Logging System for Long-lifetime Data Validation

Yingdi Yu
UCLA

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- Lifetime of a signing key
  - must be limited

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- Re-sign data with a new key
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- Re-sign data with a new key
  - maintenance is complicated
    - key rollover
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- Can we sign data once and leave it alone?
  - post-fact validation
    - validate data with an expired key?

Post-Fact Validation

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- Check if the signature was generated during the valid period of the key
- Can we have a time machine to go back?
  - a logging system may help!

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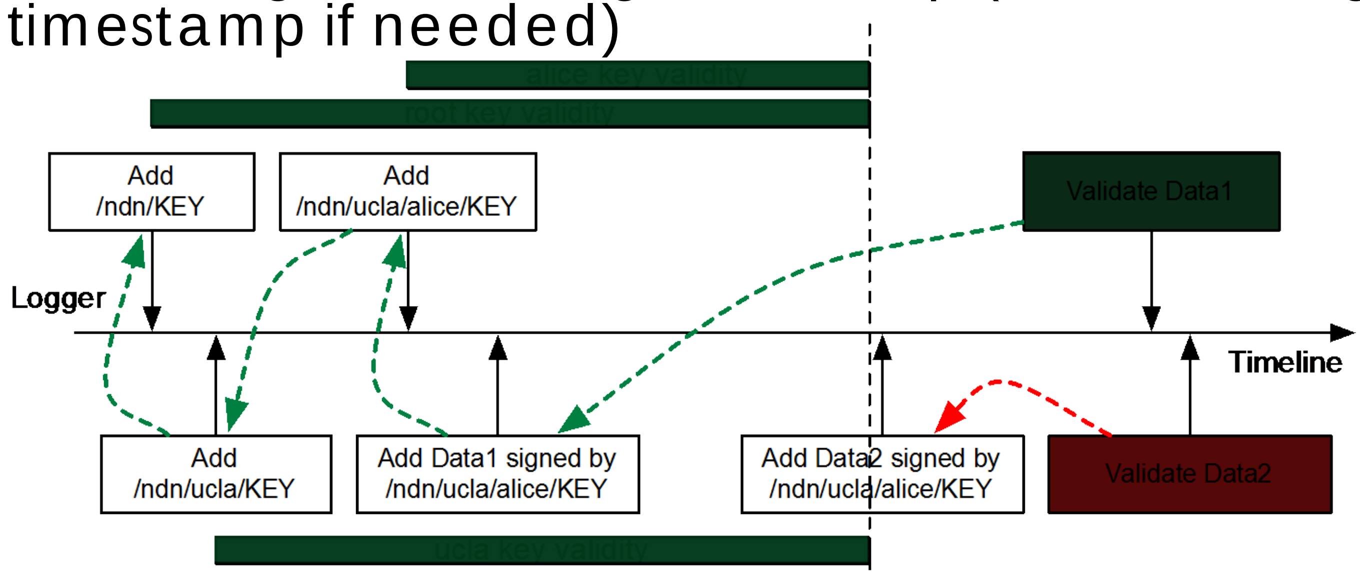

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  - tamper-evident log

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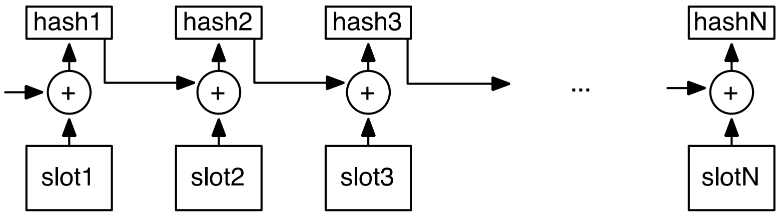

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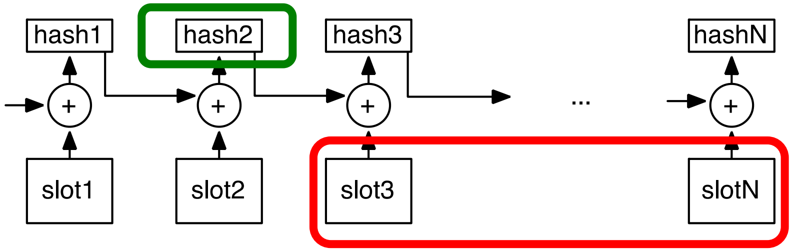

