

Systematic Literature Review on Telecom Monetisation Strategies for 5G and Future Spectrum: Insights From Business Market Trends and Practices

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Abstract

This systematic review examines telecom monetisation strategies and spectrum management practices in the context of fifth-generation (5G) and future wireless networks, with particular emphasis on evolving business models, regulatory frameworks and enabling technologies shaping global telecom ecosystems. A comprehensive review of seventy-five peer-reviewed journal articles, industry reports and policy documents published between 2006 and 2025 was conducted following PRISMA guidelines to ensure methodological rigor, transparency and reproducibility. The analysis reveals a pronounced transition from traditional connectivity-based revenue models toward diversified, value-oriented monetisation approaches supported by technologies such as network slicing, software-defined networking, network function virtualisation, artificial intelligence, cloud-native architectures and dynamic spectrum access mechanisms. Evidence from the reviewed literature highlights the increasing importance of flexible spectrum licensing, spectrum sharing and collaborative infrastructure models in improving spectrum utilisation efficiency, reducing deployment costs and enhancing long-term revenue sustainability. Regulatory adaptability is identified as a critical factor influencing successful monetisation outcomes, with innovation-friendly governance frameworks enabling alignment between technological capabilities and commercial viability. Regional differences in market maturity, policy priorities and infrastructure readiness are shown to significantly shape monetisation strategies across developed and developing economies. The findings provide integrated insights for telecom operators, policymakers and ecosystem stakeholders seeking to align investment strategies, regulatory reforms and technological innovation with the operational demands of 5G deployment and the anticipated transition toward sixth-generation (6G) networks, while supporting inclusive digital growth and resilient telecommunications infrastructure.

Keywords: 5G Monetisation Strategies, Spectrum Management, Telecom Business Models, Network Slicing, Regulatory Frameworks.

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Introduction

The evolution of mobile communication technologies has fundamentally reshaped digital economies, with fifth-generation (5G) networks representing a major transition in terms of capacity, latency, flexibility and service enablement compared to earlier generations (1–3). The enhanced performance characteristics of 5G have positioned it as a critical enabler for smart cities, autonomous mobility, industrial automation, immersive media and large-scale Internet of Things (IoT) deployments (4–6). At the same time, global 5G deployment has required unprecedented capital expenditure in spectrum acquisition,

network densification, cloud-native architectures and edge computing infrastructure, thereby intensifying financial pressure on mobile network operators (MNOs) (7–9). Traditional subscription-based revenue models that dominated previous generations have increasingly been recognised as insufficient for recovering 5G-related investments and ensuring long-term financial sustainability (10–12). As a result, a structural shift toward diversified and value-oriented monetisation strategies has been observed, including enterprise connectivity solutions, private networks, network slicing, edge computing services and platform-

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based revenue models (13–16). These developments reflect a broader transformation in which telecom operators are repositioned from pure connectivity providers to orchestrators of multi-sided digital ecosystems serving heterogeneous industrial and societal use cases (17–19). Spectrum management has emerged as a central determinant of effective 5G monetisation. As a finite and publicly governed resource, spectrum directly influences network performance, coverage and service innovation (20, 21). Conventional exclusive licensing approaches, while providing regulatory certainty, have often resulted in spectrum underutilisation, particularly in rural and low-demand regions, thereby exacerbating digital divides (22–24). In response, alternative access mechanisms such as spectrum sharing, leasing, local licensing and dynamic allocation models have gained policy and commercial relevance, enabling more efficient resource utilisation while supporting inclusive connectivity objectives (25–28).

The temporal scope of this review intentionally spans from 2006 to 2025 to capture both the pre-5G and 5G eras. Although 5G was standardised later, the conceptual foundations of contemporary 5G monetisation—including software-defined networking, network virtualisation, spectrum trading, neutral-host models and platform-based business strategies—were actively explored well before formal 5G deployment (29–32). Including pre-5G literature enables a longitudinal understanding of how regulatory thinking, technological capabilities and business models evolved incrementally toward the current 5G ecosystem and continues to inform emerging 6G strategies (33–36).

A growing body of research has highlighted network slicing as a pivotal monetisation mechanism, allowing operators to deliver customised, sector-specific services with differentiated pricing and quality-of-service guarantees (37–39). Parallel studies have emphasised the role of enabling technologies such as artificial intelligence, block chain, cloud computing and software-defined networking in facilitating dynamic resource allocation, automated orchestration and transparent spectrum transactions (40–43). These technological advances have supported the emergence of flexible revenue architectures that extend beyond traditional connectivity offerings.

Regulatory and policy-oriented literature has further underscored the importance of adaptive governance frameworks that balance revenue generation, competition, innovation and social inclusion (44–46). Policy approaches such as licensed shared access, dynamic spectrum access and local licensing regimes have been examined as mechanisms to stimulate innovation while maintaining regulatory predictability and investor confidence (47–50). Regional studies demonstrate that spectrum and monetisation strategies are strongly shaped by national market maturity, infrastructure readiness and socio-economic priorities, leading to heterogeneous deployment and revenue outcomes across developed and developing economies (51–54).

