Editors
LUCA BELLI and SENKA HADZIC

Community Networks: Building Digital Sovereignty and Environmental Sustainability

Official Outcome of the UN IGF Dynamic Coalition on Community Connectivity

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Ritu Srivastava is Director at Jadeite Solutions and Program Manager at IEEE Future Networks Entrepreneurs Program. She is a seasoned professional with a proven track record of driving innovative solutions that enable social impact. She has a deep understanding of the digital landscape and has been leveraging digital expertise and the

ICT industry in the development sector to encourage the sustainable development of underdeveloped areas, particularly in rural areas. During her 16 years of experience in the digital sector, she has also had the privilege of representing India at various international forums, including the Global Network Initiative, the UN Human Rights Council, and the High-Level Panel for Digital Cooperation. At the UN's Internet Governance Forum (IGF), she actively participated in the Best Practices Forum (BPF) on Women & Digital Rights and the Dynamic Coalition on Community Connectivity (DC3). She is also chairing the IEEE Working Group – Internet Grades of Service in Rural Areas (India). She holds a Masters degree in Electronics & Telecommunication and an MBA degree in Information Technology.

1 Community networks as drivers of digital sovereignty and environmental sustainability

By Luca Belli and Senka Hadzic

Abstract

This chapter introduces a previously absent but crucial viewpoint in the discourse surrounding community networks: their function as catalysts for commons-based notion of digital sovereignty and environmental sustainability. The chapter highlights the relevance of the community network movements not only as an engine for the expansion of connectivity but also as a vector of community empowerment, self-determination, and, ultimately, digital sovereignty, fostering the capacity of previously unconnected communities to understand and develop digital technology.

1.1 Introduction

It is always useful to start a publication on community networks (CNs) to remind the readers what CNs are. CNs are crowd-sourced collaborative networks, developed in a bottom-up fashion by groups of individuals – i.e., communities – that design, develop and manage the network infrastructure as a common resource. Hence, CNs are connectivity initiatives managed according to the governance models established by their community members, in a democratic fashion, and may be operated by groups of self-organised individuals or entities such as non-governmental organisations (NGOs), local businesses or public administrations.

This chapter introduces a previously absent but crucial viewpoint in the discourse surrounding community networks: their function as catalysts for commons-based notion of digital sovereignty and environmental sustainability. The chapter highlights the relevance of the community network movements not only as an engine for the expansion of connectivity but also as a vector of community empowerment, self-determination, sustainability, and, ultimately, digital sovereignty fostering the capacity of previously unconnected communities to understand and develop digital technology.

The first section of this chapter briefly explores the commons-based notion of digital sovereignty, while the second section highlights the main arguments leading us to argue that CNs are vectors of sustainability. The following contributions of his volume explore these elements with concrete case studies and represent the eighth annual outcome report elaborated by the Dynamic Coalition on Community Connectivity (DC3) of the United Nations Internet Governance Forum (IGF). DC3 is a multistakeholder group, fostering a collaborative analysis of CNs, exploring how such initiatives can improve and expand connectivity while empowering Internet users.

1.2 CNs as drivers of digital sovereignty

The past decade has witnessed the emergence of multiple debates narratives "digital sovereignty",[1] an increasingly debated issue, which does not have a universal definition yet. This is introductory essay, however, is to reflect upon how CNs can foster commons-based notion of digital sovereignty as an extension of network self-determination. This idea is grounded in the consideration that any entity (not only state) can be digitally sovereign when they are able to understand technology and use it for their own benefit. In this perspective, digital sovereignty is a function of one's capacity to grasp the functioning of technology and being empowered by it.

Despite not having explicit digital sovereignty agenda, community networks offer interesting examples of "Good Digital Sovereignty"[2] illustrating how new digital architectures can be constructed, managed, and self-regulated using a bottom-up approach. Indeed, digital sovereignty is not only fostered by state activities but can also be developed by local communities and CNs offer useful case studies of what can be seen as a commons-based approach to digital sovereignty.[3] CNs prove that Internet connectivity can be built by

1 For an analysis of the concept of Digital Sovereignty see J. Pohle and T. Thiel 'Digital sovereignty' (2020) 9(4). Internet Policy Review <https://doi.org/10.14763/2020.4.1532>. For a digression on why emerging economies might be keen on building digital sovereignty narratives, see L. Belli 'BRICS Countries to Build Digital Sovereignty' in L. Belli (Ed) CyberBRICS: Cybersecurity Regulations in the BRICS Countries. (1st edn, Springer 2021); Belli, L. and Jiang, M. (Eds.). (Forthcoming). Digital Sovereignty from the BRICS Countries. Cambridge University Press.

2 See: Belli L. (June 2023). Building Good Digital Sovereignty through Digital Public Infrastructures and Digital Commons in India and Brazil. G20's Think20 (T20). <https://t20ind.org/research/building-good-digital-sovereignty-through-digital-public-infrastructures/>.

3 See Belli, L. and Jiang, M. (Eds.). (Forthcoming). Digital Sovereignty from the BRICS Countries. Cambridge University Press.

the local communities for the local communities, demonstrating that such communities can be digital sovereign, understanding the functioning and developing digital technology, shaping their economic, social, and cultural development.

Besides providing access to previously disconnected populations, these networks are particularly interesting as they give rise to an ample range of positive externalities, including the construction of new infrastructure with limited investment, the engagement of locals in the development of new self-governance models, the revitalisation of social interactions amongst local community members, and the emergence of new opportunities for accessing information, learning, doing business and creating employment.[4]

There is widespread recognition that CNs are positive contributors to the local socio-economic environment because, besides providing the capacity to access and share information and knowledge, they focus on the needs of the local community.[5] In practice this means that, besides being connected to the Internet, local communities start to understand the functioning of digital technologies as they experiment with them, and frequently have a more direct approach with the governance of such technology. Such a situation contributes to the development and strengthening of digital sovereignty of the local community through a commons-based approach, where the local communities increase their capacity to understand, develop and regulate their local digital ecosystems, while connecting them to the global Internet.

The fact that CNs allow previously unconnected communities to build their own access networks, their community-tailored services, including applications and content in their own local languages, also offering the possibility to organise connectivity through governance models that reflect the self-determination of the local community is a quintessential example of digital sovereignty. In this sense,

4 See: Luca Belli (2017). Network Self-Determination and the Positive Externalities of Community Networks; Nicola Bidwell and Michael Jensen. (2019). Bottom-up Connectivity Strategies: Community-led small-scale telecommunication infrastructure networks in the global South. Association for Progressive Communications.

5 See the previous reports of the DC3, including a wide number of case studies and analyses illustrating these points, available at <https://comconnectivity.org/> as well as in the "Documents and Reports" section of the DC3 official webpage on the IGF website <https://www.intgovforum.org/en/content/dynamic-coalition-on-community-connectivity-dc3-0>.

participants of CNs become digitally sovereign by becoming the "protagonists of their digital futures",[6] as they develop a variety of tools and systems aimed at utilising connectivity to organise the community life in a more efficient and participatory fashion, while reflecting their community values and need into technology. For instance, CN users create billboards for better organisation of the local community, messaging applications in local languages, local e-commerce platforms to trade local products, or e-health applications to share medical information more easily.

As it has pointed out in several previous publications, CN debates and analyses frequently underappreciate the positive externalities generated by these initiatives, giving more prominence to the technology utilised to connect individuals rather than the concrete use of connectivity and the benefits this may produce for the newly connected communities. Furthermore, CNs offer interesting examples of how the success of these initiatives and, ultimately, the capacity of the community involved to be digitally sovereign, strongly relies on their capacity to design and implement governance models that reflect the commons-based nature of each CN, while baking the local community values into an efficient self-governance model.

Community networks can serve as testing grounds for local communities to explore and experiment the concept of digital sovereignty, from a commons-based perspective. They empower previously disconnected individuals to gain knowledge about digital technology, build and maintain hardware and software, embrace the notion of "network self-determination".[7] In this perspective the establishment and promotion of CNs allows individuals and communities "*to freely associate in order to define, in a democratic fashion, the design, development and management of network infrastructure as a common good, so that all individuals can freely seek, impart and receive information and innovation*."[8]

6 See Belli, L. (2018, March 28). Network self-determination: When building the Internet becomes a right. IETF Journal. <https://www.ietfjournal.org/network-self-determination-when-building-the-internet-becomes-a-right/>.

7 See: Luca Belli (2017). Network Self-Determination and the Positive Externalities of Community Networks. <https://bibliotecadigital.fgv.br/dspace/handle/10438/19924>.

8 Idem.

Importantly, self-determination is so fundamental in the UN legal system that both the first article of the Charter of the United Nations and the first article the International Covenant on Civil and Political Rights (ICCPR) and the International Covenant on Economic, Social and Cultural Rights (ICESCR) mandate its protection. In accordance with these instruments of international law, the UN member states agreed that "all peoples have the right to self-determination" and that "by virtue of that right, they are free to determine their political status and pursue their economic, social and cultural development. Article 1 (3) of both International Covenants obliges the signatories to "promote the realisation of the right to self-determination."

Hence, CNs offer concrete examples of the existence of alternative and complementary approaches to expand connectivity and to fulfil the United Nations Sustainable Development Goals[9] ultimately allowing affected communities to evolve into digitally sovereign communities.

1.3 CNs as drivers of environmental sustainability

The development of CNs can positively contribute to improving environmental sustainability across multiple dimensions. This section briefly presents two key avenues for CN action as regards environmental sustainability: reducing digital footprint and supporting action of local climate justice groups.

