

Decoding Meaningful Connectivity Framework: Leveraging Thailand's Universal Service Obligation (USO) Policy for Enhancing Fixed Broadband Adoption in Rural Communities

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Abstract

Despite substantial public investment in Thailand's Universal Service Obligation (USO) policy, a persistent gap remains between broadband availability and actual household adoption in rural areas. While physical networks have expanded, household-level subscriptions and regular usage continue to lag, indicating that "access" alone does not guarantee "inclusion." This study investigates how Thailand can reorient its USO policy from a traditional coverage centric approach toward a "Meaningful Connectivity" framework. The research adopts a policy-oriented mixed-methods approach. It combines a systematic review of meaningful connectivity frameworks with an analysis of Thai national regulator data. This establishes a conceptual link between fixed broadband adoption and four key dimensions: quality of service, affordability, reliability, and regularity of use. The findings reveal that expanding coverage alone is insufficient to bridge the digital divide. Rural adoption is heavily constrained by affordability barriers, and a lack of alignment between technology deployment and user needs. Evidence indicates that rural households are significantly more likely to adopt fixed broadband when service quality meets specific performance thresholds regarding speed, stability, and latency. Without reliable performance, infrastructure remains underutilized and cannot support socio-economic activities such as online learning, telemedicine, or digital financial services. The study concludes that Thailand's USO framework must transition toward an adoption-oriented model that integrates quality of service, affordability, and usability into core objectives and funding mechanisms. Furthermore, digital literacy initiatives and locally relevant applications are essential to transform access into sustained demand. By addressing these dimensions, Thailand can bridge the "missing link" between universal access and meaningful connectivity, ensuring that digital development is truly inclusive.

Keywords: meaningful connectivity, Universal Service Obligation (USO), fixed broadband, quality of service (QoS)

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Introduction

The Limits of Coverage-Based Policy

Over the past two decades, broadband infrastructure deployment has become central to national digital development strategies worldwide. Universal Service Obligation (USO) policies have been widely used to expand connectivity in underserved communities through public funding and operator contributions. Traditionally, policy success has been measured through infrastructure indicators such as coverage rates, villages connected, and “homes passed” However, growing evidence suggests that physical access alone does not necessarily translate into household adoption or meaningful participation in digital life. As infrastructure coverage approaches saturation in many middle-income economies, digital inequality increasingly reflects differences in affordability, service quality, digital capability, and actual usage rather than infrastructure availability itself.

This shift is particularly visible in countries where broadband infrastructure has expanded rapidly but household-level adoption continues to lag behind network availability.

Thailand’s Access-Adoption Paradox

Thailand serves as a critical case study illustrating both the operational success and the structural limitations of a coverage-centric USO policy. Managed by the National Broadcasting and Telecommunications Commission (NBTC), flagship initiatives like the “Fiber-to-the-Village” and Net Pracharat programs successfully extended broadband access to over 74,987 rural villages, encompassing 10.48 million residents. Despite these infrastructure achievements, national evidence suggests that access has not translated uniformly into household adoption and sustained use. Yet, these aggregated indicators conceal a persistent gap between infrastructure availability and household adoption the “Access-Adoption Paradox.” According to National Statistical Office (NSO) Household ICT data, 95.4% of rural non-municipal households without home internet cite demand-side barriers as their primary reason for non-adoption, whereas only 0.6% report an absence of infrastructure. While rural residents may access shared public Wi-Fi hotspots, fixed broadband household subscriptions remain relatively low. This suggests that the current framework has largely addressed physical access but has been less effective in creating the socio-economic conditions required for sustained household-level adoption.

Research Purpose and Questions

This study examines how Thailand can move beyond a coverage-oriented USO model toward an adoption-oriented approach to digital inclusion. Drawing on the Universal and Meaningful Connectivity (UMC) framework, the paper addresses three research questions concerning the adequacy of coverage-based policy, the drivers of household adoption, and opportunities for policy redesign. By focusing on the relationship between infrastructure provision and meaningful use, this study contributes to broader discussions on digital inclusion and offers policy insights for digitally maturing societies facing similar access-adoption challenges. To address the Access-Adoption Paradox, this paper investigates three interconnected research questions:

1. Is a conventional, coverage-based USO policy sufficient to achieve meaningful connectivity?
2. What structural factors explain the persistent gap between broadband availability and actual household adoption in rural Thailand?
3. How can the Thailand's USO policy be redesigned to better support household broadband adoption?

