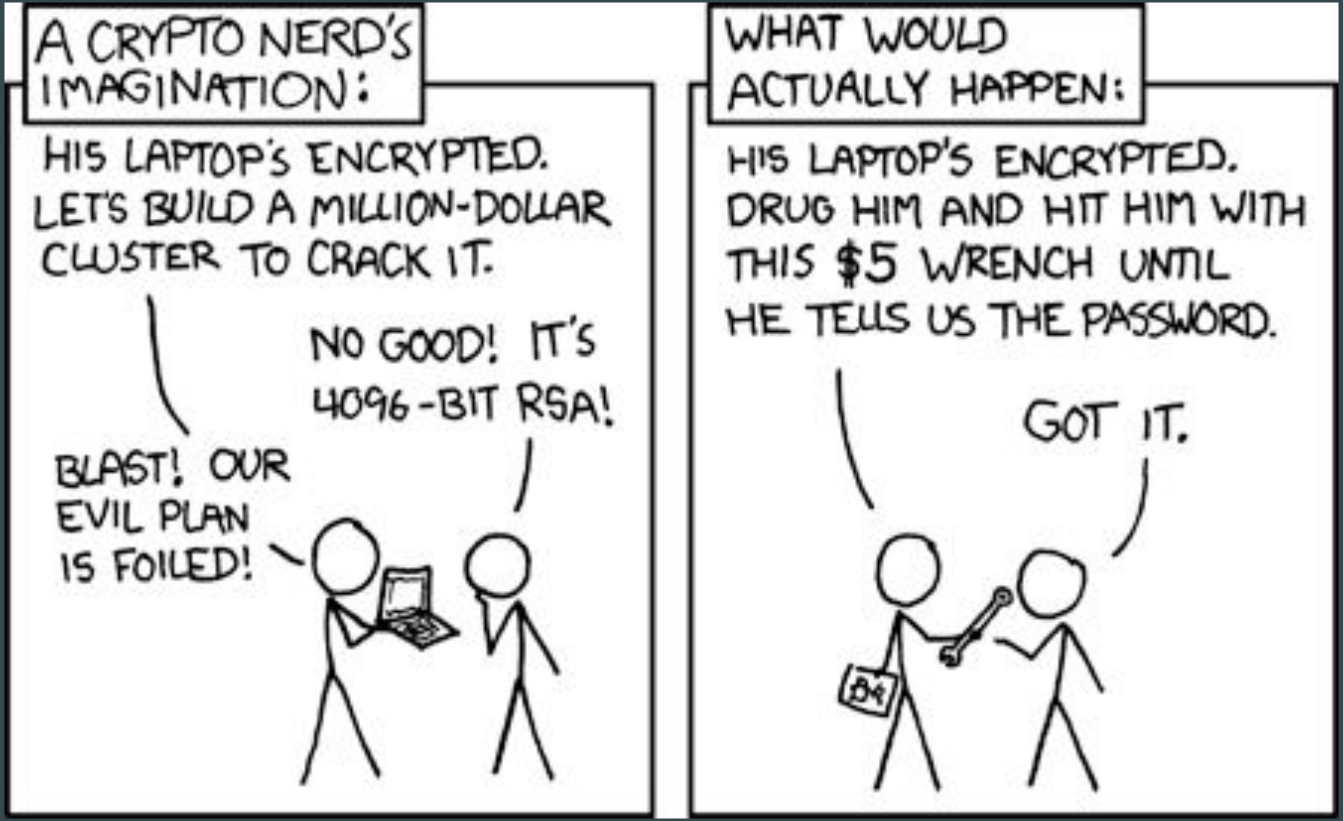

A CRYPTO NERD'S IMAGINATION:
HIS LAPTOP'S ENCRYPTED. LET'S BUILD A MILLION-DOLLAR CLUSTER TO CRACK IT.
NO GOOD! IT'S 4096-BIT RSA!
BLAST! OUR EVIL PLAN IS FOILED!
WHAT WOULD ACTUALLY HAPPEN:
HIS LAPTOP'S ENCRYPTED. DRUG HIM AND HIT HIM WITH THIS $5 WRENCH UNTIL HE TELLS US THE PASSWORD.
GOT IT.

@GusGorman... Because you asked so nicely!

Failings of the Public Key Infrastructure

•••

Jacob Mohrbutter (Qu3b4l1)

Philosophical Point of View

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    - Mainly low level stuff, C/C++, Assembly

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- The act of Designing Software is by its very nature anti-entropic. One takes data and orders it into the desired state
- A newly implemented software system exists at its most ordered state

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Philosophical Point of View: Maintenance

- Software, or a software system must meet the demands of the present
  - Fixing bugs introduces new states to a software system
  - News features have to be added to meet evolving demands
- By its very nature maintenance is entropic
  - It's not a linear decay, it's more exponential

