Research Report 1999 of the Research Group "Computer Networks and Distributed Systems"

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Research Projects

Charging and Accounting Technologies for the Internet (CATI)

CATI is a CNEC (Competence Network Electronic Commerce) project within the Swiss Priority Program for Information and Communications Structures (SPP ICS) of the Swiss National Science Foundation (SNF). The main goal of the CATI project is the design, evaluation and implementation of charging and accounting mechanisms for value-added Internet services such as Integrated Services, Differentiated Services and Virtual Private Networks (VPNs). Project partners are the ETH Zürich, the Universities of Zürich and Geneva, SWITCH, and IBM Research Zürich.The RVS group focuses on the development of a flexible VPN service system including Quality-of-Service (QoS) support by resource reservation. The user can set up, modify and tear down VPN connections on-line and choose from security features for the VPN service as well as QoS features similar to the Differentiated Services proposed by the Internet Engineering Task Force (IETF). Nevertheless, complexity which is inherent in security technology, is hidden from the user. To support Integrated Services applications, a gateway has been designed and implemented in order to map Integrated Services to Differentiated Services reservations. The implementation also handles accounting of VPN connections considering bandwidth, duration of the reservation, time of day, security parameters etc. The implementation is an instance of a generic control architecture for multi-provider network services. In order to evaluate our results, we simulated aspects of the control architecture, analyzed its security and performed local and wide area tests of our implementation between Berne and Geneva.

Research Staff

Roland Balmer, Florian Baumgartner, Manuel Günter, Mevlyde Kasumi, Ibrahim Khalil, Linqing Liu

Financial Support

Differentiated Services over ATM

Within this project an implementation of Differentiated Services (DiffServ) has been performed on a Linux-based router platform. The implementation of Premium and Assured Services is compliant with the IETFs definition of Expedited and Assured Forwarding and aims to support easy DiffServ router configuration. Initial performance tests show that the implementation can protect higher priority flows from other aggressive flows which is a common situation in the Internet. Another part of the project focussed on the implementation of Differentiated Services over ATM. In particular, we want to take advantage of the facilities (e.g. shaping, policing, and cell discards based on cell loss priorities) that ATM network equipment can provide. Both, Premium and Assured Services have been implemented over ATM. This allows to offload functionality from the Differentiated Services implementation to the ATM hardware. The implementation of a Differentiated Services router can, therefore, be kept simpler in ATM networks than in other networks.

Research Staff

Arik Dasen, Hans Einsiedler, Jayati Ghoshal, Matthias Scheidegger, Günther Stattenberger

Financial Support

IP/ATM Gateway

Although the number of Internet capable computers is growing, there are still scenarios with pure ATM capable hosts, e.g. servers in the core network or in Digital Subscriber Line (DSL) access networks. A gateway has been developed and implemented in order to interconnect ATM and IP end systems. The gateway maps UDP/IP data flows to ATM connections (PVCs) and vice versa. The implementation has been successfully demonstrated at the world telecommunications exhibition (TELECOM99) at Geneva using an audio tool (for both ATM and IP end systems) which has also been developed at IAM.

Research Staff

Florian Baumgartner, Thomas Rytz

Financial Support

Mobile IP Telephony (MIPTel) and Mobile IP Quality-of-Service (MobiQoS)

The Mobile IP Telephony (MIPTel) project started in October 1999 and is being funded by SNF. The project aims to develop adaptive telephony applications over DiffServ IP networks. The audio applications shall take advantage of DiffServ services in order to decrease packet loss and delay in mobile and wireless network environments. The project is directly linked with a research activity called Mobile IP Quality-of-Service (MobiQoS) which is performed in collaboration with INRIA Rhône Alpes and ENST (Ecole National Superieure de Telecommunication) Bretagne. Several workshops have been held to discuss and exchange the research results of the different partners in the area of integrating mobile communication environments and QoS-enabling Internet technologies such as Differentiated and Integrated Services. Problems with the integration of Differentiated Services and Mobile IP have been analysed. This analysis forms a basis for common future research work.

