INTERNATIONAL NETWORK INVESTMENTS

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EXPANDING ACCESS TO CONNECTIVITY WITH ISPs AND MNOs

Why the expansion of ISPs alongside MNOs is critical to connecting the next four billion people

WHITE PAPER | OCTOBER 2018

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Note to Version 1:

We intend to update this version of the White Paper and encourage all feedback to improve the concepts and ideas presented herein. When we started this White Paper, we assumed many of the ideas and concepts were too obvious to warrant a paper. However, we continually find operators, investors, and stakeholders – ourselves included – making the same mistakes. We intend to publish a final version of this paper under a Creative Commons and open-source arrangement with feedback acknowledged.

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INTRODUCTION

In the 21st Century, connectivity has transformed the lives of billions of people around the globe. How we communicate, consume information, enjoy entertainment, how we create and distribute content has all been altered and expanded by the technological innovations of connectivity.

Connectivity – *the interconnection of platforms, systems, and applications to share information* – is so ingrained in our daily lives it is difficult to recall what life was like before the Internet.

There are basic everyday use cases from calling a family member, texting to coordinate a meeting, and wishing an old friend happy birthday. There are more in-depth use cases such as searching for a job, finding a place to live, checking a bank balance, or learning a new skill. All of these activities, big and small, have added exponential value to our lives. **This access to information, news, and on-demand communications gives us agency over our lives in ways we rarely consider.**

Yet the transformative power of the Internet is only reaching half of the global population. In areas where connectivity is available, affordability is still a prohibitive barrier. This must and can be addressed, through technical and commercial means.

Our hope is that this White Paper can build upon the great work of others, and add clarity and focus to investments and efforts that seek to expand access to connectivity.

Key Concepts and Definitions

1

CONNECTIVITY AND THE INTERNET

are used interchangeably. As technology advances, there is a convergence of legacy systems of voice, data, and video. Today, nearly all those packets of information go over the same network connections.

2

AVAILABILITY VERSUS AFFORDABILITY

Availability is a binary yes/no question of whether one can access connectivity. Affordability is a continuum of GB data at a price one can afford.

3

BROADBAND

is defined by the U.S. Federal Communications Commission as speeds over 10mbps.[1] Quality of connectivity is a broad measure meant to include speed, reliability, and total amount of data.

4

INTERNET SERVICE PROVIDERS (ISPs)

include the entire spectrum of providers from local access ISPs to Global Tier I providers. ISPs include both fixed-line and WiFi/wireless technologies, but over unlicensed spectrum.

5

MOBILE NETWORK OPERATORS (MNOs)

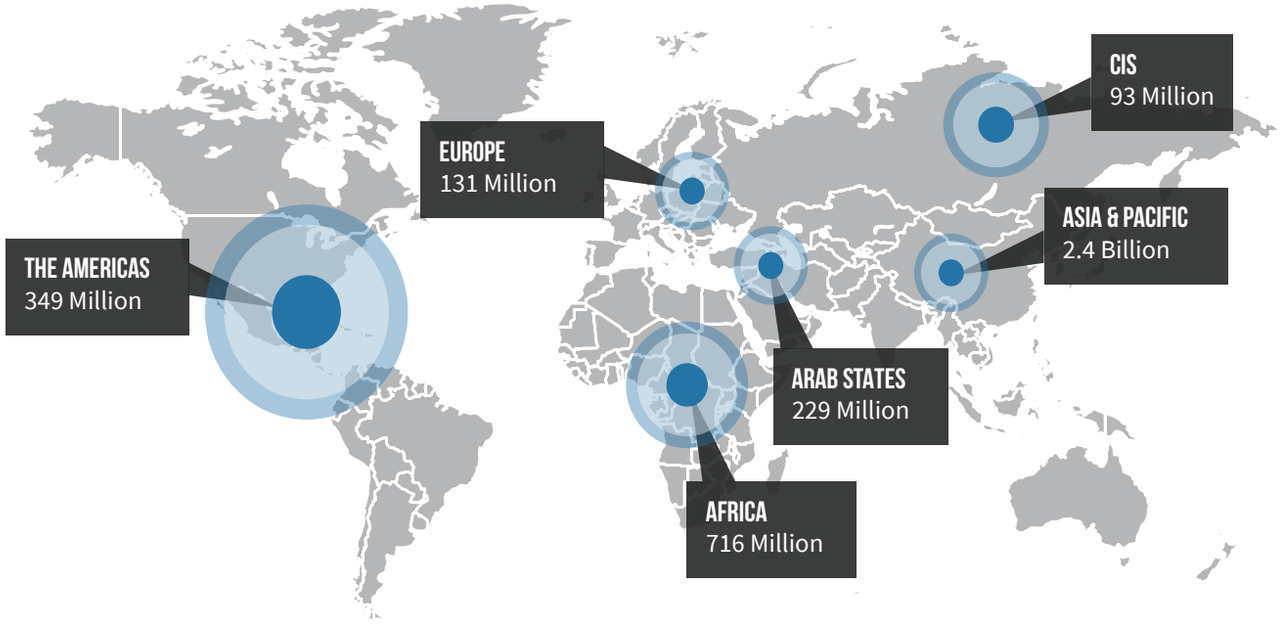
provide cellular communications services. The major differentiator between ISPs is that MNOs operate over licensed spectrum.

