

## K. PREMKUMAR

Research Fellow

Hamilton Institute

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### Areas of Interest

**Communication Networks** – Scheduling, Resource Allocation, Power Control, and Rate Adaptation

**Stochastic Systems** – Performance Modelling, Analysis, and Design

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### Education

Aug. 2005 – Nov. 2010

**Doctor of Philosophy [PhD]**

Electrical Communication Engineering

Indian Institute of Science, Bangalore, India

CGPA: 6.7 out of 8.0

Jan. 1999 – Aug. 2001

**Master of Science [MS in Engineering]**

Electrical Communication Engineering

Indian Institute of Science, Bangalore, India

CGPA: 6.2 out of 8.0

Aug. 1993 – Jun. 1997

**Bachelor of Engineering [BE]**

Electronics and Communication Engineering

ACCET, Madurai Kamaraj University, Tamilnadu, India

Percentage: 81.2% (Gold medalist)

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### Professional Experience

#### Summary

**5.5 years of professional experience,**

**1.5 years of post-doctoral experience,**

**apart from MS/PhD academic research experience**

Nov. 2010 – present	Research Fellow Hamilton Institute, National University of Ireland Maynooth, Ireland
Sep. 2009 – Oct. 2009	Visiting Graduate Student University of Illinois at Urbana–Champaign, IL, USA
Aug. 2005 – Nov. 2010	PhD Student Indian Institute of Science
Jan. 2005 – Jul. 2005	Systems Analyst Applied Research Group, Satyam Computer Services Ltd.
Sep. 2003 – Jan. 2005	Project Associate Indian Institute of Science
Aug. 2001 – Sep. 2003	Software Engineer Motorola India Electronics Limited
Jan. 1999 – Aug. 2001	MS Student Indian Institute of Science
Aug. 1997 – Dec. 1998	Software Engineer Infosys Technologies Ltd.

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## Awards

- 2009 DST Young Scientist Travel Grant award for Allerton (INR 75000)
- 2009 CSIR Travel Grant award for Allerton (INR 60000)
- 2008 Microsoft Research Student Travel Grant (STG) award for Infocom (INR 25000)
- 2008 IEEE Student Travel Grant (STG) award for Infocom (USD 1000)
- 2005 – 2010 IISc fellowship for PhD
- 2003 Bravo Award for the best performance by Motorola
- 1999 – 2001 IISc fellowship for MS
- 1993 – 1997 Gold medal for topping in under-graduation

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## Teaching Assistant

### E2–301: Topics in Multiuser Communication

This is a graduate level course on **Information Theory**. The course web page is <http://ece.iisc.ernet.in/~kprem/e2301/e2301.htm>. I scribed lecture notes, prepared home work problems and solutions, conducted tutorial classes, and gave a couple of guest lectures.

### E2–202: Random Processes

This is a graduate level course. I have done the following things as part of my TAs: preparing home work problems and solutions, conducting tutorial classes, giving a couple of guest lectures and also in grading the mid-term and final exams.

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## Research Projects

### Network Utility Optimisation

#### Hamilton Institute, National University of Ireland Maynooth

This project studies the utility–fair operation of wireless mesh networks; in particular, we study the proportional fair throughput allocation with delay deadline. We show that the PHYSical and the MAC layers are coupled in the following sense: the airtimes of flows (which is a MAC layer parameter) and the channel error control coding (which is a PHY layer parameter) depend on each other. However, if there is no delay deadline (i.e., if the receiver can wait infinitely long), then the PHY and the MAC layers are decoupled. For details, please refer to [C12], [C13], and [J08], [J09] on page 4.

### Wireless Sensor Networks

#### Indian Institute of Science

This project studies the detection of an intruder or an anomaly using a wireless sensor network. Based on the coverage of a sensor and the region under surveillance, we classify a network as small–extent or a large–extent network. We obtain detection delay optimal detection rules for both the small–extent and large–extent networks under various constraints that include energy–efficiency. For details, please refer to [C07]–[C11] on pages 4 and 5, and [J03]–[J07] on page 4.

### STA–BS/AP Association

#### Satyam Computer Services Ltd

This project aims at studying the association problem between wireless stations and, APs and Base stations. Each association vector corresponds to a value of sum-throughput of the stations. This problem is NP-hard, and we propose a greedy algorithm that achieves near optimal (maximum sum-throughput) solution. For details, please refer to [C06] on page 5.

