Instant Auditing of Cloud Storage Access without Accumulating Attestations

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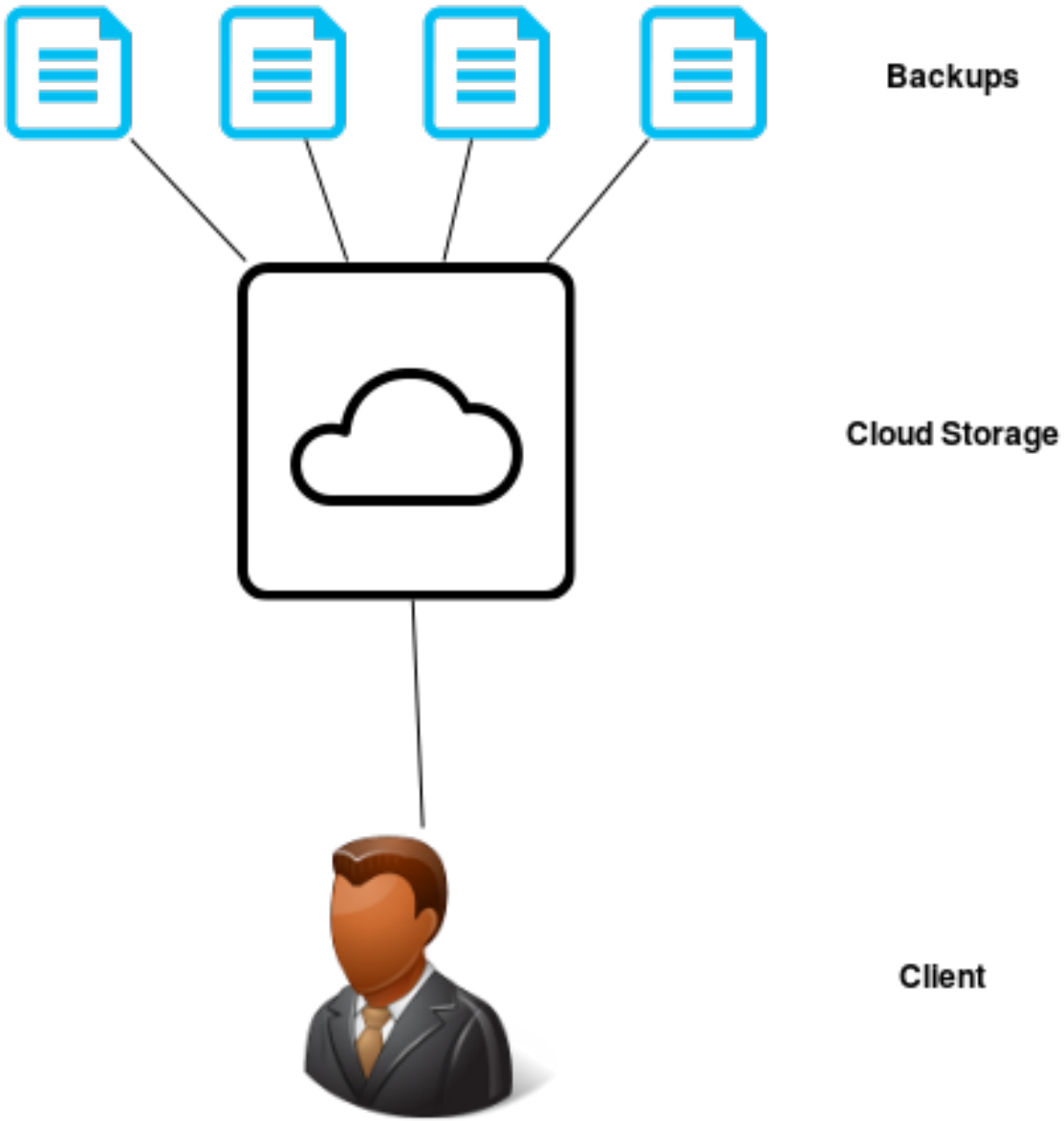
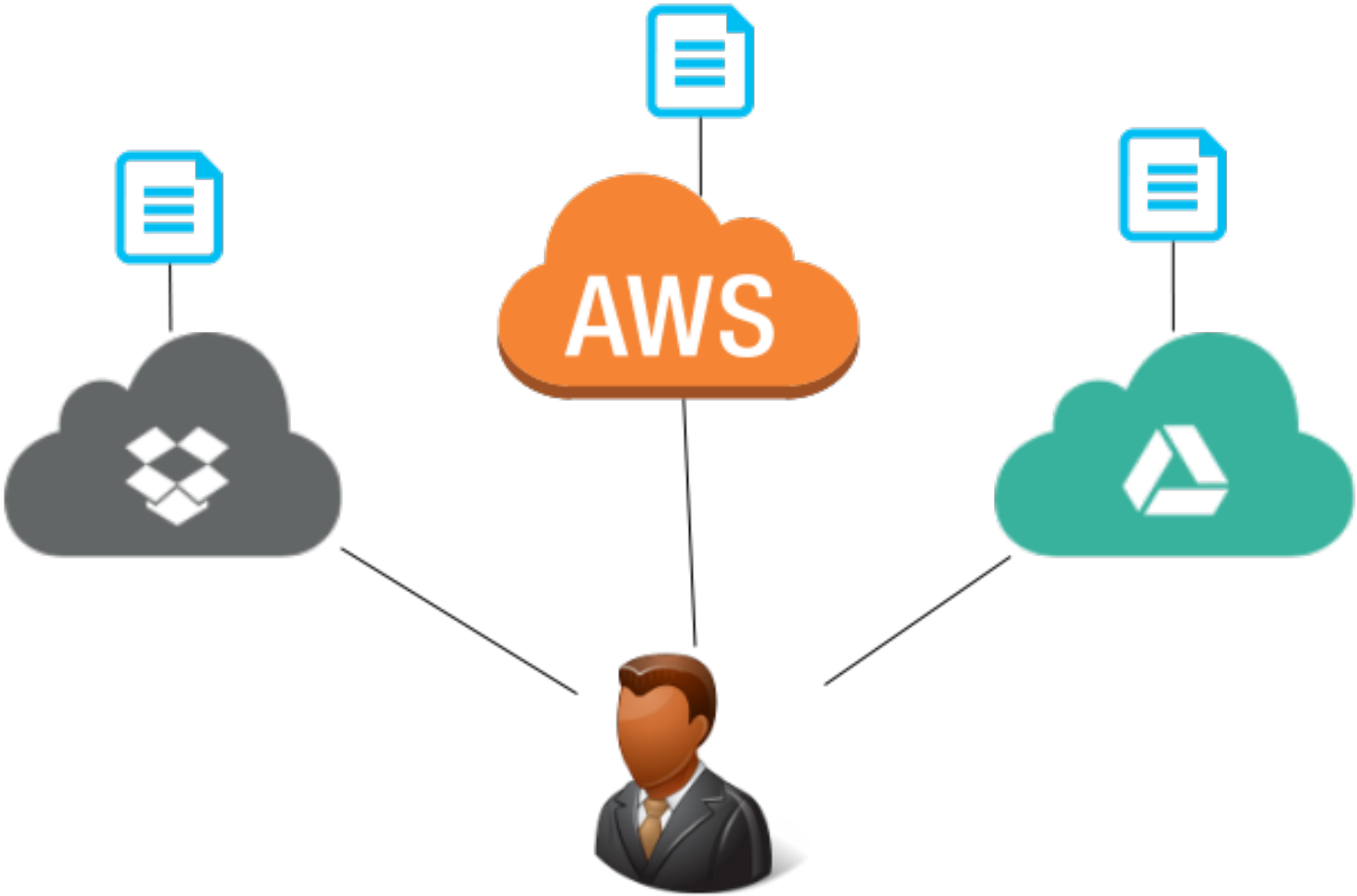
Outline

