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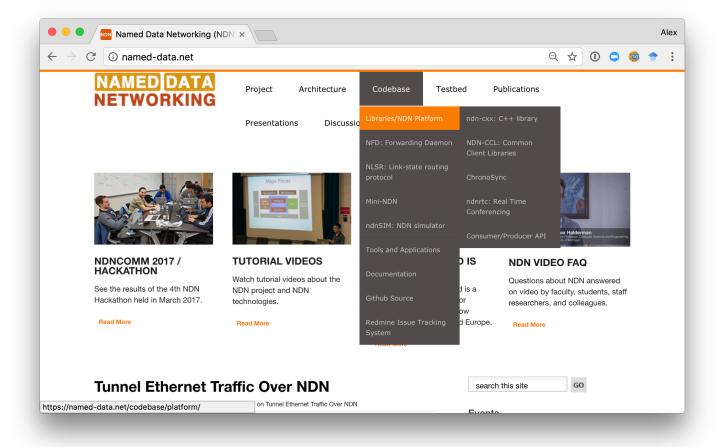
MILITARY COMMUNICATIONS AND INNOVATION - PRIORITIES FOR THE MODERN WARFIGHT

NDN Codebase and Tools

Alex Afanasyev Florida International University

BALTIMORE, MD • OCTOBER 23–25, 2017





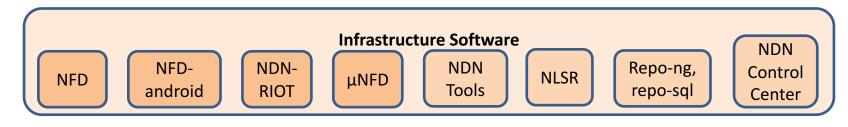


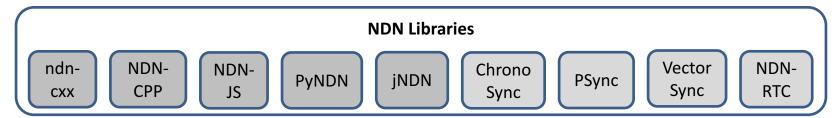
Where to Find Source Code for NDN Codebase

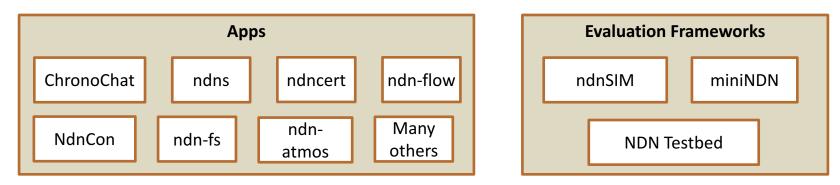
- Most linked from https://named-data.net
 Codebase
- Github organizations
 - <u>https://github.com/named-data</u>
 - NFD, core libraries, and other general use software
 - <u>https://github.com/named-data-mobile</u>
 - Android and related software
 - <u>https://github.com/named-data-iot</u>
 - IoT related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



NDN Codebase Overview









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

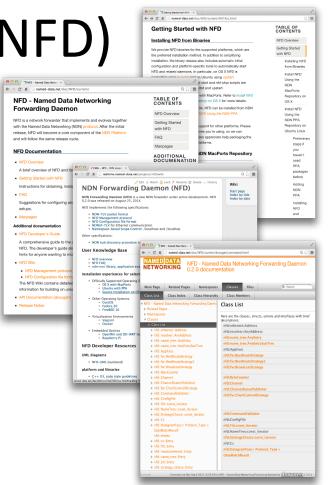
https://redmine.nameddata.net/projects/nfd/wiki

• • Wiki - NFD - NDN project issue ×					4	٩le
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Installation experiences for selected platforms						
 Officially Supported Operating Systems OS X with Homebrew OS X with MacPorts Ubuntu with PPA Source Installation on OS X or Ubuntu 						
 Other Operating Systems CentOS Fedora FreeBSD 10 OS X 10.8 Windows 						
 Virtualization Environments Vagrant Docker 						
 Embedded Devices OpenWrt and DD-WRT home routers Raspberry Pi NDN on Galileo (Intel's x86 Arduino-certified 	development	boa	rd)			



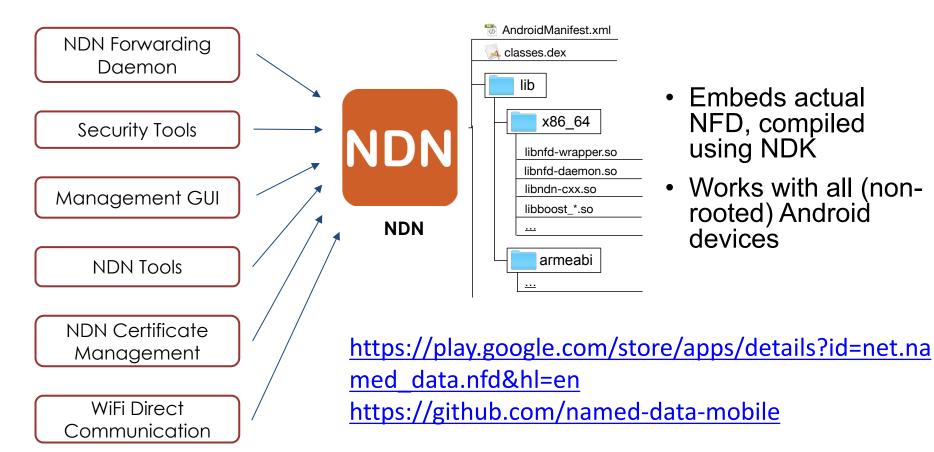
NDN Forwarding Daemon (NFD)

