

WHITE PAPER

5G Success Using the Adaptive Network Approach

Most mobile and wholesale network operators are taking a phased approach to their 5G network and services rollout, and with good reason. Besides having to evaluate the different business strategies and revenue-generating opportunities, 5G also involves numerous new technologies and standards that continue to mature. This can lead to significant operational complexity, not only to deliver the required coverage and performance, but to optimize the coexistence with 4G (and previous wireless generations), which will be required for many years to come.

In such an intricate scenario of many moving parts, mobile network infrastructure must also continuously evolve to support new features, standards, architectures, and end-user services. Having worked with many of the world's largest Mobile Network Operators (MNOs) in their 4G to 5G journey and supporting backhaul to over 75 percent of all towers in the U.S., it is evident that for mobile and wholesale network operators to be successful, their 5G network architectures must be based on the Adaptive Network™ approach and embrace the key tenets of being open, scalable, and automated.

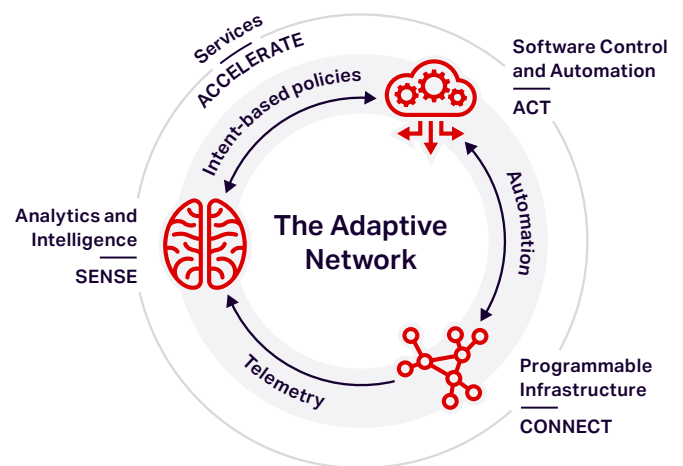


Figure 1. Ciena's Adaptive Network vision

The Adaptive Network approach

To optimize success, 5G networks can and should follow the Adaptive Network approach that leverages Programmable Infrastructure, Analytics and Intelligence, and Software Control and Automation, as shown in Figure 1. These foundational elements are supported by professional services that help network operators evolve to their ultimate network end-state, regardless of where they are along their unique 5G journey.

Maximizing synergies across these elements requires design principles that are hallmarks of the Adaptive Network—open, scalable, and automated. Based on these principles, the Adaptive Network approach can transform static mobile networks of the past into dynamic, programmable environments leveraging best-in-breed solutions that are optimized via data-driven analytics and intelligence. This ensures a successful and low-risk evolution from 4G to 5G network services.

[The Adaptive Network](#)

[Learn more](#)

Open

A phased deployment of new and evolving technologies will unleash unprecedented levels of low latency, high throughput, increased device density, and greater agility to power the future of new and emerging wireless use cases and applications. Realizing networkwide innovation at an accelerated pace is only possible with an open and programmable architecture approach where operators are free to choose what they believe are best-in-breed network components for their specific needs, often from different vendors.

Open 5G networks are built on standards-based physical network interfaces and Application Programming Interfaces (APIs), which facilitate and de-risk multi-vendor, best-in-breed network designs. This level of openness across hardware and software elements expedites the industry move towards disaggregation and virtualization of wireless and wireline network functions. It allows operators to continually evolve different parts of their end-to-end network rapidly and independently—without reliance on the innovation, investment focus, capabilities, and financial viability of any single vendor. This is precisely why closed and proprietary networks are a relic of the past and why the openness movement is an unstoppable juggernaut.

As such, mobile and wholesaler network operators are actively moving in this direction, exploring openness in trials, proofs of concept, and investing in new semiconductor R&D labs. Operator engagement in industry groups, such as the O-RAN Alliance, the Open RAN Policy Coalition, the Telecom Infra Project, and other such initiatives has steadily gained traction in a

concerted effort to develop new industry standards and guidelines that together facilitate and expedite the ongoing industry shift to open mobile networks.

