Green communications in 5G

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November 25, 2018

Introduction

- In the next decade, the number of connected devices is expected to increase 100 times and the data volume by 1000 times
- Operators are already facing significant power bills
- Moving towards green communications is important both for **environmental** and **economic** reasons

Network planning and deployment

Harvesting renewable energy resources

In order to power the Base Stations (BS), energy can be obtained from renewable sources:

- Natural sources: Sun, wind, vibration
- External: Batteries, fuel cells

User-centric designs

Smaller frame overhead [1]

- Bursty traffic cause devices to change state between idle and connected with the associate **power consumption**
- Significant **overhead** with small packets
- Contention based method have been proposed

[1] Following [178] paper in depth: Uplink Contention Based Multiple Access for 5G Cellular IoT

Uplink contention based methods

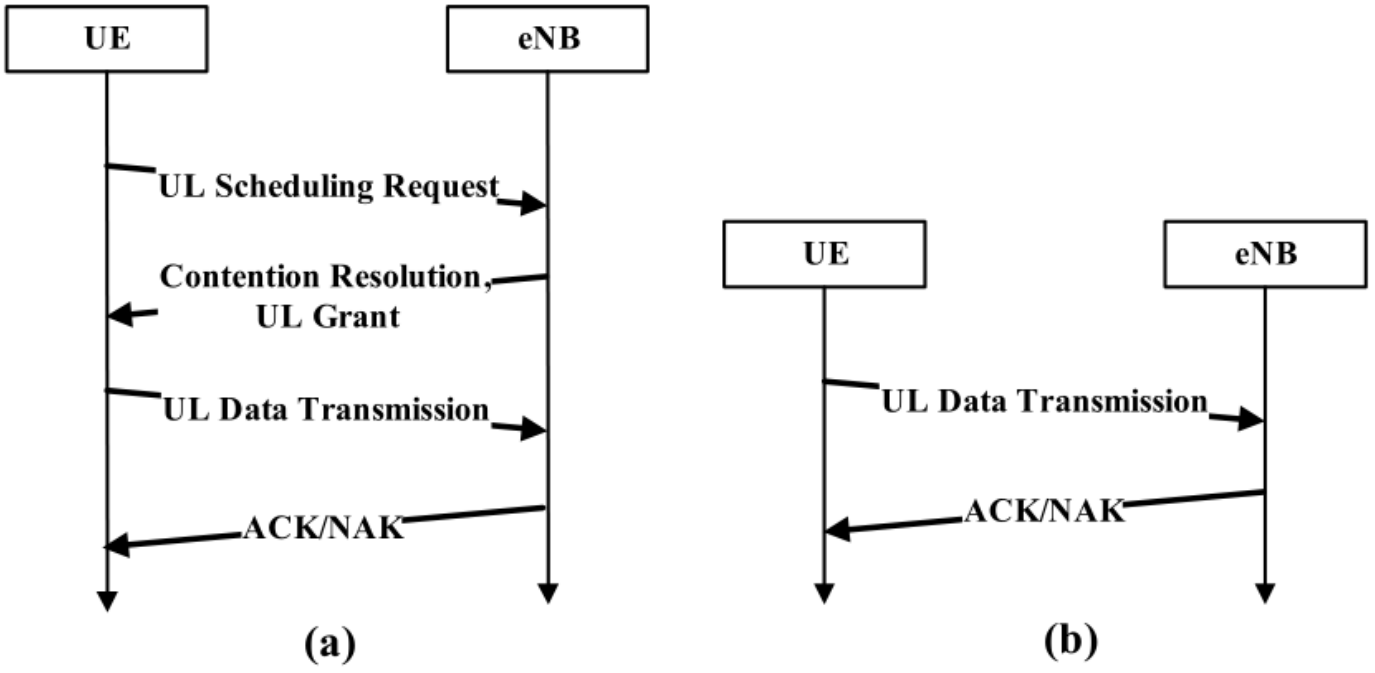

Figure 2: Data reporting via optimized Random Access procedure.

- Small signalling payload
- Direct small data packet

Results of simulation

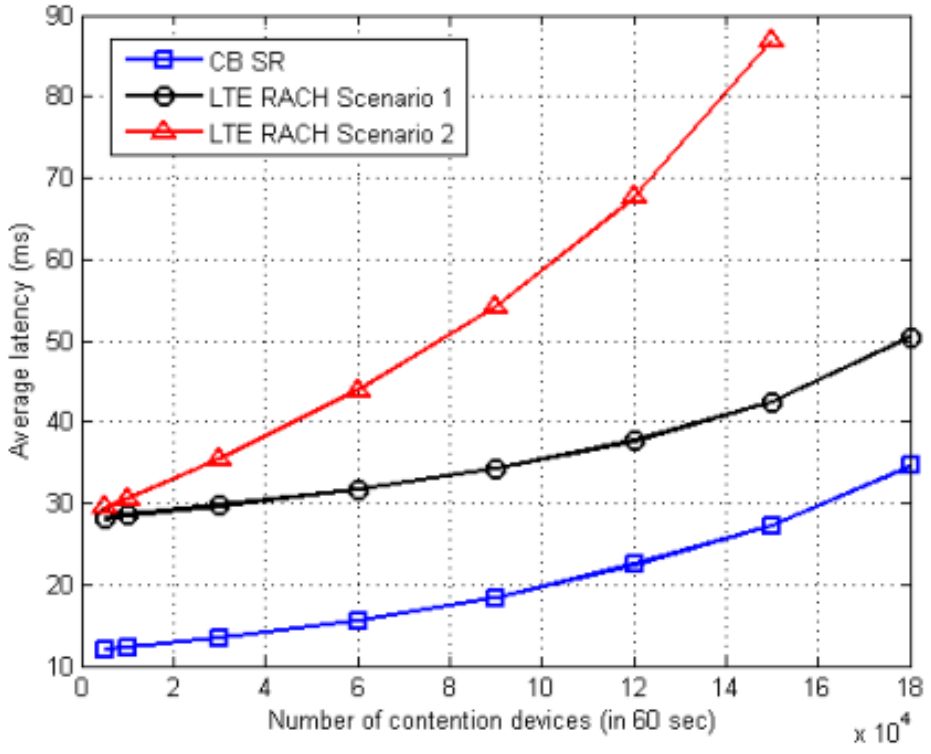

Figure 6. Latency performance improvement by proposed CB SR

Open problems

- Power control in green communications
- Energy efficient hardware
- Energy efficient network architecture
- Battery technology enhancement: sugar bio-batteries [2]

[2] Following [183] paper in depth: *A high-energy-density sugar biobattery based on a synthetic enzymatic pathway*

Sugar bio-batteries [183]

- The typical density of energy of a Lithium cell is around $0.54\,\mathrm{MJ\,kg^{-1}}$
- But the combustion energy of glucose can release up to $15.5\,\mathrm{MJ\,kg^{-1}}$
- Sugars are non toxic, safe and carbon neutral