Gram Marg: Enabling Rural Connectivity

Abhay Karandikar
Dean (Faculty Affairs)
Institute Chair Professor
Department of Electrical Engineering
Indian Institute of Technology Bombay, Mumbai, India
karandi@ee.iitb.ac.in

Challenges in Connecting Rural India

Low Average Revenue Per User (ARPU)

Unavailability of Fiber Backhaul

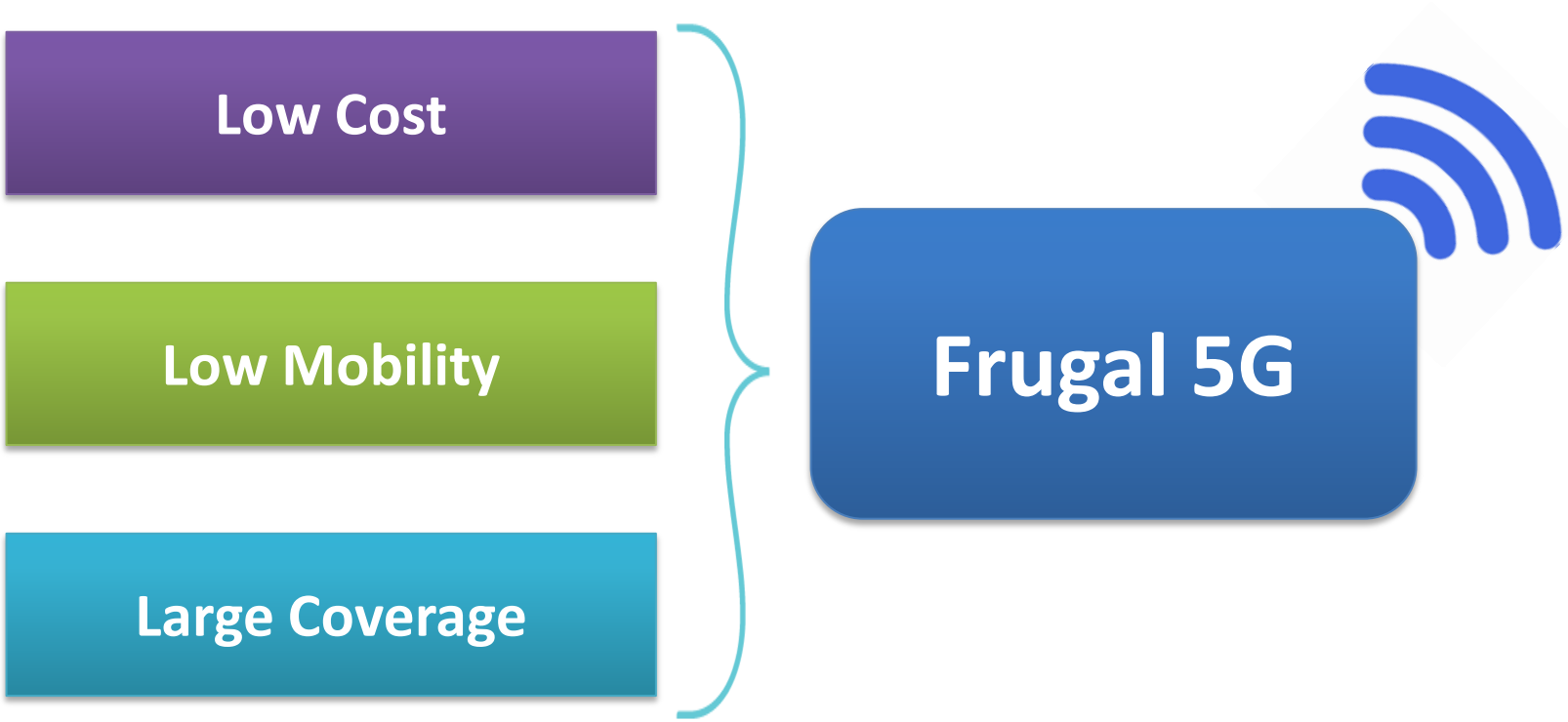
Intermitant Availability of Electricity

Rethinking 5G Requirements

- Low cost solutions
  - Low Device costs
    - Simpler Hardware and RF Design reducing the device costs
  - Low cost Connectivity / backhaul solutions
    - Using wireless backhaul/middle mile instead of fiber
  - Lower spectrum cost
    - Efficient usage of spectrum
    - Using network sharing options to share spectrum across Radio Access Technologies (RATs) across operators
- Limited mobility support
  - Mobility is required but not very high speed
  - Fixed primary access is the key

Rethinking 5G Requirements (Contd.)

