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The Progressive Case for Universal Internet Access: How to Close the Digital Divide by 2030

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Contents

Published at https://institute.global/policy/progressive-case-universal-internet-access-how-close-digital-divide-2030 on March 2 2021

Foreword by Tony Blair

Today, the internet is the beating heart of the world. And just as the roads, railways and canals provided the arteries for commerce in the Industrial Revolution, today's network infrastructure is the circulatory system on which much of modern life depends. Without it, the ramifications of Covid-19 would have been far more severe.

That we have been able to use the internet to mitigate the impact of the pandemic is a small relief, but the Covid-19 crisis has emphasised the importance of everyone being connected in the future. Eradicating extreme poverty, solving the global education crisis, building better health-care systems and responding to pandemics effectively all require connectivity. For low-income countries, being largely excluded from the exponential potential of the internet means that they cannot transform their nations. It is extraordinary that today half the world remains offline.

Closing the digital divide by 2030 should be one of the primary global policy priorities. Accelerating internet expansion will drive economic growth and enable progress and – as this report from my Institute demonstrates – the benefits of investment vastly offset the costs. It outlines the urgent action required on stimulating demand, regulatory reform and greater global coordination, and how a new digital coalition needs to be formed to transform opportunity and access for billions of people.

But prioritising internet access is not only about poverty alleviation. During these past years of isolationist and unilateralist policymaking by Western governments, China has been taking a more dominant role in developing economies. It has been investing in digital hardware infrastructure, taking an active role within international bodies and influencing the standards and values that underpin the internet.

This requires strong global leadership. Collaborating with China, as well as competing. Stewarding the right global coalitions around investment to achieve universal internet access. Leadership with the vision, commitment and confidence to establish the internet for a prosperous and inclusive global society.

We've lost our way on this in recent years, but an open and connected world will be the lifeblood for our future growth. It's time that we make it a reality.

Tony Blair
Executive Chairman

Foreword by Mathew Oommen, President, Reliance Jio

The Covid-19 pandemic has thrown out the usual playbook for economies, societies, businesses and governments around the world, and, in the process, it has accelerated the transformation to digital by as many as ten years. This shift has underscored the imperative to embrace and cultivate digital transformation across all industries, and in doing so, it has shone a stark light on the plight of the unconnected.

While great strides have been made to promote connectivity on a global scale, 46 per cent of the world's population still does not have access to broadband connectivity. The pandemic has been a reality check for those countries and economies slow to adopt a strategy to connect the unconnected.

Access to education, improving health care, building sustainable cities, achieving gender equality, delivering clean energy, driving economic growth and eliminating poverty all require access to digital services and technology. Nearly every aspect of the UN's Sustainable Development Goals and the revitalisation of the global economy depends upon access to broadband connectivity, the internet and digital platforms.

Health, education, governance and commerce have all made a dramatic shift to online platforms and applications. Digital interaction has become the de facto mechanism for families, communities and corporations to connect, communicate and collaborate.

Connectivity has become a necessity, and to lack connectivity is to lack the ability to fully participate in society and the economy.

In India, Reliance Jio was the first to offer free voice and affordable 4G data, fundamentally disrupting the digital divide and providing the ability for all to connect to the internet. Using this approach, Jio has led the digital transition, enabling all Indians to realise the full benefits of access to health information, public services and citizen services, including digital payments and ecommerce. New technologies are helping to reduce pollution, improve resilience to climate change and increase energy efficiency. With access to broadband, the new digital economy has accelerated adoption of several socioeconomic platforms, including proliferation of the India Digital Stack of Aadhar (Universal Identity) and the Unified Payments Interface (UPI), and it has had a significant impact on the way people live and work.

It is Jio's relentless drive to connect all of India to broadband. This is an essential and crucial first step to ensure full participation in and access to the new digital society. Universal access is critical to uplifting everyone across all income levels. The ability to access the internet provides a truly level playing field and a clear and sustainable path towards long-term economic and societal growth. By designing and developing the most affordable 4G phone in the world, the highly intuitive Jio Phone has been instrumental in providing universal access to the internet.

Since day one, Jio's guiding principle has been to provide affordable, high-quality broadband to meet the inherent demand among the unconnected across India. To effect change, we fundamentally transformed and disrupted business and service models, creating and using new technology and processes that addressed the aspirations of all of India.

Just four years ago, Jio was deployed as a green field, all-IP, all-4G Pan India network to ensure the greatest broadband reach. We invested in technology and talent development. We implemented an extensive fibre network and created a suite of applications, affordable devices, energy-efficient towers and sites, and meaningful digital platforms and services. Today, Jio reaches over 99 per cent of India's 1.4 billion population and has over 400 million users.

Global collaboration and a coordinated effort consisting of public and private investors is imperative to accelerate connectivity in those countries still lacking broadband. Capturing the gains of the digital economy will require streamlining regulations, making it easier for startups to launch and scale, as well as introducing policies to facilitate retraining and new economy jobs for workers.

Funding for digital initiatives must increase, as should policies that drive innovation and investment that equalises access to and the availability of digital connectivity and services of meaning to all people. While some organisations and governments may rethink their digital transformation as the economy has slowed due to Covid-19, it is essential that we instead use this time to expand and grow connectivity so that no one is left behind.

All stakeholders need to respond effectively if the unconnected regions are to achieve their digital potential. Businesses must anticipate the digital future and invest in building capabilities, including partnering with universities and cultivating talent to deliver digital projects. Governments will need to invest in digital infrastructure and public data that organisations can leverage, all while putting in place strong privacy and security safeguards.

The quantum leap in digital acceleration has driven significant change in the daily life of consumers, businesses and government, highlighting the importance and value of technology. We cannot fail to capitalise on this opportunity to bring access and, more importantly, value to all.

Mathew Oommen
President, Reliance Jio

Executive Summary

The internet is a fundamental part of daily life. The connectivity it provides underpins social and economic interactions in the 21st century. This has been brought into sharp relief by the pandemic as many of us have migrated online to continue to work, to learn, to stay in touch, to buy food to eat. Yet half of the world remains cut off from these opportunities.

The world is blighted by a digital divide. In total, 3.7 billion people have no internet access. The majority are in low- or middle-income countries (LMICs). In the developed world, just 13 per cent of people lack a connection compared with 53 per cent in developing nations, and 81 per cent in the least developed countries. Along with the country a person lives in, gender is also a factor: Globally, women are 23 per cent less likely than men to use mobile internet.

The digital divide matters because it stands squarely in the way of progress. For LMICs seeking to transform their economies, it is increasingly the case that they cannot do so without the internet. Likewise, internet access is essential in efforts to eradicate poverty, improve education and build effective health-care systems, and it has a significant role to play in responding to crises like the Covid-19 pandemic. (The Tony Blair Institute, for instance, has partnered with Oracle to deliver a cloud-based Health Management System – launching initially in Ghana and Rwanda – to help countries manage essential vaccination programmes by creating an electronic health record.)

The potential benefits of universal internet access far outweigh the costs of achieving it. The returns to GDP alone for LMICs are vast compared to the investment that would be necessary to bring everyone online. And there are wider socioeconomic benefits that internet access affords. These include improved health and education outcomes, and potential redress of gender inequalities through financial inclusion. This is particularly true if internet access is rolled out as a central feature of countries' socioeconomic development plans, working together, for instance, with their agro-industrialisation strategies.

But expanding internet access doesn't only help to alleviate poverty and develop entire nations. A better-connected world benefits all countries, and building an open internet based on liberal values should be a foreign policy priority.

China's influence on internet access in LMICs presents serious geopolitical and security challenges including cybersecurity and the fact that social media is a critical source of information for intelligence services today. Developing countries are highly unlikely to shift away from the use of China's technology in this space, so Western democracies and other democratic countries such as South Korea and Japan need to collaborate with China as well as compete. The imperative must be to build an open and inclusive internet infrastructure that is premised on human dignity, liberty and freedom, enabling all people to forge their own opportunities to learn, to innovate and to thrive. Creating a universally accessible internet based on these liberal values should be a key area of cooperation for the Biden administration and European leaders as they re-establish the transatlantic alliance.

Closing the Digital Divide as a Global Policy Priority

There are several global initiatives and coalitions focused on addressing digital inequality, and progress is being made – but as yet there has not been the political leadership to drive this agenda forward with the urgency required. The Biden administration could well provide the leadership that this critical challenge requires. If the United States and other liberal democracies hope to lead the world in the 21st century, they must ensure that global access to information is protected. If China can cement its digital infrastructure throughout the developing world, it not only diminishes the influence of the United States and other liberal democratic countries abroad but could also lead to national security risks further down the road.

We estimate – drawing on existing analysis – that the investment necessary to close the digital divide by 2030 is approximately $450 billion. To put this cost in perspective, raising these funds would require member countries of the Development Assistance Committee – an arm of the Organisation for Economic Cooperation and Development (OECD) – to contribute 0.02 per cent of their gross national income (GNI) per year. That is the equivalent of just 3 per cent of the 0.7 per cent overseas development assistance (ODA) aid target set by the UN and which the UK once adhered to – a small price to pay for a foundational investment that would enable low- and middle-income countries to forge their own paths to prosperity.

But this is not just about investment. Closing the digital divide requires a roadmap to detail how universal internet access can be achieved by 2030. Based on our analysis, we propose three key policy recommendations.

First, a coordinated effort to stimulate demand for 4G or equivalent broadband technologies, to make more infrastructure investments viable.

The private sector can and should provide investment to expand 4G or equivalent broadband coverage, but it needs a market to drive that demand. Public investment of approximately $58 billion to increase smartphone access, build digital skills and improve internet content to make it relevant to those offline will go some way towards building up that demand for 4G or equivalent broadband networks, and could help lay the foundations for 5G in the near future.

Regional coordination, such as that currently exhibited by Smart Africa, can drive down the costs associated with accessing the internet – data and smartphones – that prohibit much of the developing world from coming online now.

It is essential that efforts to address the digital divide are situated as part of the emerging industrialisation plans of many LMICs. Efforts to transform entire economies so that jobs can be created and household incomes expanded across countries are key to stimulating demand. The connection between digitalisation and industrialisation is multifaceted and is one that merits further analysis in future research.

Second, regulatory and policy reforms to open up markets and drive down prices for consumers.

Regulatory changes will be essential in closing the digital divide. These must aim to both increase ICT market competition and also reduce taxes on basic smartphones and data that currently contribute to access being prohibitively expensive. National broadband plans will be critical to ensure public investments are more effective and are coordinated with private investment.

Some administrations in LMICs may find it politically difficult to take the right policy steps to drive universal internet access. Donor countries can support leaders to make the politically or indeed fiscally challenging policy changes now, in order to reap the benefits of universal internet access in the medium term.

Third, global coordination to diversify and expand investment vehicles for 4G or equivalent broadband coverage.

More than 85 per cent of the investment required will need to address 4G or equivalent broadband network expansion and maintenance. It is anticipated that the private sector can and should meet 75 per cent of this investment, with public investment focusing on the most commercially unviable investments. But the current market for 4G or equivalent broadband network expansion is not fit for purpose. Universal 4G or equivalent coverage needs to be facilitated by boosts to demand from public investment and national regulatory change, as well as global coordination to diversify the range of investment vehicles available to make it commercially viable.

Fixing this requires an investment coalition of institutional and global investors to increase the risk appetite and diversify the funds and vehicle structures available to meet the demand for 4G or equivalent broadband networks. It will also require political capital and capacity to coordinate with governments' existing infrastructure works to ensure 4G or equivalent broadband expansion is achieved at marginal cost.

The Political Moment

Making faster progress on universal internet access will take determined geopolitical leadership. This should be a key agenda item for the G20 taking place in Rome in October 2021. The Italian presidency has made it a priority. As Prime Minister Mario Draghi looks to re-establish the transatlantic alliance, this could be a key area of cooperation for the US and European nations.

As we have highlighted, closing the digital divide is not only about solving global poverty but also about a statement of values: freedom, inclusion and opportunity for all.

The Sustainable Development Goals were an urgent call in 2016 to all countries to solve the most pressing development challenges by 2030. If universal internet access is not achieved by then, the digital divide we see today will only intensify existing inequalities. Solving the digital divide now – with universal internet access built on liberal values – is fundamental to building a prosperous and inclusive global society for generations to come.

Introduction

Throughout the Covid-19 pandemic, internet access has been critical for the continuation of our 'normal' lives, including work, relationships and commerce. Increasingly, it is also where we engage with government and receive public services.

But half of the world is still not connected to the internet.

One of the most significant and lasting impacts of the pandemic will be the seismic transition from analogue to digital in every aspect of our lives. The opportunity cost for those who are still not online will only grow. The digital divide is already magnifying existing inequalities, and this will intensify as more elements of our work, and public and private lives, are facilitated by digital technologies.

The Time Is Now

Technology develops at an exponential rate, in a way that no other sector does. The rapid rate of technological change creates an ever-growing opportunity cost for countries that do not invest in the foundations for internet-enabled growth and transformation. If countries do not invest soon, this will hold back development across all sectors, from health care to education.

The pandemic has revealed the vast disparities presented by the digital divide. For example, 94 per cent of learners were forced online regardless of whether students had connectivity or safe access to the internet. The World Bank has estimated that, without remedial action, it expects a $10 trillion loss in future earnings for the generation of students subjected to pandemic-related school closures in 2020 and 2021. This is exacerbating the already acute crisis in education across much of the developing world, with leaders only now understanding how essential connectivity and technology will be to recouping lost education for students, and supporting the recovery of economies and societies as the pandemic eases.

This growing inequality in education is being replicated across the human development indicators, with devastating macroeconomic impacts; developing economies are expected to contract by 2.5 per cent, their weakest performance for at least 60 years. Up to 100 million people are thought to have been pushed into extreme poverty in 2020, erasing all progress made in the last five years to put an end to people living in these circumstances by 2030.

As many of us migrated online to continue our work, our studies, and our social and civic engagements, the vast majority of the developing world remained shut out. If they remain offline, with extremely limited access or with suboptimal connectivity (such as 2G or 3G), they will miss out on a devastating number of opportunities. Internet access would aid post-Covid-19 recovery and give people access to advanced technologies which could help them overcome everyday challenges – for example personalised and adaptive learning software or AI-powered health detection and management applications. Universal internet access is pivotal to a leapfrog model of transformational development, enabling countries to bypass traditional stages of development to either jump directly to the latest technologies or explore an alternative path of technological development involving emerging technologies that offer new benefits and opportunities.

The Sustainable Development Goal target 9c aimed to provide universal and affordable access to the internet in the least-developed countries by 2020. This ambitious target has already been missed. Given its deadline coincided with the year that Covid-19 ravaged the world, this should mark the moment where we meaningfully galvanise support to reach this goal within the decade.

