



Research Perspective for Computer Networks

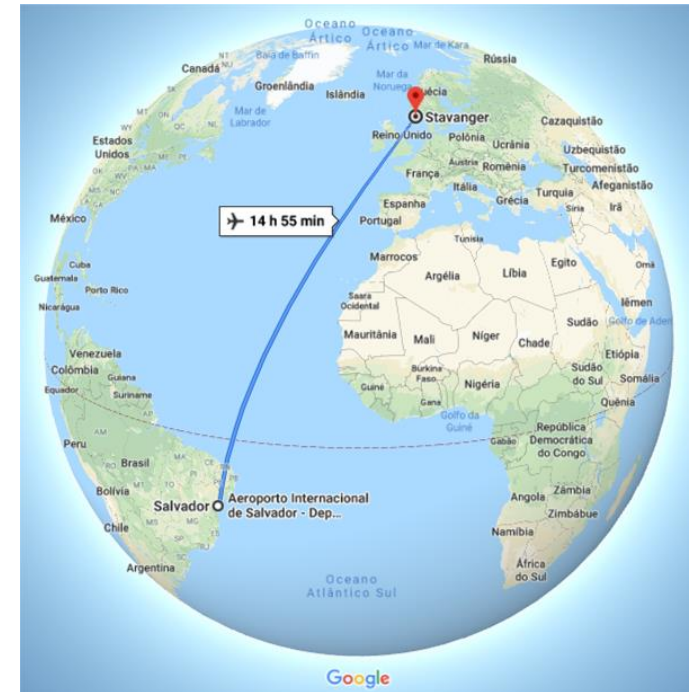
CREDESCENCE WORKSHOP

August 05-07 2019

Stavanger

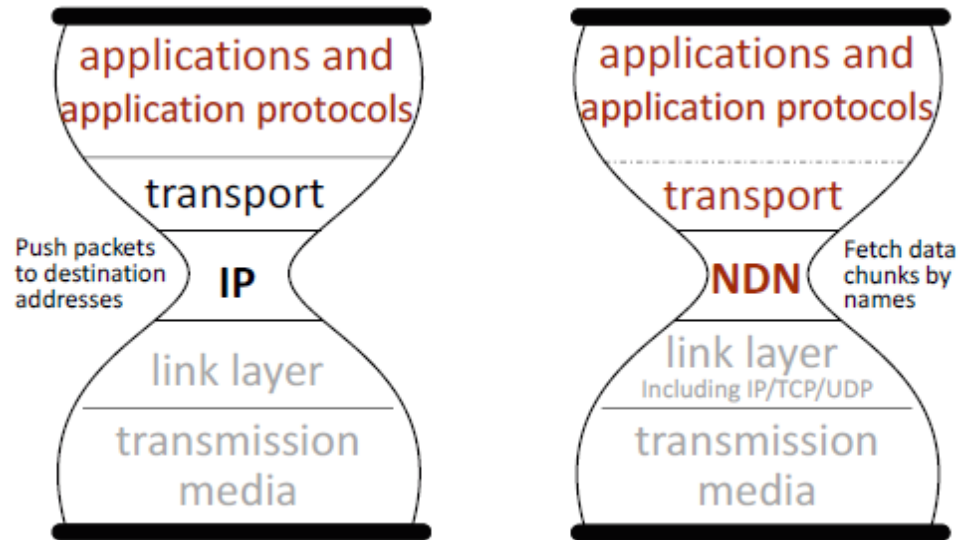
About me

- Prof. Leobino Sampaio
 - Computer networks and information security
 - Federal University of Bahia (UFBA)
- Ongoing research areas
 - Future Internet architectures
 - **Information-Centric Networking (ICN)**
 - Software-Defined Networking (SDN)



Named-Data Networking

- Information-Centric Networking
 - Proposed architectures: **NDN/CCN/DONA/NetInf**
- Fundamentals
 - Content-centric
 - Named-based routing
 - In-Network caching
 - Network layer protocol
- Characteristics
 - Data packets are immutable
 - Every Data packet carries a signature



