

Efficient and Universally Composable Committed Oblivious Transfer and Applications

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- We use the $\binom{2}{1}$ -OT version.

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- [Crépeau-Graaf-Tapp '95] use COT to solve MPC
more efficient than [Kilian '88]

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Intuition: since COT has commitment “built-in,” we don’t need to use OT to implement commitments. This makes the construction of MPC protocols more efficient.

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- + Universally composable (concurrently secure, non-malleable...)

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constant rounds, **constant** number of pub-key operations .
universally composable (in the **CRS** model)
- Efficient construction of 2-PC/MPC protocols using ECOT.
Universally composable (concurrently secure, non-malleable...)
More efficient than [Canetti-Lindell-Ostrovsky-Sahai '02]
Weaker set-up condition than [Damgård-Nielsen '03]

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Commit + Open = commitment

Commit + Transfer + Open = COT

Commit + Prove + Transfer + Open = ECOT

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- **Pedersen commitment** [Pedersen '91]
CRS is $g, h \in \mathbb{Z}_p^*$ with unknown $\log_g h$;
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- **Efficient UCZK protocols** [Garay-MacKenzie-Yang '03]
Construction of efficient UCZK protocols from Ω -protocols.
Used for the **prove** phase.
“simple relations” = “efficient protocols”

The Oblivious Transfer: basics

- Begin:

P_i has committed $B_0 = g^{r_0} h^{b_0}$, $B_1 = g^{r_1} h^{b_1}$;

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■ End:

P_j recovers b_t and commits it using Pedersen.

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- DL-related proofs \Rightarrow efficient ZK protocols \Rightarrow efficient UCECOT.

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 $(x \oplus y) = (x_0 \oplus y_0) \oplus (x_1 \oplus y_1)$
 - **AND**: needs a $\binom{4}{1}$ -OT (can be build from $\binom{2}{1}$ -OT).

P_0 prepares random z_0 and...

$$b_{00} = z_0 \oplus ((x_0 \oplus 0) \wedge (y_0 \oplus 0))$$

$$b_{01} = z_0 \oplus ((x_0 \oplus 0) \wedge (y_0 \oplus 1))$$

$$b_{10} = z_0 \oplus ((x_0 \oplus 1) \wedge (y_0 \oplus 0))$$

$$b_{11} = z_0 \oplus ((x_0 \oplus 1) \wedge (y_0 \oplus 1))$$

P_1 picks $b_{x_1 y_1}$

■ ECOT has commitments and proofs built-in. So directly secure for malicious adversaries ([GMW] needs a compiler).

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- [Damgård-Nielsen '03]: efficient universally composable MPC protocols using homomorphic encryptions in the PKI model (slightly stronger) for adaptive corruption w/o erasing (ours assumes erasing).

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- Full paper in IACR eprint