

## ECE 545 Project 1: Academic Investigation of a Selected Topic

**Objective:** The objective of this project is to help you learn the strategies and skills for conducting the academic research and writing a technical paper.

**Description:** In this project, you need to select a technical topic related to computer networks and carry on some academic study. You need to summarize your investigations into a technical report. You are expected to write a technical report in the style as an academic paper. In your report, you need to give a proper literature survey, formulate the problem that you are going to study, summarize and classify the existing solutions to the problem, identify the open issues, and give some investigation to the possible solutions. On pages 2-5, some possible topics and associated representative literature are listed for your reference. However, you are not limited to the topics on the list, and can choose any topic related to Internet or wireless networks, such as network measurement, multimedia networking, 5G/6G cellular network, sensor networks, wireless mesh networks, vehicular networks, cloud/edge computing, and big data. Note that information security related topic is out of scope for this project and NOT suggested.

### Instructions:

- You should thoroughly read at least **10 journal/conference papers downloaded from IEEE or ACM databases as your major reference** for your technical report.
- The 10 required references must be academic papers downloaded from IEEE or ACM database. **White papers “googled” from Internet can not be used as major references** for your technical report, but can be used as additional references.
- IIT Campus Network has free access to IEEE database at <http://ieeexplore.ieee.org/Xplore/home.jsp> and ACM database at <http://dl.acm.org/>. From off-campus locations, students can go to <https://guides.library.iit.edu/az.php> and use IIT login to access the databases: on the database webpage, click “IEEE Xplore - Institute of Electrical and Electronics Engineers” to access IEEE database; click “ACM Digital Library - Association for Computing Machinery” to access the ACM database.
- Your technical report should have a reasonable length of at least **4000 words**. You need to type the report using some editing software, and submit it through the blackboard system as a PDF file. **In your report, some mathematical analysis is preferred.**
- **Plagiarism is strictly prohibited.** You must give credit to the original authors whenever you use another person’s idea, opinion, or theory, or use any pieces of information (e.g., facts, statistics, graphs, drawings) that are not common knowledge. The strategies to avoid plagiarism are putting in *quotations* the sentences that come directly from somewhere, or *paraphrasing* others’ ideas with references cited. **Projects identified with plagiarism problem will get a “0” grade.**

### Deadlines:

- You need to submit an abstract (around 200 words) of the topic that you plan to work on and the list of your major references (including at least 10 references) by **23:59pm, Mar. 12, 2023, Chicago time**. Submit your reference list through the blackboard system with document named as “ID\_Lastname\_prjt1\_abstract.pdf”. **Your abstract and reference list needs to be approved by the instructor.**
- Your report is **due at 23:59 pm, April 30, 2023, Chicago time**. Submit your technical report through the blackboard system with document named as “ID\_Lastname\_prjt1\_report.pdf”
- Late submission penalty, for both the abstract and the final report, is 10% of the total grade for this project per day.

### Grading Scheme:

- Organization and writing (35%), comprehensiveness and in-depth (35%), originality (30%)

## **TCP performance**

V. Jacobson, "Congestion avoidance and control," in *Proc. ACM SIGCOMM*, 1988, pp. 314–329

B. Sikdar, S. Kalyanaraman, and K. S. Vastola, "Analytic models for the latency and steady-state throughput of TCP Tahoe, Reno, and SACK," *IEEE/ACM Transactions on Networking*, vol. 11, no. 6, pp. 959–971, Dec. 2003.

J. Padhye, V. Firoiu, D. F. Towsley, and J. F. Kurose, "Modeling TCP Reno performance: a simple model and its empirical validation," *IEEE/ACM Transactions on Networking*, vol. 8, no. 2, pp. 133–145, Apr. 2000.

W.-C. Feng, D. D. Kandlur, D. Saha, and K. G. Shin, "Understanding and improving TCP performance over networks with minimum rate guarantees," *IEEE/ACM Transactions on Networking*, vol. 7, no. 2, pp. 173–187, Apr. 1999.

S. Bohacek, J. P. Hespanha, J. Lee, C. Lim, and K. Obraczka, "A new TCP for persistent packet reordering," *IEEE/ACM Transactions on Networking*, vol. 14, no. 2, pp. 369–382, Apr. 2006.

I. Yeom and A. L. N. Reddy, "Modeling TCP behavior in a differentiated services network," *IEEE/ACM Transactions on Networking*, vol. 9, no. 1, pp. 31–46, Feb. 2001.

