3GPP TSG RAN #101
Bangalore, India, September 11-15, 2023
RP-232088
Agenda Item: 9.2.2
Document for: Discussion

Discussion on study for ambient IoT

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Background

New SID: Study on Ambient IoT

- SID (RP-222685) was approved at the RAN#97-e meeting.
- The followings are excerpted from SID objectives

- Identify the suitable deployment scenarios and their characteristics, at least for the use cases/services agreed in SA1's "Study on Ambient power-enabled internet of Things", comprising among at least the following aspects
  - Indoor/outdoor environment
  - Basestation characteristics, e.g. macro/micro/pico cells-based deployments
  - Connectivity topologies, including which node(s) , e.g. basestation, UE, relay, repeater, etc. can communicate with target devices
  - TDD/FDD, and frequency bands in licensed or unlicensed spectrum
  - Coexistence with UEs and infrastructure in frequency bands for existing 3GPP technologies
  - Device originated and/or device terminated traffic assumption

  NOTE: There can be more than one deployment scenario identified for a use case, and a deployment scenario may be common to more than one use case.
  NOTE: Where more than one deployment scenario is identified for a use case, the trade-offs between them should also be studied.
  NOTE: The study shall not prioritize deployment aspects that should be coordinated with SA, e.g. public or private network, with or without CN connection.
  NOTE: A representative use case can be studied for a group of use cases that have similar requirements.

- Formulate a set of RAN design targets based on the identified deployment scenarios and their characteristics for the relevant use cases, at least including
  - Power consumption
  - Complexity
  - Coverage
  - Data rate
  - Positioning accuracy

  NOTE: The requirements from SA1 on the relevant use cases shall be taken into consideration.
  NOTE: The study shall aim to provide better coverage compared to existing non-3GPP technologies for the relevant use cases.
  NOTE: Other RAN design targets in relation to connection density, mobility, security, latency, reliability etc. may be discussed, if necessary for the relevant use cases.
  NOTE: Detailed definitions of the RAN design targets should be discussed during the study.
- …

Connection topologies

- **Prioritization**
  - Five topologies are defined in TR. Recommendation on prioritization for future study can be made.
  - For Device A/B, topology 2/3 should be considered
    - » Because Device A/B have very limited coverage due to backscatter Tx, direct communication cannot be used to achieve same coverage as legacy network
    - » This option can support low capability A-IoT device while specification effort may be larger.
  - For Device C, topology 1 can be considered.
    - » Because Device C has active RF, the coverage would be comparable to legacy network with direct communication.
    - » This option cannot support as low capability A-IoT device as device A/B, while specification effort would be less.

  - **Proposal: Consider following options for prioritization of connection topologies.**
    - » **Opt1: Device A/B with topology 2/3**
    - » **Opt2: Device C with topology 1**

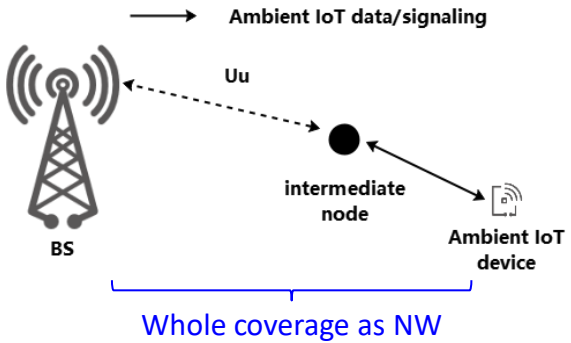
Device categorization

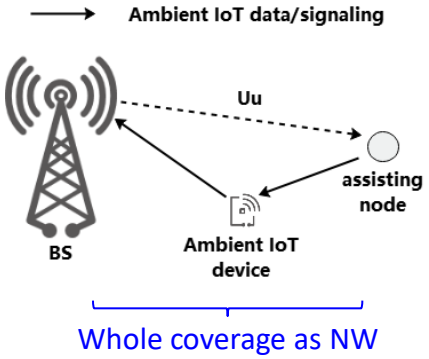
- **Energy storage capacities**
  - Following storage capacities are included in TR 38.848 v0.2.0
  - Storage capacities
    - » Storage capacity 1: No storage at all.
    - » Storage capacity 2: Up to E1 Joules
    - » Storage capacity 3: Up to E2 Joules
  - Values of E1 and E2 are FFS. From our perspective, the storage capacity is highly related to device implementation and capability. It is not necessary to restrict the maximum storage capacity in TR. Storage 2 and 3 can be replaced by description as “limited energy storage”.
  - **Proposal: Replace storage capacity 2 and 3 by “limited energy storage”.**

RAN design targets

- **Coverage:**
  - For topology 2/3, it needs to be clarified whether the term “coverage” means whole coverage as NW or the communication range b/w intermediate/assisting node and ambient IoT device.
  - For whole coverage as NW, it should be comparable to existing NW to ensure reusing existing NW deployment.

  - **Proposal: Clarify that the design target of coverage refers whole coverage as NW or the communication range b/w intermediate/assisting node and ambient IoT device for topology 2/3. For whole coverage as NW, the design target should be comparable to existing NW to ensure reusing existing NW deployment.**





RAN design targets

- **Latency:**
  - According to representative use cases in TR 38.848 and requirements defined in TR 22.840, flowing observations are made.
  - **Observation: the minimum latency requirement is 100ms, and the maximum latency requirement is 60s.**
  - **Observation: there are 34 use cases with latency requirement, where latency requirement of 11 out of 34 use cases is larger than 10s, and latency requirement of 31 out of 34 use cases is larger than 1s.**
- **Message size**
  - According to representative use cases in TR 38.848 and requirements defined in TR 22.840, flowing observations are made.
  - **Observation: the minimum message size is 96 bits, and the maximum message size is 1000 bits.**
  - **Observation: there are 33 use cases with message size requirement, where message size of 18 out of 33 use cases is less than 256 bits, and message size of 29 out of 33 use cases is less than 800 bits.**
- **Density**
  - According to representative use cases in TR 38.848 and requirements defined in TR 22.840, flowing observations are made.
  - **Observation: minimum density is 0.001 per 100m^2, and the maximum density requirement is 250 per 100m^2**
  - **Observation: there are 30 use cases with density requirement, where density of 14 out of 30 use cases is less than 1 per 100m^2, and density of 25 out of 30 use cases is less than 130 per 100m^2.**

RAN design targets

- **Speed:**
  - According to representative use cases in TR 38.848 and requirements defined in TR 22.840, flowing observations are made.
  - **Observation: the minimum speed requirement is stationary, and the maximum speed requirement is 10km/h.**
  - **Observation: there are 29 use cases with speed requirement, where speed of 18 out of 29 use cases is less than 3km/h, and speed of 25 out of 29 use cases is less than 6km/h.**
- **Indoor positioning accuracy:**
  - According to representative use cases in TR 38.848 and requirements defined in TR 22.840, flowing observations are made.
  - **Observation: minimum positioning accuracy is 1m, the maximum positioning accuracy is cell level.**
  - **Observation: there are 12 use cases with positioning accuracy requirement, where positioning accuracy of 9 out of 12 use cases is larger than 3m.**
- **Outdoor positioning accuracy:**
  - According to representative use cases in TR 38.848 and requirements defined in TR 22.840, flowing observations are made.
  - **Observation: minimum positioning accuracy is 3 m, the maximum positioning accuracy is cell level**
  - **Observation: there are 6 use cases with positioning accuracy requirement, where positioning accuracy of 5 out of 6 use cases is larger than 10 m.**

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