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On the Requirements of Mobile Wireless Sensor Network

Spreadtrum Communications
China NB

1. Introduction

In this paper, some requirements are proposed for the mobile wireless sensor network（WSN）from the perspective of converging with ubiquitous cellular network.

To set up a ubiquitous mobile WSN, it is critically important that the sink nodes, as well as the backbone network should at first be ubiquitous, so as to lay a solid foundation for the ubiquitous radio coverage. However, for any industries nowadays, such an investment does not seem to be so feasible in practice. As a result, the already existing cellular network, as well as its ubiquitous backbone network and well performed operation platforms should be reused for the ubiquitous services of mobile WSN. In this way, the specialized sensor nodes or sink nodes should be integrated with cellular modules, so as to directly access to the ubiquitous base stations to transport sensor data to indoor databases.

On the other hand, cellular terminals equipped with sensors could be utilized as sensor nodes or sink nodes if needed, which might dramatically increase the operating cost at some large-scale scenarios. However, with the next generation broadband cellular standards developing in the progress, some requirements from the mobile WSN could be considered and proposed for the possibility of being embedded into the whole specifications. If such an attempt come into practice, almost everything becomes much easier than ever, i.e. the ubiquitous cellular network, the ubiquitous the mobile WSN.

Therefore, two kinds of implementations for mobile WSN will emerge, i.e. the multi-mode integration and the single-mode solution. For the former, the specialized WSN nodes, e.g. the sink node or the sensor node, are integrated with the existing mobile terminals, e.g. GPRS or CDMA 1x, while for the latter, the single-mode WSN nodes suffices to work normally, e.g. GPRS or next generation cellular modules equipped with sensors.

2. Requirements

- Radio network (RN)
  - ✧ First layer RN:
    - ✓ Self-organized clusters based on sensor nodes
    - ✓ Up to 100 nodes and at least 100m in cluster radius
  - ✧ Enhanced layer RN:
    - ✓ Well-organized cell based base stations
    - ✓ Typically 500~1000m in cell radius
- Backbone network (BN)
  - ✧ Managed BN: operator-owned core network
    - ✓ VPN preferred
    - ✓ Rigid QoS support
    - ✓ All kinds of services
  - ✧ Unmanaged BN: Internet

- ✓ Low cost data centered services
- ✓ Much loose in latency requirement

- Physical layer transmission

✧ Support concurrent multiple-access
- ✓ OFDMA, CDMA etc.

✧ Low implementation complexity
- ✓ Fast algorithms
- ✓ Categories clearly specified

✧ Compatibility with cellular PHY
- ✓ Maximum commonalities between cellular baseband

✧ Support TDD or FDD (optional)
- ✓ Rigid QoS
- ✓ Depending on half or full duplex

✧ Low PAR in baseband signal
- ✓ High efficiency in radio amplifier
- ✓ Large coverage at similar power consumption

✧ Fast in sync. Acquisition

✧ Robust to interference
- ✓ Unlicensed spectrum usage

- Higher layer protocols

✧ End to end session layer protocol

✧ Enhanced MAC strategy with QoS guarantee

✧ Vertical handover protocol between cellular and WSN nodes

- Spectrum issues

✧ Unlicensed spectrum

✧ Licensed spectrum

- Security issues

✧ Session layer security

✧ MAC layer security

✧ PHY layer scrambling

- RF issues

3. Summary

In this contribution, we summarized the requirements when mobile WSN is deployed for industries, including the converging between the specialized WSN and the current existing or fore-coming next generation broadband cellular systems. We hope, such requirements will be discussed and fixed during the SGSN technical meetings.