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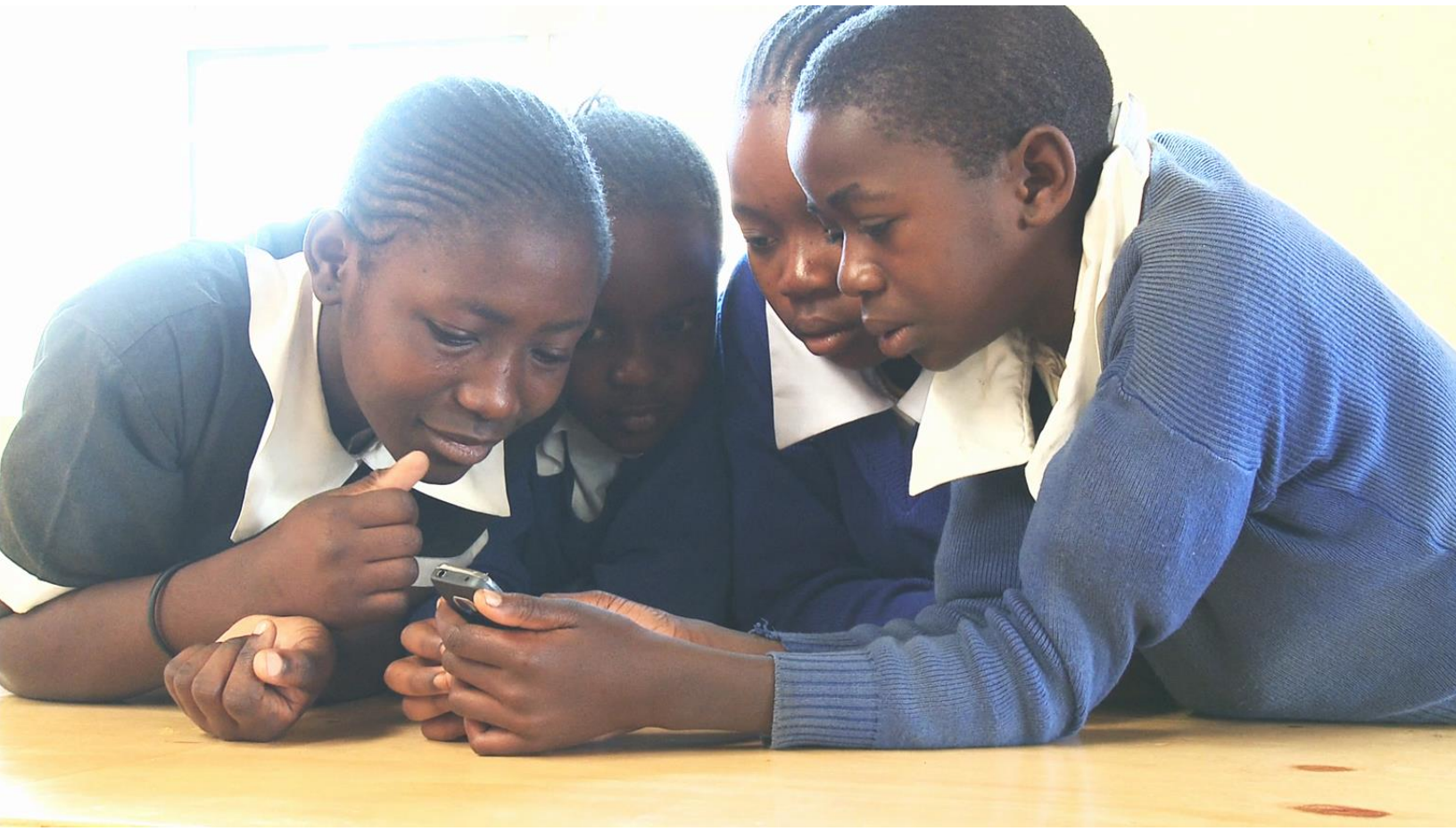

ED OWLES, WORLDVIEW FOR USAID

RESEARCH REPORT

BARRIERS TO INVESTING IN LAST-MILE CONNECTIVITY

Connectivity Capital

May 2020

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EXECUTIVE SUMMARY

USAID's Last-Mile Connectivity (LMC) Initiative has developed research on opportunities for new, innovative, enterprise-driven solutions to last mile connectivity in developing countries. The Initiative is working to provide investors a set of tools that will help identify quality network infrastructure projects by researching innovative business plans and service deployments, developing performance indicators to measure the social and economic impact of new network infrastructure, and comprehensively mapping potential sales regions lacking secure connectivity.

This report builds on the foundation of previous USAID research in last-mile connectivity, but focuses on the investor perspective, identifying key barriers to investing and opportunities to facilitate more investment activity in this segment of the sector. The research methodology was developed in partnership between USAID, DAI and Connectivity Capital. This included a landscape analysis of last-mile connectivity and interviews with 30+ Investors and operators in the sector. The main objective of the interviews was to understand the investment climate, identify key attributes of both successful and unsuccessful investments, and highlight the challenges faced by investors in sourcing deals or closing transactions. For the purpose of this research, interviews were conducted with different categories of investors with varying criteria, objectives, and return expectations – 1) Grants and Corporate Investors, 2) Development Finance Institutions (DFIs) and 3) Impact Investors, Venture Capital and Private Equity Investors.

Of the 7.6 billion people in the world, only 4.1 billion are connected to the Internet.[1] As a result of the large unconnected populations, there is significant growth opportunity and investment potential in expanding Internet access and increasing adoption, especially in the world's least developed countries. Estimates suggest that the total attainable market size of connecting the next four billion is upwards of $ 300 billion annually.[2] Our research shows that investing in last-mile connectivity is an attractive investment thesis that can achieve market rate returns. Importantly, we find that investments in last-mile connectivity can have a transformational impact across multiple sectors of the economy, increasing overall productivity, creating employment opportunities and having a direct increase on GDP growth. Studies estimate that a 10% increase in broadband penetration can improve GDP growth by 0.6% - 2.8%.[3] Achieving universal and affordable access to broadband is a capital-intensive challenge. Estimates by the UN Broadband Commission indicate that nearly $450 billion is needed to connect the 1.5 billion offline population globally.[4] Based on our interviews, we identified that most investment activity in last-mile connectivity occurs at the later stages of an operator's lifecycle. Investors generally use a systematic multi-step process

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[1] International Telecommunication Union (ITU), Measuring Digital Development Facts & Figures, 2019: https://www.itu.int/en/ITU-D/Statistics/Documents/facts/FactsFigures2019.pdf

[2] USAID, SSG Advisors, and FHI 360, Business Models for the Last Billion, 2016: International Telecommunication Union (ITU) and United Nations (UN) Data; Analysis: Richard Thanki, University of Southampton https://mstarproject.files.wordpress.com/2016/05/business-models-for-the-last-billion.pdf

[3] Imperial College Business School, How important are mobile broadband networks for global economic development, 2017: https://spiral.imperial.ac.uk/bitstream/10044/1/46208/2/Goodridge%202017-05.pdf

[4] International Telecommunication Union (ITU), The State of Broadband, 2019: https://www.itu.int/dms_pub/itu-s/opb/pol/S-POL-BROADBAND.20-2019-PDF-E.pdf

to source and evaluate a potential investment. During this process, investors are exposed to multiple risks including Sector Risk, Execution Risk, Financing Risk and Regulatory Risk. It is important to note that transactions can fail at various points along the investment transaction process. At each step of the process, investors are seeking to manage and/or mitigate various risks, and deals close successfully when there is a significant convergence of industry viability (Sector risk), company feasibility (Execution risk), and transaction desirability (Financing risk) within the regulatory ecosystem (Regulatory risk).

Through these interviews, our desk research, and Connectivity Capital's own experience as investors in last-mile connectivity deals, we identified the following four distinct but often overlapping barriers to investing:

1. Last-mile connectivity is a challenging sector with multiple external dependencies.
2. The majority of last-mile connectivity companies struggle to secure investment due to their company growth stage.
3. Investor economics and return expectations often don't align with available Internet Service Provider (ISP) potential transactions.
4. Regulatory uncertainty and ineffectiveness often add significant complexity to any potential transaction.

Each of the barriers is illustrated by a real-life case study based on our interviews and experiences in the sector.

Investing in last-mile connectivity is an attractive investment thesis that can achieve market-rate returns. While this report highlighted learnings from barriers and challenges to these investments, there are also numerous examples of success. Successful investors have adopted a deliberate strategy to take on these challenges and mitigate risk. The figure below summaries the barriers to investing and proposes recommendations to mitigate the barriers identified:

FIGURE 1: BARRIERS TO INVESTING IN LAST-MILE CONNECTIVITY AND INTERVENTIONS TO ADDRESS BARRIERS

INVESTMENT PROCESS & RISKS		BARRIERS TO INVESTING IN LAST-MILE CONNECTIVITY	INTERVENTIONS TO ADDRESS BARRIERS
Sourcing	SECTOR RISK	1. LMC is a challenging sector with multiple external dependencies.	• *Short-term:* **Knowledge sharing** of business models. • *Mid-term:* **Benchmarking** & information sharing of Investor metrics • *Long-term:* Financing **shared middle mile fiber**
	EXECUTION RISK	2. The majority of LMC companies struggle due to their growth stage.	• *Short-term:* Technical Assistance for **Standard Operating Procedures** • *Mid-term:* Technical Assistance for **Investment Readiness** • *Long-term:* Encourage *experiments but* ***fund models at scale***
Due Diligence	FINANCING RISK	3. Investor economics and return expectations often don't align with available ISP deals.	• *Short-term:* Support **blended finance** for 'missing middle' • *Mid-term:* Develop **currency risk-mitigation structures** • *Long-term:* Adapt **known financing products and structures**
	REGULATORY RISK	4. Regulatory uncertainty and ineffectiveness often add significant complexity.	• *Short-term:* Promote **transparency of regulations**. • *Mid-term:* facilitate **enabling infrastructure** • *Long-term:* **harmonization of regulatory framework** across regions

INTRODUCTION

The Digital Inclusion Team within the United States Agency for International Development's (USAID) Center for Digital Development (CDD) works to increase open, interoperable, secure and reliable Internet access and mobile connectivity to support countries on their journey to self-reliance. The Digital Inclusion team has funded research on mobilizing private capital to meet this development priority, including blended finance, development credit mechanisms, and investment funds. To expand the reach of enterprise-funded Internet and mobile networks, USAID has been examining new approaches to facilitating financing for connectivity projects. USAID's Last-Mile Connectivity (LMC) Initiative has developed research on opportunities for new, innovative, enterprise-driven solutions to connectivity in developing countries. The Initiative is working to provide investors a set of tools that will help identify quality network infrastructure projects by studying innovative business plans and service deployments, developing performance indicators to measure social impact of new network infrastructure, and comprehensively mapping areas without service today.

While previous research and reports from USAID detail a range of solutions focused on promoting greater access to the Internet, the USAID CDD team required further clarity and information regarding the investment potential in last-mile connectivity and why there aren't more investments in last-mile business models. While it's been proven that investment in this section of the market could provide good financial returns, investment continues to forgo this sector. This report builds on the foundation of previous USAID research in last-mile connectivity but focuses more on the investor perspective, key barriers to investing and how to facilitate more investment activity in this segment of the sector.

FIGURE 2: PREVIOUS USAID REPORTS ON LAST-MILE CONNECTIVITY

Business Models for The Last Billion
2016

Connecting The Next Billion
2017

Closing The Access Gap
2017

Investing To Connect
2019

This report focuses on the ecosystem of fixed connectivity provided by Internet Service Providers (ISPs) as a complement to mobile connectivity provided by Mobile Network Operators (MNOs). Mobile technology has allowed emerging markets to 'leapfrog' the infrastructure gap and has contributed tremendously in bringing connectivity to billions. However, as further described in the report, there are limits to leapfrogging, and access to last-mile connectivity will require a dual ecosystem of both ISPs and MNOs.

The objectives of this report are:

1. To provide an overview of the last mile connectivity (LMC) investment landscape and climate
2. To identify causes of failed transactions, and barriers and challenges faced by parties involved, particularly investors.
3. To evaluate the attractiveness of investment in this area of the market, and develop an overview of current investment opportunities in the digital connectivity space.
4. To identify opportunities for USAID to intervene to remove barriers and facilitate transactions
5. To provide recommendations as to where and how USAID could most effectively drive investment in last-mile connectivity through approaches such as blended/innovative finance, closing information gaps, or addressing key barriers such as policy and regulatory challenges

This report is divided into seven sections. Section 1, the Executive Summary provides a summarized version of this report synthesizing the methodology, key findings and recommendations. Section 2, the Introduction, provides an overview of the research objectives and additional background on USAID's research efforts in last-mile connectivity. Section 3, Research Methodology, sets out the approach adopted for this report including a landscape analysis, interviews, gap analysis and recommendations. Section 4, Background, provides context into the state of global connectivity today and the role and importance of ISPs in extending last-mile connectivity. Section 5, Interview Findings details the interview targets and methodology adopted while conducting primary interviews. This section also includes a summary of the key findings from the interviews. Section 6, Barriers to Investing, details the four key barriers identified and includes case studies to illustrate the challenges faced by last-mile connectivity companies. Section 7, Recommendations, concludes the report and presents actionable recommendations classified as 'short-term', 'mid-term', and 'long-term' interventions to address each barrier.

