



Accelerating the 5G transition in Europe

How to boost investments in transformative 5G solutions

Executive summary



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Executive summary

The 2020 global pandemic crisis has forced many societies to adapt their ways of work and life. The proliferation of remote working has demonstrated the potential of the digital revolution and the increased resilience it brings to businesses and customers, thus accelerating the shift towards a more digital economy.

As countries are going through multiple lockdowns, it is becoming clear that the definition of the workplace may have changed permanently. The newly found confidence in remote working gives extra relevance to applications aiming to improve telepresence: from virtual or augmented reality all the way to remote surgeries. One can hardly imagine circumstances that would more urgently demonstrate the need for continued and accelerated digitalisation.

This study discusses why the "fifth generation" of telecommunication systems, or 5G, is integral to digitalisation efforts, and how its roll-out will be one of the most critical building blocks of the European digital economy and society in the next decade. We examine the transformative properties of this technology and explore how we can ensure that Europe remains a relevant, competitive and strategically autonomous player on the global scene. Primarily, we focus on European small and medium-sized enterprises (SMEs) that are active in the 5G domain, and propose a set of recommendations for improving their access to funding.

What is 5G and why it matters for Europe

5G is a set of communications technologies that **brings unique functionalities**, starting with **up to 100 times faster data transfer speeds** (up to 10 Gbps vs. up to 100 Mbps with today's 4G technology¹). More importantly for new business models, 5G will bring **ultra low latency (the transmission time for a packet of data), and the possibility for real-time communication among massive numbers of connected devices simultaneously**. The conjunction of these features gives 5G the potential to not only replace 4G as a faster technology but also enable business innovation across multiple industries (e.g. automotive, virtual reality, healthcare and agriculture), with potentially significant social and economic benefits.

There are several reasons why **5G is strategic for Europe** and why it is urgent to address the issues limiting the financing and development of companies active in 5G communications and developing 5G applications:

¹ See <https://ec.europa.eu/digital-single-market/en/blog/eu-funded-project-breaks-available-mobile-network-speed-record-delivering-new-technology-5g-0>

5G is central to a large-scale technological, industrial and innovation transition globally, which represents a significant opportunity for Europe. 5G will enable many business applications with significant potential for economic growth and innovation across a variety of sectors including healthcare, mobility, urban development, agriculture and media. The development of 5G technologies, both for equipment and applications, is a key vector of innovation where the winners of tomorrow are decided today. This calls for attention to the success factors and potential bottlenecks currently facing 5G companies and innovators;

5G technologies are a driver of European strategic digital autonomy. European businesses developing 5G technologies, equipment and applications compete in a global market. Maintaining a strong position in this market will be key to ensuring a diversity of choice for telecom operators deploying 5G equipment, thus supporting Europe's autonomy and role in the sector;

5G can make European supply chains and industrial ecosystems more efficient and resilient. It can be deployed not only by traditional operators but also by industrial players, for example to cover specific industrial sites. This could offer new communications possibilities to support industrial processes, potentially adding efficiency and unlocking new ways of doing business, while also providing enhanced security features;

5G will enable SMEs to participate more actively in the communications ecosystem, because communications in a 5G future will see an increasingly important role for software compared to hardware ("softwarisation"²), and a more distributed networking approach relying on mobile devices for computing and performing tasks ("cloudification"³). These technological evolutions are expected to open the market to new players, in contrast to the current domination of the sector by traditional players of the telecommunications industry, such as network operators and technology providers. SMEs will play a particularly crucial role in the success of 5G by contributing to the development of 5G-based applications and technologies that support telecom network roll-outs, delivering benefits to citizens and companies;

5G may play help our societies to digitalise further and become more resilient in the face of potential future pandemics, helping people and businesses stay connected and operate as closely as possible to normal even during lockdowns. In a global context where other world regions have already seized the opportunities brought by this technology, it is critical to ensure a rapid transition to 5G in Europe to further the European Union's economic strength and competitiveness.

For these reasons, 5G is strategically important for Europe and its development needs to be supported through a combination of private and public funding sources. 5G may be one of the

2 Softwarisation: Network functionalities that were traditionally implemented via dedicated hardware will, in the future, be implemented via software modifications. This will enable frequent updates and immediate deployment of specific functionalities in parts of the network where they are needed. The lower capital expenditure associated with deploying functionalities via software rather than hardware increases the chances of SMEs developing solutions.