Outline

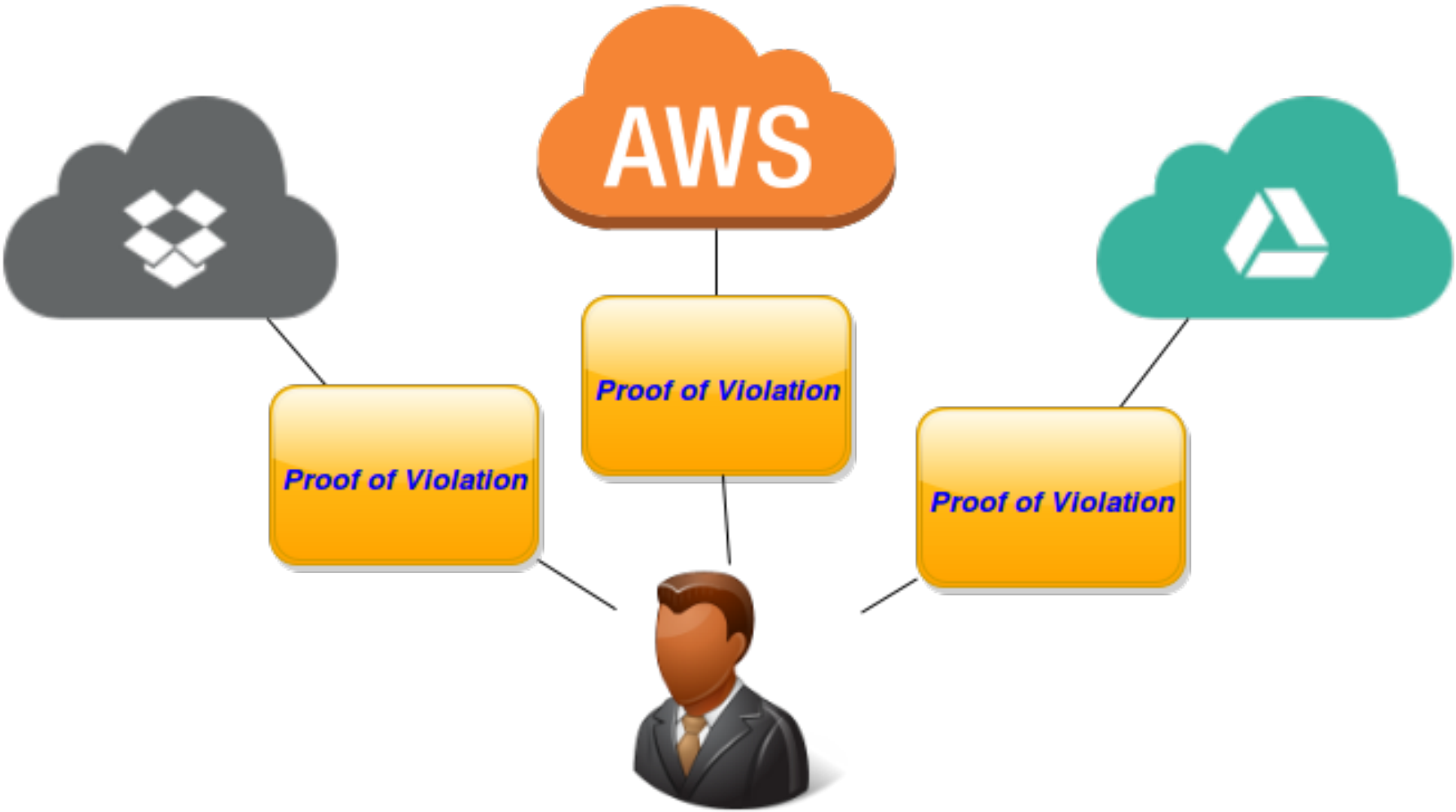
Scenario



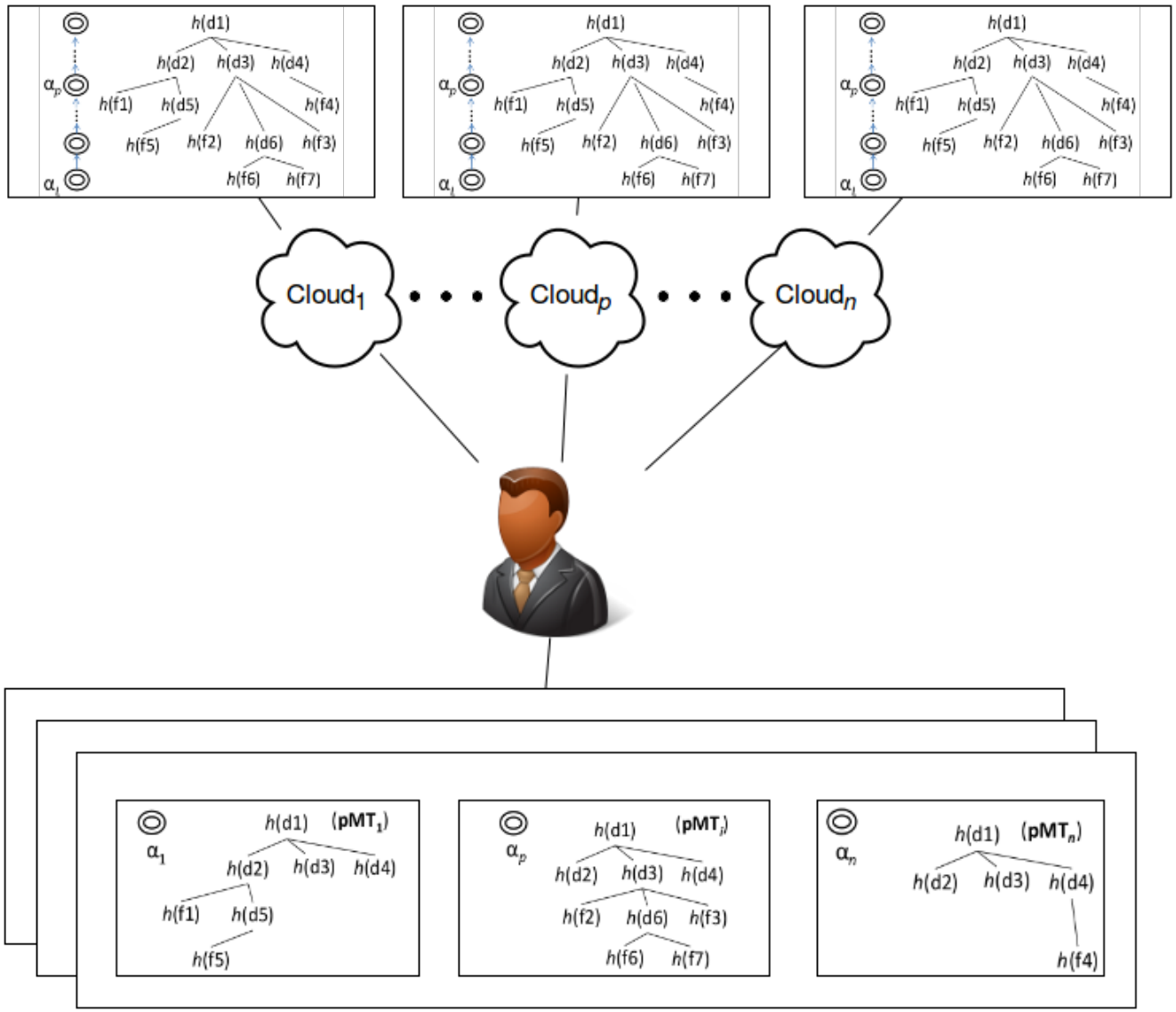
Scenario - Backup



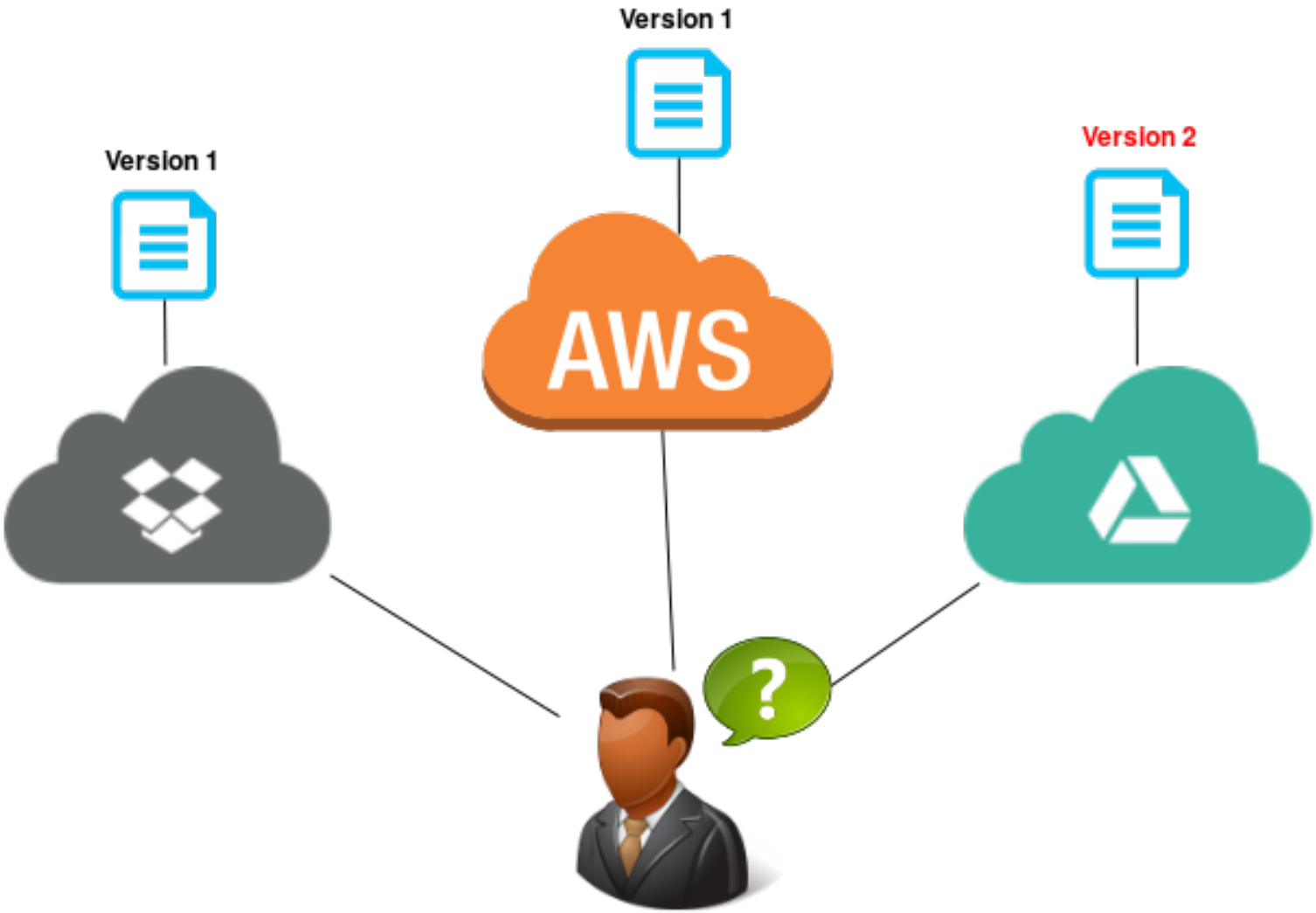
Scenario - POV



