NetInf architecture -- key features

26th IEEE Annual Computer Communications Workshop (CCW)
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Börje Ohlman

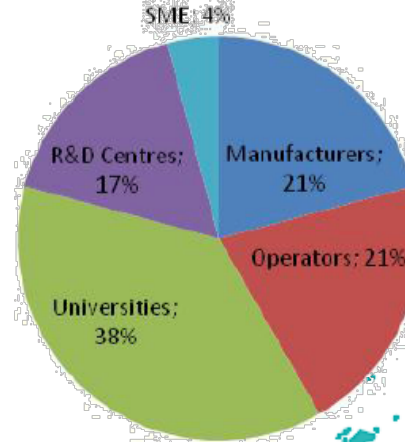Ericsson Research

& colleagues from the EU FP7 project SAIL

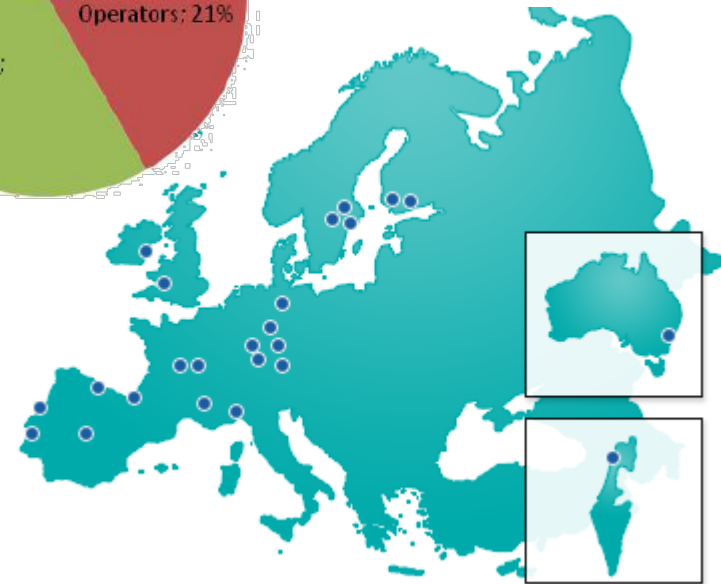SCALABLE & ADAPTIVE INTERNET SOLUTIONS

The SAIL Project
### (Scalable & Adaptive Internet Solutions)

- **EU Call FP7-ICT-2009-5**
  - **25 partners**
  - **30 months duration**
  - **12.4 M€ EU funding in 2.5 years (total ~20M€)**

- **SAIL's main objective**
  - **Design concepts and technologies for the networks of the future**
  - **Develop techniques to move from today's to future networks**

Pie chart: SME 4%, Manufacturers 21%, Operators 21%, Universities 38%, R&D Centres 17%

Partner logos: ERICSSON, Alcatel-Lucent, Nokia Siemens Networks, NEC, orange, hp, tecnalia, INSTITUT TELECOM, Technion Israel Institute of Technology, docomo DOCOMO Euro-Labs, Telefónica Investigación y Desarrollo, TELECOM ITALIA, PT inovação, SICS, INSTITUTO SUPERIOR TÉCNICO, INRIA, NICTA, UC UNIVERSIDAD DE CANTABRIA, Lyatiss, UNIVERSITÄT PADERBORN, Aalto University School of Science and Technology, KTH, Fraunhofer, Universität Bremen

SCALABLE & ADAPTIVE INTERNET SOLUTIONS

SEVENTH FRAMEWORK PROGRAMME

Scalable Adaptive Internet Solutions
On-demand usage of network resources

- Cloud Networking: Tying Cloud Computing and Network Virtualization together

- Open Connectivity: Efficient use of multi-path, multi-protocol and multi-layer networking – over any fixed and mobile networks

- Network of Information: Shift of focus from network nodes to information objects