3 Cloudification: This refers to moving data and services to the internet (the cloud). As one of the key concepts in 5G, it will allow network operators to limit the quantity of data transferred through the mobile network, with data instead transferred from the cloud directly to devices.

areas supported under the next Multiannual Financial Framework (MFF). This would help to mobilise market support across different funding stages and financing channels.

This report specifically focuses on examining the needs of small businesses and the issues they may face in developing 5G-related applications, particularly regarding access to financing to fund their activities.

The road to 5G

The deployment of **5G functionality will be gradual**. Initially, it will focus on increasing data transfer speeds and handling large volumes of traffic. Over time, a growing number of functionalities will become available, such as those necessary for ultra low latency communications, connecting large numbers of devices, and enabling more open and distributed networking capabilities.

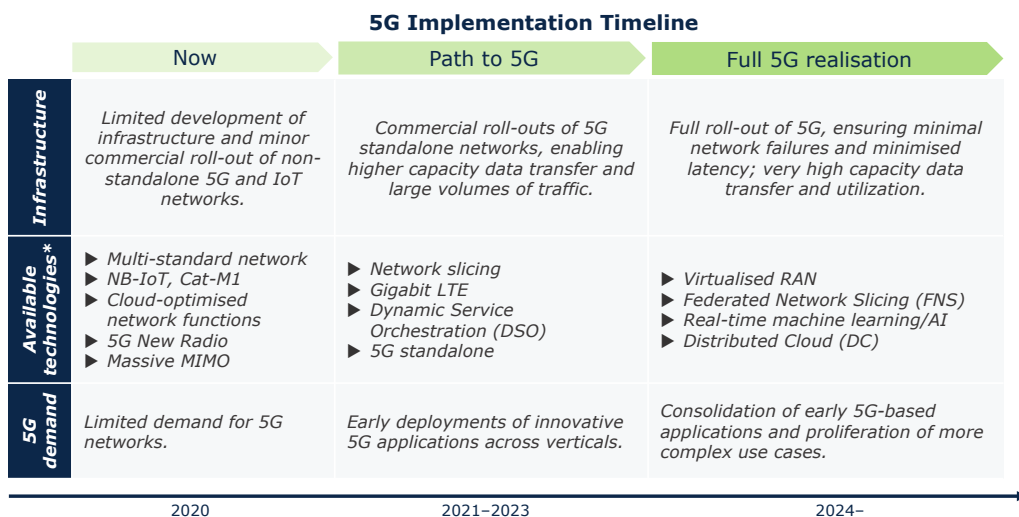


Exhibit 0.1. 5G implementation timeline [Source: Axon Consulting]

In terms of applications, **continued deployment of the more cutting-edge 5G functionalities in telecommunications networks will enable the development of progressively more advanced 5G applications and disruptive innovations and business models**. For example, advanced 5G features will be key to supporting highly autonomous vehicles, remote surgeries, remote factory operations and robotic applications, as well as advanced 3D/holographic communications in the workplace and beyond. In the interim, earlier 5G functionalities will enable applications such as smart meters, consumer IoT⁴ and enhanced media applications. Later in this report we describe such application areas with examples of companies developing them.

4 Internet of things, referring to connected consumer devices.

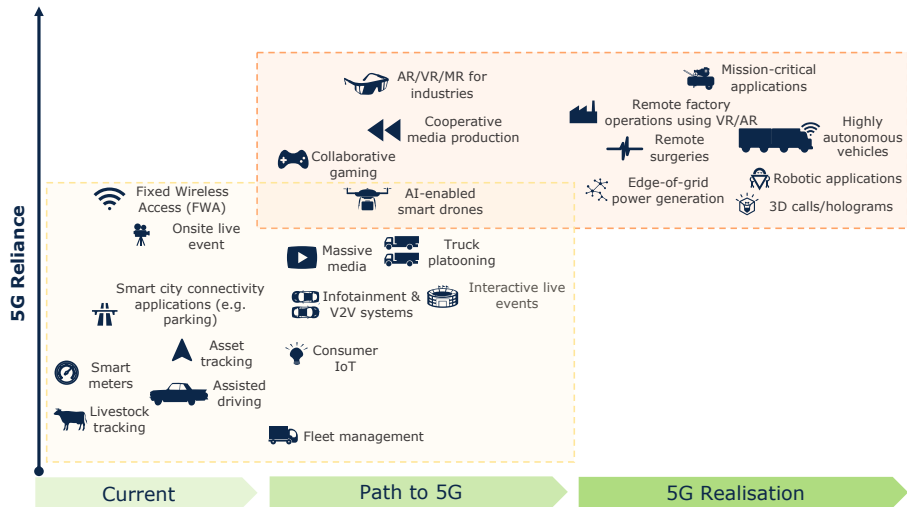


Exhibit 0.2. Path to 5G realisation [Source: Axon Consulting]

Why is there a funding gap for SMEs developing 5G applications?

