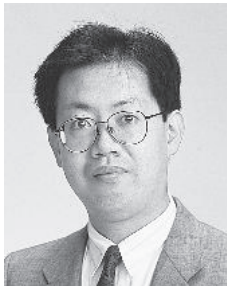
Performance Evaluation Laboratory



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The laboratory mission in the broad sense is to contribute to:

- Cooperative Communication and Networking
- Self-Organizing Techniques for Cyber-Physical Systems
- Modeling and Performance Evaluation of Cognitive Radio Networks
- New Models of Grid and Ubiquitous Computing for Image Processing

Cooperative Communication and Networking

As the wireless communication channel is shared in nature, cooperative communication has been proposed recently as an effective way to mitigate channel impairments in wireless networks. With user cooperation, single-antenna mobile terminals in a multi-user environment share antennas from other mobiles to generate a virtual multiple antenna system that exploits the spatial multiplexing and diversity gains to improve spectrum and energy efficiency of wireless networks.

In addition to the user cooperation, cooperative networking has received significant attention recently as an emerging network design strategy for future wireless networks. Next generation wireless networks will be heterogeneous by integrating different access networks, such as IEEE 802.15 WPAN, IEEE 802.11 WLAN, IEEE 802.16 WMAN, GPRS, EDGE, WCDMA, satellite networks, etc. Smart interactions among the network nodes have been proposed in order to enhance the QoS of their connections and the performance of the whole network.

Self-Organizing Techniques for Cyber-Physical Systems

Wireless sensor networks (WSNs) have been widely used and become an essential to the realization of cyber-physical society. Self-deployable, self-configurable,

self-maintainable and self-repairable autonomous wireless sensor networks are called for trust-worthy monitoring of critical infrastructures that might be subject to natural and/or human induced hazards. However, due to the limited capability of simple low-cost sensor nodes, it is difficult to realize such kind of intelligent system. We envision adding robots to assist wireless sensor networks to handle the connectivity and coverage problems and achieve autonomous and survivable network functionality in order to overcome the limitations of traditional sensor networks. It can be anticipated that, the well-designed robot-assisted wireless sensor networks will provide radically new networking paradigms and myriads of new potential applications, so as to promote the development of cyber-physical systems.

As a representative system of CPS, Smart Grid is recently proposed as an enhancement of the next generation power grid. To achieve efficient status monitoring, control and billing, a large number of smart meters are deployed and they would produce a huge volume of traffic. How to efficiently collect these data imposes a great challenge on the communication networks. In this project, we study this problem by exploring the secondary spectrum market in cellular networks. With the objective of reducing the electricity and communication cost, we formulate a problem called CMM (Cost Minimization for Meter data collection) to find an optimal channel selection and transmission scheduling scheme.

Modeling and Performance Evaluation of Cognitive Radio Networks

With the emergence of a variety of wireless multimedia applications, most of the usable radio spectrum has been densely allocated, which leads to the problem of spectrum scarcity worldwide. However, extensive measurement studies have indicated that the prime radio spectrum experiences significantly low utilization efficiency because of the current static spectrum allocation policy. Sparked by recent advances in cognitive radios, a new communication paradigm presents a possible solution to the spectrum inefficiency problem, which allows secondary users equipped with cognitive radios to opportunistically access unoccupied bands of licensed spectrum while limiting the interference perceived by the primary users. Such networking paradigm is referred to as Cognitive Radio Networks (CRNs). In this research, we studied the joint resource allocation schemes in cognitive femtocell networks.

New Models of Grid and Ubiquitous Computing for Image Processing

The main purpose of this research is to explore new software models/toolkits, named Ubiquitous Multi-Processor (UMP) system, to support distributed application development over the emerging ubiquitous/pervasive computing environment,

such as ubiquitous computing, Peer-to-Peer (P2P) computing, and mobile computing environments. In the proposed application scenario, there are many PCs equipped with some UMPs. These PCs are distributed over different domains (each PC belongs and only belongs to one domain). There also has a resource router in each domain taking charge of UMP management request processing.

In the system, the behaviors of UMPs are controlled by corresponding resource router. Once it registers to the resource router successfully, a UMP will listen and accept for the task scheduled by the resource router. the UMP will also update it status information to the resource router when a task is finished.

To support mobile computing environments, the resource router should be aware of the location of mobile users and be able to locate available UMPs from the nearest domain, so as to reduce the communication cost for the request.