Cloud Networking aspect

Network of Information aspect

Open Connectivity aspect

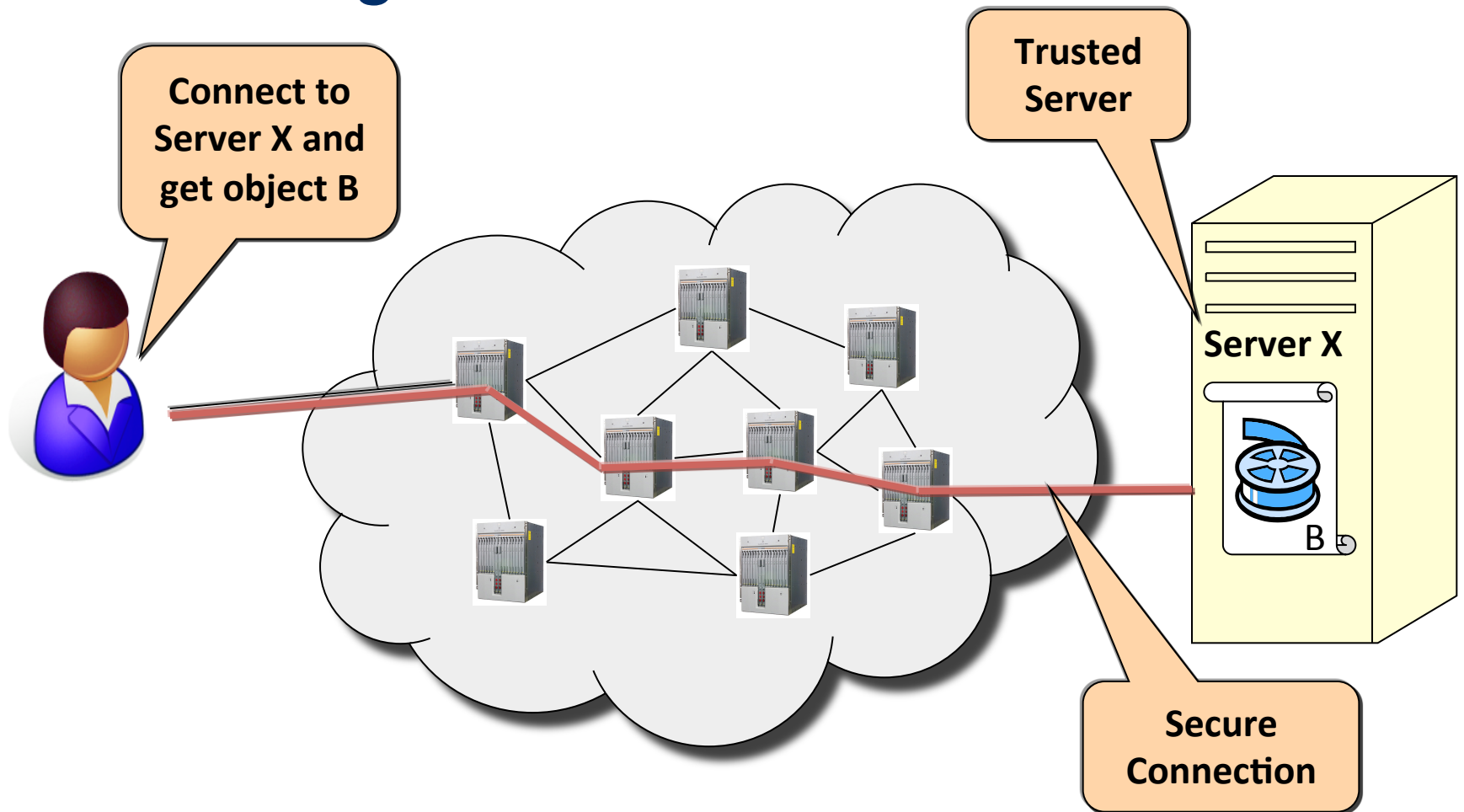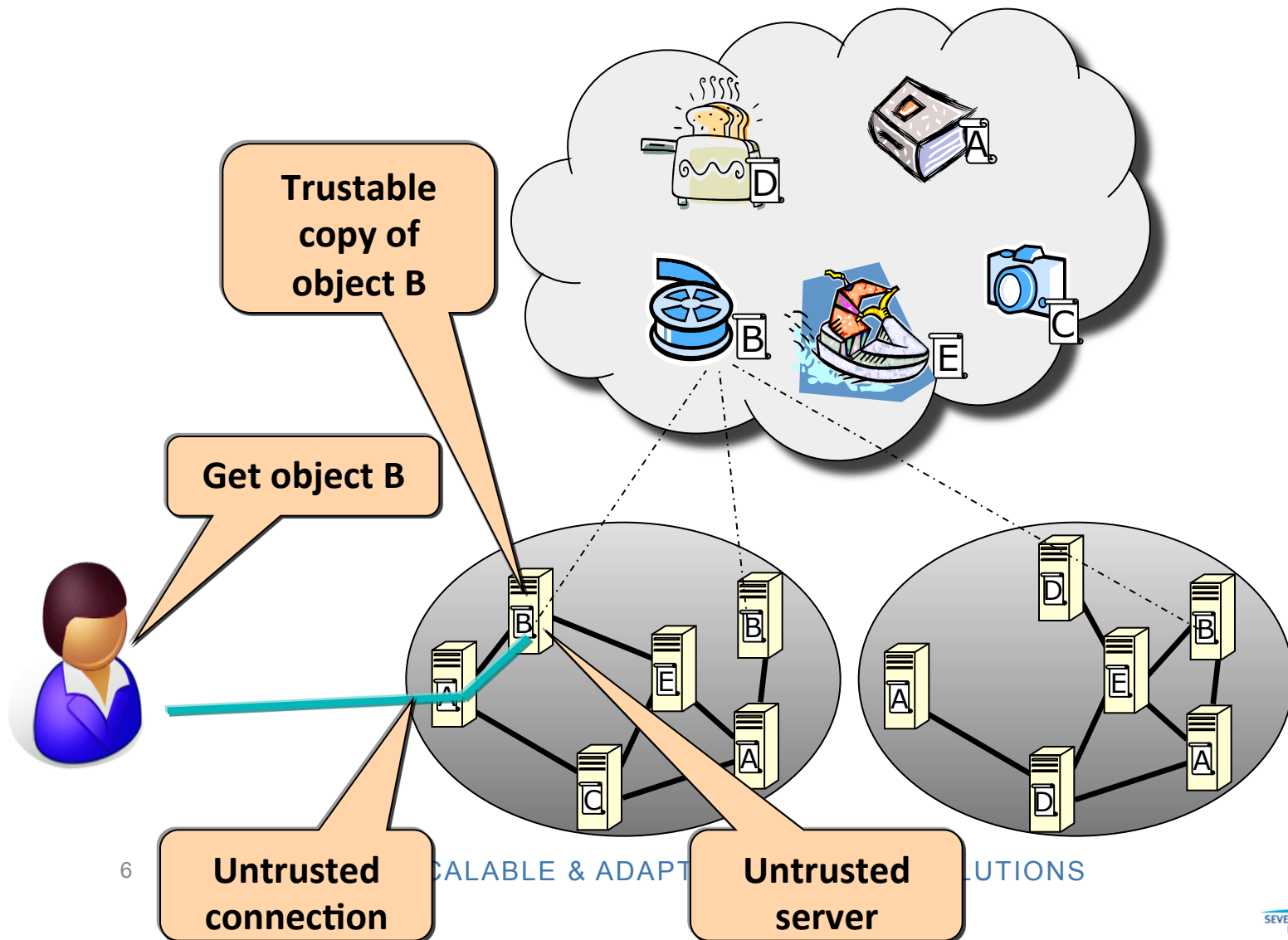SCALABLE & ADAPTIVE INTERNET SOLUTIONS
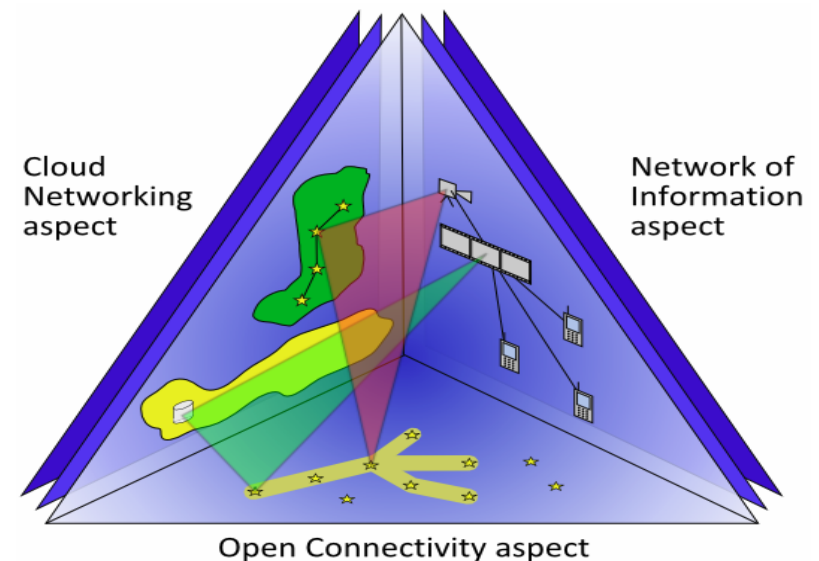
Outline