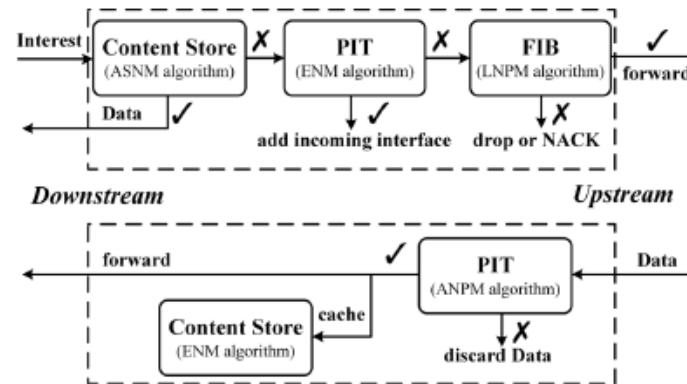
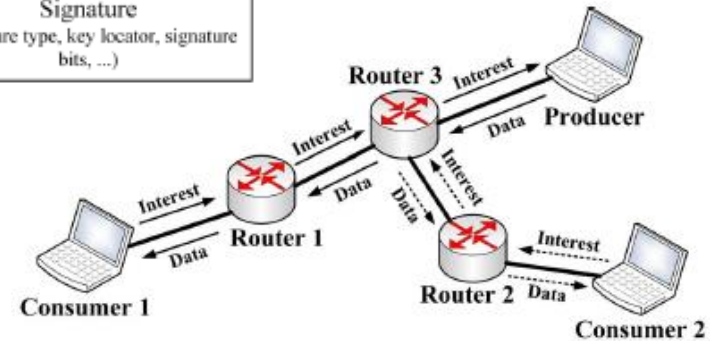
Supporting Augmented Reality: Looking Beyond Performance Lemuel Soh, Jeff Burke, Lixia Zhang. ACM SIGCOMM 2018 Workshop on VR/AR Network, August 2018.

ICN Components

- Content producers, consumers, and cache-equipped forwarding devices

Interest	Data
Name	Name
Selectors (order preference, publisher filter, exclude filter, ...)	MetaInfo (content type, freshness period, ...)
Nonce	Content
Guiders (scope, Interest lifetime)	Signature (signature type, key locator, signature bits, ...)

- Data Structures
 - Interest packet
 - Data packet
 - CS, PIT, and FIB



Z. Li, Y. Xu, B. Zhang, L. Yan and K. Liu, "Packet Forwarding in Named Data Networking Requirements and Survey of Solutions," in *IEEE Communications Surveys & Tutorials*, vol. 21, no. 2, pp. 1950-1987, Secondquarter 2019.

NAMED DATA NETWORKING

[Project](#) [Architecture](#) [Codebase](#) [Testbed](#) [Publications](#) [Discussion](#)



NDN HACKATHON

See the results of the 6th NDN Hackathon held in May 2018.

[Read More](#)



TUTORIAL VIDEOS

Watch tutorial videos about the NDN project and NDN technologies.

[Read More](#)



THE NDN TESTBED IS GROWING

The NDN research testbed is a shared resource created for research purposes, that now includes nodes in Asia and Europe.

[Read More](#)



NDN VIDEO FAQ

Questions about NDN answered on video by faculty, students, staff researchers, and colleagues.

[Read More](#)

Named Data Networking Community Meeting (NDNcomm) 2019

May 31, 2019 by FIU in [Updates](#) | [Comments Off](#) on [Named Data Networking Community Meeting \(NDNcomm\) 2019](#)

