Towards End-to-End Encrypted Calendars

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Joint work with Tomás Bertoli (UBA), Benjamin Dowling (KCL) and Simone Colombo (KCL)

Cryptographic Applications Workshop 2026

Hot takes 🌶️🔥

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- Natural question: Is CSS cryptographically usable? Can it improve my daily life?
- My favourite activity: ~~doomscrolling~~ checking my work calendar

CalDAV

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- An extension of WebDAV, a storage-over-HTTP protocol (RFC 4918)
- Rich functionality:
  - Multiple calendars per account
  - Text search, range queries, free/busy view of other users, RSVP

CalDAV overview

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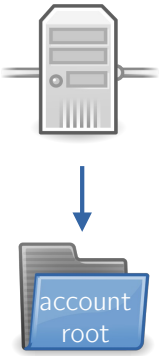

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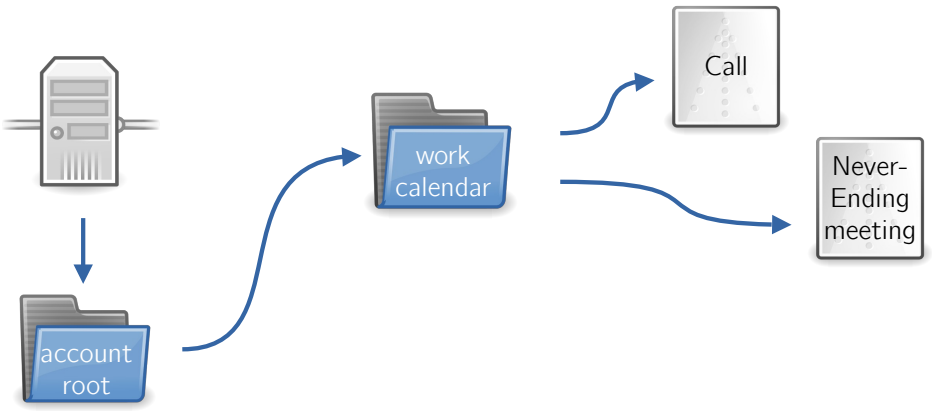

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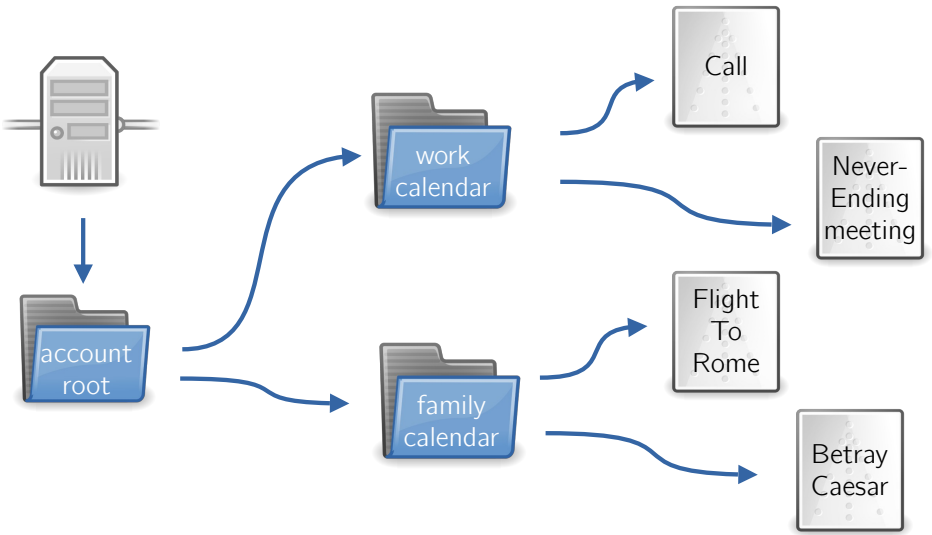

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  - WONTFIX, github.com/tutao/tutanota/issues/1470
  - In practice, at most, events disappear, a trivial denial-of-service

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- Working on implementation, paper is WIP

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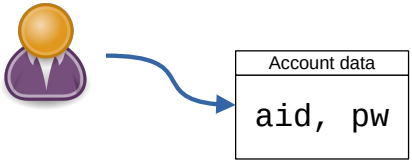

