XKCP internals

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[1]STMicroelectronics

SCA workshop
Šibenik, Croatia, June 2019

Based on joint work with Ronny Van Keer

Outline

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What is the XKCP?

Previously known as the KECCAK Code Package...

Repository of implementations of

- KECCAK-p[200 to 1600], SHA-3, (c)SHAKE, KMAC, KANGAROOTWELVE, KETJE, KEYAK, KRAVATTE, ...
- XOODOO, XOODYAK, XOOFFF, XOOFFF-SANE, ...

... now eXtended KCP

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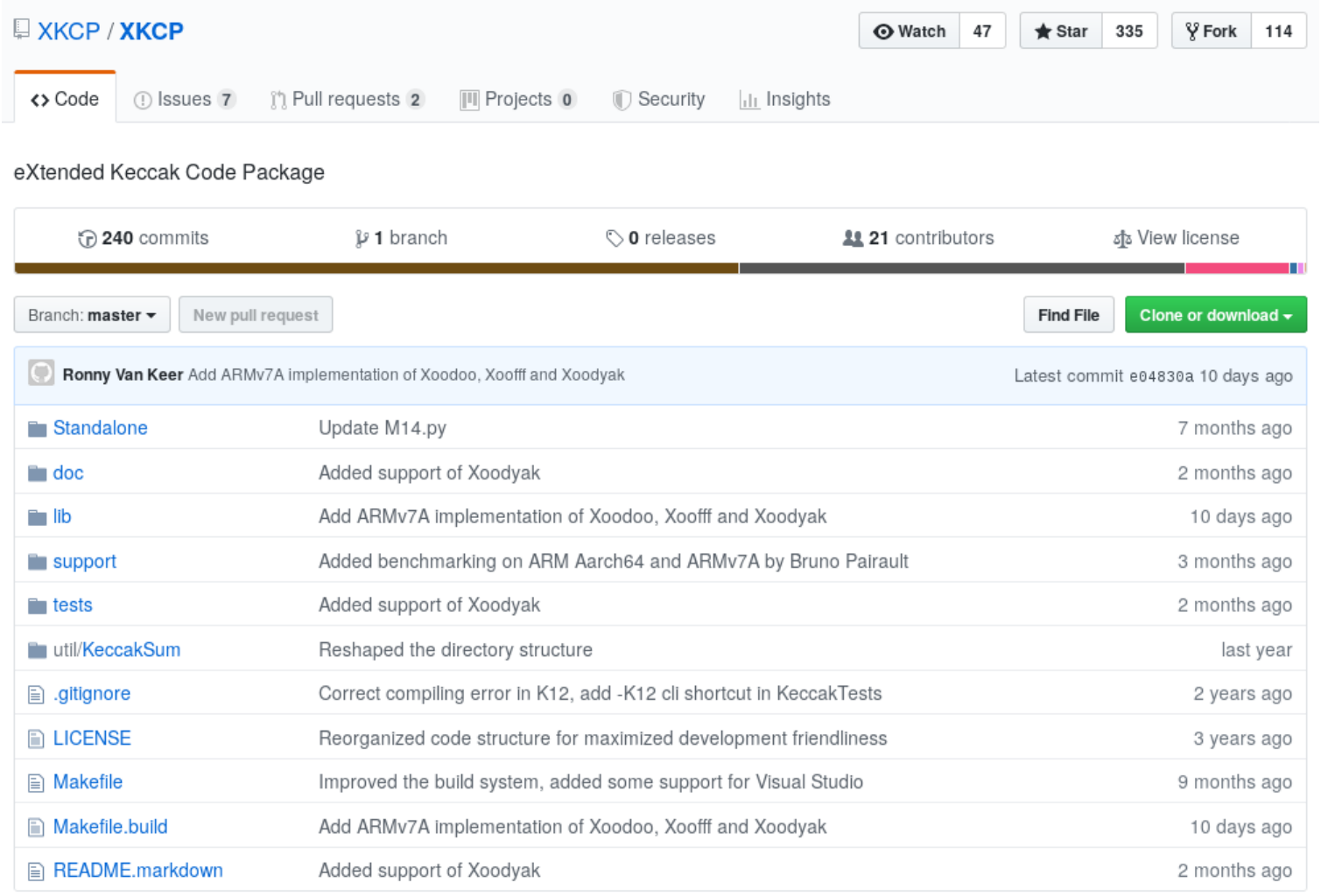
Where to find it



