WORLD BROADBAND ASSOCIATION

Achieving Broadband Excellence:

2025 Best Practices Case Studies

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Foreword

In an era of rapid digital transformation, the broadband industry stands at the forefront of shaping inclusive, sustainable, and resilient societies. The World Broadband Association (WBBA) is proud to present *Best Practices Case Studies – Achieving Broadband Excellence*, a testament to the ingenuity, collaboration, and commitment of our global members.

This publication is more than a collection of success stories—it reflects the values that unite our community: innovation with purpose, excellence in execution, and a shared dedication to advancing broadband as a force for good. Through the *Broadband Excellence Advancing Community of Networks - BEACON "CONNECT"* Initiative, we have invited our members to contribute exemplary case studies that address real-world challenges with bold, scalable solutions. From green energy integration and precision cooling to smart utility infrastructure and circular economy practices, these initiatives illuminate the transformative potential of broadband technologies.

I would like to extend special recognition to our WBBA General Manager, Nicole Cheah whose leadership and dedication were instrumental in driving this initiative forward—from concept to completion. We are also deeply grateful to our member representative and supporting analyst, Sonia Agnese from Omdia, whose expert review and insights helped shape the selection and evaluation of these case studies. Their contributions added rigor and clarity, ensuring that each featured initiative meets the highest standards of relevance, innovation, and impact.

Most importantly, we thank the member organisations, whose ground-breaking initiatives and visionary work, form the heart of this publication. Their willingness to share insights, data, and lessons learned has made this booklet a rich resource for the entire broadband ecosystem. Each case study reflects not only technical excellence but also a deep commitment to sustainability, customer-centricity, and industry progress.

Together, we are building the network excellence of tomorrow— connectivity that connects, uplifts, and endures.

Martin Creaner
Director General
World Broadband Association (WBBA)

Acknowledgement

Nicole Cheah, *General Manager of WBBA | Principal Consultant APAC, Intelligence & Advisory Omdia*
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Member Organisations:

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Overview Summary

The World Broadband Association (WBBA) is proud to present the Best Practices Case Studies Booklet, a cornerstone of the Broadband Excellence Advancing Community of Networks (BEACON) – "CONNECT" Initiative.

This publication celebrates the outstanding achievements of WBBA members, showcasing innovative solutions that address critical challenges in the broadband industry. By sharing these success stories, the WBBA aims to foster collaboration, inspire innovation, and contribute to the development of industry-wide best practices.

Each case study highlights creative approaches to problem-solving, tangible benefits to stakeholders, and practical applications for the broader broadband community. These initiatives not only demonstrate the transformative power of broadband technologies but also underscore the commitment of WBBA members to advancing sustainability, customer-centric solutions, and cutting-edge technologies.

Case Study Summaries

Fibertech Jordan: Transforming Jordan's Utility Sector with Smart Metering

Fibertech Jordan revolutionized Jordan's utility sector by deploying a nationwide smart metering infrastructure using its high-capacity fiber network. This automated system replaced manual processes for meter readings, disconnections, and reconnections, enhancing operational efficiency and billing accuracy. Robust cybersecurity measures, such as ONT access protection and VLAN segmentation, ensured secure and uninterrupted service for over 800,000 smart meters. The project also introduced innovations like prepaid metering and dynamic billing, positioning Fibertech as a replicable model for smart city applications.

Key Contributions:
- Tackled scalability, efficiency, and security challenges.
- Enhanced operational efficiency and reduced costs.
- Positioned as a scalable solution for future smart city initiatives.

China Telecom: E-surfing Safe Energy Lithium Battery System

China Telecom's E-surfing Safe Energy Lithium Battery System integrates renewable energy sources with advanced energy storage and management technologies. Featuring a liquid cooling temperature control solution, it mitigates safety risks like lithium battery combustion. The system supports peak shaving and valley filling strategies, reducing electricity costs by over 60% in some projects and increasing green electricity usage to 40-60%. It has significantly reduced carbon emissions and operational costs, laying the foundation for enterprises to transition to green energy.

Key Contributions:
- Addressed high energy consumption and safety challenges.
- Pioneered AI-driven energy management for efficient green electricity use.
- Enabled carbon reduction and green energy adoption.

China Telecom: E-surfing Cooling Pod

The E-surfing Cooling Pod is a precision cooling solution for high-power ICT equipment, achieving a PUE as low as 1.15. By adopting a fully enclosed hot and cold aisle architecture, it addresses challenges like localized hotspots, poor airflow distribution, and high energy consumption in data centers. The system improves cooling efficiency by 30% and reduces floor space requirements by up to 60%, making it suitable for both new and legacy data centers.

Key Contributions:

- Supported the green transformation of data centers.
- Introduced a novel rack-level cooling system with AI integration.
- Enhanced energy efficiency and scalability for diverse ICT equipment.

Globe Telecom: Sustainable Material Management Program

Globe Telecom's Broadband Business Customer Field Services team implemented a circular economy approach to reduce waste from fiber installation materials. The Disposal, Recycle, and Upcycle Program transformed fiber spools and drop wires into functional items like school furniture and vegetable trellises, diverting over 6.6 tons of plastic from landfills. The program also engaged local communities in sustainability practices, creating new revenue streams and strengthening community relations.

Key Contributions:

- Addressed material waste and environmental risks.
- Repurposed waste into useful products, reducing carbon emissions.
- Enhanced brand reputation as an environmentally responsible corporation.

Ookla: Turning Wanderlust into Roaming Revenue

Ookla, a global leader in connectivity intelligence, leverages its Speedtest® data to help mobile network operators in Latin America optimize their roaming strategies amidst rising post-pandemic travel and evolving market dynamics. By analyzing customer travel patterns, roaming performance, and network quality, Ookla enables operators to refine agreements and improve service quality. This approach helps MNOs adapt to challenges such as increasing travel, competition from eSIM providers, and the growing reliance on Wi-Fi.

Key Contributions:

- Addressed critical challenges in the Latin American roaming market.
- Utilized Speedtest® data to identify travel trends and analyze roaming experiences.
- Helped operators improve agreements, enhance customer experiences, and adapt to market dynamics.

These case studies highlight innovative solutions addressing challenges in utility management, energy efficiency, data center cooling, sustainability, and roaming optimization, showcasing the transformative impact of technology and circular economy practices

Fibertech Smart Electricity Meters Solution

Overview

Company Overview: Fibertech (Jordan Advanced Fiber Company)
Fibertech is Jordan's first open-access wholesale fiber network provider, established in 2019 as a joint venture between major telecom and energy companies. It builds and operates a national fiber infrastructure via existing electrical poles. With coverage extending across key populated governorates and serving over 1.65 million households and enterprise (as of mid-2025), Fibertech plays a vital role in delivering premium **Fiber to The Home (FTTH)** connectivity to Jordanian households with speeds ranging from 100 Mbps to 10 Gbps, as well as availing **Point-to-point (P2P)** active and passive leased line connectivity to Jordanian enterprises and telecom base stations with various options for leased capacities.

Fibertech has successfully completed Jordan's first test of ultra-high-speed 50Gbps on its fiber optic network, making it one of the first companies in the region to deliver such cutting-edge infrastructure. This milestone firmly positions Fibertech as a key enabler of Jordan's digital transformation, paving the way for future applications like 8K streaming, virtual reality, cloud computing, and AI-driven smart devices with the advantage of fastest speeds and exceptional performance through ultra-low latency.

As service stability, mobility, and high bandwidths become the mainstay requirements for everyday services such as online education, video, e-Sports, smart offices, users need Wi-Fi that supports high bandwidth, low latency, wide coverage, and multi-user concurrent access. Hence Fibertech has launched its **Fiber to The Room (FTTR)** solution which extends the fiber experience to every room in the property enabling users to enjoy a stable Wi-Fi experience in every corner of every room at every moment. Imagine this on top of the **Gigabit speeds,** which spoils end-users with a throughput reaching 10 Gbps in upload and download.

Simply put, Fibertech brings the joy and opportunities of high-speed broadband connectivity to millions of Jordanians, achieved through enabling telecoms and ISPs serving the Jordanian market. All the while connecting every building, in every street corner, in every neighborhood with a robust network that can power IoT, telemetry, and smart city applications.

Project Executive Summary:

Fibertech implemented a nationwide smart metering infrastructure in Jordan by leveraging its high-capacity fiber network to connect household electricity meters to centralized, private DHCP servers. This large-scale deployment transformed the utility sector by eliminating manual meter readings, disconnections, and reconnections — replacing them with a fully automated, real-time solution.

