Pablo Molinero-Fernández

Ph.D. in Electrical Engineering

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EDUCATION

Stanford University Stanford, California

10/96-6/03 Ph.D. in Electrical Engineering
Dissertation: *Circuit Switching in the Internet*. Advisor: Prof. Nick McKeown.
This study discusses the advantages and disadvantages of using circuit switching in the core of the Internet from both a technological and economical point of view. It proposes two network architectures that integrate a circuit-switched backbone with the rest of the Internet in an evolutionary manner. One approach uses fine-grain, lightweight circuits, the other coarse, heavyweight circuits.
Reading committee: Professors Nick McKeown, Balaji Prabhakar and Nick Bambos.

9/95-6/96 Master of Science in Electrical Engineering with a specialization in Computer Networking. Advisor: Prof. Fouad Tobagi.

École Nationale Supérieure des Télécommunications (ENST) Paris, France

9/92-7/94 French Advanced Telecommunications Engineer ("Ingénieur des Télécommunications")

Escuela Técnica Sup. Ingenieros Telecomunicación (ETSIT) Universidad Politécnica de Madrid, Spain

10/88-7/94 Spanish Advanced Telecommunications Engineer ("Ingeniero Superior de Telecomunicación")

These two degrees were obtained in a six-year, double-degree program involving studies at the two graduate-level engineering institutes for telecommunications. Spent the last two years at ENST Paris (92-94), specializing in design and architecture of computer systems, and the first four years at ETSIT Madrid, with a specialization in computer networks and microelectronics.

Universidad Nacional de Educación a Distancia Madrid, Spain

8/90-5/95 "Licenciado" in Physics.
Five-year program culminating in the equivalent of a Masters of Science. Major in applied physics.

AWARDS AND HONORS

6/98 Graduate Service Award given by the Dean of Students of Stanford University for "outstanding commitment to enhancing graduate student life and for fostering the spirit of community among graduate students".

9/95-6/97 Fellowship from the "Pedro Barrié de la Maza" Foundation of A Coruña, Spain.

11/94 Spanish 2nd National Prize for graduating Telecommunications Engineers from the Spanish Education Ministry.

RESEARCH INTERESTS

- Economic and pricing models in the Internet infrastructure
- Mobile Internet
- Switching, scheduling and routing of circuits and packets
- Performance and queueing modeling
- Internet traffic analysis

PUBLICATIONS

- Pablo Molinero Fernández, José López Serrano, Guillermo López Serrano, Luis Piñeiro Blanca, Joan Raventós "Facturación de servicios en la Internet móvil"
  Submitted.
- Pablo Molinero-Fernández, Konstantinos Psounis, Balaji Prabhakar, "Systems with multiple servers under heavy-tailed workloads"
  Submitted.
- Pablo Molinero-Fernández, Nick McKeown, "El Control de Conmutadores de Circuitos en el Núcleo de la Internet por medio de Flujos de Usuario"
  Jornadas Telecom I+D, Ministerio de Ciencia y Tecnología, Madrid, Spain, Nov. 2003.
- Pablo Molinero-Fernández, Nick McKeown, "The Performance Of Circuit Switching In The Internet"
  OSA Journal of Optical Networking,, Vol. 2(4), pp. 83-96, March 2003.
- Pablo Molinero-Fernández, Nick McKeown, Hui Zhang, "Is IP Going To Take Over The World (Of Communications)?"
  HotNets, Princeton, NJ, October 2002, also to be published in *ACM Computer Communication Review (CCR) in January 2003.*
- Pablo Molinero-Fernández, Nick McKeown, "TCP Switching: Exposing Circuits to IP"
  IEEE Micro, Vol. 22(1), pp 82-89, January 2002.
- Pablo Molinero-Fernández, Nick McKeown, "TCP Switching: Exposing Circuits to IP"
  Proceedings of Hot Interconnects IX, Stanford, CA, pp.43-48, August 2001.
- Pablo Molinero-Fernández, Nick McKeown, "Study Of Routing Behavior Through Traceroute Measurements"
  Network Analysis Times, NLANR, Vol. 2(1), April 2001.
- Pablo Molinero-Fernández, "La Internet, La Economía y La Sociedad" (in Spanish)
  Boletín de la Asociación de Becarios Pedro Barrié de la Maza, pp. 8-9, May 2000.
- Fouad A. Tobagi, Pablo Molinero-Fernández, Mansour J. Karam, "Study of IEEE 802.1p GARP/GMRP Timer Values"
  Technical Report, Computer Systems Laboratory, Stanford University, September 1997.
- Pablo Molinero-Fernández, "Operating Systems for Multimedia Applications"
  Engineer's Thesis, ENST Paris, May 1994.
- Pablo Molinero-Fernández, "Transport Protocols for Multimedia Traffic"
  Technical Report, ENST Paris, December 1993.

