Seventh Generation (7G) and the Future of Telecommunications Entrepreneurship: Innovation, Ecosystems, and Emerging Use Cases

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ABSTRACT

This systematic literature review examines how seventh-generation (7G) telecommunications and innovation may shape entrepreneurship in the telecommunications sector. While prior studies emphasize technological visions and network capabilities, limited research explicitly links emerging 7G use cases to entrepreneurial value creation. Addressing this gap, the study explores how 7G technologies may enable new entrepreneurial opportunities.

Using a PRISMA 2020-guided methodology, the study analyses 17 studies drawn from peer-reviewed journal articles, conference proceedings, and selected authoritative preprints through qualitative thematic analysis. The findings identify 7G-enabled opportunities across smart and sustainable cities, intelligent healthcare, autonomous systems, immersive digital services, and edge-enabled industrial applications. Three key insights emerge. First, advanced 7G capabilities such as AI-native networking, edge intelligence, ultra-high-capacity connectivity, and intelligent orchestration create the technological conditions for modular, platform-based, and cross-sector venture development. Second, entrepreneurial outcomes depend heavily on ecosystem integration, where collaboration among operators, technology providers, startups, and complementary actors supports scalable innovation and reduces commercialization risk. Third, innovation operates as the central mechanism translating 7G capabilities into viable business models.

Based on these insights, the study proposes an integrative conceptual framework linking 7G capabilities, innovation processes, ecosystem conditions, and entrepreneurial outcomes within telecommunications environments. The review clarifies how future network generations may reshape entrepreneurial dynamics and offers a foundation for future empirical research as 7G technologies advance toward standardization and deployment.

Keywords: Seventh generation (7G), Innovation, Telecommunications entrepreneurship, Emerging use cases, Digital twins, Immersive communication, Sustainable business models.

INTRODUCTION

Innovation and entrepreneurship have long been recognised as central drivers of transformation within the telecommunications industry (Lin et al., 2018; Meraviglia et al., 2025; Pandit, 2008). Empirical studies consistently demonstrate that innovation capability, particularly when supported by information and communication technologies, positively influences entrepreneurial intensity, firm competitiveness, and economic growth across developed and emerging economies (Bhat et al., 2020; Mayfield, 2011; Pervaiz & Syed, 2025; Saguy, 2013; Suematsu, 2014). Innovation is not merely a technological outcome but a socio-economic process through which new ideas are transformed into marketable products, services, and organisational practices (Mayfield, 2011; Suematsu, 2014). Since Schumpeter's early conceptualisation of innovation as "new combinations" of productive resources, telecommunications has repeatedly demonstrated how technological breakthroughs stimulate entrepreneurial reconfiguration of industries, institutions, and value chains (Girón & Beltrán, 2025; Lin et al., 2018; Thomas & Douglas, 2021).

In telecommunications, empirical evidence shows that generational technological transitions have repeatedly enabled new entrepreneurial opportunities. Studies on 3G, 4G, and 5G reveal that advancements in network capacity and flexibility directly correlate with the emergence of new service providers, digital platforms, and value-added services (Hassani et al., 2025; Pervaiz & Syed, 2025; Tuttlebee, 2006). Entrepreneurs leverage these transitions by exploiting regulatory changes, adopting new business models, and integrating digital infrastructures to improve decision-making and innovation performance. This established relationship between innovation and entrepreneurship provides a critical empirical foundation for examining future generations of telecommunications technologies (Burnham, 2008; Kushida, 2011; Meraviglia et al., 2025; Stefanov & Antonova, 2020).

The historical evolution from first-generation analog systems to fifth- and sixth-generation networks reflects a progressive expansion in performance, intelligence, and application scope (Kaur et al., 2023; Kumar et al., 2025; Nayak et al., 2024). Empirical and comparative studies of mobile generations demonstrate that each transition has extended the economic and entrepreneurial reach of telecommunications by enabling new forms of connectivity, automation, and digital service delivery (Cho et al., 2020; Lam & Shiu, 2010; Muppavaram et al., 2023). Fifth generation networks introduced ultra-reliable low-latency communication and massive IoT, while sixth generation research further advanced AI-native architectures, integrated sensing, and digital twin technologies (Hoyos, 2025; Pandi et al., 2025; Liu et al., 2024; Sharif et al., 2024; Shome et al., 2025).

Seventh generation (7G) telecommunications is increasingly conceptualised as an extension beyond performance-driven network evolution (Devi & Priya, 2023). Drawing on empirical insights from 6G research programs and early foresight studies, 7G is expected to integrate terrestrial and non-terrestrial systems, autonomous intelligence, pervasive sensing, and real-time coordination across digital and physical environments (Akhtar et al., 2020; Ran & Zhang, 2023). While empirical validation of 7G remains limited due to its emergent nature, the trajectory is grounded in observable trends from 6G pilot studies and large-scale research initiatives, which already demonstrate a shift toward system-level intelligence and cross-sector integration (Alkholidi et al., 2025; Drampalou et al., 2024; Tera et al., 2024; Zambetti et al., 2025).

Unlike previous generations, which primarily expanded entrepreneurial opportunities within telecommunications and adjacent digital markets, 7G is expected to catalyse entrepreneurship at the ecosystem and societal level (Köseoglu, 2025). Empirical studies on 6G use cases indicate that future networks will support autonomous mobility, immersive environments, intelligent infrastructure, and large-scale digital twin systems, each of which creates opportunities for new venture formation beyond traditional telecom service models (Ali et al., 2023; Ananthakrishnan et al., 2025; Bhadoriya et al., 2025; Köseoglu, 2025; Vermesan & Bacquet, 2018).

Evidence from innovation and entrepreneurship research further suggests that as technological systems become more complex and interconnected, entrepreneurial value creation shifts from product innovation toward ecosystem orchestration and platform governance (Ananthakrishnan et al., 2025; Ferlito & Faraci, 2024; Paramba & Salamzadeh, 2025). In this context, entrepreneurs act not only as service providers but as integrators of multi-actor systems involving governments, industries, and communities. Empirical findings from policy-enabled innovation ecosystems, such as national 6G programs and cross-industry platforms, support this shift by demonstrating that entrepreneurial success increasingly depends on coordination, trust, and long-term strategic alignment rather than isolated technological advantage (Uusitalo et al., 2021; Wei et al., 2021).

Despite growing research on entrepreneurship in 5G and 6G contexts, the literature on 7G remains largely conceptual and technology oriented. Existing reviews tend to emphasize technical capabilities, architectural visions, and future use cases, while giving comparatively limited attention to how these emerging capabilities may translate into entrepreneurial value creation, scalable business models, or ecosystem governance arrangements. As a result, the literature remains technologically rich but commercially underinterpreted, leaving policymakers, entrepreneurs, and innovation stakeholders without a coherent framework for assessing entrepreneurial opportunities in future 7G ecosystems (Babu & Logapadmini, 2025; Chamola et al., 2025; Pennanen et al., 2024).

This gap becomes more pronounced when considering entrepreneurship theory. Empirical studies linking ICT access, innovation capability, and entrepreneurial outcomes demonstrate strong positive relationships at the firm and ecosystem level (Cuevas-Vargas & Parga-Montoya, 2022; Gomes & Lopes, 2022; Shen et al., 2023; Subramaniam & Sambasivan, 2025; Shrivastava et al., 2021). However, these insights have not yet been systematically extended to post-6G contexts. As a result, policymakers and entrepreneurs lack empirically informed frameworks to guide decision-making in future 7G ecosystems. Addressing this gap is critical to ensuring that technological advancements are matched by entrepreneurial readiness and institutional capacity.

This unresolved gap justifies a systematic synthesis of the emerging literature at the intersection of advanced telecommunications, innovation processes, and entrepreneurship. In response to these limitations, this study addresses the following research question:

How do Seventh Generation (7G) technologies and innovation enable new forms of telecommunications entrepreneurship, and under what ecosystem conditions can these opportunities be realised?

The objectives of this study are threefold. First, it aims to synthesise empirical and conceptual literature related to innovation, entrepreneurship, and emerging post-6G telecommunications systems. Second, it seeks to identify and classify emerging 7G-relevant use cases and innovation drivers that have demonstrable entrepreneurial implications based on empirical evidence from 6G and adjacent domains. Third, the study proposes an integrative conceptual framework linking 7G technological enablers, innovation mechanisms, ecosystem readiness, and entrepreneurial outcomes, thereby extending existing empirical insights into a forward-looking 7G context.

The remainder of this paper is structured as follows. Section 2 reviews prior empirical and conceptual studies related to innovation and entrepreneurship in telecommunications, the evolution toward 7G technologies, emerging use cases, and policy and ecosystem considerations. Section 3 outlines the research methodology, including the literature review design, data sources, and thematic analysis procedures. Section 4 presents the discussion, synthesising empirical findings and theoretical insights to examine innovation dynamics, entrepreneurial opportunities, ecosystem readiness, and strategic foresight in the 7G era, and introduces a conceptual framework linking these elements. Section 5 concludes the paper by summarising key findings, outlining theoretical and practical contributions, and identifying directions for future research on 7G-enabled telecommunications entrepreneurship.

LITERATURE REVIEW

Innovation and Entrepreneurship in the Telecommunications Context

Innovation is widely recognised as a foundational driver of entrepreneurship and economic development, particularly in technology-intensive industries such as telecommunications. Empirical research demonstrates that firms with strong innovation capabilities, supported by digital infrastructure and knowledge management practices, exhibit higher entrepreneurial intensity and competitive performance (Gomes & Lopes, 2022; Haga, 2005; Pita, 2010; Yonglong & Minjie, 2011). Studies across OECD countries confirm a statistically significant relationship between ICT access, innovation capacity, and entrepreneurial activity, indicating that telecommunications infrastructure functions as both an enabler and accelerator of entrepreneurship (Afawubo & Noglo, 2021; Cuevas-Vargas & Parga-Montoya, 2022; Gomes & Lopes, 2022; Ndofirepi & Steyn, 2024).

Within the telecommunications sector, innovation has historically emerged through generational shifts in mobile technologies. Empirical analyses of earlier generations show that each technological transition lowered entry barriers, enabled service differentiation, and stimulated new venture formation, particularly in value-added services and platform-based offerings (Rajola, 2013; Kushida, 2011). These findings support Schumpeterian perspectives that view innovation as a dynamic process through which entrepreneurs recombine technological and organisational resources to generate new markets (De Castro et al., 2018; Dolfsma & Van Der Velde, 2014; Foster, 2010).

More recent empirical studies emphasise the growing importance of ecosystem-level innovation. Yang et al. (2024) demonstrate that innovation outcomes in advanced telecommunications environments increasingly depend on collaboration among firms, regulators, and technology providers. Similarly, Kariv (2013) highlights that inclusive and diverse innovation ecosystems enhance entrepreneurial sustainability, although empirical evidence linking inclusivity to next-generation telecommunications entrepreneurship remains limited. Collectively, these studies establish innovation as both a firm-level and ecosystem-level determinant of entrepreneurial success. In conclusion, the telecommunications sector exemplifies the symbiotic relationship between innovation and entrepreneurship. Technological advancements create new opportunities, while entrepreneurial efforts convert these innovations into viable business models, driving economic growth and sectoral transformation (Kushida, 2011; Stefanov & Antonova, 2020; Yang et al., 2016).

Taken together, these studies establish innovation not merely as a supporting condition for entrepreneurship, but as a core mechanism through which telecommunications actors create, capture, and scale value across evolving technological generations.

Evolution Toward Seventh Generation (7G) Telecommunications

The evolution of mobile telecommunications has historically followed a cumulative and problem-driven trajectory, in which each generation emerges to address the technical, capacity, and service limitations of its predecessor. Early generations focused primarily on voice communication, while subsequent generations progressively introduced digital transmission, mobile data, broadband access, and low-latency services. Reviews of mobile network evolution consistently show that this generational progression is not merely incremental, but increasingly transformative, as networks evolve from basic connectivity platforms toward intelligent and adaptive infrastructures governed by software-defined and data-driven control mechanisms (Zontou, 2023).

The transition to fifth-generation (5G) systems represented a major inflection point by enabling enhanced mobile broadband, ultra-reliable low-latency communication, and massive machine-type connectivity. These capabilities expanded the role of telecommunications networks beyond consumer communication into domains such as industrial automation, smart cities, and large-scale Internet of Things applications (Bhatia et al., 2023). Despite these advances, multiple studies highlight that 5G remains constrained by spectrum scarcity, high deployment costs, energy inefficiencies, and limited native intelligence, particularly in developing and emerging economy contexts (Majeed, 2025).

Sixth-generation (6G) research further extends this trajectory by embedding artificial intelligence into network control, introducing terahertz communication, and integrating satellite and non-terrestrial networks to support global coverage. Comparative and review studies consistently describe 6G as a transitional architecture that bridges connectivity-centric networks and intelligence-oriented systems, enabling immersive applications, digital twins, and pervasive sensing (Bhatia et al., 2023; Khutey et al., 2015). However, the literature also emphasizes that most 6G architectures rely on overlay intelligence layers and remain limited in their ability to autonomously adapt, reason, and optimize at scale (Petrov et al., 2023).

Seventh-generation (7G) telecommunications is therefore conceptualized as a qualitative evolution rather than a linear extension of 6G. Across recent surveys and perspective studies, 7G is framed as an intelligence-native, cognitive, and autonomous network paradigm in which sensing, learning, security, and decision-making are embedded as intrinsic network functions rather than add-on capabilities (Chamola et al., 2025; Glisic, 2024). This shift redefines telecommunications networks from data transport infrastructures into adaptive digital nervous systems capable of supporting interactions across physical, digital, and biological domains (Zontou, 2023).

Key enabling technologies identified for 7G include near-field terahertz communications and optical–terahertz convergence at the physical layer, alongside architectural innovations such as radio-over-fiber integration and mobility-aware channel modeling. Studies on near-field terahertz systems demonstrate that future wireless links will increasingly operate beyond classical far-field assumptions, necessitating fundamentally new propagation models and design approaches aligned with 7G performance objectives (Petrov et al., 2023). Complementary

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research on optical and terahertz convergence highlights the importance of seamless fiber–wireless integration to achieve the ultra-high capacity and ultra-low latency required for future access networks (Kanno, 2023).

In parallel, multiple surveys indicate that classical machine learning techniques may be insufficient to manage the scale, heterogeneity, and real-time complexity of 7G networks. Consequently, quantum computing, spiking neural networks, and neuroscience-inspired intelligence models are increasingly proposed as foundational enablers for large-scale optimization, energy efficiency, and autonomous control in 7G environments (Glisic, 2024; Glisic and Lorenzo, 2024). Network security is also re-envisioned, with zero-trust architectures and quantum-driven cryptographic mechanisms proposed to address the expanded attack surface created by pervasive connectivity and autonomous network behavior (Kumar et al., 2024).

