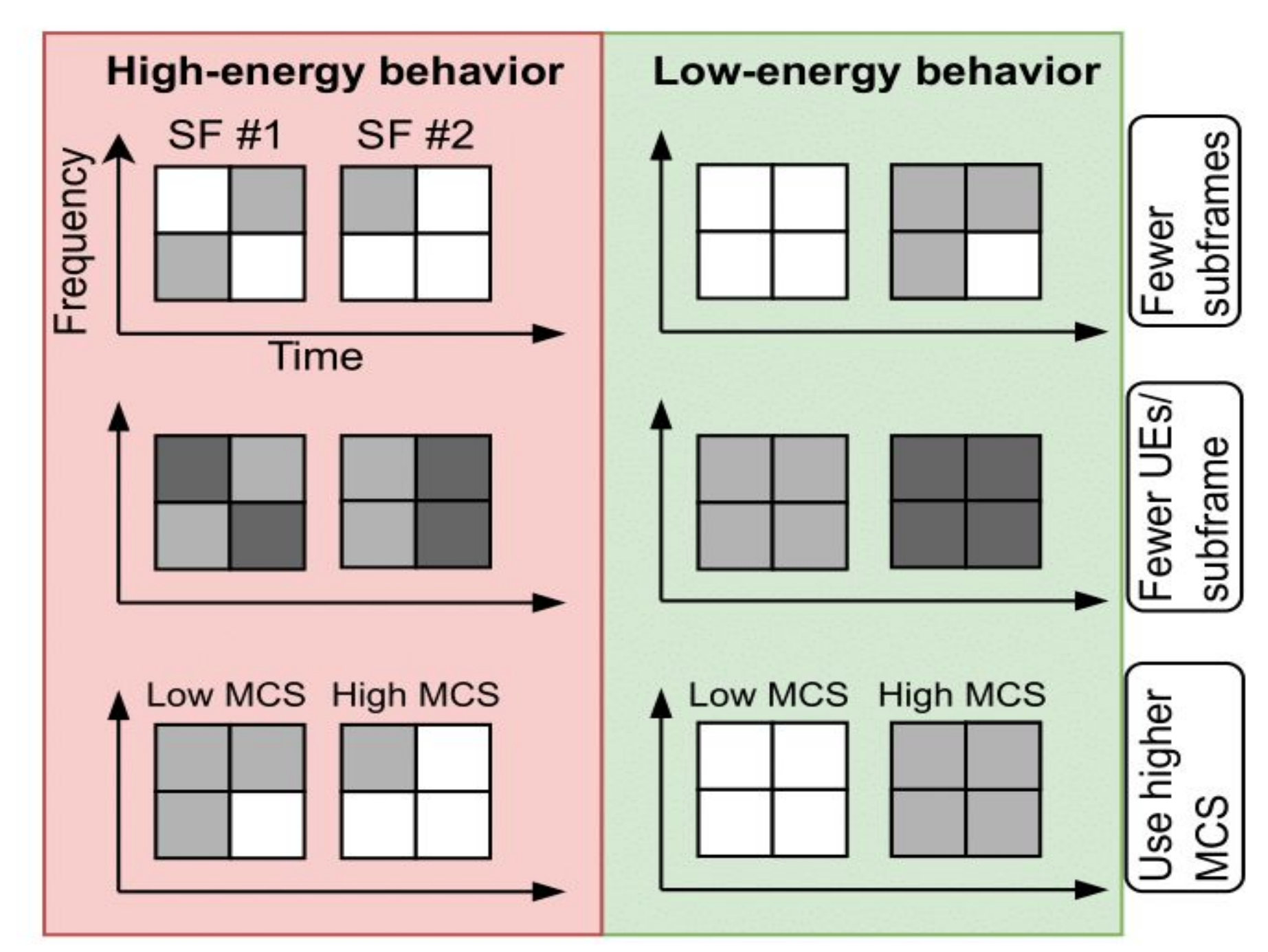


## INTRODUCTION

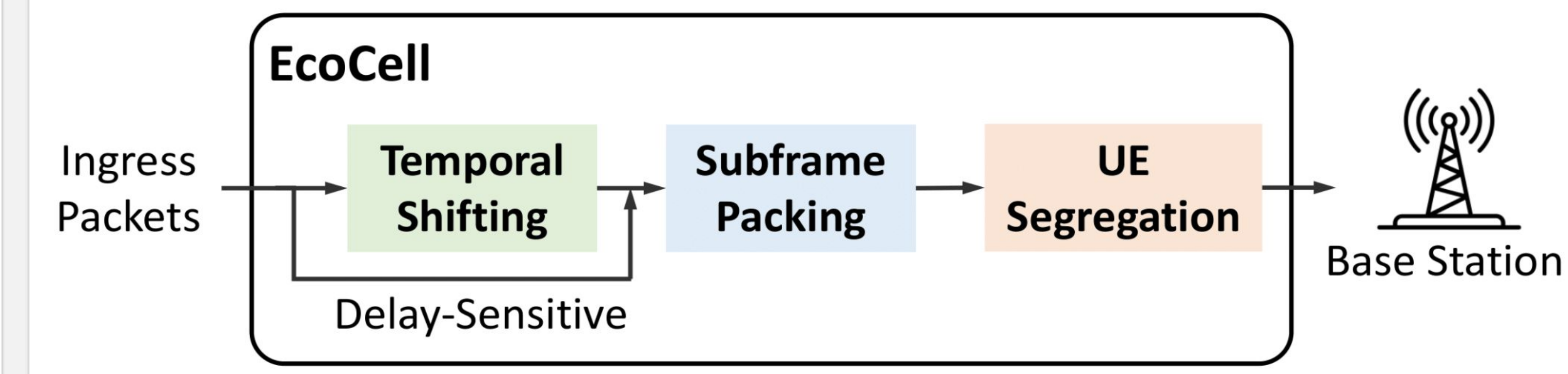
- The rapid growth of cellular networks drives global energy demands, with 6 million base stations each emitting **30 tons of carbon** annually
- Traditional methods for optimizing energy consumption in base stations (BS) lack real-world power-saving solutions
- EcoCell introduces a **software-only middlebox solution** aimed at reducing energy consumption in cellular networks by **modifying traffic patterns in real-time**

## INSIGHTS INTO ENERGY SAVING



- Packing data into fewer subframes saves energy
- Serving fewer UEs per subframe saves energy
- Using higher-order modulation saves energy

