

# Closing the Digital Divide Through Open Ecosystems

To achieve an end-to-end 5G experience in rural markets, providers should consider an open ecosystem model that fosters collaboration between the best network equipment vendors, data center operators, service providers and other stakeholders.

By Gus Vasilakis / *Kaloom*

**T**he demand on network infrastructure rises exponentially as people increasingly spend their personal and professional lives online. Scalable infrastructure that can handle high-capacity packet processing is a necessity to participate in global society, especially for those living in rural areas at the edge of the network. Unfortunately, there is a prevalent digital divide in rural communities that do not have access to high-speed connectivity and emerging services.

According to research by BroadbandNow, 42 million Americans still do not have high-speed broadband. Because additional high-speed broadband is needed to enable the emerging technologies of 5G, these regions lack a foundational component for access to next-gen applications and the opportunities they offer in entertainment, telehealth, industrial manufacturing and education.

## CHALLENGES AT THE EDGE

Lack of technological access is unsustainable if rural regions hope to participate in the global economy. Yet rural providers need help closing the digital divide. Still, there have been industry rumblings of 6G despite these ongoing difficulties. But 6G will not be revolutionary, regardless of what marketing campaigns claim. 6G will only remediate 5G. It's still essential to address many difficulties with 5G deployment.

Rural providers struggle with investments and the balancing act of FTTx builds, DOCSIS 4.0 promise, and 5G edge deployment because of difficulties with scalability; infrastructure cost time; and space, cooling and power constraints. 5G is pushing high-speed data access closer to the edge of the network for closer proximity to end users to enable the low latency and higher throughput needed for emerging applications.

Before thinking bigger, it's important to ensure 5G has been taken to its full potential and that ultra-low latency 5G has been secured in rural areas that can benefit from this mobile access the most. This requires a disruption of old industry standards among rural providers. They cannot keep running networks the same way and expect to scale appropriately. By transforming their edge infrastructure and mindset, rural providers can close the digital divide and foster economic vitality through job growth and faster delivery of emerging services.

## DISRUPTING OLD MINDSETS

Rural providers must deploy more high-speed broadband with mounting demand for 5G and its novel technologies. To secure the high-speed broadband needed for emerging applications in rural markets, providers and governments are pouring money into the problem and building out fiber through initiatives such as the Rural



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Digital Opportunity Fund. In 2021, the U.S. government spent more than \$370 billion on broadband expansion.

But money is not enough to realize an end-to-end 5G experience in rural markets. The optimization of that fiber requires the transformation of the underlying edge infrastructure to provide universal scalability. By transforming their edge infrastructure to enhance throughput and scalability, rural providers can secure new monetization models through the faster, more efficient delivery of data-consumptive applications such as next-gen gaming, industrial IoT, AR/VR and more.

But how can rural providers make this infrastructure transformation? First, it requires a shift from the old mindset of single-vendor lock-in for data center management. Rural providers realize that no single vendor can contend with the dynamic packet flows of 5G and the throughput requirements of emerging applications.

To achieve an end-to-end 5G experience in rural markets, providers should consider an open ecosystem model that fosters collaboration among

the best network equipment vendors, data center operators, service providers and more – all enabled by data center technology vendors interoperating efficiently. The International Data Corporation (IDC) affirms the need for this transformation, stating, “Recent IDC research on the future of industry ecosystems explores this digital divide. We expect that organizations that focus on industry ecosystems will begin to derive a large percentage of their revenue from these new business models.”

An open ecosystem approach allows for the additional benefit of a community of tech professionals that share knowledge and best practices for open-source implementation. To ensure all these moving pieces work together in an economically viable manner, rural providers should transform their underlying edge infrastructure with an emphasis on enhancing scalability, programmability and interoperability.

### **THE FUTURE OF EDGE COMPUTING**

Legacy edge infrastructure is rigid in its functionality, comprised of years of accumulated equipment too

inefficient and costly to handle the demands of 5G. Any given region may have different networking needs, applications and customer preferences. Providers must scale accordingly, and legacy architectures are unable to satisfy the need for universal scalability, programmability and interoperability at the edge of the network. Rural regions need edge data center architecture that supports this universal scalability to enter the next industrial revolution. The pandemic exposed the digital divide: Those without reliable high-speed broadband could not access remote learning, telehealth or telework.

