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Editorial

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Designing the future Internet requires an in-depth consideration of the management, dimensioning, economics and traffic control issues that will be involved in the network operations of these networks. The 5th Euro-NGI Conference on Next Generation Internet Networks, NGI 2009, organized within the framework of the Network of Excellence Euro-NF, provided an open forum to present and discuss new ideas in these areas.

The Network of Excellence Euro-NF "Anticipating the Network of the Future—From Theory to Design" is a European project funded by the European Union within the 7th Framework Program. The focus of Euro-NF is to develop new principles and methods to design, dimension, control and manage multi-technology architectures towards the Networks of the Future. The emerging networking paradigms raise new challenging scientific and technological problems embedded in complex policy, governance, and worldwide standards issues. Dealing with the diversity of these scientific and social, political and economic challenges requires the integration of a wide range of research capabilities, a role that Euro-NF aims to fulfil.

This special issue contains a selection of the research contributions presented at NGI 2009. The conference was held in Aveiro, Portugal, July 1–3, 2009, organized by Instituto de Telecomunicações. There were 63 papers submitted to the conference that were carefully reviewed by at least 3 members of the Technical Program Committee and a total of 34 papers were selected for oral presentation at the conference. Conference proceedings were published in IEEE Xplore. From these, the best 15 papers were invited to submit revised extended versions to this special issue.

The fifteen selected papers address a wide range of topics that must be dealt with in order to make relevant advances towards the Next Generation Internet networks. This selection includes: traffic monitoring and characterization; network economics and pricing; routing issues; mathematical models and solution techniques for optimizing the network load balance; service differentiation in Wireless Sensor and Delay-Tolerant Networks; peer-to-peer architectures for content distribution networks; multicast services; network architectures; and, erasure-correction codes for real-time streaming services.

Two papers address the issue of Internet traffic monitoring and characterization. The paper "Traffic Characterization of a Residential Wireless Internet Access" presents traffic measurements on an ISP (Internet Service Provider) network providing broadband wireless Internet access to residential users; it characterizes the observed measurements in terms of daily traffic fluctuations, flow statistics as well as application distributions. The paper "Can Multiscale Traffic Analysis Be Used to Differentiate Internet Applications?" proposes a multi-scale traffic analysis based on multi-order wavelet spectrum as a method to discriminate Internet applications traffic profiles without the need to analyse packet payload content; the efficiency of the proposed method is assessed through the analysis of real traffic traces collected in a University campus and, due to their relevance, web-browsing, movie streaming and BitTorrent applications are selected as targeted applications for analysis.

Two papers address the issue of network economics and pricing. The paper "Options and Overbooking Strategy in

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the Management of Wireless Spectrum" deals with wireless spectrum trading economics where the spectrum primary owner resells options to potential spectrum consumers and uses an overbooking strategy in order to maximise his profit; it proposes a model for the purchasing decision and price setting, and uses it to analyse the impact on the booking strategy of different parameters, such as the overbooking ratio, the penalty value, the marginal purchase probability and the block price. The paper "Understanding the Impact of Loyal User Behaviour on Internet Access Pricing: A Game-Theoretic Framework" deals with pricing strategies of ISP Internet access; based on empirical results conducted from the Hungarian ISP market, it proposes a user loyalty model and uses it in a game-theoretical framework where optimal Internet access pricing strategies are derived.

Two papers address Internet routing issues. The paper "Powering Internet with power-law networking" addresses the issue of compact routing in the so-called 'Internet-like' networks, i.e., random networks with a power-law node degree distribution (the node degree has finite mean and infinite variance); it adapts a previously known compact routing scheme based on the idea of choosing a few large degree nodes as routing hubs and using the path to the nearest hub as the address of a node; also, in order to improve network robustness, it considers using multiple name-paths per node; a 'mean-field' technique is proposed that can obtain quantitative values which are used to assess the feasibility of such compact routing technique even for very large number of nodes. The paper "Multi-Exit Discriminator Game for BGP routing coordination" exploits the Multi-Exit Discriminator attribute of BGP in order to balance more efficiently the traffic load of links connecting different tier-1 ASs (Autonomous Systems); it presents a game-theoretical framework in which efficient strategy profiles can be detected in a non-cooperative game modelling (an effective routing policy is defined relying on the concepts of Nash equilibria and Pareto-efficiency).

Two papers address modelling and solution techniques for network load balance optimization. The paper "Robust load balancing under traffic uncertainty—tractable models and efficient algorithms" deals with intra-AS routing optimization, in an MPLS based network, aiming to minimize the worst case link load; it considers both a polytopic traffic uncertainty model (defining a set of all possible traffic matrices) and an ellipsoidal traffic uncertainty model (capturing the stochastic behaviour of traffic), and it describes for both cases an iterative linear programming method which combines column and constraint generation techniques to find a robust routing setting in a finite number of optimization steps. The paper "Optimization of Link Load Balancing in Multiple Spanning Tree Routing Networks" deals with routing optimization, in an Ethernet based network, aiming to minimize not only the worst case link load but also the second worst case link load, the third, and so on; for a given set of VLAN demands to be supported by the network; the routing decision is the combined determination of (i) a set of appropriate spanning trees, and (ii) the assignment of each VLAN demand to one of the trees.

