

IEEE
Future
NETWORKS

Enabling 5G and Beyond



**International Network
Generations Roadmap (INGR)
Virtual Workshop
Connecting the
Unconnected**

Sudhir Dixit
Ashutosh Dutta
CTU WG Co-Chairs
16 June 2020

10-year Vision

- By 2030, every adult should have affordable access to digital networks, as well as digitally-enabled services in industry verticals, as a means to make a substantial contribution to achieving the UN's Vision 2030 Sustainability Development Goals (SDGs)
- Access to Information is transformational to improve quality of life of every person on this planet, requiring ubiquitous access to broadband Internet
- Digital enablement is faster and much less expensive than building physical infrastructure
- Broad, multi-stakeholder alliance, involving the UN is a must to create a platform for sharing digital public goods (DPGs), engaging talent and pooling data sets, in a manner that respects privacy and engages those who are expected to benefit
- IEEE FNI INGR WG on CTU endeavors to bring all the global initiatives on a single forum to raise awareness to bridge the digital divide, identify requirements, drive standards, and create critical mass to bring down cost of broadband access.

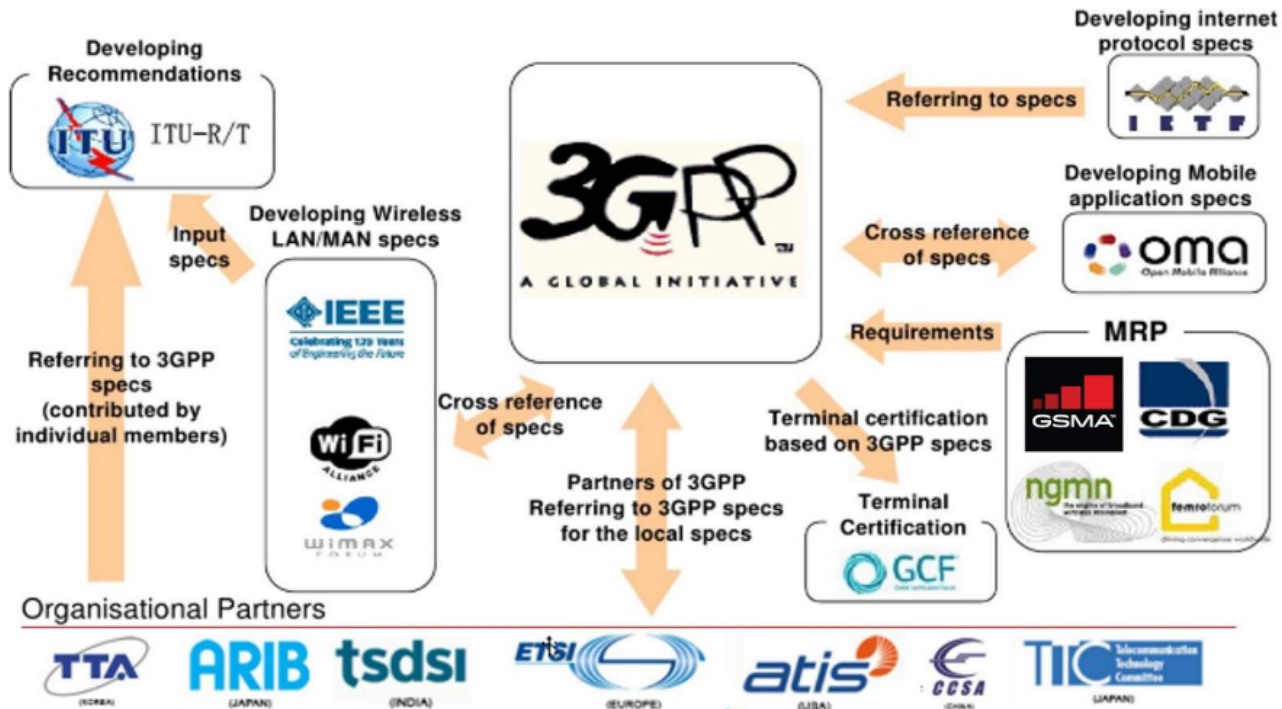
Scope

- Focus on technical requirements and commercial sustainability
- Address issues, requirements, and solutions to affordable backhaul to remote and rural areas
- Identify solutions to providing local coverage with the micro-operator service model
- Identify high priority needs of those living in rural areas
- Develop open network architecture where the target user segment could participate, where content is delivered from the edge (from local servers) and is potentially free of charge
- Raise awareness to HCI/UI which is compatible with the capacity of the target user community (digitally illiterate); i.e., migration from text based UI to audio and video in local languages
- Simplified authentication and security solutions
- In Dec 2019, a high level overview of the CTU Group and its ambition along with the scope of the WP was provided
- 1st edition in June 2020 provided a more detailed set of requirements, gaps and roadmap
- 2nd edition (in Nov 2020) will provide progress toward filling the gaps and potential solutions