USAID seeks to unlock the potential of private capital to drive inclusive growth. The Agency can leverage its resources – grants, technical assistance, guarantees, and convening power – to help raise awareness of investment opportunities, lower transaction costs, and mitigate the risk of investments that generate positive social, economic, and environmental impact.

INVEST leverages the power of private capital to drive inclusive growth in countries where USAID works, by reducing barriers for investors and channeling private capital into key regions and sectors for better development results. Through INVEST's flexible buy-in mechanism, USAID Missions and Operating Units are able to access an unprecedented network of firms and individuals that have the range of technical expertise needed to identify opportunities and effectively mobilize private capital toward development priorities. Through the INVEST mechanism, CDD, seeks to understand why more investments are not being made in the last-mile connectivity sector. In support of its efforts to promote blended finance within the Agency, the USAID Office of Private Capital and Microenterprise (USAID/PCM) awarded the INVEST contract to DAI Global, LLC in September of 2017.

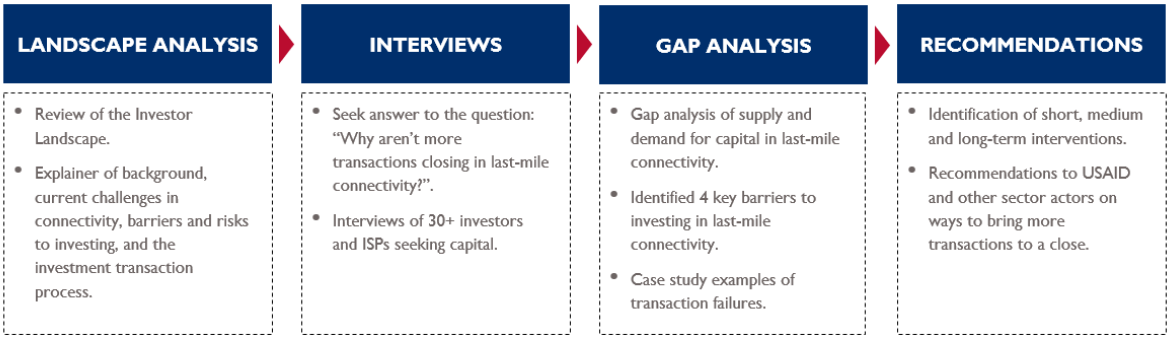
DAI Global, LLC is an international development company. For over fifty years, DAI has worked across the spectrum of international development, tackling fundamental social and economic development problems caused by inefficient markets, ineffective governance, and instability. Currently, DAI is operating across 200 countries offering advisory services to clients including international development agencies, international lending institutions, private corporations and philanthropies, and national governments.

Connectivity Capital is an impact investment firm focused on expanding Internet access in frontier markets. Connectivity Capital manages a sector-focused fund that identifies, invests in, and partners with market leading Internet Service Providers (ISPs) and network infrastructure companies that expand access to connectivity globally.

RESEARCH METHODOLOGY

The research methodology for the report was developed in partnership between USAID, INVEST, and Connectivity Capital. The objective of the research was to build on the work previously done by USAID and help the organization better understand the investment climate and why investments are not happening or closing, respectively, in last-mile connectivity. Over the course of four months, Connectivity Capital adopted the following phased approach for its research activities:

FIGURE 3: RESEARCH METHODOLOGY



In the first phase, Connectivity Capital conducted a detailed landscape analysis of the LMC sector. This included desk research, reviewing both the supply side (investor landscape) and the demand side (connectivity companies) of capital in LMC. Throughout this report, for simplicity, connectivity providers are referred to broadly as Internet Service Providers (ISPs). The analysis examined the unit economics of LMC providers as well as the investment transaction process of investors in LMC deals. There was additional emphasis on finding case studies of deals in the sector that had failed, though we also examined some cases where investment succeeded.

In the second phase, Connectivity Capital conducted robust interviews of 30+ stakeholders, including established LMC operators and experienced technology and infrastructure investors across various markets. The main objective of this phase was to identify key attributes of both successful and failed deals, highlighting the perspective of investors. Our inquiry focused on understanding why investors are reluctant to invest in connectivity and what barriers they encountered during the investment transaction process. The interview methodology and findings are summarized in Section 5: Interview Findings.

In the third phase of the engagement, Connectivity Capital conducted a gap analysis to synthesize the key findings, important takeaways and recurring themes across all interviews, and align them against the backdrop of the landscape analysis. Based on findings from the primary and secondary research, Connectivity Capital identified four key barriers preventing additional transactions from closing in the last mile connectivity sector. The barriers, specific challenges and cases have been further highlighted and explained in Section 6: Barriers to Investing.

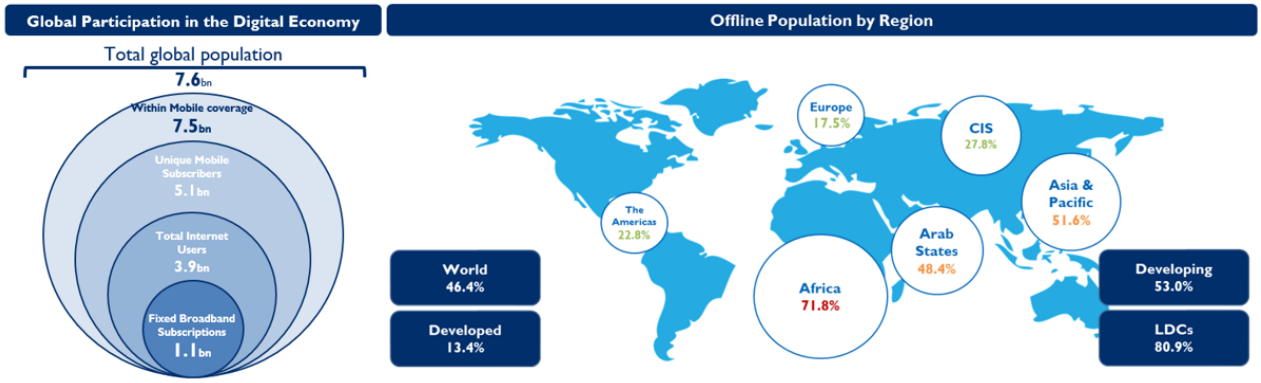
In the final phase of research, Connectivity Capital considered possible interventions or policy initiatives that mapped to each of the barriers to investing. In Section 7, Connectivity Capital lists major recommendations, with a lens to where USAID and other developmental agencies can intervene to facilitate closure of the identified gaps.

BACKGROUND

THE STATE OF CONNECTIVITY TODAY

Of the 7.6 billion people in the world, only 4.1 billion are connected to the Internet – a global penetration rate of approximately 53 percent.[5] Global Internet usage in terms of number of users has grown by approximately 10 percent year-over-year since 2005[1] and this increase in Internet availability is largely driven by the expansion of Mobile Network Operators (MNOs). Despite the revolution of Mobile Network technology, billions of people remain offline. Most of the approximately 3.5 billion offline population lives in the world's least developed countries (LDCs).[6] Within those, Africa, Asia Pacific and the Middle East account for the majority of the offline population. The penetration rate of Internet usage in Africa for example is 28%.[1]

FIGURE 4: THE STATE OF CONNECTIVITY



As Internet access overall has grown, the price of high-speed bandwidth has decreased at a much slower pace. Despite the worldwide increase in high-speed fixed-broadband subscriptions, a lack of high-speed connections persists in the developing world. For example, in Sub-Saharan Africa, access to fixed broadband connections is estimated to be at less than 1 percent of the population.[7]

[5] International Telecommunication Union (ITU), Measuring Digital Development Facts & Figures, 2019: https://www.itu.int/en/ITU-D/Statistics/Documents/facts/FactsFigures2019.pdf
[6] LDCs as defined by the United Nations are low-income countries that suffer from long-term impediments to growth. As of 2018, there are 47 LDCs with a population of close to one billion: https://www.itu.int/en/ITU-D/LDCs/Pages/Who-are-the-LDCs.aspx
[7] Connectivity Capital, Expanding Access to Connectivity, 2018: https://connectivitycap.com/resources/

The main pillars of expanding access are synthesized as Availability, Affordability and Adoption.

FIGURE 5: THE THREE PILLARS OF EXPANDING INTERNET ACCESS

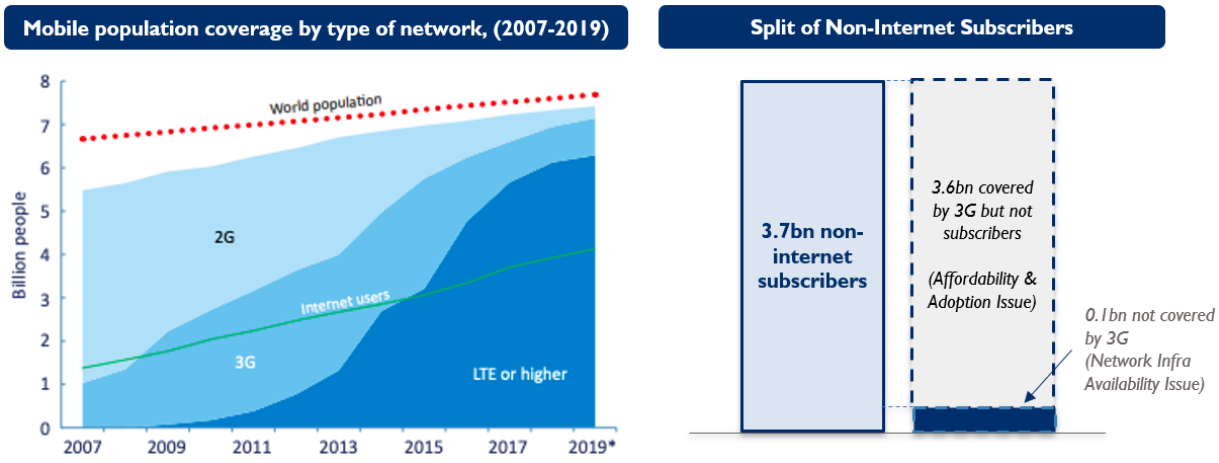
AVAILABILITY	AFFORDABILITY	ADOPTION
Availability is when a person lives or works within the footprint of broadband network, either Mobile or Fixed (Fiber/Wi-Fi).	Affordability is when a person can afford the cost of data relative to their income.	Adoption is when a person has the user capabilities, tools and incentives to access connectivity.

While a lot of progress has been made in all three areas – most significantly in Availability – some notable challenges still persist, particularly when it comes to Affordability and Adoption.

Availability

Availability is measured based on how many people live or work within the footprint of broadband network, either Mobile or Fixed (Fiber/Wi-Fi). In the last two decades, there has been tremendous progress in overcoming the Availability barrier. Approximately 97% of the global population today lives in areas with access to a mobile signal but not at broadband speeds.[8] This is notably from wider coverage of Mobile Networks deploying 2G technology. But the lack of infrastructure for both Mobile Network Operators (MNOs) and ISPs leave areas that are geographically off the grid for connectivity coverage.

FIGURE 6: AVAILABILITY OF INTERNET ACCESS



[8] International Telecommunication Union (ITU), Measuring Digital Development Facts & Figures, 2019: https://www.itu.int/en/ITU-D/Statistics/Documents/facts/FactsFigures2019.pdf

Speed, quality and quantity limitations prevent consumers from fully benefiting from 'Meaningful Connectivity'. The Alliance for Affordable Internet (A4AI) has recently developed "Meaningful Connectivity"[9] — a new standard that measures not only if someone has access to the Internet, but the quality of connection they have. A4AI identifies certain key elements of Meaningful Connectivity:

- The right speed: Users need sufficient download speeds to access multimedia and other applications that make up a full Internet experience.
- An adequate device: Users must be able to both produce and consume content online. Mobile only access is not the same as access via a laptop or desktop, because a full physical keyboard is better suited to content creation and productivity.
- Enough data: Lack of data should not stand in the way of individuals fully using the Internet-based applications they consider important.
- Frequent connection: If a user can only connect to the Internet every so often, it is less likely to be a meaningful tool for them.

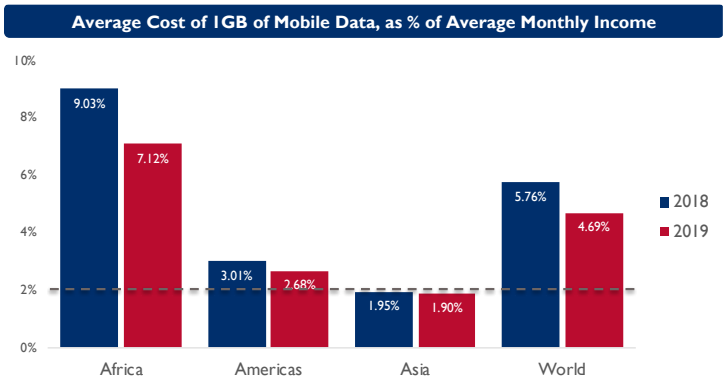
While the challenge of Availability of the Internet is nearly addressed, despite lingering challenges to access to meaningful connectivity, Affordability and Adoption, have emerged as the main barriers to Internet usage.

Affordability

Affordability is based on whether a person can afford the cost of data relative to their income and is measured as gigabytes (GBs) of data per percentage of monthly income. The Alliance for Affordable Internet standard defines "affordable" access as "1 for 2", which means 1GB of broadband data should be 2 percent or less of average monthly income.[10] While people in developed countries pay less than 2 percent of monthly income in developed countries for broadband, people in LDCs typically pay over 10 percent of their average monthly income for broadband, which illustrates how access to high speed Internet remains largely unaffordable in most of the developing world. Competitive markets and dual ecosystem use of both Mobile Networks and ISPs contribute to increasing affordability.