Despite the expanding literature, existing studies remain fragmented across technical, economic and policy domains. Many investigations focus narrowly on individual technologies, regulatory instruments, or regional case studies, limiting their ability to provide an integrated understanding of telecom monetisation dynamics (55–58). Furthermore, emerging challenges related to sustainability, security, energy efficiency and platform dominance have added additional layers of complexity to future monetisation strategies (59–62).

Recent research has increasingly extended this discussion toward the transition from 5G to 6G, highlighting the anticipated role of terahertz communications, intelligent spectrum management, AI-native networks and platform-centric revenue ecosystems (63–66). These developments reinforce the need for holistic frameworks that integrate technological innovation, regulatory reform and collaborative business models to support scalable, inclusive and sustainable digital infrastructure (67–70).

Against this backdrop, the present review systematically synthesises academic and industry literature to examine telecom monetisation strategies and spectrum management practices in the 5G era and beyond. By integrating techno-economic, regulatory and market perspectives, the study aims to provide a comprehensive understanding of how evolving technologies, governance mechanisms and business innovations collectively shape sustainable revenue models for current and next-generation wireless networks (71–73).

The objective of this review is to systematically examine the evolution of telecom monetisation strategies and spectrum management practices in the context of 5G and future wireless networks. The study aims to synthesise existing academic and industry literature to identify emerging business models, enabling technologies and regulatory frameworks influencing revenue generation across global telecom ecosystems. Particular attention is given to understanding how innovations such as network slicing, private

networks, edge computing, software-defined networking and dynamic spectrum access contribute to sustainable returns on 5G investments. The review further seeks to evaluate the role of regulatory and policy interventions in facilitating or constraining effective monetisation, while highlighting key challenges, regional variations and future opportunities that are expected to shape monetisation strategies in the transition toward 6G.