## **TCP over wireless links**

Y. Tian, K. Xu, and N. Ansari, "TCP in wireless environments: problems and solutions," *IEEE Communications Magazine*, vol. 43, no. 3, pp. S27–S32, March 2005

H. Balakrishnan, N. Padmanabhan, S. Seshan, and R. H. Katz, "A comparison of mechanisms for improving TCP performance over wireless links," *IEEE/ACM Transactions on Networking*, vol. 5, no. 6, pp. 756–769, Dec. 1997

F. Anjum and L. Tassiulas, "Comparative study of various TCP version over a wireless link with correlated losses," *IEEE/ACM Transactions on Networking*, vol. 11, no. 3, pp. 370–383, Jun. 2003.

C. P. Fu and S. C. Liew, "TCP Veno: TCP enhancement for transmission over wireless access networks," *IEEE Journal on Selected Area in Communications*, vol. 21, no. 2, pp. 216–228, Feb. 2003

## **Routing algorithms and performance**

J. J. Garcia-Luna-Aceves, "Distributed, scalable routing based on vectors of link states," *IEEE Journal on Selected Areas in Communications*, vol. 13, no. 8, pp. 1383–1395, Oct. 1995.

A. Shaikh, R. Dube, and A. Varma, "Avoiding instability during graceful shutdown of multiple OSPF routers," *IEEE/ACM Transactions on Networking*, vol. 14, no. 3, pp. 532–542, Jun. 2006.

J. J. Garcia-Luna-Aceves, "Loop-free routing using diffusing computations," *IEEE/ACM Transactions on Networking*, vol. 1, no. 1, pp. 130–141, Feb. 1993.

J. J. Garcia-Luna-Aceves and S. Murthy, "A path-finding algorithm for loop-free routing," *IEEE/ACM Transactions on Networking*, vol. 5, no. 1, pp. 148–160, Feb. 1997.

V. Paxson, "End-to-end routing behavior in the Internet," *IEEE/ACM Transactions on Networking*, vol. 5, no. 5, pp. 601–615, Oct. 1997.

J. Wu, F. Dai, X. Lin, J. Cao, and W. Jia, "An extended fault-tolerant link-state routing protocol in the Internet," *IEEE Transactions on Computers*, vol. 52, no. 10, pp. 1298–1311, Oct. 2003

## **QoS routing**

S. Chen and K. Nahrstedt, "An overview of quality of service routing for next-generation high-speed networks: problems and solutions," *IEEE Network*, vol. 12, no. 6, pp. 64–79, Nov./Dec. 1998

D. Ghosh, V. Sarangan, and R. Acharya, "Quality-of-service routing in IP networks," *IEEE Transactions on Multimedia*, vol. 3, no. 2, pp. 200–208, Jun. 2001

A. R. Bashandy, E. K. P. Chong, and A. Ghafoor, "Generalized quality-of-service routing with resource allocation," *IEEE Journal on Selected Areas in Communications*, vol. 23, no. 2, pp. 450–463, Feb. 2005.

V. Sarangan, D. Ghosh, and R. Acharya, "Capacity-aware state aggregation for interdomain QoS routing," *IEEE Transactions on Multimedia*, vol. 8, no. 4, pp. 792–808, Aug. 2006.

A. Shaikh, J. Rexford, and K. G. Shin, "Evaluating the impact of stale link state on quality-of-service routing," *IEEE/ACM Transactions on Networking*, vol. 9, no. 2, pp. 162–176, Apr. 2001.

## **Traffic engineering**

X. Xiao, A. Hannan, B. Bailey, and L. M. Ni, "Traffic engineering with MPLS in the Internet," *IEEE Network*, vol. 14, no. 2, pp. 28–33, Mar.-Apr. 2000.

D. Awduche, J. Malcolm, J. Agogbua, M. O'Dell, and J. McManus, "Requirements for traffic engineering over MPLS," IETF RFC 2702, Sept. 1999.

B. Fortz, J. Rexford, and M. Thorup, "Traffic engineering with traditional IP routing protocols," *IEEE Communications Magazine*, vol. 40, no. 10, pp. 118–124, Oct. 2002.

H. M. Alnuweiri, L.-Y. K. Wong, and T. Al-Khasib, "Performance of new link state advertisement mechanisms in routing protocols with traffic engineering extensions," *IEEE Communications Magazine*, vol. 42, no. 5, pp. 151–162, May 2004.

