Comparison of innovative asymmetric signature schemes for WSNs

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escrypt
Embedded Security

Why use asymmetric signature schemes in WSNs?

WSNs from the security perspective:

- Cheap & low-power (i.e. „unprotected“) hardware
- Exposed to:
  - eavesdropping
  - data modification
  - physical attacks

Applications for WSNs:

- Monitoring (health/environment), industrial control, etc.
- Critical applications require message integrity & authenticity

Asymmetric signature schemes...

- 👍 ..can provide adequate security mechanisms
- 👍 ..can avoid certain problems of symmetric schemes
- 👎 ..are perceived as being too slow

Typical WSN Hardware: **MICAz**

MICAz:

- 2 AA batteries (1000mAh)
- ATMega128L

ATMega128L, 8-bit uP:

- Clock: 7,37MHz
- ROM: 128kB
- RAM: 4kB

Implied constraints:

(1) Energy
(2) Computational power
(3) RAM

Potential, asymmetric **signature schemes**

Standard schemes:

- RSA (1978)
- ECDSA (1985)

Innovative (i.e. “young”) schemes:

- NTRUSign (2001)
- XTR-DSA (2000)
- MQ-based schemes (e.g. SFLASH v1-v3, **broken 2007**)

Focus of this work:

- Compare XTR-DSA, NTRUSign to a high-speed implementation of ECDSA
- Security level equivalent to an 80-bit symmetric key
- Optimized for speed
- Implementation in NesC (a C dialekt) and ASM

ECDSA

Characteristics:

- 👍 Compact signatures
- 👍 Quite well researched
- 👍 Fast
- 👎 Complex arithmetic

Major optimizations:

- Field arithmetic in ASM (based on work by Uhsadel)
- Fixed-point methods for..
  - ..single scalar multiplication: kP
  - ..simultaneous scalar multiplication: kP+lQ

XTR-DSA

Characteristics:

- 👍 Compact signatures
- 👍 Fast (supposedly as fast as ECDSA)
- 👎 Complex arithmetic
- 👎 Not as well researched as ECDSA

Major optimizations:

- Field arithmetic in ASM
- Montgomery Multiplication
- Stam's exponentiation techniques

NTRUSign

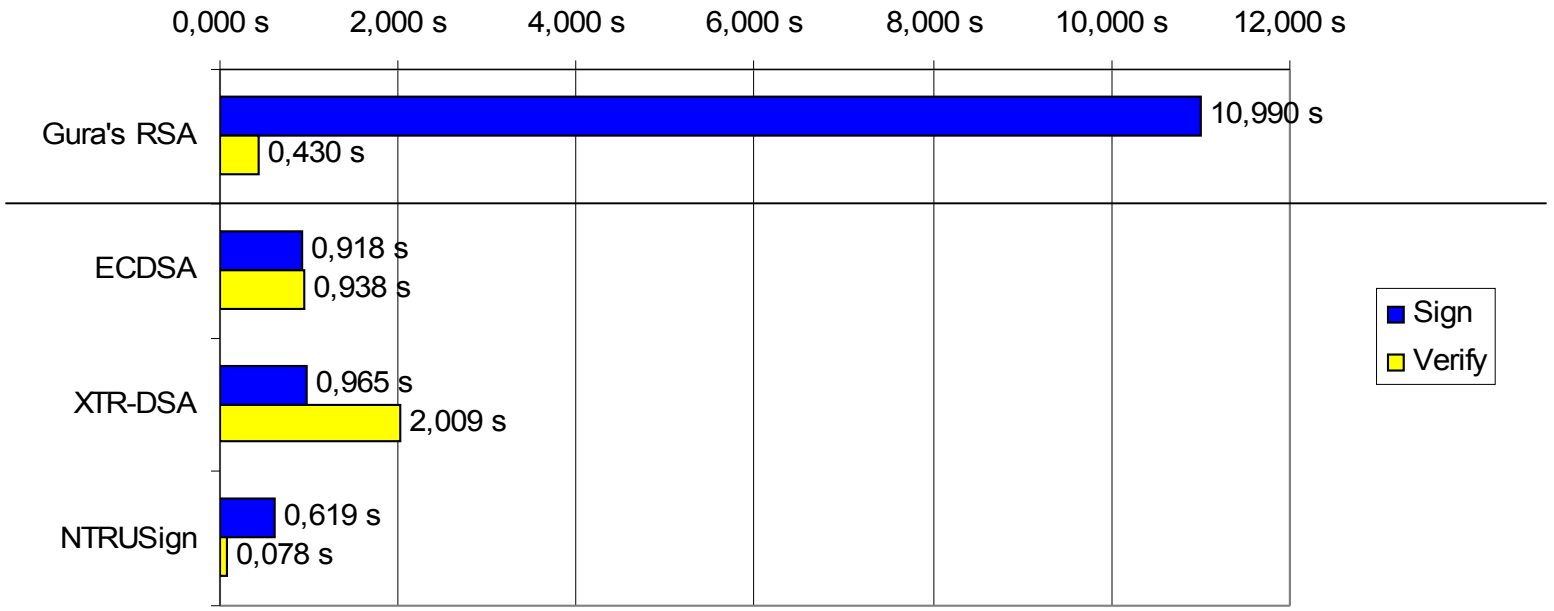
Characteristics:

- 👍 **Really** fast
- 👍 Simple arithmetic (convolution of polynomials)
- 👎 Recent attacks on NTRU
- 👎 Large signatures

Major optimizations:

- Choice of parameter-set with low N
- Karatsuba-like approaches for..
  - ..single convolution: f*g
  - ..simultaneous convolution: f1*g+f2*g

Results



NTRUSign wins

- Pure NesC implementation
- No precomputation time (ECDSA: 46s, XTR-DSA: 4s)

Thank you!

Questions?