Role of Wi-Fi 6 in Broadband Access and Rural Connectivity

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Agenda

- Wi-Fi 6 – Technical Attributes

- Public Wi-Fi Networks

- Wi-Fi 6 and 5G
  - 5G Use Cases/Services and Wi-Fi 6

- Wi-Fi 6 and Rural Broadband Connectivity
  - Rural Broadband Connectivity in India - Challenges
  - IEEE P2061 Network Architecture
  - BharatNet
  - CSC Wi-Fi Choupal

Wi-Fi 6 - Key Technical Attributes

- Dual-band - 2.4 and 5 GHz

- OFDMA Support
  - Large Number of Subcarriers - 1024
  - Long Symbol Duration - 12.8 µs
  - High Modulation Order - 1024 QAM

- Data Rate - 9.6 Gbps

- Large Channel Bandwidth – Up to 160 MHz

- 8x8 MU-MIMO - Both Downlink and Uplink
  - Supports Up to 8 users Simultaneously

- Uplink Resource Scheduling by Access Point
  - Centralized Scheduling – Improved Contention Handling

Public Wi-Fi Networks

- Wi-Fi Technology Usage by Mobile Users[1]
  - Major Economies : 50 -70% of Total Usage Time
  - India : < 10%

- Public Wi-Fi Hotspots
  - Globally 169 million Public Wi-Fi Hotspots in 2018[2]
  - Expected to reach 600+ million in 2023
  - India – only 0.1 million Public Wi-Fi Hotspots in 2018

1 – TRAI Recommendations on Proliferation of Broadband through Public Wi-Fi Networks
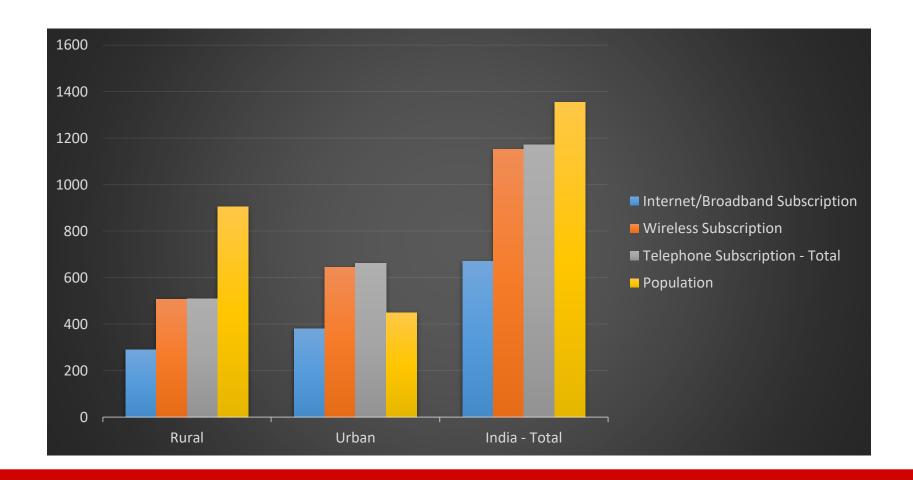*2 – Cisco Annual Internet Report (2018–2023)*

Public Wi-Fi Networks – Policies in India

- National Digital Communication Policy 2018
  - Wi-Fi Hotspots - Key Mechanism for Broadband Proliferation
  - Target - 5 Million Hotspots by 2020 and 10 Million by 2022
  - NagarNet – 1 Million Public Wi-Fi Hotspots in Urban Areas
  - JanWiFi – 2 Million Public Wi-Fi Hotspots in Rural Areas

- TRAI Recommendations on Public Wi-Fi Networks[1]
  - Promote Open Public Wi-Fi Access
    - Public Data Office Aggregators (PDOA) and Public Data Offices (PDO)
    - Small Entities, e.g., Shops to act as PDOs and host Wi-Fi APs
  - Utilize BharatNet Infrastructure
  - Ease of Access
    - Security through eKYC & a mix of OTP and MAC ID based Authentication
  - Payment through Electronic Means