> **CONNECTIVITY**
> the interconnection of platforms, systems, and applications to share information – is so ingrained in our daily lives it is difficult to recall what life was like before the Internet.

THE TWO BIG CHALLENGES IN EXPANDING CONNECTIVITY

Challenge #1: The Availability of Connectivity Needs to Expand

There are 7.5 billion people in the world, but only 3.7 billion are connected to the Internet – a roughly 50% global penetration rate. At the same time, 94% of developing countries are still offline.[2] The majority of people without Internet access live in Sub-Saharan Africa, peri-urban and rural regions of Asia, Latin America, and the Middle East.



Absolute Distribution of 3.9 Billion Offline

Proportion of offline population by regional population

Figure 1: Distribution of the offline population, 2016 by region[1]

Challenge #2: Affordability is the Major Barrier to Use

The price of connectivity is still not affordable to the vast majority of consumers in the developing world. While the availability of data has increased, the affordability of that data has not and remains a barrier to increased access. Even when customers can access a signal, it is often a signal they cannot afford to use, or use it sparingly because of the price.

There are several barriers to use including access to devices, locally relevant content, and digital literacy, to name a few. However, the biggest barrier is affordability. Developing countries pay 200% – 300% more for broadband connectivity. In Sub-Saharan Africa, for example, access to broadband connections is estimated to be less than 1%. We share the Alliance for an Affordable Internet target that entry-level broadband services should cost less than 2% of monthly gross national income per capita.

In practical terms, because of the high prices of data in developing countries, people are only using a sliver of the Internet. Heavy bandwidth activities such as watching a video or lecture online are out of reach for the average consumer. To quote the Chief Technology Officer of a prominent African ISP: “Consumers are being drip fed data.”

BACKGROUND

Two Ecosystems of Connectivity: Mobile versus Fixed

Broadly speaking, there are two ecosystems of connectivity: Mobile & Fixed. We define ecosystems by the primary connection anchor between the user and the Internet. The connection anchor is the Individual or a Location.

How people connect varies by technology (2G vs 4G or WiFi vs Fiber), but Where people connect is either location independent or location dependent. In the case of connectivity, ‘How’ is lower hierarchy than ‘Where.’ The Fixed Ecosystem includes WiFi and Fiber/fixed-line networks, as they are both location dependent. A differentiator between the two ecosystems is the use of licensed versus unlicensed spectrum. Below is a chart comparing the two ecosystems:

Connection Anchor	The Individual	A Location
Use Location	Mobile	Fixed (Home/Office)
Network	Mobile Network	Wi-Fi/Fiber Network
Provider	Mobile Network Operator (MNO)	Internet Service Provider
Spectrum	Licensed	Unlicensed
Example Data Bundle	Typical MNO Plan: 1-15 Mbps speed 10+ GB/mo. Cap	Typical ISP Plan: 10+ Mbps speed 250 GB/mo. Cap

Figure 2: Comparing Ecosystems: The Individual vs. A Location

Trade-Offs to Each Ecosystems

There are advantages and disadvantages to each ecosystem. The principle advantage to Mobile is convenience, whereas the principle advantage to Fixed is price and speed. The chart below details many of the trade-offs from the consumer point-of-view:

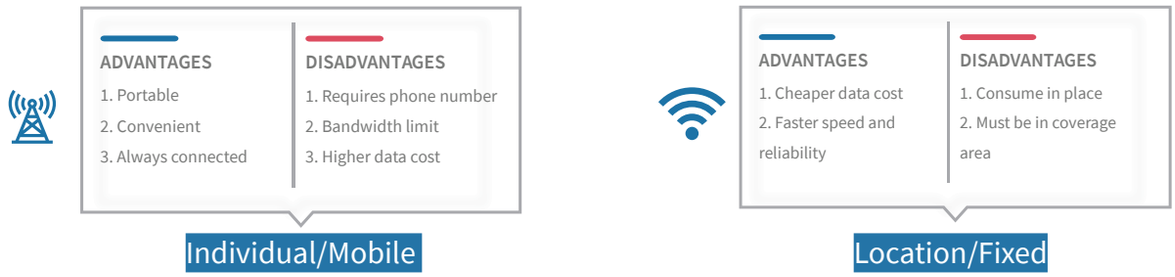


Figure 3: Advantages and Disadvantages to each Ecosystems

When both ecosystems are available, users will optimize between cost and convenience based upon their needs. In developed countries, duel ecosystem use is the norm. Users often toggle between both ecosystems with minimal hassle. On average, users will have a 25/75 split between Mobile and WiFi data.[6]

In Developing Countries, There is Only One Ecosystem

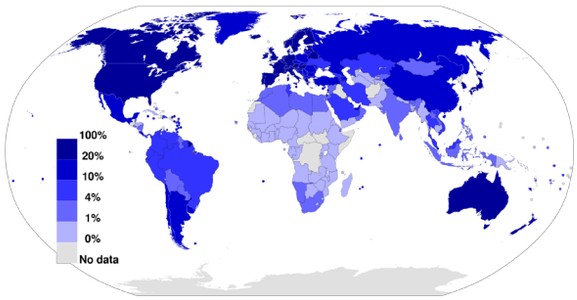
When both ecosystems are available, users will optimize between cost and convenience based upon their needs. In developed countries, duel ecosystem use is the norm. Users often toggle between both ecosystems with minimal hassle. On average, users will have a 25/75 split between Mobile and WiFi data.

Why is There Only One Ecosystem in Developing Countries?

When both ecosystems are available, users will optimize between cost and convenience based upon their needs. In developed countries, duel ecosystem use is the norm. Users often toggle between both ecosystems with minimal hassle. On average, users will have a 25/75 split between Mobile and WiFi data. The primary reason is the historic lack of communications infrastructure. In many developing countries, there was no major fixed-line telecommunications infrastructure. In most countries, the telecom infrastructure transited from copper to cable to fiber. This was the case in most developed countries including 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.

The same transition from legacy infrastructure wasn't possible in many developing countries. Fixed line penetration is <5% in South Asia and <1% in Sub-Saharan Africa. The figure below compares Fixed versus Mobile broadband globally.

Once Mobile technology was developed, it allowed markets to 'leapfrog' the infrastructure gap. However, in areas where no legacy infrastructure existed, Mobile totally dominates. This has been described as the limits of leapfrogging.



Fixed Broadband Penetration

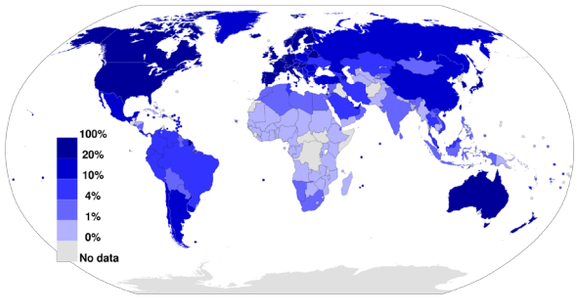


Figure 4: Comparing Fixed versus Mobile Broadband connectivity globally.
Source: ITU Data, Maps from Jeff Ogden, 2012.

