Session: Plenary Session

Wednesday, July 4; 09:00 – 09:45
Room: S. António

Improving Service Utility and Service Delivery in Next Generation Networks
Heinrich J. Stüttgen (General Manager, NEC Europe, Heidelberg, Germany)

Session: Plenary Session

Wednesday, July 4; 09:45 – 10:30
Room: S. António

Research Activities at Nokia Siemens Networks Portugal S.A.
Paulo Monteiro (Research Manager, Siemens, Portugal)

Session: Cellular Networks

Wednesday, July 4; 11:00 – 12:45
Room: S. António
Chairperson: Mahmoud Daneshmand (AT&T, United States of America)

Analysis of Joint Call Admission Control Strategies for Heterogeneous Cellular Networks
Olabisi Falowo (University of Cape Town, South Africa); H. Anthony Chan (University of Cape Town, South Africa);

“This paper investigates three joint call admission control algorithms (JCAC) for heterogeneous cellular networks. These algorithms are random-selection based, service-based, and load-based JCAC algorithms. Our approach is based on decomposing heterogeneous cellular networks into groups of colocated cells. We model the JCAC algorithms as a multi-dimensional Markov chain. For each of the three JCAC algorithms, new call blocking probability and handoff call probability are derived and evaluated. The performances of the three JCAC algorithms are compared and the results are presented.”

Adaptive Multi-Class Signaling Control for Cellular Networks
Saowaphak Sasanus (University of Pittsburgh, United States of America); David Tipper (University of Pittsburgh, United States of America);

“In this paper, we propose a paradigm for signaling congestion control based on providing quality of service (QoS) to signaling traffic in wireless cellular networks (WCNs). An adaptive multi-class token bucket with an overflow buffer combined with priority scheduling is used to provide different grades of service to classes of signaling messages. Engineering specifically for WCNs, the signaling message congestion control is tied to the state of the traffic transport network. Simulation results are given illustrating the behavior of the new signaling overload control scheme and comparing it with existing schemes in the literature. The performance study shows that the proposed scheme can control congestion and improve performance.”

Context-aware signaling for call differentiation in IMS–based 3G networks
May El Barachi (Concordia University, Canada); Roch Glitho (Ericsson Canada, Canada); Rachida Dssouli (Concordia University, Canada);

“Service differentiation is an active topic in 3G networks, which aim at supporting a diversity of IP multimedia services (with different QoS requirements) and users (establishing sessions with different levels of importance). In this paper, we propose a network level call differentiation scheme in IMS–based 3G networks. This scheme defines three new classes of calls offering different priorities/guarantees to the user. Service differentiation is achieved at the session signaling level by relying on a context-aware resource allocation strategy. An extension to the 3GPP IMS architecture is proposed to realize the service differentiation scheme and a proof-of-concept prototype is built using SIP and COPS as implementation technologies. Unlike other signaling level schemes, the system proposed here offers flexible QoS negotiation mechanisms to the user, provides preferential treatment at the beginning and during sessions, and takes into consideration the characteristics of the multimedia, multiparty, service environment offered by 3G networks.”
Cost Analysis of the MBMS Multicast Mode of UMTS

Antonios Alexaio (Research Academic Computer Technology Institute, University of Patras, Greece); Christos Boursas (Research Academic Computer Technology Institute, University of Patras, Greece); Evangelos Rekkas (Research Academic Computer Technology Institute, University of Patras, Greece);

"Along with the widespread deployment of the third generation cellular networks, the fast-improving capabilities of the mobile devices, content and service providers are increasingly interested in supporting multicast communications over wireless networks and in particular over Universal Mobile Telecommunications System (UMTS). To this direction, the third Generation Partnership Project (3GPP) is currently standardizing the Multimedia Broadcast/Multicast Service (MBMS) framework of UMTS. In this paper, we present an overview of the MBMS multicast mode of UMTS. We analytically present the multicast mode of the MBMS and analyze its performance in terms of packet delivery cost under various network topologies, cell types and multicast users' distributions. Furthermore, for the evaluation of the scheme, we consider different transport channels for the transmission of the data over the UTRAN interfaces."

Session: Network Modelling and Simulation

Wednesday, July 4; 11:00 - 12:45
Room: S. Pedro I
Chairperson: Paulo Salvador (University of Aveiro, Portugal)

Source Line Load Equalization Methods for the Source Aggregation Algorithm (SAA)

Marek Hajduczenia (Nokia Siemens Networks S.A., Portugal); Henrique Silva (University of Coimbra, Portugal); Paulo Monteiro (Nokia Siemens Networks S.A., Portugal);

"The Source Aggregation Algorithm (SAA) is a well known method for reproduction of high quality self-similar data traces, often matching some predefined Packet Size Distribution (PSD). However, lack of target link load boundaries and estimation errors in excess of 100% for short traces make it a method of choice only for 10^5 packets or longer traces. A small sources population, preferable for rapid link load convergence, results in quality deterioration of the generated trace. In this paper we aim to present the first, to the best of our knowledge, link load control mechanism for the SAA, based on modification of Pareto distribution parameters, allowing for reduction in link load estimation error to 3% for a sample population in excess of 10^4 packets with 100 individual data sources. In total, 4 individual methods are examined and their advantages and shortcomings are identified."

Modeling The Population of File-Sharing Peer-to-Peer Networks With Branching Processes

Trang Dang (Budapest University of Technology and Economics, Hungary); Roland Percezes (Budapest University of Technology and Economics, Hungary); Sándor Molnár (Budapest University of Technology and Economics, Hungary);

"In this paper we develop a simple but effective mathematical model to capture the file population dynamics of file-sharing peer-to-peer systems. Our modeling framework is based on the theory of branching processes. We describe analytically the behavior of the proposed model. The precise characterization of the necessary and sufficient conditions of population extinction or explosion is given based on the system parameters. We also present the expected ratio of active, passive and dead peers for the long-term regime. We validate and demonstrate our results in several simulation studies. Based on our results we propose a number of engineering guidelines to the design and control of file-sharing P2P systems."

Approximating Bounded General Service Distributions

James Broberg (The University of Melbourne, Australia); Panlop Zeephongsekul (Royal Melbourne Institute of Technology, Australia); Zahir Tari (Royal Melbourne Institute of Technology, Australia);

"Exponential distributions have traditionally been used to model the traffic (e.g., inter-arrival and service distributions) experienced in computer networks. They are attractive as they are amenable to analysis typically utilised in queuing models. However, modern traffic analysis has shown that many computing workloads are in fact ‘heavy-tailed’ and highly variable, and are better represented by general distributions such as Log-normal and Pareto. The use of General distributions can make an analytical analysis of some queuing metrics (e.g. waiting time, busy period, slowdown) difficult due to the fact that the Markovian properties of certain stochastic processes in queues are no longer in force. For such distributions Prony’s method can be utilised to fit a series of exponentials to the original General distribution, resulting in a Hyper-exponential distribution that represents the characteristics of the original workload, but is more amenable to analysis. Bounded representations of general distributions (such as Bounded Pareto) are frequently used, but by default, Prony’s method is not ideally suited to fitting such distributions. We present two ways of addressing this issue: by normalising the Hyper-exponential resulting from Prony’s method between the bounds of the workload distribution being approximated, and by re-evaluating Prony’s method to fit directly to a Bounded Hyper-exponential."

