RUHR-UNIVERSITÄT BOCHUM

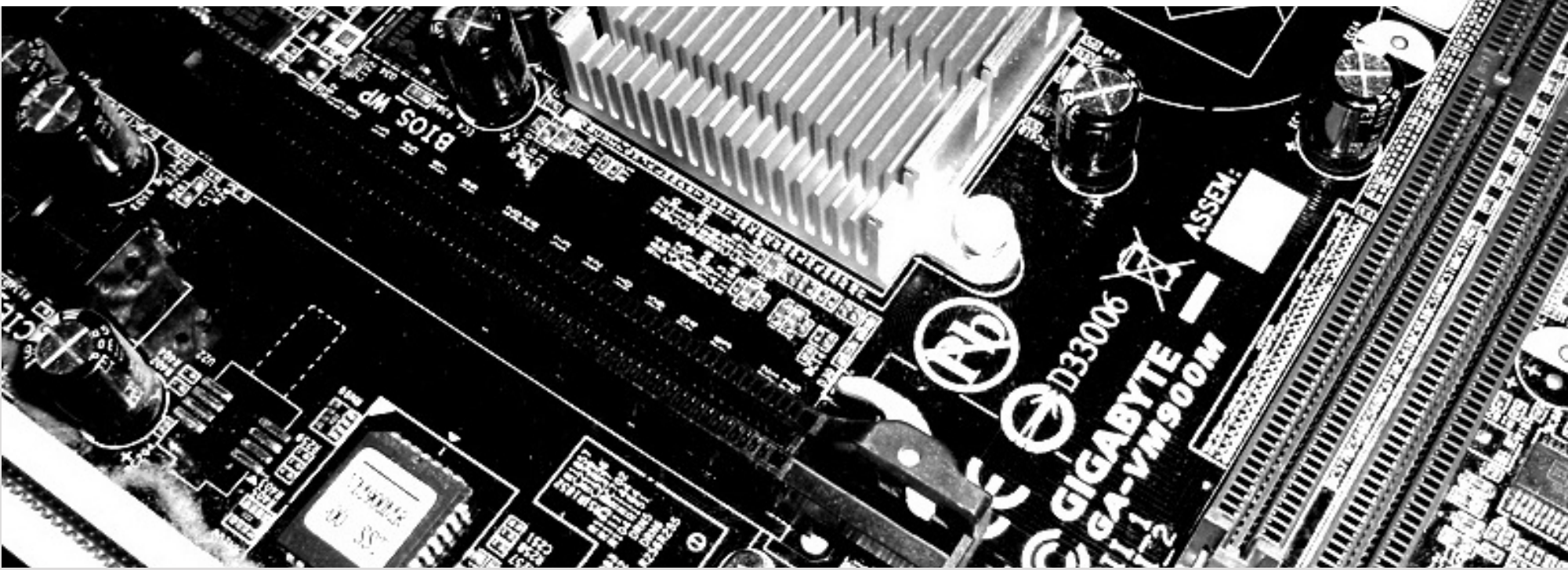
XOR Count

October XXth, 2017

FluxFingers

Workgroup Symmetric Cryptography
Ruhr University Bochum

Friedrich Wiemer



Overview

Joint Work – Its not me alone

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RUHR UNIVERSITÄT BOCHUM RUB Radboud University

Outline

What is the XOR count,

and why is it important?

RUB

Some facts

- Lightweight Block Ciphers
- Efficient Linear Layers
- MDS matrices are “optimal” (regarding security)[1]

[1] Are they?

What is the XOR count,

and why is it important?

RUB

Some facts

- Lightweight Block Ciphers
- Efficient Linear Layers
- MDS matrices are “optimal” (regarding security)[1]

- What is the lightest implementable MDS matrix?
- What about additional features (Involutory)?

[1] Are they?

What is an MDS matrix?

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Definition: MDS

A matrix M of dimension k over the field $\mathbb{F}$ is *maximum distance separable* (MDS), iff all possible submatrices of M are invertible (or nonsingular).

