

MA Music Business

Creative Business Project
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Report
Module Code: BMTY7006

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13 239 words

ACKNOWLEDGEMENTS

I would like to use this chance to convey my sincere gratitude to everyone who has contributed significantly to the completion of this thesis. I want to start by expressing my gratitude to all of my teachers, whose advice, knowledge, and constant support have been essential to me during this journey.

I owe my family a debt of gratitude for their unfailing help, love, and understanding. Their unwavering encouragement and confidence in my abilities have served as a constant source of inspiration.

Furthermore, I would like to extend my sincere appreciation to Matthias Goltz, Thomas Neukman, and the entire Iconec Campus Network team for their willingness to share their expertise, insights, and experiences. Their contributions have been instrumental in broadening my understanding of the subject matter and inspiring new ideas for my research.

Finally, I'd want to thank everyone who helped with this thesis in many ways, including giving insightful feedback, taking part in interviews, and contributing their perspectives. Your assistance has been crucial in helping to shape this work.

This thesis would not have been possible without their assistance and contributions. They have continuously supported and encouraged me throughout this trip, and I truly appreciate it.

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I/. INTRODUCTION

In recent years, the world has witnessed remarkable advancements in telecommunications, with the emergence of the fifth-generation (5G) network technology taking centre stage. As a transformative leap forward in wireless communication, 5G holds immense promise for revolutionising how we connect, communicate, and interact in the digital age. This thesis explores the profound impact of 5G networks on telecommunications, delving into its technological foundations, potential applications, and the socioeconomic implications it entails.

The introduction of 5G networks marks a paradigm shift since it allows for a new level of interaction among machines, devices, and services that go beyond simple improvements in speed and capacity. 5G opens the door for ground-breaking innovations like self-driving cars, smart cities, industrial automation, and immersive virtual reality thanks to its incredible speed, ultra-low latency, and widespread connectivity. These capabilities could change industries, transform healthcare, empower companies, and improve people's quality of life worldwide. (McKinsey, 2022)

However, achieving this revolutionary potential has its own set of difficulties. Overcoming technical, governmental, and infrastructure barriers is necessary for the successful implementation of 5G networks. Some crucial issues that necessitate rigorous research and strategic planning are spectrum availability, network infrastructure development, security considerations, and regulatory frameworks. To ensure a seamless and effective transition into the 5G era, it is crucial to thoroughly examine these difficulties, comprehend their implications, and provide workable solutions. (Abbey, 2022)

This business proposal intends to offer a thorough examination of both public and private 5G networks and their significant effects on the telecom sector. The proposal will go in-depth on the technical underpinnings of 5G, including its architectural layout, spectrum allocation, and cutting-edge network slicing capabilities. This

proposal would illustrate the distinctive benefits and difficulties related to setting up and operating private and public 5G networks through a thorough investigation. (Abbey, 2022)

This Business Proposal concludes by providing a thorough study of both private and public 5G networks, exploring their technical underpinnings, advantages, disadvantages, and management approaches. Organisations can use this innovative technology to unlock new frontiers of connectivity, efficiency, and innovation in the telecommunications sector by understanding the distinctive characteristics and implications of private and public 5G networks.

II/. 5G CAMPUS NETWORKS

“Campus networks are (tele)communication networks that are operated in non-public spaces, for example, in factories, hospitals or universities. For a long time, a distinction was made mainly between wired (LAN) and wireless (WLAN/WiFi/DECT) networks.” (Iconec, 2023)

According to Digitalregulation.org, The Federal Network Agency in Germany allowed the usage of authorised networks for an affordable cost. These licenced networks operate the same frequency band as open mobile networks. This implies that businesses or other organisations may create their own private networks on their campuses or in particular locations by securing a licence and using frequencies meant for mobile communication. These authorised campus networks provide a secure and in-control wireless networking alternative, frequently with better performance and security than conventional WiFi networks. (Digitalregulation.org, 2020)

With the help of wireless 5G campus networks, companies and organisations can build a secure, independent 5G network on their premises. These networks allow for immediate wireless communication between equipment, machinery, and workers while ensuring speed, security, and reliability. Businesses may use Industry 4.0

technologies like Internet of Things (IoT), AI Big Data analytics to automate business operations, save production costs, and boost productivity. 5G campus networks offer distinct advantages over WiFi in several key areas. Firstly, they provide significantly faster speeds, enabling expedited downloads, streaming, and file transfers. Additionally, 5G networks exhibit lower latency, resulting in quicker response times and an enhanced user experience. The networks also offer heightened reliability, ensuring seamless connectivity and optimal user satisfaction. Furthermore, 5G boasts higher capacity, accommodating a more significant number of simultaneous device connections and facilitating faster data transfer speeds. From a security standpoint, 5G surpasses WiFi by implementing robust encryption and authentication mechanisms. Lastly, 5G campus networks enable streamlined management and monitoring of network devices and applications, leading to enhanced uptime and increased operational efficiency for network operators. (Tomorrow.bio, 2023)

II.a/ Comparision between 4G and 5G technology

According to ThalesGroup, when compared to 4G, 5G technology offers a number of important improvements. The enormous rise in data speeds is one obvious distinction. While 4G networks provide download rates of a few hundred megabits per second (Mbps), 5G networks achieve download speeds of multiple gigabits per second (Gbps). Users benefit from speedier file downloads, smooth HD multimedia streaming, and quick online surfing because to this exponential surge in speed.

5G technology covers the crucial aspect of latency in addition to speed. While 5G networks have extremely low latency of just a few milliseconds, 4G networks often have delay in the range of tens of milliseconds (ms). For applications that require real-time interaction, such online gaming, autonomous vehicles, and remote surgery, this almost instantaneous response time is crucial. The user experiences across numerous industries are improved by the reduced latency, which enables smoother and more precise interactions. (Thales, 2022)

The superior capacity and connectivity of 5G are an additional important benefit. The infrastructure of 5G networks can support an unprecedented number of concurrently connected devices. Advanced methods like network slicing and beamforming, which optimize spectrum consumption and effectively distribute network resources, enable this enhanced capacity. The end result is a network that can support a large ecosystem of devices without being congested or performing worse. (Thales, 2022)

Additionally, 5G technology uses broader bandwidths than 4G, enabling improved data transmission capability. For developing technologies like virtual reality (VR), augmented reality (AR), and internet of things (IoT) devices, which demand high-speed data transfers and potentially produce massive data quantities, this additional bandwidth is very important. These bandwidth-intensive applications are supported by 5G, which gives companies access to new tools and opens up new opportunities. (Thales, 2022)

Beyond technical advancements, 5G networks are intended to be more resource- and energy-efficient than 4G. 5G optimizes network resources, enhances energy usage, and lessens overall environmental impact through the use of the technology like network virtualisation and dynamic spectrum sharing. This emphasis on efficiency makes sure that companies can profit from 5G technology while reducing their environmental impact. (Thales, 2022)

The capabilities of 5G go beyond those of conventional mobile broadband communication, as well. While 4G was largely used for smartphones to transport data at high speeds, 5G is designed to enable a variety of use cases and industries. Businesses may take advantage of revolutionary applications and technology thanks to 5G, like driverless vehicles, smart cities, industrial automation, and remote healthcare. (Thales, 2022)

In conclusion, the unequalled speed, incredibly low latency, expanded capacity, wider bandwidth, energy efficiency, and support for a wide range of use cases of 5G technologies revolutionize wireless communication. Businesses may achieve new levels of productivity, efficiency, and creativity across many industries by utilising the

potential of 5G, which will be crucial to their success in an increasingly connected world.

II.b/ 5G Private Campus Network.

A dedicated and localised network infrastructure known as a 5G private campus network uses fifth-generation (5G) wireless technology to offer seamless connection within a particular campus or building. A private campus network, as opposed to conventional cellular networks, is created to meet the specific requirements of a particular organisation, such as educational institutions, corporate campuses, industrial facilities, or healthcare complexes. (Iconec Gmbh, 2023)

A private 5G campus network is an ideal solution that addresses various connectivity requirements while offering customisation and seamless integration into existing network architectures. It is a specialised and regional network infrastructure that is entirely adaptable to the unique requirements of a business and the surrounding area. It offers numerous advantages and opens up a wide range of use cases. Business operations can be streamlined, efficiency can be improved, and new applications can be unlocked using this technology. For instance, it offers real-time monitoring and control, enables seamless coordination and communication across devices, increases efficiency through automation, and supports data-intensive applications that demand high-speed and low-latency connectivity. (Iconec Gmbh, 2023)

In conclusion, a private 5G campus network is a specialised and flexible network infrastructure that meets the particular needs of a business and its regional circumstances. It allows low-latency communications, high-volume data transfer, and effective networking of many devices. Businesses in various sectors and use cases can open up new opportunities, spur innovation, and realise their strategic objectives by utilising the potential of private networks. (Iconec Gmbh, 2023)

For instance, these Private Networks have been deployed in various industries and locations worldwide, such as:

Manufacturing and Industrial Facilities:

- *BMW Group Plant Regensburg, Germany: At its Regensburg production site, the BMW Group installed a private 5G network to serve robots, automation, and logistical operations.*

Ports and Logistics:

- *Hamburg Port, Germany: To enable autonomous cars, enhance real-time asset tracking, and boost operational effectiveness.*

Universities and Research Institutions:

- *University of Glasgow, Scotland: To promote innovation, support research programmes, and give students and faculty high-speed access.*

Healthcare Facilities:

- *King's College Hospital, London: For the purpose of enabling high-quality video consultations, remote diagnostics, and data-intensive applications.*

<https://www.medicaldevice-network.com/features/5g-remote-surgery/>

Smart Cities:

- *Barcelona, Spain: Private 5G networks have been established by the city of Barcelona for a number of smart city initiatives, such as traffic control, public safety, and environmental monitoring.*

II.c/ 5G Public Campus Network.