- ICN security model
- NetInf naming and object structure
- NetInf Name Resolution Service (NRS)
- NetInf Aplication Programming Interface (API)
- Conclusions and next steps

Traditional node centric networking

S A I L

Connect to Server X and get object B

Trusted Server

Server X

B

Secure Connection

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SEVENTH FRAMEWORK PROGRAMME

Information centric networking

Trustable copy of object B

Get object B

Untrusted connection

Untrusted server

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NDO Structure

SHA-256 Hash (Base64)

Object Name

`ni:///sha-256;B_K97zTtFuOhug27fke4_Z…`

**Object
in Message**

`multipart/mixed`

`application/json`

Object management data

`multipart/mixed`   **Named data object**
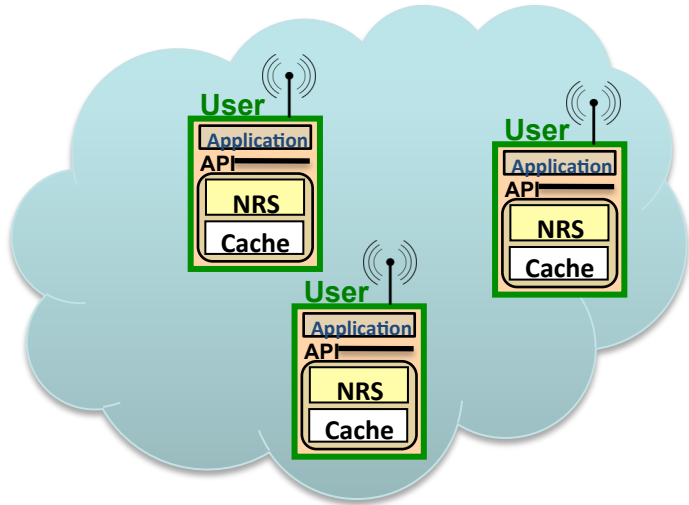
`application/steam-meta+xml`