Collectively, the literature indicates that the evolution toward 7G represents a systemic transformation of telecommunications networks. Rather than prioritizing throughput and latency alone, 7G emphasizes intelligence, autonomy, sustainability, and resilience as core network attributes.

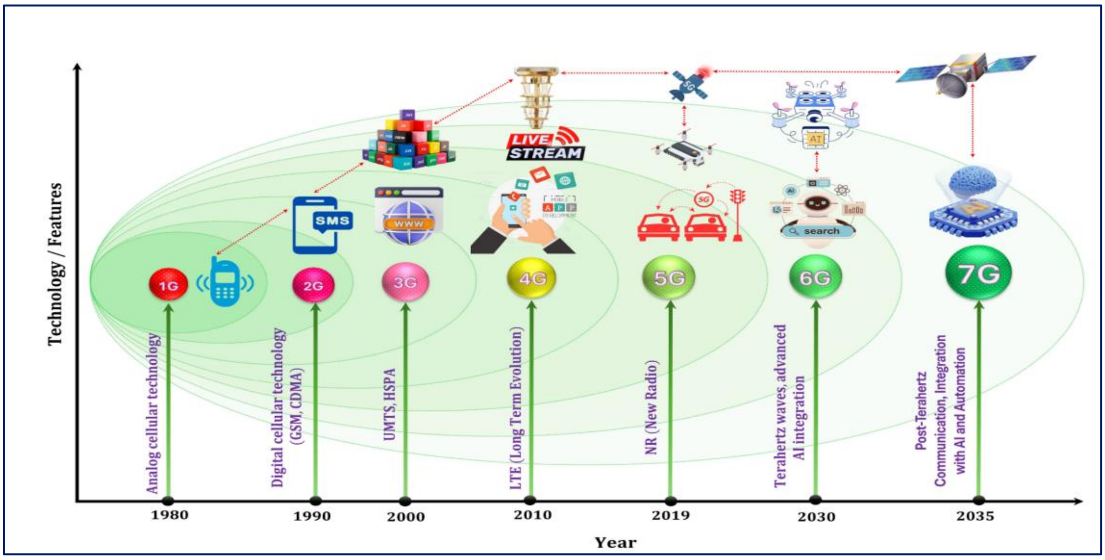

Figure 1. Evolution of cellular networks from 1G analog systems in the 1980s to AI-driven, post-terahertz 7G networks projected by 2035

Source: Adapted from Chamola et al. (2025).

This transformation establishes the technological foundation for new classes of applications and services and creates the conditions under which future innovation ecosystems and entrepreneurship-driven opportunities in telecommunications can emerge, as illustrated in Figure 1.

Enabling Technologies of Seventh Generation (7G) Telecommunications

The realization of seventh-generation (7G) telecommunications is fundamentally dependent on the convergence of multiple advanced technologies that extend beyond incremental improvements in radio access performance toward fully intelligent, adaptive, and autonomous network systems. Unlike earlier generations, where enabling technologies were largely communication centric, 7G integrates communication, computation, sensing, intelligence, and security as co-evolving capabilities within a unified network architecture (Chamola et al., 2025).

Terahertz (THz) communication is consistently identified as one of the most critical physical-layer enablers of 7G. The ultra-wide bandwidth available at THz frequencies enables data rates that exceed those envisioned for 6G, supporting extreme capacity, ultra-low latency, and high-precision localization. Empirical and survey studies indicate that the combination of THz communication with ultra-massive MIMO and reconfigurable intelligent surfaces can overcome spectrum scarcity and enable dense, high-throughput environments, despite ongoing challenges related to propagation loss, hardware design, and energy efficiency (Chamola et al., 2025;

Pennanen et al., 2024). These capabilities position THz communication as a foundational technology for immersive applications, holographic communication, and high-density intelligent systems.

Artificial intelligence and machine learning–native networking represents a second foundational pillar of 7G. In contrast to 5G and early 6G architectures, where AI is primarily applied as an external optimization layer, 7G embeds intelligence directly into network control, protocol adaptation, and resource orchestration. The literature highlights meta-learning, distributed intelligence, federated learning, and reinforcement learning as key mechanisms enabling self-optimizing, self-healing, and context-aware networks capable of real-time decision-making across edge, fog, and core domains (Chamola et al., 2025). Large Language Models further extend these capabilities by supporting automated network management, intelligent policy enforcement, and real-time operational intelligence at scale.

Quantum computing and quantum-enabled security mechanisms are also identified as essential enablers of 7G networks. As network scale, autonomy, and data sensitivity increase, classical cryptographic approaches face limitations in resilience and long-term security. Prior studies indicate that quantum computing, together with post-quantum cryptography and quantum-inspired optimization techniques, can enhance secure communication, anomaly detection, and large-scale network optimization, particularly in ultra-dense and mission-critical 7G scenarios (Glisic and Lorenzo, 2024). These capabilities are critical for protecting autonomous systems, cyber-physical infrastructure, and high-stakes digital services.

Integrated sensing, communication, and computation further distinguishes 7G from earlier mobile generations. The convergence of wireless sensing, edge intelligence, and distributed computing enables networks to operate as adaptive systems that perceive, interpret, and respond to environmental and contextual conditions in real time. This integration supports advanced applications such as autonomous transportation, smart healthcare, industrial automation, and immersive extended reality, where communication performance alone is insufficient without situational awareness and adaptive control (Chamola et al., 2025).

Finally, sustainability-oriented and self-sustaining networking technologies play a pivotal enabling role in 7G. The literature emphasizes the necessity of energy-harvesting mechanisms, intelligent power management, and green network architectures to mitigate the environmental impact of hyper-connected systems. By combining AI-driven energy optimization with novel hardware and architectural designs, 7G aims to approach near-zero energy consumption per transmitted bit while maintaining extreme performance requirements (Chamola et al., 2025).

Collectively, these enabling technologies demonstrate that 7G represents a systemic transformation rather than a single technological breakthrough. Through the integration of THz communication, AI-native intelligence, quantum technologies, integrated sensing and computing, and sustainable design principles, 7G networks are positioned to support intelligent, secure, and resilient digital ecosystems that extend well beyond the capabilities of previous mobile network generations.

2.3 Emerging Use Cases and Innovation Trajectories Beyond 7G

The transition toward and beyond seventh-generation (7G) telecommunications represents a fundamental expansion in both the scope of use cases and the nature of innovation trajectories enabled by mobile networks. Unlike earlier generations, where use cases were largely centered on enhanced communication services, the literature consistently characterizes 7G as a general-purpose intelligent infrastructure capable of supporting systemic, cross-domain, and mission-critical applications (Chamola et al., 2025; Zontou, 2023).

A prominent category of emerging use cases involves autonomous and intelligent cyber–physical systems. Survey and perspective studies indicate that 7G networks are expected to natively support autonomous vehicles, drone swarms, robotic coordination, and intelligent transportation systems through ultra-low latency, near-field terahertz communication, and AI-native control loops (Petrov et al., 2023; Kanno, 2023). These applications demand not only extreme data rates but also real-time sensing, prediction, and decision-making, positioning 7G networks as active components of system intelligence rather than passive communication substrates.

Another key innovation trajectory lies in immersive and human-centric digital experiences. Moving beyond the extended reality and holographic communications envisioned for 6G, the literature suggests that 7G will enable persistent, multi-sensory, and context-aware environments that integrate physical, digital, and biological domains. Representative use cases include large-scale digital twins, immersive telepresence, virtual therapy, and human–machine symbiosis, all of which require continuous perception, cognition, and adaptive network behavior (Chamola et al., 2025; Vaigandla et al., 2021). In this context, innovation shifts from content transmission toward experience orchestration and interaction design.

Planetary-scale and space-integrated applications further distinguish innovation trajectories beyond 7G. Building on satellite–terrestrial convergence, 7G networks are envisioned to support global sensing, space roaming, environmental monitoring, and disaster management across terrestrial, aerial, and space layers (Chamola et al., 2025; Majeed, 2025). These applications extend telecommunications beyond traditional industry boundaries and enable new forms of cross-sector coordination, entrepreneurship, and governance.

From an infrastructure perspective, AI-driven network services and autonomous networking constitute a critical innovation pathway. Empirical and simulation-based studies indicate that 7G networks will increasingly expose intelligence as a service, enabling capabilities such as autonomous resource orchestration, predictive maintenance, and intelligent traffic management (Andreoli et al., 2025; Xing, 2025). As a result, the distinction between network operators and service innovators becomes increasingly blurred, with networks evolving into programmable innovation platforms.

Security-driven use cases further illustrate innovation beyond 7G. As connectivity becomes pervasive and autonomous, conventional perimeter-based security models are insufficient. The literature emphasizes quantum-enabled zero-trust architectures, continuous authentication, and AI-driven anomaly detection as intrinsic use cases embedded within 7G network operations (Glisic, 2024; Glisic and Lorenzo, 2024; Vaigandla et al., 2021). In this context, security innovation is not merely a supporting function but a foundational requirement for sustaining trust in future digital societies.

Collectively, the emerging use cases and innovation trajectories beyond 7G reflect a shift from application-centric innovation toward ecosystem-centric and societal innovation. Telecommunications networks evolve from enabling discrete services to shaping how intelligence, autonomy, security, and sustainability are delivered at scale. This trajectory establishes the conditions for new entrepreneurial models, cross-industry ecosystems, and evolving regulatory paradigms, positioning 7G not as an endpoint of technological development but as a platform for continuous innovation beyond traditional telecommunications boundaries.

Policy, Regulation, and Strategic Ecosystems

The evolution toward seventh-generation (7G) telecommunications is shaped not only by technological advancement but also by policy frameworks, regulatory alignment, and the strategic coordination of multi-actor ecosystems. The literature consistently emphasizes that as mobile networks evolve into intelligent, autonomous, and cross-domain infrastructures, governance mechanisms must move beyond traditional spectrum management and competition regulation toward ecosystem-level coordination and oversight (Chamola et al., 2025; Zontou, 2023).

From a policy perspective, earlier mobile generations benefited primarily from liberalization, spectrum allocation, and infrastructure-sharing initiatives. However, studies examining the transition from 4G and 5G toward future generations indicate that these instruments are insufficient for 7G environments, where networks integrate terrestrial, aerial, and satellite systems and increasingly function as critical national and global infrastructure (Majeed, 2025). The expansion of non-terrestrial networks, space roaming, and global coverage introduces new jurisdictional, licensing, and coordination challenges, necessitating international policy harmonization rather than fragmented national regulation (Khutey et al., 2015).

Regulatory complexity further intensifies as 7G networks embed artificial intelligence, autonomous decision-making, and large-scale data processing as native capabilities. Reviews of 7G smart networks highlight the need for regulatory approaches that address algorithmic accountability, transparency, and trust, particularly where network intelligence directly influences safety-critical applications such as autonomous transportation, healthcare systems, and industrial automation (Chamola et al., 2025). In this context, regulation evolves from static rule enforcement toward adaptive and principle-based governance frameworks capable of responding to continuously learning systems.

Security and data governance emerge as central regulatory priorities within 7G ecosystems. The literature indicates that pervasive connectivity and distributed intelligence significantly expand the attack surface of future networks, requiring regulatory support for zero-trust architectures, quantum-safe cryptography, and continuous authentication mechanisms (Glisic, 2024; Vaigandla et al., 2021). Rather than treating security as a post-deployment compliance requirement, 7G policy frameworks increasingly position cybersecurity as an intrinsic condition for ecosystem participation and service assurance.

Strategic ecosystem formation represents another defining dimension of 7G governance. Multiple studies emphasize that innovation in future telecommunications generations is driven by coordinated ecosystems involving network operators, technology vendors, cloud and platform providers, application developers, governments, and research institutions (Bhatia et al., 2023; Andreoli et al., 2025). These ecosystems facilitate shared experimentation, standards development, and risk distribution, particularly for capital-intensive technologies such as terahertz communication, quantum computing, and satellite integration. Consequently, competitive advantage increasingly derives from ecosystem positioning and collaborative capacity rather than isolated firm-level capabilities.

Country-level analyses further illustrate the importance of ecosystem readiness. Research focused on developing and emerging markets demonstrates that infrastructure gaps, spectrum pricing structures, energy constraints, and skills shortages can significantly delay the transition toward advanced generations unless addressed through coordinated policy interventions and public–private partnerships (Majeed, 2025). These findings underscore that progress toward 7G depends not only on technological readiness but also on inclusive policy design that aligns regulation, investment, and human capital development.

Overall, the literature positions policy, regulation, and strategic ecosystems as foundational enablers of 7G rather than external constraints. Effective 7G governance requires integrated approaches that balance innovation flexibility with accountability, promote cross-border coordination, and foster collaborative ecosystems. Such alignment is essential for translating technological potential into sustainable innovation, resilient infrastructure, and long-term socioeconomic value within future telecommunications landscapes.

Innovation-Driven Business Strategy and Entrepreneurship

The emergence of seventh-generation (7G) telecommunications fundamentally reshapes innovation-driven business strategy and entrepreneurship within the telecommunications sector. The literature consistently indicates that as networks evolve from connectivity-oriented infrastructures into intelligence-native and autonomous systems, traditional revenue models based primarily on access, bandwidth, and subscription pricing become increasingly inadequate (Chamola et al., 2025; Zontou, 2023). In the 7G era, competitive advantage is increasingly derived from the strategic use of technological capabilities to create differentiated value propositions, orchestrate innovation ecosystems, and enable cross-sector entrepreneurial activity.

A central strategic shift highlighted in the literature is the movement from infrastructure-centric business models toward platform- and ecosystem-based strategies. Reviews of 6G and 7G developments emphasize that future networks will expose programmable interfaces, intelligence services, and sensing capabilities that can be monetized as platforms rather than discrete connectivity offerings (Andreoli et al., 2025; Bhatia et al., 2023). This transition allows network operators and technology providers to reposition themselves within the value chain by enabling third-party innovation, supporting startups and developers, and facilitating experimentation across multiple industries.