XKCP / XKCP

Watch 47 | Star 335 | Fork 114

Code | Issues 7 | Pull requests 2 | Projects 0 | Security | Insights

eXtended Keccak Code Package

240 commits | 1 branch | 0 releases | 21 contributors | View license

Branch: master | New pull request | Find File | Clone or download

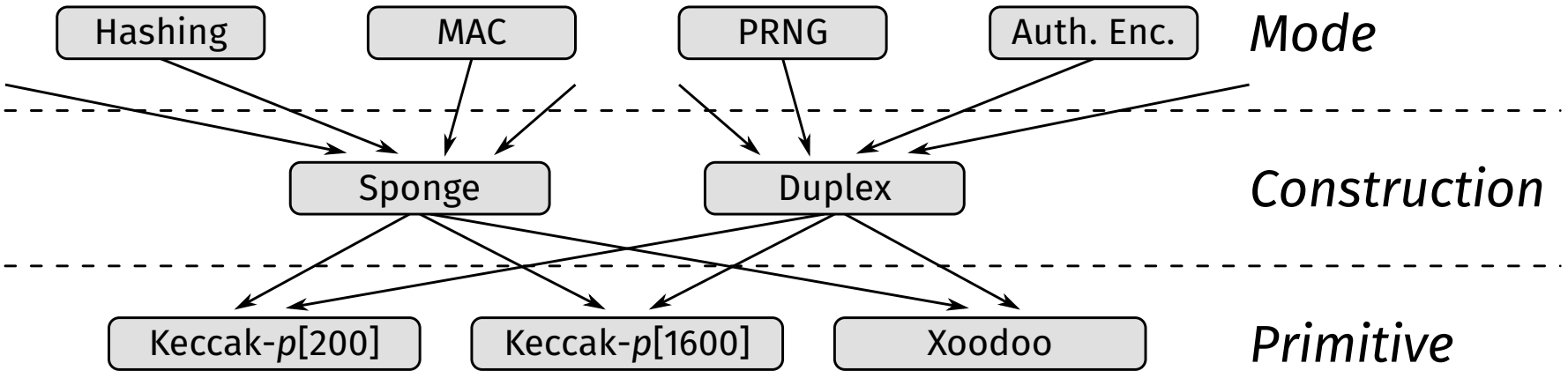
Ronny Van Keer Add ARMv7A implementation of Xoodoo, Xoofff and Xoodyak — Latest commit e04830a 10 days ago

Standalone	Update M14.py	7 months ago
doc	Added support of Xoodyak	2 months ago
lib	Add ARMv7A implementation of Xoodoo, Xoofff and Xoodyak	10 days ago
support	Added benchmarking on ARM Aarch64 and ARMv7A by Bruno Pairault	3 months ago
tests	Added support of Xoodyak	2 months ago
util/KeccakSum	Reshaped the directory structure	last year
.gitignore	Correct compiling error in K12, add -K12 cli shortcut in KeccakTests	2 years ago
LICENSE	Reorganized code structure for maximized development friendliness	3 years ago
Makefile	Improved the build system, added some support for Visual Studio	9 months ago
Makefile.build	Add ARMv7A implementation of Xoodoo, Xoofff and Xoodyak	10 days ago
README.markdown	Added support of Xoodyak	2 months ago

https://github.com/XKCP/XKCP

Outline

A layered approach



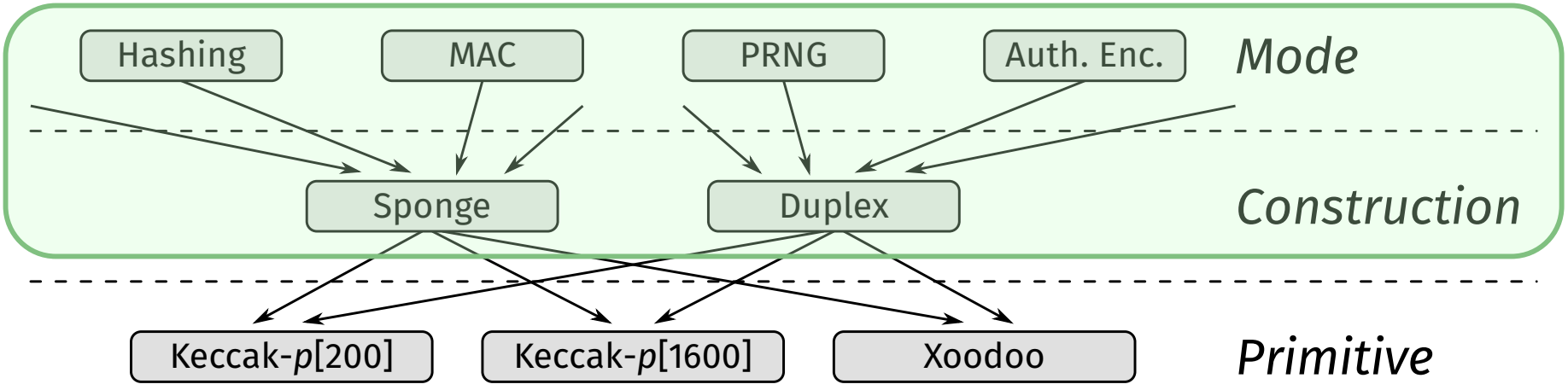
Generic

- focus on **user**
  - easy to use
  - e.g., message queue
- one implementation
  - pointers and arithmetic