By capitalizing on existing fiber access infrastructure and close collaboration with utility providers, the project established a secure, dedicated network for remote utility metering. From the beginning, robust security was a foundational principle: each smart meter was authenticated, communications were restricted to private IP address spaces, and IP segmentation was used to fully isolate smart meter traffic from public internet exposure.

As illustrated in the accompanying network topology (Figure 1), the design includes full redundancy through dual DHCP servers and firewalls at geographically distinct data centres. This ensured continuous service availability, fault tolerance, and uninterrupted data flow.

The result is a scalable, resilient, and highly secure smart metering platform that dramatically reduced manual operations, improved billing accuracy, and enhanced the overall operational efficiency of the utility providers served by Fibertech.

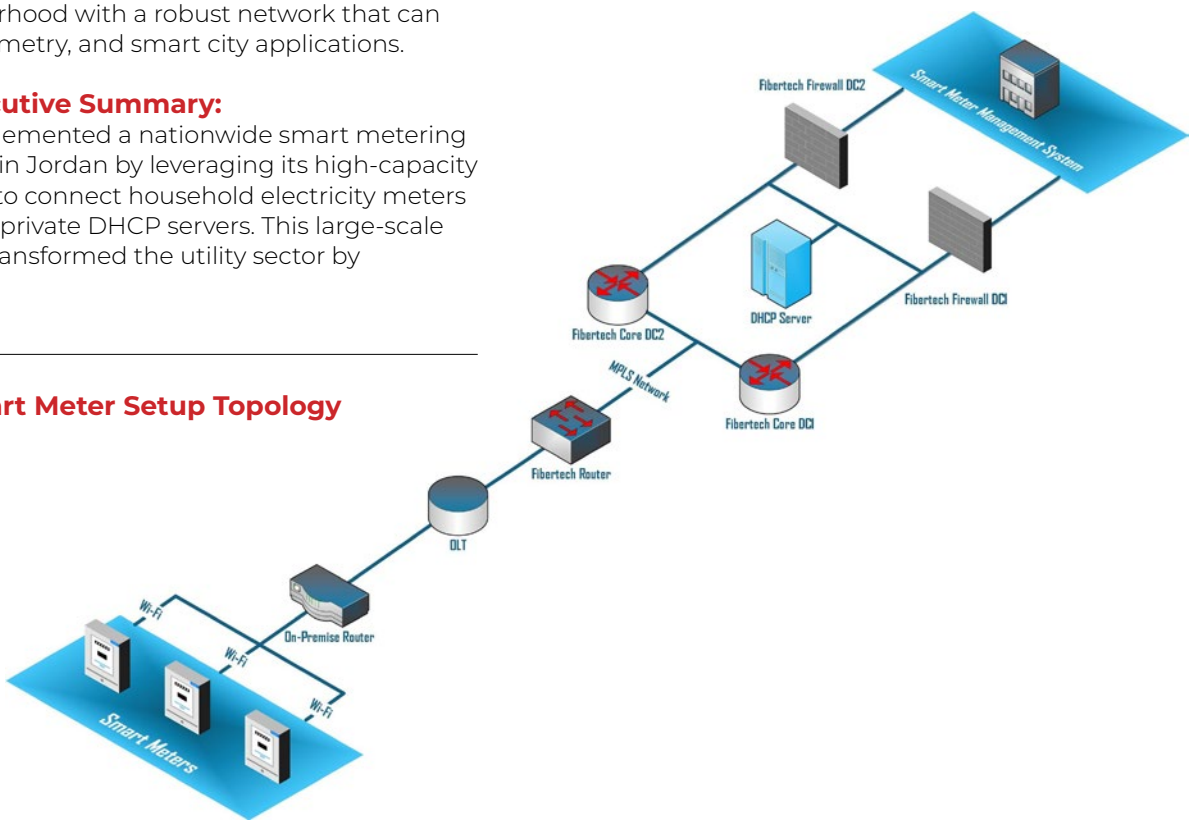


Figure 1: **Smart Meter Setup Topology**

Challenges Presented

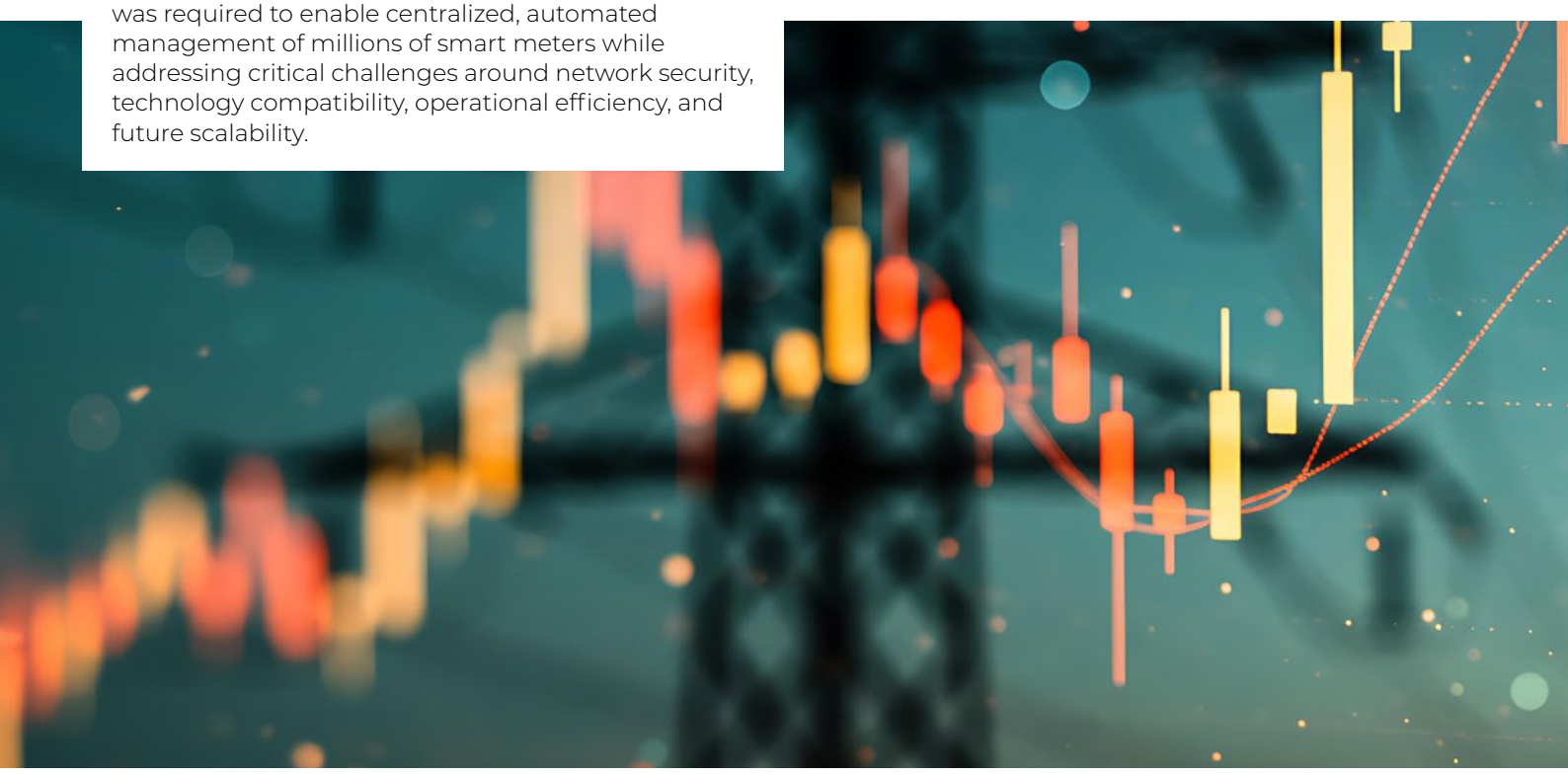
Problem Statement:
Prior to the implementation of Fibertech smart metering solution, the existing utility infrastructure faced significant limitations in terms of scalability, efficiency, and security. The legacy architecture relied heavily on manual processes for meter reading, service disconnection due to unpaid bills, and reconnection upon payment — all of which required human intervention at the premises. This not only increased operational costs and response times but also left room for human error and delays that negatively impacted customer experience and billing accuracy.