Entrepreneurship in the 7G context is further characterized by innovation under conditions of heightened complexity and uncertainty. Studies examining next-generation network evolution note that enabling technologies such as terahertz communication, AI-native networking, and quantum-enabled security require substantial capital investment and long development horizons (Glisic, 2024; Petrov et al., 2023). Consequently, entrepreneurial success increasingly depends on strategic foresight, phased investment approaches, and collaborative engagement within multi-actor ecosystems rather than isolated firm-level innovation. This perspective aligns with empirical findings in digital transformation research, which demonstrate that modular architectures and cloud-native designs lower entry barriers and allow smaller firms to participate alongside incumbents within innovation ecosystems (Chamola et al., 2025; Glisic, 2024; Petrov et al., 2023).

Another important trajectory concerns innovation-driven differentiation through intelligent and autonomous services. Simulation-based and conceptual studies indicate that 7G networks enable advanced capabilities such as autonomous resource orchestration, intelligent traffic management, and real-time security control, which can be delivered as high-value enterprise solutions rather than commoditized connectivity services (Xing, 2025; Vaigandla et al., 2021). These capabilities create entrepreneurial opportunities in sectors such as smart healthcare, intelligent logistics, immersive media, and industrial automation, where value creation is linked to reliability, performance assurance, and trust rather than data throughput alone.

The literature also suggests that entrepreneurship within 7G ecosystems is increasingly mission-oriented and societal in scope. Beyond commercial performance, future business strategies are expected to address sustainability, resilience, and public value creation. Reviews of 7G smart networks highlight green networking, energy-efficient communication, and secure digital infrastructure as strategic priorities that shape innovation agendas and entrepreneurial positioning (Chamola et al., 2025). This orientation expands telecommunications entrepreneurship to include public–private partnerships, policy-enabled ventures, and cross-industry collaborations aimed at addressing societal challenges.

Overall, innovation-driven business strategy in the 7G era reflects a shift from competition over network ownership toward competition over innovation orchestration, ecosystem leadership, and the strategic integration of intelligence. Entrepreneurship emerges not only through new firm formation but also through the reconfiguration of roles, partnerships, and value creation logic across the telecommunications landscape. In this sense, 7G functions as a catalyst for sustained entrepreneurial transformation rather than a single technological milestone.

METHODOLOGY

This study employs a systematic literature review guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) framework to examine the evolution of seventh-generation (7G) telecommunications and its implications for innovation, entrepreneurship, and strategic ecosystems. Given that 7G remains a pre-standard and emergent research domain, the available body of knowledge is largely conceptual, fragmented, and unevenly distributed across technical, policy, and business-oriented studies. A structured literature review is therefore appropriate for consolidating existing research, identifying dominant thematic patterns, and developing a coherent analytical foundation for future empirical and theoretical work, as recommended for frontier technology research (Chamola et al. 2025; Letaief et al. 2021).

Research Design

The study adopts an exploratory and theory-building research design, integrating systematic review procedures with qualitative thematic synthesis, which is appropriate for next-generation and beyond-6G telecommunications research where conceptual development typically precedes standardization and large-scale empirical validation (Chamola et al. 2025; Letaief et al. 2021). The review is intentionally interdisciplinary, synthesizing insights from engineering, innovation management, policy studies, and entrepreneurship research to capture the multi-layered nature of 7G development.

PRISMA Review Protocol

The review process follows the PRISMA 2020 protocol to ensure transparency, methodological rigor, and replicability (Page et al. 2021). PRISMA is particularly suitable for interdisciplinary reviews in emerging technology domains where quantitative meta-analysis is not feasible and qualitative synthesis is required.

The PRISMA workflow comprised four sequential stages: identification, screening, eligibility, and inclusion. Relevant studies were identified through systematic searches of major scientific databases, including Scopus, Web of Science, IEEE Xplore, SpringerLink, ScienceDirect, and arXiv, using predefined keywords related to seventh-generation telecommunications, post-6G evolution, AI-native networks, terahertz communication, quantum-secure networking, innovation ecosystems, and telecommunications entrepreneurship; duplicate records were subsequently removed, and titles and abstracts were screened to exclude studies unrelated to forward-looking telecommunications research or lacking relevance to 7G or beyond-6G concepts; the remaining full-text articles were then assessed for conceptual rigor and substantive contribution to at least one analytical dimension, namely technical foundations, emerging use cases, policy and regulation, or innovation-driven business strategy; finally, studies meeting all inclusion criteria were retained for qualitative synthesis and thematic analysis, in alignment with PRISMA recommendations for systematic reviews in emerging and interdisciplinary research fields (Page et al. 2021).

Data sources and search strategy

The data set comprises peer-reviewed journal articles, high-impact conference proceedings, and authoritative preprints published in reputable repositories. The search strategy employed Boolean combinations of keywords such as "7G telecommunications," "beyond 6G," "AI-native networks," "terahertz and optical convergence," "quantum-secure communication," "innovation ecosystems," and "telecommunications entrepreneurship." The use of multiple databases and publication types reduced selection bias and improved coverage, in line with best practices for systematic reviews in rapidly evolving technology domains (Chamola et al. 2025).

Because 7G remains an emergent and pre-standardized field, selected conference proceedings and authoritative preprints were retained where they made substantive analytical contributions and were triangulated against peer-reviewed sources.

Inclusion and exclusion criteria

Studies were included if they demonstrated explicit relevance to 7G or post-6G telecommunications, contributed to technical, strategic, policy, or entrepreneurial perspectives, were published in peer-reviewed journals, reputable conference proceedings, or recognized preprint platforms, and exhibited clear conceptual or analytical relevance to innovation, ecosystems, or value creation, while studies focusing exclusively on legacy generations without forward-looking relevance were excluded, consistent with established methodological guidance for systematic and scoping reviews in emerging technology research (Letaief et al. 2021).

Data analysis and thematic synthesis

The final set of studies was analyzed using qualitative thematic synthesis to integrate heterogeneous conceptual and qualitative evidence across disciplines, whereby studies were iteratively coded and organized into five higher-order themes encompassing evolution toward seventh-generation telecommunications, emerging use cases and innovation trajectories beyond 7G, policy, regulation, and strategic ecosystems, and innovation-driven business strategy and entrepreneurship, reflecting the co-evolution of technological capabilities and innovation ecosystems emphasized in recent 7G and beyond-6G literature (Chamola et al. 2025; Letaief et al. 2021).

Analytical framework

The synthesis is guided by an innovation ecosystem perspective, which conceptualizes 7G innovation as the outcome of interactions among technological infrastructure, firms, institutions, and policy environments. This framework is particularly relevant for seventh-generation networks, where value creation increasingly depends on ecosystem coordination, governance mechanisms, and entrepreneurial capability rather than isolated technological breakthroughs (Chamola et al. 2025). Drawing on broader innovation and entrepreneurship theory, the analysis is interpreted through the lens of dynamic capabilities, organizational learning, and platform-based strategies for value capture in advanced telecommunications contexts. Within this perspective, 7G technological capabilities are treated as enabling conditions, innovation as the primary mediating mechanism of value creation, and ecosystem readiness as the contextual condition shaping whether entrepreneurial opportunities can be realized and scaled.

Methodological rigor and justification

Methodological rigor is ensured through the systematic application of PRISMA procedures, transparent inclusion and exclusion criteria, and structured thematic synthesis. Prior studies on 6G and future network generations demonstrate that PRISMA-guided systematic reviews are effective for consolidating early-stage knowledge and informing subsequent empirical, strategic, and policy-oriented research (Chamola et al. 2025; Letaief et al. 2021). By extending this approach to the 7G domain, the present study establishes a robust methodological foundation for analyzing future telecommunications innovation and entrepreneurship.

The study selection process followed PRISMA 2020 and proceeded through four stages: identification, screening, eligibility, and inclusion. A total of 312 records were retrieved through database searching, and 9 additional records were identified through manual reference screening and forward citation tracking. After the removal of 87 duplicates, 234 unique records remained. Title and abstract screening excluded 173 records due to their exclusive focus on legacy generations, unrelated application domains, or insufficient relevance to innovation, policy, or ecosystem perspectives. This left 61 articles for full-text assessment. During eligibility assessment, 43 studies were excluded because they lacked sufficient focus on seventh-generation or beyond-6G concepts, offered purely speculative commentary without analytical contribution, or did not align with the thematic scope of the review. The final sample comprised 17 studies, which formed the basis of the qualitative synthesis and thematic analysis.

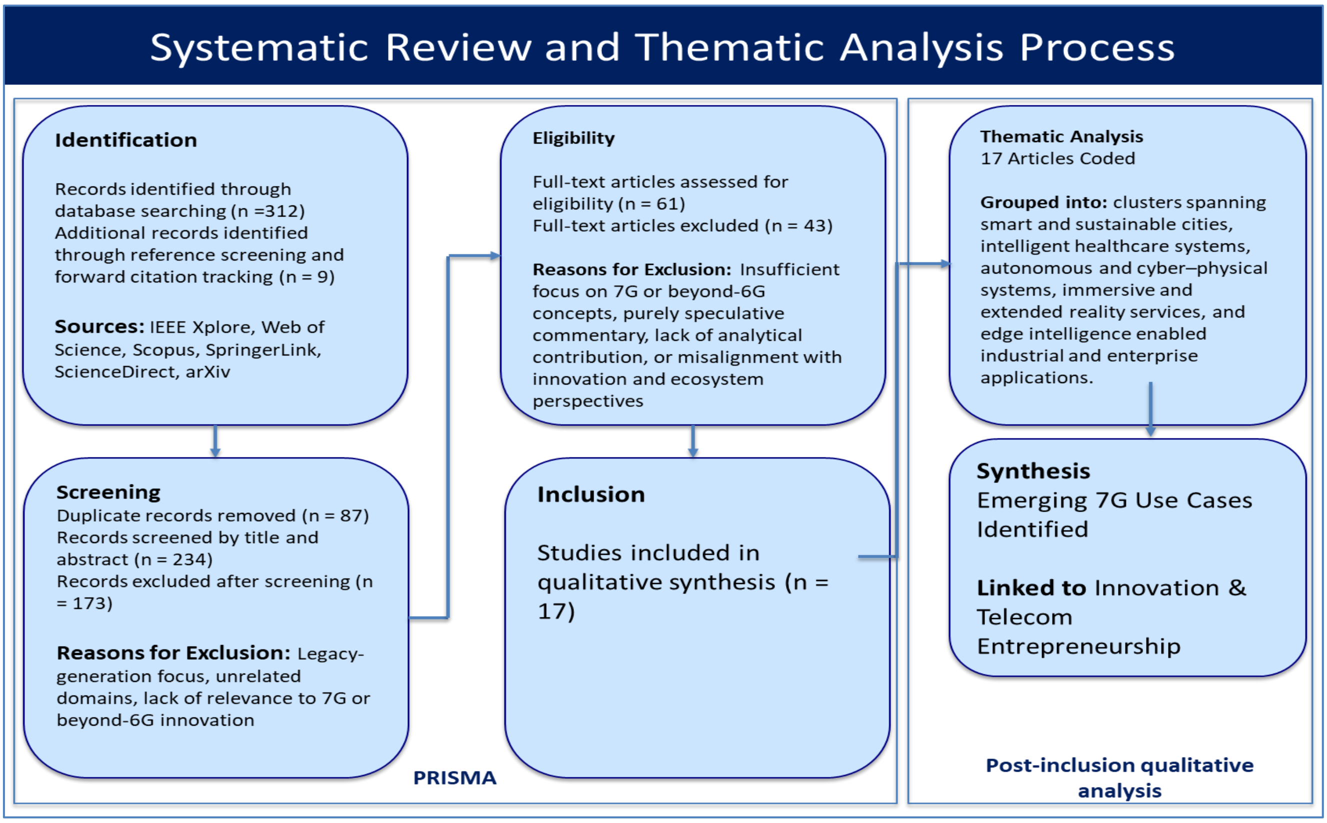

Figure 2: Systematic Review and Thematic Analysis Process

Adapted from Page et al. (2021) and Braun and Clarke (2006).

To analyse the selected literature, thematic analysis was conducted following Braun and Clarke’s (2006) six-phase approach, involving familiarisation with the data, initial coding, theme development, review, and refinement. The included studies were grouped into five overarching themes: innovation and entrepreneurship in telecommunications, trends in 7G technology and infrastructure, emerging 7G use cases, policy and regulatory ecosystems, and innovation-driven business strategies. This thematic synthesis enabled systematic identification and classification of 7G use cases and their associated entrepreneurial implications.

Table 1 summarises the thematic domains identified through the systematic review and their supporting references. Table 1 presents the five thematic areas that structured the synthesis, including one contextual foundation theme and four issue-specific analytical themes that informed the later discussion.

Table 1: 7G Thematic Domains Summary Table

Theme	**Supporting References**
Innovation and Entrepreneurship in the 7G Telecommunications Context	Andreoli et al. (2025); Bhatia et al. (2023); Chamola et al. (2025); Zontou (2023)
Evolution and Technical Foundations of Seventh Generation (7G) Networks	Chamola et al. (2025); Pennanen et al. (2024)
Emerging Use Cases and Innovation Trajectories Beyond 7G	Chamola et al. (2025); Rao et al. (2023)
Role of Policy, Regulation, and Strategic Ecosystems in 7G	Chamola et al. (2025)
Development of Innovation-Driven Business Strategies and Entrepreneurship in 7G Ecosystems	Andreoli et al. (2025); Bhatia et al. (2023); Zontou (2023)

Source: Author's own synthesis.

To enhance methodological rigor, a qualitative appraisal of study quality was undertaken, considering source credibility, methodological transparency, and relevance to the research objectives related to seventh-generation telecommunications and innovation ecosystems. Academic studies were evaluated based on peer-review status, conceptual rigor, and analytical depth, while industry and policy-oriented reports were assessed for institutional credibility, policy relevance, and consistency with academic findings on future network evolution and innovation dynamics.

The overall review process is summarised using a PRISMA-style flow diagram (Figure 2), illustrating the stages of record identification, screening, eligibility assessment, and final inclusion. This structured approach ensures transparency and reproducibility in the selection of studies relevant to the 7G research domain. In addition, a detailed literature review matrix, summarising the characteristics, thematic focus, and key contributions of the included studies, is provided in Appendix A.

This review should be interpreted in light of several limitations. First, 7G remains an emergent and pre-standardized field, which means that much of the current literature is conceptual and future-oriented rather than empirically validated. Second, although the inclusion of selected conference proceedings and authoritative preprints is justified in frontier technology research, this also means that the evidentiary base is uneven in methodological maturity. Third, the final sample of 17 studies provides a structured basis for synthesis, but it does not permit strong generalization across all regional, institutional, or commercial contexts. Accordingly, the framework proposed in this study should be understood as an analytically grounded interpretive model that requires further empirical testing as 7G research and deployment mature.

