5G Deployment Guide for 5G project promoters and 5G project developers

Telecom operators & network providers

Public sector & government entities

Transport authorities

City & regional governments

Public safety agencies

Healthcare & medical institutions

Enterprises & industrial sectors

Research & education

5GSC
5G for Smart Communities

European Commission

Lessons learned

from the CEF Digital

5G for Smart Communities projects

Purpose of the Guide

The Guide draws on the collective experience of 5G projects across Europe to support future project promoters in their planning and implementation efforts.

The purpose is to provide key recommendations, practical guidelines for the establishment, funding, and implementation of 5G projects, inspired by best practices from the ongoing CEF-funded 5G for Smart Communities pilot projects.

While the content is relevant to all stakeholders, it is specifically directed at 5G project promoters and developers. Certain recommendations are more technical in nature and are therefore particularly aimed at project developers.

Key Recommendations for 5G project promoters

- Prioritise early engagement and awareness
- Ensure regulatory compliance, access to permits and authorisations
- Make sure you have access to spectrum where required by the application
- Identify a sustainable business model
- Take full advantage of 5G benefits
- Understand the broader value proposition of 5G
- Choose the right architecture for tailored 5G connectivity
- Consider cyber security and data protection
- Anticipate chipsets and devices shortages, cost, and integration
- Tackle operational network challenges
- Plan for Post-Project Ownership
- Anticipate licensing-related constraints
- Envisage alternative solutions and test them

Prioritise early engagement and awareness

- Recognise that human behaviour plays a crucial role in the adoption of 5G.
- Actively involve citizens, end-users, and professionals from the outset to address societal concerns and built trust.
- Clearly communicate the benefits of 5G.
- Engage stakeholders early, including IT and telecom departments, ensures smoother adoption and acceptance, making the 5G project more impactful and successful.

Ensure regulatory compliance, access to permits and authorisations

- Anticipate possible administrative burdens associated with permits for buildings, networks, energy and data centres.
- Secure pre-agreements to use pre-existing infrastructure where applicable.
- Prepare for potential delays due to political fragmentation when decision-making responsibilities are shared among national, regional and local authorities.
- Think about additional authorisations unelated to the 5G network, such as aviation rules for drone operations.
- Address regulatory hurdles for specific 5G infrastructure components such as edge nodes that could slow down deployment and network expansion.
- Respect regulations protecting natural areas, cultural sites, and sensitive zones such as schools and hospitals.
- Ensure compliance with electromagnetic fields (EMF) safety standards and exposure limits.
- Adhere to relevant 5G technical standards and align with EU guidelines on cloud interoperability and data portability.
- Ensure compliance with EU state aid rules and applicable funding regulations.
- Maintain records for audits and evaluations to demonstrate regulatory compliance.

Make sure you have access to spectrum

- Ensure access to spectrum if required for your application; in some cases spectrum access may not be necessary.
- Select the most adapted frequency band based on quality of service (QoS) needs and use cases; whether through managed spectrum from 5G operators or network aggregators or private spectrum application or unlicensed spectrum.
- Consider interference risks (e.g., near airports) when selecting spectrum.
- Align your spectrum choice with the European/worldwide market development and devices ecosystem in mind.
- Check spectrum availability, including release date and conditions.
- Verify license duration and renewal conditions.

Identify a sustainable business model

- Make sure your business model will generate profits as mid/long-term sustainability has to be considered from the beginning of the project.
- Anticipate Capital Expenditures (CAPEX) and precise Operational Expenditures (OPEX).
- Conduct a full financial feasibility study, including a cost-benefit analysis (CBA), and assess budgets, finances, and existing connectivity solutions before investing in 5G.
- Evaluate the need for 5G, as many towns already have connectivity solutions in place (e.g., fibre or 4G). The upgrade must offer clear advantages in performance, efficiency, and long-term cost-effectiveness.
- Adress post aid availability, as setting up a sustainable business model can be challenging once funding ends, particularly in low-income areas.
- Assess the expected returns relative to competitive offerings and price levels, segmenting demand (consumers, businesses, industry, and public services), to understand their needs and willingness to pay for 5GSA added value.

