



POLICY OPTIONS FOR CONNECTING AND ENABLING THE NEXT BILLIONS – PHASE III

Compiled Output Document

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Executive Summary

Connecting and Enabling the Next Billions - Phase III is a part of the Internet Governance Forum (IGF) intercessional work for 2017. Phase III aims to supplement policy recommendations made in the first two phases conducted in 2015 and 2016 with concrete case studies that highlight ways in which community-level projects are progressing on key sustainable goals. This output document is an edited compilation of case studies that show how connectivity initiatives are helping countries and communities make progress on three key sustainable development goals – Sustainable Development Goals 4, 5 and 9 – collected using the IGF’s traditional bottom-up, multi-stakeholder consultative process.

The case studies shed light on different aspects that practitioners and analysts should consider while thinking about ICT-led interventions to enable Sustainable Development Goals. Among cases that contribute to our knowledge on ICT-based interventions that enable education, gender equality and infrastructure, there is a wide range that shows the true diversity in the interventions that exist all around the world. Project Awasol, Internet@MySchool, Escuela+, Connected North and Zaya Learning Labs, all focus on enabling learning at the school level, through means that vary from workshops on Internet use and computer literacy, satellite streaming of relevant content to rural schools in Latin America, to providing connectivity and innovative learning devices to promote immersive learning in schools in rural Canada and India. Other interventions, such as Level Up and Online Vidyalaya leverage the use of applications (both mobile and web-based) to reach communities with critical learning materials. Tunapanda Institute and Colnodo use community networks to reach more users with relevant content to promote long-term learning.

Similar diversity in mechanisms can be observed in the cases that seek to promote gender empowerment. A wide range of stakeholders, from Corporate Social Responsibility initiatives to Universal Service Funds engage in programmatic interventions to promote gender parity. Amakomaya and MOS@N use ICTs to monitor the health of pregnant women and provide timely access to prenatal and antenatal care. She Will Connect, Intel’s initiative, help women and girls in Kenya, Nigeria and South Africa to provide face-to-face trainings and workshops. Datamation Foundation, Makaia and Wireless Women for Education and Empowerment run specialised trainings for women in various roles – entrepreneurs, coffee growers, and teachers – in India and Colombia.

Several technologies being utilised to make progress on SDG 9, focused on infrastructure. Many community networks, such as Sarantaporo.gr, Zenzeleni Networks, VITAL Project and Southern California Tribal Digital Village, Tucan 3G are serving various unconnected communities all over the world. There are also many infrastructure improvements implemented by private sector actors, such as Vihaan Networks Limited and Vanu Inc. that seek to expand coverage to critically under-connected areas. WISPs such as Picosoft Nepal and AirJaldi networks are providing a wide range of smart services to villages that were previously unconnected. Case studies highlight the use of newer technologies that use TV White Spaces spectrum, such as Virginia’s TV White Spaces pilot, VisionNet and Axiom. ARMIX represents an interesting case study that highlights the importance of Internet Exchange Points (IXPs), and the World Economic Forum’s Northern Corridor project highlights the importance of stakeholder cooperation among various parties to overcome critical barriers.

This report provides a compilation of a rich variety of cases, all seeking to advance SDG goals.

Acknowledgements

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Interpretation notes

The designations employed and the presentation of the material in this resource do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The term ‘country’ as used in the text of this publication also refers, as appropriate, to territories and areas. The designations ‘developed’ and ‘developing economies’ are intended for statistical convenience and do not necessarily imply a judgment about the stage reached by a particular country or area in the development process. Mention of the name of any company, organisation, product or website does not imply endorsement on the part of the United Nations.

Abbreviations

BPF – Best Practice Forum

CENB – Connecting and Enabling the Next Billions

CSTD – Commission on Science and Technology for Development

DC – Dynamic Coalition

IGF – Internet Governance Forum

ICT – Information and Communication Technology

MAG – Multi-stakeholder Advisory Group

NRI – National and Regional IGF

SDG – Sustainable Development Goal

UN – United Nations

WSIS – World Summit on the Information Society

A: Introduction

IGF Intercessional Work

This report is a part of the Internet Governance Forum (IGF)'s intercessional work developed in response to The United Nations (UN) Commission on Science and Technology for Development (CSTD) working group on Internet Governance Forum (IGF) improvements in 2012 and its recommendations to develop tangible IGF outputs to impact Internet governance debates globally.

In 2015, the IGF Multi-stakeholder Advisory Group (MAG) approved the launch of an intersessional program in consonance with efforts made by Dynamic Coalitions (DC), National and Regional IGF initiatives (NRIs), and Best Practice Forums (BPF) to create a continued discussion on critical issues beyond annual meetings at the Internet Governance Forum. Intercessional work furthers the IGF's mandate to identify key issues, facilitate discourse among relevant stakeholders and to make recommendations, as laid out in the World Summit of Information Society's Tunis Agenda in 2005.

Participation in IGF intercessional work is governed by the IGF Code of Conduct.

Policy Options for Connecting and Enabling the Next Billions

The Internet Governance Forum (IGF) 'Policy Options for Connecting and Enabling the Next Billions' process is a bottom-up, community-driven endeavour to produce a collaborative document to identify ways to connect the four billion unconnected people in communities around the world. This output document represents the compilation of the third phase of multi-stakeholder consultations with a focus on case studies that show how connectivity initiatives are helping countries and communities make progress on the sustainable development goals.

In 2015, the first phase focused on defining the connectivity challenge, identifying key obstacles, and suggesting concrete policies to achieve increased connectivity, including an emphasis on infrastructure, enabling users, increasing usability and user-friendliness, accounting for affordability and facilitating an enabling environment.

In 2016, the second phase augmented this work by expanding the focus to 'Connecting and Enabling the Next Billions' and elucidating local and regional specificities and discussing how ICTs can broadly help make progress on the United Nations Sustainable Development Goals (SDGs).

Over 130 submissions were contributed to the development of comprehensive sets of Policy Options for Connecting and Enabling the Next Billions (in Phase I and Phase II). Many of the contributions came from National and Regional IGF initiatives, Dynamic Coalitions and Best Practice Forums, as well as external organisations and individuals.

Objectives of Phase III

In 2017, the third phase of Connecting and Enabling the Next Billions seeks to supplement the recommendations made in the first two phases with concrete case studies to highlight the ways in which projects on the ground are progressing on key sustainable goals.

Phase III focuses on the following - Sustainable Development Goals:

- **Goal 4: Ensure inclusive and quality education for all and promote lifelong learning**
- **Goal 5: Achieve gender equality and empower all women and girls**
- **Goal 9: Build resilient infrastructure, promote sustainable industrialisation and foster innovation**

Methodology

Phase III of Policy Options for Connecting and Enabling the Next Billion(s) followed the multi-stakeholder, inclusive approach that is at the heart of the IGF intersessional processes. An online public consultation was open to all members of the IGF community and facilitated the participation of a diverse selection of stakeholders in the work. Contributors are listed in this document's appendix, and their contributions are published in full on the IGF Website.

Initial planning for Phase III began with virtual discussions within the Multi-stakeholder Advisory Group in early 2017. Various MAG members provided input in shaping the framework in the first few months of 2017, and the coordinators published a public call for input on the 13th of June, 2017, during the second physical MAG meeting in Geneva.

A call for input was issued to various mailing lists to invite responses from various stakeholder groups. Communities within the IGF, specifically the NRIs, DCs and BPFs, were reached through targeted outreach mechanisms to encourage participation.

After the first draft was compiled by taking note of relevant contributions by all stakeholders, and organised by themes that emerged from the contributions a second public call was launched in November 2017. Since then, it has been augmented by desk research and a wider literature review. The case studies have been lightly edited for readability but it reflects text from contributions directly, where relevant. They have been organised as per the sustainable development goals they correspond to.

Structure of this Report

This report is structured into four parts. Part A presents the context in which this report was produced. Part B exemplifies the relevance of ICTs to the sustainable development goals more broadly, and provides a framework to understand the ways in which the two go hand in hand. Part B focuses on each of the sustainable development goals chosen for this phase: Goal 4 that focuses on Education, Goal 5 that focuses on Gender Equality and Goal 9 on Infrastructure. Part C concludes this phase's output in addition to the previous phases of the CENB process.

B: Relevance of Information and Communication Technologies to Sustainable Development Goals

All member nations adopted the United Nations Sustainable Development Agenda in 2015. The agenda, in Goal 9C, sets a very ambitious goal to "significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020."

The 2030 Agenda for Sustainable Development recognised that the spread of information and communication technologies (ICTs) and global interconnectedness had great potential to accelerate human progress and to bridge the digital divide and develop knowledge societies, in addition to scientific and technological innovation across areas as diverse as medicine and energy. Members States committed to harnessing the potential of ICTs to achieve the 2030 Agenda for Sustainable Development and other internationally agreed development goals by integrating information and communications technologies in their approaches to implement the Goals. It also laid immense stress on the use of ICTs for sustainable development in education (Goal 4), gender equality (Goal 5), infrastructure (Goal 9 – universal and affordable access to the internet) realising that a robust ICT ecosystem is key to attaining SDG.

As ICC-BASIS elucidated in their contribution, "An interoperable, seamless ICT ecosystem is crucial to help populations reap the benefits of ICT and further development opportunity". Another submission by Picosoft Nepal underscores the relevance of ICTs in attaining all of the sustainable development goals. "With roughly half the population lacking internet connectivity, it remains clear that underserved communities in the developing world and beyond; require better access to physical technology, access to the internet, as well as digital literacy and computer science education. This is especially the case for women and girls, who are often left behind. To truly achieve SDG 4 (Education), SDG 5 (women empowerment), and SDG 9 (infrastructure development); technology remains a key driving force that crosses over these three SDGs in addition to the remaining fourteen."

Contributors also emphasised on the unique nature of challenges that SDGs pose, and the need for information sharing through ICTs as part of the solution. As Shreedeeep Rayamajhi put it, "SDGs need an open and collaborative approach for technological sharing and development," which ICTs can facilitate at a more rapid pace than alternatives. The nature of ICT governance in a multi-stakeholder model also enables innovative approaches and creative collaborations flourish. Picosoft Nepal added that, "the information poverty is a direct contributor to lower economic and social prosperity, local social entrepreneurs are (1) designing and implementing unique solutions enabling internet connectivity, (2) developing locally driven content, and (3) partnering with multi-stakeholder approaches to improve digital communication and economic opportunities.... We must partner across the private and public sector in a multi-stakeholder approach to truly solve these lofty goals." Panama's IGF report also emphasised the need for public-private collaborations to make progress on ICTs and the SDGs.

ICTs are recognised as a key development enabler. The important role that ICTs will play in achieving the SDGs has also been stressed by the ICT community, including the World Summit on the Information Society (WSIS), the Commission on Science and Technology for Development (CSTD) and the UN Group on the Information Society (UNGIS). ICTs are already empowering billions of individuals around the world by providing access to education resources

and healthcare, and services such as mobile banking, e-government and social media, among others.

ICT is an enabler and accelerator for the development of SDGs in local economies by fostering the emergence of new value-added models through policies of innovation and entrepreneurship. The development of incubators which support the emergence of start-ups and new technologies can develop innovative services and contribute to local social and economic development.

The use of the Internet can expand the market for innovative products and services and support the growth of small-and medium-sized enterprises (SMEs) from developing countries in global markets. Electronic commerce platforms can create opportunities for transactions that would not otherwise occur or that would not be portable enough in the marketplace. The Internet can extend the geographic reach of the market and provide opportunities for transactions that could not have occurred without its existence.