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RUB

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Example

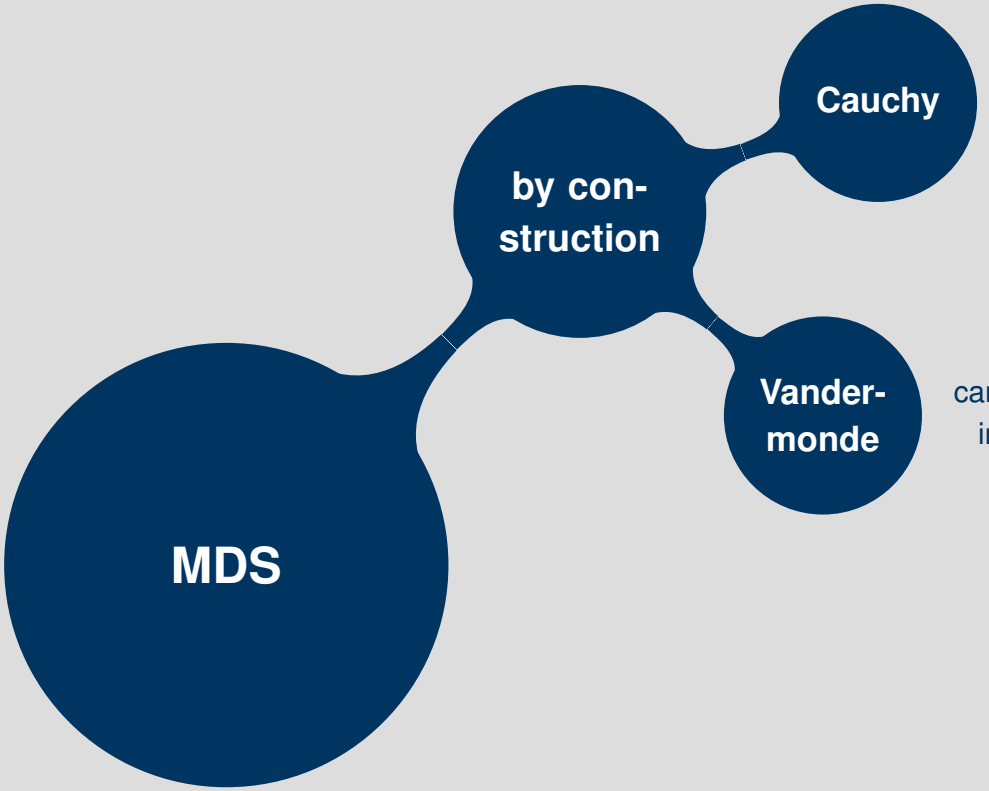
The AES MIXCOLUMN matrix is defined over $\mathbb{F}_{2^8} \cong \mathbb{F}[\mathrm{x}]/\mathtt{0x11b}$:

$$\begin{pmatrix} \mathtt{0x02} & \mathtt{0x03} & \mathtt{0x01} & \mathtt{0x01} \\ \mathtt{0x01} & \mathtt{0x02} & \mathtt{0x03} & \mathtt{0x01} \\ \mathtt{0x01} & \mathtt{0x01} & \mathtt{0x02} & \mathtt{0x03} \\ \mathtt{0x03} & \mathtt{0x01} & \mathtt{0x01} & \mathtt{0x02} \end{pmatrix} = \begin{pmatrix} \mathrm{x} & \mathrm{x}+1 & 1 & 1 \\ 1 & \mathrm{x} & \mathrm{x}+1 & 1 \\ 1 & 1 & \mathrm{x} & \mathrm{x}+1 \\ \mathrm{x}+1 & 1 & 1 & \mathrm{x} \end{pmatrix}$$

This is a (right) *circulant* matrix: $\mathrm{circ}(\mathrm{x}, \mathrm{x}+1, 1, 1)$.

What is an MDS matrix?