[9] Alliance for Affordable Internet (A4AI), Meaningful Connectivity: https://a4ai.org/meaningful-connectivity-a-new-standard-to-measure-internet-access/
[10] Alliance for Affordable Internet (A4AI), Affordable Internet is 1 for 2: https://a4ai.org/affordable-internet-is-1-for-2

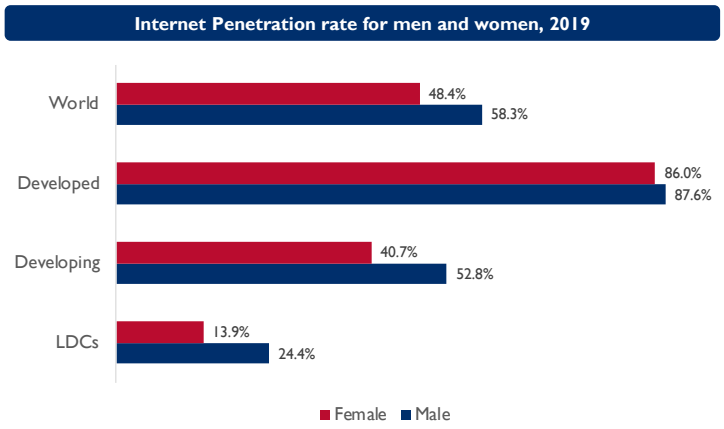
FIGURE 7: AFFORDABILITY OF INTERNET ACCESS



Adoption

Internet adoption occurs when a person has the user capabilities, tools and incentives to access connectivity. User Capabilities include digital and basic literacy. Tools include devices to access the Internet such as smartphones or laptops. Incentives include locally relevant content, and cultural or social acceptance of Internet use. The rate of adoption growth has slowed in recent years as developed countries are nearing saturation levels. Supply side barriers, such as infrastructure and services, and demand side barriers, such as education and adoption, in developing countries have contributed to the digital divide. Of particular note is that the gender gap in digital adoption continues to persist - the proportion of women using the Internet globally is 48% compared to 58% of men, with the gap being the most acute in the least developed countries. The global gender gap has increased globally on account of the rapid growth in male Internet users in developing countries especially in the Middle East, Asia-Pacific and Africa.[11]

FIGURE 8: ADOPTION OF THE INTERNET



[11] International Telecommunication Union (ITU), Measuring Digital Development Facts & Figures, 2019: https://www.itu.int/en/ITU-D/Statistics/Documents/facts/FactsFigures2019.pdf

As a result of the large unconnected populations, there is significant growth opportunity and investment potential in expanding Internet access and increasing adoption, especially in the world's least developed countries. One estimate suggests that there is an attainable market opportunity of $144 billion in annual untapped demand to connect the next one billion people. The total attainable market size of connecting the next four billion is estimated at upwards of $ 300 billion.[12]

FIGURE 9: MARKET OPPORTUNITY OF CONNECTIVITY

Market Opportunity of Connectivity

SEGMENT	AVERAGE ANNUAL INCOME (USD)	AFFORDABLE MONTHLY COMMUNICATIONS SPEND (USD)	TOTAL ATTAINABLE MARKET (USD Billion)
First Billion	$29,206	$205	$ 2,460
Second Billion	$12,722	$53	$ 636
Third Billion	$5,540	$23	$ 276
Fourth Billion	**$2,987**	**$12**	**$ 144**
Fifth Billion	**$1,771**	**$7**	**$ 84**
Sixth Billion	**$1,065**	**$4.40**	**$ 53**
Last Billion	**$540**	**$2.25**	**$ 27**

However, the ICT Infrastructure financing required for global universal connectivity is substantial. There are several types of funders in the ICT infrastructure landscape. The private sector (mobile network operators, ISPs and tower companies) accounts for the majority of ICT infrastructure spending. Governments and multilateral actors such as development finance institutions, development banks have played a relatively minor role, especially compared to the scale of their investment in other infrastructure projects.

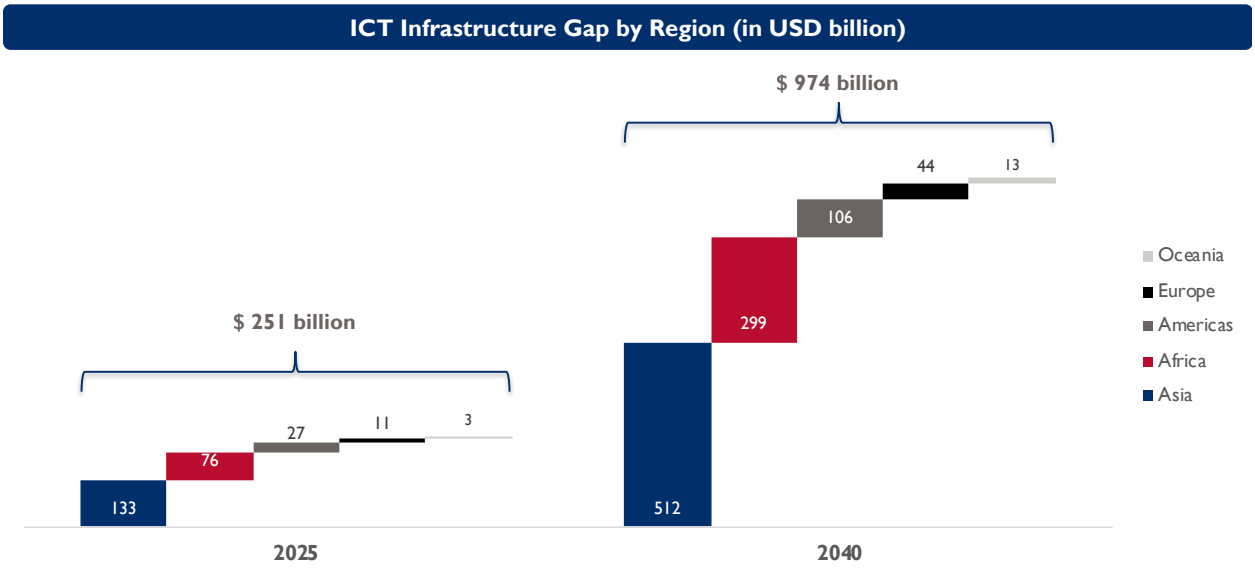
In cases where the economic incentive to invest in network infrastructure is low, such as in regions of lower income or sparse populations, private sector investors find it challenging to deploy capital because the return on investment is not up to their expectations or cost of financing the project. It is especially in

[12] USAID, SSG Advisors, and FHI 360, Business Models for the Last Billion, 2016: International Telecommunication Union (ITU) and United Nations (UN) Data; Analysis: Richard Thanki, University of Southampton https://mstarproject.files.wordpress.com/2016/05/business-models-for-the-last-billion.pdf

these cases, where the social returns of connecting unconnected communities are larger than the private returns, is where the government, other types of public financing or more patient capital has a role to play in whole or in part. USAID, for example, has provided partial grant support to commercial investors in helping to build out infrastructure in Liberia.

Achieving universal and affordable access to broadband is a capital-intensive challenge. Estimates by the UN Broadband Commission indicate that nearly $450 billion is needed to connect the 1.5 billion offline population globally.[13] In Sub-Saharan Africa alone, the Commission estimates that an additional investment of approximately $100 billion USD would be required by 2030 to connect the nearly 1.1 billion users who remain offline in the continent.[14] Likewise, World Economic Forum study estimates that the ICT infrastructure gap will reach nearly $1 trillion by 2040, with the biggest divides in Africa and Asia.[15]

FIGURE 10: ICT INFRASTRUCTURE FINANCING GAP



In order to understand how to close this gap, we must first understand how networks are built.

[13] International Telecommunication Union (ITU), The State of Broadband, 2019: https://www.itu.int/dms_pub/itu-s/opb/pol/S-POL-BROADBAND.20-2019-PDF-E.pdf
[14] United Nations Broadband Commission, Connecting Africa Through Broadband, 2019: https://www.broadbandcommission.org/Documents/working-groups/DigitalMoonshotforAfrica_Report.pdf
[15] World Economic Forum, Financing Forward Looking Internet for All, 2018: http://www3.weforum.org/docs/WP_Financing_Forward-Looking_Internet_for_All_report_2018.pdf

HOW NETWORKS ARE BUILT

In order to understand how last-mile connectivity reaches an end user, it is important to understand the layers of connectivity networks. By and large, connectivity networks are built with three distinct layers of providers: first mile, middle mile and last mile.

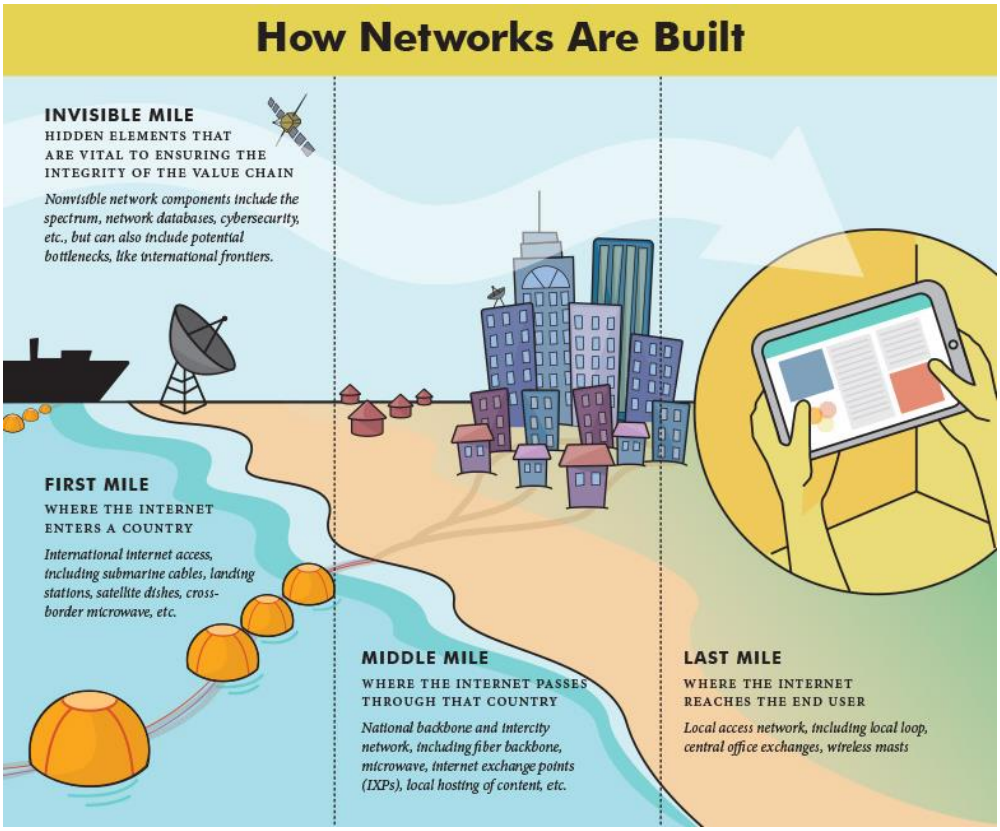
The first mile is the point at which the Internet enters a country. The components of the first mile include international Internet access, including submarine cable landing stations, satellite dishes, and domain name registration. The connection between a country and the global Internet can be measured in bits per second per Internet user. The global range is very wide — between 6.4 Mbit/s in Luxembourg to just 146 bit/s in the Central African Republic.[16] The international gateway is the point at which a country connects to the global Internet, and this can often become a bottleneck.

The middle mile is the national, intercity Internet backbone of a country. The components of middle mile include National backbone and intercity network, including fiber backbone, microwave, Internet Exchange Points (IXPs), and local hosting of content. The Internet backbone network in a country provides backhaul from cable stations or satellite stations to major cities and towns. Ideally, it should include fiber-optic cables, but microwave and even copper links can also be used. The IXP is where IP-based traffic is exchanged within a country.

The last mile is the connection between users and their nearest Internet point of presence (POP). The components of the last mile include local access network, including local loop, central office exchanges, and wireless masts. The costliest part of the network, and the hardest to duplicate, is the local access network, which connects the user to the nearest Internet POP. In the early days, this was typically achieved through dial-up, using a modem, over ordinary copper telephone lines. Starting in the late 1990s, a technology called digital subscriber line (DSL) allowed that same telephone network to be used for always-on broadband connections, while cable modems offered the same facility for cable TV networks. In developing countries, where copper-based local access networks serve only a few areas, wireless-based access networks offer the most popular alternatives.