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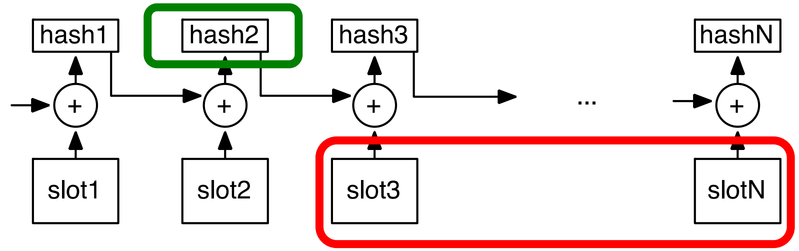

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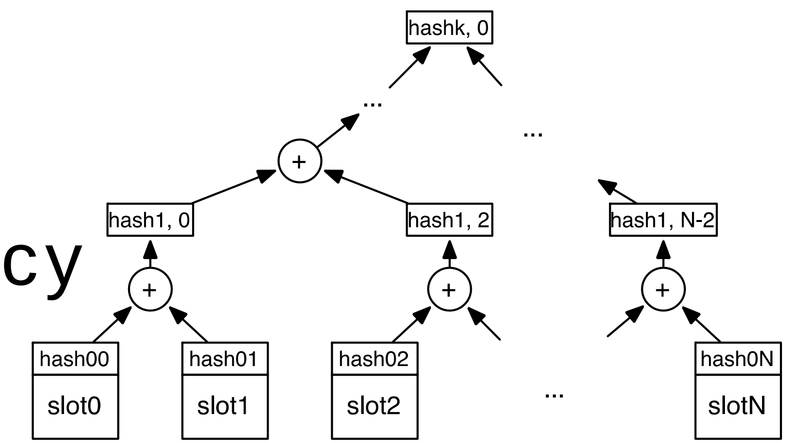

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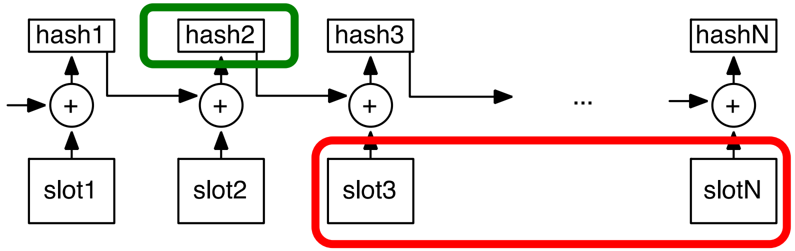