Long Horizon End-to–End Delay Forecasts: A Multi–Step-Ahead Hybrid Approach

Vinh Bui (University of New South Wales, Australia); Weiping Zha (University of New South Wales, Australia); Antonio Pescapè (University of Naples, Italy); Alessio Botta (University of Naples, Italy);

"A long horizon end-to-end delay forecast, if possible, will be a breakthrough in traffic engineering. This paper introduces a hybrid approach to forecast end-to-end delays using wavelet transforms in combination with neural network and pattern recognition techniques. The discrete wavelet transform is implemented to decompose delay time series into a set of wavelet components, which is comprised of an approximate component and a number of detail components. Thus, it turns the problem of long horizon delay forecasting into a set of shorter horizon wavelet coefficient forecasting problems. A recurrent multi-layered perception neural network is applied to forecast coefficients of the wavelet approximate component, which represents the trend of the delay series. The k-nearest neighbors technique is used to forecast coefficients of the wavelet detail components, which reflect the burstiness of background traffic. The proposed approach has been verified in both simulation and over real heterogeneous networks showing promising results in terms of averaged normalized root mean square error. In addition, when compared to some existing and well known approaches it presents the superior performance."

Subexponential Parsimonious Modeling of the Correlation Structure of VBR Video Traffic

Maria–Estrella Sousa–Vieira (University of Vigo, Spain); Andres Suarez–Gonzalez (University of Vigo, Spain); Jose–Carlos Lopez–Ardao (University of
Enabling Role-Based Delegation and Revocation on Security-Enhanced Linux credentials and certificates needed for the solution to maintain correctness. “With the increasing popularity of multimedia applications, video data represents a large portion of the traffic in modern networks. Consequently, adequate models of video traffic, characterized by a high burstiness and a strong positive correlation, are very important for the performance evaluation of network architectures and protocols. This paper presents a new model for traffic with persistent correlations based on the M/G/inf process. We use a new discrete distribution for the service time of the M/G/inf queueing system, flexible enough to give rise to a wide range of correlation structures of the resulting M/G/inf process in a parsimonious way. The corresponding simulation model is easy to initialize in steady state. Moreover, as the distribution has subexponential decay, we can apply a highly efficient and flexible generator of synthetic traces of the M/G/inf process. As an example, we analyze the capabilities of our model for capturing the empirical distribution and correlation structure of VBR MPEG video traffic.”

Session: Security

Wednesday, July 4, 11:00 – 12:45
Room: S. Pedro II
Chairperson: Weider Yu (San Jose State University, United States of America)

An Experiment in Interoperable Cryptographic Protocol Implementation Using Automatic Code Generation
Alfredo Pironti (Politecnico di Torino, Italy); Riccardo Sisto (Politecnico di Torino, Italy);

“spi2java is a tool that enables semi-automatic generation of cryptographic protocol implementations, starting from verified formal models. This paper shows how the last version of spi2java has been enhanced in order to enable interoperability of the generated code. The new features that have been added to spi2java are reported here. A case study on the SSH Transport Layer Protocol, along with some experiments and measures on the generated code, is also provided. The case study shows, with facts, that reliable and interoperable implementations of standard security protocols can indeed be obtained by using a code generation tool like spi2java.”

A Lightweight Approach to Protect Mobile Data
Takashi Matsunaka (KDDI R&D Laboratories, Japan); Takayuki Warabino (KDDI R&D Laboratories, Japan); Keizo Sugiyama (KDDI R&D Laboratories, Japan);

“This paper proposes a lightweight approach for protecting data on mobile terminals by improving our previous approach. In order the data to be not compromised due to the loss or theft, our approach prevents data leaks and allows the correct user to recover the data to a new mobile terminal as the cooperation between a mobile terminal and a network server. The fundamental concept for achieving the data security is to apply the data encryption and the secret sharing of the encryption key. The master key is newly introduced to generate all the encryption keys for data on a mobile terminal. All the user must do is simply reconstructing the master share onto a new mobile terminal to recover the environment of the lost one. We confirmed the effectiveness of our approach through the implementation of both approaches onto a mobile phone.”

PPMLP: A Special Modeling Language Processor for Privacy Policies
Weider Yu (San Jose State University, United States of America); Savitha Murthy (San Jose State University, United States of America);

“In today’s world of information technology, there’s increasing concern for the privacy of an individual’s private data stored on computers. The Internet and security vulnerabilities provide an opportunity for hackers to misuse information. The level of an individual’s trust for an organization can be ensured or increased by the organization’s Privacy Policy. Privacy has become an increasingly critical concern recently and hence, how to create well documented and comprehensive organizational Privacy Policies still remains a challenge. Also, an organizational Privacy Policy is usually too long for individuals to read and comprehend. There are machine readable privacy languages existing today that can be used to enforce certain privacy rules. But the privacy policies created using this kind of languages do not address all the issues that are of a customer’s concern. This paper focuses on a systematic and integrated technology and process to create and maintain organizational policies by making them machine readable. Having a privacy policy language grammar that can make natural language based privacy policies machine readable can help address the customer’s issues regarding the organizational privacy policies. By using an organizational privacy policy template to create a natural language based privacy policies enables the reusability of the policy template. Also, being able to automatically provide privacy related suggestions from past experience stored in a knowledge base and perform privacy compliance check helps improve the quality of a privacy policy.”

Gaining Flexibility by Security Protocol Transfer
Per Harald Myrvang (Bode Graduate School of Business, Norway); Tage Stabell-Kule (University of Tromsø, Norway);

“Even though PDAs in general — but smartcards in particular — are preferred over general-purpose computers to keep secrets, because they have meager resources, including them in security protocols is difficult. The PDAs — and again smartcards in particular — end up as a mere key-store and their processing power is not used. We describe a mechanism that allows such anemic computers to fully participate in protocols, even if the protocol in question by far exceeds their capabilities. This is done by means of machinery for transferring, at runtime, the protocol proper to a more powerful machine. We describe the mechanisms that make this possible (mainly a domain specific programming language named Obol [5] and its implementation) and we discuss the credentials and certificates needed for the solution to maintain correctness.”

