



PSIRP
PUBLISH-SUBSCRIBE
INTERNET ROUTING
PARADIGM

Publish-Subscribe Internet Routing Paradigm

PSIRP

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Observation

Fundamentals of the Internet

- Collaboration
 - Reflected in forwarding and routing
 - Cooperation
 - Reflected in trust among participants
 - Endpoint-centric services (mail, FTP, even web)
 - Reflected in E2E principle
- ⇒ **IP, full end-to-end reachability**

VS.

Reality in the Internet Today

- Phishing, spam, viruses
 - There is no trust any more!
 - Current economics favor senders
 - Receivers are forced to carry the cost of unwanted traffic
 - Information-centric services
 - Do endpoints really matter?
 - Endpoint-centric services move towards information retrieval through, e.g., CDNs
- ⇒ **IP with middleboxes & significant decline in trust in the Internet**

Hypothesis: Clean-Slate Design Required

- What stood at the beginning
 - Collaboration
 - Cooperation
 - Endpoint-centric services does not seem enough
- What about:
 - Trust?
 - Information centrism?
 - Legitimacy of E2E?
 - Role of overlays?



Clean-slate design...

- Question ALL fundamentals
- Challenge our thinking
- Take nothing for granted, including industry structures
- Clear vision

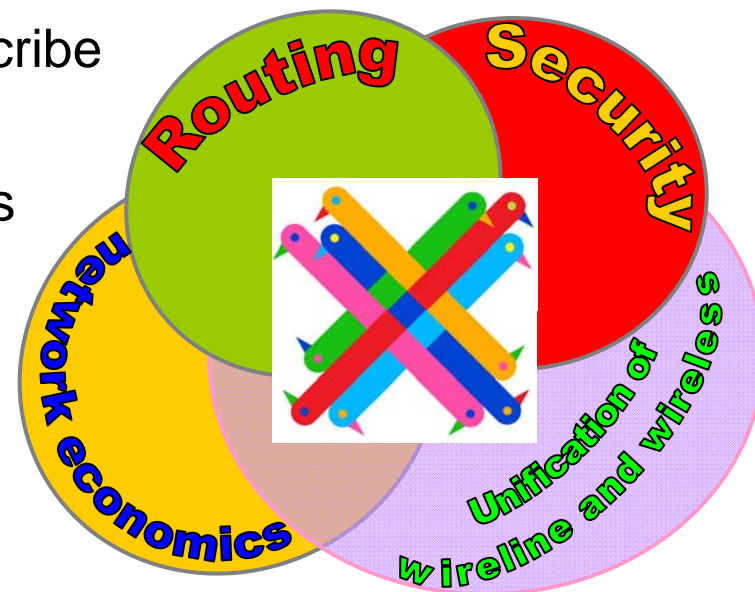
...with late binding (to reality)

- Consider migration and evolvability in separate work items
 - How to get our design into real deployments, e.g., overlay vs. IP replacement?
- Consider necessary evolution of industry (and regulatory) structures
 - How do industries need to evolve in certain scenarios?

Vision

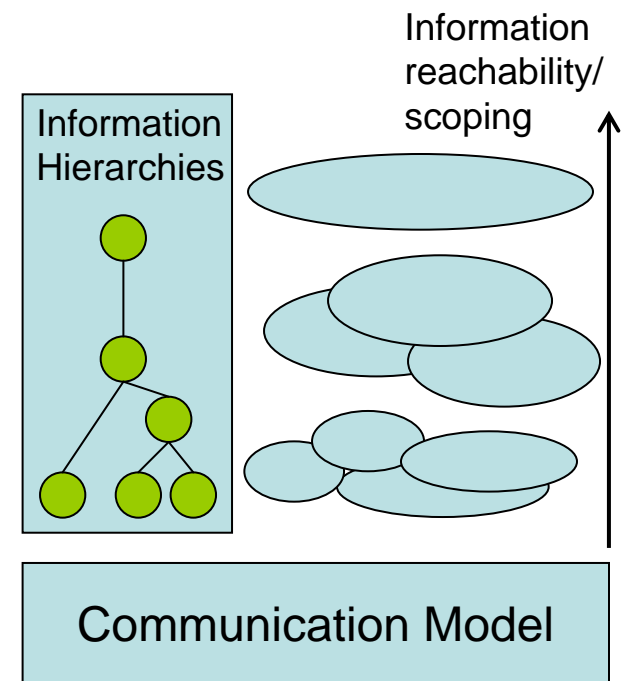
Envision a system that dynamically adapts to evolving concerns and needs of their participating users