<b>Coexistence of WLAN and Bluetooth</b>	<b>Satyam Computer Services Ltd</b> This research studies the coexistence between Bluetooth and IEEE 802.11 (WLAN). We note that these two systems use the same ISM band, and hence, interfere with each other. We propose a novel diversity technique for WLAN that mitigates the interference, and also, gives a diversity gain. For details, please refer to [C05] on page 5.
<b>Optimal Power Allocation in Wireless Systems</b>	<b>Indian Institute of Science</b> This project studies the Bit Error Rate (BER) of digital communication systems under fading wireless channels. It is well known from the classical literature that the BER under fading channels falls linearly with the Signal-to-Noise Ratio (SNR); even with diversity, the fall is polynomial. However, we obtain optimal power control strategy under which the fall of BER is exponential with SNR. For details, please refer to [C04] on page 5, and [J02] on page 4.
<b>Multi User Receivers for CDMA Systems</b>	<b>Motorola India Electronics Ltd.</b> This project aims at developing multi-user CDMA receivers based on interference cancellation techniques. We also proposed a hybrid receiver that combines the principles of beamforming and interference cancellation. This is a Motorola classified property. Also, please refer to [C03] on page 5.
<b>Throughput/Delay in GPRS Networks</b>	<b>Indian Institute of Science</b> This project studies the throughput and delay at MAC/LLC/TCP layers in GPRS networks. In the RLC layer, the basic unit of retransmission (as specified in the standard) is a block of 4 RLC packet data units (PDUs), which we call 'block level retransmission (BLR)'. We propose a retransmission mechanism called as 'slot level retransmission (SLR)' in which the basic unit of retransmission is one RLC PDU. We show that our proposed retransmission strategy, SLR performs better than BLR in terms of throughput and delay. We model the MAC layer communication using Markov chain and analyse the throughput and delay at various layers (RLC,LLC,TCP). For details, please refer to [C01], [C02] on page 5, and [J01] on page 4.

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## Expertise

Communication Networks, Digital Communications, Game Theory, Optimisation, Probability Theory and Random Processes, Statistical Theory of Communications, Stochastic Control, Stochastic Processes - Modelling and Applications, Wireless Communications

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## Computer Skills

<b>Languages</b>	C, C++
<b>Mathematical Packages</b>	MATLAB

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## Professional Services

<b>Reviewer</b>	SPCOM 2013, VTC 2009, ISIT 2009, CDC 2008, MCDES 2008, NCC 2007, ICDCN 2007, ADCOM 2007, SPCOM 2004
<b>Reviewer</b>	IEEE Transactions on Wireless Communications, IEEE Transactions on Information Theory, IEEE Transactions on Signal Processing, Methodology and Computing in Applied Probability, a Springer journal International Journal of Wireless and Mobile Computing (IJWMC)
<b>Member</b>	IEEE, SIAM, American Mathematical Society

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## Publications

### Journal Publications

- [J09] K. Premkumar, X. Chen, and D. J. Leith, "Utility Optimal Coding for Packet Transmission over Wireless Networks," *being submitted*, IEEE Transactions on Wireless Communications.
- [J08] K. Premkumar, X. Chen, and D. J. Leith, "Proportional Fair Coding for Wireless Mesh Networks," *Under Review*, IEEE/ACM Transactions on Networking.
- [J07] K. Premkumar, Anurag Kumar and Venugopal V. Veeravalli, "Optimum Bayesian Transient Change Detection," *being submitted*, IEEE Transactions on Information Theory.
- [J06] K. Premkumar and Anurag Kumar, "Optimum Sleep–Wake Scheduling of Sensors for Quickest Intrusion Detection in Small Extent Wireless Sensor Networks," *Under Review*, IEEE/ACM Transactions on Networking.
- [J05] K. Premkumar, Anurag Kumar and Joy Kuri, "Distributed Detection/Isolation Procedures for Quickest Events Detection in Large Extent Wireless Sensor Networks," *Under Review*, IEEE Transactions on Signal Processing, available at <http://arxiv.org/abs/1105.6061>
- [J04] K. Premkumar, V. K. Prasanthi, and Anurag Kumar, "**Delay Optimal Event Detection on Ad Hoc Wireless Sensor Networks**," *ACM Transactions on Sensor Networks*, Vol. 8, No. 2, May 2012.
- [J03] WSN Team, "**Wireless Sensor Networks for Human Intruder Detection**," *Journal of the Indian Institute of Science*, Vol. 90, No. 3, Jul. – Sep. 2010.
- [J02] V. Sharma, K. Premkumar, and R. N. Swamy, "**Exponential Diversity Achieving Spatio–Temporal Power Allocation Scheme for Fading Channels**," *IEEE Transactions on Information Theory*, vol. 54, No. 1, Jan. 2008.
- [J01] K. Premkumar and A. Chockalingam, "**Performance Analysis of RLC/MAC and LLC Layers in GPRS Protocol Stack**," *IEEE Transactions on Vehicular Technology*, vol. 53, No. 5, Sep. 2004.