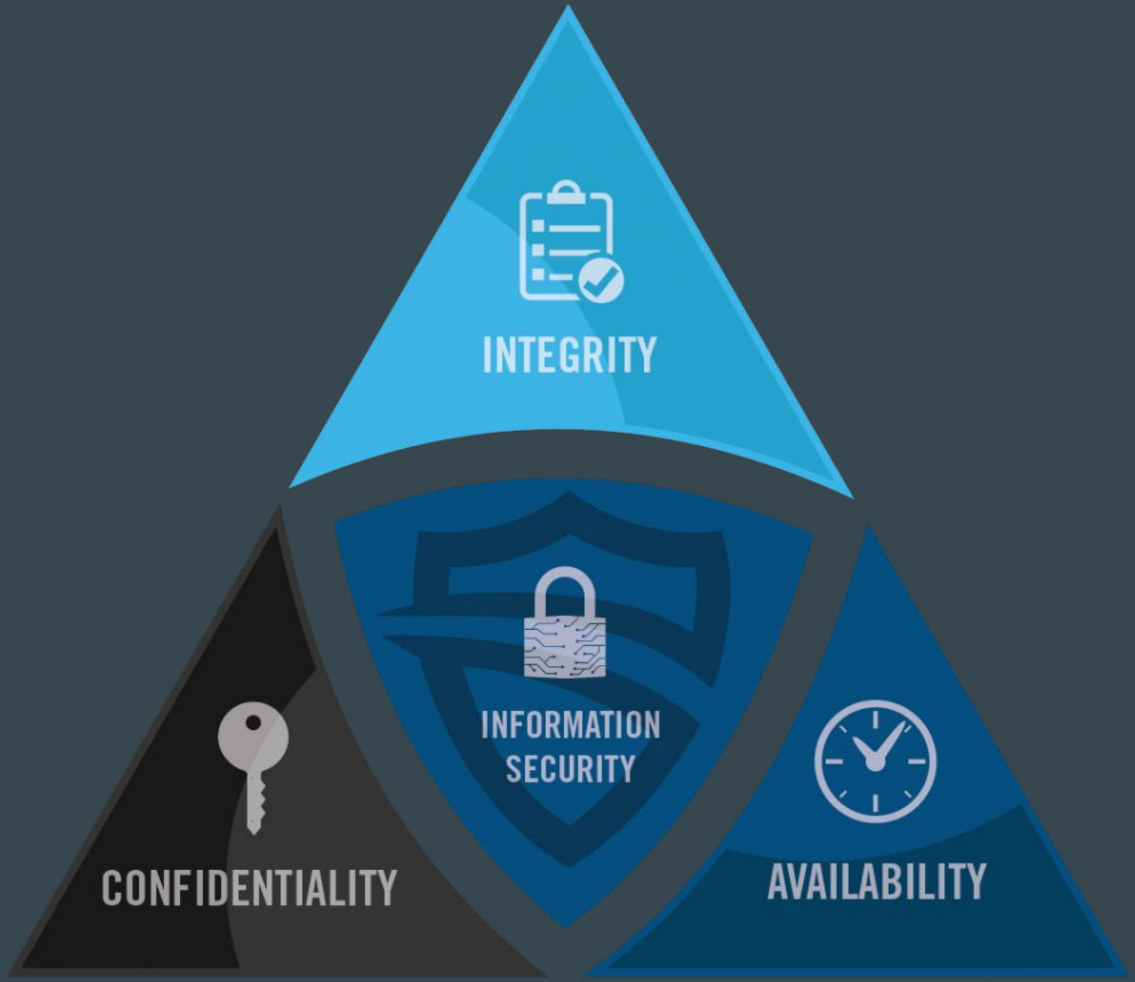
Philosophical Point of View: Obsoletion

- There comes a point where Maintenance becomes the act of deteriorating the functionality of a piece of software, or a software system

The CIA triangle

Integrity implies authenticity

Maybe the original designers of ssl took that into account



The CIA triangle

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INTEGRITY
SECURITY
CONFIDENTIALITY
AVAILABILITY

> “That whole authenticity thing, Yeah we just threw that in at the end”
>
> --Moxie Marlinspike

Certificate Revocation Lists (CRL’s)

Certificates need to be revoked some times.

How did we deal with this?

Hmm what if we DDOS that certificate authority!

RFC-5280: Certificate Revocation Lists

“

When there are no revoked certificates, the revoked certificates list MUST be absent.

Otherwise, revoked certificates are listed by their serial numbers. Certificates revoked by the CA are uniquely identified by the certificate serial number. The date on which the revocation occurred is specified. The time for revocation Date MUST be expressed as described in Section 5.1.2.4. Additional information may be supplied in CRL entry extensions; CRL entry extensions are

”

discussed in Section 5.3.