1.3.1 Reducing digital footprint

CNs can play a significant role in addressing the digital footprint by employing a range of strategies. For example, community networks can focus on designing energy-efficient network infrastructure, incorporating low-power hardware and renewable energy sources to reduce their carbon footprint. Hosting locally relevant content and services can decrease data travel distances, subsequently cutting energy consumption and carbon emissions associated with data transfer.

Moreover, establishing small-scale, energy-efficient data centres within the community network can reduce dependence on large, energy-intensive data centres located far away. Encouraging data

9 Notably, Goal 9 establishes the United Nations members' commitment to "build resilient infrastructure, promote sustainable industrialization and foster innovation." See <https://www.un.org/sustainabledevelopment/infrastructure-industrialization/>.

optimization practices, such as data compression, caching, and content delivery networks (CDNs), can further minimise data transfer and energy consumption. CNs frequently tackle the challenge of solar power generation in conjunction with providing connectivity solutions.

Education and awareness initiatives to inform users about the environmental implications of digital technology emphasise the importance of minimising their digital footprint. Advocacy for sustainable practices among users, such as powering off devices when not in use, recycling electronic equipment, and adopting energy-efficient hardware, is another essential aspect of reducing the digital footprint.

Collaboration with other community networks and organisations fosters knowledge sharing and collective efforts aimed at reducing the digital footprint. Engagement in advocacy campaigns for policies and regulations that incentivize sustainable practices within the ICT sector and support the growth of community networks is crucial.

Lastly, maintaining transparency by openly sharing information about the environmental impact of their operations with both members and the wider community encourages responsible digital behaviour and contributes to a more sustainable digital environment. By adopting these measures, community networks can make substantial contributions to reducing the digital footprint and promoting environmental sustainability within their local communities and beyond.

1.3.2 Supporting local climate justice groups

CNs provide a vital digital infrastructure that empowers local groups working on climate justice and environmental sustainability by connecting them, amplifying their voices, and supporting their efforts to create positive change within their communities.

CNs facilitate communication and networking among local environmental activists, allowing them to coordinate efforts, share updates, and collaborate on initiatives aimed at addressing climate and environmental issues. As platforms for local environmental groups to engage in digital advocacy and outreach, CNs can help these groups amplify their voices, reach a wider audience, and mobilise support for their causes through social media, email campaigns, and online petitions.

From a more technical standpoint, community networks can enable local groups to collect and share data related to environmental issues. This data can be valuable for research, advocacy, and policymaking, helping to drive evidence-based solutions. For example, some community networks.

1.4 Conclusions

As illustrated by the case studies analysed in this volume, CNs provide interesting examples of governance processes allowing different stakeholders to cooperate, to jointly construct new digital infrastructure, services, and content in local languages. Such dynamics concretely influence the evolution of digital environments and digital policies.

Since the establishment of the DC3, a growing number of individuals and organisations from around the world has started to work on CN research, projects, and initiatives[10] aimed at exploring the potential of CNs as a concrete solution to overcome digital divides and empower local communities. The purpose of this volume is therefore to provide additional insight on the extent to which CNs can positively contribute to the construction of a commons-based digital sovereignty, and the promotion of environmental sustainability.

10 In this sense, it is sufficient to analyse the programmes of major Internet governance events, such as the IGF, the ITU WTDC, RightsCon, EuroDIG, etc. and the grant projects of organisations such as Mozilla, ISOC, RIPENCC, APNIC, etc. to notice the appearance and the considerable diffusion of CN-related initiatives, since the establishment of the DC3, at the end of 2015.

2 Economies of setting up localized network infrastructure for rural settings of G20 countries: CR Bolo, a case study from India

By Ritu Srivastava[11]

Abstract

Access to the last-mile connectivity and having relevant information are essential for the social and economic development of any underserved communities during the COVID-19 pandemic, where having reliable and affordable internet connectivity is a challenge for communities. The COVID pandemic has sped up the digital transformation market because it calls for specialised, reliable networks that are managed and regulated locally to satisfy community connectivity needs. The essay attempts to explore the need of localised network infrastructure to enable uniform internet connectivity in rural regions of G20 countries. The brief deep dive on different community network operators (alternative connectivity models[12]) in emerging economies that are using a variety of affordable technology for connecting the unconnected region. By utilising the community radio's already-existing infrastructure, human resources, and community involvement, CR Bolo model is able to deliver last-mile connection services and digitise local knowledge. This essay's major goal is to put out an economic strategy that will work toward sustainability in rural India.

2.1 The Challenge: Rural Connectivity in G20 Countries

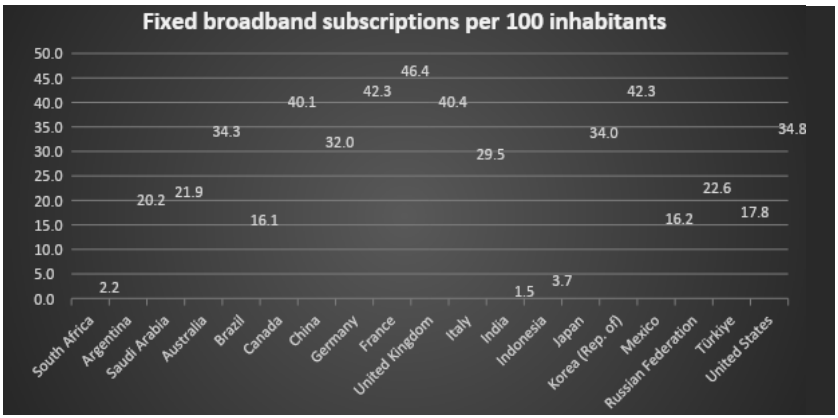
Reliable internet connectivity is a fundamental requirement for any country's digital transformation. The COVID-19 health emergency accentuated the need for broadband connectivity for providing welfare services. Along with the entire internet value chain, fixed and mobile broadband operators, content and cloud providers and internet exchange points experienced 60% increase in internet traffic compared to before the crisis. During the crisis, critical international

11 Director Jadeite Solutions & Program Manager, IEEE Future Networks Entrepreneurship Mentorship Program. Email ID: ritu@jadeite.co.in.

12 Community Network, <https://internetsociety.org.bd/trainee/ISOC-Community-network.pdf>.

policy coordination were conducted online in G20 or G7.[13] G20 countries such as operators in Korea reported traffic increase of 13%, reaching from 45% to 60% of their deployed capacity.[14] While, NTT Communications in Japan[15] reported increase in data usage of 30% to 40% and BT in United Kingdom reported increase in day time fixed broadband from 30% to 60%.[16]

The overall broadband subscriptions are increasing throughout the world; the levels of broadband subscription are higher among G20 countries. Yet countries like India, Indonesia, Brazil and South Africa are far behind as compared to other G20 countries (Graph 1). Moreover, the speed of broadband connectivity amongst these countries is also low. Fixed broadband penetration is as below 3% in South Africa, India and Indonesia because of the high cost of investment in infrastructure, hence there is a strong correlation between fixed broadband penetration and GDP per capita. Connectivity is above 20 fixed broadband subscriptions per 100 inhabitants on average in high and upper-middle income countries but it is around 10 times less than in lower-middle income countries (1.5).[17]



Source: ITU

13 OECD, Policy Responses, Keeping the Internet up and running in times of crisis, <https://www.oecd.org/coronavirus/policy-responses/keeping-the-internet-up-and-running-in-times-of-crisis-4017c4c9/>.

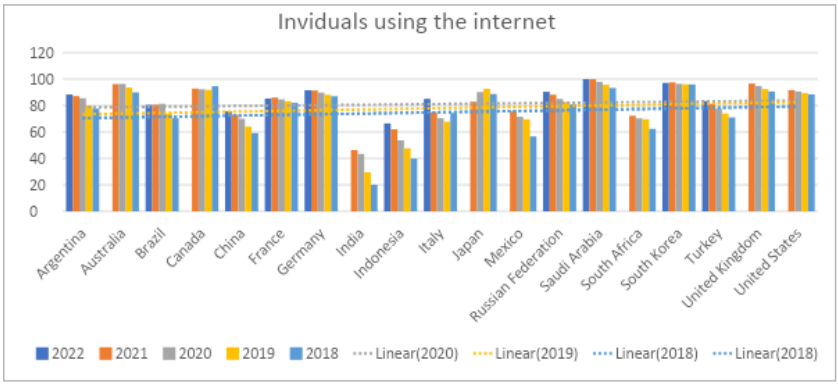
14 The Korea Herald, Internet traffic in Korea increases 13% in March as people self-quarantine <http://www.koreaherald.com/view.php?ud=20200324000656&ACE_SEARCH=1>.

15 NHK, Request to refrain from going out Increased internet traffic is not expected to affect speed, <https://www3.nhk.or.jp/news/html/20200326/k10012351831000.html>.

16 Newsroom, The facts about our network and Coronavirus, <https://newsroom.bt.com/the-facts-about-our-network-and-coronavirus/>.

17 ITU, Data Hub.

According to Ookla's Speedtest Intelligence data,[18] fixed download speeds across the BRICS countries for Q1 – Q2, 2022, India and South Africa have 48.12 Mbps download speed and 31.34 Mbps respectively, indicating that both countries have room to grow in terms of fixed performance and adoption. Even though internet service providers have deployed fibre optics further into their networks to support 'last mile' access, yet the digital divide exist as citizens do not have equal access to data at any given time.[19]-[20] Every country emphasises providing internet access to their citizens, the Graph 2 shows that most of the population still lack access to the internet. India has the lowest number of individuals accessing the internet with 46%, whereas 62% of citizens in Indonesia access the internet.



