

CubeHash

D. J. Bernstein

University of Illinois at Chicago

CubeHash security

is very well understood.

Third-party analyses by

Aumasson, Brier, Dai,

Ferguson, Khazaei,

Khovratovich, Knellwolf,

Lucks, McKay, Meier,

Naya-Plasencia, Nikolic,

Peyrin, Weinmann

show that recommended

CubeHash16/32–512

has a very solid security margin.

Thanks for all the analysis!

sh
ernstein
ty of Illinois at Chicago

CubeHash security
is very well understood.

Third-party analyses by
Aumasson, Brier, Dai,
Ferguson, Khazaei,
Khovratovich, Knellwolf,
Lucks, McKay, Meier,
Naya-Plasencia, Nikolic,
Peyrin, Weinmann

show that recommended

CubeHash16/32–512

has a very solid security margin.

Thanks for all the analysis!

CubeHas
so $\approx 2^{38}$

Alternat

boosts p

but quan

SHA-3 t

so 2^{384} i

is at Chicago

CubeHash security
is very well understood.

Third-party analyses by
Aumasson, Brier, Dai,
Ferguson, Khazaei,
Khovratovich, Knellwolf,
Lucks, McKay, Meier,
Naya-Plasencia, Nikolic,
Peyrin, Weinmann
show that recommended
CubeHash16/32–512
has a very solid security margin.

Thanks for all the analysis!

CubeHash16/32 h
so $\approx 2^{384}$ preimag

Alternate CubeHash
boosts pipe size and
but quantum com
SHA-3 to 2^{256} pre
so 2^{384} is already

ago

CubeHash security
is very well understood.

Third-party analyses by
Aumasson, Brier, Dai,
Ferguson, Khazaei,
Khovratovich, Knellwolf,
Lucks, McKay, Meier,
Naya-Plasencia, Nikolic,
Peyrin, Weinmann
show that recommended
CubeHash16/32–512
has a very solid security margin.

Thanks for all the analysis!

CubeHash16/32 has 768-bit
so $\approx 2^{384}$ preimage security.

Alternate CubeHash16/1 op
boosts pipe size and security
but quantum computers will
SHA-3 to 2^{256} preimage sec
so 2^{384} is already overkill.

CubeHash security
is very well understood.

Third-party analyses by
Aumasson, Brier, Dai,
Ferguson, Khazaei,
Khovratovich, Knellwolf,
Lucks, McKay, Meier,
Naya-Plasencia, Nikolic,
Peyrin, Weinmann
show that recommended
CubeHash16/32–512
has a very solid security margin.

Thanks for all the analysis!

CubeHash16/32 has 768-bit pipe,
so $\approx 2^{384}$ preimage security.

Alternate CubeHash16/1 option
boosts pipe size and security,
but quantum computers will limit
SHA-3 to 2^{256} preimage security,
so 2^{384} is already overkill.

CubeHash security is very well understood. Third-party analyses by Aumasson, Brier, Dai, Ferguson, Khazaei, Khovratovich, Knellwolf, Lucks, McKay, Meier, Naya-Plasencia, Nikolic, Peyrin, Weinmann show that recommended CubeHash16/32–512 has a very solid security margin.

Thanks for all the analysis!

CubeHash16/32 has 768-bit pipe, so $\approx 2^{384}$ preimage security.

Alternate CubeHash16/1 option boosts pipe size and security, but quantum computers will limit SHA-3 to 2^{256} preimage security, so 2^{384} is already overkill.

(Keccak speed advertisements have $\approx 2^{288}$ preimage security.)

CubeHash security is very well understood. Third-party analyses by Aumasson, Brier, Dai, Ferguson, Khazaei, Khovratovich, Knellwolf, Lucks, McKay, Meier, Naya-Plasencia, Nikolic, Peyrin, Weinmann show that recommended CubeHash16/32–512 has a very solid security margin.

Thanks for all the analysis!

CubeHash16/32 has 768-bit pipe, so $\approx 2^{384}$ preimage security.

Alternate CubeHash16/1 option boosts pipe size and security, but quantum computers will limit SHA-3 to 2^{256} preimage security, so 2^{384} is already overkill.

(Keccak speed advertisements have $\approx 2^{288}$ preimage security.)

CubeHash symmetries gain speed and are not a security problem.

CubeHash16/32 finalization: ≈ 320 bytes, again overkill.

sh security
well understood.
arty analyses by
on, Brier, Dai,
n, Khazaei,
ovich, Knellwolf,
McKay, Meier,
asencia, Nikolic,
Weinmann
at recommended
sh16/32–512
ry solid security margin.

for all the analysis!

