4th International Workshop on Storage Security and Survivability
StorageSS'08

Improving Secure Long-Term Archival of Digitally Signed Documents

Carmela Troncoso Danny De Cock
Bart Preneel

KULeuven COSIC/ESAT (Belgium)

31st October Washington

Why do we need long term archival?

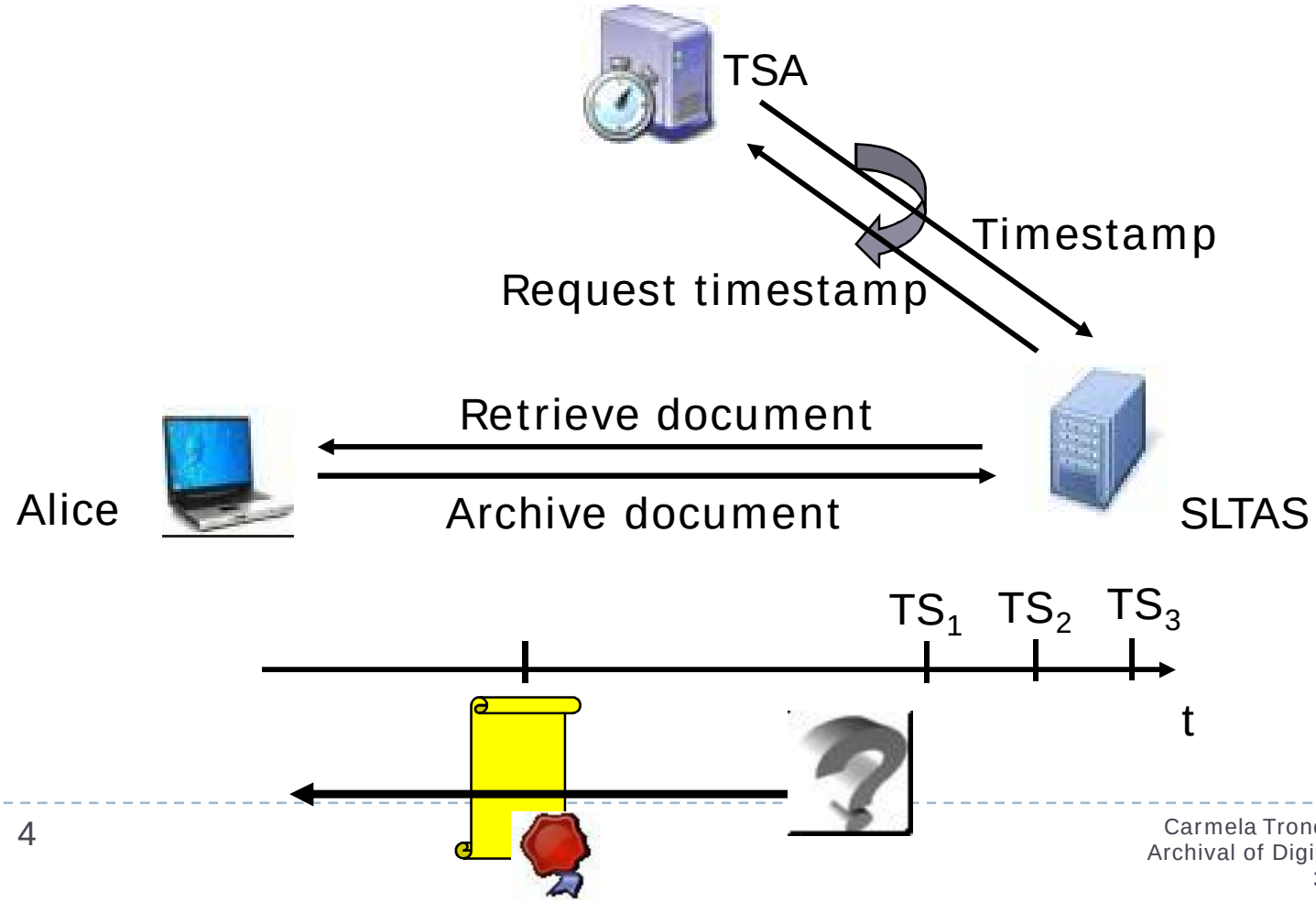
- **Digital archives**: documents and archives move to the electronic world
- **Secure Digital archives**: documents and archives move to the electronic world
  - Confidentiality
  - Integrity
  - Availability
- But… what happens in the long term?
  - Security properties degrade
  - Crypto primitives obsolescence: computing power and cryptanalysis
  - Invalidation of certificates,…

