



MARKETING REPORT

MR-470

Value of WWC

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1 Executive Summary

The integration of Wireless-Wireline Convergence (WWC), as defined by the Broadband Forum in TR-470 [1], represents a transformative advancement in network architecture, offering significant benefits to both operators and end users. By merging wireline and wireless networks into a unified infrastructure, WWC addresses the pressing challenges of network fragmentation and operational inefficiencies, while enhancing the overall user experience. This convergence not only simplifies network management and optimizes resource utilization but also opens up innovative avenues for service delivery and new revenue streams. This Marketing Report outlines the value of the BBF WWC Architecture for operators and end users.

2 Problem Statement: What are we solving and why

Migrating to the WWC architecture offers numerous advantages for both operators and end users.

For operators:

Cost Efficiency: the WWC architecture allows operators to consolidate their wireline and wireless networks, leading to significant cost savings. This consolidation reduces the need for maintaining separate infrastructures, thus lowering operational expenses.

Simplified Network Management: The unified network structure of the WWC architecture simplifies network management. It reduces the complexity associated with managing separate networks and streamlines operations.

Improved Resource Utilization: The WWC architecture enables efficient resource utilization. It allows operators to dynamically allocate network resources based on demand and network conditions, improving network performance and reducing waste of resources.

Enhanced Service Delivery: The architecture facilitates the delivery of converged services, providing a seamless user experience across different types of networks. It also enables rapid deployment of new services, offering a flexible and scalable platform for service innovation.

Competitive Advantage: By providing high-quality, seamless services across wireline and wireless networks, operators can gain a competitive edge in the market.

For end users:

Seamless Connectivity: The WWC architecture provides end users with seamless connectivity across wireline and wireless networks. This ensures uninterrupted service, enhancing user experience.

Service Equivalency: users can access offered services regardless of how they connect to the network

High-Quality Services: The efficient resource utilization and network optimization enabled by the WWC architecture result in high-quality services for end users. Whether it's high-speed internet, reliable VoIP, or uninterrupted video streaming, users can expect superior service quality.

2.1 New Revenue streams – service innovation & user experience

Wireless-Wireline Convergence as defined by Broadband Forum in TR-470 [1], provides a unified approach to managing and delivering services across both wireline and wireless networks. This not only enhances the user's experience but also opens up new avenues for revenue generation through service innovation.

The convergence of wireline and wireless networks into a unified network infrastructure brings about a multitude of benefits. For service providers, it means they can deliver a seamless user experience across different access networks, thereby increasing customer satisfaction and loyalty. The WWC architecture allows operators to use existing access networks and leverage their existing wireline infrastructure investments.

Moreover, WWC enables service providers to innovate and create new services that were delivered with less optimal overlay architectures before.

For example, service providers can now offer SD-WAN services that make use of existing legacy or 5G residential Gateways, eliminating the need for additional on-premise devices. This not only simplifies the set-up for the customer but also reduces the cost and complexity for the service provider.

Operators could also offer unified communication services that operate seamlessly across disparate networks, providing a consistent and reliable user experience regardless of the network used, with unified policies across networks. In addition, service providers can leverage the mobility inherent in wireless networks to offer location-based services. These services can provide real-time information or tailored services based on the user's location, adding another dimension to the user's experience and creating additional revenue opportunities.

A corporate user could connect from its broadband access to its company resources as a teleworker and maintain the same experience when moving to the 5G Radio network. This seamless service delivery can enhance user satisfaction and increase the competitiveness of service providers.

The WWC architecture enables the rapid deployment of new applications based on the 5G Service platform and Network Exposure Function.

These new services not only provide additional revenue streams for service providers but also enhance the value proposition for customers, thereby potentially attracting new customers and increasing market share.

In addition, WWC allows service providers to leverage the strengths of both wireline and wireless networks. For instance, they can use the high capacity and reliability of wireline networks for delivering bandwidth-intensive services such as video streaming, while using the flexibility of wireless networks for services that require mobility.