A fifth-generation (5G) public campus network is also a creative way to extend the power of wireless technology to public areas, including city centres, parks, college campuses, and business districts. A public campus network, in contrast to standard cellular networks, is focused on delivering seamless connections inside a particular geographic area to meet the demands of a larger community. The public networks provide a wealth of advantages and opportunities. They are the best choice for supporting advanced applications and services in public environments because

they also provide high-speed wireless connectivity, extremely low latency, and massive device connectivity. These networks enable the Internet of Things (IoT) to grow, promoting the development of smart cities, intelligent transportation systems, and improved public services thanks to their capacity to manage many connected devices concurrently. (Iconec Gmbh, 2023)

Municipalities and organisations may optimise resource management, boost sustainability, and improve citizen quality of life by utilising the possibilities of public 5G campus networks. These networks make real-time data gathering, analysis, and response possible, leading to more effective traffic control, environmental monitoring, and public safety programmes. In addition, they provide the smooth integration of smart infrastructure, such as linked streetlights, parking management, waste disposal, and public Wi-Fi hotspots. Additionally, they offer chances for startups, small enterprises, and entrepreneurs to flourish and innovate. They build an ecosystem that encourages entrepreneurship and promotes the creation of fresh software, services, and online experiences. These networks also improve customer connectivity in public areas while utilising real-time statistics for customised marketing efforts. (Iconec Gmbh, 2023)

In conclusion, a public 5G campus network is a revolutionary solution that provides sophisticated functionality and high-speed connectivity to public locations. It makes it possible to implement smart city programmes, improve public services, and offer opportunities for innovation and economic progress. Communities can build connected environments that improve quality of life, promote economic growth, and open the door for a more digitally empowered future by using the potential of public 5G networks. (Iconec Gmbh, 2023)

For instance, 5G Public Networks have been deployed in various industries and locations worldwide.

Cities and Urban Areas:

- *Seoul, South Korea: As one of the first cities to roll out a public 5G network, Seoul now provides locals, companies, and tourists with high-speed access. It has made a variety of smart city services and applications possible.*

Sports Arenas and Stadiums:

- *Allianz Arena, Munich, Germany: The renowned football stadium, Allianz Arena, offers a public 5G network to enhance fan connectivity, facilitate mobile applications, and deliver real-time content during games.*

Airports:

- *London City Airport, UK: A public 5G network has been installed at London City Airport to improve passenger connectivity, enable smart airport initiatives, and make real-time flight information possible.*

Shopping Centers and Retail Areas:

- *Mall of America, Minnesota, USA: To improve connectivity for customers, enable mobile payments, and offer interactive experiences through augmented reality (AR) applications.*

Public Transportation:

- *Shanghai Metro, China: To increase passenger connectivity, promote mobile ticketing, and enable seamless internet access while travelling.*

III. TECHNICAL AND LEGAL REQUIREMENTS

We will now move our attention onto looking at the technical and legal specifications related to these networks. Understanding the technical components, which include issues like network architecture, spectrum allocation, device compatibility, and connection, is essential to the effective implementation and operation of 5G networks. The legal environment around 5G networks also includes compliance with industry standards, licencing regulations, regulatory frameworks, and privacy and security considerations. We want to obtain a thorough understanding of the rules and obligations that regulate the construction and operation of 5G public and private campus networks, therefore, we will dive into these technical and legal requirements to that end. This information will give us the

insights we need to successfully negotiate the complex environment, maintain compliance, and make the most of these transformative networks.

III.a/ Allocated licensed spectrum

The practice of allocating particular frequency bands within the electromagnetic spectrum to authorised parties, such as telecommunication operators, to provide wireless communication services is known as licensed spectrum allocation. National regulatory organisations or governmental organisations in charge of regulating the distribution and use of the radio spectrum are in charge of managing and controlling certain frequency bands. (DigitalRegulation.org, 2020)

The process of allocating spectrum entails breaking down the available frequency bands into distinct segments and allocating them to various operators in accordance with predetermined standards, such as technical compatibility, national licensing regulations, and the needs of the operators. The distribution attempts to enable equal access for numerous operators to offer their services while also ensuring efficient and interference-free use of the spectrum. (DigitalRegulation.org, 2020)

Specific frequency bands have been selected and assigned to 5G networks by regulatory organisations across the world to facilitate the implementation of 5G services. These bands may differ between nations and regions, but they commonly comprise high-frequency millimetre-wave (mmWave) bands above 24 GHz as well as low-frequency bands like sub-1 GHz and mid-frequency bands like 2-6 GHz. (Iconec GmbH, 2023)

For 5G networks to operate reliably and under control, licensed spectrum must be distributed to operators. It enables operators to have sole use of particular frequency bands, reducing interference from other networks and enhancing the functionality and capacity of the network. Operators can install and run their networks in a regulated environment thanks to licensed spectrum, assuring compliance with technical standards, quality of service specifications, and legal duties. (DigitalRegulation.org, 2020)

Operators may plan and optimise their network deployments, properly allocate resources, and provide their consumers with high-quality 5G services by accessing licensed spectrum. It is essential for the effective operation of 5G networks and for sustaining the rising demand for wireless communication services across a range of sectors and uses.

III.b/ Core Server Optimisation

Core server optimisation is crucial for maximising the performance and effectiveness of 5G networks. The core server is the focal point for managing and coordinating numerous network operations, providing continuous connectivity and efficient network operation. We can improve the network's capabilities, create greater user experiences, and handle the rising needs of 5G applications and services by fine-tuning the core server configuration, utilising modern technology, and putting effective resource management into place. The following will explain how the Core Server Optimisation can improve the campus network Bandwidth or its Slicing capacities. (Chen, L., Jiang, Z., Yang, D., Wang, C. and Nguyen, 2021)

Bandwidth

The maximum quantity of data that may be sent via a network connection in a specific amount of time is referred to as bandwidth. Bits per second (bps) or its multiples, such as kilobits per second (Kbps), megabits per second (Mbps), or gigabits per second (Gbps), are frequently used to quantify it. (Iconec Gmbh, 2023)

It establishes the volume or rate of data transfer between devices or via a network. A higher bandwidth enables faster data transmission since it represents the pipeline through which data moves. It can be considered as the width of a road: a broader road can support more vehicles and facilitates a faster flow of traffic. It affects a number of network performance factors, including streaming quality, download and upload speeds, and the responsiveness of online apps. (Iconec Gmbh, 2023)

A 5G private network ensures enterprises and organisations can fully benefit from the sophisticated capabilities provided by the technology by offering adequate bandwidth. It facilitates the seamless transfer of massive volumes of data, supports data-intensive applications, boosts productivity, and ultimately increases operational effectiveness while opening up fresh opportunities for innovation and growth. (Iconec Gmbh, 2023)

Slicing

Slicing describes the capacity to build distinct virtual networks or "slices" within the overall 5G infrastructure in the context of a 5G private network. Each slice is devoted to particular use cases, applications, or user groups and offers resources and network services that are specifically catered to their needs. (Iconec Gmbh, 2023)

A 5G private network can be split into several virtual networks using network slicing, each of which can function separately and have unique properties. Each slice may be configured differently, with varying performance, capacity, security, and quality of service (QoS) standards. As a result, the network can accommodate various use cases and applications with different requirements. (Iconec Gmbh, 2023)

A 5G private network can optimise resource allocation, boost network effectiveness, and offer tailored services to various user groups or applications by utilising slicing. Businesses and organisations can use it to customise the network to their unique requirements, providing the optimum performance and user experience for every use case. Slicing is a crucial component of 5G networks that enables businesses to fully utilise 5G technology. (Iconec Gmbh, 2023)

IV/. CAMPUS NETWORK MARKET ANALYSIS

Setting specific research goals is essential to gaining a thorough grasp of the 5G private campus network industry. By directing the study into diverse areas of the industry, this stage establishes the framework for the market analysis. The main goals of this market analysis are to determine the market's current size, identify its major players, comprehend consumer wants and preferences, and look for expansion prospects. By concentrating on these goals, we hope to obtain insightful information to help strategic decision-making and propel success in the competitive 5G private campus network market.

According to Shivaji Sirssat, the Global Private 5G Network Market was valued at \$1.45 billion in 2021 and is projected to expand, reaching over \$41.80 billion by 2030. From 2022 to 2030, the market is anticipated to develop at a compound annual growth rate (CAGR) of 49.7%.

Several significant organisations have emerged as market leaders in the 5G private campus network industry's competitive environment. Samsung, Nokia Corp., and LM Ericsson are among of the leading companies vying to provide complete 5G network solutions. These enterprises provide a wide range of goods and services designed to satisfy the connectivity requirements of businesses and sectors. Another essential participant is ZTE Corp., which focuses on fast connectivity and effective management tools. Leading telecommunications provider Deutsche Telekom offers a wide range of 5G network services, including private networks. Other notable players in this market include Juniper Networks, AT&T Inc., Verizon Communications, AltioStar, Huawei Technologies Co. Ltd., Mavenir, BT Group, and more. With their expertise and innovative solutions, these key players drive the development and adoption of 5G private campus networks, enabling businesses to harness the power of advanced connectivity and digital transformation.

IV.a/ Largest Markets and Growing Markets

According to the “Custom Market Insight” report: “Global Private 5G Network Market 2023–2032”: North America, Europe, and Asia-Pacific are where 5G private campus networks are primarily sold. Significant investments in 5G infrastructure and technology have been made in these areas, accelerating the development of private networks across various sectors.

One of the largest markets is North America, specifically the United States, which has been at the forefront of 5G deployments. Private network demand is high in the region, driven by sectors like manufacturing, logistics, healthcare, and entertainment.