Secure Long-Term Archival System

- Focuses on **preserving integrity** and proof the **validity of signatures**
- Given a signed archived document, an SLTAS must be able to prove:
  - The signature was valid at the time of creation
  - The signing time (indisputable way)
  - The content has **not** changed
- even if…
  - the cryptography of its digital signature becomes obsolete
  - the certificates are not longer available

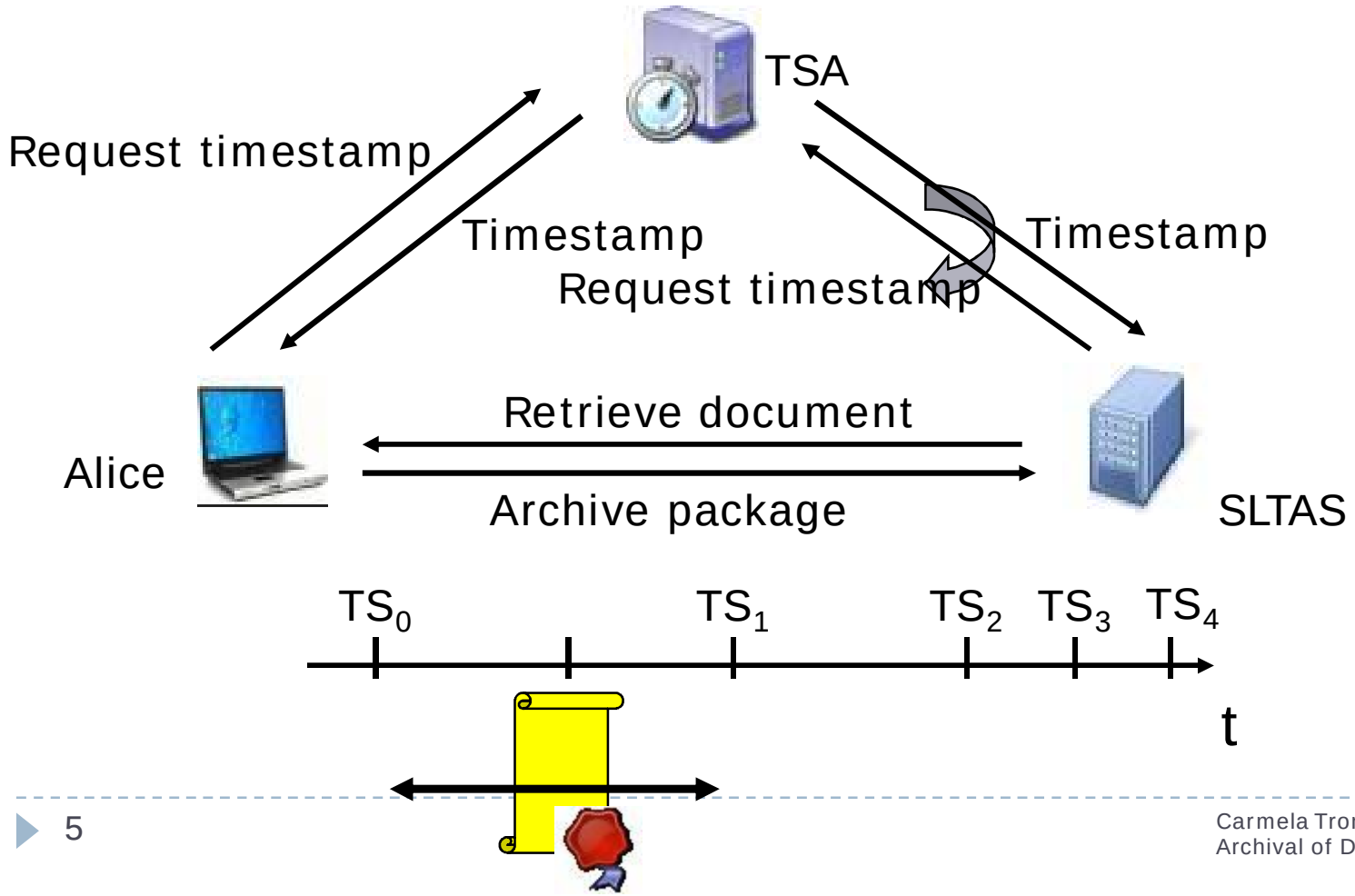
Architecture & Components (I)

- Based on refreshing the validity of the signatures using timestamps (Time Stamping Authority)

