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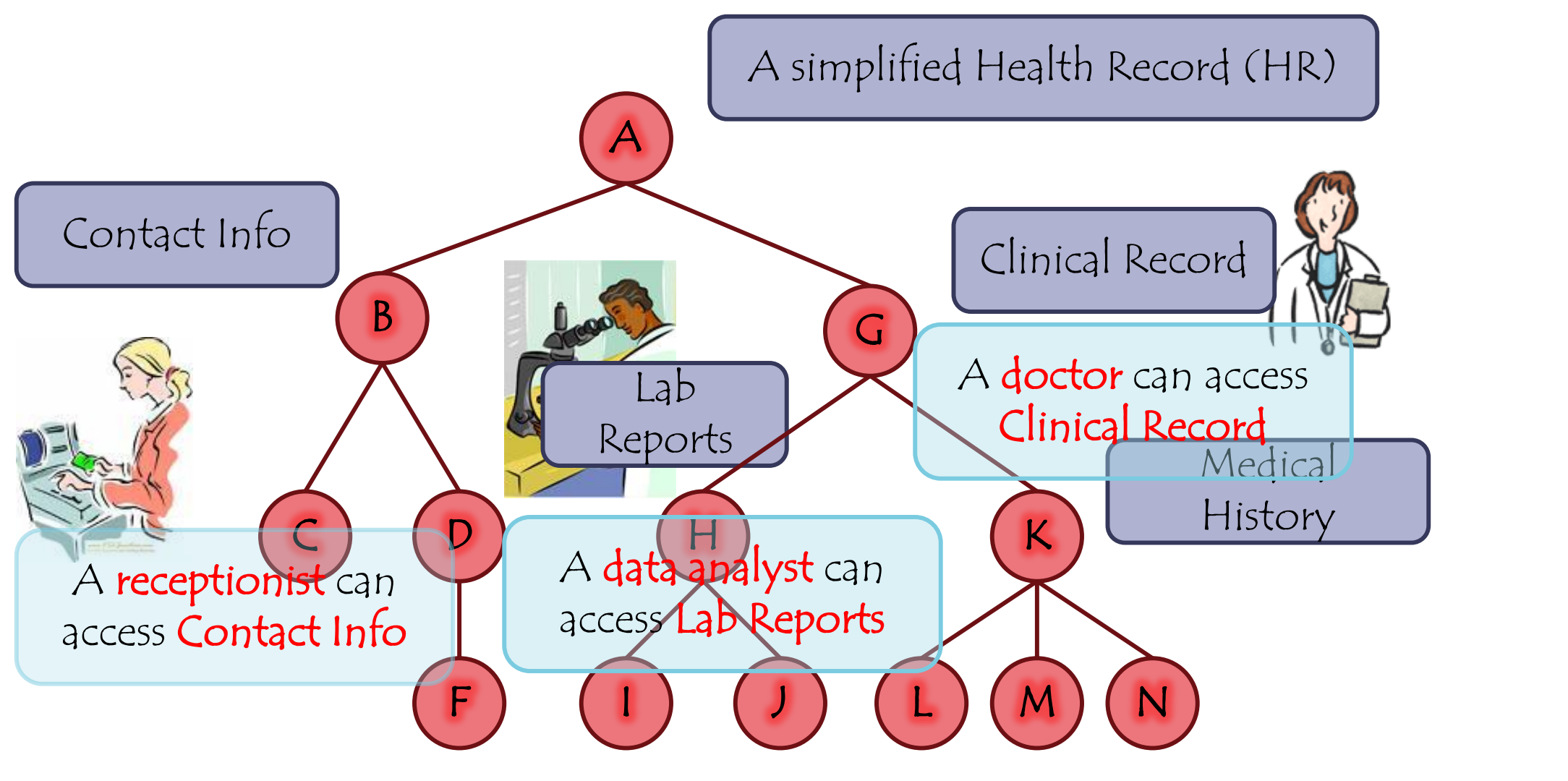
Preserving Privacy in Policy-Based Content Dissemination