Most SMEs developing business cases associated with 5G are, at the time of writing, at the early stage of development. They typically depend on public instruments and equity, generally from angel investors or venture capital (VC) firms. Over time, some of these SMEs will develop and also rely on “growth-stage” funding sources with typically larger investment tickets to finance the scaling up of their activities.

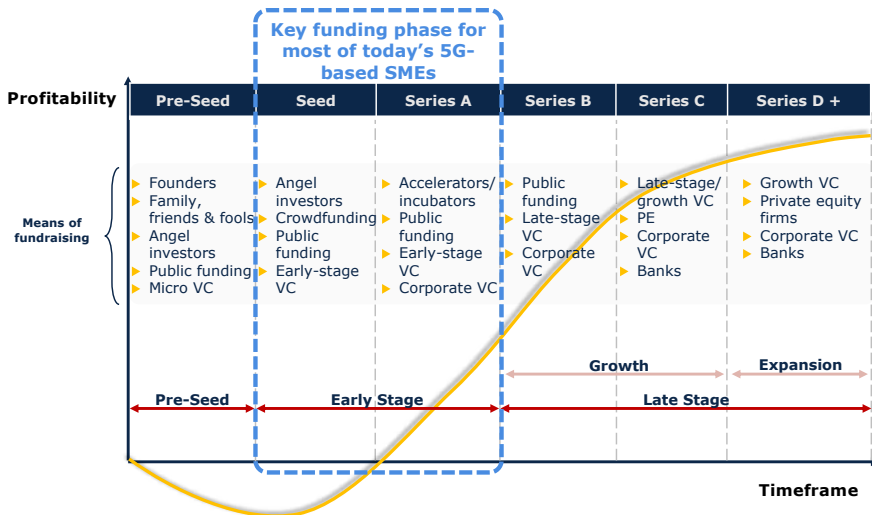


Exhibit 0.3. Funding lifecycle and the key funding phase of typical 5G-focused SMEs [Source: Axon Consulting]

Based on interviews with SMEs and industry players and research – together with our own and third-party research – we observe **an important funding gap for these SMEs**. In Europe, the gap for 5G-related business models could amount to €4.6 billion and up to €6.6 billion annually. This gap could represent a major challenge for the evolution of 5G in Europe, and poses the risk of Europe being left behind in the race for 5G leadership. The interviews conducted for this study suggest that most of the funding gap is at the early stage of development for 5G-enabled businesses. However, feedback from companies and investors also stresses the importance of growth-stage financing, particularly for successful companies with growing investment needs that typically have difficulty securing commitments from Europe-based VC funds (due to ticket sizes).

Among the various challenges facing SMEs, **the perceived high-risk profile of their businesses emerges as a key constraint**. Several factors explain the current high-risk profile, such as uncertain demand or counterparty/ecosystem dependency. This perception is further aggravated by information asymmetries: the complexity of these SMEs' business models and the underlying technologies can be difficult to understand for generalist investors, thus limiting their ability to evaluate the risk factors of 5G ventures.

Further, **traditional business angels and VCs** tend to invest in well-understood business models within industries (e.g. IoT applications for agriculture), rather than in underlying technologies (e.g. NarrowBand IoT⁵ vs. 5G). Hence, these investors have largely held off from prioritising investment in 5G.

Access-to-finance issues are also apparent in the area of **public funding**. Even though EU and Member State funding remains crucial for SME development from a very early stage, there are currently no dedicated 5G-focused programmes available at European level. Many of the SMEs consulted had to rely on general innovation programmes and reported that application processes can be time-consuming with perceived low and/or uncertain chances of success, which may discourage potential applicants.

In summary, both private (VC, CVC, angel investors) and public financing can be difficult to access for SMEs developing 5G-related applications and business models. As SMEs are expected to play an important role in the 5G ecosystem, it is vital for Europe to consider taking actions to help them make a significant impact and drive 5G innovation. The mobilisation of combined public and private resources could become a key lever for accelerating 5G deployment in Europe. The steps taken by other regions in this area, notably the United States and China, reinforce the urgency for support actions for 5G from both public and market sources.