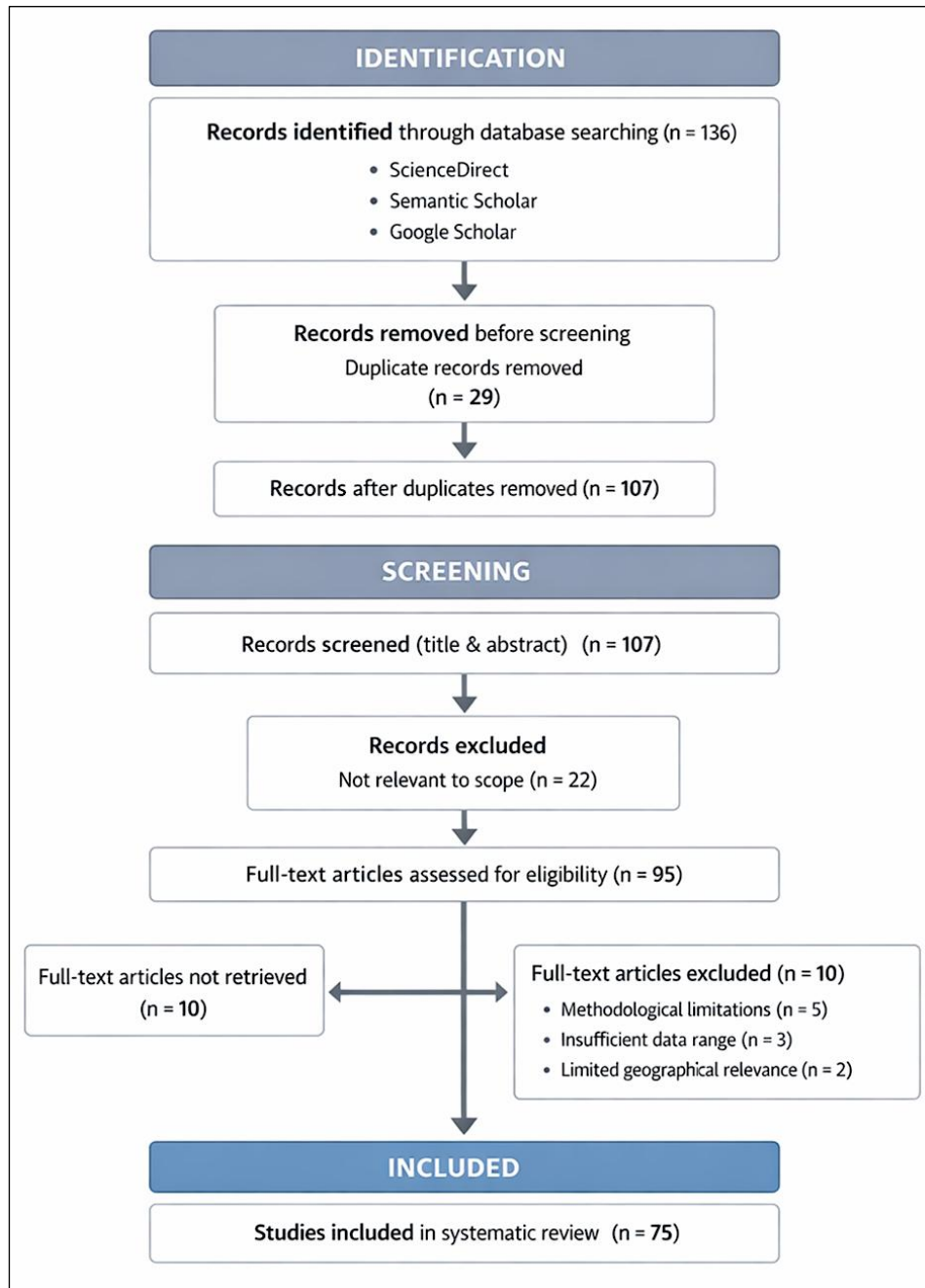


Figure 1: PRISMA Flow Diagram Illustrating the Identification, Screening, Eligibility and Inclusion of Studies in the Systematic Literature Review

Table 1: Research Focus of the Study

Focus Area	Description
Monetisation Strategies	Examination of revenue models adopted by telecom operators to recover investments in 5G infrastructure and spectrum assets
Business Model Innovation	Analysis of emerging business models such as enterprise services, private 5G networks, network slicing and edge computing
Spectrum Management	Assessment of spectrum licensing, sharing, leasing and dynamic access frameworks enabling telecom monetisation
Regulatory Environment	Evaluation of policy and regulatory frameworks facilitating or constraining telecom monetisation
Future Opportunities	Identification of challenges, innovations and opportunities shaping monetisation strategies for 5G and future networks

Research Focus

To address the above objective, this review is guided by an integrated research focus that examines current monetisation approaches adopted by telecom operators to recover investments in 5G infrastructure and spectrum assets, evaluates the influence of emerging enterprise-oriented business models on revenue generation and analyses the role of spectrum management and regulatory frameworks in enabling sustainable monetisation outcomes. The review also explores the principal operational, regulatory and market-related challenges faced by telecom operators across different regions, while identifying future opportunities and innovative approaches expected to shape the monetisation of 5G and next-generation spectrum resources.

Methodology

A systematic literature review (SLR) methodology was adopted to examine telecom monetisation strategies and spectrum management practices in the context of 5G and future wireless networks. The review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines to ensure transparency, reproducibility and methodological rigor throughout the study. The objective of this methodological approach was to systematically identify, screen, evaluate and synthesise relevant academic and industry literature addressing business models, enabling technolo-

gies and regulatory frameworks influencing telecom monetisation.

Research Design and Focus

The review followed a structured research design guided by clearly defined thematic focus areas rather than thesis-style research questions. The research focus encompassed telecom monetisation strategies, business model innovation, spectrum management approaches, regulatory frameworks and future opportunities shaping 5G and next-generation telecom ecosystems. These focus areas are summarised in Table 1, which provides a concise overview of the analytical scope of the study.

Data Sources and Search Strategy

A comprehensive literature search was conducted across multiple scholarly databases, including Science Direct, Semantic Scholar and Google Scholar, selected for their broad coverage of peer-reviewed journals, conference proceedings and authoritative industry and policy publications. A structured keyword-based search strategy was applied to capture relevant literature related to telecom monetisation and spectrum management. The search terms were grouped into two primary categories: (a) telecom monetisation and business models and (b) enabling technologies and regulatory factors. Boolean operators were used to combine these groups and refine search results. The detailed search query formulation is presented in Table 2.

Table 2: Search Query Formation for Systematic Literature Review

Group	Keywords Used
Group A	5G Monetisation OR Telecom Business Models OR Revenue Models OR Spectrum Monetisation OR Network Slicing OR Private Networks OR Edge Computing

Group B	Software Defined Networking OR SDN OR Network Function Virtualisation OR NFV OR Artificial Intelligence OR AI OR Blockchain OR Spectrum Policy OR Regulatory Framework
Final Search Query	(Group A) AND (Group B)

Inclusion and Exclusion Criteria

To ensure relevance and quality, predefined inclusion and exclusion criteria were applied systematically. The review included peer-reviewed journal articles, conference papers, policy documents and industry reports published in English between 2006 and 2025, focusing on telecom monetisation, spectrum management and

related business or regulatory dimensions. Studies that were purely technical with no relevance to monetisation or policy, non-English publications, duplicate records and studies with insufficient methodological clarity were excluded. A summary of the inclusion and exclusion criteria is provided in Table 3.