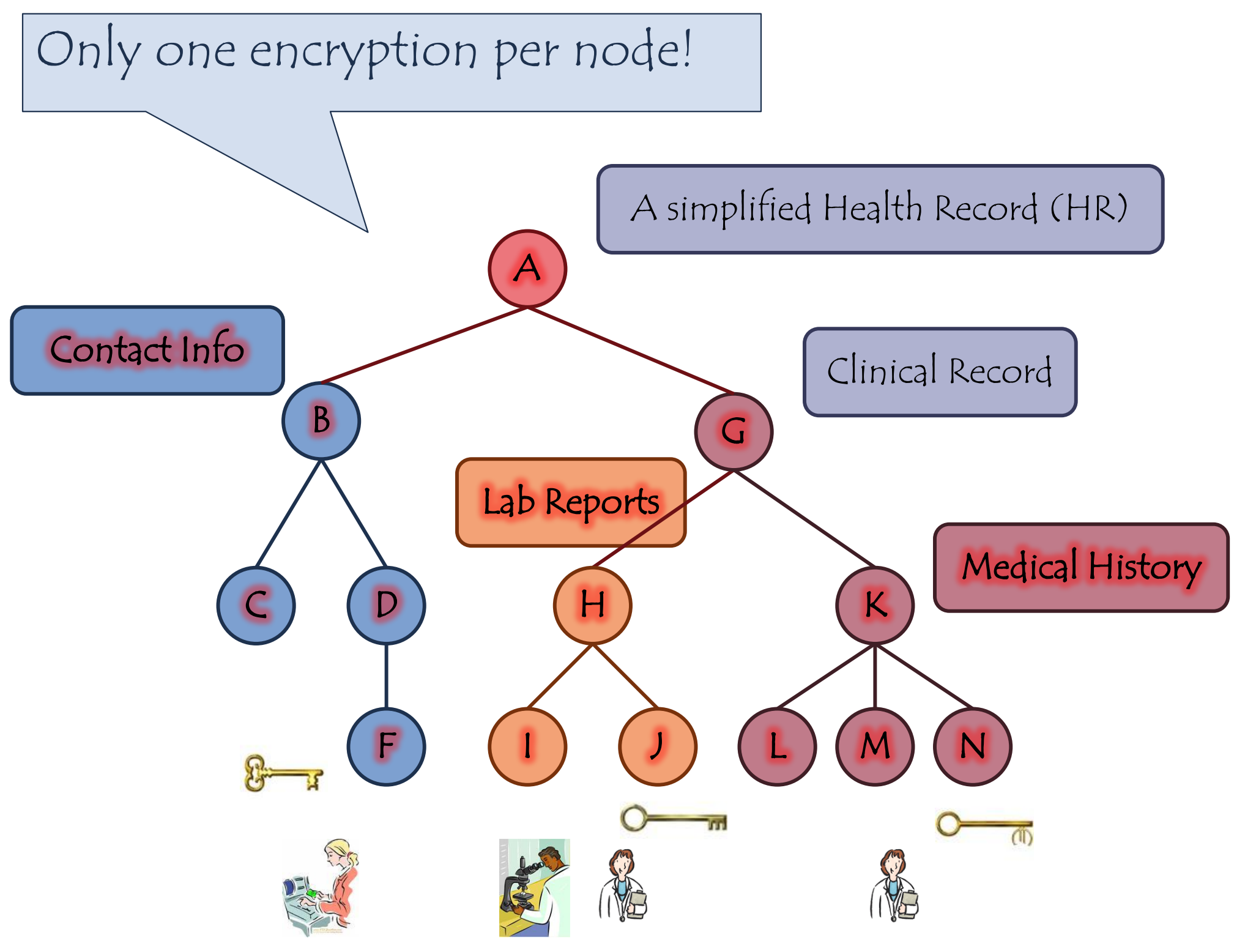
Mohamed Nabeel, Ning Shang, Elisa Bertino (Purdue University)

What is policy based content dissemination?

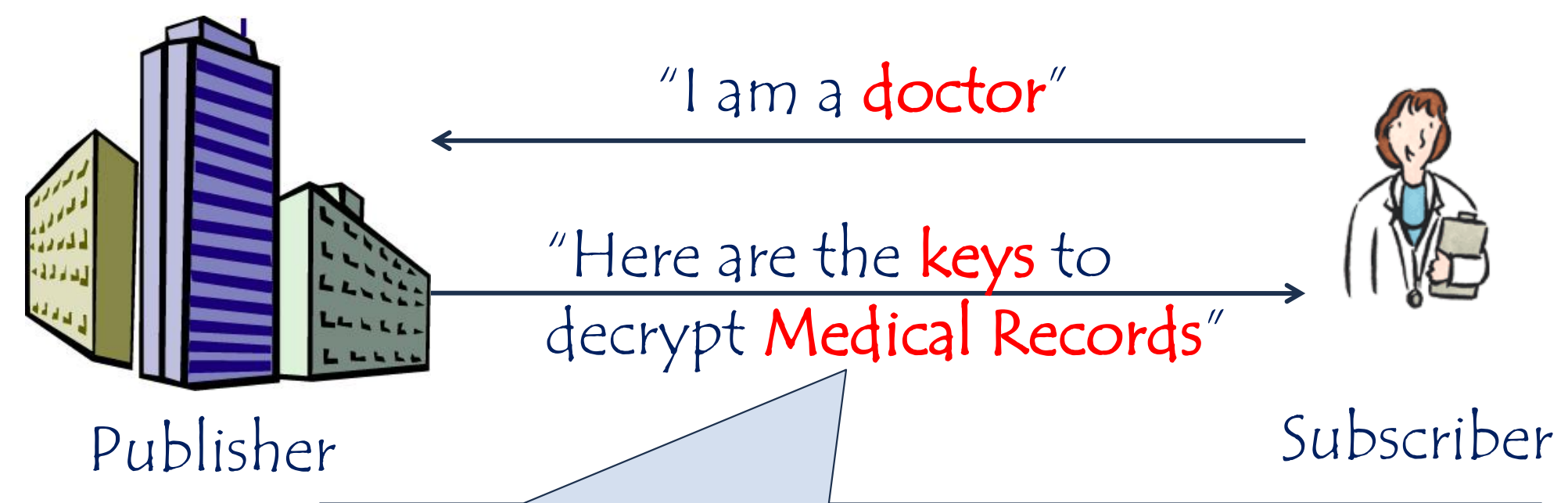

A simplified Health Record (HR)
A
B
G
C
D
H
K
F
I
J
L
M
N
Contact Info
Lab Reports
Clinical Record
Medical History
A receptionist can access Contact Info
A data analyst can access Lab Reports
A doctor can access Clinical Record

