

vivo



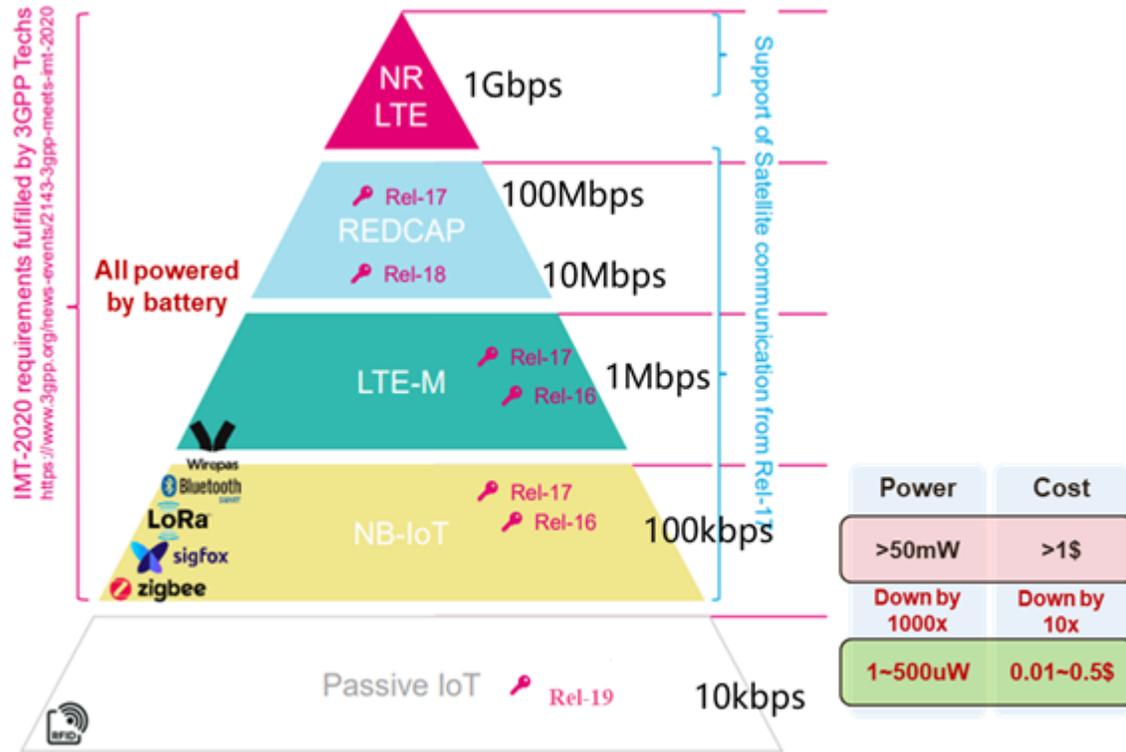
SA WG2 Meeting #157

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S2-2306420

# Discussion on Ambient IoT Study 202305

# Ambient IoT: Motivation



Source: GSMA 5G IoT Strategy Group meeting No.19, 3GPP presentation, Jan. 2022

- 3GPP already defined several IoT technologies.
- There are other kinds of the IoT devices which have very specific requirements in terms of size, weight, and power consumption. These IoT devices may be deployed under extreme environmental conditions (e.g., high pressure, extremely high/low temperature, humid environment).
- The power consumption of these IoT devices may be very low and therefore it would be benefit to support maintenance-free for them.



## Existing RFID technology

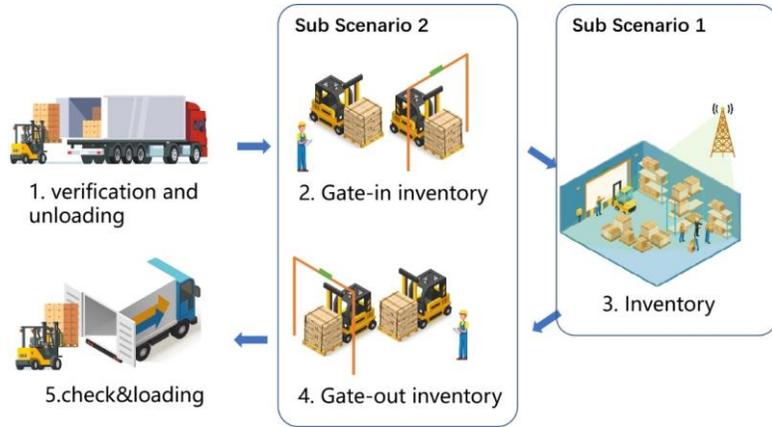
- Hand-hold machine scanning (**labor-consuming**)
- Large number of Tags (**time-consuming**)
- Close communication range, cannot work when Tag is covered, suffer from interferences between multiple readers (**easily failure**)