Application-specific meta data
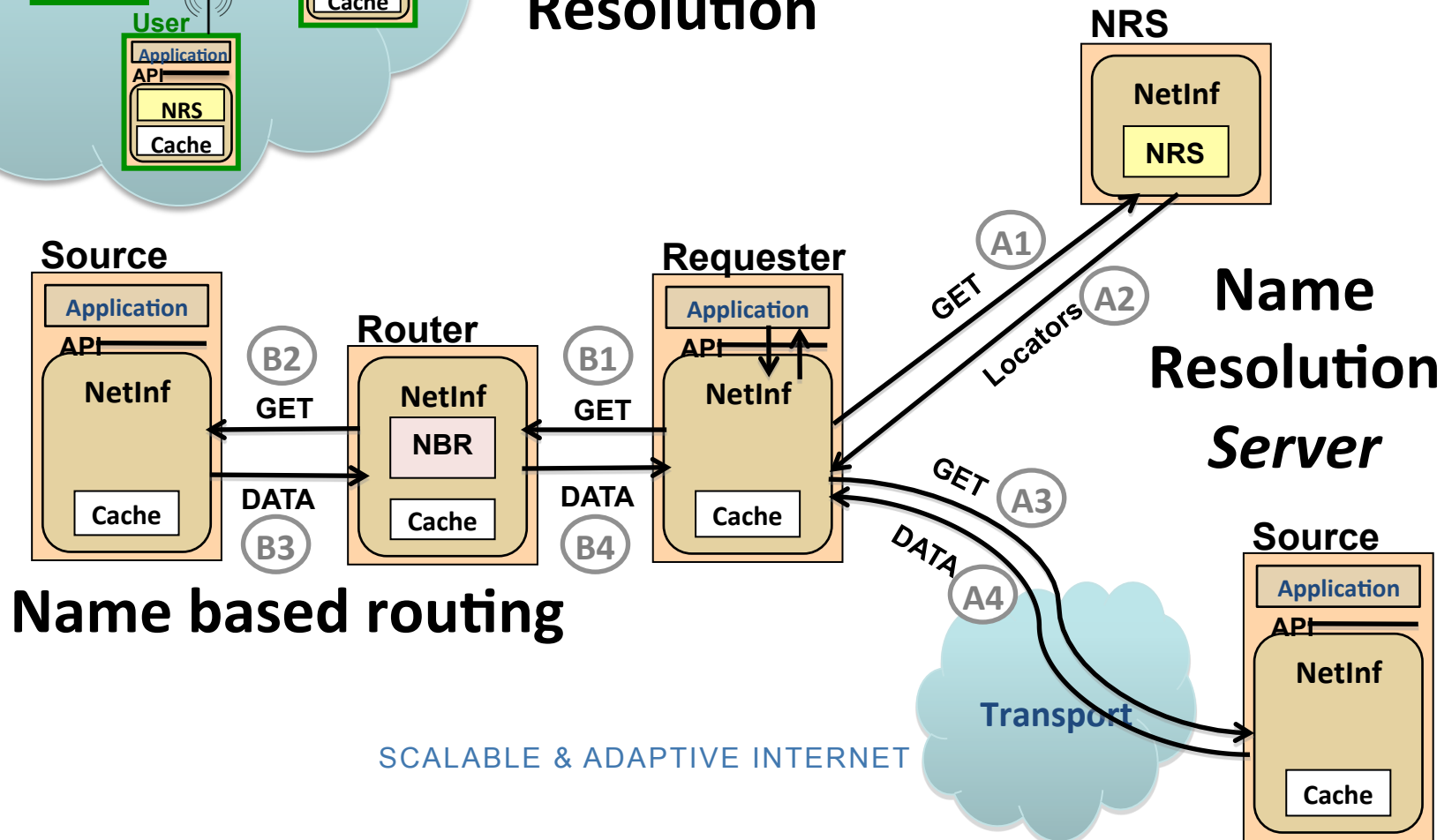
`application/binary`

Actual object bits
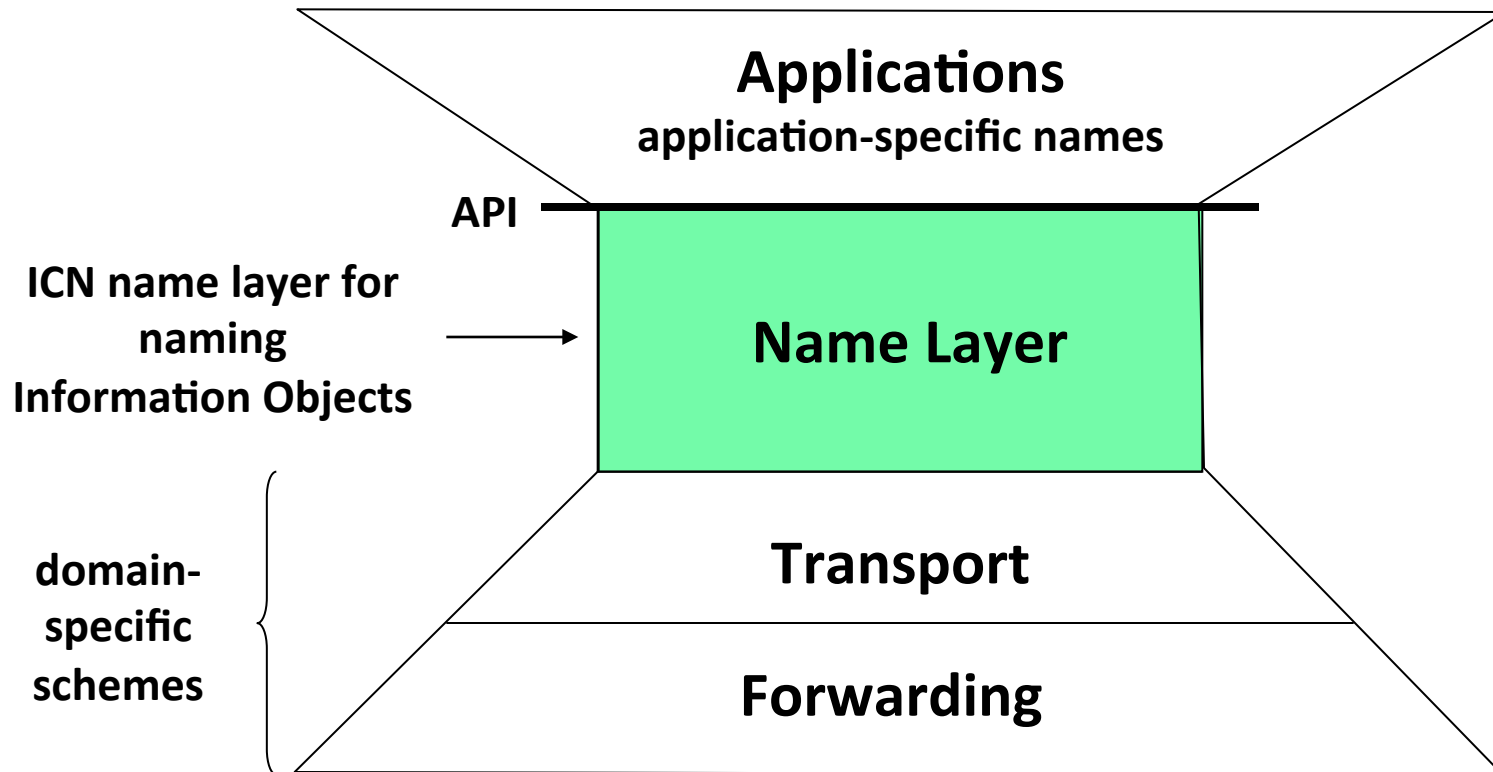
**SHA-256
hash
coverage**