Attribute Based Access Control (ABAC)

A simplistic approach using encryption



Issue #1: Privacy of the users is not preserved

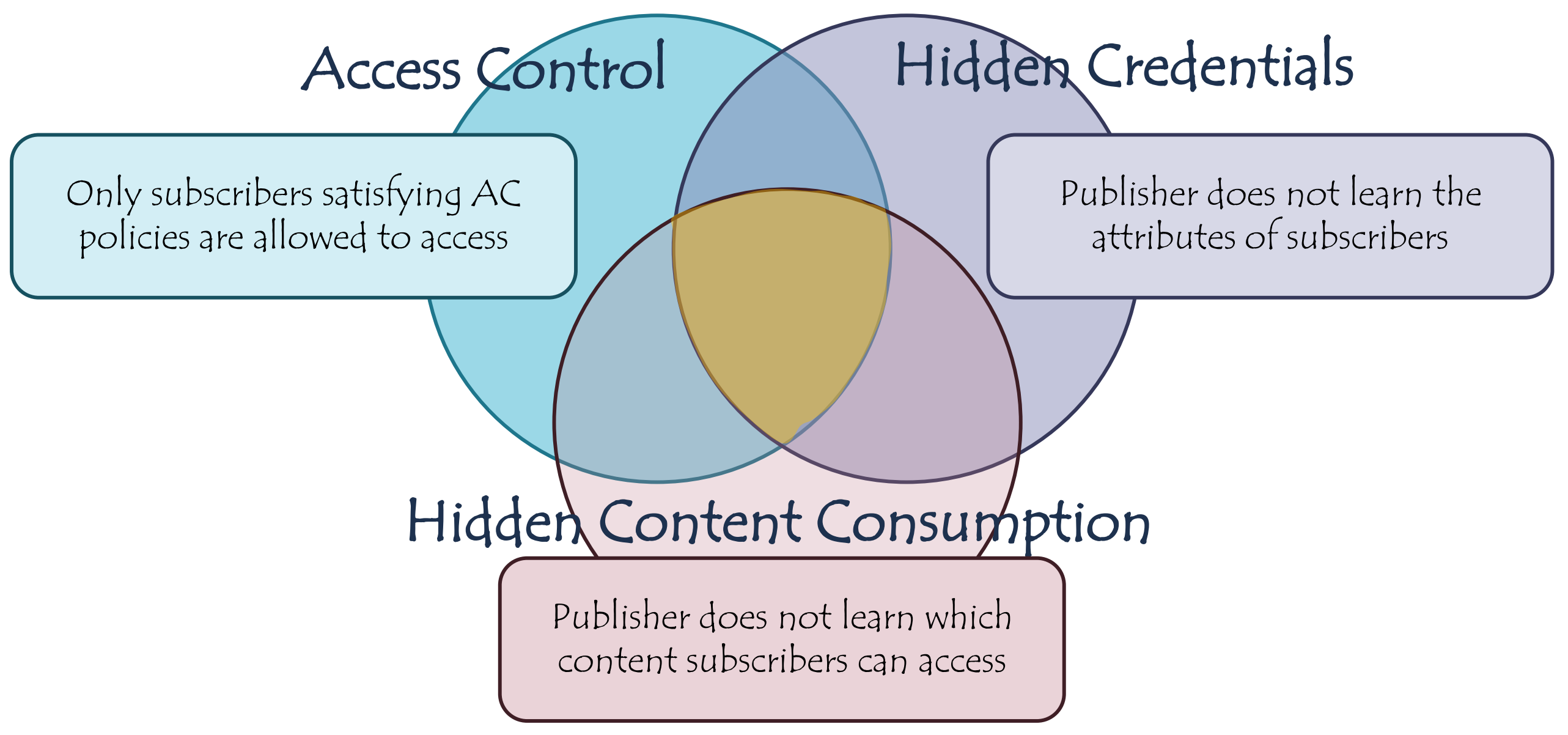


1. Need to reveal credentials
2. Need a private communication channel for re-keying

Issue #2: The key management does not scale

Re-keying has O(n) communication overhead (n = number of users)