Constructions



can be made involutory

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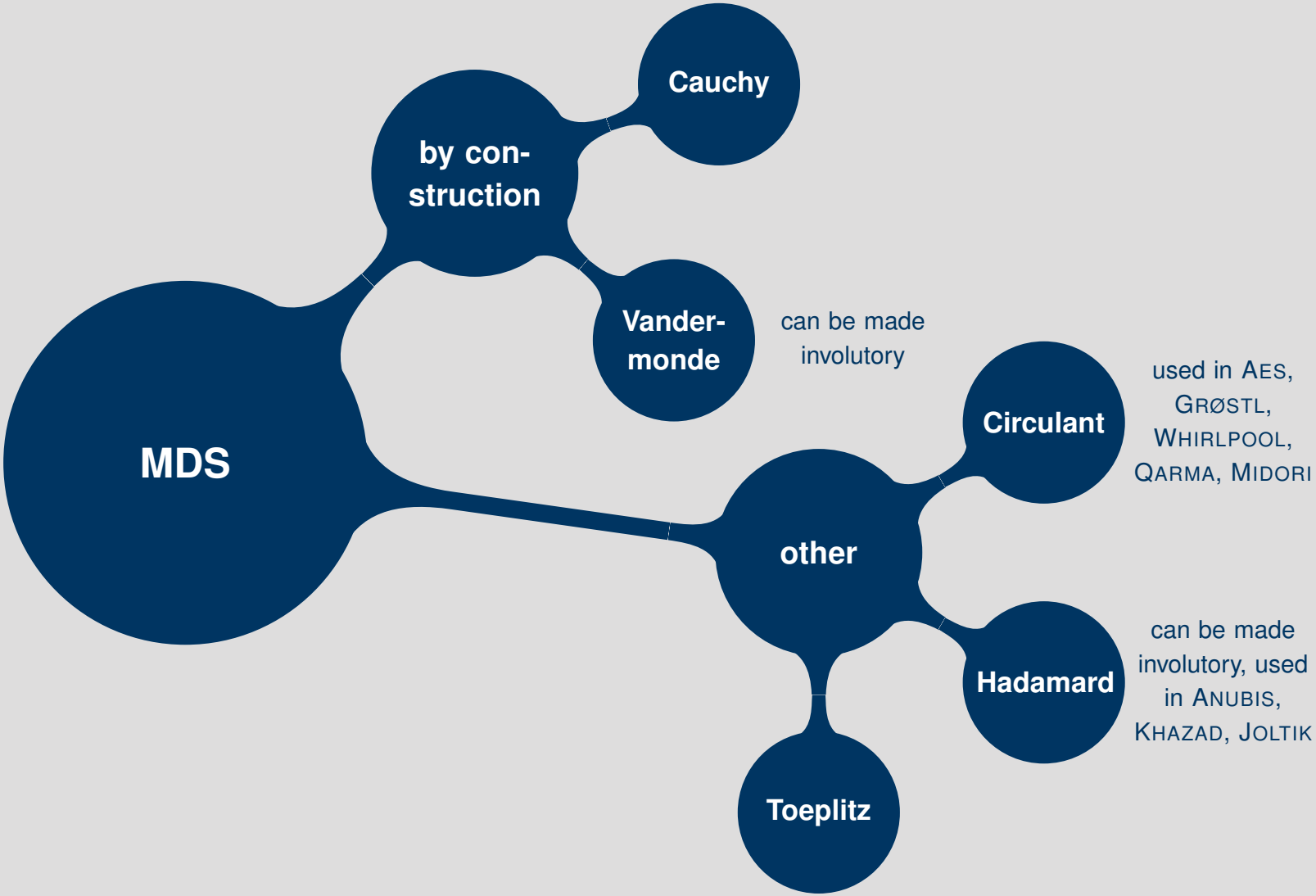