Literature Review and Conceptual Framework

From Universal Access to Meaningful Connectivity

Traditional universal service policies have historically conceptualized digital inclusion through physical infrastructure expansion and network availability. Under this logic, policy effectiveness has largely been evaluated through indicators such as coverage rates, villages connected, and household access. However, emerging scholarship increasingly argues that infrastructure availability alone is insufficient to ensure meaningful participation in digital life.

Van Dijk's (2020) digital divide theory proposes that digital inclusion develops through several interrelated forms of access, including motivational, material, skills, and usage access. While supply-side interventions such as USO policies address material access, they often overlook the conditions required for sustained adoption and productive use creating a barrier that completely bypasses the cognitive and economic dimensions of technology appropriation. Similarly, Hilbert (2016b) demonstrates that infrastructure deployment frequently outpaces household-level adoption, creating a condition described as "coverage without use." As countries approach infrastructure maturity, digital inequality increasingly reflects differences in affordability, service quality, digital capability, and patterns of use rather than simple physical availability.

Understanding the Access-Adoption Paradox

The Access-Adoption Paradox refers to situations in which broadband infrastructure exists but household subscription and meaningful use remain limited. Existing research suggests that this disconnect emerges because connectivity decisions are shaped not only by network availability but also by broader socio-economic conditions. Three recurring barriers are identified in the literature.

First, the Performance Gap refers to inconsistent service quality and poor network experiences, which reduce user's willingness to subscribe or remain connected.

Second, the Affordability Gap reflects the financial burden created by high subscription costs and device ownership requirements.

Third, the Readiness Gap involves insufficient digital skills, limited confidence, and a weak perceived relevance of online services.

These dimensions interact and reinforce one another, suggesting that infrastructure expansion alone may not be sufficient to achieve inclusive digital outcomes.

Universal and Meaningful Connectivity Framework (UMC)

To address these multidimensional barriers, this study adopts the Universal and Meaningful Connectivity (UMC) framework. Rather than treating connectivity as a binary condition, the framework understands digital inclusion as more than the mere presence of a network signal.

Instead, the UMC framework defines meaningful connectivity as the ability for everyone to access a safe, affordable, productive, and enriching online experience. It also identifies six interrelated enabling dimensions that support sustained digital participation:

1. **Infrastructure:** The availability of high-capacity, high-speed mobile and fixed networks.
2. **Affordability:** The financial accessibility of network subscriptions and user equipment relative to household income thresholds.
3. **Devices:** The individual or household ownership of internet-enabled devices, with a distinct emphasis on the contrast between smartphones and a large-screen computing hardware.
4. **Skills:** The continuum of digital literacy, ranging from basic navigational capabilities to advanced professional and productive application usage.
5. **Security:** The underlying resilience of data architectures and network protocols against external malicious threats.
6. **Safety:** The psychological and operational protection of users against online harms, fraud, and misinformation.

As countries move from basic connectivity toward meaningful connectivity, expectations shift from simple access toward quality, affordability, reliability, and effective use.

