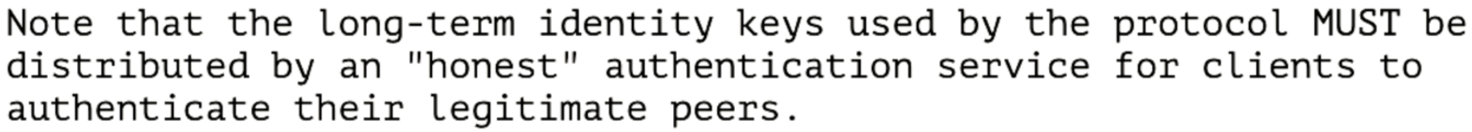
User Authentication within Groups

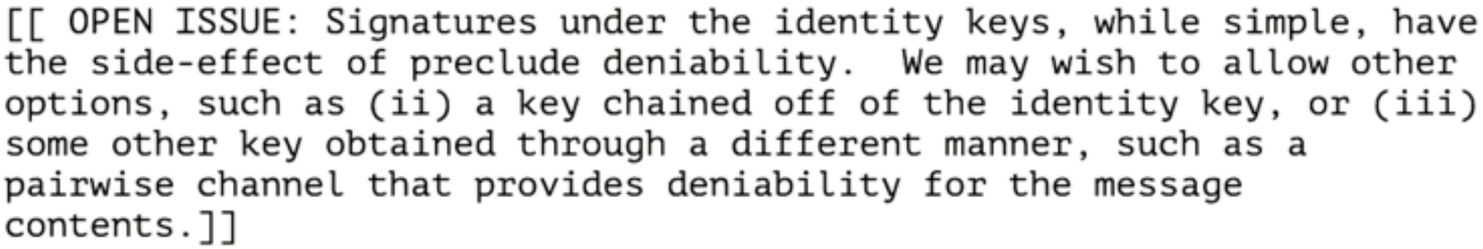
Britta Hale

Based on joint work with Benjamin Dowling

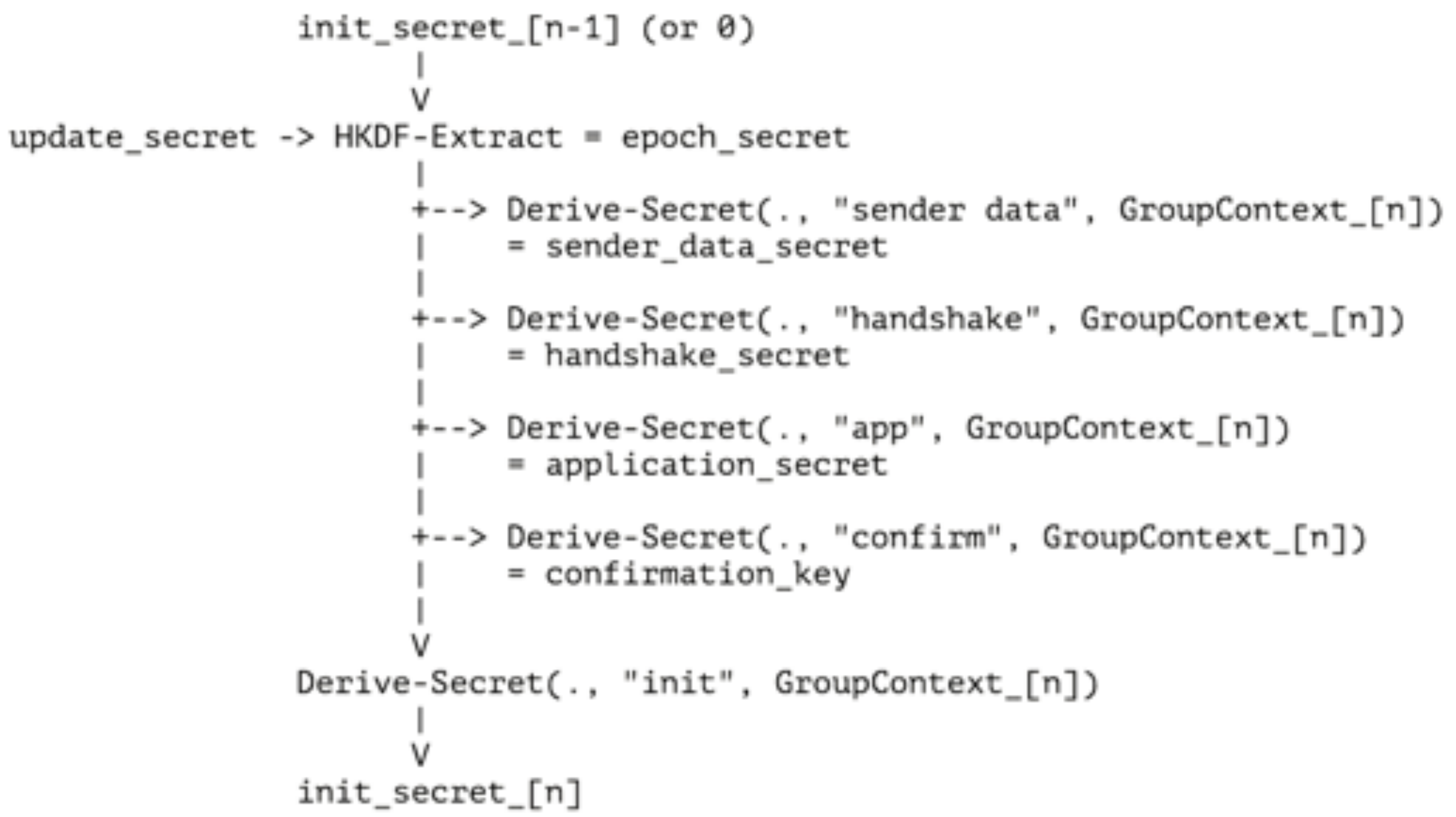
*The views expressed are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.



