ACM ICN-2017 Tutorial

Running IoT Applications over ICN: A Guided Journey to NDN, RIOT, CCN-lite and NFN

at the Freie Universität Berlin, Sep 26, 2017

Welcome
and a gentle introduction to ICN

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We are Post-Internet

"The purpose of networking is information dissemination, not picking port numbers."

ICN = Information Centric Networking

In the past:

```
get( https://repo13.content.hot:8444/here.pdf )
```

In the future:

```
get_authentic( /hot/content/here.pdf )
```

Two major advances:
- ports and hostnames are a thing of the past
- authenticity is linked to the data instead of a web server

It's all about names (and a simple request-reply protocol)

- **Clients request *Data* by a single name:**
  = ask the network to find and return that data
  Named Data Networking (NDN) and the Content-Centric Networking (CCNx)

- **Clients request *Results* by an expression with multiple names:**
  = ask the network to find the result or trigger its computation
  Named-Function-Networking (NFN)

- **The Reply contains, in both cases:**
  - the name or the expression
  - the matching data or result
  - a cryptographic signature permitting to verify authenticity ("name–content binding")

  (but no ports and no host names—all embedded in expressive hierarchically structured names)

An example scenario: Smart homes

- Read temperature, get camera feed, turn on a light, etc.

- IP solution
  - Figure out where (address) to get the information
    - thermostat, camera, home controller
  - Send request to that particular address.

- ICN solution
  - Send request *asking for the data or derived content* without specifying destination.

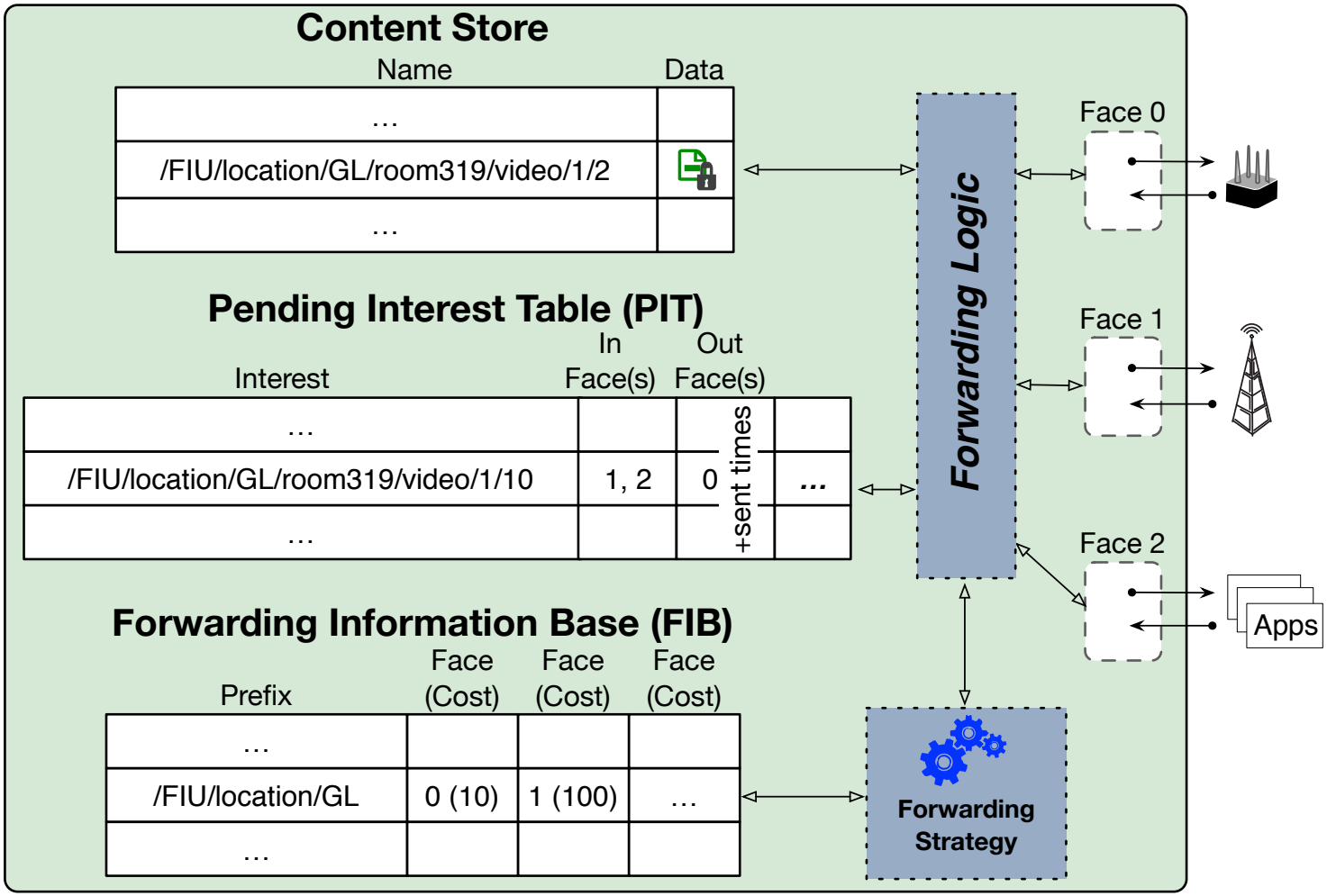
Under the Hood (1/2): Just Three Simple Ideas