ICT access can improve information management and sharing and facilitate collaboration between and with third parties, including suppliers, consumers and research organisations, universities, employees through networking sites and collaborative tools, such as electronic conferencing tools and discussion forums and wikis. The use of participative networks can allow outreach to customers and academics to help orient innovation efforts and improve their work. Furthermore, ICT and broadband networks allow SMEs and institutions to participate in larger research networks, which may encourage them to increase their research and development activities.

ICT can also facilitate knowledge diffusion and result in further development of innovations. ICT access and broadband enabled trade in services allow companies to get access to less expensive inputs and services by reaching global markets. These services create new opportunities for business efficiency. For example, cloud computing allows firms to adopt a pay as you go model for computing resources instead of making significant upfront investments in ICT infrastructure or software.

Goal 4: Ensure inclusive and quality education for all and promote lifelong learning

Case 1: Internet@MySchool, Yemen

Internet@MySchool is an initiative by ISOC Yemen that seeks to set up Internet access hotspots and provide training in ICT skills through workshops and lectures to secondary school students, as well as by commissioning training materials in the local language (Arabic) in four schools in Sanaa and Aden in Yemen.

Internet@MySchool used a two-pronged approach to improve adoption and educational outcomes: first, to connect four schools to the internet through wireless hotspots; and second, to train secondary school students through workshops, lectures, and material in the local language. ISOC-Yemen has received a grant under the Beyond the Net grants program for the deployment of Internet@MySchool in 2016-17. The project identified schools in areas relatively shielded from the conflict to deploy wireless hotspots.

The chapter introduced an Arabic-language illustrative primer for secondary school students who have never been exposed to the Internet before. Multiple workshops, and guest lectures to train students in information and communications technologies, along with contests to engage the students and measure their progress in adapting to the Internet are used to improve adoption. The project culminated with the first ever Internet@MySchool conference, conducted in July 2017.

Case 2: Project Tawasol, Tunisia

Project Tawasol is a project in Tunisia led by IEEE Sight, Tunisia chapter and People Centred Internet. The aim of the project is to connect primary schools across the country to the Internet, and train students to use the Internet through ICT skills workshops conducted by IEEE.

The project seeks to provide students small Raspberry Pi operated devices with hard disks that can be updated periodically with relevant content such as Wikipedia pages, TED Talks and other educational content from the Internet. The devices have been developed by IEEE Sight in Tunisia with aid from the San Francisco chapter. They are capable of automatically updating content when connected to Wifi or 3G networks.

In December 2016, the Sadiki school in Tunis was identified as the first “Connected School” for the dissemination of these devices coupled with digital literacy training workshops by members of IEEE Sight. With support from the government, the project aims to connect, by the end of 2017, 24 such schools – one school in each region within Tunisia. The project focuses on primary schools, with an aim to make the next generation aware of new technologies and information that can be accessed through the Internet.

As part of the project, technical talks and digital literacy as well as ICT training workshops are organised by IEEE Sight, Tunisia. These talks cover interactive sessions that teach students how to build their own websites using drag and drop interfaces. The first workshop conducted in 2016 had a 50 percent participation of women, a key step in enabling gender parity in Internet access and skills.

In digital literacy training workshops that have been conducted by IEEE Sight, students have built their own prototype websites such as a school blog using HTML, CSS and modular website building interfaces. The reactions in post-workshop surveys conducted thus far have been tremendously positive. “Most students asked us when we will return to provide them with their

own devices for development,” says Sikander Mansouri, one of the IEEE Sight members that conducted these training workshops.

Case 3: Escuela+, Latin America

Escuela+ is a program that uses satellite technology and solar-powered infrastructure on the ground combined with innovative educational programming to connect rural schools in Latin America that do not have any Internet access to high quality educational content. The program, active since 2007, has reached over 1 million students, 65,000 teachers, and 6,800 schools in eight countries in Latin America including Colombia, Chile, Brazil and Argentina. It is supported by a broad coalition of organisations, including AT&T, DirecTV, National Geographic, Discovery and Fundacion Torneos.

Escuela+ uses last mile satellite connectivity to provide educational content from high quality sources such as the Discovery channel and National Geographic, as well as the National Television Council’s educational content, to students in rural schools. The satellite connectivity provides access to this programming in any school with TV and electrical power. Where such electrical power was not easily accessible, solar-powered alternatives are being deployed to make streamed educational content easily available to school children in rural areas, as a part of Escuela+ Solar initiative. DirecTV’s DVR recording facility allows teachers to manage content and record over 100 hours of programming, and use this content as part of a pedagogy that integrates interactive and integrated learning supplemented by online information.

Teachers are trained in the use of Escuela+ audiovisual technology, as well as the *Discovery en la ESCUELA* pedagogy. Using media, technology and digital satellite television, learning processes are tailored to incorporate an innovative teaching methodology in these schools.

Over 80 percent of Escuela+ schools are in underserved areas. Independent evaluation studies conducted by the University of Chile’s Department of Education and by the Faculty of Social Sciences in two waves, concluded that students receiving education supplemented by Escuela+ methodology performed consistently better than a control group. Escuela+ students registered higher performance scores analysed by year-on-year performance, grade level and subject matter.

Case 4: Digital Village Squares, India

Digital Village Squares is an Indian corporate social responsibility initiative implemented by American Tower Corporation in collaboration with the NIIT Foundation and Hole in the Wall Education Limited (HiWEL). HiWEL learning stations and digital literacy training classes by the NIIT Foundation are now available at 51 Squares in rural India. Students can engage in self-paced interactive learning through the learning stations, and adults are trained in basic computer skills using the National Digital Literacy Mission’s curriculum at these locations.

Digital Village Squares are locations in rural India that are either adjoining tower sites or at local schools, where digital literacy training occurs. The initiative is part of American Tower Corporation’s corporate social responsibility efforts in India, and seeks to advance the Digital India vision. American Tower partners with Hole-in-the-Wall Education Limited and the NIIT Foundation in India to implement this initiative.

The sites for Digital Village Squares are carefully chosen in locations that are central to villages. After a pilot was run in a few villages, community buy-in proved to be a strong determinant of the success of the program. A comprehensive mobilisation plan is therefore used to create awareness about the training and services offered at the centre. Pamphlets, skits, and sessions at the *Gram Sabhas* (village meetings) are held to reach as many people as possible. Children enrolled in schools have also proven to be helpful in spreading awareness about the project within their communities. The trainers recruited for imparting digital literacy training are all local to the areas where these Squares are located.

A sense of ownership also plays a role in whether there is increased use of these learning stations and classes. When learning stations were installed adjacent to tower sites, initially, there was more engagement at those locations than in schools. Continued engagement with school administrations to emphasise the utility of these learning stations has led to better use. At the training classes, the National Digital Literacy Mission's curriculum is taught over a course of 20-25 days, at the end of which an assessment of ICT skills is administered by the trainer.

The program hopes to evolve to cover a wide range of e-governance services and engage local entrepreneurs in key roles to maintain these sites, and thus enhance long-term sustainability.

Digital Village Squares are presently available in 51 sites all in rural areas, out of which 28 are standalone HiWEL stations, and 23 offer digital literacy training using the National Digital Literacy Mission's curriculum. The demand for training has seen a rise in these locations, evidenced by long queues for classes at the Squares.

Case 5: Zaya Learning Lab, India

Zaya Learning Lab is a non-profit organisation established in 2013 to provide Wifi access to low-income English-language schools in India. Their unique learning-focused connectivity devices provide Internet access and educational content at a much lower cost than a regular, open-Internet Wifi connection. This case shows the value of tailoring connectivity to the needs of a specific site (region, culture, class, institution) and the importance of technical and person-to-person communication in making Internet access an effective tool for education.

Zaya Learning Labs provides affordable Wifi to low-income Indian schools via a curated, secure, dynamic device called ClassCloud. This device is both a wireless router and a high-process server. It functions like any cloud service on the Internet, provides a wide-range WiFi signal, and runs software all at once. For a yearly fee (roughly the cost of one dollar per year per child, in their estimation), Zaya provides interactive and region-appropriate digital content through this device.

This content is based on an educational methodology known as “blended learning,” which harnesses the capabilities of an online classroom in order to target students' individual requirements, educational levels, and learning speeds. Not only is the software able to dynamically respond to each student's progress through a digitised workbook or textbook, but this software is also programmed to communicate student struggles and successes to Zaya and their content providers, who use these analytics to refine and improve their tools.

Zaya currently has 400 schools spread throughout India subscribing yearly to their service, which reaches about 200,000 children between the ages of five and thirteen. They are currently working

on expanding the age range of their software content to fifteen and continuing to subscribe additional schools—in and outside of India—to their service.

Case 6: Cisco Connected North, Canada

Cisco Canada's "Connected North" initiative augments educational and healthcare services available to youth in remote indigenous communities in Northern Canada since 2013. It deploys Cisco's Telepresence technology (MX 300 G2) to offer real-time, live interactive experiences with experts and students in other classrooms around Canada, the project has grown from a single pilot location to implementation in 30 schools. Within five years, Connected North expects to have Telepresence units in 100 schools. Connected North is indicative of the utility of immersive, interactive internet learning for students in remote regions to combat endemic local social issues such as a graduation rate of approximately 20 percent and highest global per capita suicide rate amongst youth whose expansion is curtailed by funding concerns.

Connected North is an immersive, digital education and mental health and wellness network that provides customised services and real time experiences to students in remote Indigenous communities. Begun as a pilot in a single school in the Territory of Nunavut, the project has greatly expanded since 2013. Using Cisco TelePresence technology, Connected North leverages real-time, high definition two-way video to make powerful connections for students, bringing experts into JK-Grade 12 classrooms on a wide range of topics. There are five overarching content areas that Connected North focuses on: Virtual field trips, mentoring, experts on demand in a vast array of subject areas, classroom cultural exchanges (both between indigenous and non-indigenous student populations and indigenous to indigenous classrooms), and programming called "Future Pathways" which aims to help students attend post-secondary institutions as well as make them aware of career paths that are available to them.

In terms of content, 90 percent is indigenous-themed. Connected North staffers work hand-in-hand with teachers for content-offerings and work to reinforce indigenous cultural educational styles, such as emphasis in Inuit schools on collaborative learning.

In smaller schools, Telepresence setups are put in common areas so all classes may use them as needed. In larger schools, each intermediate classroom (6th, 7th, and 8th grades) has a unit. Cisco sells these units for CAD \$30,000, however, they offer a 70 percent discount to Canadian school districts, bringing the cost down to approximately CAD \$9,000. Due to the program's success, Cisco spun-off Connected North into a non-profit organisation, which partnered with Taking IT Global. The latter organisation has constructed an ecosystem of over 50 funding partners including Federal, Provincial, and Territorial governments, private sector lenders, private foundations, and individual donors.

The impetus and continued support for Connected North comes from two tragic statistics of Canadian indigenous youth; the dropout rate is approximately 80 percent and these communities have the highest rates of youth suicide per capita in the world. Combatting these systemic problems required more than just educational resources. The second facet of Connected North was to provide students with access to remote mental health and wellness professionals that would traditionally incur high travel costs for the students' families and were thus generally unavailable.