Moreover, Security vulnerabilities were also a pressing concern. Optical Network Terminals (ONTs) located in the customer building were exposed to potential physical tampering, and open LAN ports or improperly secured Wi-Fi connections could be exploited for unauthorized access. The use of static IP addresses without sufficient isolation mechanisms & security threatens the integrity of utility data and network performance.

In summary, the legacy system was not equipped to meet the demands of a modern, large-scale smart metering operation. A comprehensive transformation was required to enable centralized, automated management of millions of smart meters while addressing critical challenges around network security, technology compatibility, operational efficiency, and future scalability.

Specific Challenges:
- Managing and securing a network of over 1 million smart meters, with future expansion anticipated.
- Mitigating the high exposure risk of ONTs within households, which can serve as potential entry points for vulnerabilities and unauthorized access via Ethernet or Wi-Fi.
- Achieving rapid solution deployment to meet the ambitious target of completing the project within two years.

Constraints and Requirements:
- Develop a robust, cutting-edge cybersecurity solution to safeguard critical sectors—such as electricity—from any potential attacks with severe operational impact.
- Highly available infrastructure for 24/7 service with geo-redundancy.
- Scalable to handle future growth.
- Minimal customer impact and zero-touch provisioning from the customer side.



Solution & Value

Solution Approach:

Our solution integrates a comprehensive mix of physical, logical, and architectural safeguards to ensure maximum protection and resilience:

- **Seamless Year-Round Data Access and Real-Time Control:** Given the scale and criticality of the project, the infrastructure is designed with full protection and high redundancy to guarantee uninterrupted availability and operational continuity throughout the year.
- **ONT Access Protection:** LAN ports are disabled by default to prevent unauthorized physical connections, while Wi-Fi is secured through high and complex encryption to minimize the risk of unauthorized access.
- **Advanced Layers of Security:** An additional authentication layer was incorporated into the solution to mitigate the risk of unauthorized access and prevent any potential configuration leaks.
- **Geographical Segmentation:** Each geographic area is assigned a dedicated VLAN configuration to mitigate MAC spoofing risks and contain potential security threats within localized zones, preventing exposure across the entire network.

Impact, Innovation, and Value:

- **Solution Impact:** Currently serving over 800,000 electricity smart meters—and continuously expanding—the solution enables real-time data, event, and action transmission across Jordan's most densely populated governorates, significantly enhancing the electricity company's service levels
- **Security Reinforcement:** Eliminated unauthorized access and spoofing through multi-layer filtering and physical isolation
- **Scalability Achieved:** Readied the network to manage a fivefold increase in devices, ensuring long-term sustainability.
- **Operational Efficiency:** Enabled zero-touch onboarding and seamless integration of new smart meters.

Commercial Benefits:

- Successfully developed Jordan's first large-scale smart city application, designed as a replicable model to drive digital transformation across other sectors, positioning Fibertech with a distinct competitive advantage in this emerging market.
- Strengthened Fibertech reputation and competitiveness in national infrastructure projects.
- Reduced OPEX for meter reading and fault management while eliminating human errors.
- Enabled the innovations and new services in the utility sector, such as prepaid metering and dynamic billing

Key Learnings:

- Automation Unlocks Massive Operational Efficiency & New Business Opportunities
- End-to-End Security Requires Both Physical and Logical Controls
- Geo-Redundancy Is No Longer Optional for Critical Infrastructure

> "Prior to the implementation of Fibertech smart metering solution, the existing utility infrastructure faced significant limitations in terms of efficiency"

E-surfing Safe Energy Lithium Battery Series Products

Overview

China Telecom Corporation Limited ("China Telecom" or the "Company", a joint stock limited company incorporated in the People's Republic of China with limited liability, together with its subsidiaries, collectively the "Group") is a leading large-scale integrated intelligent information services operator in the world whose principal business is the provision of fundamental telecommunications businesses including wireline, mobile communications and satellite communications services, value-added telecommunications businesses such as Internet access services, information services and other related businesses. The Company's A Shares and H Shares are listed on the Shanghai Stock Exchange and the Main Board of The Stock Exchange of Hong Kong Limited, respectively.

Summary Overview

China Telecom's E-surfing Safe Energy Lithium Battery Series is an in-house developed innovative product that features a breakthrough liquid cooling temperature control system, effectively eliminating the risk of spontaneous combustion in lithium batteries. Equipped with a self-developed high-power control chip supporting bidirectional AC-DC conversion, it serves as the core of an integrated solar-storage solution that incorporates photovoltaic power generation, environmental monitoring, and precision air conditioning control. Through an intelligent energy management platform utilizing AI algorithms, the system dynamically monitors power load changes in communication equipment rooms and optimally coordinates grid power, solar energy, and battery storage based on real-time electricity pricing, achieving up to 60% green energy utilization.

The solution has been extended to include derivative configurations such as solar-hydrogen-storage and multi-cabinet parallel systems, adapting to various communication scenarios. Its advantages include significant electricity cost savings through peak shaving, enhanced safety with proactive thermal management, and efficient integration of renewable energy sources including photovoltaic and wind power, providing a solid foundation for green energy transformation in digital infrastructure.

"The product pioneers a liquid cooling temperature control solution that effectively resolves the safety hazards associated with lithium battery spontaneous combustion."

Challenges Presented

As the core infrastructure of the digital society, communication equipment rooms face urgent challenges in reducing high energy consumption and achieving green transition. Currently, three major issues must be addressed:

(1) **High Energy Consumption:** Rising power demand from 5G and data centers has significantly increased electricity use and carbon emissions. Most communication facilities rely on fossil-fuel-based grid power, making energy-saving measures alone insufficient. A shift toward green energy is essential.

(2) **Barriers to Green Energy Adoption:** Large-scale procurement of green electricity remains challenging due to grid limitations, high costs, and underdeveloped trading mechanisms. Urban communication sites often lack space for photovoltaics, and technical issues in grid integration further limit practical use.

(3) **Safety Concerns with Energy Storage:** Traditional lithium batteries pose thermal runaway and fire risks, hindering large-scale deployment for backup and peak shaving. Safety incidents across industries have slowed adoption in communication facilities.

These interconnected challenges underscore the need for integrated photovoltaic and energy storage systems. Such solutions enable on-site green power generation and consumption within limited space, supported by safe storage technology. They facilitate peak shaving, self-consumption of renewable energy, and reduce grid dependence and emissions, addressing both sustainability and safety concerns.

Solution & Value

Solution Approach:

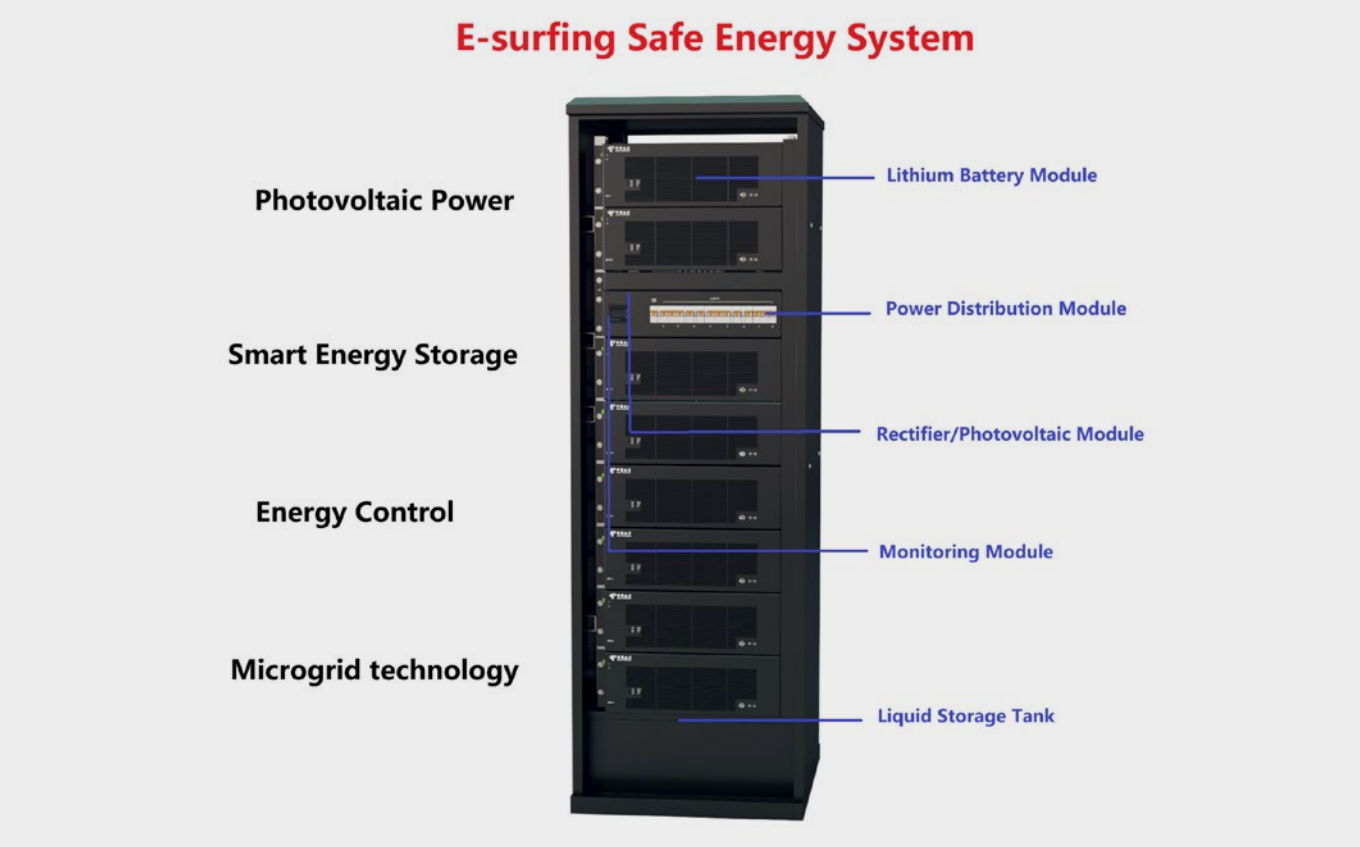
China Telecom's E-surfing Safe Energy Lithium Battery System is equipped with key components such as an early-stage liquid cooling module, renewable energy input module, lithium battery module, power distribution module, rectifier module, inverter module, monitoring module, and BMS battery management system. It can meet various power demands in communication scenarios, including DC charging, AC charging, energy storage, backup power, DC power supply, and AC power supply.

