# Server-side performance evaluation of NDN

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# Outline

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# Context

## Named-Data networking

Optimized for massive content diffusion:

- In-network cache and Interest concatenation

Rely on digital signature for content authentication:

- Each Data packet must be signed
- Compute SHA-256 then sign with a cryptographic algorithm

## Problem statement

Actual cost when a content provider generates Data packets?

- Can be critical for real-time applications that must deal with unpredictable flows of data (ex: video live streaming, ...)

# Outline

# Ndnperf

## We developed ndnperf

A performance evaluation tool

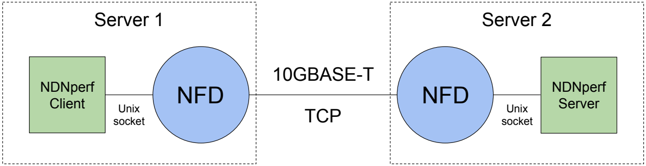
Available in C++ and Java

Features:

- Report throughput, latency and packet processing time
- Multi-threaded application
- Generate Data packets from random data or real files
- Can generate asymmetric keys thanks to the NDN library

http://madynes.loria.fr/software/ndnperf_cpp.zip

# Testbed




## Specifications

2 servers:

- CPU: 2x8 cores E5-2630v3
- RAM: 64GB DDR4
- NIC: Intel X540
- OS: Ubuntu 15.04 (3.19)

## Network

Physical layer: 10GBASE-T (ad-hoc network)

NDN network: 2 nodes, 1 NFD (0.4.0) per server

# Outline

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2 Experimental environment

3 Server-side performance evaluation
- Single-Thread environment
- Cache performance
- Multi-Thread server

4 Reduce the signature impact

5 Conclusion

# Single-Thread environment

## Signing process

Like the available NDN tools

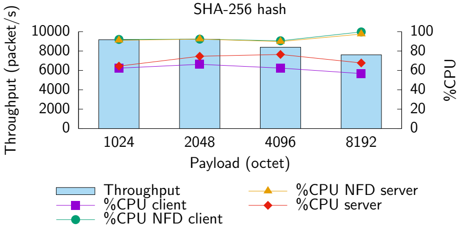
## Interpretations

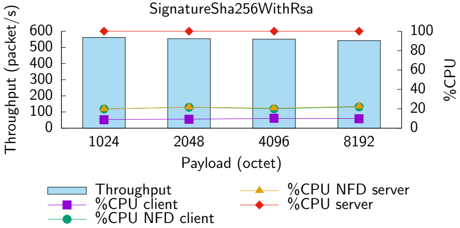
NFD limits SHA-256 throughput:

- Decent performance:
  - 500Mbps with 8K payload
- But no authentication

The server limits RSA throughput:

- 34Mbps with 8K payload



# Cache performance

## Pre-condition

Caches are preloaded with Data

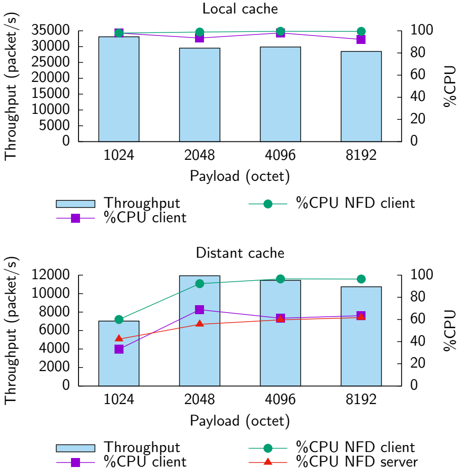
## Results

Cache throughput is much faster:

- Up to 1.8Gbps for local cache
- But 670Mbps for distant cache

When local node forwards packets:

- Additional PIT/FIB lookup
- Forwarding has a high cost



# Multi-Threaded producer

## Observations

Adding threads increases throughput:

- x6,7 with 8 signing threads
- x11,6 with all logical cores

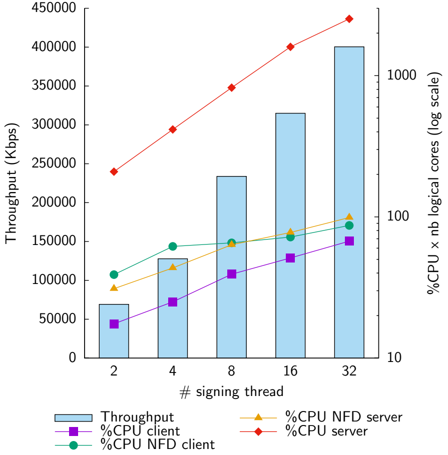
Can saturate NFD with 25 threads:

- 400Mbps with 8K payload

Heavy load for Data generation

⇒ Problem for real-time applications

⇒ Possible improvements ?