Refereed Journal Papers

Refereed Proceeding Papers

[pengli-04:2012] Peng Li, Song Guo, and Victor Leung. Improving Throughput by Fine-grained Channel Allocation in Cooperative Wireless Networks. In *IEEE Global Telecommunications Conference (Globecom)*, pages 5740–5744, 2012.

Cooperative communication provides an efficient and low-cost way to achieve spatial diversity without deploying multiple antennas on each node in wireless networks. In a channel-constrained environment, such as cognitive radio networks, the channel allocation as well as relay assignment have been identified as two critical factors in determining the performance of multiple source-destination pairs. However, the advantage of channel diversity has little been exploited in such networks under a simplified model where the transmissions within a cooperative communication pair are on a common channel. In this paper, we consider a fine-grained channel allocation scheme that the source and the relay can work on different channels to complete a signal transmission. We study its performance gain in maximizing the minimum throughput among multiple source-destination pairs in channel-constrained wireless networks with a number of dedicated relay nodes. This problem is proved to be NP-hard and an online algorithm is proposed for a dynamic wireless network where the accessible channels of each node may vary from time to time. Extensive simulations are conducted to show that the proposed fine-grained channel allocation scheme can effectively improve the performance under various network settings.

[pengli-05:2012] Peng Li, Song Guo, Weihua Zhuang, and Baoliu Ye. Capacity Maximization in Cooperative CRNs: Joint Relay Assignment and Channel Allocation. In *IEEE International Conference on Communications (ICC)*, pages 1–10, 2012.

Cooperative communication (CC) can offer high channel capacity and reliability in an efficient and low-cost way by forming a virtual antenna array among single-antenna nodes that cooperatively share their antennas. It has been well recognized that the selection of relay nodes plays a critical role in the performance of multiple source-destination pairs. Unfortunately, all prior work has made an unrealistic assumption that each source-destination

pair communicates over a dedicated channel with no mutual interference. In this paper, we study the problem of capacity maximization using cooperative communication in a cognitive radio network by jointly considering the relay assignment and channel allocation under a finite set of available channels, where the interference must be considered. It is proved to be NP-hard and a heuristic algorithm is proposed. Moreover, we exploit the network coding opportunities existing in CC that can further increase the capacity. Extensive simulations are conducted to show that the proposed algorithms can achieve high total capacity under various network settings.

[sguo-16:2012] An-Ni Shen, Song Guo, Deze Zeng, and Mohsen Guizani. A Lightweight Privacy-Preserving Protocol using Chameleon Hashing for Secure Vehicular Communications. In *IEEE Wireless Communications and Networking Conference (WCNC)*, April 2012.

Many services and applications in vehicular ad-hoc networks (VANETs) require preserving and secure data communications. To improve driving safety and comfort, the traffic-related status information will be broadcasted regularly and shared among drivers. Without the security and privacy guarantee, attackers could track their interested vehicles by collecting and analyzing their traffic messages. Hence, anonymous message authentication is an essential requirement of VANETs. On the other hand, when a vehicle is involved in a dispute event of warning message, the certificate authority should be able to recover the real identity of this vehicle. To deal with this issue, we propose a new privacy-preserving authentication protocol with authority traceability using elliptic curve based chameleon hashing. Compared with existing schemes, our approach possesses the following features: (1) mutual and anonymous authentication, (2) unlinkability, (3) authority tracking capability and (4) high efficiency. We also demonstrate the merits of our proposed scheme through extensive security analysis and performance evaluation.

[sguo-17:2012] Zhuo Li, Song Guo, Wenzhong Li, Sanglu Lu, Daoxu Chen, and Victor Leung. A Particle Swarm Optimization Algorithm for Resource Allocation in Femtocell Networks. In *IEEE Wireless Communications and Networking Conference (WCNC)*, April 2011.

Femtocell network is an efficient configuration to improve coverage and quality of service (QoS) in cellular networks. However, due to dense deployment, users in a femtocell may be interfered by the base stations nearby, resulting in a deteriorated throughput of the femtocell. In this paper, we investigate

the resource allocation problem targeting at max-min throughput of the femtocells. Under the assumption that a number of discrete power levels are available for each device, a joint optimization problem over power control and channel allocation is formulated. We show its hardness and propose a particle swarm optimization based algorithm PCASO. We demonstrate the efficiency of PCASO by thorough numerical experiments.Femtocell network is an efficient configuration to improve coverage and quality of service (QoS) in cellular networks. However, due to dense deployment, users in a femtocell may be interfered by the base stations nearby, resulting in a deteriorated throughput of the femtocell. In this paper, we investigate the resource allocation problem targeting at max-min throughput of the femtocells. Under the assumption that a number of discrete power levels are available for each device, a joint optimization problem over power control and channel allocation is formulated. We show its hardness and propose a particle swarm optimization based algorithm PCASO. We demonstrate the efficiency of PCASO by thorough numerical experiments.