Specific

- focus on **developer**
  - limited scope to optimize
  - unit tests
- tailored implementations
  - permutation
  - bulk data processing

A layered approach



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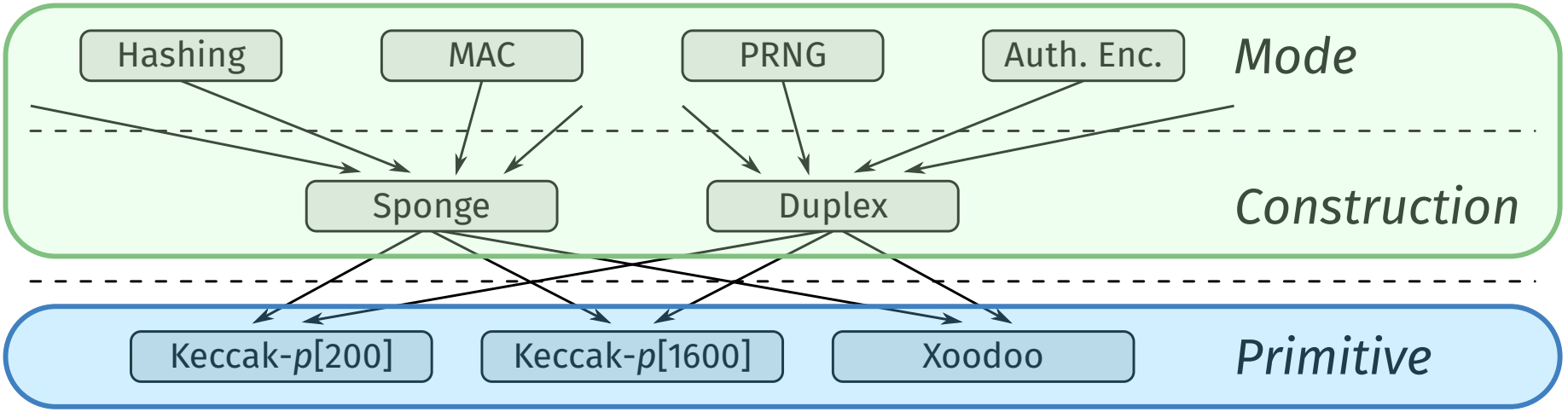

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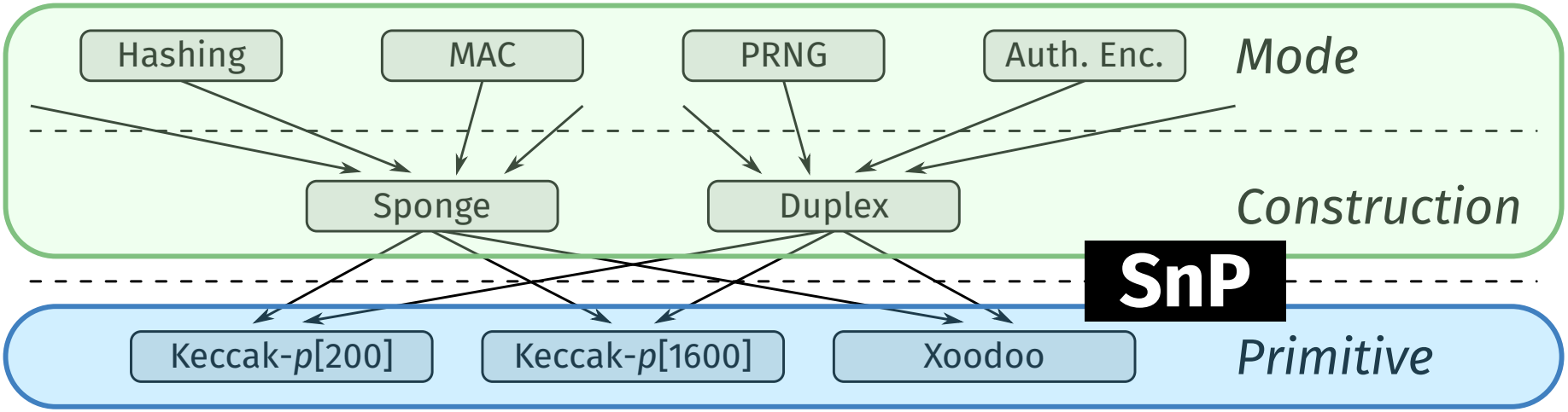