Case 7: New Sun Road SolConnect, Guatemala

New Sun Road develops technology solutions to address energy-poverty and enable Internet connectivity for off-grid communities. A lack of affordable and reliable electricity limits the full productive potential of communities, presenting a key constraint to Internet access in remote locations. New Sun Road's primary mission is to remove this barrier by developing affordable, resilient technologies to optimise the operation and management of off-grid solar micro grids—thus driving down their costs, unlocking additional capital and enabling the scale of additional systems. Employing this technology with the support of Microsoft's Affordable Access Initiative, New Sun Road have developed the SolConnect Productive Centres model—community-run energy, connectivity and economic development centres.

In Aldea Liano Grande, Santa Rosa Department, Guatemala, A SolConnect Centre is being planned for deployment in 2017 in a school in a rural agricultural community near vast (about 100 km) sugarcane plantation. The centre powers the school's computers, provides community internet and power access, and is used for printing. Partnering with the Guatemala Ministry of Education and a local architect, New Sun Road will introduce the Productive Centre model to a proposed pilot girls school where digital skills will form a key part of the curriculum and community members will have access to internet and digital skills training.

Case 8: Libraries' Efforts

Libraries have connected people to the information society for much longer than the concept of an information society itself existed. They have offered free, or nearly free information services to their communities, regardless of their status or wealth, understanding that information access leads to empowerment and development. They have welcomed the potential of the Internet and ICTs to deliver this goal, but at the same time have recognised that just having the possibility to connect is not always enough.

Libraries have a long-standing commitment to education and individual growth. They offer literacy and reading support to the young, give access to the latest scientific research as a basis for innovation, and offer adults a second chance through courses and private study. This practical experience, when combined with the potential of digital tools, leads to development of exciting and effective new means for engaging populations and aids in achieving results.

Libraries can complement the work of schools, especially in situations where education is underfunded: **The Kibera Library**, in a project started in 2012, used tablet computers preloaded with educational content, linked to the school curriculum, to help school children from under-resourced schools in Kibera—the biggest slum in eastern Africa – to improve learning and accelerate their school results. Librarians teamed up with the educational agency, eLimu, which creates digital educational material in fun formats, including animations, film and puzzles. Working with eLimu, the library taught 120 children and 48 teachers to use the tablets. To assess the children's progress, librarians organised games and quizzes. Over 50 percent of the children interviewed in a library survey said the program had helped improve their English, mathematics and science. Similarly, in Kenya, a small grant from EIFL allowed librarians, working with schools and local authorities, to develop an online math tool while successfully engaged children who might otherwise have dropped out of school.

Libraries can provide job-related education for vulnerable groups: In New Zealand, library staff at **Hutt City Libraries** have teamed up with volunteers to teach ICT skills to young people from disadvantaged communities. They learn how to use Photoshop, complete basic electronics projects, mashed up circuitry, make and edit films, take part in robotics competitions, completed graphic design jobs for community clients, and create start-up businesses. The unique ability of libraries, as trusted institutions, to reach out to people in vulnerable communities helps make this possible.

Libraries can be pioneers in adopting new technology and sharing it with users: In Sweden, **Vaggeryd's** joint public and upper secondary school library became the site of the first makerspace in Sweden in 2013. It offers workshops on robotics, lessons in CAD drawing, and the library is home to an upholstery machine that has enabled asylum-seeking unaccompanied minors to learn upholstery and carry out furniture repair as a social enterprise.

From March 2016 to June 2017, a project was implemented to create opportunities for Ethiopian children to practice basic skills such as reading and writing. Beyond Access supported the development of educational technologies such as e-books, reading apps, and games, to increase the number of tools available to educators and caregivers. Beyond access also emphasised the role of libraries as important pillars for national-scale early grade reading efforts.

Libraries have an impact beyond their walls. **Volta Regional Library, Ghana** began using a mobile operation in 2012 to improve educational opportunities for students attending schools with limited resources. The program provides hands-on computer classes, addressing a subject area in which rural schools have had high failure rates in national exams. An evaluation showed that this intervention contributed to an increase of almost 50 percent in the pass rate (rising to 65 percent from 45 percent) in information and communication technology (ICT) exams among third-grade students when compared to previous years. Based on these positive results, in 2014 additional funding supported the expansion of the program to three additional regions in Ghana. The project reached more than 3,800 students at 25 schools by the end of 2016.

SCOAP3 Networking Repositories: Internet has transformed our ability to collaborate, which in turn promotes higher impact research. However, information is not always structured or presented in a way which facilitates this cooperation, or the application of newer analytical tools, such as text and data mining. Libraries have been at the heart of efforts to overcome this challenge, both through building and structuring repositories, but also by linking them up. The example of SCOAP3, established at the CERN Library, offers a positive example of how libraries can be at the heart of realising the potential of the internet to support and promote effective sharing of information. Through its work, it has converted key journals to Open Access, further supporting access to information.

Case 9: Beyond Access

Beyond Access focuses on strengthening the social power of public and community libraries around the world. The project began with the recognition that libraries are widespread throughout developing countries, but continue to be undervalued by social development projects. By drawing on libraries' pre-existing institutional and infrastructural utilities, Beyond Access introduces long-term programs that use technology to meet the needs of the different communities it serves. Managed by the global non-profit organisation IREX and funded by the

Bill and Melinda Gates Foundation, Beyond Access works with civil and state partners such as Save the Children to transform libraries into sustainable public information and communications technology (ICT) hubs. The initiative implements library programs in nine different countries along three different axes of focus: digital literacy and inclusion, financial inclusion and economic opportunity, and community-led literacy solutions.

Case 10: Colnodo, Colombia

Colnodo, with the support of Google, has designed and implemented the JuvenTIC project, which is as an inspiring case of digital, social and youth employment to overcome the skills mismatch between unemployed youth workforce and the market demand, and strengthen ICT competencies. The project seeks to further the development of intermediate and advanced competencies in ICT for men and young women, expand opportunities for access to the productive environment through labor inclusion or creation of ventures and create low cost, certified, short-term resources aimed at strengthening competencies. This project was implemented in 2015-16. Designed in collaboration with Google Colombia and executed by Colnodo, the project seeks to strengthen ICT skills and competencies through online and face-to-face training processes. In 2016, JuvenTIC contributed to the peace process by training young victims of violence with scarce educational opportunities on ICTs through a 120-hour diploma with 14 contact hours and 106-virtual hours of training. The face-to-face training is focused on entrepreneurship and employability. The online training course comprises sections on the digital market, design and production of content, communication, and management of local information systems. It is concluded by a capstone. It reached 2,500 young men and women. It seeks to equip these people with jobs in Colombia. 3,699 young people participated in the three formative cycles of JuvenTIC of which 1,274 have graduated. JuvenTIC ventures runs with the support of Colnodo and Google participated in the peace process initiated by the Colombian Agency for Reintegration (ACR), the United States Agency for International Development (USAID), the International Organisation for Migration (IOM), the EAFIT University, Reconciliation Colombia.

In collaboration with the Ministry of Information and Communication Technologies, Colombia, Colnodo has designed locally specific digital literacy content targeted at diverse priority populations between 2008 and 2013. They have engaged in strengthening Tele-centre Managers as local ICT managers, digital literacy training for people in vulnerable situations, provided assistance to local communities at risk of displacement, developed ICT tools for the rescue of the indigenous language (En Mi Idioma - Winner of the 2013 CMSI prize in cultural diversity and identity), designed online content for government officials and online training materials for sessions run out of the National Tele-centre Academy. Close to 97,000 people in training were benefited and gained competencies in ICT including elderly people, person with disabilities, people affected by the conflict and people in extreme poverty.

Case 11: Tunapanda Institute, Kenya

The Tunapanda Institute is a non-profit organisation founded in 2014. Located in the Kibera quarter of Nairobi, the institute offers free training programs for students between the ages of 18 to 25 in information and communications technologies (ICTs), design, and business. By providing residents of the city's largest slum with the skills and equipment to qualify for entry-level jobs in tech, Tunapanda aims to empower communities by shrinking the digital

divide. It is currently developing a project to target even younger residents with ICT education and digital resources by building a community network to connect Kibera's 300 schools.

The Tunapanda Institute's training programs were established to supplement hard-to-access traditional education structures. Education in East African slums and rural areas is often unaffordable or lacking quality. Both dropout rates and demand for educational opportunity are high. Tunapanda provides a platform with access to educational content geared toward 21st-century skills. Its content is locally sourced, high quality, and geared toward immediate employment.

Tunapanda also provides other services such as market research, media production, software and web development, and e-learning, which allows the organisation to provide free, offline, open-source educative materials, and to run their digital literacy training free of cost.

Case 12: LevelUp, The Reach Trust, South Africa

Level Up is a mobile application that aims to encourage learners to increase their learning time outside the classroom through regular engagement with educational content in the form of bite-sized daily interactions. The system measures the performance of learners in these interactions and they are awarded points. These points can then be used to unlock a variety of real world rewards. The program targets high school students for incentivised learning. Learners take quizzes for points, and earned points can be redeemed in a rewards store for things like groceries and other essentials. Unlike most e-learning and mLearning products and services on the market, Level Up provides learners with access to psycho-social support, and inspirational career advice free of charge. Educational learning material is presented in a mobile friendly format with contextual references to make it meaningful and relevant to learners. Although Level Up is available on virtually any mobile phone, the main focus is on the Android operating system.

Case 13: Sprint 1 Million, United States (San Jose)

The city of San Jose, California, and the Kansas-based telecommunications operator Sprint partnered to provide free mobile hotspots and wireless Internet to help close the city's "homework gap" in fall 2017. As schools learn to incorporate hybrid-learning pedagogies, students needed access to the Internet in order to complete their homework. The project identifies those in need based on the free or reduced cost lunch program eligibility, and those who do not already have Internet at home. They provide eligible students with a mobile phone or tablet as well as monthly Internet and voice services free of charge until they graduate. The project serves students at a total of 48 schools in San Jose so far, and aims to serve 10,000 students over the next five years.

Students are guaranteed 3 GB of high-speed LTE data a month on the Sprint network and unlimited data at 2G speeds if usage exceeds the limit throughout the students' four years of high school. For students receiving a smartphone, the device will feature unlimited voice and texting while on the Sprint network. Internet service is provided to the device, rather than the household, free of charge. Additionally, every device comes with a safety filter that blocks adult content and malware, helping students focus on their studies.

Currently, the project serves students at a total of 48 schools across the San Jose Unified, Campbell Union, and East Side Union high school districts. East Side Union District has students from the most underserved communities in San Jose, with a high percentage of students who need Internet access. In one school in that district, Andrew Hill High School, 63 percent of students are eligible for the program. There are similar numbers for Independence and James Lick high schools, and many others in the district.

Case 14: Connecting E-daara Primary School, Senegal

The Senegalese Chapter of the Internet Society (ISOC) has provided connectivity and information and communications technology (ICT) equipment to the primary school in Thieyetou, a forest-encircled village of 1,800 inhabitants in the Diourbel region of Senegal. An ISOC Community Grant in 2017 facilitated the purchase of desktop computers, tablets, a printer, and long-range router, as well subsidised the significant travel costs necessary to reach the remote area. The project's goals for its implementation of connectivity include increased school retention rates, improved socio-cultural cohesion, and enhanced academic materials and methods for its pupils.

Providing Internet connectivity to the primary school in Thieyetou, which also serves the children of the surrounding villages of Garame, Ndari, Koure, and Ndialigue, aims to empower and support students in pursuing their education by narrowing the resource gap between this school and better equipped urban institutions in Senegal. In addition to enhancing the school's academic resources, the school functions as an Internet café for the community at-large. By charging a nominal fee for Internet usage and garnering the support of the community as a whole to protect, value, and maintain these newly available ICT resources, the project has made strong progress in developing a sustainable model of connectivity for the area.

