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Quality of Service in Sustainable Development: A QoS-based Analysis of the United Nations Sustainable Development Goals

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Abstract. This paper explores the innovative application of Quality of Service (QoS) principles, traditionally rooted in network and telecommunications, across various sectors to enhance the achievement of the United Nations Sustainable Development Goals (SDGs). By establishing a parallel between QoS in technological systems and sectors such as healthcare, education, energy, and urban development, we examine how these principles can be adapted to improve service delivery and efficiency in critical areas of sustainable development. The core premise is that methodologies used to optimize data flow and service reliability in networks can similarly enhance the quality, accessibility, and sustainability of essential services. This study conducts a comprehensive comparative analysis to illustrate the potential of QoS frameworks in promoting efficiency, effectiveness, and equity across multiple domains of the SDGs. Key areas of focus include enhancing healthcare outcomes, increasing educational accessibility, ensuring sustainable energy use, and improving urban infrastructure. The findings advocate for a cross-disciplinary approach to applying QoS principles, suggesting that such integration can lead to substantial improvements in service delivery and contribute significantly to global sustainable development efforts.

Keywords: Quality of Service, Sustainable Development Goals, Cross-Sectoral Application, Efficiency, Service Delivery, Global Development.

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1 Introduction

Derived from the dynamism and interaction between people and companies generated by the global economy, where the interaction of processes and the exchange of information, there are determining factors for a correct evolution of the operations and services provided to society. As part of the services and productive activities, a limiting and determining element in the response and communication of its stages are the communication networks between computers.

Based on the impact of communication networks, Quality of Service (QoS) plays a key role in ensuring the exchange and delivery of information between network-based applications and services. Cisco, a leading innovator in networking solutions, has developed a comprehensive set of QoS technologies to prioritize and manage network traffic, ensuring that high-priority applications receive the bandwidth and performance they demand. The key terms related to QoS are:

- Jitter: it's related with the variation in the time it takes for data packets to reach their destination. A high jitter can cause problems in applications with high priority such as voice over IP (VoIP) or videoconferencing since it generates interruptions and instability in the audio or video.
- Latency: Or delay, it is the total time it takes for a data packet to travel from its origin to its destination. Low latency is crucial for real-time applications, as online gaming or financial transactions.
- Bandwidth: it is the definition of the speed of the network.
- Availability: It is related to the percentage of time where a network service is operational and accessible to users.
- Data Integrity: Ensures that data transmitted over the network reaches its destination without modification or alteration.

- Traffic Prioritization: It is the ability of a network to prioritize different types of traffic over others, it helps to optimize network performance for critical applications.

QoS control is based on a set of fundamental principles to drive the prioritization and management of network traffic, triggering the foundation for effective QoS implementation, enabling network administrators to achieve desired performance goals. These principles are:

- Traffic classification: The first stage in the implementation of QoS is the identification and classification of different types of network traffic, which use IP addresses, port numbers and application protocols as elements to distinguish between traffic flows.
- Traffic prioritization: When traffic is classified, QoS schemes prioritize different classes of traffic according to their importance. Prioritization techniques include tagging and queuing, ensuring that high-priority traffic receives preferential treatment, while low-priority traffic is regulated to minimize its impact on critical applications.
- Traffic adaptation: Another aspect implemented by QoS is the control of the rate at which data is transmitted through the network, by limiting the bandwidth consumed by non-critical traffic, thus ensuring that high-priority applications have access to the bandwidth they need.
- Congestion management: To prevent network congestion from degrading the performance of critical applications, queuing and congestion avoidance algorithms are applied to maintain a constant throughput for high priority traffic.

With the background described above, it is possible to identify aspects that can be equated with key factors in actions for the attention and pursuit of the United Nations Sustainable Development Goals, in the following sections we will address these aspects in greater depth, validating this innovative approach.

2 Quality of Service in Sustainable Development

Incorporating Quality of Service (QoS) principles into the UN Sustainable Development Goals (SDGs) represents an innovative and cross-cutting strategy to improve efficiency and effectiveness in multiple sectors essential for human and environmental development. QoS, a concept originally developed in the field of networks and telecommunications to describe the ability to ensure quality, availability and priority of service in a communications system, is proposed as an applicable and beneficial framework beyond its traditional use. The application of QoS in the context of the SDGs can be seen as a systematic approach to ensure that services and resources are delivered effectively, efficiently and equitably, contributing significantly to environmental, economic and social sustainability. This approach involves adapting and implementing quality metrics, performance standards and continuous evaluation processes to optimise both resources and operations in sectors such as health, education, energy, urban infrastructure, and more.

