



## RESEARCH PAPER

# Implementation of software-defined networking (SDN) in next-generation routers for scalable network architecture

**Vivek Kumar, Vishal kholi**

*Department of Computer Science and Engineering Neelkanth Institute of Technology, Meerut, India*

### Article Information

Received: 05 January 2026  
 Revised: 13 February 2026  
 Accepted: 26 February 2026  
 Available online: 28 February 2026

### Keywords:

Software-Defined Networking  
 Next-Generation Routers  
 Network Scalability  
 OpenFlow, Control Plane  
 Data Plane, Network Virtualization

### Abstract

Internet traffic, cloud computing, and Internet of Things (IoT) applications are rapidly growing and require highly scalable and flexible network architectures. The classic networking solutions that are based on tightly coupled data and control planes cannot fulfil these needs. The Software-Defined Networking (SDN) paradigm represents a paradigm shift, whereby the control plane and data plane are decoupled, and the control plane is centralised for management and programming. In this paper, the application of SDN to the next-generation routers is discussed to realize scalable, efficient, and adaptive network architecture. It analyzes SDN architecture, its integration with routing systems as well as its effect on performance, flexibility as well as resource utilization. The paper also addresses the major advantages, issues and future research opportunities in SDN-based networking.

©2026 ijrei.com. All rights reserved

## 1. Introduction

The current communication networks have been greatly changed by the unprecedented development of digital technologies. The growth of cloud computing platforms, multimedia services, big data analytics, and the Internet of Things (IoT) has contributed to an exponential growth in the complexity and traffic of networks. With billions of devices getting interconnected networks are projected to provide high performance, low latency, reliability and scalability. But the traditional networking architectures can less and less support these changing demands because of their natural rigidity and non-programmability. Traditional routers and switches are designed based on vertically-integrated designs in which the control plane (responsible to decision-making) and the data plane (responsible to packet forwarding) are tightly coupled within the same device. This design lacks flexibility, network policies and configurations need to be implemented manually, on individual machines. It further complicates network management, making it prone to errors and consuming significant time, particularly in large-scale settings, like data

centers and enterprise networks. Moreover, vendor-specific hardware and software result in vendor lock-in and constriction of innovation and interoperability.

The other important constraint of traditional networking is that, it does not dynamically adjust to changing network conditions. Modern network traffic is extremely volatile because of the use of video streaming, online games, and real-time communication. The lack of efficient response to congestion by such configurations of statically routing and distributed control mechanisms leads to poor utilization of resources and resulted in poor Quality of Service (QoS). Also, the growing imperative of virtualization and multi-tenant environments requires flexible network provisioning, which is not easy to accomplish with the help of traditional means.

Software-Defined Networking (SDN) has become a radical paradigm to reshape the network design, implementation and management. SDN separates control plane and data plane, allowing a centralized control and world view of the network. The logic of control in this architecture is implemented in a logically centralized SDN controller, and the underlying network devices are simply forwarding elements. This

*Corresponding author: Vivek Kumar*

*Email Address: vivek.785kumar@gmail.com*

<https://doi.org/10.36037/IJREI.2026.10104>

isolation enables the network administrators to dynamically program and administer the network using software applications and greatly enhance flexibility and efficiency.

One of the enablers of SDN is the use of standard communication protocols, including OpenFlow, that enable interaction between the data plane and the control plane. With these protocols, the SDN controller is able to add flow rules in forwarding devices, calculate optimum routing paths, and impose network policies in real time. This centralized model helps simplify the administration of the network, decreasing the cost of operation and increasing the capability of applying advanced functionalities like traffic engineering, load balancing and network automation. Implementation of SDN into next generation routers is a big step towards the realization of scalable and adaptive network architectures. In contrast to routers based on traditional routers, SDN-capable routers are programmable forwarding devices that can be externally controlled by the SDN controller. This change facilitates dynamic routing decisions, which are based on the current network conditions, and result in improved performance and efficient utilization of resources. In addition, routers based on SDN support the network virtualization allowing multiple logical networks to exist on a shared physical infrastructure, which is especially useful in cloud computing and service providers. Besides scalability and flexibility, SDN increases the innovation of the network by allowing the deployment of new services and applications in a short period of time. It enables developers to design and add network functionality without altering underlying hardware, speeding up the rate of technological progress. Moreover, SDN can enhance the overall security management as it will provide a centralized control over access policies, threat detection, and mitigation policies. Although it has several benefits, the implementation of SDN in next-generation routers also present some challenges. The problems of the scalability of the controllers, the security vulnerabilities, the latency in the control communication and the compatibility with the legacy systems should be discussed in a careful way that would result in the reliable and efficient functioning of the network. To overcome these limitations, current research is directed at creating distributed controller architectures, advancing the security mechanisms, and optimizing the performance.

