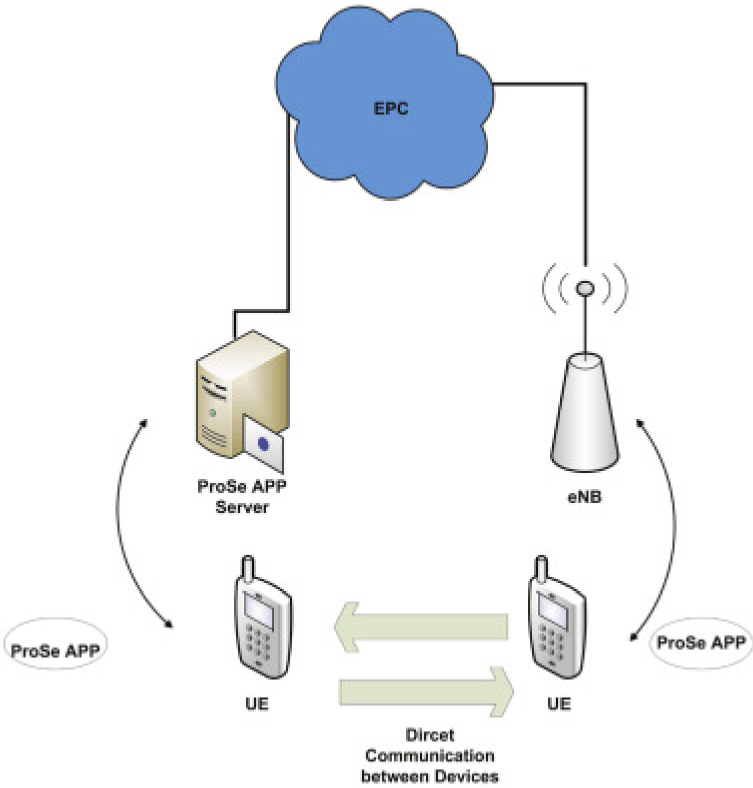
Date:09/10/21

Still working on the paper ***Resource and Power Allocation in SWIPT-Enabled Device-to-Device Communications Based on a Nonlinear Energy Harvesting Model***

Literature Review:

1. ***An overview of device-to-device communication in cellular networks***

- D2D: D2D communication is a new paradigm in cellular networks [1]. It allows user equipments (UEs) in close proximity to communicate using a direct link rather than having their radio signal travel all the way through the base station (BS) or the core network.



2. ***Interference Mitigation in D2D Communication Underlaying LTE-A Network***

- **Interference between D2D links**

Containment of the interference among D2D nodes and cellular users is one of the major problems. D2D transmission radiates in all directions, generating undesirable interference to primary cellular users and other D2D users sharing the same radio resources resulting in severe performance degradation.

3.***Simultaneous Wireless Information and Power Transfer (SWIPT) for Internet of Things: Novel*** *Receiver Design and Experimental Validation*

- **How does SWIPT work?(Time switching(TS) and power splitting(PS))**
    - Power splitting(PS):In the PS scheme, the power and data are conveyed by the same modulated signal. The incoming RF signal at the PS receiver is divided by the RF power divider, and the divided signals are fed into the information decoder and the energy harvester.
    - the TS scheme switches between the power and data transmission modes over time. It is known that the PS scheme has a better trade off between the data rate and harvested power than the TS scheme does.

4. ***SWIPT-Enabled D2D Communication Underlaying NOMA-Based Cellular Networks in Imperfect CSI***

- **Why SWIPT-Enabled D2D?**

1. In spite of its advantages, D2D suffers from large bandwidth and energy loss due to usage of half-duplex relaying and limited energy storage devices.
2. The considered harmful interference in conventional D2D communications could be exploited for **Energy Harvesting(EH)**

5.***Spectrum sharing for D2D communication in 5G cellular networks: An auction-based model***

- **What is Spectrum sharing in D2D cellular network**

  D2D uses the same cellular spectrum i.e. inband or unlicensed spectrum as used by cellular networks. The conventional cellular network communication signal always relayed through the BS, although the users are in close range or proximity. This architecture is suitable for low data rate services like voice call and text message. However, the current cellular users uses video sharing, proximity-aware social networking and gaming which consume high bandwidth.

