5G for India: Challenges and Opportunities

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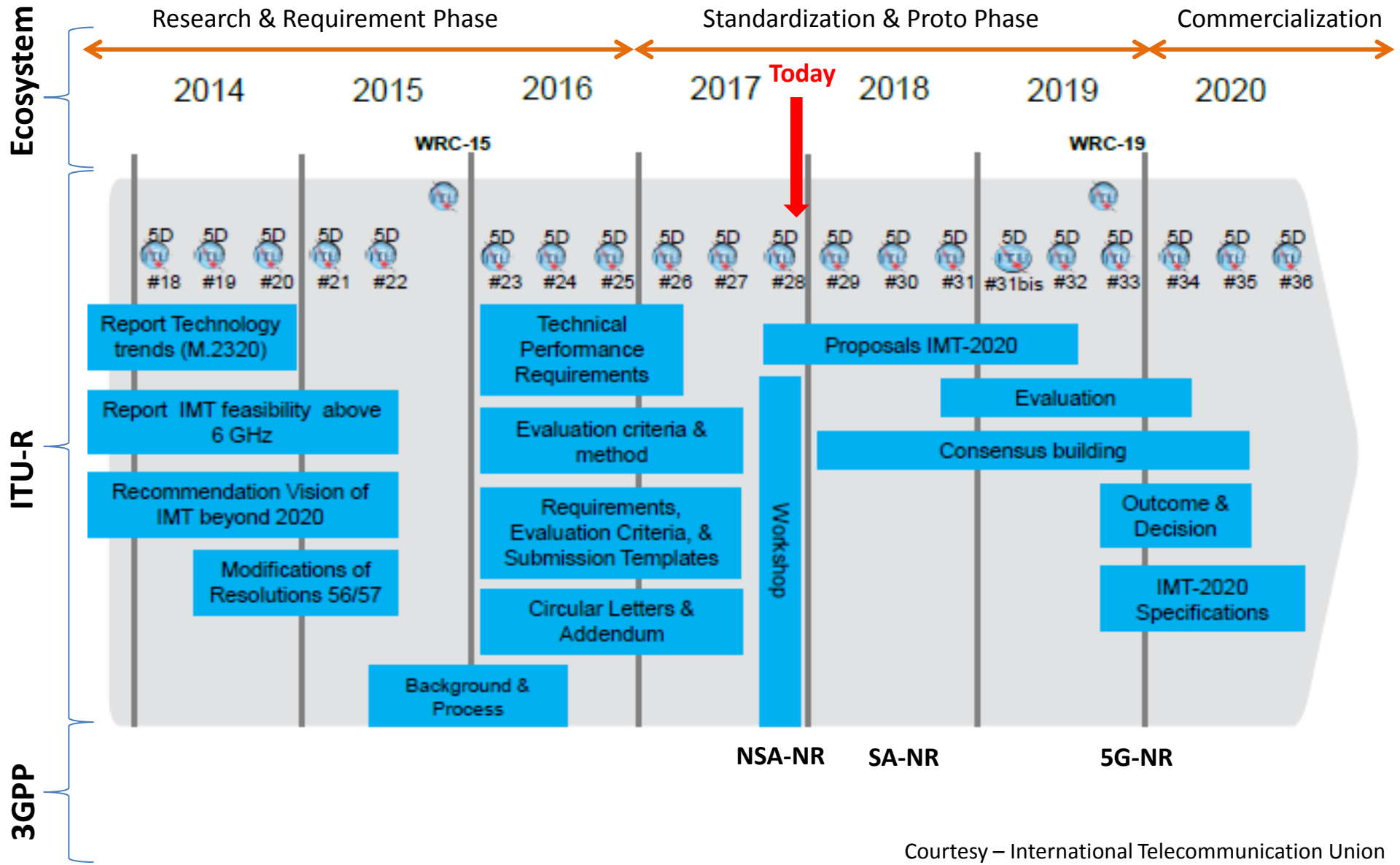
Event Timelines on IMT 2020