Table 3: Inclusion and Exclusion Criteria

Criteria Type	Description
Inclusion Criteria	Peer-reviewed journal articles, conference papers, policy documents and industry reports published in English between 2006 and 2025 focusing on telecom monetisation, spectrum management, business models and regulatory frameworks
Exclusion Criteria	Non-English publications, duplicate records, purely technical studies without business or policy relevance, studies with insufficient methodological clarity and geographically irrelevant studies

Study Selection Process

The study selection process followed the PRISMA framework and is illustrated in Figure 1. The initial database search identified 136 records. After removing 29 duplicate records, 107 studies were screened based on title and abstract relevance, resulting in the exclusion of 22 records that did not align with the study focus. Full-text assessment was conducted for 95 articles, of which 10 articles

could not be retrieved. A further 10 articles were excluded due to methodological limitations, insufficient data range, or limited geographical relevance. The final dataset comprised 75 studies, which were included in the qualitative synthesis. A numerical summary of the dataset is presented in Table 4.

Table 4: Summary of Study Selection and Dataset

Parameter	Value
Records identified through database searching	136
Duplicate records removed	29
Records screened	107
Records excluded	22
Full-text articles assessed for eligibility	95
Full-text articles not retrieved	10
Full-text articles excluded	10
Final studies included in review	75
Time period covered	2006–2025

Quality Assessment

To enhance the robustness of the review, the quality of the included studies was assessed using the Critical Appraisal Skills Programme (CASP) checklist. The CASP framework was applied to evaluate clarity of research objectives, appropriateness of methodology, validity of findings and

relevance to the study focus. Studies that did not meet minimum quality thresholds were excluded during the eligibility assessment phase. The application of the CASP checklist ensured that the synthesis was informed by methodologically sound and credible sources.

Data Analysis and Synthesis

A thematic analysis approach was employed to synthesise findings from the selected studies. The literature was systematically coded and grouped into key thematic domains aligned with the research focus areas, including monetisation models, spectrum management strategies, enabling technologies, regulatory frameworks and regional market dynamics. This analytical approach facilitated the identification of recurring patterns, emerging trends and research gaps across different geographical and regulatory contexts. The thematic synthesis enabled an integrated interpretation of how technological innovation, business transformation and policy evolution collectively shape sustainable telecom monetisation strategies for 5G and future wireless networks.

Quality Assessment: CASP Checklist

To strengthen the methodological robustness of the review, the quality of the included studies was assessed using the Critical Appraisal Skills Programme (CASP) checklist. The CASP framework was applied to evaluate clarity of research objectives, methodological appropriateness, validity of findings and relevance to the research focus. Studies that demonstrated weak methodological grounding or insufficient analytical depth were excluded during the eligibility phase. The application of the CASP checklist ensured that only high-quality and methodologically sound literature informed the synthesis and analysis.

Data Analysis and Synthesis

A thematic analysis approach was employed to synthesise findings from the selected studies. The literature was systematically coded and categorised into key thematic domains, including telecom monetisation models, spectrum management strategies, enabling technologies, regulatory frameworks and regional market dynamics. This

approach facilitated the identification of recurring patterns, emerging trends and research gaps across diverse geographical and regulatory contexts. The thematic synthesis enabled an integrated interpretation of how technological innovation, business transformation and policy evolution collectively shape sustainable monetisation strategies for 5G and future wireless networks.

Results

The systematic review resulted in the inclusion of 75 studies published between 2006 and 2025, reflecting a steadily growing scholarly interest in telecom monetisation and spectrum management. The selected literature spans multiple disciplines, including telecommunications engineering, business and management, economics and public policy, indicating the multidisciplinary nature of monetisation research in the 5G and future network context.

Geographical Distribution of Publications

The geographical distribution of the selected studies reveals a strong concentration of research output from technologically advanced and policy-active regions. As illustrated in Figure 2, the United States accounts for the highest number of publications, followed by India and the United Kingdom. European countries such as Germany and Finland also demonstrate substantial contributions, reflecting their active engagement in spectrum regulation reforms and next-generation network research. Contributions from Asian economies, including China and Japan, highlight a strong focus on technological advancement and large-scale network deployment. The diversity of contributing countries indicates that telecom monetisation and spectrum strategies are globally relevant, albeit shaped by region-specific regulatory frameworks and market conditions.