Events

<https://named-data.net/>

Named Data Networking Project

<http://named-data.net/>



Google Summer of Code 2019

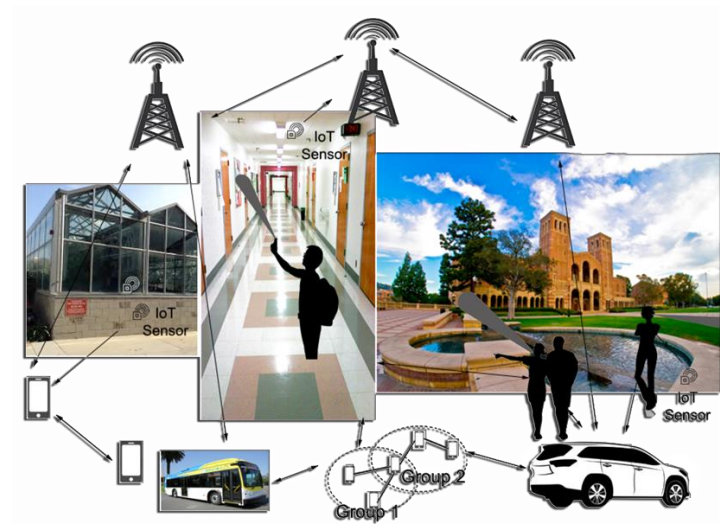
NDN Project has been selected as an organization for Google Summer of Code 2019! [GSoC page](#).

8th NDN Hackathon is next week (remote participation is allowed): <http://8th-ndn-hackathon.named-data.net>

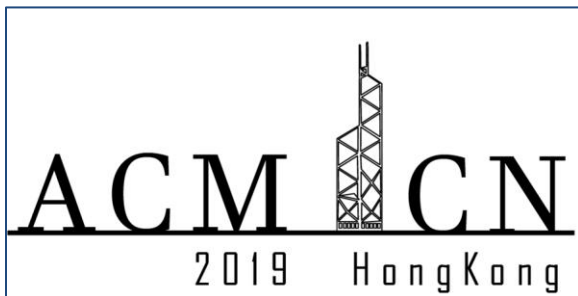
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ICE-AR Project



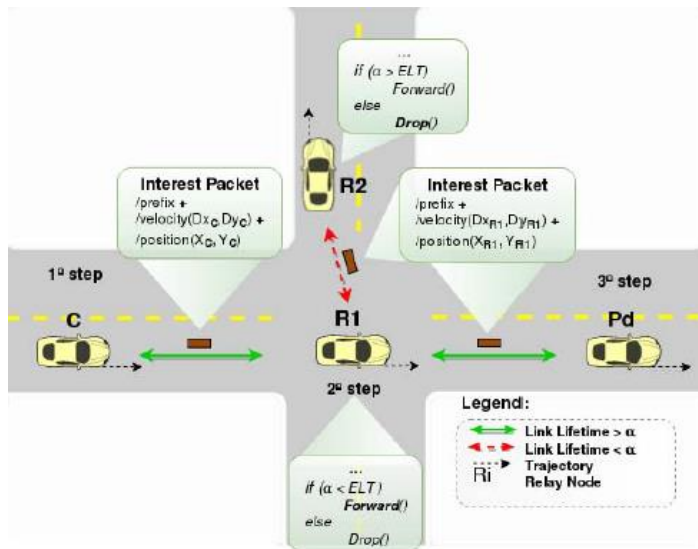
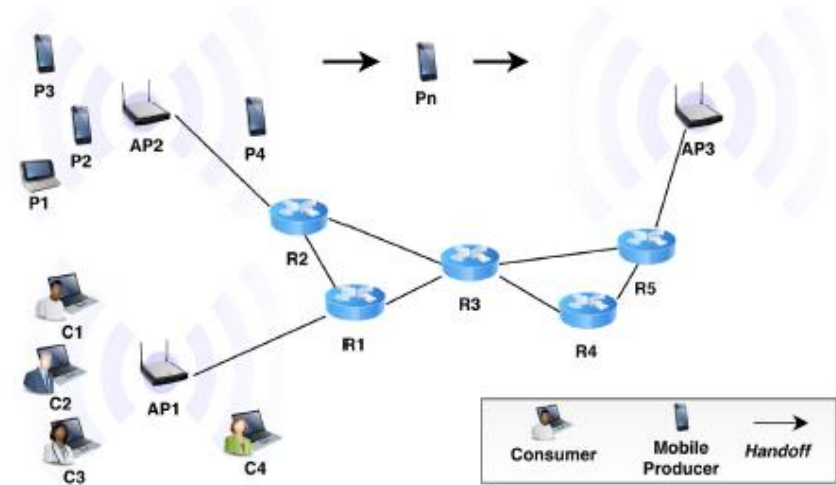
<http://ice-ar.named-data.net/>



