



Chasm: Fault-Tolerant, Information-Theoretic Secure Cloud Backup

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I'm sure there are plenty of existing
"secure" back-up solutions...so why?

- **Existing secure backup Solutions:**
 - Mozy, Carbonite, Crashplan, Backblaze
- **Bad usability, no fault-tolerance, and confidentiality:**
 - **Passwords** lost/leaked, easy to brute force
 - **Password-based keys** same low entropy problem, same lost password problem
 - **Local AES keys:** computer crashes? no recovery
 - **Long-lived ciphertexts under weak keys**
- **What is a good threat model?**

Threat model

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2. Nation state compels cloud service to reveal user data by means of law
3. Hackers break into a cloud service and steal user data

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- **Threats:**

- Cloud services are computationally powerful!
- Can brute force passwords or password-derived encryption keys
- Denial-of-service by removing access to encrypted/plaintext data

How does Chasm work?

1. **You** specify ≥ 2 cloud stores like:

 Dropbox

 Google Drive

 iCloud Drive

 Microsoft One Drive

 AWS

2. **Chasm** creates a “secure” **chasm folder** in your home directory

3. **You** can now simply drag & drop files into the folder

How does Chasm work?

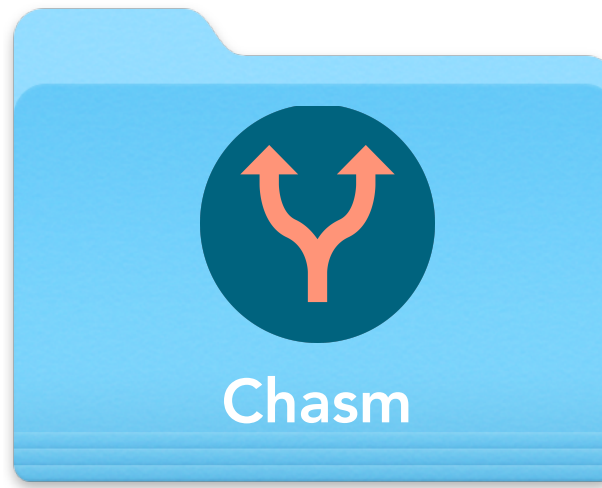
- Chasm listens for file-system events on the **chasm folder**
- When a new file is added to the **chasm folder**, the file is secret shared using the **K-out-of-N** Shamir's **Secret Sharing Scheme**
- Each share is sent to a different cloud store
- **N** = # of cloud stores
- **K** = recoverability threshold (by default **N**)