In short, Software-Defined Networking is a paradigm shift of network architecture, a scalable, flexible, and programmable solution to the limitations of traditional networking. SDN implementation in the next generation router offers a platform on which network intelligent and adaptable networks can be designed to meet the requirements of the modern applications. This paper will discuss the architectural design, implementation strategies, advantages, challenges, and future directions of SDN-enabled routing systems and how they could transform the network infrastructure.

## 2. Background and Related Work

The growing need to have scalability, flexibility, and efficient management have greatly influenced the evolution of computer networks. Conventional networking architecture, though trustworthy in previous implementation, is now

experiencing constraints owing to the accelerating data transmission, cloud computing and Internet of Things (IoT) applications. In traditional networks, the data plane and control plane are closely coupled within networking equipment, like routers and switches. Such close integration limits flexibility, since any change in network policy or configuration must be done by hand on a device level. This means that managing networks can be complicated, laborious, and liable to human error, especially in a large-scale environment. Moreover, the conventional networks are usually based on proprietary hardware and vendor-specific solutions, which results in vendor lock-in and constrained interoperability and innovation. The lack of a centralized control mechanism also makes network administrators have no global view of the network, which leads to poor utilization of network resources and suboptimal routing decisions.

Software-Defined Networking (SDN) has become a radical solution, radically changing how networks are designed and operated. SDN isolates the control plane of the network and the data plane, allowing centralized control and programmability of the network. This change in architecture enables the network intelligence to be logically centralized in a software-based controller, with the underlying network devices being simple forwarding elements. The centralized controller gives a global perspective of the network and enables more efficient decision-making, dynamic traffic control and simplified network setups. This programmability enables administrators to configure network behavior using software applications instead of manual configurations, greatly enhancing flexibility and making it difficult to describe network behavior.

The SDN framework is generally structured into three different layers: application layer, control layer and data (infrastructure) layer. The application layer would comprise different network applications and services like traffic engineering, security management, and load balancing which will convey their needs to the control layer via northbound interfaces. The SDN controller is the SDN controller located in the control layer that translates the application requirements into specific instructions to be followed by the data layer. The data layer contains forwarding equipment like routers and switches which implement the forwarding of packets based on a set of rules that are defined by the controller. This layered architecture increases modularity, scalability, and management ease, making it very appropriate to the current network environment.

Standardized protocols are used to facilitate communication between the control plane and the data plane in SDN, with OpenFlow being the most widely deployed protocol. OpenFlow allows the controller to communicate with forwarding devices directly through the installation, modification and removal of flow rule within their flow tables. These flow rules define the processing of incoming packets, which can be fine-grained control over network traffic. Besides OpenFlow, other communication mechanisms which help support programmability and efficient network management include NETCONF, RESTful APIs and gRPC.

Substantial research work has been carried out to investigate the possibilities and applications of SDN in most networking situations. Pioneering work on SDN architecture by Kreutz et

al. provided an in-depth overview of the SDN architecture, and its advantages in centralized control, programmable, and enhanced network performance. Later research has shown that SDN is effective in efficiency of traffic flow, latency, and resource utilization within data centers and enterprise networks. There has also been research into integrating SDN with the newest technologies, including Network Function Virtualization (NFV) and edge computing, which makes it possible to deploy virtualized network services and further enhance scalability and flexibility. Although these developments have taken place, a number of challenges still exist such as the problem of scalability of the controllers, fault tolerance, and security vulnerabilities. In dealing with these issues researchers have suggested solutions in the form of distributed controller architecture, redundancy and advanced security frameworks.

To conclude, Software-Defined Networking is a radical change in paradigms of traditional networking by providing centralized control, greater programmability, and more flexibility. The hierarchical SDN architecture and the utilization of standardized communications protocols allow effective network control and dynamism to changing needs. The current studies indicate the potential transformative power of SDN in contemporary networks, with the current research still underway to deal with the challenges of implementing SDN.