Courtesy – International Telecommunication Union

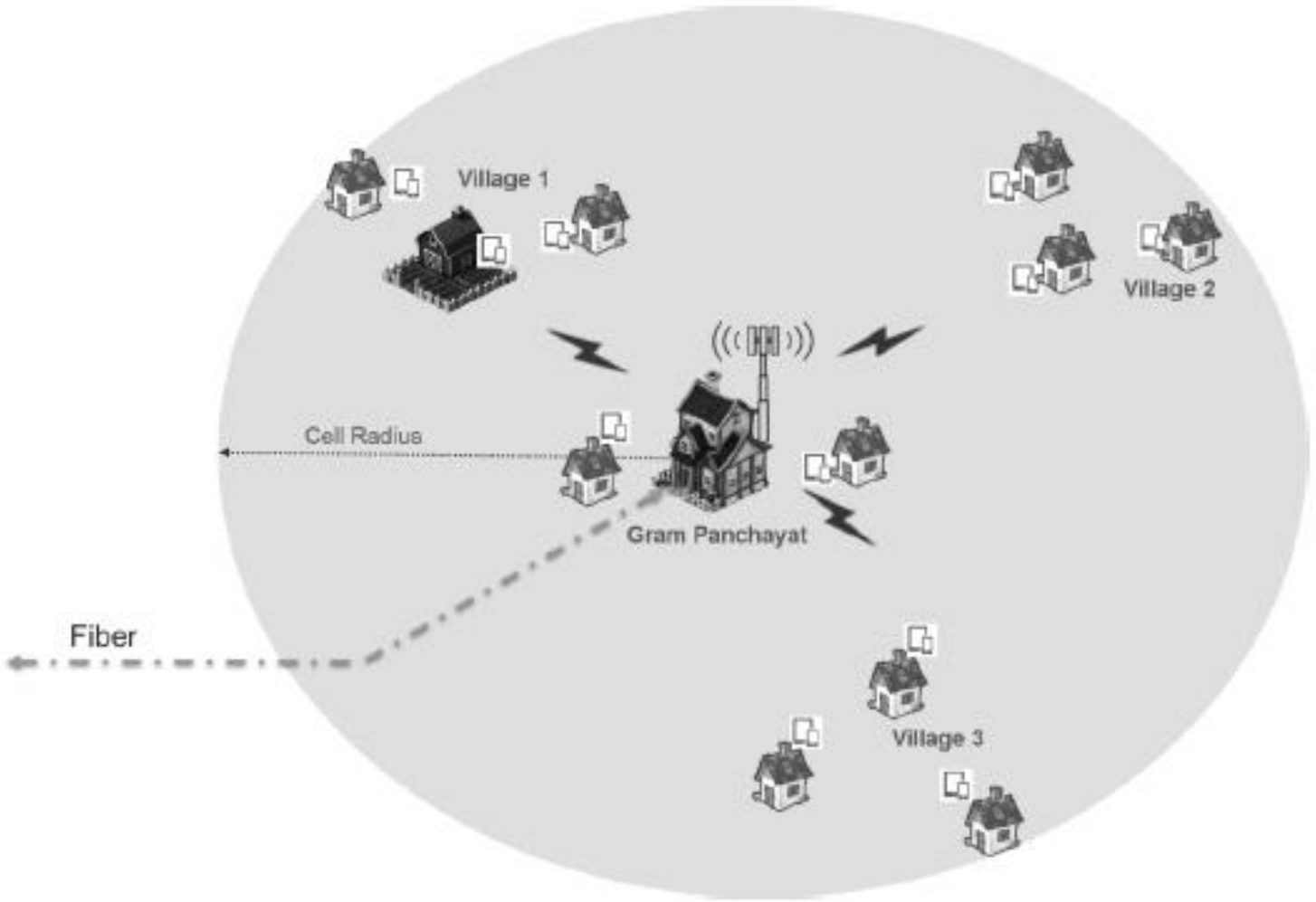
Communication Requirements of the future – key usage scenarios

- Enhanced Mobile Broadband communication (eMBB)
  - @Gigabits/second
- Ultra-reliable and low latency communication (uRLLC)
  - End-to-end data transfer within a few seconds
  - Stringent requirements for throughput, latency and availability
- Massive machine to machine communication (mMTC)
  - Millions of devices in a small area
- May not meet the requirements of all societies though
  - Low Mobility Large Cell – Indian Requirement
    - Accepted by IMT-2020
  - We are working on another one at IIT Bombay – Frugal 5G