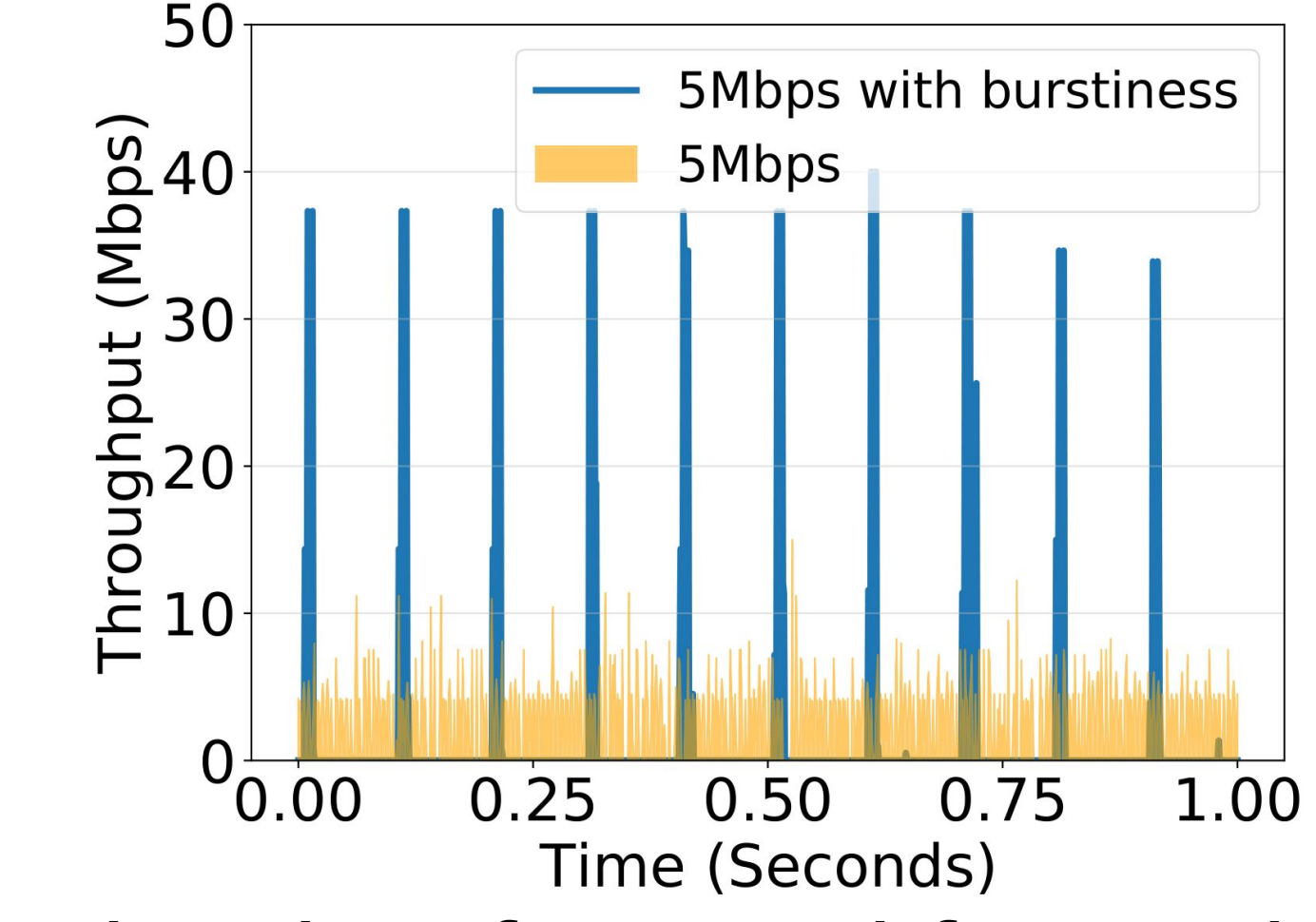
## METHODS OF ECOCELL



EcoCell acts as a middlebox that intercepts and shapes traffic before reaching the base station

