Private SCT Auditing, Revisited

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November 20, 2025

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- instead of trusting one CA: Trust two logs
- more logs in the future: back to the start?

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- Can we do better (e.g., PIR?)
  Earlier analysis suggests this is impractical

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2. revisiting SCT auditing with concrete requirements for PIR, and how the state of the art fulfills our requirements
3. Benchmarks with ideas on database management to get an efficient PIR lookup
4. Batching audits at little to no cost to scale to audits under 100 kB per day

Preliminaries

Certificate Transparency

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- domain owners can monitor logs to check for misbehaviour

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  $\rightarrow$ persist-and-retry mechanism

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- PIR protocols improved: more efficient, single-server protocols
- Can we do a lookup by sequence number and get the hash as a response?

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- Chrome says ML-DSA-44 is undeployable

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- When is a new certificate needed immediately?

Scenarios for immediate issuance

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2. **Validity Gaps** from configuration errors. Hopefully disappears over time.
3. **Urgent Re-Issuance** when a domain is moved on short notice, e.g., because of a DDoS attack.

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2. Supporting without getting reliable updates, falls back more often when becoming stale
3. No support, requires the fallback mechanism every time

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- Brand new domains: $\approx$ 95 000 new domains

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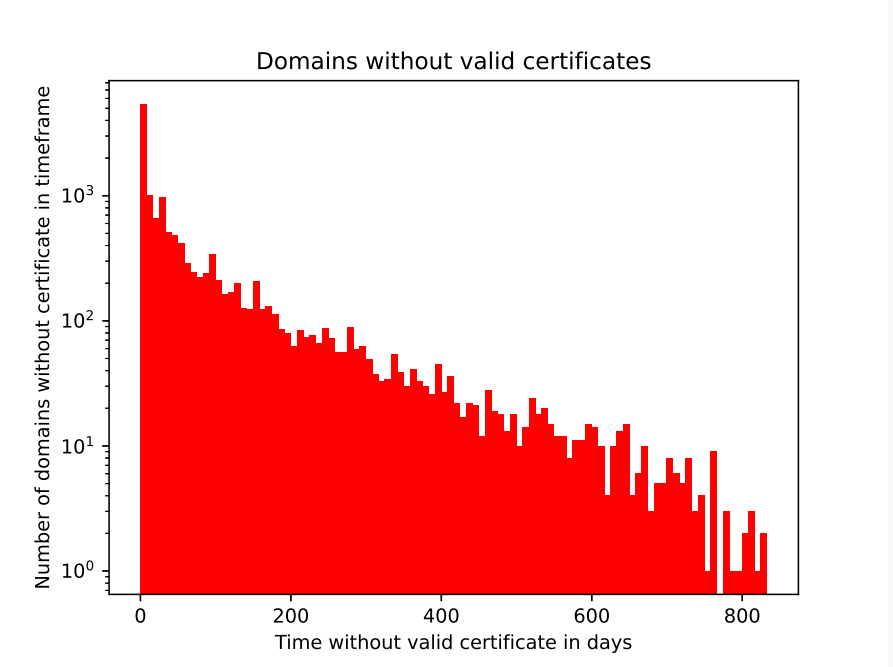

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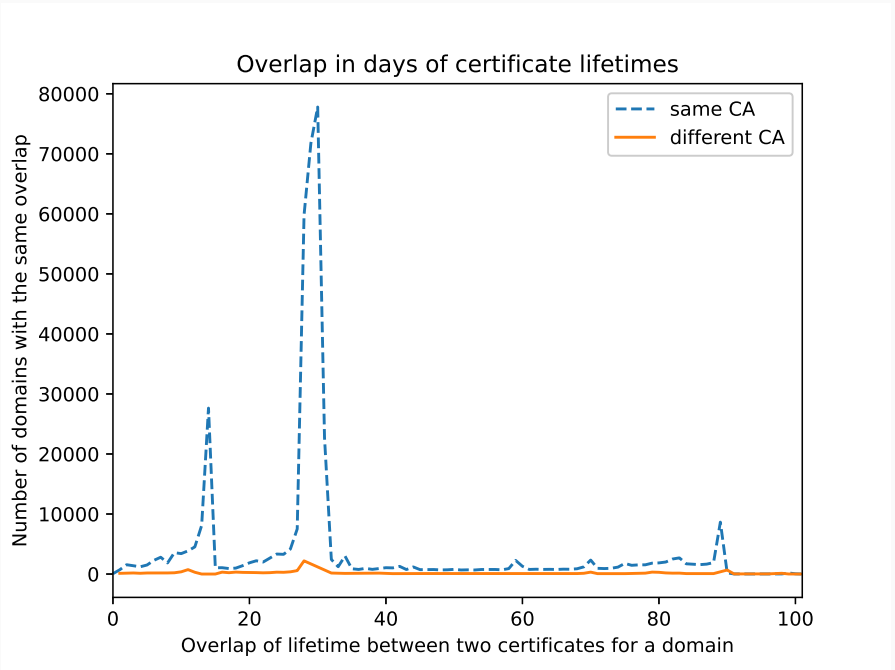