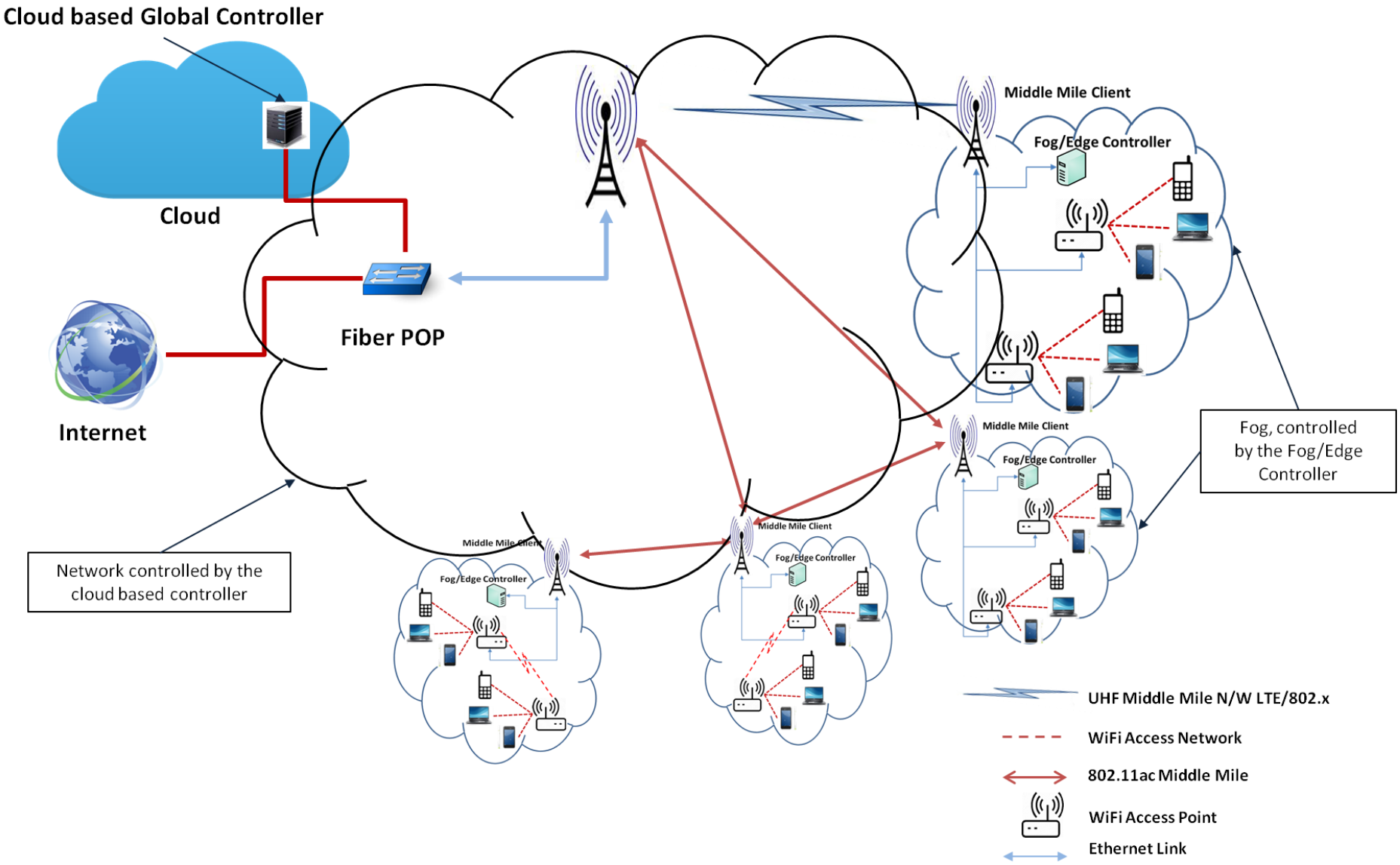
- Energy efficient solutions
  - Lowering system energy consumption
  - Support for operation in power saving mode
  - To enable working off non-conventional energy sources
- Large coverage area support
  - Support for large cells to reduce CAPEX and OPEX
- Less stringent availability requirements


Low Cost
Low Mobility
Large Coverage
Frugal 5G

Frugal 5G – IEEE ComSoc RRSA Study

- Study & analysis of existing wireless broadband technologies
  - Gap analysis with respect to following requirements
    - Low Cost Solution
    - Reduced Energy Consumption
    - Low Mobility scenarios
    - Usage of non-conventional energy sources
- Usage of affordable Wireless middle-mile network to connect the core network to IEEE 802.11 based access network
- Scalable control and management of access and middle mile network