This is in all of our interests. Connecting the world will create new channels for the interchange of knowledge and information, adding to our collective understanding and creating new ideas. It will provide new economic activity and opportunity. It is a technological grand challenge and ambitious common goal that we should work towards solving today. This will require new digital coalitions for change which, as worries about the implications of a "splinternet" (or a divided internet, controlled and regulated by different countries) continue to increase, should commit to the principles of open technologies and standards. The splinternet is no longer just a concept; it is now a reality. This presents profound geopolitical and security challenges, including cybersecurity. Social media, for example, is a critical source of information for intelligence services today.

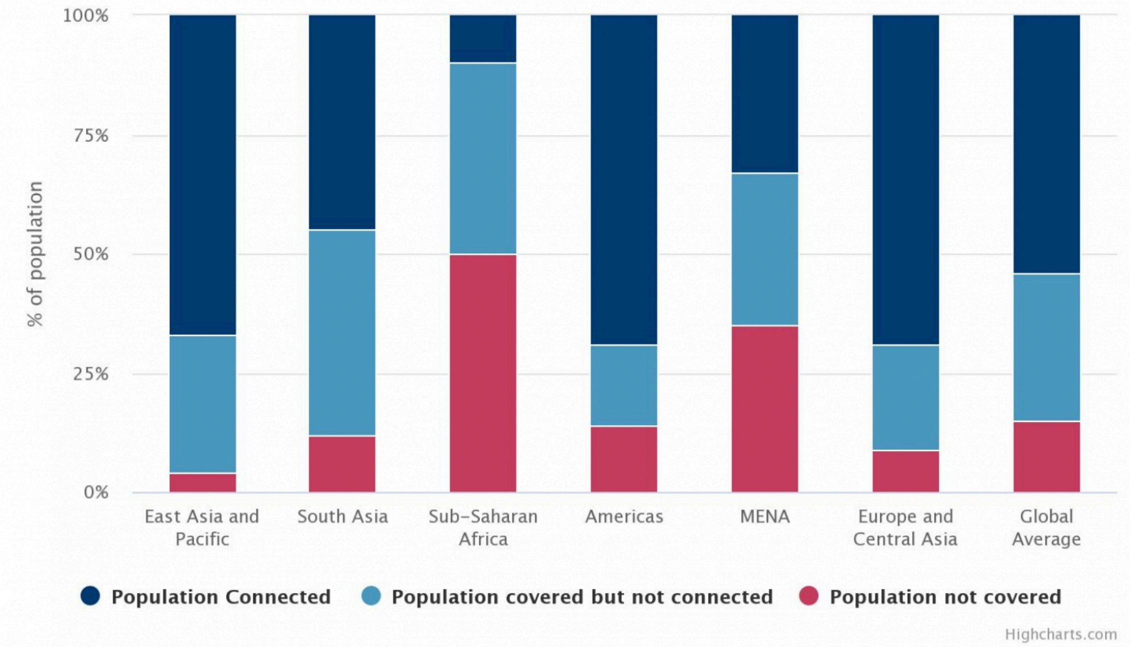
There are also strong economic reasons for investing in expanding internet access. The half of the world's population that is currently unconnected represents a significant market opportunity. The Chinese government and Chinese companies are investing heavily in LMICs in Africa and elsewhere. The West must be able to match China and others on this front.

This agenda should be a priority for the Biden administration and the European Union, but it cannot be unilateral. It should be about wider re-engagement with countries committed to the same values. For those who believe in an open and interconnected world and want strong national security and economic prosperity in the 21st century, creating internet-era infrastructure for all should be a key concern.

Defining the Digital Divide

Forty-six per cent of the world's population does not have access to 4G. This is in part driven by a lack of 4G coverage, but the reasons for limited uptake extend beyond this.

Figure 1 – 4G coverage of population by region, 2019

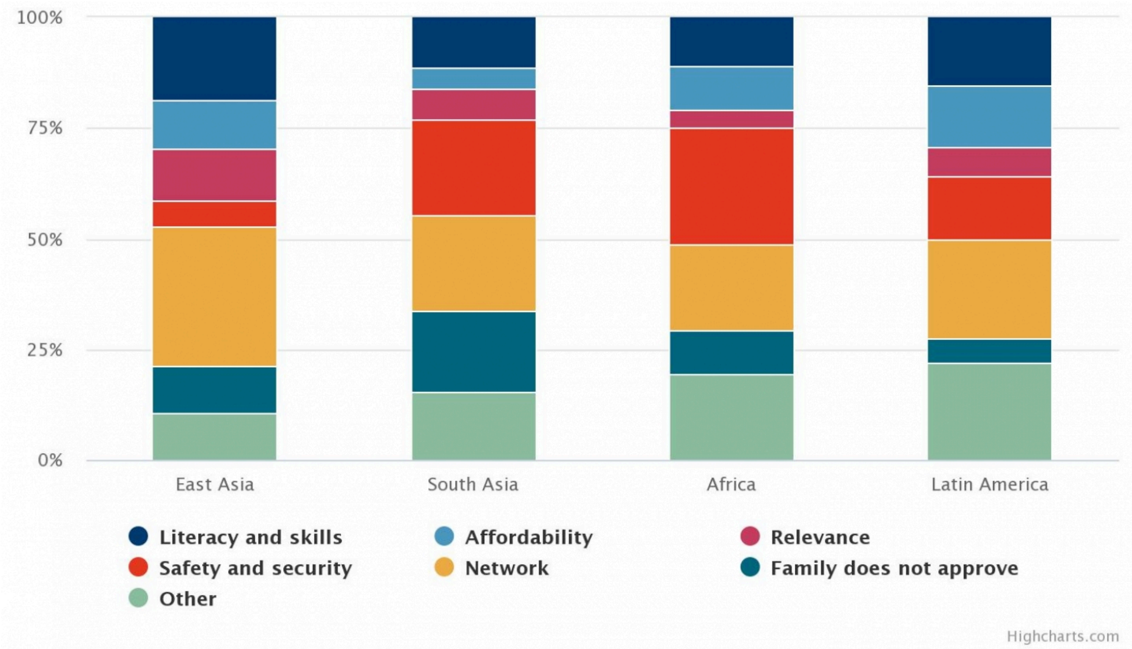


Source: ITU Connecting Humanity, 2020. Estimates based on GSMA, Xalam, UN population data.

In sub-Saharan Africa, for example, only 10 per cent of the population is using 4G, although half of the population is covered by a 4G signal. The majority of those not accessing the internet are either unable to afford it, do not know how to or do not see the utility in doing so, as opposed to not having an internet signal.

Closing the digital divide involves more than just providing broadband coverage. There are a variety of reasons why people do not access the internet. In 2018, the global telecommunications industry body the GSMA conducted a survey across low- and middle-income countries in key regions to illustrate the leading barriers to accessing the internet:

Figure 2 – The top barriers to mobile internet use in surveyed low- and middle-income countries, by region, 2018



Source: GSMA Intelligence Consumer Survey 2018. Note: Data based on the single most important barrier to using mobile internet identified by mobile users who are aware of mobile internet but do not use it, averaged across surveyed markets.

Affordability, literacy and digital skills, and a lack of content that is locally relevant are usually cited as the most significant barriers to access according to the GSMA survey. These reasons were ranked higher, in fact, than access to a network. There are also some specific hurdles to overcome on a regional level. Perceived and actual safety and security online, for example, presented a great barrier for many in Latin America, but far less so in South Asia.

Another barrier highlighted, "family does not approve", alludes to gender and other cultural factors that prohibit, or at least dissuade, the use of the internet by certain groups. The proportion of women globally using the internet is 48 per cent as compared to 58 per cent of men, and this digital gender gap is growing in developed countries. Digital exclusion is also amplified across social and cultural lines, affecting migrants, refugees, internally displaced persons, older people, young people, children, people with disabilities, rural populations and indigenous peoples.

For the purpose of this report, we identify the following four barriers as the leading issues preventing universal internet access:

1. **Access to affordable data**. A universal benchmark advocated by the Alliance for Affordable Internet (A4AI) defines affordability as "1 for 2": where 1GB of mobile broadband data is priced at 2 per cent or less of average monthly income. [1]
2. **Access to an affordable 4G-compatible device**. This is predominantly a smartphone [2] but can

include any 4G-compatible device capable of running 4G-powered applications (e.g., MiFi or a 4G dongle, but not a feature phone). [3] There is currently no global metric for what constitutes "affordability" but drawing on the affordability metrics for data should offer a meaningful comparator.

3. **Digital skills and relevant content**. This means the literacy and basic skills to not only access the internet itself, but the content available on it to make access a meaningful experience. [4] Content – including government-provided (such as government services), commercial and user-generated – needs to be locally relevant based on language and subject to provide an incentive to get online.
4. **Coverage by a 4G or equivalent broadband network**. Although 4G access was not cited as the leading barrier by some margin in the GSMA survey, it is nonetheless critical to transformational development. 4G and equivalent technologies (highlighted in Annex C) will enable advanced applications to be developed and used, with the potential for leapfrogging. Many basic online activities which fuel productivity and prosperity rely on a 4G or equivalent connection, with enough bandwidth and low enough latency to watch videos without buffering, conduct video calls without delay and participate in activities in real time as if they were in the same room.

While online security and safety and horizontal inequalities are also significant barriers to access for large proportions of the developing world, we chose not to address these directly in our analysis. This is in keeping with much of the existing literature that identifies the above barriers as the primary roadblocks to access. [5]

Furthermore, increasing affordability, expanding digital skills and enhancing the relevance of internet content to meet the needs of citizens will begin to address some of the inequalities currently amplified in digital access.

Online security and safety concerns must be targeted as part of a holistic digital-skills curriculum. Children and adults alike should learn about responsible internet use and ethical engagement online, allowing them to build key 21st-century skills around critical thinking and problem solving in order to considerately engage with, sift and balance the wide range of views and information online.

The financial and political threats posed by cyber criminals, or even governments themselves, are risks that are beyond the scope of this report. Policymakers liaising with law enforcement will need to build up credible mechanisms to protect users from cyber criminality and will need to draw on regional and international cooperation to do so. The risk that authoritarian-leaning governments may use internet access as an instrument of political control and deterrence is in some cases a very real threat, but it is one that should be met with meaningful engagement and not be used as an excuse to deny internet access to the citizens of those countries. Political suppression through internet use remains part of the wider geopolitical case for the Global North to influence the values around which, and therefore the mode with which, internet access is expanded.

The Progressive Case for Action

Internet Access Accelerates Development

Universal internet access will underpin the achievement of all the Sustainable Development Goals (SDGs) – from the human development ambitions set out in Quality Education (SDG4) and Gender Equality (SDG5), to economic growth through the Industry, Innovation and Infrastructure (SDG9) targets.

Increasing internet penetration has a significant macroeconomic impact: In low-income countries, a 10 per cent increase in mobile broadband penetration yields a 2 per cent increase in GDP; and, for middle-income countries, a 10 per cent increase in both mobile and fixed broadband penetration yields a 1.8 per cent and 0.5 per cent increase in GDP respectively. For low-income countries that continue on the trajectory towards middle income, increases in fixed broadband penetration will have a further positive impact on their economies.

But the effects of universal internet access are not just felt in productivity gains. It can also transform millions – indeed billions – of lives. The arrival of fast internet in Africa, for example, has yielded an estimated increase of between 6.9 and 13.2 per cent in jobs, regardless of education level. And this statistic does not just represent the formalisation of existing jobs, but the creation of new and better-quality jobs that are aligned with SDG8 (Decent Work and Economic Growth), with fewer workers holding jobs in unskilled occupations when fast internet is available. Increasing internet penetration levels to 75 per cent of the population in all developing countries is estimated to create more than 140 million jobs around the world.

Increased internet access is and will be transformational for individual sectors and industries, too, as seen in the wider economic transformation experienced by China and the "Asian miracles" in the second half of the last century. This is often considered the holy grail of development policy: the transformation of a low-productivity, agricultural-based economy into an advanced, highly industrialised one. To achieve this, developing countries must reach 21st-century levels of digital access and technologies in order to compete globally. For example, increased access to mobile phones and the internet for farmers reduces the price of inputs and asymmetries in information, and provides real-time data (such as accurate weather forecasts) alongside better advice on agriculture practices and inputs. This allows farmers in the developing world to compete more favourably with their global competitors. Universal internet access also paves the way for more advanced AgTech, which has the potential to revolutionise the industry. This will be critical for economic transformation, addressing poverty (SDG1) and improving food security (SDG2).

Universal internet access will significantly address global inequality and inclusivity, specific to SDG10 (Reduced Inequalities) but important to all the goals. It is estimated that there are 1.7 billion "unbanked" people in the world – i.e., those without access to traditional financial services – who would benefit from fintech by sending and receiving payments within and across borders, and accessing credit in ways that analogue methods of identification do not permit. Moreover, fintech and e-commerce promise to address the stark gender inequalities (SDG5) prevalent in financial inclusion. Digital financial services are expanding opportunities for women, increasing their engagement in the formal economy and strengthening their resilience to financial, economic and health shocks. The e-commerce revolution is reshaping the global business environment to provide more opportunity for small businesses, especially those headed by women.

Returning to education, internet access not only increases access to learning, but also can improve educational outcomes. Connecting every school would make a vast array of content available to teachers and students, and empower learners to build their confidence online and develop their own discipline of knowledge-seeking. In addition, rapidly evolving advanced technology such as EdTech applications are becoming more adaptive and responsive to individual learners' needs, which could help bridge both the shortfall of approximately 69 million teachers by 2030 and the current global learning crisis in accessing quality education (SDG4).

The role of big data – premised on widespread mobile broadband penetration – and digitised health systems in supporting epidemic preparedness and response was well documented prior to Covid-19, and will now become integral to vaccine rollout and future pandemic-preparedness strategies. Digital health innovation will also be instrumental in addressing non-communicable diseases, which account for 70 per cent of deaths worldwide (three-quarters of which occur in the developing world). And advanced technologies such as AI could begin to address the acute deficit of 18 million health-care professionals anticipated by 2030 through many promising widespread innovations in clinical care pathways (prognoses and diagnoses); patient-facing solutions, such as personalised health advice and information provision; and far-reaching efficiencies in areas like health-systems management, drug discovery and clinical-trial design.

Furthermore, the transition to digital public-service delivery more broadly will yield many benefits, from cost savings and efficiencies to greater civic engagement. In the medium term this will outweigh the cost of transitioning from an analogue to digital model of government engagement, bringing related improvements to governance and transparency in public transactions too. Over time, these financial savings will likely outweigh the investments made to provide online access to all. An example of the vast progress that digital solutions can deliver for public-service delivery is the Copenhagen Consensus's advice to the government of Bangladesh on prioritising development funding. Two digital solutions were recommended to bolster the delivery of public services: first, moving to an "e-procurement" platform to lower the costs and corruption association with the current outdated system; and, second, digitising the land-records system to deliver greater transparency and efficiencies.