The E-surfing Safe Energy Lithium Battery System features a built-in renewable energy input module, which can integrate with various renewable energy sources such as solar, hydrogen, and wind power. Combined with the self-developed DC air conditioning system from China Telecom Research Institute, the E-surfing Safe Energy Lithium Battery System serves as the core component, enabling tailored solutions for different scenarios. This forms a series of E-surfing Safe Energy Lithium Battery products, including integrated solar-storage, solar-hydrogen-storage, and solar-storage-cooling systems. Additionally, the system includes five integrated modules—monitoring, lithium battery, power distribution, rectifier, and inverter—which work together to support smart energy storage in communication rooms, build microgrids, and provide stable and reliable backup power as well as DC and AC power supply for various electrical equipment.

Impact, Innovation, and Value:

The E-surfing Safe Energy Lithium Battery System solution has applied for 6 invention patents, 2 software copyrights, and 1 technological innovation novelty search report, while also owning the independent trademark brand "E-surfing Safe Energy." These Series products have been deployed in 12 provinces of China Telecom across China, covering 31 cities.

Figure 1: **Schematic Diagram of Product Functional Modules**



Commercial Benefits:

- The E-surfing Safe Energy Safe Lithium Battery Energy Storage System offers a battery shelf life of up to 3,750 cycles, nearly 10 times that of traditional lead-acid batteries, significantly reducing maintenance and replacement costs for backup batteries.
- Its volume and weight are only about one-fourth of traditional lead-acid batteries, saving construction space and structural load-bearing costs.
- An E-surfing Safe Energy integrated solar-storage system project in Guangzhou achieves an annual photovoltaic power generation of 33,000 kWh, with green electricity accounting for over 40% of total usage and electricity costs reduced by more than 60%.
- An integrated solar-storage-cooling system project in a communication room in Qingyuan reduces electricity costs by 58.5% through peak shaving and valley filling strategies.

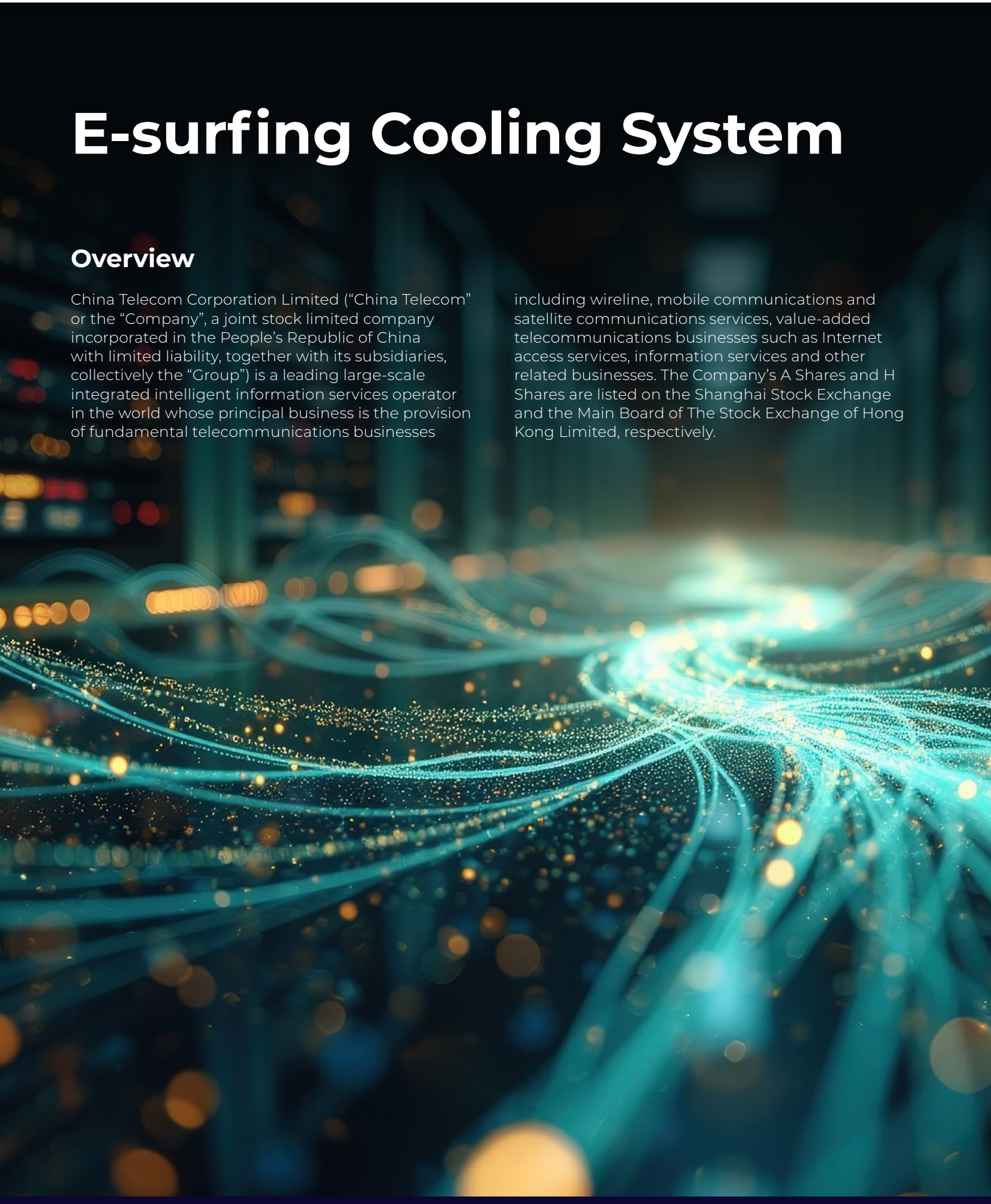
Key Learnings:

- During the preliminary planning of the project application, thorough on-site surveys should be conducted to confirm the DC load of the communication station and the available flat roof or ground area. Implementing a one-site-one-plan strategy will enable better configuration of the capacity of the energy storage system and photovoltaic system, maximizing the acquisition of green electricity and energy-saving benefits of the E-surfing Safe Energy Safe Lithium Battery Energy Storage System.
- In renovation projects for older stations, comprehensive floor load-bearing tests should be carried out to avoid floor cracking caused by added equipment, which could pose safety hazards.
- When lithium batteries are introduced into indoor environments such as communication stations and equipment rooms, local fire safety regulations must be followed. Fire emergency measures should be arranged in accordance with relevant standards.