Today's Landscape

- Significant emphasis on enabling 5G and B5G to meet high-end requirements of the developed markets, not much on how 5G and B5G can meet the challenges of the developing world
- Technologies of NFV, edge computing and cloud not being investigated for the CTU, despite them being suitable to reduce CAPEX and OPEX
- mmWave not suitable for rural coverage, instead lower bands are more suitable
- Need more lenient regulatory environment for rural connectivity
- Micro-operator eco-system that interworks with the large operators required
- Innovations in business models required, such as Freemium, credits for sharing resources, boosting proliferation
- Community engagement with local population must to make services relevant and affordable by reducing OPEX
- Use of TVWS is desirable to lower backhaul costs
- Collaborate with organizations with similar goals for economy of scale and global harmonization

Potential Collaboration Opportunities

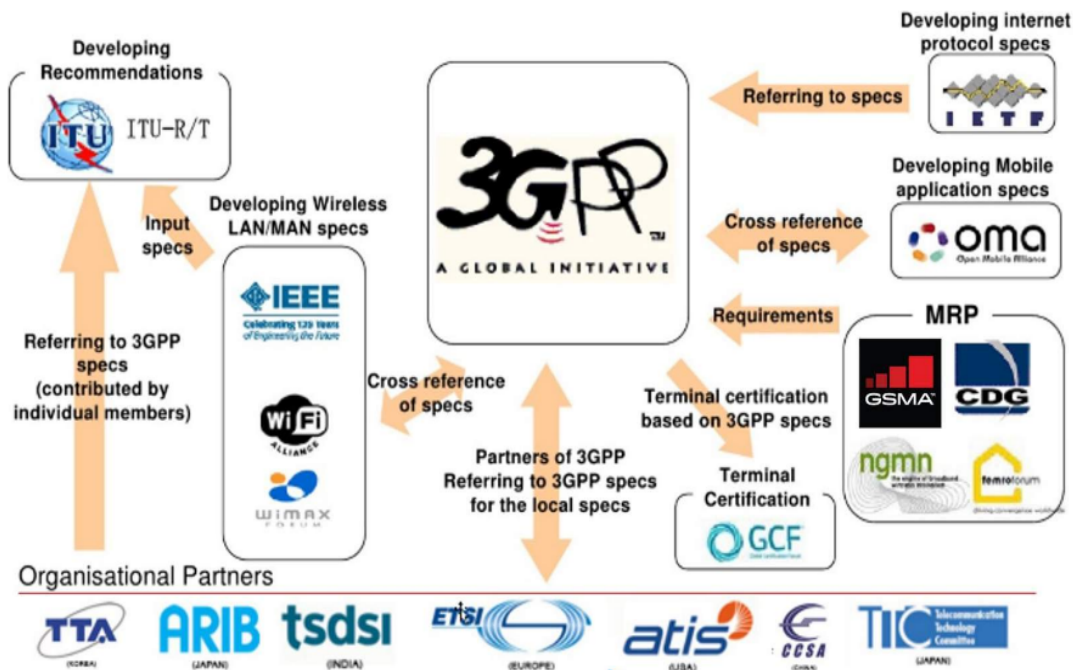


Top Needs for 10-year Vision

- Availability of low-band spectrum for long-reach, including TVWS, Low-Altitude satellites and balloons
- Cost-optimized open and distributed network architectures and standards that promotes community participation
- Cost-effective local coverage solutions with community engagement to reduce CAPEX and OPEX
- Intelligent reflecting antenna repeaters, Long-range Wi-Fi, and FSO for backhaul in rugged NLOS terrain scenarios
- Dedicated CTU network slice in 5G and B5G as a tax on operators for social good
- Edge-based content storage and delivery architectures to improve QoS and reduce costs
- Cost-effective access to renewable energy sources where grid is unavailable or intermittent
- Simplified HCI (Human Computer Interface), user authentication and security
- Innovation in business models with inclusion of human-impact KPIs and participation of users in the business eco-system
- Tiered regulatory regime for varying population segments based on regions and affordability with support from USOF (Universal Service Obligation Fund)

