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POZNAN UNIVERSITY OF TECHNOLOGY

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NARODOWA AGENCJA WYMIANY AKADEMICKIEJ

SDSU San Diego State University

Towards Networked Airborne Computing in Uncertain Airspace: A Control and Networking Facilitated Distributed Computing Framework

Poznan Workshop, October 2024

Lightweight Cryptography

Poznan University of Technology

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Agenda

1. Lightweight Cryptography
2. Criteria when choosing an algorithm
3. NIST LWC Competition
4. List of lightweight cryptographic algorithms
5. Future works

Lightweight Cryptography

- What is the difference between cryptography and lightweight cryptography?
- Role of the lightweight cryptography in IoT
- Lightweight cryptography in UVAs

https://www.adsgroup.org.uk/knowledge/countering-the-malicious-usage-of-drones/

Criteria when choosing an algorithm (I)

1. Security:
- Cryptographic Resistance
- Key and block length
- Analysis and verification

2. Performance:
- Capacity
- Delay

3. Resource Consumption:
- Memory
- Energy

4. Implementation complexity:
- Ease of implementation
- Potential Errors

5. Resistance to side-channel attacks:
- Physical attacks
- Protection measures

6. Licensing and Intellectual Property:
- Licensing
- Open Source

Criteria when choosing an algorithm (II)

7. Compliance with standards:

- International standards
- Interoperability

8. Scalability and Flexibility:

- Adaptability
- Support for different platforms

9. Implementation experience:

- Case studies
- Community and support

https://www.nokia.com/sites/default/files/2022-01/cybersecurity4_0.jpg

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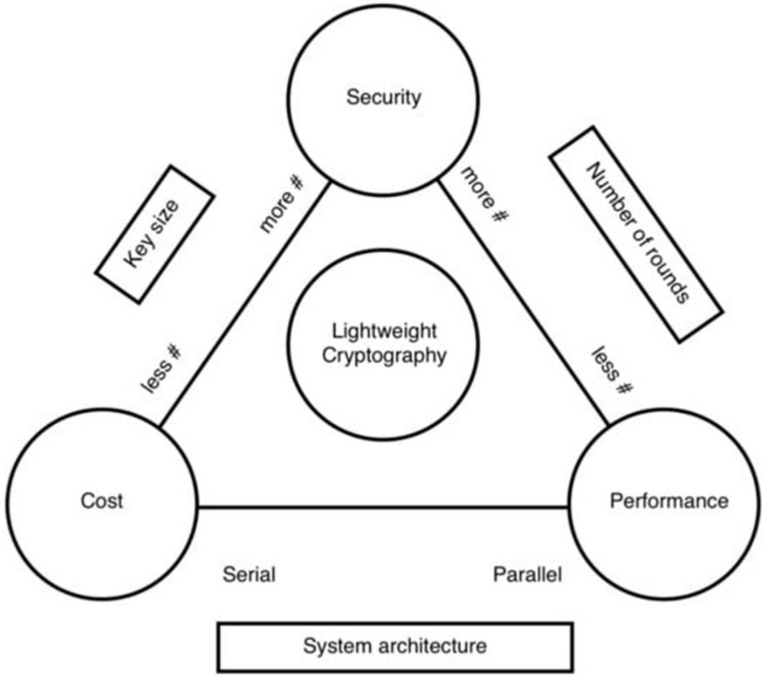
NIST LWC Competition

- National Institute of Standards and Technology
- Genesis of the Contest
- Contest Goals
- Contest Phases



National Institute of Standards and Technology
U.S. Department of Commerce

https://csrc.nist.gov/projects/lightweight-cryptography

ASCON

	Ascon-128	Ascon-128a
State(Bits)	320	320
Key(Bits)	128	128
Rate/Block (Bits)	64	128
Security (Bits)	128	128

- **Type**: Sponge
- **Mode of operation**: Duplex

- Winner of the NIST competition
- Uses only bitwise operations
- Resistant to side-channel attacks