RESEARCH EXPERIENCE

4/04-Present **Senior Product Engineer,** NetSpira Networks, Madrid, Spain
NetSpira Networks is a high-tech start-up that builds and designs advanced support nodes for the core network of mobile Internet. Its nodes help the mobile operator analyze, control, differentiate and bill data traffic going through their network. The NetSpira products allow the application of new pricing models to Internet traffic. This has important and interesting economic implications in terms of service differentiation and feature competition among operators. Responsibilities included, but not limited to, the design of the product architecture, roadmap definition, and technical presentations to clients.

7/03-4/04 **Senior Research Engineer,** NetSpira Networks, Madrid, Spain
Responsibilities included, but not limited to, the design, implementation and testing of new products and features.

9/97-6/03 **Research Assistantship,** Stanford University, Stanford, California
Advisor: Prof. Nick McKeown.

- *Queueing models*. Developed an accurate approximation for the M/GI/K queueing models for heavy-tailed workloads. Classical queueing theory using M/M/K models predicts that it is always better to pool resources together in a single, large server. However, heavy-tailed workloads suffer from frequent and long blockings of the single server, and thus they get a better response time from the system when resources are partitioned. This work allows the calculation of the optimal number of servers.
- *Circuit and packet switching*. Analyzed the scalability, reliability and performance of circuit and packet switching. Technology and usage trends indicate that packet switching will not be able to scale in terms of switching capacity to match the Internet traffic growth. In contrast, circuit-switching capacity scales better, both in electronic and optical form, and it will be able to meet the traffic demand. In addition, current implementations of circuit switches are more robust than equivalent routers and end users see no performance degradation when using circuit switching in the backbone. The recommendation is to use circuit switching in the core and packet switching in the edges of the network.
- *Traffic analysis and modeling*. Characterized a typical user flow in the Internet, and studied the statistical multiplexing gain in the Internet. Analyzed several traces of real traffic from different access points to the Sprint and vBNS backbones, and studied the effect of scaling the link speed.
- *TCP Switching*. Proposed two network architectures that integrate circuit switching in the core of the network with packet switching at the edges. The first architecture, called TCP Switching, maps user flows to light-weigh, fine-grain circuits. The second one monitors user flows to control heavy-weigh, coarse-grain circuits. They both exploit the fact that our usage of the network is very connection-oriented. The evaluation of both architectures involved ns-2 simulations and analysis of traffic traces.
- *Reliable multicast*. Studied different architectures for native reliable multicast in the Internet. Analyzed the requirements that are needed to guarantees the delivery of all data to a heterogeneous multicast group.
- *High-speed switching*. Worked on a system-level simulator in C for the Tiny-Tera, a 1-Tbps fixed-size packet switch (http://klamath.stanford.edu/tiny-tera/).
- *System administration*. System administrator for the High-Performance Networking group. In charge of a cluster of 20 office and lab computers running Linux and Windows.

2/96-8/97 **Research Assistantship**, Stanford University, Stanford, California
Advisor: Prof. Fouad Tobagi. I studied the protocol IEEE 802.1p GARP/GMRP for selective multicasting in LANs. Simulated the performance of GMRP, a protocol for multicast group management in LANs, tuned the internal timers for better response times and pointed out some problems with the protocol. The final technical report was used as a recommendation by the IEEE 802.1p/Q committee.

6/97-9/97 **Research Intern**, 3Com Corp., Technology Development Center Santa Clara, California
Designed and developed a videoconference gateway between the H.323 and H.320 standards for Computer-Telephony Integration. The Gateway translated traffic coming from Microsoft's NetMeeting on a PC sitting in a LAN, and it sent it through an ISDN network to a video-conference equipment. The gateway was used to interconnect two remote sites using the public network.

6/96-9/96 **Research Intern,** Hewlett-Packard Laboratories Palo Alto, California
Designed and developed a system for streaming MPEG-1 video using Windows 95 and NT. Designed the protocol to interconnect a server for Video-on-Demand (VoD) and several clients with a hardware decoder card.

