

Information Networking - Bringing Sense To Future Systems



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Overview

- Re-thinking our fundamentals
- A fresh start
- Towards a new system
- Impact
- ...and sensing?

Question: Are Fundamentals Still Valid?

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.

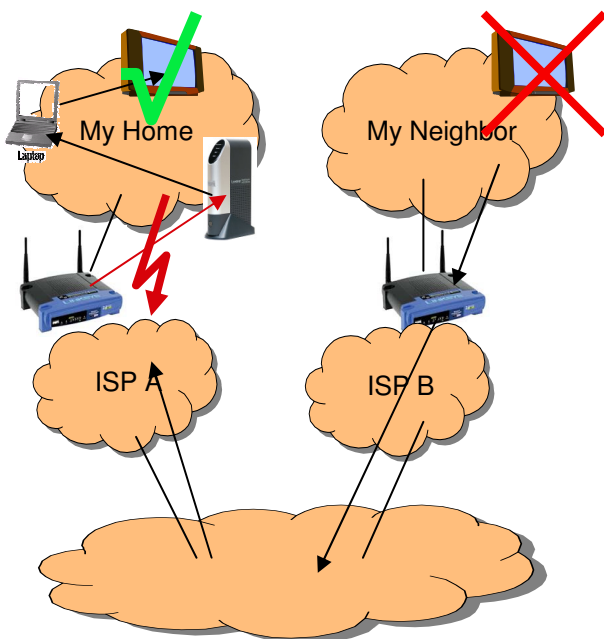
Reality in the Internet Today

- 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, sensing, ...
- ⇒ **IP with middleboxes & significant decline in trust in the Internet**

The Internet Today: Impaired Networking

Example:

Showing my photos at my neighbor's house



Problem here:

- End users don't comprehend the concept of domains & network boundaries
- Intentions of users not well exposed to solution (My Home firewall blocks all requests from outside)

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Fundamental Problem

Lack of collaboration between entities and immersion of concerns deep into the solution design

- Single **device lock-in**
- Working within single networking provider (**operator lock-in**)
- Single radio deployments (**frequency lock-in**)
- Restrictions to network domains (**network lock-in**)
- Specialized identity frameworks (**identity lock-in**)

Stove-pipe lock in represents concerns of the players within each stove pipe

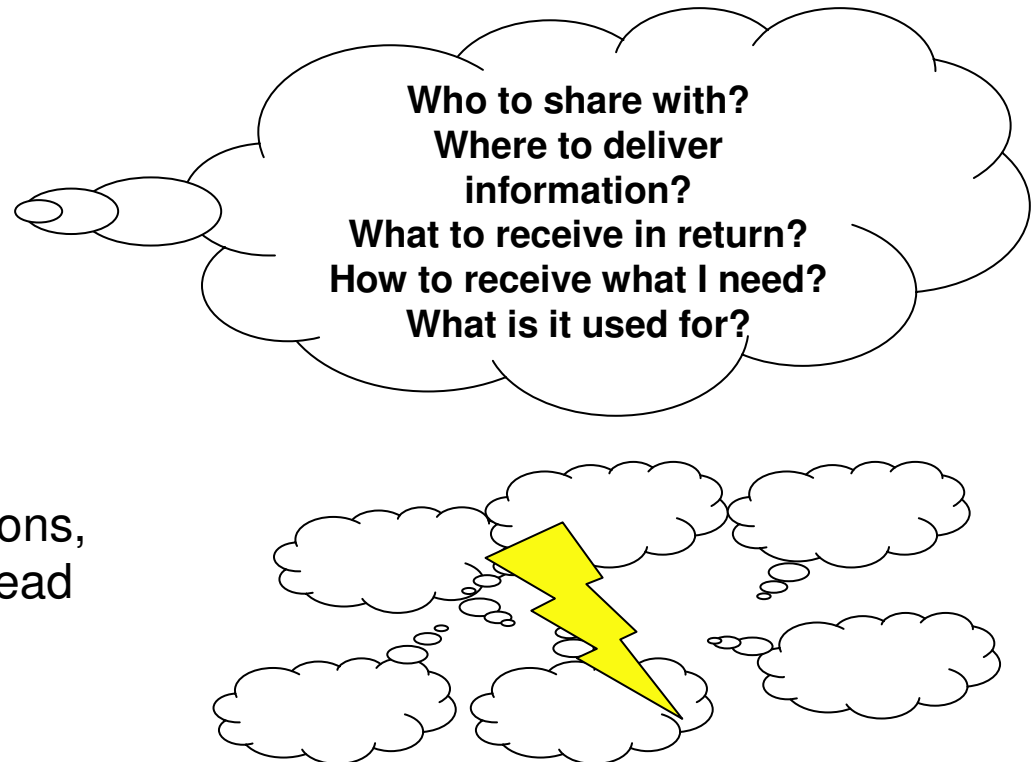
Observation: It's About Information and Speed!