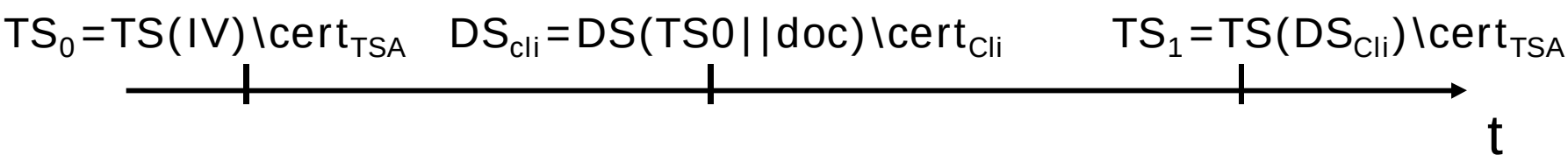


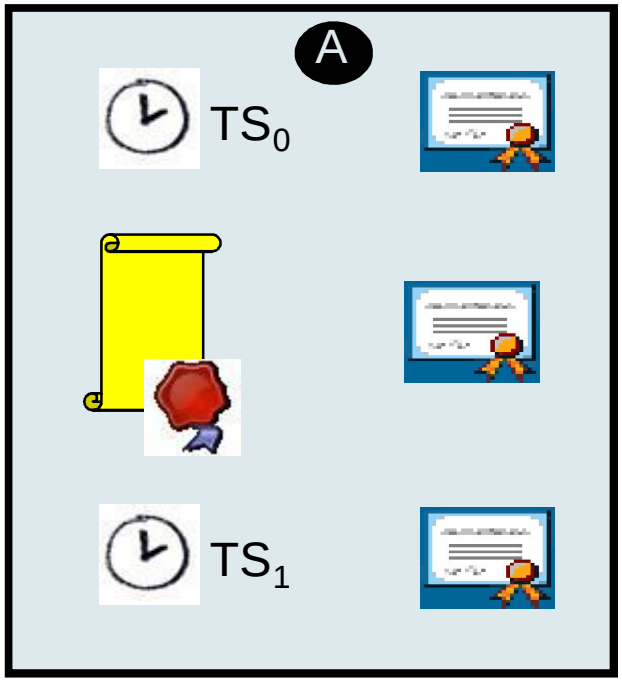
Architecture & Components (II)

- **Solution**: Timestamping in the client side!