[16] World Bank, World Bank Blogs, 2016: https://blogs.worldbank.org/digital-development/how-wdr16-policy-framework-applied-union-comoros

FIGURE 11: HOW NETWORKS ARE BUILT



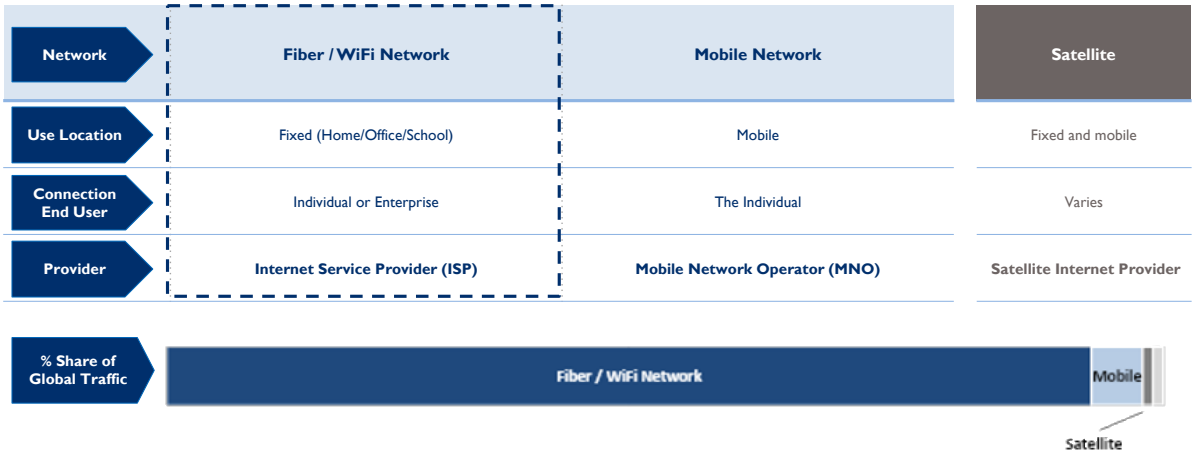
The invisible mile is another, less visible network components and potential bottlenecks. These include non-visible network components, including spectrum, border crossings, databases, SIM cards, and cybersecurity.

The effective use of capital and enabling environment interventions should begin with an understanding of the complementary role of MNOs and ISPs.

TWO ECOSYSTEMS OF CONNECTIVITY: MOBILE AND FIXED

Broadly speaking, there are two ecosystems of connectivity: Mobile and Fixed. These ecosystems are defined by the primary connection anchor between the user and the Internet. The connection anchor refers to either the individual (for mobile) or a location (for fixed access). Mobile is optimized for incidental and convenient use while Fixed is optimized for sustained and robust use. The primary differentiator between the two ecosystems is the use of licensed versus unlicensed spectrum, which affects data affordability and throughput. The figure below contrasts the two main ecosystems of connectivity.

FIGURE 12: THE ECOSYSTEMS OF CONNECTIVITY



Trade-offs between Mobile & Fixed

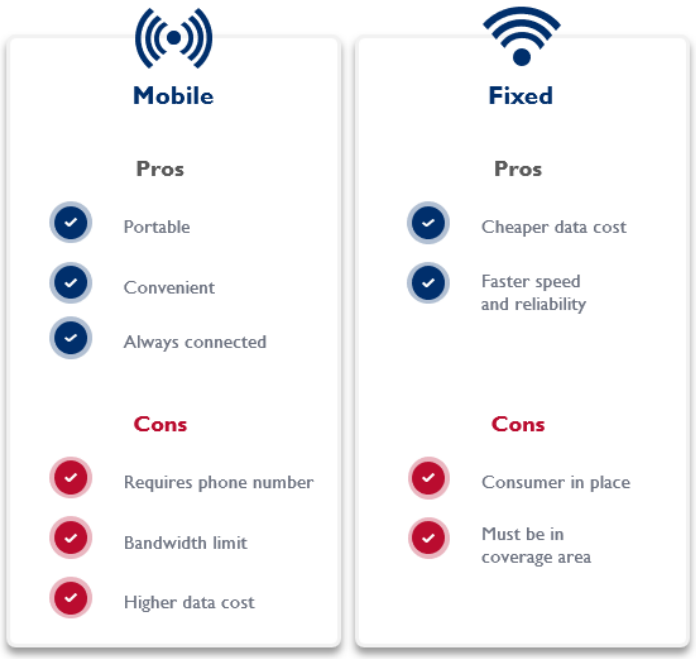
In the case of connectivity, how people connect is of lower importance than where. How people connect varies by technology (2G vs 4G or Wi-Fi vs Fiber), but where people connect is classified as either location independent or location dependent. The location dependent (or Fixed access) ecosystem includes Wi-Fi and Fiber/fixed-line networks.

Each ecosystem has advantages and disadvantages. The principle advantage to Mobile is convenience of access, whereas the principle advantage to Fixed is price and speed. The chart below details many of the trade-offs from the consumer's point-of-view.

When both ecosystems are available, users will optimize between cost and convenience based upon their needs. In developed countries, dual ecosystem use is the norm. Users often toggle between both ecosystems with minimal friction. Cisco estimates that by 2022, the global Internet traffic user split between Mobile and Fixed data will be 22% to 78% respectively.[17]

[17] Cisco, Visual Networking Index (VNI), 2018: https://www.cisco.com/c/dam/m/en_us/network-intelligence/service-provider/digital-transformation/knowledge-network-webinars/pdfs/1213-business-services-ckn.pdf

FIGURE 13: TRADE-OFFS BETWEEN MOBILE & FIXED



In Developing Countries, there is often only a Mobile Ecosystem

The primary reason there is only one ecosystem in developing countries is the historic lack of communications infrastructure on top of which most of the Fixed Internet ecosystem was built. In most developed countries, the telecom infrastructure transited from copper to cable to fiber – this was the case in countries such as the United States, parts of Europe, and East Asia where, fixed-line infrastructure existed. In the United States, for example, many of the largest ISPs are telephone or cable companies such as AT&T, Comcast, and Time Warner. Most developing countries, however, lacked major fixed-line telecommunications infrastructure, which impacted digital connectivity.

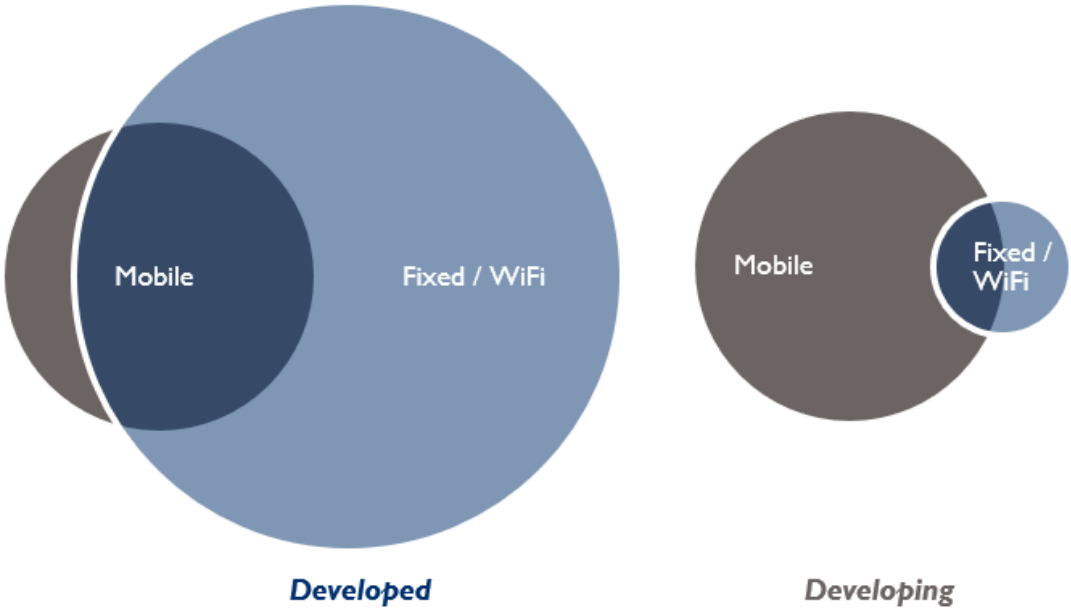
As a result, the same transition from legacy infrastructure that occurred in the developed world was not possible in many developing countries. Fixed line penetration is less than 5 percent in South Asia and less than 1 percent in Sub-Saharan Africa.[18] Once Mobile technology was developed, it allowed markets where no legacy infrastructure existed to 'leapfrog' the infrastructure gap, without backfilling fixed line connectivity. In these areas where legacy infrastructure was absent, Mobile technology has dominated market share. It should be noted that there are limits to 'leapfrogging' the infrastructure gap. Mobile Internet is not optimized for sustained heavy usage such as at work or at home. The price per unit (per GB) of mobile Internet is expensive compared to the price per unit of Fixed connectivity, which unlike mobile networks often have very high or unlimited caps on data usage.

[18] Connectivity Capital, Expanding Access to Connectivity, 2018: https://connectivitycap.com/resources/

The Dual Ecosystem Approach

In countries with both ecosystems, Mobile and Fixed networks complement each other. Users demand both affordability and convenience, and therefore, Mobile Data and WiFi Data are viewed as complementary, not substitute services. In developed countries, there are large ISPs such as the cable company networks, or the various DSL/FTTX/Fixed Wireless networks that most people use at home and in the office. Besides connecting laptops, desktops, and over-the-top (OTT) video and music systems, these networks carry two to three times more data to mobile phones than the MNOs. The overlap of Mobile and Fixed is the norm where both ecosystems exist.

FIGURE 14: DUAL ECOSYSTEMS



Fixed networks complement Mobile networks

Co-existence and thriving together is the global norm and will continue in developing countries. Some players may dominate, but connectivity is not a winner-take-all market. Fostering the dual ecosystems will provide more value for customers, as both Mobile and Fixed play a vital role in expanding access. The first wave of connectivity focused on availability. The next wave will need to focus on affordability, and ISPs will play an important role, as Mobile Network Operators (MNOs) alone cannot bridge the existing gaps. In developing countries, MNOs have become the dominant players due to the historic lack of infrastructure, but ISPs are essential to expanding access to connectivity for underserved populations.

INTERVIEW FINDINGS

Connectivity Capital conducted over 30 interviews to better understand the challenges faced by investors and ISPs in the last-mile connectivity sector. The respondents experienced technology and infrastructure investors and numerous companies at all stages of the financing spectrum and company lifecycle, including established last-mile connectivity operators and experienced technology and infrastructure investors. The interview methodology is detailed in the Appendix.

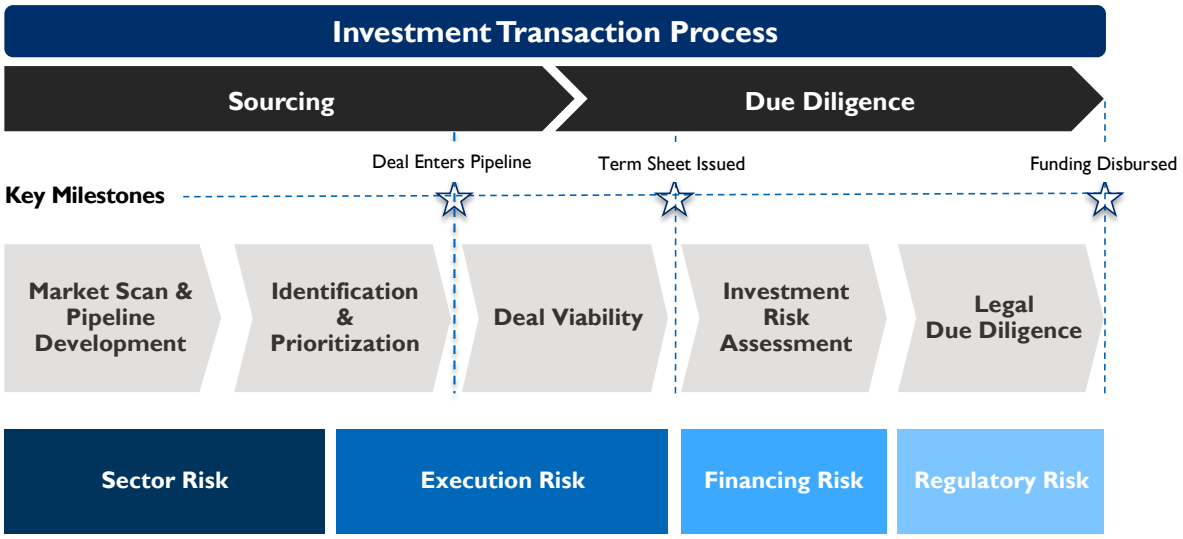
INVESTMENT PROCESS AND RISKS

To understand the barriers to investing in last-mile connectivity, it is important to first understand the typical investment process, regardless of sector. Investors prioritize investments based on risk factors and available mitigation strategies.

Investors often use a multi-step process to source and evaluate a potential investment. Each stage of the investment process introduces specific categories of risk. Investors work to identify these risks and develop pro-active risk mitigation strategies before, during, and after the investment transaction takes place. The investment process functions like a typical sales funnel. As a potential investment moves through the process, new categories of risk are identified and assessed with a decreasing number of potential transactions moving forward to the next stage of the investment process.

The figure below illustrates the typical investment process with the categories of risk that are assessed at each stage of the process:

FIGURE 15: INVESTMENT TRANSACTION PROCESS



Investors in the last-mile connectivity expect to take on a degree of risk in every investment. Often multiple risks are identified and are compounding factors to each other. As one Institutional Investor noted in our interviews, "There's no such thing as a risk-free investment anywhere. The key is mitigation and developing strategies to deal with risks pro-actively."