Communication is essentially about production, retrieval and consumption of **information**

Information is delimited by **concerns**

Concerns of individuals, organizations, communities, and societies could lead to conflicts (**tussles**)

Increasing information availability requires increased ability to **dynamically adapt** to various usage models for this information



Hypothesis: Increased Dynamics Requires Information-centric Network Approaches

Application developers care about information concepts

- Creation of information topologies of various kinds

Endpoint-centric networking structures are inadequate:

- Topological network changes too slow in timescale
- Topological network boundaries often not aligned with information topologies
- Overlaying possible but restricted in (developer) scalability

-> If it is all about information, why not route over information?

What If...

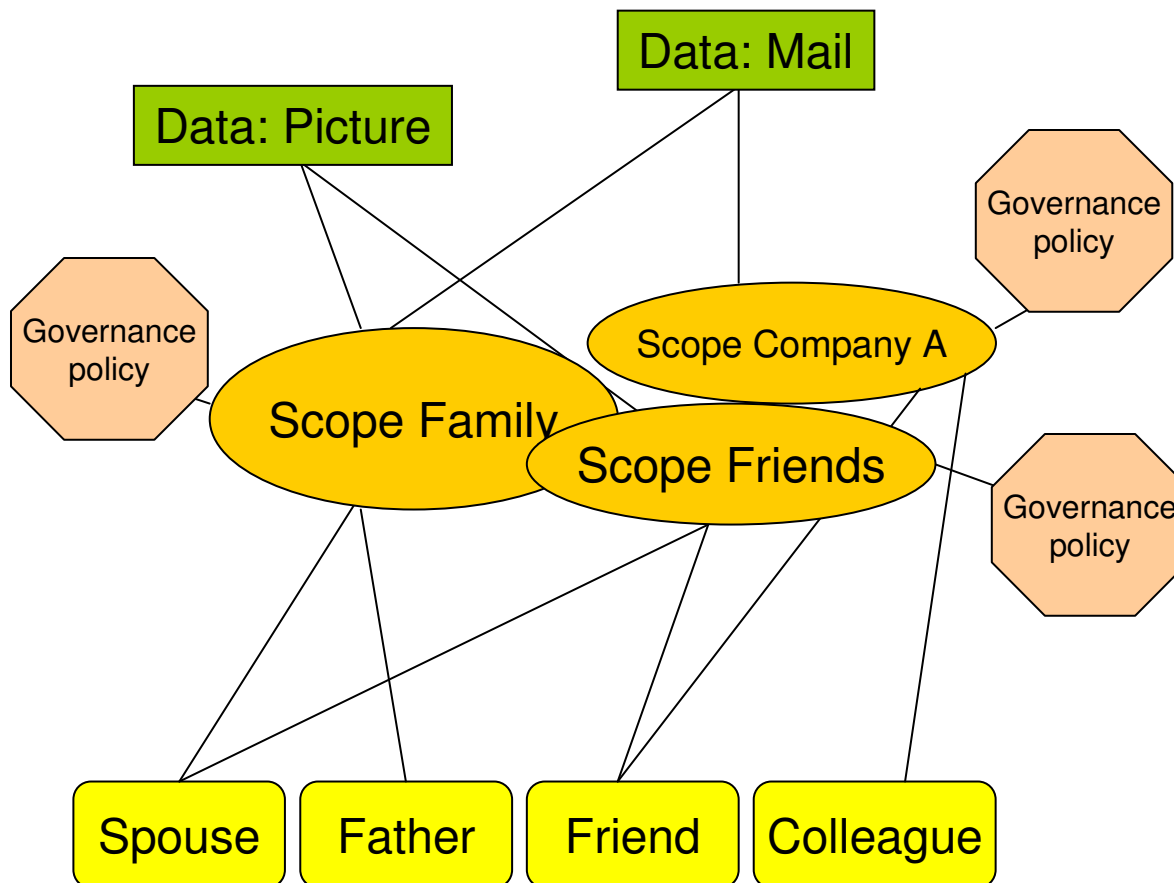
...we could design a new Internet without the pre-conceptions of today's?

