UNIVERSITY OF CAMBRIDGE

Computer Laboratory NetOS publications

Contents

2005 Publications

- **Packet error rate and bit error rate non-deterministic relationship in optical network applications**
  Laura James, Andrew Moore, Adrian Wonfor, Richard Plumb, Ian White, Richard Penty, Madeleine Glick and Derek McAuley
  in the Proceedings of the IEEE/OSA Optical Fibre Conference 2005, Anaheim, CA
  (to appear)

2004 Publications

- **PDB: Pervasive Debugging With Xen**
  Alex Ho, Steve Hand, and Tim Harris
  in the Proceedings of the 5th IEEE/ACM International Workshop on Grid Computing (Grid 2004), November 2004, Pittsburgh, PA
  (to appear)

- **Safe Hardware Access with the Xen Virtual Machine Monitor**
  Keir Fraser, Steve Hand, Rolf Neugebauer, Ian Pratt, Andrew Warfield and Mark Williams
  to appear in the Proceedings of the 1st Workshop on Operating System and Architectural Support for the on demand IT InfraStructure (OASIS), October 2004, Boston, MA
  [PDF]

- **Beyond Gigabit Ethernet: Physical Layer Issues in Future Optical Networks**
  Laura James, Andrew Moore, Richard Plumb, Madeleine Glick, Adrian Wonfor, Ian White, Derek McAuley and Richard Penty

London Communications Symposium September 2004
[PDF]

- **Reconstructing I/O**
  Keir Fraser, Steve Hand, Rolf Neugebauer, Ian Pratt, Andrew Warfield and Mark Williams
  Technical Report UCAM-CL-TR-596, August 2004
  [PDF]

- **An Implementation-Based Comparison of Measurement-Based Admission Control Algorithms**
  Andrew W. Moore
  Journal of High Speed Networks, 13(2), 2004, pp87-102, IOS Press,
  [PDF]

- **Multiprogramming Performance of the Pentium 4 with Hyper-Threading**
  James Bulpin and Ian Pratt
  The Third Annual Workshop on Duplicating, Deconstruction and Debunking, June 2004.
  [PDF]

- **Feedback, Latency, Accuracy: Exploring Tradeoffs in Location-Aware Gaming**
  Kieran Mansley, David Scott, Alastair Tse, Anil Madhavapeddy
  Proceedings of the ACM SIGCOMM 2004 Workshop on NetGames
  [PDF]

- **Exceptions and side-effects in atomic blocks**
  Tim Harris
  Workshop on Concurrency and Synchronization in Java Programs.
  [PDF]

- **PROTON: A Policy-based Mobile Client System for the Fourth Generation (4G) Mobile Environments**
  Pablo Vidales, Rajiv Chakravorty and Calicrates Policroniades
  Proceedings of the POLICY 2004: IEEE Fifth International Workshop on Policies for Distributed Systems and Networks, June 2004.

- **Alternatives for Detecting Redundancy in Storage Systems Data**
  Calicrates Policroniades and Ian Pratt
  Proceedings of the USENIX 2004 Annual Technical Conference, June 2004.

- **MAR: A Commuter Router Infrastructure for the Mobile Internet**
  Pablo Rodriguez, Rajiv Chakravorty, Julian Chesterfield, Ian Pratt, Suman Banerjee
  Proceedings of the ACM Second Mobile Systems, Applications and Services Conference (ACM Mobisys 2004), June 2004.

- **Pinocchio: Incentives for honest participation in distributed trust management**
  Alberto Fernandes, Evangelos Kotsovinos, Sven Ostring and Boris Dragovic
  Proceedings of the 2nd International Conference on Trust Management (iTrust 2004), March 2004, Oxford. Also to be published in Springer-Verlag Lecture Notes in Computer Science (LNCS)

- **Offering broadband services via the telephone system in a volatile economic env\ ironment.**
  Alberto Fernandes

Proceedings CSNDSP 2004 (International Symposium on Communi\ cations Systems, Networks and Digital Signal Processing)
[PDF]

- **Structured Errors in Optical Gigabit Ethernet Packets**
  Laura James, Andrew Moore, and Madeleine Glick
  Proceedings of Fifth Passive and Active Measurement Workshop (PAM 2004), April 2004
  [PDF]

- **Measurement Approaches to Evaluate Performance Optimizations over Wide-Area Wireless Networks**
  Rajiv Chakravorty, Julian Chesterfield, Pablo Rodriguez, Suman Banerjee
  Proceedings of Fifth Passive and Active Measurement Workshop (PAM 2004), April 2004