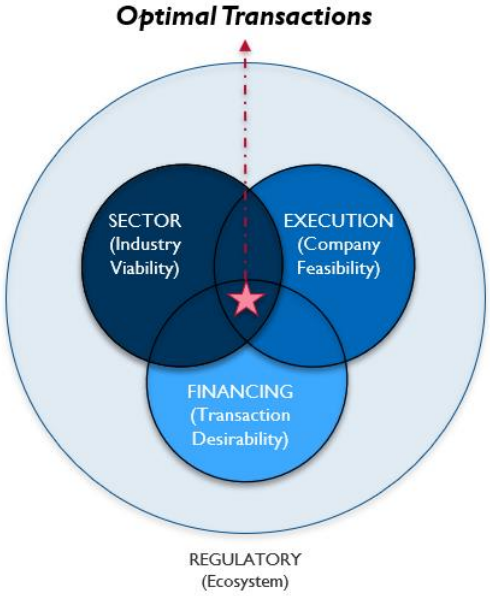
The risks presented in last mile connectivity can be classified into four overarching categories as detailed below:

1. **Sector Risk**: challenges that are industry-specific and stem from the nature of the business, customers, and competitive landscape. Sector risks in last mile connectivity emerge because the sector is still in an innovation phase of growth. Business models and technology standards are still evolving as more innovation takes place and some models scale with success and others fail. Investors are wary of the challenges faced by ISPs related to finding the right business model and go-to-market strategy that allows for sustainable profitability.
2. **Execution Risk**: challenges that are company-specific stem from the operations, processes, human resources, and technology of the specific company being evaluated. This includes an ISP's ability to efficiently design, deploy, operate, and commercialize a network.
3. **Financing Risk**: challenges that are transaction-specific and stem from the risk-return profile of last-mile connectivity deals, availability of capital, limited liquidity potential, and volatility in currency and interest rates.
4. **Regulatory Risk**: challenges that are ecosystem-specific and stem from legal regulations, industry policies, compliance requirements, and corporate governance. Regulatory risks specific to connectivity include the legislative framework around competition and investment, legal mandates for access to right of way, licensing, spectrum, open-access, consumer & data protection, pricing & usage restrictions, and overall telecommunications & ICT policies.

It is important to note that transactions can fail at various points along the transaction timeline. Each step of the process involves attempts to manage or mitigate these risks.

The figure below illustrates how these risks interact.

FIGURE 16: INVESTOR RISK CATEGORIES



Deals close successfully when there is sufficient convergence and mitigation of sector risk, execution risk, financing risk, and regulatory risk.

BARRIERS TO INVESTING

Investing in last mile connectivity requires investors to address four major barriers that emerge from the risk categories identified. In many ways, the operational complexity and commercial viability of operating an ISP has improved considerably over the last decade. The expansion of new telecom infrastructure and deconsolidation of legacy infrastructure has provided new opportunities for ISPs of various sizes to expand and thrive in previously unavailable market segments.

However, our interviews indicated that investors are still reluctant to invest in last-mile connectivity transactions. After completing the interviews, our team analyzed the findings to identify key takeaways and recurring themes across the range of Investors interviewed.

Investors prioritize the potential upside vs downside of an investment based on risk factors and available mitigation strategies. Using the framework of risk categorization across sectors, this research sought to identify specific barriers within each risk category. The section below explains each of these barriers in detail and seeks to describe the challenges Investors face in making investments in last-mile connectivity companies.

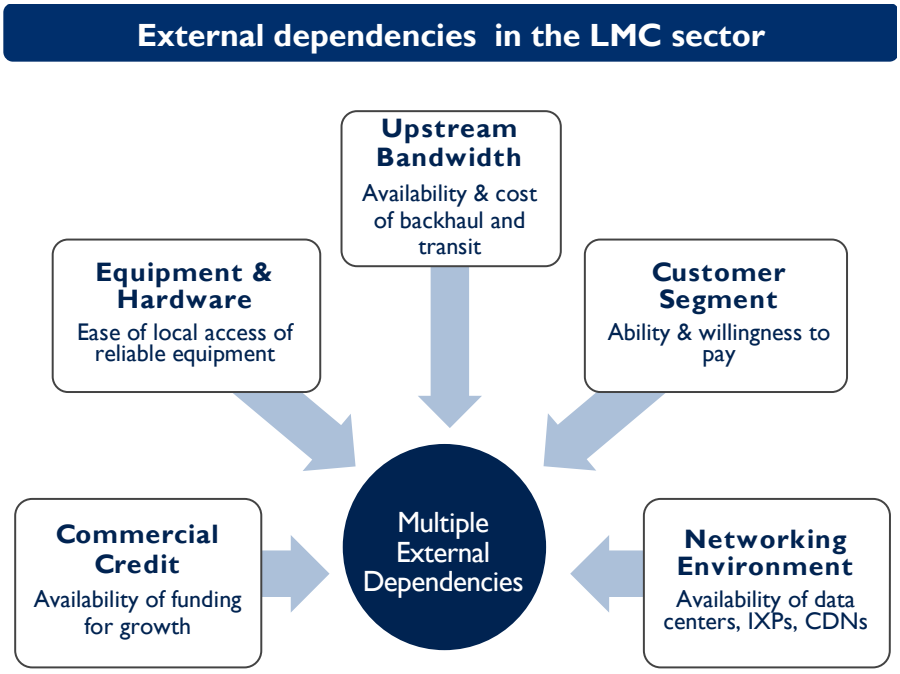
The four barriers to investing are summarized below.

FIGURE 17: BARRIERS TO INVESTING

BARRIER 1, SECTOR RISK: LAST-MILE CONNECTIVITY IS A CHALLENGING SECTOR WITH MULTIPLE EXTERNAL DEPENDENCIES

The first barrier to investment is industry-specific Sector Risk**.** The Investors interviewed pointed to the multiple external dependencies in the last-mile connectivity sector as a reason for passing on potential investments. Specifically, ISPs depend on the availability and cost of multiple external factors, such as commercial credit, equipment & hardware, upstream bandwidth, customer segment, and the network infrastructure environment.

FIGURE 18: EXTERNAL DEPENDENCIES IN LAST-MILE CONNECTIVITY



External dependencies are the critical inputs and elements of the connectivity value chain that the last-mile provider does not directly control. These dependencies increase the cost to deliver connectivity and inhibit the growth potential of ISPs in the following ways:

- **Commercial credit**: ISPs interviewed mentioned that commercial credit, including value chain financing and commercial lending, is rarely available. When available, the cost of credit is expensive, and the terms are often designed for traditional trading or manufacturing businesses that have secured inventory or real estate as collateral. One ISP that we interviewed was not able to obtain financing until the company purchased its headquarters building and used the title deed as collateral. Commercial lenders and banks often don't understand the cash flows of ISPs and revert to prohibitive financing structures without traditional collateral to fall back on.

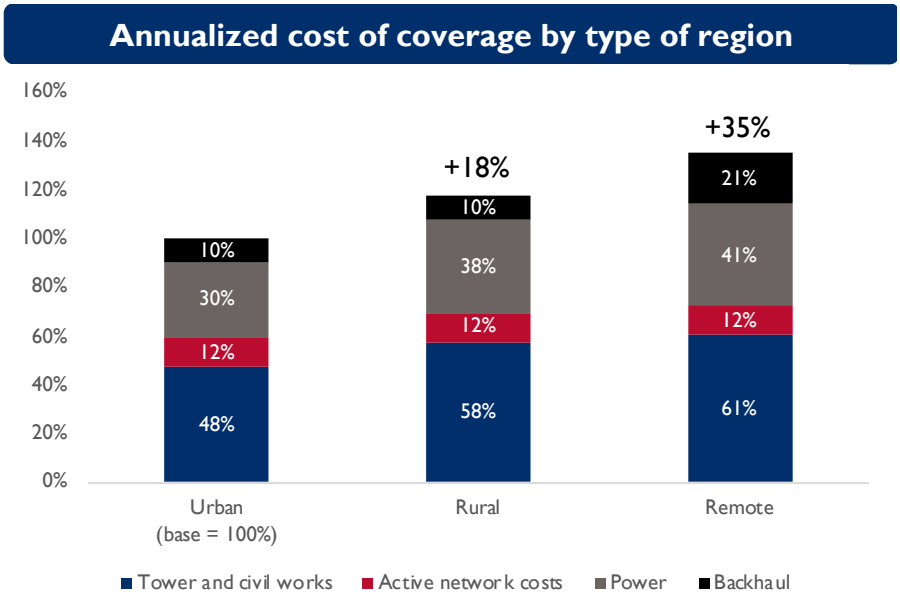
- **Equipment and hardware**: Although the cost has decreased significantly over the last few years, local access to network equipment and hardware still remains a challenge in many markets. Dependable

and affordable access to equipment is critical and allows for steady and constant expansion. Without access to such equipment, ISPs must hold significant inventory and tie up valuable working capital.

- **Upstream bandwidth (middle-mile & first mile)**: The cost upstream bandwidth is known as backhaul and/or IP transit cost. Backhaul cost is one of the largest recurring costs for ISPs and becomes much more expensive without middle-mile or national backbone infrastructure. A Development Finance Institution (DFI) Investor commented that in one example, an ISP had to fund the high capital expenditure (CapEx) costs of building their own backhaul infrastructure, thus increasing the payback period for new installations and reducing the return on investment for Investors. Commercial investors often hesitate to deploy capital to ISPs in markets with limited or expensive upstream bandwidth.

- **Customer segment**: As urban areas see greater broadband penetration, ISPs are increasingly looking at rural and remote locations for potential growth opportunities. However, as indicated in the chart below, low-density areas are almost always lower margin and less profitable to serve compared to city centers or locations with dense populations. In addition to the higher cost-to-serve, these low-density areas often also have less profitable or lower-ARPU (Average Revenue Per User) customers as well. One corporate investor noted during our interviews, "The trickiest part of last-mile connectivity, especially in rural regions, is the ongoing tension between the profitability of the customer vs. the impact of connecting the unconnected. The higher ARPU urban customer is often easier to reach and has more spending potential; whereas rural customers are usually low-earning or low profitability." When investors evaluate last-mile companies and locations to build out networks, the opportunity cost of serving these markets with low ARPU rural customers is high. Therefore, most investors with short investment horizons and high return expectations prefer not to address the burgeoning last mile connectivity opportunity beyond urban markets.

FIGURE 19: COST OF COVERAGE



- **Network infrastructure environment**: There are many parts of the network infrastructure environment - data centers, Internet Exchange Points (IXPs), carrier neutral data infrastructure, and

others. The depth of the network infrastructure environment is critical to reducing the cost of operating a network by optimizing data routes and keeping traffic within the "local loop." In many developing markets, infrastructure sharing is less common as infrastructure owners are not economically incentivized or legally compelled to create open-access infrastructure. When the network infrastructure environment is limited, access to shared backbone infrastructure or limited access to rights of way, investors are less likely to invest as ISPs struggle with the high cost of building networks or entering new areas.

The multiple external dependencies mentioned above materialize in varying intensities across different markets, and often inhibit more investments from taking place. Tackling these dependencies by enhancing their availability and ease of access or by reducing their cost can lead to more viable transactions and investment activity in the sector.

CASE STUDY 1: WORLDLINK GROUP, NEPAL

The case of WorldLink in Nepal is illustrative of how external dependencies can prevent investors from deploying capital. WorldLink struggled for many years to obtain financing, and while they have ultimately pushed through to become successful, this case study is an important example of how growth can be slowed and what could not have been.

Context

WorldLink was founded in 1995 as a connectivity and IT services provider in Nepal. Over the past 25 years, WorldLink has grown from a small ISP serving customers in Kathmandu to the largest Internet Service Provider in Nepal. The company operates across 63 districts with more than 350,000 customers and over 3,000 employees. WorldLink has vertically integrated to position itself as a comprehensive IT solutions provider offering data connectivity, network integration, web hosting, maintenance, and systems integration etc.

Challenge

WorldLink's growth and expansion rate was severely muted in its early years due to lack of capital availability and unclear pole access. The company struggled with the economics of serving low-ARPU (Average Revenue Per User) clients in underserved areas as the marginal cost to serve these clients proved to be extremely high. At that time, investors did not view the company as an attractive growth opportunity because WorldLink's limited access to enabling shared infrastructure (poles, right of way) was an impediment to growth and scale.

Conclusion

It took more than 3 years, but WorldLink was eventually able to negotiate shared pole access rights with Nepal's National Electricity Authority (NEA). NEA didn't realize the value of the infrastructure assets they possessed or that their electricity poles could be cross-purposed with minimal marginal cost to include and cross-sell fiber. The fiber lines could be used for back-haul, middle-mile or last-mile connectivity. Since then, the consumer has benefited tremendously from lower cost and increased speed. WorldLink has more than doubled its user base and pricing has been cut in half. WorldLink would not have been able to achieve the scale of operations without shared pole access. Infrastructure sharing is often constrained due to lack of coordination across different sectors, lack of stable and transparent regulations or broader strategic broadband/telecom plans, lack of financing or lack of spectrum. Addressing these constraints could have made the process more efficient and cost-effective for WorldLink sooner. Despite the eventual success of WorldLink, governments in many developing countries are still struggling to promote infrastructure sharing practices.

BARRIER 2, EXECUTION RISK: THE MAJORITY OF LAST-MILE COMPANIES STRUGGLE TO SECURE INVESTMENT DUE TO THEIR COMPANY GROWTH STAGE.

The second barrier to investment is company-specific Execution Risk**.** The Investors interviewed consistently mentioned that as a largely nascent industry, the majority of last-mile connectivity companies are not yet suitable for outside investors due to their growth stage. One corporate investor said, "It's challenging to find ISPs that can execute on all aspects of the business. Especially in developing countries, local ISPs often don't have the governance, compliance, and reporting structures in place to manage outside capital." Another investor commented with regards to equity investments in ISPs, "the moment you take on an outside equity investor, you need to have a shareholder strategy. That's often complex and expensive to develop unless you're already a large company."