...and worry about its deployment later on?

Main Design Principles

- Everything is **information**
 - Interconnection information not wires!
- Information is **scoped**
 - There is an inherent meaning in the structures of information that can help us defining a better system
- Scoped information **neutrality**
 - Within a single scope, simple (information) identifiers are the sole basis of operation
- The architecture ensures a **balance of power**
 - Sending availability of information (publisher)
 - Sending interest in information (subscriber)
 - > Reception comes ONLY after successful match

Information-Centrism is Key



- **Information** is everything and everything is information
 - Bootstrap other concepts, e.g., identity, policy, ..., on top of generic information
- Scopes build **information networks**
- Policy is metadata
 - So is scope!
- **Producers** and **consumers** need no internetwork-level addressing!

Concepts

- **Information**
 - Smallest something
- **Information collections**
 - Set of semantically similar information
- **Information networks**
 - Set of information under some common governance
- **Information producer**
 - Entity publishing information to a particular network
- **Information consumer**
 - Entity subscribing to information in a particular network



Only Concepts?

No, we are moving fast...



The Instrument: PSIRP

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- 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)

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EC Contribution: €2.5m

Contract Number: INF SO-ICT-216173

WP1 Management (TKK-HIIT)

WP2 Architecture Design
(TKK-HIIT)

WP3 Implementation,
Prototyping & Testing (LMF)