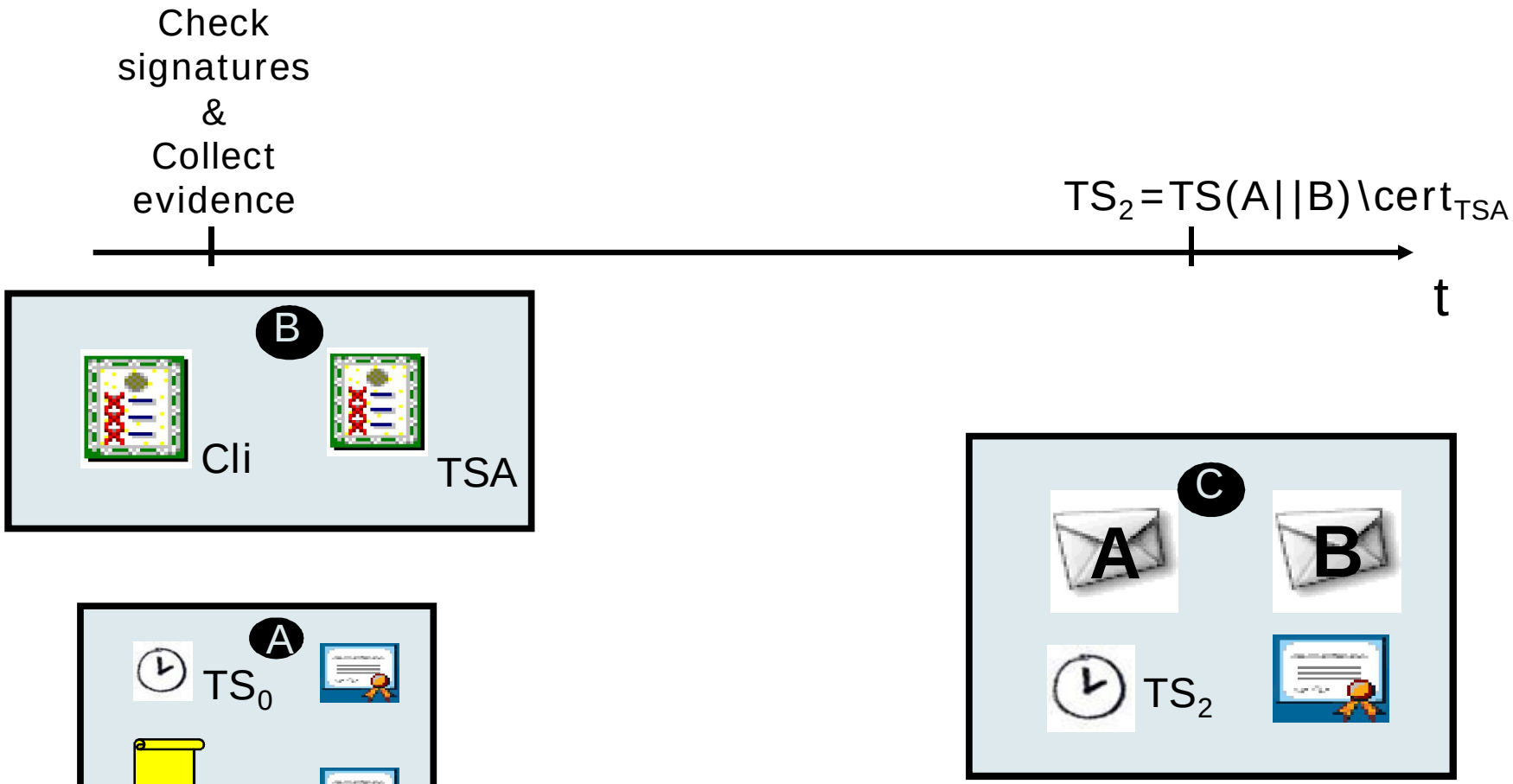


Client Side

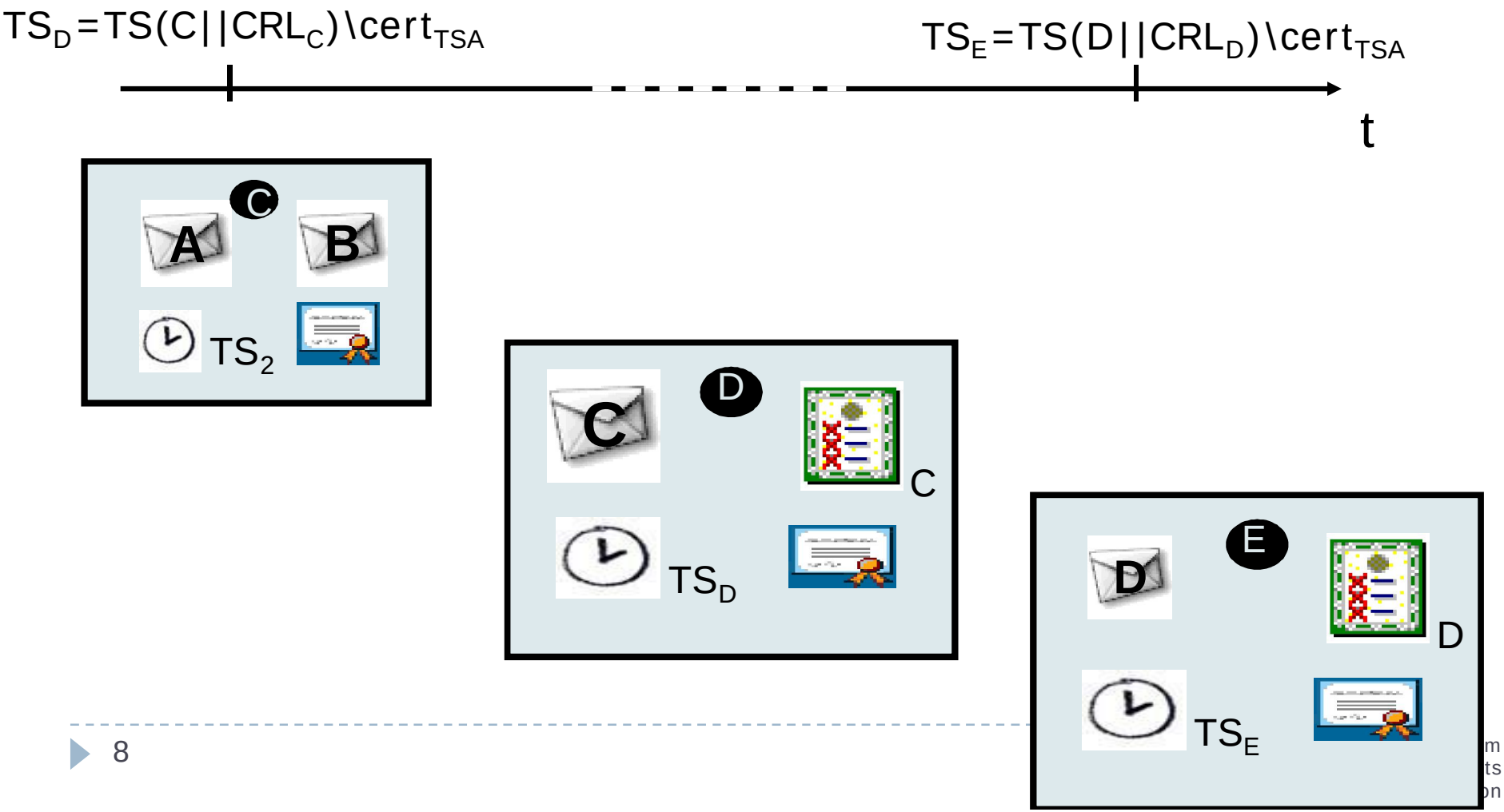

$TS_0 = TS(IV) \backslash cert_{TSA}$
$DS_{cli} = DS(TS0||doc) \backslash cert_{Cli}$
$TS_1 = TS(DS_{Cli}) \backslash cert_{TSA}$
t


