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Declaration concerning IEEE Conference Paper "INDEX: A Platform for Determining how People Value the Quality of their Internet Access"

TO WHOM IT MAY CONCERN:

1. I am one of the named authors (Björn Rupp) of the attached paper titled "INDEX: A Platform for Determining how People Value the Quality of their Internet Access". The co-authors and I prepared the article while I was attending the University of California at Berkeley.
2. The purpose of the paper was to explain the technical operation and design of an end-to-end system and network for allowing users to select a Quality of Service ("QoS") that they wanted to use when uploading or downloading information to and from the Internet. As explained in section 2.3 of the paper, QoS was differentiated in the form of bandwidth selection that was enforced using a traffic shaping method, such as a leaky bucket method. The system would allow a user to use up to, but no more than, the selected bandwidth amount that he or she chose and paid for, which allowed us to e.g. determine whether users were more willing to pay for different options of maximum bandwidths, as opposed to e.g. a flat rate.
3. The paper was submitted to the IEEE for presentation at the 6th IEEE International Workshop on Quality of Service, which was a conference sponsored by the IEEE Communications Society. The conference was held in Napa, California on May 18-20, 1998. I submitted the paper in advance of the conference. After it was accepted, I attended and presented my paper at the conference. All the papers accepted for the conference, including my paper that I have attached, were provided to all attendees of the conference in the form of a printed and bound copy of the conference proceedings. To the best of my recollection, the hard copies of the conference proceedings were handed out during the registration process of the conference in Napa.
4. The attached version is the actual copy of the paper that was handed out to me and the other attendees of the conference as part of the official conference proceedings. Also attached is a copy of the inside front cover of my copy of the conference proceedings, featuring the hand-written date (month and year) that

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I added upon receiving my copy of the conference proceedings. I have kept the conference proceedings in my files since the conference concluded.

5. I declare, under penalty of perjury, that all statements herein made of my knowledge are true and that all statements made on information and belief are believed to be true. Also, all statements made herein were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment or both under Section 1001 of Title 18 of the United States Code.

I am submitting this declaration on my own incentive. Everything that I stated above is based on my own personal knowledge.

Signed on this 22nd day of November 2019, in Berlin, Germany.



Dr. Hans Björn Rupp

*1998 Sixth
International Workshop
on Quality of Service*



Napa, California, USA
May 18–20, 1998



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Abstract

The continuing exponential growth of the Internet and the emergence of new time-critical applications have led to the integration of a large number of different services on the Internet. In the process, the question of how to efficiently allocate bandwidth as a scarce resource has become a crucial issue for the continued proliferation of these new services. Future growth depends on the division of services into quality-differentiated market segments and the pricing structure of each segment. Successful growth requires service providers to offer combinations of quality and price that match user need. But to do this providers must understand the structure of user demand. Such understanding is lacking at present.

This paper describes a platform designed to obtain a basic understanding of how individuals value Internet usage when offered different Quality of Service choices. The Internet Demand Experiment (INDEX) has two main objectives: (a) Measurement of user demand for Internet access as a function of Quality of Service (QoS), pricing structure, and application; and (b) Demonstration of an end-to-end system that provides access to a diverse group of users at attractive price-quality combinations. The data being collected is expected to reveal the correlation between user application and service demand, how demand varies with user experience, and up to what extent users form discrete market segments. This paper gives an overview of both the technology employed at INDEX and the goals of the experimental design.

1 Motivation

In recent years, the Internet has undergone a dramatic transformation from a computer network dominated by traditional, mostly text-based applications and a comparatively small, coherent user community to a universal platform for ever more users and services. This was not without its consequences. While traditional applications like electronic mail or file transfers can react in an elastic fashion to deviations in available bandwidth, new time-critical applications like Internet telephony and video conferencing cannot, thereby causing their employment to be severely limited as soon as network congestion leads to high packet delays and packet drops. With the explosion of demand for Internet services, higher speed access, and new applications, this situation continues to worsen. A single "best effort" service quality seems to become increasingly inappropriate for a network serving a wide variety of users and applications. Currently, users who occasionally need high bandwidth are either forced to lease over-provisioned dedicated lines,

risk the vagaries of the performance of "best effort"-quality shared resources, or forego the desired application altogether. When demand for Internet access varies among the population (as indicated by population-projectable data as in [CommerceNet/Nielsen 1997]), quality differentiation, along with proper economic incentives, can increase the overall value of the network by making available resources when needed for high value applications. The division of services into quality-differentiated market segments and the design of appropriate pricing structures for each segment is crucial for further proliferation of Internet services. Successful growth requires service providers to offer combinations of quality and price that match user need. But to do this providers must understand the structure of user demand. While there have been many pricing proposals in recent literature (for a short overview of different approaches, see [Shenker et al. 1996]), such understanding of user demand is lacking at present.

INDEX — the Internet Demand Experiment — is a real-world market trial seeking to provide this information and measure how individuals value Internet usage when they are offered different Quality of Service choices. INDEX has two main objectives: (a) Measurement of user demand for Internet access as a function of quality of service (QoS), pricing structure, and application; and (b) Demonstration of an end-to-end system that provides access to a diverse group of users at attractive price-quality combinations. The experiment will provide Internet access over ISDN lines to a group of about 150 users from the Berkeley campus community for a two-year period. Users select network services from a menu of QoS-price offerings and pay for their usage. It is important to stress that while the subjects' basic Internet access (in particular, the ISDN line and access equipment) is greatly subsidized, each choice on these QoS menus has a real economic cost which the subjects pay out of their own pockets. This is necessary in order to achieve incentive compatibility, i.e. given the incentive schedule as represented by their active menu, users pick the option that corresponds to their true valuation of the network resources in question. The menu changes in certain intervals in order to measure demand for a wide range of combinations of QoS, price and user characteristics. The data being collected is expected to reveal the correlation between user application and service demand, how demand varies with user experience, and up to what extent users form discrete market segments. The data will also allow to test hypotheses about the structure of the market for variable-quality ATM services. In addition, the experiment demonstrates a single system that offers variable service quality-price combinations that meet the needs of a diverse user population, an automated billing system that also gives the user control over service selection, and

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