Take full advantage of 5G benefits

- Evaluate 5G's suitability for your use case(s) by considering its key benefits: low latency, high data rates, security, slicing options, Quality of Service (QoS), Multi-Access Edge Computing (MEC) services, flexible multi-device platform.
- Leverage 5G capabilities to enhance collaboration and enable immersive experiences, such as 3D models and real-time interaction including Augmented and Virtual Reality (AR/VR), innovative learning experiences, etc.
- Use 5G to support advanced technologies like drones, ensuring high-speed, low-latency, and reliable connectivity, essential for real-time operations and data exchange.
- Deploy 5G's low-, mid-, and high-band frequencies to deliver both wide-area rural coverage and ultra-fast speeds in dense urban environments, supporting seamless connectivity everywhere.
- Keep in mind that 5G standalone is a prerequisite for most 5G use cases.

Understand the broader value proposition of 5G

- Consider indirect benefits for example increased regional attractiveness or enhanced facility operations (e.g., a hospital or an airport), in certain use cases for Services of General Interest (SGI) where revenues may not cover costs associated with a private 5G network.
- Correlate 5G value with the business opportunity and model by aligning user willingness to pay with provider incentives to invest in 5GSA, cloud and vertical integration.

Choose the right architecture for tailored 5G connectivity

- Choose between 5G network slicing and a 5G mobile private network (5G MPN), based on your use case(s), your specific requirements and the associated pros and cons.
- For 5G network slicing from a mobile network operator (MNO):
  - Check if the MNO slicing offers match your requirements.
  - Compare price plans / rates from the MNOs in your country.
  - Explore slicing solutions offered by integrators, MVNOs and international operators.
- For deploying a 5G MPN:
  - Self-build the 5G MPN.
  - Partner with an MNO to deploy and implement the 5G MPN.
  - Collaborate with a network integrator for deployment and integration.
  - Partner with a 5G network manufacturer (e.g., Ericsson, Nokia, etc.) to implement the 5G MPN.
  - Integrate the 5G architecture with edge and cloud infrastructure to meet requirements for low latency, local data processing, and scalability.

Consider cyber security and data protection

- Take into account European (GDPR) and national cyber security rules (5G Toolbox) and how to comply with the different obligations.
- Prioritise data privacy and security from day one as private mobile networks often involve the transmission and processing of sensitive data.
- Be careful with dependency on non-European devices: robotics, IoT devices, 5G cameras (equipment & modem) are mostly non-European.
- Ensure compliance with the AI Act.
- Confirm equipment compliance with the 5G Cybersecurity Toolbox.
- Make sure that backup systems and failover capabilities are available, as redundancy is a critical issue. You should keep in mind that this adds complexity and cost and might impact the scalability of certain 5G solutions.

Plan for Post-Project Ownership

- Clarify post-project ownership early in the project lifecycle.
- Plan for the transfer of 5G MPN ownership to the end user of the 5G services, ensuring long-term return of investment (ROI).
- Enable ownership models where, for example, airport authorities take over the 5G network and fund operations through service fees from airlines or logistics operators.

Anticipate licensing-related constraints

- Plan for potential delays in getting a license for a 5G private mobile network.
- Check the geographical coverage limitations and technical constraints such as power limit and channel bandwidth.
- Evaluate spectrum costs, which may hinder the development of certain 5G use cases.
- Explore sub-licensing arrangements, where large operators grant access to smaller players, as a flexible option to facilitate deployment and reduce entry barriers.

Choose the right architecture for tailored 5G connectivity

	Pros	Cons
Slicing	• Quicker to implement • No 5G expertise needed • Lower CAPEX	• Lack of control over network configurations • Less security and data privacy • Less customisation and control
5G MPN	• Enhanced network reliability and guaranteed performance • Customisation and control • Security and data privacy	• CAPEX • Internal 5G expertise or a reliable third party to operate and manage the network effectively • Obtaining spectrum licenses
Hybrid model – combines elements of both public and private 5G networks	• Flexibility to choose network based on the critical functions and non-sensitive operations • Cost optimisation • Customisation to various operational needs and control • Improved redundancy	• Complex integration as it requires seamless coordination between private and public networks • Security risks • Potential regulatory issues from public-private network interoperability

