Implementation of elliptic curve cryptography in constrained environments

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18 Februari 2009

Outline

1 Introduction

2 Elliptic Curve Pairings

3 Implementation

4 Conclussion

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Implement a compact hardware implementation of elliptic curve pairings.

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- Program in GEZEL
- Optimize in VHDL
- Synthetize to FPGA/ASIC

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Overview

1. What?
2. Why?
3. How?

What?

- Calculations over elliptic curves

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- Public key cryptography

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- Identity-based cryptography

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- Key strength [bits]:

RSA	
ECC	256

Underlying mathematics

- Discrete logarithm (DL) problem [hard]:

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- Decision DL problem [easy]:

$$\text{Given: } g, g^a, g^b, g^c \in G : g^c \stackrel{?}{=} g^{ab} \pmod{n}$$

Pairings

Q: What group satisfies CDL_{hard} and DDL_{easy}?
A: Elliptic curve pairing e:

$$e : G_1 \times G_1 \rightarrow G_2$$

Mapping needs to be bilinear, non-degenerate & efficiently computable. Several available pairings:

Weil, Tate, ate, eta, ...

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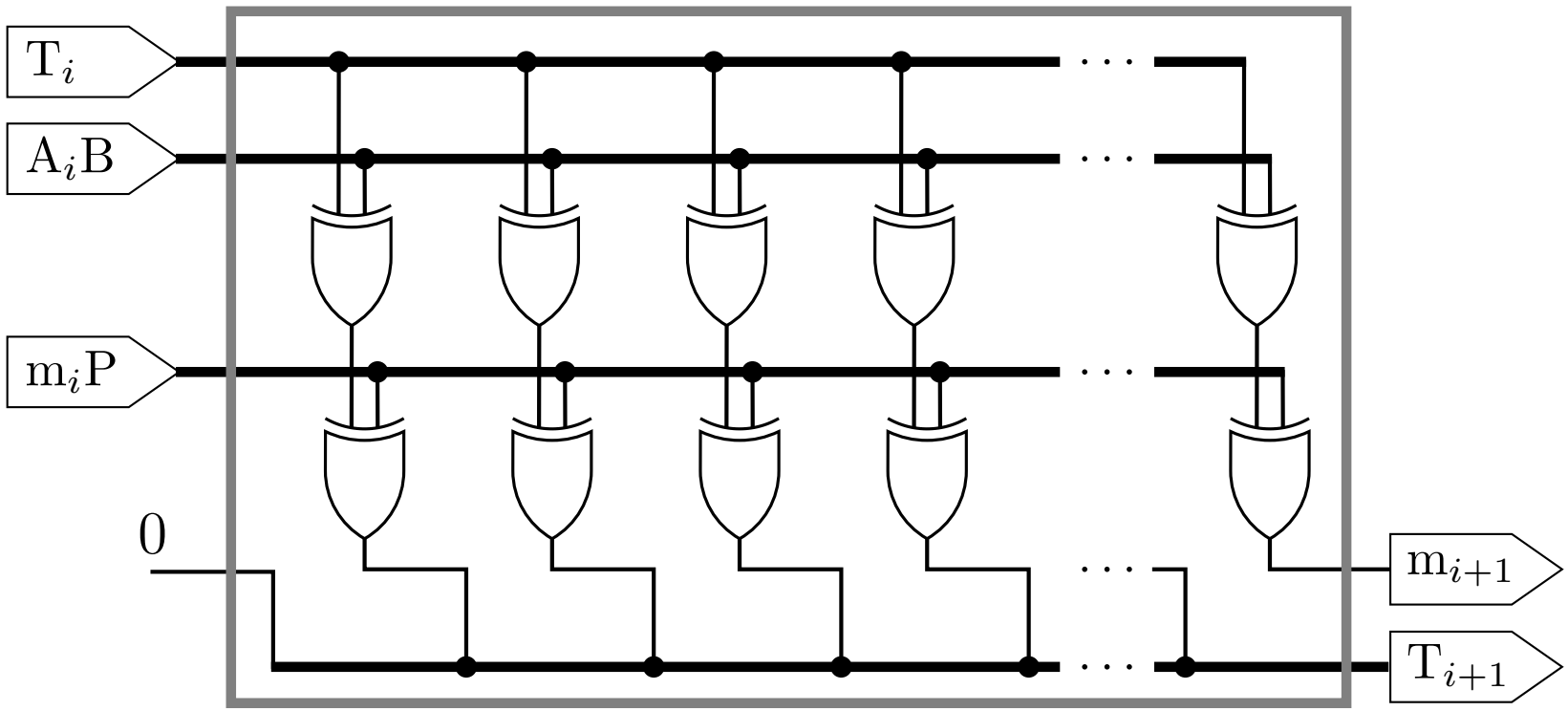
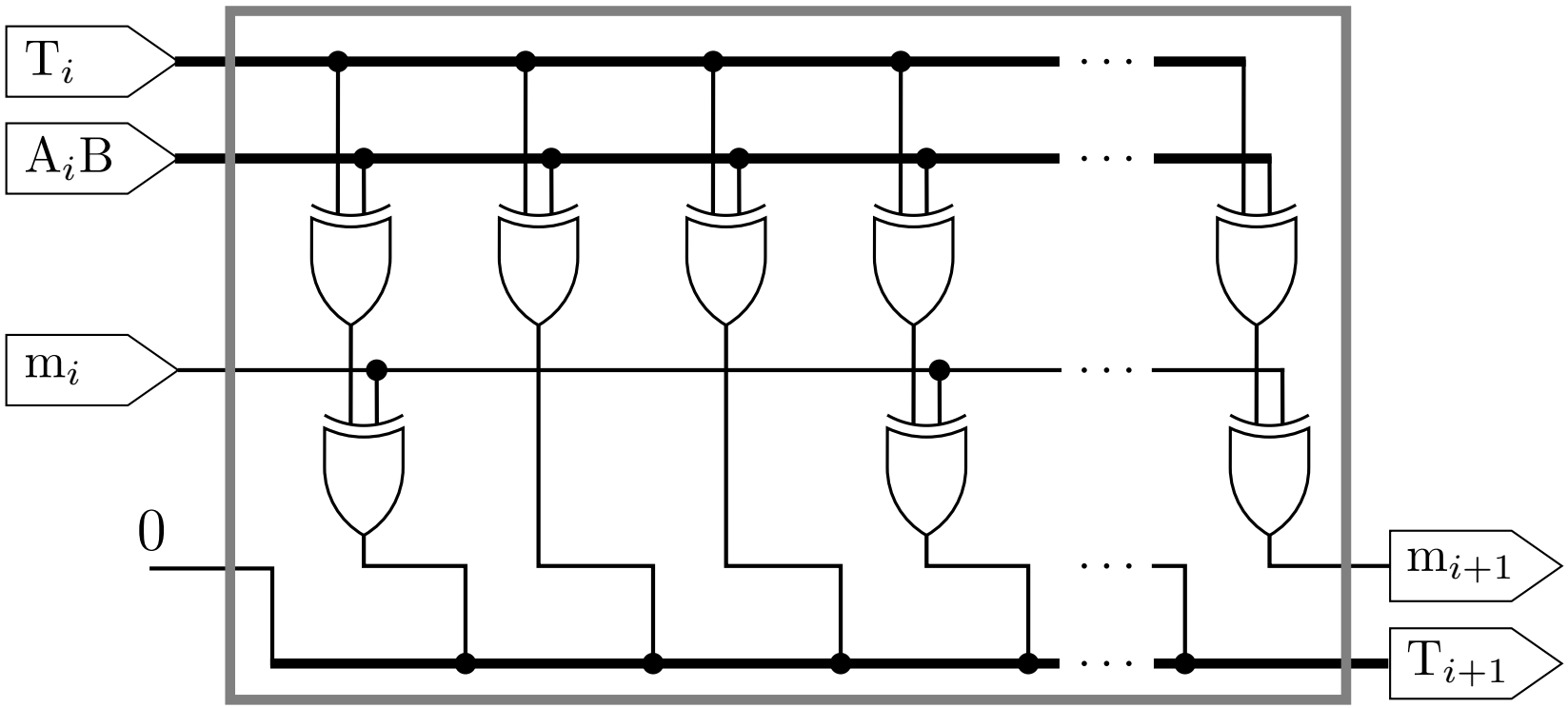
MALU