Research Gap and Conceptual Framework

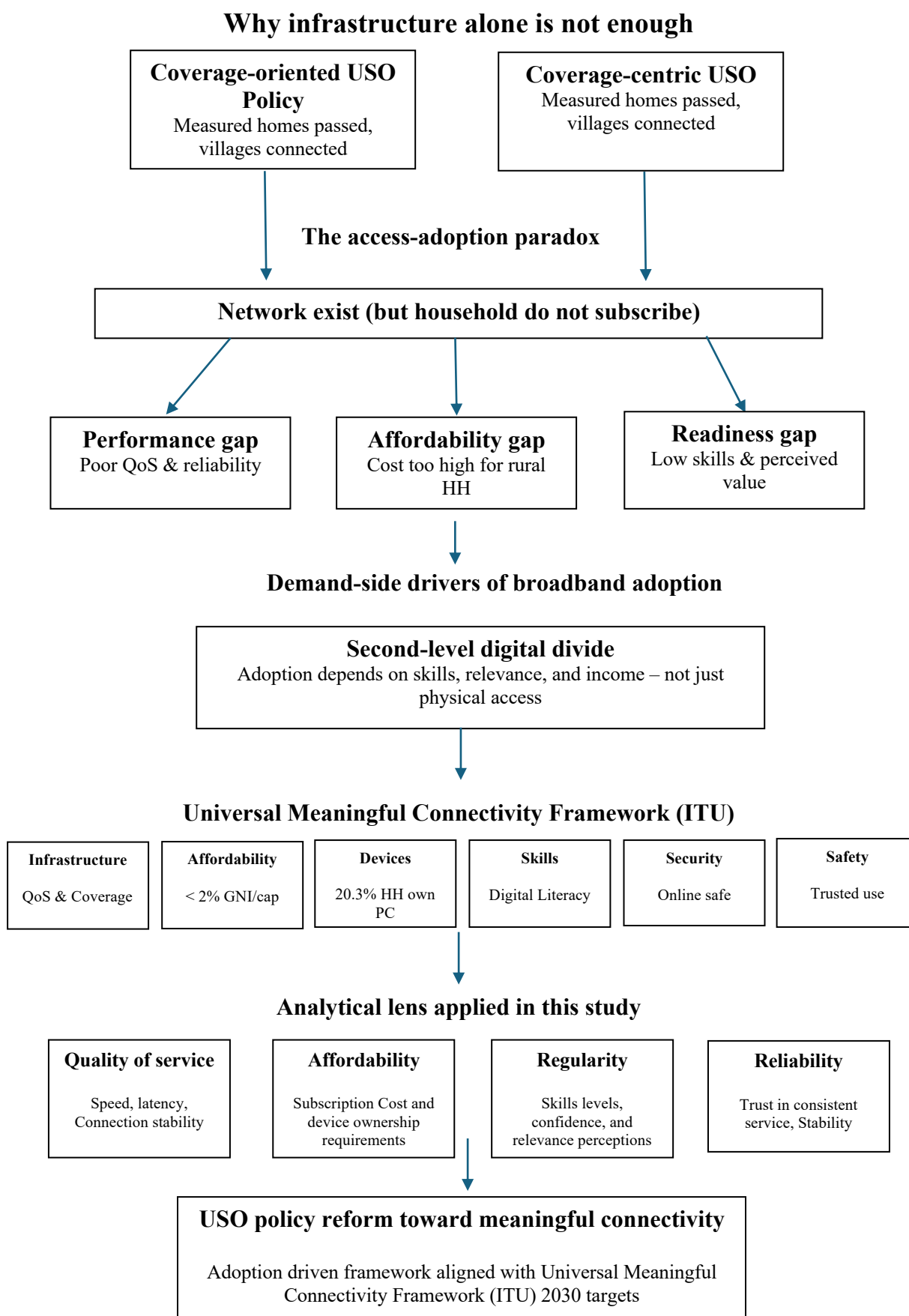
Although previous studies acknowledge the importance of adoption and digital capability, limited research integrates digital divide theory with universal service policy evaluation to explain why broadband availability does not consistently translate into household-level adoption.

This study addresses this gap by combining the Access–Adoption Paradox perspective with the UMC framework to examine how demand-side conditions influence broadband adoption outcomes in rural Thailand.

Accordingly, this study proposes a conceptual framework in which coverage-based USO policy creates infrastructure availability but household adoption is mediated through four key dimensions selected from the UMC framework: Quality of Service (QoS), Affordability, Reliability, and Digital Readiness.

These dimensions ultimately shape household broadband adoption and determine whether infrastructure translates into meaningful connectivity.

