



P4 on Raspberry PI for Networking Education
A P₄ Education Workgroup Project

SIGCOMM 2022 Hackathon



Today's Agenda

Time ET/CET	Session
1:30 pm - 1:45 pm	Introduction
1:45 pm - 2:00 pm	Projects brainstorming and forming groups
2:00 pm - 5:30 pm	Hacking!*
5:30 pm - 5:55 pm	Project presentations
5:55 pm - 6:00 pm	Closing

*Checking projects status half way through (~3.30pm)

Today's Team



Sándor Laki
ELTE



Salvatore Signorello
FCUL



Damu Ding
Oxford



Mingyuan Zang
DTU

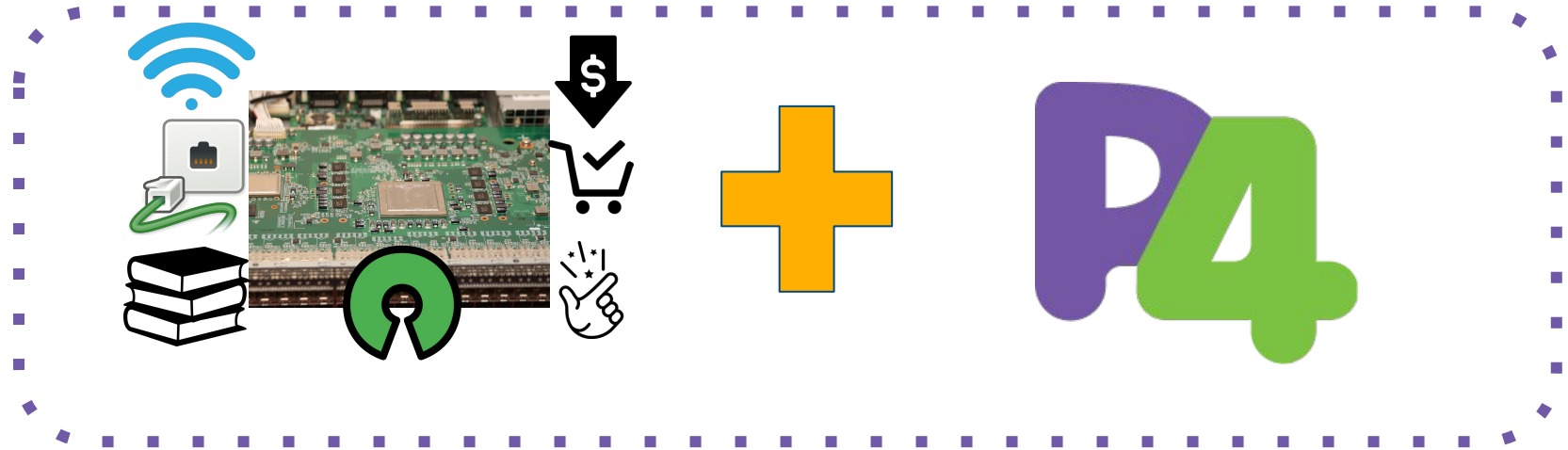


Dávid Kis
ELTE



Xinpeng Hong
Oxford

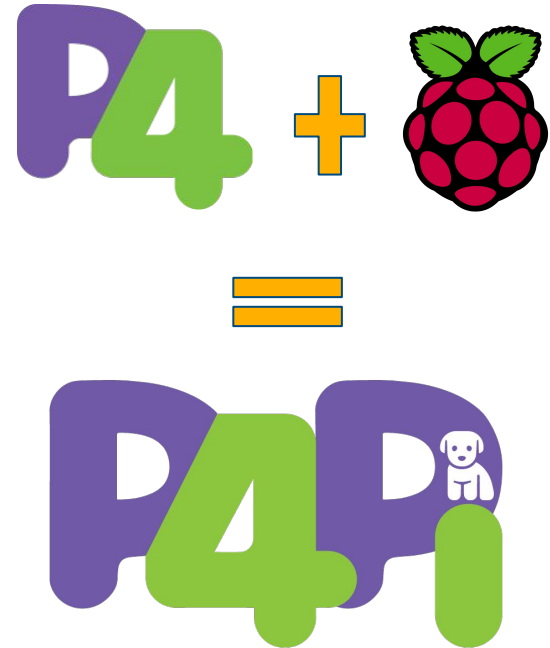
Teaching Computer Networks Using P4



The need for a hardware platform suitable for an hands-on experience with P4 in a classroom.