## Ambient IoT technology

- Large communication range
- Highly increased communication efficiency
- Automatically communication, without labor participation
- Easily tracking within the wide coverage of 5GS

# Ambient IOT: Use Cases at SA1

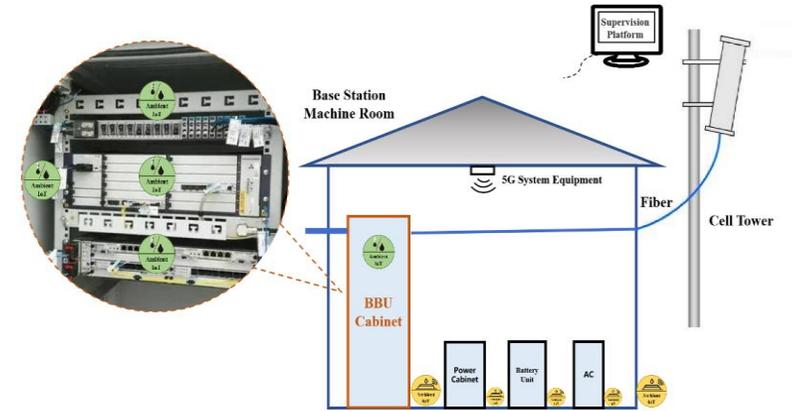
## Enterprise/Factory/Farm use cases



Automated Warehousing



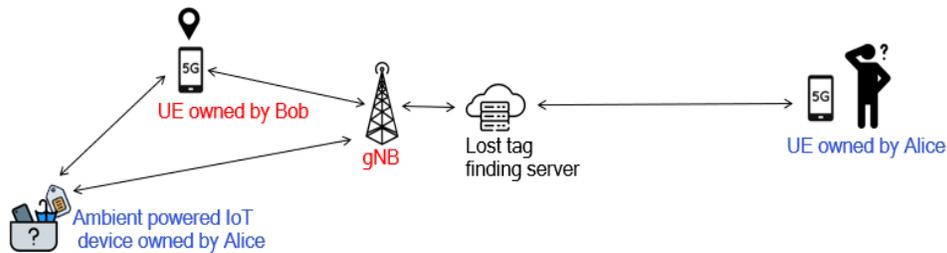
Smart Agriculture/Farm



Environmental Monitoring

- Enterprise use cases; Indoor / outdoor communication with RAN, UE assistance/relay may be needed.

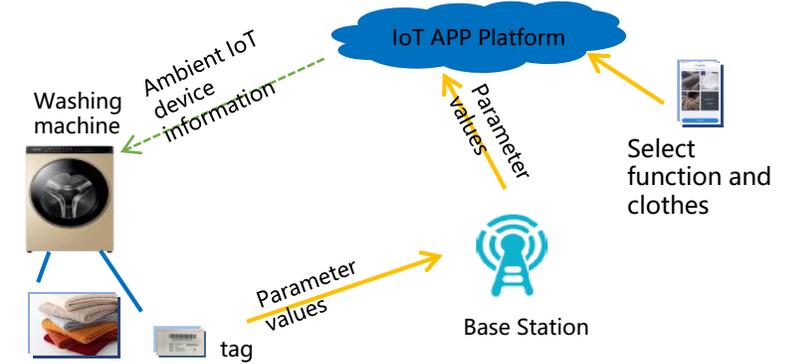
## Personal/Consumer use cases



Personal belongings Finding



Indoor Positioning



Smart laundry

- Personal use cases; Indoor communication with UE/CPE; Outdoor communication with RAN, UE assistance/relay may be needed.