Conceptual Framework



The conceptual framework illustrates the conceptual logic of this study. It proposes that although coverage-oriented USO policies improve infrastructure availability, network expansion alone does not necessarily lead to household broadband adoption. Instead, adoption outcomes are shaped by demand-side conditions associated with meaningful connectivity. Drawing on the UMC framework, this study focuses on four analytical dimensions: Quality of Service, Affordability, Reliability, and Digital Readiness to examine how Thailand's USO policy can move beyond coverage toward meaningful connectivity.

Table 1

From Universal Connectivity to Meaningful Connectivity: Conceptual Shift in Digital Inclusion

Dimension	Universal Connectivity	Meaningful Connectivity
Primary Objective	Expand network availability	Enable meaningful digital participation
Definition of Inclusion	Connected vs unconnected	Quality, regularity, and usefulness of connectivity
Success Indicators	Coverage rates; home passed	Adoption: affordability; quality; sustained use
Policy Orientation	Supply-side intervention	Integrated supply and demand side approach
USO Fund Logic	Subsidies tied directly to physical deployment targets. Physical access gap	Funding linked to performance standards and adoption outcomes.
Expected Outcome	Infrastructure expansion	Social and economic participation

Source: Adapted and synthesised by the author based on ITU & UNICEF (2022), A4AI (2020), van Dijk (2020), and OECD (2021).

Table 1 summarizes the conceptual shift from universal connectivity toward meaningful connectivity. While traditional connectivity approaches focus primarily on expanding infrastructure and physical access, meaningful connectivity emphasizes the conditions that enable sustained and productive digital participation, including affordability, quality, and effective use. This distinction provides the conceptual basis for analyzing Thailand's USO policy beyond coverage outcomes alone.

Methodology

Research Design

This study adopts a policy-oriented mixed-methods approach structured across three analytical phases: (1) systematic literature review, (2) secondary quantitative data analysis using a gap analysis approach, and (3) policy synthesis. This design enables analytical triangulation across two complementary components. First, the literature review establishes the conceptual foundations of meaningful connectivity and identifies the theoretical dimensions relevant to broadband adoption. Second, secondary quantitative analysis is used to examine the extent of the Access-Adoption gap and explore the conditions associated with household broadband adoption in rural Thailand.

Secondary data are drawn from official national and international sources, including the National Statistical Office (NSO) Household ICT Survey, National Broadcasting and Telecommunications Commission (NBTC) Telecom Thailand Indicator Database (TTID), the

ITU Universal and Meaningful Connectivity (UMC) Dashboard, Freedom House, DataReportal, and the Speedtest Global Index.

Rather than evaluating success solely through infrastructure deployment indicators, this study focuses on how demand-side conditions shape broadband adoption outcomes and meaningful connectivity.

Analytical Approach

Guided by the conceptual framework developed in Section 2, the analysis examines four dimensions associated with household broadband adoption: Quality of Service (QoS), Affordability, Reliability, and Digital Readiness. These dimensions are analyzed to evaluate how infrastructure availability translates into actual adoption and sustained use.

1. Quality of Service (QoS): Evaluated to assess whether rural infrastructure matches national broadband baselines, directly addressing the performance gap.
2. Affordability: Analyzed to measure the economic asymmetry between low-cost mobile internet and high-cost fixed broadband subscriptions, addressing the financial barrier.
3. Reliability: Examined to determine how network consistency affects user trust and long-term willingness to adopt home broadband, addressing the trust gap.
4. Skills and Regularity of Use: Measured through non-adoption reasons to evaluate the necessity of reorienting USO funds toward capacity building, addressing the readiness gap.

Methodological Considerations

This study adopts the National Statistical Office (NSO) definition of rural areas as non-municipal communities located outside municipal administrative boundaries. This definition ensures consistency with national datasets and policy reporting used throughout the analysis.

Several limitations should be acknowledged. First, the study relies on secondary data and therefore identifies broad patterns rather than establishing causal relationships between connectivity conditions and household adoption decisions. Second, national-level indicators may not fully capture variations across different rural communities. Finally, some dimensions of meaningful connectivity, such as user experience and perceived relevance of digital services, are not directly observable through the available datasets.

Despite these limitations, the combination of national and international indicators provides a useful basis for examining the relationship between infrastructure availability, household adoption, and meaningful connectivity outcomes in rural Thailand.