Digital identification, or digital ID, is a primary example of how securing universal internet access can provide opportunities for significant returns on investment, contributing to the overall sustainability of efforts to close the digital divide. A secure, well-designed digital ID system can provide countries with a cross-sector platform that enables them to leapfrog to more efficient and modern systems, thus enhancing service delivery. Beyond developmental uses, digital identity promises to generate significant savings. Potential fiscal benefits include reducing fraud and inclusion errors in government-to-person transfers; lowering administrative costs; increasing tax collection; stimulating sales of goods and services; and improving labour productivity. Digital ID can therefore deliver significant economic value for the public sector, particularly in developing countries.

This is already being realised in some countries. In Botswana, biometric enrolment of pensions and social grants achieved savings of 25 per cent by identifying duplicate records and deceased beneficiaries. Similarly, in Nigeria, biometric audits reduced the federal pension roll by 40 per cent. The government of India has reported estimated fiscal gains of more than INR 825 billion ($11.31 billion at current exchange rates) between 2013 and 2018 as a result of digital ID-enabled direct benefits transfers combined with reforms to beneficiary identification, and refined targeting of social programmes and subsidies. While the exact return on investment can be disputed, these savings are thought to be around nine times the cost of implementing Aadhaar, the digital-identity system used in India. [6] There is therefore clear evidence that the investment to achieve universal internet access – including subsidising access for those most marginalised in society – would be economically advantageous.

Covid-19 has had a catastrophic impact on human life with dire economic ramifications for countries of all development levels. Yet not all outcomes are negative. One of the lasting repercussions will be the accelerated transition from analogue to digital government. The arguments for digital ID and "government-as-a-platform" were being made well before Covid-19 but, in the coming months, these concepts will become ever more critical to vaccination rollouts, mass testing and real-time track-and-trace services in order for life and the economy to resume as quickly as possible. None of this is possible without internet access, and this pandemic has illustrated how fundamental digital public-service delivery and engagement will be to building resilience ahead of future health disasters.

These are just some of the ways in which increased internet access is and will be transformational for development. When a developing country faces challenges with food, water, electricity, sanitation and health, it may seem counterintuitive to prioritise the expansion of internet access. However, research shows that digital solutions to address these problems can often be the most transformative and cost-effective. For example, the Copenhagen Consensus analysed the investment opportunities that would best address the main binding constraints to growth and development in Bangladesh and Haiti. The researchers proposed two digital solutions among their top ten recommendations. In Haiti, one of these recommendations was increasing internet coverage to 50 per cent of the population.

Closing the Divide Benefits Everyone

Universal internet access should be a key component in the growth plans for every country. For developing countries, it should be a critical element in their economic transformation strategies – without it they will fall further and further behind in an increasingly connected and digital 21st century. For advanced countries, this means a drawing away from aid dependency: Closing the digital divide will be critical to poor countries' self-sufficiency as it will lead to transformational development.

For donor countries, the benefits of investing in universal internet access are real and are not limited to eventual reductions in foreign aid. International trade flows have been shifting away from a concentration in Global North-to-North, and even South-to-North, trade. North-to-South trade flows are already equal to those between North-to-North, and demographic trends indicate that this shift will only grow. Already, middle-class populations in advanced economies represent only 25 per cent of the world's middle-class population. Growth of this demographic in the Global South is booming and expected to increase at a rate of 6 per cent or more per year, compared with a more moderate growth rate of 0.5 to 1 per cent in the North.

China already hosts the largest middle-class consumption market segment in the world, and by 2030 it will be overtaken by India, which will also surpass the US. The larger markets in the Global South – Brazil, Mexico, Pakistan, Indonesia, Egypt, Nigeria and Vietnam – each already host middle-class populations of over 100 million. Not only do the middle classes in the South offer a huge growth opportunity for companies in the North, but their share of e-commerce growth as a percentage of all retail spending is growing significantly. The tide of trade, in part driven by globalisation and a rapidly digitalising world, is changing and these growth markets will be ignited by universal internet access.

Rich countries will depend on the Global South to sustain their own export-led growth. This trade evolution over the last 50 years, with production also shifting from rich countries to key markets in the East, has presented its own challenges to the Global North, including slower than expected labour-market adjustments for those whose jobs have been offshored. While governments in the Global North must invest significantly in their own readjustment policies to support those struggling labour groups, the growing markets in the Global South will be critical to the Global North's future prosperity and resilience.

On a macro level, the case for free trade is still hugely compelling and, for those who believe in the power of information and an interconnected world, the opening up of new nodes of knowledge is therefore also about enlightened self-interest. The transformative potential of internet access can create new wealth avenues for millions of people, with an open internet and more users providing the foundation for more choice and innovation in the global market.

The Internet, Inclusion and Liberal Values

This belief in economic openness and the power of technology extends further into the values and priorities that the centre of politics should pursue today. Harnessing technology and navigating its impact are the key challenges of our age and yet, despite being decades into the digital revolution, many still underestimate the impact of the internet. It is completely transforming all elements of society and opening opportunities that were thought nearly impossible not long ago. Part of the failure to recognise the impact of the internet is our present inability to fully quantify its value creation, let alone understand the causal effects.

However, the evidence surrounds us: The superstar companies of the modern age have capitalised on the economies of scale and strong network effects provided by the internet. Many of the breakthroughs at the frontiers of science are only possible because of the power of software and AI today. And though Covid-19 has shut off huge amounts of human activity, that which remains is almost all online. For those without the internet, the knock-on consequences can be catastrophic.

This is true even where access is relatively high. For example, when France reopened schools in 2020, it was partly influenced by the fact that 500,000 low-income students could not access remote learning due to no internet access. Internet access has therefore become fundamental for anyone who cares about equality of opportunities. It is a platform for life, learning and livelihoods. The centrality of the internet to modern life is why a number of political institutions including the EU and the UN have made affordable access key commitments. Some leaders, like Rwandan President Paul Kagame, have made calls for universal access.

From a moral perspective, access to the internet is therefore about more than a right to information; it is a matter of human dignity and of improving quality of life. Nobody can control the circumstance of their birth, and where an opportunity exists to help those most in need, there is a compelling case for doing so. Generosity of spirit is not about the deserving and undeserving, and as politics in many countries focuses on "in" and "out" groups, there is a risk of missing the bigger picture.

In an interconnected world, the case for access extends well beyond the internet being a fundamental building block for modern life. It is about liberty and freedom in that it connects people and businesses to ideas and to markets, allowing greater incorporation of developing countries into the world's economy, alongside the opening-up of new experiences and opportunities. It is not a Trojan horse that centralises power with government-to-government transfers. Conversely, it is, in many ways, key to decentralisation and democratisation of the world, empowering more individuals with autonomy and an increased ability to engage in entrepreneurship and trade.

There is also a strong geopolitical component of the push to connect the world. Concerns endure over values, power and governance and, more broadly, the international democratic order for the digital world. Action should be taken by a coalition of nations who are willing to act according to principles compatible with liberal democratic values. Global technology companies, in particular the big tech giants, also have a responsibility to uphold these principles when bringing the internet to new parts of the world.

China has a critical role to play. Its pursuit of technological dominance and control of the modern digital economy, including through the Digital Silk Road, includes a hardware push to connect countries, as well as an attempt to influence standards through its filling out of international bodies, including the International Telecommunication Union (ITU). As Sangeet Paul Choudary has written, such pursuits, along with other aspects including the smart cities push, form China's "country-as-platform strategy for global influence." The risk of a splinternet and a break in the internet's shared and ubiquitous architecture would present profound geopolitical and security challenges, including cybersecurity and the fact that social media is a critical source of information for intelligence services today.

After years of more isolationist and unilateralist policy, democratic nations need to be more determined to collectively help build the infrastructure and standards of the digital highways that connect everyone in the world today. This should therefore be a key question for the Biden administration, whose China strategy needs to rise above the partisan rancour and be clear-eyed in its assessment, understanding that technology is central to the debate today and that competitive collaboration should define relations. Competition with China does not require confrontation.

There is almost certainly going to be a break from the Trump administration in this regard, who put significant stock on this question but whose proclamations veered towards indictments. Following Donald Trump's failed bid for re-election, the State Department published a paper on The Elements of the China Challenge, which highlighted some of the key aspects that have concerned the US government. This included highlighting their view that "China aims to build the world's fifth generation (5G) wireless-telecommunications physical and digital infrastructure as a steppingstone to broader dominance in emerging and next-generation information technologies", which was central to Trump's attempt to stifle Huawei. The UK took a similar stance, banning the installation of Huawei equipment on UK networks from September, although the company already has a strong foothold in Africa.

The company is active in South Africa's network and is working with Safaricom in Kenya, while another Chinese company subject to US action, ZTE, is active in Uganda. Around 70 per cent of 4G base stations on the continent are made by Huawei, which already signed a contract for South Africa's first commercial 5G network. The company is also involved in initiatives including the Smart Africa Alliance and A4AI alongside Google, Facebook and Microsoft.

Chinese companies are investing in new technologies which could connect the planet. Satellite technology is advancing, opening up potential new opportunities for connecting the world's population through LEO (low Earth orbit) satellites (see Annex D). While US company SpaceX is the most advanced in its efforts with LEO satellites, the Chinese government is also investing in the technology. The Hongyun Project plans to launch 300 satellites into low Earth orbit, with the network operational in 2022 and complete by 2025. Chinese companies, usually in close coordination with the government, are also investing in LEO satellites. The Chinese firm LinkSure Network has announced plans for a constellation of 272 satellites with ambitions to provide free Wi-Fi to regions currently without coverage.

Developing countries are highly unlikely to shift away from the use of China's technology in this space, which is why the US and other nations are going to have to put more weight behind this issue. This will require collaborating with China, as well as competing. The pursuit of an open internet should therefore be of key strategic interest for democratic nations, and these reasons feed into why they should put their investment in universal internet access.

President Biden has emphasised the integral role of ICT to the "summit of democracies" he will convene. Access to the internet and all it entails should be central to any new digital alliance of democracies. But the issue is wider than this: New forms of technological cooperation, which also include companies, are key to the transatlantic alliance; key to relationships with countries such as Japan, South Korea and Australia; and should advance individual rights and dignity, and democratic principles and values. But China's increasing technological dominance means that it will be both pragmatic and necessary to collaborate with its government and companies on these issues in the coming years. It would be naive to believe that cooperation with liberal democratic nations will influence China's values, but finding partnerships for development will be necessary for the balance of power in the decades to come.

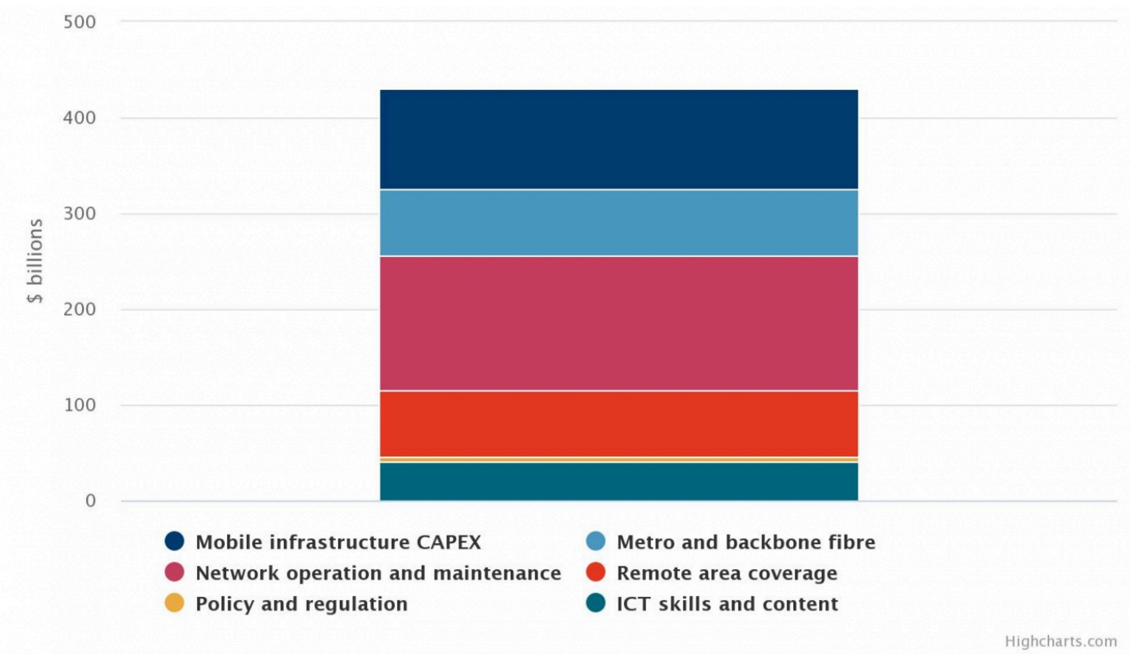
Quantifying the Challenge

We estimate that it will cost in the region of $446 billion to achieve universal internet access by 2030 and that it could deliver $8.7 trillion in benefits to developing countries. The sequencing of the investments is a policy decision, and the benefits are likely to accrue with an uncertain time lag. We investigated a range of different scenarios for timing and discount rates. We found that in every case the benefits outweigh the costs.

The Scale of Investment Required

The ITU and A4AI, which do not include devices, estimate that it will cost approximately $428 billion to achieve universal internet access by 2030. We estimate the devices gap could be closed with an investment of $18 billion. This makes a total cost in the region of $446 billion to achieve universal internet access by 2030.

Figure 3 – Investment needed to achieve universal access to broadband connectivity by 2030 (does not include devices). Total: $428 billion



Source: Estimates based on ITU, GSMA, A4AI, operator and regulator data. From ITU, 2020 Connecting Humanity.

The usage gap – driven by affordability, skills and internet relevance issues – is the greatest barrier to internet access (see Figures 1 and 2). Despite this, the bulk of investment needed to close the digital divide is for 4G or equivalent broadband infrastructure (89 per cent). This includes: mobile radio network capital expenditure (capex) for greenfield investments to expand 4G mobile coverage to underserved areas; upgrades to existing 2G and 3G networks; the installation of network backhaul infrastructure covering metro fibre, microwave or satellite; and continued network operations and maintenance costs through to 2030. The infrastructure investment includes a satellite/Wi-Fi requirement for remote areas which are out of reach of traditional mobile networks (between 10 and 20 per cent of the rural population in most countries) and localised solutions for coverage will be needed, consisting of satellite backhaul and fixed wireless access (predominantly Wi-Fi) for the last mile (these technologies are highlighted in Annex C). Innovative technologies to increase connectivity will no doubt emerge and develop between now and 2030. The potential of LEO Satellites to bring low-latency, high-speed connectivity to this demographic is particularly promising (discussed in Annex D).