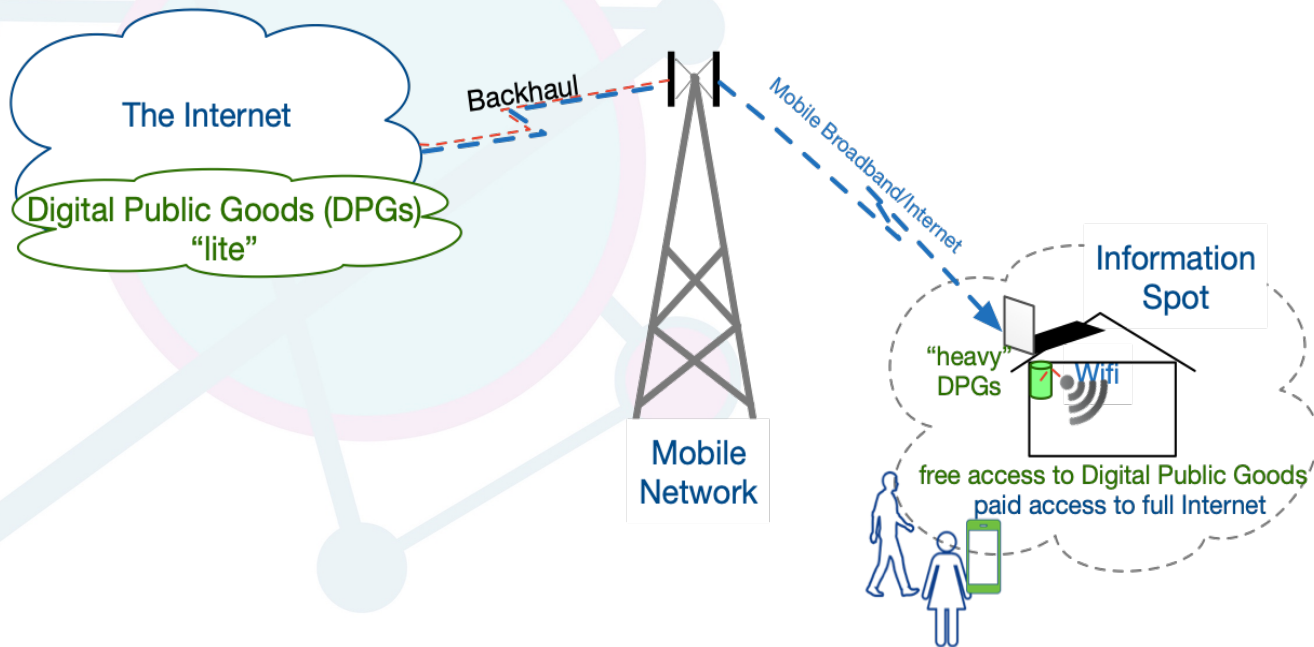
Challenges and Solutions to Meet Needs (1/9)

(1) Cooperation and collaboration to create critical mass and global visibility



Challenges and Solutions to Meet Needs (2/9)

