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# Update on P4

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## A New Future: Programmable data planes come to the mainstream

- Some devices are more programmable than fixed-function ASICs
- CPUs: 10s of Gb/s
- FPGAs & NPUs: 100s of Gb/s
- **Protocol-Independent Switch Architecture (PISA) ASICs: Tb/s**
  - A few emerging solutions
  - Merchant silicon with fully programmable data plane with effectively zero penalty
  - In next few years this kind of data plane will be inevitable for high-speed devices



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## “Turning the tables”

in P4

*“This is exactly how I want  
to process packets”*

Switch OS and Apps

Run-time API

Driver



**Programmable data plane**  
(such as PISA, NPU, FPGA, and CPU)



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## What does this mean?

- **Data-plane changes at the velocity of S/W development and release**
  - Extremely fast iteration and feature release
  - Best of breed S/W programming practices and tools leveraged
- **Networking features and behaviors custom-built for your apps, policies, and architecture**
- **Transparent data plane**
  - No more “black boxes” in the “white boxes”; no more ambiguity in forwarding behavior

**Finally, create the network you want!**

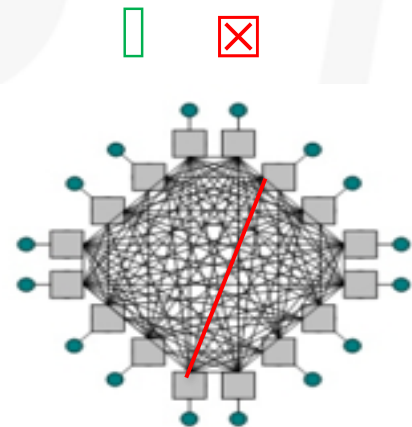
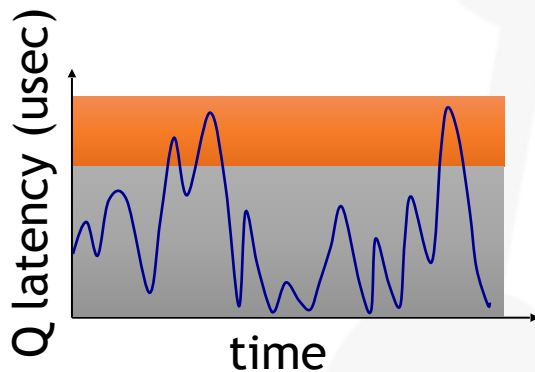


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# Enable tons of beautiful ideas!

## For better and easier network management

- Re-allocate H/W resources or even simplify the data plane in the field
- Customizable visibility and telemetry for debugging and diagnostics
- Verify network behavior
- Improve OAM capabilities





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## Enable tons of beautiful ideas!

### For better application performance, lower cost, and more ...

- Better network-fabric load-balancing to expedite job completion
- New standard or custom encapsulations and/or headers
- Improve network reliability and robustness
- Embed some middlebox functions inline
- Enhanced congestion control
- and many more ...

We've only started to scratch the surface



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## P4 Language Consortium -- P4.org



- **Build an open community**
  - Open-source software – Apache license
  - A common language – Recently released P4 spec v1.1
  - Support for various devices – Physical & virtual SWs, host networking stacks, NICs, middleboxes
  - Support for various targets – PISA chips, FPGAs, NPUs, embedded or server-class CPUs
- **Enable a wealth of innovation**
  - Diverse “apps” (including proprietary ones!) while leveraging commodity targets
- **With no barrier to entry**
  - Free membership and simple software licensing



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# P4.org Membership Growth

Original P4 paper authors from Barefoot, Google, Intel, Microsoft, Princeton University, and Stanford University

## Operators



## Systems



## Targets



## Academia







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## How to get involved with P4 – Go to <http://p4.org>

- **Try P4 development tools and reference programs** (switch.p4 and more)
  - Including P4-programmable S/W switches and test framework
  - Exciting apps for network monitoring, analysis, diagnostics, and control
- **Join the events**
  - P4 tutorial for developers on May 23 – Register at [P4.org](http://P4.org)
  - P4 workshops – e.g. 2016 Annual P4 Developer Workshop on May 24
  - P4 boot camps, hackathons, and more
- **Join the consortium and the community**
  - Join the mailing lists and participate in the discussions
- **Get familiar with P4 and contribute back!**



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## P4 evolution roadmap

- **Cleanly embrace functional and architectural heterogeneity**
- **Enable code reuse**
  - Portability – *Reuse the P4 code for various targets*
  - Architecture-language separation – *Reuse the same compiler for new targets*
  - Composability – *Write P4 code once and reuse it many times*
- **More working groups**
- **Enabling bigger long-term impact across all parts of the network**
  - Working with other open-source efforts, such as OpenSwitch, IOVisor, OVS, and DPDK



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## Key benefits of programmable forwarding

1. **New features**: Realize new protocols and behaviors very quickly
2. **Reduce complexity**: Remove unnecessary features and tables
3. **Efficient use of H/W resources**: Achieve biggest bang for buck
4. **Greater visibility**: New diagnostics, telemetry, OAM, etc.
5. **Modularity**: Compose forwarding behavior from libraries
6. **Portability**: Specify forwarding behavior once; compile to many devices
7. **Own your own network**: No need to wait for next chips or systems



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# Thank You