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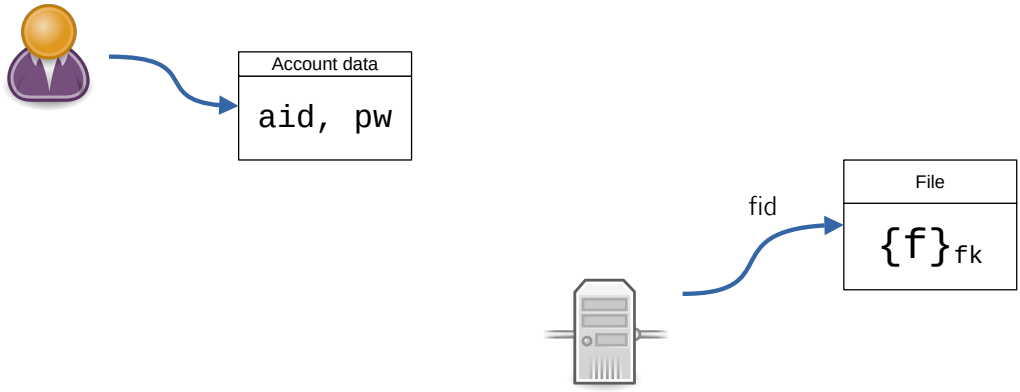

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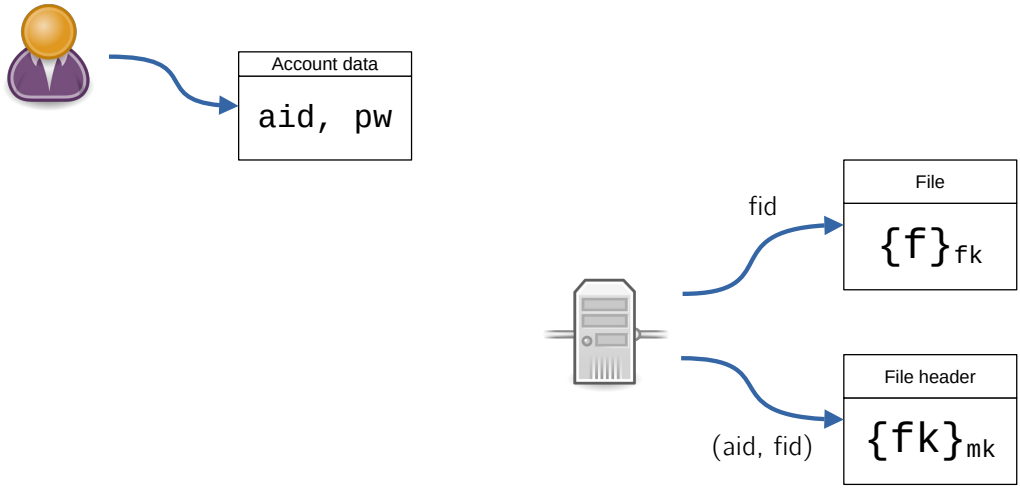

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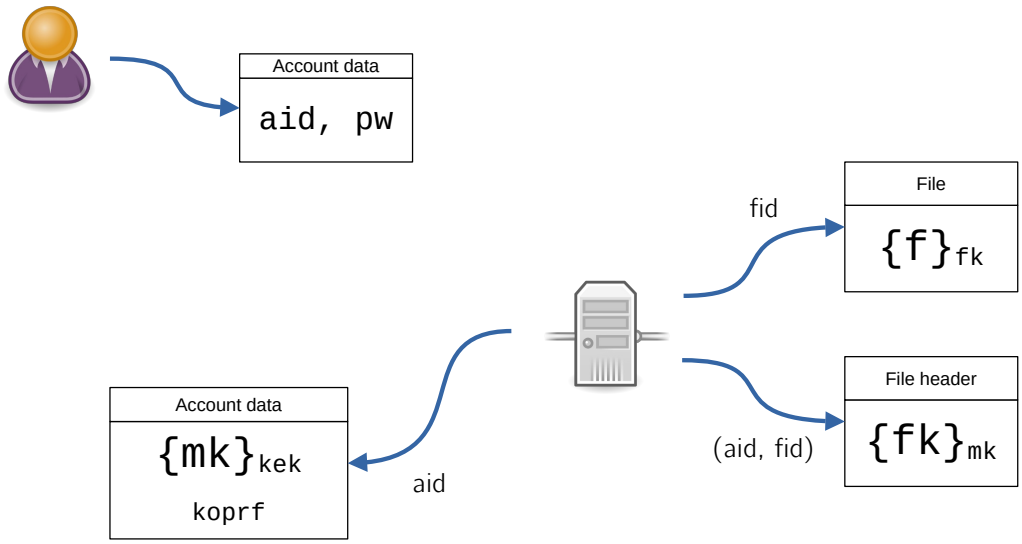