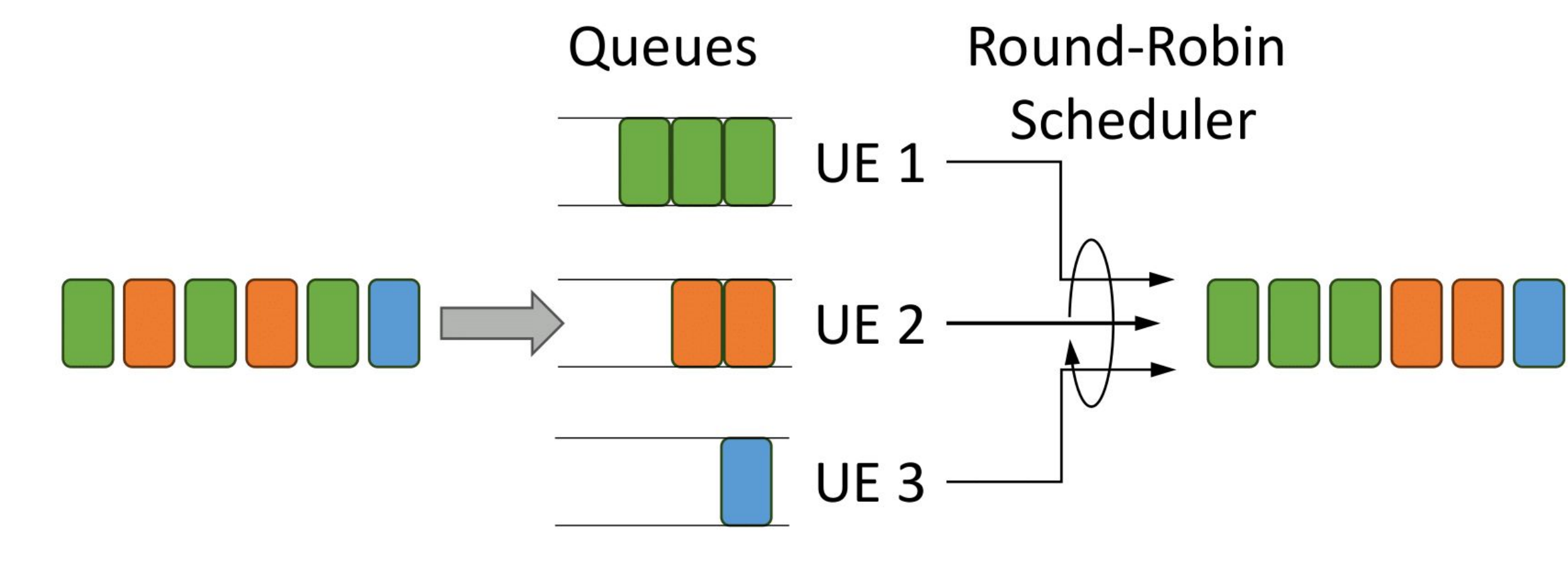
- 1) Temporal Shifting**
  - Delays non-urgent traffic until channel conditions improve for energy-efficient transmission