Europe's deployment of 5G private networks is being led by nations like Germany, the United Kingdom, and France. The expansion in this region is being driven by sectors including the automotive, manufacturing, and smart cities industries and entertainment.

The 5G private campus network industry is expanding quickly in Asia-Pacific, encompassing nations like China, Japan, and South Korea. The manufacturing, transportation, and logistics sectors are embracing private networks to improve their operations, and these nations have made large investments in 5G infrastructure.

Emerging economies in areas like Latin America, the Middle East, and Africa are seeing a spike in interest and investments in 5G private networks, making them some of the fastest-growing markets. These areas provide economic prospects supported by sectors like mining, agriculture, oil and gas, and innovative city initiatives.

IV.b/ 5G Private Campus Network Expansion Prospects

According to the “Custom Market Insight” report: “Global Private 5G Network Market 2023–2032”: The potential for 5G private campus networks to expand is enormous and holds promise for several different businesses. High-speed,

low-latency connections and innovative applications are becoming more and more necessary due to rising demand from industries like manufacturing, logistics, healthcare, transportation, and utilities. In addition to improving operational effectiveness, security, and safety, these networks also enable real-time data analytics and support innovative technologies like the Internet of Things, automation, and augmented reality.

5G private campus networks are essential for enabling connection and aiding data-driven decision-making as organisations adopt digital transformation projects to remain competitive. These networks offer the framework for seamlessly integrating devices, sensors, and systems, supporting process improvement, innovation, and sector-specific digitalization initiatives. The popularity of emerging technologies like the Internet of Things (IoT), artificial intelligence (AI), and virtual reality, which depend on strong and dependable connectivity, is further boosting the demand for high-bandwidth, low-latency networks.

Governments and regulatory agencies worldwide are actively embracing the value of 5G technology. Private network growth is influenced by policies and programmes that support the development of 5G infrastructure, spectrum availability, and investment incentives. Collaboration between network operators, technology suppliers, system integrators, and industry participants is also essential. The growth of 5G private campus networks is being driven by partnerships and ecosystem development, which support holistic solutions, knowledge exchange, and innovation.

Overall, the increased need for improved connectivity, industry-specific requirements, digital transformation programmes, developing technologies, regulatory support, and cooperative activities within the ecosystem are what are driving the expansion prospects for 5G private campus networks. The adoption and spread of these networks are anticipated to pick up speed in the upcoming years as more sectors become aware of their advantages and possibilities.

IV.c/ The Private 5G Network Market: Overview

These networks can also be customised more than public networks, in general. Depending on the radio transmitter's power, the user's needs, and the band being used, these network ranges can cover anywhere from a few thousand square feet to many square kilometres. To improve current capabilities and open up new opportunities for prominent industrial actors, an increasing number of nations are deploying private 5G networks. For instance, in 2021, Germany granted 5G personal licences for the operation of unique networks to around 33 businesses, including BASF, BMW, Bosch, Siemens, Volkswagen, and Lufthansa, among others. Additionally, nations including Australia, France, the United States, and the United Kingdom are aggressively developing regulations to roll out private 5G networks. (S. Sirssat, 2023)

IV.d/ The Private 5G Network Market: Growth Drivers

The development of 5G technology has significantly advanced the global telecom industry and is expected to have a substantial impact on nearly all other industries. As a result, the nations are establishing infrastructure development plans that support the expansion of the market for private 5G networks. For instance, the Partnership for Global Infrastructure and Investment was unveiled in June 2022 at the Group of Seven (G7) Summit by democratic nations including Canada, France, Japan, Germany, Italy, the United Kingdom, and the United States to support the development of high-quality, long-lasting infrastructure in middle-income and developing nations.

By 2027, the G7 countries hope to mobilise around \$600 billion in corporate and public money for infrastructure to increase access to healthcare, energy, and telecommunications.

Feature of the Report	Details
Market Size in 2021	USD 1.45 Billion
Projected Market Size in 2030	USD 41.80 Billion
Market Size in 2022	USD 1.80 Billion
CAGR Growth Rate	49.7% CAGR (2022-2030)
Base Year	2022
Forecast Period	2023-2032
Prominent Players	Telefonaktiebolaget LM Ericsson, Nokia Corp., Samsung, ZTE Corp., Deutsche Telekom, Juniper Networks, AT&T Inc., Verizon Communications, Altiostar, Huawei Technologies Co. Ltd., Mavenir, BT Group, and Others

Figure 1: (MarketInsights.com, 2022)

IV.e/ SWOT Analysis of the General Market Overview

Strengths:

- Improved Connectivity: 5G provides seamless connectivity and better user experiences than 4G by offering faster speeds, lower latency, and larger capacity.
- Advancements in technology: The switch to 5G introduces cutting-edge technologies like network slicing, edge computing, and massive IoT (Internet of Things), opening up new applications and services.
- Industry Transformation: 5G promotes technological breakthroughs in a number of industries, including telemedicine, smart cities, autonomous vehicles, and industrial automation.
- Economic Growth: The switch to 5G spurs economic growth by luring capital, generating employment, and encouraging the emergence of new sectors and business models.

Weaknesses:

- Infrastructure Upgrades: The transformation necessitates significant expenditures in network infrastructure upgrades, including the time- and money-consuming deployment of new base stations, small cells, and fibre-optic cables.
- Compatibility Issues: Older devices might not work with 5G technology, necessitating an expensive upgrade for consumers and enterprises.
- Spectrum availability: Allocating enough spectrum for 5G networks can be difficult because it calls for cooperation between regulators, governments, and telecom companies.

Opportunities:

- Innovation and New Services: 5G opens up new business prospects by enabling the development of cutting-edge services and applications like augmented reality, virtual reality, smart homes, and autonomous systems.
- Industry Disruption: 5G has the potential to revolutionise industries, improving the productivity and efficiency of businesses, including transportation, healthcare, manufacturing, and entertainment.

Threats:

- Security Risks: Due to a rise in connected devices and data interchange, 5G networks are more vulnerable to security threats such as data breaches, cyberattacks, and privacy issues.
- Challenges with regulations and policies: Creating and implementing proper rules and guidelines to control 5G networks can be difficult, necessitating collaboration between regulators, government agencies, and business players.
- Digital Divide: The shift to 5G could widen the digital divide by denying access to 5G infrastructure and services to particular areas or groups, creating unequal opportunities and connectivity gaps.

VI. THE PRODUCTS

We will now carry out a thorough analysis utilising the SWOT framework to have a better grasp of the 5G public and private campus networks. We will determine the internal and external elements that affect the success and effectiveness of 5G public and private campus networks by applying this study to such networks. We will identify the underlying advantages and limitations of these networks by analysing strengths and weaknesses. We will also evaluate the potential for growth and any obstacles they might encounter in the constantly changing telecommunications industry by examining the possibilities and threats. We may learn more about the distinctive qualities, benefits, and difficulties that each form of network presents by completing two independent SWOT studies, one for 5G public networks and one for 5G private networks. This research will be a valuable tool for informing decisions, formulating strategies, and seizing opportunities in the fast-moving environment of 5G public and private campus networks.

V.a/ SWOT of a Public Campus Network

Strengths:

- Extensive Coverage: Wide-ranging coverage is provided by public 5G campus networks in public areas like city centers, parks, college campuses, and business districts. In heavily crowded locations, this enables seamless connectivity and better user experiences.
- Community benefits: Public 5G campus networks provide improved connection for a range of services and applications, which benefits the greater community. These networks assist public safety programs, transit planning, smart city projects, and other ideas that enhance quality of life and stimulate economic growth.
- Collaboration Opportunities: Public 5G campus networks promote cooperation between various stakeholders, including governmental agencies, corporations, academic institutions, and neighbourhood associations. This

encourages creativity, knowledge exchange, and the creation of fresh products and services that the general public can use.

Weaknesses:

- Network Congestion: Public 5G campus networks may encounter higher levels of network congestion during peak usage times due to the large coverage and public accessibility. Users may experience slower data speeds and a decrease in network performance as a result.
- Limited Control: Governmental entities enforce rules and guidelines on public 5G campus networks. As a result, enterprises may have less control and flexibility over the network infrastructure and its management.

Opportunities:

- Economic Growth: Public 5G campus networks stimulate economic development by luring enterprises, encouraging innovation, and encouraging local entrepreneurship. By facilitating the production of new services, apps, and business models, these networks promote economic growth and employment creation.
- Smart City Advancements: Public 5G campus networks are essential for the advancement of smart city projects. They make it possible to gather, analyze, and make decisions about data in real-time for a variety of applications, including environmental monitoring, energy efficiency, and intelligent infrastructure.

Threats:

- Infrastructure Investment: A large financial investment in infrastructure, equipment, and ongoing maintenance is necessary to set up and sustain a strong public 5G campus network. It might be difficult to find financing and resources for network improvements and growth, especially for municipalities and public institutions.
- Cybersecurity Risks: Public 5G campus networks could be exposed to cybersecurity dangers such as illegal access, data breaches, and network outages. To safeguard sensitive data and maintain network integrity, it is crucial to implement strong security mechanisms and procedures.

V.b/ SWOT of a Private Campus Network

Strengths:

- Customisation: Private campus networks have the benefit of being completely adaptable to a company's unique requirements and regional circumstances. This enables customised connectivity solutions, improved performance, and seamless infrastructure integration.
- Enhanced Security: Compared to public networks, private campus networks offer a higher level of security. They provide stronger authentication procedures, encryption, and access control, which lowers the possibility of unauthorised access and data breaches.
- Dedicated Resources: Private campus networks allocate exclusive resources for the organisation's usage, providing dependable connectivity. As a result, the effects of network congestion are reduced, and users receive consistent service.