<http://ndnmap.arl.wustl.edu/>

Research results

Francisco Renato C. Araújo, Antonio M. de Sousa, Leobino N. Sampaio, **“SCaN-Mob: An opportunistic caching strategy to support producer mobility in named data wireless networking”**, *Computer Networks*, Volume 156, 2019, Pages 62-74,



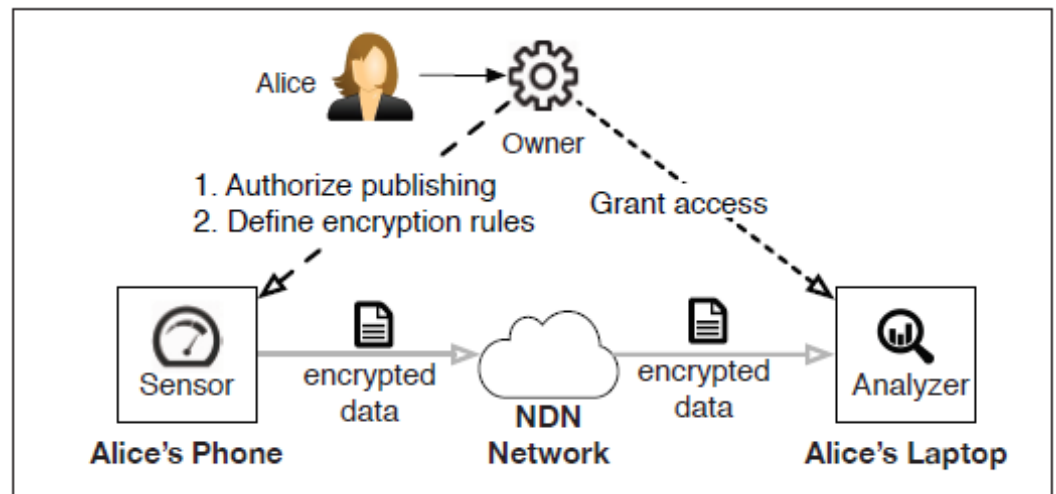
A. M. de Sousa, F. R. C. Araújo and L. N. Sampaio, **"A Link-Stability-Based Interest Forwarding Strategy For Vehicular Named Data Networks,"** in *IEEE Internet Computing*, vol. 22, no. 3, pp. 16-26, May./Jun. 2018.

Security in ICN

- Different approaches, targets, and countermeasures
 - *Tourani, et al "Security, Privacy, and Access Control in Information-Centric Networking: A Survey," in IEEE Communications Surveys & Tutorials, vol. 20, no. 1, pp. 566-600, Firstquarter 2018.*
- Security at Data level instead of communication channels
- Name semantics
 - Naming conventions help to systematically define trust policies
 - Favors automation of key management
- Certificates can be available in the network (data packets)

Authenticity, confidentiality, and availability

- Basic security mechanisms
 - Public-key cryptographic into the architecture
 - Data packet carries digital signatures
 - It requires a centralized trust anchor
- Example
 - NDNFit