2.2 Network optimization and efficiency

One of the primary benefits of the WWC architecture is the simplification of network infrastructure by integrating wireline and wireless assets. This integration results in a unified network that can handle both wireline and wireless traffic. The traditional approach involves operating separate networks for wireline and wireless services, which can be complex and costly. With WWC, service providers can consolidate their network resources, simplifying network management and reducing operational expenses. Furthermore, a unified network infrastructure enables seamless connectivity and mobility for end-users, enhancing their experience.

The WWC architecture allows for more efficient use of network resources. By combining wireline and wireless assets, service providers can optimize the allocation of network resources based on the demand and network conditions. For example, during periods of high demand, resources can be dynamically allocated to the areas where they are needed the most for eMBB services. On the wireline network, B-UPF resources can also be managed more effectively through the use of Session steering and cloud native scaling. This flexibility in resource allocation can significantly improve network performance and service quality. Additionally, efficient resource utilization can result in cost savings, as service providers can avoid over-provisioning of network resources.

By leveraging both wireline and wireless assets, service providers can optimize their network performance based on the specific requirements of different services and applications. For example, latency-sensitive applications can be prioritized over wireline and wireless access with similar QoS parameters, while bandwidth-intensive applications are given different priority. This level of network optimization can significantly improve the quality of service and user experience.

The WWC architecture can enhance network efficiency by eliminating redundancies in the network. In a traditional network setup, wireline and wireless networks often have separate backhaul and core networks, which can lead to duplication of resources. With WWC, these resources can be combined and shared, reducing the overall network footprint and enhancing network efficiency. Moreover, the WWC architecture can support advanced technologies such as network function virtualization (NFV), cloud native deployments (CNFs) and software-defined networking (SDN), which can further improve network efficiency by enabling dynamic and programmable network management.

In conclusion, the WWC architecture, as defined in BBF TR-470 [1], provides significant benefits in terms of network simplification, resource utilization, service delivery, network optimization, and efficiency. By combining wireline and wireless assets, service providers can create a unified and flexible network infrastructure that can deliver high-quality services, enhance user experience, and reduce operational costs.

3 The WWC Architecture, Key components and enablers

Figure 1 below shows the WWC architecture and exemplary use case combinations.

The key WWC technical elements (5G-RG, AGF-CP and B-UPF; specified in BBF TR-470 [1], TR-456 [2] and TR-458 [3]) are highlighted in red color.