Requirements for maximal amount of privacy & security



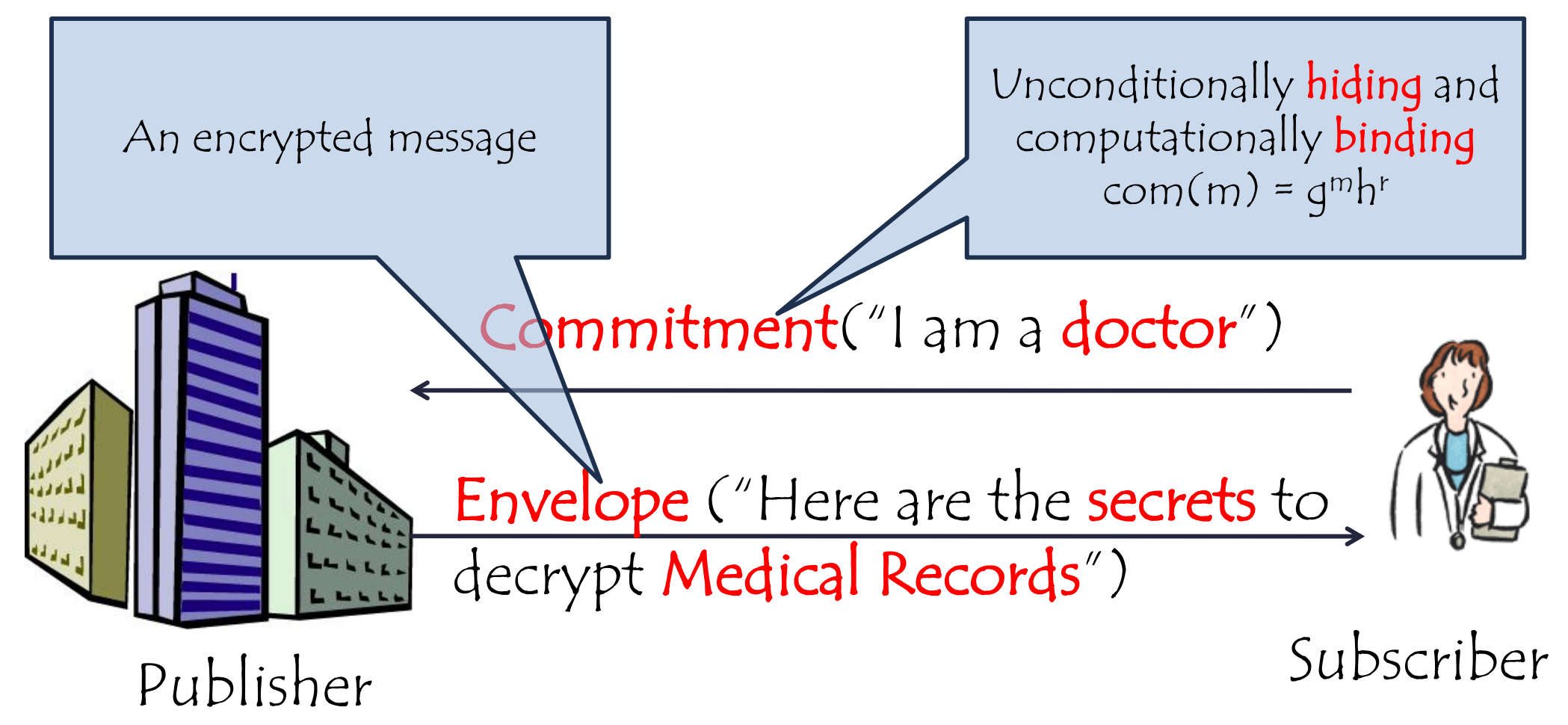
Only subscribers satisfying AC policies are allowed to access