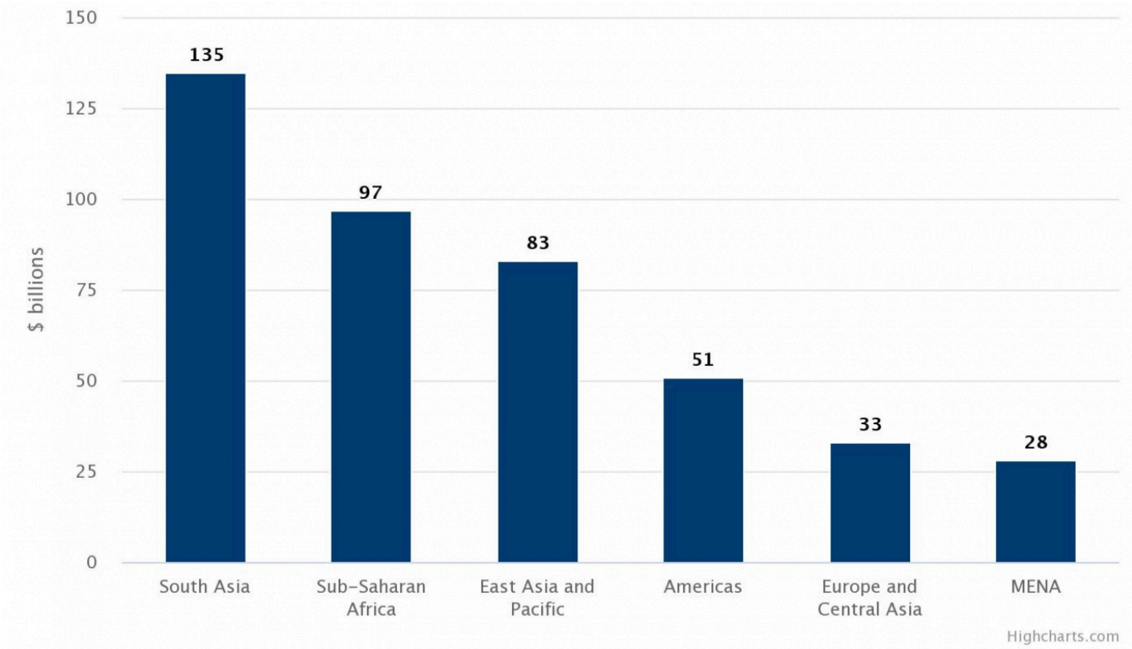
This investment also includes $40 billion (9 per cent of total investment) for improving digital skills and enhancing relevant content for the internet to be meaningful. This, for example, could include access to content in local languages or information relevant to the day-to-day lives of the unconnected (e.g., pricing data for smallholder farmers).

$6 billion (1.4 per cent of total investment) is allocated to driving policy change to liberalise markets and increase competition in the sector, bringing down prices and encouraging network expansion.

The total estimated investment figure of $428 billion is based on a model that assumed the most cost-effective data network was available.

Below is the distribution of investments by region.

Figure 4 – Investment requirements by region (does not include devices). Total: $428 billion



Notes: Country groups based on World Bank classification. This includes high-income countries, comprising 6 per cent of total investments.

Source: Xalam estimates based on ITU, GSMA, A4AI, operator and regulator data. From ITU, Connecting Humanity, 2020.

Factoring in the Cost of Devices

The ITU's global costing model does not include the cost of devices. We estimate the devices gap could be closed with an investment of $18 billion. A4AI has undertaken a separate project evaluating the cost of devices across the developing world today. Of the large number of countries it evaluated, it established that the cheapest smartphone available was in Lesotho at $17.96 (2020).

By comparison, an initiative between Google and Safaricom in Kenya to expand 4G access offers a range of more affordable smartphones with repayment plans – common in the West but unusual in the developing world. Its "Neon Ray Pro", for example, is a 4G Android (Go edition) smartphone retails at Ksh 6,500 ($58.83) and can be acquired with a downpayment of Ksh 1000 ($9.05), with the outstanding amount repaid over nine months at Ksh 20 a day ($0.18). Given a basic entry-level salary in Kenya is $5.00 per day, this makes device repayment 3.6 per cent of a modest lower-income salary. This is comparable to the universal target for data affordability (1GB at 2 per cent of monthly income).

We estimate that between now and 2030, an additional 837 million people will need assistance in accessing a device. Of those, around 385 million will still be living in extreme poverty (<$1.90 a day) and may, in the first instance, require subsidies to cover the full cost of a smartphone if they are to access the internet. [7] We assume that the remaining 453 million will be able to access a competitively priced device on a repayment plan, similar to the example offered now in Kenya.

Assuming the cheapest smartphone available today ($17.96) can be purchased at scale for those living in extreme poverty by 2030, and a device repayment plan similar to that offered by Google and Safaricom ($58.83) can be made available for the remaining 453 million not accessing the internet for affordability reasons, we estimate the devices gap could be closed with an investment of $18 billion. [8] This would include subsidies for the extreme poor and donor support to underwrite loan-guarantee schemes offered by telecoms companies to offer smartphones for the lowest-income groups. The $18 billion figure represents 4 per cent of the total investment outlined by the ITU.

Estimating the Economic Benefits

The direct economic benefits from universal internet access are significant. We estimate that the direct economic benefits from universal internet access to the developing world total approximately $8.7 trillion.

The ITU conducted a series of global and regional econometric modelling studies to estimate the impact of a 10 per cent increase in internet penetration on GDP, the results of which we summarise below:

Table 1 – Impact on GDP of a 10 per cent increase in mobile and fixed broadband penetration, by income group and region

Global	*Effect of 10% increase in mobile broadband penetration on GDP*	*Effect of 10% increase in fixed broadband penetration on GDP*
Low-income countries	2%	Not statistically significant
Middle-income countries	1.8%	0.5%
High-income countries	No economic impact	1.4%

By region		
Africa	2.5%	Not statistically significant
Americas	1.2%	1.9%
of which Latin America and Caribbean	1.7%	1.6%
Asia Pacific	0.51%	1.63%
of which low and middle income	2.43%	
Arab States Region	1.81%	0.71%
ITU Commonwealth of Independent States region[1]	1.25%	0.63%
ITU Europe region	2.1%	0.46%

of which higher income (>$20,000 GDP per capita)	Not statistically significant	2.94%
of which lower income (<$20,000 GDP per capita)	2.0%	Not statistically significant

Source: ITU, The Economic Contribution of Broadband, Digitization and ICT Regulation

We applied the ITU's analysis to current GDP levels, modelled against expected population growth and aspirational internet access levels, to ascertain the impact of expanding broadband penetration to reach universal coverage by 2030.

Key Definitions

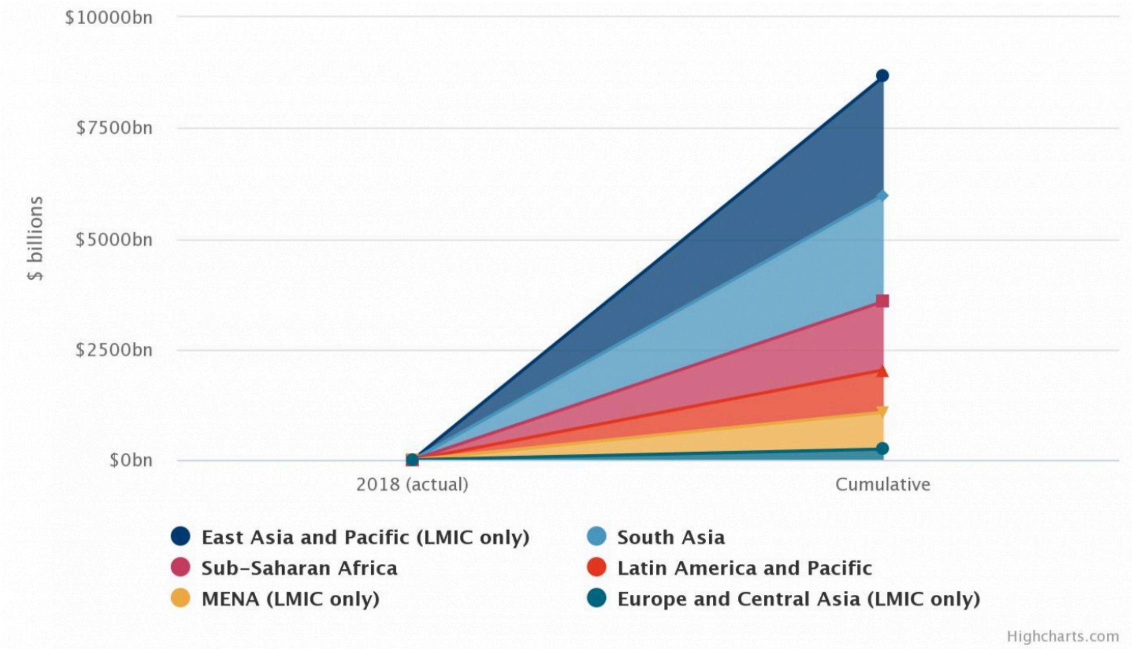
Universal internet access: For the purpose of this report, we adopt the ITU and A4AI's definition, which was developed by the UN Broadband Commission: Access to a 4G or equivalent internet connection for 90 per cent of the over 10-year-old population. The remaining 10 per cent accounts for those that would choose not to use personal ICTs, those that are prevented from doing so, such as prisoners, and those who use shared facilities. It includes only people over age 10 to accommodate for data protection measures and privacy laws protecting children.

4G or equivalent broadband: Good quality broadband internet is defined as an average download speed of at least 10 Mbps and as technology neutral (meaning that data may be transmitted via cable, fibre, satellite, radio or other technologies) as possible to ensure internet access is meaningful and has the potential to be transformational. This means 4G is used as the proxy for mobile broadband, and fixed broadband applied where most relevant, such as communities accessing the internet through Wi-Fi hotspots powered through fibre-optic.

Meaningful connectivity: See A4AI's definition for meaningful connectivity and its call to action to revise how internet connectivity is redefined. Annex C provides an overview of the different connectivity technologies available and their impact on user experience.

While this analysis does not account for country-specific differences, it provides a regional insight into the magnitude of the economic impact that universal connectivity could bring.

Figure 5 – Growth in GDP from increased connectivity only, cumulative by developing country region. Total: $8.7 trillion



A Focus on Mobile Broadband

We only model the impact of an increase in mobile broadband penetration, excluding the additional impact of an increase in fixed broadband use. This is to offer a more realistic, albeit conservative, estimate of the impact of closing the digital divide – based on reaching universal internet access that would predominantly be driven by providing users access to 4G, or equivalent, broadband through a compatible device (in most instances, a smartphone).

It is pertinent to note that the economic impact of an increase in mobile broadband for low-income countries is highly significant, becoming less significant as countries' incomes increase. However, the inverse is true of fixed broadband, where increases in penetration are not statistically significant for low-income countries, but for middle- and especially higher-income countries, the GDP impact increases (see Table 1).

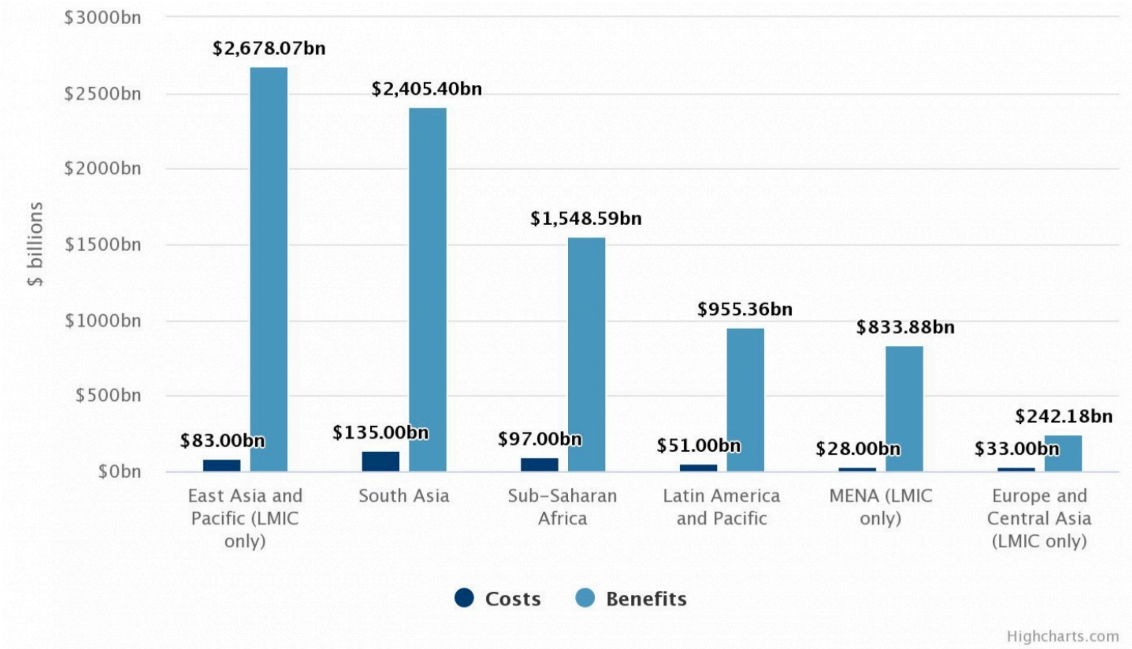
The current mobile broadband penetration rate is far higher than for fixed. In the developing world, there are 65 subscriptions for mobile broadband, compared to 12 fixed-broadband subscriptions for every 100 inhabitants. Even in the developed world, mobile broadband penetration is far higher with 125 subscriptions per 100 inhabitants for mobile broadband, versus 34 subscriptions for fixed. Most people access the internet through a smartphone – 89 per cent of internet users use a smartphone to connect, based on A4AI's Meaningful Connectivity survey. Of those that use other devices, such as laptops and tablets, only 2.3 per cent of those same respondents use this as their only means of connecting to the internet.

Mobile broadband will continue to be the primary route for new internet to get online. For developing countries, an increase in mobile broadband penetration is not only more impactful, it is also where the bulk of investment will likely go (despite the investment case for closing the digital divide, as detailed in the next chapter, being technology agnostic). Hence we only model the impact of an increase in mobile broadband penetration on economic growth, and thus the economic benefits outlined above are conservative.

Comparing Costs and Benefits

The economic benefits of reaching universal internet access far outweigh the investment costs at a macro-regional level:

Figure 6 – Economic benefit versus cost of achieving universal internet access, by region (costs excl. devices)



Note: Does not include $18 billion cost for device access. This is not included as we do not have regional data available.

Source: TBI analysis based on World Bank and ITU data. Regions based on World Bank classifications.

Not only do the econometric benefits greatly outweigh the costs – by a magnitude of over 30 times in the case of East Asia and the Pacific – but these benefits are likely to be underplayed. There are three reasons why. First, while taking into account the macro productivity gains of internet access, these estimates do not include the wider socioeconomic benefits from universal internet access such as: poverty alleviation, improved health and education outcomes, potential redress of gender inequalities through financial inclusion, for example, and improvements across other SDG dimensions.