Additional Capabilities of IMT-2020 (5G) - Indian Contribution

- Original Rural scenario of IMT
  - high speed scenario
    - Users at 120 kmph and more
    - applicable to countries like USA but may not be to India
- India proposed
  - ***Low Mobility Large Cell*** usage scenario for IMT-2020
    - For Wireless Rural Broadband
    - Part of the eMBB scenario (Rural eMBB)
    - Large (Coverage Area) Cell, Low Mobility, Large bandwidth
    - Per user data rate - may not be very high

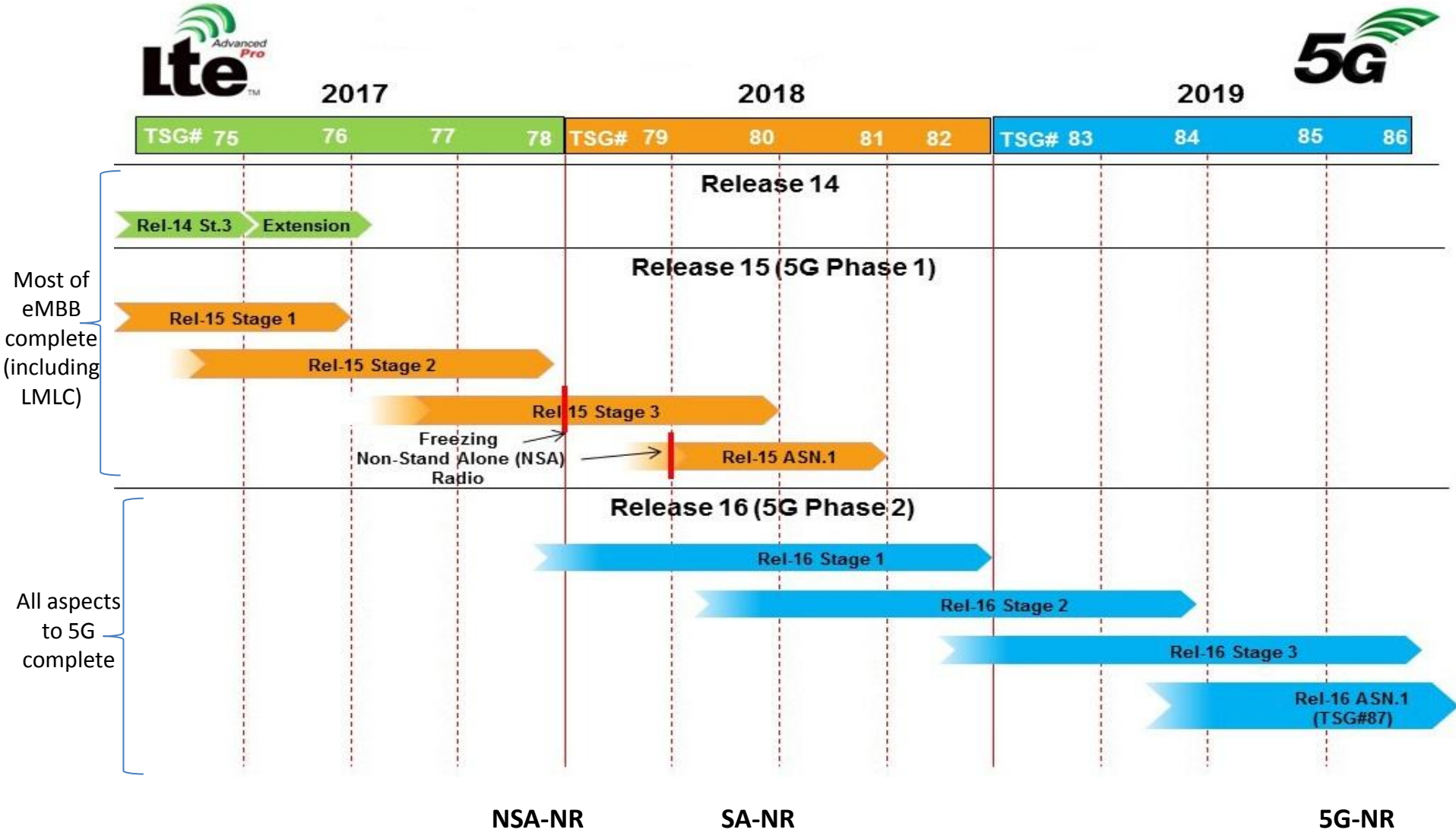
Low Mobility Large Cell Rural Scenario



Low Mobility Large Cell Scenario

Courtesy – TSDSI

3G Ongoing Releases



Courtesy – http://www.4g-lte.net/lte/how-fast-4g-5g-lte/

Challenges in Connecting Rural India

Low Average Revenue Per User (ARPU)

