The Treatment of 5G in the Broadband State aid Guidelines

Submission by Ericsson

Executive Summary

1.1 We commend the Commission for the substantial work done to update the Guidelines. We welcome the emphasis on 5G as a Gigabit capable step change technology which can play a key role in meeting the Commission's 2025 and 2030 targets. But we believe that the provisions regarding the treatment of 5G could be improved upon in a number of respects, to reflect the latest technological developments. In particular:

- the distinction between standalone and non-standalone 5G is important, but less relevant to the circumstances in which State aid might be offered than other factors, such as spectrum and backhaul;
- the inclusion of 5G Fixed Wireless Access (FWA) as an ultrafast broadband technology is welcome, but in many cases a 5G network will serve FWA as well as enhanced mobile broadband (eMBB) and Internet of Things (IoT) end-users; and
- the ability to support 5G FWA Consumer Premise Equipment (CPE) including external elements could be an important factor in driving take up of the service.

1.2 We have made a number of recommendations for the Guidelines, and enclose a marked up version of the draft Guidelines reflecting those recommendations.

Introduction

2.1 We welcome the work the Commission has undertaken to analyze the Broadband State aid Guidelines and the proposals to bring the Guidelines up to date in light of technological and market developments. The pandemic has underlined the necessity for public authorities to ensure that reliable ultrafast broadband reaches as widely as possible into all areas to serve all communities and segments of society.

2.2 We believe that the Commission's proposals provide an excellent basis to assess public support for broadband roll-out to areas that the competitive market would either not reach, or not reach within a relevant time horizon. The Commission has in particular articulated a coherent way forward for State aid for fixed access networks, and sensibly updated the mobile access network and backhaul provisions.

2.3 The proposals however also reflect the challenge of fitting 5G into a traditional telecoms framework, as is evident from the Commission's treatment of 5G FWA. FWA is likely in many cases to be provided by a 5G network which would also serve mobile broadband and IoT customers including smart agriculture, smart transport and logistics, smart grids and industry 4.0 customers. The distinction between standalone 5G and non-standalone 5G in the Guidelines is also indicative of this challenge, but more attention needs to be paid within the Guidelines to spectrum provision for 5G and to backhaul, particularly if it is to meet the FWA requirement. As discussed below, 5G – whether non-standalone or standalone – if provided with sufficient spectrum and backhaul capacity (either fibre or Gigabit microwave), is a Gigabit capable technology.

2.4 When considering how 5G should fit into the Guidelines, it is pertinent to ask whether 5G constitutes a step change from 4G and earlier mobile technologies, and whether there is a case for arguing that with 5G the distinction between fixed and mobile telecoms is less relevant. In both cases, the answer depends on how 5G is deployed. This paper considers how different forms of 5G deployment might be treated within the Guidelines.

A. Is 5G a step change from 4G?

3.1 An operator can introduce 5G as an overlay to an existing 4G network. Many of the early examples of 5G networks were of this type, and involved software upgrades but not – in the words of the Guidelines – "substantial new infrastructure investments". Although in these circumstances performance is improved incrementally, further enhancement is necessary to realize the full potential of transformational step change 5G. There are three factors that in different ways contribute to 5G delivering a step change in connectivity – increased spectrum, Gigabit capable backhaul, and 5G core.

3.2 In terms of spectrum, the Commission harmonized three spectrum band allocations for 5G: 700MHz, 3.5GHz, and 26GHz. These bands have different characteristics: the low 700MHz band has excellent propagation qualities, but there is a limited amount of spectrum available making full broadband connectivity effectively impossible using only 700MHz band spectrum assignments that most operators in the EU hold. The mid-band 3.5GHz has slightly less good propagation qualities, but operators have been able to buy significantly larger assignments, which would be sufficient for ultrafast 5G FWA broadband provision. Spectrum available in the millimeter band, 26GHz, can be used to increase capacity and speeds, vital in dense urban areas, and operators may also use 26GHz in less densely populated cell sites to off-load demand on mid-band spectrum towards the center of the cell site, thereby increasing speed and capacity at the mid-band cell edge. Ericsson calculations based on existing simulations of cell site performance demonstrate the importance of operators bringing this mid and higher band spectrum to bear in Time Division Duplex (TDD) format, including for less populated cell sites, for delivery of high performance and ultrafast broadband. Based on NUTS3[1] population density, 5G using 700MHz and 3.5GHz TDD will deliver a 6.2 – 7.2 times improvement in capacity over existing 4G LTE, a 3.4 – 3.7 times increase in average throughput, and a 2.4 – 2.5 times increase in peak throughput. If 26GHz spectrum is added, these ranges increase to 9.8 – 13.9 times (capacity), 6.2 – 7.8 times (average throughput), and 5.7 – 5.9 times (peak throughput). So irrespective of whether the cell site is connected to a 5G core or a legacy 4G core, a 5G RAN with sufficient provision of spectrum and backhaul capacity can provide a step change in broadband connection capability as defined in the Guidelines. In this case, the investment by the operator (measured against the Guidelines' "substantial new infrastructure investments") would lie in enabling increased spectrum use e.g. mid-band (3.5GHz TDD) including the deployment of massive MIMO radio antennas, as well as backhaul (see 3.4 below) to deliver a step change in speed and capacity.

