

# The Publish-Subscribe Internet Architecture

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# Our main ICN-related Research Projects



- **PSIRP: Publish Subscribe Internet Routing Paradigm**  
FP7 ICT STREP, 2008-2010
  - ◆ the basis...
  - ◆ focus on (inter)-networking
    - Academic partners: **HIIT, RWTH Aachen, AUEB, IPP-BAS**



- **PURSUIT: Publish Subscribe Internet Technologies**  
FP7 ICT STREP, 2010-2013
  - ◆ extending, above & below the Internet layer
  - ◆ optical, wireless, mobility, transport...
    - Academic partners: **Aalto U., RWTH Aachen, AUEB, CERTH, U. Essex**

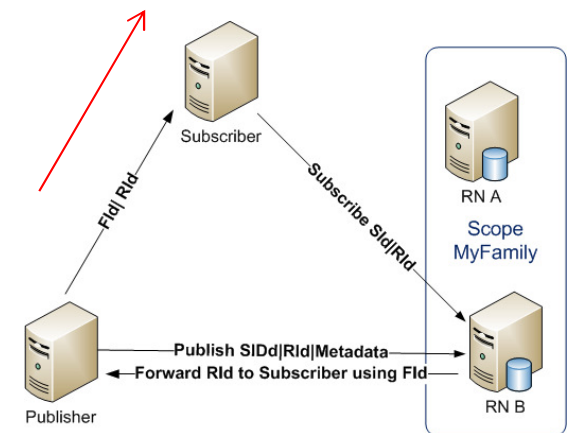
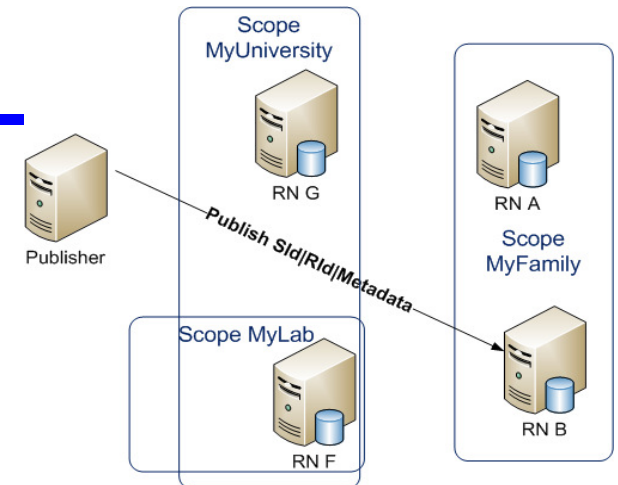
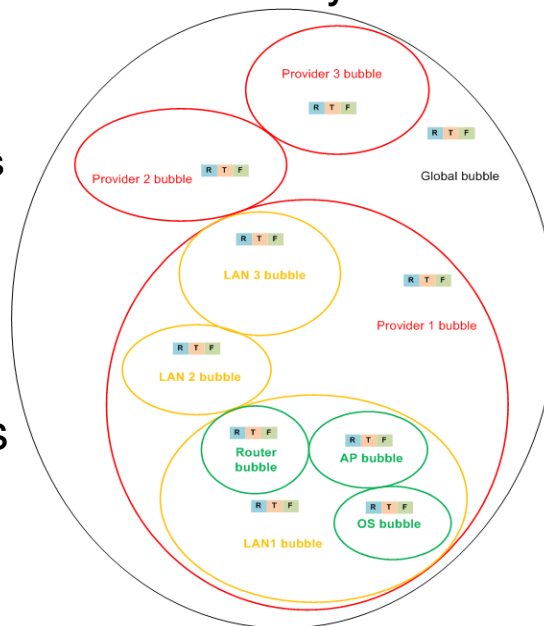


- **φSAT: The Role of Satellites in Future Internet Services**
  - ◆ European Space Agency funded