A
TS_0
TS_1

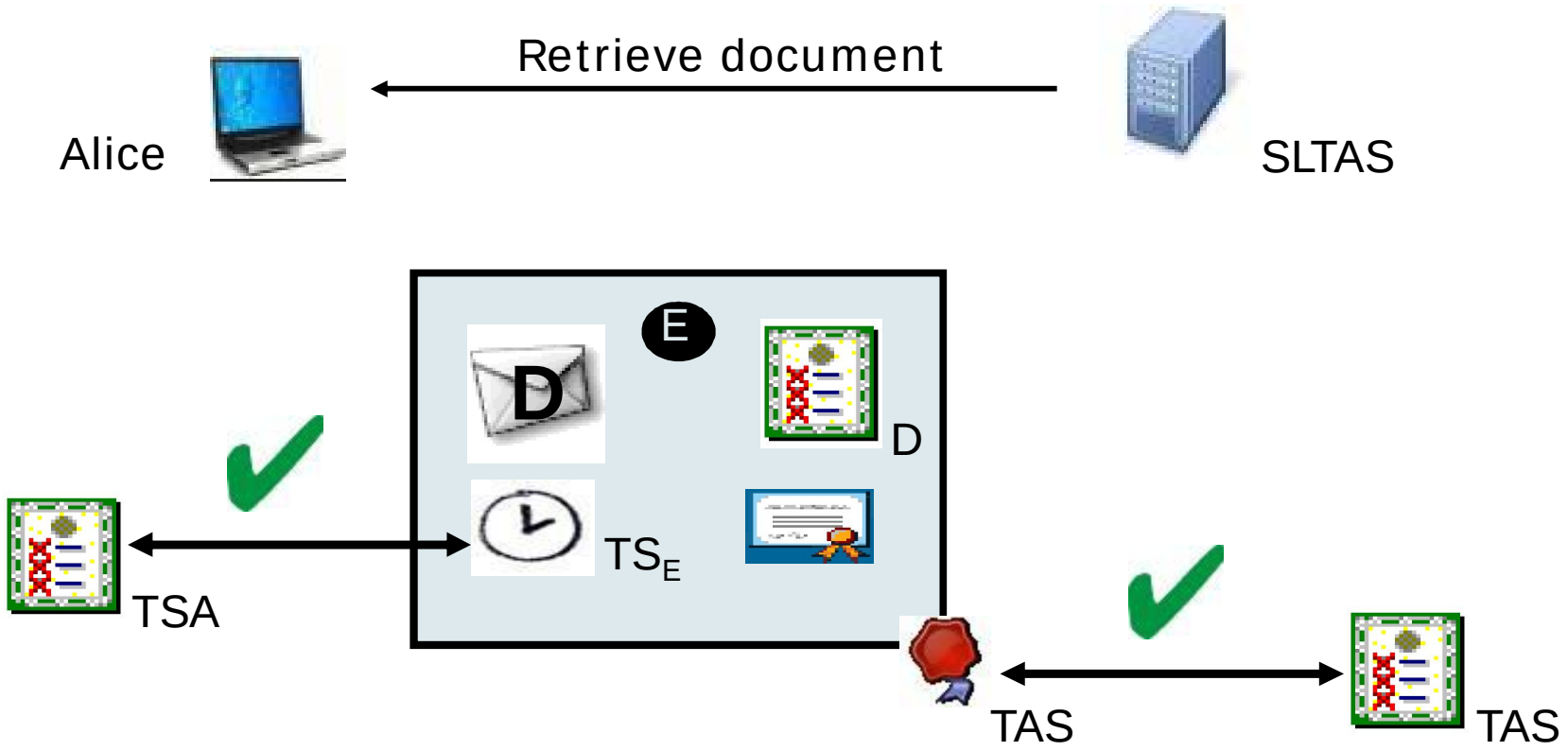
Server Side


Check signatures & Collect evidence
$TS_2 = TS(A||B) \backslash cert_{TSA}$
t
B
Cli
TSA
C
A
B
TS_2
A
TS_0
TS_1