- **Optimizations for Streaming Media over Wide-area Wireless Networks**
  Julian Chesterfield, Rajiv Chakravorty, Pablo Rodriguez, Suman Banerjee, Ian Pratt and Jon Crowcroft
  Proceedings of WiOpt'04: Modeling and Optimization in Mobile, Ad Hoc and Wireless Networks, March 2004

- **Performance Issues with Vertical Handovers - Experiences from GPRS Cellular and WLAN hot-spots Integration**
  Rajiv Chakravorty, Pablo Vidales, Kavitha Subramanian, Ian Pratt, Jon Crowcroft
  Proceedings of the IEEE Second Pervasive Communications and Computing Conference (IEEE PerCom 2004), March 2004
  [PDF]

2003 Publications

- **Honeycomb — Creating Intrusion Detection Signature using Honeypots**
  Christian Kreibich, Jon Crowcroft
  In the Proceedings of the 2nd Workshop on Hot Topics in Networks (HotNets-II), November 2003
  [PDF]

- **An implementation of a Coordinate based Location System**
  David Spence
  Technical Report UCAM-CL-TR-576, November 2003
  [PDF]

- **Xen and the Art of Virtualization**
  Paul Barham, Boris Dragovic, Keir Fraser, Steven Hand, Tim Harris, Alex Ho, Rolf Neugebar, Ian Pratt and Andrew Warfield
  In the Proceedings of the ACM Symposium on Operating Systems Principles (SOSP), October 2003
  [PDF]

- **Practical Experiences with Wireless Networks Integration using Mobile IPv6**

Rajiv Chakravorty, Pablo Vidales, Kavitha Subramanian, Ian Pratt and Jon Crowcroft
in ACM MOBICOM 2003 (poster). (Amongst top 8 abstracts to feature in forthcoming issue of ACM Mobile Computing and Communications Review (MC2R)).
[PDF]

- **Ubiquitous Networking in Heterogeneous Environments**
  Pablo Vidales, Leo Patanapongpibul, Rajiv Chakravorty
  in Proceedings of the 8th IEEE Mobile Multimedia Communications (MoMuC 2003), October 2003.
  [PDF]

- **A framework for dynamic SLA-based QoS Control for UMTS**
  Rajiv Chakravorty, Maurizio D'Arienzo, Ian Pratt and Jon Crowcroft
  in IEEE Wireless Communications, Special Issue on Merging IP and Wireless Networks, Vol. 10, No. 5, October 2003.
  [PDF]

- **Role-Based Resource Management**
  Evangelos Kotsovinos and Tim Harris
  In Proceedings of the 8th CaberNet Radicals Workshop, Corsica, France, October 2003
  [PDF]

- **Reducing \ the Guard Interval Loss via Recursive Singular Value Decomposition**
  Alberto Fernandes
  In the Proceedings of the Eigth International OFDM Workshop, Hamburg.
  [PDF]

- **Context-Aware Computing with Sound**
  Anil Madhavapeddy, David Scott, and Richard Sharp
  In the Proceedings of the Fifth International Conference on Ubiquitous Computing (UBICOMP-2003), October 2003.
  [PDF]

- **Ubiquity in Diversity - A Network-Centric Approach (poster)**
  Rajiv Chakravorty, Pablo Vidales, Boris Dragovic, Calicrates Policroniades, and Leo Patanapongpibul.
  In the Adjunct Proceedings of the Fifth International Conference on Ubiquitous Computing (UBICOMP-2003), October 2003.
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- **Language support for lightweight transactions**
  Tim Harris and Keir Fraser
  Proceedings of the 18th ACM SIGPLAN Conference on Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA-2003), October 2003.
  [PDF]

- **A Data Repository for Fine-Grained Adaptation in Heterogeneous Environments**
  Calicrates Policroniades, Rajiv Chakravorty, Pablo Vidales
  Proceedings of the 3rd ACM Workshop on Data Engineering for Wireless and Mobile Access (ACM MobiDE'2003), September 2003
  (with ACM MobiCom 2003).
  [PS]

- **Design choices for language-based transactions**
  Tim Harris
  Technical Report UCAM-CL-TR-572, August 2003
  [PDF]

- **XenoTrust: Event-based distributed trust management**
  Boris Dragovic, Evangelos Kotsovinos, Steven Hand and Peter Pietzuch
  In the Proceedings of the Second IEEE International Workshop on Trust and Privacy in Digital Business (DEXA-TrustBus'03), September 2003.
  [PDF]

- **The XenoServer Open Platform: Deploying global-scale services for fun and profit** (poster)
  Evangelos Kotsovinos and David Spence
  In the Proceedings of ACM SIGCOMM 2003, August 2003.