### **3. SDN Architecture of Next Generation Routers**

Next-generation router architecture has seen a major change with the introduction of Software-Defined Networking (SDN), which overcomes the drawbacks of the traditional networking system and allows creating scalable, flexible, and programmable infrastructures. In traditional router design, control plane and the data plane are closely interconnected in the same device. The control plane is involved in routing decision, path calculation, and policy execution whereas the data plane is concerned with forwarding packets in accordance to the established rules. The outcome of this integration is that the network is a rigid structure that is hard to manage and requires manual updates. With a growing network size and complexity, these architectures do not scale effectively, resulting in bottlenecks in the network performance and inefficient use of available resources.

The conventional routers are very dependent on the distributed control mechanisms where the individual devices decide independently on the routing path to follow using protocols like OSPF or BGP. Although, such an approach guarantees the decentralization, it does not provide a global network view, which often results in suboptimal routing decisions and slow adaptation to changing traffic conditions. Moreover, reliance on proprietary hardware, vendor-specific implementations, limits interoperability and makes operations more expensive. The challenges outlined here underline the necessity to develop a more scalable and flexible approach to network design.

The router architecture based on SDN is a paradigm shift because it decouples the control plane and the data plane. The control logic will be centralized in a central SDN controller that will play the role of the brain of the network. The routers,

in their turn, are rather simple forwarding devices that perform the instructions given by the controller. This isolation permits active and programmable network management and as such, the administrators are permitted to define policies and routing behaviors via software instead of the manual configuration.

In SDN enabled routers, routing decisions are centrally made based on a global perspective of the network. This allows optimization of path selection, efficient traffic engineering and fast reaction to network changes like congestion or a broken link. Dynamically programmable and real-time updateable policies can enable a network to scale to different workloads and application demands. Consequently, routers based on SDN provide vastly better scalability and flexibility than do traditional architectures.

The next generation router SDN architecture comprises of a number of key components. The SDN controller is positioned at the center since it has a full picture of the topology of the network and manages the communication between the applications and the forwarding devices. It converts higher-level application requirements into lower-level flow rules that regulate the forwarding of packets. Southbound Application Programming Interfaces (APIs), including OpenFlow, are used to communicate between the controller and the routers and allow installing and managing flow rules in the data plane. Such interfaces enable the controller to observe the network status, gather statistics and impose policies effectively. Conversely, northbound APIs offer interface through which developers can implement services, including traffic engineering, security management, and load balancing.

This decoupled and layered architecture contributes greatly to the flexibility of the network as it allows the centralization of control and programmability. It also enhances scalability, in that the network can expand without necessarily making any substantial alterations to the underlying hardware. Another benefit of the abstraction of control logic is that it makes the network easier to manage, and it encourages innovation by making it easier to roll out new services and features. In summary, SDN architecture implementation in next-generation routers constitutes a significant breakthrough in the field of networking as it provides a firm basis of SDN architecture operation in next-generation routers.

### **4. SDN installations in Next Generation Routers.**

The adoption of Software-Defined Networking (SDN) into next-generation routers can be seen as a paradigm shift towards software-centric network design as opposed to hardware-centric network design. This revolution aims to make routing devices simpler, to centralize intelligence and to support dynamic and programmable network operations. Using the principles of SDN, contemporary routers are able to efficiently handle increased traffic requirements, support a variety of applications and provide scalable network architectures.

Hardware abstraction is one of the most important factors when implementing SDN, as the traditional routers are simplified to mere forwarding machines. Traditional routers are complicated machines with built in control and data plane functionalities, and need specialized and frequently proprietary hardware. These complexities are abstracted by SDN by

separating the control logic and the forwarding functionality of routers, enabling routers to act as generic forwarding elements of packet-switching. This abstraction minimizes hardware dependence, reduces costs, and allows vendor neutrality, enabling organizations to deploy heterogeneous devices without compatibility problems. This makes network upgrades and expansions more flexible and cost-effective.

The other important element is controller-based routing that concentrates routing intelligence on an SDN controller. In contrast to the traditional distributed routing protocols, where each router independently decides the best route, SDN involves the use of a centralized controller to compute optimal routes based on a global view of the network. This allows dynamic path calculation, where routing decisions can be dynamically calculated based on changing network conditions like congestion or link failures. Also, the controller helps to perform efficient load balancing by allocating traffic over a variety of paths, avoiding bottlenecks and enhancing overall network performance. Traffic engineering features are also strengthened such that administrators are able to give priority to critical applications, control the allocation of bandwidth as well as optimize the utilization of network resources.

