE continues to bring a great experience for mobile broadband. The evolution of LTE continues to be relentless. Several milestones now increase capacity and speed by ten times since the start of LTE. LTE now delivers Gigabit speeds adding capacity and cutting time-to-content. 4G LTE, with state-of-the-art functionality, by 2021 from which these guidelines are valid, normally can fulfil threshold 2.

Policy Considerations

As networks evolve and technologies like Massive MIMO, Network Slicing, Integrated Access Backhauling (IAB) or 5G New Radio are introduced, network vendors are also working on continued capacity improvements in 4G LTE.

In paragraph 36, the Guidelines state that "*in practice, save for exceptional cases of LTE Advanced (4G), BEREC expects that 4G and earlier generations of mobile networks are not able to meet performance thresholds 2."* The way this text is written closes needlessly the door for a technology that, as presented in the technical context of this document, evolves not only as essential piece of 5G but also as a connectivity alternative in several markets. Based on this consideration, BEREC Guidelines should reflect the dynamics of the industry, by offering NRAs a flexible framework to include upgrades implemented to existing technologies avoiding an explicit exclusion of technologies such as LTE.

Guideline Recommendations

Revisit the Guidelines paragraphs 35, 36, and remove the text mentioning that "BEREC expects that 4G and earlier generations of mobile networks are not able to meet performance thresholds 2".

3. **Performance assessment should consider the specificities of the networks design, and not only the network capacity per se**

Technical Context

Network capacity should be understood as the ability of the network to deliver services to agreed service levels using network dimensioning and other innovative management techniques, rather than as a static resource. Being able to deliver the wide variety of network performance characteristics that future services will demand is one of the primary technical challenges faced by service providers. The performance requirements placed on the network will demand tailored connectivity in terms of data rate, latency, security, availability, and a multitude of other parameters.

From a radio perspective, 3G and 4G are capable of handling different types of bearer classes and those capabilities have improved over time in 4G. 5G will have advanced bearer capabilities from the outset. Network dimensioning combined with tools such as networks slices can ensure a balanced use of the resource with no detriment for services simultaneously running over the network.

The mobile network performance depends on the dynamic capacity of the network to adjust according to users/traffic demands and is dependent on innovative network resource management. Network slicing enables logical networks that are customized to meet the needs of each application and that can be easily adapted to fast-changing demands. Network slicing provides customized connectivity that will benefit many segments/users by offering a smart way to segment the network to support particular services or business segments.

In a multiservice network like an MBB network there exist several services that will require specific measurements.

- Networks supporting mobility are designed not to give equal performance everywhere, even in a 'sub-area', but instead capacity is targeted to locations where most usage is foreseen, and hence, a simple average over a surface may give unintended and misguiding results.

- Networks support multiple devices types may have devices, e.g. IoT and CPE devices, with vastly different transmitter and receiver capabilities than ordinary smartphones in a 'sub-area'.

Policy Considerations

While performance is related to network capacity, network dimensioning can ensure enhanced performance through effective resource management according to the different market segments/user demands.

As currently drafted, the Guidelines might lead to the wrongful interpretation of the network capacity as a static resource. But the modern network architecture and management capabilities enable smart network dimensioning that can simultaneously manage different types of services.

The Guidelines should reflect the evolution and importance of dynamic resource management in the network and put the emphasis on the capacity of the network to effectively manage resources according to the different services, rather than limiting the assessment to network capacity itself.

Networks are capable to support a variety of services and device types on the same infrastructure. The Guidelines do not offer a clear definition on how the thresholds are evaluated on scenarios where one service out of several can reach certain threshold in a subarea. Similar approach could apply for device types, and the definition of a VHCN.

Therefore, the Guidelines should clarify that NRAs can use other methodologies considering their suitability with the service delivered by the network.

Guidelines in paragraph 75 mention drive test as a methodology to measure speeds. From our point of view, BEREC should strengthen the clarification that this is only one example out of many alternatives. Methodologies should be selected according to the service.

Guideline Recommendations

Paragraph 75 should strengthen the clarification that drive test method is only one example methodology

Guidelines should also encourage NRAs to use performance measurement methodologies according to the service delivered by the network.