RFC-5280: Certificate Revocation Lists

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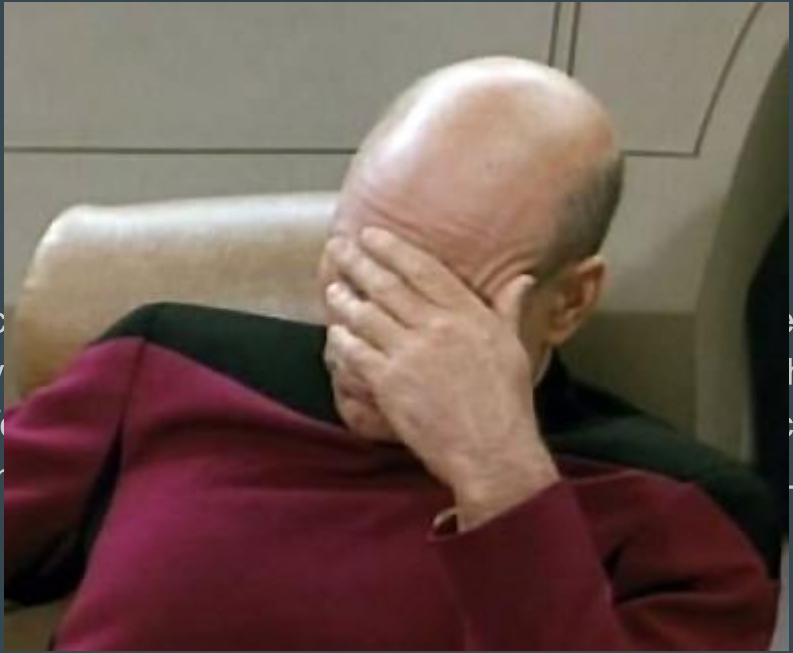

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discussed in Section 5.3.