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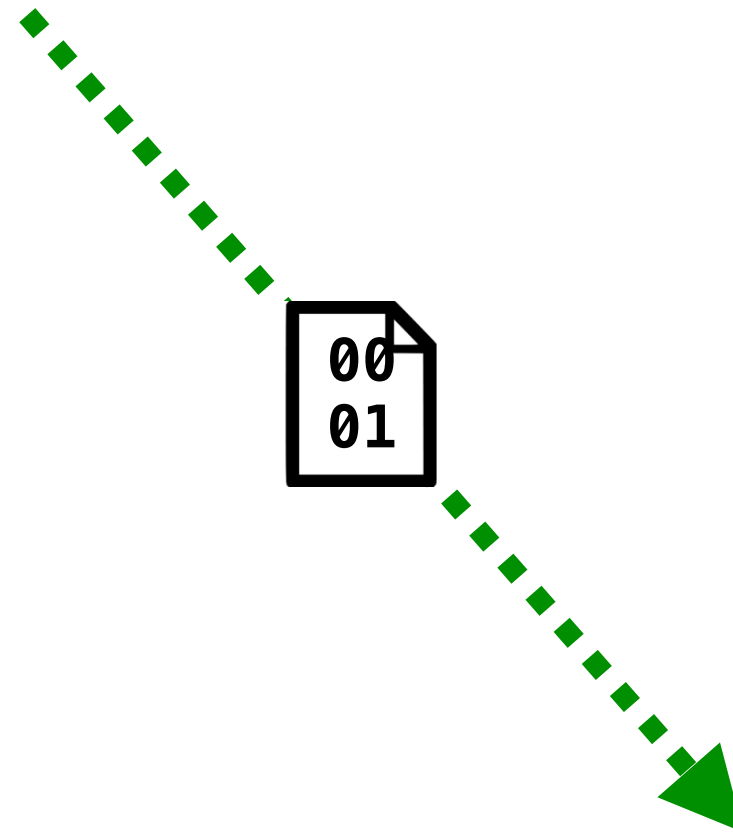
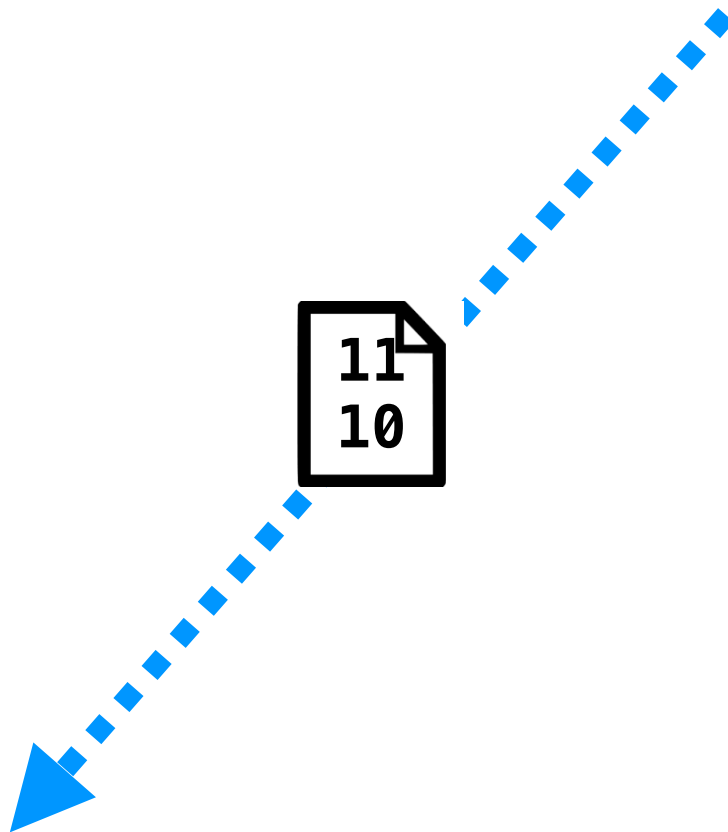
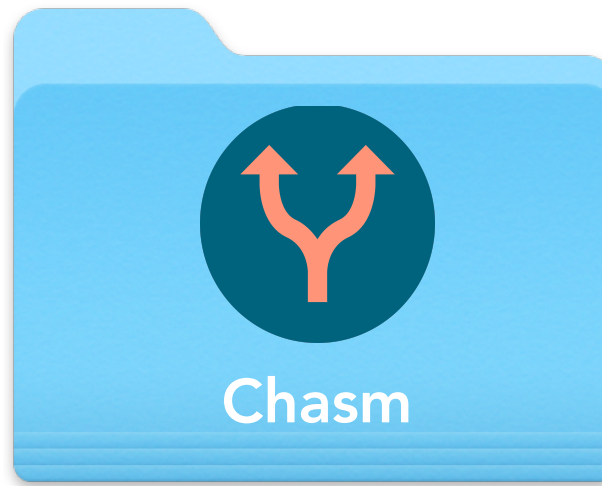