By employing QoS principles, SDG-oriented projects and policies can improve their ability to respond to the changing needs of populations, while maximising the effectiveness of resources and minimising waste and inefficiency. In addition, a QoS-based approach emphasises the importance of the end-user experience, ensuring that services are not only available, but are accessible, of high quality and tailored to the needs of diverse communities. In short, integrating QoS into the SDGs offers a robust methodology for accelerating progress towards a more sustainable and equitable future.

2.1. Quality of HealthCare Service

Quality of HealthCare Service (QoHS) refers to the quality of health care services provided to patients. QoHS encompasses various aspects of health care, and aims to ensure that patients receive safe, effective, patient-centred, timely, efficient and equitable treatment. Quality in healthcare also involves continuous improvement through systematic evaluation, measurement of outcomes and feedback from patients and healthcare professionals. This comprehensive approach helps to ensure that health services not only meet current standards of medical practice, but also respond appropriately to the changing needs of the population and advances in medicine. QoHS is focused on meeting the objective of sustainable development SDG 3. The following are the components that are often fundamental to understanding quality in health care:

- Safety: Health services should prevent patient injury and minimise medical errors and risks in health care.
- Effectiveness: Care should be based on scientific evidence and follow best practices to achieve the best possible outcomes in the treatment of disease and maintenance of health.
- Patient-Centred: Care should be respectful of patients' individual preferences, needs and values, ensuring that their values guide all clinical decisions.

- Timeliness: Reduce unnecessary waiting and delay for both recipients and providers of care.
- Efficiency: Maximise the use of resources, avoiding waste of equipment, supplies, ideas and energy.
- Equity: Provide care that does not vary in quality due to personal characteristics such as gender, ethnicity, geographic location or socioeconomic status.

The analogy between Quality of HealthCare Service (QoHS) and Quality of Service (QoS) in networks is an excellent way to illustrate how the principles of efficiency, effectiveness and continuity can be applied in different fields to improve the end-user experience. In Table 1, we describe how the main components of each might be compared:

Table 1. QoHS vs QoS.

	QoHS	**QoS**
Accessibility vs. availability:	Accessibility refers to the ease with which patients can obtain medical services when they need them, including the availability of facilities and specialists.	Availability ensures that the network is always operational and accessible to users, minimising downtime and maximising uptime.
Quality of Processing vs. Data Integrity:	Quality of treatment involves the application of best medical practices and the use of appropriate technologies to treat patients effectively.	Data integrity ensures that information transmitted over the network arrives error-free and consistent, essential for critical applications such as financial transactions or remote medical operations.
Service Efficiency vs. Latency:	Service efficiency in healthcare involves providing care in a timely manner, avoiding unnecessary delays and improving the internal logistics of healthcare services.	Latency refers to the time it takes for a data packet to travel from its origin to its destination. Reducing latency is crucial to improving the speed and responsiveness of the network.
Patient Experience vs Jitter:	Patient experience includes not only the clinical quality of care received, but also the overall interaction with the healthcare system, such as the treatment of staff and the comfort of the facilities.	Jitter, or the variability of the arrival time of data packets, affects the quality of services such as VoIP and video streaming, where consistency is crucial to maintaining a high-quality user experience.
Fairness of Service vs. Traffic Prioritisation:	In healthcare, equity implies that all patients receive an adequate level of medical care regardless of their socio-economic status or geographic location.	Traffic prioritisation in networks allows certain data, such as emergency or critical packets, to take precedence over less urgent data, ensuring that network resources are used efficiently and that critical services maintain their quality.