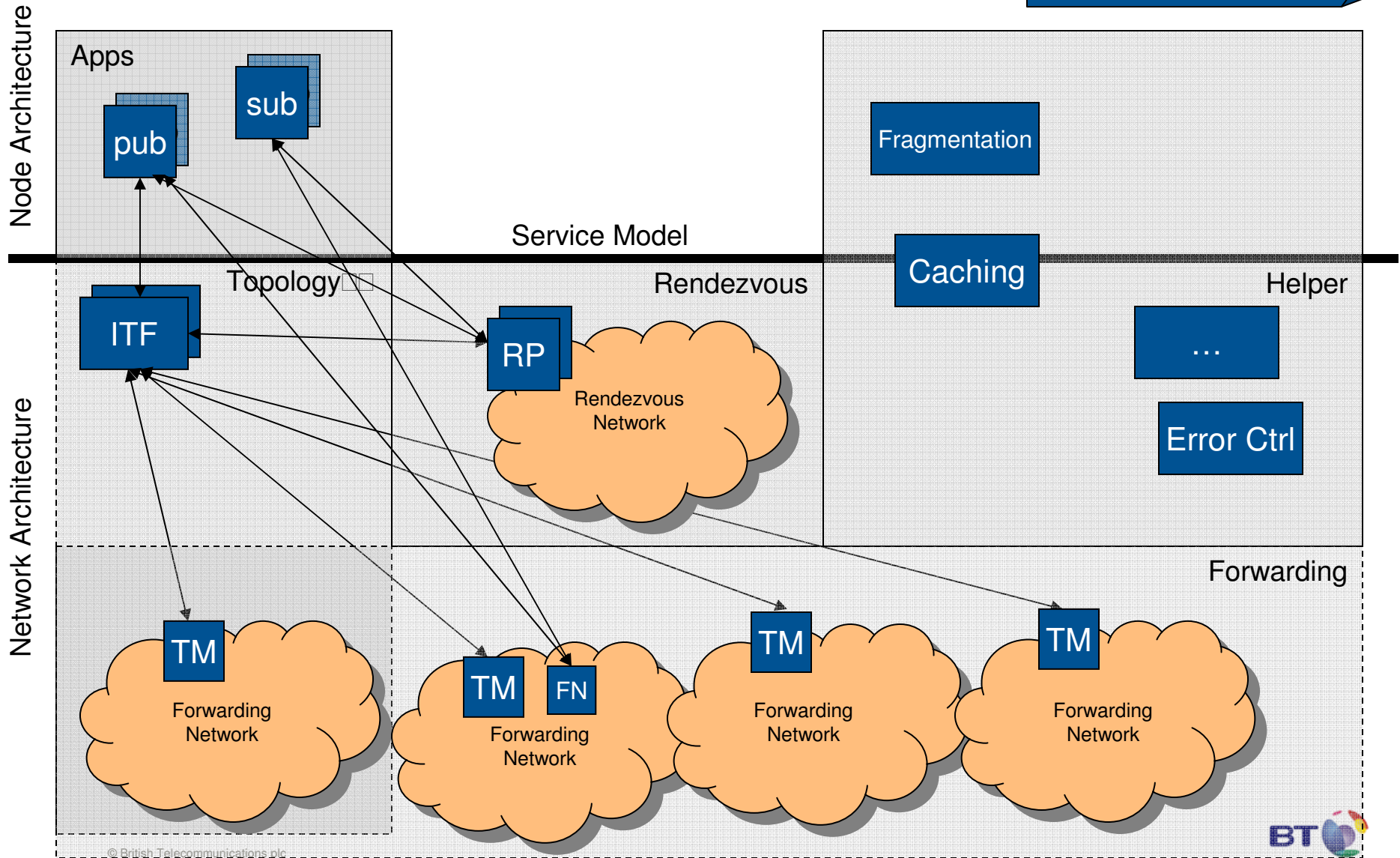
WP4 Validation and Tools
(BT)

WP5 Dissemination and
Exploitation (NSNF)

Project website: www.psirp.org

The Works: High-Level Architecture

RP : Rendezvous point
 ITF : Inter-domain topology formation
 TM : Topology management
 FN : Forwarding node



Results

- First prototype available under open source license
- All documents are publicly available
- Open engagement with partners outside the consortium
- Socio-economic market evaluation is key and ongoing

Impacts



Application Development

- No more socket API
- Internal protocol stack similar to a blackboard (minimizing copy operations)
- New way of thinking when developing applications
 - Advertisement first
 - Think in information -> enable software migration by default!
- Working with partners to develop demo applications, also in the sensing space

Value Chain

Any new architecture of that scale will have tremendous impact on the value chain

- Displacing existing players
 - More flexible peering in core networks
 - Even more caching (but who needs CDNs?)
- Creating new players
 - Rendezvous as the intelligent form of DNS today
 - It's the intelligence that matters
 - Local information providers
 - CDN²
- Understanding these shifts is important!
 - Our socio-economic work aims at first understanding

Anybody Cares About Migration?

- Radical thinking (clean slate)
 - Take nothing for granted **during the design**
- ...but easier to migrate than one thinks:
 - **Can start in single domain:** remember how IP came about?
 - **Can overlay IP very easily:** IP addresses are information
 - **Can underlay IP very easily:** IP is perfect link layer!

And How Does This Relate to Sensing?

- Sensing is all about information!
- Sensing systems often build dynamic relationships when collaborating
 - Many local, ad-hoc sensing protocols are important for our work within a single domain!
- Inter-connected sensing is about inter-connected information exchange

We believe that our architecture will change the face of sensing in the future!

Conclusions

- Sensing **systems** are about exchanging information, potentially globally, not only within sensing systems!
 - Today, the Internet and sensing systems are very disconnected!
- To move further, we need to interconnect information not wires!
- A first glimpse of such system is emerging!
- Although it is a (long) way to go, we have started!