TIM observations on BEREC 5G radar 2020-2026

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Introductory remarks

TIM is thankful for the opportunity to comment on the BEREC 5G radar 2020-2026.

Since the beginning 5G was not meant to be an evolution of 4G with better network performance for mobile broadband, but it was conceived as a paradigm shift with a clear discontinuity with respect to the evolution of previous mobile networks (2G, 3G, 4G) and the concept of network itself. It is a great opportunity for Europe and for the Digital Single market: we welcome the important role which BEREC can play in clarifying the most delicate and relevant aspects related to 5G deployment through stakeholder engagement and studies making sure that an early stakeholders' involvement and consultations at European and national levels is always granted.

In this paper we have tried to give our contribution, by presenting our views on all issues identified as relevant by BEREC, but we have also made comments with respect to some specific passages of the Guide to the BEREC 5G Radar, trying to contribute with our specific knowledge as much as possible for this common and essential purpose.

	EXCERPTS OF THE GUIDE TO THE BEREC 5G RADAR	TIM COMMENTS	
Section 1.	"For the second phase, called "3GPP Release 15 Stand-alone", substantial investments are needed. The core network must be upgraded based on cloud services and virtualisation, and the new core will not be compatible with the old core for 4G-LTE. The standardisation for phase one and two was completed in June 2018, and 5G-modules for consumer products has become available in late 2019."	Within the "3GPP Release 15 Stand-alone" phase, substantial investments are needed not only to upgrade the core network but mainly in access network (i.e. to provide nationwide coverage via 700 MHz band by deploying thousands of radio stations).	
	"The DotEcon/Axon study on Implications of 5G Deployment on Future Business Models"[6] commissioned by BEREC, described that existing technologies such as NB-IoT, Lora, SigFox etc. could be used to meet the connectivity demand for some M2M and IoT devices and could possibly complement the RLAN solutions such as Wi-Fi. An important insight is that it is not necessarily 5G which will enable all the customers demand. Different radio technologies, such as 5G, 4G, NB-IoT, will likely be used for the communications need in a "5G-context" for a customer. Hence, this will be an important aspect when analysing the study cases in order to identify the regulatory challenges."	NB-IoT is part of 3GPP "5G" standard (as being recognized by ITU-R as part of IMT 2020). Lora and SigFox, as proprietary connectivity technologies, not harmonized with international standards, they can hardly be compared with 5G, a standardized technological platform encompassing both core network and several radio accesses (including NB-IoT) and enabling a multitude of scenarios.	

Section 2.	"This will require careful planning and agreements with municipalities and property owners. The large number of new sites may also make it necessary for operators to share infrastructure. Property owners on the other hand may have objections to housing multiple base stations from several MNOs in the same building."	Infrastructure sharing agreements on a commercial and voluntary basis should be promoted.	

	Theme		**One-liner (with reference to the paragraph in the Report on the impact of 5G on regulation and the role of regulation in enabling the 5G ecosystem**	**Trend**	**Relevance and timing**	**TIM COMMENTS**
1.	Privacy	Private information as cost	End-users may not understand the impact of sharing their private information in terms of the data economy in 5G. (4.2)	Gigabit speeds and other enhanced capabilities may increase user's ability to generate or disseminate private information and to generate more private information on the web.	Data will be generated only when the new services have been launched, which will take some years. **Timing: 2024.** Despite this may become a bigger issue, BEREC's role might be limited. **Relevance: Low.**	We agree with BEREC assessment that the issue is of low relevance. 5G will increase the amount of data generated and potentially disseminated but the tools to protect the privacy of individuals are already there (both horizontal and sectorial rules) and they ensure a technologically neutral approach.