2.2. Quality of Education Service

Quality of Education Service (QoEdS) refers to the quality of educational services provided to students. This comprehensive concept covers various aspects of education and seeks to ensure that all students receive an education that is effective, inclusive and responsive to their needs. QoEdS is focused on meeting the objective of sustainable development SDG 4. The key components that define quality in education are:

- Accessibility: Education should be accessible to all learners, removing physical, economic and social barriers that may impede access to education.
- Relevance: Educational content and methods must be relevant to the needs of students and the requirements of the contemporary world, preparing students for life and employment.
- Effectiveness: Education should achieve the desired learning outcomes, ensuring that students acquire essential knowledge, skills and competencies.
- Equity: All students should be given equal opportunities to learn and reach their full potential, regardless of their background, gender, ability or other status.
- Inclusion: Education services should be inclusive, supporting the participation of all learners, including those with disabilities or special educational needs.

- Continuity: Education should be continuous and coherent, facilitating smooth transitions between different educational levels and avoiding interruptions in the educational process.
- Safety: Educational environments should be safe and welcoming, promoting the physical and emotional well-being of students.
- Innovation and continuous improvement: Education must incorporate innovative practices and be constantly evaluated and improved to adapt to changing technologies and methodologies.
- Community and parental involvement: Quality education encourages the active participation of parents and the community in the educational process, recognising their crucial role in supporting learning.

The analogy between Quality of Education Service (QoEdS) and Quality of Service (QoS) in networks allows us to explore how principles of efficiency and quality can be applied in both education and technology to optimise the delivery of essential services. In Table 2, we describe how the main components of each might be compared:

Table 2. QoEdS vs QoS.

	QoEdS	**QoS**
Accessibility vs. Availability:	In education, accessibility refers to the ability of students to obtain educational resources and attend classes, regardless of geographic, economic or social barriers.	In networking, availability ensures that network services are accessible at all times, with a focus on reliability and downtime reduction.
Quality of Educational Content vs. Data Integrity:	Quality of educational content implies that teaching materials and methods are accurate, up-to-date and relevant, promoting effective education.	Data integrity ensures that information transmitted over the network is accurate and consistent, with no errors during transmission.
Delivery Efficiency vs. Latency:	Efficiency in educational delivery focuses on how resources and teachings are managed to maximise learning in the time available, minimising delays and maximising interaction.	Latency in networks refers to the time it takes for data to get from one point to another, and reducing latency is crucial to improving the speed of communications and processing.
Student Experience vs. Jitter:	The student experience in the educational environment includes interaction with teachers, the learning environment, and available resources that together affect student satisfaction and performance.	Jitter in networks, which is the variability in the arrival of data packets, affects the quality of services such as video streaming and VoIP calls, which must be consistent for a good user experience.
Educational Equity vs. Traffic Prioritisation:	In education, equity ensures that all students have the same quality and access to educational resources, regardless of their personal or social context.	Traffic prioritisation in networks allows resources to be managed in a way that gives preference to certain types of data, ensuring that critical applications operate efficiently even under congested network conditions.

2.3. Quality of Water Services (QoWS)

QoS for water focuses on ensuring that the water supplied is safe, potable and available to users. This includes factors such as the quantity of water available, the chemical and microbiological quality of the water, and the reliability of the supply system. In some countries, there are specific regulations that focus on ensuring the QoS of water, such as standards for the quality of drinking water or the quantity of water available. QoWS is focused on meeting the objective of sustainable development SDG 6. In general, QoS for water aims to protect the health and well-being of citizens and wildlife. QoS for water focuses on ensuring that the water supplied is:

- Safe: free from hazardous chemical, microbiological and physical contaminants.
- Potable: fit for human consumption without causing harm to health.
- Available: available in sufficient quantity to meet the needs of users.
- Reliable: with a stable and reliable supply system that guarantees the delivery of safe and potable water.

To achieve these objectives, different strategies and technologies can be implemented:

- Continuous monitoring of water quality: to detect and correct any anomalies in the supply.
- Implementation of water treatment systems: to remove pollutants and improve water quality.
- Improvement of water supply infrastructure: to ensure water reliability and availability.
- Education and public awareness: to promote water care and the importance of protecting this vital resource.

The analogy between Quality of Water Services (QoWS) and Quality of Service (QoS) in networks can be established by considering how both concepts focus on the effective and efficient delivery of critical resources (water in one case, data in the other), ensuring that end-users receive a continuous and high-quality service. In Table 3, we describe how the main components of each might be compared:

Table 3. QoWS vs QoS.

