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Motivation on support Energy Harvesting enabled Communication services in 5GS

OPPO

Motivation and challenges of support Energy Harvesting enabled Communication Services (EHECS) in 5GS

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- NB-IoT/MTC have achieved low cost, low power and massive connections and can meet requirements of many IoT applications. However, there are many kinds of use cases and scenarios are still not covered with existing technologies:
  - under extreme communication circumstances e.g., high pressure, extremely high/low temperature etc.
  - where ultra-low complexity, very small size, maintenance-free and long life cycle etc. are strongly required.
  - Other scenarios where a terminal driven by a battery is not applicable

- EHECS(Energy harvesting enabled communication services) provides a promising scheme to fulfil the unmet requirements as above.
  - The terminal itself does not have a battery and uses energy harvested from radio waves, light (solar), motion, heat etc, and,
  - Meantime, EHECS shall provide sufficient capability to meet the requirements such as coverage, connection density, system efficiency etc.
    - E.g., EHECS shall provide sufficient coverage (e.g., from 30meters to 100 meters for IWSN/logistics)

- In order to support EHECS, the following aspects, which put new requirements of 5GS, need to be considered
  - Extremely-low complexity form factor of the terminal (simplified RF and baseband architecture, limited memory etc.)
  - Additional power sourcing dependency and/or unstable, limited energy that can be harvested

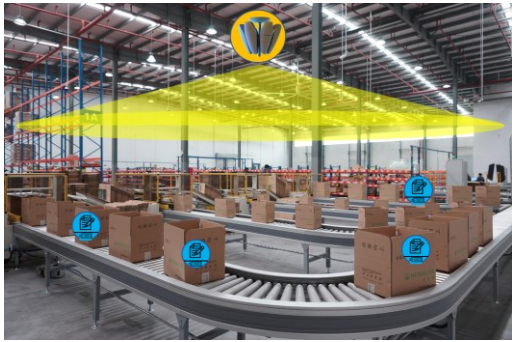
Use case 1: Industrial Wireless Sensor Network (IWSN)

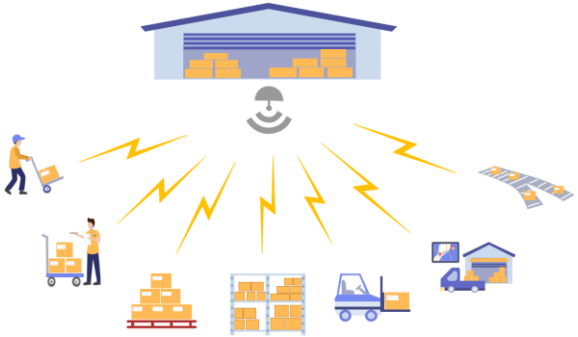
- IWSN has been widely deployed in manufacturing scenarios, EHECS can be provided by IWSN to enable more vertical applications.
- In some IWSN application, the environments are harsh with high/low temperature, moving or rotation parts, high vibration conditions, humidity and other hazardous conditions. Those require sensors with maintenance-free, battery-less, ultra-low power and long service life.

- Example requirements for IWSN
  - Coverage: 30m(indoor),100m(outdoor)
  - Power sourcing for terminal with sensors (e.g., less than 1mw) potentially including,
    - wireless power souring(indoor) , light/solar(outdoor), heat, motion ……

Use case 2: Smart Logistics and smart Warehousing

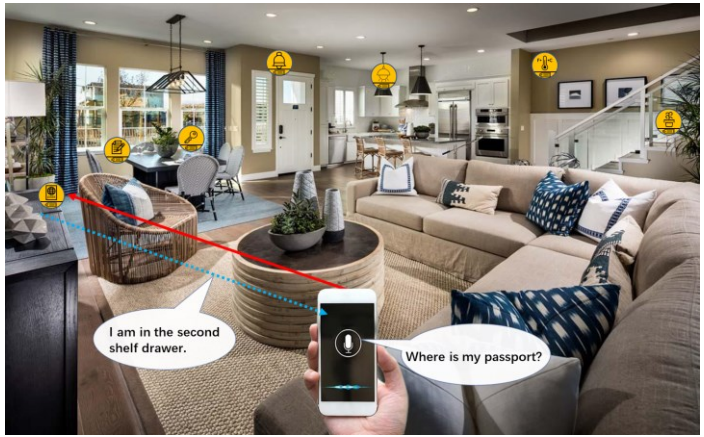
- In logistics and warehousing cases, huge amount of goods needs to be frequently transferred, stored, loaded/unloaded, and inventoried in the logistic station or warehouse (tens of thousands of m2).
- With EHECS terminals which are battery-less, ultra-low cost and with small size, the efficiency of Logistics and smart Warehousing can be significantly improved and the cost can be greatly reduced.
- Example requirements:
  - Coverage: 10-30m for indoor, 100m for outdoor.
  - Power sourcing: wireless power sourcing(less than 100uw, indoor), light/solar(less than 1mw, outdoor).
  - Reading speed (e.g.,2000 devices/s)





Use case 3: Smart Home Network

- EHECS is attractive for smart home due to ultra-low cost, very smaller size, washable, flexible/foldable form factor and very long life time[1].
- Practical use cases include house asserts management (e.g., find things at home)/house environment monitoring
- Example requirements:
  - Coverage: around 10 meters
  - Power sourcing: wireless power sourcing(less than 100uw, indoor), light(less than 100uw, outdoor).



Use case 4: Smart agriculture

- EHECS would also benefit smart agriculture. For example, terminals driven by solar can be used to monitor the soil moisture, soil fertility, the temperature, wind speed, plant growth etc. It can also be used to control the agricultural facilities such as irrigation system.

[1] Mitrokotsa A , Douligeris C . Integrated RFID and Sensor Networks: Architectures and Applications[M]. 2009.