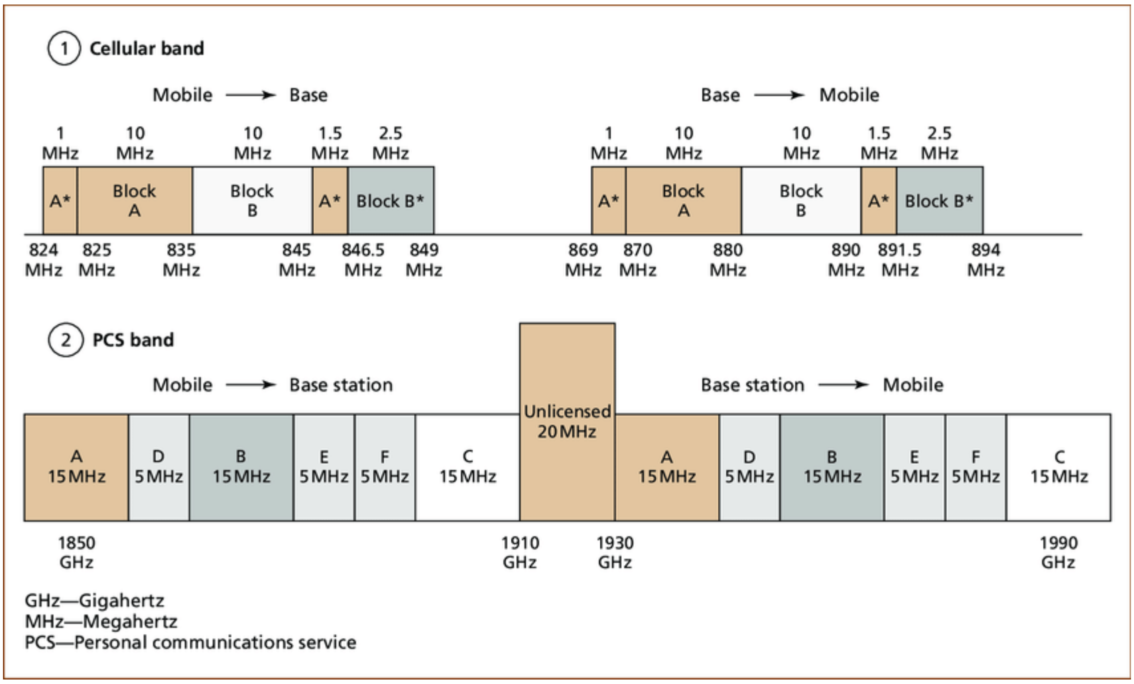


Figure 1: Cellular band and specturm

Technical Term

1.**Energy Harvesting**:

Energy harvesting (also known as energy scavenging) is the conversion of ambient energy present in the environment into electrical energy for use in powering autonomous electronic devices or circuits.

2.**Radio frequency** (**RF**) is the oscillation rate of an alternating electric current or voltage or of a magnetic, electric or electromagnetic field or mechanical system in the frequency[1] range from around 20 kHz to around 300 GHz. This is roughly between the upper limit of audio frequencies and the lower limit of infrared frequencies;[2][3] these are the frequencies at which energy from an oscillating current can radiate off a conductor into space as radio waves. Different sources specify different upper and lower bounds for the frequency range.

3.**Throughput is the actual amount of data that is successfully sent/received over the communication link.** Throughput is presented as kbps, Mbps or Gbps, and can differ from bandwidth due to a range of technical issues, including latency, packet loss, jitter and more.

Understanding for some equations

SINR of cellular link k:

$$SINR_k^C = \frac{P_k^C h_k^C}{P_i^D h_i^B + N_0 + N_I} = \frac{P_k^C d_k^{C-\alpha} h_k^{\prime c}}{P_i^D d_i^B h_i^{B'} + N_0 + N_I}$$

where $SINR_k^C$ is the **Signal to Interference & Noise Ratio**, and it is the SINR of cellular link. where P_k^C and P_i^D are the transmission power of CUE k and D2D transmitter i. h_k^C and h_i^D represent the channel responses of cellular uplink k and D2D link i. Note that the letter **k** and **i** belongs to two different established before: $\hat{C} = \{1, 2, 3 \ldots k \ldots\}$ for set of cellular link and $\hat{D} = \{1, 2, 3 \ldots i \ldots\}$ for set of D2D link. d_k^C is the distance from CUE k to the **BS(Base station),** d_i^B is the distance of interference.

N_0 is the additive white Gaussian noise power, andN_I is the noise power due to RF band to base band conversion.

And the equation above is for the non-EH D2D group. While the equation below is for SWIPT-enabled D2D group.

The throughput for SWIPT-enabled D2D link can be expressed as:

$$T_i^D = (1 + \frac{(1-\lambda_i^e) P_i^D h_i^D}{(1+\lambda_i^e)(P_k^C k_{k,i} + N_0) + N_1})$$

Remember the interference in this case is useful information, and in this equation λ_i^e was denoted as power splitting ratio.

And the received power for Energy Harvesting at D2D receiver is:

$$P_i^R = \lambda_i^e (P_i^D h_i^D + P_k^C h_{k,i} + N_0)$$

In non-EH D2D group, the product of interference response and transmission is thought as noise but in this case it is thought as useful information.