## **Internet QoS architecture**

X. Xiao and L. M. Ni, "Internet QoS: A big picture," *IEEE Network*, vol. 13, no. 2, pp. 8–18, Mar.-Apr. 1999.

V. Firoiu, J.-Y. Le Boudec, D. Towsley, and Z.-L. Zhang, "Theories and models for Internet quality of service," *Proceedings of the IEEE*, vol. 90, no. 9, pp. 1565–1591, Sept. 2002.

J. Wroclawski, "The use of RSVP with IETF integrated services," IETF RFC 2210, Sept. 1997.

S. Blake, D. Black, M. Carlson, E. Davies, Z. Wang, and W. Weiss, "An architecture for differentiated services," IETF RFC 2475, Dec. 1998.

## **Scheduling**

H. Zhang, "Service disciplines for guaranteed performance service in packet-switching networks," *Proceedings of IEEE*, vol. 83, no. 10, pp. 1374–1396, Oct. 1995.

A. K. Parekh and R. G. Gallager, "A generalized processor sharing approach to flow control in integrated services networks: the single-node case," *IEEE/ACM Transactions on Networking*, vol. 1, no. 3, pp. 344–357, Jun. 1993.

A. K. Parekh and R. G. Gallager, "A generalized processor sharing approach to flow control in integrated services networks: the multiple-node case," *IEEE/ACM Transactions on Networking*, vol. 2, no. 2, pp. 137–150, Apr. 1994.

## **Advanced network management**

P. Trimintzios *et al.*, “A management and control architecture for providing IP differentiated services in MPLS-based networks,” *IEEE Communications Magazine*, vol. 39, no. 5, pp. 80–88, May 2001.

C. Scoglio, T. Anjali, J. C., de Oliveira, I. F. Akyildiz, and G. Uhl, “TEAM: a traffic engineering automated manager for DiffServ-based MPLS networks,” *IEEE Communications Magazine*, vol. 42, no. 10, pp. 134–145, Oct. 2004.

E. Bouillet and D. Mitra, “The structure and management of service level agreements in networks,” *IEEE Journal on Selected Areas in Communications*, vol. 20, no. 4, pp. 691–699, May 2002.

Y. Cheng and W. Zhuang, “Dynamic inter-SLA resource sharing in path-oriented differentiated services networks,” *IEEE/ACM Transactions on Networking*, vol. 14, no. 3, pp. 657–670, Jun. 2006.

## **Peer-to-peer networking**

S. Androutsellis-Theotokis and D. Spinellis, “A survey of peer-to-peer content distribution technologies,” *ACM Computing Survey*, vol. 36, no. 4, pp. 335–371, Dec. 2004

D. A. Tran, K. A. Hua, and T. T. Do, “A peer-to-peer architecture for media streaming,” *IEEE Journal on Selected Areas in Communications*, vol. 22, no. 1, pp. 121–133, Jan. 2004.

I. Stoica, R. Morris, D. Liben-Nowell, D. R. Karger, M. F. Kaashoek, F. Dabek, and H. Balakrishnan, “Chord: A scalable peer-to-peer lookup protocol for Internet applications,” *IEEE/ACM Transactions on Networking*, vol. 11, no. 1, pp. 17–32, Feb. 2003.

A. J. Ganesh, A.-M. Kermarrec, and L. Massoulie, “Peer-to-peer membership management for gossip-based protocols,” *IEEE Transactions on Computers*, vol. 52, no. 2, pp. 139–149, Feb. 2003.

## **Wireless LAN**

B. P. Crow, I. Widjaja, L. G. Kim, and P. T. Sakai, “IEEE 802.11 wireless local area networks,” *IEEE Communications Magazine*, vol. 35, no. 9, pp. 116–126, Sept. 1997.

H. Zhu, M. Li, I. Chlamtac, and B. Prabhakaran, “A survey of quality of service in IEEE 802.11 networks,” *IEEE Wireless Communications*, vol. 11, no. 4, pp. 6–14, Aug. 2004.

G. Bianchi, I. Tinnirello, and L. Scalia, “Understanding 802.11e contention-based prioritization mechanisms and their coexistence with legacy 802.11 stations,” *IEEE Network*, vol. 19, no. 4, pp. 28–34, Jul.-Aug. 2005.

G. Bianchi, “Performance analysis of the IEEE 802.11 distributed coordination function,” *IEEE Journal on Selected Areas in Communications*, vol. 18, no. 3, pp. 535–547, Mar. 2000.

Y. Xiao, “IEEE 802.11n: enhancement for higher throughput in wireless LANs,” *IEEE Wireless Communications*, vol. 12, no. 6, pp. 82–91, Dec. 2005