E-surfing Cooling System

Overview

China Telecom Corporation Limited ("China Telecom" or the "Company", a joint stock limited company incorporated in the People's Republic of China with limited liability, together with its subsidiaries, collectively the "Group") is a leading large-scale integrated intelligent information services operator in the world whose principal business is the provision of fundamental telecommunications businesses including wireline, mobile communications and satellite communications services, value-added telecommunications businesses such as Internet access services, information services and other related businesses. The Company's A Shares and H Shares are listed on the Shanghai Stock Exchange and the Main Board of The Stock Exchange of Hong Kong Limited, respectively.



Summary Overview

The E-surfing Cooling Precision and Smart Pod (referred to as the E-surfing Cooling Pod), independently developed by China Telecom Research Institute, is specifically designed for high-power communication equipment to address challenges such as heat dissipation difficulties and high-power consumption. By optimizing airflow distribution, reducing cooling leakage, improving air conditioning efficiency, and eliminating local hotspots, it aims to reduce the operational energy consumption of data rooms and ensure a stable operating environment for electronic equipment.

The E-surfing Cooling Pod adopts a novel single-row DC pod architecture with fully enclosed hot and cold aisles, achieving precise and efficient cooling at the rack level. Under full load conditions, its annual PUE can be as low as 1.15. The E-surfing Cooling Pod offers numerous advantages, including a simple structure, easy installation, smart integration, visible energy efficiency, and rapid deployment. It breaks through the heat dissipation limitations of traditional air-cooling models, providing an efficient and energy-saving integrated solution for high-power ICT electronic equipment. Additionally, the product is compatible with ICT equipment of various airflow distribution types and power densities, making it suitable for applications such as renovations and new construction of communication room and data centers.

This solution has already been applied in regions such as Beijing, Shanghai, Guangdong, and Guangxi in China, achieving outstanding results. It addresses issues such as poor airflow distribution and frequent local hotspots in high-power communication equipment, achieving a PUE of less than 1.3.

Challenges Presented

With the advancement of technologies such as cloud computing, 5G, and AI, high-power ICT equipment—including servers, OTN devices, and routers—is being increasingly deployed in data centers. However, this trend introduces several critical challenges:

(1) **High power density leads to localized hotspots:** With rack power consumption often reaching 15–25 kW or even 30 kW, these hotspots necessitate additional cooling, increasing energy waste.

(2) **Poor airflow distribution and mixing of hot and cold air:** Inefficient airflow management results in the mixing of hot and cold air, especially in legacy cooling architectures. This leads to higher energy use, with PUE often exceeding 1.8.

(3) **Varied air flow patterns for different ICT equipment:** Servers use the method of cooling from front to back, while optical transmission network racks adopt the approach of same-side air intake and exhaust. This difference can cause air turbulence, thereby reducing the efficiency of heat dissipation.

(4) **Low cooling efficiency of air conditioning systems:** Both traditional "room-level" and "row-level" air conditioning solutions fails to provide precise cooling, resulting in wasted capacity and inadequate thermal management for high-density loads.

To meet rising power demands and stricter PUE standards, there is an urgent need for more economical and efficient cooling solutions to support sustainable data center operations.

Solution & Value

Solution Approach:

China Telecom Research Institute has independently developed the E-surfing Cooling Pod, which adopts a fully enclosed hot and cold aisle cooling system architecture to achieve precise cooling at the rack level. Under full load conditions, the pod's annual PUE can be as low as 1.15. The system architecture of the E-surfing Cooling Pod primarily includes a dedicated power distribution main cabinet, self-developed air conditioning units, self-developed dedicated cold aisle components, self-developed dedicated hot aisle components, high-power density cabinets, AI intelligent devices cabinet, and customized safety protection devices. Each row of pods can be customized with the number of racks based on actual needs, and it supports horizontal expansion.

By utilizing a fully enclosed system architecture for both cold and hot aisles, the E-surfing Cooling Pod completely isolates cold and hot airflows, reducing heat exchange losses with the environment and achieving full utilization of cooling

"By optimizing airflow distribution, reducing cooling leakage, improving air conditioning efficiency, and eliminating local hotspots, it aims to reduce the operational energy consumption of communication equipment rooms."

capacity. Simultaneously, it increases the return air temperature of the air conditioning system, enabling precise and efficient cooling, maximizing air conditioning operational efficiency, and reducing energy consumption. It breaks through the limits of traditional air-cooling capabilities, supporting a power density of up to 30kW per rack.

The E-surfing Cooling Pod can replace the inefficient traditional cooling approach of "cooling the environment first, then cooling the equipment," addressing challenges such as poor airflow distribution and mixing of hot and cold air in legacy data centers.

Impact, Innovation, and Value:

The E-surfing Cooling Pod possesses independent core intellectual property rights, with nearly 20 national patents, 1 PCT patent, 1 industry standard approved, and 1 SCI paper (Zone 2). The E-surfing Cooling Pod has been deployed in projects such as a data center in Beijing, the Yuanyang Lake Project in Yangjiang, Guangdong, and the Zhanlong Expansion Equipment Room Project in Jieyang, Guangdong.

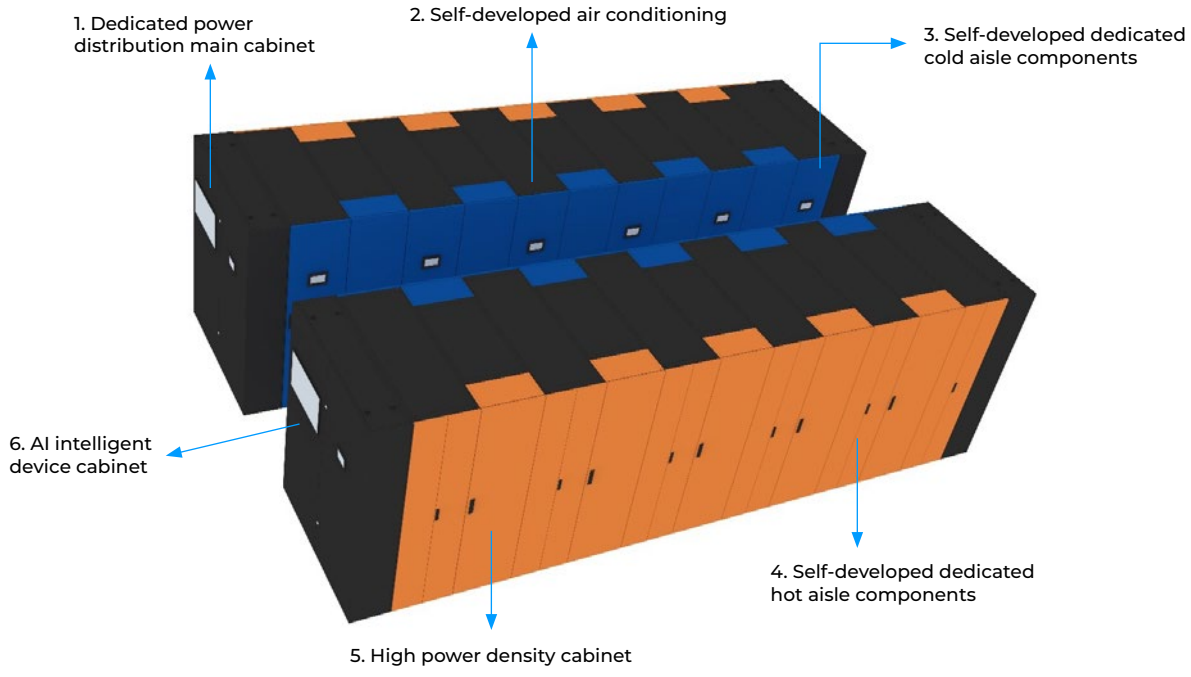
Commercial Benefits:

- It addresses issues such as poor airflow distribution and frequent localized hotspots in high-power communication equipment, achieving a PUE below 1.3.
- Compared to traditional air-cooled data centers, it improves efficiency by 30%, increases single-cabinet power density to 30kW, and reduces the floor area of the equipment room by 30% to 60%.
- It has reduced significant on electricity costs, land resources, and construction expenses.

Key Learnings:

- By adopting a single-row, fully enclosed hot and cold aisle design, complete isolation of hot and cold airflows can be achieved, enabling highly efficient cooling.
- Overreliance on traditional room-level, inefficient cooling methods must be abandoned in favor of localized and precise air supply.
- Further optimization of the supply chain (e.g., standardizing hot and cold aisle components) is needed to reduce transportation and installation costs, and facilitate large-scale adoption of the E-surfing Cooling Pod.