Enabling Role-Based Delegation and Revocation on Security-Enhanced Linux
Gail-Joon Ahn (University of North Carolina at Charlotte, United States of America); Dhruv Gami (University of North Carolina at Charlotte, United States of America);

“An increasing number of attacks experienced in existing enterprise networks and applications created a huge demand for operating system security mechanisms. As a consequence, Security-Enhanced Linux (SELinux) has been proposed by NSA and is being adopted by the industry at a fast rate. More and more enterprises are planning to move their business operations to such a secure computing environment, requiring the features of delegation and revocation. In this paper we seek to address the issue of how to leverage a role-based delegation in SELinux while minimizing the modification of SELinux system modules. Our approach is to utilize the flexible policy system used in SELinux that allows for custom rules to be defined to provide other access control requirements. We also demonstrate the feasibility of our framework through a proof-of-concept implementation.”
Session: Packet Processing

Wednesday, July 4; 11:00 – 12:45

Room: S. Pedro III

Chairperson: Reza Peyrovian (AT&T, United States of America)

Switch Architectures For Small–buffered Optical Packet Switched Networks

Onur Alparslan (Osaka University, Japan); Shin’ichi Arakawa (Osaka University, Japan); Masayuki Murata (Osaka University, Japan);

“One of the difficulties of optical packet switched networks is buffering optical packets in the network. Currently, one solution that can be used for buffering in the optical domain is using long fiber lines called Fiber Delay Lines (FDL). However, FDLs provide only a small and fixed amount of delay. Thus, bottlenecks in Internet traffic and over-utilizations cause high packet drop rates in small and fixed delayed OPS networks. Recently, we proposed a new network architecture using an XCP-based congestion control algorithm for OPS WDM networks with pacing at edge nodes for minimizing the buffer requirement at core nodes. In this paper, we investigate input and output optical switch architectures for minimizing the size of optical switching fabric with the proposed network architecture. We show the number of FDLs and switch size requirements of architectures depending on FDL granularity and packet size distribution.”

A Fair Request–Grant Matching Algorithm for Fabric Scheduling in Packet Switches

Mohammad Rostami (Bahonar University, Iran); Ali Asghar Khodaparast (Amirkabir University, Tehran, Iran); Siavash Khorsandi (Amirkabir University of Technology, Iran);

“Request–Grant (RG) matching algorithms are now widely used for scheduling in high-speed packet switches. An RG algorithm is invoked for a few iteration cycles in a time–slot to achieve a higher matching size. The required time for scheduling in a switch in a time–slot is dictated by convergence of the matching process between the inputs and the outputs of the switch. In RG algorithms, each input sends request to all/some of the outputs at each iteration cycle. Then each output sends grant to one of its requesting inputs according to an input priority sequence. Synchronization of input requests or output grants is the reason for further iteration cycles. It may also reduce throughput and cause an unfair service. In this paper, we analyze the existing RG matching algorithms showing that they have fairness and convergence problem under a range of input load distributions. Our analysis and simulation show that our proposed algorithm called FRGA is a high throughput matching algorithm that presents an optimal fairness and convergence under all load distributions.”

Toward a Differentiated–Service Enabled Parallel Packet Switch

Amin Farajiandehzadeh (Amirkabir University of Technology, Iran); Siavash Khorsandi (Amirkabir University of Technology, Iran);

“Parallel Packet Switch (PPS) is aimed to solve the problems of traditional electronic switches in providing extra high switching capacities. In theory, PPS can scale the switching capacity to infinity. Basic PPS architectures perform uniform load balancing of aggregated traffic to achieve high throughput, but it fails to support differentiated QoS for various classes of traffic flows. With recent advent of sensitive applications such as VoIP and IPTV in a commercial scale and huge amount of delay and loss sensitive traffic, the necessity of providing differentiated QoS in the switching facilities is obvious. The goal of this paper is to provide a QoS enabled Parallel Packet Switch architecture which can support three fundamental differentiated classes of service: Guaranteed-Delay (GD), Guaranteed-Loss (GL) and Best-Effort (BE). To this end, several QoS architectures are proposed in this paper and their main properties are studied under various scenarios. Backpressure, Speedup and Adaptive Rate Shaping are the three main mechanisms used in the proposed architectures to control delay for delay-sensitive and loss for loss-sensitive traffic in the switch. Simulations show that by using central backpressure, which is complex in implementation, or distributing backpressure from output multiplexers to input demultiplexers in conjunction with using adaptive rate shapers in input demultiplexers for controlling rate of loss-sensitive and Best–Effort traffic, we can reduce average delay for Guaranteed–Delay packets considerably as well as keeping loss threshold for loss sensitive traffic, with very little reduction in utilization.”

A Complete Topology Management Mechanism for the Advanced Switching Interconnect Technology

Antonio Robles–Gomez (University of Castilla-La Mancha, Spain); Aurelio Bermudez (University of Castilla-La Mancha, Spain); Rafael Casado (University of Castilla-La Mancha, Spain); Francisco Quiles (University of Castilla-La Mancha, Spain);

“The Advanced Switching technology is a new high–performance standard serial interconnect. Its specification establishes a management infrastructure in charge of maintaining the fabric operation after the occurrence of a topological change. When the change is detected, the topology management mechanism discovers the new topology, obtains a set of fabric paths, and finally distributes them to the fabric endpoints. In this paper, we propose particular implementations for all these management tasks. Without lack of generality, the result is a completely functional mechanism to handle topological changes in any kind of switched networks, as Advanced Switching. We also analyze the behavior of this first proposal, in order to identify its bottlenecks and define future improvements.”

An Embedded Networking SoC for purely Ethernet MANs/WANs

Theofanis Orfanoudakis (University of Peloponnesse, Greece); George Kornaros (Technical University of Crete, Greece); Iakovos Mavroidis (Technical University of Crete, Greece); A. Nikolopoulos (Technical University of Crete, Greece); Ioannis Papaefstathiou (Technical University of Crete, Greece);

“Ethernet technology is longer used only in Local Area Networks (LANs), it is continuously gaining momentum in the Metropolitan Area Networks(MANs) and Wide Area Networks(WANs). This paper presents a multi-service access concentrator core that has been designed specifically for multi-service, purely Ethernet, access nodes. In particular the presented system is optimised for Ethernet traffic aggregation over MPLS-based optical backbone networks. Moreover, we also demonstrate the bottlenecks that have been identified when such networking applications are executed in a general-purpose net-work processing device, and the techniques we used in order to bypass them. Our experiments results, exe-cuted in a state-of-the-art FPGA-based platform, strongly support that the combination of general pur-pose processing units with powerful specialized hard-ware modules, is the most cost–effective approach for designing systems that (i) can support today’s and fu-ture network speeds and applications, in purely Ethernet networks, (ii) provide the end-user with the required programmability.”
A Distributed Fuzzy–based Hierarchical Resource Allocation Strategy

Pejman Goudarzi (Iran Telecom Research Center, Iran); M. Adeli (Iran Telecom Research Center, Iran); M. M. Azadfar (Iran Telecom Research Center, Iran);

"Fair resource allocation is an important and challenging issue for many telecommunication service providers. Developing fast and efficient algorithms which can provide such fair rates in a distributed manner are investigated by many researchers in the literature. It is well-known that almost all of the bottleneck links in any rate allocation algorithm occur in access part of the network. In the current work, we exploit this inherent feature for designing hierarchical methods of resource allocation and by exploiting the fast Newton method and fuzzy algorithms, we improve the convergence speed of the algorithms. An important feature of the proposed method is its distributed nature, because there is no need for the feedback from the core network in developing the fuzzy method."