Rural Broadband Communication System Architecture

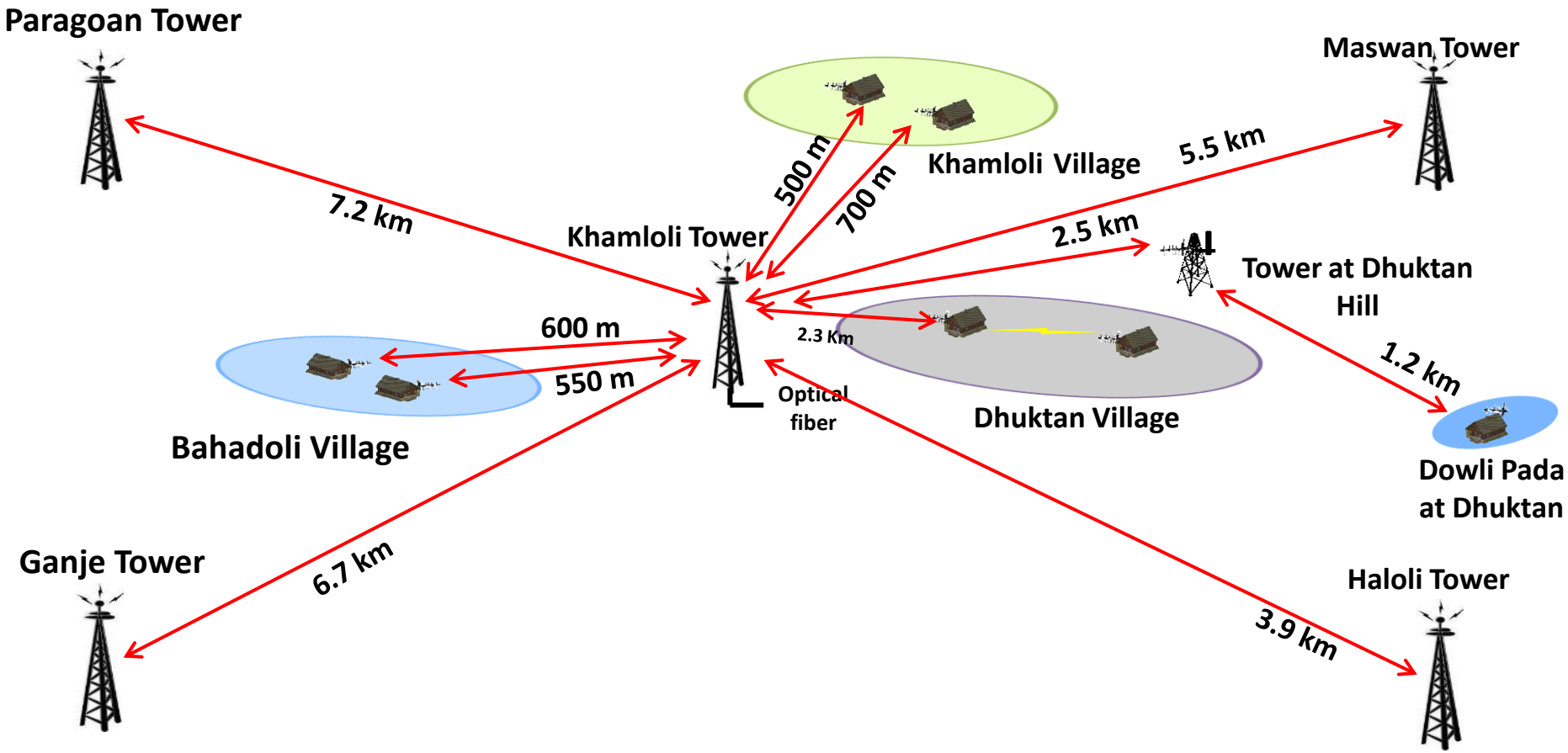


Testbed 1: TV UHF Band Pilot test-bed

- First TV White Space test-bed in India
- Situated in Palghar, Maharashtra
- Spanning an area of 25 sq. km., covering 7 villages
- Deployed 10 Wi-Fi APs and 3 GP kiosks, backhauled via TV UHF link
- A 20 Mbps leased line provisioned at the PoP
- TV UHF band device: Off-the-shelf Wi-Fi with 500 MHz RF

Objective: To test the feasibility of TV UHF band for providing connectivity in rural areas

Network Topology of TV UHF Band Pilot at Palghar



Test-bed Deployment in Palghar

Internet access via Wi-Fi Hotspots

Test-bed 2: 25 Villages Palghar Project

- Situated in Palghar, Maharashtra
- Connecting 25 villages spanning over an area of approx. 350 sq. km.
- Consists of 6 clusters, each cluster having one optical PoP
- Total bandwidth provisioned is 116 Mbps
- 65 Wi-Fi APs serving GP offices, schools, Primary Health Care (PHC) centers, anganwadi and community centers
- Unlike Test-bed 1, this test-bed also uses Wi-Fi (5.8 GHz) link as backhaul

Objectives

1. **To study the feasibility of technology mix for a cost-effective solution**
2. **Development of a sustainable economic model**

Learnings from the test-bed

- Need for a cost-effective technology solution
  - Reduction in cost of device
  - Use of renewable energy sources (solar energy)
  - Infrastructure sharing and reuse
- Need for a sustainable economic model based on partnerships
  - Involvement of community
  - Skill development of local youth
  - Viability gap funding from government and private organizations

Why is sustainable model needed?