Case 15: Ikamva Youth, South Africa

Ikamva Youth, a non-profit founded in 2004, equips learners from disadvantaged communities in South Africa with the knowledge, skills, networks, and resources to access tertiary education and/or employment opportunities once they matriculate. Ikamva Youth aims to increase the collective skill level of the population, grow the national knowledge base, and replicate its success in more communities. Ikamva Youth currently operates with branches in five provinces of South Africa: Western Cape, Gauteng, KwaZulu-Natal, northwest and eastern Cape. While learners enrol at Ikamva Youth when they are in grades 9, 10, and 11, the program's success is ultimately determined by the number of grade 12 learners who access tertiary institutions and/or employment-based learning opportunities when they matriculate. The Ikamva Youth model draws from a large and growing pool of volunteers made up of students from nearby universities and local professionals. Notably, ex-learners who advance to tertiary institutions return to tutor thus driving the organisation's sustainability.

Case 16: Medha, India

Medha is a not-for-profit social enterprise that seeks to improve employment outcomes for youth in under-resourced colleges in India. Medha provides skills training to students in the form of basic information and communications technology (ICT) and digital literacy training, alongside career counseling, support, and workplace exposure. The program is designed to prepare students to secure and excel in their first job. Medha's training includes 30-60 hours of in-class

instruction and activities, and 150 hours of on-the-job training across three advancement programs. The programs include a Career Advancement Bootcamp (CAB), Life-skills Advancement Bootcamp (LAB), and Technical Advancement Bootcamp (TAB). TAB focuses specifically on digital literacy, which includes training in the use of computers, data entry, as well as programs and applications used in the workplace. Medha currently serves six districts in Uttar Pradesh, but has plans for expansion.

Case 17: NASCO Feeding Minds, Ghana

Founded in 2012, Nasco ICT has launched a series of projects in Ghana aimed at providing children and young people with the necessary computer tools and skills needed to access education through information and communications technologies (ICTs). The project installs computer centres in local schools and provides training classes for students and community members on computer basics and more advanced topics like web development. The objective is to set up ICT laboratories and promote technology literacy for students in the northern part of Ghana and other underserved communities. Where it is not possible for the government to provide the necessary infrastructure, their goal is to close the gap for rural communities and provide ICT literacy.

NASCO's courses are built according to the Ghana Education Services curriculum, but they also have additional courses in web application and website development. They offer evening classes and alternate schedules to accommodate their users who are between the ages of 10 and 18. Another project for secondary schools covers users up to age 22.

There are three training centres, each of which are equipped with 30-40 computers with five computers on standby for quick replacement. Two new centres will have approximately 35 computers. Four out of the five centres are located in schools, while the remaining one is in a publicly accessible community library. Only the library is Internet equipped at present, however.

Case 18: Online Vidyalaya, Nepal

Online Vidyalaya is part of a 2014 initiative called "Internet – Past and Future – The Tool for Education Revolution," which sought to bring digital literacy and e-learning tools to underserved students in the mountainous region of Nepal. Training was provided to 43 teachers and 360 students from grades 8, 9, and 10 in ten schools in rural Nepal. The project also provided a web application, onlinevidyalaya.org (meaning "online school" in Nepalese), which offered students e-books and curated lessons from YouTube that would be advantageous to the students. Online Vidyalaya is an example of using technology to increase digital literacy and access to materials for students in remote, under-resourced regions.

The "Internet – Past and Future – The Tool for Education Revolution" was a 2014 initiative that had two primary objectives. The first was to introduce students to ICTs. Ten schools were selected, and trainings were given over two or three days at each location. The trainers were six information technology (IT) students who had recently graduated. They explained the basic use of the Internet. Other lessons included how to use social media for educational ends, cybercrime, and lessons on e-governance initiatives. Lessons were taught via many methods, including lectures, Powerpoint presentations, brainstorming sessions, games, and group work; to students in grades 8, 9 and 10.

The second aspect of the project was the web application onlinevidyalaya.org. Developed using WordPress and a content management system based on PHP and MySQL, Online Vidyalaya was a single platform for the students to access e-learning video and text content. The six instructors spent four months pouring over the Science and Math textbooks used in the relevant schools. After outlining the subject matter by chapter, they sought out credible sources, primarily from YouTube, and added them to the Online Vidyalaya portal. This included approximately 800 videos as well as PDFs of e-books provided by the Nepalese government.

Goal 5: Achieve gender equality and empower all women and girls

Case 1: Libraries' efforts

Libraries have many advantages over other information venues in providing access and promoting use among girls and women. They maintain a wealth of information resources like books, periodicals, journals, and audio-visual materials (CDs, DVDs, etc.), as well as increasing availability of multiple tools to access ICT. Internet access in libraries is generally free, and people can access books, documents, periodicals, and databases in-library or remotely through websites. Evidence suggests that libraries also achieve more favourable shares of female Internet users than other public access venues. The key element in libraries' success appears to be their active outreach to girls and women and the assistance they render. Cybercafés that only offer access to technology have the fewest women users.

Libraries often offer mobile services, bringing their materials to communities rather than requiring travel to a central location, and delivering information via specialised libraries. Libraries are perceived as safe, reliable, and affordable, often with trained female staff that can help in places where it is not always appropriate for females to interact with males. Librarians serve as invaluable infomediaries to guide those with little experience in accessing information and/or using ICTs. They also frequently offer training in use of multiple varieties of information services, as well as other information activities, while other venues and media tend to specialise in one type of information and means of access.

Empowering women through ICT access and training: **The Braka Miladinovci library** in Radovis in eastern Macedonia serves about 38,000 patrons. The area has high unemployment rates, especially among women (38 percent). Librarians launched a survey among library female users aged 18-40, discovering a lack of both computer skills and economic resources to undertake relevant training. With support from the EIFL Public Library Innovation Programme (EIFL-PLIP) to cover equipment and operational costs for a year, librarians bought and installed 13 laptop computers, wireless internet routers and a printer in the library's training centre. They partnered with two non-governmental organisations, Citizens' Creative Centre (KREA), which builds young people's ICT capacity, and Women's Action, an association for improving the status of women. With their new partners, they developed a training curriculum that integrates motivation, confidence-building, ICT and job-seeking skills. In just one year, the service trained 82 unemployed people, mainly women. Trainees learn basic computer skills, how to write a CV, job interview preparation and how to look for a job online. Almost half (39) of the library's trainees found jobs. The mayor of a nearby municipality, Konce, is now investing in the construction of a similar library with the support of the entire community.

Correcting the Balance: **PerpuSeru** is a public library program that operates in Indonesia, where, in 2015, only 22 percent of the population had accessed the internet. The program launched in 2011 in a pilot phase by installing computers and internet and providing training to library staff in a small number of public libraries, but has since expanded to reach hundreds of thousands of Indonesians with a goal of reaching 1,000 public libraries by 2025. It is estimated that by

reaching that goal, public libraries will provide access to information to 20 million Indonesians who previously lacked it. Women make up nearly two-thirds of the users at public libraries.

Ugandan National Library Digital Skills Training Programme: This program is offered in local languages and designed for female farmers. In addition to building women's digital skills, the program helps them find agricultural information, such as weather forecasts and crop prices, and sell their products online. Such library programs are a good start. However, stronger commitments from the public and private sectors may still be required for women to truly reap equal benefits from equal participation in the digital revolution.

Chile's Infocentros: BiblioRedes is a network of some 400 library-based Infocentros. The Infocentros approach to capabilities and the development of freedom had important implications for women's empowerment. Infocentros offer free public, non-commercial access to the internet. They aim to provide a safe, secure, and non-judgmental space for information gathering. Special efforts are made to ensure gender balance among participants, encouraging men as well as women to use their services, since most of the users were women at first.

While overall internet use is equally divided between men and women, 65 percent of those enrolled in the free information technology classes were women, who also preferred access to all BiblioRedes services (alongside young adults and poorer people). Users have the freedom to use the technology to do whatever they perceived as valuable, but in addition, the service actively sought to extend the capabilities of less advantaged people, the majority of whom were women. Female users can talk and help each other as well as get help from the (most often) female directors of the centres, in a way that they couldn't from and with men. The centre becomes a meeting place for women where they use their social resources for information empowerment, in a country still marked by machismo. Chile's Infocentros won the 2006 Stockholm Challenge Award for creating a network that delivered free digital literacy classes to 220,000, served 6 million internet users, and brought about the development of municipal websites with local content in 3,000 localities.

Case 2: SheWillConnect, Kenya, Nigeria, and South Africa

The Intel She Will Connect Africa program is an initiative that uses a combination of digital literacy training, development of gender-relevant content, and the creation of an online peer network to help bridge the gender gap in Internet access. The program has trained upwards of 150,000 women in Nigeria, South Africa, and Kenya in face-to-face trainings conducted by the program's partner organisations since its launch in 2013.

Launched in 2013, Intel adopted a three-pronged approach to fast track the uptake of information and communication technologies by citizens. It used Intel Learn Easy Steps modules to teach women who had no skills in using technology to use the Internet for the first time. The modules were tailored to be interactive and based on completion of tasks, so that women could gradually progress to completing complex tasks online. They started with basic lessons on what computers do and with the help of activity cards, progressed to teaching women how to create a resume online and how to use email and search functionalities.

Intel partnered with multiple organisations at the local level in order to provide this training to women in community centres, some prominent organisations include CARE, ChangeCorp,

Telecentre.org, World Pulse, and World Vision. The modules were provided for free to organisations willing to engage in training women. Training for trainers was organised by Intel.

Intel created an application that supports an online peer network to allow women to share common interests and find mentors. This aspect of the initiative, rolled out in collaboration with World Pulse, allowed users to search for and find relevant user-generated content in safe online spaces. It enabled users to create communities online and reap the benefits of connectivity many fold. The application is also available for free through a collaboration with Free Basics in Africa, enabling greater impact.

Recently, Intel launched My Digital Journey, an application that has an interactive approach to digital literacy training. Learners on My Digital Journey receive a digital completion certificate after successfully completing three quests, each of which involves completing three to six missions.

In addition, SheWillConnect also offers a mobile skills application that women and girls can use to receive training on their own personal devices.

Case 3: ICT for Girls, Pakistan

The Universal Service Fund in Pakistan has several specifically focused special projects. ICT for Girls is a program that seeks to empower women from marginalised communities through training in digital literacy and Internet and communication technologies. So far, they have set up 50 centres that serve 4,000 women. There are also sites set up in Punjab, Khyber Pakhtunkhwa, and Sindh aimed to help users with disabilities.

Case 4: Colnodo, Colombia

Training Project for Equal Opportunities for Women through ICT: In collaboration with the Mayor's Office of Bogotá, the Ministry of Information Technology and Communications, the District Secretary for Women and Colciencias, Colnodo enabled public access to ICT through the implementation of digital inclusion centres in Houses of Equality of Opportunity for Women, and provided training with a focus on women's rights and training to over 9,000 women. This project was implemented between October 2013 and February 2015. The project gave women the equipment and technological services necessary to increase their capacities for participation and representation in spaces of decision making, as well as reduce the digital divide. The project provided ten online training courses as part of this initiative.

