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Efficient and Flexible Attribute Policy Based Key Management

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Scalable, efficient and flexible key management is essential for many secure systems/services

Location based services

Cloud/outsourced storage services

Content dissemination

Multimedia streaming

Control access to content/service → Encryption → Group key management

A large group of users

Service/access provided to subsets of users

Users may collude

Common characteristics

New users join

Existing users leave

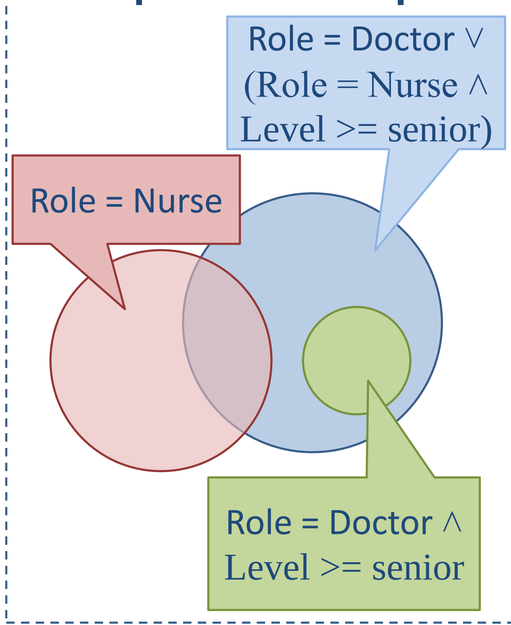
Dynamic nature of groups

User attributes change over time

Requirements

1. Forward/backward secrecy
2. Collusion resistance
3. Transparent join/leave (Stateless - Efficiency)
4. Flexible group policies (attribute based)
5. Single encryption

Group membership



Our key techniques

Any **broadcast GKM** scheme → *Subset-Cover* techniques → *Sub-linear* BGKM

Provide users **secrets** for each **attribute condition** → Construct a BGKM per attribute condition → Construct an **access tree** based on the policy using BGKMs as leaves

Threshold membership policies (Key derivation)

$q_1(0) = q_i(x)$

Each user is assigned a *unique* polynomial of degree *d - 1*

Attr Cond$_1$ (s$_1$) → BGKM$_1$
Attr Cond$_2$ (s$_2$) → BGKM$_2$
Attr Cond$_3$ (s$_3$) → BGKM$_3$
. . .
Attr Cond$_m$ (s$_m$) → BGKM$_m$

Polynomial interpolation with *d* intermediate keys

OR → *1*-out-of-*2*
AND → *2*-out-of-*2*
General → *d*-out-of-*m*

Bottom-up

Any monotonic membership policy (Keygen)

$q_1(x)$ n_1

Threshold = t_x
# children = n_x
$q(x)$ = degree $t_x - 1$ polynomial

$q_2(x)$ n_2 → $q_2(0) = q_1(2)$
$q_3(x)$ n_3 → $q_3(0) = q_1(3)$
$q_4(x)$ n_4 → $q_4(0) = q_1(4)$
. . .
$q_m(x)$ n_m → $q_m(0) = q_1(m)$

Continue until leaf nodes are reached

Internal nodes → Threshold gates
Leaves → BGKM instances

Top-down

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