Second, we only account for the economic impact of an increase in mobile broadband penetration, but the investment model for reaching universal internet access is technology agnostic. It is likely that this will mostly be through 4G, but in some instances it will be through fixed broadband, and it does not account for whichever subscription or devices a user might choose to access the internet. Moreover, existing insights highlighted above illustrate that almost all internet users access the internet through mobile, yet some of may also do so through other devices that are more likely to connect via fixed broadband. Thus, the impact and benefits of an increase in fixed broadband use as a result of overall achievements in universal internet access are not modelled or accounted for in this case.

Third, we used projected population growth figures for 2030. Most of the benefits are likely to accrue after this date, depending on the sequencing of investments, and population growth after 2030 will impact the overall benefits of universal internet access. Population size in developing countries is likely to continue growing after 2030, further amplifying the benefits of universal internet access. Thus, the estimate provided is modest.

Scenarios

The sequencing of these investments is a policy decision and the benefits are likely to accrue over an uncertain time period. We investigated a range of different scenarios for timing and discount rates by region and in every scenario the benefits outweighed the costs.

Net present value (NPV) evaluations of investments and benefits were undertaken by region. The various scenarios included an estimation of the NPV by region if:

1. The benefits and the costs were spread evenly over the course of the project.
2. The benefits were only accrued in the last seven years of the project.
3. The investments were front-loaded, and the benefits accrued only in the last seven years.
4. The investments were front-loaded and only 70 per cent of the benefits were accrued over the last seven years.
5. The investments are back-ended and only 70 per cent of the benefits are accrued over the last seven years.

We stress-tested these against the average World Bank discount rates for infrastructure investments (10 to 12 per cent), [9] as well as a more commercially viable rate of 20 per cent (as advised by industry experts to be reflective of more risky country investments, such as in Africa).

The NPV of investment in universal internet access was positive in all scenarios for all regions. Further analysis can be found in Annex B.

Barriers to Moving Faster

Why, if the benefits of investment outweigh the costs so significantly, is investment not happening at the scale necessary to close the divide by 2030? Several market failures are to blame.

First, for both telecommunication companies (telcos) and device manufacturers, the incentives to invest are focused on the most lucrative areas of the market. For infrastructure investments, telcos can drive stronger profits – and demonstrate stronger investment metrics to shareholders– by upgrading 4G to 5G than they can for updating 2G, or 3G networks to 4G. Moreover, telcos will usually be incentivised to prioritise investment in more profitable areas (4G to 5G) than low profitability ones, even though upgrading 2G to 3G, or 4G, would increase their revenue streams. Greenfield investments to bring coverage to the unconnected (such as rural, less well-inhabited or less prosperous areas) are often commercially unviable for many telcos.

Similarly for device manufacturers, it is more profitable to develop the next-generation smartphone for which there is high demand than it is to make a cheaper 4G device – for which demand may need to be stimulated. Consequently, unlike other forms of technology, the price of entry-level internet devices has remained stable. Although there are some signs that the market for cheaper devices is increasing in some regions, as seen in Africa from 2018 to 2019 (driven by device manufacturers tailoring their business models to these markets for the first time), often these basic smartphones remain unaffordable for the majority of people in these markets, and it is therefore commercially unviable for many device manufacturers to expand into these regions.

This market failure is the result of a mismatch between those who would benefit from universal internet access and those who, in the current market, would incur the costs. While the benefits of universal internet access will primarily be experienced by citizens and, consequently, the wider electorate, government and the broader national economy, investment in connectivity is shouldered predominantly by the telecoms sector alone.

Second, some industry experts indicate that telcos would expand 4G coverage if the demand existed but that the challenge is predominantly affordability and relevance, rather than a lack of coverage. Many are not accessing the 3G networks that already exist in their area– as indicated previously in Figure 1. The investment necessary to convert a 2G or 3G cell tower into a 4G one is marginal, but the demand is not yet there to justify the investment.

Third, ICT markets in developing countries can be uncompetitive or even closed, making network investment challenging. An estimated 260 million people have only one choice of major mobile network operator, while 589 million people live in countries where a lack of competition keeps prices high. [10]

A4AI also notes that progress on market competition is stalling and a lack of transparency on licensing requirements makes entry into new markets challenging. Furthermore, inflated spectrum prices or delays to spectrum allocation – often considered cash cows for governments – stifle competition, hinder infrastructure investment and, ultimately, inflate the cost of data for consumers. Inordinately high levels of taxation in the ICT sector can dissuade new entrants or even force existing market players out. For many governments in developing countries, telco revenues can be one of the most lucrative and reliable income streams available, which makes changing ICT regulation even more challenging.

Fourth, and finally, the investment market for 4G and equivalent technologies may not be fit for purpose. When telcos make significant infrastructure investments, such as laying fibre-optic cables or installing a new tower, they (and their shareholders) currently expect returns on that investment within five-year horizons. This is unfeasible for greenfield investments in unconnected areas where demand is not yet proven and is unlikely to happen in lower-income markets where telcos must wait longer to profit from increased data usage. In these markets, the returns from increased broadband coverage will thus be more meaningful for the wider economy and government treasury.

The private sector has already seen the potential that increased internet access represents and, over the last ten years, investment in narrowing the digital gap has followed. While some companies are aligning investment initiatives with their broader market strategy, others are making considerable efforts to frame their projects within a sustainability approach; Google's Next Billion Users and Facebook's Connectivity are two examples of such initiatives. US technology companies including Google, Facebook, Microsoft, Amazon and SpaceX are focusing on expanding network and internet connectivity and are testing innovations and research projects to provide alternatives to traditional infrastructure for remote and underserved areas.

Reliance Jio, an Indian telecommunications company, has brought the internet to more than 400 million people in India and has one of the cheapest data tariffs in the world. It offers plans that dropped the average cost per gigabyte of data to less than $0.10. Its collaboration with KaiOS also helped in significantly lowering the cost of smartphones. Jio has also developed the world's first 4G smart feature phone with ability to support multiple Indian languages. In addition to developing local language tools and locally relevant content, Jio has enlisted community leaders to train and educate a new group of users.

Telenor – a Norwegian telco with a massive presence in Pakistan, Myanmar and Bangladesh – has been addressing the digital divide in these frontier markets by taking into account the countries' socioeconomic context.

The influence of the Chinese technology giants on the African market has already been discussed. Some Chinese companies dominate on market penetration, mobile handsets or network connectivity, partly thanks to the Chinese government's financial support as part of its Belt and Road Initiative. However, these private-sector investments have not yet been extensive enough to deliver universal access at a global scale.

Private investment has also driven expansion of internet technologies. Despite market failures to expand internet access to the many, most governments and private investors still believe that 4G and equivalent network expansion should be led by the private sector. Most multilateral development banks (MDBs) such as the World Bank put much of their efforts into helping countries create the right enabling environment for private investment to step in. The ITU and A4AI, in their Connecting Humanity, 2020 report, expect the private sector to contribute 75 per cent of the $382 billion infrastructure investment necessary to achieve universal internet coverage, drawing on the World Bank Group's Maximising Finance for Development (MFD) approach. A key question is therefore how to shore up private investment to reach universal internet access by 2030.

Policy Recommendations

The economic case – not to mention the moral case – for closing the digital divide is unequivocal. The potentially greater challenge, then, is to identify realistic implementation strategies for universal coverage by 2030.

Here we identify key policies that: a) begin to address the market failure; and b) provide a more hospitable environment for the private sector to bridge the investment gap.

Stimulating Demand

Demand for internet access must first be stimulated to build the case for private-sector investment in 4G coverage (or equivalent). This should be done through three routes:

1. Subsidies and loans to increase access to a smartphone device.
2. Public investment in developing the digital skills necessary to access the internet.
3. Public investment to shape the content on the internet to make it relevant to all.

The donor community and national governments both have a role to play in stimulating demand through public investment.

What Should Donors and the Wider Global Community Do?

Mobilise approximately $58 billion of public funds to stimulate demand in 4G and equivalent broadband technologies between now and 2030.

1. $18 billion for supporting universal access to a smartphone by 2030. Around 56 per cent of this investment would be focused on subsidies to support smartphone access for the extreme poor, while the remaining 44 per cent would be used to underwrite loans made by telcos that are designed to help lower-income consumers purchase a smartphone through an affordable repayment plan.
2. $40 billion for building the digital skills necessary and the relevant content to make access to the internet meaningful for all. This figure is derived by the ITU and A4AI as part of their Connecting Humanity investment analysis, based on a nominal cost per user to improve the skills and content for internet access.

This figure is indicative of the scale of investment needed to reach universal internet access by 2030. Further analysis will be necessary to identify existing and planned national-level investments already being made in this area. The investment picture will remain dynamic through to 2030 as more innovative policies and technologies solve digital usage challenges.

Donors should use these funds to encourage governments to implement national strategies for increasing device access and expanding digital skills and relevant content. This could involve requiring governments to meet certain targets before they can access funds to drive demand in 4G or equivalent broadband. It would also involve providing guidance and best-practice insights for addressing these demand challenges.

What Should Governments Do?

Address access to a smartphone device through Universal Service and Access Funds (USAFs). [11] USAFs are often underused and opaque. The donor community should initiate a global review of the current status of these USAFs (similar to A4AI's assessment in 2018 that $400m across Africa's USAFs remained unused) to ascertain how much investment can be delivered by national funds and what remains to be committed by the donor community. [12]

Invest in building web literacy. Citizens must learn a basic understanding of the web and web technologies, giving them the confidence and satisfaction to read (how we explore the web) to write (how we build the web) and to participate (how we connect on the web). This can be done through:

1. National education curricula. Learning by doing will be critical – studies indicate that simply providing digital equipment (e.g., tablets) to children without teacher assistance can stimulate learning alone [13] – and thus digital literacy will be built by children being exposed to, and indeed learning through, use of the internet and digital technology. This will be catalysed once every school is connected to the internet, a target championed by the ITU and UNICEF's GIGA initiative.
2. Lifelong learning initiatives focused on building digital skills across specific marginalised groups (e.g., women, farmers). Ring-fenced funding across relevant sector ministries should focus on building digital skills of those in post-formal education through community-based training facilities attached to connected schools. [14]

Invest in making the internet relevant by:

1. Launching national and local grant-backed competitions to promote development of digital content and software to increase internet access. These could focus on the translation of websites and development of voice-activated programmes in local languages, and building apps to develop basic skills (e.g., literacy and numeracy), advanced skills (e.g., critical thinking) and digital skills more broadly. Apps that serve previously unconnected groups, such as AgTech for smallholders, should also be encouraged.

2. Leading by example by building out digital public-service delivery alongside increased internet access. Citizens become more web literate by practicing through civic engagement, e.g., accessing social-security payments or health facilities.

Regional Coordination

Public investment alone may not be enough to stimulate the necessary demand for 4G and equivalent broadband technologies. Regional and global coordination will be required for some of the above initiatives to reach scale.

Regional bodies such as the African Union, along with those **donors** investing to stimulate demand in 4G and equivalent broadband technologies, should drive acquisition of cheap smartphones. This will likely involve engaging with multinational telcos and governments to map the devices gap in each country and bulk order smartphones at a discounted rate from original device manufacturers (ODMs). [15] These smartphones can then be provided either directly to beneficiaries (the extreme poor) through national governments, or purchased by telcos to sell via device-repayment plans targeted at the lowest-income groups.

Regional bodies should also work with telcos and other private-sector actors to reduce the cost of data in developing countries. Across Africa, for example, prices exceed the universal target for affordability (1GB at 2 per cent of monthly income) in the majority of countries. The Smart Africa Alliance, made up of 31 countries, has launched a "bulk capacity purchase project" for data capacities in 2021 and is aiming to reduce the cost of the internet on the continent by 50 per cent. Capacities purchased in bulk on telecommunications infrastructure from connectivity providers will be resold at affordable prices in the member countries of the Smart Africa Alliance. More initiatives of this kind will be transformational in driving down the price of data.

Regulatory Reforms

Regulatory changes will be essential for creating an environment that stimulates private-sector investment in both expanding 4G and equivalent broadband-network infrastructure and driving down the cost of data and devices. Emerging technologies, such as LEO satellites, will push the boundaries of traditional approaches requiring regulation to evolve (see Annex D). Policy amendments can also go some way in addressing the affordability challenges those not currently accessing the internet face.

Again, both national governments and the wider development community have a role to play in opening up ICT markets and stimulating competition in the sector.

Governments Should:

1. **Modernise their ICT regulations and policies to both liberalise the telecoms sector and drive a more collaborative and holistic approach to their digital strategies.** The ITU offers useful guidance for how less advanced, monopolistic ICT markets can migrate into more advanced ones: from Generation 1, where monopolies are regulated through a command and control approach; and Generation 2, the first step towards liberalising markets; through to Generation 5, where a collaborative regulatory model is in place promoting inclusive dialogue and a harmonised cross-sector approach which, in turn, delivers meaningful digital transformation across a country's economy and society. Even moving through the first two regulatory generations identified by the ITU will make a huge impact in stimulating competition among internet providers, reducing the cost of data for consumers and catalysing investment for the expansion of 4G and equivalent broadband technologies. In addition, national broadband plans are critical to the effectiveness of public investments, and both the incentivisation and coordination of private investment as identified in A4AI's latest Affordability Report, 2020.

2. **Remove taxes for the cheapest smartphone devices** to stimulate access across the lower-income levels of society. As a result of such policies, Colombia and Kenya saw significant impacts on sales of devices (Kenya saw increases of more than 200 per cent over a two-year period), overall rates of internet use and a narrowing of the digital gender gap.

Donors Should:

1. **Encourage administrations to reform their regulators and reduce taxation on the ICT sector where it prohibits internet access.** Telecoms is often a key revenue stream for national treasuries, and telco incumbents are usually highly embedded in the political economy of a country and its political elite. Visionary leaders seeking to digitally transform their economies may require additional regional and global encouragement, as well as financial incentives, to drive this change through their administrations. This could take the form of donors offering governments cash incentives to push through transformative policies, including liberalising the sector or increasing transparency in spectrum allocation measures to increase ICT competition. It might include other types of financial and non-financial incentives to encourage Ministries of Finance in particular to accept painful short-term revenue cuts in exchange for the promise of medium-term economic benefits from increased internet access.

2. **Mobilise approximately $6 billion in investment to support the regulatory and policy changes needed**. This has been calculated as a percentage of the total investment necessary to reach universal internet access as calculated by the ITU and A4AI. This number will require further evaluation by key donors – likely the multinational development banks such as the World Bank – but provides an indication of the magnitude of investment necessary to create the right enabling environment for private-sector investment.

Greater Global Coordination

The investment necessary to achieve universal internet access is approximately $446 billion [16], of which an estimated $382 billion is needed for 4G or equivalent broadband infrastructure expansion. It is anticipated that the private-sector can and should meet 75 per cent of this investment, with public investment focusing on the most commercially unviable investments (such as greenfield expansion into the more remote and rural areas to add coverage).

The two preceding policy interventions are aimed at stimulating demand for 4G and equivalent broadband technologies and creating the right investment climate for the private sector to start playing a meaningful role. However, even with the right national policy and regulatory reforms in place, gaps in the current portfolio of investment vehicles to address expansion of 4G and equivalent technologies will likely still exist. A global, coordinated investment initiative will be necessary to address these global market failures.