- Publish–subscribe based internetworking architecture restores the balance of network economics incentives between the sender and the receiver
- Recursive use of publish-subscribe paradigm enables dynamic change of roles between actors



Main PSIRP design principles

- Information is multi-hierarchically organised
 - Higher-level information semantics are constructed in the form of directed acyclic graphs (DAGs), starting with meaningless forwarding labels towards higher level concepts (e.g., ontologies).
- Information scoping
 - Mechanisms are provided that allow for limiting the reachability of information to the parties having access to the particular mechanism that implements the scoping.
- Scoped information neutrality
 - Within each scope of information, data is only forwarded based on the given (scoped) identifier.
- The architecture is receiver-driven
 - No entity shall be delivered data unless it has agreed to receive those beforehand, through appropriate signalling methods.



Potential Impact of our Work

User

- Relevant Information at your fingertips
 - Wherever, from whoever, through whatever access, on whatever device
- More natural form of communication
 - Emulates sensing, processing, actuation
- Ability to avoid information overload
 - Tackle attention scarcity problem
- Increased security & privacy
 - Only relevant information gathered & provided to user

Industry

- Entry of new players, e.g., information brokers, information processing providers
- Content providers likely to become more powerful
- New technology means potential for new business
- Increase in (information-centric) communication needs will increase need in solutions
- Enable cross-value chain scenarios
 - retail, health, ...

Project Objectives

- Specify, implement and test an internetworked pubsub architecture
 - follow **clean-slate design** approach
- Perform qualitative and quantitative evaluation
 - Security and socio-economics important!
 - Migration and incentive scenarios important (e.g., overlay)!
- The results will be widely published
 - Open source code for the Future Internet
 - Targets specifically SMEs opportunities in Future Internet
- Engage with FI community
 - Cooperate with FIRE (Onelab2) to test on large scale
 - Engage openly through public Wikis

Project Overview

Project Coordinator

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Partners:

- Helsinki University of Technology
Helsinki Institute for Information Technology (FI)
- RWTH Aachen University (DE)
- British Telecommunications Plc (GB)
- Oy L M Ericsson Ab (FI)
- Nokia Siemens Networks Oy (FI)
- Institute for Parallel Processing of the
Bulgarian Academy of Science (BG)
- Athens University of Economics and Business (GR)
- Ericsson Magyarorszag Kommunikacios
Rendszerek K.F.T. (HU)

Duration: January 2008 – June 2010

Total Cost: €4.1m

EC Contribution: €2.5m

Contract Number: INFSO-ICT-216173

WP1 Management (TKK-HIIT)

WP2 Architecture Design
(TKK-HIIT)

WP3 Implementation,
Prototyping & Testing (LMF)

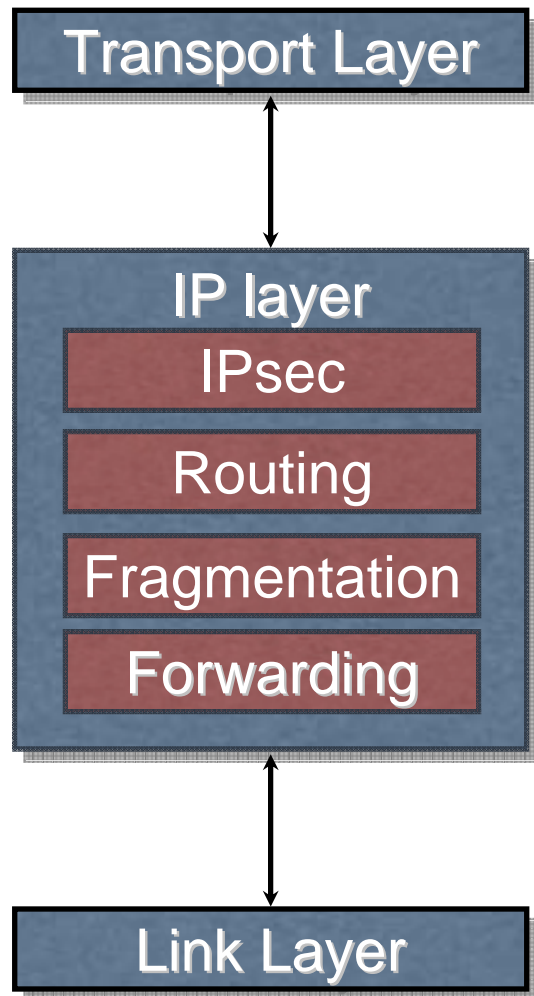
WP4 Validation and Tools
(BT)