Another notable feature that SDN facilitates in the next-generation routers is network virtualization. The use of virtualization can be used to create and run many logical networks on a single physical infrastructure. Virtual networks may have their own topology, policies and performance characteristics, independent of others. This feature is especially useful in cloud computing environments, as well as in multi-tenant data centers, where different users or organizations are required to have isolated network environments. SDN makes these virtual networks easy to create and manage, allowing rapid provisioning and efficient utilization of the physical resources.

Perhaps the most revolutionary aspect of SDN is its programmability. SDN enables network administrators to create and control network behavior programs written in software. The SDN controller can translate the policies to flow rules by automatically analyzing and translating high-level programming interfaces. This avoids manual settings of individual devices, minimizes errors and complicates operations. Automation also leads to efficiency as tasks like network configuration, monitoring and fault management can be accomplished without the involvement of a human being. Besides, programmability enables quick implementation of new services and features, facilitating innovation and flexibility in contemporary networks.

Besides these key features, SDN implementation in next-generation routers enhances the visibility and control of the entire network. Centralized management platforms can allow administrators to monitor traffic patterns, identify anomalies, and respond to issues in real time. Such a degree of control improves security, performance and reliability. In addition, SDN is compatible with new technologies including cloud orchestration systems and frameworks edge computing, which can ensure the seamless and intelligent operation of the networks.

Finally, with SDN in the next-generation routers via hardware abstraction, controller-based routing, network virtualization,

and programmability, we can see a lot of improvement in network scalability, flexibility, and efficiency. These features allow contemporary networks to scale to the increasing demands of digital applications and reduce complexity and operational costs, making SDN a very important key component in the future network infrastructure.

#### 5. Benefits of SDN-Based Routers.

The use of Software-Defined Networking (SDN) in next-generation routers have many benefits that answer the challenges of traditional networking systems and the many requirements of modern applications. Scalability is one of the most important advantages because centralized control enables the network to grow efficiently without having to add equivalent increases in configuration complexity. The SDN controller has the capability to operate large-scale infrastructures, to dynamically allocate resources and to optimise traffic flows to meet rising demand with a global perspective of the network. This renders SDN specifically applicable to data centers, cloud providers, and the enterprise scale network.

Flexibility and programmability is another great benefit, enabling networks to be dynamically configured and reconfigured using software. In contrast to traditional routers, which require manual configuration and hardware-specific modifications, SDN-based routers allow administrators to set policies and behaviors in a programmable manner. Such flexibility enables networks to react fast to evolving circumstances, roll out new services, and back various applications without the need to physically alter infrastructure. This leads to faster innovation, and makes network operations more efficient.

Another major enhancement of SDN is that the network is now under central control and monitoring. Administrators are able to control the whole network with a single interface making it less complicated to setup and maintain many devices. Centralized controller offers real time access to performance of the network and this allows faster troubleshooting, enhanced decision making, and enforcement of policies. Such simplification minimizes the chances of configuration errors and improves the overall network reliability.

Cost efficiency SDN minimizes capital expenditure and operational expenditure. By hardware-abstracting hardware, organizations can replace costly proprietary hardware with commodity networking devices, thus reducing infrastructure costs. Also, automation and centralized control minimizes the possibility of manual intervention and reduces the overheads of operation and better utilization of resources. The above cost advantages make SDN an appealing solution to companies interested in maximizing their network investments.

The other significant benefit is increased security, through SDN, policy implementation can be centralized and the network can be more readily observed. Security policies may be specified and applied uniformly to all devices, minimizing vulnerabilities due to misconfigurations. The centralized controller is also in a position to monitor traffic patterns, detect anomalies and respond to potential threat in real-time. Moreover, SDN also allows more sophisticated security features including network segmentation and isolation, which can be used to protect sensitive data and applications.

## 5. Challenges in Implementation

Although SDN has many benefits, the application of SDN in the next generation routers has a number of challenges that need to be resolved to ensure that the next generation routers operate reliably and efficiently. Scalability of the controller is among the key issues since the centralized SDN controller can be a bottleneck in large-scale networks. The higher the number of devices and data volume, the more real-time decisions need to be made and this can be hard on the computational resources of the controller. To address this problem, distributed and hierarchical controller architectures that balance the load and enhance scalability have been proposed by researchers.