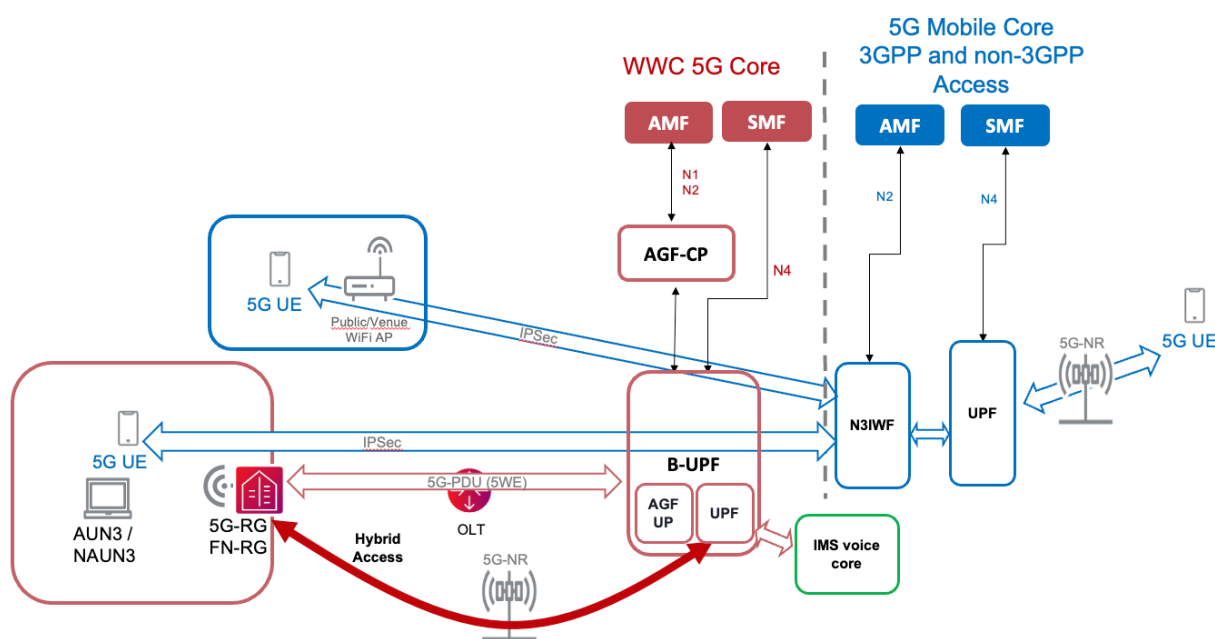


Figure 1 - WWC Use case Reference Model

4 Key Use cases

The following use cases have been identified as key differentiators in the WWC architecture to drive live deployments.

4.1 Teleworker Access

The WWC architecture facilitates the delivery of a teleworker service by enabling the separation of enterprise traffic from the 5G-RG on a separate slice. This means that while the internet traffic from the home follows one path, the enterprise traffic follows a different path from 5G-RG to AGF-UP, effectively segregating the traffic. This separation ensures that the enterprise traffic is isolated and secure, which is crucial for maintaining the privacy and integrity of enterprise data.

The WWC architecture allows for the establishment of QoS for the teleworker flows in both directions, upstream and downstream. This means that the service provider can prioritize the teleworker traffic to ensure high-quality connectivity for work-related applications. This capability enhances the teleworker's experience by ensuring reliable and consistent performance.

In the WWC architecture, the teleworker traffic could be steered to a Cloud firewall service behind the B-UPF where traffic terminates. This feature enables the service provider to apply comprehensive security measures to the teleworker's traffic, protecting against threats such as malware and cyber-attacks. This cloud-based security solution is scalable and flexible, allowing the service provider to easily adjust the security settings based on the threat landscape.

The WWC architecture supports authentication for teleworker traffic using eSIM mechanisms in the 5G-RG connecting to the 5G core. Instead of manually authenticating the RG, the eSIM mechanism automates the authentication process, enhancing security and simplifying the user experience. The 5G network could also provide other authentication mechanisms, such as multi-factor authentication, for added security.

The teleworker service is based on the 5G-RG deployed by the operator and does not require any new device on-premise. This aspect of the WWC architecture simplifies the setup for the end-user and reduces the cost and complexity for the service provider. It also ensures that the service can be easily deployed and scaled, accommodating the growing demand for teleworking solutions.

4.2 Hybrid 5G-RG for mass market

The WWC architecture can be utilized to offer a unique Hybrid 5G-RG service where the 5G Residential Gateway (5G-RG) is connected to both the broadband access network ,via the Access Gateway Function (AGF) and User Plane Function (UPF) or combined B-UPF, and the 5G radio network. This dual connectivity allows for a range of benefits both for the service provider and the end-user.

Load Balancing and Traffic Splitting: With the Hybrid 5G-RG service, traffic flows can be effectively load balanced across both the broadband and 5G radio networks. This is facilitated by the Access Traffic Steering, Switching and Splitting (ATSSS) function, which can split and recombine the traffic to optimize network performance. The ATSSS function ensures that each part of the network is utilized efficiently, enhancing the overall network performance and user experience.