# The Publish-Subscribe Internet (PSI) Architecture

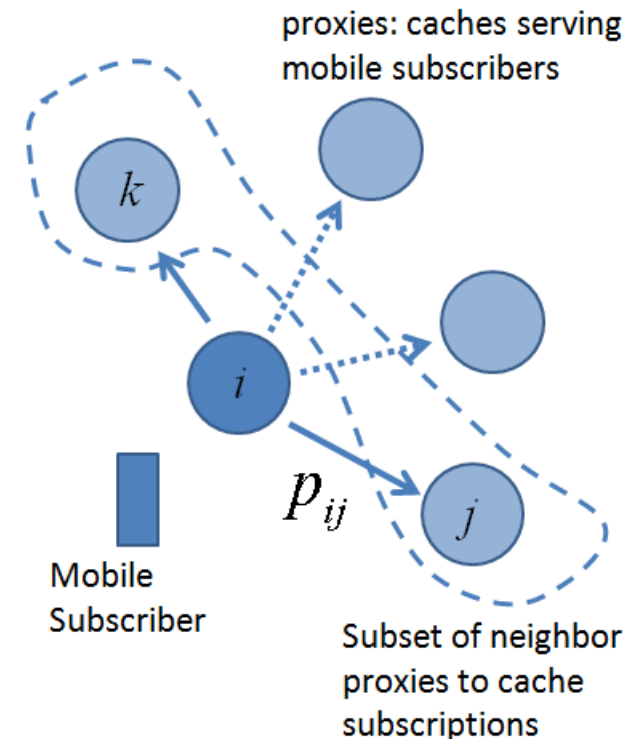
- **Rendezvous**: Matches *publications* with *subscriptions* & initializes the forwarding process
- **Topology**: Monitors the network & creates information delivery paths
- **Forwarding**: Implements information delivery
- Applied recursively...
  - ◆ local, global rendezvous
  - ◆ slow path/fast path rendezvous
- IDs: Rendezvous ID, Scope ID, Forwarding ID...
- **Separation** of functions
- 2 prototype implementations
  - ◆ Blackhawk (**PSIRP**)
  - ◆ Blackadder (**PURSUIT**)



➤ N. Fotiou, G.C. Polyzos, D. Trossen, “**Illustrating a Publish-Subscribe Internet Architecture**,” *Telecommunication Systems*, Springer, SI on ‘**Future Internet Services and Architectures: Trends and Visions**,’ Online: 23/2/2011.

# Enhancing Mobility Support in ICN

- **Decoupling IDs from location**
  - ◆ locations are ephemeral
- **Publishers & Subscribers can seamlessly & simultaneously move**
- **Pub/Sub is asynchronous & multicast**
  - ◆ Adapts better to frequent mobility
- **Anycast of the best source of content**
  
- **Mobility & user behavior prediction** together with **proactive caching/prefetching** can be used to enhance mobility support
- Effectively **integrates cellular/4G and Wi-Fi networks (mobile data offloading)**



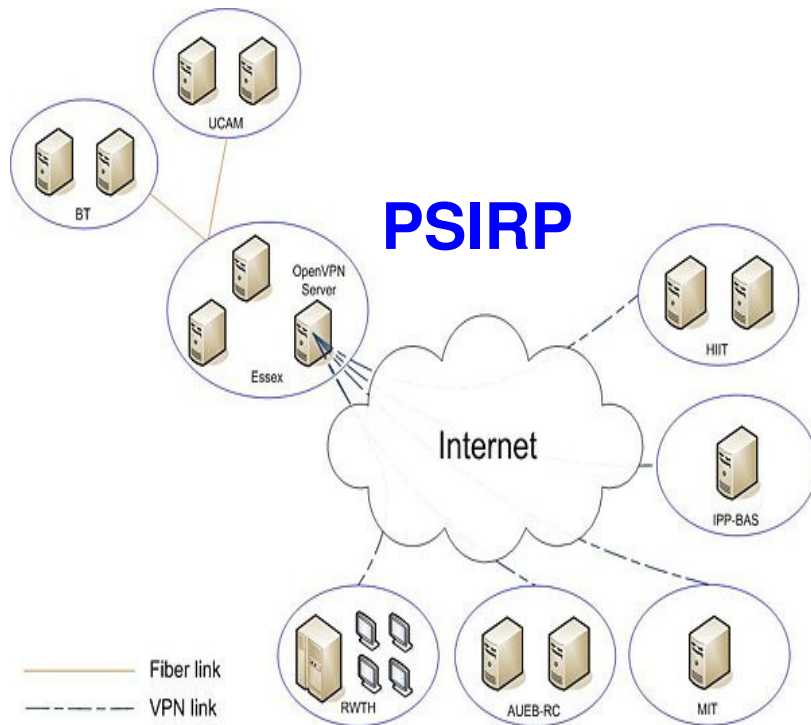
- G. Xylomenos, X. Vasilakos, C. Tsilopoulos, V.A. Siris, G.C. Polyzos, “**Caching and Mobility Support in a Publish-Subscribe Internet Architecture**,” *IEEE Communications Magazine*, feature topic on ‘Information-Centric Networking,’ July 2012.
- N. Fotiou, K. Katsaros, G.C. Polyzos, M. Sarela, D. Trossen, G. Xylomenos, “**Handling Mobility in Future Publish-Subscribe Information-Centric Networks**,” *Telecommunication Systems*, Springer, Special Issue on ‘Mobility Management in the Future Internet’ (to appear).