To attract more private VC investment to support the development of 5G-related applications, a particularly important role could be played by **corporate VCs (CVCs)**. In contrast to most VCs, CVCs are showing explicit interest in 5G businesses. They tend to bet on innovations that fit with

⁵ NarrowBand IoT is a radio technology standard designed to enable low-cost, low-power communication (mostly indoors) among a high number of connected cellular devices. Examples includes the connection of low-powered sensors in smart cities, street lighting, waste management, etc.

the strategy of their corporate parent. As such, beyond simply maximising the financial return on their investments, CVCs' objectives are also driven by strategic considerations. For example, the involvement of telecom companies in the 5G CVC field is driven by strategic incentives and potential synergies. Beyond telecom-based CVCs, 5G is also being pursued by a much broader set of corporate and industrial players, for example in the advanced manufacturing, aerospace and agricultural sectors, which are all demonstrating interest in innovative 5G use cases.

In addition, CVC players' evident interest and their unique capabilities and industry knowledge could be leveraged to support both public and private funding programmes: here, CVCs could contribute to selecting quality companies, thereby effectively de-risking the funding portfolio.

How can Europe support 5G-related SMEs?

Europe has a number of key strengths and the necessary market structure to create a thriving 5G ecosystem. Within Europe's active 5G infrastructure market, technology providers, connectivity service providers, service enablers and civil infrastructure providers together create a strong supply side of the ecosystem. On the demand side of 5G connectivity, Europe's leading industries and entrepreneurial environment represent clusters of high potential for 5G uptake.

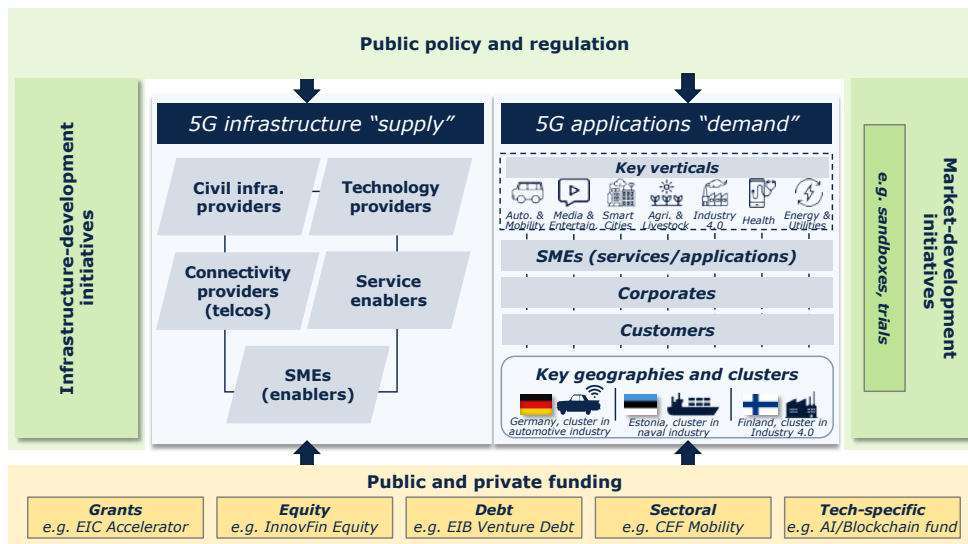


Exhibit 0.4. 5G ecosystem and vision [Source: Axon Consulting]

The following recommendations offer suggestions on how these unique European advantages could be leveraged in the coming transitional years and how the 5G ecosystem could be inclusive of SMEs. The table below provides an overview of our recommendations, highlighting funding programmes and extra measures that could help improve 5G-related access to finance for European SMEs.

Recommendations	Objectives	Actions
Recommendation 1: Allocate public capital to support 5G	Target the funding gap by mobilising financing support from several actors.	Catalyse private investment through public funding programmes.
Recommendation 2: Introduce non-financial means of supporting early-stage activity through public-private initiatives	Target very-early-stage SME development through strategic engagements.	Use key areas of exchange between 5G supply and demand to accommodate interaction between relevant stakeholders.
Recommendation 3: Overcome information asymmetry around 5G	Improve investors' understanding and awareness of 5G technology. Improve companies' awareness of funding programmes available to them.	Roll out industry events, use of digital materials, and create a searchable database to disseminate information.
Recommendation 4: Reduce cross-border challenges by promoting homogeneity and standardisation	Ensure a homogeneous landscape enabling the scalability of 5G businesses across Europe.	Strengthen policies and cross-sectoral regulations to be future-oriented, pro-investment and pro-innovation.