Dynamic Traffic Routing: The Hybrid 5G-RG service allows for dynamic traffic routing based on various parameters such as application type, latency requirements, and network conditions. For instance, latency-sensitive applications can be routed via the 5G radio network, which offers lower latency, while bandwidth-intensive applications can be directed to the broadband network, which provides higher capacity. This

dynamic traffic routing ensures optimal performance for different types of applications, enhancing the user experience.

Backup Connectivity: The Hybrid 5G-RG service can use the mobile network as a backup for the broadband access network. This feature ensures continuous connectivity even in the event of a broadband network failure, enhancing the reliability of the service.

Authentication: The Hybrid 5G-RG service can rely on eSIM authentication, which is more secure and efficient compared to traditional broadband authentication mechanisms. In traditional broadband networks, the authentication process often involves manual input of credentials, which can be cumbersome and less secure. With eSIM authentication, the process is automated and integrated into the 5G-RG, enhancing security and simplifying the user experience.

The Hybrid 5G-RG service offers several benefits for both the operator and the end user. For the operator, this service allows for efficient resource utilization, flexible network management, and the ability to offer differentiated services. For the end user, this service provides high-quality connectivity, and enhanced reliability.

Based on the TR-458 [3] disaggregation of AGF-CP and B-UPF, the operator can distribute B-UPF nodes where the broadband traffic terminates in the most efficient way. This flexibility in the placement of B-UPF nodes allows the operator to optimize network performance, reduce latency, and enhance service quality.

4.3 Converged service plans with mobility across domains: Broadband Access, Wi-Fi and 5G Wireless

The WWC architecture offers a unique approach which can be leveraged to offer converged service plans with mobility across Broadband, Wi-Fi, and 5G Wireless. This convergence has several benefits for both service providers and subscribers.

Seamless Mobility Across Access Domains: The WWC architecture enables subscribers, whether they are using 5G User Equipment (UE) or non-5G UEs, to move seamlessly across different operator access domains. This seamless mobility enhances the user experience by providing consistent connectivity, regardless of the access domain. For instance, a subscriber could start a video call on a broadband network, continue the call on a Wi-Fi network, and finish the call on a 5G wireless network without any interruption.

Unified Authentication and Policies: The WWC architecture supports unified authentication and policies per access domain. This means that the subscriber's credentials and policy settings are applied consistently across all access domains. This feature simplifies the authentication process for the subscriber and enhances security. Furthermore, the WWC architecture allows for different traffic shaping policies per access domain, enabling the service provider to optimize network performance based on the specific requirements of each access domain.

Unified Charging Policies Across Domains: The WWC architecture also supports unified charging policies across domains. This feature ensures that the subscriber is billed consistently, regardless of the access domain. This unified billing enhances transparency and simplifies the billing process for the subscriber. For the service provider, unified charging policies can simplify billing management and reduce administrative costs.

The convergence of service plans across Broadband, Wi-Fi, and 5G Wireless offers a multitude of benefits for both the operator and the end user. This approach not only enhances the user experience but also boosts the operator's operational efficiency and revenue potential.

From the operator's perspective, unified service plans across different access domains streamline operations and reduce complexities. They can manage all services under a single orchestration layer, leading to efficient resource allocation and simplified billing processes. The unified charging policies across domains eliminate the need for separate charging mechanisms for each service per domain, reducing administrative overhead and potential errors.

From the end user's perspective, converged service plans offer a seamless and integrated experience. Subscribers can effortlessly transition between Broadband, Wi-Fi, and 5G Wireless without worrying about different service plans or disruptions in service. Unified authentication means that users don't have to remember multiple login credentials or go through repeated authentication processes. This greatly enhances the user experience and increases user satisfaction. This mobility across services not only provides convenience but also ensures consistent and high-quality connectivity, regardless of the access domain.

4.4 SD-WAN and SASE with integrated RG

The WWC architecture offers a robust foundation for implementing a Software-Defined Wide Area Network (SD-WAN) service. This approach brings several benefits to both operators and end users.