Weaknesses:

- Higher Costs: A private campus network may need expensive initial setup fees and continuing expenses. To properly manage and run the network, organisations must make investments in the necessary equipment, infrastructure, and employees.
- Limited Coverage: Private campus networks often limit their coverage to a single campus or set of premises. Due to this restriction, extra steps may be necessary to maintain connectivity outside of the defined area, such as joining forces with other groups or connecting to public networks.

Opportunities:

- Industry-Specific Applications: Industry-specific applications, such as smart factories, healthcare facilities, and educational institutions, are made possible via private campus networks. These networks support cutting-edge technologies like the Internet of Things (IoT), automation, and real-time monitoring, improving operational effectiveness and opening up new avenues for innovation.

- Data Control and Privacy: Private campus networks give businesses more control over their data in light of growing privacy concerns. This presents chances to increase client trust, abide by rules, and implement effective data governance procedures.

Threats:

- Regulatory Changes: rules regarding spectrum licensing, compliance with municipality rules, and establishing private campus networks may provide difficulties. Implementation challenges may arise from complying with these rules and obtaining the required approvals and licences.

If the general products are the development, planning and installation of 5G Private and Public campus networks, the product can be sold and developed under different forms.

V.c/ 5G in a box

A comprehensive solution developed by the company Iconec GmbH called "5G in a box" makes use of the essential technical elements of 5G networks to offer a transportable and self-contained connection solution. The system contains a small 5G base station that uses the licensed frequency designated for 5G communication and is often based on small cells or microcells. To create connectivity with the larger telecommunications infrastructure, the base station links to the core network through wired or wireless backhaul.

The system also has network hardware for data processing, routing, and management in addition to the base station. A seamless data transfer within the private 5G network is made possible by using equipment, including routers, switches, and servers. These elements guarantee effective network resource management, low latency communication, and efficient data packet routing.

The 5G in-a-box system supports several wireless communication protocols, including 5G New Radio (NR), Wi-Fi, and Bluetooth, to give connectivity to end-user

devices, such as smartphones, laptops, or specialised music production equipment. This allows various devices to connect to the private 5G network and benefit from the 5G technology's high data rates, low latency, and capacity advantages.

Overall, "5G in a box" combines the technical strength of 5G networks, including radio technologies, network hardware, and wireless communication protocols, to create a transportable and self-contained solution for delivering dependable and high-speed internet connectivity in transient or remote settings.

VII. THE BUSINESS MODEL

According to Matthias Goltz, Founder of "Iconec GmbH": "My business serves the telecommunications sector as a specialised service provider, concentrating on the study, adaption, and transformation of network infrastructure into private and public campus networks. Actors, such as companies or institutions, approach prominent telecom providers like Telefonica, Deutsche Telecom, or British Telecom to convey their demand for a dedicated 5G private or public network.

The next phase is for these telecom providers to act as middlemen and issue tenders to companies that can create and deploy these specialised campus networks. Iconec 5G Campus Network team, is one of the reliable subcontractors selected for this project. We play a critical role in the execution of these projects thanks to our knowledge and experience in network transformation.

A thorough analysis step begins as soon as Iconec receives the tender. Understanding the particular needs and regional circumstances of the actor requesting the private or public campus network is necessary. Utilising our technical expertise, our team works closely with the telecom operator to assess the current network infrastructure and identify any required modifications.

Iconec creates a customised plan after doing the analysis to convert the conventional operator network into a specialised private or public campus network.

In order to do so, the network architecture must be modified, the relevant hardware and software must be configured, and the chosen geographic area must have seamless connectivity. Our expertise in network optimisation, security, and performance guarantees solid and trustworthy network architecture.

Our business works closely with the telecom operator and other project stakeholders during the implementation phase. These campus network deployments are successful because of effective project management, prompt execution, and respect to industry standards. Our team enables a seamless transition from a conventional operator network to a private or public campus network by using the most recent technology and processes.

Iconec 5G Campus Network team promotes itself as a dependable partner in the 5G ecosystem by providing this specialised service, bridging the gap between the players looking for specialised networks and the telecom carriers. Iconec plays a critical role in advancing the acceptance and deployment of private and public campus networks by utilising its technical know-how, creative solutions, and dedication to producing high-quality results.”

VII/. MARKETING

It is essential to assess the market forces at work in the highly competitive environment of the 5G commercial and public campus network market. The Five Forces research methodology offers a thorough method for comprehending the competitive landscape and assessing the market's allure. This section will explore the Five Forces study of the 5G campus network market, looking at the negotiating power of customers and suppliers, the threat of substitutes and new competitors, and the level of intense competition. We may develop useful insights into the market structure, recognise potential obstacles and opportunities, and develop successful plans to give our business a competitive edge by looking at these forces.

VIII.a/ Five force analysis

Threat of New Entrants:

New competitors for selling 5G public and private networks pose a moderate threat. The need for 5G networks is increasing, which can draw new competitors despite the high entry hurdles that can result from the infrastructural and technological know-how requirements. However, well-established businesses with years of expertise and a sizable client base have an edge over rivals in terms of consumer confidence, connections with suppliers of network equipment, and established distribution channels. (Wheeler, Simpson; 2019)

Power of Buyers:

In the market for 5G networks, consumers have average negotiating power. When choosing a network provider, customers, such as companies or organisations, have various choices. Buyers may have little negotiating power, though, if the provider of 5G networks has a solid reputation, cutting-edge technology, and a track record of successful implementations. Additionally, the difficulty of setting up and maintaining 5G networks may restrict customers' ability to switch providers quickly. (Thales, 2022)

Power of Suppliers:

In the market for 5G networks, vendors have significant negotiating leverage. Suppliers of network hardware, software, and components have a considerable advantage over businesses that offer 5G networks. providers may be able to set prices, terms, and conditions because of the small number of well-established providers and the specialised nature of their offerings. However, businesses can limit this power by forging strategic alliances with numerous suppliers or spending money on internal R&D resources. (Thales, 2022)

Threat of Substitutes:

In the market for 5G networks, the threat of replacements is minimal. While there are other network technologies, like 4G or Wi-Fi, 5G has certain distinct advantages over them, including faster data rates, lower latency, and more network capacity. The significance and necessity of 5G networks make them less susceptible

to replacement as the demand for advanced connectivity and new technologies like IoT and driverless cars continues to rise. (Solution30.com, 2023)

Industry Rivalry:

The market for 5G networks is highly competitive. Many businesses provide comparable solutions and battle for market share. Technology developments, network coverage and dependability, pricing strategies, customer service, and industry alliances are the main differentiators. Businesses will be at an advantage if they can show their competitive edge through innovation, excellent client relationships, extensive service offerings, and a proven track record of successful implementations. (Solution30.com, 2023)

VII.b/ Marketing meeting insight

I had the pleasure of attending a valuable marketing meeting while I was in Nuremberg to visit Iconec. This discussion provided insightful information about the methods and techniques Iconec has used to grow and expand their company in the competitive 5G campus network market. I learned more about the company's vision, objectives, and marketing strategies. The following paragraphs will develop what was said during this meeting.

“A key element in guaranteeing the success and wide acceptance of our 5G network technologies is the marketing strategy. The essential marketing strategies that will promote client acquisition, brand awareness, and market penetration are outlined in this section. We want to establish ICONEC as a top supplier of private and public 5G campus networks by utilising a variety of digital channels, enhancing search engine exposure, planning customer and partner events, and showing the capabilities of our network through lab days.

We will concentrate our marketing efforts on developing a strong online presence, interacting with our target market, and explaining the distinctive value of our services. These tactics will help us build our brand, create leads, and draw in clients looking for advanced network solutions tailored to their own requirements.

We place a high priority on creating a new website that will function as an extensive platform to present our 5G network solutions. The website offers a user-friendly interface for navigating through various solutions, case studies, and success stories, as well as in-depth information about our services and areas of expertise. We engage potential clients and business partners with an attractive and educational website, developing our online reputation as a top supplier of 5G campus networks.

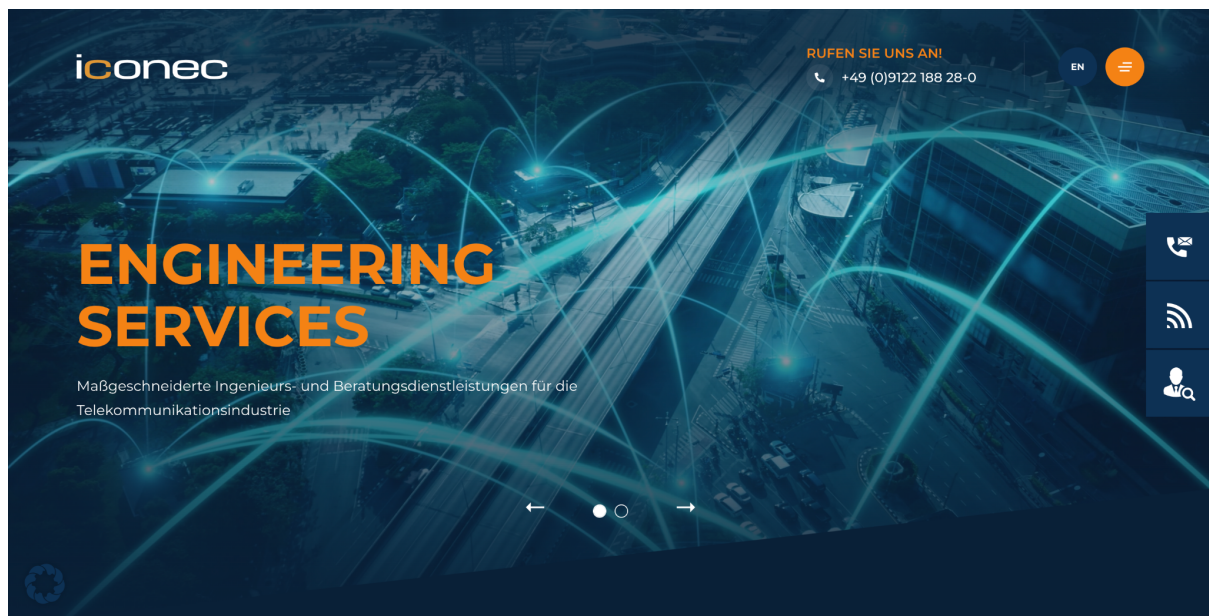


Figure 2: Front Page of Iconec's new website (Iconec GmbH, 2023)

We establish a significant presence on social networking sites like LinkedIn, Bing, and others that are pertinent to our target market. We often provide industry insights, news, project updates, and success stories in two to three postings per week. Engaging in pertinent conversations and networking with industry experts raises brand awareness and establishes us as a thought leader in the 5G network sector.