Publisher does not learn the attributes of subscribers

Publisher does not learn which content subscribers can access

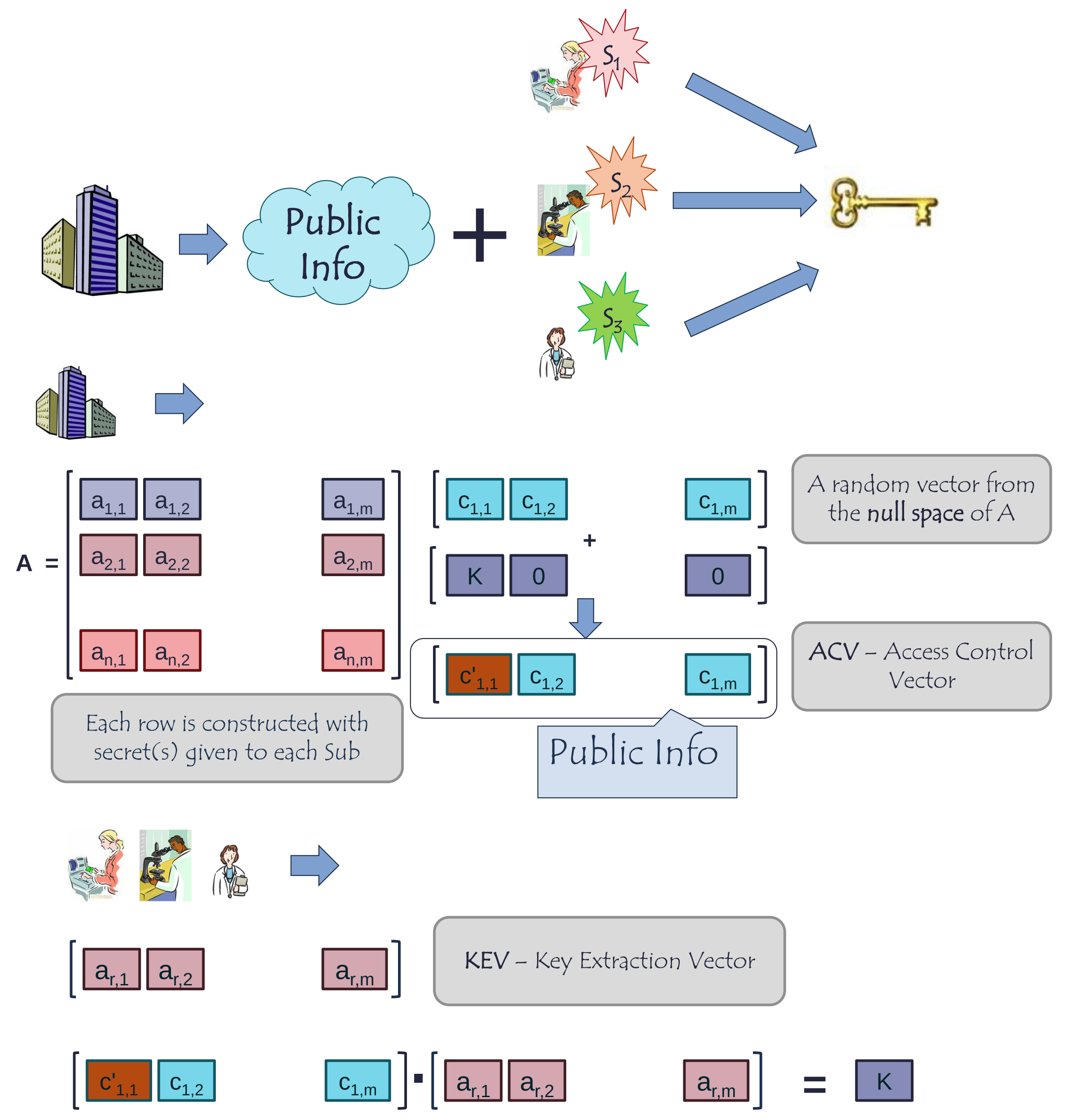
Building blocks: OCBE and BGKM schemes

OCBE: Oblivious Commitment Based Envelope


An encrypted message
Unconditionally hiding and computationally binding com(m) = $g^m h^r$
Commitment("I am a doctor")
Envelope ("Here are the secrets to decrypt Medical Records")
Publisher
Subscriber

- Publisher does not learn credentials
- User can open the envelope only if her credential satisfies the condition

BGKM: Broadcast Group Key Management


Public Info
+
S_1
S_2
S_3
A =
$a_{1,1}$ $a_{1,2}$ $a_{1,m}$
$a_{2,1}$ $a_{2,2}$ $a_{2,m}$
$a_{n,1}$ $a_{n,2}$ $a_{n,m}$
$c_{1,1}$ $c_{1,2}$ $c_{1,m}$
+
K 0 0
$c'_{1,1}$ $c_{1,2}$ $c_{1,m}$
Public Info
$a_{r,1}$ $a_{r,2}$ $a_{r,m}$
$c'_{1,1}$ $c_{1,2}$ $c_{1,m}$ · $a_{r,1}$ $a_{r,2}$ $a_{r,m}$ = K