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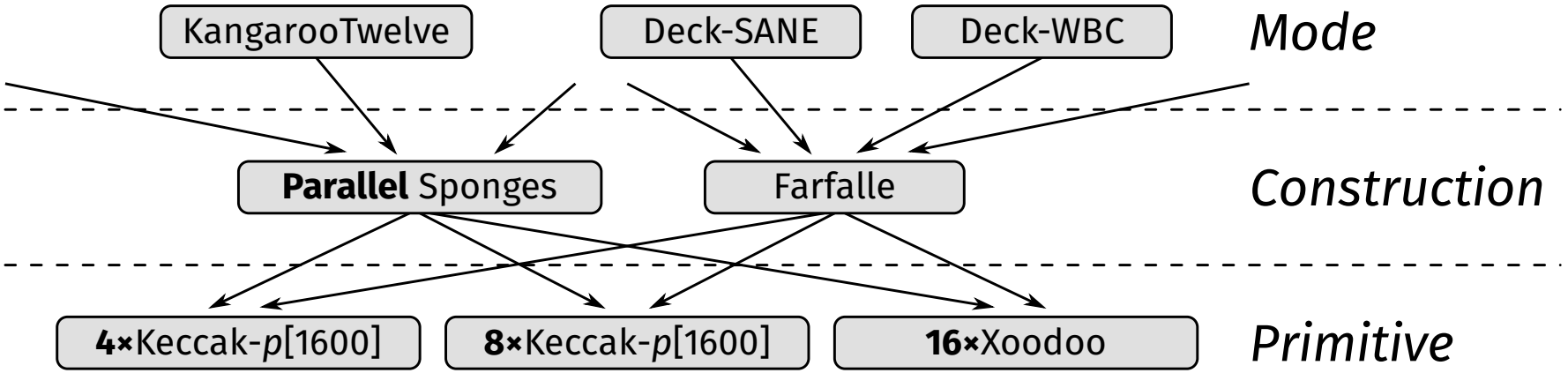
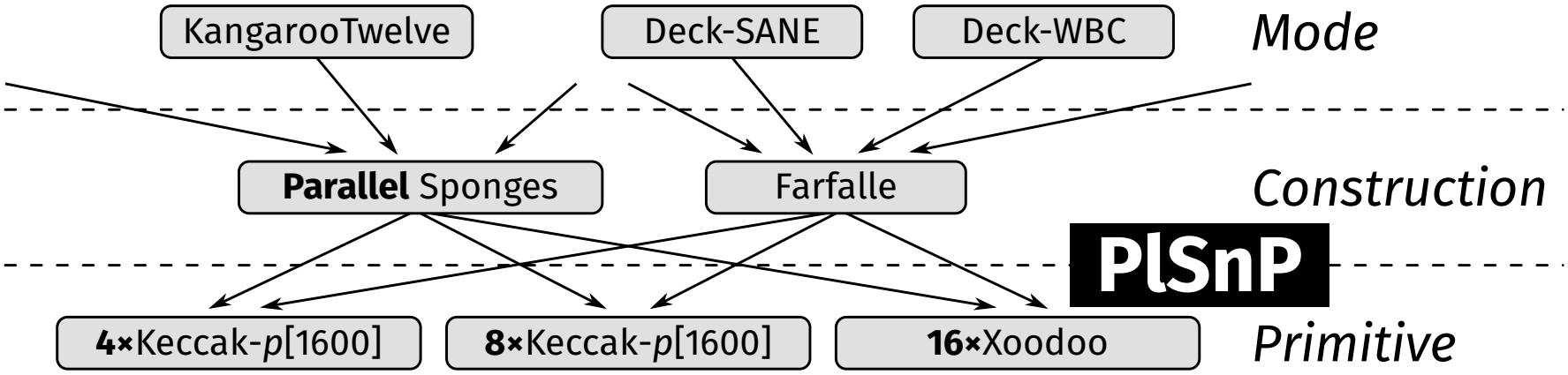
Parallel processing