Multilateral Development Banks and Key International Bodies Such as the UN and Broadband Commission Should:

Establish an investment coalition with institutional and global investors to revise the model for connectivity investment. This coalition would work together to model the various infrastructure investments necessary to reach universal 4G or equivalent broadband coverage, and structure different types of funds and instruments to best suit these types of investments.

The “dig once” nature of many backbone (core) [17] and middle-mile (backhaul) [18] network expansion projects, laying broadband cable at the same time that roadwork projects take place, requires more patient capital than telcos can offer. Insurance and pension funds, for example, may be better suited to these longer-term returns and within this low-interest environment may be investors searching for new opportunities to diversify their portfolios. In addition, these types of institutional investors have the scale and diversity of funds necessary to manage the risks inherent in investment into more volatile frontier economies.

Much of this investment will likely go towards fibre infrastructure, which requires substantial coordination with governments given the significant land disruption and planning necessary to lay these cables underground. Donor coordination with national governments will be essential to ensure that existing infrastructure works – such as road network expansion – incorporates the laying of fibre optic cables so that 4G or equivalent technologies can be expanded at marginal cost. This level of public coordination, directed from the global investment coalition, will ensure that private investment is most efficiently mobilised.

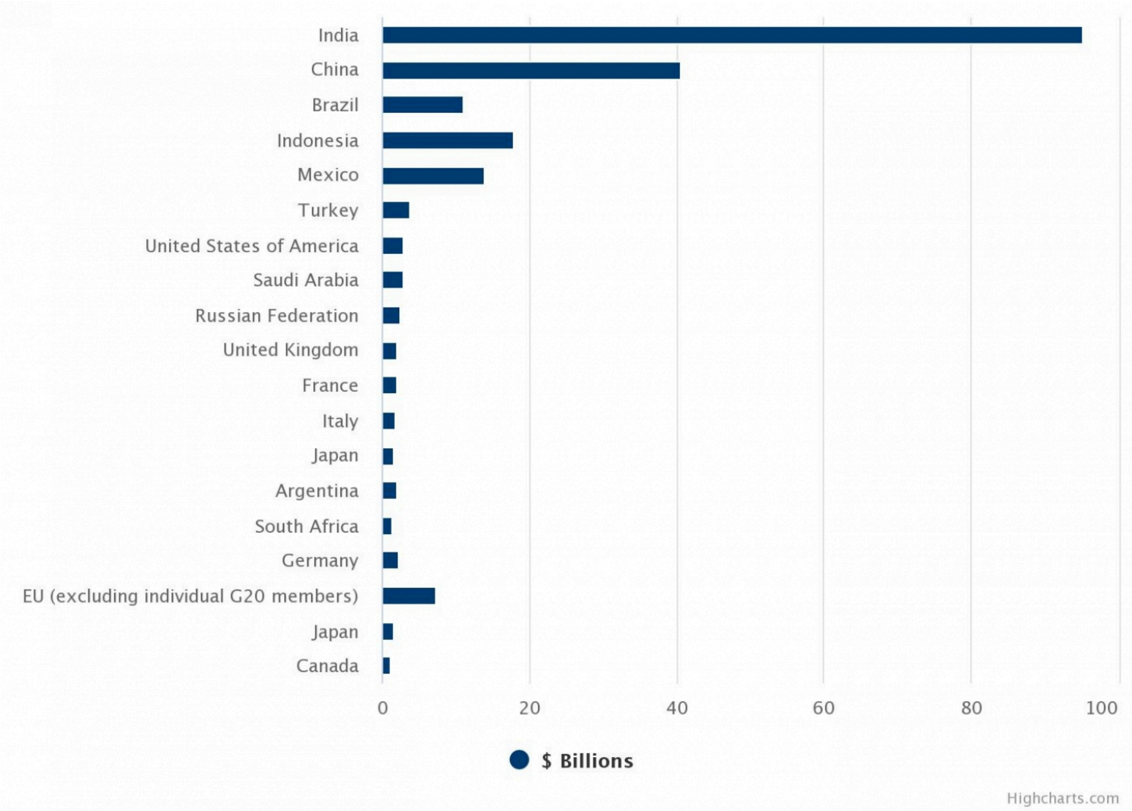
Global efforts to shore up private investment into laying and expanding the foundations for network infrastructure will empower local actors (private, public and community based) to develop innovative last-mile connectivity solutions. This will not be possible if the middle-mile network foundation is absent.

The Donor Community Should:

Commit to investing 0.02 per cent of their gross national income (GNI) per year until 2030 to close the digital divide. [19] This includes investing 25 per cent ($96 billion) of the funding required for the expansion of 4G or equivalent technologies, thus complementing private-sector investments by addressing the least commercially viable areas of infrastructure investment. In addition, it would cover investments in device access ($18 billion), policy changes ($6 billion), and upgrading skills and content ($40 billion) as outlined in Policy Recommendations 1 and 2. This includes all investments necessary to close the digital divide, and so does not account for what individual developing countries can commit to themselves. Consequently, the percent of GNI that needs to be committed could be lower. [20]

> **The Role of the G20**
>
> The G20 must play a special role in driving these recommendations. It should be a key agenda item for the next G20 summit taking place in Italy. The Italian presidency has made it a key priority. As the Italian prime minister looks to re-establish the transatlantic alliance, this could be a key area of cooperation for the US and European nations.
>
> The G20 comprises not only key donors – ten, including the EU, are Development Assistant Committee (DAC) donors themselves – but also key recipients. An estimated 50 per cent of the investment necessary (equivalent to around $212 billion) to reach universal internet access will be for the G20 itself, with India and China constituting the majority of this.
>
> An estimated 3 per cent of the G20 population, or the equivalent of 117 million people, are not covered by broadband or a 4G network, compared to the global average of 15 per cent. Approximately 1.2 billion of the G20 population, equivalent to 90 per cent of those currently not connected within the G20, are covered by a 4G signal but are not connected. This suggests that the bulk of the effort within these countries should be in addressing key barriers to usage: affordability of data and devices, and development of the basic skills and relevant content necessary to make access to the internet meaningful.
>
> The G20 governments should lead by example, presenting role models for other developing countries to make the politically (and sometimes fiscally) difficult policy and regulatory changes now that will drive transformation in the medium term.

Figure 7 – Investments across the G20 countries ($ billions)



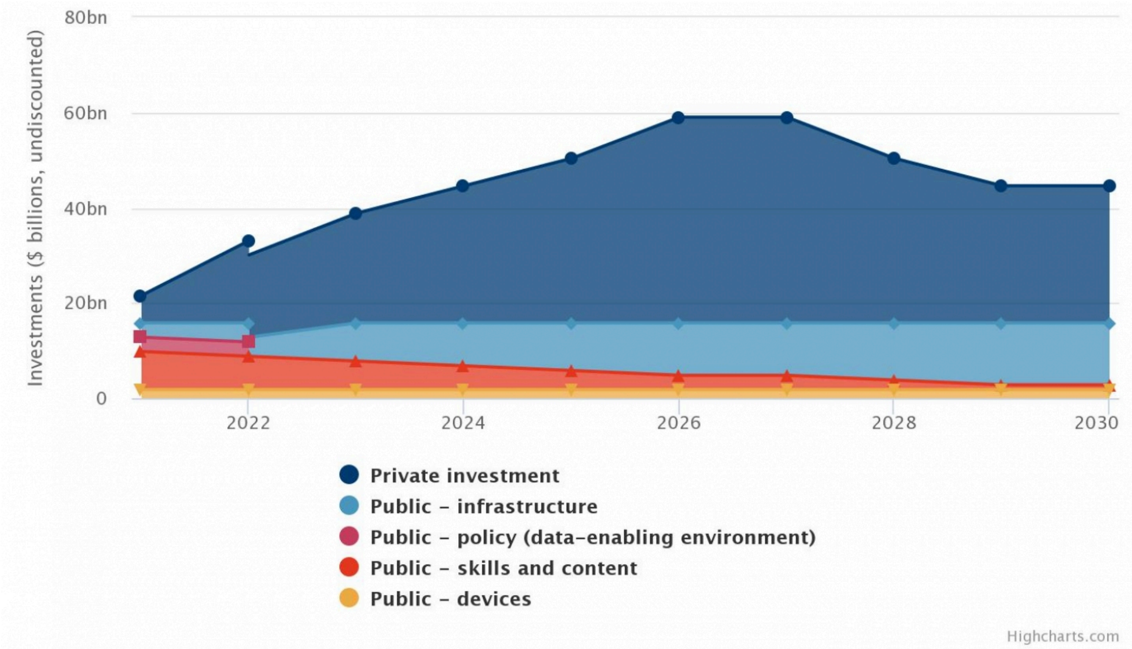
Source: Xalam estimates based on ITU, GSMA, A4AI, operator and regulator data. ITU, Connecting Humanity.

The Decade Ahead

The recommendations above map out the responsibilities of governments, donors, the international investor community, and multinational telcos and device manufacturers to close the digital divide by 2030.

Below we model an illustrative example of what the investment timeline might look like. The early years will focus on driving policy change and commencement of investment to grow demand for 4G or equivalent technologies, paving the way for private-sector investment to come in and ramp up to meet this demand and expand 4G or equivalent coverage until universal access is achieved by 2030.

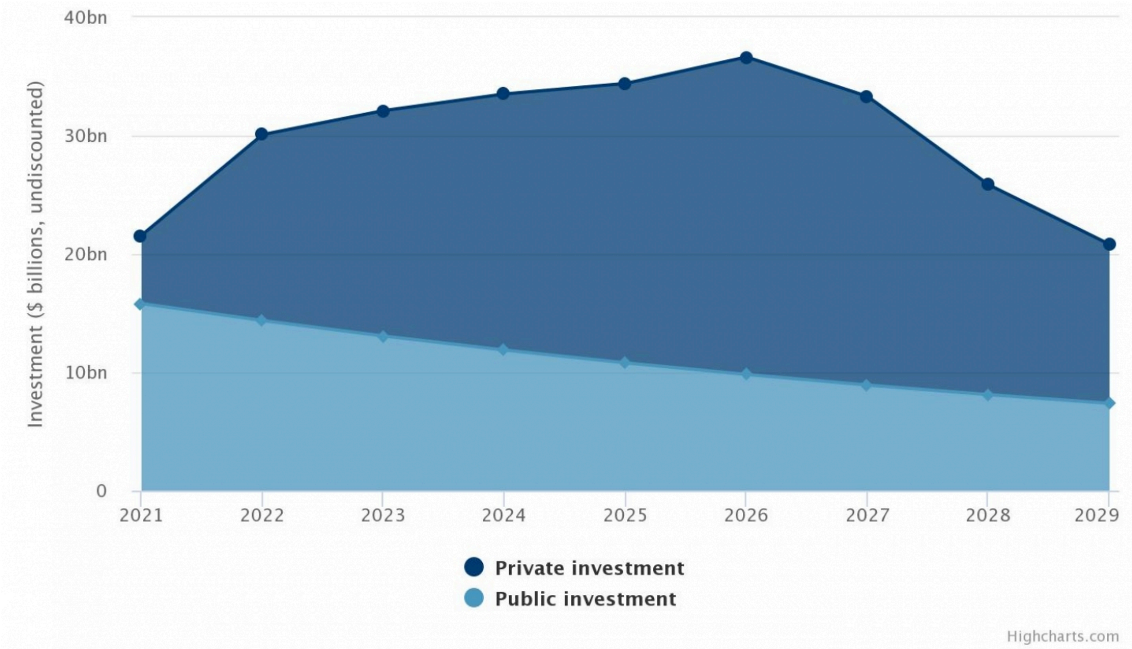
Figure 8 – Potential distribution of investments to reach universal internet access, 2021–2030



Source: TBI analysis based on World Bank and ITU data. Includes China and India.

An NPV illustration of such an investment provides a truer picture of the scale of investment necessary. A discount value of 10 per cent (based on the World Bank's standard range of 10 to 12 per cent for infrastructure investments) is applied. A higher discount rate presents a more attractive model for investment over the next decade.

Figure 9 – Potential distribution of investments to reach universal internet access (discounted), 2021–2030



Source: TBI analysis based on World Bank and ITU data.

Ensuring Action Is Sustainable

The combination of investments necessary to reach universal internet access are not all self-sustaining. If taken in isolation and not as an integral component of the wider digital economy ecosystem, each component of internet access would require some form of continual investment beyond 2030 for universal access to be maintained.

Looking at device access, for example, the above model includes giving a smartphone to everyone living in extreme poverty by 2030. However, this model does not include the replacement of a phone after a number of years use which, in reality, would be necessary over the course of the next decade and beyond 2030.

Similarly, 4G may become obsolete by 2030, and the goalposts for what constitutes meaningful internet access may be revised based on 5G or a more advanced technology generation. Dynamic political economies may mean that countries might improve their regulatory environments now, only to regress in the near future.

No matter what investment the international community makes towards closing the digital divide, it will nonetheless be national governments that determine whether universal internet access is reached by 2030 and maintained for generations to come.

Conclusion: Closing the Digital Divide by 2030

It is clear that internet access underpins transformational development, improves the lives of citizens and drives GDP growth. The benefits of investing to achieve universal internet far outweigh the costs. Closing the digital divide, however, is not only about solving global poverty. A better-connected world benefits all countries and building an open internet is fundamental to liberal values. Forming a coalition of the willing for digital development based on shared democratic aims and ambition should be central to a transatlantic alliance in the Biden era.

Achieving universal internet access will require collaborating with China, as well as competing. China is putting significant investments into expanding internet access through new technologies such as LEO satellites and more traditional technologies. Developing countries are unlikely to shift away from the use of China's technology in this space. The pursuit of an open internet should be of key strategic interest for democratic nations.

We have outlined three key policy recommendations that, if effective, would bring universal internet access to all:

1. A coordinated effort to stimulate demand in 4G or equivalent technologies to make more infrastructure investments viable.
2. Regulatory reforms to open up markets and drive down prices for consumers.
3. Global coordination to diversify and expand investment vehicles for 4G or equivalent coverage.

The total investment necessary to deliver these reforms will be approximately $446 billion, [21] of which around $382 billion is for infrastructure expansion. We would expect 75 per cent of this infrastructure investment to be met by the private sector, facilitated by boosts to demand from public investment and national regulatory change. In addition, global coordination is needed to diversify the range of investment vehicles available to make universal 4G or equivalent coverage commercially viable.

While securing investment of this magnitude will be essential, it will not be enough on its own. Universal internet access will require commitment from all developing country governments; the engagement and commitment from multinational telcos and global investors, some of whom might be new to ICT; and both global expert coordination and leadership to galvanise and steward this agenda and its necessary broad church of invested stakeholders.