CubeHash16/32 has 768-bit pipe,
so $\approx 2^{384}$ preimage security.

Alternate CubeHash16/1 option
boosts pipe size and security,
but quantum computers will limit
SHA-3 to 2^{256} preimage security,
so 2^{384} is already overkill.

(Keccak speed advertisements
have $\approx 2^{288}$ preimage security.)

CubeHash symmetries gain speed
and are not a security problem.

CubeHash16/32 finalization:
 ≈ 320 bytes, again overkill.

Those w
Harder is
third-par
increasin
different
Resulting
doable fo
 2^{71} estim
 2^{132} estim
 2^{180} estim
Compare
recommen
has $> 2.$

CubeHash16/32 has 768-bit pipe,
so $\approx 2^{384}$ preimage security.

Alternate CubeHash16/1 option
boosts pipe size and security,
but quantum computers will limit
SHA-3 to 2^{256} preimage security,
so 2^{384} is already overkill.

(Keccak speed advertisements
have $\approx 2^{288}$ preimage security.)

CubeHash symmetries gain speed
and are not a security problem.

CubeHash16/32 finalization:
 ≈ 320 bytes, again overkill.

Those were the ea
Harder issues, mos
third-party analyse
increasingly sophis
differential attacks

Resulting collision
doable for CubeHa
 2^{71} estimate for C
 2^{132} estimate for C
 2^{180} estimate for C

Compared to Cube
recommended Cub
has $> 2.5\times$ as ma

e analysis!

CubeHash16/32 has 768-bit pipe,
so $\approx 2^{384}$ preimage security.

Alternate CubeHash16/1 option
boosts pipe size and security,
but quantum computers will limit
SHA-3 to 2^{256} preimage security,
so 2^{384} is already overkill.

(Keccak speed advertisements
have $\approx 2^{288}$ preimage security.)

CubeHash symmetries gain speed
and are not a security problem.

CubeHash16/32 finalization:
 ≈ 320 bytes, again overkill.

Those were the easy issues.

Harder issues, most interestingly
third-party analyses of CubeHash
increasingly sophisticated
differential attacks.

Resulting collision costs:
doable for CubeHash4/64;
 2^{71} estimate for CubeHash5/128;
 2^{132} estimate for CubeHash6/256;
 2^{180} estimate for CubeHash8/512.

Compared to CubeHash6/32,
recommended CubeHash16/32
has $> 2.5\times$ as many rounds

CubeHash16/32 has 768-bit pipe,
so $\approx 2^{384}$ preimage security.

Alternate CubeHash16/1 option
boosts pipe size and security,
but quantum computers will limit
SHA-3 to 2^{256} preimage security,
so 2^{384} is already overkill.

(Keccak speed advertisements
have $\approx 2^{288}$ preimage security.)

CubeHash symmetries gain speed
and are not a security problem.

CubeHash16/32 finalization:
 ≈ 320 bytes, again overkill.

Those were the easy issues.

Harder issues, most interesting
third-party analyses of CubeHash:
increasingly sophisticated
differential attacks.

Resulting collision costs:

doable for CubeHash4/64;

2^{71} estimate for CubeHash5/64;

2^{132} estimate for CubeHash6/64;

2^{180} estimate for CubeHash6/32.

Compared to CubeHash6/32,
recommended CubeHash16/32
has $> 2.5\times$ as many rounds.

sh16/32 has 768-bit pipe,
 2^{34} preimage security.

the CubeHash16/1 option
pipe size and security,
quantum computers will limit
to 2^{256} preimage security,
is already overkill.

speed advertisements
 2^{288} preimage security.)

sh symmetries gain speed
not a security problem.

sh16/32 finalization:
bytes, again overkill.

Those were the easy issues.

Harder issues, most interesting
third-party analyses of CubeHash:
increasingly sophisticated
differential attacks.

Resulting collision costs:

doable for CubeHash4/64;

2^{71} estimate for CubeHash5/64;

2^{132} estimate for CubeHash6/64;

2^{180} estimate for CubeHash6/32.

Compared to CubeHash6/32,
recommended CubeHash16/32
has $> 2.5\times$ as many rounds.