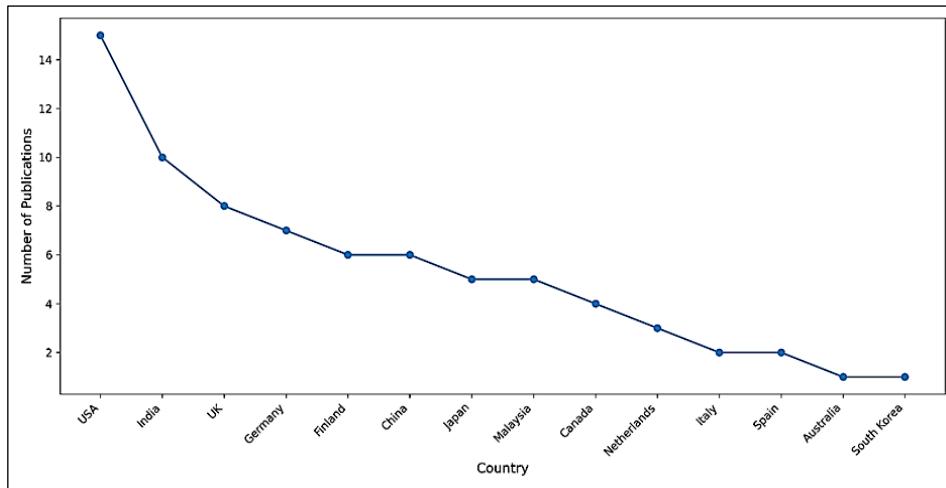


Figure 2: Country-wise Distribution of Publications on Telecom Monetisation and Spectrum Management

Temporal Trends in Research Output

The year-wise distribution of publications, presented in Figure 3, shows a gradual increase in research activity over time, with a notable acceleration after 2015. Early publications primarily focused on spectrum efficiency, virtualisation and preliminary business models. A significant rise in research output is observed from 2019 onwards, coinciding with the commercial

rollout of 5G networks and heightened industry interest in sustainable monetisation strategies. The increasing number of studies published between 2020 and 2025 reflects growing academic and industrial attention toward revenue diversification, regulatory innovation and preparation for future 6G ecosystems.

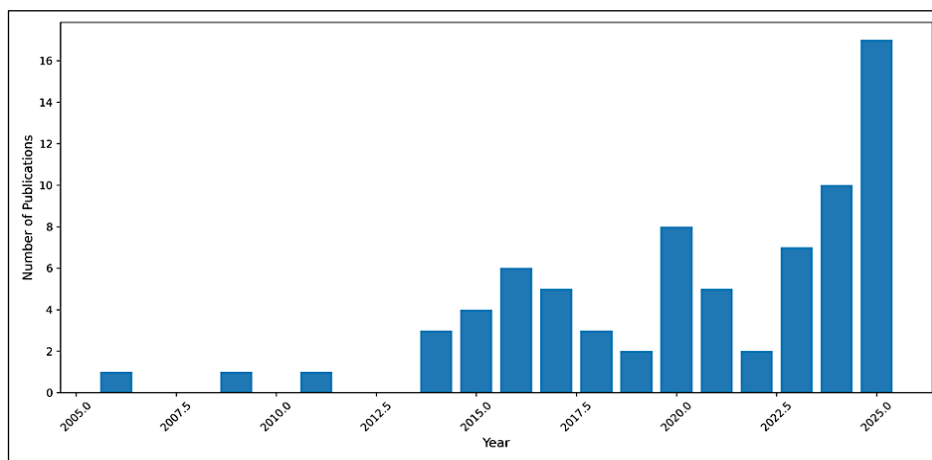


Figure 3: Year-wise Distribution of Publications (2006–2025)

Journal-wise Distribution of Publications

The journal-wise distribution, depicted in Figure 4, indicates that a substantial proportion of the reviewed studies were published in leading IEEE journals, including IEEE Access and IEEE Communications Magazine, highlighting the technical and applied nature of the research. At the same time, contributions from interdisciplinary

and policy-oriented journals demonstrate an expanding focus on economic sustainability, regulatory frameworks and social implications. The presence of studies from diverse publication outlets confirms the convergence of technical innovation and business strategy in contemporary telecom research.

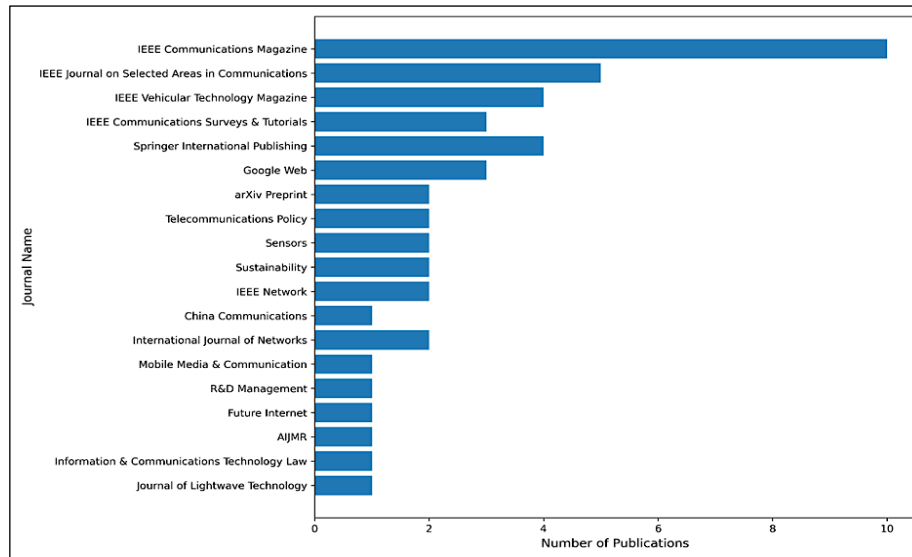


Figure 4: Journal-wise Distribution of Publications Included in the Review

Content Analysis

A thematic content analysis was conducted to synthesise insights from the selected studies. The analysis resulted in the identification of five dominant thematic domains, reflecting the evolving landscape of telecom monetisation and spectrum management.