The P4Pi Platform

- **Low cost**
 - Less than \$100
- **Easy to learn**
 - And easy to use
- **Availability**
 - Worldwide
 - Long term support
- **Open-source**
- **Wireless + Wired connectivity**
 - Students can use their laptops
 - ...or existing lab machines
- **Training resources available**



P4P



TAPAS

DPDK

OR

p4c

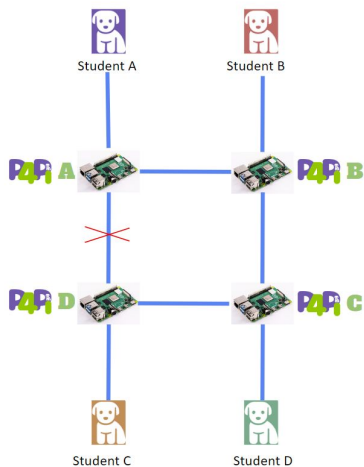
BMv2

RaspberryPI 4 Model B 4GB

- Quad-core ARM64 processor
- On-board WiFi, 1GbE RJ-45
- \$60-\$80, availability

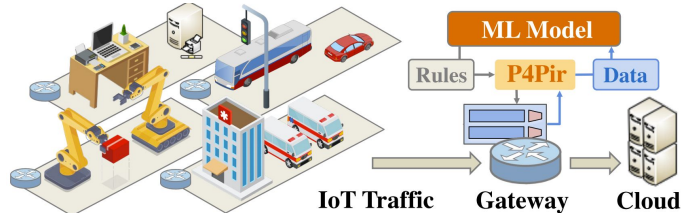
P4Pi Use-Case Examples

Educators



Building an Internet Router Class project¹.

Hackers



Smart IoT Gateways².

Contributors



Accessing P4 programmable switches for the edge³.

1 - Stoyanov et al. - "Building an Internet Router with P4Pi", EuroP4 2021.

2 - Zang et al. - "P4Pir: In-Network Analysis for Smart IoT Gateways", SIGCOMM Posters 2022.

3- NGI Pointer project - <https://p4edge.net/>

P4Pi Compilers & Workflow



Quick Overview on:

- P4 compilers and sw targets on P4Pi,
- Starting and accessing P4Pi,
- Running P4 examples on P4Pi,
- Creating a new P4 project on P4Pi.

P4Pi Hackathon

- **Goals:**
 - Learn how to use the P4Pi platform.
 - Develop P4Pi projects:
 - P4-based projects (“Hackers”)
 - Platform-specific projects (“Contributors”)
 - Teaching focused Projects (“Educators”)
 - Build collaborations and make new friends.
 - Have fun!

Code of Conduct

- Have an open, respectful exchange of ideas.
- Treat each other and the organizers with tolerance and respect.
- Demeaning, intimidating or harming anyone at the hackathon is not acceptable.
- The event will conform to the SIGCOMM anti-discrimination and anti-harassment policy <https://conferences.sigcomm.org/sigcomm/2022/policies.html>
- If you experience or witness behaviour that violates this Code of Conduct, please report this to hackathon organisers. All reports will be handled confidentially.
- Attendees violating the Code of Conduct may be asked to leave the event and other actions may be taken as deemed necessary.

Resources

- Slack channel under SIGCOMM: #sigcomm2022-hackathon
- Repository: <https://github.com/p4lang/p4pi>
- Wiki page: <https://github.com/p4lang/p4pi/wiki/P4Pi-Hackathon-SIGCOMM22>
- Release: <https://github.com/p4lang/p4pi/releases>
- Installation instructions: <https://github.com/p4lang/p4pi/wiki/Installing-P4Pi>
- p4app docker-based tool (if you don't have a Raspberry Pi):
<https://github.com/p4lang/p4pi/tree/master/p4app>

Acknowledgements

Organizers: Robert Soulé (Yale), Noa Zilberman (Oxford), Sándor Laki (ELTE), Fernando Ramos (Lisbon), Damu Ding (Oxford), Salvatore Signorello (Lisbon).

Helpers: Dávid Kis (ELTE), Xinpeng Hong (Oxford), Mingyuan Zang (DTU).

We thank the following people who contributed to the P4Pi project over time:

Robert Soulé (Yale), Noa Zilberman (Oxford), Sándor Laki (ELTE), Dávid Kis (ELTE), Péter Vörös (ELTE), Radostin Stoyanov (Oxford), Adam Wolnikowski (Humatics), Fernando Ramos (Lisbon), Damu Ding (Oxford), Changgang Zheng (Oxford), Xinpeng Hong (Oxford), Mingyuan Zang (DTU), Salvatore Signorello (Lisbon).

