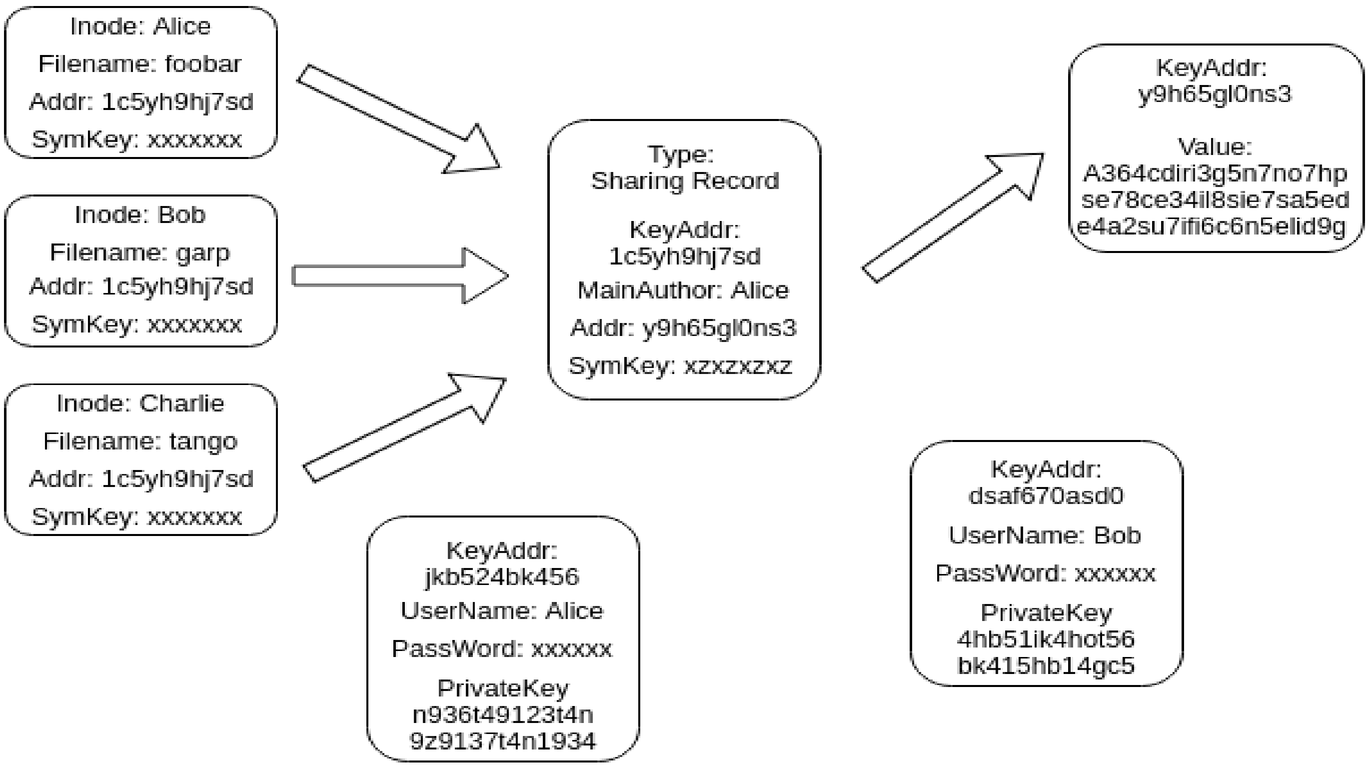
CS628 Assignment 1
2018-19 **II Semester**

Design Report for Secure Key-Value File Sharing



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1 A simple, but secure client

Purpose: To maintain Confidentiality and Integrity of data without any regards to Availability.
NOTE: *KeyAddr* field in every struct to protect against key-value-swap attack.

USER Structure

```
type User_r struct {
  KeyAddr   string
  Signature []byte
  User      struct {
      Username string
      Password string
      SymmKey  []byte
      Privkey  *PrivateKey
  }
}
```

INODE Structure

```
type Inode_r struct {
   KeyAddr   string
   Signature []byte
   Inode     struct {
      ShRecordAddr string
      SymmKey      []byte
   }
}
```

1.1 InitUser (username string, password string)

1. Obtain $UserAddr = Argon2Key(" < password > + < username > "," < username > ", 32)$. This will generate a 32 character address. This is where the value (User data) will be stored.
2. Generate a new $key = Argon2Key(" < username > + < password > "," < username > ", 16)$ for symmetric encryption and Hmac Signature. Sign $User\_r.User$ with HMAC scheme, store the signature in $User\_r.Signature$. Encrypt the $User\_r$ struct data with AES-Cipher Feedback Mode using the same key.
3. Generate an RSA Key-pair. Push the public key to the Public Key Server. Store the Private Key along with other fields in User_r struct.
4. Generate a random 16 byte symmetric key and store in user struct. This key will be used lated to sign and encrypt inode structures.
5. Call $DatastoreSet(key, ciphertext)$ to publish the encrypted User information in Data Server.