2.	Privacy	Sharing of end-user data between different actors	Increased data exchange between parties in the 5G eco system. (4.2)	Smart city use cases increase (harvesting data from different uses). Data processing actors in the 5G value chain develop but may not have a direct relationship with end users and therefore unable to request data processing consent directly.	Data will be generated only when the new services have been launched, which will take some years. **Timing: 2024.** Despite this may become a bigger issue, BEREC's role is not yet clear. **Relevance: Low.**	We agree with BEREC assessment that the issue is of low relevance. It is premature to envisage actions on this issue. New tools are being assessed by the EC to increase data exchange between parties and the role of BEREC in this new framework is yet unclear.
3.	Security	Network and application security	Cybersecurity: higher sensitivity and dependency on 5G networks (4.1)	Any vulnerability in 5G networks or applications running over 5G networks could be exploited, potentially causing serious damage to critical infrastructures and services (e.g. smart city, industry automation, e-health, logistics) and affecting the economies and societies of the EU. In the IoT environment, the growing number of connected devices enabled by 5G will	From early in the process, when vendors and suppliers are selected, network security is a relevant topic. Studies building on the work of Recommendation 2335, and the EU Toolbox of risk mitigating measures are relevant. **Timing: 2021.** This topic is high on the political agenda, and one of BEREC's strategic priorities.	We support BEREC's aims to pursue this strategically important topic. While avoiding duplicating activities that are already carried out by the European Commission and ENISA, it is important for BEREC to closely cooperate and liaise with these authorities by providing them with the expertise and knowledge on the specific telecom matters, where needed.

				increase the entry points for possible network security attacks.	**Relevance: High.**	
4.	New business models and value chains	New business opportunities	5G has the potential to impact existing value chains. (1.1)	5G technical developments and the increasing role of 5G across a range of industries have the potential to impact existing value chains and result in new business models beyond connectivity. They may influence both wholesale buyer and retail end-user choices in terms of providers (MNO, MVNO, WISP, other micro operators e.g. using a network slice) and / or fixed network operators.	New technical developments and new business opportunities resulting in changing in value chains starting to emerge. **Timing: 2022-2023. Relevance: High.**	5G cannot be considered just a more performant network capable to generally satisfy connectivity requirements of verticals. 5G is a network enabling new customized services scenarios thanks to new mechanisms related to virtualization, network slicing and specific access deployment options. Network elements and functionalities will be tailored reflecting customers' requests and respective commercial agreements: in order to fully understand the new business models 5G will enable, we esteem a delimitation between services that will be developed on the internet and services provided through new 5G network functionalities must be drawn. At this stage the picture is not yet clear enough to make any evaluation of the market for the NRAs with this respect. As regards "new regulatory challenges" in addition to the revision of the rules to support 5G ecosystem and innovative services, actions to improve industry intersectoral collaboration should be supported.

						We encourage BEREC to foster NRAs initiatives jointly coordinated with the sectoral authorities to support 5G deployment and promote use-cases by vertical sectors in order to achieve the digital transformation of the industry. Agreements between the different players in the emerging 5G ecosystem should be left to commercial negotiations. With respect to micro-operators please refer to our notes concerning "Private/local networks".
5.	New business models and value chains	New bottlenecks, dominance and monopolies	5G use cases may increase dependency on data for market access. (1.2)	5G is a potential driver for IoT applications with more data produced, stored and analysed, which can lead to network effects creating or strengthening dominant players (such as digital platforms) who may have incentives to frustrate access / sharing of their proprietary data.	'New bottlenecks' is a topic BEREC has already identified in the DotEcon/Axon study in 2018. These topics are likely to intensify during the first phase of the 5G uptake. **Timing: 2022-2023.** **Relevance: Medium/high.**	We agree with BEREC that dependence on data for market access is a potential bottleneck and dominant players in the data market such as a few platforms acting as gatekeepers may represent a threat for healthy competition in the digital economy. However, the issue is not an effect of the development of the specific technology of 5G, as it is already there today and is rightly being addressed by the EC by exploring, in the context of the Digital Services Act package consultation, the possibility of an ex ante rules regime and/or a new body oversight, to ensure that markets characterized by large