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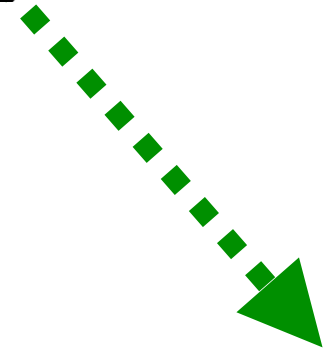
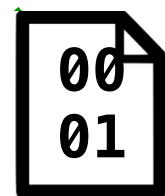
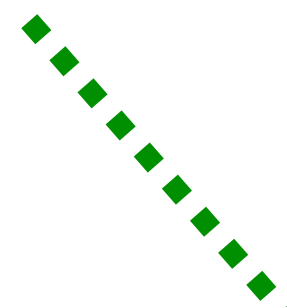
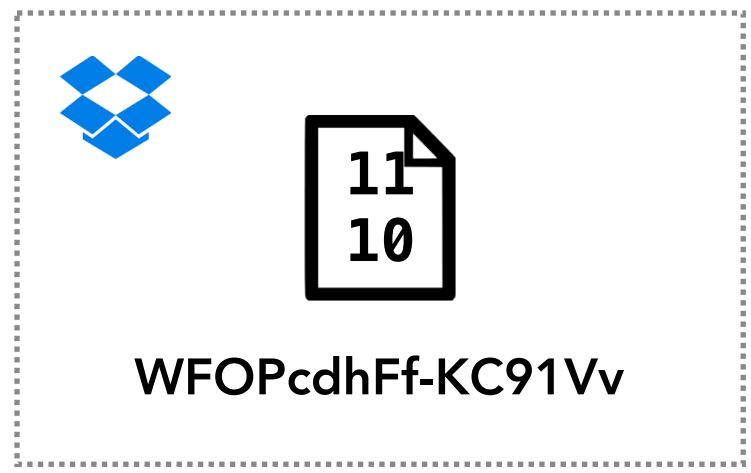
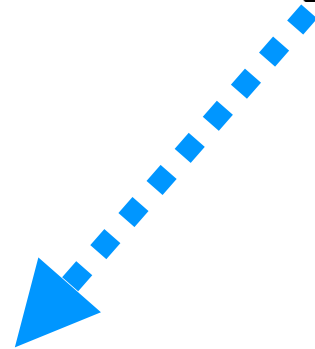
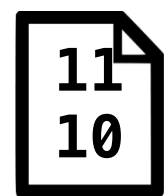
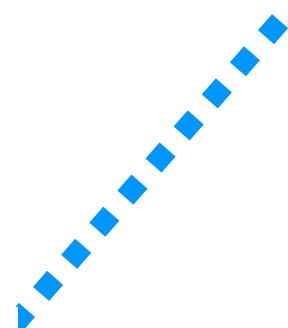
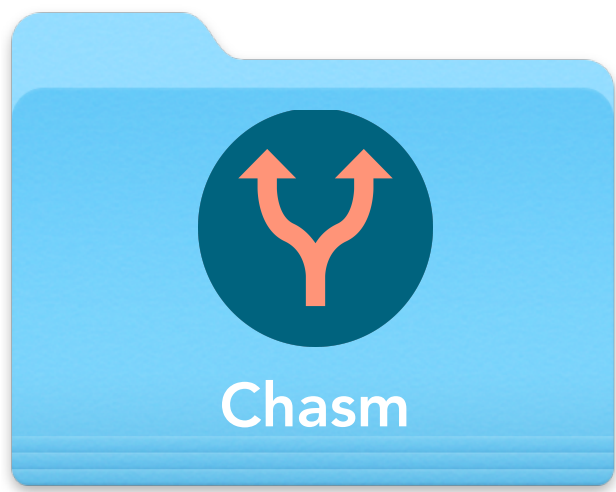