1.2 GetUser (username string, password string)

1. Get the "key" and "addr" using above Argon2Key invocation. Errors suggest either incorrect username or password. Calculate the key for CFBDecrypter(), and obtain the decrypted $User\_r$ structure.
2. Check HMAC hashes of $User\_r.User$ and $User\_r.Signature$ for any tampering. If all checks are satisfied, return the $User\_r.User$ structure.

1.3 (User) StoreFile (filename string, data []byte)

1. Obtain $InodeAddr = SHA256(SHA256(< username > + < password > + < filename >))$. This is where the Inode structure for "Username"-"Filename" will be stored (Refer to the figure).

2. Generate a random address (key) and AES-CFB key for storing and encrypting SharingRecord_r structure respectively. Fill the Inode structure. Sign it using Author's Symmetric key and store HMAC signature in *Inode_r.Signature*. Encrypt *Inode_r* with Author's Symmetric key. Push (key, encrypted Inode_r) to Data Server.
3. Check if a *SharingRecord_r* structure exists. If so, delete all the existing data blocks and write the new data in iterations. Else, initialize a new *SharingRecord_r* object.
4. Again generate a random address (key) and AES-CFB key for storing and encrypting the *Data_r* structure. Store these in the relevant fields of SharingRecord structure. Sign with a predecided HMAC key and store in *SharingRecord_r.Signature* field. Encrypt the Structure with the key decided at *Inode_r* and push to Data Server.
5. Store the "data" at the "key" generated above, Encrypt it with CFBEncrypter() method. Sign it and store the data at the "key". Push to Data Server and return.

SharingRecord Structure

```
type SharingRecord_r struct {
  KeyAddr       string
  Signature     []byte
  SharingRecord struct {
       Addresses   []string
       SymmKey     []byte
  }
}
```

DATA Structure

```
type Data_r struct {
    KeyAddr   string
    Data      []byte
    Signature []byte
}
```

1.4 (User) LoadFile (filename string)

1. Follow the method given in StoreFile() to reach, decrypt and verify the signature of the *SharingRecord_r* structure corresponding to "filename".
2. Loop over the list of addresses of data chunks (via indirect pointers), decrypt and verify the HMAC signatures of each, reconstruct the entire data as a single byte array and return it.

1.5 (User) AppendFile (filename string, data []byte)

1. Follow the method given in LoadFile() to reach, decrypt and verify the signature of the *SharingRecord_r* structure corresponding to "filename".
2. Create a new *Data_r* block and append its generated address to the list of addresses in SharingRecord structure. Push the block to DataStore and return.
3. **NOTE:** We are not verifying the integrity of previous data blocks during AppendFile(), considering the unnecessary overhead of re-encryptions/decryptions.

2 Sharing and revocation

2.1 (User) ShareFile (filename string, recipient string)

1. Get Inode and verify its integrity. Pass the SharingRecord Address and key to reciever.

2. $collected\_info = Inode\_r.Inode.(Symmkey + ShRecordAddr)$. Recieve the Public key of receiver from the Public Key Server.
3. $sharing = PubKey_{recipient}(encrypt(collected\_info)) + PrivKey_{user}(sign(collected\_info))$, to maintain confidentiality and integrity in case of a **Man in the Middle attack** while sharing the message offline.

2.2 (User) ReceiveFile (filename string, sender string, msgid string)

1. Decrypt "msgid" using Private Key of User, verify the integrity using Public Key of Sender. Obtain the Address and "key" for CFB-Decryption of SharingRecord structure of the concerned data(value) and proceed ahead.
2. Create an Inode for the receiver user using Argon2Key, with the method described in StoreFile(). Store the info in the Inode, store the RSA signature and encrypt $Inode\_r$ structure with Public key of User. Return.

2.3 (User) RevokeFile (filename string)

1. Go upto the SharingRecord structure corresponding to "filename" and verify integrity.
2. From the Inode of User, change the encryption key and the address of $SharingRecord\_r$ structure and re-encrypt it with a new key. Similarly, change the address of the actual data ($SharingRecord\_r.Address$).
3. Iterate over all data-blocks and re-encrypt them with fresh symmetric key. Also, store each of them at new addresses. Store these new key and addresses in the corresponding $SharingRecord\_r$ structure. **NOTE:** This is to prevent any further misuse by a distrusted user who knows the original key and addresses of data blocks.

3 Changes

1. Previously, we used Asymmetric encryption of Inode struct, given it only holds two values, we now change it to Symmetric encryption, given the encryption and time limit in RSA.
2. The address where we are storing inode was previously generated using Argon2, now we are using two time SHA256, given the high time and resource required by argon2
3. Updated few points to increase readability of the document.