2020

Networked Systems Group

Rui	Romain	Alexander	Roland
Maria	Edgar	Rüdiger	Coralie
Roland	Ege	Thomas	Albert
	Tobias	Laurent	

ONLINE will surely be one of the adjectives of 2020. Even for our group working on computer networks, I must confess this was more of a bug than a feature. While switching to online lecturing, conferences, and meetings illustrated once more the importance of Internet connectivity (and, hence, of our research), it also made clear that online activities can only complement, not replace, in-presence ones. Teaching and research go beyond "Zoom".

Yet, despite everything, 2020 was a good year for our group. Teaching-wise, our lectures were, once again, highly rated by the students and I was honored to receive the "Credit Suisse Award for Best Teaching". Research-wise, we published no less than 9 papers (including 1 SIGCOMM, 3 NSDI, and 2 HOTNETS)—2 of which further went on winning awards. Group-wise, we welcomed 3 new students (Rui, Ege, and Roland) and 1 post-doc (Romain), bringing us to 14 members!

Like many, I hope 2021 will mark a return to normality. I particularly look forward to coming back to the classroom, brainstorming with students, meeting with my colleagues (who knew one can miss faculty meetings?), and travelling to conferences (arguably much less than before, but still). Whatever happens though, 2021 ought to be an exciting year for our group as 3 of our PHD students (Maria, Thomas, and Rüdiger) will graduate. Needless to say, we also have plenty of cool new research ideas in our pipeline. So . . . *stay tuned!*

Laurent VANBEVER
Professor, ETH Zurich

Teaching

Having to teach online allowed me to learn *a lot* about video streaming. I continuously refined my video setup over the weeks (inspired by various YouTubers). Among others, I got myself a green screen (enabling me to "blend myself" in my slides), a good microphone, and a decent lighting setup. As our society continues to ask for more videos (also post-COVID), I see this acquired knowledge as a positive outcome of the situation—one of the few.

Photo: Laurent Vanbever My video setup

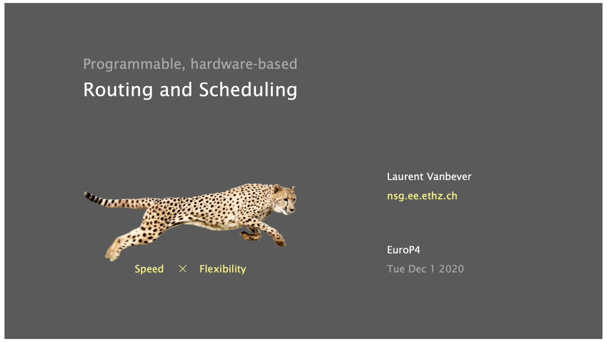
2020 was both a particularly busy *and* fulfilling year for us. Besides transitioning to online lecturing, we completely redesigned our "Advanced Topics in Communication Networks" course, not only revising the materials but also developing a new class-wide project. It was a *lot* of work, but we are very pleased with the results. Students seem to be happy too as our teaching evaluations were very positive, with an average rating of 4.5/5.0 and a median of 5.0/5.0.

Besides, 2020 was particularly successful as I was honored to receive the "Credit Suisse Award for Best Teaching". This prize is awarded by ETH students to one professor each year. While we are not chasing awards, we are obviously thrilled: with our 2 "Golden Owls" in 2016 and 2018, this is already the third teaching award we receive in my 6 years at ETH!

Photo: Oliver Bartenschlager ETH Tag 2020

Research

I had a lot of fun preparing and giving the keynote at the 3rd P4 Workshop organized in Europe (EuroP4). I spoke about our recent works on making packet scheduling programmable and on offloading routing tasks to hardware. The talk is online—check it out!



EuroP4 Keynote ▶ Watch online

Our most common research topics this year were (still) network verification, network programmability, and routing. Regarding verification and programmability, our focus nowadays is on making the technologies more general, more practical, and more usable. We want to allow operators to verify and program more of their networks, in a user-friendly manner. In the context of (Internet) routing, we work mainly on making distributed protocols more flexible and secure.

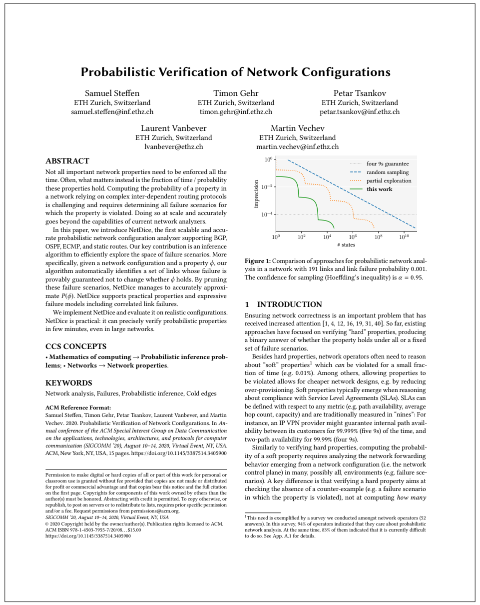
We continued to garner a strong foothold in top venues such as ACM SIGCOMM, USENIX NSDI, and ACM HOTNETS. This year actually marked the 7th year in a row we published at least one HOTNETS paper. Two of our publications further won awards: our SIGCOMM paper "Probabilistic Verification of Network Configurations" won the best student paper award, and our CCR paper "An Open Platform to Teach How the Internet Practically Works" won the "best of CCR" award.