Conceptual Synthesis of Telecom Monetisation and Spectrum Strategies

Based on the thematic content analysis, an integrated conceptual framework was developed to illustrate the interrelationship between enabling technologies, spectrum management approaches and telecom monetisation outcomes in the 5G and beyond ecosystem. The framework synthesises key findings from the reviewed literature and demonstrates how technological enablers and regulatory mechanisms collectively influence revenue sustainability, operational efficiency and inclusive digital development.

Monetisation Models

The reviewed literature demonstrates a clear shift from traditional subscription-based revenue models toward diversified monetisation approaches. Enterprise services, private 5G networks, network slicing and platform-based service delivery emerged as dominant revenue mechanisms. These models enable customised service offerings with differentiated pricing structures, allowing telecom operators to target industry-specific use cases and improve return on investment.

Spectrum Management Strategies

Spectrum management strategies play a central role in enabling sustainable monetisation. The analysis highlights increasing adoption of spectrum sharing, leasing and dynamic access models alongside traditional exclusive licensing. These approaches improve spectrum utilisation efficiency, reduce deployment costs and support inclusive connectivity, particularly in rural and underserved regions. Regulatory experimentation with flexible spectrum access models is identified as a key enabler of innovation.

Enabling Technologies

Technological enablers such as software-defined networking, network function virtualisation, artificial intelligence, block chain and cloud computing are consistently identified as foundational elements of modern telecom monetisation. These technologies support automated orchestration, real-time resource allocation and scalable service provisioning, thereby enabling flexible and cost-efficient revenue architectures.

Regulatory and Policy Frameworks

The analysis reveals that regulatory adaptability is critical to monetisation success. Policy frameworks that encourage spectrum flexibility, infrastructure sharing and market competition are associated with more robust monetisation outcomes. Conversely, rigid licensing regimes and high spectrum reserve prices are frequently cited as barriers to investment and innovation. Regional regulatory differences significantly influence monetisation strategies and deployment outcomes.

Regional and Market Dynamics

The reviewed studies indicate that monetisation strategies are strongly influenced by regional market maturity, infrastructure readiness and socio-economic priorities. Developed markets tend to focus on advanced enterprise applications and platform-based ecosystems, while developing economies prioritise affordability, coverage expansion and digital inclusion. These variations underscore the importance of context-specific monetisation frameworks rather than one-size-fits-all solutions.

Conceptual Framework for Telecom Monetisation and Spectrum Strategy

Based on the thematic content analysis of the selected studies, a conceptual flow framework was developed to illustrate the sequential relationship between enabling technologies, spectrum management approaches, telecom monetisation models and their resulting outcomes (Figure 5). The framework synthesises key findings from the reviewed literature and demonstrates how technological and regulatory mechanisms collectively shape revenue sustainability, operational efficiency and digital inclusion in the 5G and beyond ecosystem.

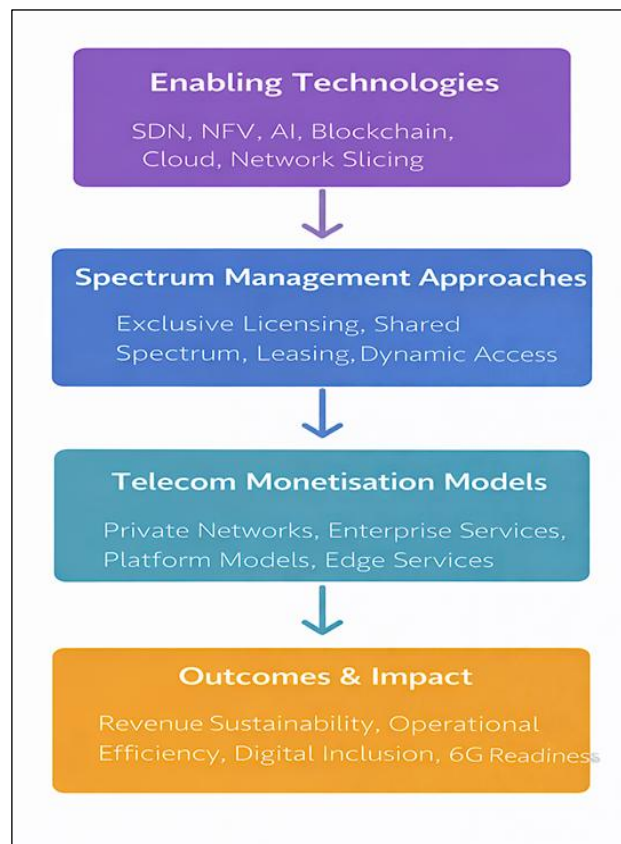


Figure 5: Conceptual Flow Diagram Illustrating the Relationship between Enabling Technologies, Spectrum Management Approaches, Telecom Monetisation Models and their Outcomes in the 5G and beyond Ecosystem