						platforms with significant network effects acting as gate-keepers, remain fair and contestable for innovators, businesses, and new market entrants. It is key to ensure a level playing field among the digital services providers and BEREC can contribute to the debate by providing the perspective of the telco sector, as well as by evaluating the impact that the application of the data processing rules addressed to telcos (i.e. e-privacy) can have on the telcos' ability to contribute to the development of the data economy.
6.	New business models and value chains	Creation of new wholesale markets	5G could allow for new players to enter the market. (1.2)	Industry automation use cases potentially increase the need for tailor-made 5G services by new micro-operators (plant wide operators, campus operators), thus creating new business models such as e.g. intermediaries that could provide wholesale access, bundle or repackage solutions for the	Timing: **2022-2023.** Relevance: **Medium/high.**	We agree with BEREC that "'New regulatory challenges' does not mean more regulation per se, but could also mean more proportionate or less regulation, depending on the issue at hand." Voluntary wholesale agreements between mobile operators and new intermediaries are a possible welfare-enhancing development that should not be prevented **nor regulated** by BEREC or NRAs. We urge caution against any premature action in the absence of concrete market problems. Attention should be devoted to licensing regime on local use in

				specific industry or specific local sites with the necessary network operator.		order to avoid assigning spectrum to micro operators to ensure an efficient spectrum use, the avoidance of market fragmentation and the sustainability of the ecosystem, taking into consideration 5G operators flexibility to properly configure network slices by MNO. The agreements between mobile operators on one hand and new intermediaries on the other in the emerging 5G ecosystem should be left up to commercial negotiations.
7.	New business models and value chains	Private/local networks	Introduction of private/local networks. (1.2)	Many see an increase in revenue streams for operators to arise from the business-to-business segment where private/local networks will play an important role for certain verticals/sectors. Enhanced 5G features such as URLLC and network slicing could be applied to Private/Local networks.	**Timing: 2022-2023. Relevance: Medium/high.**	Spectrum set-asides (or local assignments in urban areas) may easily lead to the fragmentation of both the awarded spectrum rights and the 5G market as a whole (limiting the assignment of sufficiently large contiguous blocks may prevent mobile operators from delivering the flexibility and best quality in 5G services by fragmenting the foundation on which those services will be built.) and more widely to an inefficient spectrum usage. Club use can be a solution. Thanks to the 5G flexibility to properly configure network slices, MNOs have the potential to entirely satisfy tailored user needs both with respect to the quality and characteristics of

						the service (also with URLLC needs, as indicated by BEREC) and to the degree of autonomy required by each customer.
8.	New business models	Network slicing and 5G wholesale markets	Higher QoS-requirements might be implemented using 5G network slices (1.1, page 6)	Industry automation and other use cases (e-health, gaming…) with specific URLLC and bandwidth needs may increase the need to be able to differentiate services with different classes of quality of services which might be supported by the use of network slicing beyond other technical solutions. These use cases will have to follow Net Neutrality regulation.	Even though the standards are still to be finalised, operators are already preparing for it. Slicing is likely to play a larger role in the near future. **Timing: 2022. Relevance: Medium.**	BEREC should assess whether the application of the Net Neutrality rules provides the MNOs with enough flexibility to exploit the full potential of the network slicing, and of 5G networks in general, for the benefit of the verticals and of the end users (according to the conditions provided under each specific private commercial agreement) or if any adjustment of the guidelines is needed to this specific purpose. The coherence with Open Internet principle should not hinder innovative services and new business models for the benefit of citizens and businesses.
9.	Quality of Service	QoS-requirements of Pan-European services	How might 5G impact the operation of potential transnational / pan-EU operators. (3.1)	Pan-European services (e.g. connected mobility) will require continuous QoS and seamless handover, both within a country and between different	The special services are still several years away. **Timing: 2024.** Interconnection with proper handover based on QoS is crucial. **Relevance: High.**	The roaming market is competitive enough to ensure the good functioning both at retail and wholesale level. In case of connected mobility scenarios, direct short range communications (normally used for safety applications), based on C-V2X in the 5.9 GHz frequency band, the transition from one