Thailand's USO Policy and the Access-Adoption Gap

Infrastructure Expansion and the Success of Coverage-Oriented Policy

Thailand's Universal Service Obligation (USO) policy has played a central role in expanding broadband infrastructure to underserved rural communities. Through flagship initiatives including Fiber-to-the-Village and Net Pracharat, broadband connectivity has been extended to approximately 74,987 villages, reaching more than 10 million residents and significantly reducing geographic disparities in network availability.

These outcomes demonstrate the effectiveness of Thailand's traditional USO model in addressing the first-level digital divide, where policy success is primarily measured through infrastructure deployment and physical access indicators. Expansion of network coverage has substantially improved the availability of digital infrastructure across rural and non-municipal areas.

However, as broadband infrastructure approaches national maturity, physical availability alone becomes an insufficient indicator of digital inclusion. The policy challenge increasingly shifts from connecting places toward enabling households to adopt and continuously use connectivity in ways that generate meaningful social and economic outcomes.

Evidence of the Access-Adoption Gap

Despite major improvements in broadband availability, household-level adoption remains uneven across rural Thailand. National Statistical Office (NSO) data show that among rural households without home internet access, demand-side constraints dominate the reasons for non-adoption. Approximately 95.4% cite factors unrelated to infrastructure availability, while only a very small proportion (0.6%) identify the absence of infrastructure as the primary barrier. This pattern reveals what this study conceptualizes as the Access-Adoption Gap: a condition in which connectivity exists but is not translated into sustained household subscription and meaningful use.

The disconnect becomes particularly visible under Thailand's USO implementation model. Although public connectivity has expanded through shared access mechanisms such as village Wi-Fi and community infrastructure, these forms of access do not necessarily result in household broadband subscriptions. Consequently, infrastructure achievement does not automatically indicate meaningful digital participation.

Table 2

Thailand's Connectivity Transition: From Infrastructure Availability to Household Adoption

Dimension	Specific Indicator	Value	Interpretation
Infrastructure Availability	Villages covered under USO/Net Pracharat	74,987 villages	Coverage expansion largely achieved
	Household internet access	93.2% of households	Infrastructure access approaching saturation
Service Capacity	National average fixed broadband	237 Mbps (13th globally)	Strong national network performance
Household Adoption	Fixed broadband subscriptions	10.41 million subscriptions	Household uptake remains lower than infrastructure availability
Rural Connectivity	Rural Internet Users	90.1% of rural population	Connectivity does not necessarily imply household broadband adoption
Affordability	Monthly Fixed broadband cost	833.95 THB	Cost may remain a barrier for low-income households

Dimension	Specific Indicator	Value	Interpretation
	Mobile Broadband affordability	1.1% of GNI per capita	Mobile services are substantially more accessible
Device Readiness	Household computer ownership	20.3% of households	Device constraints may limit productive use
Inclusion Gap	Rural elderly (60+) offline population	44.2%	Persistent demographic inequality remains

Source: Thailand (ITU DataHub, 2024).

Table 2 illustrates a structural transition in Thailand's digital inclusion landscape. Indicators related to infrastructure and network capacity suggest that physical connectivity has reached a relatively mature stage. However, adoption-oriented indicators including household subscriptions, affordability, device ownership, and demographic inclusion show persistent gaps. These findings suggest that policy effectiveness can no longer be evaluated solely through deployment outcomes and instead requires greater attention to demand-side conditions associated with meaningful connectivity.

Table 3

Reasons for Non-adoption of Home Internet Among Rural Households (Non-municipal Areas)

Reason for Not Having Internet at Home	Rural HH ('000)	% of Total	Barrier Category
1. No perceived need / Not interested	1,367.4	91.9%	Demand-side (Readiness)
2. Device too expensive	33.9	2.3%	Demand-side (Affordability)
3. Can access internet elsewhere (public / shared access)	30.9	2.1%	Demand-side (Adoption)
4. Service or subscription cost too expensive	18.2	1.2%	Demand-side (Affordability)
5. Privacy or security concerns	3.3	0.2%	Demand-side (Trust)
6. Service available but does not meet needs (quality)	0.4	0.0%	Supply-side (QoS)
7. Other reasons	24.0	1.6%	-
8. No internet service available in area	9.3	0.6%	Supply-side (Coverage)
Total	1,487.4	100%	-

Source: National Statistical Office (NSO). (2023).