WP5 Dissemination and
Exploitation (NSNF)

Project website: www.psirp.org



Current State



Observations

End-to-end reachability is broken

Unwanted traffic is a problem

Mobility and multi-homing are challenging

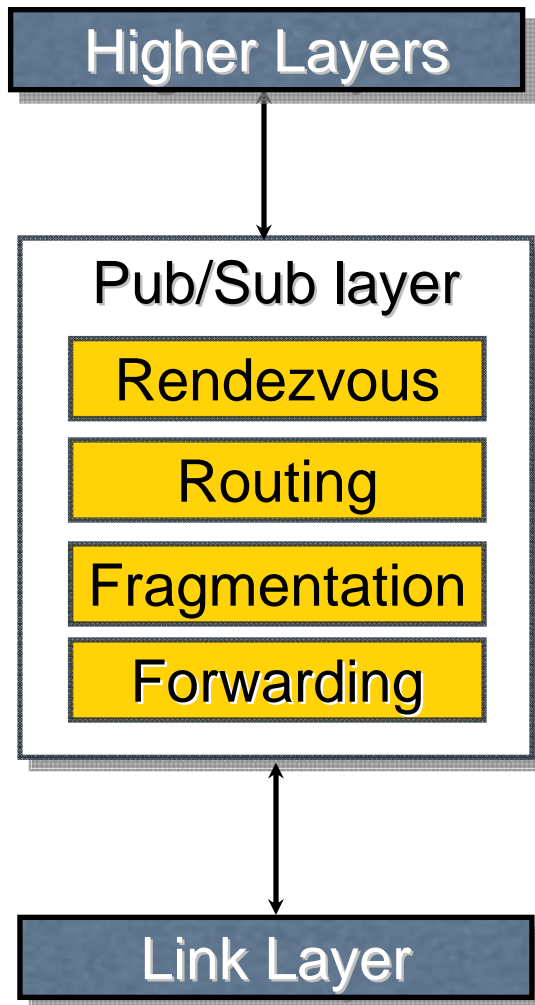
Multicast is difficult (does not scale)