DISCUSSION

This section synthesises the findings of the systematic literature review to examine how 7G technologies intersect with innovation dynamics and entrepreneurial activity in the telecommunications industry. The discussion is organised around four analytical themes: innovation as the foundation for entrepreneurship, 7G technologies as enablers of new venture creation, regulatory and ecosystem alignment, and strategic foresight for 7G-driven entrepreneurship. These themes are derived directly from the systematic review and thematic analysis presented in Section 3.

Table 2 is presented to summarise the classified 7G use cases identified through the review, which serve as the empirical basis for the subsequent discussion and synthesis.

Table 2: 7G Use Cases Identified Through the Systematic Review

Use Case Category	Specific 7G Use Cases	Enabling 7G Capabilities	Primary Application Domains	Key Supporting References
Smart and Sustainable Cities	Ultra-dense smart city orchestration, autonomous traffic management, real-time urban sensing, disaster prediction and response	AI-native networking, terahertz communication, integrated sensing and communication, satellite–terrestrial convergence	Urban infrastructure, transportation systems, environmental monitoring, public safety	Chamola et al. (2025); Rao et al. (2023); Pennanen et al. (2024)
Intelligent Healthcare and Bio-Digital Systems	Remote robotic surgery, continuous health monitoring, digital twin–based diagnostics, brain–computer interfaces	Ultra-low latency, quantum-secure communication, edge intelligence, bio-cyber integration	Healthcare delivery, telemedicine, biomedical engineering	Chamola et al. (2025); Rao et al. (2023)
Autonomous and Cyber-Physical Systems	Fully autonomous vehicles, drone swarms, autonomous logistics, industrial robotics	Ultra-reliable low-latency communication, AI-driven control, non-terrestrial networks, ultra-massive MIMO	Transportation, defense, industrial automation, logistics	Chamola et al. (2025); Pennanen et al. (2024)
Immersive and Extended Reality Services	Holographic communication, metaverse platforms, immersive education and training, digital presence systems	Terahertz bandwidth, ultra-high data rates, edge rendering, AI-assisted content generation	Entertainment, education, remote collaboration, digital commerce	Andreoli et al. (2025); Bhatia et al. (2023); Chamola et al. (2025)
Edge Intelligence and Industrial Internet of Everything	Real-time industrial control, smart manufacturing, predictive maintenance, energy-efficient edge orchestration	Edge AI, distributed intelligence, zero-energy communication, platform-based network architectures	Manufacturing, energy systems, Industry 5.0, smart enterprises	Andreoli et al. (2025); Bhatia et al. (2023); Chamola et al. (2025)
Secure and Decentralized Digital Ecosystems	Quantum-secure communications, blockchain-enabled network governance, trusted data marketplaces	Post-quantum cryptography, distributed ledger technologies, AI-driven security automation	Financial services, digital identity, cross-border data exchange	Chamola et al. (2025); Zontou (2023)

(Source: Author’s Own Work)

As shown in Table 2, the identified use cases are not isolated applications but recurring clusters derived from the thematic coding of the reviewed studies. Across these clusters, entrepreneurial opportunity is associated less with connectivity itself and more with the ability to combine advanced network capabilities with sector-specific service innovation, platform logic, and ecosystem coordination.

Innovation as the Foundation for Entrepreneurship in Telecommunications

The reviewed literature consistently positions innovation as the central mechanism through which entrepreneurial value is created in the telecommunications sector, particularly as networks evolve toward seventh-generation and beyond-7G architectures. Rather than competing solely on connectivity provision, firms are increasingly required to develop differentiated offerings that exploit advanced network capabilities such as AI-native networking, ultra-low latency, edge intelligence, and integrated sensing. This shift reflects a broader transition in telecommunications entrepreneurship from infrastructure ownership toward capability-driven and service-oriented value creation, where innovation enables new forms of digital services, platforms, and applications (Bhatia et al., 2023; Chamola et al., 2025).

As network architectures become more complex and capital-intensive, innovation also functions as a strategic response to uncertainty and competitive pressure. The literature highlights that entrepreneurial opportunities in the 7G era emerge at the intersection of technological advancement and unmet application demands, particularly in areas such as autonomous systems, intelligent urban services, immersive communication, and edge-enabled industrial solutions. Firms that actively experiment with new technologies and recombine network capabilities with application-layer innovation are better positioned to identify and exploit these emerging use cases (Chamola et al., 2025; Pennanen et al., 2024; Rao et al., 2023).

Furthermore, innovation in telecommunications entrepreneurship is increasingly ecosystem-dependent. Several reviewed studies emphasize that 7G development requires coordinated interaction among network operators, equipment vendors, platform providers, and complementary service firms, making isolated innovation efforts insufficient. Entrepreneurial value creation is therefore closely tied to participation in collaborative ecosystems, platform-based architectures, and open interfaces that enable scalable innovation across multiple stakeholders (Andreoli et al., 2025; Zontou, 2023). In this context, innovation extends beyond product and service development to include new organizational arrangements, partnership models, and ecosystem governance mechanisms.

Collectively, the findings of the systematic review reinforce the view that innovation constitutes the foundational pillar of entrepreneurship in the telecommunications sector. As the industry transitions toward 7G and beyond, entrepreneurial success increasingly depends on the ability to embed innovation as a continuous strategic capability, integrating technological foresight, ecosystem engagement, and application-driven experimentation into coherent value-creation strategies supported by advanced network infrastructures (Andreoli et al., 2025; Chamola et al., 2025).

7G Technologies as Enablers of New Venture Creation

The reviewed literature indicates that seventh-generation (7G) telecommunications technologies fundamentally reshape the conditions under which new ventures emerge and scale within the telecommunications ecosystem. Unlike earlier generations, where entrepreneurial entry was constrained by high capital intensity and infrastructure ownership, emerging 7G architectures emphasize AI-native networking, modular design, and platform-oriented service delivery. These characteristics lower traditional entry barriers and enable technology-driven startups and specialized service providers to innovate at the application and service layers without direct control over underlying network infrastructure (Bhatia et al., 2023; Chamola et al., 2025).

From an entrepreneurial perspective, 7G technologies significantly expand the opportunity space for venture creation by enabling advanced use cases that were previously infeasible or economically impractical. The literature highlights applications such as digital twins, autonomous and cyber-physical systems, immersive extended reality services, and edge-enabled industrial solutions as key areas where 7G capabilities create new market opportunities. These use cases rely on intrinsic features of 7G architectures, including ultra-low latency, edge intelligence, ultra-high data rates, and intelligent network orchestration, allowing ventures to develop differentiated value propositions across multiple sectors (Chamola et al., 2025; Pennanen et al., 2024; Rao et al., 2023).

The reviewed studies further emphasize that new venture creation in the 7G era is closely tied to ecosystem participation and platform integration. AI-native networks, open interfaces, and programmable network functions facilitate interoperability and collaboration among startups, incumbent operators, equipment vendors, and complementary service providers. Such ecosystem-based entrepreneurship reduces development risk, accelerates innovation cycles, and enables scalable experimentation, particularly in complex and regulated domains such as smart cities, industrial automation, and digital infrastructure services (Andreoli et al., 2025; Chamola et al., 2025; Zontou, 2023).

Overall, the literature suggests that 7G technologies act as foundational enablers of new venture creation by transforming both the technological and institutional landscape of telecommunications entrepreneurship. By supporting modular innovation, enabling advanced and high-value use cases, and fostering ecosystem-oriented collaboration, 7G lowers conventional barriers to entry while simultaneously increasing the strategic importance of innovation capability, entrepreneurial agility, and ecosystem alignment (Andreoli et al., 2025; Bhatia et al., 2023; Chamola et al., 2025).

Regulatory Enablement and Ecosystem Integration

The reviewed literature highlights the critical role of regulatory enablement and ecosystem integration in shaping entrepreneurial outcomes within seventh-generation (7G) and beyond-7G telecommunications environments. As networks evolve into AI-native and intelligent infrastructures supporting data-intensive and mission-critical applications, regulatory considerations extend beyond traditional spectrum allocation and competition policy to encompass issues related to security, data governance, interoperability, and platform coordination. The literature emphasizes that adaptive and innovation-oriented regulatory approaches reduce uncertainty, support investment, and facilitate the translation of advanced network capabilities into commercially viable entrepreneurial opportunities (Chamola et al., 2025; Zontou, 2023).

Ecosystem integration is increasingly positioned as a strategic prerequisite for innovation and entrepreneurship in 7G contexts. The complexity of emerging network architectures and use cases necessitates coordinated interaction among multiple stakeholders, including network operators, equipment vendors, platform providers, startups, and public institutions. Studies within the reviewed corpus indicate that collaborative ecosystem structures enable resource sharing, accelerate experimentation, and support scalable innovation, particularly where technological development is capital-intensive or system-level integration is required (Andreoli et al., 2025; Chamola et al., 2025).

The literature further suggests that regulatory mechanisms play an enabling role in ecosystem formation and integration by creating controlled environments for experimentation and collaboration. Approaches such as shared infrastructure models, open interfaces, and platform-based governance frameworks are identified as mechanisms that balance innovation flexibility with oversight and trust. These arrangements are particularly relevant for advanced 7G applications that require coordination across sectors and institutional boundaries, reinforcing the interdependence between regulation, ecosystem structure, and entrepreneurial feasibility (Chamola et al., 2025; Zontou, 2023).

Collectively, the findings indicate that regulatory enablement and ecosystem integration constitute foundational conditions for sustainable entrepreneurship in future telecommunications markets. Rather than constraining innovation, well-aligned regulatory frameworks shape the relational architecture of 7G ecosystems, influencing how entrepreneurial actors collaborate, compete, and co-create value. In the context of 7G, entrepreneurial success is therefore contingent on the alignment of advanced technological capabilities with adaptive regulation and integrated ecosystem strategies (Andreoli et al., 2025; Chamola et al., 2025).

Strategic Foresight for 7G Entrepreneurship

The reviewed literature positions strategic foresight as a critical capability for entrepreneurs operating in seventh-generation (7G) telecommunications environments, where technological trajectories, market structures, and ecosystem configurations remain uncertain and emergent. Given the pre-standardized nature of 7G, entrepreneurial decision-making increasingly depends on the ability to anticipate long-term technological developments, evaluate emerging application domains, and align innovation strategies with plausible future network architectures rather than short-term market signals. Studies emphasize that foresight-oriented approaches enable firms to identify opportunity spaces early and to position themselves advantageously as advanced network capabilities mature (Chamola et al., 2025; Pennanen et al., 2024).

The literature further suggests that effective strategic foresight in 7G entrepreneurship extends beyond technological anticipation to encompass ecosystem awareness and platform evolution. Entrepreneurs who actively monitor developments in AI-native networking, edge intelligence, immersive communication, and non-terrestrial integration are better positioned to shape value propositions that align with future ecosystem needs. This forward-looking orientation supports early engagement with emerging platforms and collaborative innovation structures, which are increasingly central to value creation in advanced telecommunications systems (Andreoli et al., 2025; Chamola et al., 2025).

In addition, strategic foresight is highlighted as a mechanism that enhances entrepreneurial adaptability and resilience in highly dynamic innovation environments. The reviewed studies indicate that ventures adopting foresight-driven strategies are more capable of adjusting to evolving standards, shifting ecosystem roles, and changing competitive dynamics by maintaining flexibility in resource allocation and business model design. Such adaptability is particularly important in 7G contexts, where innovation cycles are closely tied to ecosystem coordination and platform governance rather than isolated technological breakthroughs (Bhatia et al., 2023; Zontou, 2023).

Overall, the findings of the systematic review indicate that strategic foresight constitutes a foundational enabler of sustainable entrepreneurship in future telecommunications markets. By integrating long-term technological vision with ecosystem engagement and adaptive strategy formulation, foresight allows entrepreneurs to navigate uncertainty, influence emerging market structures, and capture value as 7G innovations transition from conceptual frameworks to deployable network infrastructures (Andreoli et al., 2025; Chamola et al., 2025).

At the same time, the review indicates that entrepreneurial opportunities in 7G are subject to important boundary conditions. First, much of the available literature remains conceptual, which limits confidence about commercialization pathways and timing. Second, several proposed 7G use cases depend on regulatory harmonization, infrastructure readiness, and cross-sector interoperability that may develop unevenly across regions. Third, the capital intensity and technical complexity associated with terahertz communication, AI-native orchestration, and quantum-enabled security may favor ecosystem-based entrepreneurship over standalone venture models. These constraints suggest that 7G opportunity realization is likely to be contingent, staged, and context dependent rather than universally accessible from the outset.

Conceptual Framework: Linking 7G Capabilities to Innovation and Entrepreneurship

The reviewed literature supports the development of a conceptual framework that explicitly links seventh-generation (7G) technological capabilities to innovation processes and entrepreneurial outcomes within the telecommunications sector. Central to this framework is the premise that 7G capabilities, including AI-native network architectures, edge intelligence, ultra-high-capacity connectivity, and intelligent orchestration, function as enabling conditions rather than direct sources of value creation. The literature emphasizes that these advanced capabilities create entrepreneurial potential only when leveraged through innovation activities that transform technical affordances into market-relevant applications and services (Bhatia et al., 2023; Chamola et al., 2025).

The systematic review further indicates that innovation acts as the primary mediating mechanism between 7G capabilities and entrepreneurship. While advanced network features expand the technological opportunity space, their entrepreneurial impact depends on firms' ability to design new services, develop platforms, and experiment with novel use cases enabled by 7G infrastructures. Studies highlight that ventures capable of recombining network intelligence, edge computing, and application-layer innovation are better positioned to generate scalable business models and differentiated value propositions across sectors such as smart cities, immersive services, and intelligent industrial systems (Chamola et al., 2025; Pennanen et al., 2024; Rao et al., 2023).

Ecosystem integration further conditions the relationship between 7G capabilities and entrepreneurial outcomes within the proposed framework. The reviewed literature consistently highlights that entrepreneurial value creation in 7G environments is ecosystem-dependent, requiring coordination among network operators, technology vendors, platform providers, and complementary service firms. Participation in platform-based ecosystems and collaborative innovation structures enables ventures to access complementary assets, reduce development risk, and accelerate commercialization, reinforcing the interdependence between technological infrastructure and ecosystem configuration (Andreoli et al., 2025; Chamola et al., 2025; Zontou, 2023).