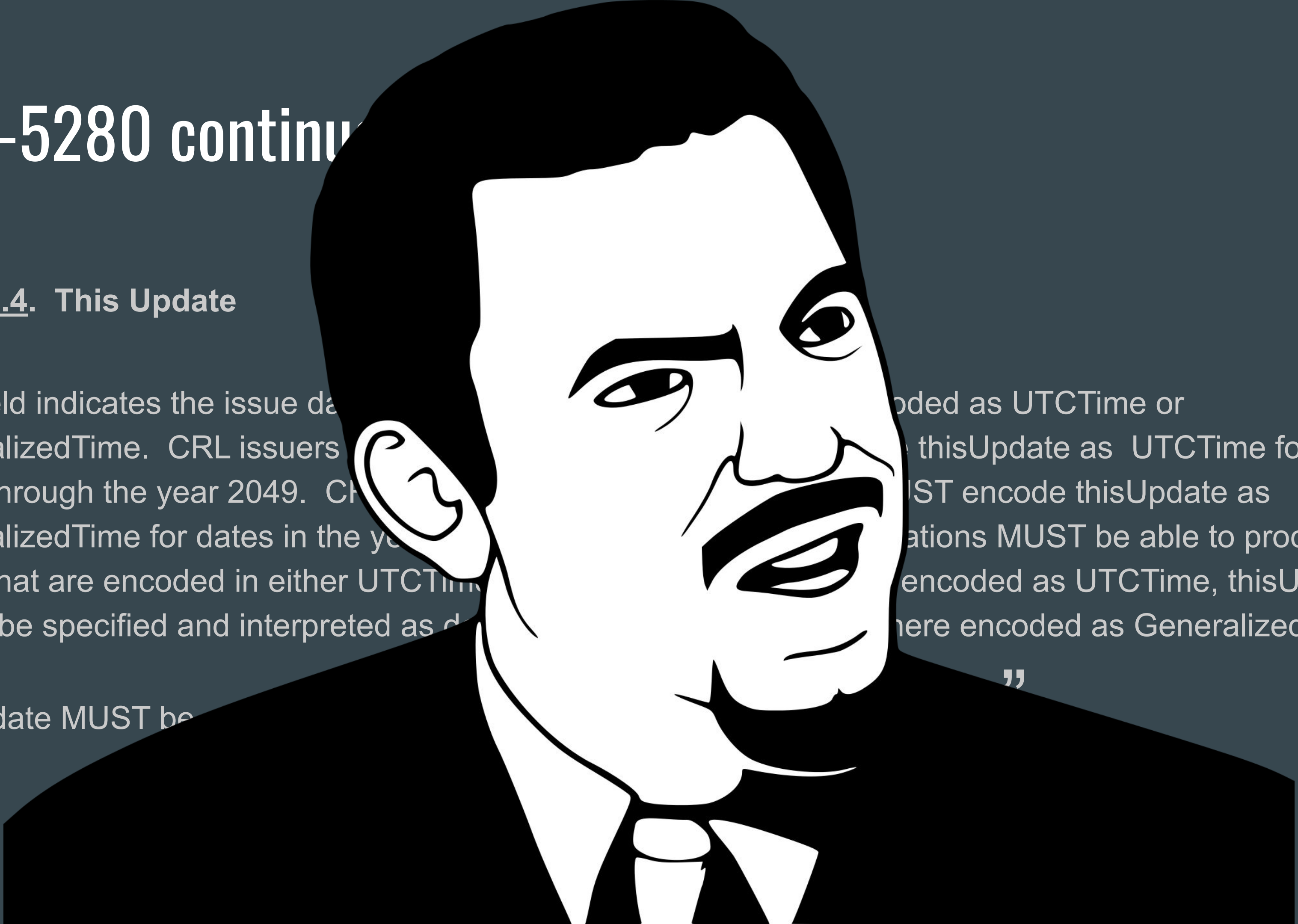
RFC-5280 continued

> “
> **5.1.2.4. This Update**
>
> This field indicates the issue date of this CRL. thisUpdate may be encoded as UTCTime or GeneralizedTime. CRL issuers conforming to this profile MUST encode thisUpdate as UTCTime for dates through the year 2049. CRL issuers conforming to this profile MUST encode thisUpdate as GeneralizedTime for dates in the year 2050 or later. Conforming applications MUST be able to process dates that are encoded in either UTCTime or GeneralizedTime. Where encoded as UTCTime, thisUpdate MUST be specified and interpreted as defined in Section 4.1.2.5.1. Where encoded as GeneralizedTime,
>
> thisUpdate MUST be specified and interpreted as defined in Section 4.1.2.5.2.”

RFC-5280 continu

> “
> 5.1.2.4. This Update
>
> This field indicates the issue da oded as UTCTime or GeneralizedTime. CRL issuers e thisUpdate as UTCTime for dates through the year 2049. C ST encode thisUpdate as GeneralizedTime for dates in the ye ations MUST be able to process dates that are encoded in either UTCTim encoded as UTCTime, thisUpdate MUST be specified and interpreted as d here encoded as GeneralizedTime,
> ”

thisUpdate MUST be



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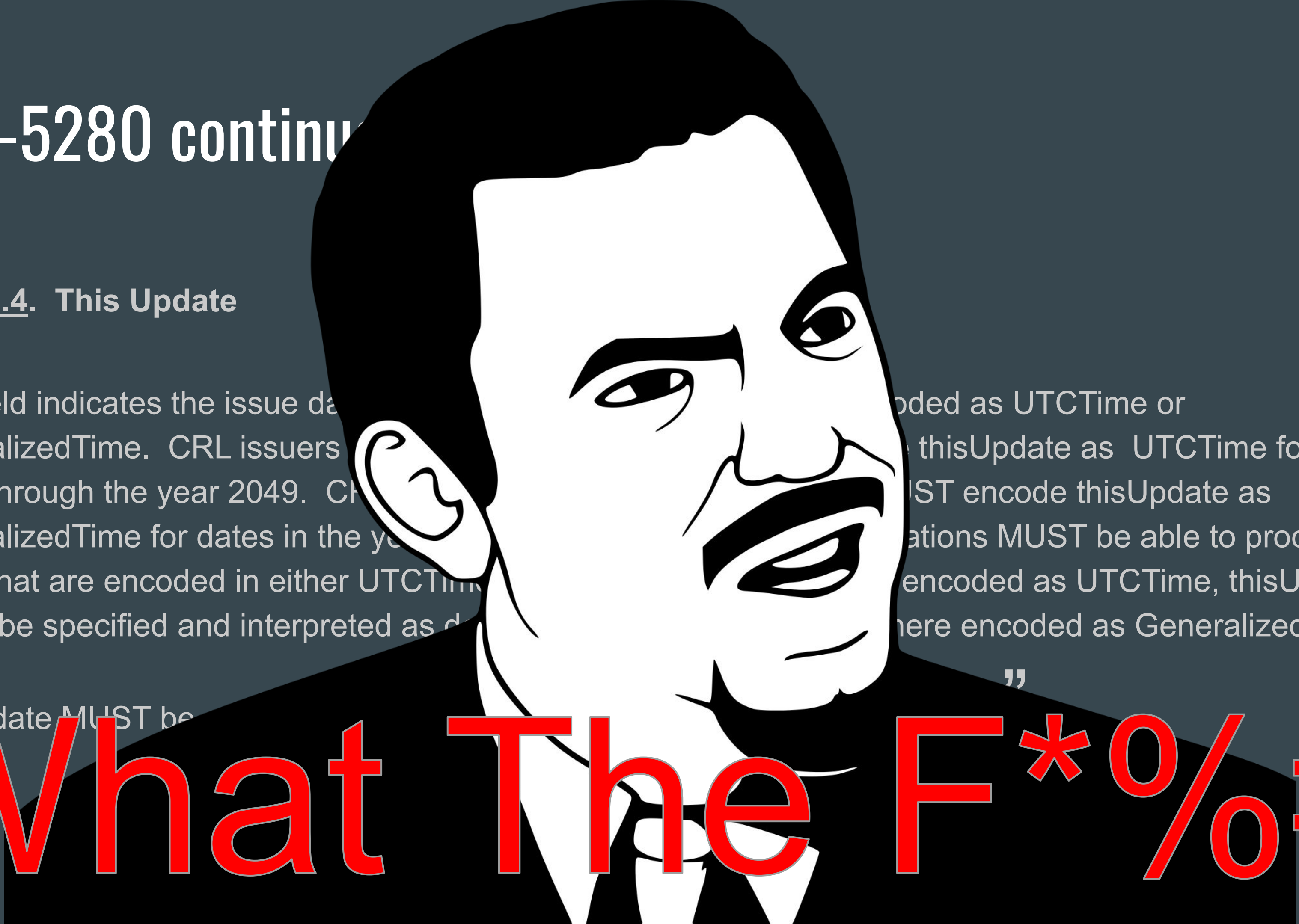