Scenario - Problem I : Too Many Attestations

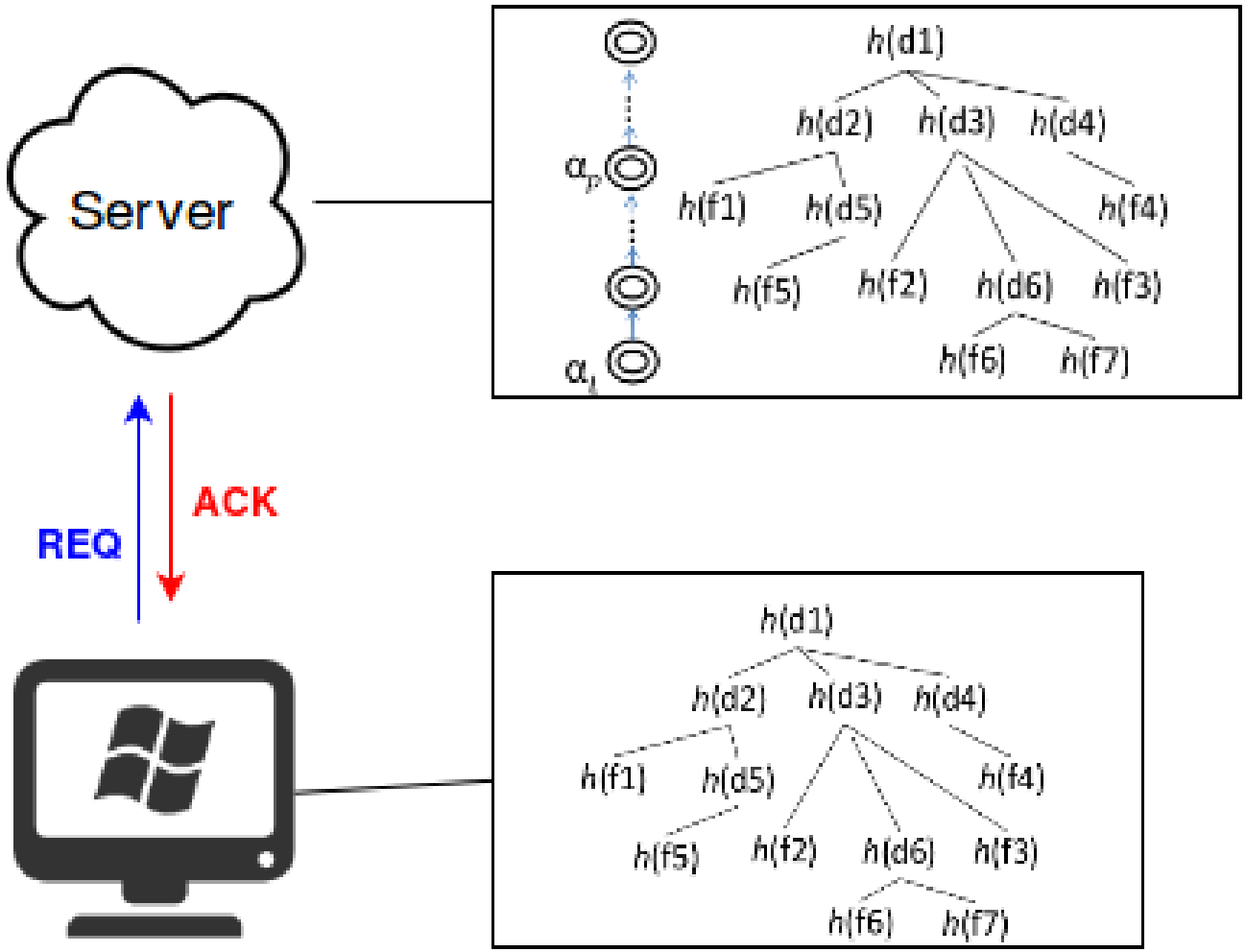


Scenario - Problem II : Version Control is Difficult



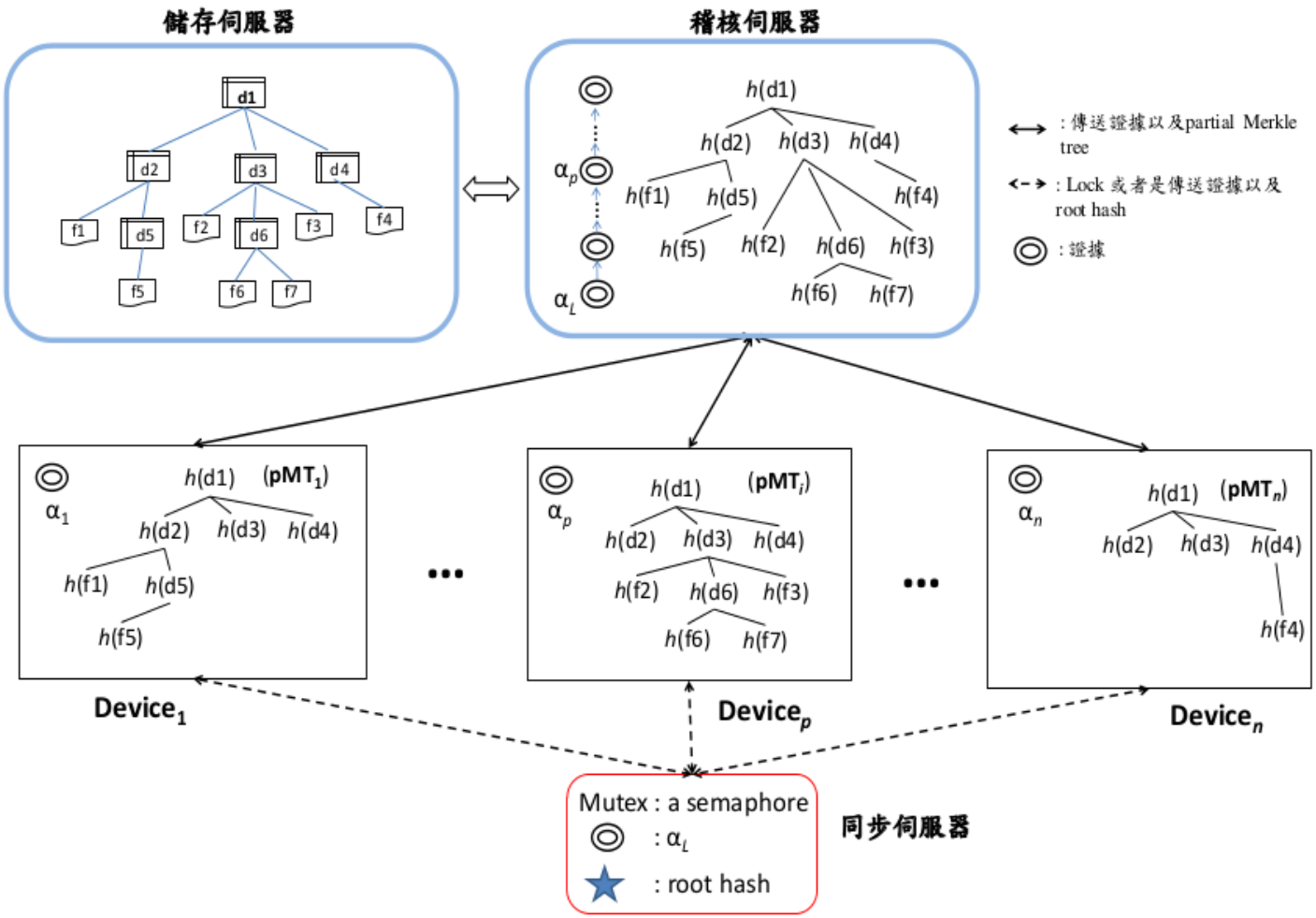