- **Honeycomb: Automated NIDS Signature Creation using Honeypots** (poster)
  Christian Kreibich, Jon Crowcroft
  In the Proceedings of ACM SIGCOMM 2003, August 2003.
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- **Plutarch: An Argument for Network Pluralism**
  Jon Crowcroft, Steven Hand, Richard Mortier, Timothy Roscoe and Andrew Warfield
  In the Proceedings of ACM SIGCOMM Workshops, August 2003.
  [PDF]

- **QoS's Downfall: At the bottom, or not at all!**
  Jon Crowcroft, Steven Hand, Richard Mortier, Timothy Roscoe and Andrew Warfield
  In the Proceedings of ACM SIGCOMM Workshops, August 2003.
  [PDF]

- **The Case for Abstracting Security Policies**
  Anil Madhavapeddy, Alan Mycroft, David Scott and Richard Sharp
  In the Proceedings of the 2003 International Conference on Security and Management (SAM-03), June 2003.
  [PDF]

- **Network QoS for GRID Systems**
  S Bhatti, S Sorensen, P Clark and J Crowcroft
  International Journal of High Performance Computing Applications Vol 17, No. 3, published by Sage Publications

- **Operating System I/O Speculation: How Two Invocations are Faster than One**
  Keir Fraser and Fay Chang
  Proceedings of the USENIX Annual Technical Conference, June 2003

- **XenoSearch: Distributed Resource Discovery in the XenoServer Open Platform**
  David Spence and Tim Harris
  Proceedings of the Twelfth IEEE International Symposium on High Performance Distributed Computing (HPDC-12), June 2003
  [PDF]

- **Dynamic SLA-based QoS Control for Third Generation Wireless Networks: The CADENUS Extension**
  Rajiv Chakravorty, Maurizio D'Arienzo, Ian Pratt and Jon Crowcroft
  Proceedings of Thirty Eighth IEEE International Conference on Communications (ICC 2003), May 2003
  [PS]

- **Managing Trust and Reputation in the XenoServer Open Platform**
  Boris Dragovic, Steven Hand, Tim Harris, Evangelos Kotsovinos and Andrew Twigg
  Proceedings of the First International Conference on Trust Management, May 2003
  [PDF] also published as part of Volume 2692 of Lecture Notes in Computer Science

- **Palimpsest: Soft-Capacity Storage for Planetary-Scale Services**
  Timothy Roscoe and Steven Hand
  Proceedings of the Ninth Workshop on Hot Topics in Operating Systems (HotOS-IX), May 2003
  [PDF]

- **GPRSWeb: Optimizing the Web for GPRS Links**
  Rajiv Chakravorty, Andrew Clark and Ian Pratt
  Proceedings of the ACM First Mobile Systems, Applications, and Services Conference (ACM Mobisys 2003), May 2003
  [PS], [HTML]

- **An Extensible RTCP Control Framework for Large Multimedia Distributions**
  Julian Chesterfield and Eve Schooler
  Proceedings of the 2nd IEEE International Symposium on Network Computing and Applications (NCA '03), April 2003,
  [PS], [PDF]

- **The Effect of Early Packet Loss on Web Page Download Times**
  James Hall, Ian Pratt, Ian Leslie and Andrew Moore
  Proceedings of the Fourth Passive and Active Measurement Workshop (PAM 2003), April 2003
  [PDF]

- **Architecture of a Network Monitor**
  Andrew Moore, James Hall, Euan Harris, Christian Kreibech and Ian Pratt
  Proceedings of the Fourth Passive and Active Measurement Workshop (PAM 2003), April 2003
  [PDF]

- **Controlling the XenoServer Open Platform**
  Steven Hand, Tim Harris, Evangelos Kotsovinos and Ian Pratt
  Proceedings of the Sixth IEEE Conference on Open Architectures and Network Programming (OPENARCH 2003), April 2003
  [PDF]

- **Flow Aggregation for Enhanced TCP over Wide Area Wireless**
  Rajiv Chakravorty, Sachin Katti, Jon Crowcroft and Ian Pratt
  Proceedings of the Twenty Second IEEE Conference on Computer and Communications (IEEE INFOCOM 2003), April 2003
  [PS]

- **Modelling incentives for collaboration in Mobile Ad Hoc Networks**
  Jon Crowcroft, Richard Gibbens, Frank Kelly and Sven Ostring
  Proceedings of WiOpt'03: Modeling and Optimization in Mobile, Ad Hoc and Wireless Networks, March 2003,
  [PDF]

- **Optimizing the Web for Wide Area Wireless: Design, Implementation and some Real Experiences**
  Rajiv Chakravorty
  Invited Workshop Talk on (recommendations for) Internet Usage over 2.5G, 3G and WLANs (WIU253), March 2003, Barcelona, Spain. Also appears in the Workshop Proceedings.
  [PPT]