The Duel 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. The below chart demonstrates the overlap of both ecosystems:

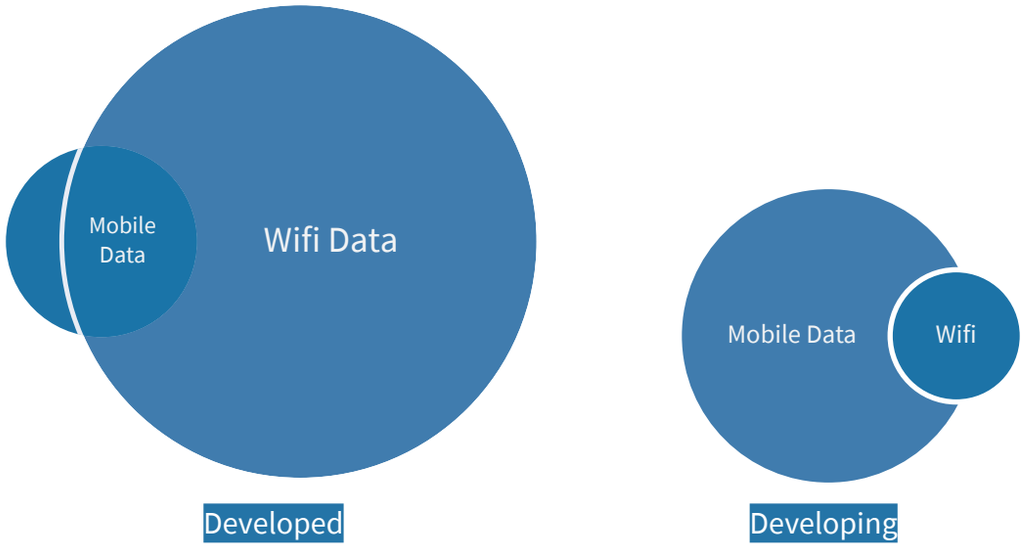


Figure 5: Estimated chart showing overlap of Mobile and WiFi data use. Source: INI Preliminary research from Cisco VNI Partial scale.

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 2-3x more data to mobile phones than the MNOs. The overlap of Mobile and Fixed is the norm where both ecosystems exist.

CONCLUSION

Takeaway # 1: The Cost of Data Inhibits Growth

The 4th Industrial Revolution refers to the ongoing transition in industrial development to cyber physical systems. This is often referred to as the information economy. However, lowering the cost of connectivity will be a prerequisite for this transition to occur. This is analogous to the 2nd Industrial Revolution of electrification and mass production where the investment focus is on lowering the cost of electricity by expanding capacity and distribution. The thinking is a country cannot have an industrial economy, unless it lowers the most expensive input (electricity). Our belief is similar: a country can't have an information economy, unless it focuses on lowering the most expensive input (data).

The focus on MNOs is a natural outgrowth of their dominance. Selective perception is the psychological phenomenon that we don't notice things that we are not conditioned to see. This partially explains the bias toward MNOs. For reasons discussed, MNOs dominate market share in many developing countries. But Where one can access connectivity is more important than how it gets delivered. How is a question of operational convenience. To unlock economic growth, the focus should be on absolute connectivity regardless of how one is connected.

Takeaway #2: ISPs will Complement MNOs

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 duel ecosystems will provide more value for customers. 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. The effective use of capital and enabling environment interventions should begin with a discussion of AND not OR understanding the complementary role of MNOs and ISPs.

Takeaway #3: New and Diverse Forms of Capital could Enable ISP Growth

The lack of capital slows ISP growth and access to connectivity. ISPs in developing markets often delay, forgo, or fail in their expansion plans because of the lack of appropriate capital. The perception of risk and understanding the specific business needs of ISPs has often been ignored. New and diversified forms of capital are needed to fund ISP growth and expand access to connectivity.

The Basics: First Principles to Remember For ISPs

Even as seasoned Investors in ISPs, we often have to catch ourselves from falling into a few unconscious tendencies about connectivity. We hope by describing them here, ISPs will consider these principles more fully and include them in their strategic considerations.

#1: The Goal of an ISP is not Ubiquity

The graveyard of ISPs is filled with companies that pushed to provide ubiquitous coverage similar to an MNO. There is a fragmentation problem inherent in WiFi technology, and successful ISPs understand this key limitation. The technologies for ISPs and MNOs are fundamentally different, and therefor should not have the same expectations. ISPs and MNOs provide the same service (connectivity), but they differ in use case. We encourage our ISPs to allocate capital based on the use case, not the volume of people. Put another way: allocate capital to the location NOT individual. From the point of view of an operator, the strategic focus should be supporting a particular person's experience anywhere versus anyone's experience in a particular place.