Research Staff

Günther Stattenberger, Matthias Scheidegger

Financial Support

QoS Support for the Internet based on Intelligent Network Elements

Active Networking (AN) is a promising technology for flexible and powerful service provisioning in future telecommunications and computer networks. The project on QoS support in the Internet based on AN includes a collaboration with a research group at Purdue University that already gained experience with Active Networking. AN technology shall be applied for management related tasks, i.e. so-called AN capsules (packets carrying programs that can be executed in network nodes such as IP routers) are used to reconfigure routers in order to provide QoS for specific flows in the Internet. This includes topics like traffic conditioning components (especially for Differentiated Services), signaling, QoS routing and the development of appropriate multimedia applications, capable to exploit the AN technology benefits. In a first step a prototypical Active Networking system and a special hybrid network simulator have been designed and implemented, allowing to emulate larger Active Networks and to study their behaviour using real applications simultaneously.

Research Staff

Florian Baumgartner

Financial Support

Simulation and Evaluation of Differentiated Services

The project evaluates the performance and facilities of the IETF's Differentiated Services approach by simulations. Initial work has been done using Berkeley´s Network Simulator (ns) for evaluation of the Assured Service and related fairness issues. More recent work includes simulations of several scheduling and queuing mechanisms using the Opnet network simulator. In addition, the impacts of Differentiated Services in ATM-based IP networks have been investigated.

Research Staff

Florian Baumgartner, Alexander Dobreff

Testbed for Mobile and Internet Communications

An experimental test network has been set up for the implementation tasks of the various research projects mentioned above. The network consists of UNIX-based servers, Linux-based and commercial routers, ATM switches, LAN switches as well as a variety of multimedia end systems. The testbed has been extended by Virtual Private Network (VPN) routers and wireless LAN equipment such as base stations and wireless/portable end systems. A separate domain with name, web, and file services has been set up. This allows to perform experiments without any impact to other university networks.

Research Staff

Florian Baumgartner, Ibrahim Khalil, Günther Stattenberger

Financial Support

Diploma Theses

- Roland Balmer: Integration von Integrated und Differentiated Services, November 1999
- Alexander Dobreff: Vergleich zwischen Simulation und realer Funktionalität für die Abbildung von Differentiated Services auf ATM, November 1999

Activities

Conference Program Committee Memberships

- 10th IEEE Workshop on Local and Metropolitan Area Networks, Sydney, November 21-24, 1999 (Torsten Braun)
- 24th IEEE Annual Conference on Local Computer Networks (LCN), Lowell/Massachusetts, October 18-20, 1998 (Torsten Braun)
- Kommunikation in Verteilten Systemen (KiVS´99), Darmstadt, March 2-5, 1999 (Torsten Braun)
- European Conference on Multimedia Applications, Services and Techniques (ECMAST'99), Madrid, May 25-28, 1999 (Torsten Braun)
- GI-Workshop Multicast-Protokolle und Anwendungen, Braunschweig, May 19-21, 1999 (Torsten Braun)
- 2nd International Conference on New Learning Technologies, University of Berne, August 30-31, 1999 (Torsten Braun, Chair)

Technical Committees

- SWITCH Stiftungsrat (Torsten Braun)
- SPEEDUP Society Committee (Torsten Braun)

Reviewing Activities

- Photonic Network Communications, Kluwer Academic Publishers (Torsten Braun)
- Computer Networks, Elsevier (Torsten Braun)
- Journal of Computer Aided Engineering, Wiley-Interscience (Torsten Braun)
- IEEE/ACM Transactions on Networking (Torsten Braun)
- dpunkt.verlag (Torsten Braun)
- Schweizerischer Nationalfonds (Torsten Braun)
- International Zürich Seminar (Torsten Braun)

Invited Talks

- Manuel Günter: "Charging Differentiated Services and VPNs: the Approach of the CATI Project", Invited Talk at IBM Research Yorktown, NY, October 27, 1999
- Manuel Günter: "Problems of the Inter-Domain Control Architecture for Value Added Internet Services", Invited Talk at Lucent Technologies Holmdel, NJ, October 29, 1999
- Torsten Braun: "Rechnernetze und Verteilte Systeme", Seminar "Universelle Verkabelungssysteme und drahtlose Übermittlungssysteme", IAM, September 2, 1999
- Torsten Braun: "Quality-of-Service in Virtual Private Networks", Seminar "One Voice to Cisco", London, May 21, 1999

Organized Events

- SNF Site Visit of the CATI project, IAM, July 9, 1999
- 2nd International Conference on New Learning Technologies, University of Berne, August 30-31, 1999
- Seminar "Universelle Verkabelungssysteme und drahtlose Übermittlungssysteme", IAM, September 2, 1999