Ella Aprende Ella Emprende: In collaboration with Facebook, Colnodo established a training program for women entrepreneurs. This project is carried out within the framework of the Campaign #EllaHaceHistoria. This initiative directly contributes to the goal of empowering women and improving their quality of life through ICT. It is an innovative commitment in terms of ICT skills training to add value to women-led businesses. The main objective of the project is to train 2,000 women in Bogotá and cities surrounding it through a 12-hour, face-to-face training. Women learn tools of social media marketing on Facebook. The workshops will be held in mobile classrooms and in the Digital Inclusion Centres of the Houses of Equality of Opportunity, as well as the District Secretariat for Women. Between October 2016 and July 2017 more than 2,400 women were trained in Bogotá.

Basta de Violencia Project: Colnodo collaborated with the Association for Progressive Communications and the Fund for Leadership and Opportunities for Women (FLOW) of the Ministry Dutch Foreign Relations (DGIS) to implement to tackle Violence against Women. The project collects evidence through documentation, information, surveillance and analysis of online violence against women. It speaks to coalitions of leaders to identify legislative and policy solutions and to major companies to develop policies and corporate practices that respect women's rights. Colnodo has initiated online campaigns to foster a culture of mutual respect.

Comparative study of ICT uses, online security and possible information management risks for gender rights activists in Colombia and Costa Rica: Citizen Lab at the University of Toronto, Colnodo and the SulaBatsú cooperative conducted research on use of online media by gender rights activists in Colombia. The project sought to strengthen the capacities of women leaders and activists in ICT and in the use of resources for online security, and provided online trainings, face-to-face workshops, and public forums, among other training spaces. The project developed a communication plan as part of Take Back the Tech campaign.

Case 5: All Girls Tech Camp, The Gambia

Give1Project Gambia is a not-for-profit organisation that organises All Girls Tech camps across Gambia. The project trains young girls aged 13-20 in web design, computer graphics, coding, and database design. Leading women in technology in Gambia give career talks and advice to youth, as part of the tech camp. The initiative brings girls from across the country to participate in training programs, develop ICT skills, and be paired with an entrepreneurial mentor. Currently, the initiative serves five schools and provides free training, food and transportation costs for participants.

All Girls Tech Camp started in summer 2015 to train young girls in urban and rural areas of Gambia in ICT skills. Educational programs offered at the tech camps include basic ICT skills for beginners, and more advanced training in developing apps, web design, Javascript, and coding. Volunteer instructors form tech teams to go into schools and organise these camps.

The initiative brings girls from across the country to participate in training programs. The camp provides opportunities to learn new skills, develop critical thinking and problem-solving techniques. The pedagogy integrates leadership and entrepreneurial sessions to empower women to start enterprises. After every training, youth participants are assigned to a mentor who encourages and monitors performance. The mentor provides guidance to youth to become a mature woman entrepreneur.

The Tech Camp seeks to empower young women in the ICT sector and raises awareness about opportunities in ICT. Publicity around the camps promotes awareness via social media and television. At the end of each camp, an award ceremony is organised with a Give1 Empowerment talk on the importance of ICT training for girls in Gambia and Africa at large.

All Girls Tech Camps have been organised at five schools in Gambia and trained over 500 girls aged 13-20. After a year of operation, All Girls Tech Camp won the Gold Fire Award for innovation in Africa, enabling the project to scale up its initiative and expand to other schools in Gambia. They won a Google grant for \$3000 to support this effort in 2016.

At present, Give1 Project is working to create training modules for prisoners in collaboration with the Minister of the Interior. They are promoting awareness of the initiative and of the importance of ICT training for girls in Gambian and Africa at large via television and social media, especially Facebook.

Case 6: Amakomaya, Nepal

After being awarded a US \$4,000 grant from the ISOC in 2011, a team of local ICT and healthcare professionals developed the web app Amakomaya, (translates to mother's love), to help women in Nepal deal with the challenges of prenatal care, pregnancy, and maternal mortality. Once a woman sets up her free profile on the app, she receives audio, video, and text content suited to her stage of pregnancy. These materials are accessible via mobile devices and can also be downloaded to be viewed at times when there is no connectivity. So far, Amakomaya has reached 11 communities and helped 1077 women with its materials. Amakomaya is an example of leveraging ICTs to affect a successful public health intervention.

Since 2011, Amakomaya has been a free digital portal for pregnancy and prenatal care to Nepali women. Once a woman creates a free profile and enters her approximate conception date, she is provided with audio, text, and video materials. Currently, this includes 5 videos dubbed in the Nepali language, 19 audio recordings, and copious text-based information. All materials are available for download so they are also available offline. The app also encourages participation of family members by focusing certain materials towards them.

Another functionality of Amakomaya is a built-in button to speak to emergency services. Amakomaya maintains a 24-hour a day call centre to ensure that women can receive a live response when facing an emergency issue. The call centre is able to employ Google Maps to triangulate the location of the woman and the health centre nearest to her. Amakomaya is funded predominantly through grants, though there has been some governmental support.

Case 7: Wireless Women for Education and Empowerment, India

The Wireless for Communities (W4C) program, launched by the Internet Society and Digital Empowerment Foundation in India in 2009, deploys community wireless networks to set up and expand connectivity in rural locations of India and equips community members with training to design, deploy, and operate wireless networks. Training for rural entrepreneurs through resource centres such as “Chanderiyaan” as well as at the Barefoot College have provided employment and benefited people who wanted to start businesses online. A phase of the project, called Wireless Women for Entrepreneurship & Empowerment (W2E2), empowers women entrepreneurs through specific capacity building efforts by providing them training to set up businesses online. This training empowers these women, who come from varied backgrounds including artisans, weavers, and Anganwadi workers, and enable them to become entrepreneurs by giving them the skills needed to set up and maintain websites for their services and goods.

Case 7: Datamation Foundation, India

Datamation is a non-profit organisation established in 2002. Based in India, Datamation is an educational foundation that links its students with skills enhancement and technology. Datamation focuses on providing its services to women, especially those who depend on informal labor markets. By training students in both basic and digital literacy and offering robust

online vocational training in a variety of different fields, Datamation facilitates income opportunities for women in marginalised social communities in India.

Datamation's educational programs are geared toward generating income opportunities for those who are socially marginalised. They put a particular emphasis on educating, advocating for, and protecting women. Datamation's socially engaged technological vision manifests not only in its work in literacy and employment, but also in its "women-centric" curriculum that aims above all at empowerment. The multimedia centres and education kiosks that make up the Foundation's brick-and-mortar operations provide opportunities for vocational training and basic education, but also socially motivating assistance, such as help navigating Islamic divorce or domestic violence. By partnering with international and local development agencies as well as private donors, Datamation has built a sustainable model to invest in the education of poor and disenfranchised communities.

Case 8: MOS@N, Burkina Faso

MOS@N is a non-profit initiative that seeks to reduce mother and infant mortality through improved access to treatment, as well as reduced the number of people living with HIV (PLHIV) who drop out of receiving treatment by providing accessible treatment and targeted health information using mobile phones. The pilot project was launched in the district of Nouna in rural Burkina Faso on 9 January 2013 and completed on 28 February 2017. It piloted the use of mobile devices to improve the use of health care services by pregnant women, sending voice medical appointment reminders and health advice to "godmothers," who act as community relays to follow up with pregnant women in their respective villages. In 26 villages, served by five different primary healthcare centres, MOS@N brings together various stakeholders, including pregnant women, godmothers, rural primary healthcare centres (PHCs), health workers, technicians, and public health researchers.

Case 9: Makaia, Colombia

Makaia is a non-profit organisation that has been using technology to advance projects for social development since 2006. Founded by Colombians Catalina Escobar, Camilo Mondragón, and Maria Claudia Camacho, Makaia draws its name from one of the region's indigenous languages. In Miskito, "makaia" means both "to do" and "to build." This active ethos and social awareness inform Makaia's mission to create innovative local development projects at the institutional, social, and economic levels. Along with this mission, Makaia focusses on improvement of digital skills and technology adoption of various communities, including teachers and coffee growers, through digital literacy programs. A dominant demographic of people that Makaia trains tends to be women. They currently host a number of different programs in different stages of development-some continuing sustainability (e.g. ICT in education); some successfully completed (e.g. access in libraries); some in the planning and assessment stages (e.g., disability and access, and digital security and ethics for schoolchildren); and some in their initial implementation phase (e.g. digital literacy for coffee farmers).

Goal 9: Build resilient infrastructure, promote sustainable industrialisation and foster innovation

Case 1: Connected Dos Hogares, Costa Rica

The Connected Homes Program is a public-private partnership in Costa Rica that seeks to subsidise Internet access and computer equipment for 14,000 vulnerable households by 2018. Initiated by the Presidential Social Council of Costa Rica in 2015, the program aims to reduce poverty and inequality for 15 percent of Costa Rica's overall population and promote economic growth through creation of new jobs over the course of the next six years.

The Connected Homes program is an initiative that brings together different state institutions, including the Vice Presidency, the Rector and Regulator for Telecommunication. It is implemented by telecommunication companies and supported by NGOs, and is part of the "Bridge to Development Strategy" of the country. The Universal Service Fund provides the financial support for the subsidy. The telecommunications service providers provide both the Internet service as well as the computer resources and software licenses, engage in program promotion, as well as provide the requisite e-government applications and digital literacy training.

The government determines eligible households using criteria such as poverty level, as well as whether they belong to groups in the fourth and fifth deciles of income but have specific social needs to include the indigenous, differently abled, female-headed households and self-employed. It provides three levels of subsidy at 80 percent, 60 percent and 40 percent depending on their income and special needs, using the ratio of household income to the cost of internet service and a basic to determine subsidy amounts.

The program, which officially started disbursing subsidies in June 2016, will invest US \$128 million over the course of five years. The subsidy lasts three years, and covers the cost of a basic computer and an Internet service at 2 MBps FONATEL, the universal service fund, covers both the cost of the subsidy as well as the service.

The main goal of the Connected Homes program is to combat poverty and inequity, and promote job creation and economic growth through increasing access to information technology in vulnerable groups. The objective is to provide up to 80 percent of subsidy for computer and broadband to almost 150,000 low income families, around 15 percent of Costa Rica homes.

Case 2: Nepal Wireless Networking Project, Nepal

Nepal Wireless Networking Project is a social enterprise that provides connectivity to villages in Nepal through community Wifi projects. Since 2001, it has connected over 200 rural hamlets in Nepal to the Internet. In late 2015, the team helped connect 12 villages in earthquake-affected areas and is presently pioneering an effort known as 'Smart Village' to provide the various benefits of connectivity such as easy access to online education, government services, health services and smart trekking routes to these communities. Nepal Wireless is implementing pilot project for the deployment of a community based hybrid wireless network using TV White Space and Wifi spectrum in remote valleys around Manaslu Himalaya and Dhaulagiri Himalaya region in 2016.

The project started as an effort to bring a telephone line and an Internet connection to the Himachal Higher Secondary School in the Mygadi district of Nepal in 1996. After overcoming an environment of political strife, stringent government regulations, as well as technical challenges and financial constraints, the first project was completed in 2002. The project is mostly set in rural and isolated areas that are often inhabited by indigenous people and subsistence farmers. There are many marginalised or socially disadvantaged groups living in these isolated villages of the Himalayan regions of Nepal.

By 2008, Internet connections had been provided to community centres, schools and clinics in 42 villages, with plans to expand to at least 19 more. In 2016, over 200 such villages have been connected to the Internet and had access to a whole host of services including telemedicine, online education, and online banking services.