- 2) Subframe Packing**



- Aggregates data into fewer subframes by introducing **burstiness in traffic**

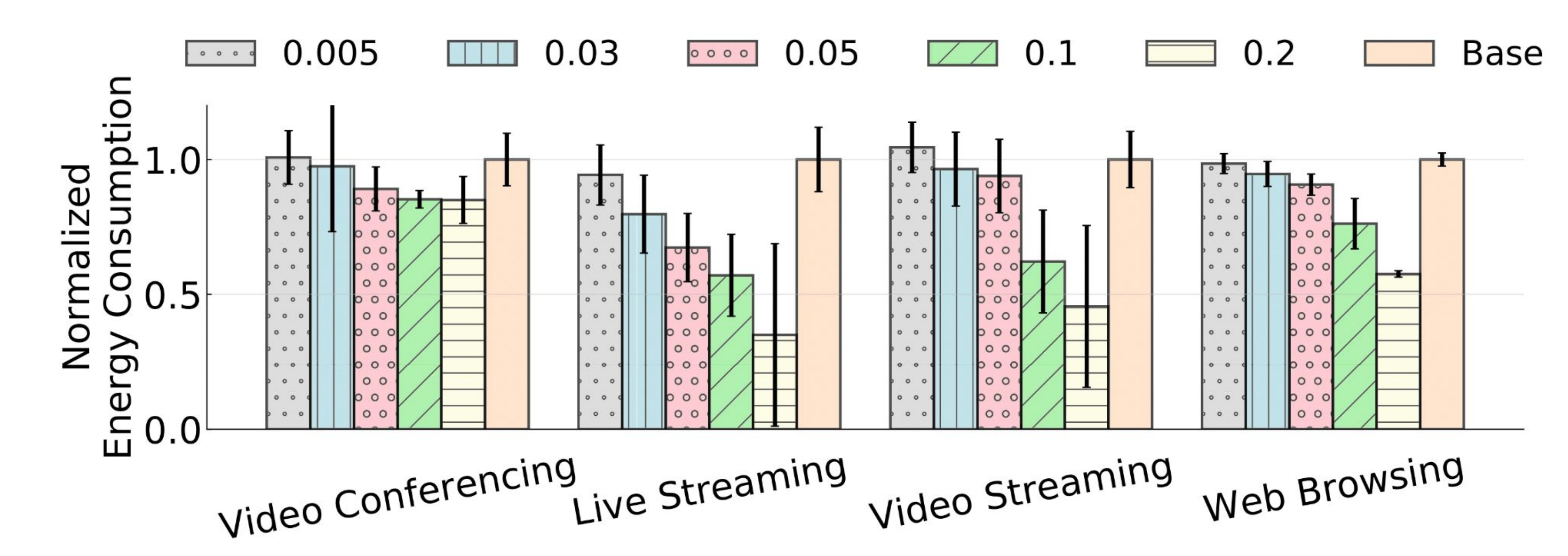
- 3) UE Segregation**



- Schedules **UEs to be served separately in subframes** to lower control signaling overhead