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Some of the slides used in this presentation were adopted from previous P4Pi presentations, tutorials and events by the above contributors and from <https://github.com/p4lang/tutorials>.



**Projects Brainstorming
&
Forming Groups**

Suggested Project Ideas

Proposer	Track	Topic
Damu Ding	Contributors / Hackers	Porting P4 tutorial examples to P4Pi
Damu Ding	Hackers	P4-based games (e.g., Tic-Tac-Toe, Wordle)
Noa Zilberman	Educators	Teaching enhancements
Noa Zilberman	Hackers	Network monitoring
Sandor Laki	Contributors	T4P4S Enhancements
Sandor Laki	Contributors / Hackers	Support for other P4-backends on P4Pi, eBPF.
Salvatore Signorello	Contributors	Improving existing P4Pi examples
Salvatore Signorello	Contributors / Educators	Porting P4 exercises from p4-learning to P4Pi
Salvatore Signorello	Hackers	Network Security
...

Your Project Ideas



Steps to Get Started

1. Gather your group around the same table (P4 Beginners gather around a table with Salvatore).
2. Be sure that your group has at least one Raspberry Pi, if not, our team has a few Raspberry Pis to loan.
3. If you have not done it yet, download the latest P4Pi image and install it on your Raspberry Pi. Follow [the installation steps on the wiki](#).
4. Test that you are able to connect (web, wireless/wired) to the P4Pi platform you have installed on your Raspberry Pi. Follow [the instructions on the wiki](#).
5. Perform the required minimal configuration to safely use the platform in today's room, namely, change your WiFi SSID and password (WiFi and OS).

You are finally ready to work on your P4Pi project





Group Time!





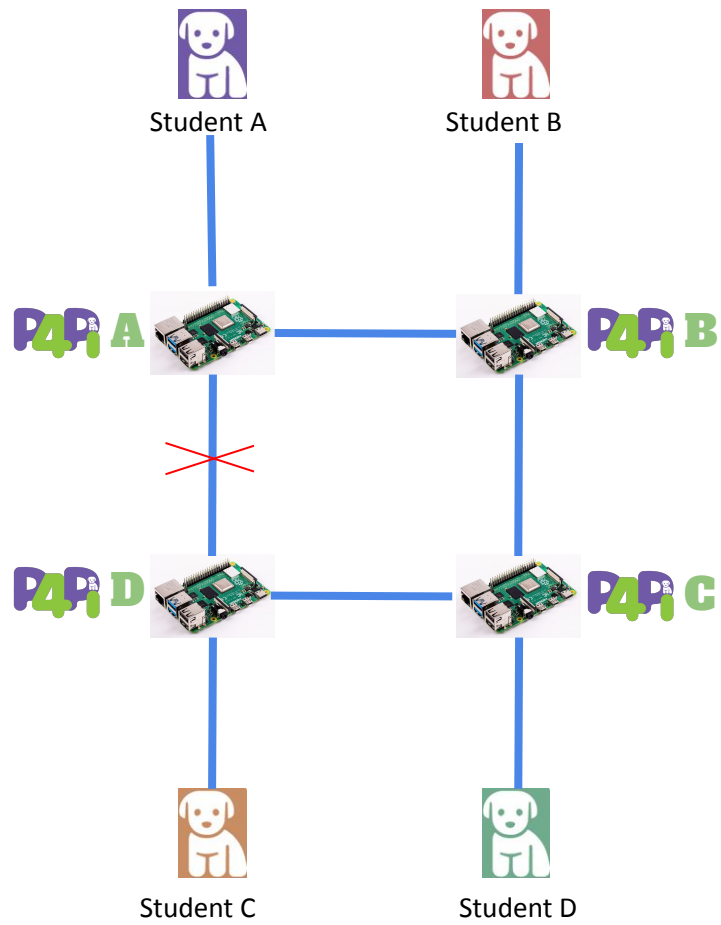
Thank You

www.github.com/p4lang/p4pi

"*P4Pi: P4 on Raspberry Pi for Networking Education*". Sándor Laki, Radostin Stoyanov, Dávid Kis, Robert Soulé, Péter Vörös and Noa Zilberman. ACM SIGCOMM Computer Communication Review, Volume 51, Number 3, July 2021

Backup Slides





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