[sguo-18:2012] Qinhui Wang, Baoliu Ye, Tianyin Xu, Sanglu Lu, and Song Guo. DOTA: A Double Truthful Auction for Spectrum Allocation in Dynamic Spectrum Access. In *IEEE Wireless Communications and Networking Conference (WCNC)*, April 2012.

Dynamic spectrum access motivates current spectrum owners to open up their idle spectrum to unlicensed users for financial gains. Auction has been proposed as an effective approach to fairly and efficiently trade the scarce spectrum resource among wireless users. The most significant challenge of designing the auction is to provide economic robustness, particularly truthfulness, under the local-dependent interference constraints. However, existing designs either do not consider spectrum reuse or are based on an impractical assumption that each user requests at most one channel. In this paper, we address the problem by proposing DOTA, a DOuble Truthful Auction for dynamic spectrum access. DOTA is economic-robust in terms of truthfulness, individual rationality, and no-deficit. It achieves an improved utilization by exploiting spectrum reuse and dealing with the interference constraints. Moreover, DOTA minimizes the network transaction overhead and provides flexible channel bidding including range bidding and strict bidding.

[sguo-19:2012] Deze Zeng, Song Guo, Hai Jin, and Victor Leung. Dynamic Segmented Network Coding for Reliable Data Dissemination in Delay

Tolerant Networks. In *IEEE International Conference on Communications (ICC)*, June 2012.

Delay/Disruption Tolerant Network (DTN) differs from the conventional networks in that it has no continuous or contemporaneous connections among wireless nodes. Its inherent characteristic of intermittent connections makes existing routing solutions hardly to be applied directly. Epidemic routing using random linear network coding has been studied and proved as an efficient way for delivering small amount of data. To our best knowledge, we are the first to study high performance reliable transmission for bulk or stream-like data in DTNs. In this paper, we propose a dynamic segmented network coding scheme to efficiently exploit the transmission opportunity that is scarce in DTNs. In particular, we adopt a dynamic segment size control mechanism, which makes the segmentation adapt to the dynamics of the network. A lower bound of the expected delivery delay for bulk-data dissemination using segmented network coding is also derived. Both analytical and simulation results validate the high performance of our proposal. Several other interesting findings are also observed.

[sguo-20:2012] Peng Li, Song Guo, Weihua Zhuang, and Baoliu Ye. Capacity Maximization in Cooperative CRNs: Joint Relay Assignment and Channel Allocation. In *IEEE International Conference on Communications (ICC)*, June 2011.

Cooperative communication (CC) can offer high channel capacity and reliability in an efficient and low-cost way by forming a virtual antenna array among single-antenna nodes that cooperatively share their antennas. It has been well recognized that the selection of relay nodes plays a critical role in the performance of multiple source-destination pairs. Unfortunately, all prior work has made an unrealistic assumption that each source-destination pair communicates over a dedicated channel with no mutual interference. In this paper, we study the problem of capacity maximization using cooperative communication in a cognitive radio network by jointly considering the relay assignment and channel allocation under a finite set of available channels, where the interference must be considered. It is proved to be NP-hard and a heuristic algorithm is proposed. Moreover, we exploit the network coding opportunities existing in CC that can further increase the capacity. Extensive simulations are conducted to show that the proposed algorithms can achieve high total capacity under various network settings.

[sguo-21:2012] Deze Zeng, Lei Cong, Huawei Huang, Song Guo, and Hong Yao.

Deadline-Constrained Content Distribution in Vehicular Delay Tolerant Networks. In *IEEE International Wireless Communications and Mobile Computing Conference (IWCMC)*, August 2012.

Content distribution in vehicular networks is essential to many emerging applications. The issues such as content distribution from road side units (RSUs) to vehicles or the cooperation between vehicles have drawn a lot of interests in the literature. However, little work is on packets distribution from content providers to RSUs and many related issues are still under-investigated. In this paper, we consider the problem of minimizing the distribution cost, which is defined as the number of packets that shall be dispatched to RSUs, for deadlineconstrained content distribution in vehicular networks. The problem is first formulated as an integer programming problem, based on a link-coloring concept. Then, a heuristic algorithm with low computational complexity is proposed. The high efficiency of the proposed algorithm is extensively validated by the fact that it performs close to the optimal solution obtained by the CPLEX solver.