- **Lighthouses for Scalable Distributed Location**
  Marcelo Pias, Jon Crowcroft, Steve Wilbur, Tim Harris and Saleem Bhatti
  Proceedings of the 2nd International Workshop on Peer-to-Peer Systems (IPTPS '03), February 2003

- **The PGM Reliable Multicast Protocol**
  Jim Gemmel, Todd Montgomery, Tony Speakman, Nidhi Bhaskar and Jon Crowcroft
  IEEE Network Special Issue on Multicasting, January 2003
  [PDF]

- **Xen 2002**
  Paul R Barham, Boris Dragovic, Keir A Fraser, Steven M Hand, Timothy L Harris, Alex C Ho, Evangelos Kotsovinos, Anil V S Madhavapeddy, Rolf Neugebauer, Ian A Pratt and Andrew K Warfield
  Technical Report UCAM-CL-TR-553, January 2003
  [PDF]

- **The Xenoserver computing infrastructure**
  Keir A Fraser, Steven M Hand, Timothy L Harris, Ian M Leslie and Ian A Pratt
  Technical Report UCAM-CL-TR-552, January 2003
  [PDF]

2002 Publications

- **Performance Issues with General Packet Radio Service**
  Rajiv Chakravorty and Ian Pratt
  Journal of Communications and Networks (JCN), Special Issue on Evolving from 3G deployment to 4G definition, pages 266-281, Vol. 4, No. 2, December 2002 (ISSN 1229-2370)
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- **Isolation of Shared Network Resources in Xenoservers**
  Andrew Warfield, Steven Hand, Timothy Harris and Ian Pratt
  PlanetLab Design Note PDN-02-006, November 2002
  [PDF]

- **Predicate Routing: Enabling Controlled Networking**
  Timothy Roscoe, Steven Hand, Rebecca Isaacs, Richard Mortier and Paul Jardetzky

Proceedings of the First Workshop on Hot Topics in Networks (HotNets-I), October 2002
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- **Practical Experience with TCP over GPRS**
  Rajiv Chakravorty, Joel Cartwright and Ian Pratt
  Proceedings of IEEE GLOBECOM 2002
  [PDF]

- **A Practical Multi-Word Compare-and-Swap Operation**
  Timothy L Harris, Keir Fraser and Ian Pratt
  Proceedings of the 2002 IEEE Symposium on Distributed Computing
  [PS], [PDF] also published as part of Volume 2508 of Lecture Notes in Computer Science

- **Practical Experience with HTTP and TCP over GPRS**
  Rajiv Chakravorty and Ian Pratt
  poster and an extended abstract in e-Proceedings of ACM MOBICOM 2002, and also in forthcoming ACM Mobile Comunications and Computing Review (MC2R)
  Poster [PDF], Extended Abstract [PS]

- **WWW Performance over GPRS**
  Rajiv Chakravorty and Ian Pratt
  Proceedings of the IEEE International Conference on Mobile and Wireless Communication Networks (MWCN 2002)
  [PDF]

- **Engineering Mobile Proxy Design for Wide-Area Wireless**
  Rajiv Chakravorty and Ian Pratt
  Proceedings of the 7th CaberNet (European) Radicals Workshop
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- **Distributed resource discovery and management in the XenoServers Platform**
  Evangelos Kotsovinos and Tim Harris
  Proceedings of the 7th CaberNet (European) Radicals Workshop
  [PDF]

- **Proactive Multipath Routing**
  Jing Shen, Jiaoying Shi and Jon Crowcroft
  Proceedings of Quality of future Internet Services (QofIS) 2002
  [PDF]

- **InfoSpect: Using a Logic Language for System Health Monitoring in Distributed Systems**
  Timothy Roscoe, Richard Mortier, Paul Jardetzky and Steven Hand.
  Proceedings of the 2002 ACM SIGOPS European Workshop
  [gzipped postscript][postscript][PDF]

- **SBM: Enabling Remote Management Services for Dynamically Reconfigurable Devices**
  Rajiv Chakravorty and Hans Ottevanger
  Proceedings of the Networks 2002: IEEE International Conference on Wireless LANs and Home Networking (IEEE ICWLHN), 2002, pages 699-710 (book chapter 15), ISBN 981-238-127-9, World Scientific Inc. (ed. Benny Bing, Pascal Lorenz)
  [PS]

- **Architecture and Implementation of a Remote Management Framework for Dynamically Reconfigurable Devices**
  Rajiv Chakravorty and Hans Ottevanger
  Proceedings of the 10th IEEE International Conference on Networks (IEEE ICON), 2002, pages 375-381, ISBN 0-7803-7533-5
  [PDF]