Ciena 5G Network Solutions are open by design, providing mobile and wholesale network operators with choice in their converged 4G/5G xHaul transport networks. Unlike the closed and monolithic approaches of the traditional RAN vendors, Ciena has, and will continue to, work with diverse RAN partners and system integrators to enable and facilitate best-in-breed, end-to-end 5G networks, as openness is in Ciena's DNA.

How is this done? Ciena Services and Blue Planet® 5G Automation solutions are RAN vendor-agnostic. In addition, Ciena's broad and growing xHaul router family is powered by a disaggregated microservice-based operating system supporting a variety of open APIs. This provides for a fully programmable infrastructure for easier integration into any operating environment, enabling rapid and continuous mobile network evolution.

Scalable

The 5G journey is unique for each operator, which involves the introduction of new wireless spectrum to support increased bandwidth required by new and emerging use cases and applications. These higher frequencies in the millimeter wave band (24GHz to 40GHz) present inherent propagation challenges, meaning cell site densification through a variety of small cells is required. Facilitating the management and performance of a highly densified cell site network favors the adoption of new centralized and cloud-based RAN (C-RAN) architectures. A highly virtualized C-RAN architecture provides three key benefits:

1. Enhanced spectral efficiency through improved wireless propagation interference mitigation
2. Less hardware required at small and macro cell sites for reduced heating, cooling, and space requirements, yielding a more environmentally sustainable architecture
3. Improved economies, due to the optimal sharing of centralized storage and compute resources hosting multiple mobile network functions

C-RAN also introduces new and challenging fronthaul and midhaul transport network scalability and latency requirements. As traditional Decentralized RAN (D-RAN) cell site equipment and functionality is virtualized and hosted in centralized hubs, the scalability of these xHaul transport networks to and from these C-RAN hub sites, increases exponentially.

Additionally, 5G is expected to deliver orders of magnitude increases in the number of endpoints, especially as new IoT applications continue to surge in popularity. As such, rapid and cost-effective scalability becomes a key 5G network attribute across multiple dimensions.

The following are key scalability factors to consider in any 5G network architecture.

- **Interface density:** 5G requires additional new radios in each cell site covering different wireless spectrum bands, in addition to existing 4G and older generation radios, that are connected to C-RAN hubs, which are connected to the 5G Core and data centers, where content and applications are hosted. In many cases, macro cell sites will aggregate traffic from multiple neighboring small cells resulting in even more connected devices. This requires platforms that provide fronthaul, midhaul, and backhaul transport connectivity to support a significant number of network interfaces to accommodate both 5G New Radios (NRs) and the aggregation of many neighboring cell sites.
- **Interface throughput:** Higher capacity per radio and new fronthaul transport network requirements will require a significant number of 25GbE interfaces. Aggregating this large number of physical interfaces results in a need for multiple 100/200GbE and 400GbE interfaces to cost-effectively transport combined traffic towards the core.
- **Space and power:** Additional 5G NRs and hardware supporting Massive Multiple-Input Multiple-Output (MIMO) antennas will exacerbate cell sites already challenged with costly and limited power and space. This requires 5G xHaul routers to be dense, in terms of the number of ports and capacity, to provide efficiency improvements related to power and

space. By converging 5G and 4G transport traffic onto the same platform, networks become simpler, more cost-effective, and sustainable.

- **Network resource optimization:** A scalable solution must support growth and do so efficiently. This means supporting multiple services, traffic flows, applications, and use cases over a common infrastructure, optimally and securely, without compromising performance. This can be achieved via network slicing, which allows new services to be rapidly and dynamically introduced, without requiring additional hardware, by logically allocating portions of shared resources to specific services or customers driving improved economics through highly efficient resource utilization.