Table 3 demonstrates that household non-adoption in rural Thailand is driven predominantly by demand-side factors rather than infrastructure constraints. The overwhelming majority of households report reasons associated with perceived relevance, affordability, and alternative access arrangements, while only a small proportion identify the absence of internet

infrastructure. These findings provide empirical support for the Access-Adoption Gap and justify examining household adoption through broader dimensions of meaningful connectivity.

Driver of Household Non-adoption

Quality of Service – The Performance Gap

Infrastructure availability does not necessarily guarantee satisfactory user experience. Although Thailand performs strongly on national fixed broadband indicators, these aggregated measures may not fully reflect conditions in rural and non-municipal areas. Variations in speed, latency, and connection stability can reduce the perceived value of subscribing to household broadband services. Consequently, service quality remains an important factor influencing adoption decisions.

Affordability – The Financial Barrier

Affordability remains a significant barrier to household broadband adoption. Fixed broadband subscriptions continue to impose a relatively higher financial burden compared with mobile alternatives, particularly for lower-income rural households. At the same time, widespread smartphone ownership combined with limited household computer ownership suggests that many users rely on mobile connectivity as their primary means of internet access. While this substitution supports basic connectivity, it may constrain more productive and high-capacity forms of digital participation.

Reliability – The Trust Gap

Meaningful connectivity depends not only on availability but also on dependable service performance. Network interruptions, inconsistent service quality, and maintenance limitations may reduce confidence in broadband as a platform for activities such as online learning, digital commerce, and access to public services. Reliability therefore becomes an important determinant of sustained household adoption.

Digital Skills and Perceived Value – The Readiness Gap

Digital readiness represents one of the most prominent constraints identified in this study. NSO data show that the majority of rural households without home internet cite “no perceived need or interest” as the primary reason for non-adoption. This finding suggests that adoption decisions are shaped not only by infrastructure and cost, but also by digital capability, confidence, and perceptions of relevance. The persistence of offline populations among vulnerable groups further indicates the continuing importance of second-level digital divide challenges.

Discussion

Revisiting Universal Service Beyond Coverage

The findings suggest that Thailand’s USO policy has been effective in expanding broadband infrastructure and reducing geographic disparities in connectivity. However, the results also indicate that infrastructure availability alone does not consistently translate into household adoption and meaningful digital participation.

The evidence presented in this study supports broader digital divide scholarship, which argues that inequalities evolve as countries move beyond initial access challenges. In Thailand's case, the dominant barriers to household adoption increasingly appear to be associated with affordability, service experience, digital readiness, and perceived value rather than infrastructure absence.

These findings suggest that evaluating digital inclusion solely through deployment indicators may provide an incomplete understanding of connectivity outcomes.

Implications for Meaningful Connectivity Policy

The Access-Adoption Gap identified in this study underscores the need to rethink how universal service policies are evaluated in digitally maturing economies.

Rather than viewing infrastructure deployment as the end goal of digital inclusion, future policies should also consider adoption, affordability, reliability, and effective use as core dimensions of meaningful connectivity.

Although this study focuses on Thailand, its findings may also apply to other contexts where infrastructure expansion has outpaced household-level adoption.

From Infrastructure Expansion to Meaningful Connectivity

The findings of this study suggest that the Access–Adoption Gap represents an emerging challenge for digitally maturing economies where infrastructure availability has expanded substantially but household adoption remains uneven.

Traditional USO approaches have historically prioritized infrastructure deployment under the assumption that expanding access would generate broader digital inclusion outcomes. However, consistent with van Dijk's digital divide perspective, the findings indicate that once physical access becomes more widely available, adoption outcomes increasingly depend on conditions such as affordability, device access, digital readiness, and perceived relevance.