Estimation of Multiplexing Gain on Small Business VoIP Networks

Szabolcs Kis (Budapest University of Technology and Economics, Hungary); Jozsef Biró (Budapest University of Technology and Economics, Hungary);

"Abstract—In this paper we shall establish a set of dimensioning rules for different VoIP networks using various measurement-based user behavior properties as input parameters. In order to solve the problem of dimensioning VoIP networks we focus on the aggregated VoIP links. These dimensioning procedures undoubtedly play an important role in efficiently operating extreme telephony networks like call centers and Small Businesses. Such special networks produce traffic characteristics significantly different from those of PSTN networks or general VoIP networks. Our purpose is to use simple input parameters in order to estimate the traffic characteristics of a certain link. By keeping the QoS parameters in sufficient range we present a solution to approximate link usage. The communication may be characterized with special properties such as few but very active subscribers, high internal call rate, very long – or very short call durations, etc. In this way a simple and useful dimensioning method is achieved, utilizing the very properties of such networks, which may reduce the number of the voice channels operated."

Optimal Scheduling of Network Consolidation

Tamas Karasz (Budapest University of Technology and Economics, Hungary); B. Karasz (Budapest University of Technology and Economics, Hungary); P. Wilczynszyk (Budapest University of Technology and Economics, Hungary); Tivadar Jakab (Budapest University of Technology and Economics, Hungary);

"To increase the capacity efficiency of provisioning oriented optical networks we have already proposed a three phase network development lifecycle, i.e. traditional provisioning phase and network extension phase extended with a consolidation phase [1]. Consolidation is a re-optimization and re-arrangement of the network on a certain extent. One of the most important questions concerning the consolidation is when re-configuration actions, i.e. the consolidation phases, should be performed. In this paper we apply some network state descriptors to schedule the consolidation. The descriptors can be classified into two groups. Local – i.e. network element level – descriptors like relative load of a link. Global – i.e. network level – descriptors, like relative load of the network. During the examinations we compared the efficiency of the strategies based on these descriptors with the most trivial scheduling solution, when the consolidation is applied at regular intervals. Based on the results we set up some recommendations about the application of these consolidation strategies. [1] T.Kárász, Zs.Pándi, T.Jakab, "Network Consolidation – How to Improve the Efficiency of Provisioning Oriented Optical Networks**, in Proc. DRCN 2005, Ischia, Italy, Oct. 2005, pp. 151-158.

A New Approximation Model for Guaranteed QoS Information Aggregation

Walid Hitra (France Telecom R&D, France); Olivier Dugeon (France Telecom R&D, France); Michel Diaz (LAAS–CNRS, France);

"The expansion of the networks in the last decade, in size and number of services, accentuated several problems, one important being the management and the control of available resources, in particular, to provide QoS. To deal with this problem, networks are often structured hierarchically and each domain keeps its own detailed state and an aggregated view about the other domains. After aggregation, the amount of information is outstandingly reduced but we can't speak about relevance only if the distortion from the exact state of the network is minimal. I.e there is a compromise between the reduction factor and the pertinence of the resulting information. This distortion can be result from a strict algorithm which leads to reduce unfeasible connections or a generous algorithm allowing to enlarge the amount of feasible connections even if the exact network state does not allow it. Although it under-estimates the network capacities, the telecom operators are in favour of the first aggregation algorithm, owing to the fact that it guarantees better the quality of service. In this paper, we give a new model for network state aggregation bringing a trade off between strict and generous algorithms. Contrary to traditional approaches where the probability of crankback is large, our solution, based on the concept of a ""Supported services guarantee"", does not over-estimate the network capacities and keep the admissibility amount reasonable. Our simulations show that the new approximation model achieves the best performance concerning the crankback rate reduction towards to the other aggregation methods."

Multi-Period Network Design of Optical Transmission Networks

Benoit Lardeux (France Telecom R&D, France); Dritan Nace (University of Technology of Compiègne, France);

"In this paper we study the Multi-Period Network Design problem (MPND), and focus on a special case, called Multi-Period Network Design with Incremental routing (MPNDI). We optimize simultaneously the network architecture and the link dimensioning under discrete cost functions in order to route all traffic demands in line with traffic growth over a discrete time horizon. We are interested here in incremental routing, that is, routing paths used at a given period to route some traffic demands have to be preserved over subsequent periods. We present here some new valid inequalities related to multi-period incremental routing, in addition to some previous results already presented in [1],[2],[3], and provide details on the solution approach. Finally, some computational results for a range of instances with eight and ten nodes for two and three periods are given. They provide a comparison of the classical MPND problem and the MPNDI problem in terms of overall costs and CPU time."

Nuru Yakub Othman (Concordia University, Canada); Roch Glitho (Ericsson Canada Canada); Ferhat Khendek (Concordia University, Canada);

"It is foreseen that several Wireless Sensor Networks (WSNs) will be deployed in the very near future to provide various sensing services to end user applications. A wide range of novel end-user applications will emerge, in particular, WSN will play an important role in context aware applications and services, which adapt to situations of the surrounding environment and that of their host devices. In some application scenarios, the sink-less model is appropriate. In this model, the applications interact directly with the sensor nodes, without going through a gateway. However, the current sensor nodes use proprietary protocols and data access frameworks. This propriety will hinder the speed of evolution of applications. There is a need for a framework that is well known to application developers and is based on standard protocols. This paper presents an embedded Web Services platform residing on the sensor nodes, allowing direct interaction between applications and individual sensor nodes. The lessons learned indicate that web service platform on sensor node is feasible, despite the nodes' limited resources and the complexity of the framework."

Service Migration in Wireless Sensor Networks

Fabrício Silva (Federal University of Minas Gerais, Brazil); Thais Braga (Federal University of Minas Gerais, Brazil); José–Marcus Nogueira (Federal University of Minas Gerais, Brazil); Antonio Loureiro (Federal University of Minas Gerais, Brazil); Alyson Cardoso (Federal University of Minas Gerais, Brazil); Linnyer Ruiz (State University of Londrina, Brazil);

"There are many approaches that can be applied to the management of wireless sensor networks (WSN) and nowadays the research in this field is only beginning. A management approach determines how the management monitor and control functions are performed by the network and network elements. Since a wireless sensor network presents severe resource constraints, a certain management approach must be chosen properly in order to optimize resource usage and at the same time satisfy the application requirements. In this paper we try to answer the following question: what is the tradeoff between to migrate management services or to adopt traditional approaches for WSN management? We have concluded from simulated and experimental results that the choice of the best approach to be adopted must consider the size of the network, the configuration of the nodes, the application goals and the management complexity, in terms of managed objects. We have also noticed that, despite the service migration approach being theoretically interesting for WSN management, for the sensor networks and sensor nodes hardware current technological situation, the approach would be applied with some negative impact on the performance of the network."