- 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

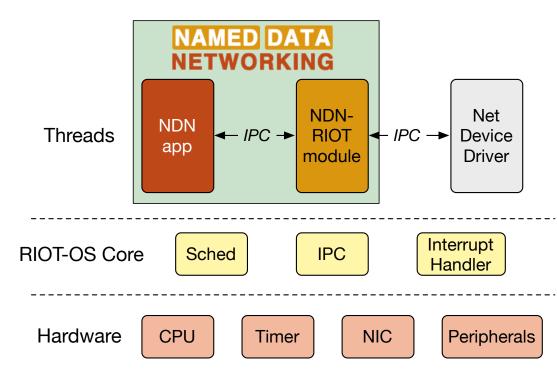




NDN-RIOT: NDN for RIOT-OS

- 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 Tools

- ndnping, ndnpingserver
 - Rechability testing tools
- ndncatchunks, ndnputchunks
 - Segmented 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 s







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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.
- <u>https://named-data.net/doc/ndn-cxx/current/</u>
 - Overview
 - Getting started
 - Trivial applications
 - Tutorials
 - Specifications
 - Manpages
 - API documentation (doxygen)
- Feedback, suggestions, and contributions are welcome.

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NDN Common Client Libraries (NDN-CPP, NDN-JS, iNDN, PyNDN)

Name.Compor ImplicitSha256 ProtobufTlv SeamentFetche

- C++, Java, Python, JavaScript, C#, Squirrel
- Used in: NDN-RTC, NdnCon, NFD-Android, etc. ullet
- https://namedulletdata.net/codebase/platform/ndn-ccl/
 - NDN Common Client Libraries API
 - NDN-CPP API
 - PyNDN API
 - NDN-JS API
 - jNDN API

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Documentation								Signature Class		
								DigestSha256Signature Class		
								GenericSignature Class		
The NDN Common Client Libraries (NDN-CCL) are written in C++, Python, JavaScript and								Sha256WithRsaSignature C		
Are not solution can be carried a very concept and an in over; yound, variable prima Java and provide a common API for client applications to use NDA. Any library in NDA-CCL suite allows an application to send interests to and receive data from an NDN forwarding deamon (NFD) and provide a large set of other functions necessary for any NDA application.							Sha256WithEcdsaSignature			
							KeyLocator Class			
							InterestFilter Class			
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Python – PyNDN								SignedBlob Class		
Javascript - NDN-JS								KeyChain Class		
Java – jNDN								MemoryContentCache Class		
Function and class documentatio	n: NDN-C							ChronoSync2013 Class		
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Supported Features								Time representation		
Supported Features								DelegationSet Class		
	NDN-							DelegationSet.Delegation Cla		
Feature	CPP	PyNDN	NDN-JS	jNDN	Notes			ForwardingFlags Class		
MemoryContentCache	~	1	1	1				NetworkNack Class TcpTransport.ConnectionInfo		
ChronoSync2013	√	1	1	√						
Name.Component from*	1	1	1	4						
Name.Component is*	√	√	√	√						
Name.Component to*	√	1	1	1						
ImplicitSha256DigestComponent	√	√	√							
ProtobufTly	√ API	√ API	√ API	√ API						

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EVALUATION TOOLS AT DIFFERENT SCALES

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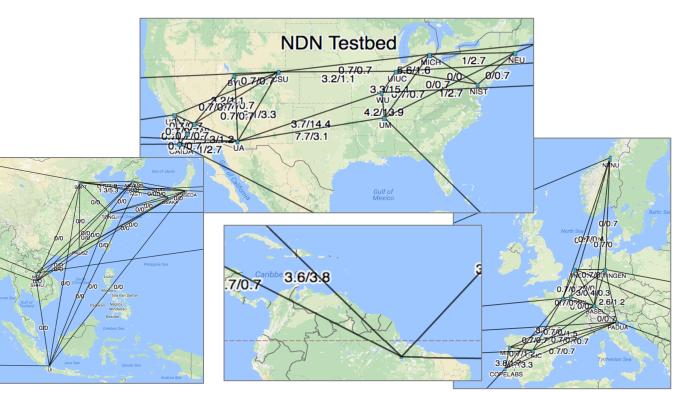
NDN Testbed

• Network of 37 sites across 4 continents, 14 countries

Open to join and use

https://named-data.net/ndn-testbed/policiesconnecting-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?
 - <u>https://onl.wustl.edu/</u>
 - And "Get an account"





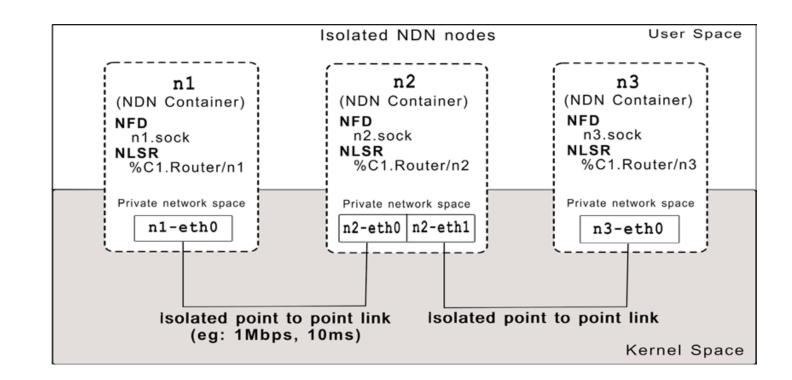
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MiniNDN: NDN Emulation Framework (Based on MiniNet)

Runs actual instances of NFD, NLSR

Medium-scale evaluations

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





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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