3.3 Features of 5G such as beam forming will improve the propagation of the mid-band and millimeter band spectrum through the cell site, in many cases without the

[1] See: https://ec.europa.eu/eurostat/web/nuts/background

operator needing to increase the number of cell sites. Massive MIMO is also an important element in delivering high capacity performance across the cell site. Uplink speeds are constrained both by spectrum and by the consumer device transmission power. A typical cell site configuration for 5G ultrafast broadband might see the 700 MHz spectrum (of which operators typically have a maximum of 2 x 10 MHz) used for the uplink, and a substantially larger breadth of 3.5GHz and/or 26GHz spectrum, used in TDD form to maximize capacity, for the downlink.

3.4 The second element which is essential to delivery of high capacity broadband is backhaul. The Commission's draft of the revised Guidelines rightly recognizes the importance of backhaul, and identifies provision of fibre or equivalent backhaul as an investment which could benefit from State aid. Many operators have been investing in fibre backhaul to the base station, which enables the cell site to receive high capacity broadband. Ericsson also has installed Gigabit capable microwave backhaul capable of delivering 10Gbps with E-band or multi-band spectrum, and in an experimental live trial has achieved 100Gbps. Installation of either fibre or Gigabit capable microwave backhaul would also meet the test of "substantial new infrastructure investments".

3.5 If the operator additionally invests in a 5G core network (referred to as "standalone 5G"), the full benefit of the enhanced features of 5G becomes available, including high reliability very low latency connectivity and end-to-end network slicing – which are key enablers for advanced IoT applications. The very low latency supports highly responsive applications such as are necessary for example in smart transport, logistics, drone communications, and healthcare monitoring. Using all of the features a 5G core can support, a 5G standalone network with the spectrum and backhaul described above will achieve higher connection speeds, and provide reliable connection to a greater number of devices. The 5G core network investment will not however be limited to supporting specific geographical areas which might be recipients of State aid to enhance connectivity, but will support the operator's entire 5G network. Operators are likely to undertake this investment over the coming years based on a business case to support their full 5G network, so it is less likely that 5G core investments would qualify for a market failure test and thus be eligible for State aid under the Guidelines.

3.6 In short, for 5G (non-standalone or standalone) to represent a step change for mobile broadband or FWA the operator is likely to have to invest in sufficient backhaul capacity, and in making provision for TDD mid-band (and potentially millimeter) spectrum with massive MIMO deployment, including if necessary through enhancing the network. If in addition the network is 5G standalone the step change criteria of evolving end-user needs and innovation would also be met.

3.7 In looking at what constitutes a 5G installation which might qualify for State aid under the Guidelines, for ultrafast broadband and for evolving end-user needs it would involve substantial investment by the operator in configuring the radio access network to benefit from sufficient spectrum (in particular mid-band TDD) to be able to deliver sustained high performance, and in sufficient backhaul capacity. We believe, in support of the Commission's 2030 target, that it would be sensible in the Guidelines to provide for an exceptional case in support of Gigabit capable technologies even where ultrafast (but not Gigabit capable) broadband is present or planned. This exceptional case could apply to 5G or fibre investments.

3.8 The lack of geographical definition to investment in the 5G core will make it in itself less likely to qualify for State aid under the Guidelines, but connection to a standalone 5G core would make the investments above meet the requirements of both the innovation and the evolving end user needs tests.