Source: 5GSC Support Platform

Envisage alternative solutions and test them

- Ensure compatibility of 5G private networks builders with existing systems and technologies, such as 3G/4G networks, neutral hosts, and Wi-Fi networks.
- Integrate Wi-Fi with 5G MPNs, especially in the enterprise segment and in-building solutions where Wi-Fi remains dominant.
- Coordinate with neutral hosts providers when relevant to enable shared infrastructure.
- Enable seamless connectivity between private and public networks, which is essential in scenarios like hospitals where ambulances rely on both.
- Support multi-RAN servicing to connect with multiple public operators when required, such as for public safety needs.
- Use interim solutions like Wi-Fi, and narrowband IoT, alongside in-house development of 5G-compatible devices and proof-of-concept projects, to conduct tests before full 5G deployment.

Tackle operational network challenges

- Check pre-activation of the 5G private network: spectrum clearing, fibre installation and testing for backhauling needs, transceiver validation, and radio discovery (make sure the communication works).
- Validate post activation of the 5G private network: transmission validation with a detailed map of the 5G signal coverage.
- Think about the global IT processes from day one: devices, SIM cards, 5G network infrastructure. Run trials before expanding the network.
- Involve application developers: involvement of application developers is necessary for easy replication of a use case.
- Define the precise 5G mobile network coverage area.
- Design the macrocell coverage to eliminate typical blind-spots (e.g., at airports, especially for safety/security scenarios).

Anticipate chipsets and devices shortages, cost and integration

- Assess devices availability and cost.
- Prioritise the procurement of 5G trusted devices and suppliers that meet specific requirements such as resistance to temperature, humidity or vibrations.
- Check availability of 5G enabled equipment such as sensors, modules, modems, routers, cameras, XR devices, etc.
- Evaluate cost implications of specific 5G devices, which may represent a challenge especially for niche use cases.
- Plan for device integration, as connecting various systems, such as wearables and other IoT systems, continues to pose challenges.
- Prepare for device procurement such as in the case of drones for public authority operations.
- Anticipate chipsets availability as a contributing factor to device scarcity, potentially affecting timelines for device readiness and 5G network implementation.

Lessons learned from the CEF Digital 5G for Smart Communities pilots

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Capacity Building Sessions and Resources

- Exploring 5G Use Cases I Education, healthcare, public security, mobility, agriculture
- Smart Communities Health Care Use Cases
- Introduction to Campus Networks for Smart Communities I Campus networks, IoT, edge computing, AgriTech HUB
- 5G Infrastructure Sharing for CEF 5G Smart Community Projects I Deployment architecture, infrastructure sharing, Towercos

- 5G Edge Cloud Integration

5G promoters' checklist

Network requirements

✅ Does your use case require a private 5G network, or can it rely on an MNO? (Yes/No)

✅ Does 5G slicing align with your operational goals? (Yes/No)

Financial sustainability

✅ Have you planned how to fund ongoing operational costs after the project ends? (Yes/No)

✅ Is post-project ownership of the 5G network clearly defined, including operational models like service fees for sustainability? (Yes/No)

✅ Are additional post-project CAPEX needs adequately accounted for? (Yes/No)

✅ Will the 5G network generate direct revenues, or is it part of a broader infrastructure strategy? (Yes/No)

✅ Have you considered how to measure indirect benefits, such as increased regional attractiveness? (Yes/No)

5G promoters' checklist

Technical and operational considerations

✅ Do your logistics applications require ultra-low latency to improve efficiency and real-time operations? (Yes/No)

✅ Have you assessed how spectrum costs will impact feasibility and financial planning? (Yes/No)

✅ Have you accounted for global IT processes, including device management, SIM provisioning, infrastructure setup and automation at scale? (Yes/No)

Risk and interference mitigation

✅ Have you conducted a thorough analysis to identify potential interference issues in dedicated 4G/5G private network bands? (Yes/No)

✅ Are there measures in place to prevent or mitigate interference risks? (Yes/No)

5GSC directory

Link to the 5G for Smart Communities directories and projects.