Discussion

The findings of this systematic review demonstrate that the telecommunications sector is undergoing a fundamental transformation driven by the widespread deployment of fifth-generation (5G) networks and the anticipated transition toward sixth-generation (6G) systems. Monetisation strategies are increasingly shaped by the convergence of advanced technologies, evolving

regulatory frameworks and intensified competitive pressures from digital service platforms and over-the-top service providers (74, 75). As a result, traditional connectivity-centric revenue models are being re-evaluated in favour of more flexible, service-oriented and ecosystem-based approaches.

The reviewed literature highlights that emerging technologies such as artificial intelligence, software-defined networking, network function virtualisation, block chain and edge computing have become central to enabling advanced monetisation mechanisms. These technologies support dynamic resource allocation, automated orchestration and scalable service provisioning, thereby allowing telecom operators to offer differentiated services such as network slicing, private networks and industry-specific solutions (63–66). Such capabilities are increasingly viewed as essential for achieving sustainable returns on high capital investments associated with spectrum acquisition and network densification (59–62).

Spectrum management practices are shown to play a critical role in shaping monetisation outcomes. Evidence from the literature indicates that exclusive licensing regimes, while offering regulatory certainty, often limit spectrum utilisation efficiency and innovation potential. In contrast, flexible approaches such as spectrum sharing, leasing and dynamic access models have been associated with improved resource efficiency, reduced deployment costs and enhanced opportunities for inclusive connectivity, particularly in underserved regions (47–50). These findings underscore the importance of aligning spectrum governance mechanisms with evolving technological and market realities.

Regulatory adaptability emerges as a decisive factor influencing the success of telecom monetisation strategies. Policy frameworks that promote innovation, infrastructure sharing and competitive neutrality are found to facilitate stronger alignment between technological capabilities and commercial viability. Conversely, rigid regulatory environments and high spectrum reserve prices are frequently identified as barriers to investment and service innovation (51–54). The literature further suggests that public-private partnerships and collaborative ecosystem models can mitigate financial risk while accelerating network deployment and service diversification across different market contexts (69–70).

Regional variations in monetisation strategies are consistently observed across the reviewed studies. Developed markets tend to prioritise advanced enterprise applications, platform-based ecosystems and data-driven services, whereas developing economies focus more heavily on

affordability, coverage expansion and digital inclusion objectives. These differences highlight the limitations of uniform monetisation models and reinforce the need for context-sensitive regulatory and business strategies that reflect local socio-economic conditions (55–58).

The discussion also extends toward future monetisation challenges and opportunities associated with the evolution from 5G to 6G. Anticipated developments such as terahertz communications, AI-native network architectures, intelligent spectrum management and immersive digital platforms are expected to further reshape revenue models and governance frameworks. Addressing sustainability, energy efficiency and equitable access is identified as a critical priority for ensuring that future monetisation strategies support long-term digital resilience and inclusive growth (67–73).

Regulatory adaptability and policy coordination emerge as decisive factors influencing monetisation outcomes. Markets that adopt flexible, innovation-friendly regulatory frameworks exhibit stronger alignment between technological capability and commercial viability.

Conclusion

This systematic literature review provides a comprehensive synthesis of evolving telecom monetisation strategies and spectrum management practices in the context of fifth-generation (5G) and future wireless networks. The findings indicate a clear shift away from traditional subscription-based and connectivity-centric revenue models toward diversified, value-oriented approaches enabled by advanced technologies and flexible governance frameworks. Monetisation mechanisms such as enterprise services, private networks, network slicing, spectrum sharing and platform-based service models have emerged as critical pathways for improving return on investment and enhancing long-term financial sustainability.

The review further demonstrates that spectrum management plays a pivotal role in shaping monetisation outcomes. Flexible spectrum access models, including spectrum sharing, leasing and dynamic allocation, are shown to enhance utilisation efficiency, reduce deployment costs and support inclusive connectivity, particularly in underserved and rural regions. In contrast, rigid

licensing regimes and high spectrum reserve prices continue to constrain innovation and investment potential in many markets.