B. Does the distinction between fixed and wireless networks still apply with 5G?

4.1 The Guidelines are based on a distinction between fixed and wireless networks. The Commission's proposals however recognize that 5G – as a Gigabit capable technology – can also be an alternative means to deliver a fixed broadband equivalent, through FWA. In the treatment of white zones, the Commission's proposals also recognize the very substantial catch up required in some areas, but the proposed ability to use State aid to upgrade very slow broadband speeds threefold risks leaving some end-users with broadband which falls far short of the 2025 target for ultrafast broadband. In many such under-served areas installation of 5G FWA, through the investments described in 3.2 – 3.4 above, would provide a quick and cost effective route to delivering ultrafast broadband. 5G FWA could therefore make an important contribution towards the achievement of the Commission's 2025 target for ultrafast broadband including for areas which currently suffer from the very lowest connection speeds, and would be an important step towards meeting the Commission's 2030 target for Gigabit communications. To achieve such performance, the 5G network would need adequate spectrum and sufficient backhaul capacity, as discussed above. It would seem perverse to use State aid to deliver much lower connection speeds when ultrafast broadband is cost-effectively and quickly available through 5G FWA.

4.2 The fixed – wireless distinction is further complicated by the role 5G (particularly standalone 5G) will have in enabling innovation in IoT, through higher capacity, greater download speeds, and lower latency, as discussed above. While some IoT applications, such as transport and logistics, would fit naturally into a mobile network framework, where mobility is a core requirement, for others which are more static 5G could be a useful alternative to a fixed connection because of complexities of getting fixed connections to wherever the connected device is installed. For such static connections, 5G could ease the cost and complexity of installation and occasional relocation if necessary, while providing the full capability required of the connection and being available much more rapidly, to help meet the 2025 and 2030 targets.

4.3 In technology terms, the distinction between 5G used for mobile applications and 5G used as a substitute for fixed connectivity lies primarily in the consumer provided equipment (CPE) – mobile handsets, fixed wireless receivers (often with an external element), IoT connection equipment etc. The 5G network itself will usually be capable of connecting to any CPE which is authorized to connect to the network, and benefits such as network slicing and very low latency are available to all CPEs.

4.4 5G – if provided based on a 5G core, and if assigned enough spectrum and sufficient backhaul capacity – is capable of a full range of applications which demand mobility and therefore fall on the wireless side of the fixed-wireless boundary, but also of providing a cost effective alternative to fixed fibre connections particularly in less well served areas. The much greater speed with which 5G provision can be established will be essential to meeting the Commission's 2025 target. The Commission is to be

commended for recognizing this by including 5G FWA within the fixed ultrafast broadband provisions of the Guidelines.

4.5 While some operators are installing 5G networks with the intention of providing only FWA as an alternative to fibre or cable networks, in many cases as noted above the 5G network will be capable of providing FWA, mobile and IoT applications, and the operator's business case for the investment in the network may be based on all of these potential market opportunities. So while it is completely legitimate for the Guidelines to assess 5G FWA against the fixed broadband criteria, the Guidelines should also accommodate the possibility of a mixed case for State aid for 5G, which could include FWA (assessed against the fixed broadband criteria) and mobile and IoT (assessed against the mobile broadband criteria).

C. Does 5G meet the tests required to benefit from State aid?

5.1 Some of the tests required to be passed in order for State aid to be legitimate, such as the existence of market failure, apply in the case of 5G as for other technologies. Where a contribution to certain economic activities is a requirement of the State aid granted, 5G has the capability to contribute to a range of economic activities, including:

- *Gigabit Society:* as a Gigabit capable technology, ubiquitous 5G is central to the achievement of many of the objectives of the Gigabit Society. In terms of the Guidelines, ensuring that step change 5G is available wherever it is needed is essential to ensuring that society as a whole benefits from the economic and social effect of innovation that 5G enables, in mobile connectivity and mobile broadband, in the important developing market of consumer IoT, smart transport and logistics, and industrial IoT.
- *5G FWA:* can provide a cost-effective complement to full fibre network installation to ensure all households and businesses have access to ultrafast broadband. It is worth noting in this context that State aid could well be justified as a take up measure to support the provision of CPE for 5G FWA (including external elements) in the case where an operator would be incentivized by such support for 5G FWA to make the necessary investments in sufficient backhaul capacity and configuration of the network to support adequate spectrum and 5G RAN for sustained ultrafast broadband.
- *Carbon Reduction:* many of the applications enabled by 5G can make an important contribution to carbon reduction – for example, remote working reducing travel to work and for business meetings; smart transport and logistics achieve greater efficiency; greater automation in agriculture and forestry; or connectivity for new low carbon industrial sites. While increased connectivity to respond to growing demand might lead to increased power consumption and carbon emissions in networks, modernization of the network as 5G is installed can mitigate this effect, providing the greater connectivity which enables carbon reduction without at the same time increasing carbon emissions from the network itself. McKinsey's Net-Zero Europe analysis estimates that connectivity can reduce Europe's carbon emissions by 15% by 2030[2]. Making 5G available