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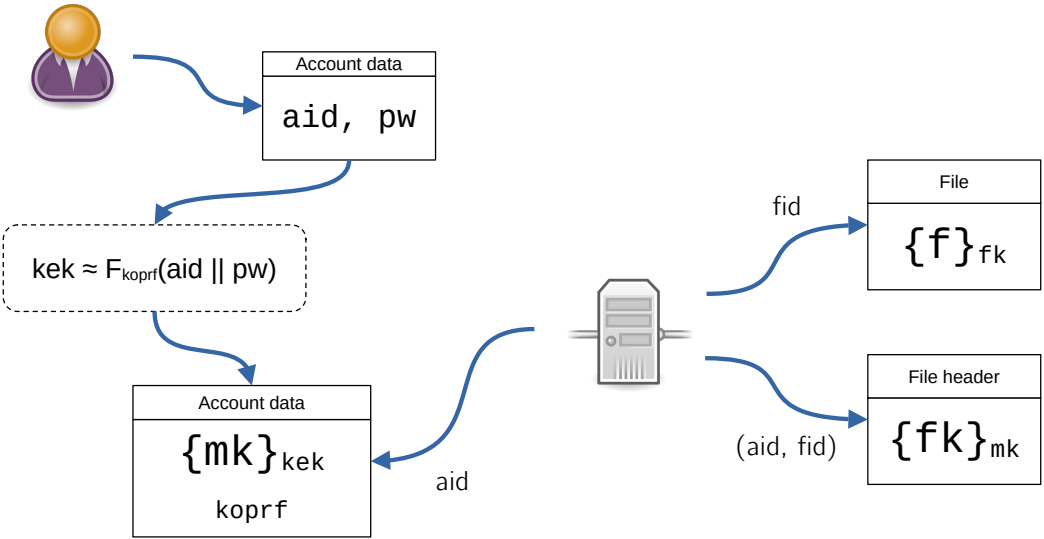

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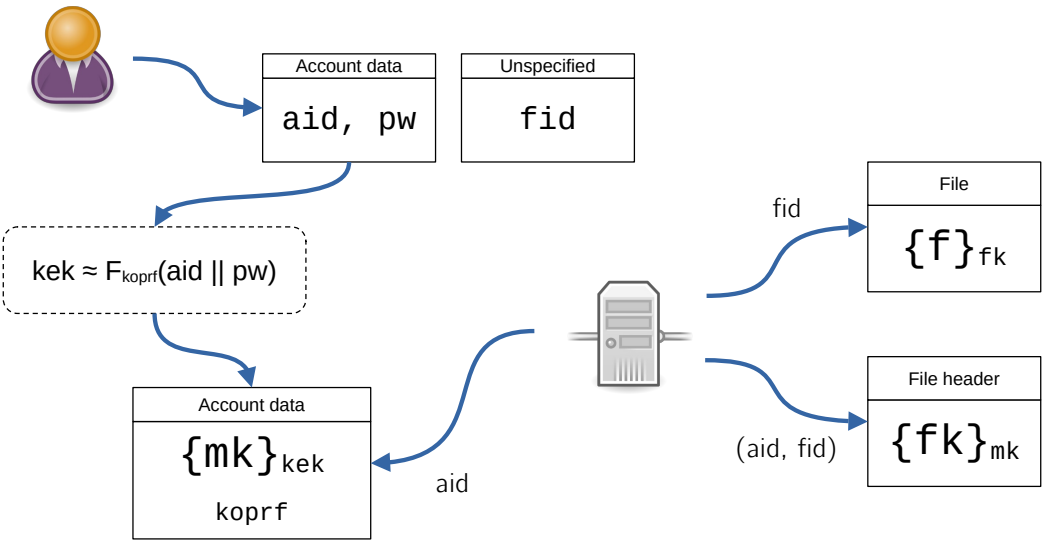

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- Push notifications: ✗
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We propose minor changes to CSS to add some of this functionality: "CSS++"

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- This allows us to include it in the security proof

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Let's look at

- Directory trees
- Event search
- Event sharing
- RSVP via read/write permissions

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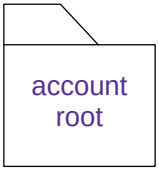


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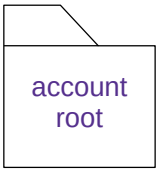


