Black Boxes: Making Ends Meet in Data Driven Networking

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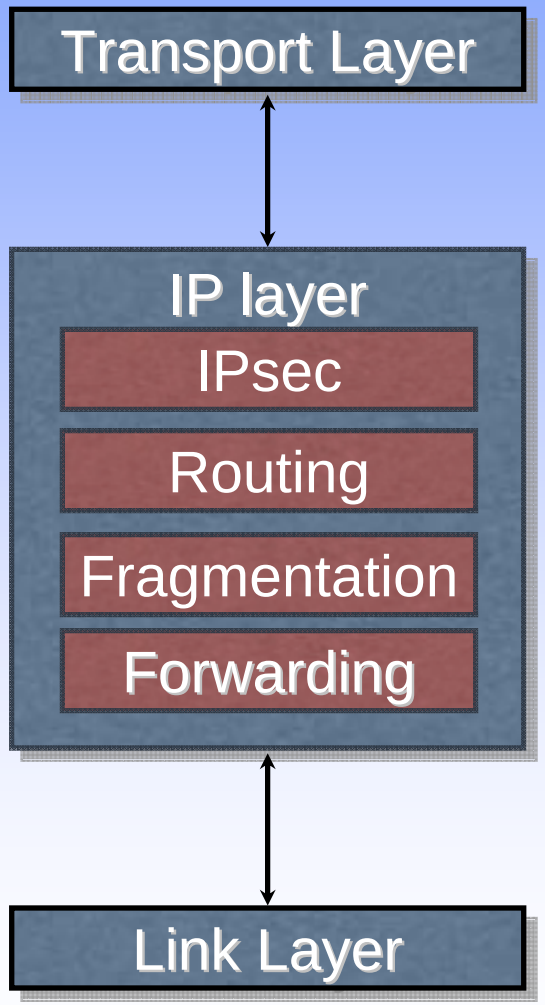
Introduction

- Current Internet is increasingly data and content centric
- The protocol stack may not offer best support for this
- End-to-end principle is no longer followed
  - Firewalls and NAT boxes
  - Peer-to-peer and intermediaries
- Ultimately, hosts are interested in receiving valid and relevant information and do not care about IP addresses or host names
- This motivate the design and development of new data and content centric networking architectures
  - Related work includes ROFL, DONA, TRIAD, FARA, AIP, ..

Current State



Observations

End-to-end reachability is broken

Unwanted traffic is a problem

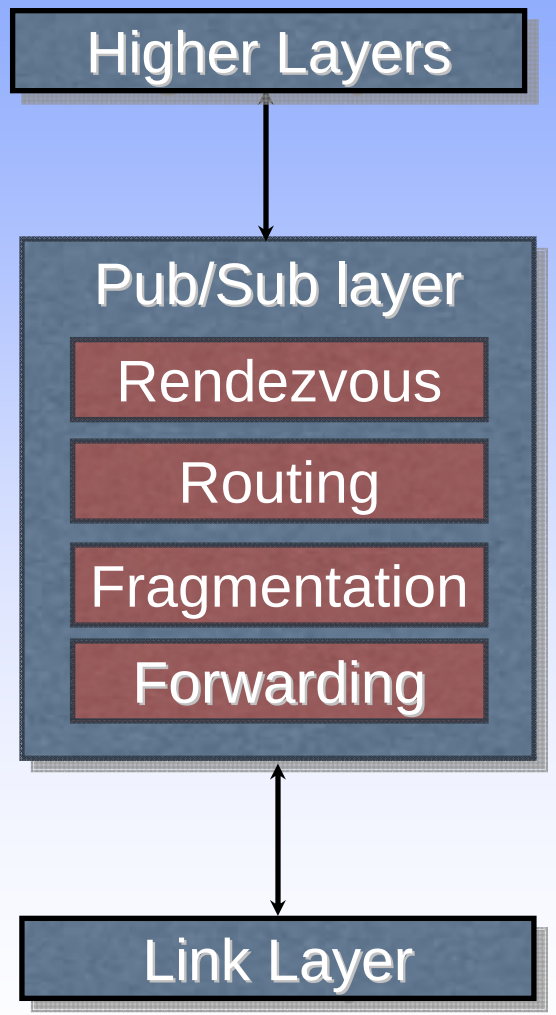
Mobility and multi-homing are challenging