# Security & Privacy

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- **E2E direct trust not applicable**
  - Socioeconomic trust through mediators (e.g., Rendezvous Providers)
  - D. Lagutin et al., "[Roles and Security in a Publish/Subscribe Network Architecture](#)," ISCC'10
- **Users change behavior, content does not**
  - Reputable Content
  - N. Fotiou et al., "[Fighting Spam in Publish/Subscribe Networks Using Information Ranking](#)," NGI'10
- **End-user privacy can be effectively supported in ICN (@ internetwork level)**
  - Who asks for what content hidden from content provider, caches
  - Pub/Sub matching through *trusted* mediator service (e.g., **Rendezvous** providers)
    - **BUT** privacy from Rendezvous providers becomes more of an issue
- **Spam & malicious content distribution is blocked**
  - There is no unsolicited traffic in the network!
  - New adversary models
  - P. Nikander & G.F. Marias, "[Towards Understanding Pure Publish/Subscribe Cryptographic Protocols](#)," SPW '08
- **Secure Forwarding Mechanism**
  - Bloom filter based source routing
  - P. Jokela et al., "[LIPSIN: line speed publish/subscribe inter-networking](#)," SIGCOMM'09
- **Access Control Delegation**
  - N. Fotiou et al., "[Access Control Enforcement Delegation for Information-Centric Networking Architectures](#)," ICN'12

# Prototype Implementations & Testbeds

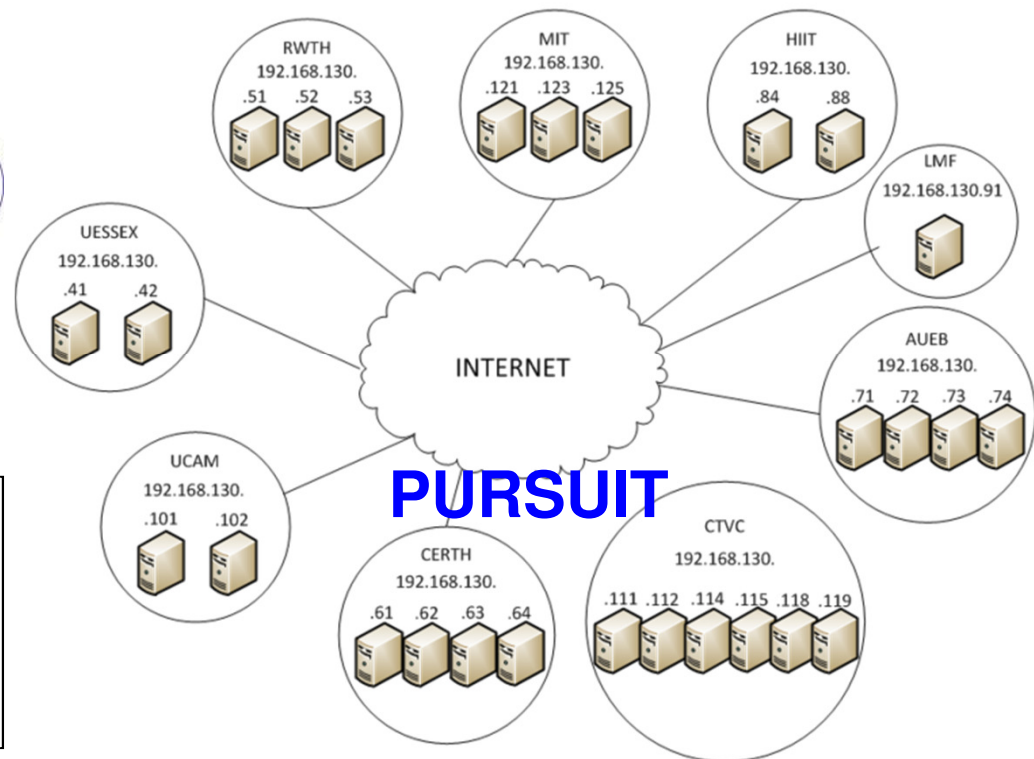


**PSIRP Testbed (w/ Blackhawk)**

- 6 countries: UK, FI, GR, D, BU, **US**
  - In addition: Belgium during ICT demos
- Tunneled over the public Internet
  - **+dedicated fiber** where available

