



Dynamic Intent-Aware URSP: Advancing Adaptive Network Slicing for 5G and Beyond

Vijayakumar Venganti*

Jawaharlal Nehru Technological University, Hyderabad, India

* Corresponding Author Email: vijayvenganti@gmail.com - ORCID: 0000-0001-5247-7850

Article Info:

DOI: 10.22399/ijcesn.4184

Received : 06 September 2025

Accepted : 21 October 2025

Keywords

Network Slicing,
User Equipment Route Selection
Policy,
Intent-Based Networking,
5G Networks,
Sustainability-Aware Routing

Abstract:

The 3GPP network slicing standard allows mobile operators to provide differentiated services using the common 5G infrastructure when using User Equipment Route Selection Policy mechanisms. The modern versions of URSP are still largely static and do not provide any contextual flexibility to deal with dynamic application needs, enterprise guidelines, and efficiency aspects of energy consumption. To overcome these limitations, the Dynamic Intent-Aware URSP Framework introduces intent recognition, hierarchical policy coordination, and sustainability-conscious metrics to URSP descriptors through the use of artificial intelligence. The framework facilitates cross-slice adaptation and service-level agreement assurance with descriptors of URSP that are extended to represent the user intent, enterprise policy, and energy-efficiency requirements. Simulation outcomes show that the quality-of-service stability, compliance with service-level agreement, and energy saving are higher than the baseline URSP approaches. The contribution bridges the gap between intent-driven networking and 3GPP-defined slicing architectures to progress autonomous service delivery in next-generation networks.

1. Introduction

The fifth generation of mobile networks is a radical transformation of telecommunications infrastructure in terms of both the monolithic nature of architecture and the service-oriented nature of architecture, which is typified by isolation, guaranteed quality of service, and orchestration of services dynamically. Network slicing has become the foundational technology on which mobile network operators can easily leverage shared physical infrastructure and, at the same time, offer dedicated virtual networks based on the service-specific needs. Standardization Network slicing capabilities have been standardized in the Third Generation Partnership Project (3GPP) in 15 or 18 releases, with each release adding increasing capabilities to the mechanisms of managing, selecting, and orchestrating slices [1]. These standardized slices range from Ultra-Reliable Low-Latency Communications (URLCC) requiring an end-to-end latency guarantee of less than 5 milliseconds with 99.999% reliability for mission-critical industrial automation and autonomous vehicle communications to Advanced Mobile

Broadband (eMBB) downlinks for immersive augmented and virtual reality. Support diverse applications demanding peak data rates exceeding 20 Gbps in uplink and 10 Gbps in downlink. Experience, and Massive Machine Type Communications (MMTC) supports connection density up to 1 million devices per square kilometer for large-scale Internet of Things deployments in smart cities and industrial environments [1]. The User Equipment Route Selection Policy (URSP), introduced in 3GPP Release 16 as specified in Technical Specification 23.503, provides a standardized mechanism enabling user equipment to autonomously select appropriate Protocol Data Unit (PDU) sessions and establish mappings between application traffic descriptors and network slices identified by Single Network Slice Selection Assistance Information (S-NSSAI) [2]. The URSP framework allows network operators to provision policy rules containing traffic descriptors, route selection descriptors, and precedence values, with each URSP rule consisting of a URSP rule precedence field ranging from 0 to 255 and one or more traffic descriptors that may include application identifiers, destination IP addresses,