2020 was also busy regarding community service. Among others, I served in the program committee of USENIX NSDI (writing >20 reviews). I also served as tutorial chair for ACM SIGCOMM (with Dr. Stefano Vissicchio from UCL) and as program chair of SPIN, the first workshop on secure programmable data planes (with Prof. Ang Chen from Rice).

We have plenty of exciting research in our pipeline and look forward to sharing it with you in 2021. Among others, we are working on: network anonymity, seamless network updates, network monitoring, configuration synthesis, fast network convergence, and "machine learning meets networks".

Network verification

Network verification is all about guaranteeing that a network enforces some important properties such as reachability or isolation. Not all properties need to hold all the time though: often what matters instead is the amount of time each property holds—that is, their probabilities. Such probabilistic properties often appear naturally in the context of Service Level Agreements. In this paper, we show how to accurately compute these probabilities.

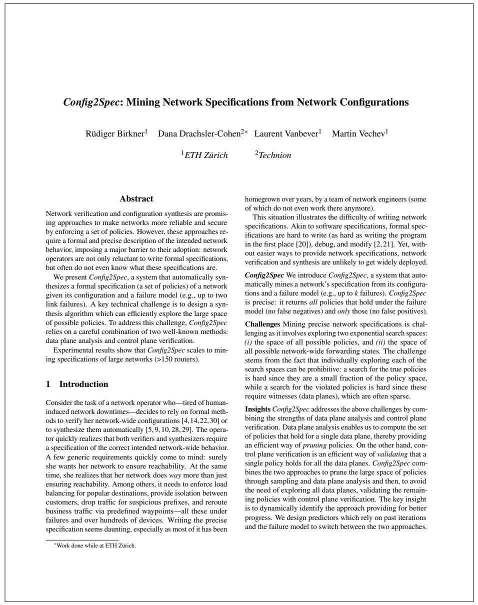


Probabilistic Verification of Network Configurations

Samuel Steffen, Timon Gehr, Petar Tsankov, Laurent Vanbever, Martin Vechev — ETH Zurich, Switzerland

ACM SIGCOMM 2020 ▶ Read online

(Probabilistic) Network verification relies on two key assumptions. First, that you know the properties you want to verify. Second, that you can write them down formally. In practice, both assumptions tend to be false. In this paper, we describe a system (*Config2Spec*) that can automatically mine these properties out from existing network configurations. Besides reading the paper, you can also learn more about the topic by checking this recent blogpost.



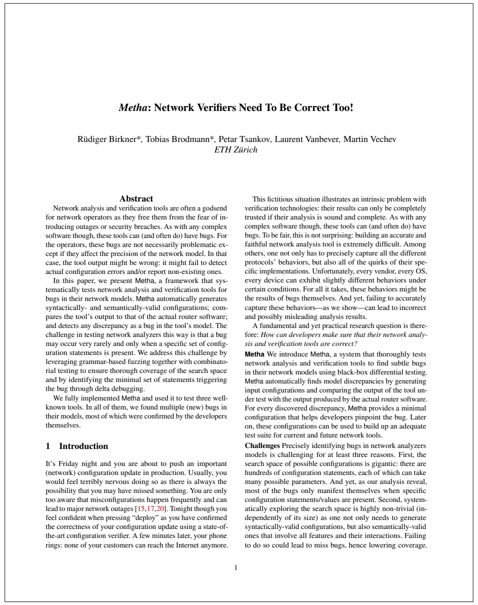
***Config2Spec*: Mining Network Specifications from Network Configurations**

Rüdiger Birkner[1] Dana Drachsler-Cohen[2*] Laurent Vanbever[1] Martin Vechev[1]

[1]ETH Zürich [2]Technion

USENIX NSDI 2020 ▶ Read online

Continuing our quest to make network verification practical, we then turned our attention to verifying the network verifiers. Buggy verifiers might indeed fail to report actual configuration errors or report non-existing ones. In this paper, we introduce a framework to systematically test such network verifiers. Using our framework, we were able to find over 60 bugs in popular verification software, most of which were confirmed by the developers.