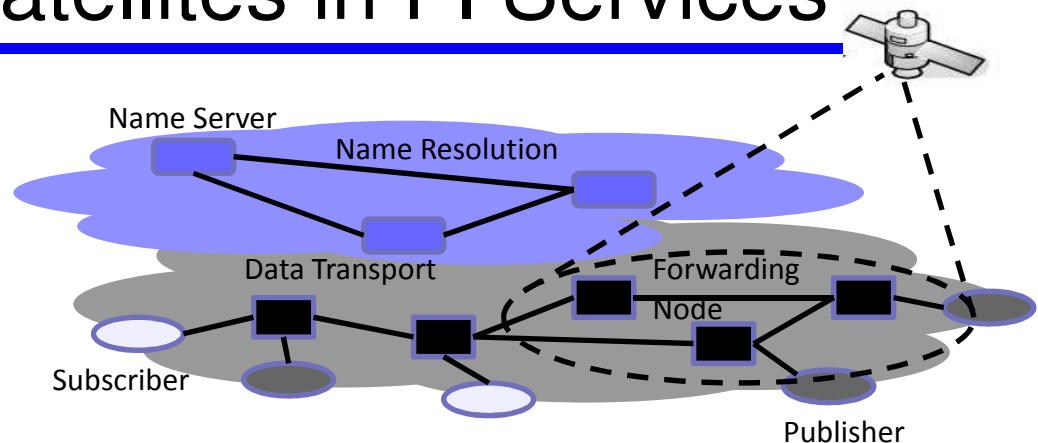
**PURSUIT Testbed (w/ Blackadder)**

- 25 nodes
- 5 countries: UK, FI, GR, D, **US**
- Tunneled (VPN)
  - over the public Internet

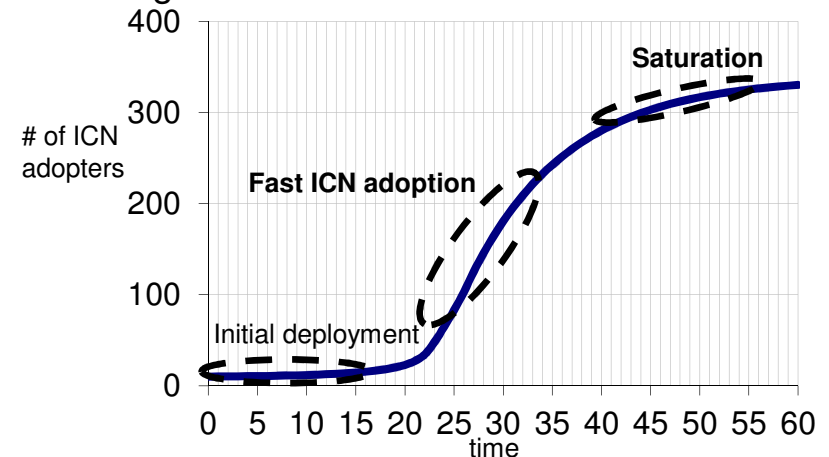


# $\phi$ SAT: The role of Satellites in FI Services

- Aim:
  - ◆ To investigate the technical feasibility & business viability of the integration of SatCom with terrestrial ICN architectures



- Results
  - ◆ Methodology to identify application/service scenarios where the capabilities of SatCom and ICN bring highest techno-economic gains
    - Key **SatCom** capabilities: Broadcast/Multicast, Wide Coverage
    - Key **ICN** capabilities: Data aggregation, Multipath Routing, Mobility Support, In-network Caching
  - ◆ Candidate scenarios identified
    - Hybrid Broadcast IPTV
    - M2M Communications
    - 4G Backhauling
  - ◆ Socio-economic evaluation
    - Market evolution for each scenario





*φSAT*

# Thank you!

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The  $\Psi$  Architecture

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