

**CHENNAI – PONDICHERRY**

**Leveraging Intelligence from Network CDR Data for Interference aware Energy Consumption Minimization**

**Abstract:**

Cell densification is being perceived as the panacea for the imminent capacity crunch. However, high aggregated energy consumption and increased inter-cell interference (ICI) caused by densification, remain the two long-standing problems. We propose a novel network orchestration solution for simultaneously minimizing energy consumption and ICI in ultra-dense 5G networks. The proposed solution builds on a big data analysis of over 10 million CDRs from a real network that shows there exists strong spatio-temporal predictability in real network traffic patterns. Leveraging this we develop a novel scheme to pro-actively schedule radio resources and small cell sleep cycles yielding substantial energy savings and reduced ICI, without compromising the users QoS. This scheme is derived by formulating a joint Energy Consumption and ICI minimization problem and solving it through a combination of linear binary integer programming, and progressive analysis based heuristic algorithm. Evaluations using: 1) a HetNet deployment designed for Milan city where big data analytics are used on real CDRs data from the Telecom Italia network to model traffic patterns, 2) NS-3 based Monte-Carlo simulations with synthetic Poisson traffic show that, compared to full frequency reuse and always on approach, in best case, proposed scheme can reduce energy consumption in HetNets to 1/8th while providing same or better QoS.

**Existing System:**

The ICI problem, low energy efficiency (EE) is another major problem in HetNets. Although SCs have a relatively lower power consumption profile, one of the major concerns in the future dense deployments is the high aggregated energy consumption. As recently demonstrated through SC and MC power consumption models developed in Earth project, *always ON cells* based approach particulary increases energy inefficiency in the network when SCs are introduced.

This is because, compared to MCs, the load independent power consumption (circuit power) component in SCs constitutes a much larger portion of over all power consumption. Therefore, a vision for an ultra-dense network cannot become a reality without addressing the two time-persistent challenges: higher ICI and higher aggregated overall energy consumption stemming from the classical always ON routine. In our study, we have proposed a pro-active approach that can simultaneously minimize the energy consumption as well as the ICI in emerging ultra-dense networks.

This is in contrast to the state-of-the art, that is predominantly reactive rather than proactive. Specifically, the proposed work exploits deluge of largely untapped Call Data Records (CDRs) data to analyze and predict the spatio-temporal user activity behavior. This intelligence is then utilized to dynamically optimize the operational states of the SC (i.e., active, partially muted, or sleep mode), to divert and focus the right amount of resources, when and where needed, while simultaneously minimizing ICI and energy consumption. To the best of author’s knowledge, this the first study to provide a detailed analysis of real CDR data and demonstrate its potential for developing a proactive energy saving mechanism.

**Proposed System:**

Using a realistic HetNet system model, we mathematically formulate the joint optimization problem for minimizing the ICI and energy consumption for the predicted traffic scenario.

We propose an algorithm that exploits the base station sleep-mode mechanism in conjunction with the resource allocation as the optimization control variables. We then propose a heuristic low complexity solution to solve this NP-hard problem. Our proposed energy consumption aware (ECA) resource allocation scheme addresses the limitation of fixed time-based sleep scheduling mechanism [41] that fails to adapt to dynamic and unusual activity, since they are manually configured for a statistical traffic cycle, usually during few hours of night when user traffic is very low.

We leverage the results of our big data analysis on Milan CDRs data to propose a HetNet deployment scenario and evaluate the performance of the proposed ECA scheme in the proposed HetNet deployment scenario, where traffic generation pattern is derived from the real data. The results indicate that with ECA the energy consumption could be reduced to 1/8th in a dense heterogeneous network deployed in a typical urban city.