				countries. This could imply a need for increased QoS provisioning for interconnection and roaming.		provider to another is already ensured. The Industry is already working on technical specifications to ensure a smooth and seamless handover based on QoS for services that need communications through the network. Regulation must be flexible enough (no exceedingly restrictive wholesale caps) to provide room for operators to differentiate QoS at wholesale level.
10.	End-user	Transparency of information	Stronger need for information on coverage and QoS of 5G networks to enable informed choices.	The introduction of 5G enables operators to differentiate products and services in much more complex ways. Information on coverage and QoS potentially becomes more important, not only for M(V)Nos, CAPs, for IoT SPs, for verticals, but also for end users. Especially with services tailor-made for specific user groups (network slicing) it becomes crucial where and	The special services are still several years away. **Timing: 2024.** QoS is strongly related to slicing. It is also important for BEREC's monitoring work to see what operators are offering, and knowledge building. **Relevance: High.**	We agree with BEREC that it is premature to study a policy objective to provide harmonized information on 5G coverage and QoS aspects of networks. Furthermore the EECC already provides for detailed transparency regulations and mapping of mobile broadband network in particular is regulated by article 22 of the EECC, in accordance with the principle of technology neutrality. The workstream has already been launched at national level: in Italy the NRA has established, with Resolution 125/19/CONS, a Technical Working Group aimed at studying and analyzing the evolutionary aspects of the campaigns to measure the quality of the services on the mobile

				when a service is available (e.g. geographically or in a roaming situation).		networks, with particular reference to services available with 5G systems. In particular, the Technical Working Group will have to define the KPIs (e.g. reliability, connection density, etc.) and the most suitable measurement methods to provide the necessary information about the quality of new services. At European level other EU initiatives on 5G deployment, such as the 5G Observatory, are mostly effective. An alignment of BEREC with such initiatives will be highly productive. We suggest Berec address a study to: - evaluate the adequateness, with respect to the fast evolving technological scenario, of the currently set QoS parameters (i.e. bandwidth without throughput and latency) for the purposes of reaching the Digital Single Market and the satisfaction of the end-users; and - set common, consistent broadband measurement tools in Europe. As stated above, 5G cannot be considered just a more performant network capable to generally satisfy connectivity requirements of verticals. 5G is a network

						enabling new customized services scenarios thanks to new mechanisms related to virtualization, network slicing and specific access deployment options. Network elements and functionalities will be tailored in accordance with the specific verticals needs and therefore geographical QoS information for vertical use is not an appropriate hypothesis considering 5G flexibility.
11.	Numbering	M2M numbers and mobile numbers	Increased demand for M2M and mobile numbers. (2.4)	Massive Machine Type Communications increase. As a result demand for numbers for M2M/IoT/MTC communication increases (given the expected increase of number of connected devices). The rising demand for devices could also lead to an increasing and potentially massive demand in other E.164 numbers (e.g. mobile numbers) and other types of	The timing and relevance may be different per Member State, depending on the market dynamics and their impact on the availability of numbering resources. This is relevant to NRAs and BEREC because of involvement of NRAs in assignment of numbers inside blocks. **Timing: 2022 Relevance: Medium**	We don't support the direct assignments to non-ECN/ECS entities because it would produce serious consequences on public operators and on public networks in general, too complicated, if not impossible, to solve. M2M/IoT/MTC devices do not necessarily need large amounts of E.164 numbers, since shared uses and other identifiers may be used such as IP addresses and Internet domain names. When also voice and/or SMS services for M2M/IoT services are to be provided, numbering needs require new numbering space in national numbering plans. Possible number portability support requirements can increase complexity and, in the case of

				numbering resources/identifiers (e.g. IPv6).		M2M/IoT, number portability obligation should be avoided, since numbers are not used directly by end users and they can be replaced in case of switching the mobile operator providing the service.
12.	Numbering	Mobile Network Codes	Increased demand for MNCs, especially due to local/private networks (campus networks). (2.4)	The importance of having a sufficient supply of numbering resources available to meet the demand, especially of campus networks. Verticals and intermediary operators may want to provide own SIMs, potentially leading to increased demand for MNCs. When E.212 MNCs are used for cross-border IoT/M2M applications, global MNCs under MCC 90x could be used. MCC 999 could be applied for standalone private networks where interconnectivity and roaming are not supported.	The timing and relevance may be different per Member State, depending on the evolving business models. **Timing: 2022** **Relevance: Medium**	5G development does not require allocation of Mobile Network Codes (MNC) to verticals and intermediary operators. We believe that the serious risk of scarcity rules out the hypothesis of an assignment of MNC to non-ECN/ECS entities. Accordingly, the E.212 identification plans should not be modified, and in the case of assignment to non-ECN/ECS entities compliance with international interoperability standards as defined by ITU-T, ETSI and the GMSA should be nationally assured and preserved beforehand. Local/private networks (e.g. campus networks) should use shared resources or resources not unique (such as behind MCC 999 which is dedicated to private networks).