Outline

Single Client and Service Provider



Multiple Clients

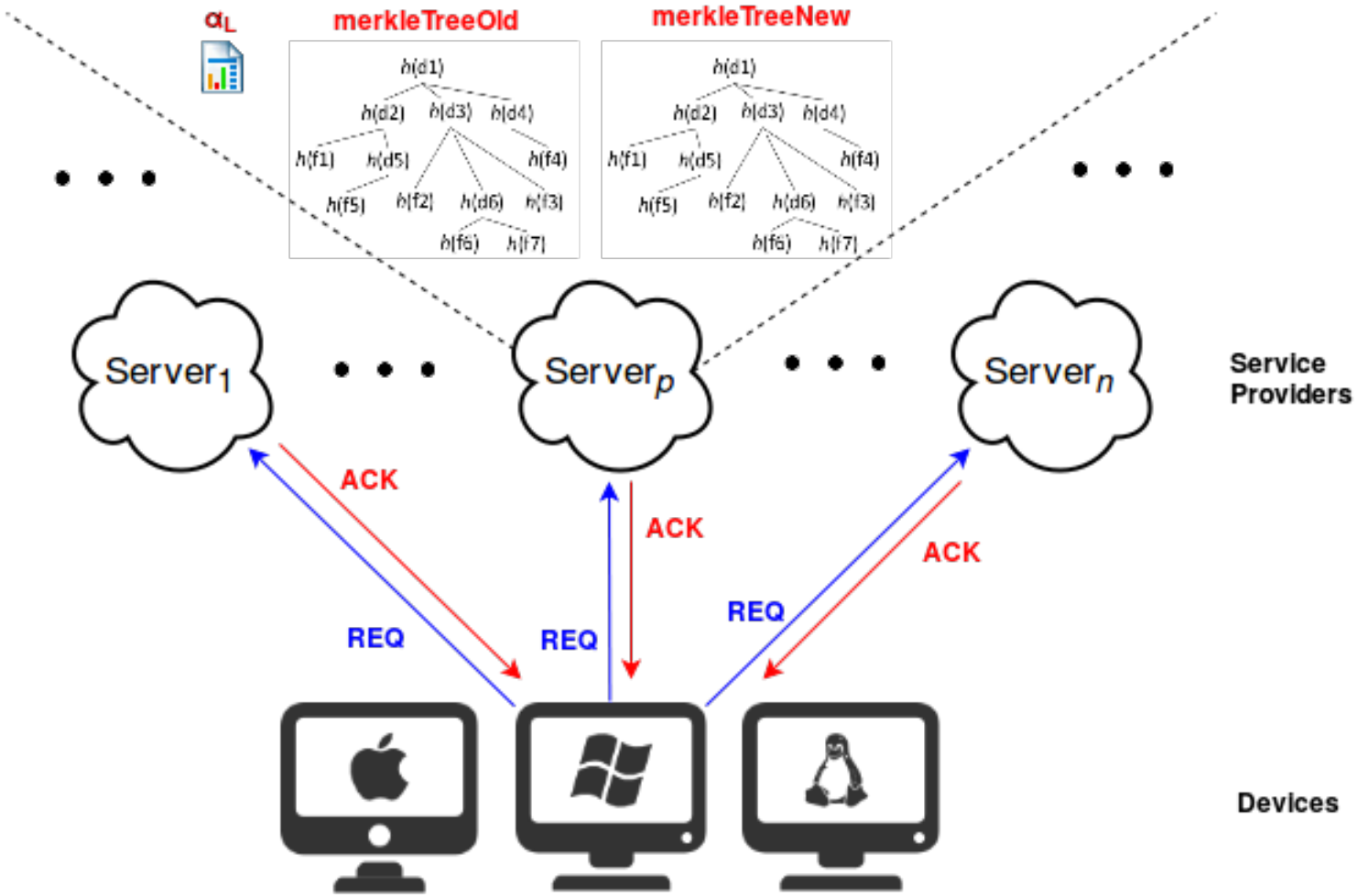
(*Instant Auditing of Cloud Storage Access by Cache Partial Merkle tree*)