ni-naming: draft-farrell-decade-ni

Name Resolution Service (NRS)
- Alternatives

SAIL

Broadcast Resolution

User
Application
API
NRS
Cache

User
Application
API
NRS
Cache

User
Application
API
NRS
Cache

NRS
NetInf
NRS

A1
A2

Name Resolution *Server*

Source
Application
API
NetInf
Cache

Router
NetInf
NBR
Cache

Requester
Application
API
NetInf
Cache

B2
GET
B1
GET

DATA
B3
DATA
B4

GET
A3
DATA
A4

Locators

Source
Application
API
NetInf
Cache

Transport

Name based routing

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An information-centric Waist

Applications
application-specific names

API

ICN name layer for naming Information Objects →

Name Layer

domain-specific schemes

Transport

Forwarding

Object Lock-in per Application

sensor application

sensor

naming
reachability

person-to-person application

person

naming
reachability

content distribution application

content

naming
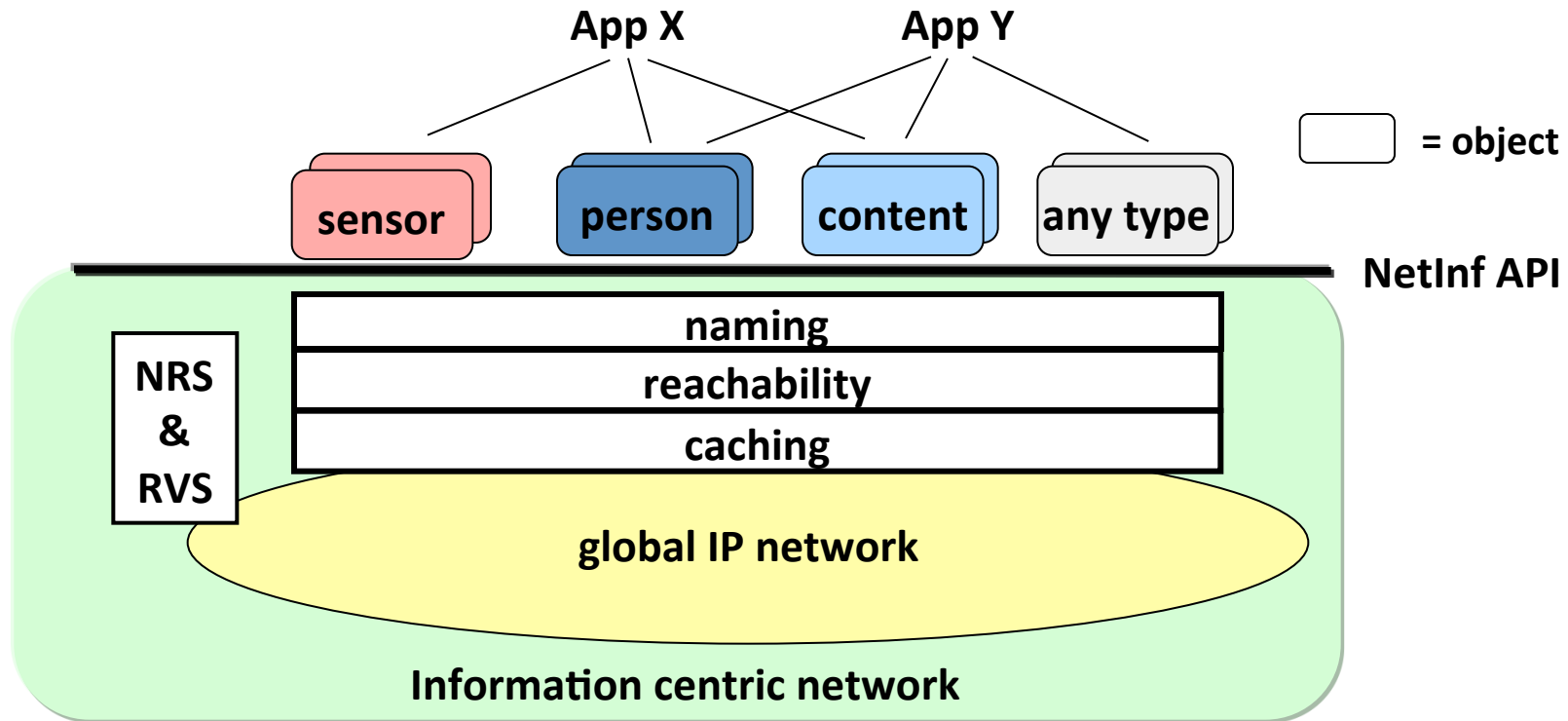**reachability**

= object

DNS

global IP network

Today's Internet
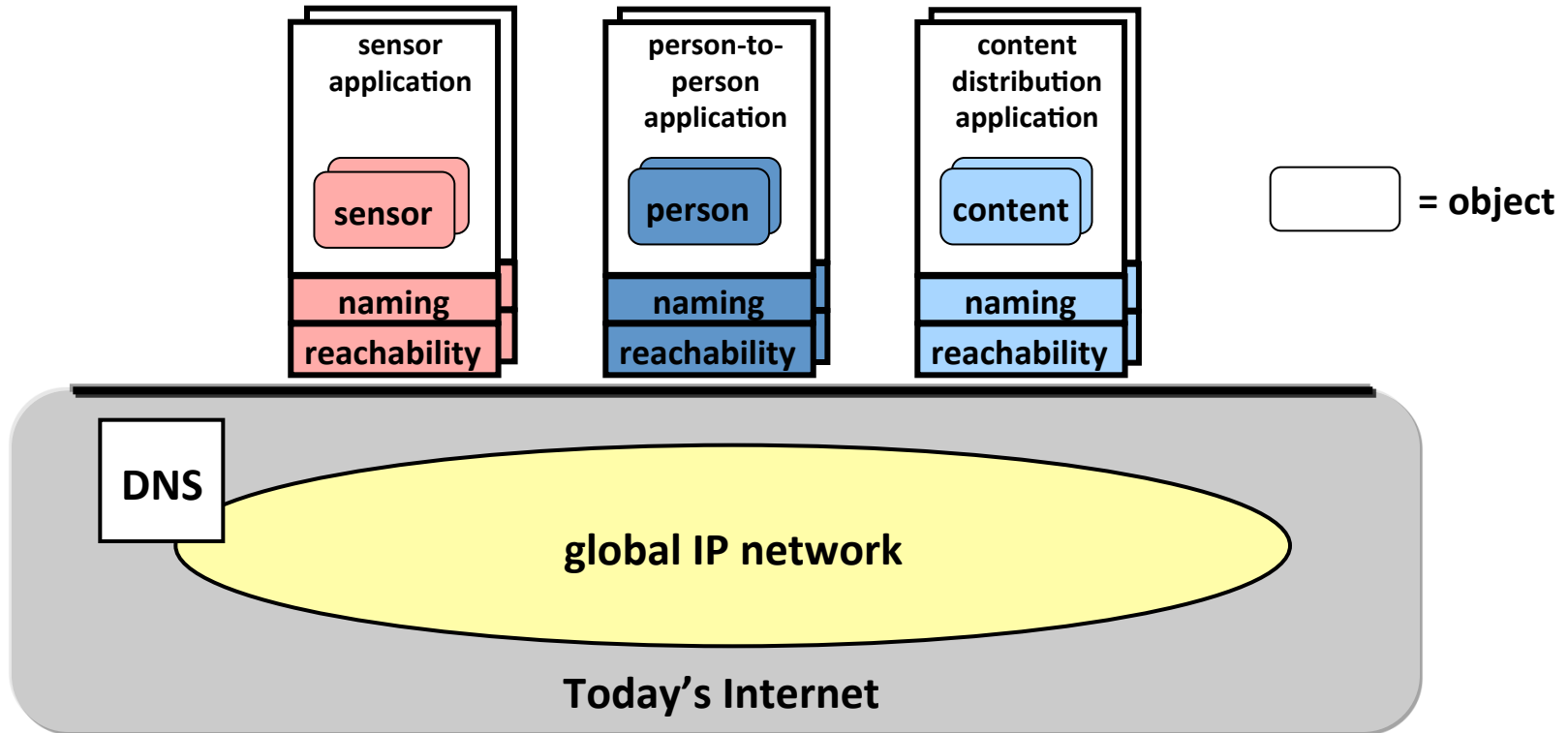
Object lock-in per application
Comparable to host lock-in per network before Internet

Application Development on a Common Naming and Reachability Infrastructure

App X   App Y

sensor   person   content   any type   ☐ = object

NetInf API

naming

reachability

caching

NRS & RVS

global IP network

Information centric network

Seamless communication between objects of all types

NRS   Name Resolution System
RVS   Rendezvous System
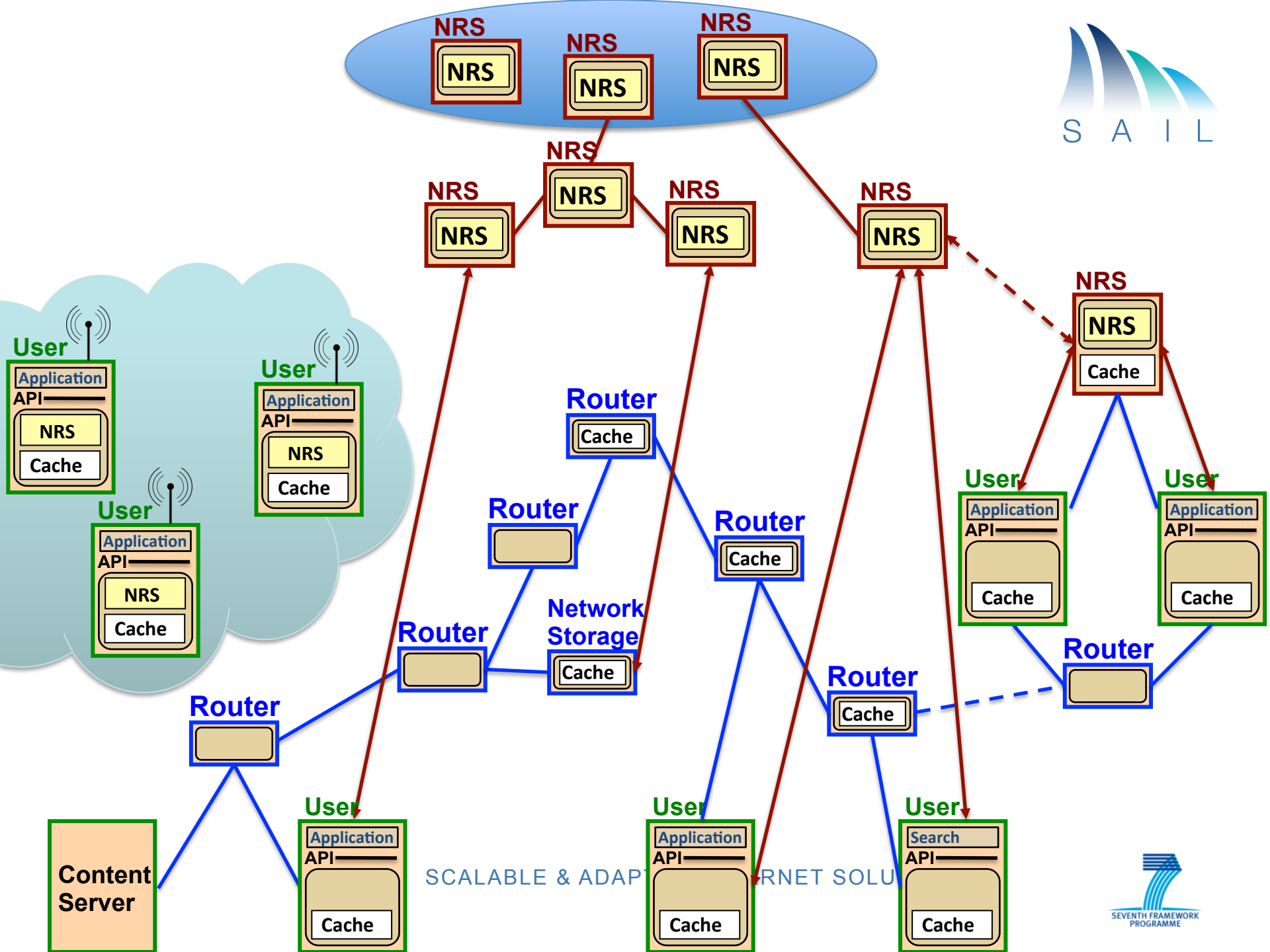
Conclusion