Exhibit 0.5. Objectives and rationales of the recommendations [Source: Axon Consulting]

Recommendation 1: Allocate public capital to support 5G

The European Commission and the EIB Group have a number of programmes that can be used to successfully support SMEs active in the 5G domain in Europe. In the sections below, we will discuss how the existing programmes could be adapted and/or complemented by new, dedicated programmes to create funding instruments that would most benefit SMEs.

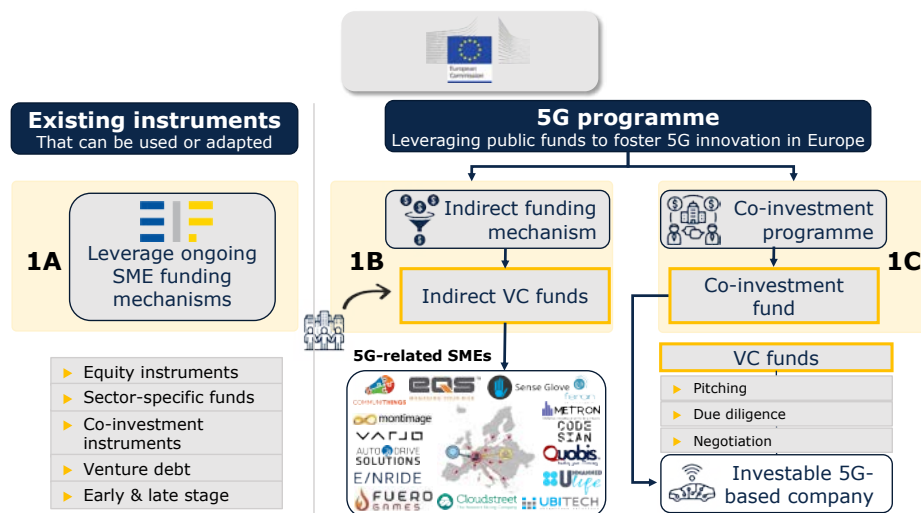


Exhibit 0.6. Scheme of Recommendation 1 and its three pillars

Recommendation 1A – Repurpose existing and planned funding mandates

The European Commission supports innovation through several funding programmes. Some well-known funding instruments with successful track records could be reused or adapted, at least partially, to help innovative SMEs in the 5G/advanced-connectivity space to transition from seed to growth stage. Future mandates such as InvestEU, which will come into effect in 2021, can be well-suited to this purpose. For example, **dedicating specific budget envelopes within MFF 2021–2027 programmes to SMEs working on 5G/advanced-connectivity solutions** could be effective for facilitating access to finance. Such programmes could cover both public funding vehicles (such as the European Innovation Council) and repayable forms of support (such as under InvestEU), both for the purpose of **encouraging private market participation in addition to public support**. In practice, one could draw from **recent experience in the setup of targeted fund-of-funds envelopes** such as the artificial intelligence (AI) and Blockchain pilot programme implemented by the European Investment Fund, which deployed €100 million to catalyse an overall investment of more than €700 million in eligible companies.⁶

Furthermore, for certain 5G applications, existing instruments such as the Connecting Europe Facility (CEF), particularly CEF Transport for 5G mobility solutions, are already well-suited to supporting the roll-out of infrastructure linked to 5G. **Ensuring the continuity of such programmes would help to promote 5G-enabled mobility applications**, particularly if an explicit reference to 5G-enabled applications were included in eligibility criteria. This approach could potentially also be used as a blueprint for similar funding instruments under this mandate, within other relevant application areas beyond mobility.

Recommendation 1B – Launch an indirect funding programme mobilising venture capital and corporate investment

Another potential means to support European SMEs developing 5G-based applications could be the creation of an indirect investment mechanism. Such a mechanism would focus on **making targeted investments in venture capital (VC) funds that finance early-stage SMEs developing advanced-connectivity applications**. The funds could be deployed with a thematic focus to eligible fund managers (for example making investments in specific industries) and to SMEs of a particular level of maturity.

Such programmes have already been deployed successfully in the form of fund-of-VC funds. A specific characteristic of this proposed funding programme would be the requirement and opportunity to enlist **telecom or other corporate VCs to participate as limited partners** in the capital structure of individual fund beneficiaries. Bringing in corporate VCs as lead investors or anchors would add significant value, know-how and confidence, thereby encouraging other private investors to participate in the selected funds. This structure would also make it possible to steer the programme's investments to strategic industries through the combined engagement of VCs

⁶ https://www.eif.org/what_we_do/equity/news/2020/six-funds-backed-innovfin-artificial-intelligence-blockchain-technology.htm

and corporate players. **Adequate governance would be required to support and encourage knowledge exchanges and strategic input from corporate partners, while leaving full investment discretion to private fund managers** (thereby minimising any perceived conflicts of interest for corporate players). The programme mechanics are overviewed in Exhibit 0.8.