Worst-case : 很久沒更新而累積了大量的files update動作

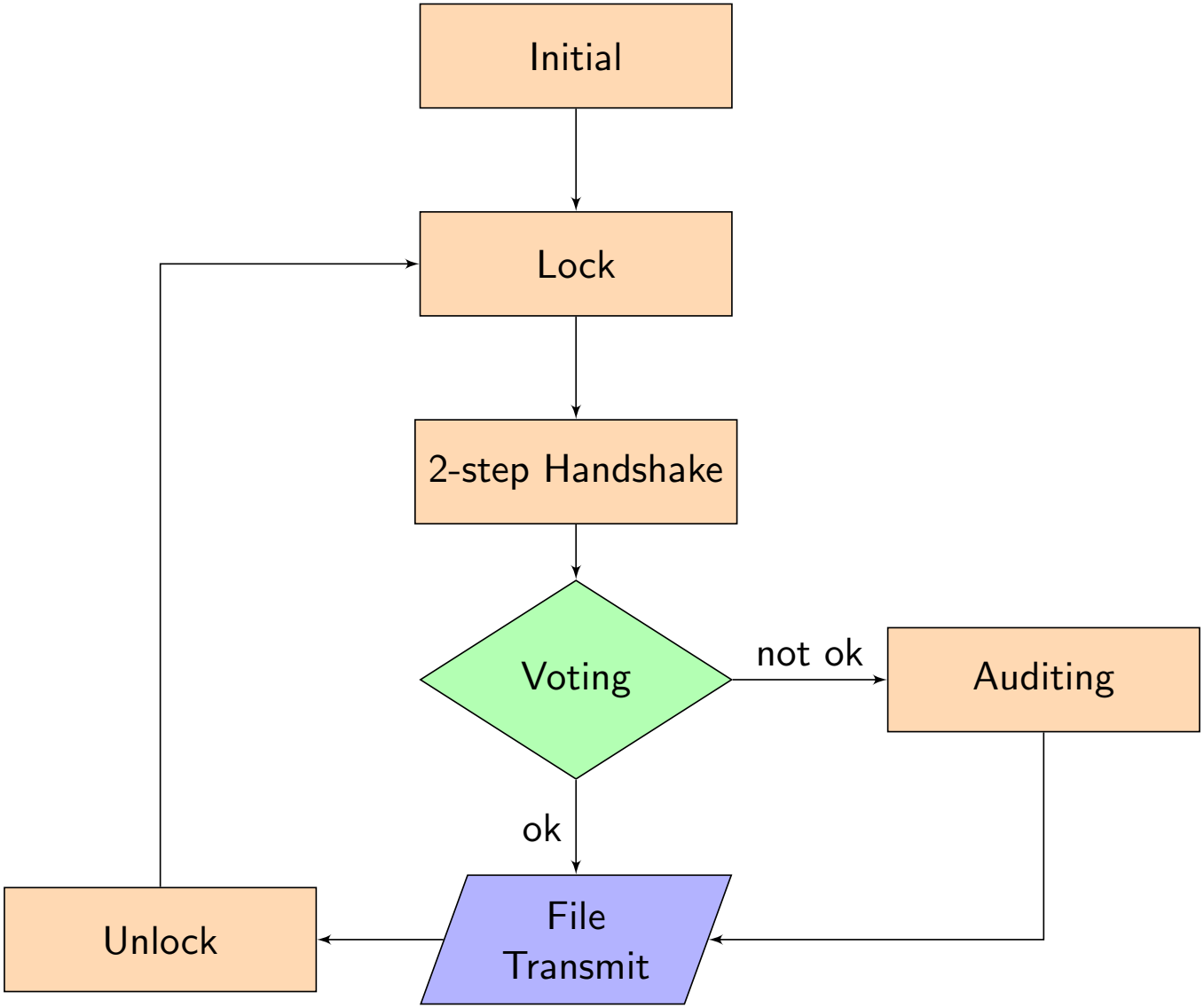
Reduce Device's Storage Usage

Assumption: 同時有k個server上同一file出問題的機率 ≈ 0



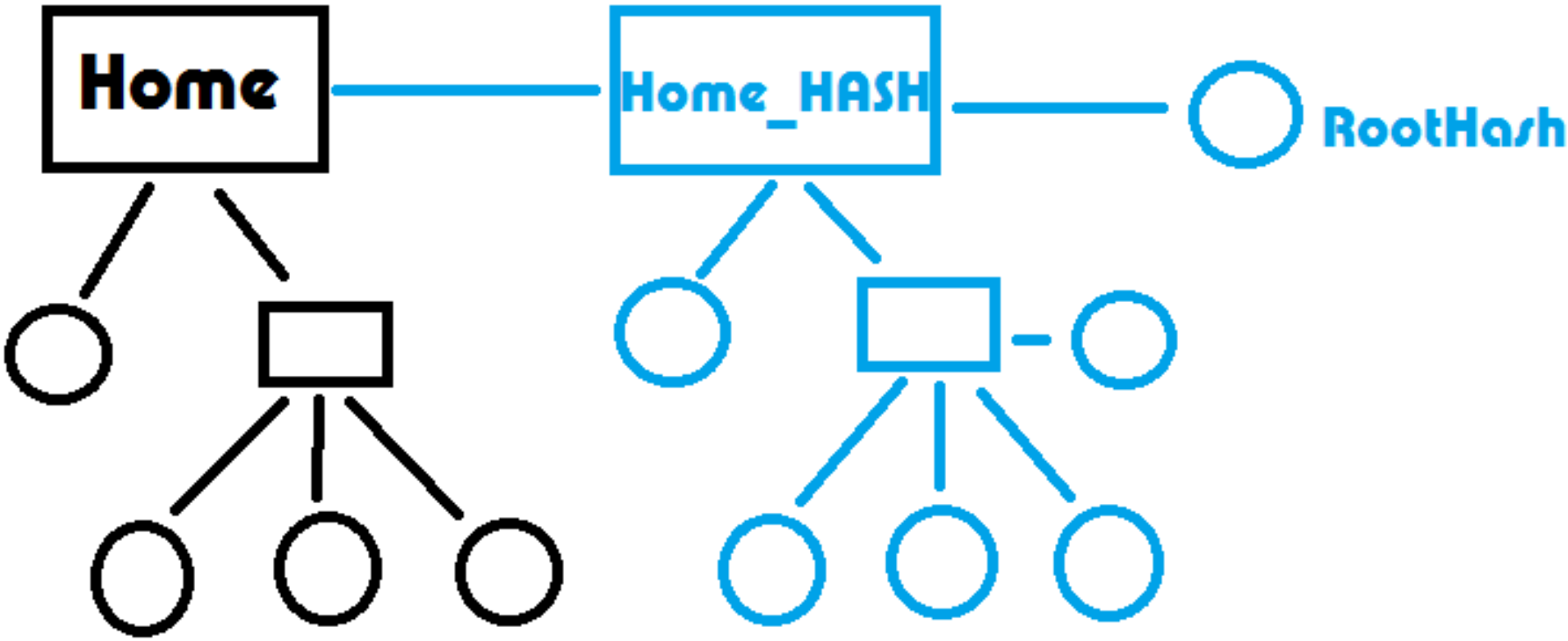
Outline

Flowchart


Initial
Lock
2-step Handshake
Voting
not ok