4. **These Guidelines have the potential to accelerate Europe's journey in achieving its Gigabit connectivity**

The importance of these Guidelines is well acknowledged by all stakeholders. We understand and agree with BEREC's acknowledgement that matters of state aid go beyond the scope of the Guidelines as outlined in paragraph 24.

Guidelines recommendations:

Revisit Paragraph 24 by:

1) Clarifying that the Guidelines provide criteria for the consideration of both a fixed or wireless network to be considered VHCN (as both fixed and wireless networks have capabilities to boost connectivity and contribute to EECC's objective).
2) In order to minimize misinterpretation regarding the relationship between the BEREC Guidelines on Very High Capacity Network (the VHCN definition and criteria described in the Guidelines) and state aid/ public funding matters, we suggest removing any references to state aid / public funding in the Guidelines.

Suggested amendments

In this section, we suggest amendments which follow the recommendations provided in the previous sections. Additions to the text are marked in bold, while deletion of a specific part of the text is shown as strikethrough.

Original text	Proposed text
Paragraph 16 In accordance with the EECC (see section 2) and based on data collected from network operators (see section 4 and annex 2 to 4), BEREC has determined that any network which fulfils one (or more) of the following four criteria is a very high capacity network: Criterion 1: Any network providing a fixed-line connection with a fibre roll out at least up to the multi-dwelling building. Criterion 2: Any network providing a wireless connection with a fibre roll out up to the base station. Criterion 3: Any network providing a fixed-line connection which is capable of delivering, under usual peak-time conditions, services to end-users with the following quality of service (performance thresholds 1): a. Downlink data rate ≥ 1000 Mbps b. Uplink data rate ≥ 200 Mbps c. IP packet error ratio (Y.1540) ≤ 0.05% d. IP packet loss ratio (Y.1540) ≤ 0.0025% e. Round-trip IP packet delay (RFC 2681) ≤ 10 ms f. IP packet delay variation (RFC 3393) ≤ 2 ms g. IP service availability (Y.1540) ≥ 99.9% per year Criterion 4: Any network providing a wireless connection which is capable of delivering, under usual peak-time conditions, services to end-users with the following quality of service (performance thresholds 2). a. Downlink data rate ≥ 150 Mbps b. Uplink data rate ≥ 50 Mbps c. IP packet error ratio (Y.1540) ≤ 0.01% d. IP packet loss ratio (Y.1540) ≤ 0.005%	**Paragraph 16** In accordance with the EECC (see section 2) and based on data collected from network operators (see section 4 and annex 2 to 4), BEREC has determined that any network which fulfils one (or more) of the following four criteria is a very high capacity network: Criterion 1: Any network providing a fixed-line connection with a fibre roll out at least up to the multi-dwelling building. Criterion 2: Any network providing a wireless connection with a fibre or a fibre-like performance technology roll out up to the base station. Criterion 3: Any network providing a fixed-line connection which is capable of delivering, under usual peak-time conditions, services to end-users with the following quality of service (performance thresholds 1): a. Downlink data rate ≥ 1000 Mbps b. Uplink data rate ≥ 200 Mbps c. IP packet error ratio (Y.1540) ≤ 0.05% d. IP packet loss ratio (Y.1540) ≤ 0.0025% e. Round-trip IP packet delay (RFC 2681) ≤ 10 ms f. IP packet delay variation (RFC 3393) ≤ 2 ms g. IP service availability (Y.1540) ≥ 99.9% per year Criterion 4: Any network providing a wireless connection which is capable of delivering, under usual peak-time conditions, services to end-users with the following quality of service (performance thresholds 2). a. Downlink data rate ≥ 150 Mbps b. Uplink data rate ≥ 50 Mbps c. IP packet error ratio (Y.1540) ≤ 0.01%