Despite
CubeHash
is about

Slower o
but faster
8.23 cyc

Will be
on next
thanks t

Can even

FPGA: F
in the sa
and solid

ASIC: Si

as 768-bit pipe,
ge security.

sh16/1 option
nd security,
puters will limit
eimage security,
overkill.

vertisements
age security.)
tries gain speed
rity problem.

nalization:
n overkill.

Those were the easy issues.

Harder issues, most interesting
third-party analyses of CubeHash:
increasingly sophisticated
differential attacks.

Resulting collision costs:
doable for CubeHash4/64;
 2^{71} estimate for CubeHash5/64;
 2^{132} estimate for CubeHash6/64;
 2^{180} estimate for CubeHash6/32.

Compared to CubeHash6/32,
recommended CubeHash16/32
has $> 2.5\times$ as many rounds.

Despite the security
CubeHash16/32–5
is about as fast as
Slower on some ol
but faster on newe
8.23 cycles/byte o
Will be < 5 cycles
on next year's "AV
thanks to 256-bit
Can even use futu
FPGA: Faster than
in the same numb
and solidly beats S
ASIC: Similar story

Those were the easy issues.

Harder issues, most interesting third-party analyses of CubeHash: increasingly sophisticated differential attacks.

Resulting collision costs:

doable for CubeHash4/64;

2^{71} estimate for CubeHash5/64;

2^{132} estimate for CubeHash6/64;

2^{180} estimate for CubeHash6/32.

Compared to CubeHash6/32, recommended CubeHash16/32 has $> 2.5\times$ as many rounds.

Despite the security margin, CubeHash16/32–512 is about as fast as SHA-2.

Slower on some old CPUs but faster on newer CPUs.

8.23 cycles/byte on Core i5

Will be < 5 cycles/byte

on next year's "AVX" Intel C

thanks to 256-bit vectorization

Can even use future 512-bit

FPGA: Faster than SHA-256

in the same number of slices

and solidly beats SHA-512.

ASIC: Similar story.

Those were the easy issues.

Harder issues, most interesting
third-party analyses of CubeHash:
increasingly sophisticated
differential attacks.

Resulting collision costs:
doable for CubeHash4/64;
 2^{71} estimate for CubeHash5/64;
 2^{132} estimate for CubeHash6/64;
 2^{180} estimate for CubeHash6/32.

Compared to CubeHash6/32,
recommended CubeHash16/32
has $> 2.5\times$ as many rounds.

Despite the security margin,
CubeHash16/32–512
is about as fast as SHA-2.

Slower on some old CPUs
but faster on newer CPUs.
8.23 cycles/byte on Core i5 520.
Will be < 5 cycles/byte
on next year's "AVX" Intel CPUs,
thanks to 256-bit vectorization.
Can even use future 512-bit AVX.

FPGA: Faster than SHA-256
in the same number of slices;
and solidly beats SHA-512.

ASIC: Similar story.

were the easy issues.

Issues, most interesting
security analyses of CubeHash:

Increasingly sophisticated
practical attacks.

Estimating collision costs:

Estimate for CubeHash4/64;

Estimate for CubeHash5/64;

Estimate for CubeHash6/64;

Estimate for CubeHash6/32.

Compared to CubeHash6/32,

Extended CubeHash16/32

uses 1.5× as many rounds.

Despite the security margin,
CubeHash16/32–512
is about as fast as SHA-2.

Slower on some old CPUs
but faster on newer CPUs.

8.23 cycles/byte on Core i5 520.

Will be < 5 cycles/byte

on next year's "AVX" Intel CPUs,
thanks to 256-bit vectorization.

Can even use future 512-bit AVX.

FPGA: Faster than SHA-256
in the same number of slices;
and solidly beats SHA-512.

ASIC: Similar story.

We have
with solid
and acc

What's s

... issues.

... most interesting
... of CubeHash:

... sticated

... s.

... costs:

... ash4/64;

... ubeHash5/64;

... CubeHash6/64;

... CubeHash6/32.

... eHash6/32,

... beHash16/32

... ny rounds.

Despite the security margin,
CubeHash16/32–512
is about as fast as SHA-2.

Slower on some old CPUs
but faster on newer CPUs.

8.23 cycles/byte on Core i5 520.

Will be < 5 cycles/byte

on next year's "AVX" Intel CPUs,
thanks to 256-bit vectorization.

Can even use future 512-bit AVX.

FPGA: Faster than SHA-256
in the same number of slices;
and solidly beats SHA-512.

ASIC: Similar story.

We have other SH...
with solid security
and acceptable sp...