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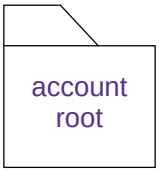

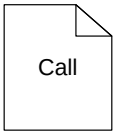


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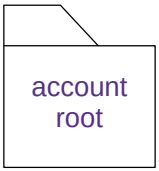

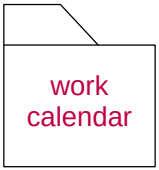

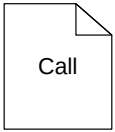


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No guarantee that root fid is not taken

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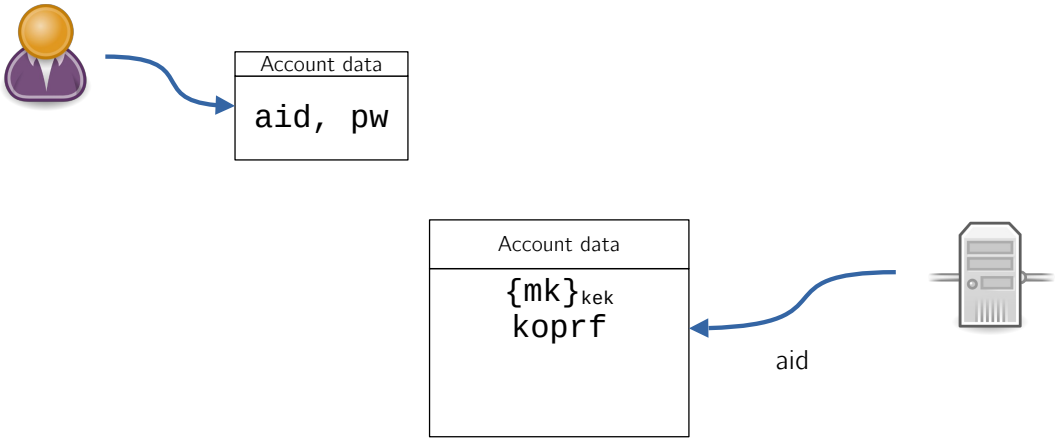

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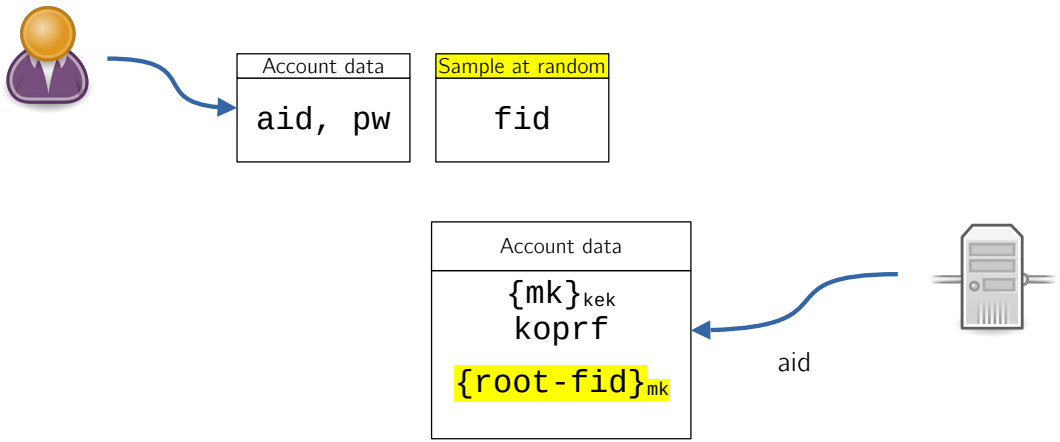

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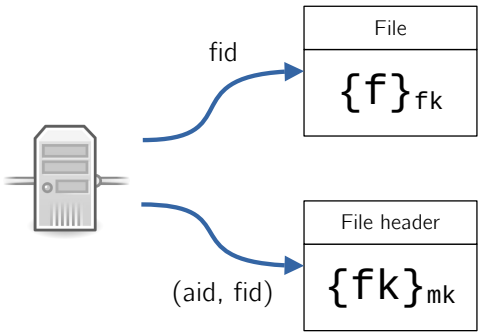