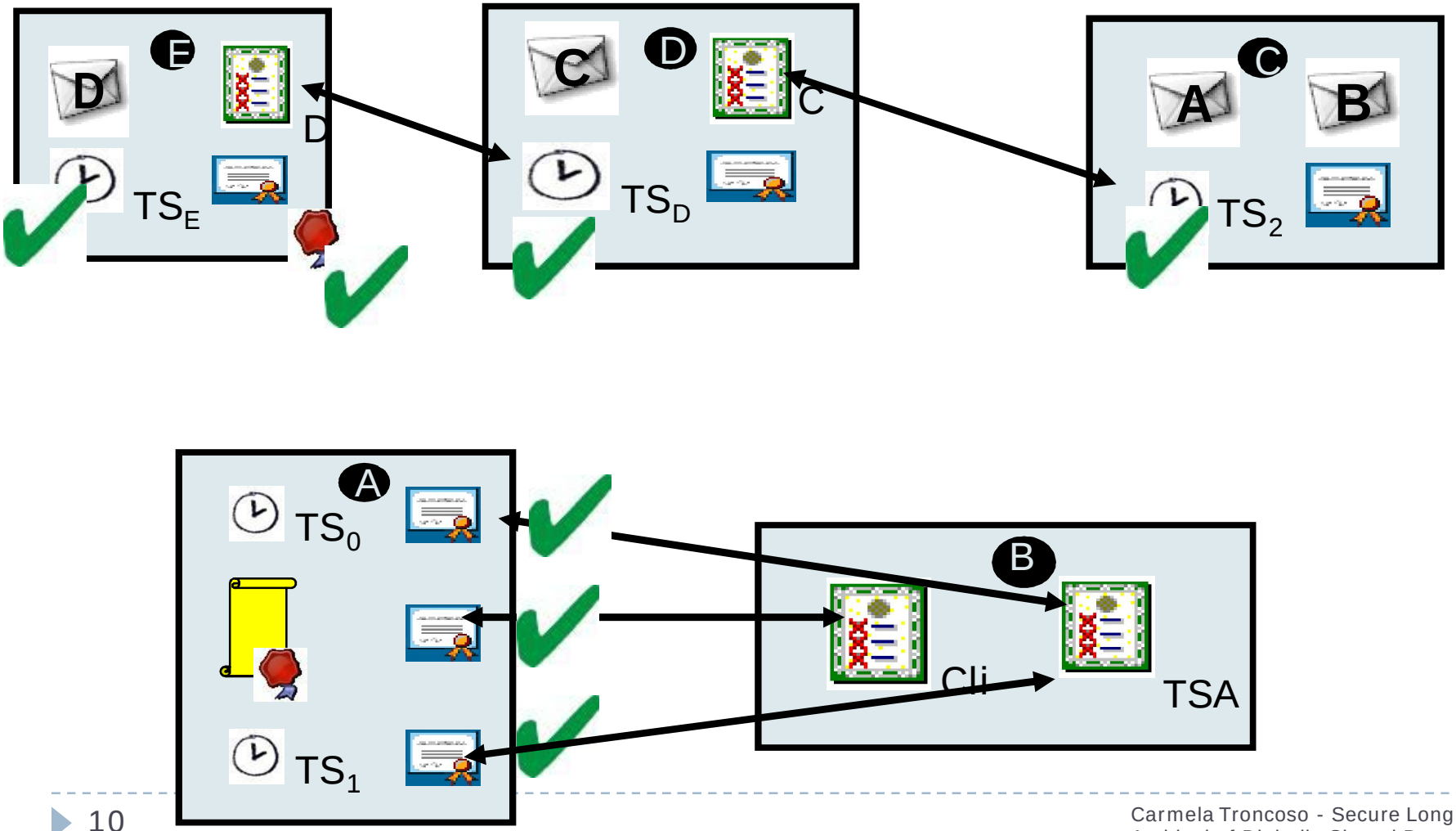
Re-timestamping



Retrieval - One-signature validation



Retrieval - Complete validation



Discussion

- Cryptographic algorithms take time to break
- No modification operation (against goal)
  - Store modification (Haber and Kamat, 2006)
  - Could solve migration
- Potential "infinite" storage space needed
  - Kryder's Law: ~Moore's law disk storage cost (half cost per year)
  - Not that large…

Discussion

- Confidentiality
  - SLTAS will be able to read after long time
  - What is the SLTAS archiving?
  - Key management?

- Availability
  - Replication and backups
  - PASIS, SafeStore,…

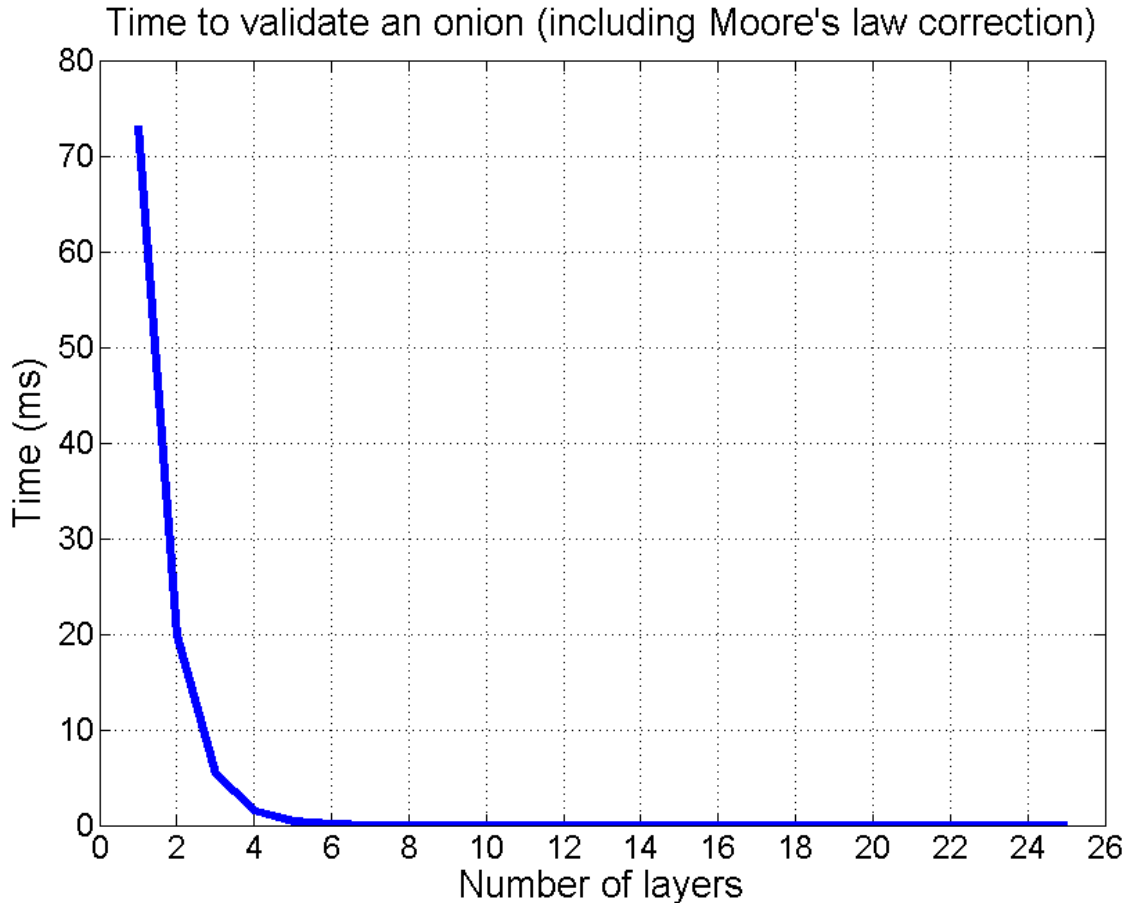
- Retrieval token storage and integrity preservation