We identified three recurring themes that explain why the majority of LMC providers are not yet suitable for outside investors, thereby inhibiting the level of investment activity in the sector:

- **Many business models are still evolving, which leave investors cautious that LMC providers can scale their model.**

As one corporate investor noted, "the business model for sustainable access in underserved areas is still in flux". ISPs have a diversity of choice related to their deployment model. They have considerable flexibility in their commercialization strategy, and often thrive when they have a combination of different deployment and revenue models. ISPs rarely deploy just one technology stack or address just one market segment when serving their clients. Investors look for ISPs that have already found the right mix of revenue model options between pre-paid, post-paid, ancillary services, up-sell, cross sell products, etc.

Another investor noted that "in many developing markets there is a long-tail of smaller operators. These smaller operators often face an inflection point in their scale between being locally knowledgeable and being scalable across a larger region. As an investor, the challenge is to balance operators with scale potential and low-cost structures. More transactions don't close because many ISPs lack both scalability potential and profitability."

Investors note that they are cautious with their investments in last-mile connectivity because of the limitations of many business models. Additionally, previous high-profile failures have sent signals to the investor community that some LMC models may not be scalable or commercially viable.

- **Investors are wary because they believe that operational costs can't be supported by potential revenue streams in many markets**

An early stage investor who was interviewed expressed the concern that some higher-profile ISPs had, "developing world revenue streams with developed world cost structures". This point alludes to the fact that ISPs in developing countries have lower average revenue per user (ARPUs), and therefore need to have lower cost structures to be sustainable. Backhaul costs are fairly inflexible as they are set on a market-basis and are largely driven by distance to the source (i.e. IP transit drop points). A key driver of the cost dynamics of bandwidth cost is based on the location of where the network is operating. Bandwidth costs vary across geographies. For example, backhaul costs are approximately 14 times more expensive in Africa

than many developed markets. This is one of the main reasons why running a rural ISP or an ISP in a landlocked country is comparatively more expensive. Much of the previous investment activity in LMC has been focused on operators in dense urban markets with high ARPU customers. With these markets approaching saturation, many of the LMC deals available now are in lower-density regions with lower ARPUs. Many of these areas often impose higher capital expenditure and operating expenses to serve while offering lower revenue potential. This is a key reason why many market-rate investors cast doubt on the operational sustainability of an ISPs network in serving the next billions of customers located in peri-urban or rural areas.

- **Investors find that many companies lack the commercial experience, tools and human capital to scale**

The inclination of many ISPs upon raising initial capital is to build as big as they can. One investor referred to this as adopting an "If you build it, they will come strategy". This can often lead to an overbuilt network with limited usage. Additionally, ISPs sometimes build a network without a clear commercialization strategy or understanding of true demand for its services. Investors observed that cost effective network design is often done in phases. As one ISP noted, "We made some early mistakes by overbuilding. Now we value engineer based on demand over the next 18-24 months. It is much cheaper to upgrade capacity once you have a paying customer."

Investors also observe that ISPs often face the typical human capital and operational challenges that all growing small and medium-sized enterprises face. In smaller ISPs, the CEO is often the CTO, CCO, and founder all in one, and struggles to find and upper management to fill these roles. Additionally, since the sector is relatively new, employees have not had careers at other ISPs where they can bring technical skills and market expertise. Investors noted that companies typically rely on internally grown talent. One area in particular that Investors noted was ISPs lacking sales or marketing know-how to commercialize their networks.

Last-mile connectivity companies often have a limited history of interacting with and taking on outside investors. This reflects in a lack of investment preparedness. Companies often lack the ability to prove their competence or cite specific investor-relevant metrics to demonstrate evidence and communicate that they have a repeatable and scalable business model.

The themes identified why many LMC providers are still evolving to find the right mix of deployment model, customer segment or revenue model to grow profitably. Investors are weary of LMC providers that are still experimenting to find the right business model, and are not yet suitable for outside investment.

CASE STUDY 2: VAST NETWORKS, SOUTH AFRICA

The second case study we identified is VAST Networks in South Africa. VAST is an interesting example of a company that scaled an alternative business model, but ultimately failed to make it profitable despite several valiant pivots. In particular, this case study highlights the execution risk and the following barrier to investing: **The majority of last-mile connectivity companies struggle to secure investment due to their company growth stage.**

Context

VAST networks, South Africa's once largest public WiFi network player, entered the market in November 2015. VAST was established as an open-access WiFi network infrastructure provider resulting from the merger between the WiFi assets of two companies – Mweb and Internet Solutions. Dimension Data, an IT services company, and Multichoice Group, a spin-off from Naspers, one of the largest technology investors in the world, were the main shareholders of VAST Networks. VAST won multiple contracts to deliver WiFi to hospitals, shopping centers, hotels and restaurants.

Challenge

In late 2019, MultiChoice Group and Dimension Data decided to liquidate VAST Networks after multiple failed attempts to find new investors or strategic buyers. For over 18 months, the company was in conversations with multiple potential buyers, but failed to secure additional outside investment. While there was speculation that fiber-optic infrastructure company Link Africa and South African telecom giant Vodacom, were both in discussions to buy VAST Networks, neither party ultimately reached a deal. The Board also evaluated multiple options to continue the business, such as follow-on investment from existing investors and partnerships but VAST's failed business model and sustained history of operating loss meant that all alternatives to continue the business were exhausted.

VAST's business model relied partly on generating revenue from selling Wi-Fi bundles and mobile advertising on its portal. The company struggled with adequately monetizing its offering through advertising and selling usage data while managing the operating costs associated with implementation and on-going service provision of open-access WiFi. While the number of 'eyeballs' or unique logins to the WiFi Hotspot was significant, the amount of data consumption was sporadic, and monetization was low. Consumers either weren't interested in purchasing WiFi bundles in public hotspots or they were not in a hotspot location regularly enough.

Conclusion

VAST Networks' failure to commercialize a profitable public WiFi model was a significant learning for investors evaluating investments in the last mile connectivity sector. VAST, however, is not the only player that struggled to demonstrate a financially sustainable public WiFi model. As recently as February 2020, Google announced that it will wind down its free WiFi program, Google Station, across all its operating locations (India, Indonesia, Mexico, Thailand, Nigeria, Philippines, Brazil, Vietnam and South Africa). Although the initiative helped millions of users access the Internet, Google also struggled to find a sustainable business model to continue operating in several markets. Another player on a more localized level, WiFi Interactive Networks (WIN) in the Philippines, has also had to significantly pivot from the public WiFi model to a prepaid revenue model.

The business model for public WiFi hotspots, much like other emerging business models in the last mile connectivity sector, is still evolving as customers have not shown the desire to pay for the service or advertisers are not able to extract sufficient value from sponsoring these models. Consequentially, investors are reluctant to deploy capital as they believe a majority of companies in the sector are still in an experimental stage struggling to find a commercially viable scalable business model.

BARRIER 3, FINANCING RISK: INVESTOR ECONOMICS AND RETURN EXPECTATIONS OFTEN DON'T ALIGN WITH AVAILABLE INTERNET SERVICE PROVDIER POTENTIAL TRANSACTIONS

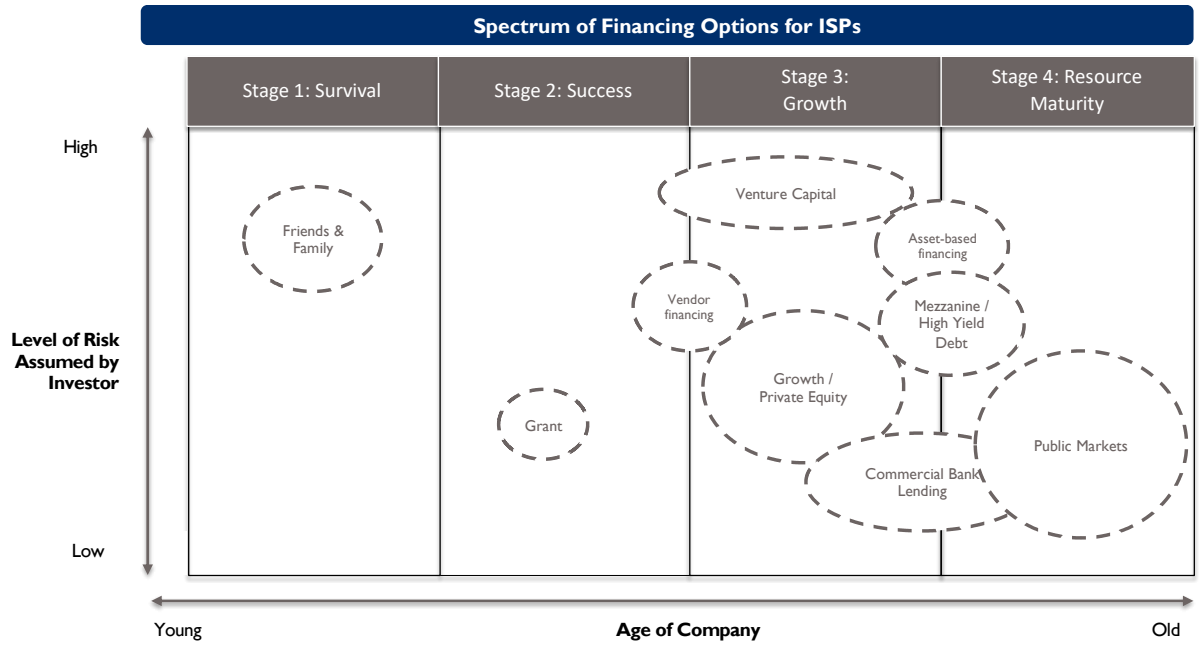
The third barrier to investment is transaction-specific Financing Risk**.** The Investors interviewed mentioned several instances where the economics of a specific investment vehicle dictated the transaction size and stage of the ISP, or where the return expectations did not align with their target rate of return. One DFI with a global portfolio of investments mentioned the "skewed perception of risk-adjusted returns in last-mile connectivity" as a key barrier to making investments.

The interview revealed three main reasons why the economics and return expectations of investors don't align with available ISP deals:

- **Investor minimum transaction sizes are often not aligned with the middle bracket of capital needs for LMC Providers**

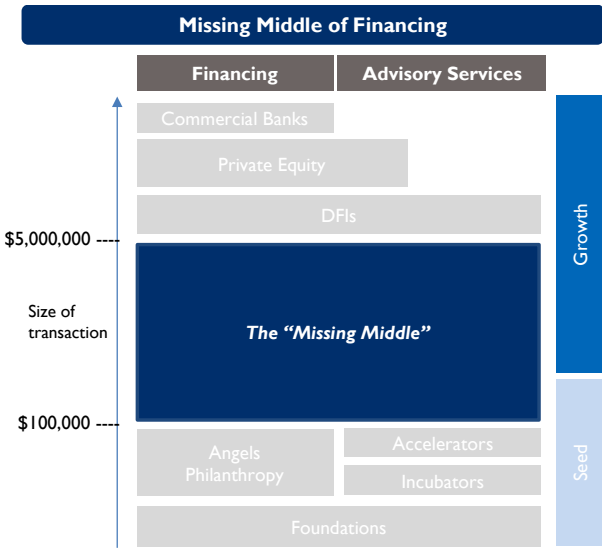
Companies require different types of capital at different stages of their lifecycle. Assessing financing risk starts with matching stage appropriate capital between investors and companies. The figure below is meant to serve as an illustrative example of how different types of financing are appropriate at different stages of an ISPs lifecycle.

FIGURE 20: SPECTRUM OF FINANCING OPTIONS



Upon examining the funding landscape, we found that most potential transactions are between $100,000 and $5 million. However, most Investors seek to place capital either under $100,000 or above $ 5 million. There is a gap – what we are calling the 'Missing Middle' where financing for ISPs is not available. The below figure illustrates the gap in financing needs.

FIGURE 21: MISSING MIDDLE OF FINANCING



On the lower end of the spectrum, transaction sizes below $100,000 do not face as much difficulty finding funding because of the presence of various funding agencies and mechanisms that support seed stage transactions. Angel investments, early-stage philanthropic funding, corporate accelerators, and university incubators often fund ventures at this stage due to the relatively small transaction size and experimental nature of such investments. Though supportive of innovative and experimental ISP businesses, these investors rarely have the capacity to continue funding these ISPs beyond the initial Survival stage.

At the other end of the spectrum, development finance institutions (DFIs), venture capital and private equity investors evaluate investing in late growth stage opportunities typically above deal sizes of $5 million. These professional investors often operate with transaction size minimums that prevent them from investing in last-mile connectivity providers that typically require less than $ 5 million. Many Institutional investors and DFIs that we interviewed had a minimum transaction size of $10 million with the anticipation of making follow on investments of an additional $10 million plus.

Investors also noted that while the infrastructure required to build out an ISP network is expensive, ISPs have limited capital assets of low equipment value to mortgage or leverage with banks, who don't easily understand the value of fiber cables or wireless connectivity infrastructure. This is a key reason why loans or bank financing is not made available to ISPs in the early stage.

Our research indicates that there exists a significant 'missing middle' bracket of ISP financing that is not aligned to most investor interests. More transactions don't close in LMC simply because of the lack of available capital at this vital stage of expansion and growth.

- **Investor misconception of LMC infrastructure investments as technology investments.**

One East-African based private equity investor interviewed mentioned that "some venture capital funds view last-mile connectivity as a tech play, and the IRRs (Internal Rate of Return) aren't venture like." To understand why investors are reluctant to invest in ISPs it is helpful to compare several characteristics of ISPs and typical venture-backed companies that usually secure funding at this stage. The figure below reflects the very different nature of investing in ISPs vs. investing in scalable technology companies that are typically recipients of venture financing.