Towards Fully Private Auditing

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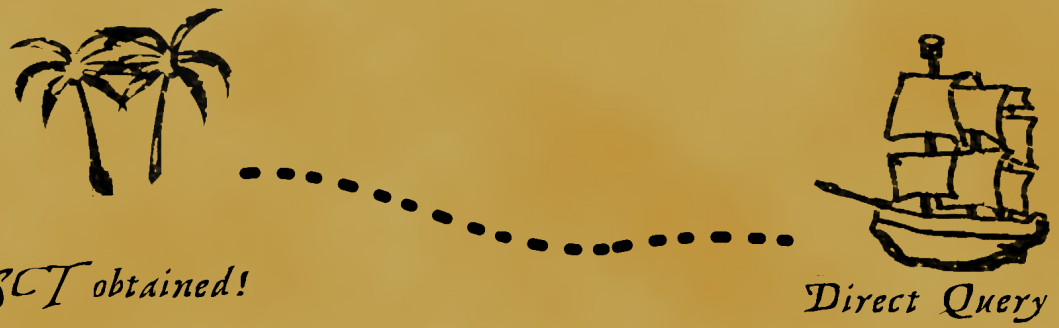
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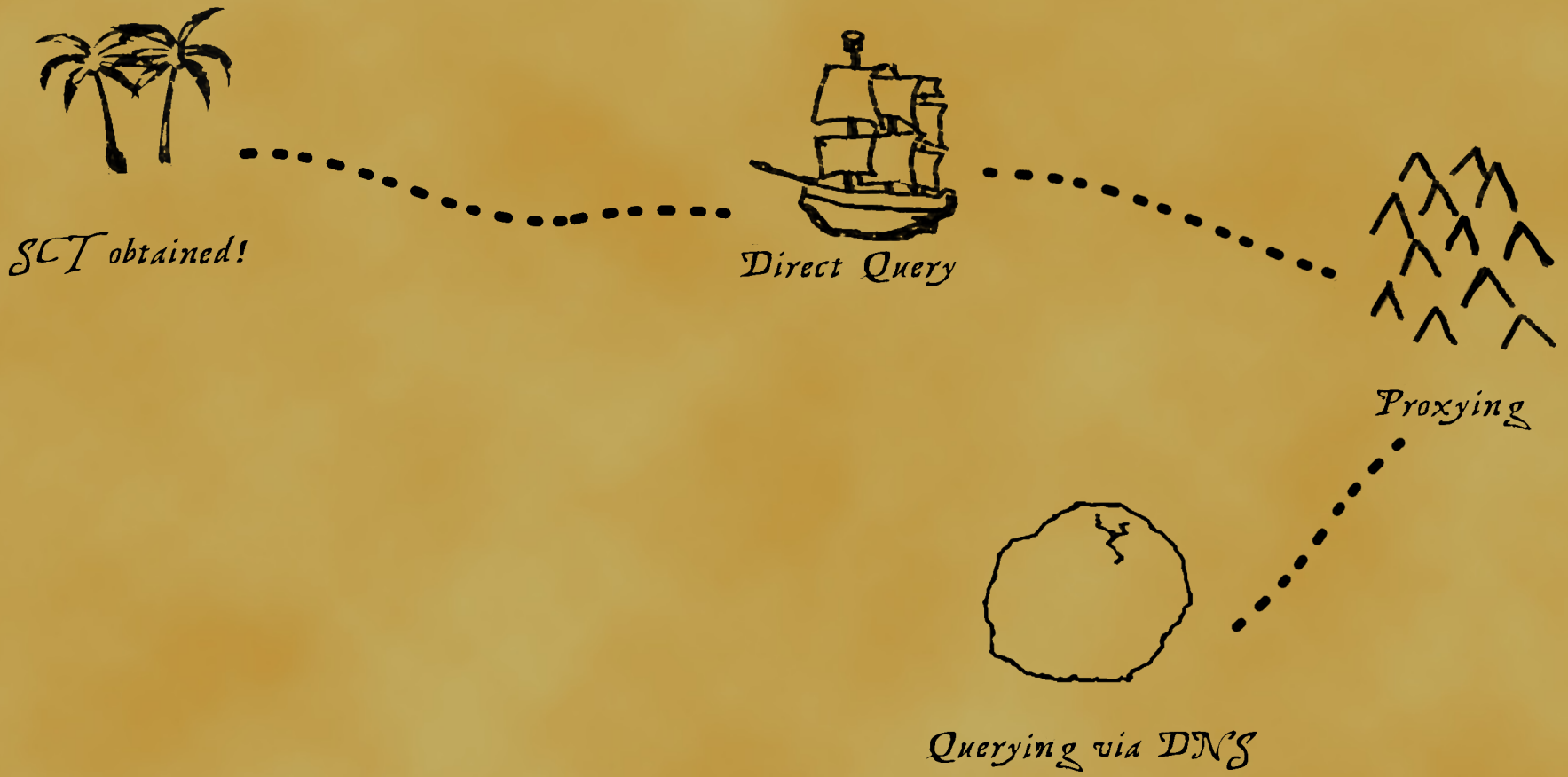
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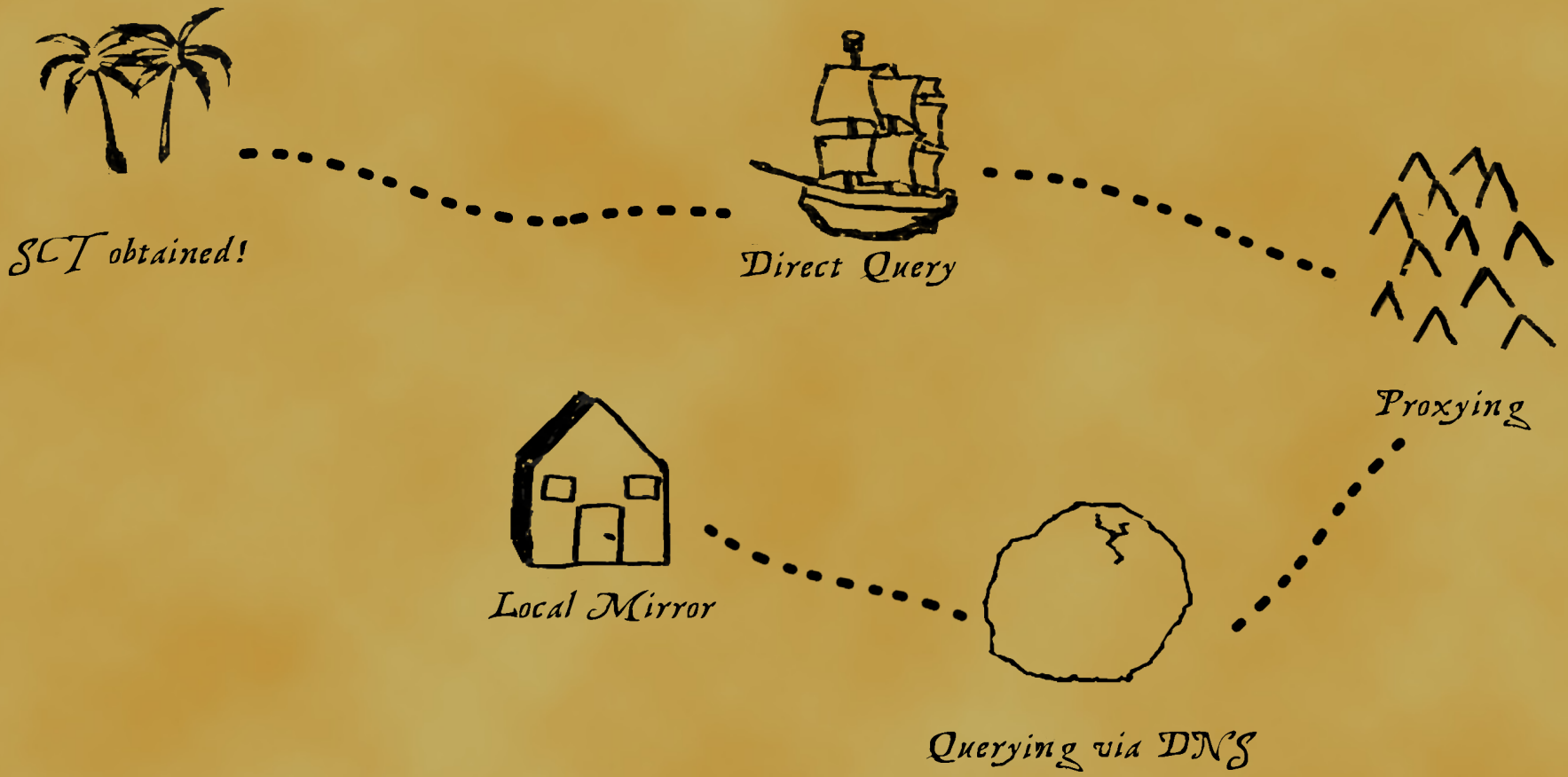
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