Source: ITU

The lack of internet access[21] and therefore, the majority of the population's inability to access information and data [22] slows down communication. Hence, it stalls development, causing inequality.[23]

18 Ookla Speedtest Global Index.

19 Broom, D. (2020, April). Coronavirus has exposed the digital divide like never before. In World Economic Forum (Vol. 22).

20 STOICIU, Andreea. The role of e-governance in bridging the digital divide. UN Chronicle, v. 48, n. 3, p. 37-39, 2011.

21 Ortega, A., Pérez, F. A., & Turianskyi, Y. (2018). Technological justice: A G20 agenda (No. 2018-58). Economics Discussion Papers.

22 UN News. Despite COVID-19 connectivity boost, world's poorest left far behind . <https://news.un.org/en/story/2021/12/1106862>.

23 Dijk, Jan A.G.M. van. "Closing the Digital Divide." UN.org. 2020. <https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2020/07/Closing-the-DigitalDivide-by-Jan-A.G.M-van-Dijk-.pdf>.

Affordability Report 2021[24] points out that lack of infrastructure among others are the main reasons for this divide in G20 countries.

Given to the existing challenges to the digital divide, community-led wireless networks also known as community networks (CNs) and community connectivity providers (CCPs),[25] a combination of localised telecommunication infrastructure, set-up by local stakeholders to establish the local network infrastructure and provide the low-cost internet connectivity and communication services but also enable communities to have a meaningful access. It includes how the local network infrastructure can established localised communication platform that can be used for real benefits such as providing education, healthcare, financial inclusion services, etc.[26]

2.2 Catalysing community radio for 'Internet for development'

Known as 'crowd-sourced' network infrastructure(s), the community-led networks are mostly developed and built by small enterprises, civil society organisations in collaboration with local institutions and citizens by pooling their existing resources available within the region.[27] These community-led networks are open, free and neutral relying on the active participation of local communities in the design, development and management of shared infrastructure as a common resource, owned by the community and operated in a democratic environment.[28]

Like CNs, the community radio stations are community-centric organisations that are providing information services to most remote regions where traditional media are not available or there is no medium for citizens to voice their opinions and views. There are

24 Affordability Report. Affordability Report 2021: A new strategy for universal access. Washington DC: Alliance for Affordable Internet (A4AI), 2021.

25 Connecthumanity, Financing mechanisms for locally owned internet infrastructure, <https://connecthumanity.fund/wp-content/uploads/2022/09/Financing-Mechanisms-for-Locally-Owned-Internet-Infrastructure-Updated_Sep-21-2022.pdf>.

26 A4AI, Meaningful Connectivity, <https://a4ai.org/meaningful-connectivity>.

27 IFLA, Community Networks A briefing for libraries (ver. April 2020); <https://www. ifla.org/wp-content/uploads/2019/05/assets/faife/publications/community_networks_-_a_briefing_for_libraries.pdf>.

28 IGF DC3 Community, Community connectivity: building the Internet from scratch, <https://comconnectivity.org/wp-content/uploads/2020/05/2016_paper_community_connectivity_-_building_the_internet_from_scratch.pdf>.

about 4000 community radio stations worldwide (World Association of Community Radio Broadcasters).[29] The strength of these CRs lies in understanding the local community, the local language, the local dialect, the local cultural content and the local problems. This vast knowledge is also essential for community network operators so that they can contextualise the Internet for the local community to ensure maximum relevance of the technology.

Community networks in other parts of the world have collaborated with community radios. For example, Mesh Bukavu Network in the Democratic Republic of Congo (DRC) has established the central server at the local CR, Radio Maendeleo.[30] ASORCOM community Wi-Fi network in Myanmar is supporting community radio stations in the country in conducting surveys, meeting with communities, offering radio journalism training and workshops, and drafting constitutions and bylaws for community radio stations which will contribute towards reforming the national broadcasting law.[31]

During the COVID-19 pandemic, CR stations and Community Networks in India have been providing last-mile access to information services in rural regions. Despite having community radios have stronghold with community members, these CR stations face the following challenges:

1. Unreliable internet connectivity to not only share, upload or broadcast their programmes but to reach out to wider audience/users was the need of the current scenario.
2. Lack of economic sustainability.

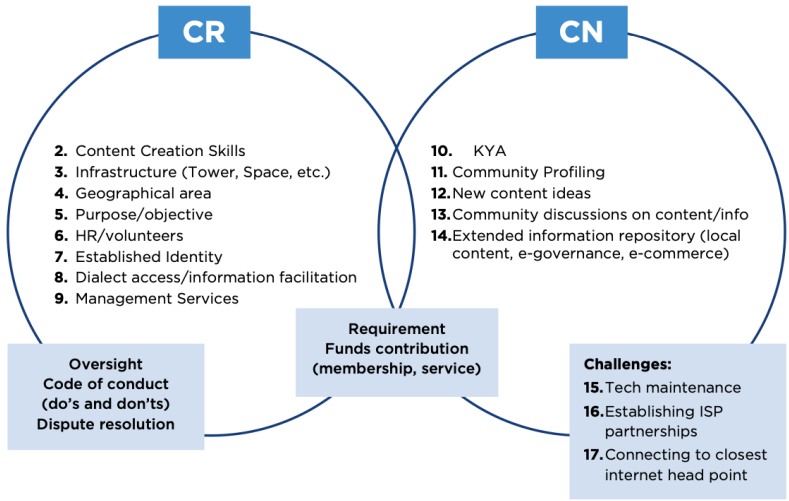
In India, most of these CR stations are operated by small organisations, therefore, having a reliable internet connectivity to share, upload or broadcast their programmes was one their prime concern and reaching out to wider audience was the need of the current scenario. CRs in general complement the strengths of CCPs, yet both entities are working in isolation in rural and remote regions of India. The commonalities and differences between CR stations and CN operators are identified in attributes of: 1) infrastructure; 2) technology; 3)

29 World Association of Community Radio Broadcasters [AMARC] (n.d.). About Amarc.

30 Global Information Society Watch (GISW) 2018.

31 Asorcom, <https://asorcom.net/>.

licensing; 4) local content; and 5) social inclusion and sustainability (depicted in fig 3)



These CR stations have a 30-metre tower along with electricity backup for setting up the antenna and router tower; therefore, they can leverage this existing infrastructure for setting up the wireless network and distributing it further. Whereas any CN operator identifies tall buildings usually for setting up a 5-metre tower atop them for establishing the network or to extend the network. Except for having an ISP licence, CR stations in India have broadcasting licence and SACFA clearance.[32] Human resources working in CR stations also have the capability to set up the router, broadcasting devices and other devices.

2.3 Economies of setting up CR Bolo for 'Internet for Development'

CR Bolo is an initiative of Jadeite Solutions Pvt. Ltd,[33] a social enterprise established at CR station – Radio Bulbul located in Bhadrak

32 SACFA license is given by the Department of Telecommunications, Ministry of Electronics and Communications for installing the tower. The clearance is given on the basis of tower and broadcasting equipment (s)' technical specifications, including Frequency, Radiated Power, Emission, Bandwidth, Antenna Parameters. SACFA document can be accessed at <https://dot.gov.in/sites/default/files/SACFA%20Simplification%20OM_06th%20Oct%2C%202021.pdf>.

33 <https://jadeite.co.in/>.

district of Orissa in partnership with local partners – Young India and Disha. Funded by the Internet Society (ISOC), under the project 'CR and CN synergies through the Radio Bulbul project facilitated by Young India in Bhadrak district of Orissa'. Renamed as 'CR Bolo' is a cost-effective model that leverages the existing rural infrastructure for creating rural entrepreneurship and strengthening the rural economy. CR Bolo is enabled with three features:

1. Wireless mesh network enabling local network and internet as per need of the community;
2. Plug-in-Play IVR (Interactive Voice Response) coupled with the network and CR stations
3. Development of localized D2C (Direct to Customer) platform on the local network.

Utilizing the height of the CR tower, a wireless mesh network within a radius of 5-7 km of CR stations. The network set-up for CR Bolo at Radio Bulbul was done phase-wise. In the first phase, CR Bolo network was established at Radio Bulbul and three Access Points (APs) were set-up at three schools connecting with CR station on a local server. CR Bolo used a unlicensed spectrum and low-cost wireless devices such as Ubiquity, Microtek router for creating a point-to-point (P2P) and extending the network between schools and SHG centers.

Since CR station has leased line of 4 Mbps, therefore, CR Bolo provides both online and offline connectivity allowing community members are always connected with or without the availability of internet connectivity. These three schools are Disha and two schools of Society for Weaker Community. Based on the established local network, local content including radio programmes were put-up on the local network, so that it can be easily accessible by schools.

In the second phase, CR Bolo established the network between CR station and 3 SHG (Self-Help Group) centres. One of the requirements we received from radio stations and community members is to identify methods through which people can listen to the radio programmes later whenever they want and also share their feedback with CR stations. Therefore, IVR channel was set-up operating on intranet web and GSM band. Through IVR number – 7789929218, anyone can contact the Radio Bulbul and listen or record their program or their feedback.