Bootstrapping a very low power beacon enabled wireless sensor network

Nicola Altan (University of Duisburg – Essen, Germany); Erwin Rathgeb (University of Duisburg-Essen, Germany);

"Wireless sensor networks (WSN) consisting of a large number of tiny inexpensive sensor nodes are a viable solution for many problems in the field of building automation, especially if the expected lifetime of the network permits to synchronize the network maintenance with the schedule for routine maintenance of the building. A challenging and up to now only marginally addressed problem concerns the power-on phase and the automatic topology discovery and maintenance process of the sensor network. We suggest a simple heuristic algorithm, which permits the integration of all sensor nodes into a tree-like failure tolerant routing structure and also provides continuous adaptation of the structure to possible changes. We developed a simulation model to reproduce the problems of a realistic indoor placement of the nodes to test the proposed algorithm. Simulation results show that the suggested algorithm converges quickly to a structure with the desired properties even in the worst case."

A Cover-Up Scheme for Data-Centric Storage in Wireless Sensor Networks

Wen–Yua Liao (Tatung University, Taiwan); Wan–Chi Wu (Tatung University, Taiwan);

"In data-centric storage techniques, each event type is stored at a corresponding hashed location. But all of them fail to deal with storage memory space due to high percentage of the load is assigned to a relatively small portion of the sensor nodes. These nodes could become a hotspot, both for communication and storage. In this paper, we propose a cover-up scheme for data-centric storage. The main idea is to generate virtual coordinate for a sensor node whose storage status is full to cover up the original. A cover-up scheme uses GPSR routing algorithm to forward the packet to the sensor node closest to this location, where the event data can be stored. GPSR routing algorithm won’t find the same storage node. The scheme can spread storage into different sensor nodes. Simulations have shown that the cover-up scheme can reduce the energy consumption while there are a vast number of the events in sensor network or the network size is very large."

Performance evaluation of the IEEE 802.15.4A UWB physical layer for Body Area Networks

Jérôme Roussetel (CSEM, Switzerland); Amre El–Hoiydi (CSEM, Switzerland); Jean–Dominique Decotignie (CSEM, Switzerland);

"The IEEE 802.15.4 standard is gaining momentum in the field of wireless sensor networks. The IEEE 802.15.4A draft specification proposes an impulse radio Ultra Wide Band (IR-UWB) physical layer. This technology aims at being robust against multipath propagation and multi user interference, and at providing the added benefit of accurate ranging. In the context of body area networks, the impact of multi user interference must be evaluated precisely. This work evaluates the IEEE 802.15.4A draft specification and use this result to evaluate the performance of this technology in body area networks scenarios. We establish an upper bound on the packet error rate, a lower bound on the total aggregated throughput between two groups of nodes, and evaluate the maximal network density that meets the application throughput requirements."
A Performance Evaluation of a Hybrid Multicast Transport Protocol for a Distributed Collaborative Virtual Simulation of a Brain Tumor Tele–Surgery Class of Applications

Azzedine Boukerche (University of Ottawa, Canada); Haifa Mazmar (University of Ottawa, Canada); Abu Hossain (University of Ottawa, Canada):

"In recent years, we have witnessed a growing interest in synchronization based collaboration of class applications. Several techniques for Collaborative Virtual Environments (CVE), Haptic, Audio and Visual Environments C-HAVE were designed. However several challenging issues remain to be resolved before CVE and C-HAVE become a common place. In this paper, we focus upon applications that are based on closely coupled and highly synchronized haptic tasks that require a high- level of coordination among the participants. Four main protocols were designed to resolve the synchronization issues in such environments: the Synchronous Collaboration Transport Protocol (SCTP), the Selective Reliable Transmission Protocol (SRTP), the Reliable Multicast Transport Protocol (RMTP) and the Scalable Reliable Multicast (SRM). While these four protocols have shown good performance for CVE and C-HAVE class of applications, none of these protocols was able to meet all the of the basic CVE requirement i.e., scalability, reliability, synchronization and minimum delay. In this paper, we present a hybrid protocol that is able to satisfy all the CVE and C-HAVE requirements and discuss its implementation."

A Negotiation Framework for the Composition of Registries in Ambient Networks

Fatna Belqasmi (Concordia University, Canada); Roch Gilho (Ericsson Canada, Canada); Rachida Dssouli (Concordia University, Canada):

"Ambient Networks (AN) is a new networking concept for beyond 3G. Network composition is a core concept of AN. It provides dynamic cooperation between heterogeneous networks. Each ambient network can host several registries. When the networks compose, the registries also have to cooperate. This composition is based on a composition agreement that must be negotiated between the different parties involved. This paper presents a framework for dynamic negotiation of an agreement for the composition of registries. It presents the framework principles and a template for the composition agreement proposals, and describes the main steps of the negotiation. It also describes the negotiation protocol (i.e., entities, messages and state diagrams). We have validated our protocol using SPIN, a software tool for simulating and validating distributed systems behavior. The process and the results are discussed."

Reliable Communication in the Presence of Agent Mobility

Hervé Paulino (Universidade Nova de Lisboa, Portugal):

"Although mainly resorting to local communication, all mobile agent systems also provide some kind of remote communication facility. This introduces issues not addressed in the protocols provided by the transport layer, such as TCP, nor in its extensions to cope with physical mobility. The problem consists of tracking the agent to which the channel must be established, and providing support for the migration of any of the channel’s endpoints. In this paper, we propose a model that solves both problems, transparently to the application, by resorting to sophisticated interaction with a naming service and by featuring a protocol to support the migration of both the connection’s endpoints."

