Densification and rationalisation of the 5G mobile networks across the country

Executive Summary

Study conducted by the Institut Cerdà within the 5G City project and in collaboration with Cellnex. The study is based on various sectoral sources, in particular, on more than 30 interviews with representatives of the sector's value chain, regulatory bodies and other subjects from outside the sector, but with influence upon it.

5G is a disruptive technological development that will bring about changes in productive models, spurring the development of new activity sectors and the emergence of new services for businesses and consumers. However, 5G will also spell a radical change in urban and territorial models, both physically and in terms of services and social uses. It is essential to consider not only the demanding technical requirements for the roll-out of the new technology, but also how it fits within a territorial and societal framework, and which management models are most efficient.

I. Development and expectations of 5G across the country

The development of 5G is not merely a new development in step with the progression of previous generations of mobile networks, but heralds a **disruptive technological change** with far-reaching consequences in terms of **digital transformation for the economy and for society.** While 5G is expected to be commonplace by 2022-2025, projections of new usage cases and the significant investments being triggered in the ICT sector have already generated **considerable expectations** within the business, institutional and social sectors about the opportunities it offers.

The **technological functionalities** of 5G are already well-known (principally high data transmission capacity, mass device connection, maximum connection latency), however there are **considerable uncertainties** concerning:

- Time frames and the technological standardisation model
- The regulatory framework
- Usage cases that support the business model
- How it will fit in with the territorial set-up and its management framework

Of all these points, the question of how it will fit in with the territorial set-up and its management framework has been least considered to date by the main drivers of the new technology. Uncertainties in this area revolve around two key areas:

- The scope of the future **densification** of the 5G infrastructure network and therefore its territorial **fit** and possible consequences for the **urban space**, the **rural** world and the **social** environment
- The administrative and technical **management model** of 5G infrastructure in cities and across the country and the role to be played by the municipalities as the entities responsible for the public sphere and social welfare.

The common denominator driving this uncertainty is the forecast **major infrastructure deployment that 5G will require** to ensure coverage and ubiquity of services such as connected vehicles or continuity of service to mobile users. Although initially the 5G service may be based mainly on the current network of telecommunication antennas, in a subsequent phase this **network will need to be densified and multiplied** 2 to 4 times, requiring between 50,000 and 75,000 additional antennas around the country. The new 5G support infrastructures will have unprecedented characteristics with respect to the infrastructure set-ups of previous generations up to 4G. They will be based on a hierarchy of antennas entailing a **capillary system of micro-antennas** that will need to be placed low down and close to the

user (therefore principally in the public space, using elements of urban fixtures), primarily connected to the optical fibre network (Spain has one of the best coverage rates in the world) and with a complementary mesh of on-site processors to guarantee instant data transmission and ensure low latency rates.

Around this disruptive development of mobile infrastructure and services, and due to the high expectations generated, a **complex map of stakeholders** is identifying needs or expressing precaution regarding the new scenarios. This network of actors comprises companies that are part of the value chain (equipment suppliers, infrastructure operators, telephone operators, service providers), public regulatory agents (particularly the Spanish State Administration, which is responsible for regulation and roll-out, but also the regional and especially the local administrations) and the remaining external agents with a key role developing, prescribing and even granting a "social license" to operate (R&D and training centres, professional sectors, business associations and especially social groups, residents' associations or citizen platforms).

II. Roll-out models

Broadly speaking, development can be based on three main models: networks rolled out on the initiative of each operator; infrastructure networks shared by several operators; or one network that is shared and managed by a specialised neutral operator.

I. One **network per operator** ensures competition among operators, but can trigger an excessive and inefficient proliferation of antennas. This model involves a considerable investment for operators and could accentuate the risk of a digital divide between different territorial areas (optimal coverage for the high demand of urban centres or business areas vs. neglect of suburban neighbourhoods and rural areas). Roll-outs of previous generations of infrastructure (including fibre) caused unease in the local administration and social groups.

II. A network of **infrastructure shared among several operators** via agreements between companies. This more efficient model requires operators to align their roll-out strategy to converge into infrastructure sharing. Rationalisation, however, occurs spontaneously and can fall prey to the natural dynamics of companies in search of economic efficiency in their investments balanced with a good level of service provision.

III. Finally, network infrastructure-sharing can be assisted by the figure of the **neutral infrastructure operator**. This model fosters not only rationalisation of investments and efficiency in implementing infrastructure, but also enables overarching models of network planning, management and operation while facilitating dialogue with the administration. The main challenge of this model is how to define and ensure the compatibility of a neutral process with operators' various business models and differentiation of services, and how to ensure free and fair competition among them.