# Ambient IOT: Existing studies at RAN and SA1

## SA#1 Study

SA1 TR describes 33 use cases (3 traffic scenarios included)

- Reader: UE reader+Base Station Reader
- Communication mode:
  - Passive AIoT device;
  - Active AIoT device
- Use case categories
  - Inventory, Sensor, Positioning, Control;
  - Indoor, Outdoor
- Operations to an AIoT device include:
  - Activate, Deactivate, Inventory, Read, Write, Positioning, Control.
- Access network include:
  - PLMN
  - NPN
- Architectures:
  - Direct communication
  - Indirect communication (for the case UE as reader)
- **Note: Using “Reader” in the DP is for briefly presenting a UE/Base Station communicating with AIoT Devices. It doesn't means to introduce a new terminology.**

## RAN Study

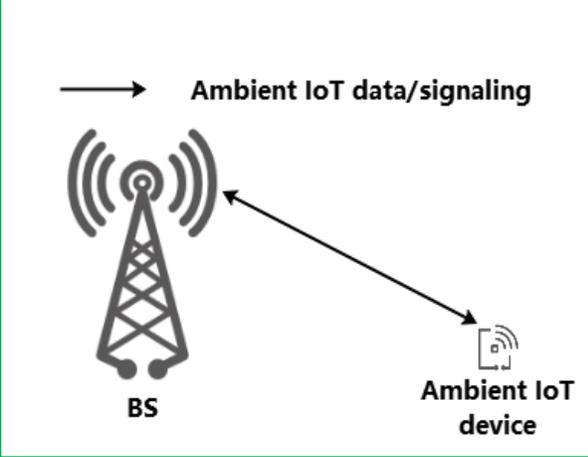
- Use case categories at RAN study
  - Inventory, Sensor, Positioning(P2), Control;
  - Indoor, Outdoor
- Four Topologies
- Three Ambient IOT Devices

## vivo's Proposal

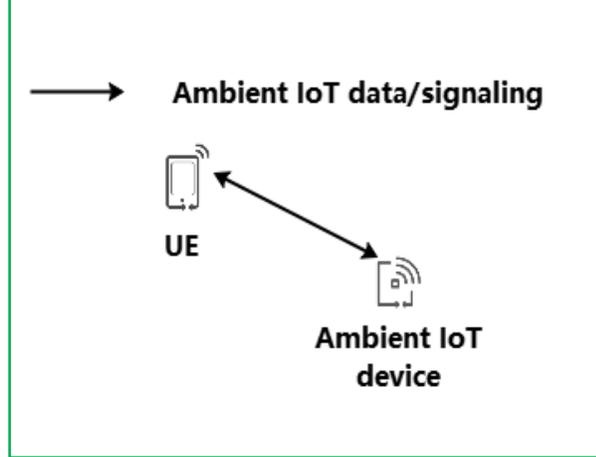
- It is difficult to consider all the use case in one study phase1 and propose to differentiate the use cases in different phases
- Rel19 focus on phase1 use cases
  - Inventory/read /write
  - PLMN
  - licensed spectrum,
  - Indoors & Outdoors
- Phase2
  - others