Streamlined Infrastructure: With WWC, SD-WAN can utilize native 5G PDUs from 5G-RG, eliminating the need for additional SD-WAN appliances with an L3 overlay tunnel. This simplifies the network infrastructure, reduces operational costs, and enhances network performance.

Flexible Service Offering: The WWC architecture allows operators to create multiple 5G PDU slices for different enterprise departments or segments. This enables operators to create services to meet the specific needs of each department or segment, providing a competitive advantage in the market.

Enhanced Security: The WWC architecture supports service chaining to a Cloud Secure Access Service Edge (SASE) Gateway for Unified Threat Management (UTM) security. This allows operators to provide robust security measures, protecting enterprise networks against various threats and enhancing customer trust.

4.5 IMS for 5G-RG

The WWC architecture offers significant benefits in delivering a converged IP Multimedia Subsystem (IMS) voice service across both Broadband and Mobile networks.

Utilizing a single voice network core through WWC reduces the operational cost and complexity for operators. It eliminates the need for maintaining separate cores for broadband and mobile networks, leading to more streamlined operations.

Offering a converged IMS voice service via WWC allows for integrated billing across both broadband and mobile networks. This simplifies the billing process, making it more transparent and user-friendly for customers.

With WWC, users can seamlessly use the voice service on either wireline or broadband or wireless networks. This flexibility enhances the user experience, as they can choose the most convenient or efficient network for their needs.

The WWC architecture simplifies the operator's Operational Support Systems (OSS) layer. It enables unified management of services across both networks, reducing administrative overheads and improving operational efficiency.

4.6 Enterprise vCPE with integrated RG

The WWC architecture provides a robust framework for delivering a virtual Customer Premises Equipment (vCPE) service. This service can be delivered by leveraging existing Fixed Network Residential Gateways (FN-RGs) and 5G Residential Gateways (5G-RGs), offering several benefits for both operators and end users.

5G-RG Connected to Ethernet Service: By connecting the 5G-RG to an Ethernet service over Broadband terminating on B-UPFs, operators can deliver high-speed, reliable connectivity to end users while cloudifying specific network functions, simplifying network management for the operator and ensuring consistent service quality for the end user.

SD-LAN Using L2 Bridged 5G PDU from RG: The WWC architecture enables the implementation of a Software-Defined Local Area Network (SD-LAN) using a Layer 2 Bridged 5G Protocol Data Unit (PDU) from the RG. This capability allows operators to offer flexible, programmable network services, enhancing their service offering and competitive advantage.

Multiple 5G PDU Slices for Enterprise Departments/Segments: Operators can create multiple 5G PDU slices for different enterprise departments or segments. This enables tailored services that meet the specific needs of each department or segment, enhancing network performance and user satisfaction.

End-Device Policy Enforcement: A vCPE Service based on the WWC architecture supports end-device policy enforcement, including security measures, Access Control Lists (ACLs), traffic shaping, and additional service chaining in the cloud to cloud Firewalls or UTM solutions.

4.7 Managed MDU

The WWC architecture provides a solution for delivering a Multi-Dwelling Unit (MDU) connectivity service.

One of the key features of this service is the creation of multiple PDUs per 5G-RG. This allows for the provision of private access, including LAN and private Wi-Fi for each tenant, ensuring secure, dedicated connectivity. Additionally, this feature enables Wi-Fi access in common areas, providing convenient, high-speed internet access for all residents and guests.

To ensure secure and efficient authentication, the WWC architecture supports N5GC authentication through a captive portal or AAA server. This enhances network security and simplifies the authentication process for MDU tenants.

Furthermore, 5G capable User Equipment (UE) in the MDU can connect to the core 5G network through the N3IWF, with all traffic being encrypted for security. This ensures secure, reliable connectivity for all 5G-enabled devices in the MDU.

The WWC architecture supports end-device policy including security enforcement, Access Control Lists (ACLs), traffic shaping, and additional services.