Note that the long-term identity keys used by the protocol MUST be distributed by an "honest" authentication service for clients to authenticate their legitimate peers.

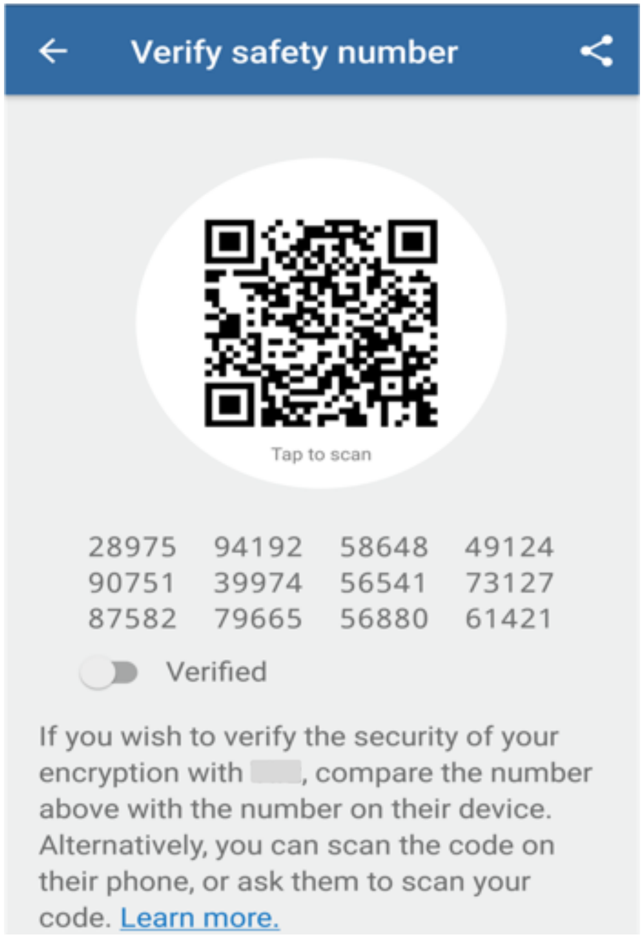


[[OPEN ISSUE: Signatures under the identity keys, while simple, have the side-effect of preclude deniability. We may wish to allow other options, such as (ii) a key chained off of the identity key, or (iii) some other key obtained through a different manner, such as a pairwise channel that provides deniability for the message contents.]]



```
               init_secret_[n-1] (or 0)
                     |
                     V
update_secret -> HKDF-Extract = epoch_secret
                     |
                     +--> Derive-Secret(., "sender data", GroupContext_[n])
                     |    = sender_data_secret
                     |
                     +--> Derive-Secret(., "handshake", GroupContext_[n])
                     |    = handshake_secret
                     |
                     +--> Derive-Secret(., "app", GroupContext_[n])
                     |    = application_secret
                     |
                     +--> Derive-Secret(., "confirm", GroupContext_[n])
                     |    = confirmation_key
                     |
                     V
               Derive-Secret(., "init", GroupContext_[n])
                     |
                     V
               init_secret_[n]
```