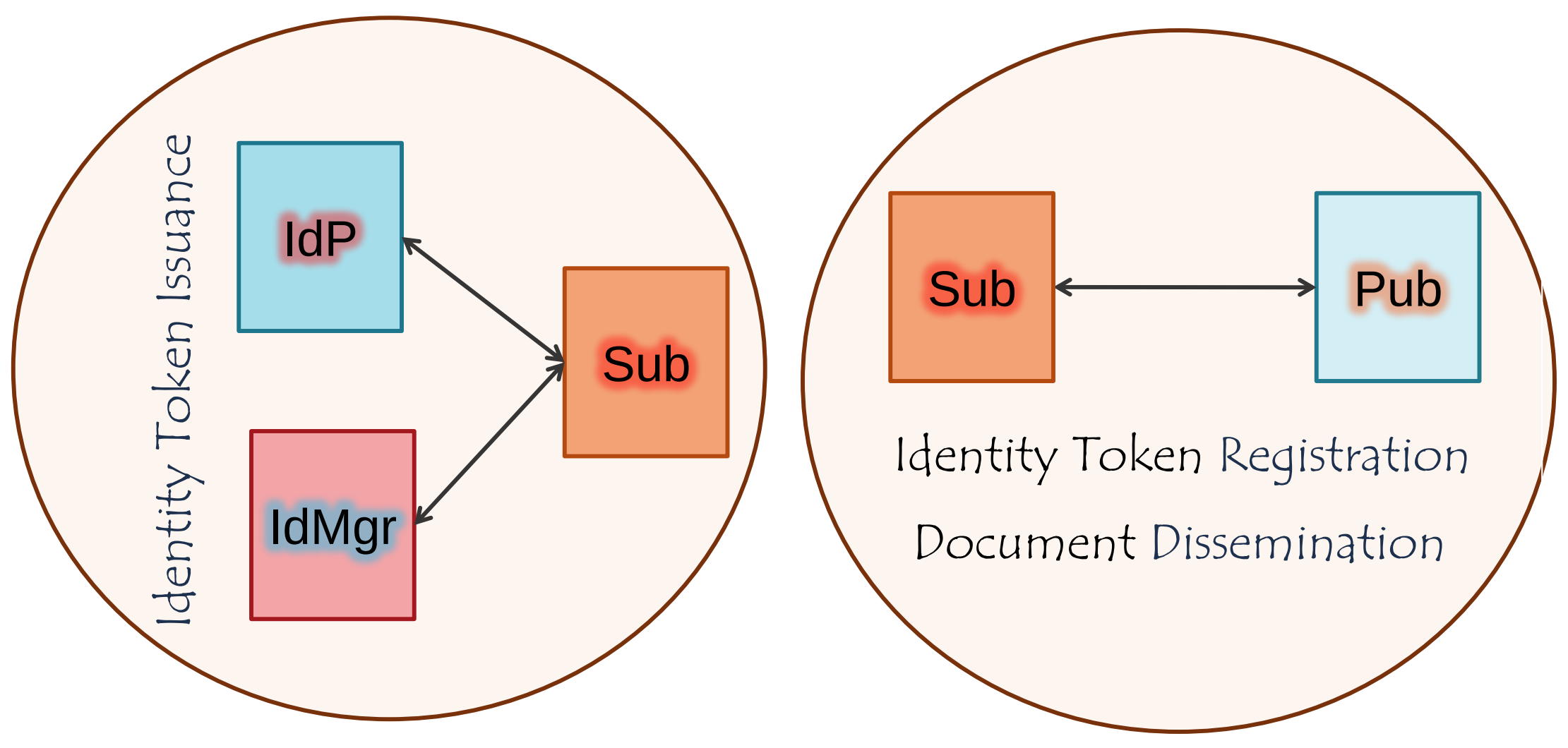
A random vector from the null space of A

ACV – Access Control Vector

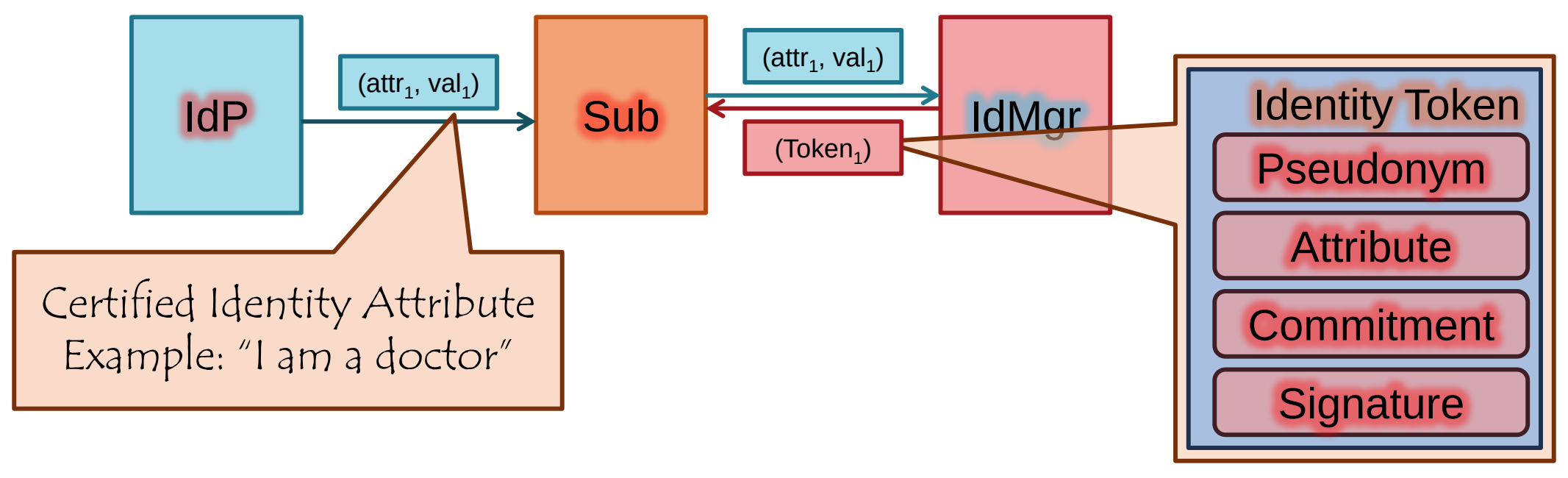
Each row is constructed with secret(s) given to each Sub

KEV – Key Extraction Vector

Putting everything together (OCBE + BGKM)