5 Summary

In conclusion, Wireless-Wireline Convergence (WWC) represents a paradigm shift in network architecture, offering transformative benefits for both operators and end-users.

By seamlessly integrating wireline and wireless networks, WWC addresses the critical challenges of network fragmentation, operational inefficiencies, and inconsistent user experiences.

For operators, it delivers substantial cost savings through infrastructure consolidation, simplifies network management, and optimizes resource utilization.

This convergence unlocks new revenue streams through innovative service offerings such as integrated SD-WAN, unified communications, and enhanced teleworker solutions.

End-users benefit from seamless connectivity across diverse network environments, enjoying consistently high-quality services whether at home, in the office, or on the move. The flexibility and scalability inherent in the WWC architecture position operators to rapidly adapt to evolving market demands and technological advancements.

Ultimately, WWC not only solves current networking challenges but also lays the foundation for a more agile, efficient, and user-centric telecommunications ecosystem, ready to meet the demands of today and tomorrow's connected world.

6 Terminology

6.1 References

The following references are of relevance to this Marketing Report. At the time of publication, the editions indicated were valid. All references are subject to revision; users of this Marketing Report are therefore encouraged to investigate the possibility of applying the most recent edition of the references listed below.

A list of currently valid Broadband Forum Technical Reports is published at www.broadband-forum.org.

Document	Title	Source	Year
[1] TR-470 issue 2	<i>5G Wireless Wireline Convergence</i>	Broadband Forum	2022
[2] TR-456 issue 2	<i>AGF Functional Requirements</i>	Broadband Forum	2022
[3] TR-458	<i>Wireless and Wireline Convergence with Control and User Plane Separation. Reference Architecture, Interface, and Protocol Specification</i>	Broadband Forum	2023

6.2 Definitions

The following terminology is used throughout this Marketing Report.

Term	Definition
AGF	Access Gateway Function as specified in TR-470 [1] and TR-456 [2].
B-UPF	Broadband User Plane Function as specified in TR-458 [3].
AAA Server	A logical entity in the client-server relationship that replies to AAA Client Authentication, Authorization and Accounting requests.
5G-RG	5G Residential Gateway as specified in TR-470 [1].
FN-RG	Fixed Network Residential Gateway as specified in TR-470 [1].
5G PDU	Protocol Data Unit in 5G, providing end-to-end user plane connectivity between the User Equipment (UE) and a Data Network (DN).

6.3 Abbreviations

This Marketing Report uses the following abbreviations:

Term	Definition
AAA	Authentication, Authorization, and Accounting
AUN3	Authenticable Non-3GPP device

B-UPF	Broadband User Plane Function
ACL	Access Control List
AGF	Access Gateway Function
AGF-CP	AGF Control Plane
AGF-UP	AGF User Plane
AMF	Access Management Function
ATSSS	Access Traffic Steering Switching and Splitting
CNF	Cloud native Network Function
DN	Data Network
eSIM	embedded Subscriber Identity Module
eMBB	5G Enhanced Mobile Broadband
IMS	IP Multimedia Subsystem
IPSec	Internet Protocol Security
MDU	Multi-Dwelling Unit
MR	Marketing Report
NAUN3	Non-Authenticable Non-3GPP device
N3IWF	Non-3GPP Interworking Function
NFV	Network Function Virtualization
OLT	Optical Line Terminal
PDU	Protocol Data Unit
RG	Residential Gateway
SASE	Secure Access Service Edge
SD-LAN	Software-Defined Local Area Network
SD-WAN	Software Defined Wide Area Network
SDN	Software Defined Networks
SMF	Session Management Function
UE	User Equipment
UPF	User Plane Function
UTM	Unified Threat Management
vCPE	Virtual Customer Premises Equipment
WiFi AP	Wi-Fi Access Point
WWC	Wireless-Wireline Convergence
5WE	5G Wireless Wireline Convergence User Plane Encapsulation

End of Broadband Forum Marketing Report MR-470