Unser Veranstaltungshighlight der Woche: **#5gDialog** 🙌

Zur 10. Ausgabe war unser **#5G** Experte **Christopher Branston** vor Ort ...voir plus

[Notez cette traduction](#) · 🌐

Our event highlight of the week: **#5gDialog** 🙌 For the 10th edition, our **#5G** expert **Christopher Branston** was on site in Nuremberg at the OM7 start-up and creative industries centre to gather valuable impressions. The 5G Dialogue is a meeting place for innovations and groundbreaking ideas. Far away from traditional sales events, the opportunity for open discussion was offered - around the topics **#5G**, **#6G** & **#Campusnetze** - with a lot of **#Kreativität** and inspiring lectures 💡 The highlight was undoubtedly the interactive exchange with experts from various industries, who promote the active transfer of knowledge and joint development. ⚡ The 5G Dialogue showed us once again that 5G technology has the power to push the boundaries of our industries and open up new horizons. 🚀 Many thanks to the organizers of **NIK e.V.** & **Fraunhofer IIS** for a wonderful event 🙌 We are already looking forward to the next opportunity 😎 **#Innovation** **#Wissenstransfer** **#TechnologieDerZukunft**



It is essential that we keep in constant contact with our partners and clients. As a result, we employ a newsletter approach that makes use of both our own specific newsletter and the newsletter of our parent company, Alten. These newsletters contain information about our most recent projects, technology developments, market trends, and future events. We build great relationships with our audience by keeping them informed and interested, making sure they are always aware of the most recent advancements in the industry.

A priority is to use search engine optimisation (SEO) strategies to improve our online presence and get targeted traffic to our website. We strategically incorporate specific keywords into the content and structure of our website, such as Industry 4.0, 5G Campus, private Campusnetz, IoT, smart industry, VR, AR, and others. This raises our search engine ranking, making it simpler for new clients and business partners to find us when looking for 5G network solutions and related services.

	A	B	C	D
1				
2	Keyword	Suchvolumen	cpc in \$	Keywordschwierigkeit
3	5g-campusnetz	200	8,55	26
4	campusnetze	90	2,24	31
5	5g campus	100	5,38	28
6	5g campus network	70	10,12	29
7	5g-technologie unternehmen	90	1,95	25
8	private 5g	90	9,09	31
9	wer baut 5g in deutschland	80	1,91	31
10	industrienetze	30	1,8	15
11	industrie 4.0	20 500	3,14	43
12	smart factory	2 700	15,32	31
13	digitalisierung 4.0	510	2,17	33
14	digitalisierung industrie 4.0	210	3,99	38
15	industralisierung 4.0	260	n.v.	21
16	technologie 4.0	210	2,29	34
17	produktion 4.0	230	3,68	32
18	iot industrie 4.0	140	8,52	18
19	profinet	4 200	1,95	31
20	drahtlose steuerung	10	0,26	11
21	iiot	2 400	13,11	30
22	industrial internet of things	370	12,73	40
23	ehealth	1 800	4,75	39
24	ehealth tec	160	1,04	25
25	krankenhaus digitalisierung	60	8,94	36
26	digitalisierung im krankenhaus	140	5,48	35
27	digitalisierungsstrategie krankenhaus	60	8,94	36

Iconec is a firm believer in the value of strong customer and partner relationships and direct interaction. We host Usecase Days in addition to dedicated days for partners and customers to help with this. These occasions provide us with a chance to talk with our customers, learn about their unique needs, show off our skills, and illustrate the advantages of our 5G network solutions using actual use cases. We create new business prospects and long-lasting collaborations by encouraging collaboration and open communication.

The Nuremberg office holds lab days to demonstrate the usefulness and efficiency of the 5G network solutions. These events allow us to show off our network's features live while highlighting its high connection, low latency, and capacity to handle various applications, including IoT, VR, AR, and more. Customers and partners receive personal knowledge of the revolutionary potential of our 5G networks through these practical experiences, and they develop trust in our capacity to provide dependable and innovative solutions.”

In conclusion, the marketing strategies described in this part play a crucial role in the 5G network business' success and expansion. By increasing their exposure and reach among their target audience by developing a new website, active participation on social media platforms, frequent newsletters, and search engine optimisation. Additionally, occasions to highlight their abilities, cultivate connections, and showcase the possibilities of their network solutions will be presented by client and partner events like Usecase Days and lab days. The company is convinced that by successfully putting these marketing techniques into practise, they will be able to draw in new clients, create valuable alliances, and establish Iconec as a leading innovator in the development of private and public 5G campus networks. These marketing initiatives will increase visibility, produce leads, and help the company succeed overall in this fast-paced and cutthroat market.

VIII/. PROOF OF CONCEPT FOR TILEYARD

With more than 250 business working together to rebuild the creative industries brick by brick; Tileyard is a renowned creative hub located in London, United Kingdom where music, entertainment, and creative industries have their own vibrant community and workspace in order to collaborate, invent, and advance their projects, artists, musicians, producers, record labels, and other creative professionals can come together at Tileyard. (Tileyard, 2023)

The campus offers a wide range of amenities and services designed with the requirements of the creative community in mind. Modern recording studios, music production facilities, practice rooms, co-working spaces, event locations, and a range of support services are all available such as SoundCloud, Ableton, or Believe. In addition to music-related enterprises, Tileyard also houses offices and facilities for various other sectors within the entertainment and creative industries such as video games production with F1 Arcade or Videography with Teepee Films. The energetic environment at Tileyard is renowned for encouraging teamwork, networking, and artistic development.

For their daily operations and creative projects, many of the businesses in Tileyard need a dependable and fast internet connection. A strong internet connection is necessary for a variety of tasks like online collaboration, content streaming, file sharing, research, marketing, and communication as technology becomes more and more important in the creative industries.

Following, we will analyse different types of businesses present in Tileyard, explaining why these businesses require a great and sustainable internet connexion.

Indeed, an efficient internet connection is necessary for the operation of music production studios in Tileyard. For streaming and downloading big audio files, communicating with remote artists, and accessing online music libraries and software tools, these studios are dependent on reliable internet connectivity.

Similarly, Tileyard's game production companies rely largely on a stable internet connection to run their businesses. For tasks like online multiplayer testing, downloading game assets and updates, interacting with gaming communities, and accessing cloud-based development tools and resources, these studios need a reliable internet connection.

A solid internet connection is also essential for Tileyard content creation businesses, including those working in animation, visual effects, cinema, and television. These businesses rely on an important internet connectivity to use cloud-based rendering services, perform remote collaborations with clients and talent, and upload or download high-resolution video files.

Additionally, the operations of the digital marketing and PR (Public Relation) firms in Tileyard strongly rely on a great internet connection. For content development, online advertising, social media monitoring, data analysis, strong and secure network, and customer communication, these businesses need a dependable internet connection.

Last but not least, in order to run their businesses, technology entrepreneurs in Tileyard that create software, mobile apps, or online platforms want a reliable and great internet connection. These startups depend on a this network for online research, cloud-based services, software testing, and development.

Providing a robust and dependable internet connection is essential for Tileyard to keep a competitive edge in today's intensely competitive creative business. The need for seamless collaboration, the creation of digital content, and online advertising is growing as new creative hubs appear. The professionals at Tileyard can work more productively thanks to a strong internet connection, completing projects more quickly and ensuring timely communication with clients and partners. With a strong relationship, they may use social media and digital platforms to expand their online presence and interact with more people, perhaps luring in new business partners and customers. Keeping up with technological improvements in the cutthroat environment of creative hubs requires a very fast, secure and reliable internet connection, but it also means exceeding client and partner expectations. Strong internet access differentiates Tileyard as a hub capable of delivering

top-quality work, meeting strict deadlines, and offering excellent client experiences in a world where quick and seamless connectivity has become the standard.

Tielyard Education Songwriting camps: 5G In a box

In addition to other artistic pursuits, London's Tielyard has developed a reputable reputation for its part in holding national and international songwriting camps. These camps take place beyond the walls of the Tielyard campus and unite accomplished musicians, producers, and performers from all around the world. By hosting songwriting retreats overseas, Tielyard offers participants a rich and varied experience that promotes cross-cultural cooperation and exposes them to new musical influences. Creative workers can explore various creative environments, establish worldwide relationships, and broaden their artistic viewpoints by attending these international songwriting camps. With a dedication to promoting international collaborations, Tielyard has made a name for itself as a platform for creative interchange and songwriting relationships outside of the local music scene as well.

The limits and unreliability of internet connections, however, present a considerable obstacle during these songwriting camps, both nationally and abroad. For musicians and artists, having a strong and dependable internet connection has become essential due to the music industry's reliance on digital technology, online collaboration tools, and streaming platforms. The constraints of internet connectivity might present considerable difficulties in the context of songwriting camps, where real-time collaboration and seamless communication are crucial. High-quality audio file sharing and streaming, taking part in live remote sessions, and accessing online resources that are essential to the creative process can all be hampered by unstable connections. These restrictions can obstruct the free flow of creativity, impair effective teamwork, and reduce the total output and effectiveness of songwriting camps.