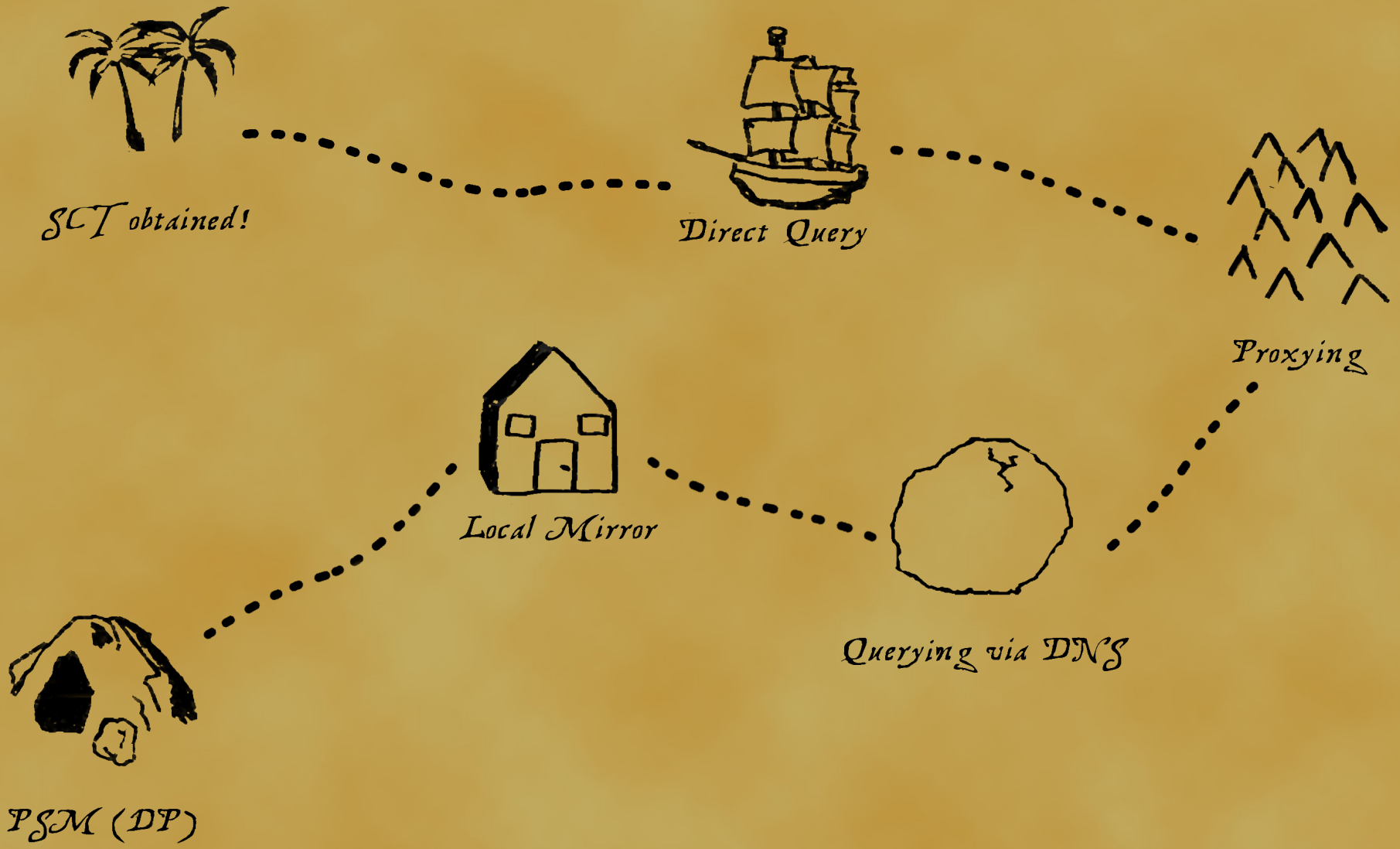
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- YPIR uses an algebraic transformation between RLWE and LWE, tiny responses