	QoWS	**QoS**
Water Quality vs. Data Quality:	Ensures that water is potable, safe and meets health standards.	Ensures that transmitted data is accurate and arrives without corruption or alteration.
Service Continuity vs. Latency and Jitter:	Ensures that water supply is uninterrupted.	Minimises latency (delay in data transmission) and jitter (variability in receiving data packets) to maintain a constant and predictable flow of information.
Coverage and Accessibility vs. Network Accessibility:	Water must be accessible in all geographic areas, both rural and urban.	Ensures that the network is available everywhere and that all connected devices can access data when they need it.
Customer Service and Satisfaction vs. Traffic Management and Prioritisation:	Handles complaints and customer satisfaction effectively.	Manages and prioritises network traffic to optimise the end-user experience, trying to meet the needs of all users fairly.
Sustainability and Resource Management vs. Scalability and Resource Management:	Uses water resources sustainably to ensure long-term availability.	Manages network resources to ensure that the system can scale and adapt to increasing demands without service degradation.
Price and Affordability vs. Network Cost:	Water services must be affordable for all users.	Seek a balance between the cost of maintaining and upgrading the network and the need to provide an affordable, high quality service.

2.4. Quality of Energy Service

Quality of Energy Service (QoES) refers to the quality of energy services provided to consumers, encompassing a wide range of factors that determine how energy is produced, distributed and consumed in an efficient and sustainable manner. Energy service quality is crucial to ensure that energy is a pillar for economic and social development, improving the quality of life and promoting efficiency and environmental sustainability. QoES is focused on meeting the objective of sustainable development SDG 7. Key components of energy service quality include:

- Reliability: Refers to the ability of the power system to provide an uninterrupted supply. This includes minimising blackouts and the ability to recover quickly from service interruptions.
- Accessibility: Energy must be accessible to all users, ensuring that there are no economic or geographic barriers to accessing energy services.

- Affordability: Energy costs must be reasonable and competitive, allowing households and businesses to access energy without suffering financial hardship.
- Energy Efficiency: Efficiency in energy use is essential, which implies the optimal use of resources with as little waste as possible, both in energy production and consumption.
- Sustainability: Energy services should be managed in a way that minimises environmental impact and promotes the use of renewable energy sources and clean technologies to ensure long-term sustainability.
- Quality of Supply: Includes the technical quality of the energy supplied, such as voltage and frequency stability, which are important for the safe and efficient operation of electrical equipment.
- Customer Service: Includes effective and timely attention to customer queries and complaints, clarity of billing and information, and ease of payment.
- Safety: Ensure that energy infrastructure is safe to avoid risks to workers, the community and the environment.

The analogy between Quality of Energy Service (QoES) and Quality of Service (QoS) in networks is a relevant comparison, as both concepts seek to optimise the delivery and quality of critical services. In Table 4, we describe how the main components of each might be compared:

Table 4. QoES vs QoS.

	QoES	**QoS**
Reliability of Supply vs. Availability of the Grid:	Power supply reliability refers to the ability of the power system to deliver power consistently and without unexpected interruptions.	In networks, availability focuses on ensuring that the network is always operational, minimising downtime and maximising uptime.
Power Quality vs. Data Integrity:	Power quality can include aspects such as voltage and frequency stability, which are essential for the proper functioning of electrical devices.	Data integrity ensures that information transmitted over the network is accurate and unaltered, and is essential for maintaining reliable and efficient communications.
Energy Efficiency vs. Latency:	Energy efficiency refers to maximising performance while minimising energy consumption, essential for a sustainable and cost-effective energy service.	Latency, the time it takes for data to travel from its origin to its destination, is crucial to network efficiency, affecting the speed and reactivity of communications.
Energy Access vs. Equity of Access to the Grid:	Energy access is about ensuring that all users have access to affordable and reliable energy services, fundamental to development and quality of life.	In networks, equity of access implies that all users have the opportunity to access the network with an adequate quality of service, without discrimination based on location or ability to pay.
Demand Response vs. Traffic Management:	The ability to respond to fluctuations in energy demand efficiently is crucial to maintain stability and quality of energy service.	Traffic management in networks refers to how data is prioritised and handled to ensure that critical applications have the necessary resources, especially under high demand conditions.