Overall, the conceptual framework synthesises the review by positioning 7G technological capabilities as enabling inputs, innovation as the central mediating mechanism of value creation, and ecosystem integration as the contextual condition that shapes entrepreneurial feasibility and scale. Entrepreneurship is therefore conceptualised not as an automatic consequence of technological progress, but as an outcome that depends on how effectively firms convert network capabilities into new applications, service architectures, and platform-based business models within coordinated ecosystems. This framing provides a clearer basis for future empirical testing as 7G technologies move closer to standardisation and deployment.

To consolidate insights from the systematic review and discussion, Figure 3 presents the proposed conceptual framework linking 7G technological capabilities, innovation drivers, and entrepreneurial outcomes in the telecommunications sector.

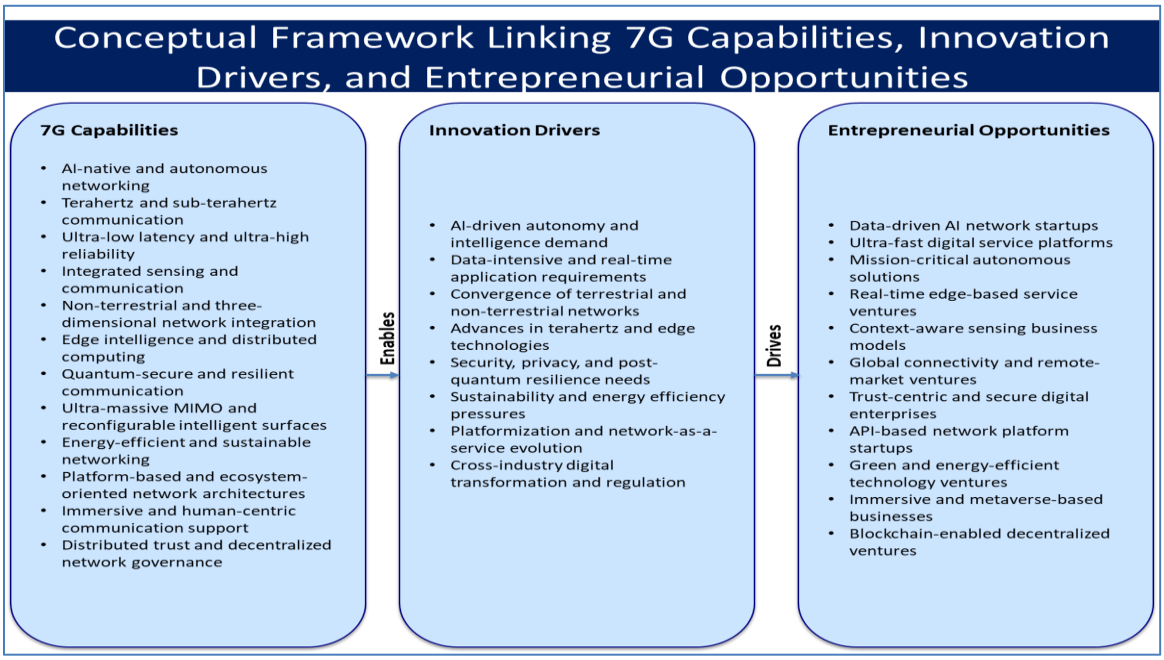

Figure 3: Conceptual Framework Linking 7G Capabilities, Innovation Drivers, and Entrepreneurial Opportunities

Source: Author's own elaboration.

The framework illustrates a progression from core 7G enablers, such as AI-native architectures, ultra-low latency, and digital twin systems, to innovation drivers including human-centric design, cross-sector integration, and sustainability orientation. These drivers, in turn, create entrepreneurial opportunities across domains such as immersive communication, digital healthcare, autonomous mobility, and intelligent edge platforms. The framework is grounded in the thematic domains summarised in Table 1 and the detailed use cases presented in Table 2, thereby explicitly linking review evidence to conceptual development.

From a theoretical perspective, this framework advances existing literature by integrating previously fragmented technical and innovation-oriented studies into a unified model. Practically, it offers a roadmap for entrepreneurs, policymakers, and ecosystem stakeholders seeking to align 7G investments with scalable, inclusive, and sustainable business opportunities.

Practical Implications for Entrepreneurs, Industry, and Policymakers

For entrepreneurs, the findings suggest that value creation in 7G will likely emerge less from basic connectivity provision and more from application-layer innovation, platform participation, and cross-sector service integration. For incumbent telecommunications firms, the findings indicate a strategic shift from infrastructure-centric competition toward ecosystem orchestration and programmable service enablement. For policymakers, the review highlights the importance of adaptive regulation, interoperability support, and public-private coordination to ensure that entrepreneurial opportunities can be realized in a scalable and regionally inclusive manner.

CONCLUSION AND FUTURE RESEARCH DIRECTIONS

This study synthesised the emerging literature on seventh-generation (7G) telecommunications to examine how advanced network evolution may reshape innovation and entrepreneurship within the telecommunications sector. The review shows that 7G should be understood not simply as a further improvement in speed or capacity, but as a broader transition toward intelligence-native, autonomous, and ecosystem-oriented digital infrastructure.

The findings indicate that entrepreneurial value in 7G environments will depend less on technological capability alone and more on the capacity to transform those capabilities into scalable applications, platform-based services, and cross-sector solutions. Innovation emerged as the primary mechanism linking 7G capabilities to entrepreneurship, while ecosystem integration and regulatory alignment shaped whether such opportunities could be realised and sustained.

Overall, the study suggests that 7G is likely to function as a catalyst for entrepreneurial transformation rather than as a standalone technological milestone. Its significance lies in how future actors combine advanced network capabilities, innovation processes, and ecosystem coordination to create commercially viable and societally relevant ventures. Future research should therefore move beyond conceptual analysis and examine how firms, startups, and policy ecosystems operationalise these dynamics in practice.

Future research should examine how 6G pilot ecosystems evolve into commercially meaningful 7G experimentation environments through comparative case studies across regions and industry sectors. Quantitative and mixed-method studies may also test the proposed framework by examining how specific 7G-related capabilities, such as edge intelligence, AI-native orchestration, or secure decentralized architectures, influence venture formation, business-model design, and ecosystem participation. Additional work is also needed on regulatory readiness, platform governance, and the uneven geography of 7G opportunity realization, particularly in emerging markets where infrastructure, policy, and skills constraints may shape entrepreneurial outcomes differently.

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Author contributions

Umar Pervaiz conceived the idea, drafted the manuscript, and refined the final version. Obed Rashdi Syed and Rosmini Omar contributed to improving the manuscript through their valuable comments and suggestions throughout the writing process.

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Competing interests

The authors declare that they have no conflict of interest.

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APPENDIX

Appendix A Literature Review Matrix

Author (Year)	Focus Area	Contribution to 7G / Innovation	Key Insight	Research Title	ear	Country of Research	Research Index	Dependent Variable	Independent Variable Name	Result	Conclusion	Abstract	Summarize Paper	Use Cases for 7G
Ahmed, S.; Shihab, I. F.; Khokhar, A. (2025)	Quantum-enhanced cybersecurity, zero trust architecture, and anomaly detection for 7G networks	Proposes a **quantum-driven zero trust architecture** integrated with a **neural-network-based dynamic anomaly detection mechanism** to enhance cybersecurity in 7G networks	Quantum computing combined with neural networks can improve anomaly detection while addressing scalability and computational efficiency challenges in next-generation networks	*Quantum-driven zero trust architecture with dynamic anomaly detection in 7G technology: A neural network approach*	025	United States	Elsevier – *Measurement: Digitalization* (Vol. 2–3, 2025, Article 100005; ScienceDirect indexed, Scopus indexed)	Anomaly detection performance (detection accuracy, false positive rate, response efficiency)	Quantum-driven zero trust framework; neural network–based anomaly detection model	Experimental evaluation demonstrates improved anomaly detection accuracy and reduced false positives compared to traditional security approaches, while maintaining scalability	The study concludes that integrating quantum computing principles with zero trust architecture and neural-network-based anomaly detection provides a robust, scalable, and efficient cybersecurity solution suitable for 7G network environments	As cyber threats grow in complexity, modern networks face significant challenges in mitigating evolving attack patterns while maintaining scalability and computational efficiency. Quantum computing presents a promising approach to enhancing cybersecurity; however, its adoption is hindered by scalability constraints and inefficiencies in classical implementations. This paper	The article presents a novel Quantum-Enhanced Zero Trust Architecture (QNN-ZTA) that integrates quantum neural networks (QNNs) with zero trust security principles to enhance anomaly detection, adaptive access control, and dynamic micro-segmentation in 7G networks. Key contributions include: Quantum-driven anomaly detection using QNNs	The paper discusses several key use cases for 7G networks: Autonomous systems, innovative healthcare, decentralized finance, and hyper-connected edge computing: 7G networks promise unparalleled connectivity, ultra-low latency, and seamless integration of AI-driven automation, IoT ecosystems, and space-terrestrial networking, enabling these transformative applications. Cybersecurity challenges: The expansion of attack surfaces in 7G networks makes

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												proposes a quantum-driven zero trust architecture with dynamic anomaly detection for 7G technology using a neural network approach. The proposed framework integrates quantum-enhanced security mechanisms with intelligent anomaly detection to improve threat identification and response. Experimental results indicate enhanced detection performance and scalability, demonstrating the potential of the proposed	that leverage superposition, entanglement, and variational optimization for high-precision threat identification. Dynamic and risk-adaptive policy enforcement that utilizes quantum-enhanced metrics to continuously evaluate access permissions and adjust micro-segmentation. Innovative quantum-enhanced micro-segmentation that dynamically isolates high-risk network regions to limit lateral movement of attackers.	them highly susceptible to advanced persistent threats, AI-powered adversarial attacks, large-scale privacy breaches, and quantum-enabled cryptographic threats.

												approach for securing future 7G networks.	A scalable hybrid quantum-classical architecture that balances computational costs and ensures seamless deployment in large-scale network environments. The framework demonstrates significant improvements in detection accuracy, reduced false positives, and faster response times compared to classical security approaches. The article also discusses the advantages of QNNs, such as leveraging superposition, entanglement, and nonline	

													ar transformations to enhance cybersecurity capabilities.	
Alkassbeh, J. S.; Al-Taweel, F. M.; Alawneh, T. A.; Al-Qaisi, A.; Makableh, Y. F.; El-Mezieni, T. (2024)	Evolution of wireless communication from 4G to 7G, including network architecture, spectrum allocation, data rates, security, and coverage	Provides a comprehensive analytical comparison of 4G, 5G, 6G, and proposed 7G systems, highlighting technological advancements, spectrum usage, energy efficiency, security evolution, and anticipated capabilities of 7G networks	Each generation introduces improvements in data rate, latency, reliability, power consumption, and security, with 7G anticipated to deliver terabit-level data rates, near-zero latency, quantum-resistant security, and ultra-high capacity	*Advancements in Wireless Communication Technology: A Comprehensive Analysis of 4G to 7G Systems*	024	Jordan; Kuwait	Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications (JoWUA), Vol. 15, No. 3	Not explicitly defined	Not explicitly defined	Data rates increase from up to 1 Gbps in 4G to nearly 1 Tbps in proposed 7G; latency reduces from 30 ms in 4G to sub-millisecond levels in 7G; spectrum efficiency improves from 15 bps/Hz in 4G to 60 bps/Hz anticipated in 7G; energy consumption per bit approaches near-zero in 7G	The transition to 7G technology promises to meet society's evolving demands by enabling new applications and enhancing wireless communication quality; continued research and innovation are essential to fully realize the potential of 7G systems and their impact on industries and daily life	*This paper presents a comprehensive analysis of the advancements in wireless communication technology from 4G to 7G systems, focusing on critical aspects such as network architecture, spectrum allocation, data rates, security, and coverage. The evolution of wireless communication technology has been remarkable, with each generation introducing significant*	This paper provides a comprehensive analysis of the advancements in wireless communication technology from 4G to 7G systems. Key highlights include: Data Rates and Throughput: Data rates have increased from up to 1 Gbps in 4G to nearly 1 Tbps in proposed 7G. Latency and Reliability: Latency has been reduced from 30 ms in 4G to sub-millisecond levels in 7G.	The paper discusses the anticipated use cases of 7G wireless communication systems: Smart healthcare: 7G is expected to enable real-time remote health monitoring, intelligent diagnostics, and seamless communication in the healthcare sector. Industrial automation: 7G's capabilities are anticipated to drive the next wave of flexible manufacturing and smart industrial automation. Smart cities: The ultra-high speed, low latency, and ubiquitous connectivity of 7G are expected to greatly

												improvements to meet the growing demands of users and applications in an increasingly connected world. From the early adoption of 4G technology to the anticipated rise of 7G systems, sweeping changes have reshaped the landscape of wireless communications and changed the way we communicate, work and interact with our surroundings we are surrounded by communication. These changes signal a shift towards more efficient, high-speed	Reliability has also improved, with 5G introducing ultra-reliable low latency communication (URLLC) services. Connectivity and Coverage: Spectral efficiency, MIMO schemes, cell size, and frequency bands have all been enhanced to improve coverage and connectivity, with 7G expected to provide continuous coverage from cities to the country side. The paper also discusses the integration of energy efficiency and sustainability,	enhance traditional systems like waste management in smart cities. Intelligent transportation systems: 7G's features are anticipated to significantly improve traffic management and fuel consumption through advanced connectivity and low latency.

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											and high-capacity systems designed to meet the needs of a variety of industries. Furthermore, the need to strengthen security measures and expand network services highlights the importance of ensuring reliability and security in networks in the face of competition and threats Continued research and innovation are essential and for further developments in this area and to realize and enable new work capabilities and services to benefit	security challenges, and the evolution of applications and use cases across the generations.	