Security is difficult

Not optimal fit for broadcast and all-optical networking



Where we are going



Observations

No topological addresses, only labels

Security enhanced using self-certification

End-to-end reachability, control in the network

Natural support for multicast, it is the norm

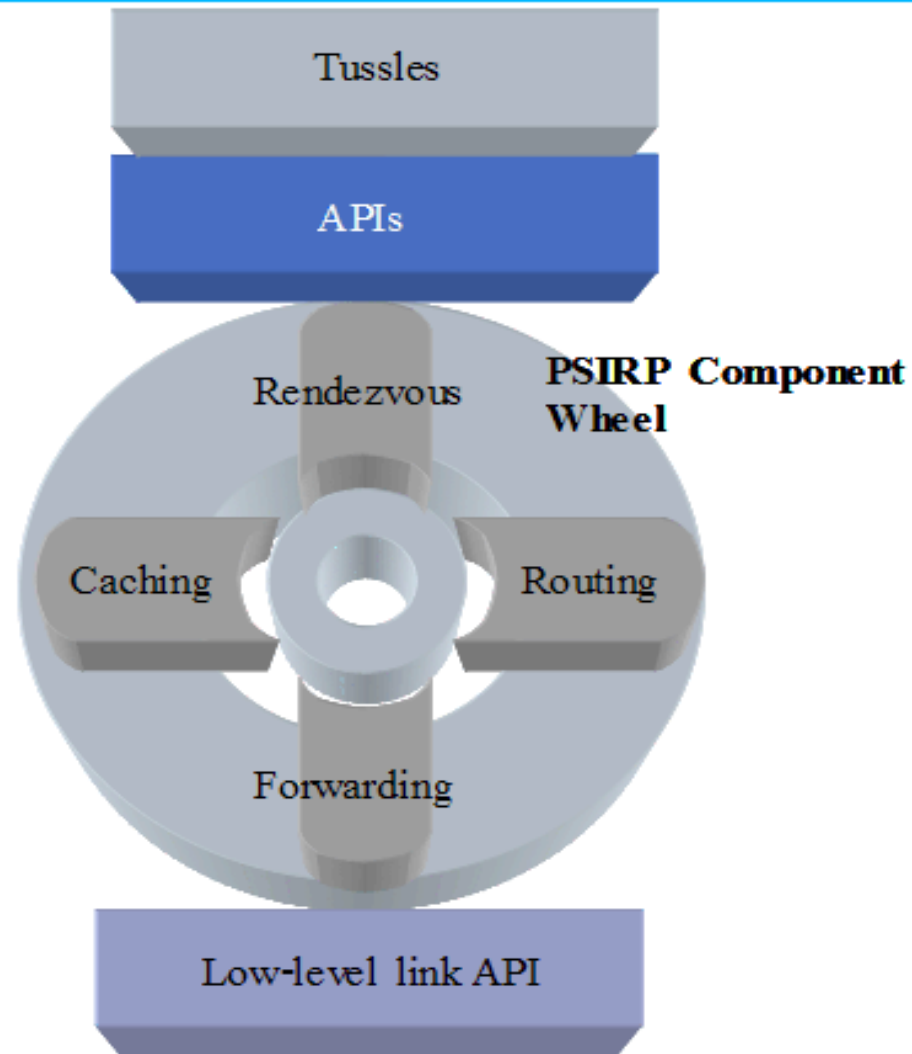
Support for broadcast and all-optical label-switching technologies

