Επισκόπηση Ερευνητικών Δραστηριοτήτων
Εργαστήριο Ασυρμάτων Δικτύων και Πολυμεσικών Τηλεπικοινωνιών

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ΗΡΑΚΛΕΙΤΟΣ ΙΙ / «Το ΟΠΑ Ερευνά»
Μέλη ΔΕΠ
- Γεώργιος Πολύζος, Διευθυντής
- Ιορδάνης Κουτσόπουλος
- Ιωάννης Μαρίας
- Γεώργιος Ξυλωμένος
- Βασίλειος Σύρης
- Σταύρος Τουμπής
- κ.α. λιγότερο στενά συνδεδεμένοι

Επισκέπτης Ερευνητής
- Μερκούριος Καραλιόπουλος, PhD

Υποψήφιοι Διδάκτορες
- Ξενοφών Βασιλάκος
- Βαγγέλης Δούρος
- Πάνης Θωμάς
- Χάρης Στάης
- Χρήστος Τσιλόπουλος
- Νίκος Φωτίου

Πτυχιούχοι, ερευνητές
- Μεταπτυχιακοί φοιτητές
- Προπτυχιακοί φοιτητές

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Alumni

- **Ph.D.**
  - Pantelis Frangoudis (2012)
    - PostDoc, INRIA
  - Konstantinos Katsaros (2010)
    - PostDoc, UCL
  - Christopher Ververidis (2008)
    - Researcher, AIT
  - Elias Efstathiou (2006)
    - Manager @ OTE

- **M.Sc.**
  - Sergios Soursos, PhD
    - Researcher, Intracom Telecom
  - Emanouil Panaousis, PhD
    - PostDoc, Queen Mary U. London

- **Undergraduate**
  - Vasilios Kemerlis
    - PhD candidate, Columbia U., NY
  - Ioannis Gasparis
    - PhD candidate, UCR, CA
**MMlab Awards**

- **Future Internet Award** to the EU FP7 research project “PURSUIT”
  - awarded during the Future Internet Assembly, Dublin, Ireland 10 May 2013
  - [http://www.fp7-pursuit.eu/PursuitWeb/?p=967](http://www.fp7-pursuit.eu/PursuitWeb/?p=967)

- Best paper

- Best student paper

- **ΑΡΙΣΤΕΙΑ II (ΓΓΕΤ)**

- **Microsoft Research:** *Cell Phone as a Platform for Healthcare Award*
  - ARCHANGEL: 1 of 10 universities around the world

- **Competitive Research Projects**
  - EU: FP6, FP7; European Space Agency; ΓΓΕΤ (Θαλής, Ηράκλειτος, Πυθαγόρας…)

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Selected Research Projects

- EU FP7 (2007-2013)
  - **EIFFEL**: Evolved Internet Future for European Leadership
  - Anticipating the Network of the Future-From Theory to Design (**Euro-NF**)
    - Network of Excellence
    - **ASPECTS**: Agile SPECTRum Security
    - Governance and Privacy Implications of the ‘**Internet of Things**’
    - Energy-Aware Key Management in **Mobile Wireless Sensor Networks**
  - **PSIRP**: Publish-Subscribe Internet Routing Paradigm
  - **PURSUIT**: Publish-Subscribe Internet Technology
- European Space Agency
  - **φSAT**: The role of SatCom in the Future Internet
  - Service Delivery over Integrated Satellite and Terrestrial Networks
- Microsoft Research: Cell Phone as a Platform for Healthcare Award
  - **ARCHANGEL**: 1 of 10 universities around the world
- EU FP6 (2002-2006) and other projects
Interference in Wireless Networks

- **Heterogeneous** wireless networks cover **diverse** needs
- Many (mostly) **selfish** devices share the **limited** spectrum and compete for better QoS
- How can they **efficiently** co-exist?
Interference Management in Wireless Networks

- Our approach: power control along with game theory and bargaining to design distributed schemes that fulfill the QoS constraints
- Key issues: Existence/uniqueness of a Nash Equilibrium, how we can find it, how efficient it is
Embedded Software for Wi-Fi and other Wireless Systems

**P2PWNC: P2P Wireless Network Confederation**

- Λογισµικό που εκτελείται σε φτηνό οικιακό εξοπλισµό ασύρµατων δικτύων και σε φορητούς υπολογιστές / PDAs
- Embedded Linux on Access Points
- Λογισµικό ανοιχτού κώδικα, ελεύθερα διαθέσιµο από:
  - [http://mm.aueb.gr/research/p2pwnc/](http://mm.aueb.gr/research/p2pwnc/)
- Πρωτόκολλα με ανοιχτές προδιαγραφές
- Ισχυρή κρυπτογραφία δηµοσίου κλειδιού:
  - RSA
  - Elliptic Curve Cryptography

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ARCHANGEL: An architecture for ubiquitous, intelligent, transparent activities monitoring for active ageing and independent living through the early detection of signs of medical problems

- Funding from Microsoft Research through a Cell Phone as a Platform for Healthcare Award

1. Project Highlights
- **Sensor-based system** for monitoring and modeling the activities of the elderly and people with special needs.
- Applies to the home life and possibly to the person outside the home
- Monitored person carries GPS-enabled cellular phone and/or other localization devices
- Deploy off-the-self sensors to home, other locations

2. Objectives
- Learn the daily activities of the monitored individuals
- Detect changes in individuals' routines and health status
- Provide alerts and preliminary diagnosis as quickly as possible when something out of the ordinary occurs
- Actuator-based automation of certain tasks in the home