Philosophical Point of View Revisited

- Programmers are happy to fill in the blanks
    - If the spec is not written well, no one will be working under the same assumptions
- Specifications need to be written so that there is no underlying assumptions needed
- Communication, or lack thereof, breaks shit

Somehow this all worked up until ~2011

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map of certificate authorities in ~2010

Stuxnet - Was a valid Realtek device driver from January 25th, 2010 to July 22nd, 2010

Flame - Had a valid certificate from December 28th, 2010 to june 4th, 2012

Oh.. and then We have the CA’s themselves

Comodo: private keys compromised in 2012 by “Nation State actors”… cough cough, script kiddie, cough.

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Diginotar, compromised July 10th, 2011. Removed as a trusted root CA September 2nd, 2011 after issuing 531 invalid certificates.

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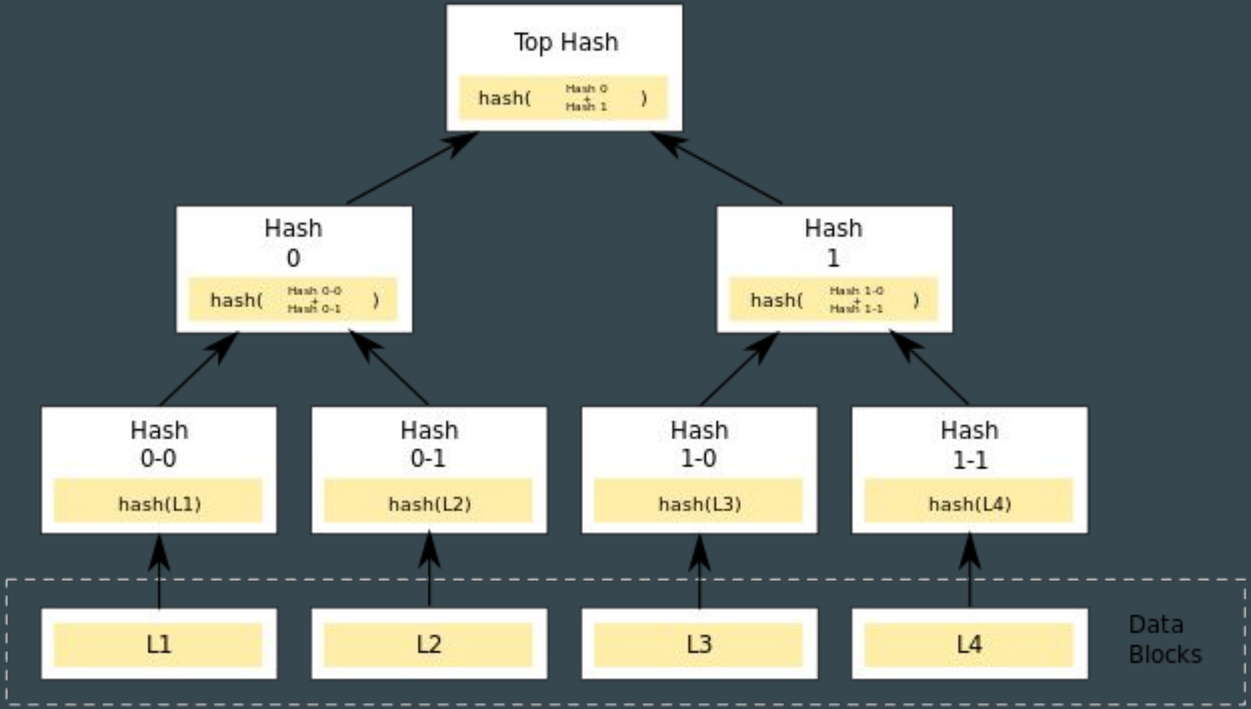
Thus we have Certificate Transparency 2011