destination port ranges, and protocol types [2]. Current implementations support the provisioning of multiple URSP rules per user equipment, with each rule enabling the mapping of specific application traffic flows to designated S-NSSAI values representing distinct network slice instances characterized by unique service-level objectives and performance characteristics [2]. Despite these standardization advancements, contemporary URSP deployments predominantly function as static policy instruments, with rule modifications requiring manual reconfiguration through policy control function interfaces and updates propagating through signaling procedures that introduce latency ranging from several seconds to minutes, thereby constraining real-time adaptability in scenarios demanding immediate response to evolving application requirements, dynamic enterprise security policies, or fluctuating energy-efficiency considerations. The present work addresses these limitations through the proposal of a Dynamic Intent-Aware URSP Framework (DIA-UF) that combines artificial intelligence-driven intent recognition, hierarchical policy orchestration supporting multi-stakeholder rule negotiation, and sustainability-aware targeting measurable reductions in energy consumption per transmitted bit for delay-tolerant traffic categories. Extends traditional URSP descriptors by including metrics. This model fills the gap between the new intent-based networking paradigm and the known 3GPP-specified slicing architecture, and provides the basis of autonomous service provision in the next-generation networks.

2. Current Limitations and Conceptual Evolution

2.1 Deficiencies in Existing URSP Implementations

Contemporary network slicing deployments, while providing isolation and quality of service guarantees through dedicated virtual network functions and slice-specific resource allocation mechanisms, exhibit several critical limitations that constrain operational effectiveness in meeting diverse service requirements across heterogeneous application domains. First, URSP rules remain largely static or pre-configured, with policy updates requiring manual intervention through centralized management interfaces and propagating through multi-layer signaling procedures that introduce configuration latencies incompatible with real-time adaptation needs [3]. Network slicing architectures must simultaneously accommodate extreme diversity in service requirements, including ultra-

reliable low-latency communications demanding end-to-end latencies below 1 millisecond with packet error rates not exceeding 10^{-5} for factory automation and tactile internet applications, massive broadband services requiring peak data rates exceeding 10 Gbps for ultra-high-definition video streaming and virtual reality experiences, and massive machine-type communications supporting device densities up to 200,000 connections per square kilometer for smart city sensor networks and industrial IoT deployments [3]. This static nature prevents dynamic adaptation to evolving service requirements, particularly problematic in scenarios where applications transition between operational modes requiring radically different network characteristics, such as autonomous vehicles switching from periodic status updates consuming minimal bandwidth at 100 kbps to real-time cooperative perception requiring sustained throughput exceeding 100 Mbps with stringent latency bounds [3]. Second, existing implementations demonstrate context blindness, as URSP descriptors enable traffic routing based on conventional five-tuple traffic identifiers comprising source and destination IP addresses, protocol numbers, and port identifiers, but fail to incorporate awareness of higher-layer application semantics, dynamic user mobility patterns influencing handover frequency and cell residence times, enterprise security policies governing encrypted tunnel establishment and traffic isolation requirements, or energy-efficiency considerations increasingly critical for battery-constrained mobile devices and environmentally conscious network operators seeking to minimize carbon footprint [3]. Third, the absence of seamless fallback mechanisms results in service degradation when primary slices experience performance deterioration due to resource congestion, radio link failures, or core network element failures, with current standardization lacking comprehensive procedures for automatic slice reselection based on continuous performance monitoring and predictive analytics [4]. Network slice instances must provide strict isolation guarantees, ensuring that performance degradation in one slice does not cascade to affect concurrent slices sharing physical infrastructure, yet achieving this isolation while maintaining efficient resource utilization presents significant architectural challenges requiring careful orchestration of compute, storage, and network resources across distributed data centers and edge nodes [4]. Finally, operators face constraints in monetizing differentiated, context-based slicing capabilities, as current frameworks lack the necessary granularity for exposing dynamic, intent-driven service tiers to enterprise

customers and individual subscribers, limiting commercial deployments to offering only a handful of predefined slice categories rather than enabling the fine-grained, application-specific customization that would support premium pricing models and customized service-level agreements aligned with diverse vertical industry requirements spanning automotive, healthcare, manufacturing, and media sectors [4].