- **Dependable computing needs pervasive debugging**
  Timothy L Harris
  Proceedings of the 2002 ACM SIGOPS European Workshop
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- **Spread Spectrum Storage with Mnemosyne**
  Steven Hand and Timothy Roscoe
  Proceedings of Future Directions in Distributed Computing (FuDiCo02)

- **Storage, Mutability and Naming in *Pasta***
  Tim D Moreton, Ian A Pratt and Timothy L Harris
  Proceedings of the International Workshop on Peer-to-Peer Computing at Networking 2002
  [gzipped postscript][postscript][PDF] also published as part of Volume 2376 of Lecture Notes in Computer Science

- **Transaction-based Charged in Mnemosyne: a Peer-to-Peer Steganographic Storage System**
  Timothy Roscoe and Steven Hand
  Proceedings of the International Workshop on Peer-to-Peer Computing at Networking 2002
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- **Channel Islands in a Reflective Ocean: Large Scale Event Distribution in Heterogeneous Networks**
  Jon Crowcroft
  Proceedings of the IFIP-TC6 Networks 2002 Conference
  [PDF]

- **Peer-to-Peer: Peering into the Future**
  Jon Crowcroft and Ian Pratt
  Proceedings of the IFIP-TC6 Networks 2002 Conference
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- **Resource Control in Network Elements**
  Austin Donnelly
  PhD dissertation, Computer Laboratory Technical Report 534
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- **Internet Traffic Engineering**
  Richard Mortier
  PhD dissertation, Computer Laboratory Technical Report 532
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- **Measurement-Based Management of Network Resources**
  Andrew William Moore
  PhD dissertation, Computer Laboratory Technical Report 528
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- **Mnemosyne: Peer-to-Peer Steganographic Storage**
  Steven Hand and Timothy Roscoe
  Proceedings of 1st International Workshop on Peer-to-Peer Systems
  [gzipped postscript][postscript][PDF]

2001 Publications

- **Non-Intrusive Estimation of Web Server Delays**
  James Hall, Ian Pratt and Ian Leslie
  IEEE LCN2001, November 2001
  [gzipped postscript 99.62 KB]

- **Observing Web Browser Behaviour Using the Nprobe Passive Monitoring Architecture**
  James Hall, Ian Pratt and Ian Leslie
  Cabernet 2001
  [pdf 32KB]

- **A Pragmatic Implementation of Non-Blocking Linked Lists**
  Timothy L Harris
  Proceedings of the 2001 IEEE Symposium on Distributed Computing
  [gzipped postscript][postscript][PDF] also published as part of Volume 2180 of Lecture Notes in Computer Science

- **Extensible Virtual Machines**
  Timothy L Harris
  PhD dissertation, Computer Laboratory Technical Report 525
  [PDF]

- **Elastic Network Control: An Alternative to Active Networks**
  Herbert Bos, Rebecca Isaacs, Richard Mortier, Ian Leslie
  Journal of Communications and Networks
  Note: This was due to appear in the March 2001 special issue on programmable switches and routers. Due to extensive delays on the part of the editors it will now appear in a later issue.
  [gzipped postscript 94.56 KB]

- **Support for Resource-Assured and Dynamic Virtual Private Networks**
  Rebecca Isaacs and Ian Leslie
  IEEE Journal on Selected Areas in Communications (JSAC) 19(3) March 2001
  [PDF]

- **Arsenic: A User-Accessible Gigabit Ethernet Interface**
  Ian Pratt and Keir Fraser
  Proceedings of the Twentieth Annual Joint Conference of the IEEE Computer and Communications Societies (INFOCOM), April 2001
  [postscript]

2000 Publications

- **Implicit Admission Control**
  Richard Mortier, Ian Pratt, Christopher Clark, Simon Crosby
  IEEE Journal on Selected Areas in Communications (JSAC) 18(12) December 2000

- **Dynamic Adaptive Pre-Tenuring**
  Timothy L Harris
  Proceedings of the 2000 ACM International Symposium on Memory Management
  [postscript]

- **Lightweight, Dynamic and Programmable Virtual Private Networks**
  Rebecca Isaacs
  IEEE OPENARCH, March 2000
  [gzipped postscript 63.92 KB] [PDF]

- **Open Extensible Network Control**
  Herbert Bos
  Journal of Network and Systems Management, 8(1), March 2000
  [gzipped postscript 102.35 KB]

1999 Publications

- **An experimental configuration for the evaluation of CAC algorithms**
  Andrew Moore and Simon Crosby
  Performance Evaluation Review, 27(3), pp43-54, December 1999
  [gzipped postscript]

