Introduction

Nokia welcomes the opportunity to comment on the draft BEREC common positions on mobile infrastructure sharing.

Nokia is a global leader in creating the technologies at the heart of our connected world. Powered by the research and innovation of Nokia Bell Labs, we serve communications service providers, governments, large enterprises and consumers, with the industry's most complete, end-to-end portfolio of products, services and licensing. We adhere to the highest ethical business standards as we create technology with social purpose, quality and integrity. Nokia is enabling the infrastructure for 5G and the Internet of Things to transform the human experience.

Nokia enables our customers to transform their communication networks with 5G, IoT, the cloud, software and other mission-critical communication solutions. Nokia also licenses valuable portfolios of intellectual property, including patents, advanced technologies and our brand.

Nokia has long-standing relationships with Communications Service Providers (CSPs), including fixed, mobile, converged and cable network operators, located around the world. Our solutions help transform our customers' business and their networks. Through our comprehensive portfolio of hardware, software and services we enable the digital transformation of networks to address capacity needs, reduce complexity and leverage network intelligence to create and deliver new services.

Through its products and services, Nokia supports and enables both individual network and network sharing operations. Network sharing allows reducing investment and operational costs while accelerating investment, facilitating deployments and reducing time-to-market. In addition, competition in mobile markets will benefit to end users (consumers, businesses, and public administrations) by offering them access to better services, coverage, quality of experience, quality of service and price (including unit price).

Nokia believes that investment, innovation, connectivity and sharing agreements are all important objectives that must be driven together and not as individual targets.

Promoting investment and competition

Nokia agrees with BEREC's view that it is of utmost importance to recall that the majority of infrastructure sharing agreements in Europe are the result of **commercial agreements** and

supports the principle the sharing agreements should rely on commercial agreements between the commercial actors. National Regulatory Authority interventions should neither hinder investment incentives, nor allow sharing agreements that could run against network investment.

Nokia believes that regulators and policymakers should put **mobile network investments and growth** at the heart of their regulatory strategies, enabling Europe to lead in 5G mobile communication through its attractive market size, growth potential and technology expertise. Deploying the new 5G technologies implies continuous investments in infrastructure for the update of the existing mobile networks. But Europe has accumulated delays in investments, declining revenues and mobile usage since 2008[1], which delay the roll-out of networks and the adoption of new services by end users. The average revenue per user (ARPU) in Europe is lower than in any other regions, but the unit price for what the consumer gets is higher. This is an expected but unfortunate result of a policy focused on lowest price (ARPU) instead of best value for service. The European policies so far on making mobile broadband access affordable for its citizens have been ambitious and commendable, but they have been lacking a longer-term perspective that, through investments, secures the best value for the price paid. These infrastructure investments, and the order-of-magnitude capacity increases they bring, coupled with the potential savings from network sharing, are crucial for transferring their economy-of-scale and innovation advantages into high-quality and high value per bit services to end-users.

Nokia believes that **infrastructure competition** is a key regulatory objective. Certain degrees of mobile network sharing should be allowed and encouraged if it leads to more competition nationally or in specific regions. Mobile network sharing agreements should not undermine the incentive to invest in the first place. Mobile network coverage reflects the level of investment that operators make in their networks and, as such, sharing agreements should not undermine the incentive to invest in the first place. While passive sharing of infrastructure is beneficial for deploying network elements, national and local roaming agreements do not incentivise investment in additional coverage and should be limited in scope and time. Nokia is of the view that regulators' interventions should focus in those areas where effective competition is potentially possible and remedies can have maximum impact and complement with another set of remedies in areas where effective competition might not be possible. On the latter, Nokia believes the public-sector involvement in **passive sharing** agreements for mobile deployment in rural areas via broadband **state aid** interventions is justified by the necessity of connectivity for socio-economic development.

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[1] White paper – Mobile operators' investments: Europe needs a pro-investment mobile regulatory framework, November 2015, Idate

Nokia notes that the **scope and objectives** of the document are unclear as mobile sharing agreements assessment fails under the authority of either the national regulatory authority or the national competition authority. The contexts where the common position applies should be clarified.

Promoting innovation in new technologies and generation networks

Nokia noticed that while the draft document is listing existing types of sharing agreements available to date in the existing networks, **some potential network sharing alternatives that are specific to new technologies such as 5G** are not listed.