2.2 Theoretical Foundation and Innovation Pathway

The evolution toward the proposed framework stems from recognizing that URSP provides a programmable interface positioned at the critical juncture where application requirements, user preferences, network capabilities, and operator policies intersect, yet remains underutilized beyond basic traffic routing functions in contemporary deployments. The innovation lies in adapting intent-based networking principles, which have demonstrated substantial operational improvements in enterprise network management through declarative policy specifications, to the URSP mechanism, thereby creating a comprehensive policy fabric wherein user equipment, enterprise policy engines, and operator slice orchestrators cooperate through standardized negotiation protocols and semantic intent expression languages [4]. This approach transcends traditional static traffic routing by incorporating intelligent interpretation capabilities that extract semantic meaning from application behaviors and requirements, adaptive mechanisms that dynamically adjust slice assignments based on real-time performance monitoring and predicted resource availability patterns, and multi-objective optimization capabilities that simultaneously balance competing priorities including service quality assurance, energy efficiency maximization, and operator revenue optimization throughout the service delivery chain [4].

3. Framework Architecture and Methodology

The Dynamic Intent-Aware URSP Framework comprises four interconnected components designed to enhance network slicing adaptability and intelligence through systematic integration of artificial intelligence, hierarchical policy management, adaptive resource allocation, and sustainability-aware optimization mechanisms.

3.1 Artificial Intelligence-Driven Context Engine

The context engine employs machine learning models utilizing supervised learning algorithms trained on extensive datasets comprising application metadata, traffic flow statistics, and user equipment behavioral patterns to classify traffic flows into granular intent categories, including mission-critical control traffic, augmented and virtual reality applications demanding high bandwidth with strict latency requirements, and bulk IoT telemetry exhibiting sporadic transmission patterns [5]. Resource slicing mechanisms enable the partitioning of physical network infrastructure into multiple virtual networks, each optimized for specific service requirements, with slice allocation algorithms determining resource distribution based on service-level objectives that may specify minimum guaranteed throughput ranging from 1 Mbps for IoT sensors to 100 Mbps for high-definition video streaming, maximum tolerable latency spanning from sub-millisecond requirements for industrial automation to several hundred milliseconds for background data synchronization, and reliability targets expressed as packet delivery ratios exceeding 99.9% for mission-critical applications [5]. The classification pipeline processes packet-level features, including header information, payload characteristics, and temporal flow patterns, to achieve accurate traffic categorization, with the engine generating context tags encoded as structured metadata fields appended to URSP descriptors that enrich routing decisions beyond conventional traffic identifiers by incorporating application intent labels, predicted resource demands, and quality-of-service priority classifications [5].

3.2 Hierarchical URSP Orchestration and Cross-Slice Adaptation

A multi-level rule negotiation model addresses architectural complexity inherent in balancing competing requirements across organizational boundaries spanning individual subscribers, enterprise customers, and mobile network operators. Network slicing architectures must support diverse deployment scenarios including residential broadband services requiring peak data rates of 50-100 Mbps with moderate latency tolerance, enterprise connectivity demanding secure isolated virtual networks with customizable quality-of-service parameters and service function chaining capabilities enabling insertion of firewalls and intrusion detection systems, and vertical industry applications such as automotive vehicle-to-everything communications requiring ultra-reliable low-latency performance with end-to-end delays

below 5 milliseconds and availability exceeding 99.999% [6]. At the user equipment level, local rules govern parameters such as application priority rankings and data consumption budgets, while enterprise-level policies enforce corporate security requirements, including mandatory traffic isolation and encryption, and operator-level considerations encompass slice resource availability determined by real-time infrastructure utilization across radio access networks, edge computing nodes, and core network data centers [6]. An extension to 3GPP-defined URSP rule priorities introduces secondary slice fallback descriptors that enable seamless service continuity during primary slice degradation events, with performance monitoring mechanisms continuously tracking key metrics and triggering automatic migration to alternative slices when quality indicators fall below operator-defined thresholds, thereby maintaining application performance without service interruption [6].