- SnP = State and Permutation
- PlSnP = Parallel States and Permutations

Parallel processing



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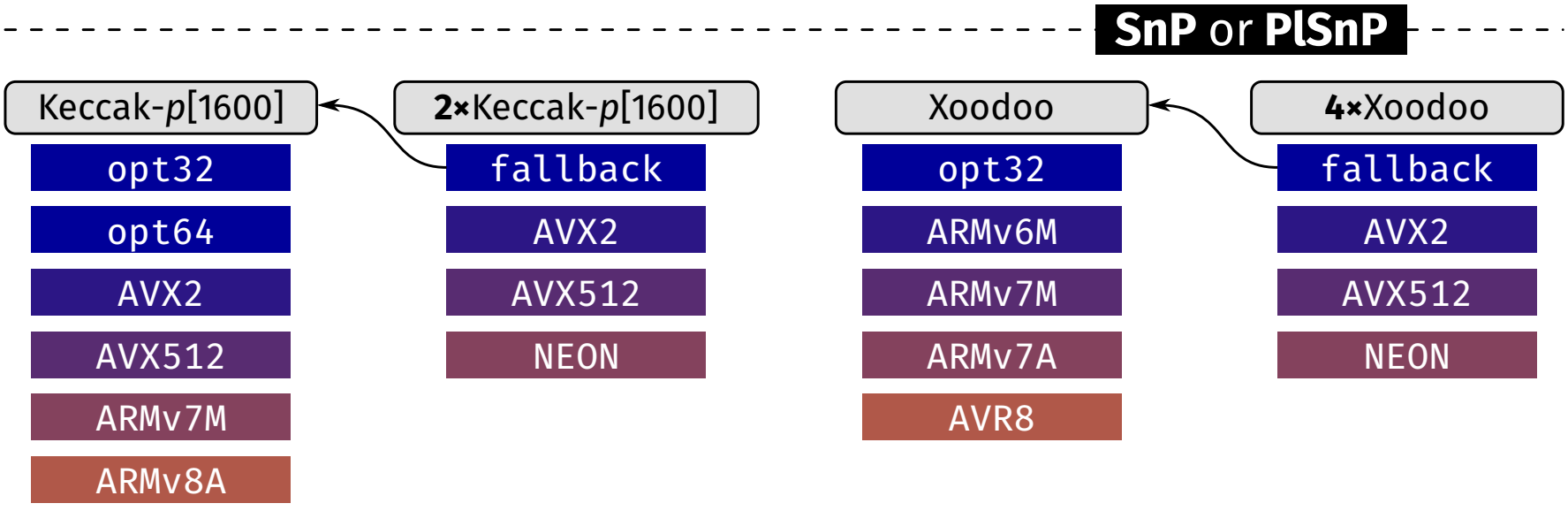
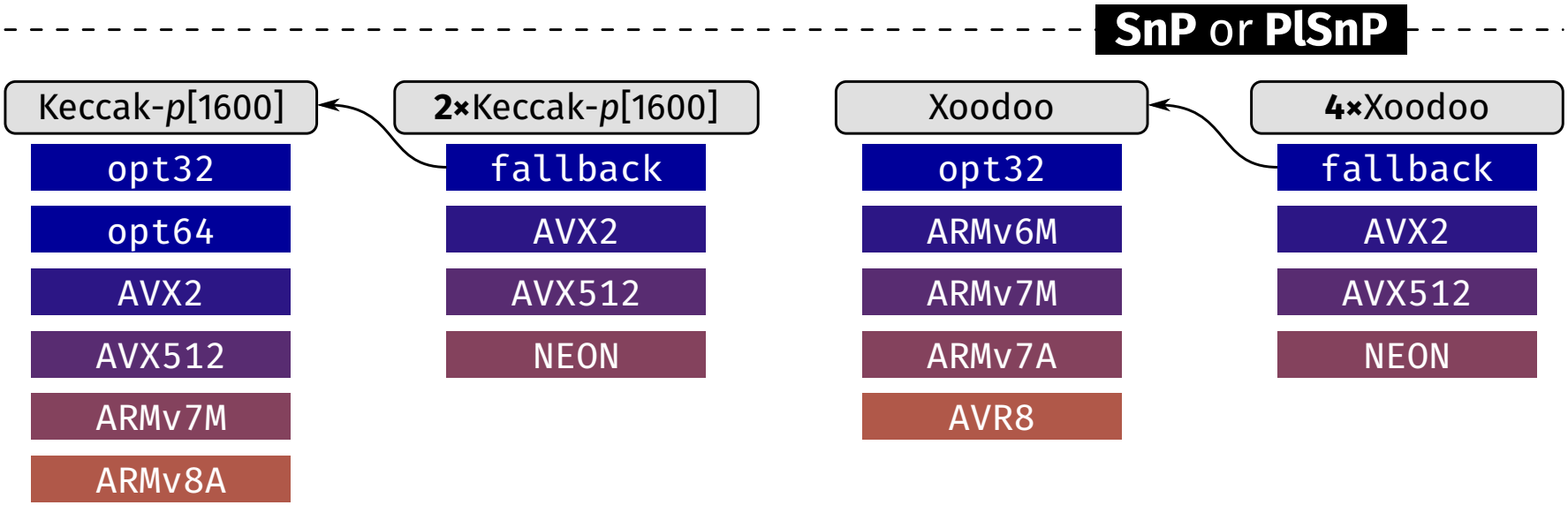
Multiple implementations



