Adapting ICN to Function Execution for Edge Computing

Function Execution in ICN

Any node can execute functions

Not just routing to the service

Natural load balancing

No need for DNS

Environment

 Requesting node

 Executing node

 Function provider

Function execution vs data retrieval

- Interests can trigger functions and retrieve data
- Execution time vary
- Execution is more costly than retreiving data
  - have to avoid double execution
  - easy DoS

Design inconsistencies

PIT Expiry

Delay is easy to predict with data retrieval

Functions add execution time that can vary

How long should a PIT entry remain in the table?

Pit Expiry

- Higher timer value
- Time in the Interest
- Persistent PIT

Mantaining a session

Multiple chunk result retrieval

Function interaction

We have no guarantee that consecutive interests will be received by the same node

Mantaining a session

- Unique node names/Callback
- Return data name only
- Indicate a path/Labels switching

Execute the function or look for cached results

- Finding cached data is also important in static content retrieval
- Cost of function execution is higher
- We want to execute the function as close to the source as possible...
- ... but we do not want to execute the function multiple times

Security

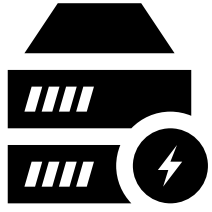
User identification

Signatures seem to be the best option...

...but require a key distribution scheme

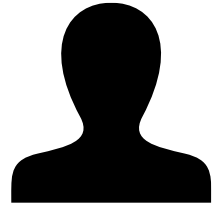
Should the signature be a part of the name?

Signature

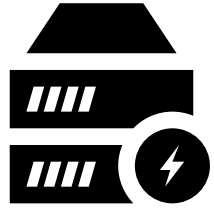


PIT

Name	upIf	downIf



Packet spoofing



User authorization

How to determine if a user has access to a resource

Easy in a managed environment

Subscriptions

Border routers

Trusted environment

User Authorization

Difficult in unmanaged environment...

...but blockchain can help

Open, public ledger

High resource usage

What about the delay?

Communication encryption

User want to communicate with functions

The data should be invisible for the executing node/function provider

Intel SGX

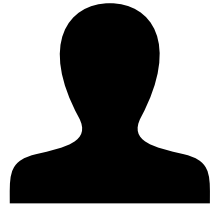
Hardware based cryptography

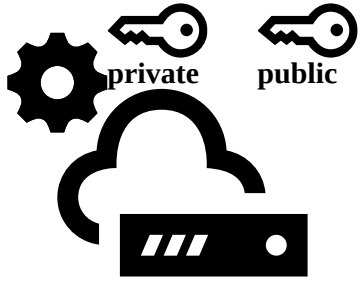
Applications can form encrypted enclaves

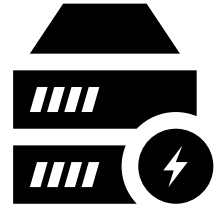
An enclave is protected from the OS and cannot be accessed by anyone but the application

An enclave can be used to securely store a secret/private key

Intel SGX







Intel SGX - limitations

Application size limit (currently 90MB)

Need a TLS connection to transport a secret (only once)

.so .dll files only (extentions for docker being investigated)

Payments

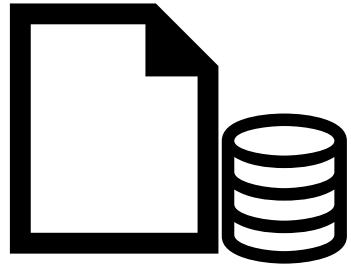
- Untrusted environment
- Requesting node
  - does not know who will receive the request
  - have to make sure, the result is correct
- Executing node
  - does not want to work without a payment

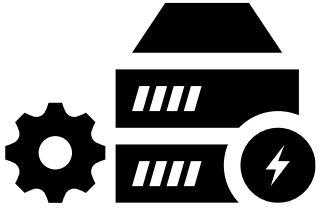
Smart Contracts

Runs on blockchain

Publicly visible

Smart contracts





Thank you