Improved connectivity for passengers on commuter trains

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Content

› ICN background, short introduction
› Improved connectivity for passengers on commuter trains problem description
› Project proposal outline
Evolution of networking

Today’s Internet
Focuses on Conversations between Hosts

Host-centric abstraction
Who to communicate with

Information-centric network
Focuses on Dissemination of Information objects

Information-centric abstraction
What to communicate

Connect nodes

Evolution

Web CDN P2P

Access information
Host-centric networking

Connect to Server X and get object B

Trusted Server

Secure Connection

Server X
Information-centric networking

Untrusted host

Trustable copy of object B

Get object B

Untrusted connection
Key elements in ICN

› Object Naming
› Object Caching
› How to find Objects
Object naming

› How to make objects trustable?

› Object name = type/”hash of object content”

› An object containing nothing (empty string) will get the name

  Sha-256/e3b0c44298fc1c149afbf4c8996fb92427a

  e41e4649b934ca495991b7852b855
Caching

› Storage capacity in nodes will continue to increase.

› “New Seagate technology promises hard drive storage capacities of up to 60 terabytes in the next decade”

Assumption:
In the not to far future nodes should be able to store most of the content that they are forwarding or downloading.

› This will decrease network traffic. A copy of the content you are looking for is probably available close to you in a cache.
How to find Objects

- Broadcast
- Add hook routing
- Name based routing
- Name resolution servers
  - Hierarchical
  - Distributed Hash table
Network characteristics

Node-centric network

Information-centric network
ICN vs current networks

› Caches integrated in the network infrastructure
  – Combines today's CDNs and user caching (p2p) in the basic network service

› Network service in terms of named data objects
  – No direct host addressing
Object Lock-in per Application

Object lock-in per application
Comparable to host lock-in per network before Internet
Application Development on a Common Naming and Reachability Infrastructure

Seamless communication between objects of all types

NRS  Name Resolution System
RVS  Rendezvous System
Today mobile networks have difficulties to provide adequate service in some challenging situations, e.g. when a commuter train with large numbers of active users are moving relative the network infrastructure.
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problem description (2)

› Implement solutions for this problem using ICN technology

– p2p communication and caching
– Local cache with WiFi access
– Real world trial
– …..
Project proposal outline

› Develop an NetInf node in Erlang with WLAN and caching
› Deploy SAIL NetInf Androids together with WLAN caching node in a train environment
› Perform extensive testing and evaluation of how connectivity is changed using this technology
› Develop new NetInf functionality, e.g. caching strategies, multihop vs. infrastructure communication, ….
› The train scenario is an example. Alternative NetInf scenarios can be considered.
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- We would like to investigate in some type of real-world trial how ICN, by p2p communication and caching could improve the situation by off-loading traffic from the mobile infrastructure.

- Local cache with WiFi access in train can be managed by:
  - train operator interested in improving the travel experience
  - cellular operator offloading the cellular network by offering a cellular access via the cache
  - if none of the above is at hand, caching can be distributed on the mobile end user devices on the train
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Local cached copies are found and used
4WARD NetInf Naming Scheme

› Information Object (IO) = (ID, Data, Metadata)
› ID = (Type tag, Authenticator, Label)
› Each IO has an owner
› All equivalent copies have the same ID

![Diagram of 4WARD NetInf Naming Scheme]

ID — Type | A=Hash(PK_{IO}) | L={attributes}

Security Metadata

Data

SK_{IO}
1. Step: Persistently identify information via identifier/locator split
   - Location-independent identifiers
   - Represent multiple copies

2. Step: Representation of information via Information Objects (IOs)
   - Another level of indirection
   - Represent information independent of specific copy and encoding
     - E.g. a text, a song
   - Contains information-specific metadata
     - E.g. access rights, attributes

Information Objects can do more:
- Representation of:
  - Streams
  - Services
  - Real-world objects (e.g., a book, person)
- IOs can be used to organize information

- Enables efficient information dissemination
  - System can automatically choose encoding and copy (e.g. based on metadata)
  - User can navigate information (e.g. choose encoding)
ICN is more than CDN

- Augmented Internet – Real-world objects
  - Linking real world objects in the virtual information world
  - Clicking on and bookmarking real world objects
  - Semantic information model
- Support for DTN
  - The ICN pub/sub API naturally support asynchronous communication
- Sensor networking
  - ICN handle sensor data just like any other type of information object