Auditing
ok
File
Transmit
Unlock

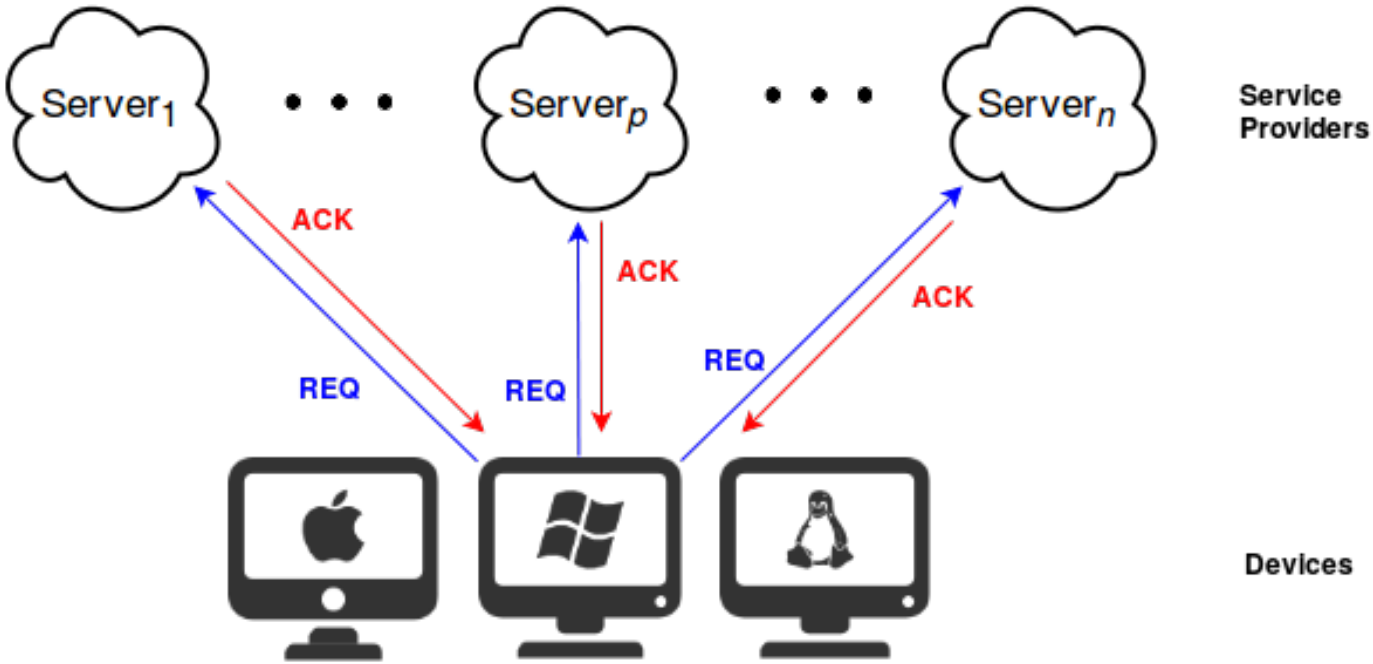
Initial

File → Merkle Tree



READ

I. 2-step Handshake



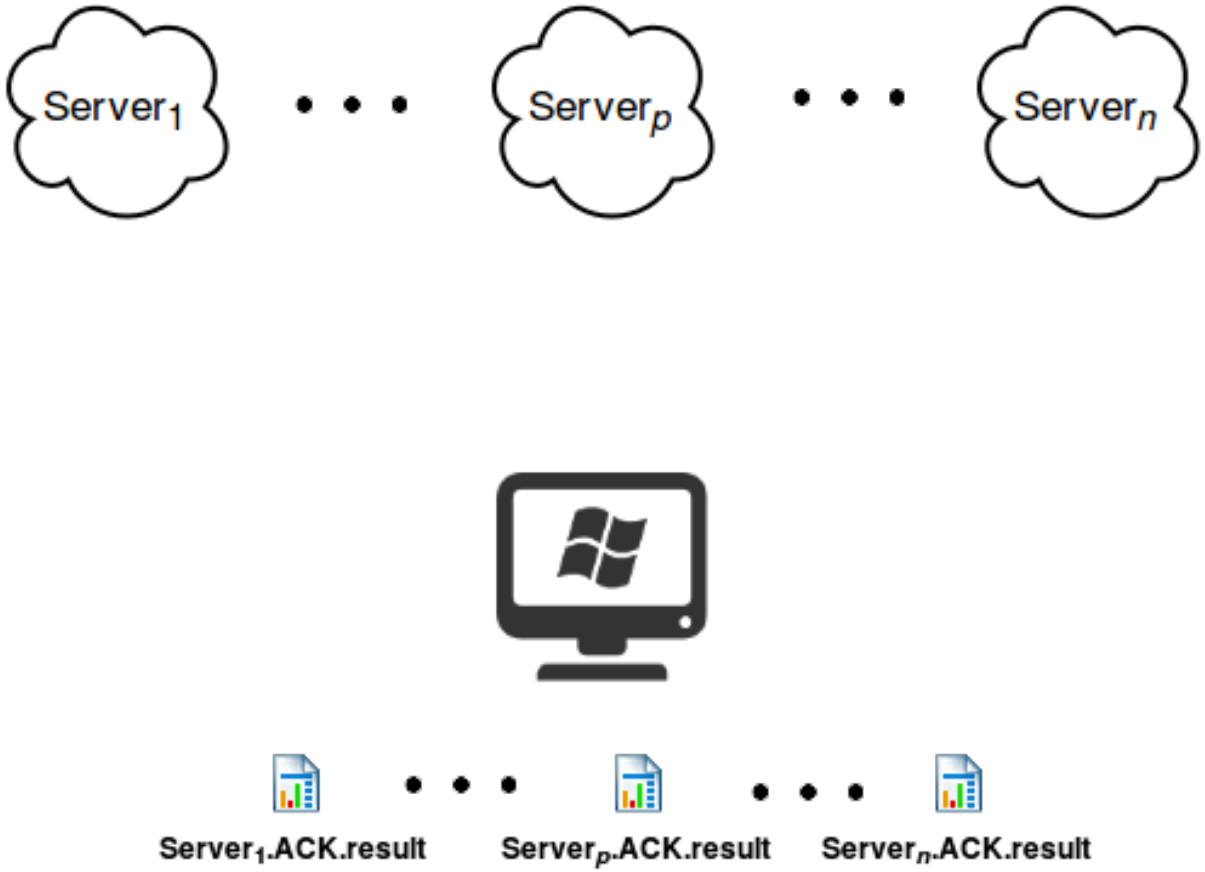
$REQ = (op, [op]_{pri(D)})$

op.type = DOWNLOAD
op.path = filepath
op.msg = " "