[sguo-22:2012] Felix Musau, Guojun Wang, Song Guo, and Muhammad Bashir Abdullahi. Neighbor Similarity Trust against Sybil Attack in P2P E-Commerce. In *IEEE International Conference on Autonomic and Trusted Computing (ATC)*, September 2012.

Peer to peer (P2P) e-commerce applications exist at the edge of the Internet with vulnerabilities to passive and active attacks. These attacks have pushed away potential business firms and individuals whose aim is to get the best benefit in e-commerce with minimal losses. The attacks occur during interactions between the trading peers as a transaction takes place. In this paper, we propose how to address Sybil attack, which is a kind of active attack. The peers can have bogus and multiple identity to fake their own ones. Most existing work, which concentrates on social networks and trusted certification, has not been able to prevent Sybil attack peers from participating in transactions. Our work exploits the neighbor similarity trust relationship to address Sybil attack. In this approach, referred to as SybilTrust, duplicated Sybil attack peers can be recognized as the neighbor peers become acquainted and hence more trusted to each other. Security and performance analysis shows Sybil attack can be minimized by our proposed neighbor similarity trust.

[sguo-23:2012] Deze Zeng, Song Guo, Mohsen Guizani, and Baoliu Ye. All-to-All Throughput Maximization in Wireless Relay Networks with Multiple

Packet Reception. In *IEEE Global Telecommunications Conference (Globecom)*, December 2012.

Network Coding (NC) has shown the promise of significant throughput improvement to wireless networks. Meanwhile, Multiple Packet Reception (MPR) has been proved as an efficient way to combat the Multiple Access Interference (MAI) problem and to make wireless networks truly scalable. Their outstanding advantages to wireless network performance have attracted considerable research interests. In this paper, we find that the greedy use of MPR may take side effect to NC and degrade the overall network throughput for All-to-All (A2A) communication in two-way relay networks. To fully explore the potential of both MPR and NC, the transmission should be carefully scheduled. The optimal scheduling to achieve the maximum A2A throughput is then formulated as an Integer Programming (IP) problem. A heuristic transmission scheduling algorithm with low computational complexity is also proposed. Simulation results show that our heuristic algorithm performs very closely to the optimal solution obtained by solving the IP problem, and achieves a significantly improved performance over the greedy scheduling that always exhausts the MPR capacity. Furthermore, a non-strict monotonic relationship between the MPR capacity and the maximum A2A throughput has been also discovered from our experimental results.

[sguo-24:2012] Honglei Jiang, Song Guo, Deze Zeng, and Hai Jin. Improving Content Availability by Request-Adaptive Incentive in Private Peer-to-Peer Communities. In *IEEE Global Telecommunications Conference (Globecom)*, December 2012.

Recently, BitTorrent (BT) communities are rapidly evolving towards Private Torrent (PT) sites. The efficiency of such content sharing system depends on how well it can satisfy the requirements of users. The traditional way to improve usability is to make users extend their seeding duration by incentives like Share Ratio Enforcement (SRE). However, our measurement-based studies show its inefficiency in meeting various download requests from users. For example, some available contents have not been requested for long and some requests are not available, recognized as the "available but no request" and "request but not available" problems respectively. To make the content availability match users' download demands, we propose new incentive polices that only reward the seeding behaviors for needed torrents. This is achieved by providing users the rewarding information of seeding various

contents that vary based on their interests and timeliness to the community. Our trace-driven simulation result shows the proposed "Max Cost Interval" and "Max Time Interval" policies can significantly improve the content over existing policies in a more cost-efficient way.

[sguo-25:2012] Peng Li, Song Guo, and Victor Leung. Improving Throughput by Fine-grained Channel Allocation in Cooperative Wireless Networks. In *IEEE Global Telecommunications Conference (Globecom)*, December 2012.

Cooperative communication provides an efficient and low-cost way to achieve spatial diversity without deploying multiple antennas on each node in wireless networks. In a channel-constrained environment, such as cognitive radio networks, the channel allocation as well as relay assignment have been identified as two critical factors in determining the performance of multiple source-destination pairs. However, the advantage of channel diversity has little been exploited in such networks under a simplified model where the transmissions within a cooperative communication pair are on a common channel. In this paper, we consider a fine-grained channel allocation scheme that the source and the relay can work on different channels to complete a signal transmission. We study its performance gain in maximizing the minimum throughput among multiple source-destination pairs in channel-constrained wireless networks with a number of dedicated relay nodes. This problem is proved to be NP-hard and an online algorithm is proposed for a dynamic wireless network where the accessible channels of each node may vary from time to time. Extensive simulations are conducted to show that the proposed fine-grained channel allocation scheme can effectively improve the performance under various network settings.