Technological enablers such as software-defined networking, network function virtualisation, artificial intelligence, block chain and cloud-native architectures are identified as foundational elements supporting scalable, automated and cost-efficient monetisation strategies. Regulatory adaptability and policy coordination are also highlighted as decisive factors influencing the alignment between technological capability and commercial viability across diverse regional contexts.

The review underscores the need for integrated and context-sensitive approaches that align technological innovation, regulatory reform and collaborative business models. Such alignment is essential for enabling sustainable, inclusive and resilient telecom ecosystems as the industry transitions from 5G toward sixth-generation (6G) networks and beyond.

Key Findings and Takeaways

The review identifies a clear shift in telecom monetisation from traditional connectivity-driven revenue models toward diversified, value-oriented approaches enabled by fifth-generation technologies. Enterprise services, private networks, network slicing and edge-based platforms emerge as viable pathways for improving return on investment and addressing rising network deployment costs. Flexible spectrum management approaches, including spectrum sharing, leasing and dynamic access, are shown to enhance spectrum utilisation efficiency while supporting inclusive connectivity, particularly in underserved regions. The findings further indicate that rigid licensing regimes and high spectrum reserve prices continue to act as barriers to sustainable monetisation. Technological enablers such as software-defined networking, network function virtualisation, artificial intelligence, block chain and cloud-native architectures are critical in operationalizing advanced monetisation models by enabling automation, scalability and real-time optimisation. Regulatory adaptability and policy coordination are identified as decisive factors influencing monetisation outcomes, with innovation-friendly regulatory frameworks demonstrating stronger alignment between technological capability and commercial viability.

Limitations

Despite offering comprehensive insights, this systematic review has certain limitations that should be acknowledged. First, the analysis is primarily based on peer-reviewed and indexed literature published in English, which may have resulted in the exclusion of relevant regional studies, policy briefs, or industry reports available in other languages. Second, the telecommunications domain is evolving rapidly and some findings may be affected by the pace of technological and regulatory change, particularly in areas related to spectrum policy and emerging 6G developments. Third, although the review was designed to provide broad thematic coverage, depth may be limited in certain specialised subdomains such as metaverse monetisation, terahertz communications and highly technical network optimisation mechanisms. These constraints may influence the generalizability of the findings across all regional and technological contexts.

Recommendations and Future

Research Directions

Future research should prioritise comparative and cross-regional analyses to better understand how telecom monetisation strategies vary across different socio-economic, regulatory and cultural environments. Evaluating spectrum sharing and licensing models across diverse markets may help identify context-specific best practices that support sustainable investment and inclusive connectivity. Greater emphasis should also be placed on interdisciplinary collaboration that integrates perspectives from engineering, economics, policy studies and social sciences, enabling the development of monetisation frameworks that balance technological innovation with societal impact.

Further investigation is required into advanced financial planning and investment modelling approaches, particularly for low- and middle-income economies facing high spectrum costs and capital constraints. Research focusing on co-investment models, public-private partnerships and data-driven return-on-investment estimation techniques could support more resilient deployment strategies. In addition, policy-oriented studies examining adaptive regulatory mechanisms, cross-border harmonisation and the integration of artificial intelligence and block chain

into spectrum governance are essential for addressing emerging challenges in next-generation networks.

As the transition toward sixth-generation networks accelerates, future work should also explore the socio-economic, environmental and sustainability implications of evolving monetisation models. Understanding the trade-offs between commercial viability, public value creation and digital equity will be critical for designing future-proof telecom ecosystems that support inclusive and sustainable digital transformation.

Abbreviations

None.

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Author Contributions

Mohammad Ather Ansari: conceptualisation, study design, screening, data analysis, interpretation of results, manuscript drafting, Syed Shahid Mazhar: conceptualisation, study design, screening, data analysis, interpretation of results, manuscript drafting, Farhina Sardar Khan: conceptualisation, study design, screening, data analysis, interpretation of results, manuscript drafting, Kashif Mazhar: literature search, data collection, screening, screening, data analysis, interpretation of results, manuscript drafting, Murad Ali: literature search, data collection, screening, screening, data analysis, interpretation of results, manuscript drafting, Amir Mazhar: literature search, data collection, screening, screening, data analysis, interpretation of results, manuscript drafting, Aseel Smerat: literature search, data collection, screening, screening, data analysis, interpretation of results, manuscript drafting, Hiba Khan: literature search, data collection, screening, data analysis, interpretation of results, manuscript drafting. All authors reviewed, revised and approved the final version of the manuscript for publication.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

Data Availability

The data are available from the corresponding author on a reasonable request.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this manuscript, generative artificial intelligence tools were used to assist with language refinement and structural organisation of the content. The authors critically reviewed and edited all AI-assisted outputs and take full responsibility for the accuracy, originality and integrity of the manuscript.

Ethics Approval

This study is based on a systematic review of published literature and does not involve human participants, animals, or any primary data collection. Therefore, ethical approval was not required.

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