Under the section on active sharing (3.1.2), Nokia would recommend adding "**Network slicing**" which has the following features:
- Dynamic network configuration with flexibility for service provisioning
- Multiple logical/virtual networks over one physical one to handle different service use cases (based on performance terms, functional requirements, security protection mechanisms…)
- End-to-end system architecture solution that is applied to each of the 5G domains, i.e. access, transport, cloud, etc. A slice may be purely local within a factory (such as "Slice B"), but may also include public networks, for example for connecting two different factories (such as "Slice C") or for establishing a connection to a cloud (such as "Slice A").
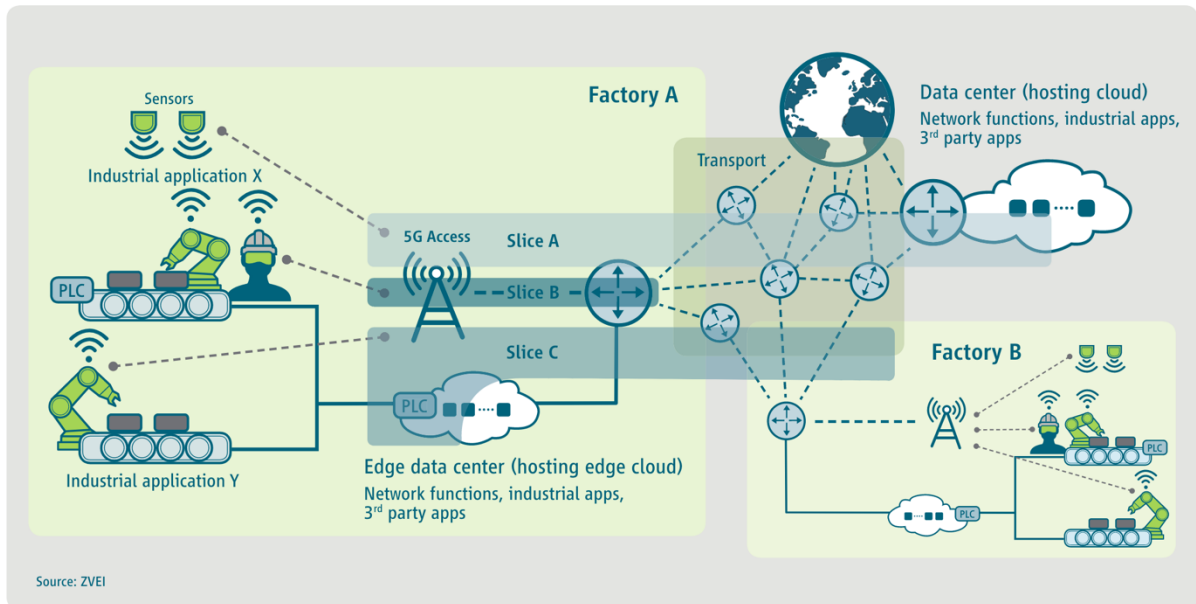
<u>Source:</u> White Paper 5G for Connected Industries and Automation, 2nd Edition (5G-ACIA)[2]

- Dedicated or shared resources (for radio, it is spectrum)

Under the same section (3.1.2), on the **frequency (or spectrum) sharing**, the report fails to consider potential new sharing models that can be enabled in the 5G era, especially when considering the use of high-frequency bands which can be shared between services (e.g. with satellites, backhauling) or between users of the same service (e.g. sharing of the 26 GHz frequency in Italy between mobile operators). To this end we consider that spectrum sharing can play a role in the 5G context but a poor implementation risks harming its potential. Nokia is of the view that for a good functioning of the spectrum sharing agreements in the 5G context, enhancing a solid and fluid secondary market is of crucial relevance. New spectrum management models such as LSA, CBRS and neutral host cannot properly develop without a flexible spectrum management system.

Under the section on other sharing types (3.1.3), Nokia recommends adding "**Network Transport slicing**" as a network sub-layer which could be linked to the Broadband Forum definition of Fixed Access Network Sharing (FANS) for virtual infrastructure sharing. This concept of transport slicing is also being defined by the "Draft Standard for Packet-based Fronthaul Transport Networks" IEEE p1914.1[3].

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[2] https://www.5g-acia.org/index.php?id=5125
[3] http://sites.ieee.org/sagroups-1914/p1914-1/

Promoting sharing models that allow commercial and societal goals

Nokia also foresees new innovative sharing models which may fulfil both commercial and societal goals. However, such models require commercial collaboration between mobile operators and vertical industries and/or non-traditional partners, shift from the traditional business models, and a cross sectoral regulation to allow such collaboration.

1. **Sharing public and private network slices**

    On the principle of the private branch exchange (PBX) sharing model, network slices at a location could be shared between among public and private stakeholders. One would outsource to the other its network management, operations and security.

2. **Cooperation between MNOs, utilities and public operators for sharing local and utility networks**

    As one the 2025 European broadband policy objectives is to have uninterrupted 5G coverage for all major terrestrial transport paths, ensuring road and train track mobile network coverage can be supported targeted through cooperative funding of shared networks by multiple stakeholders. This could equally apply to smart grid and public safety networks.

3. **Multi-operator Core Network sharing in a form of MORAN or MOCN sharing**

    See attached Nokia technical paper "Network Sharing: Mobile broadband delivered more efficiently and at lower cost" on the benefits of such sharing models.

4. **"Neutral Host" sharing model**

    Neutral Host is a widely used term for the "wholesaler" in the small cells environment. This model could apply in public locations and administrations, shopping malls and airports where costs can be significantly reduced if physical assets and transport networks are shared by multiple network operators or service providers. In such a scenario, one network infrastructure, owned by a non-operator third party is leased to any interested operators. There are two different approaches:

    (a) **Distributed Antenna System** (DAS) (shared indoor antenna system), which is passive sharing

    (b) **Small Cells as a Service** (indoor and outdoor), which is active sharing.

In both cases, a third party operates the network, fills any coverage gaps and sells capacity to mobile network operators. DAS is evolving to Small Cells as a Service in many cases due to the need for capacity upgrades (legacy passive DAS systems typically do not support 2x2 MIMO LTE, not to mention 4x4 MIMO).

In the 5G context densification is one major concern and the deployment of small cells is a major element in assuring the right capacity and service quality. As such, defining the right regulatory environment that would allow a fast roll out of small cells and the incentives for joint deployments will be in the best interest of the end-users that will benefit of the services in a timely manner.

5. **Higher frequency spectrum sharing**

Spectrum sharing is a common practice in rural areas where operators share their networks to allow efficient use of low-frequency spectrum through pooling between operators for better performance.

In the context of 5G and the use of millimetre bands that provide small area coverage, such an approach can provide beneficial for operators to enhancing low latency / high capacity 5G services in an efficient manner. However, access to the spectrum of another operator require the regulatory environment to permit such type of sharing arrangements while preserving the market competition.

Nokia would be pleased to engage further with BEREC on how to ensure effective network sharing with 5G technologies, review the different models highlighted in our response and their benefits, and discuss on the synergies between public and private operators in the telecommunications, utility and transport sectors (incl. the Broadband Cost Reduction Directive).

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