1. Per hop forwarding state ("flow balance"), interest aggregation and content deduplification
   - → Creating closed feedback loop
     - Measure performance, detect failures
   - → Enabling multi-path forwarding
     - Add a strategy module to assist the forwarding decisions
2. Hierarchical naming of data, and/or intrinsic name (hash value)
   - → Fetching data by application-defined, semantically meaningful names
3. Securing every data packet
   - → Removing dependency on transport security

Immutable named data, universal caching

Under the Hood (2/2): Node architecture

- CS:
  the cache
- PIT:
  state of requests (aggregation, dedup)
- FIB:
  prefix-to-face map



What is inside this Tutorial Day?

- Target audience:
  The curious, the interested, and the hacker.
- ICN and IoT and RIOT:
  Learn how to walk three cool things in one tutorial day, under guidance
  (reflects collaboration efforts between RIOT, NDN and CCN-lite)
- Part I (9:00am-2:20pm)
  one common intro on foundations, including demos
- Part II (2:30pm – 5:00pm)
  three tracks: 2 x hands-on and 1 x consume-only
- *Wrap up and Q&A (5:00-6:00pm)*

"The Cast" (1/2)

- **CCNx:** original research project at Xerox PARC since 2008, latest version sold to CISCO in 2016, today known as CICN, see `https://wiki.fd.io/view/Cicn` and its parallel half day tutorial track
- **NDN:** spawned from CCNx in 2011, independent wire format, runs a global ICN testbed, multiple ongoing research projects both academic and with industry (Intel), GNU license, strong role of UCLA
- **CCN-lite:** code base compatible with multiple wire formats, less complete, much leaner, often easier to experiment with, BSD/ICS license, UofBasel
- **NFN:** Named function as a natural generalization of named data, makes ICN a trio: connectivity, memory and computation, UofBasel
- **RIOT:** an OS for IoT, now also for the *ICN-of-Things*, supported by FU, HAW Hamburg and INRIA

"The Cast" (2/2)

- **NDN**

Alex Afanasyev *(FIU, previously UCLA)*
Muktadir R Chowdhury *(U Memphis)*
Susmit Shannigrahi *(CSU)*

- **RIOT**

Cenk Gündogan *(HAW Hamburg)*
Peter Kietzmann *(")*
Martine Lenders *(")*
Oliver Hahm *(Zühlke Engineering)*

- **CCN-lite and NFN**

Claudio Marxer *(U of Basel)*
Dima Mansour *(")*
Christopher Scherb *(")*
Urs Schnurrenberger *(")*
Christian Tschudin *(")*

Timetable and Presenters (1/2)

9:00	Alex + Christian	Welcome
9:15	Oleg	Why IoT with ICN
9:30	all	Quick ICN Demo
9:40	audience	Setup and hand out Raspberry Pi's
10:00	audience	Hands on "Hello, world", including RIOT basics
10:30	--	break
11:00	Alex	NDN Security
11:25	Alex	NDN-RIOT
11:50	Christopher	CCN-lite
12:10	Oleg + HAW H	IoT-Lab
12:30	--	lunch

Timetable and Presenters (2/2)

13:30	Susmit	NDN-Android		
13:55	Claudio	NFN		
14:20	audience	Sign up for parallel tracks (and change room)		
14:30		Track I / MiniNDN+ ***lecture hall*** Alex, Susmit and Mukhtadir	Track II / RIOT ***room 046*** HAW Hamburg, Oleg	Track III / NFN ***room 051*** Claudio, Dima, Chris, Urs and Christian
15:30	--	break		
16:00		Track I – continued	Track II – continued	Track III – continued
17:00	--	return to main room		
17:10	audience	Q&A and wrap up		