There are already a number of commissions in existence which focus on addressing digital inequality, including the Broadband Commission and the UN Secretary-General's Roadmap for Digital Cooperation. These are making substantive inroads in identifying the issues and setting out the means by which they can be addressed. What we feel has so far been lacking is the global political drive, and indeed a leader, to champion this issue: positioning universal internet access as mission critical and as urgent as climate change or pandemic preparedness.

We are not recommending reinventing the wheel. There are a number of worthy initiatives and projects that seek to address aspects of the universal internet access question that should be supported. The ITU and UNICEF's GIGA initiative, for example, offers a promising model to achieve universal access by focusing on connecting every school in the world, providing a hub from which the wider community can hotspot and the private sector can provide innovative last-mile connectivity solutions. The emotive mission to improve educational outcomes and children's futures, as well as the simplicity of the goals to be measured at an international level, are commendable. What this, and other initiatives, might still need, is the global political leadership, resources and coordination to ensure these are supercharged to close the digital divide by 2030.

The pandemic, for all its devastation and disruption, has illustrated how much of life, prosperity and dignity in the 21st century is reliant on internet access. And this trend is exponential; the migration from analogue to digital will only grow. The opportunity to drive real change in the outcomes for the developing world seems palpable with the beginning of 2021 marked by the widespread rollout of vaccination programmes, the distant promise of a post-lockdown life and a revitalised liberal hegemonic dawn with the inauguration of President Biden. Universal internet access should be a key agenda item for the G20 taking place in Rome later this year. If the digital divide is left to expand, it will exacerbate the global inequalities that Covid-19 brought into stark relief. Now is the time to make closing the digital divide by 2030 a foreign policy priority.

Annex A

We developed an estimate for the present value cost for addressing device affordability for those currently not online, based on a triangulation of inputs and extrapolated through to 2030. An "undiscounted" figure for this investment was then derived, in line with the total undiscounted investment figure for achieving universal internet access to 4G or equivalent broadband technologies (barring device access) that the A4AI and ITU present in their Connecting Humanity report. We outline our methodology below.

1. Overall growth in internet penetration market

First, we identified the size of the population requiring internet access between now and 2030

Table 2 – Growth in internet users by region

	Population using internet (2018) [i]	*Population using internet (2030, universal access)* [ii]	*Difference in population using internet (2018-30)*	*% using the internet (2030)* [a]
SSA	270,956,399	952,129,849	681,173,451	66%
South Asia	545,743,885	1,546,026,300	1,000,282,415	75%
East Asia and Pacific (LMIC [b] *only)*	1,085,726,660	1,710,289,800	624,563,140	79%

MENA (LMIC [b] only)	208,690,193	339,066,000	130,375,807	73%
Americas (LMIC [b] only)	362,402,997	482,080,770	119,677,773	77%
Europe and Central Asia (LMIC [b] only)	278,451,103	322,083,900	43,632,797	61%
Total	2,751,971,237	5,351,676,619	2,599,705,382	75%

Notes:
a. Universal Internet Access: % based on 90% of the over 10-year-old population, as at % of total population in 2030.
b. LMIC: low- and middle-income countries.
Sources:
i. ITUICT-Eye – ICT Data Portal
ii. Data for total population and population under 10 years old from World Bank DataBank. TBI analysis to calculate total population accessing the internet in 2030, assuming universal coverage as 90% of the population 10 years old and above.

2. Device access for extreme poor by 2030

We assume that, to stimulate demand for 4G and equivalent broadband technologies for the extreme poor, the donor community should be able to secure the cheapest available smartphone at current market rates by procuring at scale. The cheapest smartphone available today is $17.96, available in Lesotho (2020), and we used this as the basis for this costing exercise.

Table 3 – Methodology for identifying cost to provide cheapest available smartphone to extreme poor, 2030

	Numbers of extreme poor (2030)[i]	*% requiring access to internet (2030)*[a]	*Extreme poor requiring access to internet*[b]	*Subsidy required to provide smartphone devices*[c]
SSA	477,390,000	66%	312,945,918	5,620,508,686
South Asia	14,750,000	75%	11,118,679	199,691,474
East Asia and Pacific	4,150,000	79%	3,297,564	59,224,246
MENA	43,510,000	73%	31,910,351	573,109,908
Americas	24,860,000	77%	19,254,666	345,813,808
Europe and Central Asia	2,100,000	61%	1,285,533	23,088,166
Rest of World[d]	6,460,000	75%	4,835,440	86,844,510

Total	573,220,000	75%		384,648,151	6,908,280,796

Notes:

a. Universal internet access: % based on 90% of the over 10-year-old population, as at % of total population in 2030.

b. Number of extreme poor, 2030, multiplied by % requiring access to internet, 2030, by region.

c. Population of extreme poor using the internet multiplied by the cheapest available smartphone today, at $17.96 USD.

d. The Rest of World region is based on the World Bank's calculation of extreme poverty in 2030. For the purpose of this analysis, we applied the global internet penetration expected (75%) to achieve universal internet access (90% of the over 10-year-old population) to Rest of World.

Sources:

i. World Bank blogs, Projecting global extreme poverty up to 2030: How close are we to World Bank's 3% goal?

3. Device access for low-income groups struggling with affordability of devices

We assume that, for those unable to afford a device but who are not in extreme poverty, the donor community should underwrite a portion of the loans necessary to encourage telcos to provide a competitively priced smartphone through an affordable repayment plan.

It has been assumed that a competitively priced smartphone could be benchmarked against Google and Safaricom's smartphone offer to the Kenyan market today, at approximately $58.83 USD (Ksh 6,500). Early, and as yet unpublished, pilots and research suggest that default rates for ICT at the lowest income levels are low, at 10 to 15 per cent, rising to 20 per cent for the highest risk groups. We assume, as a conservative estimate, that donors would need to underwrite 20 per cent of all loans necessary for telcos to offer a competitive basic smartphone through a repayment plan for those struggling with affordability.

Table 4 – Methodology to identify market size for smartphone repayment plans for those affected by affordability

	Growth in population requiring internet (2018–30)[a]	*Population requiring internet excl. extreme poor (2018–30)*[b]	*% affected by issues of affordability (2019)*[i]	*Population requiring device access support (2018–30)*[c]

SSA	681,173,451	368,227,533	30%	110,468,260
South Asia	1,000,282,415	989,163,736	15%	148,374,560
East Asia and Pacific	624,563,140	621,265,576	21%	130,465,771
MENA	130,375,807	98,465,456	30%	29,539,637
Americas	119,677,773	100,423,106	25%	25,105,777
Europe and Central Asia	43,632,797	42,347,264	21%	8,892,925
Total	2,599,705,382	2,219,892,671		452,846,930

Notes:

a. Drawing from analysis in Table 2.

b. Growth in population requiring internet, 2018-30, minus the extreme poor requiring internet, 2018–30 (see Table 3).

c. Population requiring internet excl. the extreme poor, multiplied by % affected by issues of affordability (2019).

Sources:

i. Based on GSMA's The State of Mobile Internet Connectivity, 2019, p.33.

Table 5 – Cost to donor community to underwrite global smartphone repayment plans

	USD (2020 current prices)
Global population requiring device access support, 2018–30	452,846,930
Price of smartphone	58.83
Total loans for smartphone repayment plan	26,638,720,662
Proportion of total loans underwritten by donors (at 20%)	5,327,744,132

4. Total cost of device access programme in current prices and undiscounted

Table 6 – Total cost of a smartphone access programme in today's prices (net present value)

	Investment, USD (2020 prices)
Subsidies for smartphone access for extreme poor	6,908,280,796

Investment to underwrite loans for people unable to afford device	5,327,744,132
Total investment necessary to solve device access by 2030	12,236,024,929

The ITU and A4AI's total investment figures to reach universal internet coverage by 2030, excluding device access, was at an undiscounted rate. We applied a 10 per cent discount rate to stress-test their investments against the expected econometric benefits of internet access (see Annex B).

For comparative purposes, a 10 per cent discount rate was also assumed for device access, with the assumption that the investment in today's prices of $12.2 billion to address device access would be spread equally per year from 2021 through to 2030 in cash terms (i.e., undiscounted), resulting in an undiscounted investment figure of approximately $18.1 billion for device access.

Table 7 – Present value and undiscounted value of device access investment, 2021–2030

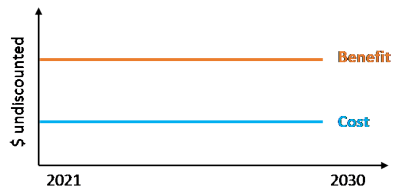
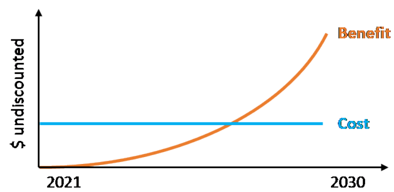
	Cash investment (undiscounted)	*Real-terms investment (discounted, NPV)*
2021	1,810,000,000	1,810,000,000
2022	1,810,000,000	1,645,454,545
2023	1,810,000,000	1,495,867,769
2024	1,810,000,000	1,359,879,790

2025	1,810,000,000	1,236,254,354
2026	1,810,000,000	1,123,867,595
2027	1,810,000,000	1,021,697,813
2028	1,810,000,000	928,816,194
2029	1,810,000,000	844,378,358
2030	1,810,000,000	767,616,689
Total	18,100,000,000	12,233,833,107

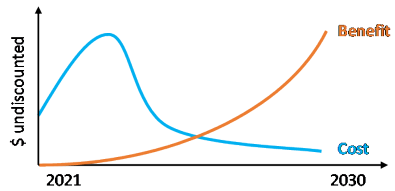
Annex B

The ITU and A4AI's total investment analysis for achieving universal internet access was based on undiscounted figures. To compare this investment to the likely econometric benefits that would arise from universal internet access, we stress-tested the cost-benefit analysis against various scenarios and discount rates to determine if the global net present value (NPV) of such an investment could remain positive.

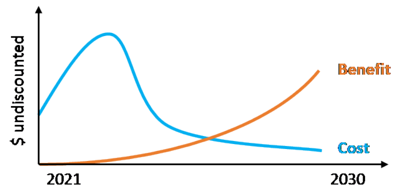
Table 8 – The various net benefit scenarios tested:

Scenarios tested	*Illustration of cost / benefit distribution ($ undiscounted)*
1. The benefits and the costs are spread evenly over the course of the project	
2. The benefits are only accrued in the last seven years of the project	

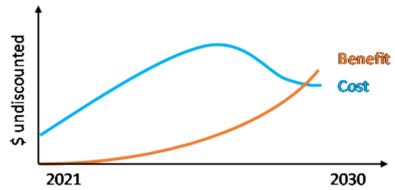
3. The investments are front-loaded, and the benefits accrued only in the last seven years



4. The investments are front-loaded and only 70% of the benefits are accrued over the last seven years



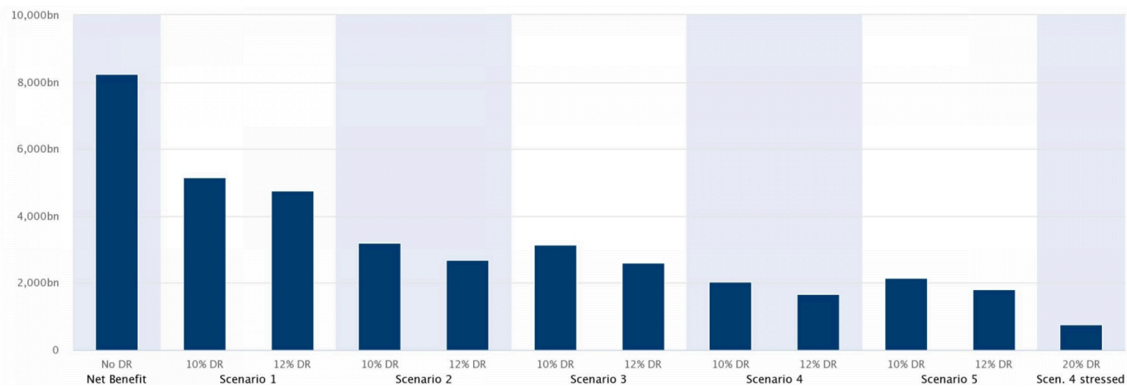
5. The investments are back-ended and only 70% of the benefits are accrued over the last seven years



For each of these scenarios we stressed a discount rate of 10 per cent and 12 per cent, the standard range of discount rates applied by the World Bank for their infrastructure projects. We also stressed the most adverse scenario (Scenario 4) against a more commercially viable rate of 20 per cent as advised by industry experts to be reflective of more risky country investments.

Below illustrates the NPV for each of these scenarios, flexed by the different discount rates. In all scenarios, the NPV of this project is positive.

Figure 10 - NPV of global project to achieve universal internet access by various stress scenarios, 2021–2030



Annex C

Defining Meaningful Connectivity

The quality of a person's connection is critical to their experience. A4AI define meaningful connectivity as a connection which is reliable, or has sufficient bandwidth, with a low enough latency to enable them to experience the internet's potential. This includes video.

Video content is data-intensive and requires a far greater bandwidth than text-based communication alone. Today many internet users experience speeds and connections that make access to video content unattainable or unreliable with videos constantly buffering or delays in video calling conversations.

A 4G or equivalent broadband connection is the minimum-level technology that enables a user to stream video, share content, and participate meaningfully in the internet. It offers a realistic but substantial threshold for many low- and middle-income countries.

Mobile broadband technologies

Table 9 – Characteristics of mobile broadband technologies

Cellular Generation	Latency	Top Theoretical Speed	Current Real-World Speed	Frequency	Potential and current internet applications
3G	100 milliseconds	7.2 Mbps	3 Mbps	800 MHz–2,100 MHz	Web browsing

4G	50 milliseconds	100 Mbps	<35 Mbps	600 MHz to 2.5 GHz	Web browsing Download and upload video files
5G	< 10 milliseconds	20 Gbps	50 Mbps–3Gbps	**Low-band:** operates between 600-850 MHz **Mid-band:** **5G** operates in the 2.5-3.7 GHz range **High-band:** operates at 25-39 GHz	Web browsing Download and upload video files Enhanced mobile broadband Wireless for industry including mobile applications in manufacturing, autonomous vehicles in logistics, the Internet of Things, augmented reality and virtual applications.

Figures are based on estimates made by various sources including: Qualcomm; Telekom; Business Insider; 4G.co.uk; GSMA. [22]

Latency is a measure of the time it takes a packet of information to travel between two points. It can be thought of as the delay that taxes any data transfer, no matter how fast the connection otherwise is. Latency in 4G networks is currently about 50 milliseconds. This level of latency is critical for running video applications. Latency in 5G networks is expected to shrink to 1 millisecond. This will allow connected devices to rely on the cloud for processing of data – such as self-driving cars that might use 5G to let a cloud-based AI make real-time navigational decisions.