Figure 1: **System Architecture Diagram of the E-surfing Cooling Pod**



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Globe

Sustainable Material Management Program

Overview

Globe Telecom's Broadband Business Customer Field Services (CFS) team has pioneered innovative approaches to material sustainability through partnerships with our vendor network. Our comprehensive waste reduction strategy transforms installation materials from potential landfill waste into valuable resources, while simultaneously improving operational efficiency.

Our flagship initiative, the Disposal, Recycle, and Upcycle Program, addresses the environmental impact of fibre installation materials by implementing a circular economy approach. By converting fibre spools into functional items and repurposing fibre drop wires, we've successfully diverted over 6.6 tons of plastic from landfills. This core program is complemented by our truck roll optimization, modem refurbishment, and sustainable packaging initiatives, creating a holistic approach to environmental stewardship. Together, these programs demonstrate how telecommunications operations can achieve significant sustainability gains while maintaining service excellence and cost efficiency.

Challenges Presented

Problem Statement

Globe Telecom's broadband installation and maintenance activities produce significant material waste, especially from fiber spools and drop wires, leading to environmental risks and lost opportunities for resource recovery. In addition, frequent and unnecessary truck rolls increase carbon emissions, underscoring the need for more sustainable solutions such as remote network fault detection and resolution.

Specific Challenges Encountered

- **Material Waste Volume:** Thousands of fibre spools and kilometres of drop wire were being discarded after single use
- **Limited Recycling Infrastructure:** The Philippines lacks comprehensive recycling facilities for specialized telecommunications materials
- **Plastic Pollution:** By August 2025, over 1.6 million cable rolls and accessories (6.6 tons of plastic) were at risk of incineration or landfill disposal
- **Community Impact:** Waste materials affected local environments where broadband services were being deployed
- **Sustainable Alternatives:** Traditional plastic packaging and components lacked environmentally friendly alternatives

Constraints and Requirements

- Develop solutions applicable across 51 clusters of Broadband Business Customer Field Services Vendors
- Create practical applications for materials that would otherwise become waste
- Engage local communities in sustainable practices
- Implement programs without disrupting broadband installation and maintenance operations
- Establish measurable environmental impact metrics

Solution & Value

Core Initiative: Disposal, Recycle, Upcycle Program

1. **Recycling Transformation:** Converted fibre spools into pre-school stools and trash bins
2. **Community Upcycling:** Repurposed fibre drop wires into vegetable trellises, chicken cages, fruit baskets, and decorative items
3. **Responsible Disposal:** Partnered with specialized recyclers like WARM and Green Antz
4. **Sustainable Materials:** Implemented biodegradable packaging for fibre drop spools, eliminating plastic insulation and minimizing plastic wraps
5. **Material Conversion:** Replaced plastic cable reel accessories with wood components that can be sold to junk shops, creating a new revenue stream

Supporting Initiatives

1. **Truck Roll Optimization:** Reduced invalid repair tickets by 80% through automated systems, preventing 569.36 tons of CO2 emissions
2. **Electric Vehicle Deployment:** Introduced 20 electric vehicles for service calls, avoiding 191.76 tons of CO2 emissions, including use of electric scooters in the central business district to navigate through traffic.
3. **Modem Refurbishment:** Reduced costs from PHP 674.75 to PHP 100 per unit while eliminating inter-island logistics
4. **Sustainable Packaging:** Transformed modem boxes into laptop stands, extending usefulness beyond initial purpose


Community Upcycling

Community Upcycling


Responsible Disposal


Material Conversion

Project Impact, Innovation and Value

- **Material Recovery:** Successfully diverted 1,636,489 cable rolls and accessories from landfills
- **Community Engagement:** Donated 695 fibre spool materials to recycling partners and 725 spools to local communities
- **Creative Repurposing:** Converted 215 fibre spools and 24,740 meters of fibre drop waste cables into functional items
- **Plastic Reduction:** Prevented 6.6 tons of plastic from incineration and landfill disposal
- **Regional Implementation:** Successfully deployed across Luzon and Vismin areas including Laguna, Bulacan, Camanava, South GMA, Cebu, and Davao

Commercial Benefits

- **Waste Management Cost Reduction:** Eliminated expenses related to proper disposal of materials
- **New Revenue Stream:** Created income from selling wood components, nuts, and bolts to junk shops
- **Operational Funding:** Generated funds for warehouse departments to cover office supplies and fuel costs
- **Community Relations:** Improved relationships with local communities through material donations
- **Brand Enhancement:** Strengthened Globe's reputation as an environmentally responsible corporation


Electric Vehicle Deployment


Modem Refurbishment


Sustainable Packaging

Key Learning

Sustainability Transformation

Globe Telecom's Broadband Business Customer Field Services has successfully implemented a comprehensive sustainability framework that transforms operational waste into valuable resources while reducing environmental impact. By reimagining telecommunications materials as assets rather than waste, the team has created circular economy solutions that span industries—converting fibre spools into school furniture and repurposing drop wires for agricultural applications. This approach has been systematized through detailed documentation, enabling vendor partners to independently scale these practices while fostering community partnerships that multiply impact through knowledge sharing and innovation.

Simultaneously, operational improvements like truck roll optimization and electric vehicle adoption have significantly reduced carbon emissions, with over 569 tons of CO2 avoided through process efficiencies alone.

The program's success stems from its integrated approach that embeds sustainability within existing workflows rather than treating it as a separate initiative. By establishing clear measurement protocols that translate technical achievements into relatable environmental benefits, the team has created accountability and healthy competition among vendor partners.

This has driven continuous improvement while influencing equipment design toward greater recyclability. The transformation extends beyond materials to organizational culture, with sustainability metrics incorporated into performance evaluations and leadership visibly participating in sustainability initiatives, signalling organizational commitment that resonates with employees and customers alike.

Key Takeaways

- **Think Circular:** Evaluate all materials for second-life potential before classifying as waste; most telecommunications items have 2-3 viable applications
- **Integrate, Don't Separate:** Embed sustainability checkpoints within existing workflows rather than creating isolated "green" initiatives
- **Measure What Matters: T**ranslate technical achievements into relatable environmental metrics (trees saved, emissions avoided) to increase engagement
- **Document Success:** Create visual libraries of successful transformations to facilitate knowledge sharing and scaling
- **Align Incentives:** Include sustainability metrics in performance evaluations to drive meaningful behavioural change
- **Engage Communities:** Partner with local groups who can provide valuable feedback while becoming sustainability advocates

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OOKLA®

Turning Wanderlust into Roaming Revenue

Overview

Ookla, a global leader in connectivity intelligence, brings together the trusted expertise of Speedtest®, Downdetector®, Ekahau®, and RootMetrics® to deliver unmatched network and connectivity insights. By combining multi-source data with industry-leading expertise, we transform network performance metrics into strategic, actionable insights.

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Our solutions empower service providers, enterprises, and governments with the critical data and insights needed to optimize networks, enhance digital experiences, and help close the digital divide. At the same time, we amplify the real-world experiences of individuals and businesses that rely on connectivity to work, learn, and communicate. From measuring and analyzing connectivity to driving industry innovation, Ookla helps the world stay connected.

Ookla is a division of Ziff Davis (NASDAQ: ZD), a vertically focused digital media and internet company whose portfolio includes leading brands in technology, entertainment, shopping, health, cybersecurity, and martech.

Project Executive Summary

Tools to Assess Roaming in Latin America and Elsewhere

As in many other areas of the world, post-pandemic travel into, out of and throughout Latin America is on the rise. And that's no surprise: Whether the destination is Rio de Janeiro, Cancún, Iguazu Falls or the inside of an important client's office, many of the 20 countries that make up Latin America are reporting major increases in tourism and travel.

And – as in many other areas of the world – this is paramount to the mobile network operators that cover Latin America. That's because more travel means more possible revenues from roaming. After all, wireless connectivity is quickly shifting from a travel convenience to a travel necessity.

Here's a look at how Ookla data can help operators navigate their roaming businesses through these changes.