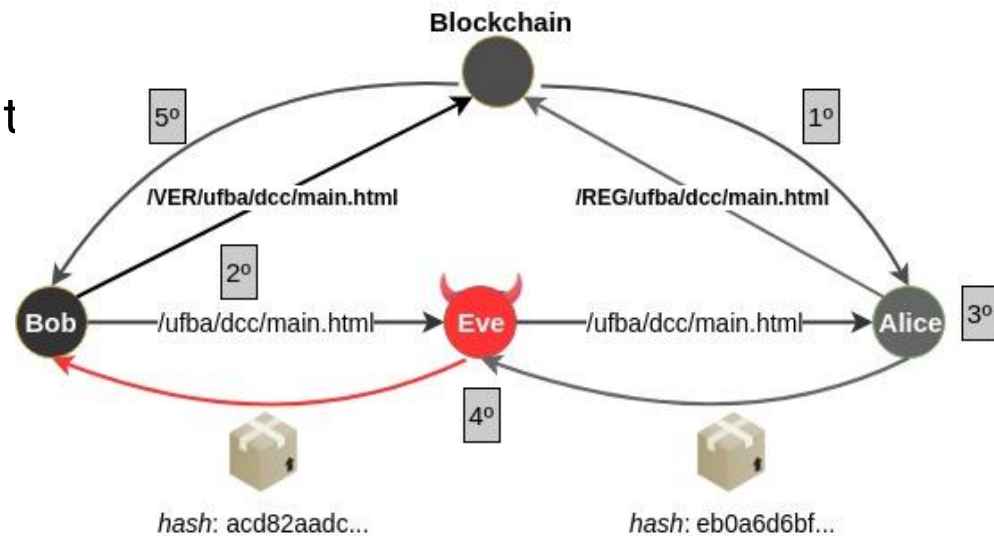


Open Issues

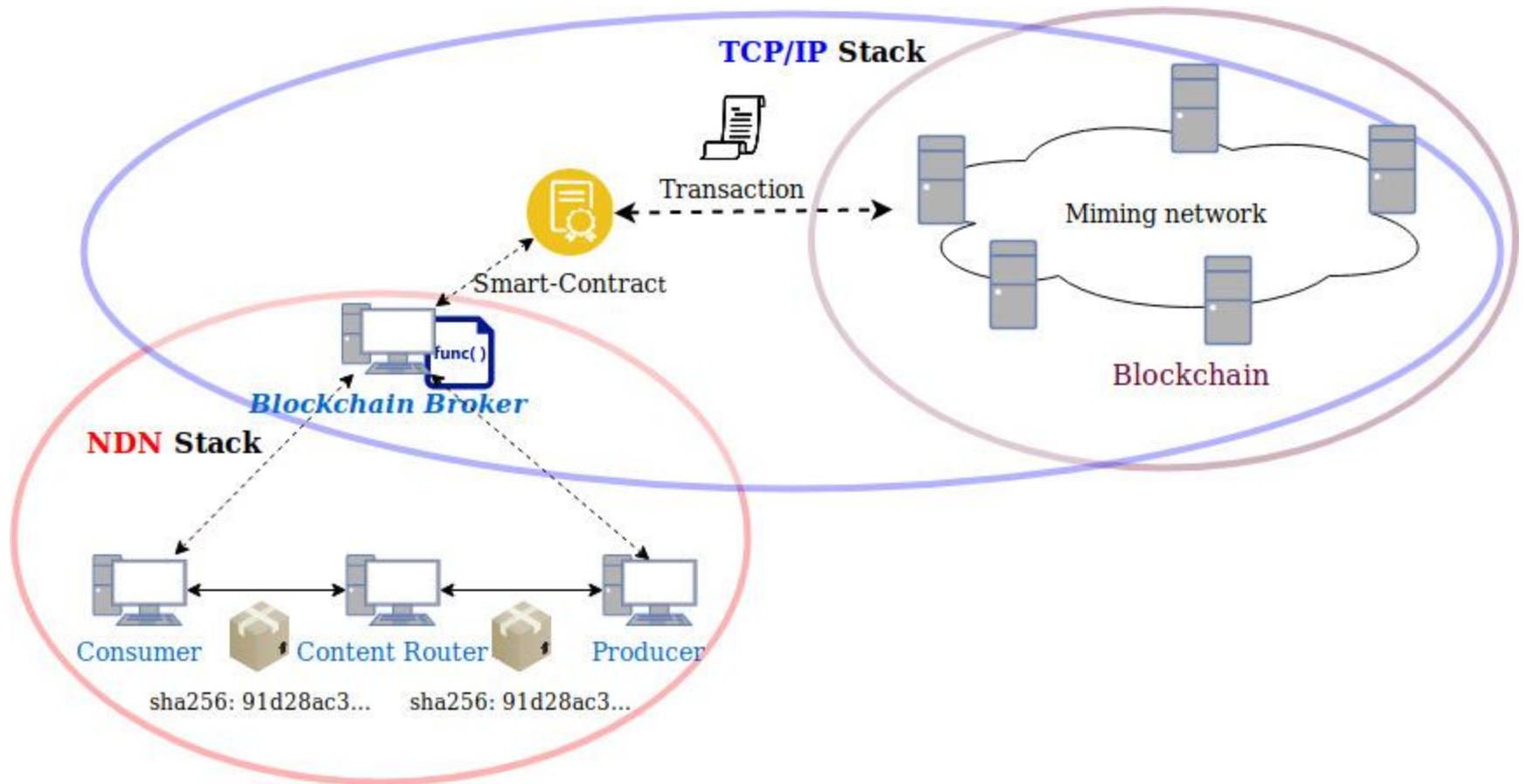
- Centralized trust anchors
- Data provenance is required
- Lack of lightweight solutions for IoT
 - Resource constrained devices
- Solutions proposed recently
 - Initial stages of development
- Rooms for new proposals and developments