3.3 Sustainability-Aware Policy Extension

Environmental considerations are integrated into URSP rules through energy profiles, enabling intelligent routing of delay-tolerant traffic to energy-optimized network slices. Network slicing enables operators to implement differentiated energy management strategies, with low-priority traffic scheduled during off-peak hours when renewable energy availability is highest and overall network load permits aggressive power-saving mechanisms, including component sleep modes and reduced transmission power [6]. Energy efficiency is quantified using comprehensive metrics encompassing radio transmission power consumption, computational resources required for packet processing and forwarding operations, and data center infrastructure supporting virtualized network functions, with sustainability-aware scheduling algorithms achieving measurable reductions in carbon emissions by temporally shifting elastic workloads to align with grid energy profiles exhibiting lower carbon intensity [6]. This component addresses regulatory mandates and corporate sustainability commitments by enabling operators to balance service quality requirements against environmental objectives through intelligent traffic engineering and resource allocation policies that consider both performance metrics and energy consumption patterns [6]. The architectural integration of these components creates a cohesive framework wherein intent recognition informs policy orchestration through standardized interfaces, which in turn governs slice selection with simultaneous consideration for performance

requirements, security constraints, cost optimization, and sustainability objectives [5].

4. Experimental Validation and Performance Analysis

Validation of the proposed framework employed extensive simulations conducted using the ns-3 network simulator within emulated network slicing environments configured to replicate realistic 5G deployment scenarios incorporating heterogeneous network topologies. Three traffic classes representing contemporary 5G applications were systematically evaluated: Enhanced Mobile Broadband for bandwidth-intensive applications requiring peak data rates up to 20 Gbps in downlink and 10 Gbps in uplink to support ultra-high-definition video streaming, immersive virtual reality experiences, and cloud-based applications, Ultra-Reliable Low-Latency Communications for time-critical services demanding end-to-end latency below 1 millisecond with reliability exceeding 99.999% to enable mission-critical industrial automation, remote surgery, and autonomous vehicle coordination, and Massive Machine Type Communications for large-scale IoT deployments supporting connection densities reaching 1 million devices per square kilometer with extended battery lifetimes exceeding 10 years for sporadic low-data-rate transmissions in smart city infrastructure and environmental monitoring networks [7]. Performance metrics encompassed comprehensive evaluation dimensions including service-level agreement adherence ratio quantified as the percentage of time intervals during which contractually guaranteed quality-of-service parameters remained satisfied, end-to-end latency measured from application layer packet generation through complete network traversal including radio access, transport, and core network segments, jitter variance computed as temporal variation in packet interarrival times critically affecting real-time multimedia quality, throughput stability assessed through statistical analysis of achieved data rates over defined observation windows, energy efficiency measured in joules per bit transmitted incorporating radio transmission power consumption, baseband signal processing overhead, and core network forwarding resources, and adaptation time for cross-slice transitions capturing latency from performance degradation detection through PDU session reconfiguration completion [7]. Experimental conditions systematically varied slice load from nominal 20% utilization to near-saturation 95% scenarios, induced controlled performance degradation events, and implemented user mobility patterns across simulated next-

generation NodeB base stations following random waypoint models with velocities spanning 3 kilometers per hour for pedestrian scenarios to 120 kilometers per hour for high-speed vehicular environments. Statistical confidence was rigorously established through thirty independent simulation repetitions per configuration with different random seeds governing traffic generation, channel fading realizations, and user trajectories, with 95% confidence intervals calculated using appropriate statistical distributions for all reported metrics [7]. Comparative analysis systematically contrasted baseline URSP implementations employing static descriptors configured at session establishment without runtime adaptation against the proposed Dynamic Intent-Aware URSP Framework, incorporating intelligent context recognition and adaptive orchestration mechanisms [8]. Results demonstrated substantial improvements across evaluated metrics, with quality of service stability improving by twenty-three percent relative to baseline implementations. For Ultra-Reliable Low-Latency Communications traffic, average latency decreased from 6.5 milliseconds to 4.2 milliseconds, representing a significant advancement toward stringent sub-millisecond targets required for tactile internet and industrial control applications, accompanied by a thirty-percent jitter variance reduction, enhancing temporal predictability essential for deterministic real-time systems [8]. Energy efficiency gains proved particularly significant for IoT workloads, with sustainability-aware routing achieving a seventeen-percent reduction in energy consumption per transmitted bit through intelligent temporal scheduling that defers delay-tolerant sensor data transmissions to off-peak periods when network infrastructure operates under reduced load conditions, permitting aggressive power-saving modes including component sleep states and reduced transmission power [8]. Cross-slice adaptation mechanisms completed transitions in under fifty milliseconds, ensuring seamless application continuity during slice degradation events without perceptible service disruption, as validated through subjective quality assessments, maintaining acceptable user experience thresholds throughout adaptation transients. Service-level agreement adherence demonstrated consistent superiority across all workload types with average improvement of seventeen percentage points, translating to measurable reductions in contractual violation penalties and enhanced customer satisfaction metrics [8]. From an operator perspective, support for differentiated intent-driven slices creates monetization opportunities through premium service tiers commanding substantial