1 – TRAI Recommendations on Proliferation of Broadband through Public Wi-Fi Networks

Wi-Fi 6/6E and 5G Use Cases

- Wi-Fi 6/6E – Important Access Technology for 5G
  - Support for 5G Use Cases (Esp. Stationary & Low Mobility Users)
- Wi-Fi Integrated with 5G Core as Non-3GPP Access
  - Shown Later
- Excellent Support for Public Wi-Fi and eMBB Use Cases
  - Hotspots
  - Work in Cloud
  - Online Classroom
  - HD Video, Conferencing
  - Virtual Reality
  - Social Networking
- Support for IoT Use Cases
  - Smart Homes
  - Smart Cities

Internet/Broadband Penetration Status: India

~675 million people do not have Broadband/Internet access in India

Internet/Broadband Access- How is it enabled?

Developed Countries

Mostly enabled through wired communication infrastructure, Fiber and DSL

Developing Countries

Cellular Technology - Primary broadband access mechanism ✓

Fiber/DSL Infrastructure - Inadequate ✗

Challenges in using Cellular Technology in Rural Areas

1. Existing/Emerging Cellular Technology Standards

- Focused on urban usage scenarios
  - Key Targets for 5G : 20 Gbps rate, 1 ms latency, 500 km/h mobility
- Challenges and Characteristics of Rural Connectivity
  - Not factored in specification and design
- Variations in use cases across regions, countries, continents ignored

2. Operators Roll our networks in urban/semi-urban areas

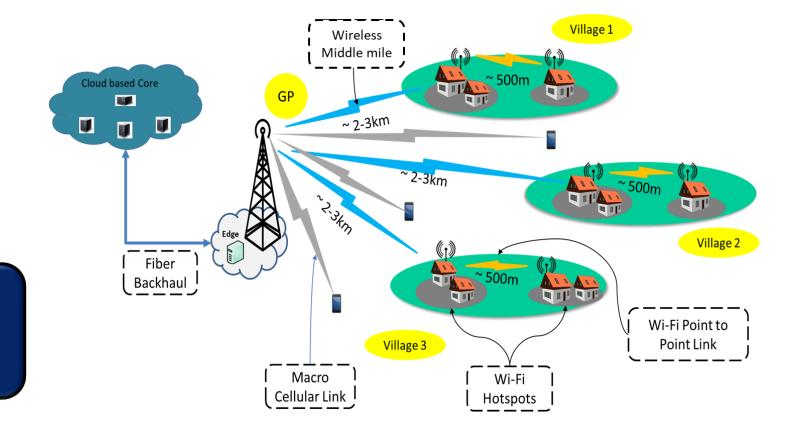- No compelling commercial reason for them to target rural areas

Rethinking 5G Requirements for Rural Areas

- Low cost Solution
  - Low Cost Backhaul Solutions - Wireless backhaul instead of Fiber
  - Lower Spectrum Cost

- Limited Mobility Support
  - Mobility required but not very high speed
  - Small no of vehicles in Rural Areas

- Energy efficient solution

- Large coverage area support

Rural Broadabd Network Architecture

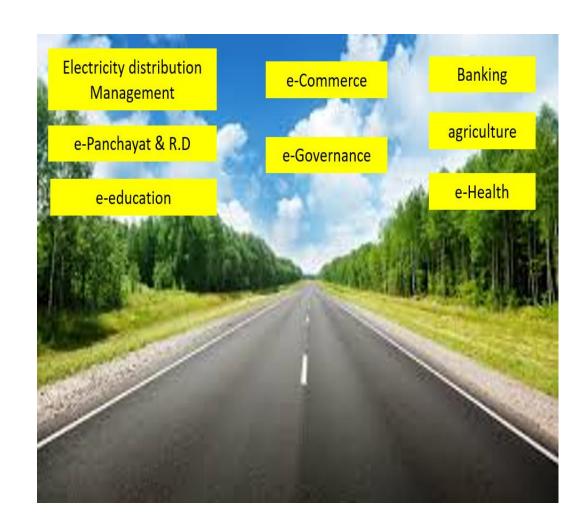Large Coverage Area Cells to provide ubiquitous connectivity