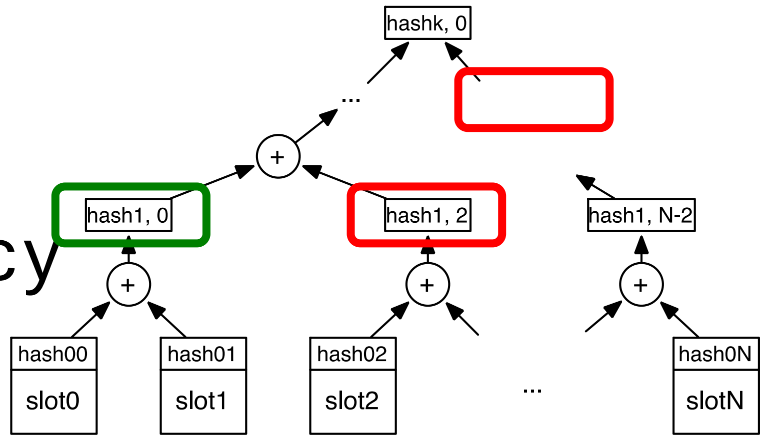

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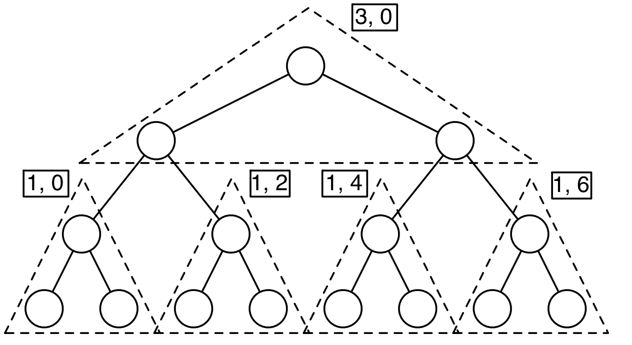

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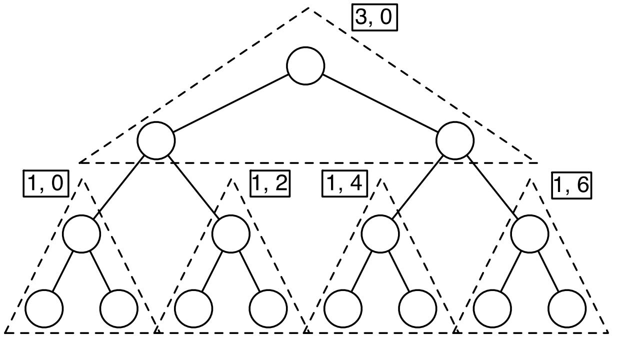

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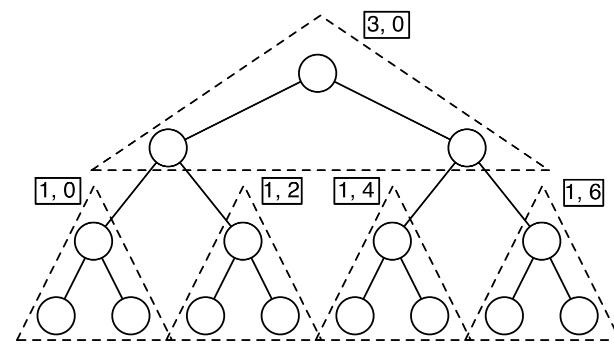

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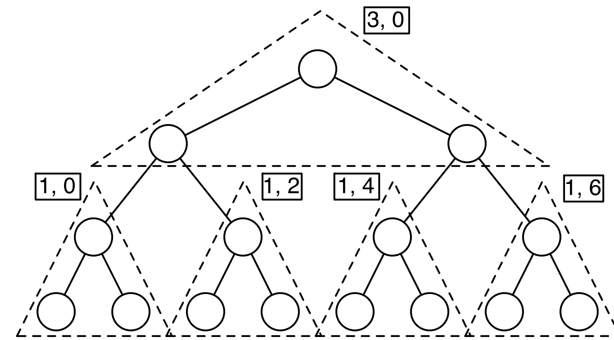

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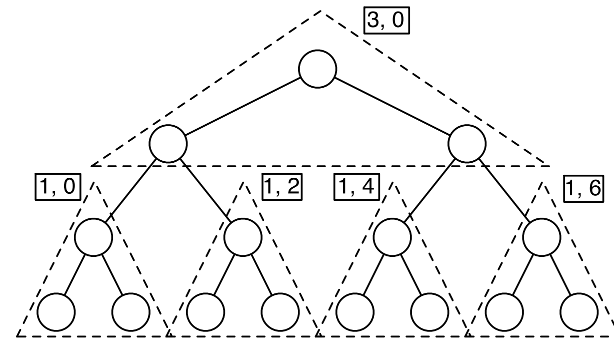