Lessons from Signal Authentication



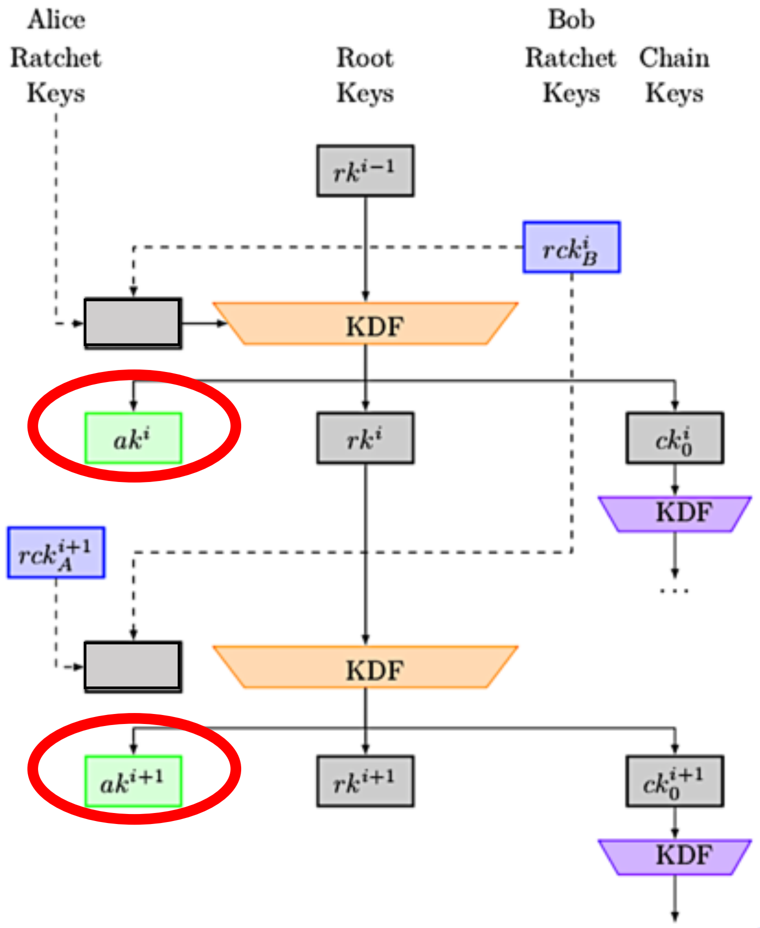
28975 94192 58648 49124
90751 39974 56541 73127
87582 79665 56880 61421

Verified

If you wish to verify the security of your encryption with [redacted], compare the number above with the number on their device. Alternatively, you can scan the code on their phone, or ask them to scan your code. Learn more.

Epoch-Level Authentication

Modified Device-to-User Signal Authentication

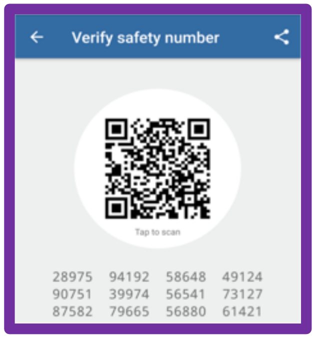


New QR-code computation:

$$\mathtt{fprint}^{i-1} = \mathsf{HMAC}(ak^{i-1}, H^{i-1}\|\mathtt{fvers}\|role)$$
$$\mathtt{fprint}^{i} = \mathsf{HMAC}(ak^{i}, H^{i}\|\mathtt{fvers}\|role)$$

*Session specific

*Asynchronicity in computation



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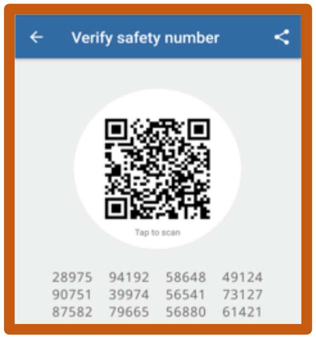
87582 79665 56880 61421