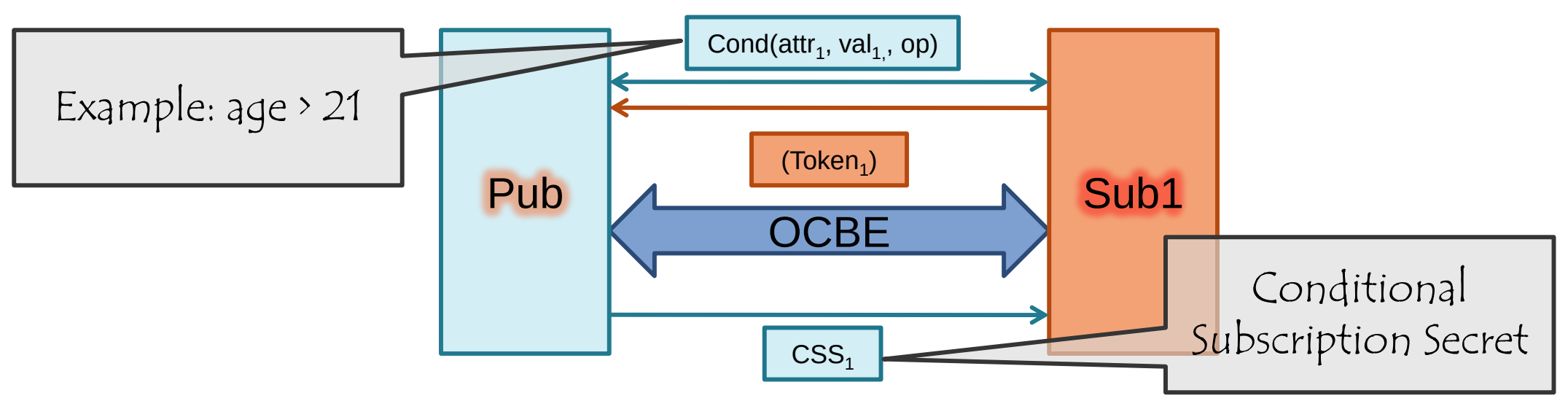


Identity Token Issuance

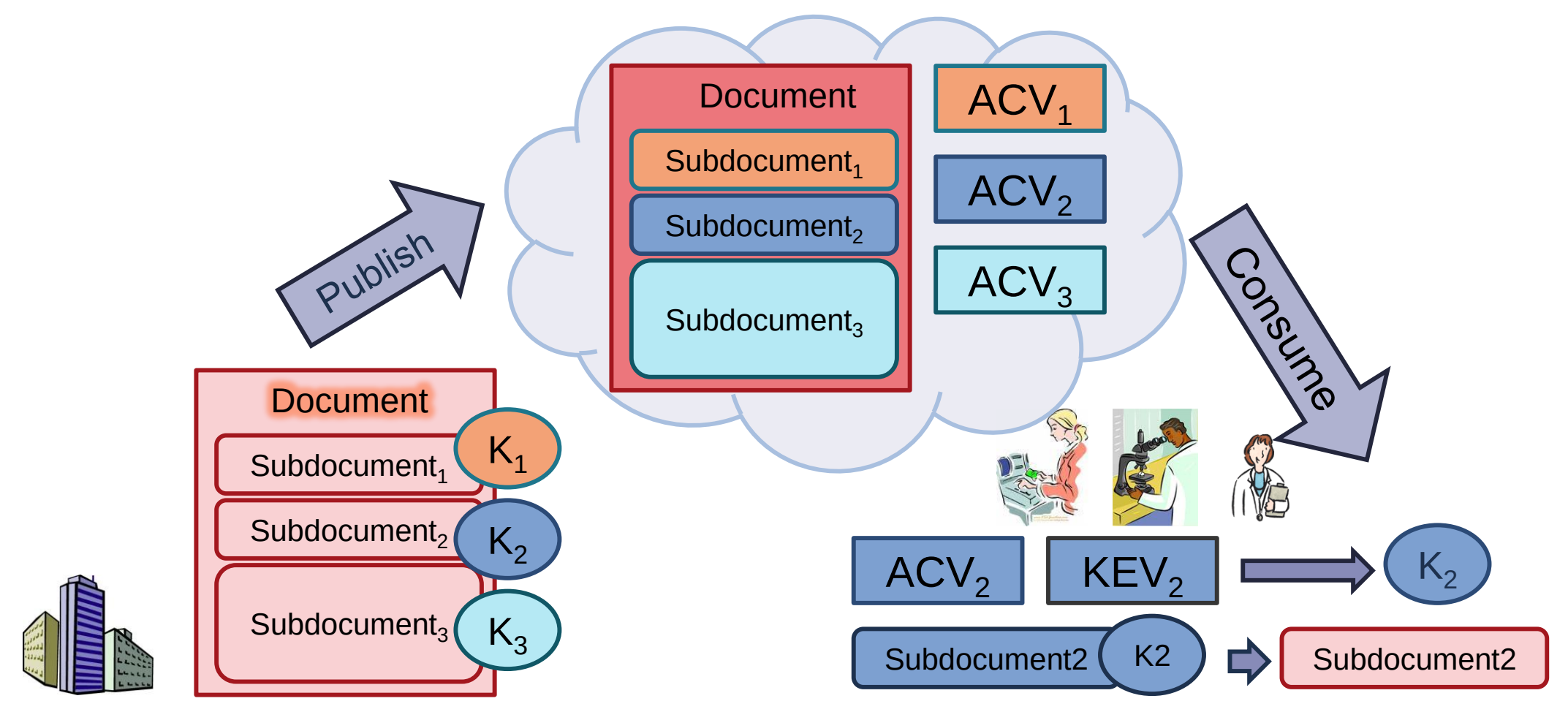


Certified Identity Attribute Example: "I am a doctor"