A Review of the NIST Lightweight Cryptography Finalists and Their Fault Analyses, Hasindu Madushan, DOI: 10.3390/electronics11244199

PHOTON-Beetle

	PHOTON-Beetle-AEAD[128]	PHOTON-Beetle-AEAD[32]
State(Bits)	256	256
Key(Bits)	128	128
Rate/Block (Bits)	128	32
Security (Bits)	121	128

- **Type**: Sponge
- **Mode of operation**: Beetle

- Finalist of the NIST competition
- Uses Beetle Sponge
- Resistant to multi-block manipulation attack

A Review of the NIST Lightweight Cryptography Finalists and Their Fault Analyses, Hasindu Madushan, DOI: 10.3390/electronics11244199

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TinyJAMBU

	TinyJambu
State(Bits)	128
Key(Bits)	128
Rate/Block (Bits)	32
Security (Bits)	120

- **Type**: Sponge
- **Mode of operation**: TinyJambu

- Finalist of the NIST competition
- Uses Nonlinear-feedback shift register
- Resistant to abuses nonce
- Prepared to perform parallel

A Review of the NIST Lightweight Cryptography Finalists and Their Fault Analyses, Hasindu Madushan, DOI: 10.3390/electronics11244199

ISAP

	ISAP-K-128	ISAP-A-128
State(Bits)	400	320
Key(Bits)	128	128
Rate/Block (Bits)	144	64
Security (Bits)	128	128

- **Type**: Sponge
- **Mode of operation**: ISAP

- Finalist of the NIST competition
- Different permutations in variants
- Re-keying function
- Uniqueness of the nonce

A Review of the NIST Lightweight Cryptography Finalists and Their Fault Analyses, Hasindu Madushan, DOI: 10.3390/electronics11244199

Grain

	Grain-128AEAD
State(Bits)	256
Key(Bits)	128
Rate/Block (Bits)	1
Security (Bits)	128

- **Type**: Stream
- **Mode of operation**: N/A

- Finalist of the NIST competition
- Only stream cipher in final
- Two main components
- Fault attacks

A Review of the NIST Lightweight Cryptography Finalists and Their Fault Analyses, Hasindu Madushan, DOI: 10.3390/electronics11244199

Fault Analysis of GRAIN-128, Alexandre Berzati, DOI: 10.1109/HST.2009.5225030

ACORN

	ACORN-128
State(Bits)	293
Key(Bits)	128
Rate/Block (Bits)	1
Security (Bits)	128

- **Type**: Stream
- **Mode of operation**: N/A

- Finalist of the CAESAR competition
- Prepared to perform parallel
- Linear-feedback shift register

Shi, Tairong, i Jie Guan. „Cryptanalysis of the Authentication in ACORN". KSII Transactions on Internet and Information Systems 13, nr 8 (2019): 4060–4075. https://doi.org/10.3837/tiis.2019.08.013.

PRESENT

	PRESENT
State(Bits)	64
Key(Bits)	80 or 128
Rate/Block (Bits)	64
Security (Bits)	80 or 128

- **Type**: Block
- **Mode of operation**: N/A

- PRESENT is included in the following standards:
  - ISO/IEC 29167-11:2014
  - ISO/IEC 29192-2:2019

· Ultra Low-Power Encryption/Decryption Core for Lightweight IoT Applications.”, Zaky, Ahmed, https://doi.org/10.1109/ICENCO48310.2019.9027471

Future work

- Classification of algorithms according to the presented criteria
- Choice of encryption key management method
- Selecting algorithms and testing
- Implementing selected algorithm

References (I)

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- Shi, Tairong, i Jie Guan. „Cryptanalysis of the Authentication in ACORN”. KSII Transactions on Internet and Information Systems 13, nr 8 (2019): 4060–4075. https://doi.org/10.3837/tiis.2019.08.013.

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Thank you very much.