Modulo Arithmetic Logical Unit [general]:



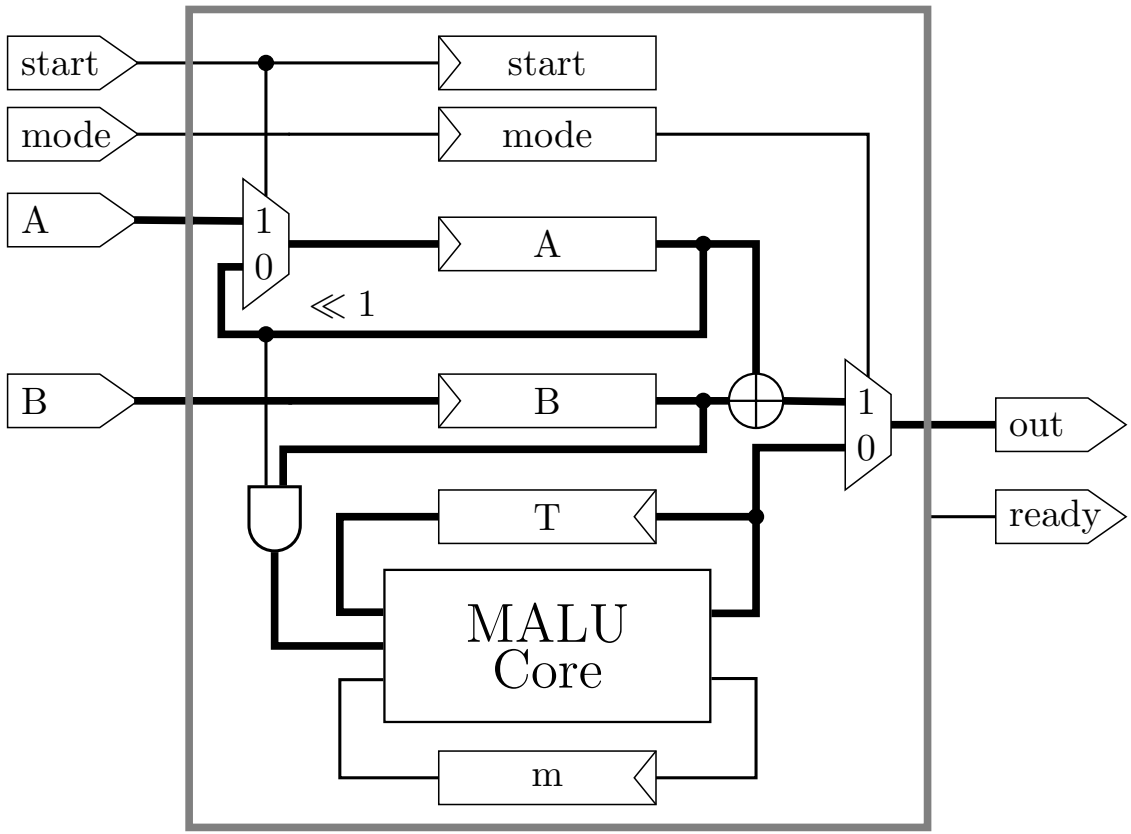
MALU

Modulo Arithmetic Logical Unit [optimized]:



Wrappers

Multiplication/Addition:



State of the art

Current available implementations:

Name	SW/HW	Speed
TinyTate	SW	5s

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Progress so far

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- ECC functions

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- Pairing functions

To do

- Bugfixing

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- Optimization (VHDL)

The end

Questions?