In Thailand, the predominance of demand-side reasons for household non-adoption suggests that future connectivity strategies may benefit from complementing infrastructure investment with measures that support sustained household participation. In this context, the Universal and Meaningful Connectivity (UMC) framework provides a useful lens for evaluating connectivity beyond physical availability and toward broader dimensions of use and inclusion.

Although this study focuses on Thailand, the findings may provide broader insights for ASEAN countries and other middle-income economies undergoing rapid digital infrastructure expansion.

As broadband deployment progresses, policy priorities may increasingly shift from extending coverage toward enabling households to translate available connectivity into meaningful participation. Thailand's experience suggests that infrastructure expansion alone may not eliminate digital inequalities when affordability, digital capability, and perceived value continue to influence adoption outcomes.

Accordingly, policy frameworks that incorporate both supply-side and demand-side dimensions may offer a more comprehensive approach to evaluating digital inclusion. Instruments such as the UMC framework may support this transition by complementing traditional infrastructure indicators with measures related to adoption, affordability, quality, and effective use.

Conclusion and Policy Recommendations

Conclusion

This study examined the extent to which Thailand's Universal Service Obligation (USO) policy can support meaningful connectivity beyond infrastructure expansion. Drawing on secondary evidence from the NSO, NBTC, and international connectivity indicators, the findings suggest that Thailand has achieved substantial progress in expanding broadband availability across rural communities. However, improved infrastructure availability has not translated uniformly into household-level adoption.

The analysis identifies a persistent Access–Adoption Gap in which barriers to household connectivity appear to be increasingly associated with demand-side conditions rather than infrastructure absence. Evidence from rural non-municipal areas suggests that affordability, service experience, digital readiness, and perceptions of value continue to influence broadband adoption outcomes.

By combining digital divide perspectives with the Universal and Meaningful Connectivity (UMC) framework, this study contributes an adoption-oriented perspective on universal service evaluation. The findings suggest that as countries progress toward infrastructure maturity, policy attention may increasingly shift from measuring network availability toward supporting meaningful and sustained digital participation.

Policy Recommendations

To address the Access-Adoption Gap identified in this study, Thailand's USO policy should gradually transition from a deployment-oriented model toward an adoption-oriented and meaningful connectivity framework. Rather than focusing exclusively on infrastructure availability, future interventions should combine supply-side and demand-side mechanisms across four complementary policy dimensions.

Table 4

Proposed Policy Roadmap for Strengthening Household Broadband Adoption in Rural Thailand

Policy Dimension	Policy Direction	Policy measured	Agency
1. Quality of Service	Expand USO evaluation beyond coverage indicators	• Monitor household adoption • Conduct periodic QoS assessments • Publish local connectivity reports	NBTC DES
2. Affordability	Reduce household cost barriers	• Pilot broadband support schemes • Encourage affordable rural packages • Expand access to productive-use devices	NBTC Operators
3. Reliability	Improve continuity of service	• Introduce service monitoring • Strengthen maintenance mechanisms • Establish local reporting channels	NBTC Operators
4. Digital Readiness	Increase perceived value and practical use	• Develop localized digital programs • Support community learning • Promote e-government and productive use cases	DES MOE Local government

Source: Developed by the author based on findings from this study and adapted from the Universal and Meaningful Connectivity (UMC) framework (ITU & UNICEF, 2022), van Dijk's Digital Divide Theory (2020), and Thailand's Universal Service policy context.

Together, these recommendations suggest complementing existing infrastructure investment with interventions that support sustained household adoption and broader digital participation.

Limitations and Future Research

Several limitations should be acknowledged. First, the analysis relies on the NSO definition of rural areas as non-municipal communities, which may conceal variation across different local contexts. Second, measures of service quality and reliability are derived primarily from institutional indicators rather than direct household-level performance data. Third, the study identifies patterns and associations but does not establish causal relationships between connectivity conditions and household adoption.

Future research may build on these findings through localized household surveys in USO-supported communities, finer-grained analysis of network performance and subscription

behavior, and comparative studies across ASEAN economies to better understand how meaningful connectivity can be translated into effective policy design.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Grammarly, an AI-assisted writing software, was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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