III. Levers and challenges

We can identify certain levers or competitive advantages at the current stage of the development of 5G and the dynamics of how the model is being shaped, as well as some challenges and limitations that need to be addressed:

Levers and competitive advantages:

- **The wide-ranging optical fibre coverage** in Spain is one of the main factors facilitating the capillary implantation of 5G.
- **Administrations share a full commitment to leading 5G**. There is a special commitment by the Spanish State Administration (monitoring offices, promotion of pilot projects, finance lines, etc.), as well as a strategy by the Autonomous Community (regional) governments and interest by local administrations.
- **Growing collaboration between various players**, both in the business value chain and regulatory and support bodies (administrations, R&D centres, professional associations, supporting business sectors, etc.).
- **Support from vertical industries**: More and more private sector players are investing in the new opportunities of this technology.
- **Ubiquity of communications**. Intensification of mobile technology globally, on all layers of society.
- **Expectations of new innovative services** for cities, industry and the public.
- Unavoidable opportunity to commit to 5G in the interest of **dynamisation, attractiveness and competitiveness of the area.**

Challenges and limiting factors:

- **Misinformation among end users.** Despite the media-heavy projection and expectations of recent years, the general public is still largely ignorant of the characteristics and possibilities of 5G technology and is far from accepting them.
- **The technology and the business model are not yet mature.** Several technical, business and administrative aspects remain to be resolved, particularly as concerns implementation and adjustment across the territory.
- **Implementation costs.** There is uncertainty around network deployment costs and concern by investors who need to find a business model to monetise it.
- **Occupation of the public area and densification.** One of the most noticeable effects of roll-out for local administrations and the public is the implementation of 5G in the urban environment, involving doubts about its technical suitability and social acceptance.
- **Administrative uncertainties**. Local administrations still require a clear and level regulatory and powers-based playing field to empower them. Availability of stable and reliable frameworks, channels and interlocutors for relations between administrations and operators to maximise efficiency.
- **Limitations of the spectrum.** There is a need to manage the limited available contiguous frequency bands caused by spectrum saturation and high demand by other players within the ecosystem.
- **Security and privacy.** It is imperative to guarantee the security and privacy of transactions both for operators sharing a network and, especially, in the relationship with users. The players involved must ensure *cybersecure* spaces and relationships.
- **An asymmetric territorial and social context** requires policies that can ensure homogeneity and equal opportunity in the availability of service, both territorially and socially.

IV. Roll-out criteria

Finally, we propose ten basic criteria to foster a rational and sustainable model for rolling out 5G infrastructure

1. **Rationalising the occupation of public and private space.** The roll-out of 5G will change the face of cities as they seek to guarantee its functionalities. Efforts will be needed to minimise the possible impacts of the new 5G components and should involve good planning, infrastructure sharing and involving all stakeholders involved in the process. In this context, local administration planning powers must be guaranteed while fostering streamlined and homogeneous roll-out procedures clearly establishing technical, urban and environmental requirements.

2. **Improved public services and opportunity for the development of territorial areas**. Enhanced connectivity should help to implement the fourth industrial revolution that is already under way and should bring improvements to urban functionality, the environment and the day-to-day life of all citizens. 5G is an opportunity to position cities as leaders of digital transformation. Administrations must continue to promote investments by the various players in the ecosystem to ensure that 5G drives development for various economic sectors.

3. **Territorial balance and commitment to comprehensive and equitable roll-out models**. The Administration must develop tools in tandem with the private sector to ensure that everyone is treated fairly (especially the most vulnerable citizens) in terms of access to services and the revitalisation of areas with lower demand, such as rural and peri-urban environments.

4. **Fostering co-investment and guaranteeing free competition.** The high initial investment costs in infrastructure, estimated at over € 300 billion, must be borne by the operators. The Administration should therefore encourage co-investment, making competition rules more flexible in new networks involving more than one operator

5. **Network or infrastructure sharing.** The Administration should consider demanding sharing agreements as a way of ensuring efficiency in territorial implementation, minimising externalities and providing ubiquity of coverage. Neutral operators could be the leaders of the multi-operator management model.

6. **Developing the technological challenges of 5G.** The technology surrounding 5G is currently in a pre-commercial phase and is expected to be mature only in 2021. In the next few years we will therefore need clear answers to unresolved challenges, such as the handicaps of active infrastructure sharing, the form of the devices, their autonomy, the last mile challenge, the demands of new equipment processing - *small cells* -, how *network slicing* will fit in with net neutrality, etc.)

7. **The importance of R&D in enhancing usage cases of the technology.** The role of the main players in the technological ecosystem - manufacturers, operators, research centres and service providers - is essential in terms of research and joint efforts to develop and implement new services and applications. In this connection, facilitating opportunities to perform pilot tests in real contexts in partnership the administration is vital.

8. **Spreading the technology and the participation of social groups**. How fully technology is developed will depend on the use and applications that users give it. It is essential for the groups using 5G to publicise and spread the new functionalities acquired. Furthermore, it is essential to create forums in which users can participate in operational, consultative and consensus terms to ensure that projects are not blocked and to boost their positive impact. Technological development must respond to public expectations.

9. **Knowledge about its effects**. Social concern about the health risks of electromagnetic fields is deeply rooted. It is therefore essential to respond to these concerns by following transparent

implementation processes, providing rigorous scientific data, and promoting knowledge and dissemination drives.

10. **Data, privacy, ethics and digital security**. Work must be done to promote a clear framework of digital rights to guarantee net neutrality and privacy while protecting users and their data. It is also important to ensure the cybersecurity of the digital solutions of service providers.

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The Institut Cerdà is an independent private foundation set up in 1984, involving more than 60 professionals from various areas. Its mission is to advise and accompany public and private bodies making strategic decisions for developing the area through innovation and sustainability.