The creative solution in the shape of "5G in a box" is available to alleviate the issues brought on by sporadic and unreliable internet connectivity during songwriting camps or other events. This mobile, self-contained 5G network solution provides a dependable, fast internet connection that is tailored to meet the requirements of

transitory, movable settings like songwriting camps. A private and dedicated 5G network may be established anywhere thanks to the "5G in a box" solution, which offers a portable infrastructure with a 5G base station, antennas, and network hardware. Because of its sophisticated features, 5G in a box offers a number of benefits, including as faster speeds, low latency, and high capacity. Songwriting camps can address the constraints of conventional internet connections by utilising the power of 5G technology. This will enable musicians and artists to unleash their creativity and improve their collaboration experiences fully.

IX/. BUDGETING

A 5G private network implementation requires careful planning, execution, and resource allocation, including funding. Understanding and efficiently managing the financial aspects become increasingly important as companies and organisations embrace the transformative promise of 5G technology. Budgeting for a 5G private network requires considering several things, including the price of the infrastructure, the cost of the equipment, the deployment of the network, continuing maintenance costs, and operational costs. This approach necessitates a thorough assessment of the organisation's needs, strategic goals, and expected return on investment. Businesses can assure optimal resource utilisation, tap into the full potential of advanced connectivity, and enable cutting-edge applications that promote growth and competitiveness by successfully budgeting for a 5G private network. (Iconec Gmbh, 2023)

Five categories: Material, Design, Installation, Training, and Maintenance & Support typically make up the budgeting sheet for putting in place a 5G private network. With regard to budget allocation, each category stands for a crucial component of the network deployment process. Purchasing necessary tools like base stations, antennas, routers, and other hardware parts falls under the Material category. Costs associated with design include those related to planning, site surveys, and network architecture development. Installation costs include physical installation, cable installation, and connectivity configuration when infrastructure is deployed. Training

costs involve educating personnel on the operation and maintenance of the network. Lastly, the Maintenance & Service category offers continuous assistance, system troubleshooting, and routine upgrades. (Iconec Gmbh, 2023)

The budgeting sheet that is shown below has been created by the Iconec Campus Network team specifically for Tileyard. The budgeting sheet seeks to offer a thorough overview of the costs associated with deploying the 5G private campus network solution after carefully considering their needs and preferences. We can make sure that the financial plan smoothly connects with Tileyard's goal and supports them in making educated decisions throughout the project by customising the budgeting sheet to their particular context.

We will go into great length about the budgetary factors and associated costs for putting in place a 5G private network in the paragraphs that follow.

p5G Standard calculation Indoor Scenario				
	Customer / End price net	Internal/Buying Price net	Margin	Project Margin
Material				
Indoor RAN (BTI): 1x Base Band Unit, 1x Switch (EU) N x Radio Unit (12sqm ~3 Radios per floor)	61 400,00 €	38 600,00 €	22 800,00 €	37,13%
5G core 10Gbit/s HW platform + Switch + 2500 user license, commercial use/ Academic use	120 000,00 €	76 800,00 €	43 200,00 €	36,00%
Small parts, cables, feeders, adapters, splitters, mast etc.	6 000,00 €	4 000,00 €	2 000,00 €	33,33%
2500 SIM Cards	8 000,00 €	4 000,00 €	4 000,00 €	50,00%
Sum Material	195 400,00 €	123 400,00 €	72 000,00 €	36,85%
Design				
Site Survey	4 800,00 €	2 400,00 €	2 400,00 €	50,00%
Net architecture & Design	25 000,00 €	12 500,00 €	12 500,00 €	50,00%
Documentation (network planning, component documentation etc)	10 000,00 €	5 000,00 €	5 000,00 €	50,00%
Sum Design	39 800,00 €	19 900,00 €	19 900,00 €	50,00%
Installation				
Pre configuration	24 000,00 €	12 000,00 €	12 000,00 €	50,00%
Installation (Core + Radio) Indoor	9 600,00 €	4 800,00 €	4 800,00 €	50,00%
e2e Integration on site	9 600,00 €	4 800,00 €	4 800,00 €	50,00%
Acceptance e2e system	48 000,00 €	24 000,00 €	24 000,00 €	50,00%
Sum Installation	91 200,00 €	45 600,00 €	45 600,00 €	50,00%
Training				
Training of employees as required (2 days)	4 500,00 €	2 250,00 €	2 250,00 €	50,00%
Sum Training	4 500,00 €	2 250,00 €	2 250,00 €	50,00%
Maintenance & Support				
SW subscription and best-effort support annually 5G core & RAN	20 000,00 €	11 400,00 €	8 600,00 €	43,00%
50 man days technical support on call (2h blocks) first year (ticket system, phone contact, remote support)	40 000,00 €	20 000,00 €	20 000,00 €	50,00%
Sum Services	60 000,00 €	31 400,00 €	28 600,00 €	47,67%
SUM Project	390 900,00 €	222 550,00 €	168 350,00 €	43,07%

Material

	Customer / End price net	Internal/Buying Price net	Margin	Project Margin
Material				
Indoor RAN (BTI): 1x Base Band Unit, 1x Switch (EU) N x Radio Unit (12sqm ~3 Radios per floor)	61 400,00 €	38 600,00 €	22 800,00 €	37,13%
5G core 10Gbit/s HW platform + Switch + 2500 user license, commercial use/ Academic use	120 000,00 €	76 800,00 €	43 200,00 €	36,00%
Small parts, cables, feeders, adapters, splitters, mast etc.	6 000,00 €	4 000,00 €	2 000,00 €	33,33%
2500 SIM Cards	8 000,00 €	4 000,00 €	4 000,00 €	50,00%
Sum Material	195 400,00 €	123 400,00 €	72 000,00 €	36,85%

Several of the items listed in the Material section are necessary to establish a 5G private network. The Indoor Radio Access Network (RAN) solution offered by BTI is one of these elements. A Base Band Unit (BBU), a Switch (EU), and several Radio Units make up this system. The Switch enables productive connectivity between network parts, while the BBU acts as the core unit for managing data transmission and reception. The Radio Units allow for wireless communication within the allocated space, with an estimated density of three radios per floor covering an area of about 12 square metres.

The 5G core hardware platform, which consists of a 10Gbit/s HW platform, a Switch, and a 2500 user licence, is also included in the material section. This platform may be used for both professional and academic purposes, and it supports the fundamental features of the 5G network.

Numerous tiny components, including cables, feeders, adapters, splitters, and mast equipment are also provided to guarantee the network's installation and operation go without a hitch. These elements are essential in building the network's physical infrastructure.

To further facilitate connectivity and communication for devices and users within the 5G network, 2500 SIM cards must be made available.

In terms of cost, Iconec spent 123,400.00 € internally to acquire these materials. However, after adding in additional expenses for implementation, customisation, and support services, the final cost to the user for Tileyard will be 195,400.00 €. (Iconec GmbH, 2023)

Design

Design				
Site Survey	4 800,00 €	2 400,00 €	2 400,00 €	50,00%
Net architecture & Design	25 000,00 €	12 500,00 €	12 500,00 €	50,00%
Documentation (network planning, component documentation etc)	10 000,00 €	5 000,00 €	5 000,00 €	50,00%
Sum Design	39 800,00 €	19 900,00 €	19 900,00 €	50,00%

The Site Survey, which entails doing a thorough analysis of the actual site where the network will be placed, is one of the essential elements. This study aids in locating the best spots for setting up equipment, locating antennas, and planning coverage while considering variables including signal quality, interference, and site-specific needs.

The total network architecture is designed based on the unique requirements and objectives of Tileyard, which is another crucial feature. To ensure effective data transmission and network performance, this includes choosing the right network structure, choosing the required components, and establishing the connectivity and routing protocols.

In the design process, documentation is just as important as the technical design considerations. This comprises the documentation for network planning, which describes the suggested network architecture, equipment setups, and connectivity information. Additionally, component documentation is produced to offer thorough details about the particular components utilised in the network design, ensuring accurate deployment and long-term upkeep.

The internal cost for Iconec to do the design work is 19,900.00 €, according to pricing. However, the final cost to the customer for Tileyard, which takes into account the knowledge and time required to create a specific 5G network solution, will be €39,800.00. (Iconec Gmbh, 2023)

Installation

Installation				
Pre configuration	24 000,00 €	12 000,00 €	12 000,00 €	50,00%
Installation (Core + Radio) Indoor	9 600,00 €	4 800,00 €	4 800,00 €	50,00%
e2e Integration on site	9 600,00 €	4 800,00 €	4 800,00 €	50,00%
Acceptance e2e system	48 000,00 €	24 000,00 €	24 000,00 €	50,00%
Sum Installation	91 200,00 €	45 600,00 €	45 600,00 €	50,00%

To bring the design to life and guarantee the smooth deployment of the network infrastructure, the installation phase of the 5G private network implementation is essential. To properly set up and integrate the required components, it involves a number of critical operations.

The initial setup and configuration of the network equipment, including the core and radio units, before installation, is known as pre-configuration. This entails setting up software, configuring network settings, and assuring interoperability with the overall network architecture.

The physical installation of the core and radio units in the indoor setting is a part of the installation process. According to the outcomes of the site survey and the design requirements, this comprises mounting and connecting the equipment. To build a robust and effective network infrastructure, care is taken to ensure optimal component arrangement, cabling, and connection.