Small Cells (WiFi Hotspots) as high speed access points

Wireless Middle Mile Network to backhaul data

Point to point wireless links to connect the nodes in villages

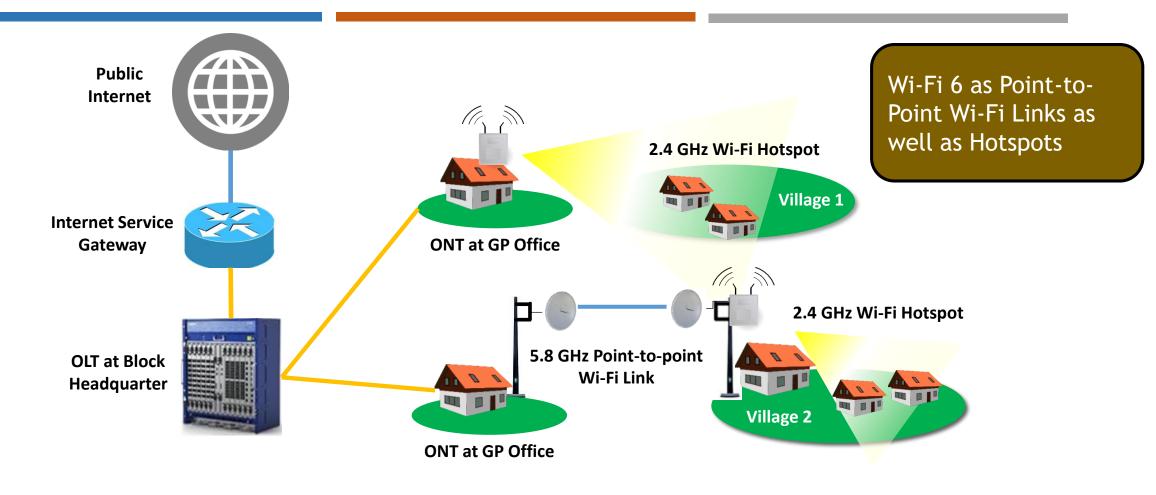Wi-Fi 6 Can Support both Wireless Backhaul and Wi-Fi hotspots

Wireless Middle mile

Village 1

Cloud based Core

GP

~ 500m

~ 2-3km

~ 2-3km

~ 2-3km

Edge

Fiber Backhaul

Village 2

~ 500m

Village 3

~ 500m

Wi-Fi Point to Point Link

Macro Cellular Link

Wi-Fi Hotspots

BharatNet

- An Initiative to Provide Broadband Access in Rural Areas
  - Through Optical Fiber Connectivity to Gram Panchayats (GPs)
- Aims to provide 1Gbps (upgradable to 10 Gbps) to 2,50,000 GPs in the country
- Challenges
  - Last Mile Access
  - Connectivity between the GP Office (ONT) and Villages
  - Irregular Supply of Electricity from the Grid
  - Maintenance of Optical Equipment and Cables (ONT and OFC)
  - Availability of skilled man power for the up-keep of Equipment

BharatNet Wi-Fi Service Delivery Model

Public Internet

Internet Service Gateway

OLT at Block Headquarter

ONT at GP Office

ONT at GP Office

2.4 GHz Wi-Fi Hotspot

Village 1

5.8 GHz Point-to-point Wi-Fi Link

2.4 GHz Wi-Fi Hotspot

Village 2

Wi-Fi 6 as Point-to-Point Wi-Fi Links as well as Hotspots

WiFi Hotspots for Service Delivery at all 2.5 Lakh GPs under BharatNet is proposed
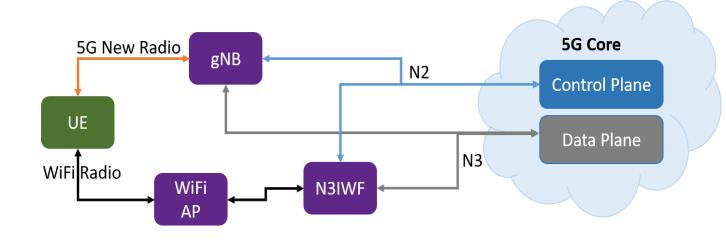
Emerging Mobile Network Architecture