Unavailability of Fiber Backhaul

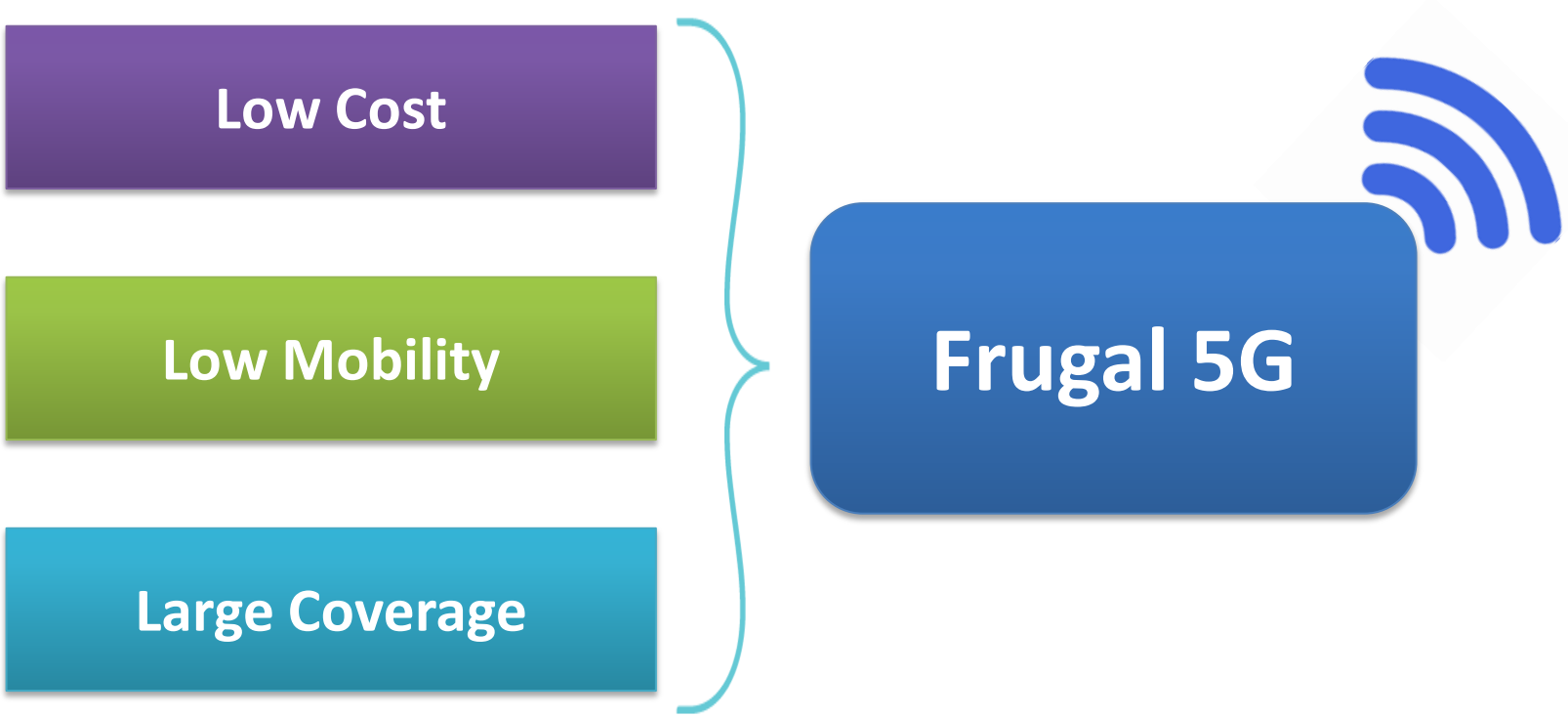
Intermitant Availability of Electricity

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