E2E (End to End) integration occurs on-site when the installation is finished. To achieve flawless interoperability, this step entails merging the various network components, including the core, radio units, and other supporting systems. The smooth running of the network and the transmission of data are made possible by the integration process, which makes sure that all components coexist peacefully.

Acceptance of the E2E system marks the end of the installation phase. To guarantee that the network satisfies the established performance criteria and objectives, it must be thoroughly tested and verified. To determine whether the network is prepared for operational usage, this testing includes examining connectivity, network dependability, and data transfer capabilities.

The internal cost for Iconec to complete the installation jobs is 45,600.00 €. However, the final cost to the customer for Tileyard will be 91,200.00 €, reflecting the knowledge and work required to ensure a smooth and effective installation process. (Iconec GmbH, 2023)

Training

Training				
Training of employees as required (2 days)	4 500,00 €	2 250,00 €	2 250,00 €	50,00%
Sum Training	4 500,00 €	2 250,00 €	2 250,00 €	50,00%

For the 5G private network at Tileyard to be implemented successfully, the training component is essential. It entails giving the staff the information and abilities they need to use and operate the network infrastructure efficiently.

Iconec will offer the Tileyard personnel specialised training sessions as part of the training. The training will cover crucial facets of the 5G network, such as its features, use, and upkeep. The staff members will receive thorough training on how to use network capabilities, manage network resources, and troubleshoot typical problems.

Considering the unique needs of Tileyard and its employees, the training programme is created to be brief but instructive. Two days will be allotted for the training sessions, providing ample time for information transmission and practical application.

The training hours will cost Iconec 2,250.00 € internally. However, the final cost to the customer for Tileyard will be €4,500.00 and will include the knowledge and value imparted through the training programme.

Maintenance & Support

Maintenance & Support				
SW subscription and best-effort support annually 5G core & RAN	20 000,00 €	11 400,00 €	8 600,00 €	43,00%
50 man days technical support on call (2h blocks) first year (ticket system, phone contact, remote support)	40 000,00 €	20 000,00 €	20 000,00 €	50,00%

In order to guarantee the seamless and continuous operation of the 5G private network at Tileyard, maintenance and support are essential components.

Iconec understands the value of offering continuing support and fixing any technical difficulties that may come up over the lifecycle of the network.

Iconec provides a yearly software subscription that covers the 5G core and radio access network (RAN) to provide thorough support. This subscription gives users access to the most recent software patches, feature upgrades, and bug fixes, ensuring that the network is always current and operating at peak efficiency.

In addition to the software subscription, Iconec offers Tileyard specific technical assistance. This includes 50 man-days of on-call technical assistance offered in 2-hour increments during the first year. Tileyard has several ways to get in touch with the support staff, including a ticket system, phone calls, and remote assistance. To ensure minimal downtime and optimum network performance, the support crew is well-equipped to answer technical enquiries, solve problems, and give prompt resolutions.

This maintenance and support package will cost Iconec 31,400.00 € internally. However, the final cost to the customer for Tileyard, which includes the benefits and assurance gained from this all-inclusive service package, will be 60,000.00 €. (Iconec GmbH, 2023)

Budgeting Conclusion:

For the SUM project, Iconec meticulously planned out the budget and price for the 5G private network solution for Tileyard. Iconec has determined an internal pricing for completing the project of 222,500.00€, which includes the expenses for materials, design, installation, training, and maintenance & support. In order to reflect the value and advantages of the 5G private network, Tileyard will be paying 390,900.00€ for the project.

The project margin for Iconec as a result of this price structure is 43.07%. This margin indicates the revenue and financial gain Iconec realised while carrying out the project. It represents the gap between the price charged to the consumer and the internal cost of supplying the services. Iconec can guarantee the long-term viability and expansion of their company with a project margin of this size. It makes it possible to maintain investment in R&D, improve the standard of services, and adapt to changing client needs.

XI. CONCLUSION

In fine, the broad panorama of 5G private campus networks has been examined in this business proposal, as well as its relevance in revolutionising sectors and providing cutting-edge connectivity. The study started by giving a general overview of 5G technology, its salient characteristics, and the distinctions between 4G and 5G networks. It went deep into market analysis, showing the rising need for 5G public and private campus networks across various industries and naming major players, including Telefonaktiebolaget LM Ericsson, Nokia Corp., Samsung, ZTE Corp., and others.

It also included topics like network design, spectrum allocation, and system integration while discussing the implementation aspects of 5G private campus

networks. It highlighted the significance of core specialisation based on particular network requirements, like optimising download and upload rates, lowering latency, and assuring effective data transfer. Additionally, it emphasised the idea of network slicing, which allows for customisation and allocation of network resources to accommodate various application requirements.

The marketing facets of 5G private campus networks were also investigated, emphasising techniques including website creation, social media presence, newsletters, and client interaction programmes. Strong collaborations, partner and customer events, and live demonstrations of the network's capabilities were stressed.

The financial issues of creating a 5G private campus network were covered in detail, along with extensive insights into the material, design, installation, training, and maintenance components. The financial components were emphasised, showing project margins, internal pricing for Iconec, and the associated customer end price for Tileyard.

The government's assistance, regulatory activities, rising demand from many industries, cooperative efforts within the ecosystem, and government support all contribute to the optimistic future view. The adoption and growth of these networks are further fueled by the promise for improved operational efficiency, digital transformation, and the incorporation of cutting-edge technologies like IoT, AI, and VR.

In conclusion, this thesis offers a thorough grasp of 5G private campus networks by addressing technological, marketing, financial, and market analysis opportunities. It highlights how these networks have the power to revolutionise sectors, enable seamless connectivity, and promote creativity. The significance and utility of 5G private campus networks will only increase in the years to come as businesses continue to embrace digitisation and look for advanced connectivity options.

REFLECTIVE ANALYSIS

I have found the issue of 5G campus networks to be fascinating and interesting, especially given how closely it relates to my forthcoming six-month Strategic Partnerships internship at Canal+ television group. I will take a lead role in the creation of their OTT/VOD platform, myCANAL, as part of my internship. The relevance of 5G public and private networks in the context of Canal+'s operations and expansion ambitions across Europe, Africa, and Asia has been made possible for me by my position, which has provided me with a rare opportunity to observe personally.

The fusion of 5G technology and the media sector, particularly in the area of streaming services, has piqued my interest and inspired me to learn more about 5G campus networks. It is essential to comprehend the complexities and potential of these networks in order to improve the functionality, usability, and user experience of systems like myCANAL.

I have been exposed to the dynamic world of strategic alliances and the ever-changing nature of media consumption. Faster data transfers, seamless delivery of high-quality content, and new opportunities for media sector innovation are all made possible by the development and deployment of 5G networks.

I have learned a lot about the strategic planning, negotiations, and collaborations necessary to build strong 5G networks that satisfy Canal+ and its partners' particular demands and goals as a result of my focus on strategic alliances. I've come to understand the enormous potential of 5G campus networks to transform how information is provided, consumed, and experienced.

I'll delve into my experiences, views, and ideas in this reflective study about 5G campus networks, focusing on how this technology relates to my internship at Canal+ and what it means for the future of the entertainment and media business

Tileyard

Furthermore, I have come to understand the enormous potential and value that this technology represents for businesses like Tileyard during my thorough investigation and analysis of 5G campus networks. As I learned more about the advantages and potential of 5G networks, I saw how perfectly it matches Tileyard's mission and objectives. Regarding operations, efficiency, and meeting the changing needs of its clients in the creative industries, 5G networks' seamless connectivity, high-speed data transfers, and low latency provide Tileyard with a game-changing opportunity.

With this in mind, a major section of my business proposal has been devoted to describing a customised solution that has been created especially for Tileyard. By utilising 5G private and public networks, Tileyard can position itself as a leader in offering its community of independent artists and enterprises cutting-edge connection solutions. This involves making live streaming of high quality possible, fostering collaboration through virtual and augmented reality technologies, and producing immersive experiences using Internet of Things (IoT) gadgets and smart technology. My proposal emphasises the strategic benefits and market positioning that Tileyard may achieve by embracing this technology, in addition to the technical requirements of deploying 5G networks.

Through my investigation and analysis, I have come to the firm conclusion that 5G campus networks can significantly impact Tileyard's overall expansion and success. By incorporating this technology into its ecosystem, Tileyard is able to stimulate innovation, open up new creative channels, and solidify its position as the top centre for the creative industries. This conviction is reflected in my business proposal for Tileyard, which presents a thorough plan for the effective deployment and use of 5G networks that is adapted to the unique requirements and goals of Tileyard and its neighbourhood.

In this reflective analysis, I'll go into more detail about my experience researching, evaluating, and realising the potential of 5G campus networks for Tileyard. I'll talk about the lessons learned, the difficulties I ran into, and the strategic value it offers the company.

Iconec: Nuremberg

Iconec GmbH, known as one of the top authorities in this industry in Germany, came to my attention throughout the course of my research and inquiry into the world of 5G campus networks. I recognised a special chance to cooperate with them on my business project because I valued their knowledge and their excellent track record in implementing 5G campus network solutions.

Iconec's work piqued my interest, so I got in touch with them to convey my enthusiasm for the potential of working together and to lay out the goals and vision of my business proposal. I discussed how integrating 5G campus networks may significantly benefit Tileyard, a well-known centre for independent artists and enterprises, and how this collaboration could provide exciting new opportunities for both parties.

They had never entered the UK market before, so the possibility of working with an organisation like Tileyard sparked their attention. After exchanging a few emails, we had several interesting meetings in which we investigated potential connections between Tileyard's distinctive creative environment and Iconec's technological know-how in implementing 5G networks.