The Nepal Wireless Project uses 2.4 GHz and 5.8 GHz frequencies to connect the villages, relay stations and base stations. Most of the network backbone is connected using Motorola Canopy radios at 5.8 GHz due to high reliability and to avoid signal interference. Last-mile connectivity uses wireless Ethernet (802.11b/g standard) radios at 2.4 GHz, which is cheaper and compatible across various manufacturers. In Mygadi, for instance, the system has two relay stations to forward the wireless signal to a base station and Linux server facility in Pokhara, the nearest city with Internet access, with a connection to a hospital in the city. Users at the school use Internet on desktop computers and laptops.

The Internet connectivity is used to provide teaching and telemedicine services to the villagers. While dependent on the distance of a village from the relay and base stations, most connections provide a minimum bandwidth of 1MBps in the local network, which allows for video conferencing facilities. At the telemedicine clinics, doctors use a network camera that can be controlled remotely.

The project charges a service fee to rural communication centres to ensure sustainability and cover the operating and maintenance costs of the network. The management structure allows community organisations to make their own decisions to run their communication centres and the system is deployed with active participation from local governments and youth from the communities.

The Nepal Wireless Networking project has connected 200 hamlets in remote, rural and mountainous areas in Nepal – the populations in each of these villages vary from a few hundreds to a few thousands. This connectivity provides villagers with vital information for trading their produce in local markets. Many villages now provide online bookings in trekking areas for tourists. Nepal Wireless has established a mechanism for online money transfers through different local agencies in rural areas, which benefits tourists and mountaineers.

There are also educational and health benefits that stem from providing connectivity to these rural hamlets. Telemedicine services at eight rural clinics now connect patients in remote villages with Kathmandu Model Hospital, Skin Hospital, and Pokhara Om Hospital for expert care. Tele-teaching provides children in rural schools with multimedia educational content on the Internet.

Nepal Wireless has also partnered with several international organisations and has established weather stations for real time weather monitoring to assess the impacts of climate change over a long period.

Case 3: Sarantaporo.gr, Greece

Sarantaporo.gr is a non-profit organisation that aims to revitalise communities by providing Internet connectivity and technology education in rural Greece. Officially established in 2013, the organisation has grown from connecting the mountain village of Sarantaporo to providing high-speed Wifi to residents, organisations, and visitors in fifteen different villages in the region. With volunteer labor, grants, and a longstanding partnership with TEI University, Sarantaporo works to help villagers incorporate connectivity into their daily lives. Conceiving of the Internet as a commons, the organisation endeavours to foster community-oriented mindsets in order to ensure the sustainability of the networks. This case highlights the importance of active community participation and investment in implementing and maintaining Internet connectivity and infrastructure in small towns.

In 2010, a small group of young people who had grown up in the village of Sarantaporo decided to help their village connect to the Internet. With no experience in IT or telecommunications, they reached out to open-source connectivity communities and applied to a local Greek foundation offering grants for hardware. They were successful and installed their first mesh routers in the local village, providing free local connectivity for the first time.

Word spread and the project expanded to fourteen other villages in the surrounding region. Several volunteers with no connection to the villages joined the project out of a sense of social reasonability and outreach. Through this expanded demand for Internet connectivity in previously underserved areas, the group could secure a Euro 90,000 grant to solidify the network in 2014, interconnecting all the villages, and partnering with TEI University (60 km away) for free bandwidth.

Today, the project maintains its operations with low overhead from an all-volunteer staff, financial donations from private citizens and the communities themselves, and grants from organisations such as CONFINE (a European FP7 project), The People's Trust, and the Greek Free Open-Source Software Society. They aim to provide improved quality of life and social cohesion to inhabitants of rural areas that have suffered from increased isolation due to economic crises and ongoing digitisation in metropolitan areas.

Case 4: Tucan 3G, Peru

TUCAN 3G is a largely European-funded research organisation that has worked since 2009 to provide 3G mobile voice and data access and infrastructure to isolated areas of Latin America. The organisation's focus is on providing sustainable low-cost ITT solutions to improve quality of life and life expectancy in rural communities. With a focus on healthcare, TUCAN 3G aims to connect underserved populations in developing countries with the medical resources of urban hospitals and treatment centres via telemedicine.

In its early stages, TUCAN 3G deployed its 3G femtocell and WiLD (WiFi for Long Distances) technologies in order to provide single-access points for rural Latin American villages to connect

to urban medical centres. These access points were by and large in regional government outposts and meant for widespread community use.

In recent years, a TOUCAN 3G project in the Napo River basin in the Peruvian Amazon was begun in partnership with telecom companies to enhance the sustainability of its networks. The Napo network is additionally significant in that it is experimenting with shifting TUCAN 3G's emphasis from providing telecom access to regional government outposts to connecting entire communities.

The link between sustainability and community is key: by facilitating relationships between large mobile service providers and smaller regional ones, the project is hoping to incentivise the continued participation of telecom corporations that have ignored these sparsely populated, low-income areas. By growing the user base, TUCAN 3G aims to make the rural network a worthwhile interest for urban-centric corporate profitability and thus maintain connectivity in these underserved communities.

Case 5: Open Wireless Network of Slovenia, Slovenia

Since 2006, WLAN Slovenia has been working on a community wireless network to provide open and free access to the Internet across Slovenia. As of 2017, over 400 wireless nodes are active with over 2 million non-unique usages. Originally started in the Ljubljana region of Slovenia, WLAN Slovenia now extends beyond the country's borders and into Croatia and Austria. Costs are low because the system relies on common technologies already in use, though there has been private support. Users join on a voluntary basis and each individually adds value to the overall network by increasing its reach. WLAN Slovenia is an example of building a community wireless network that is a symbiosis of accessibility needs and a shared interest in propagating the network that has the potential to be hindered by uneven retention, unfriendly or indifferent governmental/legal restrictions, and a too localised model.

WLAN Slovenia is an open-source and free community wireless network that has been active since 2009. WLAN Slovenia, like many other community wireless networks, repurposes widely used technologies (e.g., commercially available routers) and capitalises on fibre optic internet capabilities of urban centres to make the network function. By finding redundant capabilities within the existent networks (e.g., bandwidth users are paying for but not using), WLAN Slovenia provides individuals with reciprocal use ability. Users allow their bandwidth to be shared and then link to a larger antenna which broadcasts their "unused" internet. In this way, users are able use their own internet at home, have connectivity for guests, and "borrow" from another participant in the network when they are mobile. Beginning with the cities, WLAN Slovenia has moved into rural areas as well to meet their demands. Awareness of the project propagated by word of mouth.

While the initial genesis of the network demanded expertise, WLAN Slovenia made the end-user process as seamless as possible. Originally there were DIY instructions for interested participants to repurpose their in-home modems, however, users asked for ready-made versions and WLAN Slovenia provided these by mail. From the outset, WLAN Slovenia has fostered a community that is linked by its desire to see the whole country have access to network.

WLAN Slovenia has minimal overall costs, though they have received some private and grant funding, and relies on voluntary participation and expertise.

Case 6: Colnodo, Colombia

Community network: In collaboration with Rhizomatica in Mexico, the Internet Society, National Spectrum Agency, Association for the Progress of Communications and Organized Communities of Cauca – Colombia, Colnodo has been deploying community networks to reach unreached communities through unlicensed spectrum.

Case 7: ARMIX, Armenia

Energy costs are a significant contributor to an IXP's monthly operating costs, which was growing concern for ARMIX, an Internet exchange based in Yerevan, Armenia. In 2014, ARMIX reached out to the Internet Society (ISOC) seeking ways to help them integrate renewable energy into their operations, promote green energy solutions, and reduce their electricity costs and consumption. ISOC eventually donated 18 solar panels that produce more than 4 kilowatts of power to help them with one of their points of presence (PoPs).

As a result, their electricity costs have dropped by more than 30 percent, and they are now much less reliant on non-renewable energy sources. The panels have been so helpful, they are now looking for ways to expand the use of solar to their other two PoPs. Moreover, they want to set a good example of technology companies that help to change their physical environment, and are also encouraging other operators within the Commonwealth of Independent States (CIS) region to integrate renewable energy sources.

ARMIX's success is also an example of the success that can come from the combination of enabling government policy-making, effective public-private partnerships, and sustainable planning, since the government began incentivising solar and a local solar solution provider assisted them. It is also a good example to other operators looking to cut their own costs. Perhaps other local or country-specific initiatives could help bring solar, wind, or other renewable solutions to an IXP or other technical body's operations, whether it is via a government mechanism or by collaborating with local solar providers in the private sector.

Case 8: Picosoft Nepal

One innovation driving innovative and affordable access including the use of TV White Space connectivity in Nepal is by Picosoft. By combining new solutions with digital literacy and computer science programs designed for and by the local market, they drive local communities and citizens to empower themselves through true digital inclusion.

While regulatory policy is often a consideration in such endeavours, it is important to identify unique ways to empower local communities and local partnerships, and encourage local regulators to balance existing rules with the need to advance society.

Picosoft was one of ten recipients to win Microsoft's annual Affordable Access Initiative grant aimed at furthering local entrepreneurs actively involved in increasing energy and Internet access around the world. Through this grant, mentorship from Microsoft and other industry experts, as well as participation in an incubator program with Village Capital, PicoSoft aims to further its existing footprint of providing affordable, high-speed Internet services in rural Nepal.

In a country with difficult terrain, delivering broadband through traditional means is exceedingly challenging, not to mention economically infeasible. Picosoft believes other rural communities could replicate such technological innovations to empower its citizens via Internet and TV White Spaces technology or what is often referred to as “super Wifi”. TV White Spaces can travel over long distances and through mountainous regions, making this a unique and affordable connectivity solution for rural and developing communities within Nepal and beyond. Their program plans to increase connectivity to more than twenty K-12 schools, which have already been piloted during recovery efforts following the devastation of the 2015 earthquake.

They believe there is a more cost-effective way to solve the digital divide, to introduce telemedicine options in unserved communities, and to innovate within the agricultural sector and more. TV White Spaces is one of the keys to solving these three SDGs in Nepal and around the world, where being disconnected means not participating in today’s digital economy. By bringing together the research community, local Internet Services Providers like Picosoft, practitioners, teachers, NGOs, non-profits, industry partners, government, and our rural communities, we believe we can identify and articulate opportunities for research and impact. TV White Spaces and locally driven content might just be the silver bullet to overcome the overarching challenges that restrict growth of quality of life in rural communities and greater inclusion.

Case 9: World Economic Forum Internet for All - Northern Corridor, Africa

The Internet for All initiative aims to accelerate internet access and adoption for the world’s 4 billion unconnected people through new models of public-private collaboration. The initiative provides multi-stakeholder platforms at the global, regional and national levels through which leaders from government, donor organisations, the private sector and civil society can collaborate to develop, deploy and scale innovative models and activities to close the digital divide. Country programs launched so far concern East Africa’s Northern Corridor (Kenya, Rwanda, South Sudan and Uganda) and Argentina, and the Internet for All framework has been used as the basis for these programs. Achieving the target of accelerating internet access and adoption in the Northern Corridor requires that four main hurdles be addressed.

Infrastructure: The intervention chosen was to expand 3G and 4G coverage. This was due in part to the realisation that 42 percent of people in the Northern Corridor countries are not covered by a mobile broadband signal.

Affordability: The intervention chosen was to increase access to smartphones. Smartphone adoption in the region was low, ranging from only 10 percent to 29 percent in the four countries, owing in part to the high cost of devices.