Key Takeaways:

- Plenty of new trends are poised to cut into operators' roaming revenues such as increasingly capable and available Wi-Fi options. Beyond that, eSIM operators are threatening to upend traditional competitive dynamics. Some regulators are pushing for cheaper and simpler roaming agreements. And some bigger operators are using their competitive weight to push for unlimited international roaming options.
- Amid these threats, Ookla Speedtest® data can help operators ascertain their customers' top travel destinations. Knowing that Canada is one of the top stops for travelers from Mexico, for example, can help guide operators in their pursuit of international roaming agreements.
- Ookla data can also help illuminate some operator's existing roaming strategies. For example, it seems some providers, like America Movil, have kept their customers' connections inside their own network footprints, or those of select partners. Meanwhile, other operators have been more willing to let their traveling customers roam onto a variety of competing networks.
- Finally, it's clear that Latin American travelers can have a wide variety of roaming experiences. In some cases, customers' travel connections have been faster than the speeds they receive in their home country – for example, users with Telefonica service from Mexico recorded 34.4 Mbps median download speeds in Mexico, but 55.8 Mbps median download speeds when they traveled internationally.

Challenges Presented

Problem Statement:

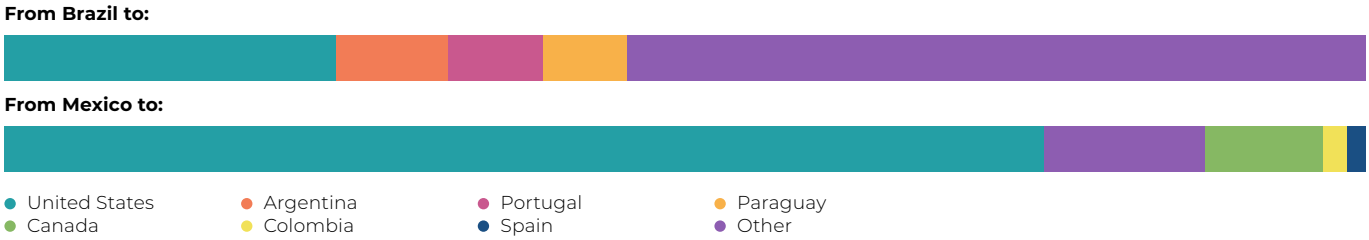
(1) Travel Destinations

Mexico has a population of 131 million, putting it second to the region's biggest country, Brazil, which counts 212 million residents. But Mexico is the undisputed tourism leader in Latin America. The country attracted 45 million international visitors in 2024, up 7.4% from the previous year. Brazil, for its part, hosted 6.8 million international tourists in 2024, up 14.6% year over year.

Those figures are undoubtedly a boon to the two countries' mobile network operators, which can profit from the sale of roaming connections to all those inbound travelers. However, those same operators also must address outbound roaming fees if they want to keep their customers connected when they travel abroad. This is where Ookla data comes in handy.

Over the past 12 months, customers with service from a Mexican mobile network operator often traveled to the US or Canada, according to Ookla Speedtest data. Other top destinations for travelers from Mexico included Colombia, Spain and Guatemala. Similarly, the US was a top destination for customers who purchased their mobile services from a Brazilian operator. Other top destinations for such customers included Argentina, Portugal, Paraguay and Italy.

Figure 1: **Latin American travelers' top roaming destinations** *(Past 12 months)*



The US was also a popular destination for travelers from other Latin American countries, such as Argentina and Chile, though not to the same degree as for travelers from Mexico (which of course sits on the southern border of the US).

Regardless, this kind of information can help guide Latin American operators as they sign roaming agreements with their international operator peers – and those decisions will ultimately impact the experiences their roaming customers will receive. After all, customers who use the Speedtest app to check their connections are probably the ones who care about the quality of those connections. Within this data, it's also worth noting that almost all of these countries are enjoying a general rise in their overall mobile Internet speeds. That's important given the concurrent increase in the number of people traveling across Latin America's borders.

This rise in speeds spans much of the region – except for outlying locations such as Paraguay, where 5G is still in its infancy.

This kind of network performance information can also help assuage travelers who are increasingly relying on their phones for travel necessities like maps, translation apps and, of course, sun-drenched Instagram posts – as long as their roaming plans provide access to these speedy networks.

Figure 2: **Median mobile download speeds at top destinations for Latin American travelers**
(From Ookla Speedtest Intelligence, for all cellular technologies)

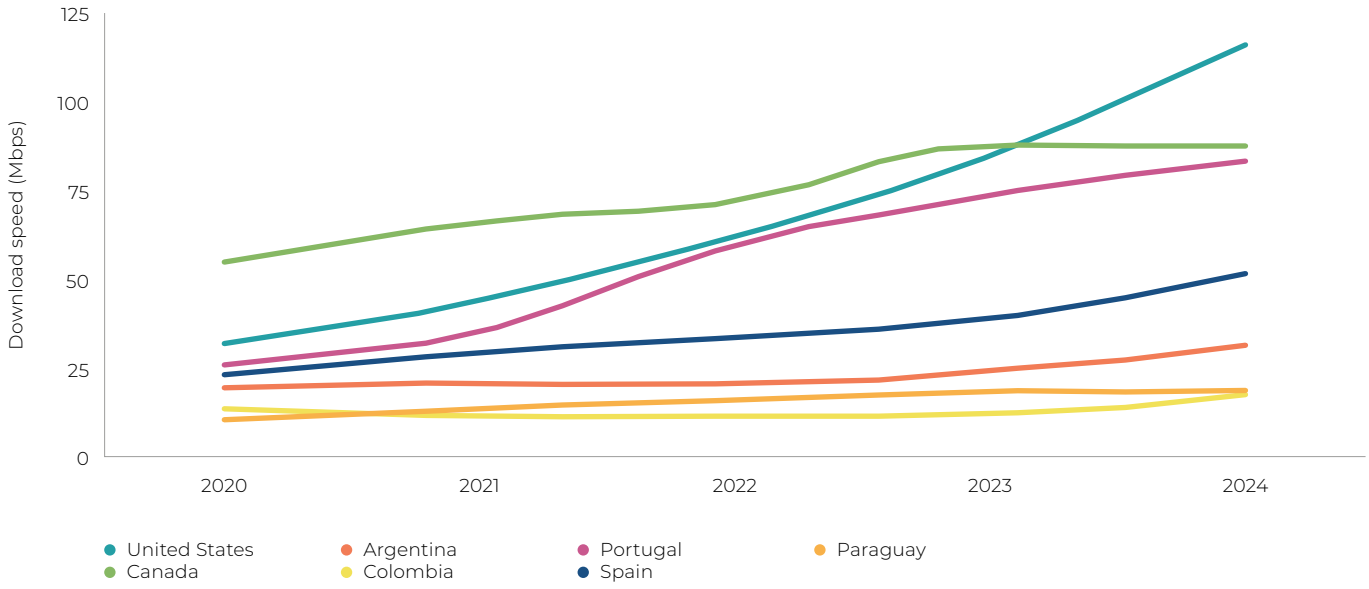
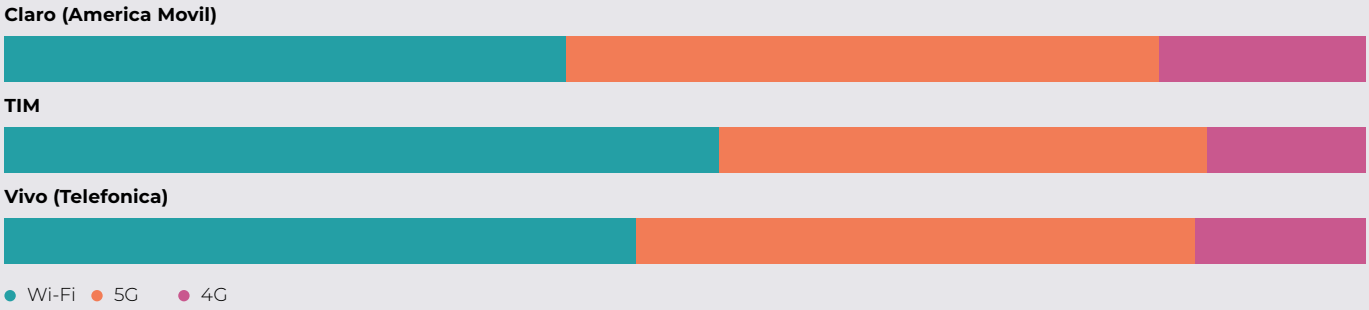


Figure 3: **Travelers from Brazil & Mexico to the US, by connection type**
(Customers who purchased service in Brazil & Mexico and then connected to a US network, past 12 months)



(2) Picking the right connection
Like all modern travelers, Latin American globetrotters must decide: Cellular or Wi-Fi? Is it possible to use local Wi-Fi connections in order to avoid a mobile operator's international roaming fees?