Blockchain-based Framework for ICNs

- Blockchain framework for ICN
- Main goals to prevent
 - Content integrity to prevent content poisoning
 - Authenticity to prevent content injection
- Approach adopted
 - Blockchain as a service

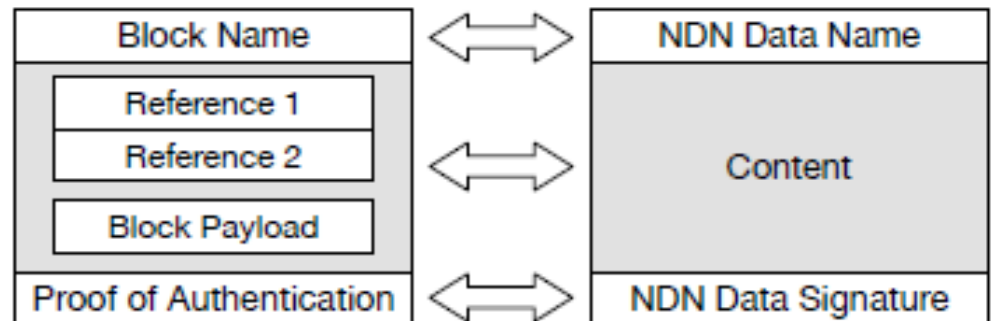


Framework's components



DLedger

- Private distributed ledger
- Main features
 - Designed for IoT networking scenarios
 - Based on Proof of Authentication (PoA)
 - Alternative for Proof of Work approaches
 - Leverages properties of NDN to synchronize and distribute the ledger
- Implementation
 - Relies on Tangle



A Note on Routing Scalability in Named Data Networking. Zhang, Zhongda Xia, Alexander Afanasyev, and Lixia Zhang. 2019 IEEE International Conference on Communications Workshops

Future works and research perspectives

- Contribute to NDN development effort
 - Collaborate with Prof. Lixia Zhang (UCLA) in 2020
 - Design and implementation of distributed ledger upon ICN architecture
 - Implementation data provenance infrastructures
- Research initiatives in other fields
 - Data plane network programming with P4
 - Distributed ledger for SDN. To support distributed information from network controllers.

Research projects

- *Human and Context-Awareness as Mobility Support in Information-Centric Networks*
 - Prof. Artur Ziviani (LNCC), Prof. Aline Viana (INRIA), 2 PhD students
- *On Supporting the Internet of Things Through Named Data Networking: Interoperability, security, and mobility*
 - Prof. Lixia Zhang (UCLA), 1 PhD, 1 MSc, 1 graduated students
- *Bamboo: a metropolitan network testbed for experimentation*
 - many professors and students, seven institutions involved



Thanks!
leobino@ufba.br