13.	Numbering	eSIM	Using eSIM to support application implementation and switching. (2.4)	Using eSIM may help in initial device provisioning and in switching between providers due to lower implementation costs when over-the-air switching is applied. The availability of eSIM is also relevant in IoT use cases with device miniaturization and deployment in high-risk and/or restricted accessibility environments.	The timing and relevance may be different per Member State. 5G may accelerate the adoption of eSIMs in more devices. **Timing: 2022. Relevance: Medium**	We believe that the remote provisioning of eSIMs is more efficient. The remote provisioning of Embedded SIM addresses concerns regarding the ability to switch connectivity providers for IoT connected devices. The use of a remote provisioning capability provides a solution that enables providers to select a connectivity partner at a later stage in the product lifecycle as well as eases the switching of connectivity provider. An harmonization across all countries of the different regulations regarding the Customer identification and enrollment should be implemented in order to avoid potential discrimination and market abuse due to the remote provisioning (non in presence).
14.	Interoperability	Interoperability	Possibilities of interoperability of networks, including cross-border. (3.3)	There will be an increased number of service providers and localised networks. It will be vital that different networks are interoperable, wherever this is demanded,	First the new services need to be developed before the interoperability of the networks becomes relevant. The last standards still need to be developed. **Timing: 2024.**	We agree with BEREC that interoperability is important for the provision of different services end-to-end and for the development and uptake of verticals avoiding customers lock-in. The use of standardized solutions should be promoted. Special focus should be put on open standardized interfaces in

				especially in a context where 5G involves important virtualization of the network and increased reliance on software, notably through SDN and NFV technologies. It might require a deeper standardization process or the implementation of APIs. Lack of interoperability could raise many issues. Notably, it could hinder end-to-end connectivity. Furthermore, if verticals want to switch to a new service provider whether WISPs, MNOs, MVNOs, micro-operators or fixed providers, vendor lock in could become a more prevalent issue due to the opportunity to highly customise networks in 5G.	BEREC may not be involved with the standardization process, but interoperability is important for network effects, avoidance of dominance of new platforms, end-user choice, operator-lock-in etc. **Relevance: High.**	order to avoid the risk of vendor lock-in.

15.	Roaming	New requirements for national roaming	National roaming agreements will include new requirements, such as coverage and infrastructure sharing. (2.5)	New services will become available requiring a high level of coverage and/or QoS which in many cases will not be possible to be provided by a single network or operator alone. Operators may therefore require national roaming or infrastructure sharing agreements for the new services to meet QoS requirements or coverage obligations set out in the spectrum authorization regime . This would allow an efficient use of spectrum. Operators may also wish to share the costs of deploying network elements and engage in co-investment projects.	BEREC could further explore the national provisions with regard to the use of national roaming and infrastructure sharing agreements as well as co-investments.Timing of those topics should probably be aligned.**Timing: 2023.** **Relevance: High.**	Pursuant to the EECC, public electronic communication networks have the right to negotiate the interconnection. As previously stated, we support the promotion of infrastructure sharing agreements on a commercial basis. We consider it important that the market test options on this front, before BEREC considers adopting conclusions on the issue. At present, the roaming agreements already have to be compliant with competition law requirements, which must be assessed, where required, by competition law authorities. At national level we also have to comply with specific spectrum award roaming conditions, national roaming obligations should be avoided and eventually only included in the spectrum licensing conditions in case of market failure.
16.	Roaming	New requirements for	5G will contribute to the addition of new services to	In the next few years, other international roaming services	International roaming is crucial for the functioning of the telecom	The nature of IoT/M2M business model is fundamentally different from traditional voice and data services; typically characterized by