FIGURE 22: ISPS VS. TECHNOLOGY COMPANIES

Comparison of Characteristics for ISPs vs. Typical Tech Companies

	ISPs	Typical VC backed Tech Company
Upside Potential	Linear	Exponential
Average Return on Investment (ROI)	5-15%	25-40%
Investment Profile	Capex heavy	Capex light
Risk Profile	Low beta	High beta
Collateral	High	Low

In all parameters considered – upside potential, return on investment, investment profile, risk profile and collateral, the nature of investing in ISPs is very different from investing in tech companies. Investing in connectivity is probably more similar to investing in infrastructure – which also requires significant upfront capital investment, is relatively asset-heavy and takes many years before generating a return on the initial capital invested.

- **Volatility in currency, interest rates & liquidity opportunities erode return profile.**

Many investors pointed to the volatility in macroeconomic financial indicators such as currency rates, interest rates and liquidity ratios as key challenges in deploying capital in many markets that high-potential ISPs typically operate in. This is especially relevant for investors with a focus on investing in emerging markets but without local presence or for those investors deploying capital in non-local currency denominations.

Investors experience that currency fluctuations impact and can often erode returns when converting back and forth between domestic and foreign currencies. Investment regulations in the destination region may require that any foreign investments be subject to various liquidity restrictions or may impose additional fees or commissions on such transactions.

CASE STUDY 3: EXTREME BROADBAND, MALAYSIA

The third case study is on the Malaysian Internet Service Provider, Extreme Broadband. Extreme Broadband's early growth was abundant with challenges related to gaining access to external financing. EBB has grown cautiously over the last 15 years since it was founded; the company has taken on limited external financing and remains privately owned. In particular, this case study highlights the following key barrier to investing: **Investor economics and return expectations don't align with available ISP deals.**

Context

Extreme Broadband (EBB) is a licensed Internet Service Provider in Malaysia. The company has two key business focuses: Broadband Internet and Voice Over Internet Protocol (VoIP). The team has extensive expertise in the construction of communications towers and remote POPs (Point of Presence) having participated in several nationwide broadband infrastructure projects for countries in the Asia Pacific Region (e.g. China, Taiwan). The company recently opened Malaysia's first open Internet Exchange which allows peering from any organization - local or international - in Johor Bahru. Peering is a voluntary interconnection of separate Internet networks for the purpose of exchanging traffic between users of each network. In contrast to "transit" where the network operator pays money to another network for Internet access or transit, peering enables networks to 'swap' traffic between their users, often freely and for mutual benefit.

Challenge

For much of its early existence, EBB had severely limited access to affordable financing.

- ***Equity investors not aligned with connectivity infrastructure return profile or deal size.***

EBB found that investors often perceived connectivity companies as typical technology companies. The general perception of investors they approached was that EBB had exponential scalability potential similar to software companies. However, upon explaining the linear growth trajectory of connectivity businesses, similar to infrastructure companies, investors were often reluctant to invest. This misalignment in expected return profile of connectivity investments, meant that EBB faced a severe dearth of available capital in the market. In cases where EBB approached investors who understood the nature of infrastructure investing, EBB did not meet the minimum deal-size of these investors.

- ***Banks unwilling to loan without hard assets to pledge as collateral.***

EBB also tried accessing the pool of debt financing available as bank loans. In this case, as EBB did not have sufficient hard assets to pledge as collateral, banks required property deeds, personal guarantees and several years of audited financials in order to qualify for a loan. The terms of financing of capital available at this stage are often geared for traditional trading or manufacturing businesses that have secured inventory or real estate as collateral. In another case, WorldLink, an ISP in Nepal (referenced in a previous case study) had a similar experience: the debt financing available in Nepal was heavily dependent on collateral and was made accessible to them only after 7 years of being in business.

Conclusion

This inability to access affordable capital in its early years hindered the growth of EBB. Starved for financing at this stage, EBB had to resort to several value engineering tactics and network expansion hacks to survive instead of investing with a strategic, scale-efficient and long-term perspective. The company built initial

networks in a bite-sized and bootstrapped manner as opposed to larger scale capital efficient networks. This meant that over time, as users added to the network, EBB had to significantly reengineer and redesign the network to operate at scale.

EBB has been able to backfill this apparent funding gap in its early stages with vendor financing because traditional bank financing is limited and on onerous terms. EBB turned to one of their main vendors, MyTelehaus, to develop a customized solution for routing traffic to the datacenter. The vendor worked with EBB to extend payment terms. EBB was able to realize immediate cost savings through network optimization and use that cash to repay MyTelehaus.

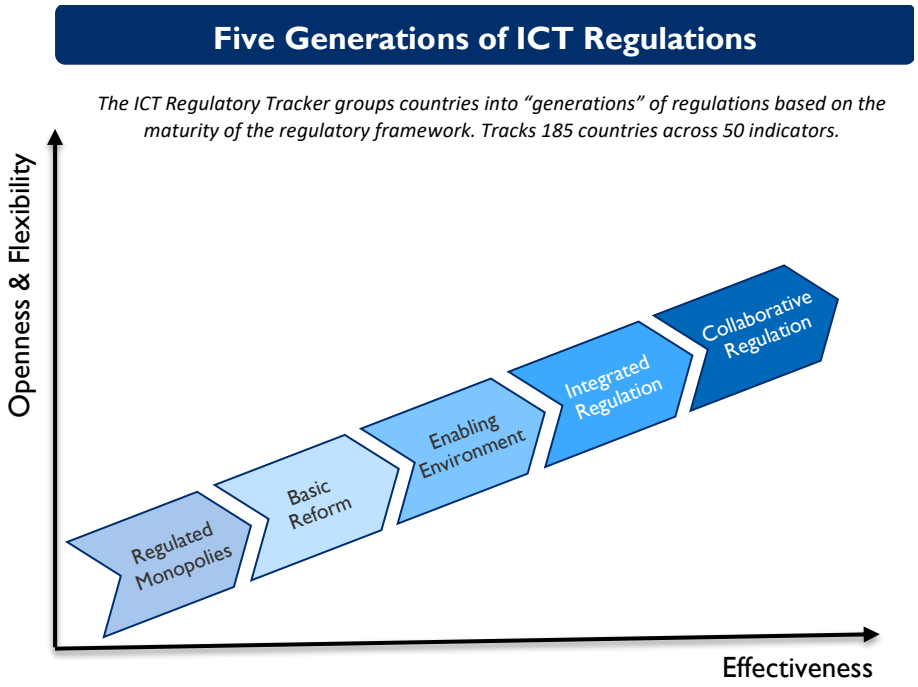
Although this case illustrates how EBB managed this challenge through value engineering its network expansion and resorting to unique strategies such as vendor financing, this lack of affordable financing severely hinders the growth of many ISPs, who, unable to secure funding at this crucial stage, often fail entirely.

BARRIER 4, REGULATORY RISK: REGULATORY UNCERTAINTY AND INEFFECTIVENESS OFTEN ADD COMPLEXITY TO ANY POTENTIAL TRANSACTION.

The fourth barrier to investment is ecosystem-specific Regulatory Risk. Both Investors and ISPs interviewed mentioned that regulations and government policies have a strong influence on investment activity in last-mile connectivity. However, many Investors and ISPs acknowledged their role was to react to regulations and not drive them. Their choices were often limited to proceed or not with an investment.

To understand regulatory risk, it is important to understand different regulatory frameworks. The ITU recently launched *The ICT Regulatory Tracker* that developed a framework for monitoring and comparing varying levels of ICT regulatory policy environments between countries. The tracker captures data from over 185 countries across fifty different indicators over the last nine years, ranging from accountability to quality of service obligations and monitoring to competition in market segments, across four clusters: regulatory authority, regulatory mandate, regulatory regime and competition framework. Countries have been grouped into "generations" of regulations based on the maturity of the regulatory framework. The figure below describes the various regulatory generations:

FIGURE 23: ICT REGULATORY TRACKER



Investors pointed to three themes of how ineffective regulations or regulatory uncertainty inhibits more transactions in LMC:

- **Investors reluctant to enter markets that emphasize control over oversight and compliance.**

One impact investor noted that, "Regulation is not an end in itself. We look to invest in markets where regulators prevent anti-competitive practices and ensure customer protection, not exercise outright control. When regulators exercise control as opposed to provide oversight, it often unintentionally leads to picking winners and losers." Many Investors view the objectives of a regulatory framework are to enforce safeguards of effective competition, prevent anti-competitive practices, ensure consumer protection, and avoid market failures.

Investors emphasized the importance of certainty when making infrastructure investments that are repaid over long time horizons. Regulatory frameworks that are transparent and consistent allow investors to undertake significant capital expenses with the confidence that the rules will be fairly applied across all market participants.

- **Policies are often not designed to enable shared access to network infrastructure.**

ISPs often depend on sharing infrastructure to expand in a capital efficient manner. One main challenge ISPs encounter in sharing infrastructure is limited access to rights of way. Network operators must focus on purchasing or leasing land and obtaining permits to dig conduit or install towers. The costs and time for these civil works is considerably more expensive than for the actual network hardware needed to carry more data to new locations. For example, with a fiber installation, typically over 80 percent of the cost is obtaining street-level access, trenching and installing poles, and laying conduit as opposed to the fiber, relays, radios, and antennas to grow the network. In many developing markets, infrastructure sharing is rare as infrastructure owners are not economically incentivized or legally compelled to create open-access infrastructure. In the absence of access to shared backbone infrastructure, ISPs struggle with the high cost of building networks.

- **Certain regulations promote incumbent dominance and prevent competition.**

Government regulations can foster competition in spectrum and service, often expanding availability and affordability of Internet access for end users. Investors commented that understanding the market dynamics and competitive landscape within a market was a critical part for their investment analysis. One Impact Investor noted that turnkey infrastructure has been proposed as a solution, where one outside provider builds and finances the entire backbone infrastructure at concessionary rates. While this is appealing, it has major pitfalls. Since ISPs require constant upgrades, having the capacity to manage the upgrade internally is critical. By building the network yourself, it also forces you to build the capacity to maintain it.

CASE STUDY 4: AMERICAN TOWER CORPORATION, TANZANIA

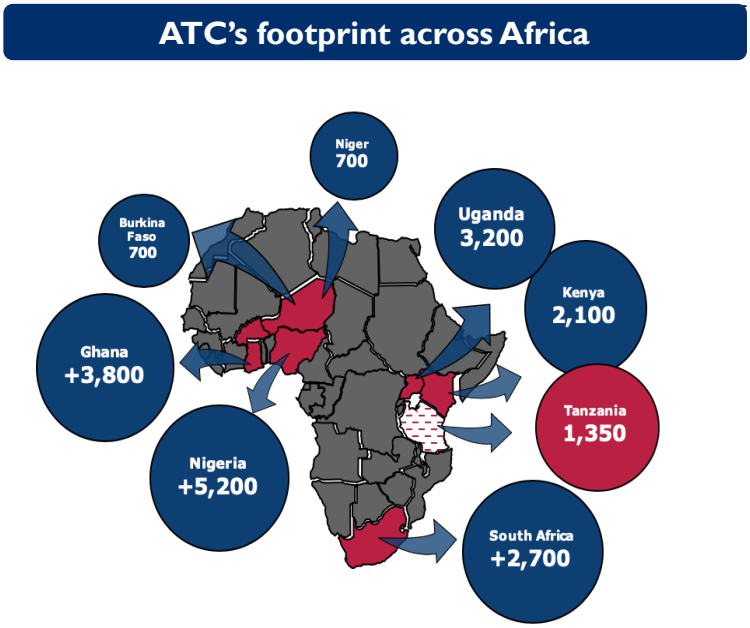
The final case study identified is on American Tower Corporation (ATC). Specifically, we focus on ATC's failed entry into the Tanzanian market as it illustrates the following key barrier to investing: **Regulatory uncertainty and ineffectiveness often add complexity to any potential transaction.**

Context

Founded in 1995, American Tower Corporation (ATC) is a leading independent owner, operator and developer of wireless and broadcast communications real estate. ATC has a global portfolio of 180,000 tower sites in advanced, evolving and developing wireless markets, and in various stages of wireless network deployment. In Africa, American Tower currently has a footprint of over 12,000 sites across Burkina Faso, Niger, Kenya, Nigeria, Uganda, Ghana, and South Africa. In addition to leasing space on wireless and broadcast towers, American Tower provides customized solutions through in-building systems, outdoor distributed antenna systems and other right-of-way options, managed rooftops and services that speed network deployment.

As part of its global expansion strategy, ATC steadily expanded across Eastern, Western and Southern Africa Region through tower acquisition from MNOs. In March 2016, ATC sought to enter the Tanzanian market through acquiring 1,350 towers from the global telecommunication company, Bharti Airtel. The announced deal would have been the second between the two companies, after Bharti Airtel sold 4,800 of its towers in Nigeria to ATC.