What's special abo...

ng
Hash:

Despite the security margin,
CubeHash16/32–512
is about as fast as SHA-2.

Slower on some old CPUs
but faster on newer CPUs.
8.23 cycles/byte on Core i5 520.
Will be < 5 cycles/byte
on next year's "AVX" Intel CPUs,
thanks to 256-bit vectorization.
Can even use future 512-bit AVX.

/64;
6/64;
6/32.

FPGA: Faster than SHA-256
in the same number of slices;
and solidly beats SHA-512.

2,
32

ASIC: Similar story.

We have other SHA-3 candi
with solid security margins
and acceptable speed.

What's special about CubeH

Despite the security margin,
CubeHash16/32–512
is about as fast as SHA-2.

Slower on some old CPUs
but faster on newer CPUs.
8.23 cycles/byte on Core i5 520.
Will be < 5 cycles/byte
on next year's "AVX" Intel CPUs,
thanks to 256-bit vectorization.
Can even use future 512-bit AVX.

FPGA: Faster than SHA-256
in the same number of slices;
and solidly beats SHA-512.

ASIC: Similar story.

We have other SHA-3 candidates
with solid security margins
and acceptable speed.

What's special about CubeHash?

Despite the security margin,
CubeHash16/32–512
is about as fast as SHA-2.

Slower on some old CPUs
but faster on newer CPUs.
8.23 cycles/byte on Core i5 520.
Will be < 5 cycles/byte
on next year's "AVX" Intel CPUs,
thanks to 256-bit vectorization.
Can even use future 512-bit AVX.

FPGA: Faster than SHA-256
in the same number of slices;
and solidly beats SHA-512.

ASIC: Similar story.

We have other SHA-3 candidates
with solid security margins
and acceptable speed.

What's special about CubeHash?

CubeHash is the *smallest*
high-security SHA-3 proposal.

Several meanings of "smallest":

- Smallest memory use.
- Smallest description.
- Smallest code size.
- Smallest vector-code size.
- Smallest area in hardware.

Despite the security margin,
CubeHash16/32–512
is about as fast as SHA-2.

Slower on some old CPUs
but faster on newer CPUs.
8.23 cycles/byte on Core i5 520.
Will be < 5 cycles/byte
on next year's "AVX" Intel CPUs,
thanks to 256-bit vectorization.
Can even use future 512-bit AVX.

FPGA: Faster than SHA-256
in the same number of slices;
and solidly beats SHA-512.

ASIC: Similar story.

We have other SHA-3 candidates
with solid security margins
and acceptable speed.

What's special about CubeHash?

CubeHash is the *smallest*
high-security SHA-3 proposal.

Several meanings of "smallest":

- Smallest memory use.
- Smallest description.
- Smallest code size.
- Smallest vector-code size.
- Smallest area in hardware.

(New: Mask bitsliced CubeHash
⇒ low-area DPA resistance.)

the security margin,
sh16/32–512
as fast as SHA-2.

on some old CPUs
er on newer CPUs.
les/byte on Core i5 520.
< 5 cycles/byte
year's "AVX" Intel CPUs,
o 256-bit vectorization.
n use future 512-bit AVX.

Faster than SHA-256
same number of slices;
dly beats SHA-512.

similar story.

We have other SHA-3 candidates
with solid security margins
and acceptable speed.

What's special about CubeHash?

CubeHash is the *smallest*
high-security SHA-3 proposal.

Several meanings of "smallest":

- Smallest memory use.
- Smallest description.
- Smallest code size.
- Smallest vector-code size.
- Smallest area in hardware.

(New: Mask bitsliced CubeHash
⇒ low-area DPA resistance.)

Bernet–
Fichtner
ASIC: 76
"particu
lightweig
No chea
no "free
no "core
no secur
Fast enc

ty margin,

512

SHA-2.

d CPUs

er CPUs.

n Core i5 520.

/byte

/X" Intel CPUs,

vectorization.

re 512-bit AVX.

n SHA-256

er of slices;

SHA-512.

y.

We have other SHA-3 candidates with solid security margins and acceptable speed.

What's special about CubeHash?

CubeHash is the *smallest* high-security SHA-3 proposal.

Several meanings of "smallest":

- Smallest memory use.
- Smallest description.
- Smallest code size.
- Smallest vector-code size.
- Smallest area in hardware.

(New: Mask bitsliced CubeHash ⇒ low-area DPA resistance.)