# Outline

# Improve signing function

## Statement

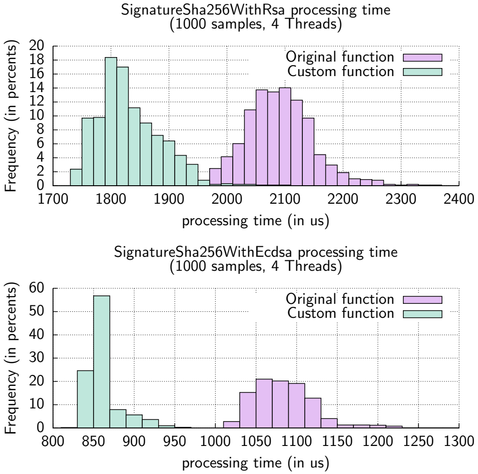
For each Data packet:

- Find key pair
- Compute *SignatureInfo*
- 2 hashs computations
- Load public and private keys

$\Rightarrow$ Can be done once and for all

## Speed up

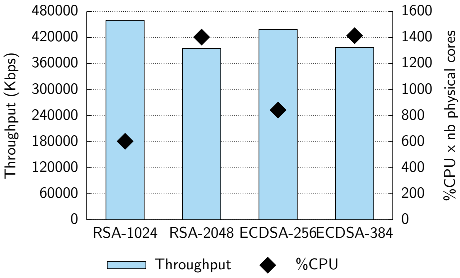
13% for RSA or 20% for ECDSA



# Change default signing algorithm

## Available asymmetric algorithms

1. **RSA**(1024, **2048**)
2. ECDSA(256, 384)




## Interpretations

- Lowering the key size can help tiny servers to serve more users
- ECDSA-256 seems to be a better solution for servers since it has comparable security lvl (but is harder to verify for clients)

# Increase packet size

## Hypothesis

Current limit size: 8800 Bytes

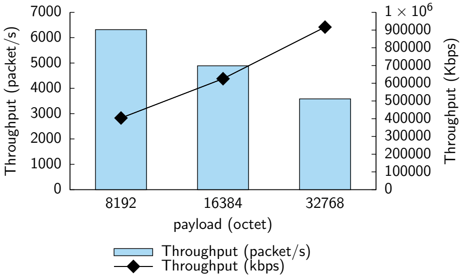
Fewer signatures per content:

- Reduce computation cost
- Interesting for big contents

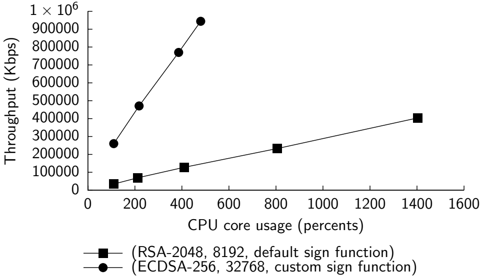
## Consequence

Speed up NDN throughput

- 900Mbps with 32k payload



# Improvements vs default




Great throughput increase per core:

- From 30 to 200 Mbps/core (x6,7)

Need less cores to saturate NFD:

- Only 5 cores against 14 for default RSA (9 for ECDSA-256)

# Outline

# Conclusion

## In these experiments we demonstrate that

- NFD cache performs good throughput
- Servers may have difficulties to serve users for real-time apps
  - No problem with SHA-256, but no authentication
  - Heavy load when using asymmetric algorithms (sum up below)

## Improvements can be done by

- Changing algorithms
- Improving the signing function
- Increasing the packet size

| Source of NDN Data | Throughput | Nb of server cores |
|---|---|---|
| Client-side cache | 1792 Mbps | 0 |
| Server-side cache | 671 Mbps | 0 |
| Server with SHA256 | 487 Mbps | 1 |
| Server with RSA-1024 | 460 Mbps | 6 |
| Server with RSA-2048 | 394 Mbps | 14 |
| Server with ECDSA-256 | 439 Mbps | 9 |
| Server with ECDSA-384 | 397 Mbps | 14 |
| Server with improvements | 922 Mbps | 5 |