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90751 39974 56541 73127
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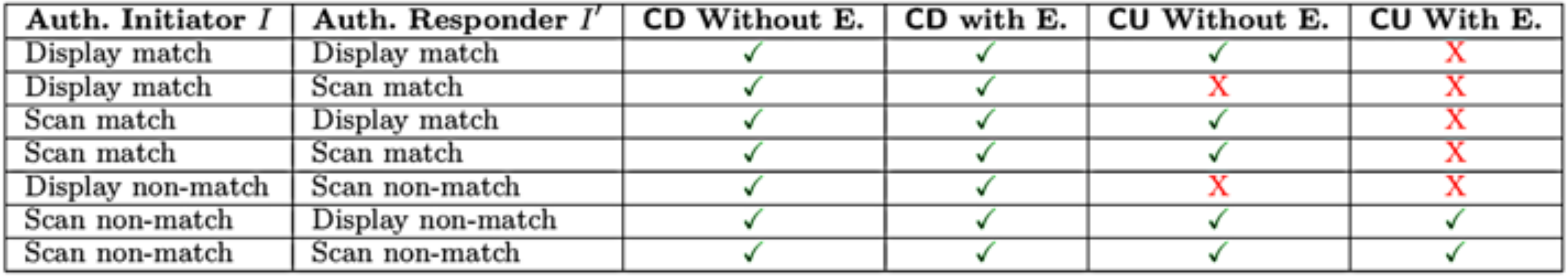
Achievable Guarantees

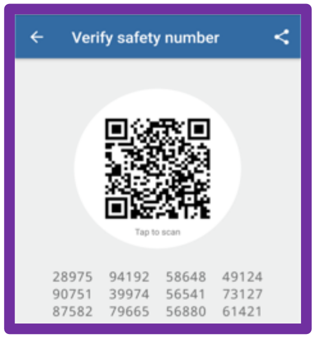


Auth. Initiator I	Auth. Responder I'	CD Without E.	CD with E.	CU Without E.	CU With E.
Display match	Display match	✓	✓	✓	X
Display match	Scan match	✓	✓	X	X
Scan match	Display match	✓	✓	✓	X
Scan match	Scan match	✓	✓	✓	X
Display non-match	Scan non-match	✓	✓	X	X
Scan non-match	Display non-match	✓	✓	✓	✓
Scan non-match	Scan non-match	✓	✓	✓	✓

CD: Compromised Device

CU: Compromised User

E: Eavesdropper



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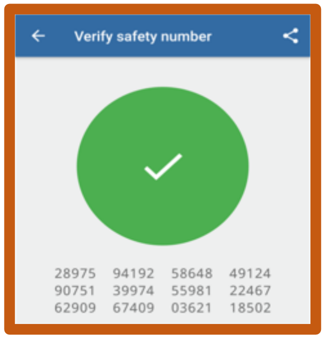
90751 39974 56541 73127
87582 79665 56880 61421