Bernet–Henzen–K

Fichtner CubeHash

ASIC: 7630 gate e

“particularly appea

lightweight implem

No cheating:

no “free external m

no “core functions

no security compro

Fast enough for al

We have other SHA-3 candidates with solid security margins and acceptable speed.

What's special about CubeHash?

CubeHash is the *smallest* high-security SHA-3 proposal.

Several meanings of “smallest”:

- Smallest memory use.
- Smallest description.
- Smallest code size.
- Smallest vector-code size.
- Smallest area in hardware.

(New: Mask bitsliced CubeHash ⇒ low-area DPA resistance.)

Bernet–Henzen–Kaeslin–Fel
Fichtner CubeHash8/1–512
ASIC: 7630 gate equivalents
“particularly appealing for
lightweight implementations

No cheating:

no “free external memory”;
no “core functions only”;
no security compromises.

Fast enough for almost all u

We have other SHA-3 candidates with solid security margins and acceptable speed.

What's special about CubeHash?

CubeHash is the *smallest*

high-security SHA-3 proposal.

Several meanings of “smallest”:

- Smallest memory use.
- Smallest description.
- Smallest code size.
- Smallest vector-code size.
- Smallest area in hardware.

(New: Mask bitsliced CubeHash
⇒ low-area DPA resistance.)

Bernet–Henzen–Kaeslin–Felber–
Fichtner CubeHash8/1–512
ASIC: 7630 gate equivalents,
“particularly appealing for
lightweight implementations.”

No cheating:

no “free external memory”;

no “core functions only”;

no security compromises.

Fast enough for almost all users.

We have other SHA-3 candidates with solid security margins and acceptable speed.

What's special about CubeHash?

CubeHash is the *smallest* high-security SHA-3 proposal.
Several meanings of “smallest”:

- Smallest memory use.
- Smallest description.
- Smallest code size.
- Smallest vector-code size.
- Smallest area in hardware.

(New: Mask bitsliced CubeHash
⇒ low-area DPA resistance.)

Bernet–Henzen–Kaeslin–Felber–
Fichtner CubeHash8/1–512
ASIC: 7630 gate equivalents,
“particularly appealing for
lightweight implementations.”

No cheating:

no “free external memory”;
no “core functions only”;
no security compromises.

Fast enough for almost all users.

Can anyone show me another
SHA-3 candidate that fits full
functionality into this area?
... with security above 2^{128} ?

Other SHA-3 candidates
and security margins
acceptable speed.

Special about CubeHash?

What is the *smallest*

Security SHA-3 proposal.

Meanings of “smallest”:

Best memory use.

Best description.

Best code size.

Best vector-code size.

Best area in hardware.

Mask bitsliced CubeHash
(area DPA resistance.)

Bernet–Henzen–Kaeslin–Felber–
Fichtner CubeHash8/1–512

ASIC: 7630 gate equivalents,
“particularly appealing for
lightweight implementations.”

No cheating:

no “free external memory”;

no “core functions only”;

no security compromises.

Fast enough for almost all users.

Can anyone show me another
SHA-3 candidate that fits full
functionality into this area?

... with security above 2^{128} ?

How many
about per

Maybe 1

Maybe 1

CubeHash

whenever

SHA-3 candidates
margins
need.
about CubeHash?
smallest
-3 proposal.
of “smallest” :
y use.
tion.
ze.
code size.
hardware.
ced CubeHash
(resistance.)

Bernet–Henzen–Kaeslin–Felber–
Fichtner CubeHash8/1–512
ASIC: 7630 gate equivalents,
“particularly appealing for
lightweight implementations.”
No cheating:
no “free external memory” ;
no “core functions only” ;
no security compromises.
Fast enough for almost all users.
Can anyone show me another
SHA-3 candidate that fits full
functionality into this area?
... with security above 2^{128} ?

How many users w
about performance
Maybe 1/100 care
Maybe 1/10 care
CubeHash is the b
whenever size is cr

dates

Bernet–Henzen–Kaeslin–Felber–
Fichtner CubeHash8/1–512

ASIC: 7630 gate equivalents,
“particularly appealing for
lightweight implementations.”

Hash?

No cheating:

no “free external memory” ;

no “core functions only” ;

no security compromises.

Fast enough for almost all users.

al.

st” :

Can anyone show me another
SHA-3 candidate that fits full
functionality into this area?

... with security above 2^{128} ?

Hash

)

How many users will care
about performance of SHA-3

Maybe 1/100 care about time

Maybe 1/10 care about size

CubeHash is the best choice

whenever size is critical.