At the current stage, CR Bolo has established three APs in schools and connected with Radio Bulbul. The cost for setting up CR Bolo covering 3-5 kms of the region from the CR station. There are two important cost indicators, which need to be analysed properly for understanding sustainability of any model: Capital Expenditure (CAPEX) and Operational Expenditure (OPEX).The below table provides the connectivity cost for setting CR Bolo, which includes – hybrid network (online and-offline) and IVR cost for localised communication.

Table 1: Cost for setting up CR Bolo

S.N	Category	Quantity	Amount (INR)	Avg. Monthly cost (INR)	Avg. Monthly cost (USD)	Notes
1	Capex cost		341000	28416.7	347	Avg. monthly capex cost that CR station needs to recover
1.1	Equipment cost	1	211000	17583	214	This include 3 Microtek LHG 5 Router, 6 Ubiquity NSM2 Router, 4Giga 8 Port Switch, 1Cat 6 Ethernet Cable and 3 Laptops (for local server) and Miscellaneous (20K)
1.2.	Training & Capacity building	1	50000	4167	51	This include the 5-10 days training cost to locals on operating CR Bolo (wireless network & IVR)
1.3	IVR Set-up	1	80000	6667	81	This include GSM gateway and software for IVR designing
2	Opex Cost		540000	45000	256	Operational cost for CR Bolo
2.1	Bandwidth cost (100 Mbps) for Aps	1	36000	3000	37	For each Aps, taking 500 Mbps fibre connection for creating wifi hotspots and further extending it. Each hotspot will serve around 50 users, Thus, in total, serving 150 users
2.2	Local network engineer for maintenance & operating CR Bolo	1	144000	12000	146	Local youth to be trained on maintenance & troubleshooting of the network
2.3	Electricity	1	72000	6000	73	Per month

1 USD = INR 82

While comparing with any ISP under Category C (district level),[34] the cost of setting up a wireless network covering the same distance of around 3-5 kms in any district is calculated in below **table 2**.

S.N	Category	Quantity	Amount (INR)	Avg. Monthly Cost (INR)	Avg. Monthly Cost (USD)	Notes
1	Capex		550000	45833	559	
1.1	Avg cost for setting up wifi tower[35]	1	250000	20833	254	As per market rate
1.2	Per AP equipment cost (3)	1	300000	25000	305	Per access point, the cost of equipment is 100
2	Opex		906000	75500	921	
2.1	Bandwidth cost (100 Mbps) for 3 Aps (23000 for monthly rental)	1	828000	69000	841	Per month
2.2	Network engineer from ISP for any troubleshooting per visit	1	18000	1500	18	Per month
2.3	Electricity	1	60000	5000	61	Per month

Table 3: Comparison between CR Bolo & Conventional ISP operator.

	CR Bolo (hybrid network + IVR)		Traditional ISP	
	INR	USD	INR	USD
Capex	28416.7	347	45833	559
Opex	45000	256	75500	921
Total	**73417**	**603**	**121333**	**1480**

The cost of a decentralised network is half that of any conventional ISP operator, according to Table 3.

The approach to providing connectivity that distinguishes CR Bolo from traditional ISP methods is “bottom-up” in the first case, while “top-to-bottom” approaches are designed by marketing teams and follow specific steps without considering local community needs.

34 Category C is SSA (Secondary Switching Area), <https://trai.gov.in/sites/default/files/Recommendations_31082021.pdf>.

35 Connect2India, <https://connect2india.com/Wifi-Tower>.

CR Bolo leverages the existing rural infrastructure available with CR station and their skilled human resources, therefore it is easy to convert 'Social Capital' for economic gains and knowledge enhancements.[36] Moreover, it also helps to gain economic capital while maintaining trust with local people. The motivation behind setting up CR Bolo is to enable rural connectivity and provide meaningful access to rural communities using different low-cost technologies and driving a multi- stakeholder approach by bringing local community-led entities and different stakeholders from communities to work together.

2.4 Proliferating localised network infrastructure

There is dire need of connecting people living in rural regions specifically in times COVID-19 pandemic. Simply connecting a community is insufficient; rather, there should be an emphasis on including as many locally run organisations as possible, such as community radio stations, on what the community can do with Internet connection, and on how it can assist improve socioeconomic conditions in the area. Similar to CNs, any CR station is viable when it collaborates with other local stakeholders and organisations and can plan how to introduce and utilise technology to speed up digital transformation. Following are the reasons for having localised infrastructure and connectivity solutions in G20 countries:

Bridging the digital divide is one of the main justifications for a localised and decentralised internet access strategy. There are still many places in the world without access to high-speed internet service, especially in rural and outlying locations. G20 countries can guarantee that these regions have access to dependable and affordable internet connectivity by encouraging localised and decentralised connectivity solutions.

Freedom to promote localised infrastructure – By giving local communities the freedom to develop their own internet infrastructure and services, this can be accomplished. Local content, local employment, and the growth of regional digital economies can all result from this.

36 Adler, P. S., & Kwon, S. W. (2002). Social capital: Prospects for a new concept. Academy of management review, 27(1), 17-40.

Enhancing Security and Privacy – An internet connectivity strategy that is decentralised and localised can improve security and privacy. Data leaks and cyberattacks are possible with a paradigm of internet connectivity that is centrally controlled. On the other hand, a localised model can make sure that data is handled and stored locally, lowering the danger of data breaches.

Ensuring Resilience – Finally, resilience can be guaranteed through a localised and decentralised internet connectivity strategy. Localized models can make sure that communities can still access crucial services and connect with one another in the case of natural catastrophes or other disruptions to the internet infrastructure. For rural and distant locations, which can be more susceptible to such disturbances, this can be especially crucial.

It is necessary to take a multi-sectoral strategy, and all sectors must cooperate to promote meaningful connectivity and concentrate on "responsible connectivity," allowing stakeholders and consumers to take advantage of digital potential. In order to connect the unconnected, community-led network providers must be adopted on a global scale, not as a "alternative," but as the "Prime" model.

3 Can environmental practices foster community networks sustainability?

By Bruna Zanolli, Nils Brock and Sarbani Belur

Abstract

Bearing in mind that human, social, environmental and technological practices should not be dissociated, LocNet project (APC and Rhizomatica) worked the framework of Communities of Practice, so that the knowledge produced and exchanged met this premise in a holistic way. This paper will share the outcomes from the Community of Practices that fostered the prototyping of CN passive infrastructure technologies (such as solar energy and bamboo construction), local services and circular economy for CNs that are more aligned with environmental best practices. From the selection of topics, to forming groups to discuss and work together, implementation on the ground focused on the need of the communities to bring forth the issue of environmental rights and justice as a key component for CNs sustainability.

3.1 Introduction

Community Networks (CNs) are bottom-up community-driven solutions for access to connectivity in places the market and states fail to reach. Usually, in territories where connectivity is absent other basic human rights are lacking too, such as access to electricity, basic sanitation, work and income, and leisure and culture, among others. Therefore, in order to be able to have a functioning CN, other issues need to be addressed beyond only connectivity. And that can open the possibility of pursuing more environmentally friendly solutions in the CN context, such as solar energy, bamboo construction and the circular economy.

It is not uncommon that the same territories that lack connectivity are historically marked by deep inequality and environmental conflicts, such as indigenous, traditional and quilombolas territories; racialized populations and places that embody the consequences of predatory colonialism. And these populations, who have stewarded the land

for decades, if not centuries, tend to have lifestyles that are more harmonious with nature and protect forests and the environment. At the same time, they are the most affected by environmental changes and their territories are among the most at risk of predatory extractivist practices. CNs, therefore, offer a way to strengthen community actions by increasing communications to the world and providing more data and means of protection against threats.

Considering the above, this paper will share experiences from a Community of Practices approach that has been adopted by the Locnet project and had fostered the prototyping of CN passive infrastructure technologies (such as solar energy and bamboo construction) as well as local services and circular economy for CNs that are more aligned with environmental best practices.

3.2 Communities of Practice: How to enable more sustainable practices in CNs

Since 2017, the Association for Progressive Communications (APC) and Rhizomatica have been co-managing a project called LocNet, which has provided advice, financial resources and forums to support numerous Community Networks (CNs) in Global South countries and other partners working towards similar objectives. The goal of the Communities of Practice (CoPs) is to increase cooperation among community network practitioners around the world through the provision of online collaborative spaces created around different topics of interest to CN practitioners.

The CoP approach includes activities aimed at enhancing support for key issues of interest to the CN community by bringing together different threads of technology and innovation work. In this sense, a CoP is a group of people who share a common concern, set of problems or interest in a topic and who come together to meet both individual and group objectives. CoPs usually focus on sharing best practices and creating new knowledge to generate advances in a given field and one of the crucial components in this exercise is ongoing interaction.

LocNet's CoPs approach brought together people and activities during 2022-23 that aimed at improving support for key issues of interest

to community networks (CNs), addressing the lack of meaningful connectivity, but also other digital exclusions, human rights issues and the quest for a better collective and individual quality of life. Below we'll give a panoramic view of the outcomes from Locnet CoPs related to Solar Energy, Bamboo constructions and Local Services.

3.3 CoP on Bamboo

To improve meaningful connectivity in rural and remote territories remains an infrastructural challenge in many ways. In most approaches resources, construction materials and technological components that are not locally available are introduced to communities. Focusing on environmental impacts, the construction of passive infrastructure for telecommunications, such as towers, masts and support infrastructure, use carbon and cost intensive materials like concrete and steel. A promising game changer for this unsustainable situation is the cultivation and use of bamboo as a locally grown and nature-positive construction material.