Two papers address delay differentiation issues in Sensor and Delay-Tolerant Networks. The paper "Adaptive Packet Prioritisation for Large Wireless Sensor Networks" exploits the idea of providing differential prioritisation of packets on a WSN (Wireless Sensor Network) by spatially re-routing them according to a priority-specific policy, i.e., higher priority packets are routed through the neighbours that are closer to the sink node while lower priority packets are routed through other neighbour nodes, and, in this way, avoiding the need of the MAC (Medium Access Control) layer to support multiple queues; it extends the RRR (Random Re-Routing) routing protocol, which is designed to operate over a geographic routing protocol. i.e., a routing protocol that uses the geographic location of the nodes to find the shortest routes between each node and the network sinks. The paper "Traffic Differentiation Support in Vehicular Delay-Tolerant Networks" considers networks where mobile nodes (e.g., vehicles) carry data exchanging bundles of packets and stationary relay nodes (located at road intersections with store-and-forward capabilities) allow mobile nodes passing by to pickup and deposit bundles on them; it uses a priority class service model together with different buffer management strategies and drop policies and different scheduling policies to achieve traffic differentiation.

Two papers address issues related with content distribution networks based on Peer-to-Peer (P2P) architectures. The paper "Symmetric Routing in DHT Overlays" proposes a super-peer lookup algorithm for structured P2P architectures based on DHT (Distributed Hash Table) systems; on such architectures, the P2P network topology is organized in a two-layer hierarchy where some peers are defined as super-peers running the lookup algorithms between them; the main motivation for the proposed algorithm is to allow nodes, with a degree of connectivity higher than the average, to emerge as super nodes in the network so that super-peer topology can be dynamically formed. The paper "Integrating Mobile Cellular Devices into Popular Peer-to-Peer Systems" proposes a mobile P2P architecture to support the participation of mobile devices (MDs) on P2P content distribution networks in an energy efficient way; in the proposed architecture; MDs schedule download jobs on an extended peer, go off-line to save energy and when the extended peer finishes the download job, the data is transferred to the MD; the proposed architecture includes partnership schemes where MDs provide incentives in the form of mobile services (for example, advertisements or SMS message delivery) to get support from the P2P extended peers.

The paper "Mobility of Sources and Listeners: Real-Time Support of Multicast Services" proposes a new solution

for multicast communications in environments with mobile sources and listeners; current IP multicast support over mobile communications is not efficient and when multicast sources mobility is taken into account, the performance of IP multicast is significantly degraded, due to the requirement for constantly changing the overall multicast tree; the proposed solution, named MUTE (MUlticast TEleport) is based on a hierarchical architecture composed by two agents (MTAs, MSDA) and one control protocol (MDP); it overcomes mobility problems in SSM (Source Specific Multicast) enabled networks through separating SSM trees into two sub-trees, enabling the seamless movement of both multicast sources and listeners.

The paper "Controlling QoS in EPON-based FTTX Access" addresses the issue of how to arbitrate the access of upstream traffic to the fibre in order to avoid collisions in an EPON (Ethernet Passive Optical Network) access network; an EPON architecture consists on an Optical Line Termination (OLT), located at the central office, and multiple remote Optical Network Units (ONUs) that deliver broadband services to subscribers (downstream and upstream traffic flows use two different wavelengths on a single fibre); the paper first proposes an analytical model for the Interleaved Polling with Adaptive Cycle Time (IPACT), with Gated Service, one of the most popular schemes for Dynamic Bandwidth Assignment (DBA) in the EPON upstream; then, this model is used to demonstrate that all users experiment performance degradation in case of local overload, which indicates that such scheme is only suitable for best effort services and, finally, a versatile control plane for EPONs is proposed to support several relative classes of service, or a mix of committed bandwidth and best effort services which includes a framework for enforcing Service Level Agreements (SLAs) and fairly sharing of available resources.

Finally, the paper "Fountain-Inspired Erasure Coding for Real-Time Traffic: Performance Analysis and Simulation" applies the fountain coding principle to derive a fountain-coding-like erasure correction method for real-time streaming services; in the original fountain coding, the transmitter sends a virtually infinite number of different encoded packets, given by a stochastic function of the original data blocks; for real-time streaming, this paper uses a sliding window defining the part of the stream the encoder is working on (its size is determined by the real-time requirements of the application) and proposes a systematic coding scheme in which each block of the stream entering the window is sent once as such (the ideal mode of operation for real-time traffic, as the receiver can immediately consume its content) followed by a repair packet sent with a given probability P (with the aim to fill possible receiving gaps); P is the planning parameter that controls the trade-off between the code rate and the residual probability of missing blocks.

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