Skills and awareness: Not only do people in these countries lack ICT skills, but basic literacy and numeracy are also widespread problems; for example, less than half of eligible youth are enrolled in secondary education. The intervention chosen was to train two people per family in digital skills and provide 10 percent of the population with advanced digital skills.

Local content: Numerous studies have shown the importance of locally relevant content in encouraging local internet adoption and use. Local content is hard to find in the Northern Corridor countries, only 0.1 internet domains are registered per 1,000 people, compared to the

global average of 26 per 1,000 people. The intervention chosen was to develop a tech park to support the development of local content.

Case 10: New Sun Road SolConnect, Uganda

SolConnect Productive Centres aim to provide a centralised solution for off-grid communities without effective power or internet services. The Centres address the problem of how to support more of value-added commercial activities in communities that face infrastructure constraints. The key objectives of the Productive Centres are to optimise power usage for a variety of productive needs articulated by a community, while enabling Internet connectivity and introducing ICT skills development in tandem. With energy access as the anchor, centres rely on partnerships with local organisations advancing health, education and/or economic outcomes, aiming to accelerate and broaden these outcomes via connectivity. With the current SolConnect Productive Centres still in their infancy, New Sun Road are exploring further partnership opportunities, as well as the role of community-based networks in developing more robust, sustainable frameworks for future centres.

Currently active SolConnect Centres:

Kitobo Island, Uganda: A SolConnect Productive Centre was commissioned at the village centre of a poor fishing community with few services in August 2016. People use this centre for renting tablets, Internet access, computer lessons, sewing activities. Adopting a community-operated business model, this SolConnect centre was developed in the Kitobo village centre, adjacent to the solar power house. It provides energy and physical infrastructure supporting light industrial work, access to digital training and access to the internet enabling access to markets on the mainland.

Tekera Resource Centre, Masaka, Uganda: Serving a poor agricultural community, Tekera Resource Centre (“TRC”) provides health clinic, child education, craft outlets and agricultural services. It was commissioned in June 2017. People use this centre for Internet access, computer lessons, vocational school, sewing, printing, and using power tools. In addition to its medical clinic and a wide array of services, TRC provides educational, agricultural and crafts services, with an objective of increasing the prosperity of the community and making the centre completely sustainable. New Sun Road has introduced energy and Internet connectivity to support the growth of additional productive activities, internet and digital skills training for children and women in the community.

Case 11: Zenzeleni Networks

Zenzeleni Networks is a community network in Mankosi in the Eastern Cape province of South Africa, set up in 2012. It started through a collaboration between researchers at the University of Western Cape and the Tribal Authority in Mankosi. It provides affordable communications access to its 3500 residents, at half the price charged by the then-incumbent operator.

The Zenzeleni network initially comprised a mesh network of 12 single-radio wireless nodes scattered around an area of 30 square kilometres. Since 2012, a research team from University of Western Cape actively started engaging with the Mankosi community, and began installation as well as training the community members to host base stations at their households. These houses were chosen to maximise reach of the network, as Mankosi’s twelve villages were in hilly areas.

Local community members learned to fit the aerals with solar panels and mesh on rooftops, and made wooden boxes to hold the batteries.

Initially, public phones were able to call villages within the community, with an eventual shift to mobile phones on other networks. The system also had a mechanism of revenue generation through charging of the mobile phones at base stations. The committee decided to keep intra-community calls free, but charged calls to mobile phones. Besides these communal phones, Zenzeleni provides internet at low cost to the local school, small businesses and NGOs.

Zenzeleni Networks is registered as a co-operative, and was able to do business with a Voice over Internet Protocol company to place calls to other networks (cellular or landline) for 17 percent of the normal cost. The co-op charges users 50 percent of the normal price charged by the incumbent, reducing costs drastically for community members. The billing uses voice menus in IsiXhosa, to cater to local community needs.

Case 12: VITAL Project

The Vanuatu Inter-Island Telemedicine and Learning (VITAL) Network Project began in the geographically isolated and remote village of Naviso on Maewo Island. A community with no cellular network successfully advocated for Internet access to communicate with doctors at a hospital in Luganville, on Santo Island. Leveraging a multi-stakeholder approach, in less than six months, two villages have engaged with doctors over 1,250 times and have helped 32 patients. This includes six life-threatening cases involving mothers and children, and ten patients who would have been permanently disabled without intervention.

VITAL provided essential medical advice to help care for 32 patients including six life-threatening cases involving mothers and children as of June 2017. These numbers, when viewed in the context of the project which covered half the island's total population of 3,569 people are significant wins that the project has achieved in the last six months.

Despite no digital literacy, primary healthcare workers were trained in three days to use a tablet to initiate a video conference via the Internet with a doctor at the referral hospital. With little supervision and prompting, communications rose over 1000 percent. A Facebook group conversation included all the remote health workers in the connected areas to three doctors from the referral hospital who helped handle cases. The Facebook platform integrated in their daily routines and has been utilised over a 1,000 times. Emojis were used to convey emotion and feelings of the health staff as they interacted.

One of the patients who was helped using the VITAL network was a child under five with severe diarrhoea and acute malnutrition. This was a life-threatening case, but telemedicine services enabled the doctor to guide the nurse and continuously monitor progress until the diarrhoea ended and the child was stable and regained his strength through adequate nourishment.

Case 13: Virginia TV White Spaces Pilot

The Virginia TV White Space (TVWS) Pilot Project, the largest of its kind in the United States, delivers critical at-home Wifi access and educational content to K-12 students in Charlotte and Halifax counties in Virginia. In May 2017, the Mid-Atlantic Broadband Communities Corporation (MBC) and Microsoft, with support from the Virginia Tobacco Region Revitalisation Commission, launched an innovative “homework network” to deliver broadband

Internet access at home to thousands of students in southern Virginia at no cost to their families. Partnering with local school districts, the program is designed to serve the 50 percent of students in Charlotte and Halifax who currently lack broadband access at home.

MBC deploys Adaptrum's high-power TVWS base-stations at existing school and tower locations along with ACRS2.0 client radios at student's homes. This services students with a filtered selection of educational content that mirrors school curricula and enables at-home learning and educational advancement. Currently, the project is providing coverage to approximately 200 homes across the two counties, and paid service options subsidise this free service to students. As it is a pilot project, it plans to expand to other counties in Virginia pending its ability to secure additional funding.

Case 14: Vihaan Networks Limited

Vihaan Networks Limited, in partnership with the Ministry of Home Affairs in India, decided to build a mobile phone network in areas prone to left-wing extremist violence. This network -- the world's largest green mobile network -- offers voice and mobile data connectivity to deprived millions in affected Indian states. These regions include some of the most challenging terrain in the country, with practically no roads, power or security. Vihaan Networks Limited has helped BSNL set up 2,199 solar-powered mobile communication towers in 18 months, altering not just the geographical, but the social landscape of the area.

Case 15: Vanu Rwanda

Vanu Rwanda deploys Compact Radio Access Network (CRAN) technology to provide GSM and Wifi connectivity to hyper-rural communities in Rwanda. Vanu uses a unique wholesale network provider model, where Vanu's infrastructure can be used by existing Mobile Network Operators (MNOs) to extend their service. As of 2017, they have built 31 solar-powered sites in various communities in Rwanda. Three of these sites provide free Wifi using the sBRCK technology, which works in areas without connectivity.

Vanu's Compact RAN architecture is solar-powered, and operates in off-grid areas well owing to a very low power consumption of 90 watts. The vision is to connect the 1 million unconnected people in Rwanda's rural communities to affordable cellular and Wifi connectivity. It uses latency and jitter-tolerant, packet-based Internet Protocol (IP) backhaul with software radios that allow for remote bug fixes. The architecture can also be maintained easily as a consequence of remote monitoring, and does not require high technical training. The carrier grade outdoor base station weighs only 9.6 kilograms and occupies a 6x10 metre area. The small form factor allows for simplified mounting on poles and alternative structures.

Vanu uses a wholesale network operator model, which means that existing network providers can use Vanu's infrastructure to extend the reach of their network and penetrate rural markets at lower costs than if they had to roll out the network themselves.

Case 16: Southern California Tribal Digital Village, United States

The Southern California Tribal Digital Village (SCTDV) is administered by the Southern California Tribal Chairmen's Association (SCTCA), a non-profit that has served 19 federally-recognised Southern California Indian tribes since 1972. The Tribal Digital Village, and early community network, was established in 2001 to bring Internet access to Native

American communities. The network, free to use for municipal centres and priced affordably for others, is tribally operated and is located entirely on tribal lands.

Since the network's inception in 2001, high school graduation has increased radically in these communities due to additional resources made available via the Internet. The network serves a collection of tribal communities, and is focused on social welfare and educational outcomes. By providing free Internet access to libraries, schools, head start programs, and health and community centres, SCDTV prioritises the support and empowerment of its users. By offering a paid service to private homes, SCDTV both assures sustainable profitability and encourages the integration of all kinds of digital tools and cultures into tribal communities.

Case 17: Rural Communications Project, Papua New Guinea

The Rural Communications Project was envisaged to provide Internet connectivity for rural and remote areas. Financed by the World Bank and managed by the National ICT Authority of Papua New Guinea, the Rural Communications Project has deployed mobile base stations in 59 sites in remote areas in all four regions of the country, providing basic telecom services to about 500,000 Papua New Guineans. A one-time subsidy has been provided to the telecom operator Digicel in order to set up these stations.

The benefits of rural connectivity are felt acutely in villages like Kore, which previously had no access to any form of telecommunication services. Initially, villagers had to climb up a hill to receive weak mobile signals from a cell phone tower in Hula 25 kilometres away. The establishment of a base station in Korea allows farmers to order seeds and fertilisers using a cell phone instead of spending the extended time needed to travel to Port Moresby. Women entrepreneurs have started selling prepaid top-up cards to the villagers and set up solar-based charging stations for mobile phones. Access to services enhances economic opportunities for these communities.

One of the significant advances has been in emergency service delivery. Mobile phone services allow for people in unconnected areas to reach medical assistance far quicker, saving many lives.

By August 2017, the project aims to contribute to many social and economic development objectives of the country. Local businesses are expected to experience lower communications costs and improved access to information about markets and prices as well as ICT-enabled entrepreneurship, and new services such as e-commerce platforms and Internet cafes.

The stations are often coupled with solar-powered charging stations to allow people to charge their cell phones in areas with minimal electricity.

Case 18: AirJaldi Networks, India

AirJaldi is an Internet service provider (ISP) that designs, builds, and operates Internet networks in rural areas. Serving more than 230,000 subscribers across five states in India, they operate public hotspots with paid access as well as provide fixed wireless Internet to homes, businesses, medical centres, and schools. AirJaldi focuses on both social outcomes and profitability, and finds inventive and lucrative solutions to connect unserved, low-income areas at sustainable, inexpensive rates. The Harisal project in India served as an experiment for a TV white space (TVWS) deployment. Since the deployment in 2015, 80 surrounding villages have been

connected in Amravati district in Harisal, Maharashtra, India using unlicensed spectrum and TV white spaces.

The project in Harisal and the secondary network around it has surpassed initial goals. Although the goal was to connect 50 neighbouring villages after Harisal, the project has now connected 80. The Harisal project also won recognition for its innovative implementation of digital service in rural areas. In addition to public hotspots, three schools, four banks, and a hospital have been connected.