***Metha*: Network Verifiers Need To Be Correct Too!**

Rüdiger Birkner*, Tobias Brodmann*, Petar Tsankov, Laurent Vanbever, Martin Vechev

ETH Zürich

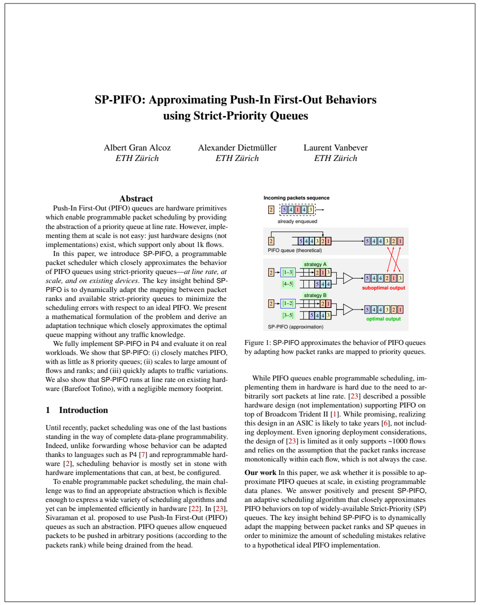
USENIX NSDI 2021 Coming soon

Network programmability

Packet scheduling is one of the last bastions standing in the way of complete data-plane programmability. Even recent programmable switches do not allow operators to reprogram their scheduling behaviors. In this paper, we enable programmable packet scheduling in existing hardware switches by approximating the behavior of Push-In First-Out (PIFO) queues. We do so by dynamically adapting how packets are mapped to strict-priority queues.

If you have ever programmed a hardware-based programmable switch, you know that its resources are limited and come at a huge premium. And yet, it might be that your network traffic is such that your switch only use a small portion of its precious resources. In this paper, we show how making the compiler traffic-aware enables it to allocate resources in a smarter way—think profile-guided optimizations for programmable data planes.

Early 2020 we decided to release all the materials we used for our master lecture “Advanced Topics in Communication Networks” including: our lecture slides, a set of comprehensive P4 examples, documented P4 exercises (with solutions), and a complete production environment (P4-utils) which makes it easy to build, run, and debug P4 networks. Since then many people have started to use/build upon our ressources. Why don’t you take a look?

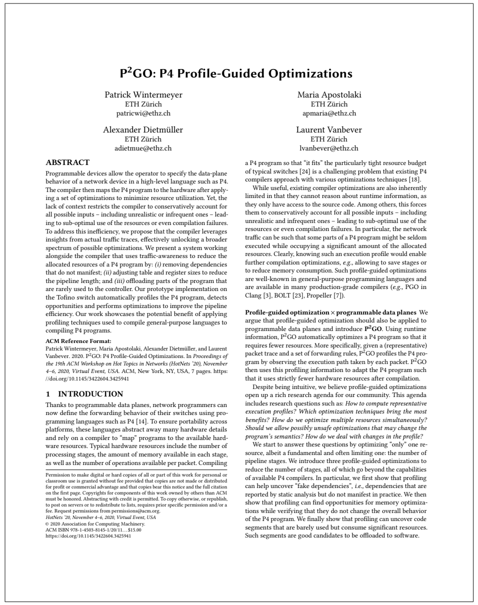

SP-PIFO: Approximating Push-In First-Out Behaviors using Strict-Priority Queues

Albert Gran Alcoz, ETH Zürich; Alexander Dietmüller, ETH Zürich; Laurent Vanbever, ETH Zürich

Abstract

1 Introduction

USENIX NSDI 2020 ▶ Read online

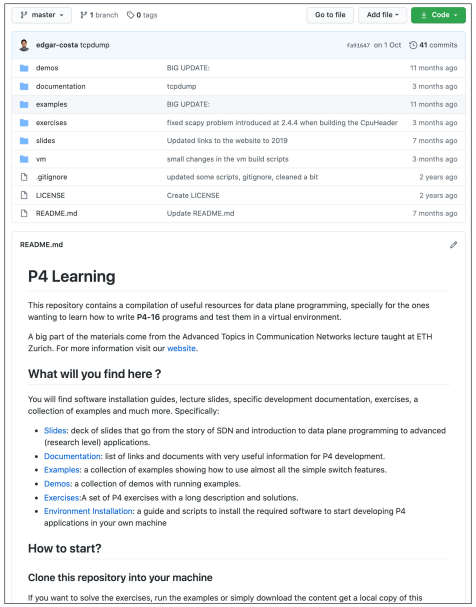

P²GO: P4 Profile-Guided Optimizations

Patrick Wintermeyer, ETH Zürich; Maria Apostolaki, ETH Zürich; Alexander Dietmüller, ETH Zürich; Laurent Vanbever, ETH Zürich