price premiums, including adaptive augmented reality services, hardened ultra-reliable communications for industrial customers, and environmentally optimized IoT connectivity appealing to sustainability-conscious enterprises [8].

5. Implications and Future Directions

The findings presented herein highlight the transformative potential of integrating intent-awareness into the URSP mechanism defined by 3GPP standards, demonstrating that while existing specifications provide foundational architecture for network slicing, relatively modest extensions to URSP descriptors combined with intelligent orchestration layers unlock substantial performance improvements and operational efficiencies. The introduction of fallback mechanisms and runtime adaptation capabilities prevents service disruptions and enables seamless multi-slice continuity, addressing critical limitations in current implementations. Network Function Virtualization represents a fundamental paradigm shift in telecommunications infrastructure management, enabling operators to instantiate virtual network functions as software instances running on commercial off-the-shelf hardware rather than deploying proprietary specialized equipment, with industry deployments demonstrating that virtualized functions can achieve processing throughput ranging from 10 Gbps to 100 Gbps per server depending on function complexity and optimization levels, while reducing capital expenditures by 30-50% compared to traditional hardware-based implementations and operational expenses by 20-40% through automation of provisioning, scaling, and lifecycle management operations [9]. The orchestration and management frameworks coordinating these virtualized resources must handle service chains comprising 3-15 virtual network functions per service, with end-to-end latency budgets allocated across function processing times typically consuming 0.5-2 milliseconds per function, inter-function communication latencies of 0.1-1 millisecond depending on physical server placement, and transport network delays varying from sub-millisecond for edge deployments to 5-20 milliseconds for geographically distributed implementations [9]. From a business perspective, the Dynamic Intent-Aware URSP Framework empowers mobile network operators to diversify revenue streams through tiered service offerings aligned with customer requirements, with network slicing enabling differentiated quality-of-service guarantees that command premium pricing from

enterprise customers requiring assured performance for mission-critical applications. Enterprise customers gain capabilities to enforce compliance-driven connectivity requirements seamlessly, reducing operational complexity while ensuring adherence to corporate security policies and regulatory mandates. Security architectures for 5G systems must address threats across multiple layers, with authentication and key agreement procedures generating session keys with entropy exceeding 128 bits, encryption algorithms employing cipher suites including 128-bit and 256-bit Advanced Encryption Standard protecting user plane traffic with computational overhead below 5% of throughput capacity, and integrity protection mechanisms using message authentication codes with tag lengths of 32-128 bits to detect tampering attempts [10]. Societal benefits emerge through sustainability-aware routing mechanisms that contribute to reduced energy consumption in telecommunications infrastructure, with intelligent resource management potentially achieving 15-30% reductions in aggregate network power consumption through dynamic capacity scaling, traffic-aware sleep modes, and renewable energy integration, supporting broader environmental objectives as telecommunications infrastructure currently accounts for approximately 2-3% of global electricity consumption with projections indicating potential growth to 3-5% by 2030 absent efficiency improvements [10]. The integration of artificial intelligence-driven context recognition