Evaluation

- Java non optimized implementation
  - RSASSA-PSS signatures (Client: 1024 bits, SLTAS and TSA: 2048 bits)
  - X.509 certificates
- 1st step: archiving a document
  - Client create the first packet (A): overhead 9.7Kb, <1s
  - SLTAS reception and verification: <350ms
- 2° step: retimestamp
  - each 3 years
  - +256bits per retimestamping iteration
  - <700ms (Moore's Law)

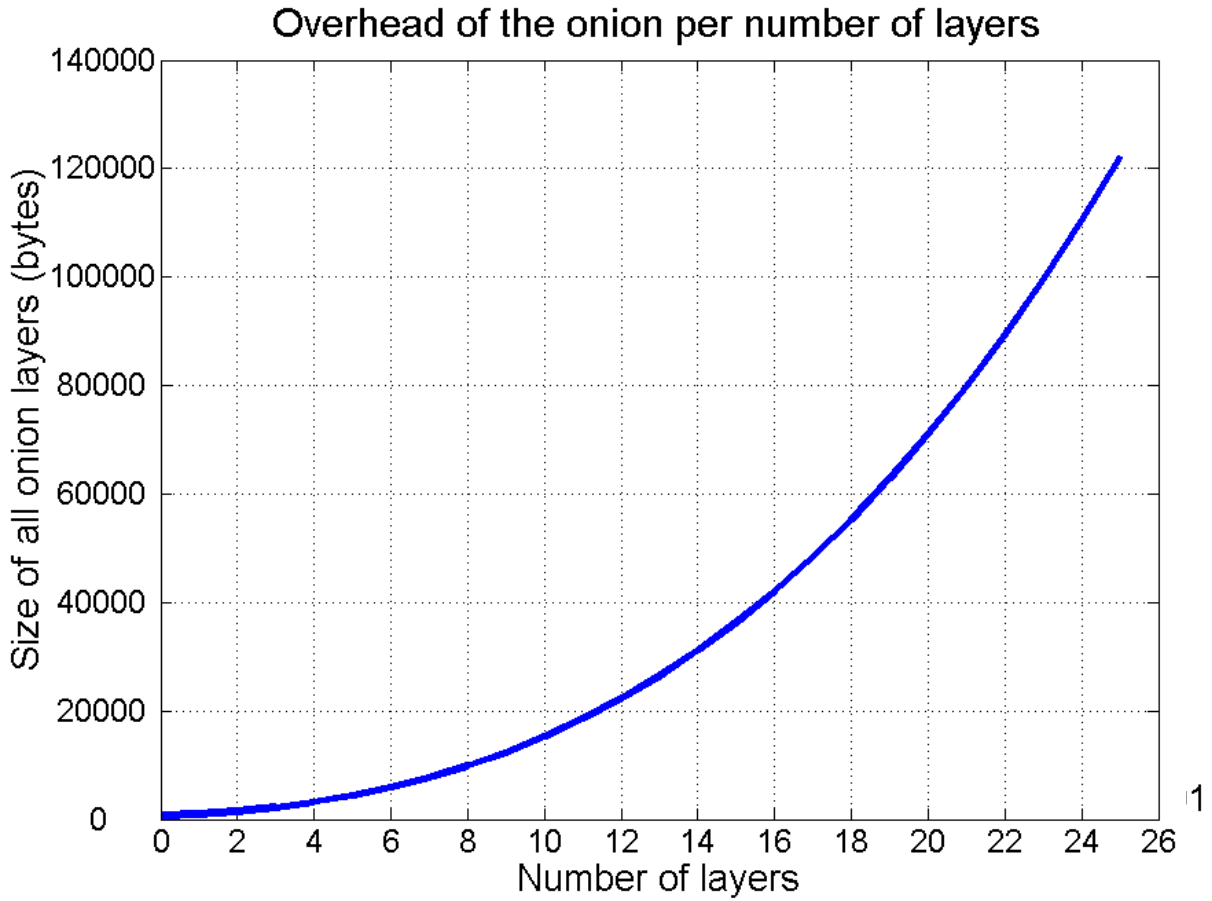
Evaluation

- 3° step: retrieving a document (full-validation)



Evaluation

- Storage overhead (all but document)



Conclusion

- Step forward in the design of SLTAS:
  - Integrity over time
  - Validity of signatures
  - Even if certificates revoked or unavailable
  - **Bounded** time of signing
- Space and time efficient
- Future work
  - Privacy friendly?
  - Other schemes: e.g., data checking

COSIC

Car mela.Troncoso@esat.kuleuven.be

Thanks for your attention!!

Questions?