Bernet–Henzen–Kaeslin–Felber–
Fichtner CubeHash8/1–512

ASIC: 7630 gate equivalents,
“particularly appealing for
lightweight implementations.”

No cheating:

no “free external memory” ;

no “core functions only” ;

no security compromises.

Fast enough for almost all users.

Can anyone show me another
SHA-3 candidate that fits full
functionality into this area?

... with security above 2^{128} ?

How many users will care
about performance of SHA-3?

Maybe 1/100 care about time.

Maybe 1/10 care about size.

CubeHash is the best choice
whenever size is critical.

Bernet–Henzen–Kaeslin–Felber–
Fichtner CubeHash8/1–512

ASIC: 7630 gate equivalents,
“particularly appealing for
lightweight implementations.”

No cheating:

no “free external memory”;

no “core functions only”;

no security compromises.

Fast enough for almost all users.

Can anyone show me another
SHA-3 candidate that fits full
functionality into this area?

... with security above 2^{128} ?

How many users will care
about performance of SHA-3?

Maybe 1/100 care about time.

Maybe 1/10 care about size.

CubeHash is the best choice
whenever size is critical.

Some other proposals

can fit into ≈ 10000 gates

if security is limited to 2^{128} .

The hardware cannot talk to

high-security protocols

that send 512-bit hashes.

Implementation nightmare,

as bad as having two SHA-3s.

Henzen–Kaeslin–Felber–
CubeHash8/1–512
530 gate equivalents,
larly appealing for
ght implementations.”
ting:
external memory”;
e functions only”;
ity compromises.
ough for almost all users.
one show me another
candidate that fits full
ality into this area?
security above 2^{128} ?

How many users will care
about performance of SHA-3?
Maybe 1/100 care about time.
Maybe 1/10 care about size.
CubeHash is the best choice
whenever size is critical.
Some other proposals
can fit into ≈ 10000 gates
if security is limited to 2^{128} .
The hardware cannot talk to
high-security protocols
that send 512-bit hashes.
Implementation nightmare,
as bad as having two SHA-3s.

Tiny AS
tiny Cub
tiny Cub
Same fe
on many
Microco
Limited
Limited
RAM co
ROM co
CubeHa

Shao-Ming Li, Felber–
SHA-3/1–512
equivalents,
waiting for
implementations.”

“memory”;
“only”;
promises.
most all users.

“me another
that fits full
this area?
above 2^{128} ?

How many users will care
about performance of SHA-3?
Maybe 1/100 care about time.
Maybe 1/10 care about size.
CubeHash is the best choice
whenever size is critical.

Some other proposals
can fit into ≈ 10000 gates
if security is limited to 2^{128} .
The hardware cannot talk to
high-security protocols
that send 512-bit hashes.
Implementation nightmare,
as bad as having two SHA-3s.

Tiny ASIC takes a
tiny CubeHash sta
tiny CubeHash coo
Same features help
on many other pla

Microcontroller? M
Limited RAM size
Limited ROM size
RAM competition
ROM competition

CubeHash fits an

How many users will care about performance of SHA-3?

Maybe 1/100 care about time.

Maybe 1/10 care about size.

CubeHash is the best choice whenever size is critical.

Some other proposals

can fit into ≈ 10000 gates

if security is limited to 2^{128} .

The hardware cannot talk to

high-security protocols

that send 512-bit hashes.

Implementation nightmare,

as bad as having two SHA-3s.

Tiny ASIC takes advantage of tiny CubeHash state *and* tiny CubeHash code.

Same features help CubeHash on many other platforms.

Microcontroller? No problem.

Limited RAM size? No problem.

Limited ROM size? No problem.

RAM competition? No problem.

ROM competition? No problem.

CubeHash fits anywhere.

How many users will care about performance of SHA-3?

Maybe 1/100 care about time.

Maybe 1/10 care about size.

CubeHash is the best choice whenever size is critical.

Some other proposals

can fit into ≈ 10000 gates

if security is limited to 2^{128} .

The hardware cannot talk to high-security protocols

that send 512-bit hashes.

Implementation nightmare,

as bad as having two SHA-3s.

Tiny ASIC takes advantage of tiny CubeHash state *and* tiny CubeHash code.

Same features help CubeHash on many other platforms.

Microcontroller? No problem.

Limited RAM size? No problem.

Limited ROM size? No problem.

RAM competition? No problem.

ROM competition? No problem.

CubeHash fits anywhere.