Ciena 5G Network Solutions provide unmatched scalability that fully addresses these dimensions. With up to 32 x 25/10/1GbE ports, Ciena's purpose-built 4G/5G xHaul routers support the ongoing deployment of 5G NRs at cell sites well into the future. With up to 4 x 100/200GbE or 2 x 100/200/400GbE aggregation ports, these routers support the most demanding mix of fronthaul, midhaul, and backhaul requirements.

Ciena also addresses mobile and wholesaler network operator concerns related to optimizing power and space, as well as the need for varied installation scenarios. Ciena's 4G/5G xHaul router family offers a reduced footprint (1RU, 300mm deep) in a sleek, shallow depth, and front-access-enabled form factor to facilitate cabinet deployments. In addition, supporting an extended temperature range (-40oC to +65oC) allows for installations in uncontrolled environments with additional weatherproofing and different mounting options (pole, wall, H-frame, strand) for direct outdoor deployments. This increases deployment flexibility with minimal cell site impacts. The integrated GNSS/GPS

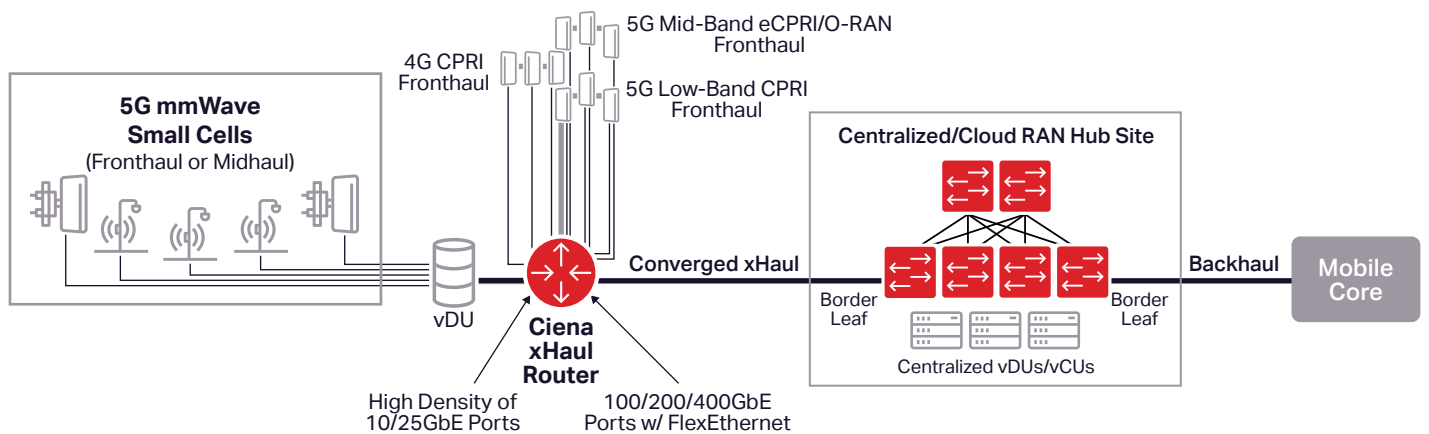


Figure 2. Converged 4G/5G Centralized/Cloud RAN (C-RAN) architecture evolution

receiver eliminates the need for external timing devices. A versatile and rich feature set enables a single Ciena xHaul router to address all the diverse demands of a typical cell site, without the need for additional and costly transport hardware.

Finally, to make the most of network resources, and to target new and emerging use cases, Ciena 5G Network Solutions fully support both hard and soft network slicing. This enables the introduction of new premium services based on a specific Service Level Agreement (SLA) over a shared infrastructure in a simple, cost-effective manner. FlexEthernet (FlexE) support provides deterministic, low-latency transport over an Ethernet transport layer to facilitate the aggregation of different traffic types and flows over a single, shared link. This permits the combination of stringent fronthaul and midhaul traffic with backhaul, and even non-mobile traffic such as residential and enterprise, each isolated and with its own guaranteed network performance to further maximize asset utilization.