Transparent Risk–free Synchronization in the High–Level–Architecture Interoperability Standard

Francesco Quaglia (University of Rome ”La Sapienza”, Italia); Andrea Santoro (University of Roma ”La Sapienza”, Italia):

"The High-Level-Architecture (HLA) is an IEEE standard for the interoperability and integration of (autonomous) simulation packages and applications (termed federates in the HLA context). It is based on a middleware level component referred to as Run-Time-Infrastructure (RTI) offering a set of interoperability services to the overlying simulation software. Time-Management is the suite of services allowing synchronized execution among the federates, which, according to the HLA specification, covers pure conservative and pure optimistic synchronization schemes. In this paper we provide the design and implementation of a software layer, we refer to as Risk-Free-Speculator (RFS), which supports an optimistic oriented intermediate approach to synchronization embedding the aggressiveness property of optimistic systems (hence simulation events can be speculatively executed without preventive assurance of their safety), but discarding risk (hence no message is ever sent out towards remote federates unless it is a committed message). This is done in a totally transparent manner to the overlying applications, and does not even require any modification of the underlying RTI. Also, RFS can provide advantages in applicable scenarios where the RTI publish/subscribe services might get overwhelmed by large volumes of messages eventually retracted due to rollback of some federates (e.g. simulations with large pub/sub groups). While intermediate synchronization approaches have been widely investigated in the context of traditional Parallel Discrete Event Simulation (PDES), this is the first attempt towards such an intermediate synchronization scheme in the context of the HLA standard. The effectiveness of RFS has been tested against simulated demonstration exercises using the Joint Semi-Automated Forces (JSAF) simulation program."

Modeling of Latency and Saturation Phenomena in Interconnection Networks

Yelena Rykalova (Boston University, United States of America); Lev Levitin (Boston University, United States of America); Richard Brower (Boston University, United States of America):

"A multiprocessor network modeled as a ring and as a 2-dimensional toroidal lattice of nodes are considered. Each node generates messages with probability 1 per clock cycle per output port. Once an output buffer is not empty, the output port sends out exactly one message every clock cycle. We derive analytical expressions for the queue length distribution, the average number of messages in buffers, and the latency. The network experiences a phase transition from equilibrium to the saturation regime, and the critical exponent is equal to 1. Simulations demonstrate an excellent agreement with theoretical predictions and validate the assumption of independent queues. A model of a ring network where the message generating rate depends on the intensity of the incoming messages is studied by simulation. The results show the emergence of dependences between queues in closely located nodes, and changes in the values of the critical load and critical exponent."

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**Session: Data Mining & Knowledge Base Apps**

Wednesday, July 4: 14:15 - 16:00

Room: S. Pedro III

Chairperson: Anup Kumar (University Of Louisville, United States of America)
Seminar Mapping between RDBMS and Domain Ontology

Ki Jung Lee (Kyungwon University, Republic of Korea); Taeg Keun Whangbo (Kyungwon University, Republic of Korea);

"In general, although most data existing in the WWW are modeled as some type of relational database, characteristically even information in the same domain is often structured in different ways depending on the individual manager. In order to materialize a semantic web, a method to efficiently map these different kinds of data is needed. This paper presents an algorithm for the matching between a relational database and domain ontology. Existing studies on the matching between a relational database and domain ontology were performed by extracting local ontology from a relational database. However, the problem of losing domain information remains as a correlation with domain ontology is not used in the process of extracting local ontology. As a solution to this problem, we attempted to prevent the information loss through the measurement of similarity between the instances of the relational database and domain ontology, and increased the efficiency of the matching process by using information on the relation between tables in the relational database and also the relation between classes in ontology."

GP-Growth: A New Algorithm for Mining Frequent Embedded Subtrees

Marwa Hussein (Ain Shams University, Cairo, Egypt); Tayyor Soliman (Ain Shams University, Cairo, Egypt); Omar Karam (Ain Shams University, Cairo, Egypt);

"Frequent tree mining has great uses in many domains employing tree structures, e.g. bioinformatics, text and web mining. Many challenges were tackled to adapt frequent pattern mining techniques, to fit into the tree structure. Previous studies proved that Pattern Growth methods are more efficient than candidate generation methods using join functions. In the current work, an efficient pattern growth algorithm, Guided-Pattern Growth, GP-Growth, is introduced for discovering frequent embedded subtrees from a collection of labeled, rooted, and ordered trees. GP-Growth is based on frequent pattern growth methodology that uses the input trees model as a guide to generate candidates. All frequent subtrees are efficiently discovered without duplication or generation of invalid candidates. GP-Growth is compared to the TreeMiner algorithm — a tree mining algorithm that uses join function. Experiments show that GP-Growth can find all frequent subtrees while generating fewer candidates. GP-Growth outperforms TreeMiner by an average order of magnitude 2."

Dealing with Subjective Uncertainty in Knowledge Based Systems

Fabio Campos (Universidade Federal de Pernambuco, Brazil); Andre Neves (Universidade Federal de Pernambuco, Brazil); Edvar Vilar Neto (Universidade Federal de Pernambuco, Brazil);

"Knowledge based systems depend on algorithms able to relate the inputs of a system to a correct answer coming out of the knowledge-base. Practical systems shows that imperfect information will always get into the data-base and an imperfect knowledge-base will always exist, thus it is usual for a knowledge based system to have to be able to model and deal with information imperfections. The kind of information imperfections involved in knowledge-base systems can be modeled by the "subjective uncertainty", which with the "objective uncertainty" compose the dual nature of the uncertainty, a taxonomy first defined by Belton. One of the formal models that deals with subjective uncertainty is the Mathematical Theory of Evidence, or Dempster-Shafer Theory. This theory provides a method for combining evidence from different sources without prior knowledge of their distributions, however, it has some pitfalls caused by the non-natural embodiment of the uncertainty in the results. In this paper we analyze the counter-intuitive behavior of the theory, identify the sources of the subjective uncertainty, and present a method of automatic embodiment of the uncertainty which overcomes the pitfalls, allowing its use in a broad range of situations."

Modeling and Simulation of Low Speed Wind over the Great Sphinx

Ashraf Hussein (Ain Shams University, Cairo, Egypt); Hisham ElShishiny (IBM Cairo Center for Advanced Studies, Egypt);

"Great Sphinx is the first truly colossal royal sculpture in Egypt. The statue was built 4,500 years ago to the northeast of Chephren's Valley Temple southwestern of Cairo. Nowadays, the statue is crumbling because of the wind, humidity and the smog from Cairo. Wind is one of the most critical denudation factors that cause erosion of the statue specially when transporting dust as a two phase flow. In this paper, the low speed wind over the Great Sphinx is simulated in order to investigate the effects of the wind flow structure on the surface of the statue. The three-dimensional incompressible Navier-Stokes equations are solved based on Chorin-type projection method and using finite difference approximations. The computational mesh of such large scale simulation problems contains several millions of points, therefore the MPR-based parallel solution of Navier-Stokes equations is addressed on distributed-memory parallel architecture. The distributed solution methodology of Navier-Stokes equations is optimized to get the best accuracy and performance. This optimized methodology is used to simulate the low speed eastern and northeastern wind over the Great Sphinx at Reynolds number of 1000. The wind flow structure over the statue is visualized and intensively studied."

mArachna – Ontology Engineering for Mathematical Natural Language Texts

Sabina Jeschke (Technische Universitaet Berlin, Germany); Nicole Natho (Technische Universitaet Berlin, Germany); Sebastian Rittau (Technische Universitaet Berlin, Germany); Marc Wilke (Technische Universitaet Berlin, Germany);