- Some characteristics of Networking of Information (NetInf)
  - *Secure information-centric architecture* by embedding security into identifiers
  - *Scalable* name to locator resolution for 10^{15} objects and beyond
  - A *common infrastructure and API* for accessing all types of objects (including real world objects), regardless of their location

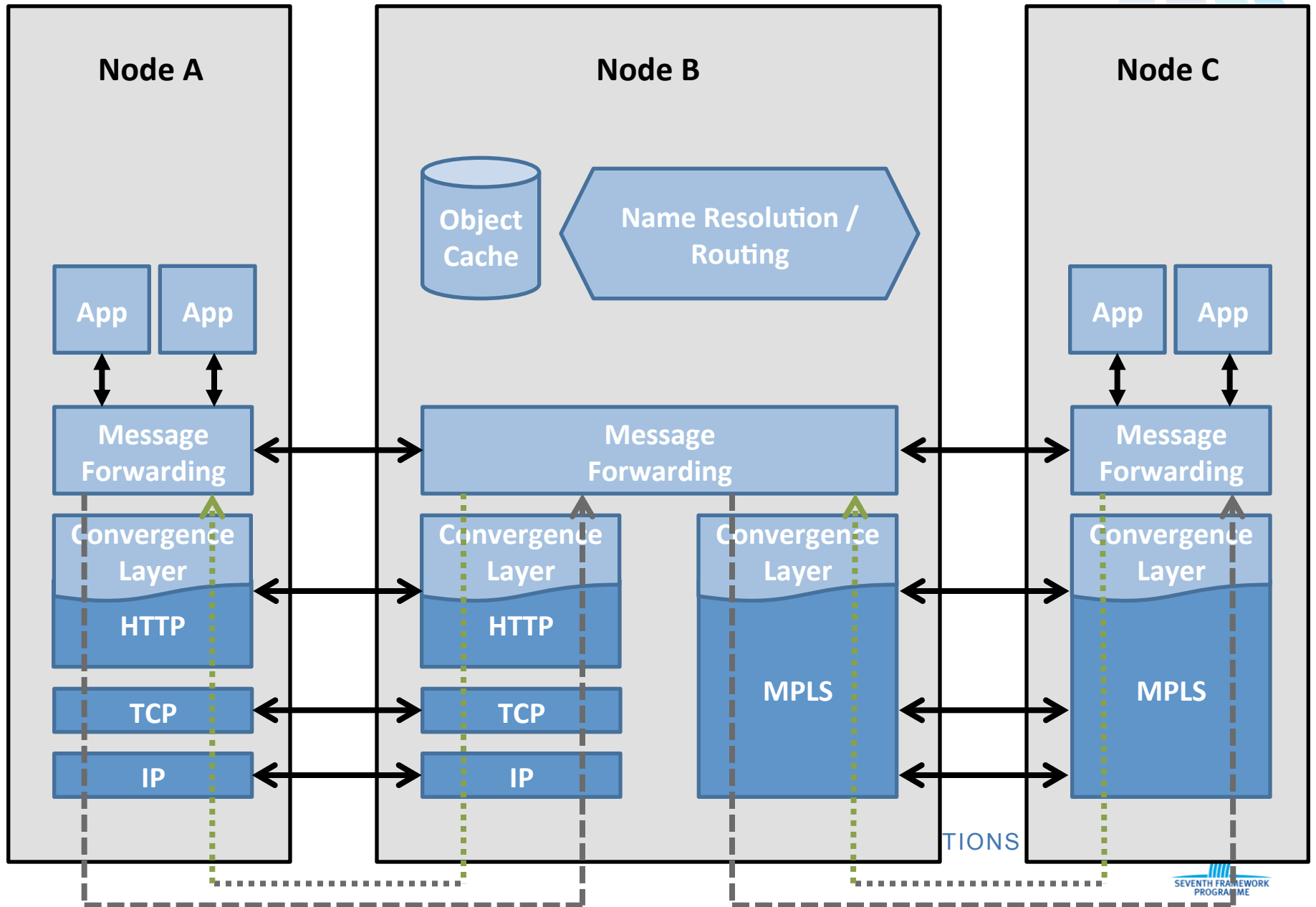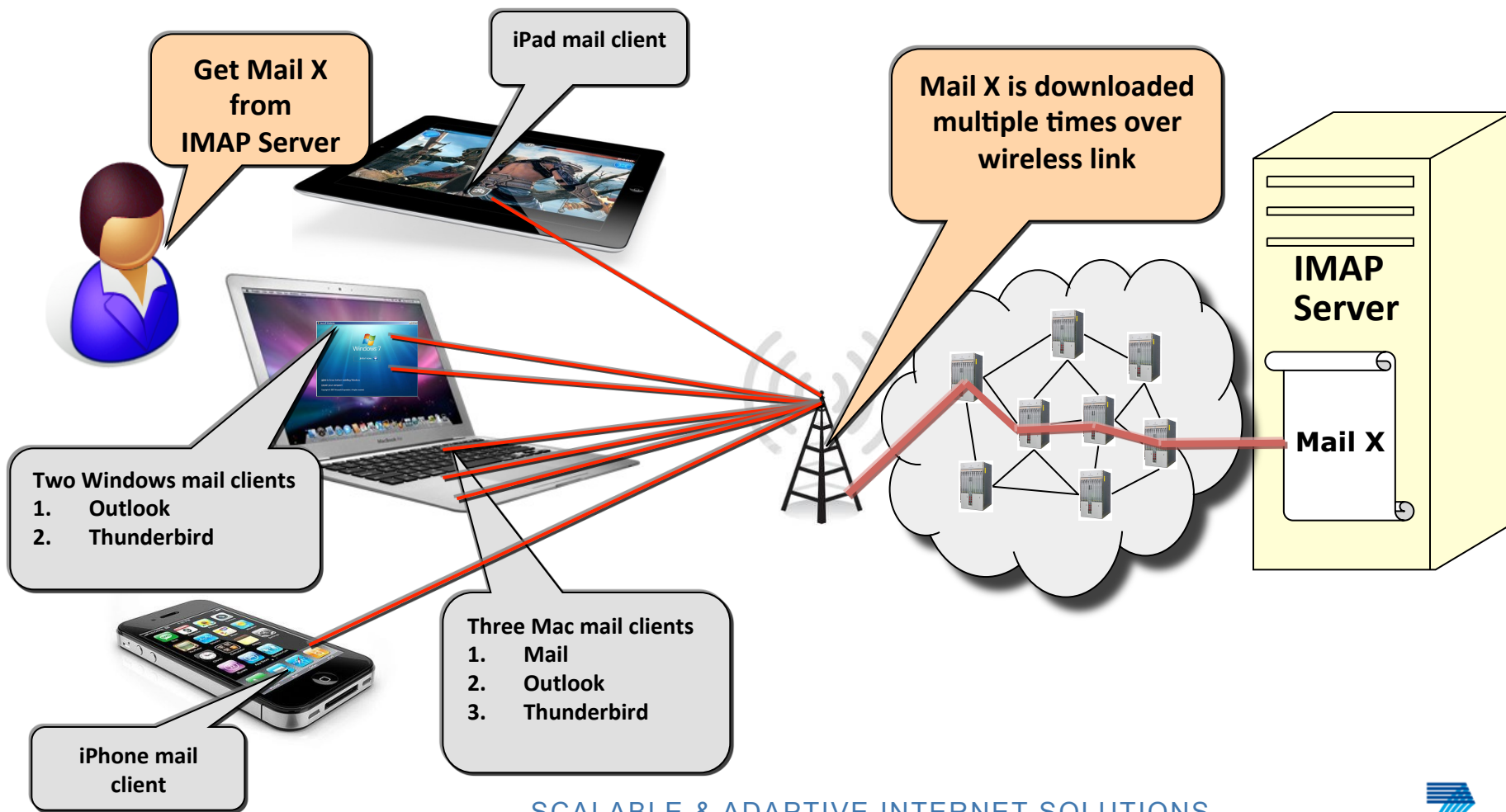SCALABLE & ADAPTIVE INTERNET SOLUTIONS

References

- ICN Survey
  - IEEE Communications Magazine July 2012

- SAIL Project: www.sail-project.eu

- URI naming scheme based on NetInf ideas is on the RFC track in IETF naming things with hashes, i.e. Named Data Objects (NDO)
  - http://datatracker.ietf.org/doc/draft-farrell-decade-ni/

- NetInf Architecture and Protocol Details
  - Deliverable on *NetInf Content Delivery and Operations*
  - http://www.sail-project.eu/wp-content/uploads/2012/06/SAIL_DB2_v1_0_final-Public.pdf

SAIL

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SEVENTH FRAMEWORK PROGRAMME

Mail download in traditional node centric networking

SAIL

Get Mail X from IMAP Server

iPad mail client

Mail X is downloaded multiple times over wireless link

IMAP Server

Mail X

Two Windows mail clients
1. Outlook
2. Thunderbird

Three Mac mail clients
1. Mail
2. Outlook
3. Thunderbird

iPhone mail client

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2012-11-08

SEVENTH FRAMEWORK PROGRAMME

Mail download with Information Centric Networking

Get Mail X from IMAP Server

iPad mail client

Mail X is downloaded only once over wireless link

Local cached copies are found and used

Two Windows mail clients
1. Outlook
2. Thunderbird

Three Mac mail clients
1. Mail
2. Outlook
3. Thunderbird

iPhone mail client

IMAP Server

Mail X

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2012-11-08