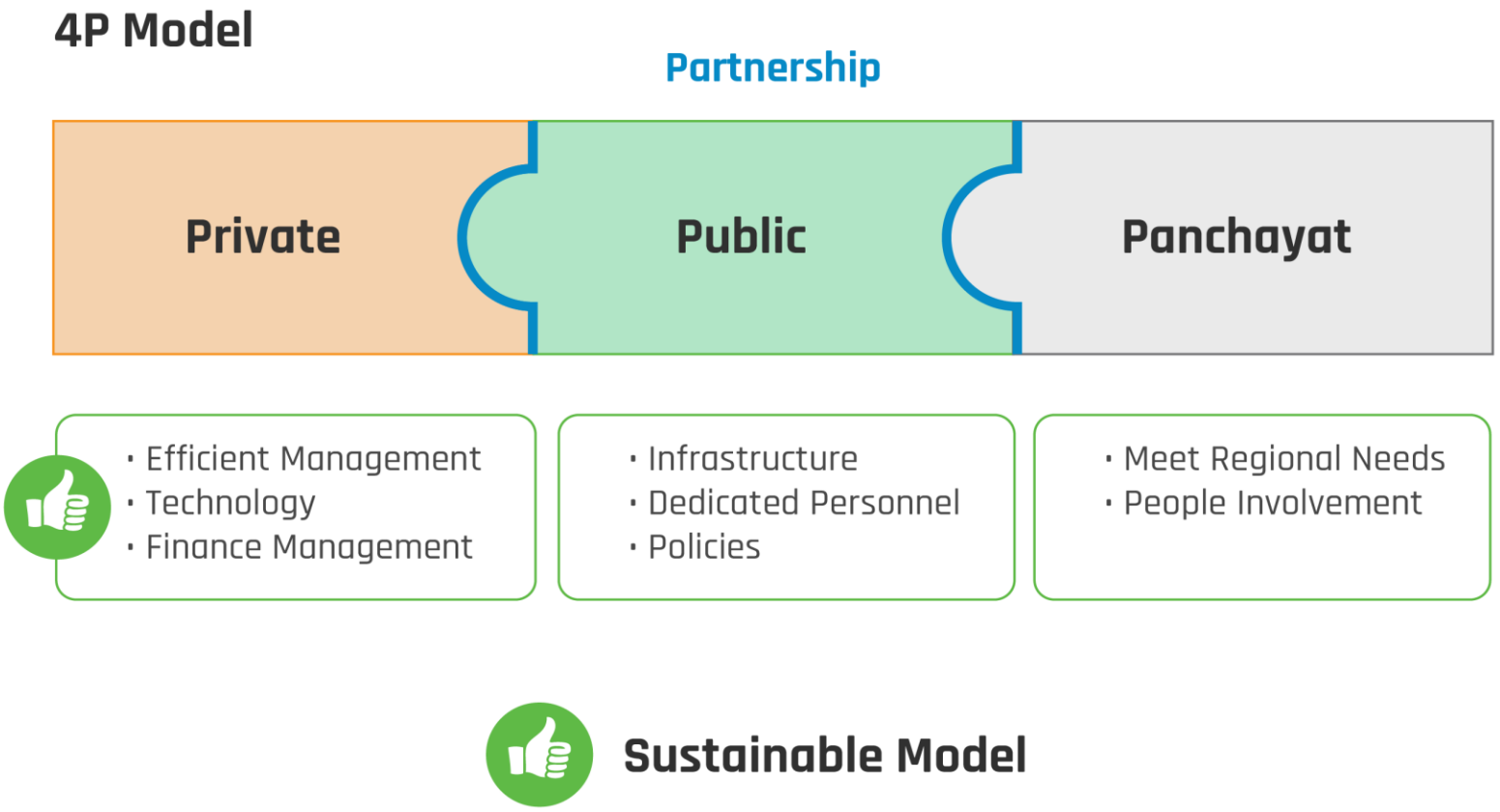
Uneven Demand and Supply

ISPs Unwilling To Go → Low ARPU

Lack of Digital Awareness → Less Demand

Failure of Joint Venture Models and Partnership Models

4-P Model


4P Model
Partnership
Private
Public
Panchayat
• Efficient Management
• Technology
• Finance Management
• Infrastructure
• Dedicated Personnel
• Policies
• Meet Regional Needs
• People Involvement
Sustainable Model

Meet our Team

Thank you