However, to make bamboo really available within a community-centered perspective, it is necessary to create practical knowledge that includes the planting of the correct type of bamboo, its treatment to turn it into a reliable construction material and accessible instruction and localizable information for construction. With the participation of CNs, NGOs and experts from different regions, the CoP on Bamboo has brought forward approaches that contribute to the spread of critical bamboo infrastructure.

The first contribution consists of the participatory work "Bamboo for Community Networks. A plantation manual for green infrastructure"[37] led by Indian NGO, BAIF. Based on their expertise, a practical guide for the cultivation of bamboo species suitable for solid constructions was developed. The work explores regional differences in terms of plants, soil and further conditions to broaden the scope of application. The participation of bamboo practitioners added to the coordinated effort, as well as illustrations and pictures. The manual is available in three languages.

37 See <https://cnlearning.apc.org/resources/bamboo-for-community-networks-a-plantation-manual-for-green-infrastructure/>.

The second contribution is centred on design solutions of bamboo towers for community networks, structures to support different kinds of antenna, routing devices and solar panels. Again, the CoP collaboration included bamboo construction practitioners, namely IIT Bombay and NIT Silchar from India, Bandung Institute of Technology (ITB) in Indonesia and Casa Criatura from Brazil. The participating organisations shared their designs and created at least one prototype of their designs.

The design process happened in dialogue with the local population (Brazil), in exchanges with traditional knowledge keepers and practitioners (Indonesia) and in response to national standards and norms (India). The design approaches do not detail all steps for the replication and have to be further localised and appropriated by the communities. However, the successful localization of the ITB design by the Ugandan CN BOSCO shows the potential of this sustainable path towards locally grown and community oriented infrastructure.

3.4 CoP on Solar Energy

Another key factor for sovereign and sustainable digital networking is a resilient energy supply. Digital services and communication in territories loosely or not at all connected to centralised power grids face the challenge of finding solutions based on alternative energy generation. The CoP on solar energy explored the needs shared by participating CNs and created a temporary space to work with invited experts on guiding materials and practical solutions.

One identified need was to increase the practical knowledge on electricity basics and photovoltaic systems. The response was twice fold: Live and recorded online sessions to engage with CN members with few or no former skills, drawing on comparisons and models that tried to reduce the complexity of concepts and technologies without oversimplifying. The extensive Q&A sessions also provided a participatory space to further explore the topic. In a second step the online classes were adapted to create a manual: "*Here comes the sun. An introductory framework to understand the basics of electricity and photovoltaic systems for community networks*".[38]

38 See <https://cnlearning.apc.org/wp-content/uploads/2023/02/CoP_2023_Manual_Her_comes_the_sun.pdf>.

Yet another, more ambitious approach was the proof of concept and documentation of a solar powered irrigation device (OSPIT). This work is a practical adaptation of the Open Maximum Powerpoint Tracker (OMPPT), an open hardware and software device for efficient photovoltaic energy generation that aims to prototype an automatized and remotely controllable, sensor guided irrigation device for small scale farming and permaculture projects on the community level. Positioned at an intersection of autonomous energy production and data driven solutions at the local level, the device showcases the potential of local services for the livelihood (in this case especially food security) of communities.

3.5 CoP on Sustainability and Local Services

Bearing in mind that human, social, environmental and technological practices should not be dissociated, LocNet's CoPs worked so that the knowledge produced and exchanged met this premise in a holistic way. In order to do that, the CoP on Sustainability and Local Services has sought ways to give back to the local and circular economy by using community networks (through documentation and improvement of time bank methodologies and tools, social currencies and captive portals); encouraging the production and use of local content and platforms; and researching the main obstacles to the implementation and sustainability of community networks, considering them as common goods and not only a telecommunications service.

The topics and methodologies for these learning exchanges and forms of interaction were defined collectively and not hierarchically, with the goal of inclusion of gender, race/ethnicity, diverse abilities and different levels of knowledge, validating empirical knowledge and promoting an environment free of prejudice. Thus, it reflects the interest and experience of the people and organisations who engaged in it and the exchanges of knowledge that happened within the different projects to the extent time, virtuality, language and cultural barriers allowed. Our goal is to use this approach to incentivise and share the dynamics of technology design and production, and sustainability practices that are community-centred and take into account the situatedness of tech practices from the start.

Here we'll put some light on the three manuals launched, that have in common local and circular economy strengthening through local services. The 'Pedagogical Manual for Social Exchanges: caring for our common goods'[39] by Colnodo and Turimetria traces a path to understand the relevance of traditional forms of exchange and to find strategies to identify, value and optimise them through the use of digital technologies such as time banks. The manual is inspired by experiences with the "Poliniza Network" in Colombia and the recognition of community processes, resources and needs (available in English and Spanish).

The 'Community Networks Meet Community Currencies'[40] by iNethi and Grassroots Economics is a guide to powering community currencies from local clouds. It integrates a Community Inclusion Currency that amplifies local markets (Grassroots Economics) with the local content and services platform that promotes ownership of the network to the community and foster locally relevant content and services (iNethi platform), in a way that users are, for example, able to purchase internet vouchers and other digital services on the iNethi platform with a Community Inclusion Currency (voucher). Finally, the booklet How to use Pirania? Lessons from real use on community networks[41] by SOF, RAMA and PSP, was produced based on the real-life experience of installing the Libremesh's Pirania Captive Portal on a women led community network in Vale do Ribeira, Brazil. There was a demand from the territory to have more financial control, so through popular education methodologies the booklet was written together with the community so they could enable and learn how to use access vouchers.

3.6 CoPs as a way towards discussion on environmental rights

Over the years that the LocNet project from APC has enabled community networks to be seeded in the Global South, it has been a steep learning curve for various such networks to learn from each

39 See <https://cnlearning.apc.org/wp-content/uploads/2023/04/Pedagogical%20Manual%20for%20social%20exchanges.pdf?>.

40 See <https://cnlearning.apc.org/wp-content/uploads/2023/04/FINAL_iNethi-Guide-En_Final_Final.pdf>.

41 See <https://cnlearning.apc.org/resources/how-to-use-pirania/>.

other. However, with each passing year, the LocNet project gathers momentum and provides a platform for different community network initiatives to voice their concerns regarding environmental rights, and the Communities of Practice (CoPs) provide a much needed platform.

From the selection of topics, to forming groups to discuss and work together, implementation on the ground focused on the need of the communities to bring forth the issue of environmental rights and justice. For example, the Bamboo CoP shared important aspects of indigenous knowledge of bamboo and how such knowledge helps in bringing about environmental balance and biodiversity preservation.

Though the focus of the bamboo CoP was to understand the relevance of bamboo usage for passive infrastructure like towers and masts, it eventually gave us a better understanding on why and how communities can build their discussions around environmental rights. In a similar way, the CoP on Solar Energy sprung from the debate of ensuring environmental quality, led to an understanding of how communities have worked towards ensuring the quality through the use of frugal technologies.

The CoPs on sustainability and local services comes from the premise that in order to have a sustainable CN, first you need to have a sustainable community and it's much better if the CN can play a role at enabling that by fostering the local and circular economy. In order for community networks to continue creating meaningful connectivity, it needs to enable common voices to share concerns and work towards a common goal of ensuring environmental rights.

4 National Community Network Schools: Capacity building as a strategy for building local meaningful access solutions in community contexts

By Carlos Baca-Feldman and Adrián López Angulo

Abstract

This paper addresses the lessons learned from a training initiative, namely the National Schools of Community Networks (NSCNs). These schools have been operating in Brazil, Indonesia, Kenya, Nigeria and South Africa under coordination by the Association for Progressive Communications (APC) and Rhizomatica Communications. The authors present aspects of the training curriculum related to environmental sustainability, such as choice of technologies, peer-to-peer learning within communities as well as knowledge exchange between different geographies. Careful design of training processes contributes to strengthening the life and territory of the communities, and helps avoid technologies' impact on the community's ways of life through extractive processes.

4.1 Introduction

Local solutions for access to telecommunications services by communities that are not yet "connected" is a process that is growing and that day by day demonstrates that when the communities themselves are the ones who deploy, manage and maintain their own last (or first) mile networks, they are more likely to be sustainable over time.

These initiatives, which we call "community networks", although they are very complex to define due to the diversity they imply, share the characteristic that they are managed by people from the same community and this achieves a close link with the communication needs and objectives of community development in their territories. They are very diverse because the communities themselves are diverse, but also because the choice of technologies, the objectives of the networks, the value-added services and the sustainability mechanisms they use are also diverse.

For these initiatives to take root, it is essential that the people in the communities have the knowledge and skills needed to deploy, manage and maintain their networks. But just as with homogeneous connectivity strategies that do not really work, capacity building processes in community contexts cannot be the same for everyone and must be designed and implemented based on the training needs and the ways of life and learning that are present in each territory.

Although this type of contextualized training initiatives have taken on relevance and different forms, as they are intrinsic to the creation of community networks, for this brief text we base the discussion on the lessons we have learned in the accompaniment of the National Schools of Community Networks (NSCNs) in Brazil, Indonesia, Kenya, Nigeria and South Africa.

These experiences exemplify the way in which escaping from homogeneous ideas of connectivity and access through contextualized community training processes allows the generation of processes that strengthen the ways of life in the communities. Fundamentally, we want to highlight three aspects of this type of capacity building programs that allow us to understand their role in driving sustainability.