$ACK = (result = merkleTreeNew.roothash, REQ, [result, REQ]_{pri(S)})$

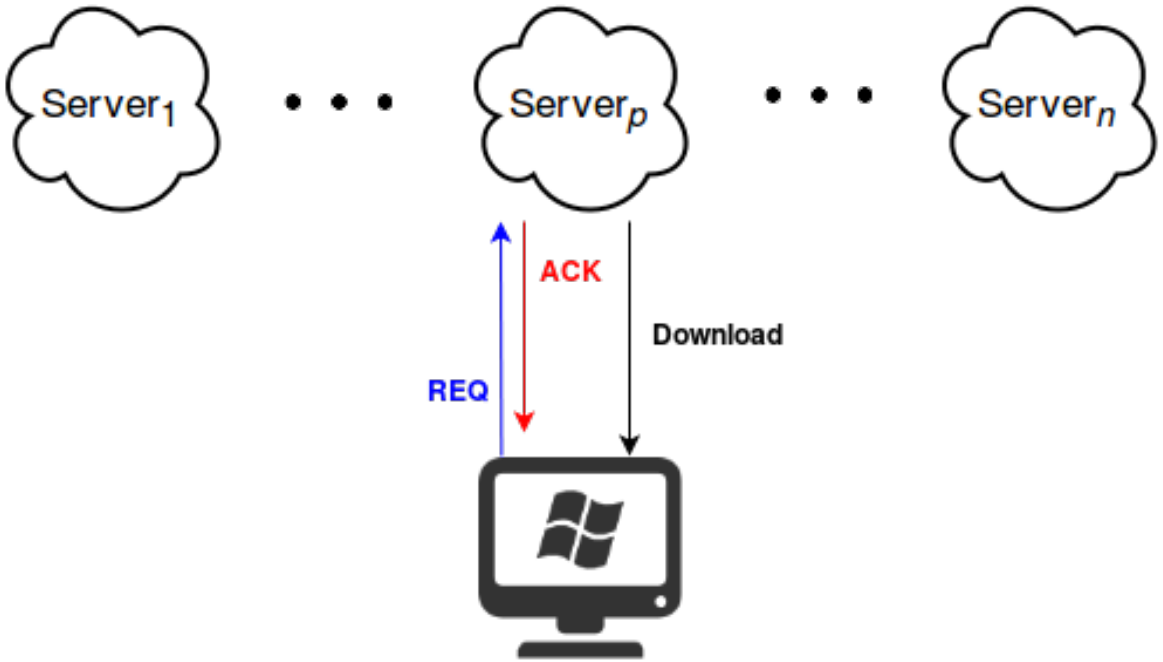
READ

II. Voting



READ

III. Download



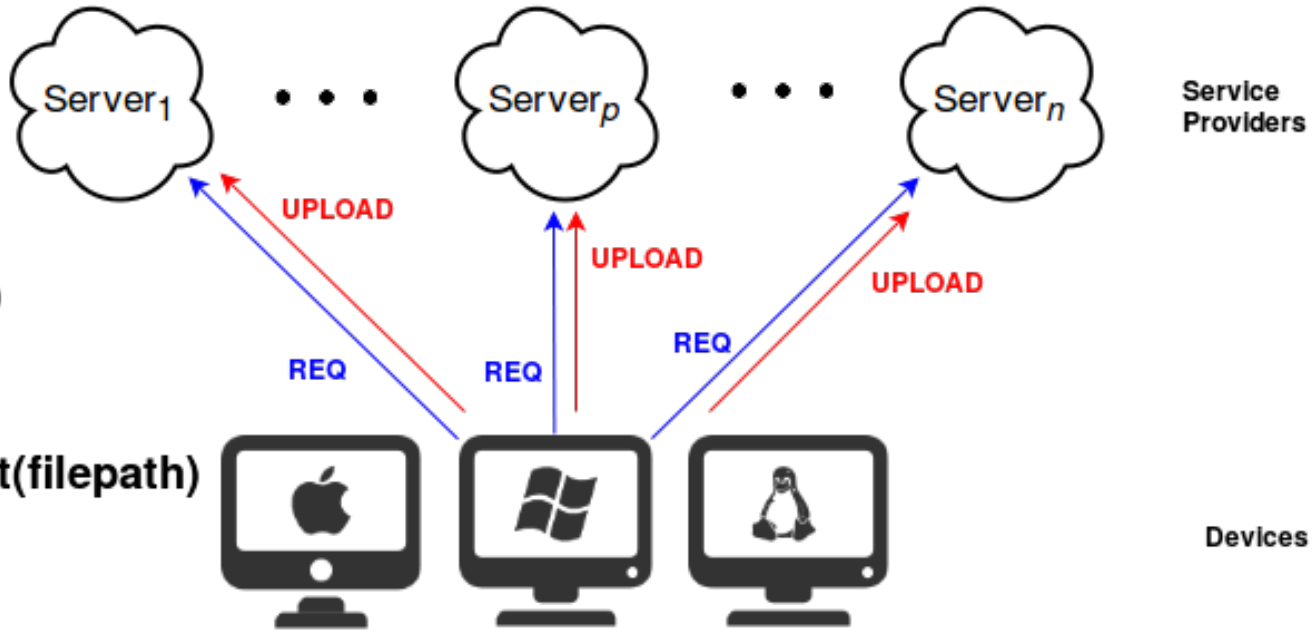
$REQ = (op', [op']_{pri(D)})$

op'.type = DOWNLOAD
op'.path = op.getPath()
op'.msg = ACK.result

$ACK = (result = merkleTreeNew.roothash, REQ, [result, REQ]_{pri(S)})$

WRITE

I. Upload



REQ = (op, [op]$_{pri(D)}$)

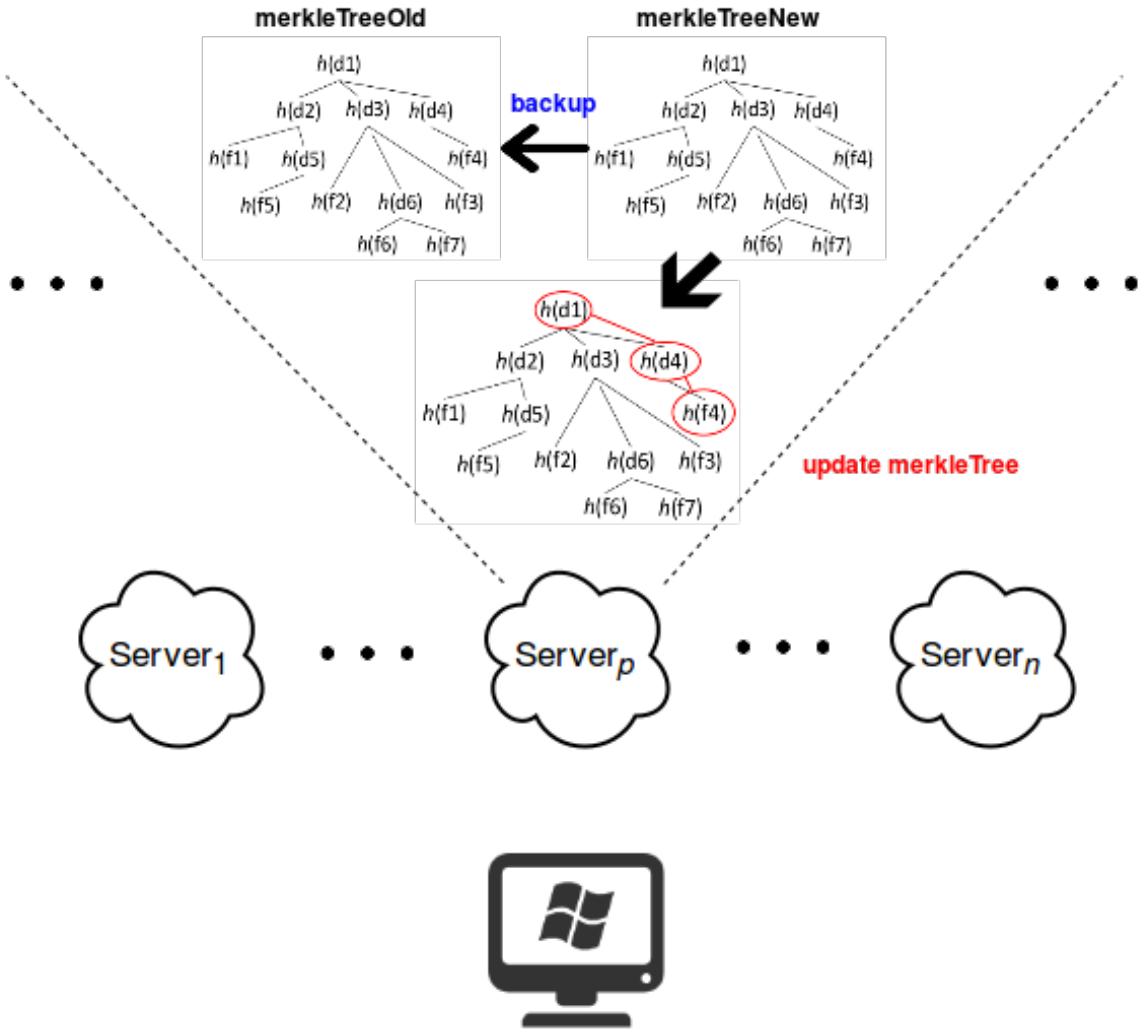
op.type = UPLOAD

op.path = filepath

op.msg = Utils.digest(filepath)