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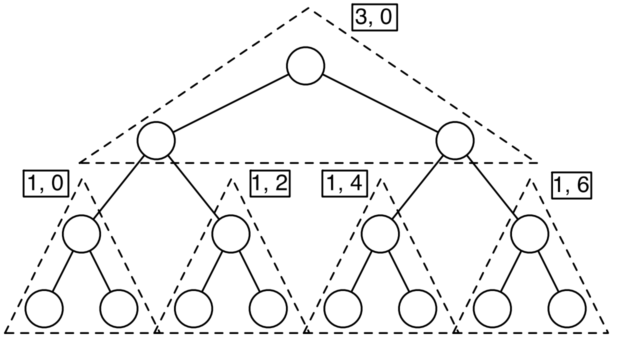

- Encode each sub tree in a data packet
  - name: /<loggerPrefix>/[subTreeIndex]/[digest]
  - content: node digests in BFS order
- Leaf node
  - name: /<loggerPrefix>/leaf/[seqNo]
  - detailed info (signed data, timestamp…)

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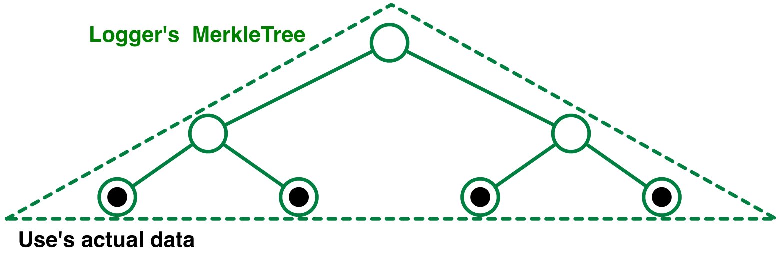

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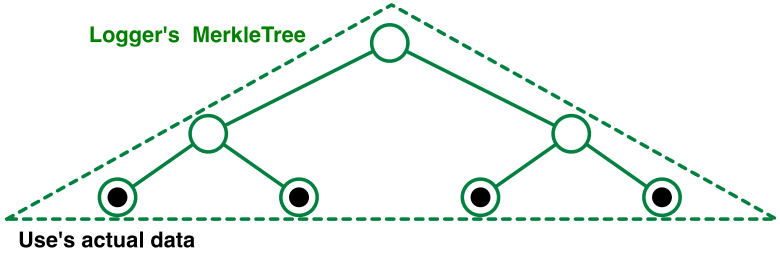

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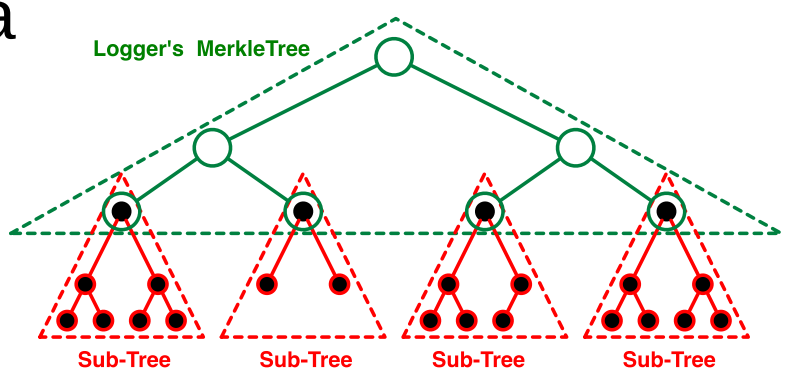
  - Users maintain actual data
    - no need to retrieve log for unavailable data
- User cannot change actual data
  - digest is fixed in log
- Users may even keep a sub-tree
  - contain a user's own data
  - could be incomplete
  - root digest is fixed in log



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- Loggers synchronize with each other
  - improve redundancy
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  - using/extending ChronoSync
    - each logger has its own prefix & seqNo

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- A hash function may be broken eventually
- Two copies using different hash functions
  - one is relatively stronger than the other
    - e.g., Sha256(B), Sha3-384(B)
  - assume: not broken on the same day
    - weaker broken, stronger still valid
    - enough time to reconstruct another copy with a stronger hash at that time
    - hopefully, it rarely happens

Conclusion

- logging system enables
  - post-fact validation
  - usage of short-lived keys
- Secure logging system through public auditing
- Increase redundancy of certificate provisioning

Thank you!

yingdi@cs.ucla.edu