Open ecosystems are a prerequisite to delivering an end-to-end 5G experience and closing the digital divide. What technologies should rural providers consider when making this transformation? Furthermore, how do these technologies fix the cost issues of distributed 5G edge deployment? Rural providers can prepare for the unprecedented by leveraging solutions that enable virtualized network slicing, disaggregation and containerization. These capabilities enhance scalability and interoperability and improve programmability at the data plane.

The P4 programming language helps operators simplify their edge network management, optimize network functions and more easily converge and manage cloud and edge data centers through virtualization. This enables rural providers to quickly deliver and monetize business-critical applications.

## MAKING 5G DEPLOYMENTS MAKE SENSE

Network engineers know what they need for distributed 5G edge deployment, yet rural providers tend to think in dollars and cents. 5G deployment has not been financially viable when considering the total cost of ownership for distributed 5G edge infrastructure versus the ROI of deploying through legacy architecture. To ensure their 5G investments make financial sense, rural providers can implement key capabilities via an open ecosystem approach that unlocks the economics of the distributed 5G edge through novel monetization opportunities.

Terms such as “network slicing” and “containerization” have been gaining popularity in the edge data center management world for good reason. These open-source capabilities help providers satisfy the throughput requirements of 5G applications and address edge infrastructure constraints. Even government bodies realize the importance of open-source technology and interoperability to improve proprietary equipment. A 2021 report, “Potential Threat Vectors to 5G Infrastructure,” claims, “The lack of interoperability with these untrusted proprietary technologies limits the ability of trusted companies to compete in the 5G market.”

By implementing an open ecosystem mindset, rural providers can secure technologies that realize the original promises of software-defined networking and improve on the shortcomings of virtual machines that suffer from duplication, inadequate

packet processing and inefficient resource usage.

P4 enables this next generation of robust edge infrastructure. P4 is an industry-standard programming language created with the specific objective of bolstering programmability at the data plane. This enhanced programmability helps operators simplify their edge network management, optimize their network functions and more easily converge and manage cloud and edge data centers through virtualization. As a result, P4-programmable edge infrastructure enables rural providers to quickly deliver and monetize business-critical applications that serve a foundational purpose in the digital-first society.

## HELPING RURAL COMMUNITIES GET A PIECE OF THE PIE

Containerization and network slicing are the primary capabilities rural providers should consider if they want to close the digital divide and speed up the time-to-market of emerging applications. Network slicing helps rural providers access the benefits of multitenancy and private 5G monetization by partitioning physical data centers into independent virtual edge data centers. This open-source implementation enables an end-to-end 5G experience and minimizes network complexity and subsequent labor costs by simplifying network management across hundreds of distributed 5G edge locations.

Containerization enhances interoperability and programmability by allowing the same code to run on switches and servers through SmartNICs. This minimizes labor

expenditures for network engineers because they can write one piece of code and run it anywhere in their network stack. Through containerization, network functions are optimized and do not share resources with servers.

Improved resource-use efficiency and enhanced flexibility are possible through the disaggregation of software from hardware via an open ecosystem model. Granular resource optimization allows more resources to go toward monetization instead of sitting idle or being wasted. These capabilities reflect the industry trend toward digitalization and virtualization to improve efficiency and minimize opex and capex costs through automation.

## MONETIZATION THROUGH OPEN ECOSYSTEMS

A rising number of edge software solutions promise network slicing, containerization and more. And companies are taking an interest: Research from Analysys Mason states, “More than 80 percent of the largest global companies are interested in investing in edge computing, 5G slicing and cloud and IoT services within the next five years.” But rural providers must be careful to choose solutions that enhance programmability, interoperability and scalability to provide an end-to-end 5G experience featuring terabit performance.

These factors will prove vital for closing the digital divide and solving the constraints rural providers face at the distributed 5G edge. By satisfying these factors, open ecosystems are crucial for a provider’s financial bottom line via private 5G monetization and for optimizing customer experiences and access to the opportunities emerging technologies enable. ❖

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