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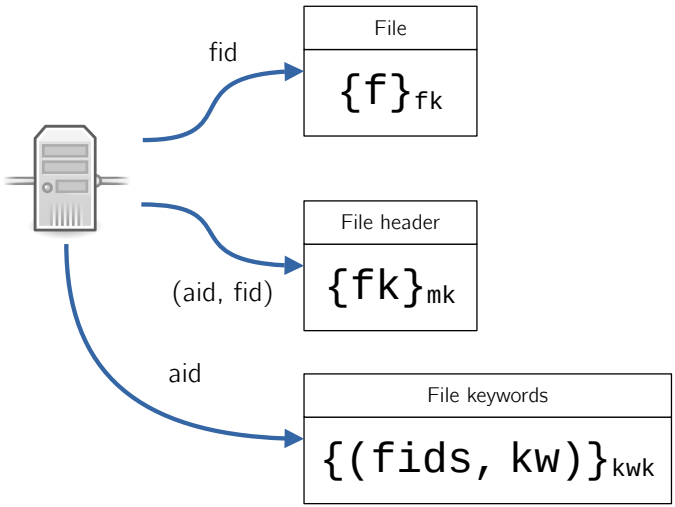

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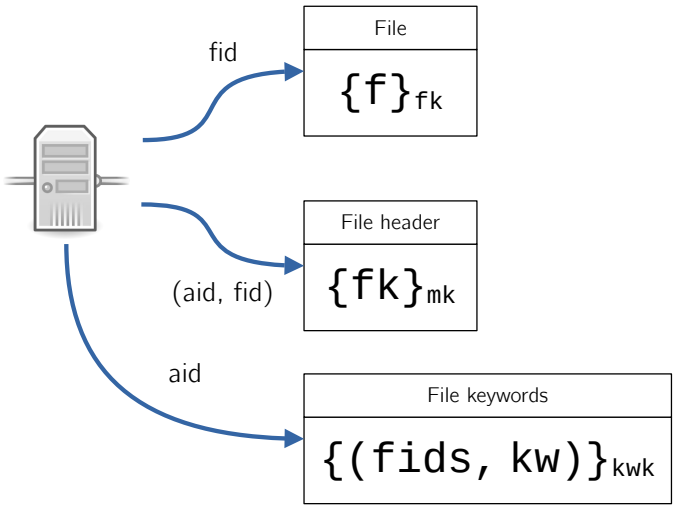

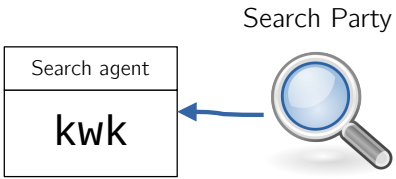

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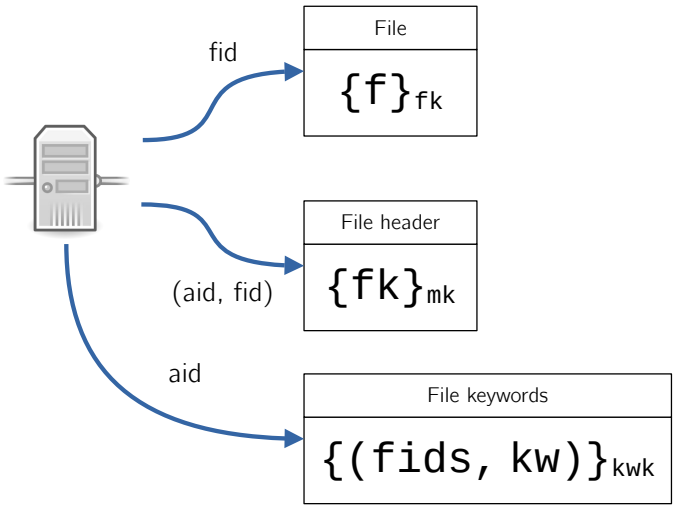

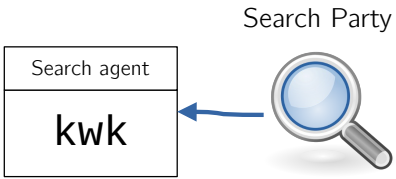

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- Could implement this as a simple encrypted file shared with the Search Party

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If you like controversy

- Add an *extra* layer of leaky searchable encryption (SE)
- Store $\texttt{\{SE(fids, kw)\}}_{\texttt{kwk}}$ in place of $\texttt{\{(fids, kw)\}}_{\texttt{kwk}}$

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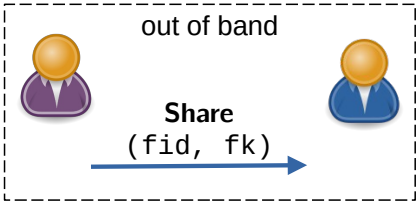