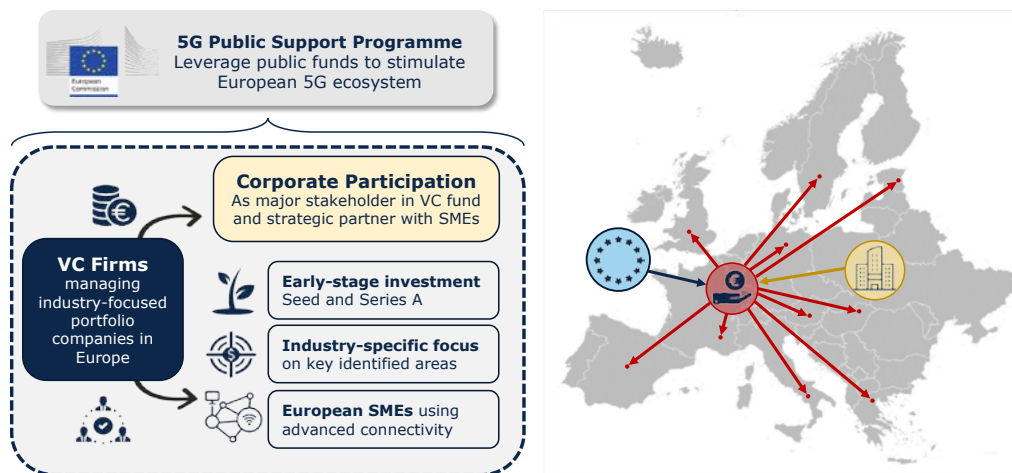


Exhibit 0.7. Overview of Recommendation 1B [Source: Axon Consulting]

Overview of programme mechanics with illustrative figures	
	Programme makes investments into a VC-led fund , for example contributing ~33% of total fund size, with an upper investment limit.
	One or several corporate/telecom anchors are required to contribute extra 20-40% of total fund size.
	VCS must contribute the remaining share with their own or private investment , therefore providing ~33% of total fund size.
	Funds would invest predominantly in early-stage companies with focus on advanced-connectivity applications .
	Funds are “thematic,” covering a specific, or multiple, predefined industries with the tied corporate anchor having a strategic interest in the fund theme.

Exhibit 0.8. Mechanism of the programme [Source: Axon Consulting]

Recommendation 1C – Develop a 5G-focused co-investment platform for VC funds

A **dedicated 5G co-investment platform** would be another highly effective way for public capital to catalyse private investment. In this case, deal sourcing, negotiation and execution would remain in the hands of private investors, but by co-investing on an equal footing with them, public capital **could make larger deal sizes feasible, allowing SMEs to engage in larger investments**. This would help address a **gap in growth financing** for European SMEs involved in 5G technologies and applications, helping these companies to finance more of their growth in Europe, rather than seeking funding from larger foreign VCs.

Such a co-investment platform would not, in principle, actively engage in company management. This would instead be handled by the private partner investors able to de-risk their investment by acquiring larger stakes in SMEs for less capital. This approach would facilitate private management of SMEs funded by the co-investment programme, creating the conditions for value creation and attracting further capital from private investors for SMEs operating in sectors related to 5G.

A fund prequalification approach could further increase the efficiency of the co-investment programme. As deal-by-deal evaluation of co-investment opportunities is time-consuming and labour-intensive, an alternative that has already been successfully tested would involve delegating co-investment opportunity evaluation to the fund manager. By creating fund prequalification criteria and an open tender for VCs to participate in the platform, the programme would enable the best partners to be selected and offer them quick deal-by-deal execution. However, to adopt a fund prequalification approach in this context, the alignment of public and private interests would need to be addressed.