		international roaming	the current international roaming services portfolio, such as M2M. (2.5)	than voice, SMS and data, such as IoT/ M2M are likely to play an increased role. It makes sense for the current revision of the Roaming Regulation to consider those services and investigate whether there is a need to adapt the provisions to meeting both the market and technological developments.	markets across the EU EEA and BEREC has a crucial role in providing its expertise to the Commission and Co-legislators when discussing amendments for the Roaming Regulation. The work has already commenced. **Timing: 2022. Relevance: High.**	low data volumes and relatively high use of signaling resources, cross-border deployment with a need for permanent roaming, variable QoS requirements enabled by 5G network slicing. To ensure a healthy development of the market, that allows the correct remuneration of all actors, IoT/M2M should therefore be excluded from the scope of the Roaming regulation.
17.	Roll-out	Backhaul, fronthaul and anyhaul	Further fiber roll-out in networks. (2.2)	Because of the increasing demand for bandwidth, connections to the RAN (x-haul) will mainly be realised using fibre, as well as fast wireless technologies. Stakeholders emphasize that NRAs should ensure the existing backhaul is available on reasonable terms while fibre is rolled out quickly.	Backhaul is a very relevant topic in the roll-out of 5G networks. Initially operators will roll-out backhauls to existing base stations, which may still be linked with radio waves or copper. Therefor this topic will be relevant soon. **Timing: 2021/2022. Relevance: High.**	We agree with BEREC that the fast wireless technologies can be a valid complement to fiber. The need for regulatory intervention in the mobile backhaul market shall not be presumed by BEREC since the market has shown at EU level to be competitive. In particular, in Italy AGCom has recently confirmed (in its notification to the EC of the draft decision regarding the review of market 4/2014) that all mobile operators are vertically integrated and are able to exert a countervailing market power. MNOs can self-produce radio links. Indeed the operators can use for mobile backhaul not only fibre

						based solutions, but also solutions based on other technologies such as radio links.
18.	Roll-out	Small cells	Gigabit coverage requires small cell deployment. (2.3)	Small cell deployment will be necessary in order to achieve gigabit coverage. A harmonised approach for network planning and permits will facilitate roll-out. Deployment is costly and initiatives seeking to allow deployment in a cost effective manner such as infrastructure sharing or other co-investments initiatives will likely occur.	Deployment of small cells will be intensified with the availability of suitable spectrum. For many MS availability of 26GHz is not a priority until after other pioneer bands are awarded. The timeframe is more likely 2023. The topic of small cells may have many aspects; note that the timing may differ per MS. **Timing: 2023. Relevance: High.**	TIM fully shares BEREC view regarding the importance of facilitating the deployment of small cell and that infrastructure sharing and co-investment are important models to reduce the costs of fixed and mobile network roll-out. Anyhow, the measure aimed at reducing the roll-out costs should not only focus on small cells, but should facilitate the deployment of any element of a network capable of contributing to the achievement of Gigabit society targets. Strong attention should be devoted to 5G misinformation and fake news that have generated both acts of vandalism from a few radical communities and a mistrust attitude from local administrations that are hindering 5G deployment and affecting the ability of the MNOs to legitimately use the frequencies they have purchased
19.	State aid	Coverage	State-aid to meet coverage targets.	Extension of broadband coverage to rural areas is one of the main objectives of national state aid rules and spectrum	Coverage is an important issue, because it involves the roll-out plans of new fiber. This happens in the beginning of the	State aid concession should always be carefully assessed not to crowd-out private investment. They should take into consideration the high costs for the acquisition of frequencies rights of use and should avoid producing

				licensing conditions. The requirements associated to 5G use cases could potentially affect existing state aid plans for broadband extension. In order to increase coverage in rural areas and to reduce a digital divide, state-aid for FWA or fibre based backhaul solutions, state-owned infrastructure or spectrum coverage obligations could for example be relevant to apply.	process. It is important to have clarity on state aid, because it concerns high levels of investments. **Timing: 2022.** This is relevant for operators, and also for BEREC and NRAs. But BEREC's role in state aid may be limited. **Relevance: Low/medium.**	competition distortions. In any case, State aid rules are flexible enough and do not need a specific adaptation due to 5G.
20.	Convergence	Convergence	Issue of convergence of broadcast and broadband requirements in 5G. (4.3)	In the context of 5G, convergence could become an issue with advances in Release 14 principally allowing improved support for national TV services to both mobile devices and stationary TV sets over eMBMS (enhanced multimedia broadcast and	Based on stakeholder input BEREC concludes that this technical development becomes relevant later in time. For example, BEREC notes that the use of the band 470 – 694 MHz will be reviewed c. 2025, with some MS issuing licences	