Record-keeping has been improved by connectivity. Before connectivity, school officials needed to physically deliver their attendance records to the state government office in the city. With Internet access, the village is able to report through e-government services. Before connectivity, students were reliant on print textbooks, many of them outdated. Now students have access to self-guided Internet research, and schools have integrated online tutorials and lessons into their classrooms.

There are only three medical doctors in the village and no specialists. With Internet connectivity, rural general practitioners can consult with a range of medical professionals in Mumbai, the largest city in the state.

Case 19: Axiom, United States (Maine)

Axiom is a small ISP in rural Maine, United States, which serves around 1,200 customers. Axiom is a hybrid of for-profit and non-profit entities. The for-profit arm builds connectivity infrastructure and sells Internet services in rural, remote, and sparsely populated regions of Maine. The non-profit arm, Axiom Education and Training Centre, provides mandatory but free digital literacy and inclusion training programs. Axiom leverages grants and subsidies, offers connectivity at affordable prices through innovative technologies, and ensures that users have the skills and knowledge to effectively use their connections to form sustainable networks in difficult geographic, social, and economic conditions.

Case 20: VisionNet, Democratic Republic of Congo

VisionNet is an Africa-based organisation that offers a large range of high-speed wireless Internet services to customers in Bunia and Goma in the Democratic Republic of the Congo (DRC). They also offer satellite Internet access across the DRC. Launched in 2015, Pocket Cyber Café is a service that aims to provide low-cost Internet connectivity via Wifi hotspots at rural universities in the DRC. The target audience is the student population on campus in rural areas, but the service also extends to private access points for small business owners, non-governmental organisations (NGOs), and others in need of service. Each university has customer-provided equipment (CPE) that receives broadcasts from a central signal from the main transmitter, and transmitted to numerous hotspots across campuses. Five universities are currently using the service that is supported by Microsoft's Affordable Access Initiative.

C: Conclusion

This document provides a preliminary glimpse at some case studies that are trying to leverage the power of ICTs to make critical progress on the Sustainable Development Goals. The case studies highlight some important lessons that have been emphasised in previous phases of the Policy Options for Connecting and Enabling the Next Billions. Several contributors in Phase I emphasised enabling environments to induce investment through supportive policies, legislation and regulation. The World Economic Forum's Northern Corridor for Internet for All provides an excellent case study that provides multi-stakeholder platforms at the global, regional and national levels through which leaders from government, donor organisations, the private sector and civil society can collaborate to develop, deploy and scale innovative models and activities to close the digital divide.

In terms of deploying infrastructure, more investment in and partnerships to support infrastructure development was recognised as a key driver for sustainable development. ARMIX and WEF's case studies highlight this, and leverage key partnerships to promote deployment. Another important dimension highlighted in Phase I was the need to improve the use of universal service and access funds (USFs) for enabling Internet access through (regulatory) provisions for network expansion, as well as for programmatic interventions to support women and girls. The report highlights three cases that use USFs for the same in Costa Rica, Pakistan and Papua New Guinea.

The need to enable users was also highlighted in the findings from Phase I – especially the need for promoting and enabling the youth, people with disabilities, and the elderly. Several cases focus in this report on youth – Intel She Will Connect and Medha conduct workshops that enable youth, for instance. Ikamva Youth and Africa ICT Right also focus on providing critical training for youth, sometimes leveraging the ubiquity of phones among youth to do the same.

Education and development of human capital was highlighted as an important challenge around the world. Barriers to education affect women more profoundly, with two-thirds of the world's illiterate adults being female. Several case studies in Phase III make progress on this dimension, by providing critical training and support to these communities. Datamation Foundation and Wireless Women for Education and Empowerment, in particular, conduct training for adult, often less literate women, and empower them to be entrepreneurs, allowing them to have financial autonomy.

Various other contributions in Phases I and II recognised that “connecting and enabling users can help to ensure inclusive and equitable, quality education by (among other things) letting educational content be shared with larger audiences at lower costs, connecting classrooms, supporting teacher training, improving access to learning and teaching resources in both urban and rural areas, and by making content more relevant and responsive to learners' needs.” Zaya Learning Lab case study highlights the implementation of this recommendation, by creating access to devices with relevant content that can promote learning.

Some contributors in previous phases noted that there are fewer than 25 percent schools with Internet access in some developing countries. Connecting E-Daara primary school in Senegal, for instance, provides a case where this challenge has been tried to be overcome using grant-funding from ISOC.

In Phase II, women's empowerment and gender equality was achieved, in some part, through the training and support of female farmers and entrepreneurs. Cases such as Makaia and Wireless Women for Education and Empowerment by the Digital Empowerment Foundation seek to achieve just that, through the use of training for entrepreneurs and farmers who are women.

This resource thus provides a lot of empirical backing for the opinions that several contributors made in previous phases. A draft version of this resource was presented and discussed during a main session on Policy Options for Connecting and Enabling the Next Billion(s) and other intersessional activities at the 12th IGF, held from 18 to 21 December 2017 in Geneva, Switzerland. During this session, Phase III's work received broad approval from the IGF community.

D: Appendices

Annex 1: CENB Phase III received 12 formal contributions in reaction to its June 2017 and November 2017 public call for contributions. The CENB team wishes to thank all contributors for their valuable insights and ideas.

List of Contributors

1. 1 World Connected
2. IFT Mexico
3. World Economic Forum
4. ICC-BASIS
5. Michael Oghia
6. Picosoft Nepal and Microsoft
7. New Sun Road
8. Rayznews
9. IGF Panama
10. IGF Peru
11. Colnodo
12. IFLA

Call for Public Input

13 June 2017

1. Introduction

The IGF's **Multi-stakeholder** Advisory Group ([MAG](#)) recently decided to further develop the IGF's intersessional work, "*Policy Options for Connecting and Enabling the Next Billion(s)*". This will therefore be Phase III (CENB III). This year's work on *Policy Options* will **build on the IGF** community's past two years of important work on the theme of promoting meaningful access.

In 2015, the IGF MAG decided to develop the intersessional work under the topic "Policy Options for Connecting the Next Billion" ([CNB](#) track), starting a new methodology to build the policy recommendations based on broad consultations, bottom up crowdsourcing and cross-engaging the work of [NRIs](#), DCs and BPFs. The discussions were focused on infrastructure, increasing usability, enabling users, entering affordability and enabling environments. The final output document is [here](#).

Given the successful results of this trend, the IGF MAG has continued a second phase of the intersessional work for Connecting the Next Billion, focused narrowly on how ICTs can help reach United Nations' Sustainable Development Goals (SDGs), with the lens on local and regional specificities. Phase II built on the policy options developed in 2015 during the first phase, which aimed at supporting the creation of enabling environments, including deploying infrastructure, increasing usability, enabling users, and ensuring affordability. The final report is [here](#).

In the past two years, over 130 [submissions](#), including many from national and regional IGF initiatives (NRIs), contributed to the development of comprehensive sets of Policy Options for Connecting and Enabling the Next Billions ([Phase I](#) and [Phase II](#)).

These Policy Options are already serving as tangible and useful resources for policymakers and other stakeholders, but also symbolise the IGF community's conviction that the need for multi-stakeholder collaboration towards expanding meaningful Internet access is a shared goal that remains at the core of Internet governance.

1. **Phase III (2017): Policy Options for Connecting and Enabling the Next Billion(s)**

For 2017, the recommendation is to focus on a limited number of SDGs that are impacted by ICTs and to do a deep dive in collecting and analysing case studies worldwide. This approach would complete phase I and II with concrete local experiences.

The proposed focus would be:

Goal 4: Ensure inclusive and quality education for all and promote lifelong learning

Goal 5: Achieve gender equality and empower all women and girls

Goal 9: Build resilient infrastructure, promote sustainable industrialisation and foster innovation

The IGF community contributions will build a series of case studies and success stories in which the Internet is playing a key role in advancing the selected SDGs, collected notably through the national and regional IGFs. That's a intertwined approach, emphasising the tangible work that happens within the IGF community while demonstrating its value in relation to the 2030 Agenda.

1. **Guidelines for background contributions**

All stakeholders are invited to submit contributions on the theme "*Policy Options for Connecting and Enabling the Next Billion(s) – Phase III*".

Contributions from NRIs, best practice forums (BPFs), dynamic coalitions (DCs), and IGF workshops are particularly welcome.

a. **What format should my feedback be in?**

Contributions are expected to:

- demonstrate through case studies how ICTs can enable SDGs 4, 5 or 9. They can come in various formats: links to publications, reports, references, statistics, stories, etc.
- be of reasonable length in order to maximise readability.

Note that various projects already explore the link between ICTs and SDGs (e.g. ITU). The IGF's added value will be to complement other existing efforts by collecting information in the field, in a bottom-up fashion, that validate existing theories and assumptions.

Contributions are preferred to be in English and to use of an editable file, compatible or readable with Microsoft Word. Documents in other languages will be translated using an automate system which might reduce accuracy.

Additional templates may be developed to aid contributions if this is deemed helpful.

b. What will happen to my contribution?

All contributions will be published publicly with contributors' names on the IGF's website. As an example, see submissions from 2016 [here](#).

Contributions will be analysed and incorporated into the outcome document for *Policy Options for Connecting and Enabling the Next Billion(s) – Phase III*, as far as is deemed possible and relevant by an editorial group of volunteers. All contributors' details will be credited in the outcome document, and contributions may be published on the IGF's website.

c. What is the deadline for contributions?

All submissions should be made by 31 July 2017.

d. Who do I send my feedback to?

Email contributions should be sent to cenb@intgovforum.org

e. What if I have more questions?

For further queries, or for more information, please contact Constance Bommelaer (bommelaer@isoc.org), Raquel Gatto (gatto@isoc.org) or Christopher S. Yoo (cyyoo@law.upenn.edu), the initial coordinators of this initiative.

f. Proposed questions to guide your response:

The first phase (2015) and the second phase (2016) of *Connecting and Enabling the Next Billion* have identified a set of policy options aimed at the creation of enabling environments, and investigated the ways in which meaningful Internet access can support and contribute to realising the United Nations' Sustainable Development Goals (SDGs). The third phase (2017) aims at gathering concrete examples of how these policy options has been implemented in relations to SDGs 4, 5 and 9.

While inputs of any format will be considered for incorporation, the following suggestions that you can tackle in your contribution:

- Give examples of how local or regional policies have helped connect and enable users, giving them access to information and communications technology and providing universal and affordable access to the Internet in least developed countries.
- Share a story from any region about how connecting people to the Internet has brought quality education for boys and girls.
- Give concrete examples showing how access to the Internet has increased higher education, including in ICTs and technical engineering, as well as qualifying teachers, especially in least developed and developing countries, and small island states?
- Share concrete examples and stories in which the use of ICTs has empowered women. Explain how specific policies or legislation might have helped promote gender equality?
- Give examples of how local or regional policies have helped connect and enable users, giving them access to information and communications technology and providing universal and affordable access to the Internet in least developed countries.

Important dates:

- **May - 31 July:** Call for inputs is open to receive any contributions.

- **31 July:** Editorial work to compile version 1.0 of the document, based on all contributions received by the IGF Secretariat.
- **1 August - 31 August:** Launch of the first draft and open for comments
- **1 September - 30 September:** Editorial work to compile version 2.0 of the document, taking into account the comments on the previous round
- **2 October - 31 October:** Launch of the second draft and another round of public comments.
- **30 November:** Issue of the final draft by the MAG editorial group that will be delivered in the IGF Geneva 2017