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue III March 2026

												people, businesses and businesses This article examines the proposed mobile communication features from 4G to 7G in. Each generation brings unique spectrum allocation, usage and operational challenges. Each generation presents unique spectrum allocation, utilization, and efficiency challenges. Furthermore, this paper investigates network architecture aspects, data rates, and throughput, emphasizing latency and reliability		

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue III March 2026

												improvements.		
Andreoli, Zhao, Cucinotta, & Buyya (2025)	Modeling and simulation of next-generation cloud and edge computing systems	Introduces **CloudSim 7G**, the seventh-generation CloudSim toolkit, enabling simulation of **7G-aligned cloud, edge, fog, serverless, and hybrid computing environments** through a unified, extensible architecture	Accurate evaluation of future-generation (7G-era) cloud systems requires integrated simulation of heterogeneous resources, nested virtualization, and intelligent resource management rather than isolated cloud models	*CloudSim 7G: An Integrated Toolkit for Modeling and Simulation of Future Generation Cloud Computing Environments*	025	Australia and Italy	Software: Practice and Experience (Wiley, SCI/SCIE indexed, Scopus indexed)	Simulation performance metrics (run-time performance, memory usage, resource utilization accuracy)	CloudSim 7G architectural redesign, standardized interfaces, refactored simulation modules	Experimental evaluation shows up to **25% reduction in memory usage**, faster simulation run-time (4–10 seconds improvement), and improved flexibility compared to CloudSim 6G	CloudSim 7G significantly improves scalability, extensibility, and performance of cloud simulations, providing a robust experimental foundation for evaluating future-generation and 7G-aligned computing environments	Cloud computing evaluation is challenged by the complexity of large-scale data centers. This paper proposes CloudSim 7G, a re-engineered simulation toolkit featuring standardized interfaces and a generalized architecture that integrates multiple CloudSim extensions within a single environment. Extensive refactoring reduces code complexity and improves run-time performance and memory efficiency. Perfor	This article proposes CloudSim 7G, the seventh generation of the CloudSim toolkit, which features a re-engineered and generalized internal architecture to facilitate the integration of multiple CloudSim extensions within the same simulated environment. The key contributions include: Standardized interfaces to abstract common functionalities and enable seamless integration of CloudSim modules. Refactoring and refinem	CloudSim 7G introduces several key features that enable new use cases for modeling and simulating future generation Cloud Computing environments: Standardized Interfaces for Integrating Multiple Modules: CloudSim 7G provides a set of Java interfaces to standardize the definition, configuration, and creation of new components and their interactions. This allows seamless integration of various CloudSim modules, such as containers, networks, and serverless computing, within the same simulated scenario.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue III March 2026

											mance evaluation demonstrates that CloudSim 7G enables more realistic, flexible, and efficient modeling of next-generation cloud computing environments, supporting research into future-generation and 7G-enabled systems.	ent of the codebase, resulting in a 13,000+ line reduction with no loss in functionality. Support for nested virtualization, such as containers within VMs. Introduction of a virtualization overhead parameter to better characterize real-world scenarios. Significant improvements in simulation run-time performance and memory usage.	Support for Nested Virtualization: CloudSim 7G enables the simulation of scenarios with nested virtualization, such as containers within VMs or VMs within VMs. This allows for more accurate modeling of real-world Cloud infrastructures that leverage nested virtualization for multi-tenancy and enhanced isolation. Virtualization Overhead Modeling: CloudSim 7G introduces a virtualization overhead parameter that can be used to characterize the performance impact of nested virtualization and networking in Cloud environm

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														ents. This feature helps researchers evaluate resource management techniques more realistically. Improved Performance and Memory Efficiency: The refactoring and optimization of the CloudSim codebase in version 7G has led to significant improvements in simulation run-time performance and memory usage, compared to previous versions.
Bhatia, S.; Gupta, U.; Mallikarjuna, B.; Kumar, S.; Gautam, D.; Verma, S. (2023)	Internet of Things evolution supported by 5G, 6G, and 7G technologies	Provides a comparative review of **IoT evolution across 5G, 6G, and 7G**, highlighting the role of AI, SDN, terahertz communication, and post-quantum security as	Future IoT systems will rely on integrated 6G/7G environments combining AI, IoT, and SDN to achieve ultra-low latency, high throughput, energy efficiency, and	*The Future IoT: The Current Generation 5G and Next Generation 6G and 7G Technologies*	023	India	IEEE Conference Proceedings (DICCT 2023; IEEE Xplore indexed)	Not applicable (review and comparative study)	Not applicable (review and comparative study)	Not applicable (review and comparative study)	The paper concludes that 6G and 7G technologies will significantly enhance IoT applications by providing higher data rates, lower latency,	The paper reviews the evolution of the Internet of Things supported by current 5G and emerging 6G and 7G communication technologies. It discusses IoT applications	The article discusses the evolution of Internet of Things (IoT) technologies, from the current 5G to the upcoming 6G and 7G generations. It covers the following key	The paper does not discuss specific use cases of 7G technology. However, it provides a high-level overview of the evolution of mobile wireless communication technologies from 1G to 7G and their impact on

		foundational enablers for future IoT ecosystems	secure smart applications								improved energy efficiency, and integrated AI, IoT, and SDN capabilities, while addressing challenges related to security, privacy, interoperability, and infrastructure readiness	ranging from smart cities and healthcare to transportation and agriculture, and compares communication generations in terms of data rates, latency, spectrum usage, and enabled services. The study emphasizes that future IoT ecosystems will depend on integrated 6G/7G architectures incorporating AI, SDN, terahertz communication, and post-quantum security to support scalable, intelligent, and sustainable smart environments.	points: IoT combines various objects and communication strategies to connect devices and transfer data over the internet. IoT has numerous applications, from home automation to smart cities and transportation. The transition from 5G to 6G and 7G aims to improve network latency, reliability, and throughput to support the growing IoT ecosystem. 6G is expected to be 1000 times faster than 5G, with enhanced integration of	the Internet of Things (IoT) applications. The key points regarding 7G from the paper are: 7G Technology 7G is predicted to be available beyond 2035. 7G is expected to provide about 20 Gbps data rates. 7G will support horizontal and vertical integration. 7G will leverage the frequency band of 90 GHz to 3.5 THz. The paper suggests that 7G, along with 6G, will provide the integrated environment of IoT, AI, and SDN with the layer of openness and customization to enable more innovative applications across industries. However, the

													AI, IoT, and Software-Defined Networking (SDN). The article discusses the methodology and objectives of the integrated environment of upcoming IoT-enabling technologies, including network security, privacy, and interoperability challenges that need to be addressed. The impact of 4G, 5G, 6G, and 7G technologies on IoT applications is analyzed, highlighting the improvements in data transmission capabilities, latency,	specific use cases of 7G are not discussed in detail.

													and throughput.	
Chamola, V.; Peelam, M. S.; Guizani, M.; Niyato, D. (2025)	Innovations, enabling technologies, challenges, and future directions of 7G smart networks	Provides a comprehensive review of 7G networks, consolidating innovations across AI and machine learning paradigms, terahertz communication, quantum computing, blockchain security, satellite–terrestrial integration, sustainability, and intelligent networking	7G networks represent a transition from connectivity-centric systems to AI-native, secure, intelligent, and sustainable digital infrastructures capable of supporting autonomous systems, IoE, immersive technologies, and global smart applications	*Future of Connectivity: A Comprehensive Review of Innovations and Challenges in 7G Smart Networks*	025	India; United Arab Emirates; Singapore	IEEE Open Journal of the Communications Society (Scopus-indexed, Web of Science indexed)	Not applicable (review paper)	Not applicable (review paper)	Not applicable (review paper)	The study concludes that 7G networks will enable a hyper-connected, intelligent, and sustainable digital ecosystem by integrating advanced AI techniques, quantum communication, terahertz spectrum usage, satellite networks, and secure decentralized architectures while addressing challenges related to energy efficiency, spectrum management, security, and scalability	The evolution from 1G to 6G networks has transformed global communication from basic voice calls to immersive AI-enabled experiences. As AI-driven applications such as autonomous systems, the Internet of Everything, and immersive technologies demand unprecedented capabilities, 7G networks are expected to redefine connectivity. This paper reviews innovations and challenges in 7G networks, focusing on advanced AI and	This article provides a comprehensive review of the innovations and challenges in 7G networks, focusing on integrating advanced AI and machine learning paradigms to enhance adaptability, resource allocation, and edge performance. Key highlights include: Exploration of meta-learning, incremental learning, distributed intelligence, and reinforcement learning to enable intelligent,	The paper discusses several transformative applications of 7G networks, including: Smart Cities: 7G will enable real-time, low-latency communication between billions of devices, powering intelligent infrastructure, autonomous transportation, and interconnected environmental monitoring systems. Autonomous Systems: 7G's ultra-reliable, low-latency communication will support fully autonomous vehicles, robotics, and industrial automation, enabling rapid decision-making and enhanced operational efficiency.

												machine learning paradigms, large language models, blockchain, quantum computing, terahertz communication, zero-energy solutions, and generative AI, envisioning 7G as the foundation for a secure, intelligent, and sustainable digital future supporting smart cities, healthcare, autonomous systems, and industrial IoT.	self-optimizing 7G networks. Integration of blockchain, quantum computing, and zero-energy solutions to build secure, decentralized, and sustainable 7G infrastructure. Potential of Large Language Models (LLMs) and ambient intelligence for achieving hyper-connectivity and real-time actionable intelligence. Applications of 7G in smart cities, autonomous systems, healthcare, and industrial IoT, enabled by cutting-edge	Healthcare: 7G will facilitate remote healthcare applications like real-time remote surgery and personalized diagnostics, leveraging its high-speed, low-latency capabilities. Immersive Technologies: 7G will enable seamless, high-quality holographic communication and mixed reality experiences, blending the digital and physical worlds.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue III March 2026

													technologies.	
Glisic, S. (2024)	Enabling technologies for 7G networks with emphasis on quantum computing, quantum cryptography, machine learning, and satellite networks	Provides a comprehensive **survey of potential enabling technologies for 7G**, highlighting quantum computing, quantum key distribution, spiking neural networks, and experience-aided learning as foundational pillars for 7G network design and optimization	7G networks will require native integration of quantum computing and advanced AI to address security, large-scale optimization, energy efficiency, and decision latency challenges that are beyond classical computing capabilities	*Potential Enabling Technologies for 7G Networks: Survey*	024	United States	arXiv (arXiv:2408.11072); not yet peer-reviewed journal indexed	Not applicable (survey paper)	Not applicable (survey paper)	Not applicable (survey paper)	The paper concludes that quantum computing, quantum cryptography, spiking neural networks, and experience-aided learning are essential for solving security, optimization, and efficiency challenges in 7G networks, and proposes a comprehensive quantum-enabled optimization framework for future network design	This paper surveys potential enabling technologies for seventh-generation (7G) networks, focusing on innovations beyond incremental performance improvements. It emphasizes the role of quantum computing in accelerating network optimization and enabling quantum-secure communications through quantum cryptography and quantum key distribution. The study also reviews spiking neural networks to	The article provides a survey of potential enabling technologies for 7G networks, with a focus on quantum computing (QC) and quantum key distribution (QKD). Key points include: QC can speed up network optimization algorithms and enable quantum-based cryptography for 7G networks. Spiking neural networks can improve energy efficiency of AI used in network control, and experience-	The paper discusses several potential use cases for 7G networks: Enabling distributed quantum computing by interconnecting future quantum computers to leverage their computing speedups for optimizing complex network problems. Integrating spiking neural networks to significantly improve the energy efficiency of AI systems used for network control and optimization. Leveraging experience-aided learning to reduce decision latency in the network. Enabling

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue III March 2026

												improve energy efficiency and experience-aided machine learning to reduce decision latency. In addition, the paper proposes a quantum-based optimization framework for large-scale satellite networks, particularly low-Earth-orbit constellations for quantum key distribution. The survey aims to support 7G network designers in evaluating when and how quantum and AI-driven technologies should be deployed in future commu	aided learning can reduce decision latency. The article discusses post-quantum cryptography schemes as a near-term solution, and quantum cryptography as the ultimate solution for network security in 7G. A framework for optimizing satellite network topology to facilitate energy-efficient QKD is presented, leveraging the advantages of quantum computing algorithms.	quantum networking and quantum key distribution (QKD) to enhance network security.

												nication systems.		
Glisic, S.; Lorenzo, B. (2024)	Quantum computing and neuroscience-inspired intelligence for future wireless networks	Provides a comprehensive survey of **quantum computing, neuroscience, and complex-network-based paradigms** as enabling technologies for 6G and 7G networks, focusing on energy efficiency, computational acceleration, synchronization, and large-scale optimization	7G networks will require integration of quantum computing and neuroscience-inspired learning models to overcome limitations of classical machine learning in terms of complexity, power consumption, and real-time control	*Quantum computing and neuroscience for 6G/7G networks: Survey*	024	United States	Intelligent Systems with Applications (Elsevier; Scopus-indexed)	Not applicable (survey paper)	Not applicable (survey paper)	Not applicable (survey paper)	The paper concludes that quantum computing, spiking neural networks, tensor networks, and neuroscience-inspired learning models are critical enablers for future 6G and 7G networks, particularly for improving energy efficiency, reducing computational complexity, enabling large-scale synchronization, and supporting real-time network optimization	Recently significant effort has been invested in studying commonalities between human brain operation and advanced machine learning algorithms to enhance learning efficiency while reducing complexity and power consumption. As machine learning models become increasingly complex, research on 7G networks is exploring new computing technologies such as quantum computing and	The article provides a comprehensive survey of the potential use of quantum computing (QC) and neuroscience for the development of 6G/7G networks. Key points include: Advances in classical neural networks (NNs): Discusses lifelong machine learning, multi-task learning, and deep NNs for improving efficiency and reducing complexity of signal processing algorithms used in wireless networks. Spiking	The paper discusses several use cases of 7G networks: Leveraging quantum computing (QC) and neuroscience to enhance the efficiency and performance of 7G networks. This includes using QC to speed up machine learning algorithms and reduce complexity, as well as incorporating insights from neuroscience to improve network intelligence, energy efficiency, and synchronization. Integrating brain-type communications and brain-network interfaces to enable direct communication between the brain

												new models for complex networks. Under the umbrella of complex networks theory, this paper provides a unified survey of how quantum computing, neuroscience, and machine learning can be jointly applied to address challenges in future communication systems. The survey emphasizes commonalities in quantum computing applications across multiple domains and aims to inform 7G network designers on how results	neural networks (SNNs) for energy efficiency: SNNs can provide several orders of magnitude energy savings compared to classical NNs by using spike-based signaling. The paper surveys models of short-term and long-term synaptic plasticity. Quantum solutions for computational efficiency: Quantum NNs and quantum machine learning algorithms can significantly speed up the execution of complex algorith	and 7G networks. This could enable new applications like wireless brain implants and the Internet of Bio-Nano Things. Applying complex quantum models from computational chemistry to improve the modeling and optimization of 7G network components and dynamics. This includes leveraging quantum simulations and tensor networks for network analysis and design.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue III March 2026