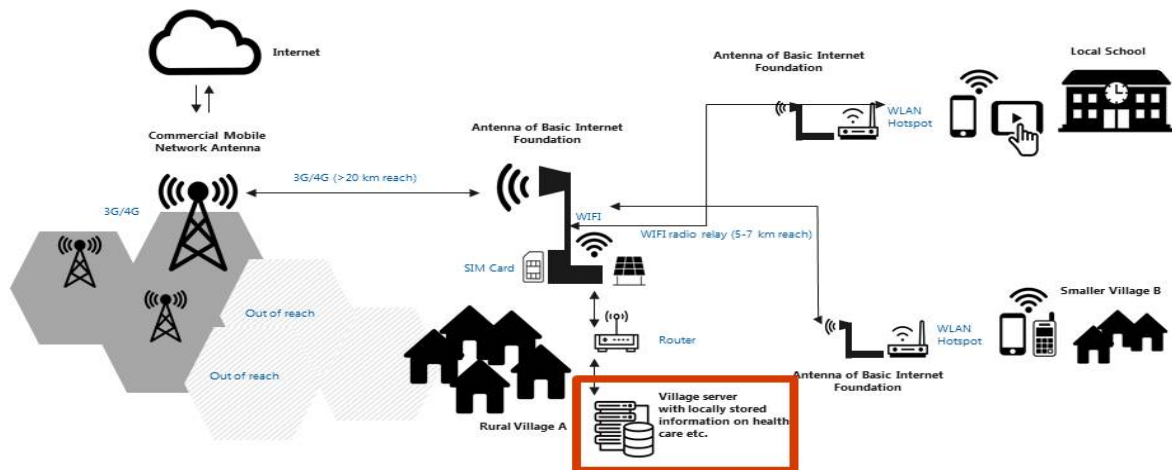
(2) Community Networks



Courtesy: Basic Internet Foundation

Challenges and Solutions to Meet Needs (3/9)

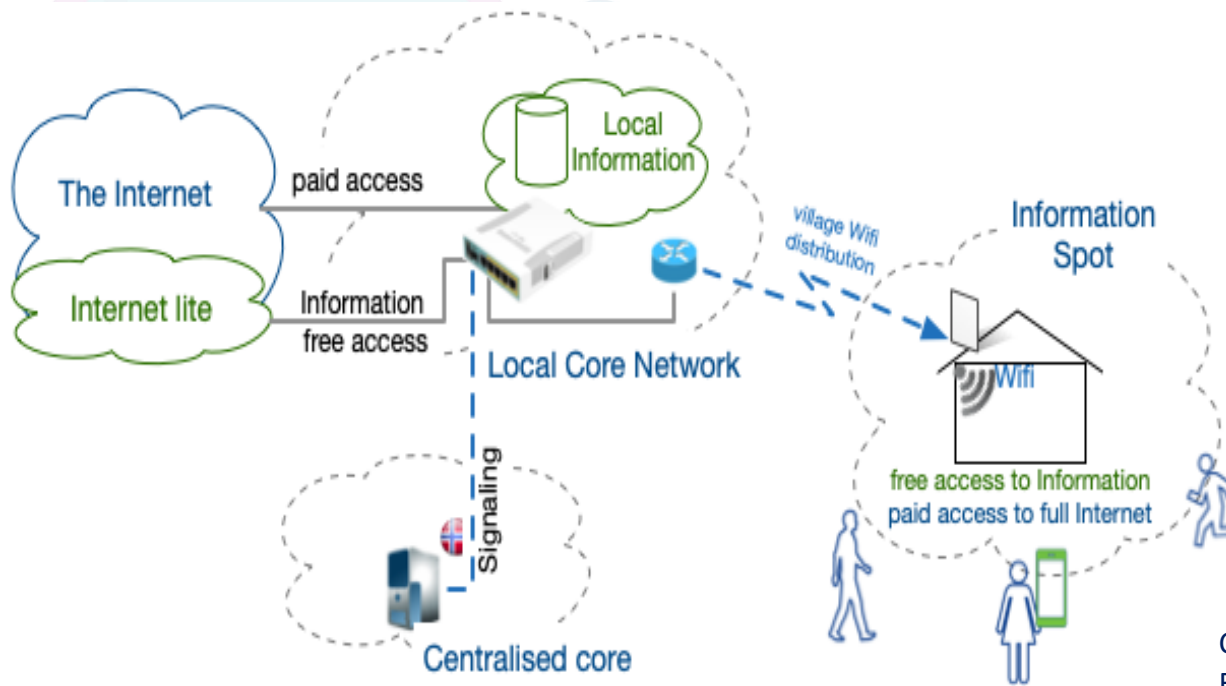
(3) Distributed and Open Architecture



Courtesy: Basic Internet Foundation

Challenges and Solutions to Meet Needs (4/9)