4.2 What are the National Schools of Community Networks?

The National Schools of Community Networks (NSCNs)[42] are training processes aimed at building technical, organizational, social and sustainability capacities for the deployment and management of local solutions for meaningful access to telecommunications services for people in indigenous, rural or marginalized communities in the Global South. They are part since 2020 of the project "Supporting Community-led Approaches to Addressing the Digital Divide",[43] coordinated by the Association for Progressive Communications (APC) and Rhizomatica Communications, with the financial support of the UK FCDO Digital Access Programme (DAP).[44]

42 A more detailed description of the Schools can be found at: <https://cnlearning.apc.org/national-school-of-community-networks/>.

43 More info in: <https://www.apc.org/en/project/supporting-community-led-approaches-addressing-digital-divide>.

44 More info about it in: <https://devtracker.fcdo.gov.uk/projects/GB-1-204963/summary>.

These training processes are based on a previous experience in Mexico and Latin America: Techio Comunitario.[45] This diploma course was first developed in Mexico by organizations linked to community and indigenous communication; its first two generations took between 6 and 8 face-to-face modules. Subsequently, this initiative, thanks to a collaboration between the International Telecommunication Union (ITU) and the organizations that promoted the Mexican editions, was expanded through the creation of the blended Training Programme for Managers in ICT Networks in Indigenous and Rural Communities in Latin America.[46]

This Latin American training program and the NSCNs share the methodology of Participatory Action Research (PAR) (Stringer, 2007) as the basis for their design and implementation. The phases of this methodology (scenario building, seeing, thinking, acting and evaluating) allowed for the generation of training processes that are very different from each other, but that meet the real needs and ways of learning of the communities.[47]

The Schools were developed in five countries: Brazil, Indonesia, Kenya, Nigeria and South Africa. Each was coordinated by national or regional organizations[48] that had the organizational capacity to carry out a task of this nature. These organizations invited three representatives from at least seven community-based organizations to participate in the training. Thus, at the end of the first cycle of the NSCNs in 2023, there are more than 170 graduates that have gone through these processes.

Although the time frame for each of them was different, in general, the NSCNs were divided into three stages:

1. Collective design and formation of program advisory committees.

45 More information about this training program can be found at: <https://techiocomunitario.org/en/>.

46 This video explain the general characteristics of this program: <https://youtu.be/xqhdXK8c83k?si=MoybGxLhE6nFnCF5>.

47 This methodology is systematized in the guide: Technological autonomy as a constellation of experiences. Guide for the collective implementation of training programs for community technical promoters Baca-Feldman, Bello, Carrillo, Parra & Soto, 2021).

48 The organizations that have coordinated the NSCNs in each country are: Projeto Saúde & Alegria in Brazil, Common Room in Indonesia, TNET in Kenya, Centre for Information Technology and Development (CITAD) in Nigeria, and Zenzeleni Networks NPC in South Africa.

2. Implementation of online and face-to-face courses and workshops.
3. Development of projects to strengthen community initiatives through grants and mentoring.

In each of the countries, very different challenges were addressed at each stage of implementation of the NSCNs. For example, on the one hand, the Covid-19 pandemic represented a great challenge, as the development of an online training process for people living in contexts with little or no connectivity was very complex. On the other hand, many of the participants had no training in project development, so much of the mentoring in the third stage was designed to train them in this area. Another great challenge was the participation of women who, although the number of women was quite good, the training process revealed many of the contradictions that exist in technological appropriation with respect to gender.

In the development of the first NSCNs there were many challenges, but we can say that they were successful processes to the extent that the participants have the basic knowledge for the installation and maintenance of community networks. Plans are currently being developed in various countries and regions to replicate the model, but as in this experience, the important thing is that the program design phase considers the specificities necessary for the programs to truly meet the needs and be based on the way of life of the communities.[49]

4.3 What is the contribution of these training processes to environmental sustainability?

Among the lessons learned from the NSCNs we can find at least three aspects that seem fundamental to us to understand the role of these training processes towards community networks and sustainability.

49 Between August and December 2023, an evaluation is being carried out to gain a deeper understanding of the challenges faced and the improvement actions necessary for the replicability of the model. Based on the results of this evaluation, we will also redesign the basic methodological guide for the development of the NSCNs.

4.3.1 The critical vision in the process of choosing technologies

In the first place, these spaces for capacity building allow critical reflection that enables the choice of technologies that are less harmful to the territory and adequate to the reality of the communities. In a hyperconnected world, it seems that connectivity without limitations is always the ideal, regardless of the ecological, social and economic price to be paid. However, through processes of reflection on the implications of technologies it is possible to choose those that are more appropriate to the contexts of each community. This generates a more responsible and less harmful use of technologies (Parra & Baca-Feldman, 2020). In addition, this process of critical reflection leads to observing the impact of ICTs on the planet and the consequences of a hyperconnected world, so that communities can take measures in this regard.

This has been visible in general in the Schools, since all of them have started from a critical vision that questions the idea of connectivity and emphasizes the design of networks that meet the real communication needs of the communities and that are managed through the ways of sustaining life in the territories. In this process, the use of more sustainable tools is reinforced, such as the provision of energy for the networks through autonomous photovoltaic systems in Brazil or Nigeria.

This also led to cases in which technological development was contextualized to the needs and territories of the communities to be served. For example, in Indonesia, two bamboo towers were developed within the framework of the School, one in Tembok Village in Bali and the other in Ciracap sub-district in West Java. In the same country, they generated artificial intelligence products that bring direct benefits to communities. On the one hand, the monitoring of fish stocks to make fishing more efficient and sustainable. On the other hand, monitoring shrimp farms that are cared for by women and who now have time for the development of other community projects.

In the same vein, throughout the two years of training, but especially in the last stage of project development in the communities, the participants of the NSCNs put into practice solutions to the problems they face as CNs. A key challenge was to support participants in

designing and structuring their ideas in order to bring them to fruition. In Nigeria, for example, this challenge was particularly important as the participants had no previous experience in project development.

Likewise, this final stage of the NSCNs enabled the participants to put into practice the knowledge they had acquired, allowing the projects to be developed to be tailored to their contexts and needs. To this end, instruments or field visits were generated to learn about the real needs of the communities, which allowed a good understanding of the characteristics of the communities to be served and how the technologies would have to be adapted to them.

4.3.2 Peer-to-peer learning and technical know-how

Secondly, the process of obtaining technical knowledge of the operation of telecommunications networks and the possibility of maintaining and transforming technologies is very important.

A fundamental part of the failure of public policies and commercial connectivity strategies in remote areas is related to the lack of equipment maintenance. In rural and indigenous communities of the Global South it is common to find rooftops full of antennas, of different companies and functionalities, almost all of them in disuse. The disuse of this equipment is due, among other things, to the fact that due to the remoteness and operating costs, companies and governments decide not to maintain them and instead antennas are added as new connectivity programs appear with each change of government.

In this sense, having people in the communities themselves with the knowledge and skills to deploy, maintain and operate the equipment means that it lasts longer and can also be reused. Not to mention that, by avoiding the need for technicians to travel from the cities, the environmental impact of equipment maintenance is also reduced.

In the NSCNs, an essential part of the training process was the knowledge of the equipment that last mile networks require to operate. In this sense, peer-to-peer training as a fundamental pedagogical practice in community training processes was very important for the participants to lose their fear of using and repairing the equipment, in addition to learning the solutions and detection of common failures.

This peer-to-peer learning was quite evident in the processes carried out in South Africa and Kenya, where the national organizations that coordinated the Schools already had a community network in operation. On the one hand, TNet in Kibera division of Nairobi Area, Kenya; on the other, Zenzeleni Networks in the rural communities of Mankosi and Zithulele, South Africa. In both cases, those who had already developed a community network were the same people who taught the other participants how to maintain the equipment based on their own experiences.

4.3.3 Weaving of learning communities between different territories

Thirdly, the creation of learning communities and the sharing of knowledge from other territories allows for the appreciation of one's own. Therefore, a fundamental element of these capacity building programs is the creation of support and accompaniment networks among the participants. This element is fundamental because it is in this way that peer networks are woven and a movement is strengthened that will have resonance in new communities and that little by little consolidates existing experiences. Thus, it is not only a matter of providing knowledge and reinforcing skills, but also of creating relationships that foster the defense of community life and the territory.

One of the great challenges of the NSCNs in almost all the countries was the itinerancy of the workshops and courses; the training of the participants was accompanied by an experience in territories different from their own. This generated new ways of understanding the world among the participants, especially those who had never left their regions. Cultural exchange in this context became fundamental for sharing cultures, but also ways of defending life and territory in their communities. In a special way, when talking with participants from South Africa, for example, it was possible to see the emotion of getting to know other territories, to understand how big their country is and how fundamental it was to strengthen the processes so that this beautiful thing does not cease to exist.

There is also the example of Kenya, where trips were made to each community to attend to their specific needs. Mentors and members of

the coordinating team participated in these trips, but also representatives of the School's students. In addition to directly addressing the needs in each community, this allowed the participants to become involved in the search for solutions to the problems faced by their peers through the application of the knowledge they had acquired.

This was reinforced in cases such as Brazil, where many of the participants are indigenous communicators. From the beginning, the Amazon School had a very important component in community communication and many of the projects that concluded have a radio broadcasting component. They are also linked to forest defense movements such as Guardianes del Buen Vivir (Guardians of Good Living). This gave this school a special personality closely linked to the sharing of contents and the reflection on the importance of communication so that their territory does not suffer any more extractivist attacks.