One of the factors that are also a big challenge in SDN environments is security risks. The centralized aspect of the controller poses a possible single point of failure and becomes a prospective cyberattack target. In case of vulnerability, the controller may interfere with the whole network. Moreover, the communications between the controller and the forwarding devices can be susceptible to attacks including spoofing or interception. To mitigate these risks, there has to be strong security measures in place such as encryption, authentication and intrusion detection systems.

The second challenge is interoperability with legacy systems because many existing networks are based on traditional routing protocols and hardware. Implementing SDN within these environments can be challenging and it may necessitate hybrid architecture that integrates SDN and traditional networking methods. To have a smooth communication and compatibility of these systems is critical to ensure a gradual and cost-effective adoption.

Last but not least latency issues come in as a result of communication between the data and the control plane. In SDN, forwarding devices can be driven by the controller to make decisions, which can introduce delays, especially in large or geographically distributed networks. This may affect time sensitive applications which demand low latency. To solve this problem, local caching of flow rules, edge-based processing, etc. can be used to make decisions not highly dependent on the controller.

## 6. SDN Cases of Next Generation Network.

By availing centralized control, programmability and dynamic resource management, Software-Defined Networking (SDN) has been pivotal in allowing a broad spectrum of practical uses to be undertaken in modern network settings. Among the most noticeable use cases is in data centers, where SDN enables the dynamically allocation of resources and efficient routing of traffic. The traffic patterns in large-scale data centers are highly fluctuated because of the virtualization and cloud-based workloads. In real time, SDN controllers can observe these patterns and update routing paths based on them, ensuring optimal utilization of bandwidth and reduced congestion. This leads to a higher level of performance, lesser latency, and enhanced Quality of Service (QoS) of applications.

SDN is also instrumental in facilitating the deployment of the new capabilities of the network slicing and ultra-low latency communication in 5G networks. Network slicing enables more

than one virtual network to be run on a common physical infrastructure, each being specialized to a particular use case such as autonomous vehicles, smart cities, or enhanced mobile broadband. SDN offers the flexibility and central control needed to dynamically create and control these slices. Furthermore, SDN helps to ensure the low latency demands needed to support real-time applications in 5G networks.

The other significant use of SDN is in cloud computing where it facilitates provisioning of elastic resources. Cloud environments demand quick scaling of resources depending on user demand and SDN supports this by dynamically allocating network bandwidth and computing resources. The centralized controller is able to dynamically adjust network settings as workloads vary, to ensure efficient use of infrastructure and smooth delivery of services. This is especially useful when dealing with large clouds services providers that must cope with huge, and distributed data centers.

SDN can be used in Internet of Things (IoT) networks to create scalable and efficient management of devices. The IoT environments are comprised of a huge volume of interconnected gadgets producing a constant flow of data. Their scale and heterogeneity make it difficult to manage such networks with the traditional methods. SDN eases the IoT network management by offering centralized control, making it possible to auto-configure, and facilitating effective data routing. It also increases security because it enables administrators to introduce similar policies in all devices and quickly react to possible threats.

## 7. Future Directions

The future of SDN in next-generation routers and networks is firmly connected with the emerging technologies that are supposed to further advance network intelligence, efficiency and automation. Integration of Artificial Intelligence (AI) and Machine Learning (ML) with SDN takes one of the most promising directions. Using AI/ML algorithms, SDN controllers are able to process large amounts of network data, determine traffic patterns, and make proactive routing decisions. This results in high performance, the elimination of congestion, and the efficient use of resources. Anomalies and security threats may also be detected by intelligent SDN systems to respond to them faster and more accurately.

Edge computing is another major field of development where computational resource are located nearer to end users to decrease latency and enhance service delivery. SDN is crucial to edge network operations, dynamically assigning resources and optimizing the flow of data between edge devices and central data centers. This is especially crucial to applications that are latency sensitive like autonomous systems, augmented reality, and real-time analytics.

A promising trend is also the integration of SDN with Network Function Virtualization (NFV). NFV allows the virtualization of network functionality, including firewalls, load balancers, and intrusion detection systems, which traditionally run on dedicated hardware. These virtualized functions with SDN can be dynamically deployed and managed with centralized control, increasing flexibility and reducing costs. This SDN

and NFV synergy provide very flexible and efficient network infrastructures.

Also, intent-based networking (IBN) is an enhanced development of SDN, wherein the network administrator defines high-level objectives or goals, or commonly known as intents, and the system automatically configures the network to achieve it. This method minimizes manual configuration requirements and enables networks to self-optimize, according to pre-configured objectives. Intent-based systems leverage SDN's programmability to translate business requirements into network policies, further simplifying network management and improving operational efficiency.