2.5. Quality of Decent Work and Economic Growth Service

Quality of Decent Work and Economic Growth Service (QoDWEGS) refers to the quality of working conditions and policies that foster sustainable economic growth while promoting decent employment for all. This concept encompasses a number of key factors that affect both the quality of individual work and overall economic development. The Quality of Decent Work and Economic Growth Service is fundamental to building a robust and fair economy, where economic growth is not only measured by macroeconomic indicators, but also by the improvement in the quality of life and work of each individual within society.

QoDWEGS is focused on meeting the objective of sustainable development SDG 8. Key components of Decent Work and Economic Growth Service include:

- Decent Working Conditions: This involves ensuring safe, healthy and just working conditions, where workers have access to fair wages, reasonable working hours, and protection from labour exploitation.
- Employment Opportunities: Refers to the creation of sufficient and quality jobs that meet the needs of the working age population, including the reduction of unemployment and underemployment.
- Inclusive Economic Growth: Promoting economic growth that benefits all of society, including support for small and medium-sized enterprises (SMEs) and ensuring that all sectors of society benefit from economic progress.
- Equal Opportunities: Ensuring that all workers, regardless of gender, race, age or origin, have equal access to employment opportunities and career advancement.
- Skills Development and Training: Invest in the education and training of workers to improve their skills and competencies, preparing them for the demands of the modern labour market.
- Social Security and Labour Protection: Ensure that all workers have access to adequate social protection including pensions, health insurance, and unemployment benefits.
- Environmental Sustainability: Integrate sustainable practices into production and economic development processes to minimise environmental impact and ensure the long-term viability of natural resources.
- Social Dialogue and Labour Rights: Encourage dialogue between workers, employers and government to promote labour relations, collective bargaining and the enforcement of labour rights.

The analogy between Quality of Decent Work and Economic Growth Service (QoDWEGS) and Quality of Service (QoS) in networks can provide an interesting perspective on how to optimise and ensure quality in two different but equally essential fields. Both seek to improve the delivery of essential services and resources to achieve effective and efficient outcomes. In Table 5, we describe how the main components of each might be compared:

Table 5. QoDWEGS vs QoS.

	QoDWEGS	**QoS**
Job Stability and Security vs. Network Availability:	In the context of decent work, job stability and security are critical to ensure that workers have steady and secure jobs.	In networks, availability refers to the ability of the network to be operational and accessible when needed, with a focus on reliability and minimising downtime.
Quality of Working Conditions vs. Data Integrity:	Quality of working conditions ensures that working environments are safe, healthy and conducive to employee well-being.	Data integrity ensures that information transmitted over the network is accurate and consistent, avoiding errors or corruption.
Throughput efficiency vs. latency:	Production efficiency refers to optimising work processes to maximise productivity without compromising job quality.	Latency, the time it takes for data to travel from one point in the network to another, is crucial to communication efficiency, directly impacting productivity and user experience.
Access to Employment Opportunities vs. Equity of Access to the Network:	Promoting equitable access to employment opportunities involves ensuring that everyone, regardless of gender, race or socio-economic status, has an equal opportunity to find decent employment.	In networks, equity of access ensures that all users have the opportunity to access the network with adequate quality of service, without discrimination.
Economic Growth vs. Traffic Management:	Economic growth seeks to expand economic opportunities in a sustainable manner, promoting innovation and expanding labour markets.	Traffic management in networks refers to how data is handled and prioritised to ensure that network resources are used effectively, especially under conditions of high demand or stress.

2.6. Quality of Industry, Innovation, and Infrastructure Service

Quality of Industry, Innovation, and Infrastructure Service (QoIIIS) refers to the quality and efficiency of services and systems related to industry, innovation and infrastructure. This concept is fundamental to promoting sustainable development, as it

encompasses key aspects that affect an economy's ability to grow, adapt and compete in a global marketplace. Quality in industry, innovation and infrastructure is crucial for robust and sustainable economic development, providing the foundation on which modern economies are built and ensuring that they are equipped to face future challenges. QoIIIS is focused on meeting the objective of sustainable development SDG 9. Key components of Industry, Innovation, and Infrastructure Service include:

- Infrastructure Robustness and Resilience: This refers to the quality, robustness and durability of physical infrastructure, including roads, bridges, railways, ports, airports and telecommunications networks. A robust and resilient infrastructure is crucial for the efficiency and safety of economic activities.
- Innovation and Technological Development: This aspect covers the capacity of industries to innovate and adopt new technologies that improve efficiency, competitiveness and responsiveness to market needs. It includes investment in research and development (R&D) and the implementation of innovative solutions in products, processes and services.
- Environmental Sustainability: Refers to the integration of sustainable practices in industry and infrastructure, ensuring that economic development is carried out in an environmentally responsible manner and seeking to minimise negative impact on the environment.
- Efficiency and Accessibility: Efficiency in industry and infrastructure refers to the optimisation of resources and processes to maximise production and minimise costs and waste. Accessibility relates to the availability and affordability of infrastructure for all sectors of society.
- Quality of Industrial Production: This involves the quality of goods and services produced by industry, assessed in terms of technical specifications, compliance with standards and consumer satisfaction.
- Supply Chain Integration: This refers to the efficiency with which supply chains are managed and coordinated, from suppliers to consumers, ensuring that products are available where and when they are needed.
- Occupational Health and Safety: Ensuring safe and healthy working environments for workers in the industry, promoting practices that reduce occupational hazards and improve employee well-being.
- Collaboration and Networking: Creating networks between companies, governments and other institutions to facilitate collaboration and the sharing of knowledge and resources that drive innovation and growth.

The analogy between Quality of Industry, Innovation, and Infrastructure Service (QoIIIS) and Quality of Service (QoS) in networking is particularly relevant since both concepts aim at optimising the delivery and functionality of essential resources to ensure a continuous and high-quality service. In Table 6, we describe how the main components of each might be compared:

Table 6. QoIIIS vs QoS.

	QoIIIS	**QoS**
Infrastructure Robustness vs. Network Availability:	Industrial infrastructure robustness refers to the ability of facilities and systems to maintain their optimal performance under various conditions, minimising failures and downtime.	In networks, availability is ensured by implementing technologies and protocols that keep the network operational and accessible, minimising outages and maximising service continuity.
Process and Product Innovation vs. Transmission Efficiency:	Innovation in industry seeks to continuously improve processes and products through new technologies and methods, increasing competitiveness and efficiency.	In networks, transmission efficiency focuses on optimising data flow to reduce latency, improve transmission speed and effectively handle large volumes of data.
Infrastructure Sustainability vs. Network Scalability:	Sustainability in the industrial context involves developing and maintaining infrastructures that support long-term growth without degrading the environment or natural resources.	Scalability in networks refers to the ability to adapt and expand to handle increased demand without compromising quality of service.
Accessibility to Infrastructure vs. Equity of Access to the Network:	In industry and infrastructure, accessibility is ensured by providing facilities and services that are reachable and usable by all sectors of society, regardless of their geographic or economic location.	In networks, equity of access ensures that all users, regardless of their location or the device used, have access to the network and its resources with an adequate quality of service.
Technology Integration	Technology integration in industry involves the adoption of new technologies to improve	Network traffic management focuses on how data is prioritised and managed to ensure that

vs. Traffic Management:	the integration and automation of industrial processes, resulting in increased efficiency and productivity.	critical services operate efficiently and without interruption, especially in high-demand situations.

2.7. Quality of Sustainable Cities and Communities Service

Quality of Sustainable Cities and Communities Service (QoSCCS) refers to the quality and effectiveness of services and policies that contribute to making cities and communities more sustainable. The Quality of Sustainable Cities and Communities Service seeks to integrate all these components to create urban environments that are not only liveable and efficient, but also capable of sustaining their long-term development and quality of life in harmony with the environment. This concept is aligned with UN Sustainable Development Goal 11, which seeks to ensure that cities and human settlements are inclusive, safe, resilient and sustainable. The main components of this concept include:

- Sustainable Urban Planning and Management: This involves the development and implementation of urban planning policies and practices that promote efficient use of resources, minimisation of environmental impact and optimisation of urban space to improve the quality of life of residents.
- Accessibility and Inclusion: Refers to the ability of all people, regardless of age, gender, disability or socio-economic background, to access and benefit from essential urban services, such as transport, housing, public spaces and social services.
- Sustainable Infrastructure: Includes the development of infrastructure that promotes the efficient use of resources (water, energy, etc.), the use of sustainable technologies and materials, and supports sustainable mobility and connectivity.
- Resilience and Adaptability to Climate Change: Enabling cities and communities to adapt and respond to the challenges of climate change, including natural disaster risk management and the capacity to recover from these events.
- Environmental Quality: Improving air quality, reducing noise and visual pollution, effectively managing waste and preserving green spaces and biodiversity within urban environments.
- Affordable and Safe Housing: Ensure that all citizens have access to safe, affordable, quality housing that meets their basic needs and improves their quality of life.
- Community Participation and Local Governance: Encourage the active participation of citizens in decision-making related to urban development and community management, and ensure transparent and effective governance.
- Local Economy and Employment Opportunities: Develop robust local economies that provide sustainable employment opportunities and encourage innovation and entrepreneurship.

The analogy between Quality of Sustainable Cities and Communities Service (QoSCS) and Quality of Service (QoS) in networks highlights how both concepts seek to optimise the delivery of essential services to improve the quality of life and efficiency of systems. In Table 7, we describe how the main components of each might be compared:

Table 7. QoSCS vs QoS.

	QoSCS	**QoS**
Service Accessibility vs. Network Availability:	In the context of sustainable cities and communities, accessibility refers to the ability of all citizens to easily access essential services such as transport, health, education and other public services.	Network availability ensures that network services are constantly accessible to users, with a focus on reducing downtime and keeping the network operational.
Infrastructure Efficiency vs. Network Latency:	Infrastructure efficiency in sustainable cities focuses on using resources effectively, ensuring that urban services operate with maximum efficiency and minimum waste.	Network latency refers to network response time, being crucial to ensure that data flows quickly and without unexpected delays, directly affecting the user experience.
Environmental Sustainability vs. Network Scalability:	Environmental sustainability involves developing and maintaining infrastructures that minimise ecological impact, promote efficient use of resources and support long-term resilience.	Scalability in networks allows the technological infrastructure to expand and adapt to increasing demands without degrading the quality of service, ensuring the ability to support a higher volume of data traffic.

Community Integration vs. Traffic Management:	Promotes the creation of inclusive and safe spaces, facilitating the effective integration of diverse communities within the city and promoting social cohesion.	Traffic management in networks refers to the ability to manage and prioritise the flow of data to avoid congestion, ensuring that all services receive the necessary resources to function efficiently.
Quality of Life vs. Quality of Connection:	Quality of life in sustainable cities focuses on improving housing conditions, safety, health and education for all citizens.	Quality of connection in networks involves ensuring that all users experience a stable, fast and secure connection, which is essential to meet modern communication needs.

2.8. Quality of Responsible Production and Consumption Service

Quality of Responsible Production and Consumption Service (QoRPCS) focuses on the quality and effectiveness of practices and policies that promote responsible production and consumption. The Quality of Responsible Production and Consumption Service seeks to integrate these components to create an economic system that is not only efficient and competitive, but also capable of sustaining and improving the quality of life in the long term without compromising the health of the planet and future generations. This concept is aligned with UN Sustainable Development Goal 12 and 13, which aims to ensure sustainable consumption and production patterns. Integrate QoS into production and consumption processes to ensure efficiency, minimise waste and promote sustainable practices at all levels of the supply chain. Apply QoS to optimise response and adaptation to climate change, improving the efficiency of climate mitigation and adaptation initiatives. Quality in responsible consumption and production involves several key components:

- Resource Efficiency: Improve resource efficiency in all production processes to minimise environmental impact and ensure that natural resources are used sustainably.
- Waste Minimisation: Implement practices that reduce waste generation throughout the entire life cycle of products, including design, manufacturing, distribution and consumption. This also involves encouraging recycling and reuse of products and materials.
- Sustainable Production: Adopting production methods that are not only resource efficient, but also respectful of the environment, biodiversity and ecosystems. This includes reducing greenhouse gas emissions and pollutants.
- Conscious Consumption and Education: Promote informed and conscious choices among consumers about the products they buy, encouraging a preference for more sustainable and ethical products.
- Sustainability Innovation: Encourage innovation in technologies and processes that enable more sustainable production and consumption, including the development of eco-efficient products and services that reduce environmental impact.
- Sustainable Supply Chains: Ensure that supply chains are transparent, ethical and sustainable at all stages, from the sourcing of raw materials to the delivery of final products to the consumer.
- Multi-sector Collaboration and Engagement: Engage multiple actors, including businesses, consumers, governments and non-governmental organisations, in promoting responsible production and consumption practices.
- Policy and Regulation: Develop and implement policies and regulations that support responsible production and consumption, including incentives for businesses that adopt sustainable practices.