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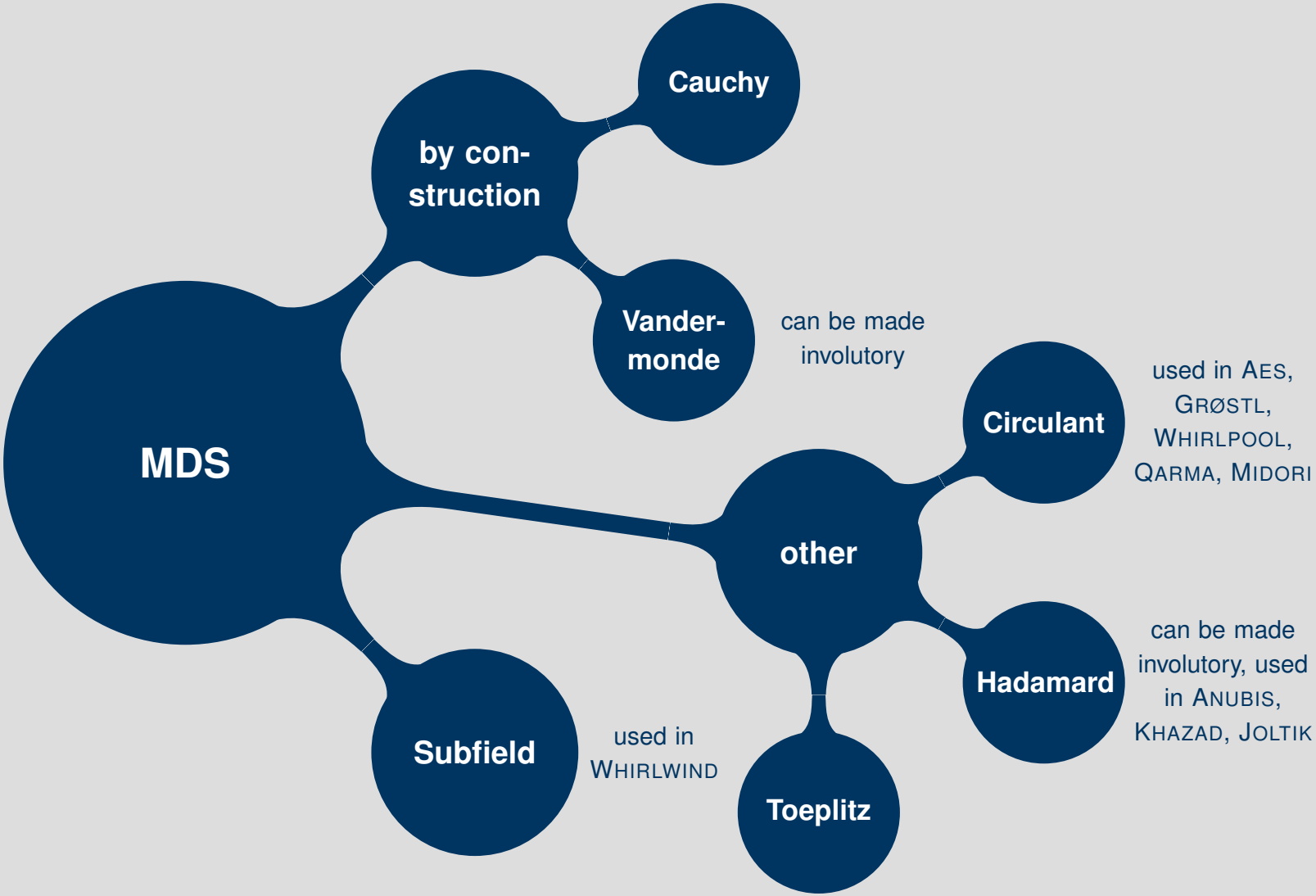

What is an MDS matrix?

Representations

What is an MDS matrix?

Representations

The General Linear Group

State of the Art

Before our Paper

Related Work I

Related Work II

State of the Art

After our Paper

Future Work

Questions?

Thank you for your attention!

Mainboard & Questionmark Images: flickr

References I