# Ambient IOT: Topologies+ AIOT Devices Types

## Topology 1: BS ↔ Ambient IoT device

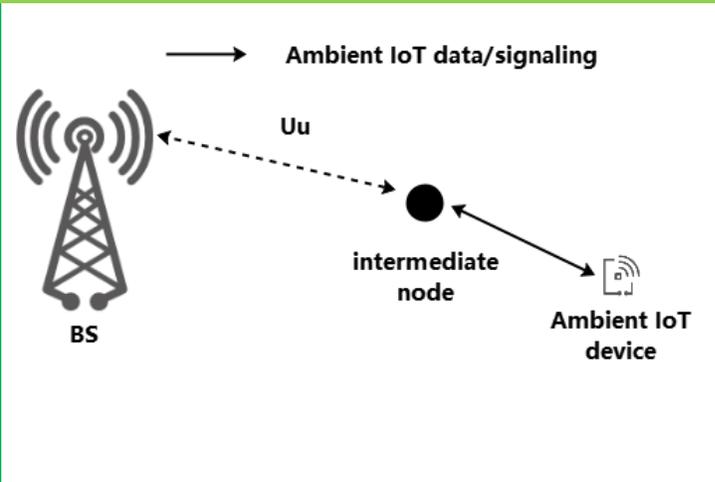


## Topology 4: UE ↔ Ambient IoT device

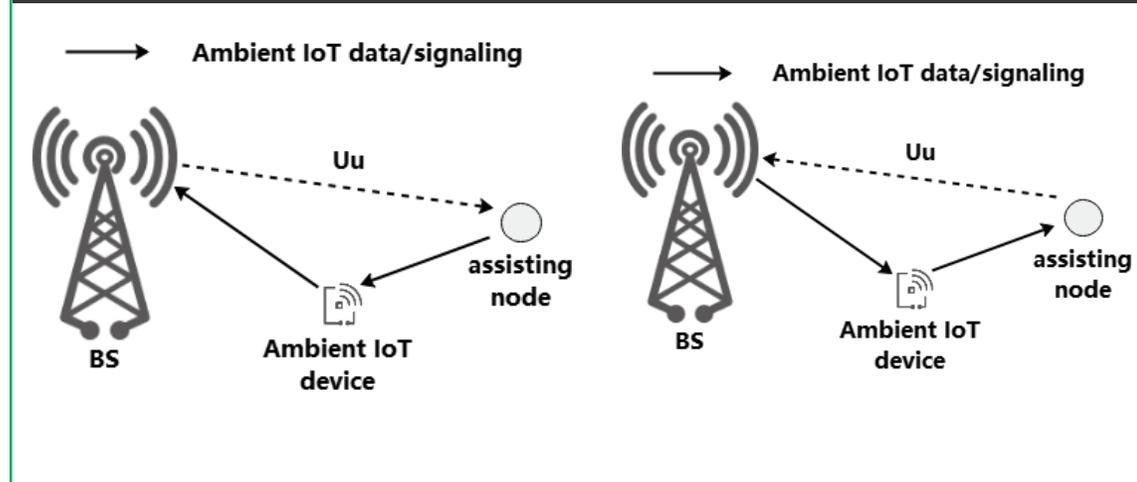


Device Type		
Device A	No energy storage	no independent signal generation, i.e. backscattering transmission
Device B	Has energy storage	no independent signal generation, i.e. backscattering transmission. Use of stored energy can include amplification for reflected signals
Device C	Has energy storage	has independent signal generation, i.e. active RF component for transmission