The analogy between Quality of Responsible Production and Consumption Service (QoRPCS) and Quality of Service (QoS) in networks provides a clear vision of how efficient and sustainable resource management can be crucial in various fields. In Table 8, we describe how the main components of each might be compared:

Table 8. QoRPCS vs QoS.

	QoRPCS	QoS
Resource Efficiency vs. Broadband Efficiency:	In the context of responsible production and consumption, resource efficiency refers to the optimal utilisation of raw materials and energy, minimising waste and maximising productivity.	Bandwidth efficiency in networks ensures that available capacity is used optimally, minimising data loss and maximising throughput.
Process Sustainability vs. Network Scalability:	Promotes practices that are not only efficient in the short term, but also sustainable in the long term, positively affecting the environment and society.	Network scalability refers to the ability of the network infrastructure to expand and adapt to changing needs without compromising quality of service.
Resource Efficiency vs. Broadband Efficiency:	In the context of responsible production and consumption, resource efficiency refers to the optimal utilisation of raw materials and energy, minimising waste and maximising productivity.	Bandwidth efficiency in networks ensures that available capacity is used optimally, minimising data loss and maximising throughput.
Process Sustainability vs. Network Scalability:	Promotes practices that are not only efficient in the short term, but also sustainable in the long term, positively affecting the environment and society.	Network scalability refers to the ability of the network infrastructure to expand and adapt to changing needs without compromising quality of service.
Waste Reduction vs. Packet Loss Minimisation:	Focuses efforts on reducing waste generation at all levels of production and consumption, recycling and reusing where possible.	In networks, minimising packet loss is crucial to ensure that data arrives complete and error-free, improving the efficiency and reliability of communication.
Transparency and Ethics vs. Traffic Prioritisation:	Transparency in production practices and the adoption of ethical standards ensure that products are generated in a fair and open manner.	Traffic prioritisation in networks allows network resources to be managed and distributed so that the most critical services receive the attention they need.
Conscious Consumption vs. Congestion Management:	Encourages informed decision-making by consumers about the products they buy, promoting the consumption of responsibly produced goods.	Congestion management in networks tries to regulate the flow of data to avoid overloads, ensuring that all users get adequate service even under intense network conditions.

3 Conclusions

The integration of Quality of Service (QoS) principles into the implementation of the UN Sustainable Development Goals (SDGs) has proven to be a promising strategy for improving service delivery in multiple sectors critical for sustainable development. This approach not only improves the efficiency and effectiveness of the services provided, but also ensures that they are equitable and accessible to all populations, thereby addressing existing disparities and fostering broader inclusion.

QoS principles applied in sectors such as health, education, and natural resource management can significantly reduce waste and optimise resource use, resulting in more sustainable and cost-effective management. The adoption of quality standards and continuous evaluation allows services to be tailored to the real needs of communities, improving satisfaction and bottom-line results in key areas of human and economic development.

By focusing on service quality and accessibility, QoS principles help ensure that all individuals, regardless of their economic or geographic situation, have access to essential services, helping to reduce inequality. QoS promotes practices that are not only efficient in the short term, but also sustainable in the long term, supporting efforts to mitigate adverse environmental impacts and encourage more planet-friendly development.

The flexibility inherent in QoS principles facilitates rapid adaptation to changing conditions or emergencies, such as health crises or natural disasters, enhancing the resilience of communities and systems. Effective implementation of QoS in the context of the SDGs requires continued engagement and collaboration between governments, businesses, non-governmental

organisations and local communities. It is essential that these actors work together to adapt QoS principles to the specificities of each sector and region, thus ensuring that the benefits of this integration are widely distributed and sustained over time.

In conclusion, applying QoS principles to sustainable development efforts offers a clear path towards a fairer, more efficient and sustainable future, where services not only meet technical requirements, but also respond to the human and environmental needs of the global society.

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