- **INCA: Support for IN Using the Tempest**
  Rebecca Isaacs and Richard Mortier
  IEEE GLOBECOM, December 1999
  [gzipped postscript 61.10 KB] [PDF]

- **Elastic Network Control**
  Herbert Bos
  PhD dissertation, August 1999
  Technical Report No. 483
  [gzipped postscript 679.45 KB]

- **Application-Specific Policies: Beyond the Domain Boundaries**
  Herbert Bos
  IFIP Integrated Network Management VI, May 1999
  [gzipped postscript 82.70 KB]

- **An Economic Approach to Adaptive Resource Management**
  Neil Stratford and Richard Mortier
  IEEE Hot Topics in Operating Systems (HotOS) VII, March 1999
  [online][gzipped postscript 98.09 KB][postscript][PDF]
  Resource management is a fundamental concept in operating system design. In recent years it has become fashionable to consider the problem as an aspect of heterogeneous support for Quality of Service (`QoS'). Several authors have advocated the construction of an ``oracle''-like entity, with the effect of abstracting the fundamental problems into oblivion. In this paper

we propose a radically different approach that attempts to address the underlying issues in a uniform and fundamentally scalable manner.

- **Xenoservers: accountable execution of untrusted code**
  Dickon Reed, Ian Pratt, Paul Menage, Stephen Early, Neil Stratford
  IEEE Hot Topics in Operating Systems (HotOS) VII, March 1999
  [online][gzipped postscript 57.30 KB][postscript][PDF]
  Many networked applications could benefit from executing closer to the data or services with which they interact. By doing this they may be able to circumvent long communication latencies or avoid transferring data over congested or expensive network links. However, no public infrastructure currently exists that enables this. We propose a system that can execute code supplied by an untrusted user, yet can charge this user for all resources consumed by the computation. Such servers could be deployed at strategic locations throughout the Internet, enabling network users such as content providers to distribute components of their applications in a manner that is both efficient and economical. We call such a server a Xenoserver. This paper discusses the construction of such a system, examining how accounting, billing, and quality of service provision can be achieved.

- **Self-Paging in the Nemesis Operating System**
  Steven Hand
  Usenix Third Symposium on Operating Systems Design and Implementation, February 1999
  [online][gzipped postscript 150.84 KB]
  In contemporary operating systems, continuous media (CM) applications are sensitive to the behaviour of other tasks in the system. This is due to contention in the kernel (or in servers) between these applications. To properly support CM tasks, we require ``Quality of Service Firewalling'' between different applications. This paper presents a memory management system supporting Quality of Service (QoS) within the Nemesis operating system. It combines application-level paging techniques with isolation, exposure and responsibility in a manner we call self-paging. This enables rich virtual memory usage alongside (or even within) continuous media applications.

- **Elastic Network Control with Future Reservations**
  Herbert Bos
  ERSADS, February 1999

1998 Publications

- **Controlling run-time compilation**
  Timothy Harris
  IEEE Workshop on Programming Languages for Real-Time Industrial Applications, December 1998
  [gzipped postscript 43.20 KB]
  This paper describes a technique for integrating run-time compilation which is effectively pause free and for which the worst-case impact can be bounded. Three extensions to a JVM implementation are used. Firstly, a new scheduler allows the allocation of CPU time to threads to be controlled. Secondly, a code generator provides a mechanism for run-time compilation. Finally, a control interface allow application-specific compilation policies to be specified. By defining a compilation policy in which native code is generated in a designated compiler thread with a limited CPU allocation, it is possible to bound the worst-case impact of the compiler.

- **Building a Distributed Video Server using Advanced ATM Network Support**
  Herbert Bos

IFIP/IEEE MMNS, November 1998

- **The Tempest: A Framework for Safe, Resource-Assured Programmable Networks**
  Sean Rooney and Jacobus E. van der Merwe and Simon A. Crosby and Ian M. Leslie
  IEEE Communications Magazine, 36(10), October 1998
  [gzipped postscript 91.23 KB]

- **Efficient Reservations in Open ATM Network Control Using Online Measurements**
  Herbert Bos
  International Journal of Communication Systems, 11(4), August 1998
  [gzipped postscript 135.73 KB]

- **A new audio device driver abstraction**
  Dickon Reed
  IEEE NOSSDAV98, July 1998
  [online][gzipped postscript 55.68 KB]
  Traditional audio device drivers are unable to provide low latency audio services and often do not provide audio mixing services. High quality audio has, compared to other media types, relatively low bandwidth, but is very sensitive to latency and errors. This paper presents a device driver abstraction that exploits the low bandwidth and constant bit rate of audio to provide multiple channels of low latency audio efficiently. It provides applications with a great deal of flexibility with regards to latency, blocking behaviour and mixing.