												from natural and quantum-based sciences can be integrated into future network paradigms.	ms compared to classical approaches. The paper reviews the work on quantum perceptrons, quantum neural networks, and quantum machine learning.	
Jayant hiladevi et al. (2025)	AI-based cybersecurity for 7G-enabled virtual therapy platforms	Proposes a **novel AI-driven cybersecurity framework** tailored for 7G networks, integrating deep learning, reinforcement learning, federated learning, and privacy-preserving techniques to support ultra-low-latency healthcare applications	7G-enabled immersive virtual therapy significantly increases cyber-attack surfaces, requiring autonomous, predictive, and self-healing AI-based security architectures	*AI-Based Cybersecurity Frameworks for 7G-Enabled Virtual Therapy Platforms*	025	India	Elsevier (Cyber Security and Applications)	Threat detection accuracy; response time; data confidentiality	AI-based cybersecurity framework components (DL-based anomaly detection, RL-based threat response, federated learning, homomorphic encryption, continuous authentication)	Detection rate improved to **98.5%** in simulated 7G environments; response time reduced by approximately **30–35%** compared to 6G-based systems	AI-driven, self-healing cybersecurity architectures are essential for securing 7G-enabled healthcare platforms, enabling proactive threat mitigation, privacy preservation, and continuous authentication	The study proposes an AI-based cybersecurity framework for 7G-enabled virtual therapy platforms, addressing challenges related to data privacy, real-time threat detection, and continuous authentication. The framework integrates machine learning, deep learning, reinforcement	The article proposes an AI-based cybersecurity framework for 7G-enabled virtual therapy platforms. The key components of the framework include: Predictive Threat Detection System (PTDS): Uses anomaly detection, time-series analysis, and reinforcement learning to proactively identify	The paper summarizes the following key use cases for the proposed AI-based cybersecurity framework in 7G-enabled virtual therapy platforms: Threat Detection with Proactivity: Actively monitor network activity and user behavior to detect potential security compromises before they become significant problems, using techniques like

												learning, federated learning, and homomorphic encryption. Simulation-based evaluation demonstrates improved threat detection accuracy and reduced response time compared to 6G systems, highlighting the necessity of autonomous cybersecurity mechanisms in future 7G healthcare networks.	and mitigate threats. Adaptive Threat Intelligence System (ATIS): Leverages natural language processing and generative adversarial networks to generate real-time threat signatures and updates security systems. Privacy-Preserving Data Management (PPDM): Employs homomorphic encryption and federated learning to protect sensitive patient data. Continuous Authentication System (CAS): Utilizes biometrics and behavioral profiling for seamless user	anomaly detection and predictive models . Continuous Authentication: Employ continuous authentication of users through biometric verification, multi-factor authentication, and behavioral profiling to ensure only authorized users can access sensitive health information and virtual therapy sessions . Privacy-Preservation: Utilize privacy-preserving techniques like homomorphic encryption, federated learning, and zero-knowledge proofs to process sensitive patient data without revealing private information, ensuring compliance with regulations like GDPR . Self-Sufficient

													verification during therapy sessions. Self-Healing Cybersecurity System (SHCS): Applies reinforcement learning for autonomous patch management and system recovery. The framework aims to enhance the confidentiality, integrity, and availability of 7G-enabled virtual therapy platforms while addressing key cybersecurity challenges such as data privacy, real-time threat detection, and continuous authentication.	Reaction in Real-time: Automatically isolate or reduce security incidents and recover services with limited latency upon detection of a threat.
Kanno, A. (2023)	Convergence of terahertz radio and	Presents seamless conversion techniq	Seamless optical–terahertz conver	*Seamless Convergence Between Terahe*	023	Japan	IEEE Journal of Selected Topics in Quantum Electronics (Scopus-	Not applicable (invited techni	Not applicable (invited techni	Not applicable (invited techni	The paper concludes that radio-	Seamless conversion techniques betwee	This article discusses the seamless	The paper discusses several use cases for 7G systems:

	optical fiber communications for future access networks	ues between terahertz radios and optical fiber communications using radio-over-fiber technologies as a core enabler for **7G access networks** with low latency and low carbon footprint	gence using photonic techniques is essential to achieve ultra-high capacity, low latency, and energy-efficient access networks required in the 7G era	*rtz Radios and Optical Fiber Communication Toward 7G Systems*			indexed, Web of Science indexed)	cal review paper)	cal review paper)	cal review paper)	over-fiber technologies combined with photonic oscillators, optical frequency combs, and hybrid analog–digital transmission schemes are key to realizing terahertz-based access networks in the 7G era, particularly under constraints of energy consumption, latency, and severe environmental conditions	n terahertz radio and optical fiber communication systems are in high demand for future access networks with a low carbon footprint. Radio-over-fiber technologies are a promising solution for realizing conversion in the millimeter-wave and terahertz bands using advanced optical modulation and photodetection devices. The paper introduces radio-over-fiber technologies applicable to access networks in the seventh-generation mobile	convergence between terahertz radios and optical fiber communication systems for future 7G mobile networks. Key points include: Seamless conversion techniques between terahertz radio and optical fiber communication systems: Radio-over-fiber (RoF) technologies enable conversion in the millimeter-wave and terahertz bands using advanced optical modulation and photodetection devices. Analog RoF (A-RoF) and IF-over-fiber (IFoF) are promising	Autonomous vehicles and remote industrial vehicles: In the 7G era (2040s), autonomous vehicles will be operated without remote operators, and fully remote industrial vehicles will perform civil engineering in harsh environmental conditions. This scenario requires high-frame-rate 8K video transmission with low latency, which will be enabled by 400 Gbps radio capacity and less than 1 ms round-trip latency. Terahertz fixed wireless systems: The paper suggests that terahertz fixed wireless systems with capacities exceeding 10 Gbps and approaching 100 Gbps can

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												system era, investigates low-noise and high-frequency photonic oscillator configurations for terahertz transceivers, and discusses future systems integrating fixed wireless terahertz radio with optical networks while considering geographical and severe weather conditions.	solutions. Optical frequency comb generation: Optical frequency combs can be used to generate stable terahertz signals by heterodyning selected comb lines. Modulator-based and Kerr-effect-based optical frequency comb generation techniques are discussed. Optoelectronic oscillators (OEOs): OEOs can provide low phase noise terahertz oscillators, which are critical for high-performance wireless transmission. Injection-locked OEOs	be used as an alternative to optical fiber links where fiber deployment is not feasible due to cost and geographical issues. These high-capacity terahertz links can enable flexible network configurations for mobile fronthaul, midhaul, and backhaul in 7G systems.

													are a promising approach. Hybrid digital-analog techniques: Combining digital and analog techniques, such as delta-sigma modulation and digital-aided analog waveform compensation, can optimize bandwidth and performance for RoF systems.	
Majeed, A. (2025)	Limitations of 4G–5G networks and evolution toward 7G in a developing-country context	Provides a country-specific analysis of **4G and 5G limitations in Pakistan** and outlines **technical, infrastructural, regulatory, and economic challenges** shaping the transition toward 6G and concept	The evolution toward 7G in Pakistan is constrained by infrastructure gaps, spectrum cost, energy instability, and skills shortages, requiring coordinated investment, policy reform, and adoption of AI-	*From 4G–5G Limitations to 7G Evolution: Challenges and Opportunities for Next-Generation Networks in Pakistan*	025	Pakistan	Spectrum of Engineering Sciences (ISSN e: 3007-3138; p: 3007-312X)	Not applicable (review and descriptive analysis)	Not applicable (review and descriptive analysis)	Not applicable (review and descriptive analysis)	The study concludes that while 5G has the potential to transform Pakistan's digital landscape, its deployment is hindered by infrastructure limitations, high spectrum costs, energy challen	This paper examines the evolution of mobile communication networks in Pakistan, focusing on the limitations of 4G and 5G systems and the emerging opportunities for next-generation networks. It	The article discusses the evolution of mobile communication networks, focusing on the challenges and opportunities for next-generation networks in Pakistan. It covers topics such as network optimization	The article does not discuss any use cases of 7G technology. The paper focuses on the limitations of 4G and 5G networks in Pakistan and strategies to improve network optimization, coverage, and reliability. It mentions that future

		ual 7G networks	driven optimization and satellite-based solutions								ges, and regulatory delays. The paper emphasizes that future evolution toward 6G and 7G will require AI-based automation, efficient spectrum management, satellite integration, renewable energy solutions, and skilled workforce development to achieve reliable, sustainable, and inclusive next-generation networks	reviews network architecture, optimization techniques, spectrum management, energy efficiency, and the role of artificial intelligence in improving performance and reliability. The study highlights infrastructural, economic, and regulatory challenges faced by Pakistan and discusses future trends toward 6G and conceptual 7G networks, emphasizing the need for strategic planning, investment, and technological modernization to support sustain	techniques, 5G limitations, AI and machine learning applications, and strategies for boosting weak mobile signals in urban and rural areas. The article also provides a comparative analysis of network deployment strategies adopted by major US carriers like AT&T, T-Mobile, and Verizon. Additionally, it examines the impact of network infrastructure on internet speed and stability, as well as the challenges in deploying 5G networks in	trends will focus on 6G, edge computing, AI-based automation, and quantum communication, but does not provide any details on 7G specifically.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue III March 2026

												able national connectivity	developing countries.	
Pennanen, Hänninen, Tervo, Tölli, & Latva-aho (2024/2025)	6G vision and roadmap; first structured 7G sketch	Provides a structured **7G vision** as "Deeply Intelligent Network of Hyperverses" and positions 7G as deep intelligence + IoI + unlimited wireless, supporting beyond-connectivity innovation narratives	Networks evolve from transport to intelligence-native platforms; 7G is framed as the next disruption after 6G	*6G: The Intelligent Network of Everything*	025	Finland	IEEE Access	N/A (survey/vision)	N/A (survey/vision)	N/A (survey/vision)	Establishes 6G as intelligent network platform and sketches an early structured 7G vision	Summarized: 6G becomes an "Intelligent Network of Everything" built on wireless, AI, and IoE; article also sketches an initial 7G vision and discusses post-6G trends.	This article provides a comprehensive vision, survey, and tutorial on 6G wireless networks. Key highlights include: 6G is expected to evolve toward the "Intelligent Network of Everything" by integrating wireless, artificial intelligence, and the Internet of Everything. This will enable a wide range of disruptive applications like metaverse, extended reality, and connected autonomous systems	Potential Applications of 7G According to the article, the authors envision that the next major disruption after 6G will be the 7G/8G-enabled "mobile hyperverse". The key elements of 7G are identified as: Unlimited Wireless: Virtually unlimited wireless resources in connectivity, information, positioning, sensing, and energy. Deep Intelligence (DI): AI will expand vertically and horizontally, leading to "deeply intelligent" entities. Internet of Intelligence (IoI): A network of deeply intelligent

INTERNATIONAL JOURNAL OF RESEARCH AND INNOVATION IN SOCIAL SCIENCE (IJRISS)
ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue III March 2026

													. 6G will push performance to the extreme in terms of capacity, latency, reliability, density, coverage, and mobility. It will also expand capabilities beyond communication, such as sensing, positioning, and energy transfer. The article reviews 27 potential 6G technologies across 10 categories, including spectrum, antenna systems, transmission schemes, network architecture, network intelligence, and beyond	entities, evolving from the Internet of Everything (IoE). Based on these fundamental pillars, the authors identify three categories of potential 7G applications: Human-DI Interactions: Examples include augmented humans, brain-DI interfaces, personal DI assistants, telepathic communications, and holographic worlds. Deeply Intelligent World: Examples include global intelligent systems, global monitoring/management/prediction entities, and a deeply intelligent society. Interconnected Intelligent Ecosystems: Large-scale intelligent entities on the ground, in the air,

													-communication capabilities. The article also discusses the 6G development process, research activities, and a high-level vision for 7G as the next generation beyond 6G.	and at sea, leveraging wireless, DI, and IoI technologies.
Petrov, V.; Bodet, D.; Singh, A. (2023)	Mobile near-field terahertz (THz) communications for future wireless networks	Identifies and systematizes **key research challenges of mobile near-field THz communications**, positioning near-field THz as a critical enabler for late 6G and especially **7G wireless systems**	Future mobile THz systems will predominantly operate in the **near-field regime**, invalidating far-field assumptions and requiring new channel models, beam designs, interference handling, and mobility-aware solutions	*Mobile near-field terahertz communications for 6G and 7G networks: Research challenges*	023	United States	Frontiers in Communications and Networks (Scopus-indexed, Web of Science indexed)	Not applicable (perspective article)	Not applicable (perspective article)	Not applicable (perspective article)	The paper concludes that efficient exploitation of mobile near-field THz communications will provide a non-incremental performance improvement for future wireless systems and is likely to become a defining feature	This perspective article discusses the inevitability of using sub-terahertz and terahertz frequency bands in next-generation wireless networks due to increasing data-rate demands. While stationary point-to-point THz links have been demons	The article discusses the research challenges in enabling mobile near-field terahertz (THz) communications for 6G and 7G wireless networks. Key points include: Challenges in Theoretical Modeling: Developing accurate THz near-field channel models Modeli	The article does not explicitly discuss the use cases of 7G networks. However, it advocates that efficient harnessing of mobile near-field terahertz (THz) communications will be an essential element of late 6G or, more likely, 7G wireless systems . The key points are: Mobile THz communications in the near-field will complem

											of late-stage 6G and early 7G networks	trated, enabling **mobile THz communications** introduces significant challenges because such systems will often operate in the near-field due to large electrically sized antenna arrays. The article outlines major theoretical and engineering challenges, including near-field channel modeling, blockage, interference, mobility, beam selection, beam generation, spatial multiplexing, and beam steering. The authors argue that addressing these challenges is	ng THz signal blockage and interference in the near-field Incorporating the impact of mobility patterns on near-field THz propagation Engineering Challenges: Selecting the appropriate THz beam type (e.g. Bessel, Airy) for near-field communications Efficiently generating and manipulating the desired near-field THz beam Achieving spatial multiplexing of THz channels in the near-field Electronically steering THz near-field	ent existing microwave and millimeter wave systems in 6G and 7G networks. Achieving mobile near-field THz communications is a major research challenge that needs to be addressed, including aspects like channel modeling, blockage modeling, interference modeling, and mobility modeling. Potential use cases for mobile near-field THz communications include cellular, wireless local area networks (WLANs), on-body radio links, and similar scenarios.