#2: People Consume More Data When Stationary

Have you ever tried to read a website while walking? It is possible, but it's a very uncomfortable experience. There are certain activities like a voice call, using GPS, and sending/receiving text messages that are simple over Mobile data. These activities are also, by and large, low data consumption activities. This seems obvious, but a central principle of ISPs is: people consume more data when stationary.

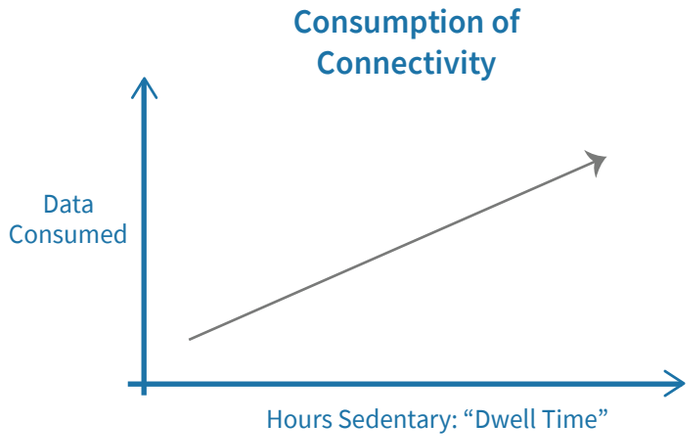


Figure 6: Consumption of Connectivity increases with dwell time

The locations where people are stationary may vary by time of day and day of week. However, in our experience, is often in this order: 1) home, 2) work, 3) coffee shop/restaurant, and 4) then others. The first two are by far the dominant data consumption locations.

While network expansion will vary based on local market dynamics, successful ISPs recognize divergence from this principle. A great example is hotspots. It's important to separate the technology from the revenue model when discussing hotspots.

The technology has proven multiple use cases for a variety of public and private locations. The revenue model, however, is still unknown. Are these high data consumption locations, a 'digital filling station,' or an amenity where the user and payer are different?

#3: Data Consumption Changes by Activity or Use Case

Another way to think about the power of connectivity is the depth of use. As discussed in #2: where people sit, they consume data. If one is not stationary, they're likely performing lower data consumption activities. As demonstrated in the chart below, many lower use activities have extremely high utility (text, voice call, email). But the full depth of use requires more data.

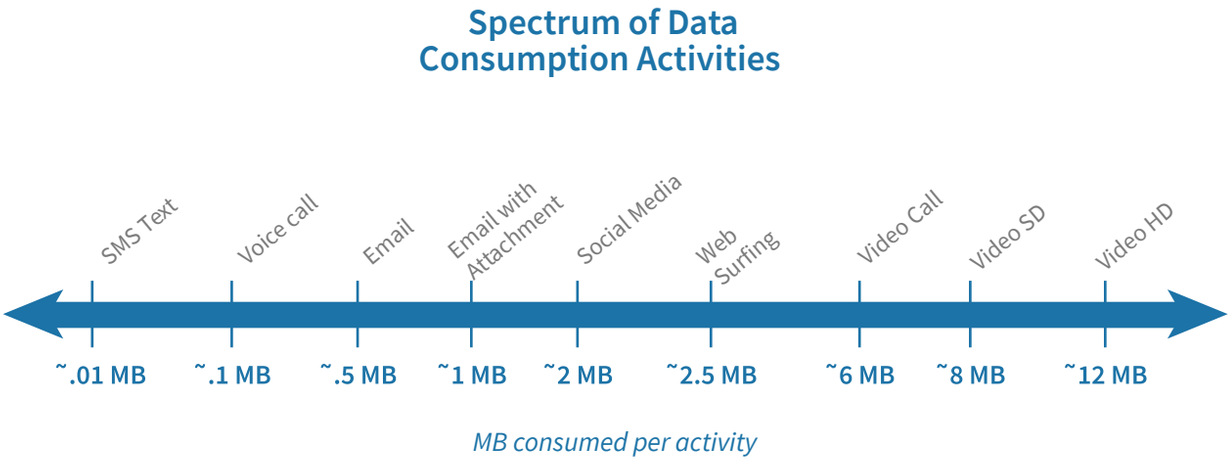


Figure 7: There is a wide spectrum of data uses and needs.
Source: Lifewire, How Much Data Do I Need? May 13, 2018.