Automated

With additional wireless spectrum bands, intense cell densification, numerous additional radios, new C-RAN architectures, advanced antenna coordination techniques, and evolving technologies, 5G adds ample complexity to network design, management, and planning. At the same time, 5G services and applications will continue to become more sophisticated, each requiring different levels of network performance to be delivered dynamically and on demand, like how cloud-based storage and compute assets are utilized today. Consumption-based connectivity is the future of 5G mobile network services.

Time to market is critical for 5G services, but so is properly differentiating and monetizing these services in a hyper-competitive market. This creates a challenge with many operators evaluating network slicing as a strategy to deliver guaranteed end-to-end SLAs and the ability to support tiered performance and associated pricing all the while optimizing overall network resource utilization. To improve network management and performance, rapid time to market, and enhance service differentiation and monetization requires a different operational approach. Using traditional operational approaches of the past that are manual, time-consuming, and error-prone will not provide the necessary agility and scalability that operators need to meet new 5G end-user expectations.

5G needs a comprehensive, end-to-end automation approach, powered by data-driven analytics. This level

of automation capabilities must also support multi-layer, multi-vendor best-in-breed networks. And with a massive leap in connected endpoints—humans and machines—5G automation must be highly scalable to cope with a massive increase in complexity related to the number of new services.

Ciena's Manage, Control and Plan (MCP) domain controller enables automated lifecycle operations allowing operators to manage a multi-vendor xHaul transport network from Layer 0 to Layer 3 via a highly intuitive graphical interface or APIs. This ensures network operations are highly efficient, streamlining legacy time-consuming and error-prone workflows for rapid provisioning, management, and troubleshooting of transport network services. MCP's integrated analytics leverage real-time network telemetry to drive informed actions and optimize multi-layer network performance.

Ciena's Blue Planet provides a modular and vendor-agnostic portfolio of software products optimized for end-to-end slice lifecycle automation across the RAN, xHaul transport, and Core. The open, cloud-native Blue Planet 5G Automation solution combines unified inventory, Multi-Domain Service Orchestration (MDSO), real-time path visualization, and analytics-driven assurance capabilities to help operators simplify service management, reduce costs, improve service velocity, and operationalize end-to-end network slicing.

Realizing a more adaptive 5G network

Guided by Ciena's vision of the Adaptive Network, Ciena 5G Network Solutions allow mobile and wholesale network operators to evolve to their ideal 5G network end-state. Not only do Ciena 5G Network Solutions provide the programable infrastructure, analytics, software-driven control, and professional services required to evolve towards a network that readily adapts, they are designed to maximize the synergies across these assets by leveraging the key network tenets of being open, scalable, and automated.

Ciena 5G Network Solutions are truly open by design to provide mobile and wholesale network operators choice in their 4G/5G xHaul network architectures. These solutions also provide the required scalability to support evolving RAN architecture paths with greater efficiency than ever before—by supporting converged 4G/5G xHaul transport networks on a common

5G insights

[Explore](#)

infrastructure. Plus, analytics-driven end-to-end 5G automation ensures rapid and intelligent network control of the routing, switching, and optical network layers providing rapid time to market and monetization. The result is a highly dynamic 5G network ready to meet end-user expectations—both humans and machines—of the 5G experience. Closed, proprietary, single vendor mobile networks is an obsolete past. Only operators

who embrace open, scalable, and automated networks will realize the true promise of 5G and successfully and financially excel in the new wireless era.

Ciena may make changes at any time to the products or specifications contained herein without notice. Ciena and the Ciena Logo are trademarks or registered trademarks of Ciena Corporation in the U.S. and other countries. A complete list of Ciena's trademarks is available at www.ciena.com. Third-party trademarks are the property of their respective owners and do not imply a partnership between Ciena and any other company. Copyright © 2023 Ciena® Corporation. All rights reserved. WP246 9.2023

Was this content useful?

Yes No

ciena®