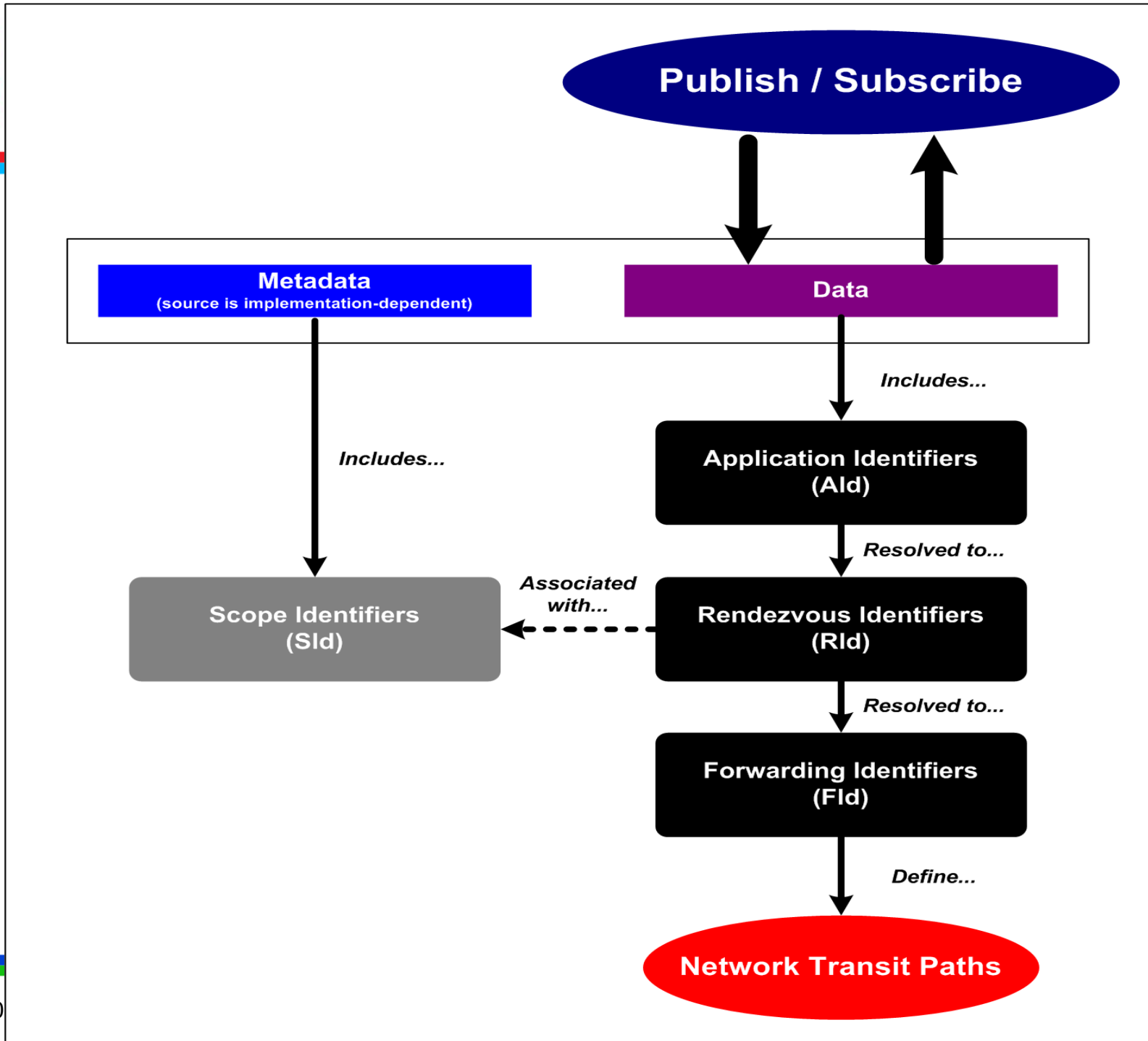
Dynamic state is introduced into the network

How do we make it scale?