Finally, an important part of the NSCNs methodology was the formation of advisory committees to which, in addition to the grassroots organizations that took the training, different stakeholders such as academia, technical experts, representatives of regulators, community leaders, etc. were invited. This allowed the networks to focus not only on the participants of the NSCNs but also to strengthen key links with other actors for the continuity of their projects. As was the case in South Africa where the closing of the School was a presentation of the grassroots organizations' projects to potential donors and partners.

4.4 Final notes

As we have discussed in this brief overview, the solution for the third of the world's population (ITU, 2023) that is not a telecommunications user goes beyond coverage or connectivity; it also has to do with affordability, the relevance of services and content, the ability to use devices and gender gaps. A challenge that is also accompanied by increasingly harsh processes of climate change and extractivism that these same still unconnected communities have to face.

However, it is also essential to move away from a way of thinking that puts technologies at the center and thinks in terms of homogeneous

solutions. There is something wrong here and it is related to a way of understanding technologies from a digital determinism or, as Landon Winner (2010) prefers to call it, Technological Somnambulism. In other words, it is necessary to go beyond the logic in which international organizations, governments and companies provide resources and undertake actions that have little or nothing to do with the realities and/or needs of the community in order to "include" them in the digital world.

In this scenario, training processes from a community logic, such as the NSCNs, allow reflections and processes of construction of local solutions that escape from technological adoption as an end and thus significantly access telecommunications services. This implies not only the training of people in the communities, but also the creation of learning processes based on the ways of life and the ways of transmitting knowledge in each territory, escaping from the instrumentalist vision of education for digital inclusion (Angulo, 2023).

In this way, training processes of this nature will contribute to strengthening the life and territory of the communities, avoiding the incursion of technologies that destroy the community's ways of life and promote extractive processes.

Internet Access, Freedom and Empowerment of the Tea Tribe and Adivasi Community in Assam in India: An Initiative in Community Network

By Osama Manzar and Dr Syed S. Kazi

Abstract

Access to the internet has become an essential tool for economic and social development in the 21st century. However, many marginalized communities, such as the Tea Tribe and Adivasis in Assam in India, have been left behind in the digital divide due to historical, social, economic and institutional exclusions as an indentured labour community. This abstract explores the transformative potential of the Community Network (CN) in bridging this gap and empowering these communities. The Tea Tribe and Adivasis, often residing in remote tea gardens and forested regions in Assam, are perennially facing socio-economic challenges due to limited access to education, healthcare, and economic opportunities. The CN is a community-driven initiative that leverages existing mobile network and internet connectivity, creating a digital bridge to these underserved areas. Through CN, the tea tribe community members are gaining access to critical information, educational resources, healthcare information, public schemes, citizen entitlements, and alternative opportunities. Additionally, the internet, through the garden level Community Internet Library (CIL), provides a platform for preserving and promoting their local oral *Sadri* dialect, local heritage, and traditions. Internet access not only empowering these communities' information and services wise, but also playing a crucial role in fostering social and civic awareness. This paper highlights the potential of the Community Network as a transformative force, bringing internet access, freedom, and empowerment to the Tea Tribe and Adivasis in Assam.

4.5 Introduction

The tea tribes and Adivasis of Assam are around 6.5 million people in the Assam State of India in the North East India region, making up 20% of the State's population across 20 districts. They are descendants of Adivasis (indigenous) largely from the Chotanagpur region in present day Jharkhand State, brought by the British colonial administration as indentured labourers in the mid-nineteenth century. Over the years, the plight of the tea community has been largely documented. The globalized 21st century and the recent coronavirus pandemic has brought in the importance of a digitalized world. Not surprisingly, digital exclusion that the tea community of Assam faces has hardly been mentioned or documented.

The community, designated as Other Backward Classes (OBCs), contributes almost 53% of the country's total tea production, a major contribution to the economy. Despite this, the tea neighbourhood continues to be among the most politically, economically, and socially vulnerable resulting in limited access to crucial services, including healthcare, education, clean drinking water, and sanitation facilities.[50] This community's appalling socioeconomic situation has contributed to their continued exploitation.[51] The pay of tea workers is less than the minimum wage for agricultural laborers in Assam (only recently the wages increased to INR 260 for regular workers, though the casual workers are more and wages even lower).

50 Kazi, Dr Syed S; Patgiri, Ritwika; Singha, Dr Rajdeep (2021), Digital Empowerment of Tea Tribe: Towards Vulnerability Reduction and Unlocking Opportunities; CSDD; <https://csddindia.in/wp-content/uploads/2022/01/Digital-Empowerment-of-Tea-Tribe-Policy-Brief_Final.pdf [Accessed on 06/9/23]>.

51 Sharma, C. K. (2012). The immigration issue in Assam and conflicts around it. Asian Ethnicity, 13(3), 287-309.

The problem concerning the social welfare of the vast number of tea workers constituted one of the major considerations of the Assam Government since country's independence in 1947 (Pio, 1990).[52] To enable entitlement and social protection support, the Government of Assam, since 2004, has been implementing welfare schemes through the Tea Tribes Welfare Directorate. However, unless the beneficiaries are made conscious of this aspect, the purpose of the social security programme is likely to remain under-fulfilled (ibid). In the digital age, the convergence of historical isolation and the digital divide compounds the challenges faced by the Tea Tribe and Adivasi communities, perpetuating their marginalization.

4.6 State of Access in Tea Tribe and Adivasi Community

The data availability of tele density for every district of Assam is very poor. The total telecom / mobile subscriber base in Assam (India) as of 31st March, 2020 was 23.49 million. The rural tele density of Assam is 47.11 per 100 which is lower than the all-India average of 58.54. There is a lack of data when it comes to district wise access to network and devices.

A study on improving access to information in tea gardens in 6 districts of Assam in 2019,[53] however, gives some information on access to the internet. The districts covered in this study include Dibrugarh and Tinsukia, two of the largest tea districts in India. The table below lists the percentage of access to the internet by tea tribes in six tea districts of Assam.

Status	Percentage of Tea Tribe Community Having Access to Internet (number of people responding in the survey)
No Internet Access	47% (1259)
Have Access to Internet	53% (1420)

Table 1: Status of Internet Access in Gardens (Source: Improving Access to Information in Tea Gardens in Six Tea Tribe Districts of Assam, 2019; Digital Empowerment Foundation).

52 Pio, S. (1990). Socio-physical factors in the development of tea industry in Assam, A case study of three tea estates (Doctoral dissertation).

53 Kazi, Dr Syed S. (2019); Factors Determining Access to Public Schemes Information and Entitlement Benefits for the Tea Tribe Community: A Qualitative Study in Assam <https://www.defindia.org/wp-content/uploads/2021/09/Factors-determining-access-to-entitlement-of-the-tea-tribe-community-in-Assam.pdf [Accessed on 07/09/2023]>.

47% of individuals not having access to the Internet may not seem like a large percentage. But when compared with the national and global averages, according to the World Bank data, this remains low. The global average is 50%, however, it is much higher for developed countries like the US (87%), France (82%), Canada (91%), Australia (87%).[54] In India, there are around 54 Internet subscribers per every 100 people. The internet access among the tea tribes, when compared to this, is not an ideal picture. Besides, the percentage of the population among tea tribes who are found connected may not enjoy meaningful connectivity.

While people in the tea gardens can have access to basic Internet, that still does not imply being able to use the Internet. One reason, apart from the lack of digital literacy, is the poor speed of the Internet in these areas. The table below gives an idea.

Internet Access	Speed
16 Tea Gardens	< 512 kbps
9 Tea Gardens	> 512 kbps

Table 2: Internet Speed in Tea Gardens (Source: Improving Access to Information in Tea Gardens in Six Tea Tribe Districts of Assam, 2019; Digital Empowerment Foundation).

The above table reveals that mere access to the Internet is not sufficient to draw an analysis, and it is evident that the speed in the 6 districts surveyed is far from the optimum speed. The survey also tried to understand the presence of community libraries, community centres, and other spaces that provide public internet. The table below provides the data for this.

Community Access Provision in Tea Gardens to Device and Internet (Community Library, Community Centre and others)	
No Provision for Community Access	98%
Provision for Community Access (Café or Local Digital Service Centre nearby)	2%

Table 3: Community Access in Tea Gardens (Source: Improving Access to Information in Tea Gardens in Six Tea Tribe Districts of Assam, 2019; Digital Empowerment Foundation).

54 Kawoosa, K.M. (2020, August 14). Connectivity Gets Better But Parts of India Still Logged Out. Hindustan Times. <https://www.hindustantimes.com/india-news/connectivity-gets-better-but-parts-of-india-still-logged-out/story-VSqXriMdGUudWb7eBcWzjN.html [Accessed on 07/09/2023]>.

Only 2% of the tea population in the 6 districts surveyed has access to such public spaces. This has an appalling number and reflects the lack of digital infrastructure in the tea districts.

The survey further reveals that 46% of women have no access to the internet while the overall percentage of not having access is 47%. The table below provides the information.

Internet Access	Gender (Girls and Women) Access
Women / Girls have no Internet Access	401 (46%)
Women / Girls have Access to Internet	471 (54%)

Table 4: Gender access to Internet (Source: Improving Access to Information in Tea Gardens in Six Tea Tribe Districts of Assam, 2019; Digital Empowerment Foundation).

Overall, the access scenario last mile in remote tea gardens and in the community is still a distant opportunity in terms of ease of access, services and provisions.

