

# Characterizing Energy-Delay Tradeoff in Hyper-Cellular Networks with BS Sleeping Control

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Public Lecture  
IEEE NSW VTS & ComSoc Chapters

## Date:

**Tuesday,  
10 November 2015**

## Time:

**11:00am - 12:30pm**

## Location:

Seminar room 11.06.408  
Level 6, Building 11  
University of Technology,  
Sydney  
Corner of Jones St and  
Broadway, Ultimo

## Cost:

Free

## RSVP:

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## Abstract:

Base station sleeping control is one of the most effective ways to make mobile networks greener, whereas some users may have to experience extra delay or other kind of QoS degradation due to unavailability of the BSs during sleep, i.e., energy can be traded off by some delay. The fundamental question then arises: how much energy can be saved by a tolerable delay? In this talk, we characterize the tradeoffs between energy consumption and service delay in a base station with sleep mode operations by queueing models. The base station is modeled as an M/G/1 vacation queue with setup and close-down times, where the base station enters sleep mode if no customers arrive during the close-down time after the queue becomes empty and it starts to setup when it sees  $N$  arriving customers during its sleep period. Several closed-form formulas are derived to demonstrate the tradeoffs between the energy consumption and the mean delay by changing the close-down time, setup time, and  $N$ . It is shown that the relationship between the energy consumption and the mean delay is linear in terms of mean close-down time, but non-linear in terms of  $N$ . The explicit relationship between total power consumption and average delay with varying service rate is also analyzed theoretically, indicating that sacrificing delay cannot always be traded for energy saving. In other words, larger  $N$  may lead to lower energy consumption, but there exists an  $N^*$  that minimizes the mean delay.

## Speaker Biography

Dr. Niu graduated from Beijing Jiaotong University, China, in 1985, and got his M.E. and D.E. degrees from Toyohashi University of Technology, Japan, in 1989 and 1992, respectively. During 1992-94, he worked for Fujitsu Laboratories Ltd., Japan, and in 1994 joined with Tsinghua University, Beijing, China, where he is now a professor at the Department of Electronic Engineering. His major research interests include queueing theory, traffic engineering, mobile Internet, radio resource management of wireless networks, and green communication and networks.

Dr. Niu received the Best Paper Award from IEEE ComSoc Asia-Pacific Board in 2013, and the Best Paper Awards from the 13th, 15th and 19th Asia-Pacific Conference on Communication (APCC) in 2007, 2009, and 2013, respectively. He is a fellow of both IEEE and IEICE and a distinguished lecturer of both IEEE ComSoc and VTS.