e. Round-trip IP packet delay (RFC 2681) ≤ 25 ms f. IP packet delay variation (RFC 3393) ≤ 6 ms g. IP service availability (Y.1540) ≥ 99.81% per year	d. IP packet loss ratio (Y.1540) ≤ 0.005% e. Round-trip IP packet delay (RFC 2681) ≤ 25 ms f. IP packet delay variation (RFC 3393) ≤ 6 ms g. IP service availability (Y.1540) ≥ 99.81% per year
Paragraphs 35 and 36 35. For this reason, the following technologies are considered. a. In case of fixed networks with copper access, G.fast on twisted pair. b. In case of fixed networks with coax access, the most advanced DOCSIS technology (e.g. DOCSIS 3.1). c. In case of mobile networks, LTE Advanced (4G) with carrier aggregation and MIMO9, however, only carrier aggregation with the highest aggregated spectrum and MIMO with the highest number of parallel data streams used in mobile networks. 36. 5G will be deployed after these Guidelines enter into force. However, 5G had not yet been deployed in networks to a relevant extent at the time when it was necessary to collect the data for the development of these Guidelines. Therefore, it is not possible to determine the performance thresholds 2 (wireless networks) based on these technologies. However, in order to take 5G into account as much as possible, the performance thresholds 2 are determined based on the highest values (and not e.g. on the average of the values) of the achievable end-user QoS, according to the answers from the network operators. Therefore, in practice, save for exceptional cases of LTE Advanced (4G), BEREC expects that 4G and earlier generations of mobile networks are not able to meet performance thresholds 2.	**Paragraphs 35 and 36** 35. For this reason, the following technologies are considered. a. In case of fixed networks with copper access, G.fast on twisted pair. b. In case of fixed networks with coax access, the most advanced DOCSIS technology (e.g. DOCSIS 3.1). c. In case of mobile networks, LTE or LTE Advanced (4G) with carrier aggregation and MIMO9, however, only carrier aggregation with the highest aggregated spectrum and MIMO with the highest number of parallel data streams used in mobile networks. 36. 5G will be deployed after these Guidelines enter into force. However, 5G had not yet been deployed in networks to a relevant extent at the time when it was necessary to collect the data for the development of these Guidelines. Therefore, it is not possible to determine the performance thresholds 2 (wireless networks) based on these technologies. However, in order to take 5G into account as much as possible, the performance thresholds 2 are determined based on the highest values (and not e.g. on the average of the values) of the achievable end-user QoS, according to the answers from the network operators. ~~Therefore, in practice, save for exceptional cases of LTE Advanced (4G), BEREC expects that 4G and earlier generations of mobile networks are not able to meet performance thresholds 2.~~
Paragraphs 69 and 75 69. A sub-area meets performance thresholds 1, if, under usual peak-time conditions, the end-users in this sub-area will typically experience at least the QoS of the performance thresholds 1 at the point where the subscriber access line ends in its living space (not including limitations from the customer premises equipment). For example, if end-users in this sub-area would measure the data rate of the service with an internet	**Paragraphs 69 and 75** 69. A sub-area meets performance thresholds 1, if, under usual peak-time conditions, the end-users in this sub-area will typically experience at least the QoS of the performance thresholds 1 at the point where the subscriber access line ends in its living space (not including limitations from the customer premises equipment). For example, if end-users in this sub-area would measure the data rate of the service with an internet

speed test during peak-time, then they would typically measure at least 1,000 Mbps in downlink and 200 Mbps in uplink (at the level of the IP packet payload) in case their customer premises equipment does not limit the data rate. 75. A sub-area meets performance thresholds 2, if, under usual peak-time conditions, in this sub-area an end-user will experience on average at least the QoS of the performance thresholds 2 at outdoor locations.23 For example, if the data rate in this sub-area will be measured during peak-time with a drive test, then the average value of the measured data rate would be at least 150 Mbps in downlink and 50 Mbps in uplink (at the level of the IP packet payload) in case the mobile equipment used in the drive test sufficiently supports the technology used in the wireless network.	speed test during peak-time, then they would typically measure at least 1,000 Mbps in downlink and 200 Mbps in uplink (at the level of the IP packet payload) in case their customer premises equipment does not limit the data rate. 75. A sub-area meets performance thresholds 2, if, under usual peak-time conditions, in this sub-area an end-user will experience on average at least the QoS of the performance thresholds 2 at outdoor locations. For example, if the data rate in this sub-area will be measured during peak-time with a drive test or any other fit for purpose methodology, then the average value of the measured data rate would be at least 150 Mbps in downlink and 50 Mbps in uplink (at the level of the IP packet payload) in case the mobile equipment used in the drive test sufficiently supports the technology used in the wireless network.