4.7 Building Opportunities, Leveraging Technology: Network for the Community

The mounting evidence that current efforts to meet international goals for increasing Internet connectivity are likely to fall short has heightened interest in alternative connectivity models such as community networks.[55] Schuler (1994) thinks that community networks must address community needs and Bidwell (2019) points to the potential economic gains motivate stakeholders to consider community networks.

In this context, the Building Opportunities/Leveraging Technologies (BOLT), by the Internet Society Foundation, seeks to focus on building technical and social innovations related to Internet connectivity that strive to be – cost-reducing, environmentally sustainable, trust-enhancing, relevant to users and community, imaginative and engaging in experimentation and play, and accessible.[56]

55 LGwaka, L., Haseki, M., & Yoo, C. S. (2022). Community networks as models to address connectivity gaps in underserved communities. Information Development, 02666669221089658.

56 <https://www.isocfoundation.org/grant-programme/bolt-grant-program/ [Accessed on 07/09/23]>.

4.8 The Network Solution for the Tea Tribe & Adivasi Community in Assam, India

In the context of inaccessible remote tea gardens and with the support of BOLT, the implementation of the 'Internet Roshni (Light)' network solution in 50 tea gardens in Assam across 5 districts had provided an opportunity to Digital Empowerment Foundation (DEF) in early 2022 to co-facilitate last mile access services by and for the tea tribe and Adivasi community. The network for the community involved plan and implementation by the local youths centred on setting up community access points (Community Internet Library – CIL) in each remote garden by setting up a 4G LTE router with SIM boosting the GSM signal locally through its powerful wireless antennas.

By connecting the Government's Prime Minister Wireless Access Network Interface (PM WANI) scheme integration,[57] with the 4G LTE router with SIM through the Ethernet Cable (Cat6), Wi-Fi coverage has been deployed. The advantages of the PM WANI router are threefold: a) data receiving/transmission speed between 100-150 Mbps; b) Use of Wi-Fi frequency bands of 2.4 GHz and 5.8 GHz; and c) AAA (Authorization, Authentication & Accounting) compliance. However, the model poses a constraint as it will provide 360° Wi-Fi coverage till only 150 feet or 0.05 km, that too without obstruction to signal. As a s**ub-solution:** Omni Antenna or Sector Antenna is attached to the PM WANI router through the Ethernet Cable (Cat6) to boost the 360° Wi-Fi coverage area to 2-3 km connecting local clients through outdoor Customer Premises Equipment (CPE) to access the Wi-Fi.

4.9 Community Network and the Freedom of Access

The establishment of Community Networks in 50 tea garden communities has extended the reach of access to more households through the garden-based CILs as WIFI access points. Before the project, 76% of the households (HHs) out of 956 HHs covered in the baseline had slow and limited access to the internet, and post

57 <https://dot.gov.in/sites/default/files/202-_12_11%20Brief%20PM%20WANI_0_0.pdf?download=1 [Accessed on 09/09/23]>.

project, the coverage increased for approx. 96% of the HHs and beyond. In approximate terms, the total number of beneficiaries that were covered under the BOLT Internet Roshni Project with Community Network access has been 19911 till date.

Percentage of households with access to the internet before and after the project	
BEFORE THE PROJECT	AFTER THE PROJECT
76% out of 956 HHs	95 % of 956 Households

Relatedly while the speed of access in tea gardens has been an 'all known' story of frustrations and inability to avail timely and relevant information, the network through the CILs contributed to increase in average speed of access from 2 MBPS to 10 MBPS for the users.

Speed and reliability of internet connections	
BEFORE THE PROJECT	AFTER THE PROJECT
ON AVERAGE 2 MBPS	ON AVERAGE 10 MBPS

Network access has no relevance if access to digital literacy and skills are not available.

Through the 'Internet Roshni' project network, digital skills became an utmost priority to prepare the locals with focus on the adolescents and the youths who can further reach out to families and locals.

Number of community members who have received digital literacy training and online educational resources and opportunities	
BEFORE THE PROJECT	AFTER THE PROJECT
The community did not have access to proper digital literacy.	1834 Community Members were imparted with Digital Literacy and accessed online resources including scholarships

The network has a positive educational access transformation in the adolescents and the youth with students participating in online learning and opportunities like scholarships.

While the project baseline indicated close to 45% using the internet somewhat for education, work and services purposes, the network support through the CILs scaled up this access to nearly 92% of the population of each garden. This also indicates that to carry out

high-speed services, the CILs proved essential for increasing demand and uptake for services.

Percentage of community members using the internet for education, work, accessing government services, or other purposes	
BEFORE THE PROJECT	AFTER THE PROJECT
AROUND 45 TO 52 %	92%

The network played a role in involving young women and girls to access the CILs, the devices for learning and access and availing opportunities and services within their garden ecosystem that is safe, secured, timely and at ease.

Percentage of women participating in internet-related activities and digital literacy programs	
BEFORE THE PROJECT	AFTER THE PROJECT
Prior to the CN facility, there were no public access to network and devices for the poor women and girls.	Till Date 7970 girls and women got access to digital literacy and activities.

4.10 Sustainability of the Network

Klaus Stoll (2005) studied the introduction of Wi-Fi in a remote, poor village in the Ecuadorian rainforest El Chaco. He shows that the people in El Chaco asked: "How can we make it sustainable not only in a financial but also in a technical, social, cultural and political sense?" (Stoll 2005, 192). Douglas Schuler (1996) uses the term sustainability of what he considers to be community networks' six core values of conviviality, co-operative education, strong democracy, health and well-being, economic equity, information and communication. This particular 'Internet Roshni' CN project is interpreted at 4 levels in terms of sustainability – Environmental, Economic, Political and Cultural level.

4.11 Environmental Sustainability

De Decker (2015a) and others have highlighted the energy aspect of WIFI networks and devices with focus on establishing connections that consume relatively low amounts of energy and low operational costs. The 'Internet Roshni' network has deployed short range WIFI

that is indoor and outdoor (10-15 m range) and omni device network for clients with 150-200 metres range, with clear line of sight. The spectrum band used is 2.4 and 5 GHZ, as allowed by the government with minimum radiation impact on the environment. The Mikrotik and TP LINK routers are used with 12 volts energy usage and 0.5 ampere. There is energy efficiency in the routers being used with re-usable and updateable scope.

4.12 Economic Sustainability

Understanding economic sustainability of community networks is the bigger question. Alternative, non-commercial, non-profit media and technology projects in general face existential threats in a capitalist environment (Fuchs 2010a, Sandoval and Fuchs 2010). Schuler (1996) discusses as funding options support by direct users or indirect users.[58]

The economic sustainability of the tea garden CN is based on a plan on how the necessary resources can be guaranteed and maintained in its maintenance and operation. The set-up cost of one garden network including the CIL with the PM-WANI network integration has come around USD3000. The network is currently run with payment for certain services, membership fees, and support by participating organisations. With this, the network is allowing the "principles of neutrality that allow contents and services to flow without deliberate interference".[59] The second entails support by foundations and this support has come from the Internet Society Foundation (ISOC) and the Digital Empowerment Foundation.

4.13 Political Aspects of Network and Access

Armin Medosch (2015) argues that "free networks contribute to the democratisation of technology" because users are involved in the establishment and maintenance of technology.[60] Antoniadis and Apostol (2014) write that community networks can make a

58 Schuler, D. (1996). New community networks: Wired for change. ACM Press/Addison-Wesley Publishing Co.

59 http://guifi.net/en/FONNC , accessed on February 8, 2016.

60 Medosch, Armin. 2015. The Rise of the Network Commons. Book draft (accessed on February 8, 2016). http://www.thenextlayer.org/NetworkCommons .

contribution to fostering participatory democracy.[61] The tea garden network has enabled ease of access to the last mile, participation of the community and local stakeholders including Women Self Help Groups (SHGs), that was not possible earlier due to long distances of travel and costs to go out of the remote gardens and get access and services.

4.14 Cultural Aspects

A survey conducted among 22 community networks shows that providing local education and training in technical skills is an important activity of such projects (Dimogerontakis et al. 2016). The tea garden network engaged more than 2000 tea tribes and Adivasi adolescents and youths, including girls and young women, in digital and internet skills. More importantly, the 50 Soochnapreneurs (information entrepreneurs including male and female) from the local community manning the network and CILs are being trained in networking management to support the community with ease of access and services.

61 Antoniadis, P., & Apostol, I. (2014). The Right (s) to the Hybrid City and the Role of DIY Networking. The Journal of Community Informatics, 10(3), 1-14.

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This book is the Official 2023 Outcome of the Dynamic Coalition on Community Connectivity (**DC3**) of the United Nations Internet Governance Forum (IGF). DC3 is a multistakeholder group, fostering a collaborative analysis of **community networks** (CNs), exploring how such initiatives can improve and expand connectivity while empowering Internet users.

As the DC3 has demonstrated over the past eight years, community networks represent an important complementary strategy that can foster not only connectivity but also a community-based conception of environmental sustainability and digital sovereignty. CNs are crowd-sourced collaborative networks, developed in a bottom-up fashion by groups of individuals – i.e., communities – that design, develop and manage the network infrastructure as a common resource. Hence, CNs are connectivity initiatives managed according to the governance models established by their community members, in a democratic fashion, and may be operated by groups of self-organised individuals or entities such as non-governmental organisations (NGOs), local businesses or public administrations.

CNs should not be considered as a competing or antagonistic model either to the state or to the market. On the contrary, they should be seen as a particularly interesting complementary solution to fill the existing connectivity gaps.

All previous DC3 publications can be found at **www.comconnectivity.org**

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