### Conference Publications

- [C13] K. Premkumar, X. Chen, and D. J. Leith, "Utility Optimal Coding for Packet Transmission over Wireless Networks - Part II: Networks of Packet Erasure Channels," *Forty–Ninth Annual Allerton Conference On Communication, Control, and Computing*, Monticello, IL, USA, Sep. 28 – Sep. 30, 2011.
- [C12] K. Premkumar, X. Chen, and D. J. Leith, "Utility Optimal Coding for Packet Transmission over Wireless Networks - Part I: Networks of Binary Symmetric Channels," *Forty–Ninth Annual Allerton Conference On Communication, Control, and Computing*, Monticello, IL, USA, Sep. 28 – Sep. 30, 2011.
- [C11] K. Premkumar, V. K. Prasanthi, and Anurag Kumar, "**Delay Optimal Event Detection on Ad Hoc Wireless Sensor Networks**," *Forty–Eighth Annual Allerton Conference On Communication, Control, and Computing*, Monticello, IL, USA, Sep. 29 – Oct. 01, 2010 (Invited Paper).
- [C10] K. Premkumar, Anurag Kumar, and V. Veeravalli, "**Bayesian Quickest Transient Change Detection**," *International Workshop in Applied Probability (IWAP)*, Colmenarejo, Spain, Jul. 2010 (Invited Paper).

- [C09] K. Premkumar, Anurag Kumar, and J. Kuri, "[Distributed Detection and Localization of Events in Large Ad Hoc Wireless Sensor Networks](#)," *Forty-Seventh Annual Allerton Conference On Communication, Control, and Computing*, Monticello, IL, USA, Sep. 30 – Oct. 2, 2009.
- [C08] M. M. Nadgir, K. Premkumar, Anurag Kumar, and J. Kuri, "[CUSUM Based Distributed Detection in WSNs](#)," *Managing Complexity in a Distributed World (MCDES, an IISc centenary conference)*, Bangalore, India, May 2008.
- [C07] K. Premkumar and Anurag Kumar, "[Optimal Sleep–Wake Scheduling for Quickest Intrusion Detection Using Sensor Networks](#)," *IEEE International Conference on Computer Communications (INFOCOM)*, Arizona, USA, Apr. 2008.
- [C06] K. Premkumar and Anurag Kumar, "[Optimum Association of Mobile Wireless Devices to a WLAN-3G Access Network](#)," *IEEE International Conference on Communications (ICC)*, Istanbul, Turkey, Jun. 2006.
- [C05] K. Premkumar and S. H. Srinivasan, "[Diversity Techniques for Interference Mitigation between IEEE 802.11 WLANs and Bluetooth](#)," *IEEE International Conference on Personal, Indoor and Mobile Radio Communications (PIMRC)*, Berlin, Germany, Sep. 2006.
- [C04] K. Premkumar, A. Rangarajan, and V. Sharma, "[Exponential Diversity achieving Spatio-Temporal Power Allocation Scheme for MIMO Fading Channels](#)," *IEEE International Symposium on Information Theory (ISIT)*, Chicago, IL, USA, 2004.
- [C03] M. Beuttner, B. Jayachandran, and K. Premkumar, "[Design and Analysis of Smart Antennas with MUD](#)," *Motorola Antenna Symposium*, Oct. – Nov. 2002.
- [C02] K. Premkumar and A. Chockalingam, "[Performance of LLC and TCP on GPRS Uplink with RLC Slot Level Retransmission](#)," *National Conference on Communications (NCC)*, IIT Bombay, Jan. 2002.
- [C01] K. Premkumar and A. Chockalingam, "[Performance Analysis of RLC/MAC Protocol in General Packet Radio Service](#)," *National Conference on Communications (NCC)*, IIT Kanpur, Jan. 2001.