FIGURE 24: AMERICAN TOWERS CORPORATION AFRICAN FOOTPRINT

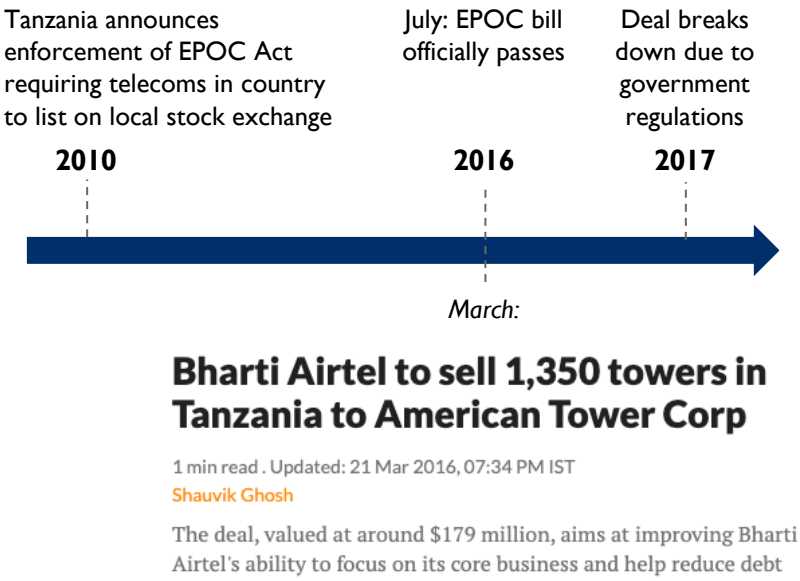


Challenge

In 2016, the Tanzanian National Assembly announced that it would begin enforcing a 2010 regulation targeting telecommunication companies - mandating all holders of Network Facilities, Network Services, Application Services and Content services licenses, to list on the local exchange.

The requirements set forth by the national assembly and subsequently the regulator was not conducive for a listed multinational company. For ATC, listing in the DSE was a deal breaker because it could have had a serious ramification on the company's market valuation. Cross national listing of shares comes with a number of risks. In the NYSE market, ATC investors can instantly find a buyer or a seller for their shares due to the large trading volumes. However, the DSE had a trading volume of only $13,750 per day, which means that market is very illiquid and therefore ATC investors would have difficulties finding potential buyers or sellers for their shares. The listing requirement significantly changed the economics of the transaction.

FIGURE 25: ATC TIMELINE OF EVENTS



Conclusion

The ATC-Bharti Airtel Tanzania deal was expected to be closed in the first half of 2016, and another attempt at closing the deal was subsequently made in 2017, but the transaction was never finalized due to incompatibility with the regulatory environment. The listing requirement was unique to Tanzania and was cited as the primary difference between that country and the nine other African markets that ATC has entered so far; illustrating that regulations can be starkly different even in regions in close geographic proximity.

The failure of the tower sale deal between Bharti Airtel and ATC hinged completely on the failure of ATC to conduct an in-depth risk assessment of the legal regulations associated with telecommunications companies in Tanzania. A legal and regulatory due diligence would have made clear that the purpose of the listing was to put shareholding into the hands of the Tanzanian people and Tanzanian government ownership would not annul that law. Although Bharti Airtel had communicated that it would lobby for this to be waived, an objective due diligence would reveal that it would be going against constitutional rulings and represents behavioral impropriety that could have additional legal, reputational and economic implications.

RECOMMENDATIONS

USAID seeks to unlock the potential of private capital to expand access to connectivity for inclusive growth. Investing in last-mile connectivity is an attractive investment thesis that can achieve market rate returns. While this report has highlighted the various barriers and risk factors to investing in last mile connectivity, it is important to understand that investors exist on a risk continuum. Each investor has a separate risk appetite based on their investment objectives. Investors prioritize investments based on risk factors and available mitigation strategies. The recommendations below seek to expand the availability of risk mitigation strategies.

Barrier 1, Sector Risk: Last-mile connectivity is a challenging sector with multiple external dependencies.

The Internet thrives on a diversity of approaches and business models. Investors noted that finding ISPs with the right business model and revenue mix is essential for the commercial viability of last-mile connectivity. USAID and donor agencies should encourage the diversity of those approaches while at the same time-sharing knowledge about what works. LMC is a tough sector with multiple external dependencies, but over time driving down the costs of those external dependencies lowers the cost of all forms of connectivity to end users.

The following recommendations could be implemented to reduce the industry-level sector risks that are a barrier to investment:

- Short-term
  - Encourage knowledge sharing of business models, with specific focus on deployment model, customer segmentation, and revenue models.
- Mid-term
  - Advance benchmarking and information sharing of Investor metrics
- Long-term
  - Financing middle mile that enables last mile and overall sector attractiveness

Knowledge sharing and ecosystem development can be vague terms, however, in our interviews, we learned of several specific instances where targeted assistance could have outsized impact. Specifically, topics such as best practices for network design, commercialization strategies, and pricing of data packages were mentioned by Investors as gaps in knowledge.

Additionally, it is worth noting the importance of Universal Service Funds. Universal Service Funds are an important regulatory tool to achieve universal access. In practice, however, they can be bureaucratic and politically driven. It is important that they specifically address Industry-level Sector risks so that all competitors benefit.

Barrier 2, Execution Risk: The majority of last-mile connectivity companies struggle to secure investment due to their company growth stage.

USAID and donor agencies can advance the investability of LMC providers by encouraging formalization of operations and investment readiness. The following recommendations could be implemented to reduce the company-level execution risks that are a barrier to investment:

- Short-term:
    - Develop open-source Standard Operating Procedures (SOPs) to provide low-touch productized technical assistance at scale.
- Mid-term:
    - Support targeted TA for Investment Readiness of ISPs, emphasizing investor need for a track record of performance packaged in a way that speaks to their investment criteria
    - Advisory and market intelligence TA support for Investors, to help reduce risk misconceptions
- Long-term:
    - Encourage experimentation but elevate what's working at scale

Expansion stage ISPs face a common set of operational challenges related to customer acquisition, sales & marketing process implementation, talent management, etc. Technical assistance can assist ISPs with stage-relevant insights and a playbook for growth and expansion. The challenge with technical assistance is that it does not scale and the knowledge often leaves when the engagement is complete. A good example of successfully avoiding this pitfall comes the microfinance sector and more recently the fin tech sectors. Both sectors created open-source productized technical assistance where the most common challenges could be addressed in implementation ready modules. Then high touch technical assistance is layer on top to provide customization to the specific circumstances of the challenge faced. Investors often refer to this as the value-add beyond the capital they provide. This TA strategy can have substantial leverage as it uses limited grant capital to develop materials and maximizes impact over a broader number of LMC providers.

Additionally, many LMC providers struggle to present themselves as investable opportunities ready for outside capital. Targeted technical assistance enables Investors to identify what works and scales opportunities that are ready to expand access immediately. Common terms for investment and benchmarking could be developed to reduce transaction costs and investment matching.

Barrier 3, Financing Risk: Investor economics and return expectations often don't align with available Internet Service Provider (ISP) potential transactions.

ISPs often grow gradually, funding smaller steps and upgrading capacity on existing networks as demand grows. There is a clear need for approaches that bridge the gap between Investors return expectations and ISP growth trajectory. Blended finance and targeted credit enhancement can play a catalytic role in leveraging private sector capital.

The following recommendations could be implemented to reduce the transaction-level financing risks that are a barrier to investment:

- Short-term:
    - Support blended finance to reach missing middle growth stage ISPs
- Mid-term:

- Develop currency risk-mitigation structures to unlock and leverage significant pools of private yield-minded infrastructure capital.

- Long-term:
  - Adapt known financing products and structures to LMC that can reduce cost of capital, risk perception, and standardize transaction process

Barrier 4, Regulatory Risk: Regulatory uncertainty and ineffectiveness often add complexity to any potential transaction.

Regulators should strive for a framework that ensures fair competition and protects consumers. Regulators should openly analyze and discuss the competitive state of the ICT sector as a whole and facilitate lower cost structures across the industry. Regulatory policy should encourage competition in spectrum and not favor incumbents, especially when spectrum is underutilized.

The following recommendations could be implemented to reduce the ecosystem-level regulatory risks that are a barrier to investment:

- Short-term:
  - Promote transparency of regulations and all sizes and types of LMC providers.
- Mid-term:
  - Facilitate enabling infrastructure including data centers, Internet exchange points, local hosted content, etc.
- Long-term:
  - Encourage harmonization of regulatory framework across economic regions.

Infrastructure sharing & open-access generates many benefits including better connectivity, increased cost savings, enhanced revenue generation opportunities and increased competition leading to lower overall prices to the end consumer. Moreover, it is critical to expanding fiber in a low-cost way for both middle-mile and last-mile providers. By sharing network roll-out with other ISPs, an operator can save up to two-thirds of this cost.

Network expansion needs to be capital expenditure efficient for last-mile connectivity investments to yield favorable return economics. Open access and infrastructure sharing practices enhance sector attractiveness for potential investors.

Additionally, regulators can incentivize businesses to find solutions to build sustainable last-mile delivery while also easing the regulatory requirements. For example, there is often limited visibility of capacity usage impacting complimentary stakeholders' ability to design models, products and services that could leverage unused capacity. Government can encourage an enabling environment through public fiber maps. Competition in spectrum & service can achieve the same end as Universal Service Funds at a lower cost to the Government.

APPENDIX

Limitations to Research Methodology

There are limitations to this research methodology that are worth noting. First, the Information and Communications Technology (ICT) sector is a multi-trillion-dollar industry, and any sector scan will undoubtedly have limitations and applicability concerns. Next, the ICT sector thrives on a diversity of approaches and often there are several ways to achieve the same end. Approaches and challenges described herein are meant to be illustrative and not definitive or comprehensive.

The contributions of dedicated connectivity sector actors (International Telecommunications Union (ITU), United Nations (UN) Broadband Commission, Alliance for Affordable Internet (A4AI), The World Bank, Internet Society, and the World Economic Forum (WEF), among others, were critical to our research findings and recommendations. The contributions of these actors have been referenced and attributed in cases where we draw from previous reports or research.

Interview Methodology

The main objective of the interviews was to identify key attributes of both successful and failed deals in last-mile connectivity, highlighting the perspective of investors in sourcing deals or closing transactions. An emphasis was placed on understanding the main investors in this space and their investment objectives, key risks or barriers encountered during the investment transaction process, and best practices of structuring transactions so as to mitigate risk or avoid failure.

There are different types of investors and actors in the last-mile connectivity sector. For the purpose of this research we wanted to gain the perspective of different categories of investors who typically have different investment theses, objectives, and return expectations. We focused on investors who had previous experience of investing in connectivity and also on others who had not previously invested in the sector. Additionally, we also interviewed last-mile connectivity operators to understand their perspective on the challenges of gaining access to capital. Another consideration while selecting interview targets was to ensure representation from a broad geographic spread across developing and developed regions as well as representation from different roles and positions, ranging from fund managing partners, connectivity investment sector leads, corporate executives, to business heads.

Questions for investors were designed to elicit their previous investment experience (especially in the connectivity sector) and barriers during the investment process. These related to concerns during the investment sourcing phase, issues encountered during due diligence, and challenges post transaction closure. Additional questions to understand return expectations or risk mitigation strategies were also included. For connectivity operators, questions were designed to probe challenges in accessing capital and expanding connectivity to unconnected populations. Questions were also included to gather information regarding innovative business models or financing structures that failed or succeeded.

In total we spoke with over 30 investors and operators in the sector. Summarily, the investors fell into the following four categories that have been mapped into quadrants below based on their risk-bearing appetite and expectation of return.

TYPE/CATEGORY OF INVESTOR	CHARACTERISTICS
Grants and Corporate Investors	These investors often offer philanthropic grants to address underserved populations. An example are the grants given out by Microsoft's Affordable Access Initiative. They see great business potential in the long-term, but limited investment ready opportunities. Corporate investors, especially those in the technology sector, understand the technicalities of LMC and make these investments more for research and development into new business models and new market development opportunities. In general, they have longer time horizons and low/no return expectations.
DFIs and Impact Investors	This category of investors provides capital with the objective of receiving economic and social returns. A prominent example of a DFI that has been investing in connectivity is the CDC Group. DFIs and impact investors understand the transformational impact of connectivity and are ready to deploy capital but are faced with insufficient deal flow or a mismatch in size or type of investment.
Venture Capital and Private Equity (VC & PE)	VC/PE investors generally deploy capital with the objective of generating outsized financial returns. This category of investors is looking for highly scalable exponential growth opportunities with attractive return profiles. VC/PE investors generally find a mismatch of return profiles in connectivity investments, which similar to infrastructure investing, yield steady linear returns.
Industry	Industry sources account for a vast majority of private funding in the sector. Industry operators that invest are generally large MNOs, ISPs or Tower companies such as American Tower Corporation. Industry operators generally have a low appetite for risk and have low economic incentive to invest beyond densely populated urban regions.

FIGURE 26: INVESTOR QUADRANTS

NO.	ORGANIZATION	NO.	ORGANIZATION	NO.	ORGANIZATION
1	Microsoft	11	Bluetown	21	Extreme Broadband
2	Facebook Connectivity	12	Albright Capital	22	Habari Node
3	4DX Ventures	13	Araneo	23	Emerging Capital Partners
4	NovaStar	14	Garden Impact Investments	24	Converged Technology Networks
5	Energy Access Ventures	15	Asian Development Bank	25	Chanzo Capital
6	CDC Group	16	APNIC Foundation	26	PAIX Inc.
7	C-Squared	17	Genymobile	27	Myanmar Internet Exchange
8	Worldlink	18	WiFi Interactive Network	28	Kenya Data Networks
9	USAID West Africa	19	Liquid Telecom	29	Ekovolt Nigeria
10	Frontiir	20	Poa! Internet	30	Workonline

FIGURE 27: INTERVIEW RESPONDENTS