"The knowledge contained in the growing number of scientific digital publications, particularly over the internet, creates new demands for intelligent retrieval mechanisms. One basic approach in support of such retrieval mechanisms is the generation of semantic annotation, based on ontologies describing both the field and the structure of the texts themselves. Many current approaches use statistical methods similar to the ones employed by Google to find correlations within the texts. This approach neglects the additional information provided in the upper ontology used by the author. mArachna, however, is based on natural language processing techniques, taking advantage of characteristic linguistic structures defined by the language used in mathematical texts. It stores the extracted knowledge in a knowledge base, creating a low-level ontology of mathematics and mapping this ontology onto the structure of the knowledge base. The following article gives an overview over the concepts and technical implementation of the mArachna prototype."
An adaptive ARQ protocol for IEEE 802.16e

Giovanni Ciccarese (University of Lecce, Italy); Mario De Blasi (University of Lecce, Italy); Pierluigi Marra (University of Lecce, Italy); Cosimo Palazzo (University of Lecce, Italy); Luigi Patrono (University of Lecce, Italy);

"In this paper, a frame size control algorithm, fully compliant with the IEEE 802.16e standard, has been proposed. This algorithm aims to optimize the performance of a data link ARQ protocol, trying to evaluate dynamically the frame size that maximizes the mean advancement of the sender window. It offers the possibility to maximize system throughput in every mobile scenario, even in presence of wireless time-variant channels. The effectiveness of the defined algorithm has been evaluated, through computer simulation, in terms of normalized TCP Goodput. Simulation results have shown that the dynamic choice of the frame size plays a relevant role in maximizing TCP performance. Keywords: IEEE 802.16e, Adaptive ARQ Protocol, Frame Size Control, TCP Performance."

An Effective Path Selection Metric for IEEE 802.16–based Multi–hop Relay Network

Sheng-Shih Wang (Chihlee Institute of Technology, Taiwan); Hua-Chiang Yin (Tamkang University, Taiwan); Yi-Hsueh Tsai (Institute of Information Industry, Taiwan); Shiang-Tsong Sheu (National Central University, Taiwan);

"Communication technology of Broadband Wireless Access (BWA) systems designed for wireless metropolitan area networks (WMANs) has become matured in recent years. For usage of models of coverage extension and throughput enhancement, a novel framework, called Multi–hop Relay (MR) network, proposed by the study group under the IEEE 802.16 WG. In general, an MR network consists of various kinds of stations, including the base station (MR–BS), the relay station (RS), and the mobile station (MS). With the help of RRs, data transmissions between MR–BS and MS become more reliable and effective. In the paper, we propose a new measurement, called the effective radio resource index (ERRI), to indicate the effectiveness of radio resource of a link used to transmit data. The EIRI of a link is normalized and compared to the metric defined as the bandwidth unit required for transmitting a fixed amount of data using 64-QAM CC. 5/6 with repetition 1. Additionally, a cost function of a relay path between MR–BS and MS is also proposed to efficiently facilitate the evaluation of path selection schemes for MR networks. Simulation results show that the relay path selection scheme with ERRI considerations is indeed effective in terms of network throughput."

On Traffic Flow Diversity over IEEE 802.11 Wireless Links

Changchun Xu (Huazhong University of Science and Technology, People’s Republic of China); Zhongkai Yang (Huazhong University of Science and Technology, People’s Republic of China); Wenqing Xu (Huazhong University of Science and Technology, People’s Republic of China);

"IEEE 802.11 DCF has been extensively studied in saturation conditions. Recently, remarkable attention have been attracted for modeling and performance analysis of IEEE 802.11 wireless links in unsaturated conditions because in practical cases the 802.11 wireless networks are unsaturated. This paper develops a quite simple yet very accurate mathematical model for performance analysis of 802.11 WLAN with traffic flow diversity (i.e., packet size and arrival rate diversity). The results show that 802.11 WLAN can achieve very low packet delay and maximum throughput in not saturated conditions. Furthermore, when the normalized total load is less than the optimal value, the throughput of each station is approximately equal to its load and the packet delay is much lower than that in saturated cases despite the packet size and arrival rate diversity. The simulation results show that the analytical model is highly accurate."

Session: Network and System Performance

Wednesday, July 4; 16:30 - 17:30
Room: S. Pedro I
Chairperson: António Nogueira (University of Aveiro, Portugal)

Cross–Access Capacity and Performance in B3G Systems

Pablo Vidales (Deustche Telekom Laboratories, Germany); Jose Ignacio Moreno (Universidad Carlos III de Madrid, Spain); Antonio Cuevas (Deustche Telekom Laboratories, Germany);

"The deployment of next generation networks (NGN) is a high priority for telecommunication operators. Future access networks will be based on a multi-access architecture, in which many independent radio access technologies will collaborate to offer a unified access platform for mobile users. In this scenario, it will be fundamental to control the interactions among the different systems (i.e. networks) in the best possible way. Therefore, it is urgent to develop tools that can assist network engineers in this complex task. This paper presents xCAT (Cross-access Capacity Analysis Tool), a tool that helps in the design and planning of next generation wireless networks. We also include results from a performed analysis focused on two typical situations in future wireless composite access networks: (1) inter-technology user reallocation and (2) network collocation. The experiments assess the impact of these interactions on the overall performance of NGN systems."

Performance of scheduling policies in adversarial networks with non synchronized clocks

Juan Céspedes (Universidad Rey Juan Carlos, Spain); Antonio Fernandez (Universidad Rey Juan Carlos, Spain); José Luis López-Presa (Universidad Politecnica de Madrid, Spain); Araceli Lorenzo (Universidad Politecnica de Madrid, Spain); Pilar Manzano (Universidad Politecnica de Madrid, Spain); Juan Martinez-Romo (Universidad Rey Juan Carlos, Spain); Alberto Mozo (Universidad Politecnica de Madrid, Spain); Anna Puig-Centelles (Universitat Jaume I, Spain); Agustin Santos (Universidad Rey Juan Carlos, Spain); Christopher Thraves (Universidad Rey Juan Carlos, Spain);

"In this paper we generalize the Continuous Adversarial Queuing Theory (CAQT) model by considering the possibility that the router clocks in the network are not synchronized. We name this new model Non Synchronized CAQT (NSCAQT). Clearly, this new extension to the model only affects those scheduling policies that use some form of timing. In first approach we consider the case in which although not synchronized, all clocks run at the same speed, maintaining constant differences. In this case we show that all universally stable policies in CAQT that use the injection time and the remaining path to schedule packets remain universally stable. These policies include, for instance, Shortest in System (SS) and Longest in System (ILS). Then, we study the case in which clock differences can vary over time, but the maximum difference is bounded. In this model we show the universal stability of SS and a family of policies related to LFS (the priority of a packet in these policies depends on the arrival time and a function of the length of the path traversed). The bounds we obtain in this case depend on the maximum difference between clocks. We then present a new policy that we call Longest in Queues (LQ), which gives priority to the packet that has been waiting the longest in edge queues. This policy is universally stable and, if clocks maintain constant differences, the bounds we prove do not depend on them. To finish, we provide with simulation results that compare the behavior of some of these protocols in a network with stochastic injection of packets."