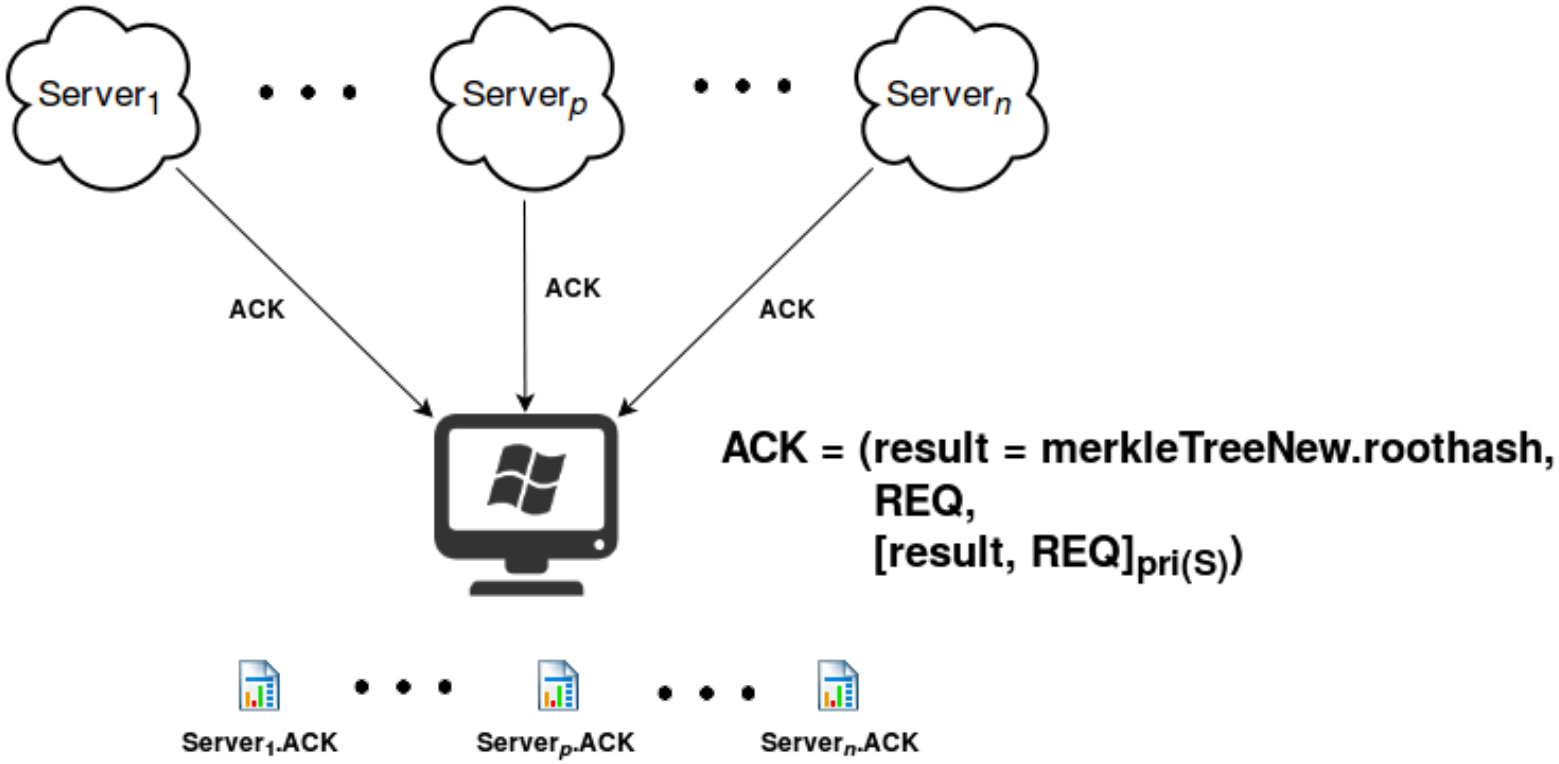
WRITE

II. Update Merkle Tree



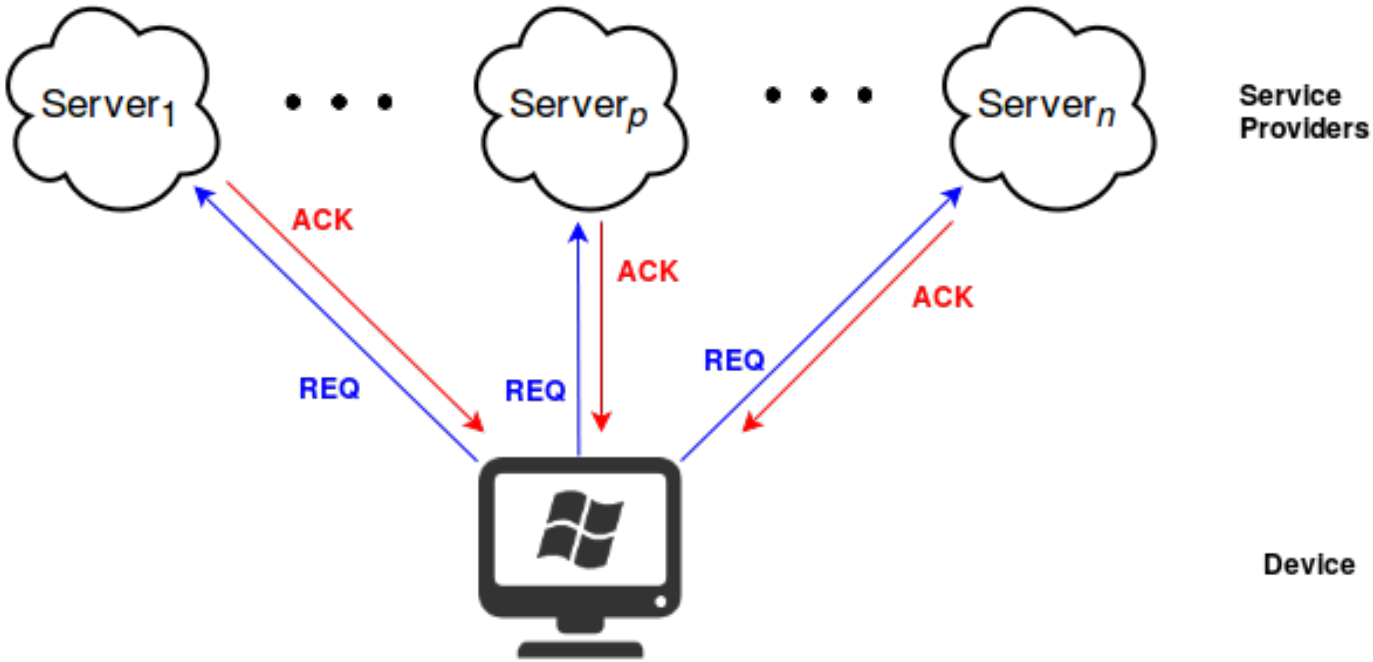
WRITE

III. Voting



AUDIT

I. Download and Check LastReq



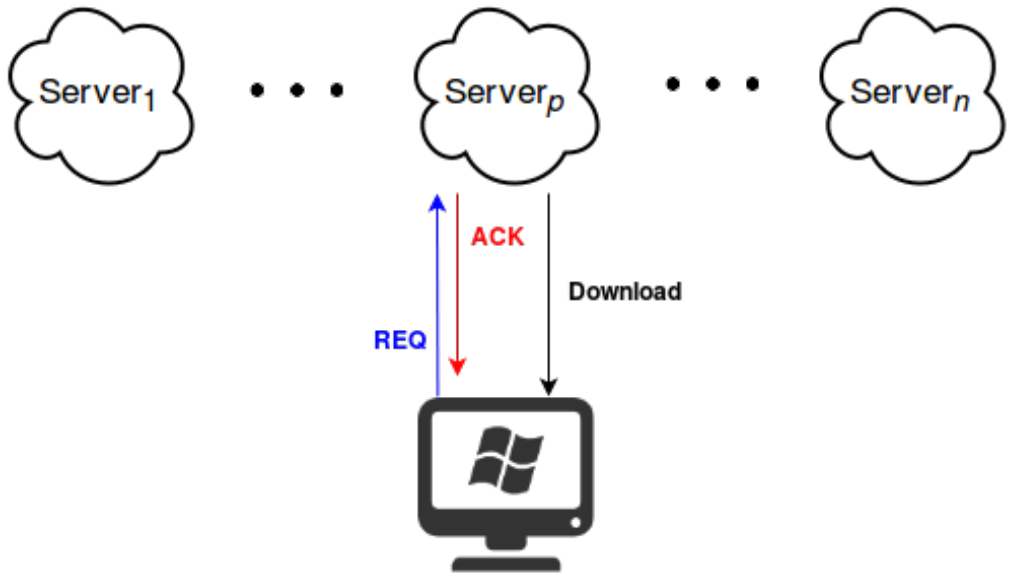
$REQ = (op, [op]_{pri(D)})$

op.type = AUDIT
op.path = " "
op.msg = " "

$ACK = (result = merkleTreeNew.roothash,$
$REQ = lastReq,$
$[result, REQ]_{pri(S)})$

AUDIT

II. Download Roothash or Merkle Tree



$REQ = (op, [op]_{pri(D)})$

op.type = AUDIT
op.path = attestationPath
op.msg = " "

ACK = (result = Utils.digest(file),
REQ,
$[result, REQ]_{pri(S)}$)
if lastReq.op == DOWNLOAD:
file = merkleTreeOld.roothash
if lastReq.op == UPLOAD:
file = serialize(merkleTreeOld)

```
1  AUDIT(lastAck)
2        op ← lastAck.req.op
3        if op.type = DOWNLOAD
4              success ← roothash.equals(lastAck.result)
5        if op.type = UPLOAD
6              merkleTreeOld.update(op.msg)
7              success ← roothash.equals(lastAck.result)
8        return success
9
```

Listing 1: Audit algorithm

Outline

Implement Steps

1. Hash Handle : create, update, delete
2. Operation Handle : read, write, audit
3. File Transmit : send, receive
4. Merkle Tree Transmit : serialize
5. *Instant Auditing of Cloud Storage Access by Cache Partial Merkle tree*
6. Run on Real Cloud Environment (VM)

Outline

Create Merkle Tree

Account A	666 MB	42 files	6 directories
Account B	34 MB	54192 files	188 directories
Account C	6.54 GB	58484 files	1718 directories
Account D	20.6 GB	175389 files	5154 directories

Table: TIMES REQUIRED TO GENERATE THE ROOT HASH FROM NOT-HASHED FILES (IN SECONDS)

Account	Senior	My	MerkleTree Size
A	*3.404*	*3.645*	3.74 KB
B	*16.618*	*7.669*	3.77 MB
C	*229.351*	*242.198*	4.30 MB
D		*815.408*	12.9 MB

Operation Processing Time

Table: DOWNLOAD TIME (ms)

Account	100 times	Audit*
A	*4635*	*34 + 0*
B	*4660*	*33 + 0*
C	*5429*	*31 + 0*
D	*5554*	*31 + 0*

Table: UPLOAD TIME (ms)

Account	100 times	Audit*
A	*4322*	*41 + 7*
B	*5643*	*421 + 997*
C	*9236*	*421 + 2621*
D	*11466*	*1263 + 8085*

* download attestations time + audit time

Thank You!