Throughput Enabled Rate Adaptation Methods

Tech ID: 23229 / UC Case 2013-651-2

BACKGROUND

Most wireless standards support multiple data rates that may vary between few Mbps to few Gbps. Reaching the maximum supported data rate is what most application seek for. Nevertheless, the choice of data rates is very closely related to the quality of communication links and their stability. IEEE 802.11 standard introduced multi-rate support, since then, a lot of research has been done on rate adaptation, dealing with the different parameters that lead to an estimation of the channel conditions and the metrics that affect the network performance. The main objective for rate adaptation in a wireless network is to assign the largest possible transmission rates to nodes in a way that multiple access interference (MAI) is minimized while the receiving nodes are still able to decode the transmitted packets under the current channel state. Rate adaptation constitutes a key aspect of the functionality of the IEEE 802.11 physical layer (PHY). Designing a rate adaptation algorithm that performs well in diverse settings is challenging due to the complex physical-layer effects of wireless links, including interference, attenuation, and multi-path fading. While many solutions exist addressing the rate adaptation problem, the design of an efficient solution applicable to multiple diverse scenarios has proven to be elusive. This is due in part to the complex nature of a wireless channel and its interaction with the channel contention caused by users as they access the shared resource, plus the fact that network-level steps taken by nodes (e.g., attempting to use alternate routes around congestion hot spots) may induce additional interference by making more nodes relay packets.

TECHNOLOGY DESCRIPTION

To overcome challenges with respect to rate adaptation, researchers at UC Santa Cruz (UCSC) have developed a new approach called Throughput Enabled Rate Adaptation (TERA) which accounts for interference and congestion effects implicitly but is based solely on measurements of the throughput attained at different data rates. UCSC's use of throughput as the single parameter for rate adaptation in TERA has led to a solution that is surprisingly simple, robust, and efficient. The design of TERA is based on the insight that providing effective rate adaptation in a wireless network is related to the throughput experienced by nodes at different data rates. Furthermore, end-user applications care about the throughput attained, rather than the transmission rate used or the loss ratios. TERA's main method involves the wireless node: measuring the wireless node throughput attained while communicating at different data rates on a channel in the digital wireless communication network, calculating the measured throughput a current transmission rate (without any a priori knowledge of a state of the channel), and transmitting at the calculated rate. TERA determines a ratio of the measured throughput with respect to an exponential weighted moving average of the measured throughput, performed at a polling frequency, and decreased if the measured throughput oscillates. Extensive simulations and real-world experiments have shown that TERA consistently outperforms all prior rate adaptation schemes used to date (2014).

APPLICATIONS

- wireless cellular networking
- wireless networking

FEATURES/BENEFITS

- Based solely on throughput measurements that do not need any careful tuning of system parameters to work well.
- Compatible with existing 802.11 implementations.
- Outperforms all prior rate adaptation schemes used to date (2014).

INTELLECTUAL PROPERTY INFORMATION

CONTACT

Marc Oettinger
marc.oettinger@ucsc.edu
tel: 831-502-0253.

OTHER INFORMATION

KEYWORDS

networking, network protocols, networks, wireless networks, rate adaptation, rate adaptation algorithms, WiFi, IEEE 802.11, mobility, interference

CATEGORIZED AS

- **Communications**
  - Internet
  - Networking
  - Wireless

RELATED CASES

2013-651-2

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,197,572	11/24/2015	2013-651

RELATED MATERIALS

- Nguyen, Duy Duc. Multi-channel and multi-rate adaptation for high-throughput wireless networks. University of California, Santa Cruz, 2012. - 12/31/2012

University of California, Santa Cruz
Industry Alliances & Technology Commercialization
Kerr 413 / IATC,
Santa Cruz,CA 95064

Tel: 831.459.5415
innovation@ucsc.edu
officeofresearch.ucsc.edu/
Fax: 831.459.1658