Certificate Transparency

Collect certificates



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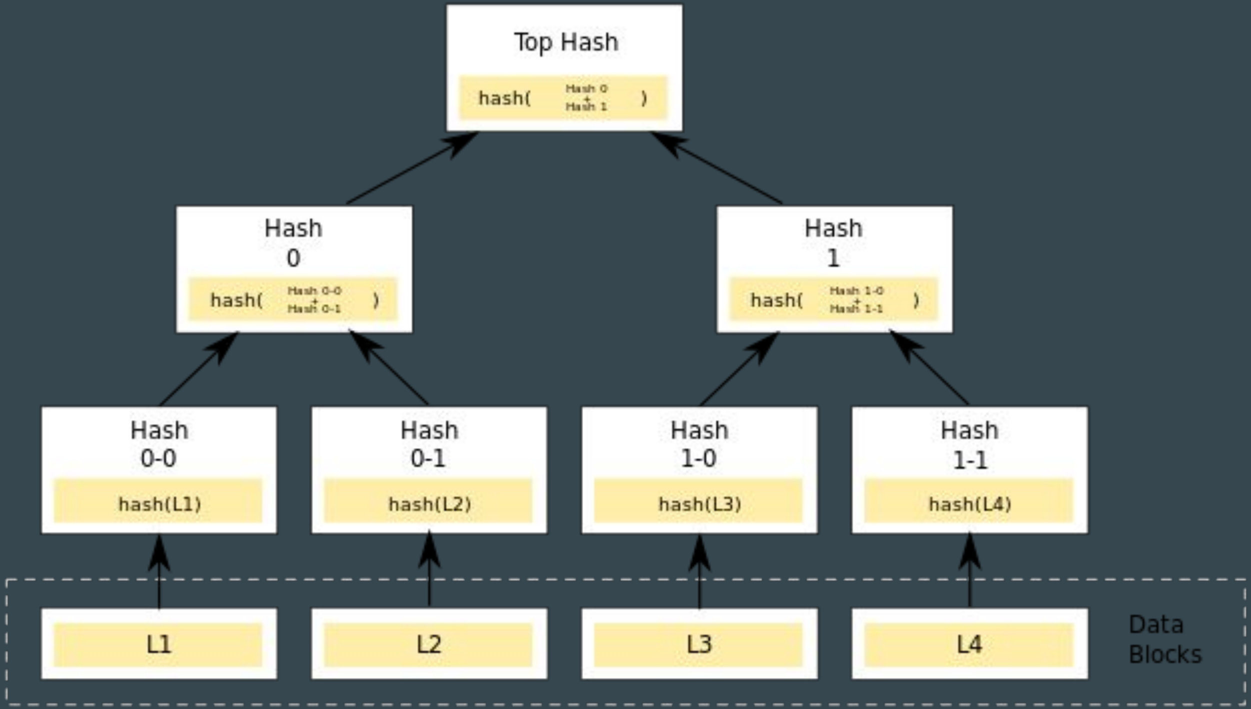

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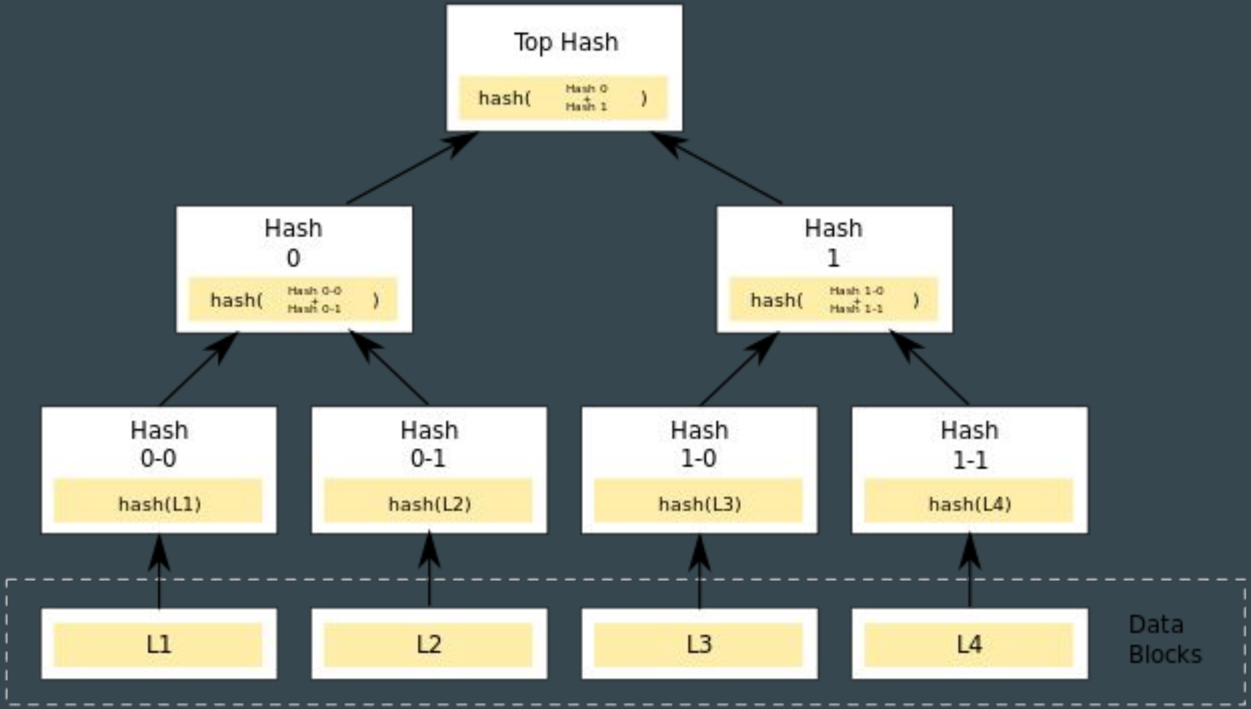