												essential for realizing efficient mobile THz access and that near-field THz communications will be a fundamental component of future 7G wireless networks.	beams The article advocates that enabling efficient mobile near-field THz communications will be a key research direction for 6G and 7G wireless networks.	
Rao, A. S.; Mole, S. S.; Raju, D. V. R. (2023)	Overview of 7G wireless communication technologies, enabling technologies, applications, challenges, and impacts	Provides a comprehensive overview of 7G wireless communication technologies, highlighting terahertz waves, massive MIMO, artificial intelligence, quantum computing, and their potential applications, benefits, challenges, and societal impacts	7G wireless communication is expected to deliver unprecedented data rates, ultra-low latency, higher capacity, and intelligent connectivity by integrating terahertz communication, massive MIMO, AI, and advanced networking techniques	*Beyond 5G and 6G: A Comprehensive Overview of 7G Wireless Communication Technologies*	023	India	European Chemical Bulletin, Vol. 12 (Special Issue 4), pp. 9725–9739	Not applicable (review paper)	Not applicable (review paper)	Not applicable (review paper)	The paper concludes that 7G technology has the potential to revolutionize wireless communication by enabling terabit-level data rates, enhanced reliability, intelligent networking, and broad societal applications, while emphasizing the need to	As wireless communication continues to evolve, the next generation 7G wireless communication promises to deliver even faster data speeds, lower latency, and higher capacity than 5G and 6G. The development of 7G networks is expected to leverage advancements in	This article provides a comprehensive overview of the potential of 7G wireless communication technology. Key points include: 7G is expected to offer faster data transfer rates, lower latency, and higher capacity compared to 5G and 6G networks. This will enable	The article discusses several potential use cases for 7G wireless communication technology: Threat detection: 7G could enable advanced sensors and surveillance systems to detect threats like weapons and explosives with greater accuracy and speed. Crime control: 7G could assist law enforcement in tracking and identifying criminals

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue III March 2026

											address challenges related to spectrum availability, energy consumption, security, cost, regulation, and environmental impact	terahertz waves, massive MIMO, and artificial intelligence to provide an even more seamless and efficient wireless communication experience. This paper provides an overview of the current state of research on 7G wireless communication technology including potential areas, benefits, and challenges. Furthermore, it explores the possible applications of 7G technology in various industries, such as healthcare, transportation, and entertainment,	new applications like virtual/augmented reality and telemedicine. Advancements in terahertz waves, massive MIMO, and artificial intelligence are expected to be integrated into 7G to enable these improvements. 7G could have a significant impact on various industries like healthcare, transportation, and entertainment. However, it also raises concerns around privacy, security, and environmental impact that need to be addressed.	using advanced data analytics and biometric technologies. Health monitoring: 7G could enable more advanced medical sensors and wearable devices to monitor vital signs and health indicators in real-time. Facial recognition/expressions: 7G could enhance the accuracy and speed of facial recognition technology, even in challenging conditions. 3D image synthesis: 7G could allow for the creation of highly detailed and realistic 3D models and simulations. Autonomous systems: 7G could enable the development of highly advanced autonomous vehicles

												and discusses the potential societal and environmental impact of 7G technology, as well as the regulatory and ethical considerations that must be addressed in its development.	Key challenges in 7G development include spectrum availability, interference, power consumption, security, cost, and regulatory issues.	and drones. Manufacturing and industry: 7G could enable advanced automation, remote operation, and predictive maintenance in manufacturing.
Shoewu, O.O.; Ayangbekun, O.J. (2020)	Development trends and evolution of mobile wireless communication technologies from 0G to 7G	Provides a comparative review of wireless communication generations and introduces conceptual features, advantages, and challenges associated with 7G mobile wireless networks	7G is envisioned to enable space roaming, nanocore-based networking, artificial general intelligence integration, and global satellite-supported connectivity	*Insights into the development trends in 7G mobile wireless networks*	020	Nigeria	Journal of Advancement in Engineering and Technology, Vol. 8, Issue 1 (Open Access; DOI: 10.5281/zenodo.3930583)	Not applicable (review paper)	Not applicable (review paper)	Not applicable (review paper)	The paper concludes that the world is moving rapidly toward a fully wireless environment, and that 7G technology with space roaming potential, nanocore networking, and AI integration will provide uninterrupted global connectivity, high	From past year wireless technology has made enormous development. The development of wireless technology is reached at 7.5G. Wireless technology FG (Future generation) portable communications will have higher information transmission rates in 6G and 7G. Over the past decade,	The article provides an overview of the evolution of wireless communication technologies, from 1G to 7G. It discusses the key features, capabilities, and timelines of each generation, highlighting the increasing data rates, bandwidth, and functionalities with each advancement. The	The article discusses the expected features and use cases of 7G mobile wireless networks: Key 7G Use Cases and Features Space roaming with support from global navigation, telecommunication, and earth-imaging satellite systems The telecommunication satellite will be used for voice and multimedia communications The navigational

INTERNATIONAL JOURNAL OF RESEARCH AND INNOVATION IN SOCIAL SCIENCE (IJRISS)
ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue III March 2026

											bandwidth, and advanced services across diverse applications	wireless technology has experienced enormous development. Surveys have shown that another wireless subscriber signs up every 2.5 seconds. Be that as it may, wireless is not an ongoing technology. Several wireless technologies are accessible with their own advantages and disadvantages. Current times are just the start of sending 5G versatile correspondence systems. At present we have numerous technologies each fit for perfor	article focuses on the upcoming 6G and 7G technologies, which aim to integrate satellite networks for global coverage and enable space roaming. Key features of 6G include ultra-fast internet access up to 11 Gbps, smart home/city applications, and defense/space applications. 7G is expected to further enhance space roaming capabilities, with support from various satellite networks, and introduce advanced technologies like artificial general intelligence (AGI) and	satellite will be used for global positioning systems (GPS) The earth-image satellites will provide up-to-the-minute weather updates and help with natural disaster preparedness Extremely high data speeds up to 11 Gbps, providing cheap and fast internet access anywhere Integration of technologies like artificial general intelligence (AGI), mind reading, and big data analytics

												ming functions like supporting voice traffic using voice over IP (VoIP), broadband and information access in versatile condition and so forth., however, there is an incredible need of sending such technologies that can incorporate every one of these systems into a single brought together system. In this paper we present the study of several generations that are being used 0G, 1G, 2G, 3G, 4G, and 5G and attempt to locate some people in the future which are under	mind-to-mind communication.	

												research like 6G, and 7G. Comparison is made among all the generations and every generation's functions, execution, and usage of technology are clarified in the paper.		
Vaigandla, K. K.; Azmi, N.; Ramya, P.; Karne, R. (2020)	Survey of wireless communication generations from 0G to 7G	Provides a comprehensive survey of wireless communication technologies from 0G to 7G, outlining architectural evolution, multiple access techniques, applications, and expected features of future 6G and 7G systems	Wireless communication is evolving toward higher data rates, wider coverage, and unified global connectivity, with 6G and 7G envisioned to support space roaming, satellite integration, and seamless broadband access	*A Survey on Wireless Communications: 6G and 7G*	020	India	International Journal of Science, Technology & Management (Open Access journal; ISSN: 2722-4015)	Not applicable (survey paper)	Not applicable (survey paper)	Not applicable (survey paper)	The paper concludes that future wireless generations aim to integrate multiple technologies into a unified platform, with 6G and 7G expected to deliver higher data rates, broader coverage, and improved service quality to meet the growing deman	One of the fastest growing sectors is wireless technology, which is evolving in all areas of mobile and wireless communications. Wireless technology has increased greatly in the last decade. 7.5 Generation (G) represents the history of wireless technology	Overview of the Article This article provides an overview of the evolution of wireless communication technologies, from 0G to 7G. It discusses the key features, capabilities, and advancements of each generation, highlighting how they have improved over time in terms of data rates,	The article discusses the evolution of wireless communication technologies from 0G to 7G, but does not provide specific use cases for 7G. According to the paper: 7G: Mobile communication networks will be more advanced with 7G. 7G aims to receive space roaming for mobile wireless networks. World demand for wireless networks is growing,

											d for wireless communication	today. With 6G and 7G, data transmission rates will be higher over future generation wireless technology. With new technologies emerging in all fields of mobile and wireless communications, wireless technology continues to emerge as one of the hottest sectors with a high rate of development. Currently, 5G mobile communications systems are just getting started. Our current infrastructure supports a number of technologies, including voice	network architecture, and supported applications. The article covers the transition from analog to digital technologies, the introduction of cellular networks, and the increasing focus on high-speed data, multimedia, and global connectivity in the later generations. The article delves into the details of 5G, 6G, and 7G, which are the upcoming and future generations of wireless communication. It explains how 5G aims to provide a wireless world without	enabling always-on, high-speed, increased bandwidth, and low-cost access to information at anytime, anywhere. 7G technology will bring us unprecedented levels of mobility. The paper states that 7G will differentiate itself from 6G with its satellite functions for global inclusion and space roaming. However, the details on the specific use cases of 7G are not covered in this article.

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												over IP (VoIP), broadband data access over wireless, and more. This paper discusses several generations of wireless technologies from 0G to 7G. Wireless technology is important and beneficial to society. In this paper, we compare all of the generations and explain how each generation uses technology in its execution, application, and usage.	limitations, 6G integrates satellite networks to achieve global coverage, and 7G is expected to enable space roaming for mobile wireless networks.	
Xing (2025)	AI-based multi-path transmission for 7G integrated terrestrial–satellite	Proposes **AIICN**, an artificial-intelligence-driven multi-path transmission mechanism based	Traditional MPTCP/MPQUIC protocols are unsuitable for 7G; integrating ICN with reinfor	*AI ICN: a 7G multi-path transmission based on information-centric network*	025	China (Shanghai)	Frontiers in Computer Science (Scopus-indexed)	Transmission throughput; load balancing; transmission delay	AI-based ICN multi-path transmission scheme using reinforcement learni	Simulation results show approximately **21% higher throughput**, impro	AI-driven, ICN-based multi-path transmission effectively meets the performance and	This study proposes AIICN, an artificial intelligence–based multi-path transmission mechan	The article proposes an artificial intelligence-based multi-path transmission mechanism (AIICN	The paper discusses the use cases of 7G networks in the following ways: 7G network integration with artificial intelligen

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	networks	on **Information-Centric Networking (ICN)**, addressing key 7G challenges such as low latency, protocol heterogeneity, and satellite mobility	cement learning enables low-complexity, high-throughput, and adaptive multi-path transmission						ng (DDPG)	ved load balancing, and faster convergence compared with traditional multi-path methods	adaptability requirements of 7G networks, particularly for integrated satellite–terrestrial environments	ism for 7G networks built on information-centric networking. The entire transmission process is modeled as a mixed-integer linear programming problem and solved using reinforcement learning. Simulation experiments using Mininet and NS-3 demonstrate that AIICN achieves higher throughput, low complexity, fast convergence, and effective load balancing, outperforming conventional multi-path transmission protocols and confirming its suitability for future	) for 7G networks. The key points are: Motivation 7G networks integrate satellite, airship, and base station technologies, requiring new multi-path transmission approaches beyond traditional MPTCP/MPQUIC. Information-Centric Networking (ICN) offers advantages like mobility and bandwidth efficiency suitable for 7G networks. Approach The multi-path transmission problem is modeled as a mixed-integer linear progra	ce, satellites, and blockchain: The paper states that 7G has been integrated with technologies such as artificial intelligence, satellite networks, and blockchain, making it a key next-generation network. Efficient transmission of large data sets and AI model updates: The paper mentions that 7G networks can efficiently transmit huge data sets and model updates required by artificial intelligence, with a peak transmission rate of 36 Gbps. This exceeds the capabilities of 5G and 6G networks. Suitability for multi-path transmission: The 7G network comprises a satellite network

												7G networks.	mming problem. Reinforcement learning is used to solve the optimization problem and generate low-complexity, intelligent multi-path transmission strategies. Evaluation Experiments show the proposed AIICN achieves high throughput, load balancing, and fast convergence compared to traditional multi-path approaches.	and a terrestrial network, making it highly suitable for implementing multi-path transmission. The paper focuses on proposing a multi-path transmission scheme based on artificial intelligence for 7G networks.
Zontou, E. (2023)	Evolution of cellular mobile networks from 1G to 7G	Provides a comprehensive historical and technical overview of mobile network generations, positioning **7G**	The evolution of mobile networks is a continuous progression driven by increasing deman	*Unveiling the Evolution of Mobile Networks: From 1G to 7G*	023	Greece	arXiv (arXiv:2310.19195v1; not peer-reviewed journal indexed)	Not applicable (descriptive review paper)	Not applicable (descriptive review paper)	Not applicable (descriptive review paper)	The paper concludes that 7G represents a natural continuation of mobile network	This paper explores the evolution of cellular network generations from 1G to the prospective	The Evolution of Mobile Networks: From 1G to 7G This article provides a comprehensive	According to the article, the upcoming 7G cellular technology is expected to have significantly enhanced capacity,

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		as the next evolutionary step characterized by ultra-high capacity, near-zero latency, and support for advanced applications such as artificial general intelligence	ds for capacity, latency reduction, and intelligent services, with 7G envisioned to enable seamless connectivity and transformative applications across industries								evolution, promising dramatic improvements in capacity and latency while enabling new applications in healthcare, transportation, entertainment, and artificial intelligence, though challenges related to cost and deployment remain	future of 7G. It traces the development of mobile communication technologies beginning with the first commercial 1G network in Japan and examines the technical foundations, architectures, and limitations of successive generations. The study discusses the transition from analog to digital systems, the rise of broadband and low-latency networks, and the growing role of artificial intelligence. It concludes by outlining the anticipated capabilities, opportunities,	overview of the evolution of cellular network generations, starting from the introduction of 1G in the late 1970s to the potential future of 7G. It discusses the key advancements and features of each generation, including: 1G: Analog wireless networks with limitations in voice quality, capacity, and security. 2G: Digital networks like GSM, enabling voice and data communication with features like terminal mobility. 3G: Significant improvements	even higher frequencies, and vastly lower latency compared to previous generations. The article speculates that 7G could potentially revolutionize various industries, including: Healthcare: 7G's seamless connectivity, real-time data processing, and advanced communication systems are expected to reshape healthcare applications. Transportation: The article mentions that 7G could benefit self-driving cars by enabling rapid construction of on-the-fly networks and processing large volumes of real-time data with extremely low latency. Entertainment: The transform

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												and challenges of 7G networks and their potential impact on a digitally interconnected society.	in data speeds and network capabilities, supporting services like video calling and fast internet. 4G: Leveraging technologies like OFDM and MIMO to deliver high-speed data transfer and low latency. 5G: Designed to handle increased data demands, offering higher speeds, larger wireless capacity, reduced latency, and improved energy efficiency. 6G: Anticipated to provide even greater bandwidth, lower latency, and utilize advanced technol	ative capabilities of 7G are anticipated to impact the entertainment industry as well, though specific use cases are not detailed in the article.

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													ogies like AI and machine learning. 7G: Speculated to succeed 5G and 6G, promising significantly enhanced capacity, higher frequencies, and vastly lower latency.	