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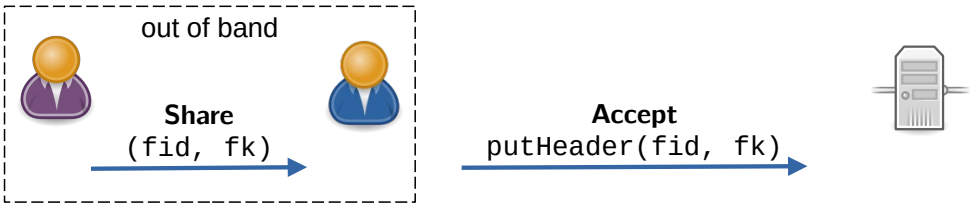

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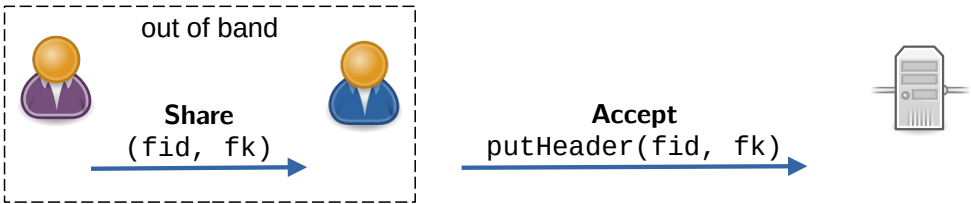

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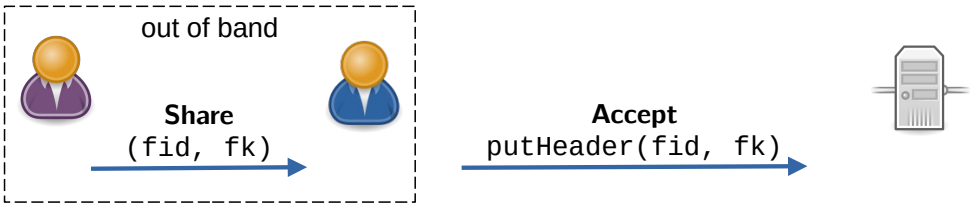

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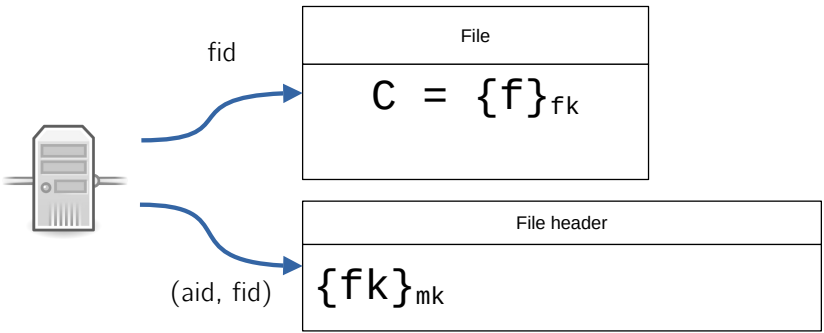
CSS file sharing vs event sharing, and R/W access

Adding read/write permissions to file



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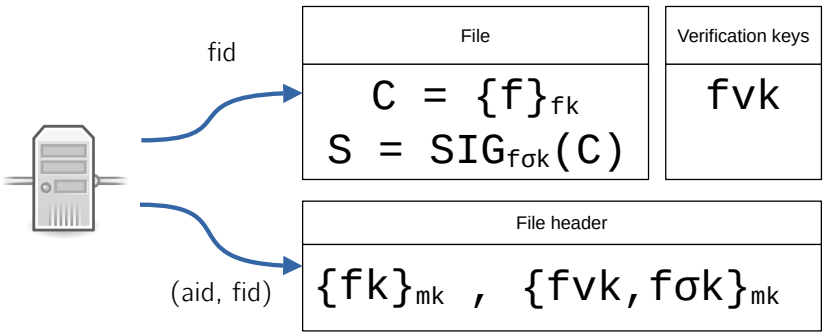

