

# Information-Centric Networking Privacy



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**PSIRP**  
PUBLISH-SUBSCRIBE  
INTERNET ROUTING  
PARADIGM



## AUEB/MMlab Collaborators

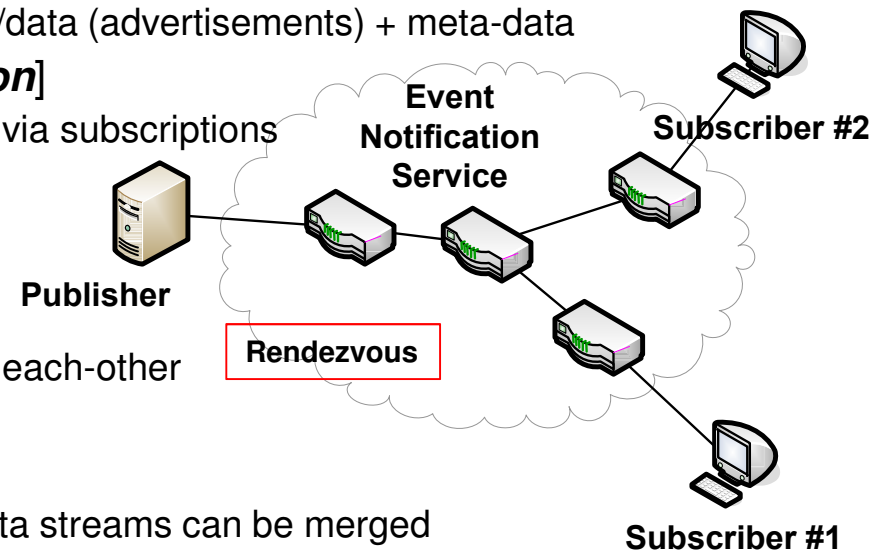
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# Information-Centric Networking (ICN) ... in a nutshell

- Information or Content-Centric Networking (**ICN** or CCN) or Named Data...
  - ◆ **CCN** is a specific (PARC) project and is a specific architecture and CCNx its implementation
  - ◆ Named Data Networking (**NDN**) is an NSF project and architecture, related to CCN
  - ◆ Publish Subscribe Internetworking (**PSI**) is an architecture developed by FP7 PSIRP & PURSUIT
- 1st **ACM SIGCOMM ICN** Conference, Paris, France, Sept. 2014.
- **IRTF ICNRG**
- **Publishers** (data 'holders' ← producers/owners) [**publication**]
  - ◆ Announce availability of pieces of information/data (advertisements) + meta-data
- **Subscribers** (data consumers) [**subscription**]
  - ◆ Express interest in pieces of information/data via subscriptions
- **Rendezvous Network**
  - ◆ Matches subscriptions with publications
- Endpoint decoupling (pub-sub)
  - ◆ Publishers-Subscribers need not be aware of each-other
  - ◆ Asynchronous communication
- Multicast
  - ◆ Multiple subscriptions can be grouped and data streams can be merged
- Caching
  - ◆ Suitable for in-network on-path and off-path caching



# ICN Characteristics & Tradeoffs

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## ICN vision

- Enabler for FI, IoT, Cloud, 5G...
- Information is key
- Balancing the power between tx-rx
- Better resource utilization
  - ◆ **Caching** / pointer operations
  - ◆ Network is **data-aware**
    - Name/ID & metadata
- multicast, multi-homing & mobility
- Security addressed @ design time
- Better(?) Privacy

## PSI vs. CCN/NDN

- **PSI**: uncoupled Resolution/Routing
- **CCN**: coupled Resolution/Routing
  - ◆ better for ad hoc nets / **robust**
    - **flooding** of interests

## PSI characteristics

- **SDN similarities**
  - ◆ **fast, predetermined forwarding**
  - ◆ centralized decisions/flows/paths
- Reliance on ***Rendezvous Network***
  - ◆ but many RNets, independent
  - ◆ strength: prof. mgmt., reputation
  - ◆ **trust-to-trust** instead of E2E

## Privacy inherent in ICN (?)

- **publishers do not know subscribers**: forwarding techniques that do not reveal destination(s)
  - ◆ PSI: zFilters (Bloom filters on links)
  - ◆ CCN/NDN: crumb based routing
- pub/sub msgs: sensitive info?
  - ◆ **Yes** for PSI, **No** for interests in CCN

# Privacy and ICN—The Issues

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- The power of the (Rendezvous) Network
    - ◆ PSI: explicit requests with requestor ID to Rendezvous Network
    - ◆ CCN/NDN: requests to the whole network without requestor ID
      - but implicit ID based on proximity/reverse path
    - ◆ Explicit protection from the Rendezvous Network
      - through *homomorphic encryption*
    - ◆ Access Control *Delegation* as a privacy enhancing technique
      - ... for Access Control policies
  - Privacy attacks based on inherent ICN properties
    - ◆ e.g., low(er) delay → cached nearby → neighbor requested it...
    - ◆ monitoring, decisional interference, and invasion attacks
  - A common ICN reference model to study privacy
    - ◆ system, adversaries, and threats models
    - ◆ evaluating design choices for: **naming, advertisement, resolution, forwarding**
- N. Fotiou, S. Arianfar, M. Sarela, G.C. Polyzos, “[A Framework for Privacy Analysis of ICN Architectures](#),” APF’14.
- Applicability of ICN techniques to the IoT: privacy concerns
  - **Challenge:** Protect user privacy & unleash the full potential of ICN

# Thank you!

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### Selected Publications

- G. Xylomenos, C.N. Ververidis, V.A. Siris, N. Fotiou, C. Tsilopoulos, X. Vasilakos, K.V. Katsaros, G.C. Polyzos, “**A Survey of Information-Centric Networking Research**,” *IEEE Communications Surveys and Tutorials* (online, 7/2013).
- N. Fotiou, G.F. Marias, G.C. Polyzos, “**Access Control Enforcement Delegation for Information-Centric Networking Architectures**,” ACM SIGCOMM *Computer Communication Review*, 10/2012.
- N. Fotiou, D. Trossen, G.F. Marias, A. Kostopoulos, G.C. Polyzos, “**Enhancing Information Lookup Privacy through Homomorphic Encryption**,” *Security and Communication Networks* (online 11/2013).