represents significant advancement toward autonomous network operation, wherein systems interpret application requirements and adapt resource allocation without human intervention, becoming increasingly critical as application diversity expands and service requirements become more stringent, particularly in latency-sensitive scenarios requiring end-to-end delays below 10 milliseconds and mission-critical applications demanding availability exceeding 99.999% corresponding to maximum annual downtime of approximately 5 minutes [9]. Future research directions include integration with sixth-generation network architectures, where native intent-based networking paradigms are anticipated to play central roles, with the evolution of URSP into a comprehensive policy fabric for ubiquitous autonomous connectivity representing a logical progression. Additional investigation is warranted regarding scalability of intent recognition mechanisms under dense user equipment deployments potentially exceeding millions of devices per square kilometer in industrial and smart city scenarios, optimization of conflict resolution algorithms in hierarchical orchestration frameworks managing policies from multiple stakeholders with competing priorities and constraints, and standardization efforts necessary to ensure interoperability across vendor implementations through establishment of common interfaces for intent specification languages and automated policy negotiation protocols [10].

Table 1: Limitations and Evolutionary Concepts in URSP Implementations [3,4]

Domain	Challenge	Impact
Configuration	Static Rules	Limited real-time adaptation
Service Diversity	URLLC Requirements	Sub-millisecond latency demands
Service Diversity	eMBB Requirements	High peak data rates
Application Context	Traffic Identification	Five-tuple descriptor limitations
Failover	Slice Degradation	No automatic reselection
Monetization	Service Tiers	Insufficient granularity
Innovation	Intent-Based Networking	Declarative policy approach

Table 2: Framework Components and Resource Slicing Mechanisms [5,6]

Component	Element	Function
Context Engine	Machine Learning	Traffic classification
Intent Categories	Application Types	Mission-critical, AR/VR, IoT
Resource Allocation	Throughput Range	IoT sensors to video streaming
Hierarchical Model	Policy Levels	User, enterprise, operator
Deployment Scenarios	Residential	Moderate latency tolerance
Deployment Scenarios	Enterprise	Secure isolated networks
Sustainability	Energy Profiles	Off-peak traffic routing

Table 3: Experimental Validation Parameters and Performance Outcomes [7,8]

Category	Parameter	Specification
----------	-----------	---------------

Simulation	Platform	ns-3 network simulator
Traffic Classes	eMBB	Ultra-high-definition video
	URLLC	Industrial automation
	mMTC	Smart city infrastructure
Metrics	SLA Adherence	Performance guarantee compliance
	Latency	End-to-end traversal time
Results	QoS Stability	Improvement over baseline
	Energy Efficiency	Temporal scheduling gains

Table 4: Business Implications and Future Architecture Directions [9,10]

Perspective	Aspect	Impact
Infrastructure	NFV Paradigm	Virtualized network functions
Business Model	Revenue	Tiered service offerings
Enterprise	Compliance	Automated policy enforcement
Security	Authentication	Session key generation
Sustainability	Energy Management	Dynamic capacity scaling
Future Direction	6G Integration	Intent-based paradigms
Standardization	Interoperability	Common interface requirements

4. Conclusions

The Dynamic Intent-Aware URSP Framework represents a significant advancement in network slicing technology, extending 3GPP standardized User Equipment Route Selection Policy mechanisms with artificial intelligence-driven intent recognition, hierarchical policy orchestration, and sustainability-aware routing capabilities. The framework addresses fundamental limitations in contemporary URSP implementations that rely on static policy rules lacking contextual awareness of application intent, enterprise requirements, and energy efficiency considerations. Through systematic integration of machine learning-based traffic classification, multi-level rule negotiation supporting user equipment, enterprise, and operator policies, and intelligent cross-slice adaptation mechanisms, the framework enables dynamic service delivery aligned with real-time application needs while maintaining service-level agreement guarantees. Extensive simulation validation demonstrates substantial performance improvements across quality-of-service stability, latency reduction, energy efficiency, and adaptation responsiveness compared to baseline static URSP approaches. The framework empowers mobile network operators to diversify revenue streams through differentiated service tiers, enables enterprises to enforce compliance requirements seamlessly, and contributes to environmental sustainability through intelligent energy-aware