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MCP: Few Bits for Fairing and Small Queues in the Stable State

Maxim Podolsky (Washington University in St. Louis, United States of America); Sergey Gorinsky (Washington University in St. Louis, United States of America);

"Interactive and other delay-sensitive applications are interested in keeping end-to-end delays of their packets minimal. Unfortunately, congestion control offered by Transmission Control Protocol (TCP) and other existing protocols inflates the end-to-end delays by building up queues at bottleneck links. In this paper, we investigate Multimodal Control Protocol (MCP) designed to maintain low queues after converging to the stable state where MCP flows utilize shared bottleneck links efficiently and fairly. To achieve this goal, MCP incorporates multiple modes of operation and allocates few bits in each packet header for explicit communication between hosts and routers. An innovative aspect of the explicit communication mechanism is an ability of a flow to urge all flows on its bottleneck links to switch temporarily into a fairing mode and thereby improve fairness of the bottleneck sharing. To make the fair sharing independent of round-trip times and packet sizes, MCP uses the sending bitrate as a control parameter and employs uniform adjustment timing for all flows. Our extensive evaluation of MCP demonstrates its efficient fair operation and significantly shorter stable-state queues than under existing congestion control protocols."

Session: P2P II

Wednesday, July 4; 16:30 - 17:30
Room: S. Pedro II
Chairperson: Paulo Salvador (University of Aveiro, Portugal)

Extending the VoDKA Architecture with P2P Aggregated Content Management

Carlos Abalde (University of A Coruña, Spain); Victor Gullias (University of A Coruña, Spain); Laura Castro (University of A Coruña, Spain);

"This paper presents our results building a decentralized and structured P2P video content distribution network, developed as an extension of an existing on-demand streaming server. It has been designed to improve streaming server capacity, without any infrastructure upgrade, when it must deal with big LAN-networks and highly-correlated server access patterns. A coordination algorithm build on top of a distributed hash table is presented, and its integration inside the streaming server architecture is explained. Experimental results show that the design is an appropriate approach for video content distribution with interesting scalability and availability properties."

Hybrid Overlay Structure Based on Virtual Node

Ruichuan Chen (School of Electronics Engineering and Computer Science, Peking University, People’s Republic of China); Wenjia Guo (School of Electronics Engineering and Computer Science, Peking University, People’s Republic of China); Liyong Tang (School of Electronics Engineering and Computer Science, Peking University, People’s Republic of China); Jianbin Hu (School of Electronics Engineering and Computer Science, Peking University, People’s Republic of China); Zhong Chen (School of Electronics Engineering and Computer Science, Peking University, People’s Republic of China);

"Current peer-to-peer architectures generally can be grouped into three categories: centralized architectures that utilize central directory servers to process queries, decentralized structured architectures that accurately build an underlying topology to support distributed hash table efficiently, and decentralized unstructured architectures that impose no structure on the topology and typically propagate queries to neighbors for searching. Aiming at integrating the flexibility of unstructured architectures with the regularity of structured architectures, we propose a hybrid overlay structure based on virtual node. Especially, the hybrid architecture utilizes virtual nodes to build a distributed ring with random links. We can use the distributed ring to perform short jumps, and apply random links to long jumps. With our hybrid design, keyword searching, even multi-keyword searching, can be performed efficiently, both popular and rare keywords can be quickly located. Furthermore, our architecture is robust to the change of system scale, and it can work well with low maintenance cost in the dynamic environment."

Embeddable Overlay Networks

Eng Keong Lua (NTT Service Integration Laboratories, Tokyo, Japan); Timothy Griffin (University of Cambridge, United Kingdom);

"Internet Round-Trip-Times (RTTs) exhibit widespread and persistent Triangle Inequality Violations (TIVs). It has been shown that TIVs are a natural consequence of the Internet’s routing structure and they degrade the embedding accuracy of any Internet coordinate systems based on RTTs. In this paper, we simulate a coordinate system in a hypothetical overlay environment where RTTs are measured with respect to overlay forwarding that has eliminated all the TIVs. The resulting coordinate system is much more accurate and the embedding accuracy is predictable and stable (under simulated node churn) than the existing techniques based on RTTs along paths chosen by native IP forwarding. We believe that this work helps to illustrate the detrimental effects of TIVs on Internet coordinate systems, and it suggests that high quality coordinate systems in the global Internet may be possible only with overlay forwarding."

Session: Pattern Recognition and Classification

Wednesday, July 4; 16:30 - 17:30
Room: S. Pedro III
Chairperson: Armando Pinho (University of Aveiro, Portugal)

SQS: Similarity Query Scheme for Peer-to-Peer Databases
Similarity search is a hot research topic on peer-to-peer systems. In this paper we present SQS, a similarity query scheme for peer-to-peer databases. In this work we provide a novel linearization mechanism that enables structured queries without the burden of a global information maintenance scheme. The system offers exact match and range searches to multidimensional data. SQS employs Cyclone, a hierarchical overlay that is able to build disjoint clusters in terms of network latency and enables data search load balancing by caching per cluster scheme. Finally, we show the good properties of SQS through representative simulation results.

Self Organizing Maps for Distributed Localization in Wireless Sensor Networks

Luca Paladina (University of Messina, Italia); Maurizio Paone (University of Messina, Italia); Giuseppe Iel Jaime (University of Messina, Italia); Antonio Puliafito (University of Messina, Italia);

“Providing an efficient localization system is one of the most important goals to be pursued if an efficient utilization of sensor networks has to be addressed. This paper proposes a novel localization system based on Kohonen’s Self Organizing Maps (SOMs), able to provide some Artificial Intelligence features to sensor nodes. A SOM is a particular neural network that learns to classify data without any supervision. In each sensor node, a SOM is implemented to evaluate the sensor node position, using a very little amount of storage and computing resources. In a scenario where thousands of sensor nodes are placed, this system evaluates the position of each sensor in a distributed manner, assuming a very little percentage of nodes knowing their actual position.

Succinct Representation Of Static Packet Classifiers

Wencheng Lu (University of Florida, United States of America); Sartaj Sahni (University of Florida, United States of America);

“We develop algorithms for the compact representation of the 2-dimensional tries that are used for Internet packet classification. Our compact representations are experimentally compared with competing compact representations for multi-dimensional packet classifiers and found to simultaneously reduce the number of memory accesses required for a lookup as well as the memory required to store the classifier.”