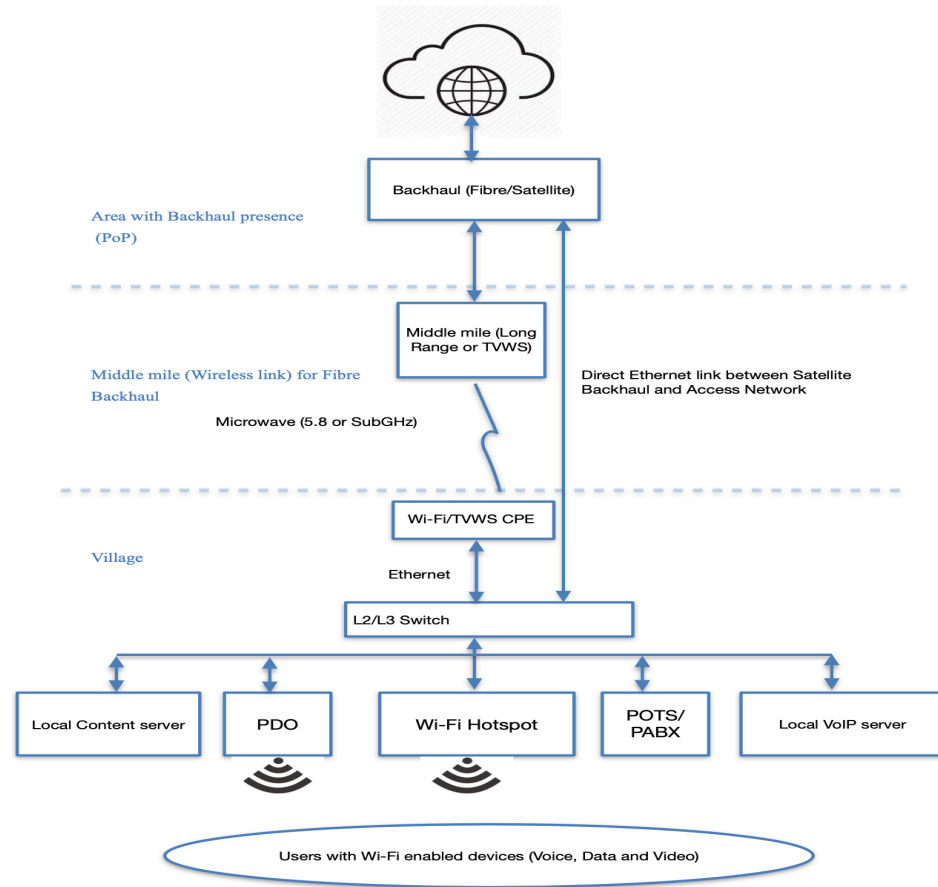
(4) "Network slice for All" to Bridge the Digital Divide



Courtesy: Basic Internet Foundation

Challenges and Solutions to Meet Needs (5/9)