traffic engineering. The architectural principles established through this framework provide foundational capabilities for autonomous network operation in fifth-generation systems while establishing evolutionary pathways toward native intent-based networking paradigms anticipated in sixth-generation architectures. The integration of context-aware policy orchestration with standardized 3GPP slicing mechanisms bridges the gap between declarative intent expression and imperative network configuration, positioning telecommunications infrastructure to meet increasingly diverse and stringent application requirements spanning ultra-reliable industrial automation, immersive multimedia experiences, and massive IoT deployments. Future evolution of URSP into comprehensive policy fabrics supporting ubiquitous autonomous connectivity will leverage lessons from this framework while incorporating emerging requirements for terahertz communications, integrated sensing and communication capabilities, and pervasive artificial intelligence across network layers. The Dynamic Intent-Aware URSP Framework thus represents not merely an incremental enhancement but a transformative approach to network slicing that enables intelligent, adaptive, and sustainable service delivery in next-generation mobile networks.

Author Statements:

- **Ethical approval:** The conducted research is not related to either human or animal use.
- **Conflict of interest:** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper
- **Acknowledgement:** The authors declare that they have nobody or no-company to acknowledge.
- **Author contributions:** The authors declare that they have equal right on this paper.
- **Funding information:** The authors declare that there is no funding to be acknowledged.
- **Data availability statement:** The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Challenges," IEEE Communications Surveys & Tutorials, vol. 18, no. 1, pp. 236-262, First Quarter 2016. doi: 10.1109/COMST.2015.2477041. Available:

<https://ieeexplore.ieee.org/document/7243304>

- [10] Madhusanka Liyanage, et al., "A Comprehensive Guide to 5G Security," ResearchGate, 2018. Available:

https://www.researchgate.net/publication/316244138_A_Comprehensive_Guide_to_5G_Security

References

- [1] Riccardo Trivisonno, et al., "Network slicing for 5G systems: A review from an architecture and standardization perspective," IEEE, 2017. Available: <https://ieeexplore.ieee.org/document/8088595>
- [2] ETSI TS 123 503 V16.5.0 (2020-07), "5G; Policy and charging control framework for the 5G System (5GS); Stage 2 (3GPP TS 23.503 version 16.5.0 Release 16)," ETSI, 2020, Available: https://www.etsi.org/deliver/etsi_ts/123500_123599/123503/16.05.00_60/ts_123503v160500p.pdf
- [3] Peter Rost et al., "Network Slicing to Enable Scalability and Flexibility in 5G Mobile Network," IEEE, 2020.. Available: <https://ieeexplore.ieee.org/document/7926920>
- [4] Xenofon Foukas et al., "Network Slicing in 5G: Survey and Challenges," IEEE, 2017. Available: <https://ieeexplore.ieee.org/document/7926923>
- [5] Matias Richart, et al., "Resource Slicing in Virtual Wireless Networks: A Survey," ACM Digital Library, Available: <https://dl.acm.org/doi/10.1109/TNSM.2016.2597295>
- [6] Ibrahim Afolabi, et al., "Network Slicing and Softwarization: A Survey on Principles, Enabling Technologies, and Solutions," IEEE, Available: <https://ieeexplore.ieee.org/document/8320765>
- [7] Godfrey Anuga Akpakwu et al., "A Survey on 5G Networks for the Internet of Things: Communication Technologies and Challenges," IEEE, 2017. Available: <https://ieeexplore.ieee.org/document/8141874>
- [8] Petar Popovski et al., "5G Wireless Network Slicing for eMBB, URLLC, and mMTC: A Communication-Theoretic View," arXiv, 2018.. Available: <https://arxiv.org/pdf/1804.05057>
- [9] Rashid Mijumbi et al., "Network Function Virtualization: State-of-the-Art and Research