[2] https://www.mckinsey.com/~/media/mckinsey/business%20functions/sustainability/our%20insights/how%20

across the power, transport, buildings, and manufacturing sectors could lower Europe's emissions by up to an additional 5%[3]

- *Industrial modernization / IoT:* in addition to the positive carbon impact, EU competitiveness depends on industrial modernization which is in turn enabled by automation. Because of the much lower latency in standalone 5G, a 5G network can support much greater precision in automated processes, which would underpin innovation and lean, efficient production. Similarly, the low latency can support remote medical intervention and real time precision monitoring systems for critical infrastructure.
- *Smart transport / logistics:* the same low latency combined with high data transfer rates will support much smarter transport (rail, bus, car, e-bike) and logistics operations, including developments in drone technology, which – in addition to greater efficiency and responsiveness to consumer demand – will allow a cleaner, greener society, improving the quality of life for communities.

D. Recommendations for the Guidelines

6.1 We welcome the many positive developments which the Commission has recommended in the revised draft Guidelines, including the important provision to bring active network equipment in scope for State aid, and the recognition of 5G FWA as an ultrafast broadband network technology capable of meeting the 2025 and 2030 targets. We believe that the Guidelines could nonetheless be improved upon in the following ways, reflecting the considerations above.

i. We believe that the Guidelines could place more emphasis on the importance of achieving Gigabit capable connectivity, and recommend generally strengthening the Guidelines to reflect this[4].

ii. We specifically recommend the inclusion of an exceptional case justification for Gigabit capable broadband investments[5].

iii. In order to bring 5G to as wide a population as possible, we believe that it is important to allow for a "mixed case" for State aid support for 5G installation, in which FWA (measured against the fixed criteria) and mobile / IoT applications (measured against the mobile broadband criteria) can be used in combination to justify the aid. We recommend that the Guidelines should explicitly allow for this "mixed case"[6].

iv. Because potential users of 5G as an innovation platform are likely to wait until 5G is available before developing new and innovative services, we believe that the mobile market failure test would be stronger with reference to innovation (which is correctly the key element of the step change definition). We therefore recommend adding a reference to innovation to the market failure test[7].

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the%20european%20union%20could%20achieve%20net%20zero%20emissions%20at%20net%20zero%20cost/net-zero-europe-vf.pdf

[3] https://www.ericsson.com/en/about-us/sustainability-and-corporate-responsibility/environment/connectivity-and-climate-change

[4] See proposed changes to paragraphs 11 and 64, and proposed new paragraphs 52 & 54

[5] See proposed new paragraphs 77-80

[6] See proposed changes to paragraph 35, and proposed new paragraph 81

[7] See proposed changes to paragraphs 49 (footnote), 66 and footnote, and 109, and proposed new paragraphs 55 and 121

v. We believe that the Commission has correctly identified the importance for the adoption of new and innovative services of standalone 5G as opposed to non-standalone 5G, but we believe that the Guidelines should recognize for 5G FWA and eMBB the distinction between standalone and non-standalone 5G is not relevant – what matters in this case is adequate spectrum and any necessary reconfiguration of the network (e.g. mid-band spectrum with massive MIMO deployment), as well as fibre or Gigabit capable microwave backhaul. We recommend that the Guidelines should place more emphasis on the importance of adequate spectrum and sufficient backhaul capacity for 5G FWA and eMBB, including reference to Gigabit capable microwave alongside fibre, and should not distinguish between standalone and non-standalone 5G for these purposes[8].

vi. Given the existence of 5G FWA as a cost-effective and rapidly deployable ultrafast broadband solution, we believe that State aid should not be given for any investment which fails to meet ultrafast broadband speeds, regardless of how great an improvement on current provision lesser speeds might be in some badly served areas, and recommend removing the references to State aid for lower speed connectivity[9].

vii. We believe that provision and installation of CPE could be a significant factor in driving uptake of – and thus securing the benefits of – 5G FWA, particularly if delivering ultrafast broadband inside the premises involves installing external CPE elements We do not consider that a state intervention involving support for installation of FWA CPE – for example through vouchers – would be excluded by the current proposed drafting of the Guidelines, but we believe that explicit mention would be advisable. We recommend that the Guidelines refer to provision of FWA CPE as a possible take up measure[10].

6.2 We have reflected these recommendations, and a number of more technical suggested amendments, in the annex to this document

[8] See proposed changes to paragraphs 22 (footnote), 23 (footnote), 24, 71, 72, 108, and 110

[9] See proposed changes to paragraph 99 and footnote

[10] See proposed changes to paragraphs 175, 191 and proposed new paragraph 53