- **The Tempest --- A Practical Framework for Network Programmability**
  Jacobus E. van der Merwe and Sean Rooney and Ian Leslie and Simon Crosby
  IEEE Network Magazine, 12(3), June 1998
  [gzipped postscript 125.23 KB]

- **Service Specific Control Architectures for ATM**
  Jacobus E. van der Merwe and Ian M. Leslie
  IEEE Journal on Selected Areas in Communications, 16(3), April 1998
  [gzipped postscript 117.20 KB]
  The concept of a Service Specific Control Architecture (SSCA) in an ATM environment is presented. Here a Control Architecture denotes the out-of-band control and management mechanisms operation in a network or virtual network (or part thereof). An SSCA can use knowledge about the application it serves to make better use of network resources and thus provide a more efficient service. Such a control architecture can be designed to provide only the subset of control functions required by the applications it serves, thereby greatly reducing its complexity. The switchlet mechanism, which allows more than one control architecture to be operational simultaneously within the same network, enables the use of service specific control architectures. Implementation work is presented to illustrate the use of switchlets and SSCAs. This includes both an environment which uses switchlets to dynamically create virtual networks, and an SSCA used to provide video and audio conferencing facilities in an ATM environment

- **Controlling the Tempest: Adaptive Management in Advanced ATM Control Architectures**
  David A. Halls and Sean G. Rooney
  IEEE Journal on Selected Areas in Communications, 16(3), April 1998
  [gzipped postscript 104.53 KB]

- **ATM Admission Control based on Measurements and Reservations**
  Herbert Bos

IEEE IPCCC, February 1998
[gzipped postscript 109.50 KB]

- **The Structure of Open ATM Control Architectures**
  Sean Rooney
  Ph.D. dissertation, February 1998
  Technical Report No. 451
  [gzipped postscript 362.69 KB]

- **Measurement Based Admission Control and Resource Allocation for Multimedia Applications**
  Paul Barham and Simon Crosby and Tim Granger and Neil Stratford and Fergal Toomey and Muriel Huggard
  Proceedings of IEEE MMCN'98, Janurary 1998

- **Practical Connection Admission Control for ATM Networks Based on On-line Measurements**
  Simon Crosby and Ian Leslie and John Lewis and Raymond Russell and Fergal Toomey and Brian McGurk
  Computer Communications, 1998

1997 Publications

- **Protocol Implementation in a Vertically Structured Operating System**
  Richard Black, Paul Barham, Austin Donnelly, and Neil Stratford
  Proceedings of IEEE Conference on Computer Networks, November 1997
  [online][gzipped postscript 51.24 KB]
  A vertically structured Operating System is one in which neither the ``kernel'' nor ``servers'' perform work on behalf of applications - the former because it exists only to multiplex the CPU, and the latter in order to avoid Quality of Service interference between the applications. Instead, wherever possible, the applications perform all of their own processing. Such a vertical structure provides many advantages for applications but leads to some interesting problems and opportunities for protocol stack implementation. This paper describes the techniques we used in our protocol implementation and the benefits that the vertical structure provided.

- **Open Service Support for ATM**
  J.E. van der Merwe
  Ph.D. dissertation. September 1997
  Technical Report No. 450
  [gzipped postscript 504.38 KB]

- **Statistical Properties of a Near-Optimal Measurement-based CAC Algorithm**
  John Lewis and Raymond Russell and Fergal Toomey and Brian McGuirk and Simon Crosby and Ian Leslie
  Proceedings of ATM'97, May 1997

- **The Hollowman: An Innovative ATM Control Architecture**
  Sean Rooney
  IFIP Integrated Network Management V, May 1997
  [gzipped postscript 61.36 KB]

- **Switchlets and Dynamic Virtual ATM Networks**
  Jacobus E. van der Merwe and Ian Leslie
  IFIP Integrated Network Management V, May 1997
  [gzipped postscript 91.09 KB]

- **A Fresh Approach to File System Quality of Service**
  Paul Barham
  IEEE NOSSDAV 97, May 1997.
  [online][gzipped postscript 115.99 KB]
  This paper describes a file system structure for supporting Quality of Service (QoS) guarantees. The device driver model clearly separates control and data path operations and presents a low level of abstraction. The data path module provides translation and protection of I/O requests enabling the file system layers to be executed as unprivileged code within shared libraries. Scheduling of low level operations within the device driver is used to provide isolation between clients and Quality of Service guarantees.