#4: ISPs Are Different Than MNOs in A Few Fundamental Ways

1. **Price of spectrum.** The key difference is the use of licensed versus unlicensed spectrum. ISPs predominately use the unlicensed ISM band frequencies that are free. In developing countries, underserved places tend to have less interference in these frequencies. MNOs, on the other hand, operate over cellular frequencies that are auctioned by governments and can run several millions of US dollars.

2. **Lower capital expenditures.** ISPs and MNOs have inherently different cost structures especially with regards to capital equipment. For example, an MNO tower is $100,000 - $150,000 whereas an ISP point-to-multipoint tower can range from $2,500-$25,000.

3. **Business model dynamics.** As a business model, MNOs are fairly monolithic, whereas ISPs are varied. This leads to numerous different ISP actors where the networks of relationships are heterogeneous. The ISP networks allow for more and varied types of capital. MNOs do sub-contract, but all under their balance sheet. There is a long history of these two ecosystems complementing each other. One example is automatic offload, where cell traffic is routed through ISPs in high traffic airports, stadiums, etc.

CASE STUDY:

THE U.S. ROAD & HIGHWAY SYSTEM

The Internet is more analogous to the *distributed* Road & Highway system than the *centralized* telephone system. Both the Internet and the U.S. Road & Highway System function with a common theme: highly varied participants with regulations for interaction.

Distributed Road System

Distributed Highway System

Centralized Telephone System

The Internet is a distributed system of interconnected computer networks that use a common protocol to link devices. The landline telephone network is a centralized system where devices (telephones) are connected to a single exchange point: the public switched telephone network.

The United States Road & Highway System is an analogous example of a distributed system. The road system connects a wide variety of different roads built by local, State, and Federal governments. There is significant diversity of “devices” on roads: cars, trucks, buses, motorcycles, bicycles, and pedestrians. Different types of actors including private citizens, companies, and governments travel on roadways. There are separate business critical enabling environment needs: petrol stations, vehicle sales and repair, freight services, and others. There are multiple owners and investors with different capital and risk profiles.

References

1. International Telecommunications Union (ITU), Connecting the Unconnected, 2017. https://www.broadbandcommission.org/Documents/ITU_discussion-paper_Davos2017.pdf.

2. Ibid.

3. A few notable outliers exist, but by and large, the price and quality of bandwidth has not increased in line with availability. In India, for example, Reliance Jio is disrupting the market with a massive offering of low-cost connectivity to push affordability of data to the entire population. Reliance Jio serves 57,000 TBs of data everyday – more than AT&T, Verizon, & Sprint in the United States combined. This has required upwards of $30 billion investment in capital expansion including complete build out of fiber backbone and access networks.

4. International Telecommunications Union (ITU), ICT Facts and Figures, 2017. https://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2017.pdf Note: Based on simple averages including data for 167 countries. Prices are based on entry-level plans with a minimum data allowance of 1 GB per month. PPP$ refers to prices in international dollars, calculated using purchasing power parity (PPP) conversion factors instead of market exchange rates.

5. Alliance for Affordable Internet. Redefining Broadband Affordability: Adopting a “1 for 2” Target to Enable Universal, Affordable Access 2017. https://a4ai.org/1for2-affordability-target/.

6. Cisco Systems, Visual Networking Index (VNI) reports, 2016.

7. International Telecommunications Union (ITU). Dynamic Report, 2012.,

Acknowledgements

We have the great pleasure of working with a dedicated, thoughtful, and exceptionally talented group of entrepreneurs in the INI portfolio. Many of the comments and insights in this White Paper are shared learnings from these partnerships. We are grateful for their input and continued commitment to advance access to connectivity.

HOW WE CREATE AND DISTRIBUTE CONTENT HAS ALL BEEN ALTERED AND EXPANDED BY THE TECHNOLOGICAL INNOVATIONS OF CONNECTIVITY.

INTERNATIONAL NETWORK INVESTMENTS

Notes

about INI HOLDINGS

International Network Investments (INI) is a privately owned investment company focused on closing the digital divide. We are passionate about extending the Internet and Communications Technologies to underserved populations, specifically across Sub-Saharan Africa and India. We focus our efforts by investing in great companies and exceptional teams that share our fundamental ethos: affordable, reliable, and high- speed connectivity is a right and should reach every community in the world.

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