Publications

Journal and Conference Papers

- Florian Baumgartner and Torsten Braun: "Evaluation of Assured Service", in R. Steinmetz (ed.): "Kommunikation in Verteilten Systemen (KiVS)", Informatik aktuell, Springer-Verlag, March 2-5, 1999, pp.72-85, ISBN 3-540-65597-2 (presentation by Florian Baumgartner)
- Torsten Braun and Manuel Günter: "Virtuell aber real - Virtuelle Private Netze und deren Basistechnologien", NET 4/99, Hüthig-Verlag, ISSN 0947-4765
- Torsten Braun, Claude Castelluccia, and Günther Stattenberger: "An Analysis of the DiffServ Approach in Mobile Environments", 1st Workshop on IP Quality of Service for Wireless and Mobile Networks (IQWiM99) Aachen, Germany, April 8-9, 1999 (presentation by Torsten Braun)
- Burkhard Stiller, Torsten Braun, Manuel Günter, and Bernhard Plattner: "The CATI Project: Charging and Accounting Technology for the Internet", in H. Leopold, N. Garcia (eds.): "Multimedia Applications, Services and Techniques - ECMAST'99", Lecture Notes in Computer Science 1629, Springer, pp. 281-296, Madrid, May 25-28, 1999, ISBN 3-540-66082-8. (presentation by Manuel Günter)
- Hans Joachim Einsiedler, Paul Hurley, Burkhard Stiller, and Torsten Braun: "Charging Multicast Communications Based on a Tree Metric", in Proceedings of GI-Workshop "Multicast-Protokolle und Anwendungen", Braunschweig, May 20-21, 1999 (presentation by Hans Einsiedler)
- Florian Baumgartner, Torsten Braun, and Christian Siebel: Fairness of Assured Service, in: H. Szerbicka (ed.): "Modelling and Simulation: A Tool for the Next Millennium, 13th European Simulation Conference 1999, Warsaw, June 1999, Vol. 1, pp. 390-397, SCS Publication, ISBN 1-56555-171-0 (presentation by Florian Baumgartner)
- Florian Baumgartner, Torsten Braun, Hans Einsiedler, and Ibrahim Khalil: "Differentiated Internet Services", in G. Cooperman, E. Jessen, G. Michler (eds.): "Workshop on Wide Area Networks and

High Performance Computing", Lecture Notes in Control and Information Sciences 249, Springer, June 1999, pp. 37-60, ISBN 1-85233-642-0

- Torsten Braun: "Kommunikation ohne Tricks - IPv6 - das Internet-Protokoll der nächsten Generation (Teil 1)", NET 10/99, pp. 62-65, Hüthig-Verlag, ISSN 0947-4765
- Manuel Günter, Torsten Braun, and Ibrahim Khalil: "An Architecture for Managing QoS-enabled VPNs over the Internet", in Proceedings of the 24th Conference on Local Computer Networks LCN'99, IEEE Computer Society, pp.122-131, Lowell/Boston, October 1999, ISBN 0-7695-0311-X. (presentation by Manuel Günter)
- Manuel Günter and Torsten Braun: "Evaluation of Bandwidth Broker Signaling", in Proceedings of the International Conference on Network Protocols ICNP'99, IEEE Computer Society, p.145-152, November 1999, ISBN 0-7695-0412-4 (presentation by Manuel Günter)
- Torsten Braun: "Kommunikation ohne Tricks - IPv6 - das Internet-Protokoll der nächsten Generation (Teil 2)", NET 11/99, S. 60-63, Hüthig-Verlag, ISSN 0947-4765

Technical Reports

- Torsten Braun, Manuel Günter, Mevlyde Kasumi, and Ibrahim Khalil: "Virtual Private Network Architecture", Technical Report, IAM-99-001, April 1999
- Manuel Günter and Torsten Braun: "Evaluation of Bandwidth Broker Signaling", Technical Report, IAM-99-002, May 1999
- Roland Balmer, Florian Baumgartner, Torsten Braun, Manuel Günter, and Ibrahim Khalil: "Virtual Private Network and QoS Management Implementation", Technical Report, IAM-99-003, July 1999
- Torsten Braun, Hans Einsiedler, Matthias Scheidegger, and Karl Jonas: "DiffServ Implementation Report", NEC Internal Technical Report NPDLE-HD-IR-1999-02, July 1999

Books

- Torsten Braun: "IPnG: Neue Internet-Dienste und virtuelle Netze", dpunkt.verlag, March 1999, ISBN 3-920993-98-5
- Frederico Flückiger, Torsten Braun, and Andreas Ninck (eds.): "2nd International Conference on New Learning Technologies", Berne, August 30-31, 1999