NDN Codebase and Tools

Alex Afanasyev
Florida International University
Starting Point: https://named-data.net/ ➔ Codebase
Where to Find Source Code for NDN Codebase

- Most linked from https://named-data.net Codebase
- Github organizations
  - https://github.com/named-data
    - NFD, core libraries, and other general use software
  - https://github.com/named-data-mobile
    - Android and related software
  - https://github.com/named-data-iot
    - IoT related software
  - https://github.com/named-data-ndnsim
    - ndnSIM core, example and real simulation scenarios
NDN Codebase Overview

**Infrastructure Software**
- NFD
- NFD-android
- NDN-RIOT
- μNFD
- NDN Tools
- NLSR
- Repo-ng, repo-sql
- NDN Control Center

**NDN Libraries**
- ndn-cxx
- NDN-CPP
- NDN-JS
- PyNDN
- jNDN
- Chrono Sync
- PSync
- Vector Sync
- NDN-RTC

**Apps**
- ChronoChat
- ndns
- ndncert
- ndn-flow
- NdnCon
- ndn-fs
- ndn-atmos
- Many others

**Evaluation Frameworks**
- ndnSIM
- miniNDN
- NDN Testbed
Supported Platforms

- Desktop Systems
  - Ubuntu, OSX, FreeBSD and other Linux distributions
- Home routers
  - OpenWRT, DD-WRT
- Mobile:
  - Android, iOS (library only)
- IoT:
  - Arduino, ESP8266, RIOT-OS
  - Raspberry Pi (runs NFD, available binary packages)
- Web browser
  - NDN-JS library + microforwarder

https://redmine.named-data.net/projects/nfd/wiki
NDN Forwarding Daemon (NFD)

• The reference implementation of NDN forwarder
• https://named-data.net/doc/NFD/current/
  – Overview
  – Getting started
  – NFD Developer’s Guide
  – Manpages
  – Wiki
  – API documentation (doxygen)
• Feedback, suggestions, and contributions are welcome.
NDN-Android: NDN Stack for Android

- Embeds actual NFD, compiled using NDK
- Works with all (non-rooted) Android devices

https://github.com/named-data-mobile
NDN-RIOT: NDN for RIOT-OS

- Optimized for IoT apps
- Support
  - Data-centric security
  - Stateful NDN packet forwarding
  - Replaceable forwarding strategies
  - 802.15.4 and Ethernet
- Simple application APIs
- Several simple examples to get started

https://github.com/named-data-iot
Getting Started with NDN-RIOT Examples

- **Downloading**
  - `mkdir riot`
  - `cd riot`
  - `git clone https://github.com/named-data-iot/RIOT`
  - `git clone https://github.com/named-data-iot/ndn-riot`
  - `git clone https://github.com/named-data-iot/ndn-riot-examples`

- **Compiling an example**
  - `cd ndn-riot-examples/<APP>`
  - For host architecture (for debugging)
    - `make`
  - For a specific RIOT board
    - `make BOARD=samr21-xpro`
    - `make flash BOARD=samr21-xpro` # to flash firmware
    - `make term BOARD=samr21-xpro` # to access board via serial interface

- `ndn-benchmark`
- `ndn-consumer`
- `ndn-ping`
- `ndn-producer`
- `ndn-rtt`
- `ndn-template`
NDN Tools

• ndnping, ndnpingserver
  – Rechability testing tools
• ndncatchunks, ndnputchunks
  – Segemented file transfer between a consumer and producer
• ndnpeek, ndnpoke
  – Transmit a single packet between a consumer and a producer
• ndndump, dissect, wireshark-dissect
  – Debug NDN packet flow

• repo-ng, repo-sql: NDN repositories providing managed persistent st...
ndn-cxx: NDN C++ library with eXperimental eXtensions

- C++11
- The reference library and security library implementation
- Used in: NFD, NLSR, ndn-tools, ChronoChat, etc.
- [https://named-data.net/doc/ndn-cxx/current/](https://named-data.net/doc/ndn-cxx/current/)
  - Overview
  - Getting started
  - Trivial applications
  - Tutorials
  - Specifications
  - Manpages
  - API documentation (doxygen)
- Feedback, suggestions, and contributions are welcome.
NDN Common Client Libraries (NDN-CPP, NDN-JS, jNDN, PyNDN)

- C++, Java, Python, JavaScript, C#, Squirrel
- Used in: NDN-RTC, NdnCon, NFD-Android, etc.
- [https://named-data.net/codebase/platform/ndn-ccl/](https://named-data.net/codebase/platform/ndn-ccl/)
  - NDN Common Client Libraries API
  - NDN-CPP API
  - PyNDN API
  - NDN-JS API
  - jNDN API
EVALUATION TOOLS AT DIFFERENT SCALES
NDN Testbed

- Network of 37 sites across 4 continents, 14 countries
  
  **Open to join and use**
  
  [https://named-data.net/ndn-testbed/policies-connecting-nodes-ndn-testbed/](https://named-data.net/ndn-testbed/policies-connecting-nodes-ndn-testbed/)

- Examples applications and experiments: videoconferencing, network management, virtual machine migration, strategies, nTorrent, etc.

- Small scale evaluations
Open Network Lab (ONL)

- Remotely accessible network testbed
  - Operated and maintained by Applied Research Lab in Department of Computer Science and Engineering at Washington University in St. Louis
  - Real Hardware for running repeatable network experiments with trusted results. (NOT simulations)
- Use for NDN
  - NDN installed on each host/VM
  - NFD performance study
  - NDN Testbed Emulation to test new releases
- How to join?
  - https://onl.wustl.edu/
    - And “Get an account”
MiniNDN: NDN Emulation Framework (Based on MiniNet)

**Runs actual instances of NFD, NLSR**

Medium-scale evaluations

- Easy to configure network emulation
- Runs any real application
- Number of emulated nodes $\propto$ CPU power
- Cluster edition can be used to scale emulations

http://minindn.memphis.edu/
ndnSIM: NDN Simulation Framework (Based on NS-3)

**Fully integrated with NDN prototype implementations: NFD & ndn-cxx**

Large scale evaluations

- Provide interoperability between simulation and prototyping
- Enable a two-way of experimentation and evaluation
- Enable high-fidelity NDN simulations
- 1500+ nodes with WiFi channels in the evaluation of NDN for vehicular networking

[Diagram showing ndnSIM components and simulation scenarios]

https://ndnsim.net/