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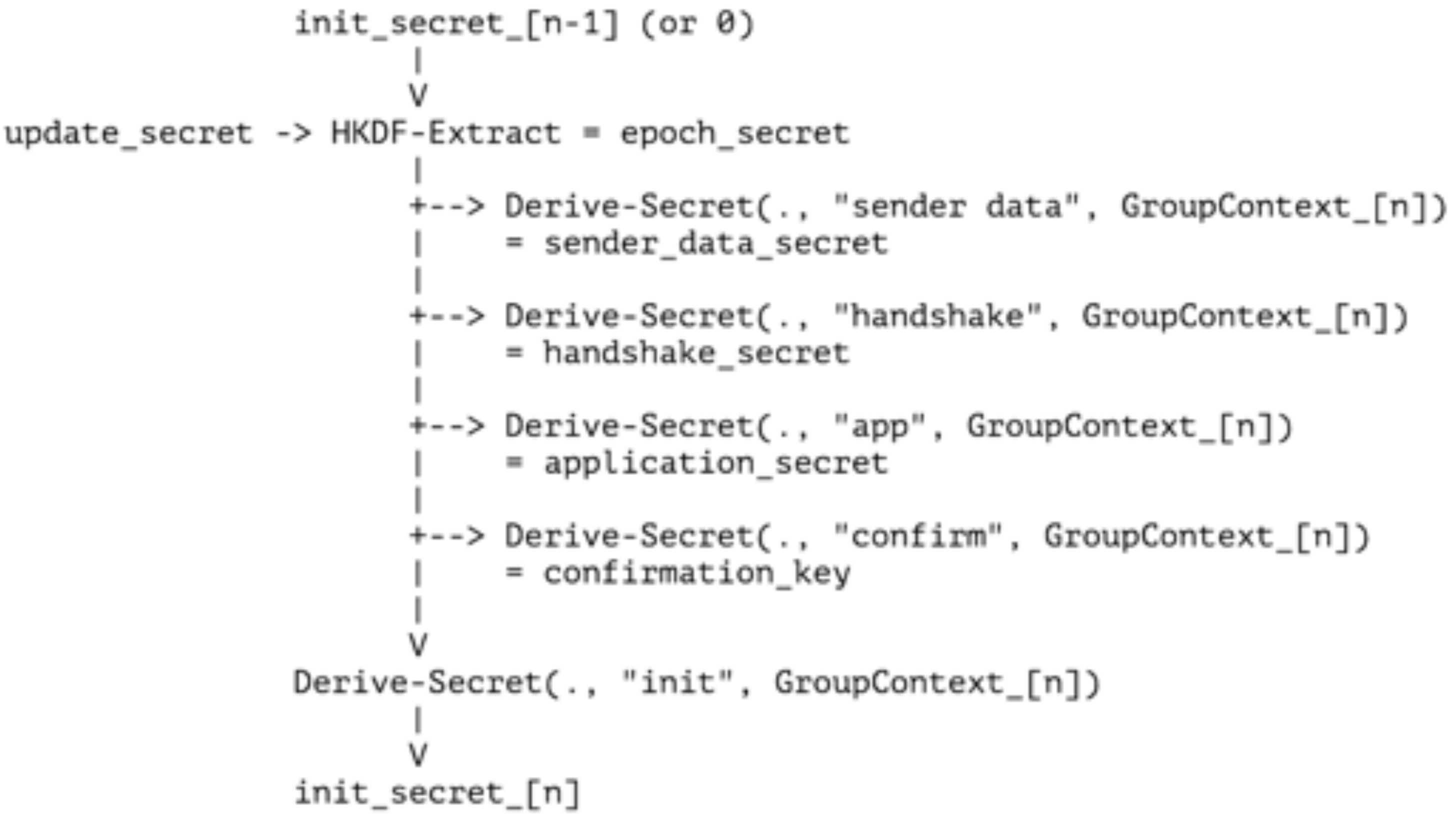
90751 39974 55981 22467
62909 67409 03621 18502