Both Tileyard and Iconec benefited from the potential this collaboration provided. While Tileyard could benefit from Iconec's vast experience in 5G campus networks to improve operations and offer state-of-the-art connectivity solutions to its community, Iconec saw an opportunity to diversify its clientele and enter the UK market with a reputable customer. We formed a promising alliance due to our mutual enthusiasm and shared objectives, which provided the groundwork for the seamless integration of 5G private networks at Tileyard.

Difficulties

On a 5G private campus network, writing a business proposal has not been without its difficulties. First and foremost, the subject matter presented a substantial challenge due to its complexity and technical nature. It was necessary to conduct

considerable research and take a deep dive into the field of telecommunications and network infrastructure in order to fully comprehend the complex aspects of 5G networks, including their architecture, deployment patterns, and interaction with current systems.

The lack of relevant case studies and actual instances of 5G private campus network implementations presented another challenge. Finding particular examples of private campus deployments was more challenging despite the fact that there were prominent examples of 5G networks being used in public contexts, such as smart cities or significant industrial uses. For organisations considering the adoption of such networks, it was difficult to prove the potential benefits and return on investment due to the lack of hard data.

The financial side also presented a unique set of difficulties. For many organisations, a major hurdle was the high cost of obtaining and deploying 5G infrastructure, including baseband units, radio units, and core network components. It was necessary to carefully take into account several elements, including the purchase, installation, training, and continuing maintenance of the equipment, to precisely estimate the financial consequences and provide a thorough cost analysis.

Last but not least, the business plan also needed to cover the legal and regulatory issues related to 5G networks. Compliance with spectrum laws and licencing requirements became essential in implementing private campus networks, including the use of radio frequencies. The concept became even more complicated when the legal system had to be understood, and compliance had to be guaranteed.

Despite these difficulties, I persevered and addressed the assignment with tenacity. I sought to overcome these challenges and present a thorough and well-informed business proposal on 5G private campus networks by significant study, engagement with industry experts, and rigorous analysis. I believe the plan has acquired depth and legitimacy by admitting and confronting these difficulties head-on, empowering decision-makers to make sensible decisions about using this game-changing technology.

Visit of the Offices in Nuremberg.

I had the honour of visiting the Iconec offices in Nuremberg while on my exploration of the world of 5G private campus networks. This trip represented a crucial turning point in my research since it gave me the chance to speak with the minds driving the creation and deployment of 5G networks.

When I walked into their premises, I was welcomed by a buzzing environment propelled by creativity and passion. I was kindly welcomed by the Iconec team, who also took the time to present me to their innovative technologies and highlight their current projects. I learned a lot about the sophisticated operations of a 5G private campus network from directly experiencing how the network was run and controlled.

I had the ability to have in-depth conversations with the team members during my visit, which included engineers and project managers. These conversations helped me gain a greater comprehension of the difficulties they encountered, the tactics they used, and the lessons they discovered on their path. Their drive to produce dependable and effective 5G solutions as well as their research for pushing the limits of technology were incredibly motivating.

It was enlightening to observe the 5G network architecture in operation. I saw how baseband units, radio units, and other crucial parts all functioned in unison to provide high-speed connectivity and serve a variety of applications. It was intriguing to see how this technology aided in corporate transformation and promoted innovation in a variety of industries.

The trip to Iconec's offices also gave me the chance to get to know the staff better personally. Engaging conversations and the sharing of ideas were encouraged by the open and cooperative environment. I was encouraged to enquire, get answers to my inquiries, and learn more about particular facets of their work. My understanding of 5G private campus networks was further enhanced by the team's readiness to share their knowledge and experiences.

Overall, the trip to Iconec was a great experience that added to my research and gave my thesis and business plan a practical perspective. It reaffirmed the value of first-hand exposure to complicated technology in obtaining a thorough grasp of them. I am appreciative of the Iconec team's hospitality, information sharing, and insightful advice.

The visit extended my perspectives while also enhancing my knowledge. I now have a greater understanding of the potential of 5G private campus networks and how they can influence connectivity in the future. The encounter reaffirmed my enthusiasm for this area and strengthened my resolve to help 5G technologies grow.

Knowledge, Skill and Perspective.

I can without a doubt say that conducting in-depth research and developing a business proposal on 5G private campus networks have broadened my knowledge, abilities, and perspectives in several ways. First of all, it has improved my comprehension of network infrastructure and telecoms. I now have a thorough understanding of the 5G networks' design, parts, and deployment strategies, as well as the possible uses and advantages they may have. This information has given me a strong foundation in the subject of communications and extended my view of how 5G technology may change numerous businesses.

This endeavour has also improved my research abilities. I've honed the skill of critically analysing intricate technical concepts, locating pertinent sources of data, and synthesising the results into a convincing and thoroughly researched business plan. My research and analytical abilities have improved as a result of conducting thorough market assessments, examining industry trends, and comprehending the competitive environment. This has made it possible for me to approach future projects with a more methodical and informed mentality.

In addition, this topic has helped me to grasp corporate strategy and planning better. Considerations for creating a business proposal include market analysis, competitive positioning, financial viability, and risk evaluation. I learned more about these components by examining them in the context of 5G private campus networks. I also

learned how crucial it is to match technological ambitions with overarching business goals. Without a doubt, having this information will help me in my future endeavours since it will enable me to address problems in the corporate world more strategically and holistically.

Additionally, this research has increased my understanding of the wider effects that 5G technology will have on society and the economy. I became aware of this technology's disruptive potential as I looked into the possible uses of 5G networks, such as its role in enabling smart cities, industrial automation, and immersive technologies. My thoughts on the opportunities and difficulties that lie ahead have been widened as a result of learning the societal and economic effects of 5G networks. It has also given me a sense of obligation to help in the ethical and responsible deployment of 5G networks, making sure that they are advantageous to people, companies, and communities in general.

In general, my knowledge of the topic of 5G private campus networks has increased. It has also improved my research and analytical abilities, helped me better comprehend corporate strategy, and given me new perspectives on the revolutionary possibilities of developing technology. It has given me the skills I need to navigate the constantly changing telecommunications industry successfully and piqued my interest in further studying the points where technology, business, and society converge in the search for novel solutions.

Personal and Professional growth.

Significant growth in both my personal and professional life has resulted from working on my thesis/business proposal on 5G private campus networks. First of all, it has improved my project management abilities. Effective time management, organisation, and prioritisation were needed to balance the project's many facets, including research, data analysis, and the creation of a thorough proposal. I am now better at organising and carrying out complicated activities, meeting deadlines, and maintaining focus in the face of conflicting objectives thanks to this experience.

This project has also improved my presentation and communication abilities. Creating a persuasive business proposal required the clear and succinct explanation of intricate technical ideas and conclusions from market analyses. I have developed my capacity to communicate information clearly, modify my communication style for various audiences, and involve stakeholders in insightful debates as a result of writing and presenting my thoughts.

Additionally, the project's research and analysis have improved my ability to think critically and solve problems. I've developed the ability to approach problems from various angles, critically assess the information I get, and base my conclusions on facts and logic. This has given me useful abilities that I can use in a variety of professional contexts, allowing me to approach complex challenges methodically and analytically.

My interest in emerging technologies and their business applications has also grown as a result of working on this thesis/business proposal. It has increased my motivation to continually look for chances for innovation and to keep up with the most recent trends and developments in the telecoms sector. This experience has given me a growth attitude that motivates me to accept ongoing education and flexibility in a constantly evolving technical environment.

This initiative has cultivated my perseverance and toughness on a personal level. It took commitment, tenacity, and the capacity to overcome challenges to complete a thorough research project and create a thorough business plan. It has helped me understand the significance of perseverance and the benefits of remaining dedicated to a goal.

Conclusion:

In conclusion, starting the road of learning about 5G private campus networks and creating my thesis/business proposal has been a rewarding and life-changing experience. I've had the chance to research the topic, evaluate my own experiences, and think back on my development and newfound insights thanks to this reflective analysis.

5G private campus networks was the topic that was chosen due to both my personal and professional interests. I became aware of the enormous potential of 5G networks as I started my six-month internship with the Canal+ Television Group and worked on the creation of their OTT/VOD (Over The Top/Video on Demand) application myCANAL. This realisation piqued my interest and inspired me to learn more about 5G networks, especially in the context of college settings.

I studied different facets of 5G private campus networks, such as their architecture, advantages, difficulties, and implementation methods, throughout the process. I was able to put my academic understanding to use in real-world situations by conducting market research, examining important industry players, and creating a business proposal for Tileyard. Furthermore, the chance to work with Iconec, a top provider of 5G campus networks, increased my expertise and broadened my viewpoints.

The difficulties and complications associated with creating a business proposition on 5G private campus networks have been brought to light by this reflective analysis. I ran into a number of challenges along the way, from figuring out technical lingo and market dynamics to handling financial concerns and spotting development prospects. However, these difficulties offered priceless chances for learning, encouraging both professional and personal development.

My knowledge, abilities, and perspectives have considerably increased as a result of working on this thesis/business proposal. I now have a thorough understanding of the technical nuances of 5G networks, the competitive environment, and potential applications in a range of businesses. My investigative, analytical, and critical thinking skills have also improved as a result of the training, allowing me to tackle complicated challenges from a strategic perspective.

On a personal level, this experience has given me a deep respect for technology's potential and its influence on society. My enthusiasm for the field has been stoked by seeing the transformative potential of 5G networks to improve connectivity, inspire innovation, and promote economic growth, which has strengthened my dedication to making a contribution to its advancement.

In fine, it has been a rewarding and educational experience to conduct the research for and write the thesis/business proposal on 5G private campus networks. It has broadened my perspectives, enhanced my comprehension, and given me the information and abilities I need to successfully navigate the constantly changing telecommunications industry. I will carry the priceless lessons I learned from this experience with me as I advance in my academic and professional endeavours, igniting my curiosity and propelling me to keep discovering new technological horizons.

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