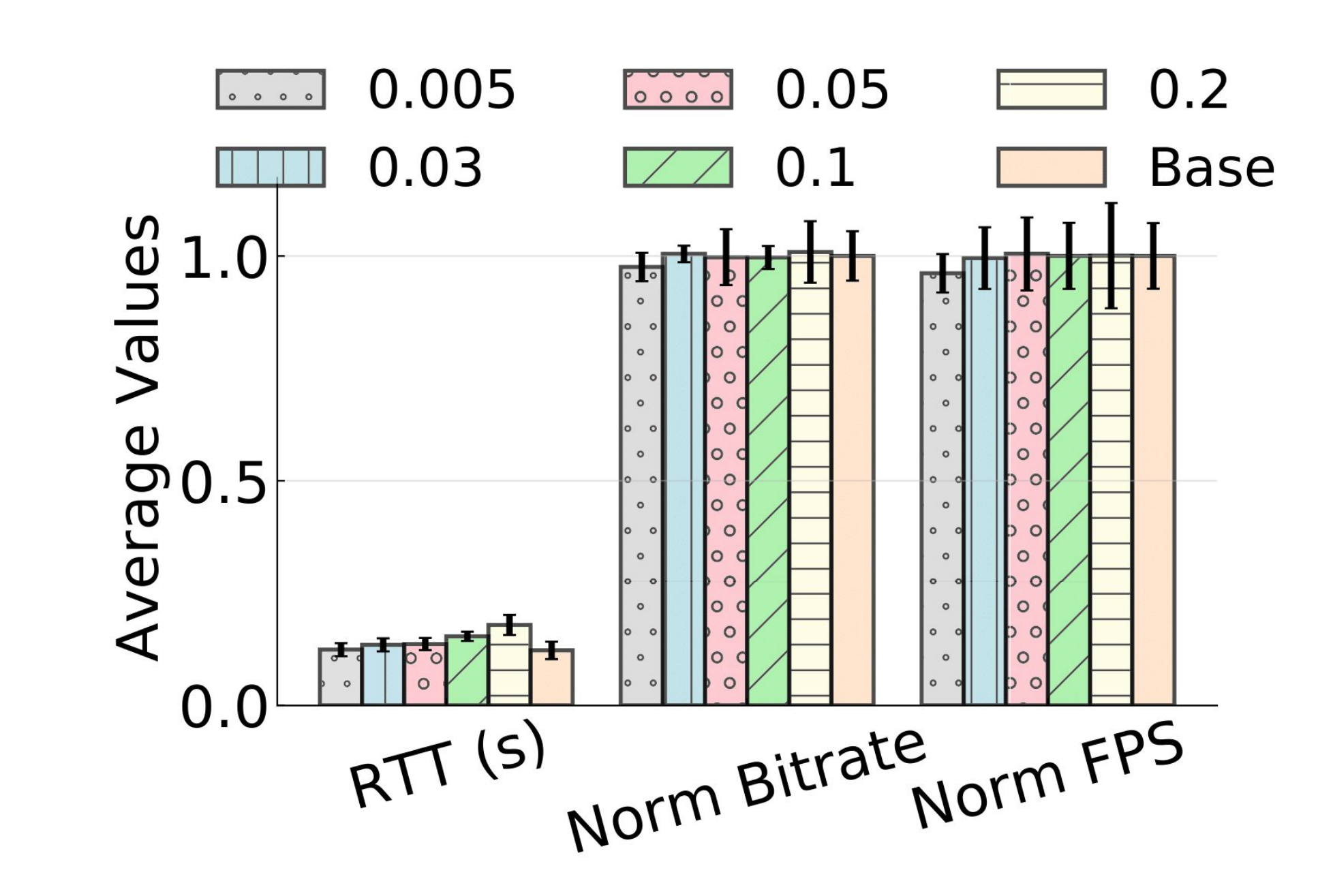
## EVALUATION RESULTS

- Impact of EcoCell on **energy consumption** of multiple applications with different burst times



EcoCell saves energy in most configurations and across multiple applications. The benefits are the most pronounced for **video streaming** and **live streaming** applications, with power savings of max 32% and 42%

- Impact of EcoCell on **QOE** of video conferencing with different burst times



EcoCell doesn't affect the bitrate and FPS but introduces small extra delays. The RTT increased from 92ms to 118ms but this delay is still within acceptable limits for video-conferencing applications

EcoCell saves 30-40% base station dynamic energy with minimal impact to application QoE!