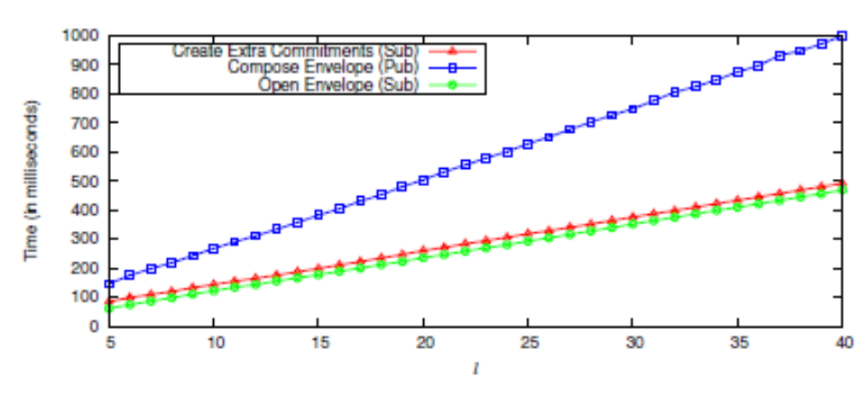
Identity Token Registration



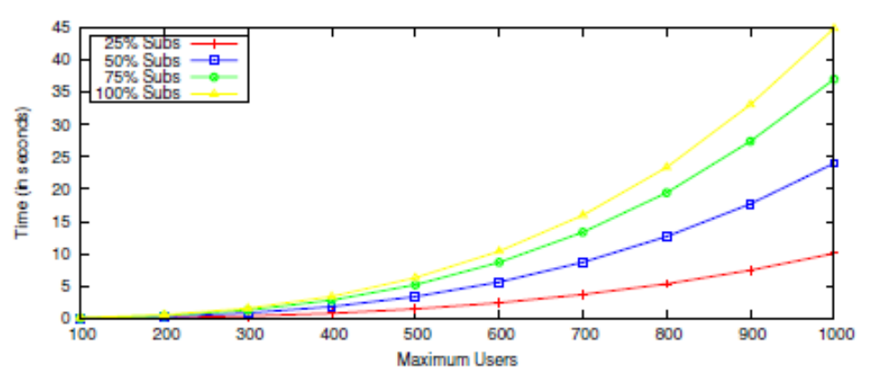
Document Dissemination



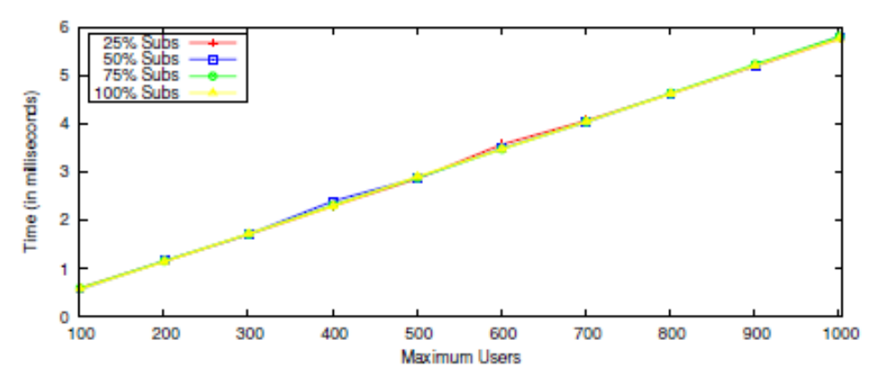
Some selected experimental results



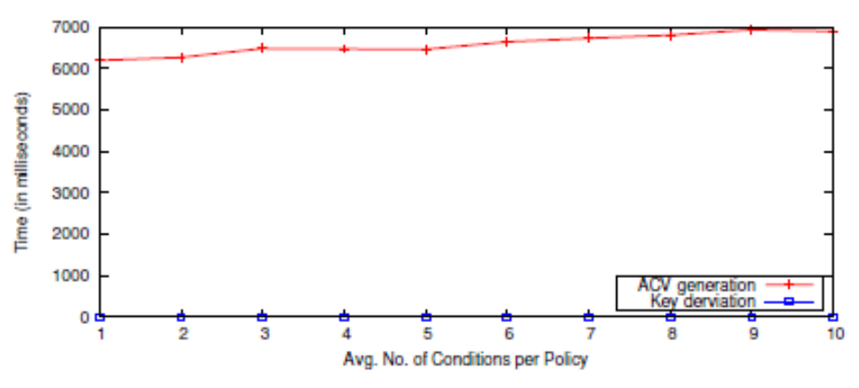
Average computation time for running one round of GE-OCBE protocol



Time to generate an ACV for different user configurations



Key derivation time for different user configurations



ACV generation and key derivation for different number of conditions per policy

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