ABSTRACT

1 INTRODUCTION

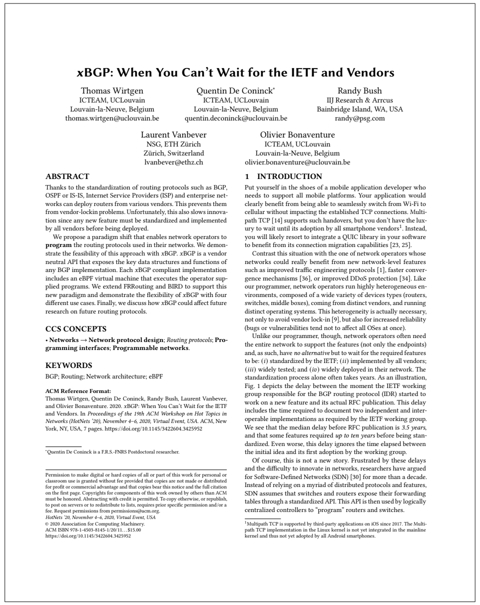
ACM HotNets 2020 ▶ Read online



P4-learning repository ▶ Browse online

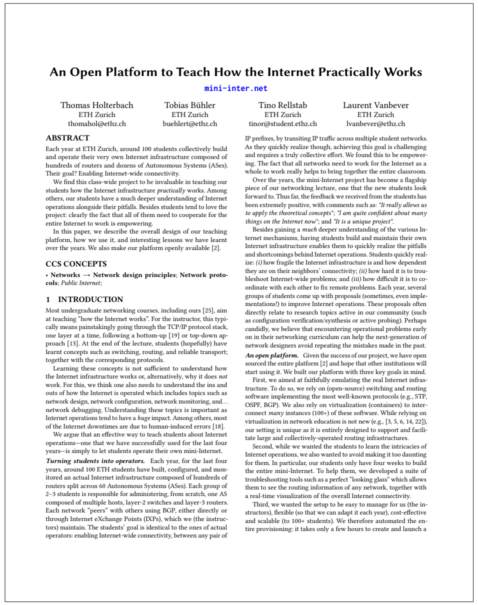
Internet routing

If you are a network operator, you are most likely frustrated by the slowness at which you can deploy new features in your network. It can literally take *years* between an initial idea and its corresponding standardization by the Internet Engineering Task Force (IETF). And while SDN promises to solve this problem, it is not a panacea either. In this paper, we propose a lightweight alternative with an API that allows to (easily) reprogram routing protocols logic.



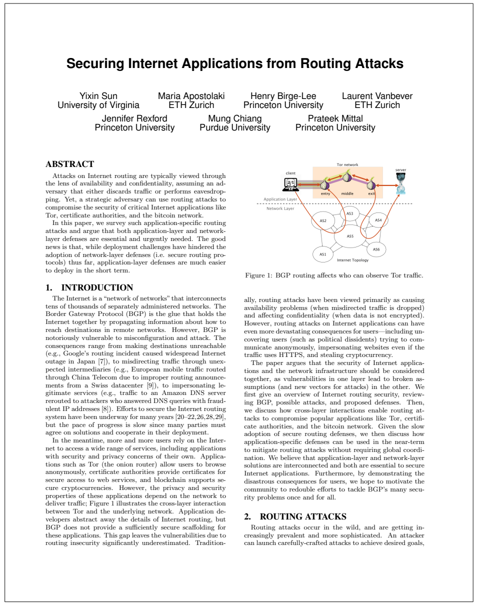
ACM HotNets 2020 ▶ Read online

A key element of our "Communication Networks" lecture is our routing project in which we have the entire classroom (150 students in 2020) build and operate their very own "mini-Internet". We have found that students not only love the project but also learn *a ton* from it. In this paper, we describe our experiences and the platform we built to support class-wide assignments. We have open-sourced all our resources. Check them out: www.mini-inter.net



ACM SIGCOMM CCR 2020 ▶ Read online

It is notoriously known that Internet routing is vulnerable to misconfigurations and attacks. And while efforts to secure the Internet are underway, the pace of progress has been (frustratingly) slow. In this paper, we survey how routing attacks can also compromise the security of critical applications like Tor, certificate authorities, or the bitcoin network. The good news though? Protecting an application is *much* easier than protecting the entire Internet.



Communications of the ACM ▶ Read online

Looking forward to *see* you in 2021!

Our upcoming lectures

Spring	Communication Networks
	Seminar in Communication Networks
Fall	Advanced Topics in Communication Networks
	Discrete Event Systems

Our upcoming PhD graduations

Spring	Maria Apostolaki
	Thomas Holterbach
Fall	Rüdiger Birkner

Our incoming PhD students

Spring	Tibor Schneider
	You?

Zurich, Mon 11 Jan 2021

Visit our webpage at https://nsg.ee.ethz.ch