Assumption: **the state representation is opaque!**

Multiple implementations



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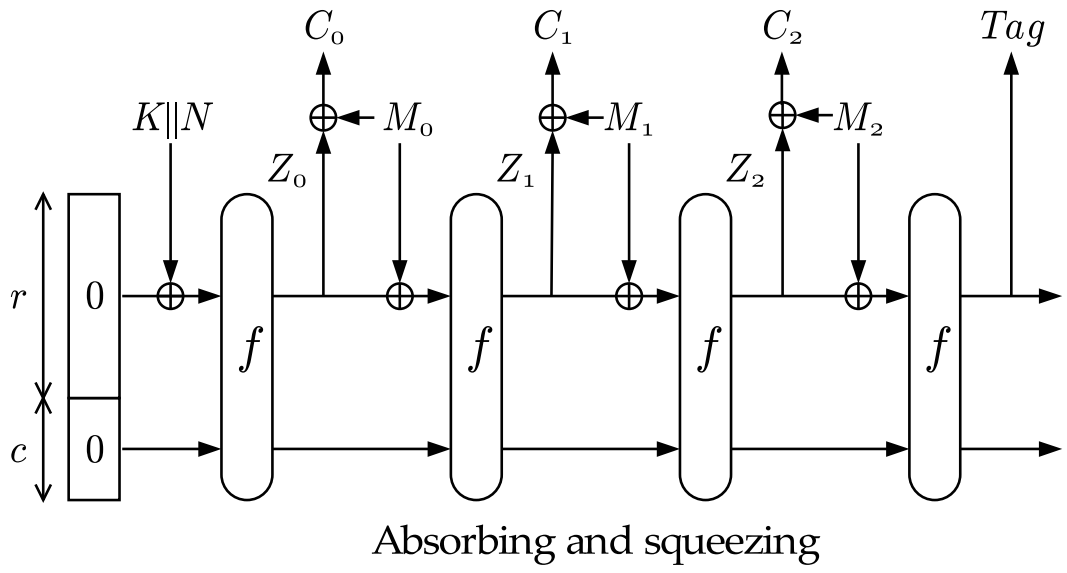
Operations on the state



Absorbing and squeezing

- initialize the state
- apply the permutation f
- XOR/overwrite bytes into the state
- extract bytes from the state
  - and optionally XOR them

Example for KECCAK-*p*[1600]

Declarations in **KeccakP-1600-SnP.h**:

- `#define KeccakP1600_implementation "generic 64-bit optimized implementation"`
- `#define KeccakP1600_stateSizeInBytes 200`
- `#define KeccakP1600_stateAlignment 8`

Typical functions to be implemented (or macro'ed):