(5) Affordable Backhaul, Midhaul and Access

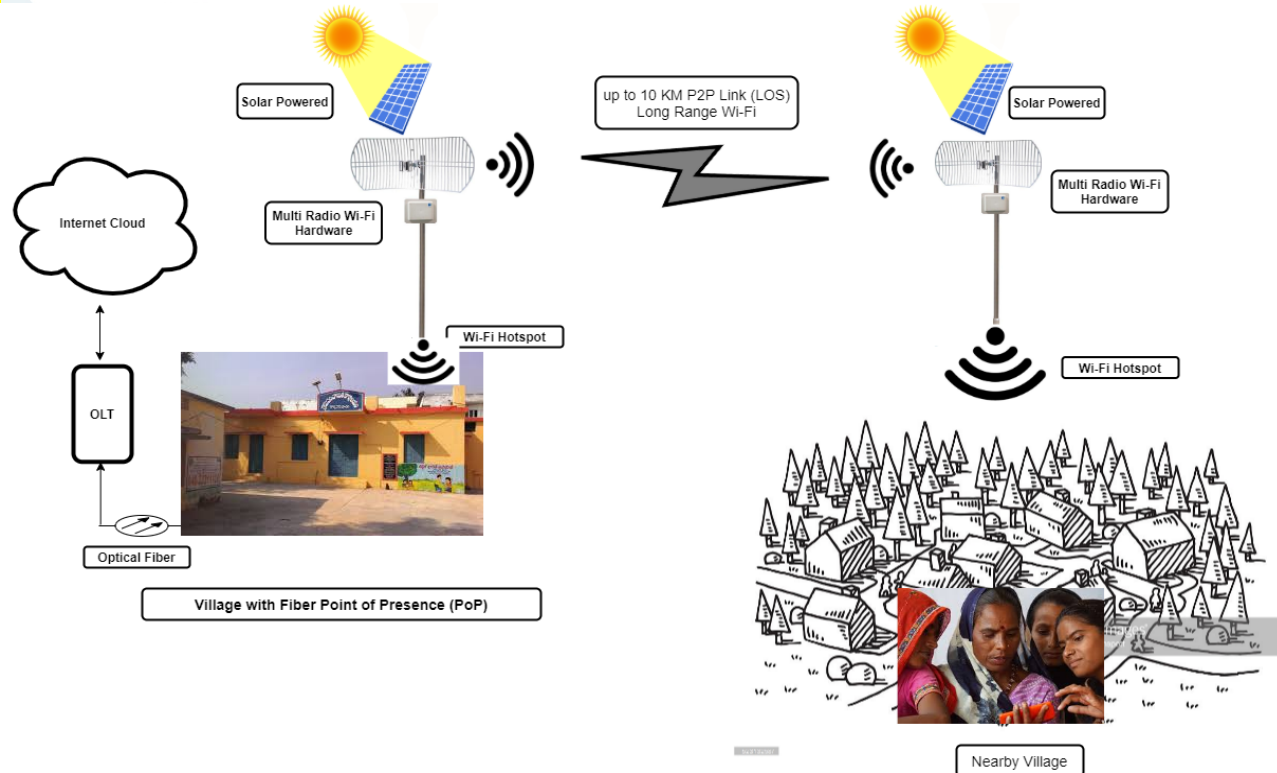


Enabling 5G and Beyond | FutureNetworks.ieee.org/ro

Courtesy: C-DoT

Challenges and Solutions to Meet Needs (6/9)

(6) Widespread Commercialization of LR Wi-Fi

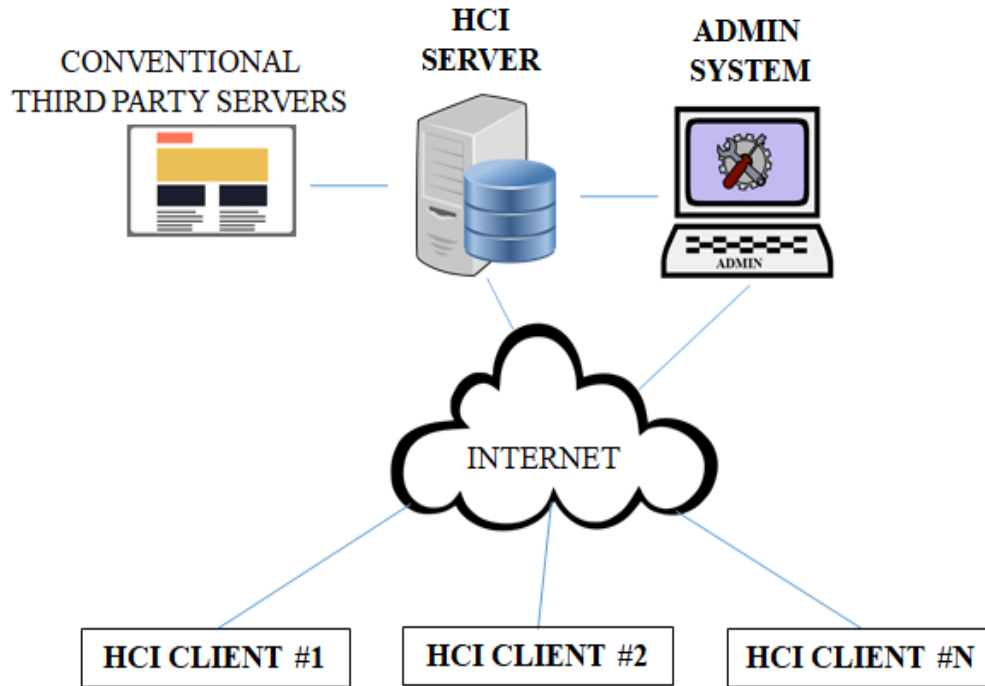


Extending Rural Broadband to nearby villages through Wi-Fi Access & Middle mile with Fibre Backhaul

Courtesy: C-DoT

Challenges and Solutions to Meet Needs (7/9)

(7) Simplified Non-text HCI



Courtesy: C-DoT

Challenges and Solutions to Meet Needs (8/9)

(8) Simplified User Authentication and Security

- APP based authentication
- QR code based authentication
- Audio based authentication
- Face recognition
- Biometric authentication
- MAC-based authentication
- Mobile + OTP
- Password protected Wi-Fi configuration
- Require use of https

Challenges and Solutions to Meet Needs (9/9)