10/94-7/95 **Research Assistant,** ETSIT, Systems, Signals and Radio Communications Dept. Madrid, Spain
Ported the XTP transport protocol to Windows NT for its use with multimedia applications.

1/94-7/94 **Research Assistant,** ENST, Computer Science Department Paris, France
Analyzed different operating systems as a support for multimedia applications, with special emphasis in the throughput, latency and jitter guarantees.

8/93-12/93 **Research Intern,** Siemens AG, R&D Center Munich, Germany
Compared various transport systems for distributed multimedia applications over high-speed networks. Measured the performance of TCP and XTP.

TEACHING EXPERIENCE

04 **Visiting Professor,** Saint Louis University Madrid, Spain
Part-time Professor in the Madrid program of this American University during the Spring Semester. Taught the course EE101 *Introduction to Electrical Engineering*. Classes were in English and students came from four different continents.

00-02 **Teaching Assistant,** Stanford University Stanford, California
Teaching Assistant for CS244a, *Introduction to Computer Networks*, during the winter quarters of 2000, 2001 and 2002 at Stanford University. The class typically has an enrolment of 80-120 students. In 2001 was the Head Teaching Assistant, and in 2002 was in charge of the programming assignments.

90-92 **Teaching Assistant,** ETSIT, Electronic Engineering Department Madrid, Spain
Teaching assistant for various laboratories: Digital Electronics, Digital Systems and Circuit Electronics.

ACADEMIC SUPERVISION

98-02 Supervised several research projects for different M.Sci. students at Stanford University:

- Horng Jye Oh (Spring 98), Looja Tuladhar (Spring 98) and Jin Cheng (Summer 98) developed a java applet for real-time visualization of simulations using the simulators SIM and TTsim.
- Bo Yang (Fall 00-Winter 01) and Feng Wang (Fall 00) worked on ns-2 scripts to simulate a network using TCP Switching in the backbone.
- Byung-Gon Chun (Fall 00-Winter 01) and Ranganath Rao (Fall 00) implemented a boundary router for TCP Switching in Linux. First as a user-space program then as a kernel module.
- Xiaoyan Cheng (Winter 02) used ns-2 to study fine-granularity circuit routing in TCP Switching.

ACADEMIC SERVICE

4/98-8/00 **President of the Spanish Student Association,** Stanford University, Stanford, California
Co-founded the Spanish Student Association, whose goals are to be a meeting point for students who are interested in Spain and to promote Spanish culture around campus.

4/98-1/99 **Co-founder of Calendus Software,** Stanford University, Stanford, California
Developed a web- and email-based calendar system used by over 200 student organizations and departments at Stanford University (http://klamath.stanford.edu/~molinero/calendus/)

93 **University representative**, ENST Paris, Madrid, Spain
Representative for ENST Paris at the Satelec research exhibition at ETSIT Madrid.

90-92 **Student representative**, ETSIT Madrid, Madrid, Spain
Various positions in the Student Association at ETSIT Madrid.

PROFESSIONAL AFFILIATIONS

1/96-Present Student member of IEEE (*Institute of Electrical and Electronics Engineers*)

5/92-1/94 Member of the *International Student Circle* of Siemens AG, a select program for European engineering students sponsored by Siemens.

PROFESSIONAL EXPERIENCE

6/00-8/00 **Summer Associate,** McKinsey&Company Madrid, Spain
Did management consulting for an Internet Service Provider and a Satellite TV provider.

7/92-8/92 **Development Intern,** Siemens AG, Mobile Communications Department Munich, Germany
Developed a microcontroller system for a base station using the GSM standard for mobile phones.

7/91-8/91 **Software Intern,** Linde AG, Process Control Department Munich, Germany
Programmed a model to optimize the production of a Repsol SA oil refinery in Tarragona (Spain).

REVIEWING EXPERIENCE

Reviewed papers for ACM Sigcomm (2000, 2001), IEEE Infocom (2000, 2001, 2002), IEEE Hot Interconnects (1998), QoS-IP (2003) and IEEE International Conference on Communications (2004) conferences, *IEEE Journal on Selected Areas in Communications* (1998), *SPIE Optical Networks Magazine* (2002) and *IEEE/ACM Transactions of Networking* (2001).

LANGUAGES

Native Spanish speaker. Fluent in English and French. Working knowledge in German and Italian.