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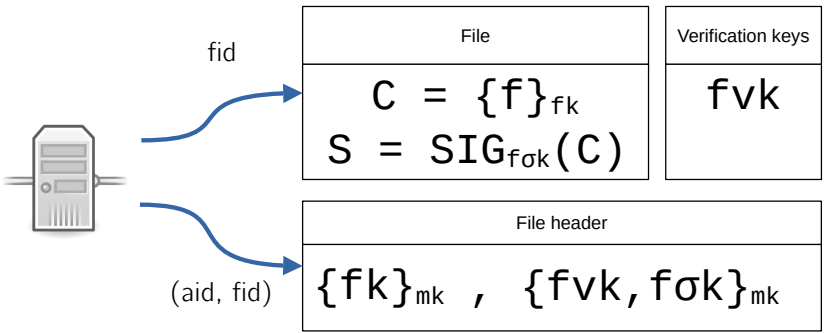

- At time of file creation, add `(fvk, fσk) = SIG.Kg()` to file header and sign `C`

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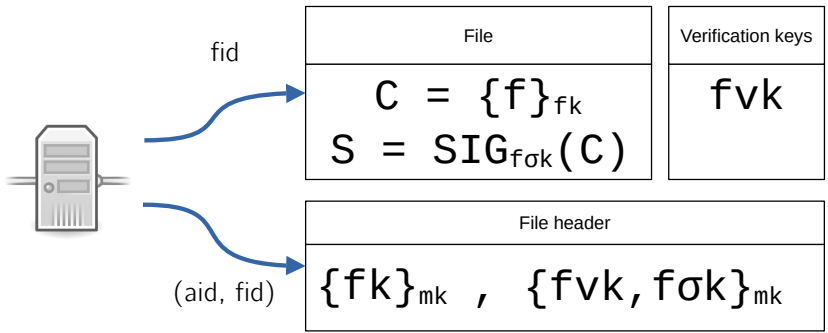

- At time of file creation, add `(fvk, fσk) = SIG.Kg()` to file header and sign `C`
- With every file change, server/other users can verify update

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$(vk, \sigma k)$

pk

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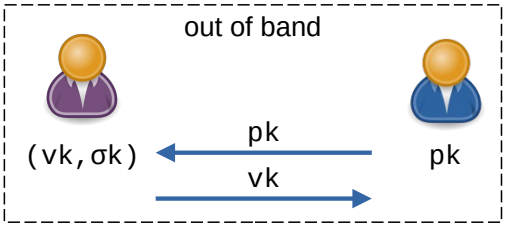

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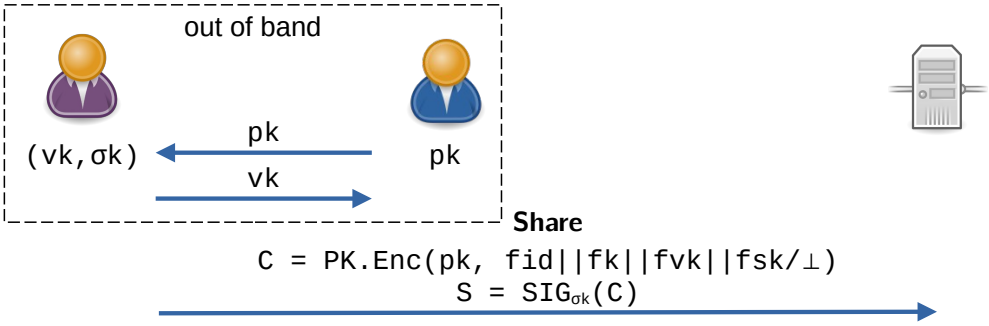

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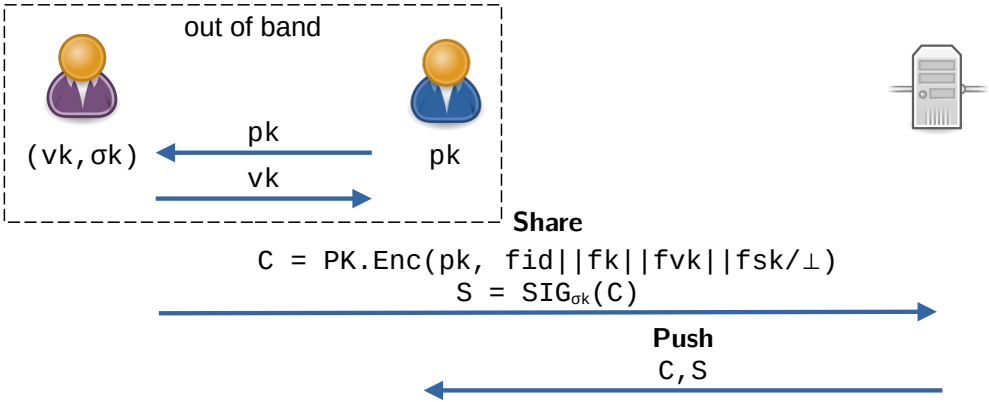