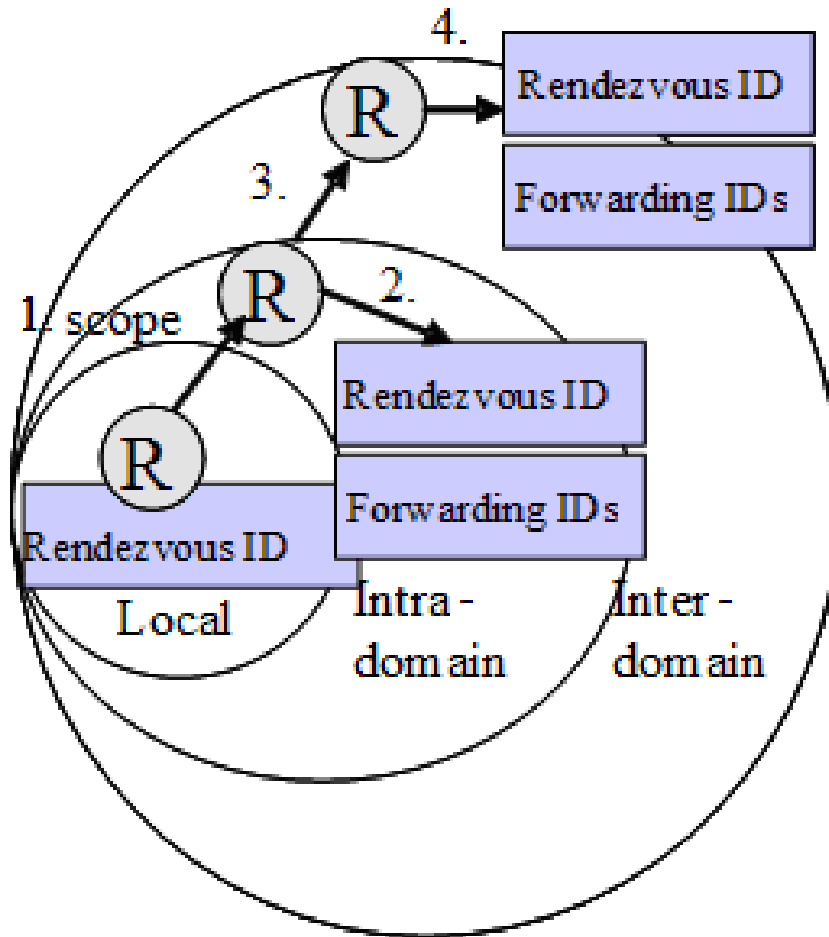
Component Wheel





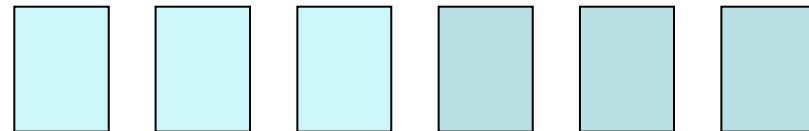
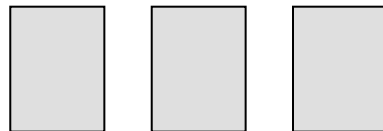
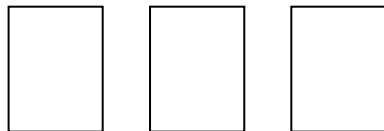
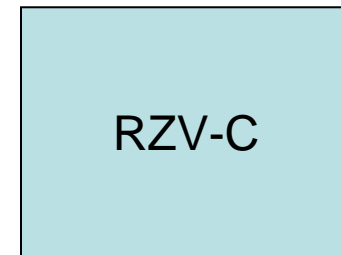
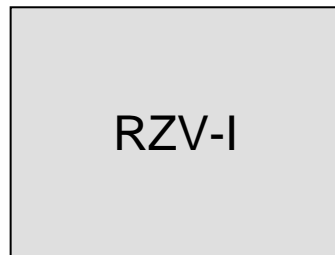


Rendezvous and Forwarding





Many Faces of Rendezvous



Basic connectivity

Internetworking

Information Services

Communal Services



Rendezvous

- The network is defined in terms of domains and their interconnections
 - Interconnections between domains include upstream, transit, downstream
- Rendezvous is the central primitive
 - Rendezvous on multiple layers
 - Builds forwarding paths
- We utilize the notion of completeness to optimize processing and mobility updates
 - Complete / incomplete dissemination structures between rendezvous points
 - A structure is complete when the operation (sub, adv) has been processed by all elements that should process it → typically partial in a global network
 - Completeness can be used for network diagnostics



Dissemination

- Deliverables and Technical Reports
 - State of the Art Report and Technical Requirements (D2.1)
 - Conceptual Architecture (D2.2)
 - Prototype Platform and Applications Plan and Definition (D3.1)
 - Preliminary Validation Plan and Selection of Tools (D4.1)
 - Dissemination and Exploitation Plan (D5.2)
 - From Design for Tussle to Tussle Networking: PSIRP Vision and Use Cases (TR08-0001)
- Publications
 - RTFM: Publish/Subscribe Internetworking Architecture. Mikko Särelä, Teemu Rinta-aho, Sasu Tarkoma. Mobile ICT Summit 2008.
 - Towards Understanding Pure Publish/Subscribe Cryptographic Protocols. Nikander, Pekka, Marias, Giannis F. Cambridge Security Protocols Workshop (SPW 2008).
 - Black Boxed Rendezvous Based Networking. Sasu Tarkoma, Dirk Trossen, Mikko Särelä. Mobiarch 2008 — The 3rd ACM International Workshop on Mobility in the Evolving Internet Architecture.

Conclusions

- We outlined a information centric network architecture
 - **Publish** and **subscribe** are the basic primitives making **multicast** the norm
 - Receiver driven (subscriber has control)
 - **Rendezvous** as the primitive to connect publishers and subscribers across domains on multiple levels
 - Mapping to forwarding structures
 - **Scoping** to group data into manageable sets
 - Architecture work is iterative
 - Implementation and evaluation are on-going activities