e-Cash

Lecture 22

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- Users should not be able to cheat honest merchants. In particular, users should not be able to double-spend

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- Merchant contacts the Bank (online) who ensures that the coin has not been used before (i.e., no double spending) and the signature is valid. If so adds the coin to the spent-coin list

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  - Unforgeability: After t sessions, User cannot output signatures on t+1 distinct messages

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- Blindness, because signer sees only Commit(m). Unlinkability from encryption. Unforgeability from soundness of NIZK, efficient decryption of PKE, and unforgeability of the signature scheme
- Efficient variants (under suitable assumptions) using Groth-Sahai NIZK (or NIWI) scheme and compatible primitives

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  - Idea: verification in two sessions of the spending protocol with the same coin exposes the user's identity

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  - Merchant needs to transfer the User's proof to Bank (i.e., Bank should be convinced that the merchant didn't fake)

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- Fiat-Shamir heuristic (in the Random Oracle Model) to make proofs transferable (and non-interactive)
- Alternately, in the CRS setting, use a NIZK (e.g. Groth-Sahai)

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  - Interactive verification (transferable only using RO)

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    - e.g. (Weak) Boneh-Boyen signature: $\mathrm{Sign}_{SK}(x) = g^{1/(SK+x)}$

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  - Compact e-Cash: Remove linking multiple spending

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  - Issue: A PRF that supports efficient proofs

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- Security/Efficiency/Usability issues: need to cancel stolen electronic wallet; need to recharge electronic wallet (cellphone?) online, but protect it from malware; efficient multiple denomination coins; allow transferability; tracing may not deter double-spending

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  - And they cannot link together multiple proofs coming from the same user

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- Obtaining credential: Carol signs SK_A using the P-Signature scheme using A_C (without learning SK_A). If Carol is a root authority, she requires a proof that A_C is a valid commitment of SK_A that corresponds to PK_A (not anonymous). Else Carol verifies that A_C has a credential from the root authority (as below)

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- Proving: Alice wants to prove to Carol that owner of A_C has a credential from Bob. She commits SK_A again to get A' and shows that she has a signature from Carol on the message in A'. She also proves that A' and A_C have the same message

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- Next: More signatures