Grants

[sguo-26:2012] Song Guo. Context-Aware System Guaranteeing Quality of Service for a Wide Area, 2010 - 2012.

PI, Joint Research Fund of Olympus Corporation

[sguo-27:2012] Song Guo. Self-Organizing Techniques for Cyber-Physical Systems, 2012.

PI, Competitive Research Funding for Young Researchers

[sguo-28:2012] Zixue Cheng, Song Guo, Anh Pham, Truong Cong Thang, Lei Jing, and Junbo Wang. New Algorithms/Protocols of Internet of Things (IOT) and Their Applications to Smart Home/Town for Elderly People, 2012.

Co-PI, Competitive Research Funding for Multi-Lab Project

[sguo-29:2012] Toshiaki Miyazaki, Takfumi Hayashi, Tsuneo Tsukahara, Jyunji Kitamichi, and Song Guo. Demand Addressable Sensor Network, 2012 - 2014.

SCOPE (Strategic Information and Communications R&D Promotion Programme, MIC) Project

Academic Activities

[sguo-30:2012] Song Guo, 2001 -.

Senior Member

[sguo-31:2012] Song Guo, 2006 -.

Senior Member

[sguo-32:2012] Song Guo, 2010 -.

Associate Editor-in-Chief

[sguo-33:2012] Song Guo, 2011 -.

Associate Editor

[sguo-34:2012] Song Guo, 2011 -.

Editor

[sguo-35:2012] Song Guo, 2012 -.

Area Editor

[sguo-36:2012] Song Guo, 2010 -.

Editor

[sguo-37:2012] Song Guo, 2012.

Guest Editor

[sguo-38:2012] Song Guo, 2012.

Publication Chair

[sguo-39:2012] Song Guo, 2012.

Program Vice-Chair

[sguo-40:2012] Song Guo, 2012.

Program Chair

[sguo-41:2012] Song Guo, 2012.

Member of Program Committee:
International Conference on Mobile, Ubiquitous, and Intelligent Computing (MUSIC)
IEEE International Conference on Computer Communications (INFOCOM)
IEEE Vehicular Technology Conference (VTC)
IEEE Wireless Communications and Networking Conference (WCNC)
IEEE International Wireless Communications and Mobile Computing Conference (IWCMC)
IEEE Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC)
IEEE International Conference on Communications in China (ICCC)
IEEE International Conference on Mobile Ad-hoc and Sensor Systems (MASS)
IEEE International Conference on Connected Vehicles and Expo. (ICCVE)

Ph.D and Others Theses

[sguo-42:2012] Miki Imai. Research Topic: UMP System, University of Aizu, 2012.

Thesis Advisor: Song Guo

[sguo-43:2012] Hirokazu Odagiri. Research Topic: UMP System, University of Aizu, 2012.

Thesis Advisor: Song Guo

[sguo-44:2012] Takashi Saito. Research Topic: UMP System, University of Aizu, 2012.

Thesis Advisor: Song Guo

[sguo-45:2012] Shogo Maki. Research Topic: UMP System, University of Aizu, 2012.

Thesis Advisor: Song Guo

[sguo-46:2012] Kohei Iimura. Research Topic: UMP System, University of Aizu, 2012.

Thesis Advisor: Song Guo

[sguo-47:2012] Shunsuke Komata. Graduation Thesis: Extension of Control Unit Cooperating with an Editor for Dataflow Application, University of Aizu, 2012.

Thesis Advisor: Song Guo

[sguo-48:2012] Takumi Nagao. Graduation Thesis: Development of Error Detection Mechanism Using Token Ring in Dataflow Application, University of Aizu, 2012.

Thesis Advisor: Song Guo

[sguo-49:2012] Teru Fujihara. Graduation Thesis: Extension of Application Editor Enabling Run-time Edit of Dataflow Application, University of Aizu, 2012.

Thesis Advisor: Song Guo

[sguo-50:2012] Marina Toda. Graduation Thesis: Extension of a User Command Server Cooperating with an Editor for Dataflow Application, University of Aizu, 2012.

Thesis Advisor: Song Guo

[sguo-51:2012] Yuki Izumi. Graduation Thesis: Sound signal generation by analysis of narrow band instantaneous frequencies - analysis and generation of random signals, University of Aizu, 2012.