Details of the co-investment platform		
A qualified third-party VC identifies an opportunity benefiting from advanced connectivity	Execution of the public-private agreement, incentivising VCs to pursue similar deals	Three beneficiaries of the co-investment fund
An independent VC firm applies for the co-investment programme	Prequalified VC fund submits a request for the public body to co-invest on an equal footing	The target SME, which receives the full funding amount from a joint public-private source
If requirements are met -> prequalified status	Prequalified VC is able to receive fast approval once the opportunity is reviewed	The VC, which increases its assets under management and has a partner to de-risk the individual investment
VC finds investment opportunity in an advanced-connectivity-based SME and negotiates the potential deal	VC receives full control, management fees on the co-invested amount and carried interest on exit, if applicable	The public body, which boosts the 5G ecosystem by leveraging its investment with private capital

Exhibit 0.9. Overview of the co-investment platform [Source: Axon Consulting]

Adopting all three recommendations (1A, 1B and 1C) would deliver optimal outcomes, as their implementation would constitute three pillars for allocating public capital to support 5G tools and applications.

Due to the nature of the risk taken, partnering with traditional VC would be a suitable way to effectively deploy public funding. In this tried and tested model, professional general partners would be called upon to identify the best financing opportunities and how to finance them, and would actively support companies through their growth – all while complying with the strategic criteria predefined by the provider of public funds.

The above-mentioned **InvestEU and CEF** are both good examples of mandates that could be used to enhance investments in 5G infrastructure and broader ecosystem-building at pan-European level within the **priorities of the EU Digital Strategy**; this should be explored further with the European Commission. At a national level, the **Recovery and Resilience Facility** is another mandate where closer cooperation and coordination between Member States and the European Commission could promote the further integration of 5G infrastructure and innovation-ecosystem-building programmes. In addition, with the support of EU Member States, **the European Commission and the EIB Group could set up a dedicated financial instrument** to enhance access to equity and growth finance for the scale-up of companies focused on developing 5G solutions, and to support the adoption of 5G-enabled technologies across all sectors of the economy. In the following sections, we will describe how these measures should be complemented by other measures, including skills development and advisory programmes to strengthen the adoption of 5G technologies in Europe, and how this would support the priorities of the **Digital Europe Programme**.

Recommendation 2: Introduce non-financial means of supporting early-stage activity through public-private initiatives

This recommendation promotes the **potential to involve telecom and other corporate players** as relevant partners in the 5G ecosystem, **beyond their role as potential investors.**

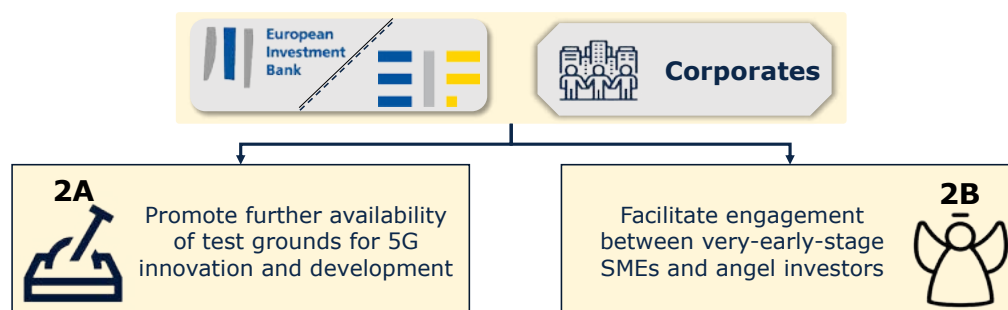


Exhibit 0.10. Overview of Recommendation 2 [Source: Axon Consulting]

Recommendation 2A – Promote further availability of test grounds for 5G innovation and development

One of the most promising non-financial mechanisms for supporting the sector is to **increase the availability of testing facilities**, so-called sandboxes, where multiple players can interact and test the latest iterations of 5G technology. In the 5G corridors initiative ⁷, the European Union and its Member States are already committed to developing large-scale testing sites for connected and automated driving, turning a large area of Europe into an experiment zone for 5G technology. Such initiatives could be complemented by increasing active support for localised sandboxes – these would serve as areas of shared interest between the supply and demand sides of the 5G ecosystem, and thus form a key space for engagement between them. Numerous interviewees expressed a need for more sandboxes, as they allow the parallel testing of equipment, processes/ systems and proof-of-concepts, and demonstrations of technical innovations. This, in turn, enables fast prototyping, development and proofing of technology, and provides favourable conditions for collaboration, demonstration and open innovation.