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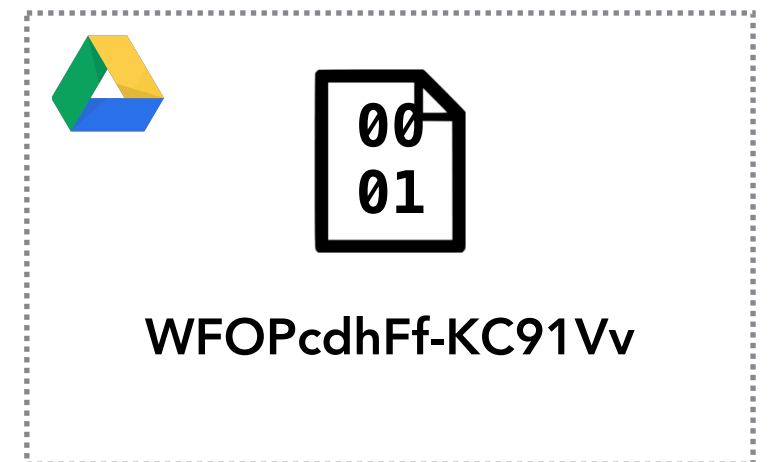
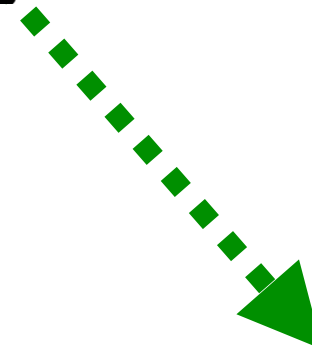
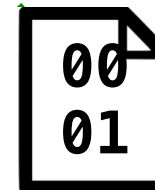
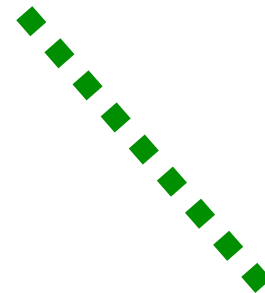
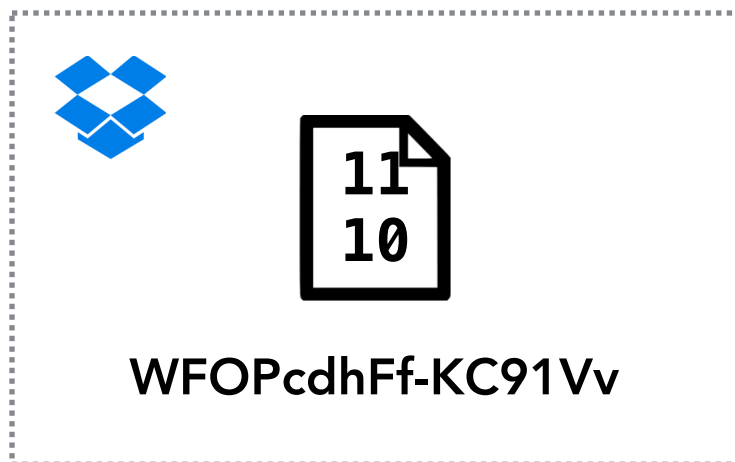
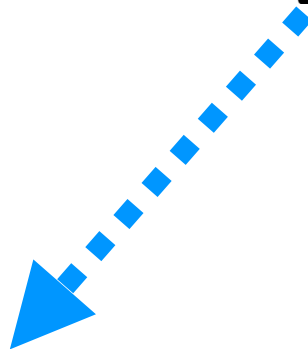
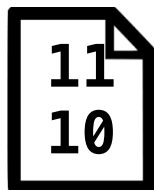
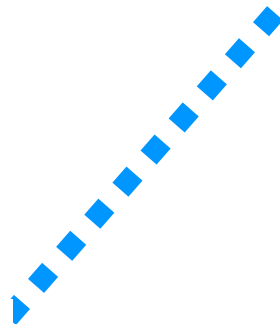
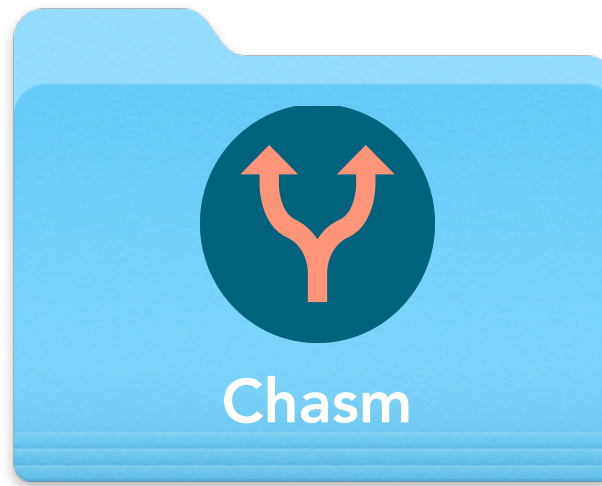


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DEMO  TIME!

System Guarantees

- **Information-Theoretic Confidentiality** of data if less than K -out-of- N cloud services collude
- **Fault-tolerance** lost data is recoverable if at least K -out-of- N cloud services available
- **Integrity** of data if at least K -out-of- N cloud services are honest (achieved by taking majority)

Win on usability

- No passwords to remember
- Easy setup & restore
- Drag & drop to secure
- Most user's already have existing cloud services like Dropbox, Drive, iCloud, etc...


Vulnerabilities

(& how we can fix some of them)

- Cloud stores can determine the number of files and the size of each file
- A network adversary can potentially combine outbound shares as they are being sent
- I use the same password for everything?

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- I use the same password for everything?
 - **Turn on 2FA.**

Related Systems

- **“Simulating cloud environment for HIS backup using secret sharing.”** (Kyoto University Hospital)
 - Hospitals can secret share data to backup to different remote sites
- **“Responsive Security for Stored Data.”** (Georgia Institute of Technology)
 - A secure system that improves on replicated state machines with secret sharing schemes
- **No consumer cloud backup services using secret sharing**

Questions?