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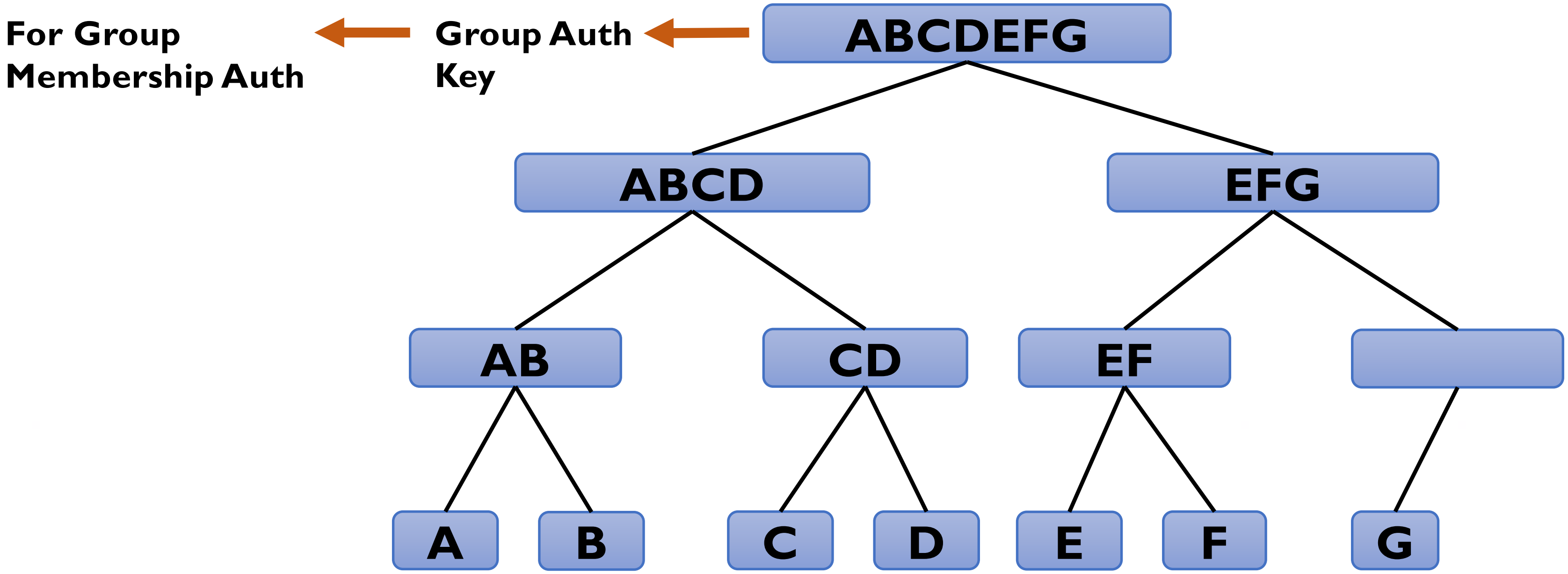
                     +--> Derive-Secret(., "confirm", GroupContext_[n])
                     |    = confirmation_key
                     |
                     V
               Derive-Secret(., "init", GroupContext_[n])
                     |
                     V
               init_secret_[n]
```

Epoch-Level Authentication
Group-Level Authentication



For Group
Membership Auth

Group Auth
Key

ABCDEFG

ABCD

EFG

AB

CD

EF

A

B

C

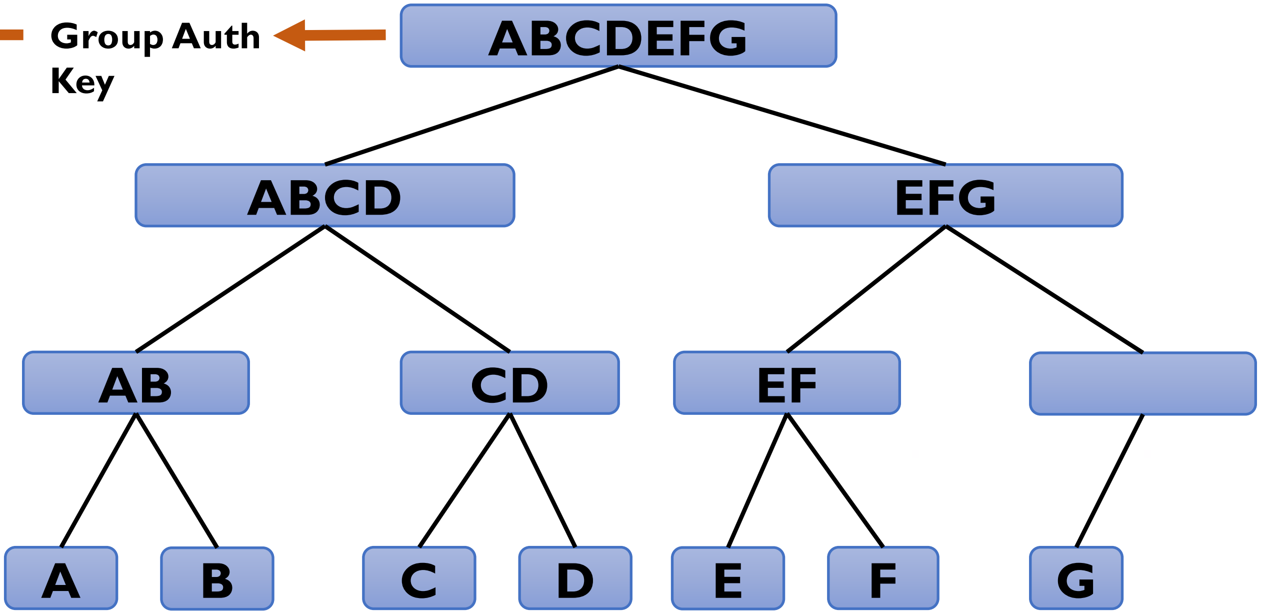
D

E

F

G

For Group Membership Auth ← Group Auth Key ←



For Entity Auth? ← SigKeyA

Entity Auth breaks under static long-term SigKey