⁷ The 5G corridors are projects designed to provide seamless 5G connectivity to vehicles even as they cross borders, thereby paving the way for autonomous driving on main road, train and maritime routes. See: <https://5gobservatory.eu/info-deployments/pan-eu-5g-corridors/>

Recommendation 2B – Facilitate engagement between very-early-stage SMEs and angel investors

In addition to public grants, very-early-stage SMEs are often supported by angel investors, who provide early equity financing. To promote private investment in very-early-stage SMEs, dedicated events could be organised with the primary objective of **bringing together investors and SMEs**. A particularly helpful type of interaction could involve the **demonstration of 5G technology capabilities** – such events could also educate angel investors on the potential impact of 5G on industries from an investment perspective, thereby enhancing their understanding of these technologies. These events could be complemented by tailored funding schemes to attract investments into such projects by angel investors. In addition, advisory services could also contribute to matching companies with relevant investors, and such services could be delivered through local/regional innovation agencies or digital innovation hubs.

Recommendation 3: Overcome information asymmetry around 5G

Information asymmetry was identified during interviews as a key hindrance of investment in 5G and its wider adoption, with the complexity and potential of underlying 5G applications and technologies often not understood by VCs. This information asymmetry is apparent in two areas: (i) knowledge of the transformation potential of 5G technology, and (ii) awareness of existing financing options that could support SMEs developing 5G applications.

Recommendation 3A – 5G Monitor: Disseminate information around 5G and advanced-connectivity-enabled business cases and their potential impact

Knowledge of the potential and future capabilities of 5G technology is crucial for VCs to conduct realistic risk assessments and thereby minimise the possibility of negative biases. Increased confidence in the potential business impact could drive industry adoption of 5G applications. Industry-focused events could provide a good platform to discuss the impact and importance of 5G within specific industries. In addition, digital content such as blogs, podcasts and articles could help to disseminate information on the potential of 5G technology in multiple industries through key channels, including industry-specific channels. The current COVID-19 crisis provides a particularly good opportunity to demonstrate the usefulness of 5G technology and, therefore, the full potential of its use cases.

Recommendation 3B – Provide clarity on financing options through advisory services

European SMEs generally lack vital information about the available financing opportunities, and this not only in the 5G sector; in many cases, this is further compounded by limited understanding of how to structure a financeable investment plan. Education and easy access to relevant information on a single platform would increase transparency and potentially provide an early opportunity to connect capital seekers and capital providers in a more productive way. To this

end, creating a database-style portal would help to collate financial and business model information from startups and investment funds. On such an information platform, investors would find relevant data on SMEs in a searchable database of investment opportunities. **Advisory services** will also be key to addressing this need by **raising awareness** of available financing instruments. Awareness-raising opportunities include **direct engagement** with specific companies, the **organisation of relevant events** matching companies and investors, and other **market-development initiatives** to bring public finance solutions closer to where they are needed. Such awareness initiatives should also build on existing events, ranging from the Mobile World Congress and Web Summit to more tailored events specifically focused on 5G and related applications.

Recommendation 4: Reduce cross-border challenges by promoting homogeneity and standardisation

Although focused primarily on financing bottlenecks for SMEs active in the 5G domain, this study also revealed various non-financial issues related to regulation, standards and homogeneity in the European market for digital services. SMEs and investors both noted the **lack of homogeneity and standardisation** as potentially having a **severe impact on the scalability of 5G-related business models**; in turn, this could harm the valuation of SMEs and the level of investments.

The European Commission has correctly identified the most relevant barriers, notably 5G spectrum allocation and the need to facilitate network deployment (particularly small cell deployment), which should be addressed by the European Electronics Communications Code. The Commission has also established deployment targets, initially in the 5G for Europe Action Plan, which were further developed as part of the Gigabit Society broadband targets. On the technology and applications side, some projects under the 5G Public–Private Partnership initiative, such as those related to 5G corridors, should also contribute to future network coverage and functionality homogenisation.

Further efforts should target the effective implementation of already developed improvement measures, as well as the increased homogenisation of deployments, in terms of not only general coverage but also the specific capacity and functionality of those networks (required levels of basic metrics such as throughput and latency, and of functionalities implemented). Otherwise, the high level of degrees of freedom of 5G deployment could lead to significant diversity among networks, making it impossible to deploy highly innovative applications in certain markets where networks comply with the regulations but lack the most advanced features.

From a regulatory standpoint, specific verticals (e.g. drones, autonomous driving) also depend on increased regulatory clarity across Europe. These issues call for specific efforts from the respective regulatory bodies.

Further harmonisation and coordination on these issues are a key enabler and should be encouraged. These drivers can help to maximise the potential of the European Digital Single Market and facilitate the scale-up of European SMEs. This is especially important in light of the expected impact of 5G on a wide range of industries; ensuring true cross-sectoral policy and regulation will be essential to fully realising the benefits of the 5G technology for these industries and its transformative potential.



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