Over the past 12 months, it appears that travelers who hail from Mexico were keen to employ the Wi-Fi option. For example, more than half of all travelers from Mexico to the US relied on Wi-Fi connections instead of 4G LTE or 5G when they arrived in the US. In contrast, travelers who bought service from an operator in Brazil and then traveled to the US didn't show nearly as much interest in Wi-Fi as their Mexican peers.

Travelers originating in Argentina, Colombia and Chile showed this same proclivity for Wi-Fi. Indeed, roughly 80% of the mobile customers over the past 12 months who purchased service in Argentina and then traveled to Brazil (the top destination for these kinds of Argentinian travelers) connected to Wi-Fi when they arrived in Brazil.

However, this could be due to a variety of factors beyond the price of international cellular data. For example, Mexico City's "Internet for All" initiative, aimed at bridging the digital divide, now spans tens of thousands of free Wi-Fi hotspots, earning the effort a nod from the Guinness World Records in 2021. Since 17% of Mexico's total population lives in the larger Mexico City metropolitan area, travelers from Mexico may have a higher affinity for public Wi-Fi connections.

But Wi-Fi isn't the only technology affecting the roaming equation for mobile customers and network operators in Latin America and elsewhere. For example, eSIM technology allows travelers to bypass their home operator's roaming packages in favor of local or regional data plans that may be less expensive. This trend could help erode operators' legacy roaming revenues – the GSMA projects that a remarkable 75% of smartphone connections in Latin America will use eSIM by 2030.

A final, critical factor that may affect the Latin American market stems from unlimited roaming offerings. For example, T-Mobile and AT&T are selling premium plans in the US that include roaming across Latin American at no extra cost. This reframes international connectivity as an included feature rather than a costly add-on – another competitive lever against the traditional roaming business model.

(3) Roaming costs and roaming partners
A central question in any analysis of the Latin American roaming market is the financial impact of such services on operators, whether through fees paid to their international roaming partners or through revenues gained from inbound connections. However, obtaining precise figures in this area is difficult since operators generally do not disclose roaming revenues in their public financial statements.

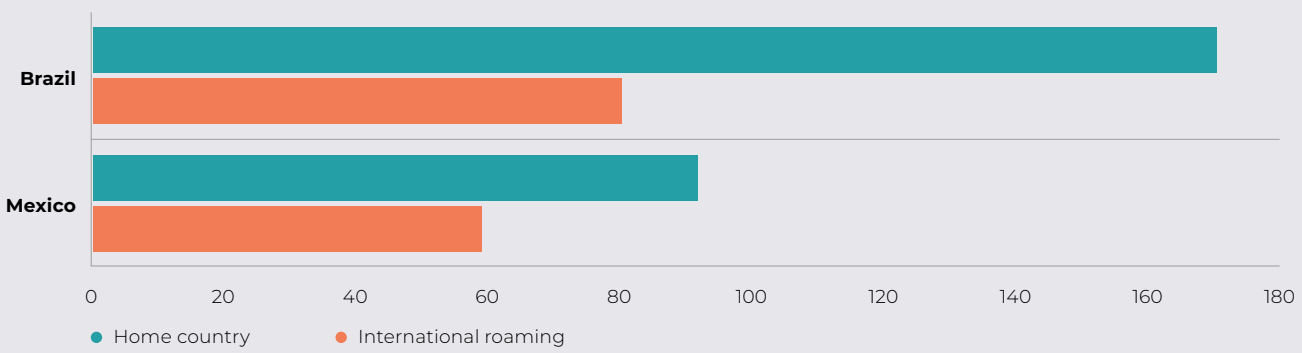
An anecdotal view of the situation comes from Telecom Argentina's 2024 financial results, which list "roaming, international settlement charges and lease of circuits" among expenses totalling $118.5 billion Argentine pesos, or around $90 million US dollars. That's roughly 2.8% of the telecom operator's total consolidated operating costs.

These expenses can be affected by a variety of factors. Variations in exchange rates – such as the appreciation of the Mexican peso and the Brazilian real against the US dollar – can substantially influence the profitability of operators' roaming agreements. And

Figure 4: **America Movil roaming connections to US operators** *(Past 12 months)*

Figure 5: **America Movil & Telefonica's customers' connections when roaming** *(Past 12 months)*

Figure 6: **Median mobile download speeds in home countries vs roaming countries**
(All cellular technologies, past 12 months)



local regulations can have a major impact as well. For example, the telecom regulator in Mexico, IFT, recently renewed rules governing the rates America Movil can charge other operators for roaming onto its network in Mexico, in a bid to expand telecom competition in the country.

Although roaming revenues might be difficult to assess, operators' roaming partners are a bit clearer. Here too Ookla data can offer some insights. For example, over the past 12 months it appears that America Movil strongly favored one roaming partner per country. In the US, that was mostly T-Mobile.

Further, in many markets where the company operates its own network, Ookla data showed that America Movil was reluctant to push its customers onto any other operator's network except its own. Other big operators, like Telefonica, appeared more open to maintaining multiple roaming relationships.

AT&T, meantime, appeared to take an egalitarian approach to roaming in Canada by spreading its mobile customers – those with service from Mexico – evenly across Canada's top mobile network operators: Telus, Bell, Rogers and Videotron. But, like other operators, AT&T pushed most of its customers in the US and in Mexico onto its own network in those countries.

So, what to make of these approaches to roaming? First, it's worth noting that Ookla data showed the median mobile download speeds that customers received in the locations where they traveled as well as in the market where they initially purchased their mobile services:

Thus, mobile users who purchased America Movil's services in Brazil, for example, saw a clear decline in speeds when they were roaming vs. when they were in Brazil. But in other cases the reverse was true. As shown in the above chart, when a customer purchased their service in Mexico and then traveled abroad, they tended to find faster speeds at their destination if they were a Telefonica customer.

To be clear, network quality can vary by destination. Latin American customers who travel to the US, for example, will probably receive higher overall speeds than if they travel to Paraguay. That's because US operators are roughly five years into their 5G buildouts whereas operators in Paraguay are just getting started.

Nonetheless, this data can help operators understand their customers' roaming experiences, and then adjust as necessary.

Solution & Value

Conclusions and recommendations

The roaming market globally, as well as in Latin America, is undergoing significant change. Some of that change is obvious – for example, Telefonica is offloading its mobile businesses in Argentina (to **Telecom Argentina**), Colombia (to **Millicom**), Peru (to **Integra Tec**), Uruguay (to **Millicom**) and Ecuador (again to **Millicom**). AT&T too is reportedly considering a sale of its business in Mexico. All these ownership changes could affect the region's roaming agreements.

Other changes may be less clear, given the opaque nature of roaming revenues in general and the quiet rise of independent eSIM providers like Airalo and Holafly.

But there are a few things that operators in Latin America and elsewhere can focus on amid these changes:

Network performance. As 5G expands throughout Latin America, mobile customers in the region will likely begin to focus more closely on the quality and coverage of their 5G connections while they're traveling. Similarly, big mobile network operators outside the region will be watching the construction of 5G networks in Latin America carefully as they decide how to keep their own roaming customers connected. Latin American operators that can offer a reliable, high-speed 5G experience may have a better chance at winning these roaming deals.

Digital experience. Operators that make international travel easy and seamless may be a step ahead of startup eSIM operators or Wi-Fi providers. For example, they may want to consider no-extra-charge roaming plans if such services can profitably attract high-value customers. Alternatively, operators could consider simplified purchasing and management systems for roaming, to prevent their customers from seeking eSIM alternatives.

Efficiency. Roaming-focused infrastructure may improve operators' traffic management. For example, local breakouts can route mobile customers' Internet traffic directly into the nearest local Internet exchange in the country they're visiting, rather than all the way back to their home country's network. This reduces customers' overall latency and improves their experience (this too is recorded in Ookla data). Operators may also consider using blockchain technology, such as the GSMA's eBusiness Network, to speed up roaming settlements.

WORLD BROADBAND ASSOCIATION

About the World Broadband Association

The World Broadband Association (WBBA) is a multilateral, industry-led association, providing leadership for digital broadband innovation across the next decade.

Our objective is to overcome industry challenges and drive the provision of networks and services for all. We aim to accelerate the healthy development of the global telecom industry, creating sustainable benefits for stakeholders, end users, and society. The WBBA is an independent not-for-profit industry organisation registered in Switzerland.

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