- **Connection Closures: Adding Application-Defined Behaviour to Network Connections**
  Sean Rooney
  ACM Computer Communication Review, April 1997
  [gzipped postscript 79.38 KB]

- **An Active Distributed File Server For Continuous Media**
  Herbert Bos
  ERSADS, March 1997

1996 Publications

- **Devices in a Multi-Service Operating System**
  Paul Barham
  Ph.D. Dissertation, October 1996
  Technical Report 403
  [online][gzipped postscript 1.50 MB]

- **Exploring the queueing behaviouer of ATM switches**
  Nils Bjorkman and Alexander Latour-Henner and A Miah and Simon Crosby and Ian Leslie and M Davey and Raymond Russell and Fergal Toomey
  Proceedings Performance 96, October 1996

- **The Design and Implementation of an Operating System to Support Distributed Multimedia Applications**
  Ian Leslie, Derek McAuley, Richard Black, Timothy Roscoe, Paul Barham, David Evers, Robin Fairbairns, and Eoin Hyden
  IEEE Journal on Selected Areas in Communications, 14(7), September 1996
  [online][gzipped postscript 119.64 KB]
  Support for multimedia applications by general purpose computing platforms has been the subject of considerable research. Much of this work is based on an evolutionary strategy in which small changes to existing systems are made. The approach adopted here is to start ab initio with no backward compatibility constraints. This leads to a novel structure for an operating system. The structure aims to decouple applications from one another and to provide multiplexing of all resources, not just the CPU, at a low level. The motivation for this

structure, a design based on the structure, and its implementation on a number of hardware platforms is described.

- **Predicting bandwidth requirements of ATM and Ethernet traffic**
  Simon Crosby and Ian Leslie and Neil O'Connel and Raymond Russell and Fergal Toomey
  Proceedings of the Thirteenth UK Teletraffic Symposium, March 1996

1995 Publications

- **The Structure of a Multi-Service Operating System**
  Timothy Roscoe
  Ph.D. Dissertation, August 1995
  Technical Report 376
  [online][gzipped postscript 403.18 KB]

- **CLANGER: An Interpreted Systems Programming Language**
  Timothy Roscoe
  ACM Operating Systems Review 29(2), April 1995
  [online][gzipped postscript 54.21 KB]
  CLANGER is a powerful, yet simple, command language for the Nemesis operating system. It uses runtime type information to interface directly with operating system components. CLANGER is a combination of command-line interpreter, scripting language, debugger and prototyping tool. This paper describes why such a language is possible, how it is being implemented, and outlines the language as it currently stands.

- **Bypassing Modelling: an Investigation of Entropy as a Traffic Descriptor in The Fairisle ATM Network**
  Simon Crosby and Ian Leslie and Muriel Huggard and John Lewis and Brian McGurk and Raymond Russell
  Proceedings of the Twelfth UK Teletraffic Symposium, March 1995

- **Wide-Area Audio Synchronization**
  Paul Barham, Richard Black and Ian Pratt
  [gzipped postscript]
  A brief note on performing highly accurate multi-source stream synchronization over the wide area without the use of a global clocking.

1994 Publications

- **Explicit Network Scheduling**
  Richard Black
  Ph.D. Dissertation, December 1994
  Technical Report 361.
  [online][gzipped postscript 300.04 KB]

- **Linkage in the Nemesis Single Address Space Operating System**
  Timothy Roscoe
  ACM Operating Systems Review 28(4), October 1994
  [online][gzipped postscript 61.17 KB]

The recent interest in single address space operating systems has resulted in a number of papers, most of which gloss over the issues of linking programs to run in multiple protection domains. Some of the confusion about 64-bit address spaces is due to the almost pervasive use of UNIX and UNIX-like operating systems (such as Mach, Chorus and Amoeba) and languages with poor enforcement of abstraction like C and C++. This paper describes some of the linkage structure of Nemesis, a multi-service operating system being developed as part of the Pegasus project. Nemesis provides a simple and efficient mechanism for program linkage which provides rich sharing of text at a level of individual object classes.

- **Operating System Support for Distributed Multimedia**
  Sape Mullender, Ian Leslie and Derek McAuley
  Usenix Summer Technical Conference, June 1994
  [online][gzipped postscript 70.63 KB]
  Multimedia applications place new demands upon processors, networks and operating systems. While some network designers, through ATM for example, hae considered revolutionary approaches to supporting multimedia, the same cannot be said for operating systems designers. Most work is evolutionary in nature attempting to identify additional features that can be added to existing systems to support multimedia. Here we describe the Pegasus project's attempt to buil an operating system from the ground up with multimedia support as a prime objective.

- **Operating System Support for Quality of Service**
  Eoin Hyden
  Ph.D. Dissertation, February 1994
  Technical Report 340.
  [online][gzipped postscript 688.82 KB]

Please send any comments to steven.hand (at) cl.cam.ac.uk
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