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- shard database for better performance

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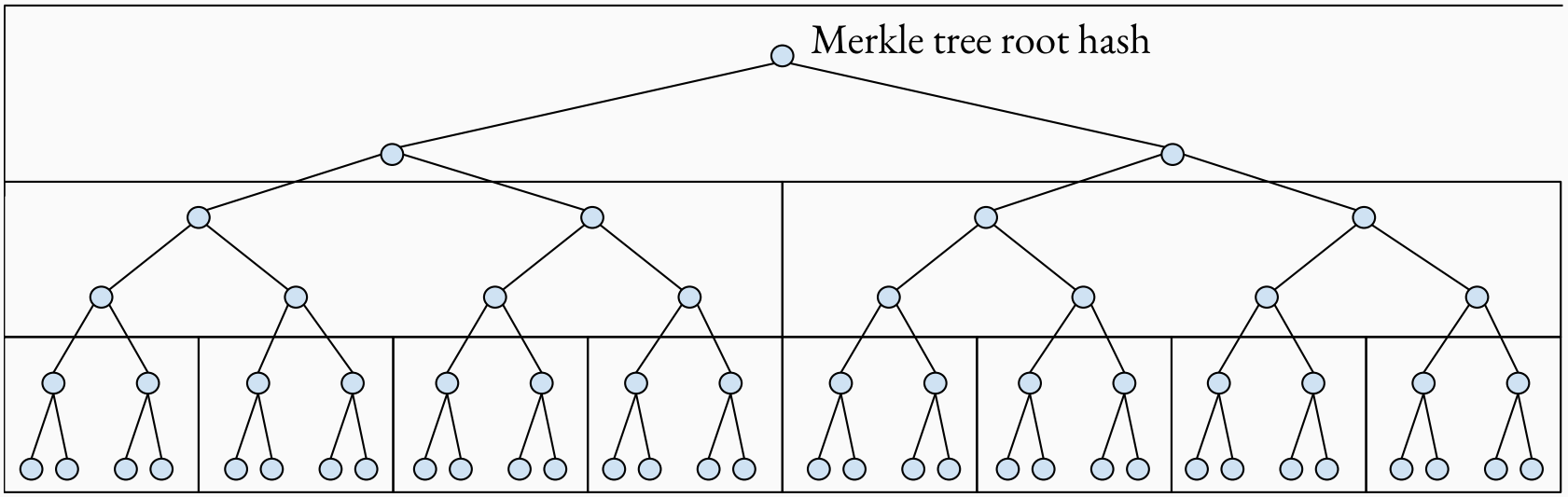
- $2^{15.5}$ to $2^{23.5}$ database records (2 levels up, one level up)



Each rectangle represents a tile with a height of 2, containing up to 6 hashes

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Sharding by Epoch:

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- especially interesting for the fast-issuance fallback case

Benchmarks

Database parameters	Scheme	Request Size	Response Size
$\lvert DB\rvert = 2^{31.5}$ $\lvert r\rvert = 1$	plain YPIR	735 kB	12 kB
$\lvert DB\rvert = 2^{15.5}$ $\lvert r\rvert = 256$	SealPIR $d = 1$	**46 kB**	46 kB
	SealPIR $d = 2$	93 kB	185 kB
	Hintless PIR	370 kB	5.9 MB
	YPIR-SimplePIR	932 kB	**12 kB**
$\lvert DB\rvert = 2^{15.5}$ $\lvert r\rvert = 131072$	SealPIR $d = 1$	-	-
	SealPIR $d = 2$	-	-
	Hintless PIR	-	-
	YPIR-SimplePIR	932 kB	61 kB
$\lvert DB\rvert = 2^{17}$ $\lvert r\rvert = 256$	SealPIR $d = 1$	**46 kB**	46 kB
	SealPIR $d = 2$	93 kB	186 kB
	Hintless PIR	371 kB	6.0 MB
	YPIR-SimplePIR	1.4 MB	**12 kB**

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  expansion is linear

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- retrieving sums: AdHASH map needs to be collision resistant(against published hashes)
- Wagner's algorithm: Collisions in $O(k2^{\frac{n}{2+\lg k}+1})$ for k elements
- unclear if the attack is optimal: lower bound is $\Omega(2^{\frac{n}{2k}})$

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- e.g. $x^i + x^j + x^k \to -2x^i + 5x^j + x^k$

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    - blocked traffic/captive portals
    - reporting open problem: actionable and concrete evidence of log's misbehavior