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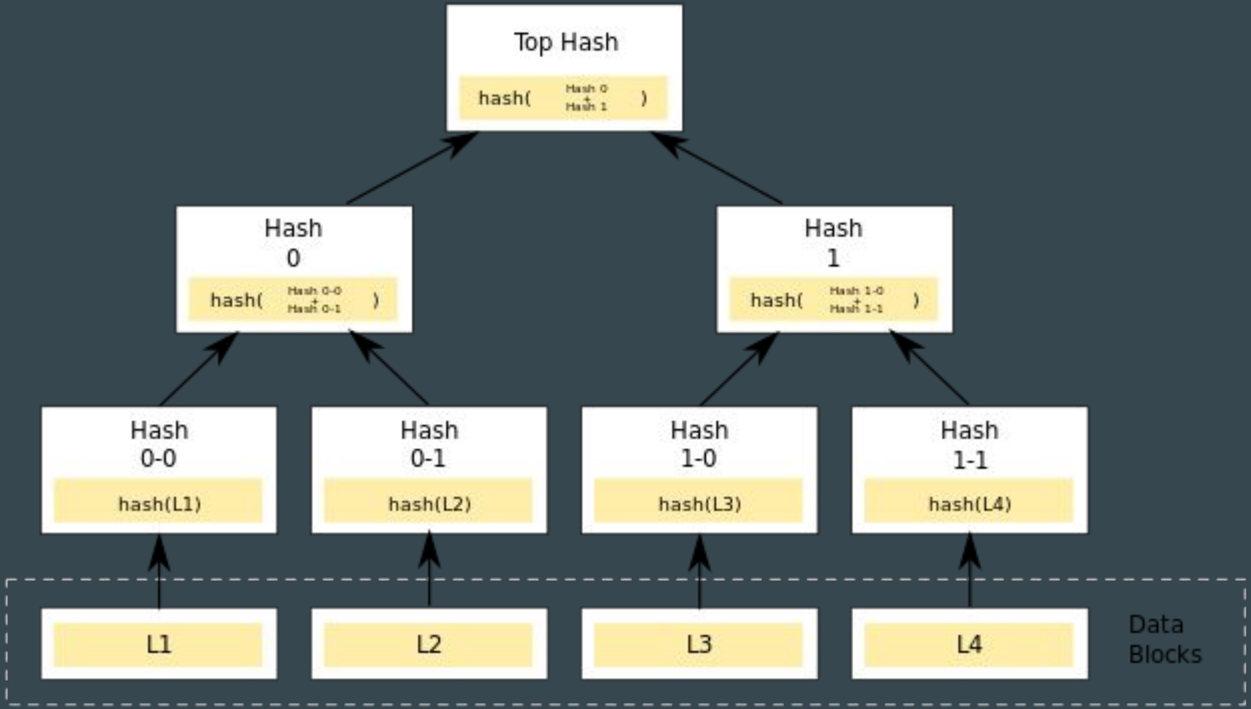

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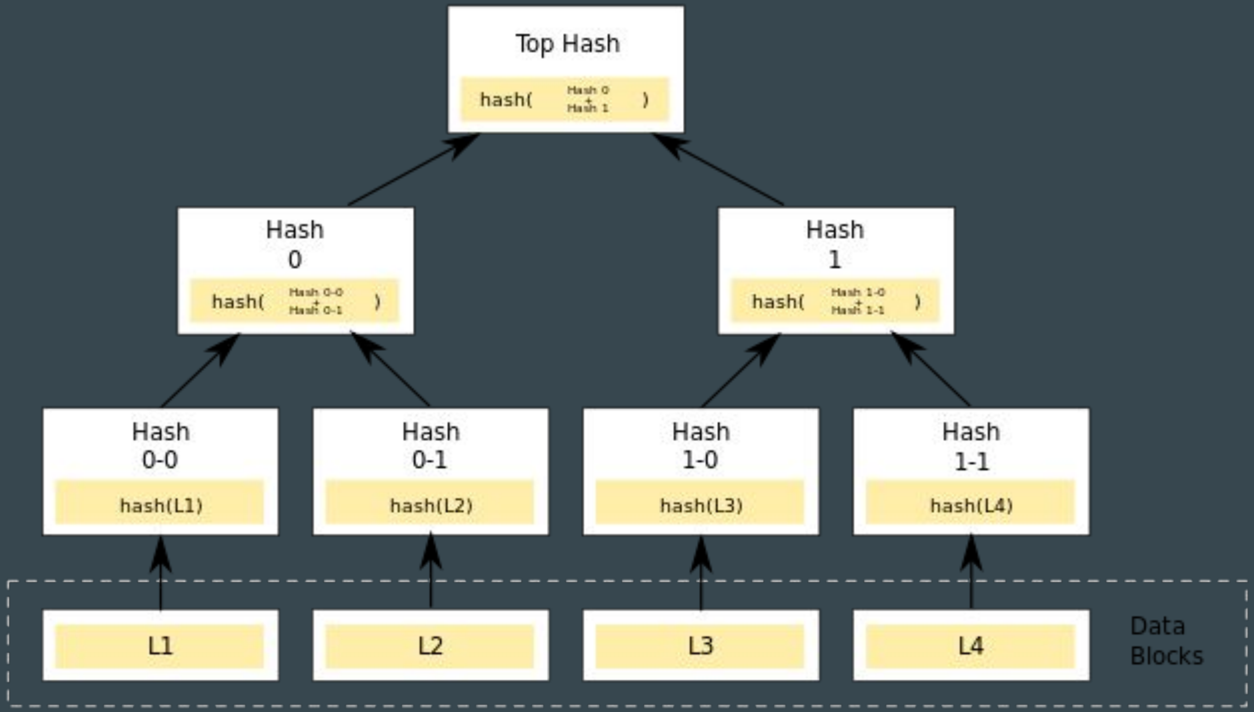