3. System Architecture
A. Monitoring Environment
- 1) Indoor Area Component (IAC)
- 2) Outdoor Area Component (OAC)
- 3) User Registrar Component (URC)
B. Diagnostic Environment
- 1) Event Recognizer Component (ERC)
- 2) Activities Modeling Component (AMC)
Internet Clean-Slate Design

- At the beginning
  - Cooperation/Collaboration
  - **NO** commercial traffic allowed!
  - Endpoint-centric services

- What developed:
  - real *inter*-network

- What about:
  - Trust?
  - Legitimacy of E2E?
    - NAT, firewalls, middleboxes…
  - Role of overlays? P2P?
  - **Information centrism**?
    - >50% video access & ↑

Clean-slate design…
- Question ALL fundamentals
  - take nothing for granted
    - including industry structures

…with late binding (to reality)
- Consider migration and evolvability
  - From designs into real deployments
    - e.g., overlay vs. IP replacement
- Consider necessary evolution of the industry (and regulatory) structures

From
- connecting wires… to
- connecting machines… to
- **connecting information!**
ICN timeline

papers/talks  projects

G. Xylomenos, C.N. Ververidis, V.A. Siris, N. Fotiou, C. Tsilopoulos, X. Vasilakos, K.V. Katsaros, G.C. Polyzos,
“A Survey of Information-Centric Networking Research”
*IEEE Communications Surveys and Tutorials*, (DOI 10.1109/SURV.2013.070813.00063; July 2013).

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Publish-Subscribe Internet Vision

- **information centrism**
  - everything is information & information is everything
- **Recursive** & and generalized use of publish-subscribe
  - enables dynamic change of roles between actors
  - Network cache
    - publishes info (cached)
    - subscribes to get info to cache
  - Access Points publish ID
    - mobiles subscribe

**Objectives**
- Specify, implement, & test an internetworked pub/sub architecture
  - follow a clean-slate design approach
- Perform qualitative and quantitative evaluation
  - **Security and socio-economics important!**
  - Migration and incentive scenarios important (e.g., overlay)!
PSI Key Functions and Components

- **publish – subscribe – rendezvous**
  - Rendezvous **ID: hash of content** (/name)
    - asynchronous and multicast
    - restores the imbalance of power sender/receiver(s)
    - + Scope ID: aggregation, policies…
  - **PSI Basic Functions: RTF**
    - **Rendezvous**: Matches *publications* with *subscriptions* and initializes forwarding
    - **Topology**: Monitors the network and creates information delivery paths
    - **Forwarding**


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PSI Unique Features

- Fast forwarding
  - Bloom filter based forwarding (→ forwarding identifiers)
    - simple, stateless, fast forwarding
    - incl. for multicast
  - path (‘source’) routing
    - path as compact Bloom filter carried on packets
- Centralized – ‘SDN compatible’ approach
  - (intra-domain) routing/resource allocation
  - topology discovery/management
- ‘recursive’ use of pub/sub …
  - object level
  - chunk/packet level…
    - pull transport, error control, rcvr flow control
    - = slow & fast rendezvous
  - topology formation: handover = subscribe to network…
Prototype Implementations & Testbeds

1. **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

2. **Pursuit** Testbed (w/ Blackadder)
   - 25 nodes
   - 5 countries: UK, FI, GR, D, **US**
   - Tunneled (VPN)
     - over the public Internet

3. **φSAT** Testbed w/ SAT emulation

PSI Security & Privacy

- … in addition to intrinsic ICN security features…
- Publisher and Subscriber do not know each other
  - Scopes: PSI’s information firewalls
  - Bloom filter path cannot be replayed (later)
    - rotation of link IDs…
    - DoS attacks to publishers/subscribers eradicated
  - Rendezvous (point/network) knows much…
  - Privacy wrt:
    - publisher: great… (at network & higher layers)
    - rendezvous (broker): bad…
    - proposal: use Homomorphic Encryption
      

- Access Control Delegation
  - important for fast effective and efficient caching
    
Multimedia (streaming) over PSI

- Motivation:
  - “YouTube” a la PSI …

- Streaming videos
  - without RTP/TCP/IP
  - only native PSI

- Basic Components of the application:
  - Publisher: the owner of the video
  - Subscriber: the user that seeks to view the video

- Technologies Involved
  - Java-JMF player
  - JPSI
  - JNI
  - PSI

- We tried different applications
  - Video
  - Audio/voice (VoPSI)
  - …


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Proactive Selective Neighbor Caching for enhancing Mobility Support in ICN

- Delay can be reduced by using proxies to pre-fetch and cache data
  - Mobile obtains data from local cache rather than remote server
  - Local network can have low capacity backhaul (e.g. femto/small-cells, hotspots)

- Proactive Selective Neighbor Caching
  - Mobile initially connected to proxy $i$
  - ICN receiver-driven model reveals which data items are requested
  - Select optimum subset of neighbor proxies to proactively cache requested data
  - If mobile connects to one of these proxies it can immediately receive data not obtained due to disconnection

- Selection of neighbor caches to pre-fetch data depends on
  - Probability mobile connects to caches
  - Available cache space
  - Delay reduction gains

ICN Research Community

- workshops…
  - with ACM SIGCOMM
    - ICN 2011 (Toronto)
    - ICN 2012 (Helsinki)
    - ICN 2013 (Hong Kong)
  - with IEEE INFOCOM
    - NOMEN 2012, 2013

- 1st ACM ICN Conference
  - Paris, France, (end of) Sept. 2014

- ICN RG@IERTF

- Journal & Magazines Special Issues
Ευχαριστώ!

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