- **Spectrum Refarming and Regulatory Relief**
- **Innovative Business models promoting user participation and micro-operator eco-system**
- **Network resource sharing**
- **Local capacity building to absorb technology**
- **Uninterrupted availability of power and use of renewable energy sources**

Stakeholders

Users, Governments, Network operators, Service and App providers, manufacturers

At IEEE FNI INGR: Several (15) Working Groups (<https://futurenetworks.ieee.org/roadmap>)

Contributing Working Group Members to the White Paper

Sandeep Agrawal
Daniel Altamirano
Marvin Arias Olivas
Vimal Bhatia
Sudhir Dixit
Ashutosh Dutta
Pranav Jha

Matogoro Jabhera
Amit Karna
Sanjram Premjit Khanganba
Catherine Kimambo
Roman Lara-Cueva
Nelson Wasilwa

Get involved!

Working Group Members

Addisalem Genta	addisalemgenta@yahoo.com
Annemijn Perrin	emea@digitalskillsfoundation.org
Ashtuosh Dutta	ad37@caa.columbia.edu
Brad Kloza	b.kloza@ieee.org
Carlos Martinez	carlos.elsalvador@ieee.org
Catherine Kimambo	africanchildprojects19@gmail.com
Daniel Altamirano	cdaltamirano@espe.edu.ec
Felix Sukums	sukums@gmail.com
Gulzar Azad	gulzar@google.com
Hana McTaggart	hanam@loon.com
Humphrey Muhindi	hmuhindi@comsoc.org
Ivan Seskar	seskar@winlab.rutgers.edu
Josef Noll	josef@jnoll.net
Joseph Bishi (Zimbabwe)"	bishji@gmail.com
Julius Kusuma	jkusuma@fb.com
Ken Riordan	riordank@loon.com
Linda Wilson	linda_wilson1225@IEEE.ORG
Marvin Arias	marvin.arias.phd@ieee.org
Narendra Mangra	nmangra@ieee.org
Pranav Jha	pranavjha@ee.iitb.ac.in
Robert Owino (AHERI)"	owinor@aheri.org
Roman Lara	ralara@espe.edu.ec
Sanjram P. K."	sanjrampk@iiti.ac.in
Sandeep Kumar Agrawal	sandeepa@cdot.in
Sudhir Dixit	sudhir.dixit@ieee.org
Theresa Cavrak	t.cavrak@ieee.org
Vimal Bhatia	vbhatia@iiti.ac.in
Amit Karna	amitk@cdot.in

For additional information, contact the
CTU WG Co-Chairs

Sudhir Dixit: sudhir.dixit@ieee.org

Ashutosh Dutta:

ashutosh.dutta@ieee.org

If you would like to join the working
group please send mail to:
5GRM-connecting@ieee.org

Next Steps

- Periodic Working Groups Meetings
- Work on the second edition of the Working Group document
- Bring Your Research Ideas, Talks to discuss in the meeting
- CTU Workshops, Conferences
- CTU Webinars and Podcasts
- CTU Hackathon, Proof-of-Concept
- Industry and Standards Engagement

Cross Team Meeting Schedule for June 17 and 18

Please contact working group co-chairs if you are interested to attend, we will share the webex links

Contacts: CTU Working Group Co-Chairs

Sudhir Dixit: sudhir.dixit@ieee.org

Ashutosh Dutta: ashutosh.dutta@ieee.org

June 17

Start Time	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM
Apps & Svcs AI ML					Apps & Svcs Deployment		EE Hardware	Apps & Svcs EE		EE Deployment	
			EAP Massive MIMO	EAP Security		EAP Standards	EAP Testbed				
	Satellite Standards	Satellite Testbed			Massive MIMO Hardware		Massive MIMO Deployment	Massive MIMO Standards			Deployment CTU
					Standards CTU	Sys Opt CTU		Security Sys Opt		CTU Testbed	Sys Opt Testbed
						Satellite Security	Satellite AI ML				
			Security AI ML								

June 18

Start Time	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM
	Apps & Svcs Satellite				AI ML EAP	Apps & Svcs EAP			Apps & Svcs Security		Apps & Svcs Sys Opt
	AI ML Massive MIMO					AI ML CTU		EAP EE	EAP Deployment		
						Security Testbed	Standards Testbed	Standards Security		EE Sys Opt	
									AI ML Testbed		