Thesis Co-Advisor: Song Guo

[sguo-52:2012] Hiroyuki Sasajima. Master Thesis: Dynamic Path Switching in Network-based Data Flow Processing System, University of Aizu, 2012.

Master Supervisor: Song Guo

[sguo-53:2012] Tomohiro Sugahara. Master Thesis: Investigation on the Context-Awareness in Network-Based Dataflow Processing System, University of Aizu, 2012.

Master Supervisor: Song Guo

[sguo-54:2012] Shunsuke Komata. Master Research Topic: Development and Evaluation of Library Server on the UMP Network, University of Aizu, 2013.

Master Supervisor: Song Guo

[sguo-55:2012] Takumi Nagao. Master Research Topic: Task Processing Time Aware Routing Strategy in UMP System, University of Aizu, 2013.

Master Supervisor: Song Guo

[sguo-56:2012] Chih-Wei Hsu. Master Research Topic: Optimal Device-to-Device Relay Algorithm Maximizing Multicast Throughput, Chao Yang University of Technology, 2012.

Master Co-Supervisor: Song Guo

[sguo-57:2012] Wei-Lun Chang. Master Research Topic: An Artificial Bee Colony Algorithm for Data Collection Path Planning in Sparse Wireless Sensor Networks, Chao Yang University of Technology, 2012.

Master Co-Supervisor: Song Guo

[sguo-58:2012] Hsiang-Yu Chan. Non-degree Exchange Student, Chao Yang University of Technology, 2012.

Master Co-Supervisor: Song Guo

[sguo-59:2012] Jhih-Cyuan Jheng. Non-degree Exchange Student, Chao Yang University of Technology, 2012.

Master Co-Supervisor: Song Guo

[sguo-60:2012] Hsin-Tse Lee. Non-degree Exchange Student, Chao Yang University of Technology, 2012.

Master Co-Supervisor: Song Guo

[sguo-61:2012] Kun-Jheng Sun. Non-degree Exchange Student, Chao Yang University of Technology, 2012.

Master Co-Supervisor: Song Guo

[sguo-62:2012] Jui-Yu Lin. Non-degree Exchange Student, Chao Yang University of Technology, 2012.

Master Co-Supervisor: Song Guo

[sguo-63:2012] Huawei Huang. Non-degree Exchange Student, China University of Geosciences, 2012.

Master Co-Supervisor: Song Guo

[sguo-64:2012] Chih-Hao Hsu. PhD Research Topic: Energy-Efficient Information Retrieval in Sensor Network, University of Aizu, 2012.

PhD Supervisor: Song Guo

[sguo-65:2012] Mianxiong Dong. PhD Research Topic: Efficient Algorithms for Resource Management and Service Provision in Wireless Networks, University of Aizu, 2012.

PhD Supervisor: Song Guo

[sguo-66:2012] Deze Zeng. PhD Research Topic: Network Coding in Two-way Relay Networks and Delay Tolerant Networks, University of Aizu, 2012.

PhD Supervisor: Song Guo

[sguo-67:2012] He Li. PhD Research Topic: Multicasting in Data Center, University of Aizu, 2012.

PhD Supervisor: Song Guo

[sguo-68:2012] Lin Gu. PhD Research Topic: From Internet Clouds to Mobile Clouds: Vehicular Communication to Assist Content Retrieval, University of Aizu, 2012.

PhD Supervisor: Song Guo

[sguo-69:2012] Peng Li. PhD Disertation: Cross-layer Optimization in Wireless Networks using Network Coding and Cooperative Communication, University of Aizu, 2012.

PhD Supervisor: Song Guo

[sguo-70:2012] Long Zheng. PhD Disertation: Architecture-based Performance Tuning for Genetic Algorithm on Multi-core and Many-core Heterogeneous Systems, University of Aizu, 2012.

PhD Supervisor: Song Guo

[sguo-71:2012] Yingzhi Wang. Master Research Topic: Security in Cloud Computing, University of Aizu, 2012.

Master Supervisor: Song Guo

[sguo-72:2012] Peng Li. Postdoc Research Topic: An Intermediate Research Report on Smart Grid Networking and Communications, University of Aizu, 2012.

Supervisor: Song Guo

[sguo-73:2012] Long Zheng. Postdoc Disertation: A Study of the Environment and Programming Models in Energy-Aware Multi-core and GPU Systems, University of Aizu, 2012.

Supervisor: Song Guo