

**ΟΙΚΟΝΟΜΙΚΟ
ΠΑΝΕΠΙΣΤΗΜΙΟ
ΑΘΗΝΩΝ**



**ATHENS UNIVERSITY
OF ECONOMICS
AND BUSINESS**

Information-Centric Networks

Section # 2.3: Internet Evolution

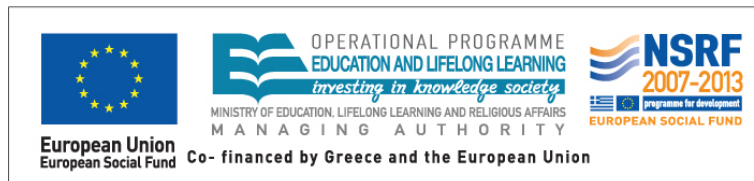
Instructor: George Xylomenos

Department: Informatics



Funding

- These educational materials have been developed as part of the instructors educational tasks.
- The **“Athens University of Economics and Business Open Courses”** project only funded the reformatting of these educational materials.
- The project is being implemented as part of the Operational Program “Instruction and Lifelong Learning” and is co-financed by the European Union (European Social Fund) and national funds.



Licencing

- These educational materials are subject to a Creative Commons License.



Week 2 / Paper 3

- Future Internet architecture: clean-slate versus evolutionary research
 - Jennifer Rexford, Constantine Dovrolis
 - Communications of the ACM, Volume 53 Issue 9, Sep 2010
- Main point
 - Should researchers focus on designing new architectures?
 - Point: Jennifer Rexford
 - Or should they focus on improving the current Internet
 - Counter-point: Constantine Dovrolis

Point: New network architectures

- The Internet has been hugely successful
 - A minimalist network with powerful endpoints
 - Easy to adopt new applications and link technologies
- Then why even consider clean-slate designs?
 - Evolutionary and clean-slate research are not at odds
 - Clean-slate can help guide Internet evolution
 - And maybe we do need a new Internet
 - Plant the seeds of a new network
- Towards a networking discipline
 - Networking is far from a mature field
 - We do not really understand the Internet
 - Example: the congestion collapse of 1987

Point: New network architectures

- How can we create a network science?
 - It is not enough to describe protocols
 - We need laws and rules of thumb
 - It is not enough to study today's Internet
 - We need to understand networks in general
 - Only clean-slate can allow us test different theories
 - New designs may offer solutions not feasible on the Internet
 - Clean-slate also requires experimental facilities
 - Paper designs are not enough
 - What we need is continuous network research
 - As in the early ARPANET
 - Who could think of what it would become?
 - We should not consider the Internet as the end of networking

Point: New network architectures

- Toward an Internet worthy of our trust
 - The Internet has many obvious shortcomings
 - Pervasive security issues
 - No support for mobile hosts and countless sensors
 - Best-effort is a bad fit for IPTV
 - Reliability is much lower than in telephony
 - Some are deeply rooted in its early design decisions
 - Lack of security, coupling address and location
 - Clean-slate allows experiments in many directions
 - Some may fail, some may be added to the Internet
 - Some clean-slate ideas are already proving useful
 - OpenFlow adds programmability in the network
 - We should not assume that the Internet is the end
 - This is what telcos thought about telephony!

Counter-point: Improve the Internet

- What is evolutionary research?
 - Understand Internet behavior and identify problems
 - Resolve issues under two constraints
 - Backward compatibility
 - Incremental deployment
- Clean-slate research is not new
 - Active networks, per-flow QoS, CLNP, XCP, Nimrod
 - All have failed miserably
 - Even backwards compatible ideas have trouble
 - They were not incrementally deployable
 - IPv6, IP multicast, RSVP, IPsec, S-BGP
 - Evolutionary ideas are adopted though
 - NATs, CDBs, caches, endpoint security

Counter-point: Improve the Internet

- Can emerging technologies replace entrenched ones?
 - Technical superiority is not enough
 - A valuable new service must be offered
 - Which cannot be offered by the entrenched solution
 - Only this can justify the switching cost
- So clean-slate needs to show new applications
 - The “security” promises do not seem realistic
 - A new network will probably be buggier than the Internet!
- Deployment experiments are not enough
 - It is the business issues that killed good ideas
- The Internet itself was not a clean-slate design
 - It evolved slowly from circuit switching

Counter-point: Improve the Internet

- Is the Internet really ossified?
 - The Internet Protocol is very hard to change
 - But what is so bad about this?
 - New applications are developed all the time
 - New link technologies are adopted all the time
 - Would these be possible with an evolving IP?
- An agenda for evolutionary Internet research
 - Measure and understand the Internet ecosystem
 - Mutate the design to avoid future problems
 - We need more monitoring and measurement infrastructure
 - We need an experimental wide area ISP
 - A lot has been achieved within the Internet framework
 - Congestion control, queue management, traffic characterization

**ΟΙΚΟΝΟΜΙΚΟ
ΠΑΝΕΠΙΣΤΗΜΙΟ
ΑΘΗΝΩΝ**



**ATHENS UNIVERSITY
OF ECONOMICS
AND BUSINESS**

End of Section # 2.3

Course: Information-Centric Networks, **Section # 2.3: Internet Evolution**

Instructor: George Xylomenos, **Department:** Informatics