				multicast system over LTE) and unicast.[9]	for broadcasting services in this band up to c. 2030/32. **Timing: 2024-2026.** Stakeholder input did not give much indication of relevance on the BEREC agenda. **Relevance: Low.**	
21.	Convergence	Fixed-Wireless Access	FWA potentially emerging as pioneer 5G use case. (1.1)	5G Fixed Wireless Access (FWA) has emerged as one of the early 5G use cases offering gigabit connectivity. With increased capacity in the networks, operators are likely to have more opportunities to offer competitive FWA services. The technological developments will enable mobile networks to match the expectations that consumers already have with regard to fixed broadband services.	Fixed Wireless Access is one of the early developed business cases. **Timing: 2022-2023. Relevance: Medium.**	We fully share BEREC view that 5G FWA will be able to offer gigabit connectivity and that mobile broadband will be more and more a substitute service to fixed broadband. We suggest a study to assess the impact of 5G on the fixed-mobile substitution and the competitive constraints exerted by mobile on fixed markets.

22.	EMF	Electromagnetic fields	Increased attention for EMF. (2.6)	At the EU level, the limitation of exposure to EMF is based on the Guidelines from ICNIRP (endorsed by WHO and ITU). This is updated in March 2020[10] to include 5G technologies and may impact the EU-level framework in 2021-2022. Consistency at EU and national/local level with ICNIRP EMF exposure limits is a matter of concern for stakeholders, to avoid adverse effects on rollout and reassure public opinion using evidence-based scientific recommendations.	With significant attention for EMF roll-out of new base stations or upgrading of existing base stations may be impacted if scientific information on health effects is miss-communicated. Locations for roll-out will soon be selected. Recent incidents have shown that this needs our immediate attention, **Timing: 2021**. BEREC is very much interested in this topic, including misinformation and fake news. Otherwise the topic as such is not in BEREC's immediate remit and competences. **Relevance: medium**.	BEREC should aim to ensure that national and local EMF exposure limits are based on scientifically grounded recommendations, reflecting the recommendation of WHO/ICNIRP. Accordingly, we support BEREC's proposal for action and encourage to remove unreasonable barriers that are to the detriment of 5G roll-out and potential benefits of EU citizens. On the other hand, we sustain any possible initiative in order to promote both a well spread knowledge based on scientific facts on 5G and its effects on health as well as a general education to the respect for technology and what it brings and will bring to people's lives, especially during these days of uncertainty.

23.	Environment	Sustainability	5G as an enabler of sustainability in the face of increased network energy consumption	5G systems have been designed to ensure higher level of energy efficiency: the energy required to process a data unit has been decreased compared to previous technologies. Nevertheless, the new services made possible by 5G systems may impact data consumption, which in the end may offset what a better energy efficiency can provide in terms of overall energy consumption: the so called rebound effect.	BEREC recently started working on sustainability and its possible role in improving it. **Timing: 2021-2022.** Sustainability is high on the political agenda and relevant for all NRAs. **Relevance: High.**	We are very engaged in energy saving and in many sustainable solutions. TIM is very proud to be able to contribute to the so much acclaimed enabling effect that 5G will bring. It is therefore important that all the necessary elements of Europe's telecom policy are streamlined to support the telecom sector and accelerate roll-out of 5G networks. This includes supporting the transition from legacy to new networks, including through a pro-investment approach to radio spectrum policies. On the other hand, it is also fundamental that the Green Deal pushes digitalisation across sectors of society. This can create a virtuous cycle: demand-side policies for digitalization in the Green Deal will not only significantly contribute to the modernisation of Europe's industrial sectors, but also boost demand (and the business case) for new 5G networks. With respect to the "rebound effect" BEREC makes reference to, special technical solutions and infrastructure sharing agreements will bring the better energy efficiency that Europe needs.