## 8. Conclusion

The introduction of Software-Defined Networking in the next generation router is a major step toward the creation of scalable, flexible and efficient network architectures. SDN allows centralized control, increased programmability, and dynamic response to network changes by decoupling the control plane and data plane. These features enable contemporary networks to effectively manage the swelling traffic requirements, sustain a variety of applications, and maximize the use of resources.

Routers based on SDN offer many benefits, such as better scalability, easier network management, lower costs and increased security. Simultaneously, issues with the scalability of the controllers, security vulnerabilities, incompatibility with the existing systems, and the problem of latency will have to be carefully tackled in order to achieve successful deployment. Research and technological advancements are currently in the process of trying to eliminate these drawbacks.

With the ever-evolving nature of emerging technologies, including 5G, IoT, cloud computing, edge computing, and others, SDN is likely to take centre stage in defining the future of networking. Its combination with the latest technologies such as AI/ML, NFV, and intent-based networking, will also expand its capabilities, making networks smarter, faster, and more adaptive. As such, SDN is a major facilitator of next

generation network infrastructures and is the catalyst of innovation and enables the ever-increasing demands of the digital world.

## References

- [1] M. Hussain, J. J. P. C. Rodrigues, and S. A. Kozlov, "Software-defined networking: Categories, analysis, and future directions," *Sensors*, vol. 22, no. 15, p. 5551, 2022.
- [2] D. Kreutz, F. M. V. Ramos, P. Verissimo, C. E. Rothenberg, S. Azodolmolky, and S. Uhlig, "Software-defined networking: A comprehensive survey," *Proceedings of the IEEE*, vol. 103, no. 1, pp. 14–76, 2015.
- [3] W. Braun and M. Menth, "Software-defined networking using OpenFlow: Protocols, applications and architectural design choices," *Future Internet*, vol. 6, no. 2, pp. 302–336, 2014.
- [4] R. Sharma and S. K. Mishra, "Software-defined networking concepts and applications: A survey," *Turkish Journal of Computer and Mathematics Education*, vol. 11, no. 1, pp. 1–10, 2020.
- [5] N. McKeown et al., "OpenFlow: Enabling innovation in campus networks," *ACM SIGCOMM Computer Communication Review*, vol. 38, no. 2, pp. 69–74, 2008.
- [6] A. Lara, A. Kolasani, and B. Ramamurthy, "Network innovation using OpenFlow: A survey," *IEEE Communications Surveys & Tutorials*, vol. 16, no. 1, pp. 493–512, 2014.
- [7] S. Sezer et al., "Are we ready for SDN? Implementation challenges for software-defined networks," *IEEE Communications Magazine*, vol. 51, no. 7, pp. 36–43, 2013.
- [8] M. Jammal, T. Singh, A. Shami, R. Asal, and Y. Li, "Software defined networking: State of the art and research challenges," *Computer Networks*, vol. 72, pp. 74–98, 2014.
- [9] H. Kim and N. Feamster, "Improving network management with software defined networking," *IEEE Communications Magazine*, vol. 51, no. 2, pp. 114–119, 2013.
- [10] Open Networking Foundation, "Software-defined networking: The new norm for networks," ONF White Paper, 2012.
- [11] M. Casado et al., "Ethane: Taking control of the enterprise," *ACM SIGCOMM*, pp. 1–12, 2007.
- [12] X. N. Nguyen, D. Saucez, C. Barakat, and T. Turlitti, "OFFICER: A general optimization framework for OpenFlow rule allocation and endpoint policy enforcement," *IEEE INFOCOM*, 2015.
- [13] P. Berde et al., "ONOS: Towards an open, distributed SDN OS," *ACM HotSDN*, pp. 1–6, 2014.
- [14] T. Nadeau and K. Gray, *SDN: Software Defined Networks*, O'Reilly Media, 2013.
- [15] A. Gupta and N. K. Jha, "A survey of 5G network: Architecture and emerging technologies," *IEEE Access*, vol. 3, pp. 1206–1232, 2015.

**Cite this article as:** Vivek Kumar, Vishal kholi, Implementation of software-defined networking (SDN) in next-generation routers for scalable network architecture, International Journal of Research in Engineering and Innovation, 10(1), (2026), 31-36.  
<https://doi.org/10.36037/IJREI.2026.10104>