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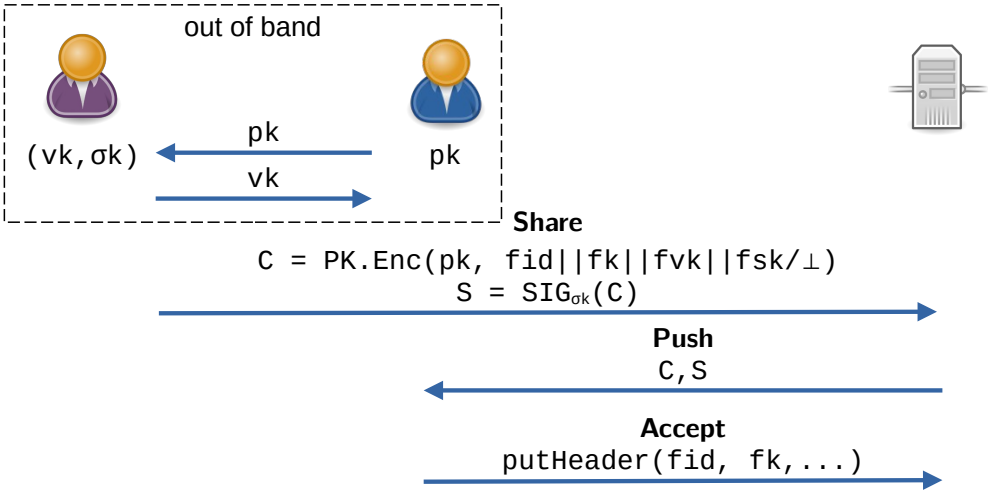

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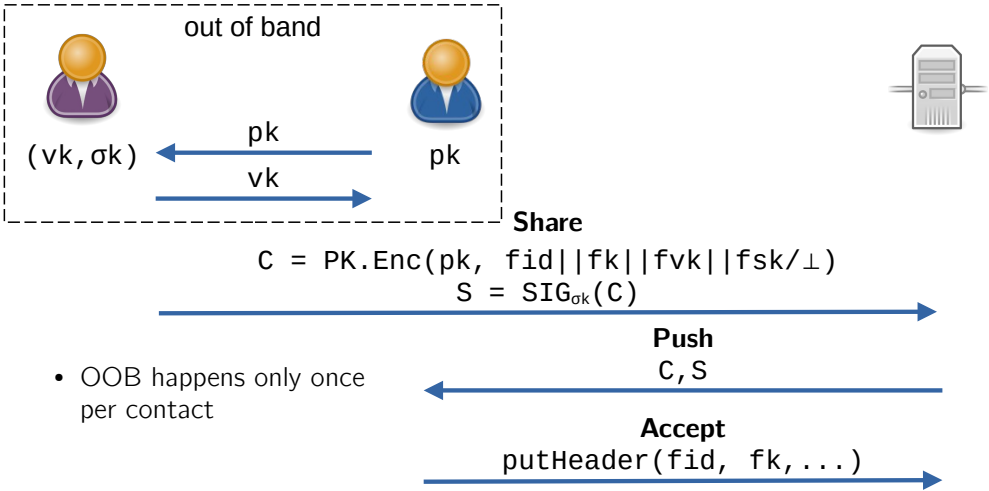

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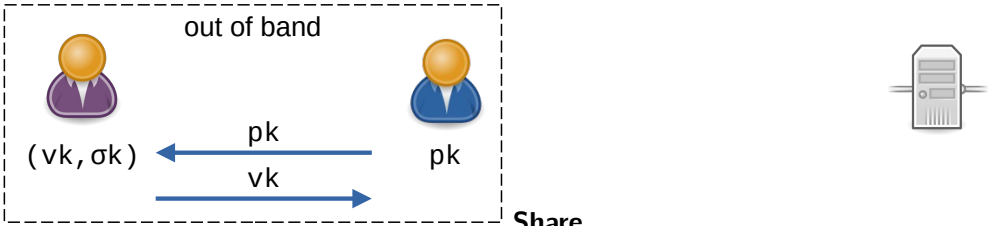

- OOB happens only once per contact
- If `fsk` is not shared, receiver has read-only access

Event invitations with RSVP support

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If party G decides to RSVP, they simply edit R_G accordingly.

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Thank you