- `KeccakP1600_Initialize`
- `KeccakP1600_AddBytes`
- `KeccakP1600_OverwriteBytes`
- `KeccakP1600_Permute_Nrounds`
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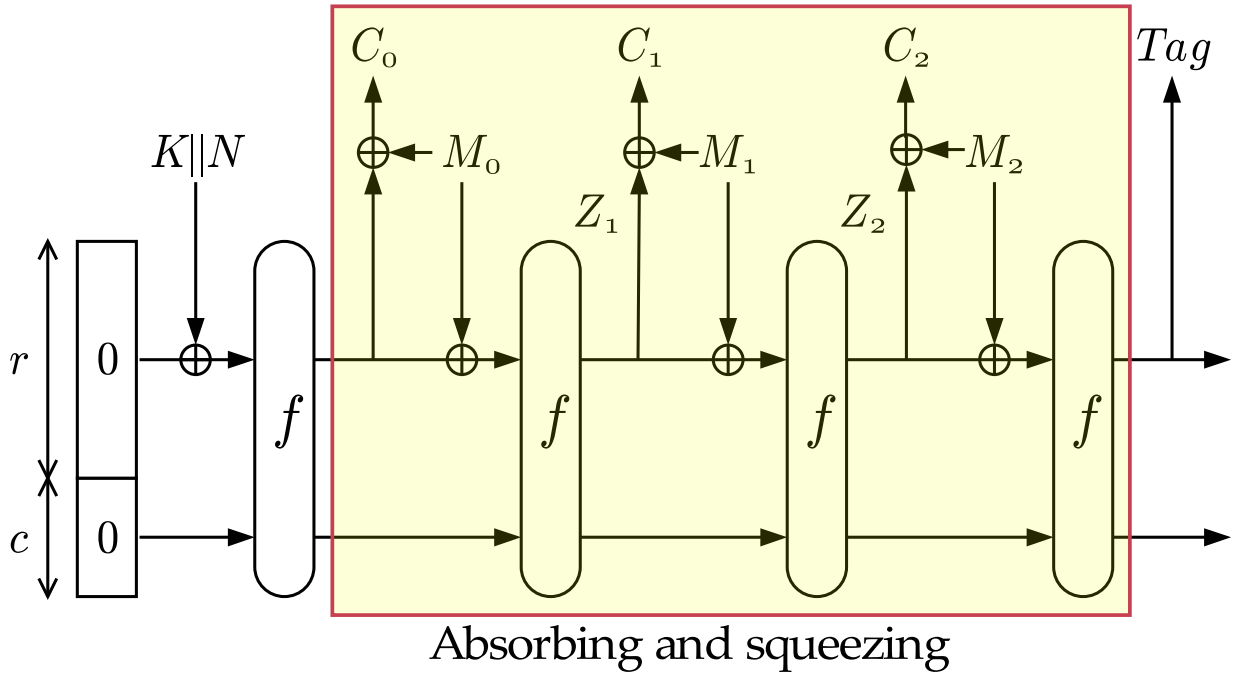
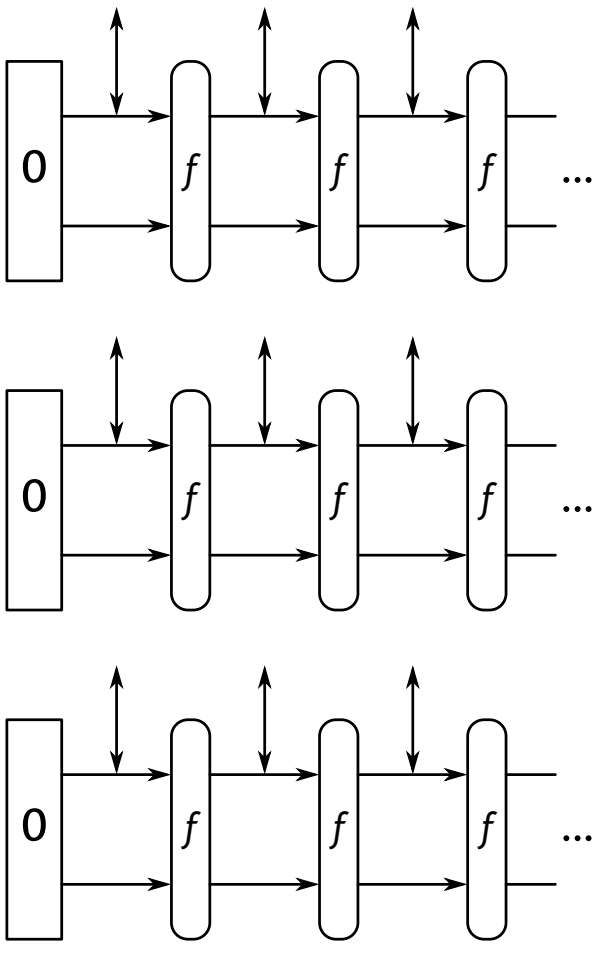
Fast loop optimization



Specialized repeated application of some operations

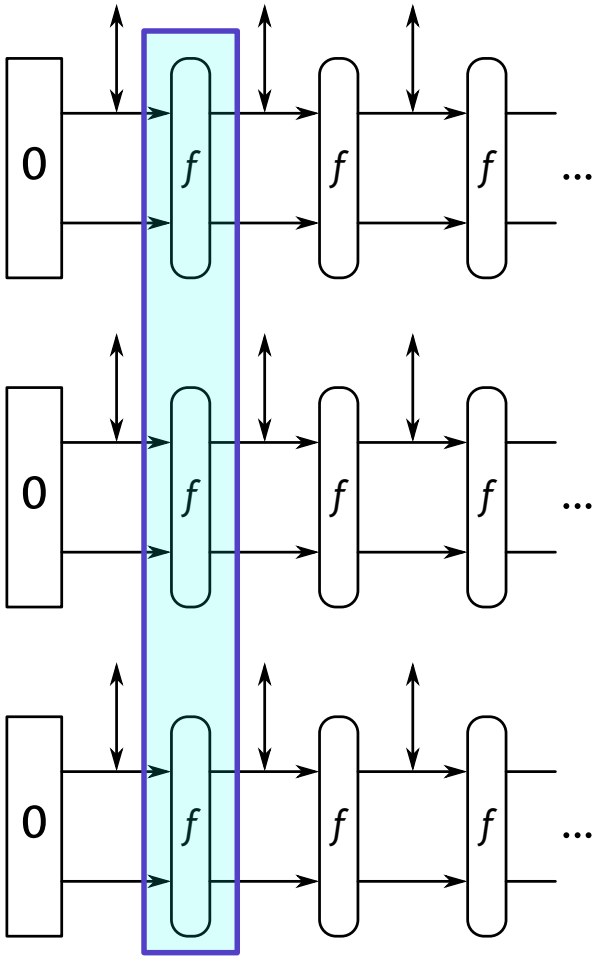
(optional)