## Topology 2: BS ↔ intermediate node ↔ Ambient IoT device



## Topology 3: BS ↔ assisting node ↔ Ambient IoT device ↔ BS

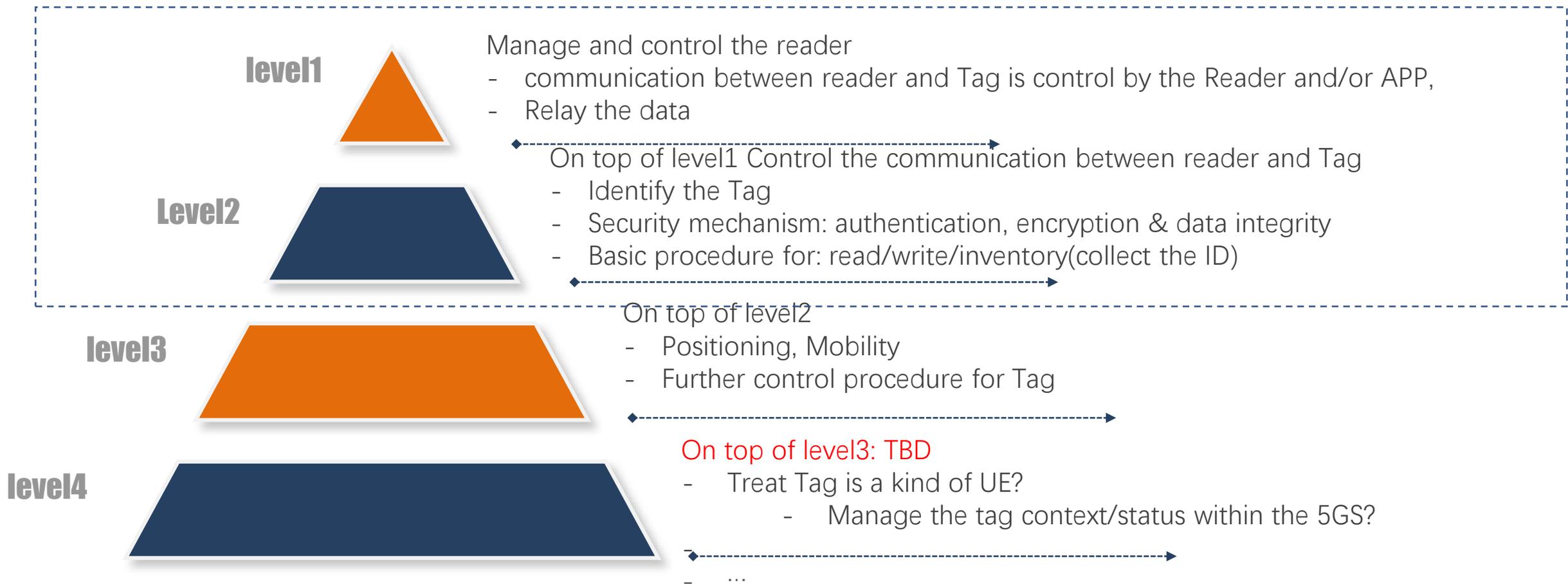


## vivo's Proposal

- Phase1
  - All AIOT device types
  - Basic Topology1+4
  - Can further consider Topology2 if time allowed
- Phase2
  - Topology 3

# Ambient IOT: Motivation for CN involvement

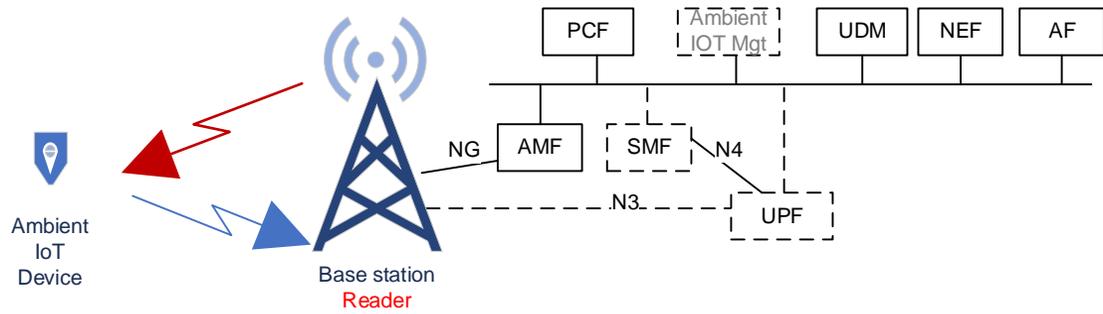
- CN involvement could be **optional** to connect reader and 3rd party App
  - However, at least in the 3<sup>rd</sup> party request scenario, CN behavior needs to be discussed
- Different involvement levels can be considered
- Phase1 study focus on level1 or level2



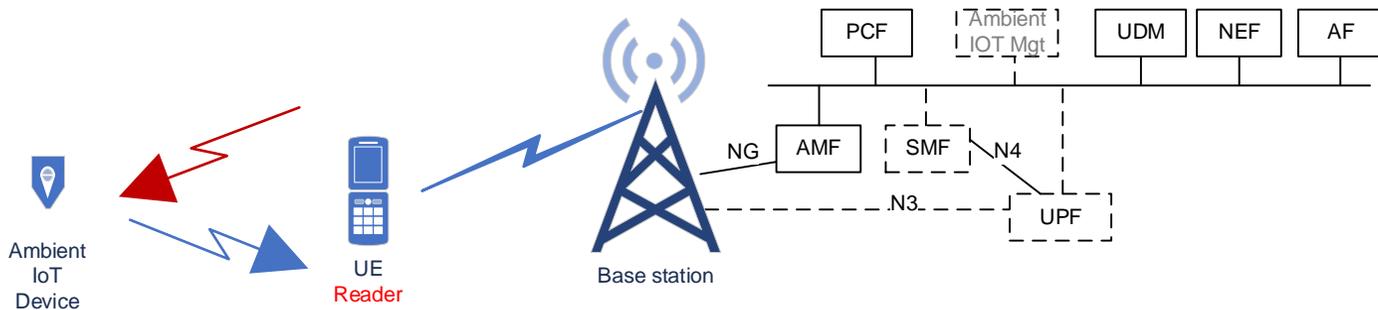
# Ambient IOT: Architecture

- “UE as reader” : left is reader, right connecting to 5GC in UE's way

**A compatible and sufficiently extensible Arch. for different kinds of readers and AIOT devices types**



- “Base Station as reader” : left is reader, right connecting to 5GC in gNB's way