Increased Network Densification

Multi-RAT Networks - Presence of 3GPP & Non-3GPP Access (e.g. Wi-Fi)

Unified 5G Core

Common Interface towards Core for Access Networks

Wi-Fi an Important Access Technology for 5G

5G New Radio

gNB

UE

WiFi Radio

WiFi AP

N3IWF

N2

N3

5G Core

Control Plane

Data Plane

**Fragmented Decision Making in RAN
Need for Unified Control of Multi-RAT RAN**

IEEE P 1930.1 – Unified Multi-RAT RAN

SDN Middleware
- Abstract Information Model of underlying RAN
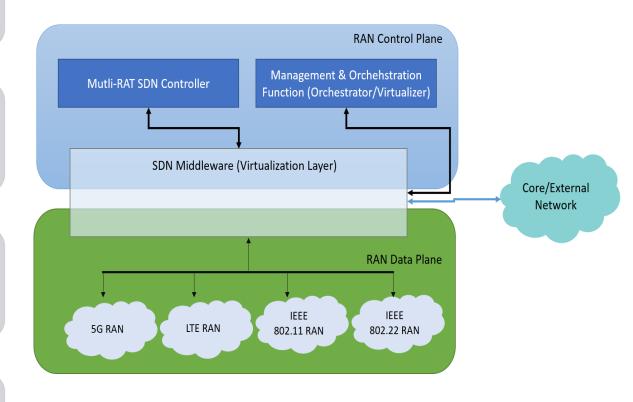- Through Virtual Network Entities

SDN Controller
- Control and Management of the Access Network

Management and Orchestration Entity
- To Orchestrate & Manage the SDN Middleware over RAN Infrastructure

Radio Access Network Infrastructure
- Access Points, Base Stations, Network Interworking Functions

RAN Control Plane

Mutli-RAT SDN Controller

Management & Orchehstration Function (Orchestrator/Virtualizer)

SDN Middleware (Virtualization Layer)

Core/External Network

RAN Data Plane

5G RAN

LTE RAN

IEEE 802.11 RAN

IEEE 802.22 RAN

Summary

- WiFi 6 offers huge opportunity for public WiFi network and support for 5G use cases

- Enabler for Low Cost Low Mobility Energy Efficient architecture for rural broadband connectivity

- Need for regulatory and policy changes
  - Fulfill the goals of NDCP 2018
  - Coexistence studies with Satellite services

THANK YOU

Wi-Fi 6 - Key Technical Attributes

- Wi-Fi 6
  - Target Wake Time
    - A Device may remain Inactive till its turn to transmit data
    - Reduced Congestion and Energy Saving (Enhances Battery Life)
  - Improved IoT handling
    - With smaller 2 MHz Resource Units and Target Wake Time
  - Support for Low-power, Low-bandwidth Devices
    - Sensors, Automation devices

- Wi-Fi 6E
  - Extended to 6 GHz Band
  - Larger Spectrum Size - 1200 MHz
  - 80 MHz Channel - 14
  - 160 MHz Channel - 7

BharatNet and CSC

- CSC – An Organization to Deliver Citizen Services
  - As Mandated by Government of India and State Govts

- Convergence of Bharat-Net and CSC
  - CSC can provide Last Mile Access through Wi-Fi Chaupal
  - CSC Maintains Optical Equipment and Cables

- Convergence would
  - Help in Effective Maintenance and Utilization of Bharat-Net
  - Strengthen Common Services Centres to Deliver Citizen Services
  - Enable access to Information, Knowledge and Skill to citizens especially in Rural Areas
  - Support Govt's Digital India initiatives and Empower Rural Communities