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

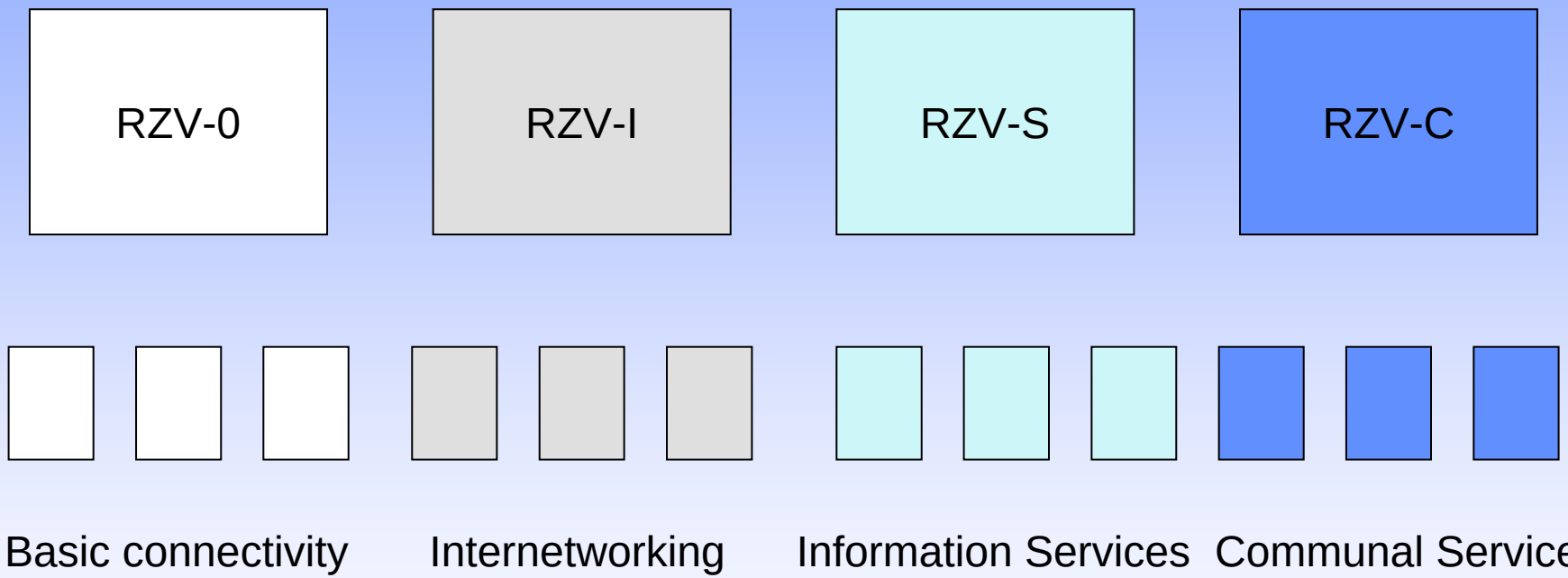
Dynamic state is introduced into the network

How do we make it scale?

Publish/Subscribe Internet Routing

- We propose a future network design that
  - gives more **trust** and more **anonymity** to Internet
  - ensures network and data **availability**
  - ensures **rapid** and **accurate** dissemination of crucial information
- The **publish/subscribe** model
  - Subscribers and publishers
  - Many-to-many communication
  - End-points described in terms of data and local links
  - Incorporating support for end-point identification
    - Flat self-certifying labels
  - **Data-centric** routing, forwarding, rendezvous

Many Faces of Rendezvous



Black Boxes

- The distinguishing feature is that the network is defined in terms of black boxes and their interconnections
  - Interconnections between boxes, upstream, transit, downstream
- Rendezvous is the central primitive
  - Rendezvous on multiple layers
- We utilize the notion of completeness to optimize processing and mobility updates
  - Complete / incomplete dissemination structures between boxes
  - 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

Conclusions

- We outline a data-centric network architecture
  - Publish and subscribe are the basic primitives making multicast the norm
  - Receiver driven (subscriber has control)
  - Composed of black boxes that hide internal routing
  - Rendezvous as the primitive to connect publishers and subscribers across boxes on multiple levels
  - Scoping to group data into manageable sets
- Principles and completeness are discussed in more detail in the paper
- FP7 Publish-Subscribe Internet Routing Paradigm (PSIRP) project (www.psirp.org)