- CN impact for Ambient IOT
  - Option1: enhance existing NF (preferred)
  - Option2: consider new NF
  - Support:
    - Device Type A/B/C
    - Topology1+4: UE Reader + Base Station reader
    - Use cases: Inventory/Sensor data/Control
    - Group handling for massive Tag number
    - licensed spectrum, Indoors & Outdoors
  - Consider:
    - Positioning/Mobility
    - Energy Harvest

## Ambient IOT: Simplified and Common interface/protocol stack



- **Simplified** protocol stack of the interface between Reader and AIOT devices for low power consumption, low complexity and low cost.
- **Simplified** AIOT devices
  - Simplified procedures and features for AIOT devices
- **Common and consolidated** interface between AIOT device and reader for all topologies and device types
  - Common signal channel design and procedures for all topologies, as much as possible.
  - CN involvement should be **compatible** to both UE reader and Base Station reader

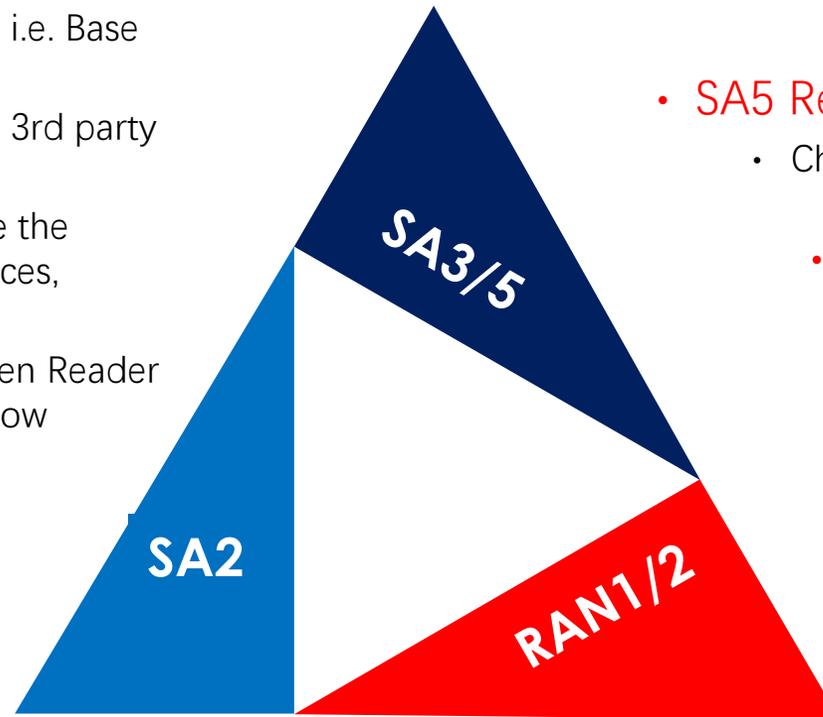


# Ambient IOT Phase1 study

## SA2+SA3+RAN cooperation

### SA2 Responsibility

- Architecture enhancement for ambient IOT within 5GS
  - Considering two new roles and possible CN impact for AIOT: AIOT device, Reader Device
  - Two communication between AIOT device and Network: direct access or indirect access, i.e. Base Station reader and UE reader
- Reader control and management, support both 3rd party reader, operator reader, and personal reader,
- Based on 3<sup>rd</sup> party request, control and manage the communication between Reader and AIOT devices, including read, write, inventory, etc.
- Simplified protocol stack of the interface between Reader and AIOT devices for low power consumption, low complexity and low cost.
- Charging for Ambient IOT device related service
- NOTE2: The ambient IOT device might not be a UE, might without UICC.
- NOTE3: The study should focus on PLMN scenario and licensed spectrum indoor/outdoor.



### SA3 Responsibility

- Authentication + Security detail
  - On demand authentication, e.g. authenticate Ambient IOT devices by 5GS, authenticate reader by Ambient IOT devices

### SA5 Responsibility

- Charging

### RAN1/2 Responsibility

- AS Layer communication between Reader and AIOT devices
- Signal channel design and procedure description between Reader and AIOT devices;
- Simplified protocol between AIOT device and Reader
- Indoor/outdoor
- Licensed Spectrum

THANK YOU.

谢谢。