Parallel operations on the states



- Functions on individual instances
- Functions on **all instances**
  - Parallel application of f
  - XOR blocks into state
- Optional **fast loop** optimization

Parallel operations on the states



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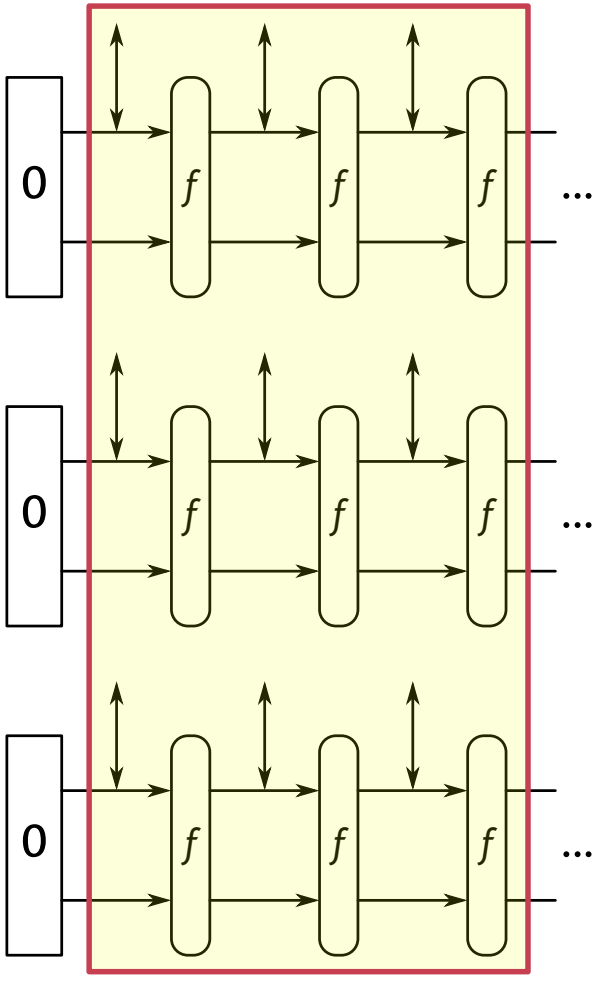

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Making targets

- Making a library (**.a** or **.so**)
  - `make generic64/libXKCP.a`
  - `make generic32/libXKCP.a`
  - `make Skylake/libXKCP.a`
  - `make ARMv7A/libXKCP.a`
  - `make compact/libXKCP.a`
- Extracting the source files
  - `make generic64/libXKCP.a.pack`
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- And more: benchmarks, KeccakSum utility

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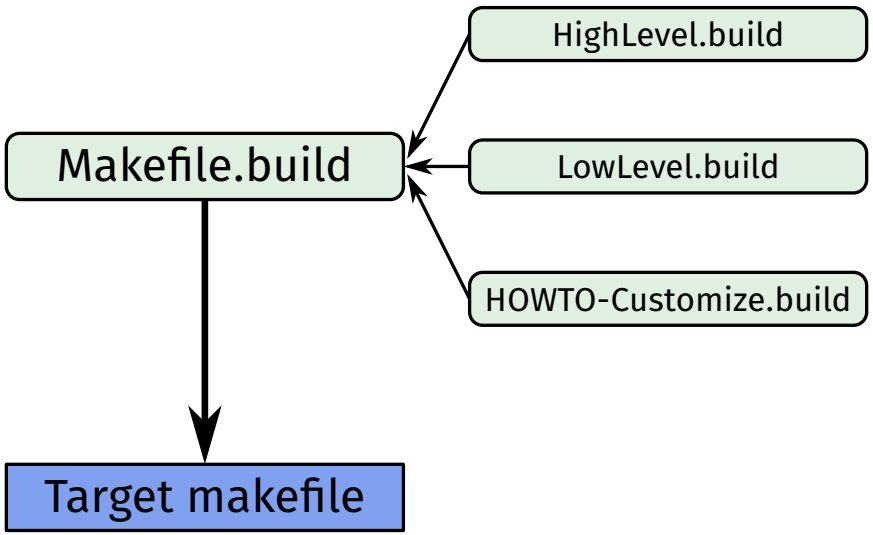
XML-driven Makefile



In `*.build`, one defines **fragments** that ...

- ... are sets of files and compilation options
- ... represent
  - a concrete service, mode, construction
  - the implementation of a permutation

Customizing targets

HOWTO-Customize.build

Examples:

- `<target name="XoodyakCortexM3"/>`
- `<target name="K12onAVX2"/>`

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Any questions?

Thanks for your attention!

`https://keccak.team/`