Acknowledgments

Doing a Ph.D. is simultaneously the most difficult and the most enriching experience I have undertaken. I am deeply indebted to my adviser, Nick McKeown, for supporting me in every step of this journey and for providing just the right balance of independence and guidance. Nick, thank you for looking out for me. I have learned a lot from you—to take no assumption for granted, to distill every problem down to its essence, and many other valuable lessons which will hold me in good stead for my next adventure. I am glad to say that I have inherited from you a taste for real, practical problems and simple solutions that are grounded in theory.

I am grateful to Mohammad Alizadeh for the many insightful discussions we have had on congestion control in the last few years. Mohammad, thank you for introducing me to message passing algorithms, and for all the practical advice and feedback you have given. I also want to thank you for inviting me to the Dagstuhl workshop on “Network Latency Control in Data Centres.” The breakout session on “Congestion Control in 100 Gb/s Networks,” inspired by PERC, helped me to see the problem from expert perspectives across industry and academia.

I must also thank Sachin Katti for all the support from the beginning of my time at Stanford, when he reached out first to let me know I was accepted, until the very end, when he agreed to be my thesis reader. Sachin, thank you for taking me under your wing in my first quarter and advising my first rotation project, where I learned as much about the cellular packet core as I did about writing papers and working efficiently.

Many thanks to professors Balaji Prabhakar and Ramesh Johari for the insightful discussions during the last few months, which have enriched this thesis. Professor Prabhakar, I would have loved to start our collaboration sooner. I have come away much wiser from each of our meetings, amazed at how good notation and ordering of arguments can make all the difference. Professor Johari, thank you for sharing your optimization-theory perspective of the problem and for discussions that gave me much food for thought.

I am also grateful to George Varghese for mentoring me in my first two years at Stanford when we worked on the compiler project and the Fair (PERC) algorithm. George, your passion for problems is infectious, and
I thank you for the voice in the back of my head that nudges me to reach out across disciplines and find new perspectives.

The PERC approach started from discussions back in 2015, with Nick, Mohammad, George, Lisa Yan, and Isaac Keslassy about using the network in cool and interesting ways. Thanks to Isaac for conscientiously reading through early drafts of the proofs of the Fair algorithm. Thank you also to Steve Ibanez and Jonathan Perry for being a sounding board for my ideas about a practical PERC algorithm.

I count myself very lucky to have found a collaborator like Steve to work with me on s-PERC. Steve, this thesis wouldn’t have been possible without your help. Thank you for helping to make s-PERC a reality with the P4-NetFPGA prototype and test bed; for demoing our work at Florianopolis, despite many bugging issues (Zika included) at the last minute; for reading through the first draft of this thesis; for being an unflappable, cheerful and super hard-working team mate through different iterations of s-PERC; and for being a great office mate with an inspiring work ethic.

I would like to extend my sincere thanks to Radhika Mittal, Srinivas Narayana, Sundar Iyer, Mani Kotaru, KK Yap, Lisa Yan, Sean Choi, Vimalkumar Jeyakumar, and Nandita Dukkipati for reading my drafts carefully and critically and providing invaluable feedback. I would like to thank Sabrina Leroe, for proofreading the final version of my thesis.

I would like to thank Rui Zhang, Jahangir Hasan, and Yaogong Wang for hosting me during my internships at Google, which helped me understand networking in the wild and see where it fits in the big picture. Many thanks to Jahangir and Yaogong for letting me try proactive congestion control in a real data-center network; it convinced me that I was on the right track with PERC. I also learned a lot from discussions with Hassan Wassel, Nandita Dukkipati, Abdul Kabbani, David Wetherall, Dina Papagiannaki, KK, Jon Zolla, and Amin Vahdat at Google.

A special thank you to Nandita for mentoring me through my time at Google over summers and beyond. Nandita, thank you for all your advice on life and work. I still cherish the day trip with Rong Pan and you following the Dagstuhl workshop, when I realized with awe—here are two women who were in my shoes 10 years ago, getting their Ph.D. in networking at Stanford, and are now making the Internet faster for everyone, through their contributions to networking, whether in the Cloud or in home routers across the world. Thank you, Nandita and Rong, for being inspiring role models for me.

I was lucky to have overlapped with many academic siblings during my time at Stanford and made lasting friendships—a huge thanks to James Zeng, Peyman Kazemian, KK, TY Huang, Glen Gibb, Yiannis Yiakoumis, Nick Shelly, Lisa, Steve, Sean Choi, Eyal Cidon, Catalin Voss, and Bruce Spang for all the ways you have enriched my Ph.D. journey. Lisa, thank you for being the best (and only!) office mate and sounding
board during the early years, and for collaborating with me on the compiler and PERC papers. Many thanks to my current officemates Colleen Josephson, Steve, Mani, Catalin and Jenny Hong for making Gates 314 my favorite place to work. I’d like to recognize all the efforts of Lancy Nazaroff and our former group admin, Chris Hartung for making everything work smoothly.

I was a lucky undergraduate before I came to Stanford—I am deeply indebted to professors Jennifer Rexford, Christiane Fellbaum, and Moses Charikar for introducing me to research, and to the thrill of working on open problems that can give you (great) sleepless nights.

Finally, I would like to acknowledge how grateful I am for having a group of people in my life who are always ready to listen to my rants about research with a smile on their face. Sravya, Xiaoyang, Ramya, and Arun: thank you for all the wonderful conversations and for boosting my motivation by sharing your own Ph.D. stories with me. Ben: thanks for helping me put things in perspective. Thalia: it’s finally done! I’m glad we kept in touch after the Tech Venture Formation class, our conversations about life, startups, poetry, and everything under the sun made my life much more colorful. A huge huge thank you to my sister, Betty, thank you for more than 65,000 minutes of pep talk and wisecracks over FaceTime over the last six years. As you know, all of it was completely unsolicited but absolutely essential to help me finish. Last but not least, I would like to thank my parents, to whom I dedicate this thesis. Thank you for believing in me more than I believe in myself. Thank you for encouraging me to make crazy life decisions, such as coming to the United States for college, all by myself, and then embarking on a roller-coaster journey that is a Ph.D., decisions that left me wiser and more grateful than ever before—for all the lessons I have learned, for all the mentors I have met, and for all the friends I have made.