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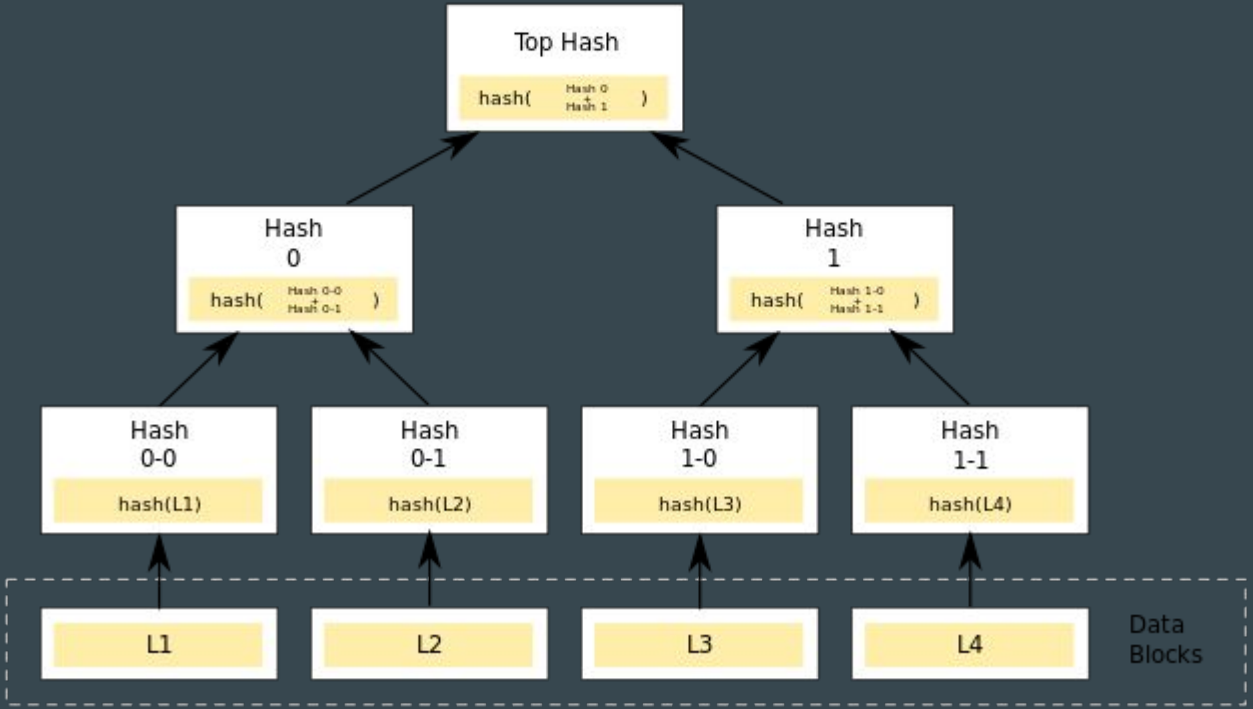
SCT acts to locate the specific entry



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Auditing becomes easier and visibility within the public key infrastructure is increased.

WOHOOO! PROBLEM SOLVED
TIME TO GO HOME!
makeameme.org

But wait, We can fuck with this

Lets execute a split-world attack

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Attacker gets a valid certificate

Attacker submits certificate to the certificate log and gets a SCT

Attacker sends victim the certificate and SCT.

The victim can’t see that a revocation was made in a future log because they have a valid but fraudulent SCT

Back to square one

Well, I think it's fairly obvious, there's no way forward without scraping the whole thing.

There are takeaways from this system. Maybe some important design considerations for a next generation public key infrastructure.

Design Considerations

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The current cryptographic functionality of the public key infrastructure should be maintained. This does not mean it’s bolted on, it needs to be an integrated member of the design.

Thank You for putting up with me for this long

I allude to a viable solution in my paper while addressing a few more design considerations

https://github.com/Qu3b411/Failings-of-the-Public-Key-Infastructure/

Ping me on slack and let me know what you thought!

@Qu3b411