Broadband speeds are measured in megabits per second or Mbps. Each megabit is made up of 1,000,000 bits or 1,000 kilobits. The more megabits, the faster the broadband. Faster broadband speeds mean faster downloads of music and movies, and smoother streaming of video and video calls. Each cellular generation has been significantly faster than the one before. The real-world performance of 3G is less than 3 Mbps; 4G can currently reach top speeds of up to 100 Mbps, though real-world performance is generally no more than 35 Mbps; and 5G has the potential to be 100 times faster than 4G, with a top theoretical speed around 20 Gbps and current real-world speeds from 50 Mbps to 3 Gbps. 5G is divided into three different bands with its own frequency range and speed, and each one has its own speed. Low-band 5G is somewhat faster than 4G with performance around 50-250 Mbps. The fastest version of 5G, called high-band 5G, can reach 3 Gbps.

Each cellular generation also has had significantly more bandwidth, or capacity, than the one before. In part, this is because each generation make much more efficient use of available spectrum. 3G uses a narrow slice of the available spectrum (frequencies from 800 MHz – 2,100 MHz), 4G uses a larger slice, and 5G is divided into three different bands. Each band has its own frequency range and speed, and will have different applications and use cases for consumers, businesses and industries.

Examples of 4G/5G equivalent broadband technologies

Between 10 and 20 per cent of the rural population in most countries will need to be covered by localised solutions consisting of satellite backhaul and fixed wireless access (predominantly Wi-Fi) for the last mile. The table below lists some of the alternatives to mobile technologies that could be used.

Table 10 – Notable alternatives to 4G mobile technologies

	Fibre	Microwave	Traditional Satellite GEO/ MEO	LEO HTS Satellite
Capacity	Unlimited	1-2 Gbps (or multiple)	50-100 Mbps (GEO) 100-800 Mbps (MEO)	1-5 Gbps very low latency
Latency	Low latency	Low latency	High latency 400ms (GEO) 135ms (MEO)	Low latency
Regulatory	Access to local infrastructure (above or below ground)	Spectrum	Earth Stations License	Earth Stations License
Cost drivers	Variable cost per km Long deployment time	30-50km w/o Repeater Fixed cost per link + repeater	Fixed cost - Fast deployment High variable cost per Mbps Independent of	Fixed cost - Rapid deployment Low variable cost per Mbps Independent of

	Fibre	Microwave	Traditional Satellite GEO/ MEO	LEO HTS Satellite
			distance	distance
Terrain	Trenching outside urban terrain costly	Impact on number of repeaters required Cost for maintenance	No impact	No impact

Source: Satellite Evolution Group

Annex D

Advances in Satellite Technologies

Satellite technology is advancing and opening up potential new opportunities for connecting the world's population. The high cost and high latency of satellite solutions have to date restricted satellites to specific functions (e.g. direct-to-home broadcasting). While terrestrial networks are likely to remain imperative for some time, especially with the roll-out of 5G, the viability of low Earth orbit (LEO) may enable satellite operators to bring low-latency, high-speed connectivity to people who currently are not within the reach of cellular towers or connected to high-speed lines.

The mass constellation low Earth orbit (LEO) broadband concept is now a viable proposition due to cheaper space launches, increased demand for connectivity, the emergence of low-cost modular satellite design and manufacturing processes, and an environment in which technology companies and investors now have much larger stores of capital to invest and fund large constellations.

LEO satellites orbit closer to Earth than traditional geostationary orbit (GEO) satellites and medium Earth orbit satellites (MEO) and therefore deliver lower latency. LEO satellites can only communicate with a small portion of the Earth's surface at any given moment, meaning a larger number of LEO satellites are needed for global coverage compared to GEO satellites which have a wide field of view, allowing operators to cover most of the planet's surface with three satellites spaced at appropriate intervals. With a higher density of constellations there is greater aggregate network capacity. In combination these factors mean that LEO satellites could perform time-sensitive applications, such as video calling, streaming and data-heavy applications. Over a dozen potential LEO satellite operators have attracted significant investments. Additionally, Russian and Chinese state-run companies and private firms want to create their own constellations.

Table 11 – Overview of notable proposed low Earth orbit (LEO) satellite constellations

Owner / name	Orbital altitude (km)	Registered country	Approx. no. of satellites	Status	Current speed / latency	Target for global coverage*

Blue Origin (Kuiper Systems)	590–630	USA	3,236 by 2029	Regulatory approval granted. Prototype satellite launched.	Up to 400 Mbps.	Unknown
SpaceX (Starlink)	1,100–1,325, also 550	USA	12,000 by 2027. Seeking regulatory approval to expand to 42,000	953 satellites in orbit. Beta testing with consumers in Northern latitudes underway.	50–150 Mbps with latencies from 20 to 40 milliseconds. .	Late 2021
OneWeb	1,200	USA/UK	110–650	110 satellites in orbit. Needs to raise an additional funding.	Over 400 Mbps. With latencies less than 40 milliseconds.	Middle of 2022
Telesat	1,115 - 1325	Canada	1,671	Prototype satellite launched. Seeking regulatory approval.	50 Mbps downlink and 10 Mbps uplink. With latencies less than 50 milliseconds.	Unknown

Various Sources including: Tech Crunch; SpaceNews.com; CNBC; The Financial Times; OneWeb; Cicleid.com; Telesat.com; Geospatialworld.net

SpaceX, which is the most advanced in its efforts, has pledged to deliver speeds up to 1Gb per user (far greater than speeds provided by 4G) after deployment and optimisation of its first 12,000 satellites. It has already started public beta testing. Internal SpaceX documents estimate that its global communications services business might represent $30 billion in annual revenue in 2025 (based on 40 million subscribers), while its launch business might only represent $5 billion in annual revenue.

While LEO satellites are promising there are some critical uncertainties which will impact how effective LEO satellites will be at closing the digital divide:

Opaqueness of business goals. The goals and business models of these satellite broadband companies are varied and are still opaque. Little is known about what these services will cost consumers and businesses – for subscriptions and user terminals – and if the cost will be competitive with more traditional alternatives. There is scepticism that low-income communities will be likely to support the scale of revenues that are needed to justify the capital expense of LEO satellites. The cost of these programmes is very high with costs ranging from $3.5 billion to $12 billion for a first-generation constellation. Additionally, many of these satellites have a relatively short life expectancy of less than seven years. This means that companies will need to regularly launch new satellites to replenish the fleet, as well as safely de-orbit old ones – creating ongoing operational costs. However, today there are companies with both enough capital to survive the critical gap between development and revenue generation, and business goals are likely to extend beyond gaining profits through subscriptions. There is potential for some of these providers to offer a comprehensive suite of services on top of basic connectivity. Instead of selling bandwidth to other service providers, some may opt to create their own new applications deployed through their satellite networks. If this happens, successful satellite broadband providers could own entire value chains in areas such as commerce and communication. For example, the vertical integration of Elon Musk's launch (SpaceX), communications (Starlink) and automotive brands (Tesla) could provide Starlink with the opportunity to build a vast connected car market. Blue Origin, owned by Jeff Bezos, could offer a whole host of existing and new Amazon services directly to consumer and enterprise customers, bypassing legacy internet services providers.

Cost reductions in user equipment. While demand has increased and costs have decreased since the 1990s, when several companies tried and failed to provide global connectivity, analysis indicates that companies planning large LEO satellite internet constellations still need to reduce a range of costs significantly to ensure long-term viability. The extent of market penetration will depend critically on cost reductions of user technologies. Customers on the ground in remote areas use flat-panel automatically steerable antennas (needed to track and switch between the large number of LEO satellites) to receive broadband signals and these need to be low-cost. While the technology exists, the costs of manufacturing are currently prohibitive. For example, to join Starlink's Beta, users in North America must purchase ground equipment for $499. Low-income rural communities will need receivers that cost tens of dollars at most. Economies of scale from volume production could address this need. A focus on non-consumer segments, such as mobility, mobile backhaul and security or defence may represent a potential solution. This is because the revenues and performance needs for these sectors can support higher terminal costs. Once penetrated, these high-margin segments could create the certainty, scale and revenues needed to lower terminal costs for the consumer segment.

Regulation. Introducing thousands of new objects into LEO will create new risks as well as opportunities. Although the technology could act as an enabler for new services, providing momentous benefits, it also has the potential to impair our access to space by making it a much riskier and complex environment. Challenges such as the allocation of scarce spectrum, the mitigation of frequency interference, the management of orbital debris and concerns about the visual pollution from bright satellites disrupting ground-based astronomy are likely to emerge. There are also concerns that introducing thousands of new objects into LEO will not only crowd existing orbits but create a dangerous environment with the potential for exponentially more collisions between satellites. Regulations around deployment rate, frequency allocation, orbital debris mitigation and de-orbit procedures will and should evolve. There will likely be disagreements and challenges among satellite operators, as well as challenges with regulatory bodies in different countries, affecting the competitive landscape.

Acknowledgements

The authors are extremely grateful to the following for sharing their expertise:

- Thomas Abell, Asia Development Bank
- Aminata Amadou-Garba, International Telecommunications Union
- Jonathan Bahmani, World Economic Forum
- Kojo Boakye, Facebook
- Jim Cashel, Forum One/Author
- Genaro Cruz, GSMA
- Monica Desai, Facebook
- Tunde Fafunwa, United Nations Economic Commission for Africa (Digital Centre for Excellence)
- Jim Forster, Connectivity Capital
- Doyle Gallegos, The World Bank
- John Garrity, Consultant/Broadband Commission author
- Beth Gertz, Seven Hills Advisors
- Sonia Jorge, Alliance for Affordable Internet
- Raul Katz, Telecom Advisory Services
- Samir Khan, International Budget Partnership
- Fatema Kothari, Microsoft
- David McNair, The ONE Campaign
- Elvis Melia, University of Duisburg-Essen/Consultant Digital Skills Accelerator Africa
- Koy Miller, Facebook
- Alice Munyua, Mozilla
- Charles Murito, Google
- Michael Murungi, Google
- Maiko Nakagaki, Alliance for Affordable Internet
- Robert Pepper, Facebook
- Renuka Rajaratnam, Facebook
- Naria Santa Lucia, Microsoft

- Steve Song, Mozilla
- Fargani Tambeayuk, Facebook
- Thys Kazad Tshibind, Facebook
- Tom Varghese, Facebook
- Moctar Yedaly, African Union
- Alex Wong, International Telecommunications Union

Footnotes

1. ^ So far adopted by the UN Broadband Commission, the Economic Commission of West African States (ECOWAS), Nigeria, and Ghana.
2. ^ A4AI's review into meaningful connectivity identified smartphones as the predominant means by which people access the internet (89 per cent based on a survey conducted across Colombia, Ghana and Indonesia), as opposed to only 2.3 per cent of respondents that used another device without a mobile phone. A smartphone is a mobile communication device distinguished by its operating system, its ability to download third-party applications, and its touchscreen of at least three inches.
3. ^ A feature phone is a mobile communication device that has the functions of a basic phone and some internet capabilities, even if limited to pre-selected applications or to basic HTML pages. These devices commonly have a 12-key touchpad or a tactile keyboard.
4. ^ See GSMA's 'Figure 1: Stages of digital literacy' for steps to becoming digitally literate, and 'Figure 3: Percentage of female and male respondents who cited technical literacy and confidence-related barriers to using a mobile phone, in Accelerating Digital Literacy: Empowering women to use the mobile internet, 2015
5. ^ See [ITU/A4AI; GSMA; World Bank]
6. ^ However, the full methods and data for calculating these figures have not been made public, and there have been many high-profile debates that dispute the government's claims of savings from Aadhaar. See https://thewire.in/economy/the-curious-case-of-the-world-bank-and-aadhaar-savings ; https://qz.com/india/1519209/why-india-cant-cite-world-bank-to-brag-about-aadhaar.
7. ^ In our roundtable discussions with industry experts, there was debate as to whether the extreme poor could afford to pay even a small portion of their income on internet access. If, for example, the cheapest smartphone in today's prices was offered as a repayment plan over nine or 12 months, this would be the equivalent of 3.5 per cent or 2.6 per cent of the extreme poor's income. Disagreement remains as to whether the extreme poor can afford this, but one key argument was that the extreme poor still make choices as to how they spend their income. Based on the evidence of MPesa's use and its impact on lifting people out of poverty, particularly female-headed households, there is an argument that if the extreme poor experienced the benefits of the internet as they did with mobile money, they would see its utility and be willing to invest in its access. See our blog on "Can Universal Internet Access Be Sustained Beyond 2030?" for further insights.

8. ^ For full breakdown of devices investment analysis, see Annex A

9. ^ While no current standard World Bank discount rates are available, a previous Bank Handbook on Economic Analysis of Investment Operations, 1998 has cited this figure "as a notional figure for evaluating Bank–financed projects", which correlates with the rates used in many World Bank infrastructure projects today.

10. ^ A4AI's Affordability Report 2019

11. ^ A4AI make a similar recommendation. Malaysia and Costa Rica offer examples of such use of their USAFs.

12. ^ See Annex A for how this investment could achieve universal access to a device.

13. ^ See World Economic Forum Internet for All: A Framework for Accelerating Internet Access and Adoption, pp.19–20

14. ^ See World Economic Forum Internet for All: A Framework for Accelerating Internet Access and Adoption, Figure 9 and 'Spreading Skills and Awareness' section, pp.18–21 for a framework to increase digital literacy

15. ^ ODMs mass produce mobile phones which they sell to retailers, often telcos, that then market these devices under their brand name. These devices are prolific in developing countries and are often the cheapest devices available. See A4AI's From Luxury to Lifeline: Reducing the Cost of Mobile Devices to Reach Universal Internet Access.

16. ^ This includes the ITU's estimate of $428 billion USD to cover 4G infrastructure expansion, affordability of data, and digital skills and content, and TBI's estimate of $18 billion USD to address device affordability. See Annex A for breakdown of device affordability.

17. ^ Connects international internet traffic (usually through undersea or terrestrial fibre-optic cables) to the national high-speed, high-capacity backbone network connecting the country's bigger cities and major population centres.

18. ^ A distribution network that connects the national backbone to a point in a locality/geographic area (PoP) for broader distribution out to the last-mile network.

19. ^ Based on DACC GNI as of 2019, World Bank. GNI based on current USD prices while investment figures are undiscounted. Consequently this per cent contribution figure will be lower.

20. ^ Excludes China and India. However, the exclusion is based on a high-level estimate of their representation in the total portfolio, as estimated by ITU in Connecting Humanity, 2020 (see

Annex B, p.25). This has been extrapolated as a direct per cent reduction across all investment components, including device access, which was not included in ITU's analysis. It does not account for the unique internet access challenges in these countries (see Callout Box The G20) and, consequently, further analysis is required. Note of comparison: if China and India were included, DACC contributions to close the digital divide would be 0.03 per cent of GNI.

21. ^ This includes the ITU's estimate of $428 billion USD to cover 4G or equivalent infrastructure expansion, affordability of data, and digital skills and content, and TBI's estimate of $18 billion USD to address device affordability. See Annex A for breakdown of device affordability.

22. ^ The speed you will get from mobile broadband is dependent on many other factors, including how far you are from a mobile phone mast and how strong the signal is.

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