

Best Effort Cloud Service for Ultra-low-Latency Guaranteed-rate Internet

S.Jayaprakash¹, M.Punitha², R.Deepika³, C.Madhubala⁴

H.O.D, Department of CSE, Idhaya Engineering College for Women, Chinnasalem, India ¹

PG Scholar, Department of CSE, Idhaya Engineering College for Women, Chinnasalem, India ²

PG Scholar, Department of CSE, Idhaya Engineering College for Women, Chinnasalem, India ³

PG Scholar, Department of CSE, Idhaya Engineering College for Women, Chinnasalem, India ⁴

ABSTRACT: An enhanced-internet network that provides ultra-low-latency guaranteed-rate (GR) communications for cloud services is proposed. The network supports traffic flows receive low-jitter GR service over virtual-circuit-switched (VCS) connections with negligible buffering and queueing delays, up to 100% link utilization, deterministic end-to-end quality-of-service (Qos) guarantees, and improved energy efficiency. End-to-end delays are effectively reduced to the fiber “time of flight.” A new router scheduling problem called the bounded normalized-jitter integer-programming problem is formulated. A fast polynomial-time approximate solution is presented, allowing TDM-based router schedules to be computed in microseconds. We establish that all admissible traffic demands in any packet-switched network can be simultaneously satisfied with GR-VCS connections, with minimal buffering. Each router can use two periodic TDM-based schedules to support GR-VCS connections, which are updated automatically when the router’s traffic rate matrix changes. The design of a silicon-photonics all-optical packet switch with minimal buffering is presented. The enhanced-internet can: 1) reduce router buffer requirements by factors of ≥ 1000 ; 2) increase the internet’s aggregate capacity; 3) lower the internet’s capital and operating costs; 4) lower greenhouse gas emissions through improved energy efficiency.

KEYWORDS: buffer sizes, cloud, cloud computing, data centers, diffserv, energy efficiency, future internet, low latency, quality of service (Qos), routing, scheduling.

I. INTRODUCTION

The BE internet is a universal platform for supplying digital services. To achieve relatively poor Qos guarantees, it depends on significant overprovisioning bandwidth which gives output as poor utilization, throughput and energy efficiency in references [1]-[10]. A simple change to the best-effort internet results in packet switching network which gives support to guaranteed-rate virtual circuit switched (GR-VCS) connections known to the enhanced internet. The static-GPS algorithm, the dynamic-GPS algorithm and the random algorithm are the three flow scheduling algorithms are defined and analyzed.

A new paradigm offered by a cloud for service delivery. CSPs (cloud service providers) deploy new services on global scale and compute facilities from cloud service infrastructure providers. Cloud services includes Netflix and you tube, and high performance computing systems in the cloud. To create a global intercloud, global services infrastructure are created by an public and private clouds. The internet faces challenges due to its lack of Qos guarantees for critical-time, poor utilization and energy efficiency as a service oriented infrastructure. The greentouch consumption stated that energy consumption is achieved by an significant reduction in the energy costs.in network, ultra-low latency for machine to machine communication has received considerable attention lately. Smooth traffic flows with low latencies, deterministic qos guarantees, and improved energy efficiency are provided by enhanced-internet. The Cloud offers a new paradigm for service delivery. Cloud service providers (CSPs) can deploy new

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

services on a global scale by leasing cloud storage and computing facilities from cloud infrastructure providers. Cloud services include large-scale video distribution (i.e., Netflix and YouTube), and high performance computing (HPC) systems in the cloud.

In this paper, a simple change to the basic *Best-Effort Internet* is proposed, resulting in a packet-switching network that supports guaranteed-rate virtual circuit switched (GR-VCS) connections called the Enhanced-Internet. It supports the *existing bursty BE traffic class*, a new Smooth (Guaranteed- Rate) class, and optionally one or more Quasi-Smooth (Guaranteed-Rate) traffic classes. Smooth traffic flows receive congestion-free guaranteed-rate service with deterministic QoS guarantees, over TDM-based GR-VCS connections on the packet-switched Internet.

Three flow scheduling algorithms are defined and analyzed in this paper: 1) the *Static-GPS* algorithm; 2) the *Dynamic-GPS* algorithm; and 3) the *Random* algorithm. These algorithms can reduce the router buffer sizes to packet per smooth traffic flow per router. In comparison, existing BE routers using TCP flow control can buffer up to one million IP packets per link (at 100 Gb/s), and they cannot achieve 100% throughput or any deterministic QoS guarantees. Extensive simulations indicate that the buffer sizes for *Smooth* traffic flows can be reduced by factors of compared to current BE routers using TCP flow control. These results are important for future all-optical routers, where optical buffering is very limited. For *Smooth* traffic flows, the majority of buffering can be removed from the core routers and can occur at the cloud data centers. Existing routers typically have programmable token-bucket based *traffic shaper queues* (TSQs), which are often unutilized for Best-Effort traffic. In the *Enhanced-Internet*, TSQs can be enabled at each cloud data center to aggregate bursty traffic streams and generate a low-jitter stream of IP packets for transmission. A *traffic playback queue* (TPQ) can be used at each destination (i.e., a cloud distribution center) to demultiplex the aggregated stream into the original bursty traffic streams. The TSQ and TPQ queues are external to the core routers in the Internet and can reside in the access routers.

Note that the access routers at cloud data centers already have extensive buffering capacity and TSQs/TPQs, so no new buffering capacity is needed at the data centers. The US Department of Energy (DOE) has recently concluded that the cloud computing is not cost-effective and is only suitable for applications with minimal communication requirements, due to the excessive delays and poor energy efficiency of the Best-Effort Internet. The costs of energy inefficiencies in global data-centers and the Internet can be estimated at several billion \$US/year. By enabling large-scale scientific cloud computing, the *Enhanced-Internet* can recover much of these costs, offering a significant return- on-investment. It can: 1) increase the utilization and energy efficiency of data centers, and 2) increase the utilization and energy efficiency of the Internet. The *Enhanced-Internet* requires only relatively minor hardware changes to the existing BE-Internet, i.e., the addition of an FPGA per linecard to manage the schedules.

II. LITERATURE SURVEY

It deals with review of ATM and MPLS-TE and review of scheduling. The heuristic router scheduling algorithms are implemented in BE-internet routers, ATM, MPOLS-TE switches. In each time slot BE-schedulers are used to find maximal matchings (MMs) in each router/switch. ex: iSLIP schedulers cannot achieve 100% throughput due to weakness in networks. iSLIP have 75% peak throughput for non uniform traffic, they exhibit several thousand packets at high loads, (i.e) $\leq 33\%$, it results in bursty traffic and overprovisioning. It is often called as "a best effort is as strong as its weakest Qos link." In (1) BE-scheduler are used to implement BE-internal routers, ATM, and MPLS-TE switches. In [2] the concept of capacity region stability region and schedulability region as been defined to explain the concept of maximum achievable capacity of an network.

In the prior work of [3] and [4], have shown that a *Maximum Weight. Matching* (MWM) scheduling algorithm can achieve bounded buffer sizes and stability within one input-queued (IQ) router. In recent works the authors have studies about the number of intervening switches, their queue management, and line speeds have a significant impact on the distribution of the CDV that must be handled.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

It is shown that when two technologies are combined—1) a control plane with a resource-reservation signaling protocol, and 2) a QoS-aware low-jitter scheduling algorithm for the routers—then all admissible traffic demands can be satisfied with TDM-based GR-VCS connections, and achieve: i) reduced router buffer sizes by factors of ; ii) reduced router queuing delays to a negligible value relative to the fiber delays; iii) deterministic and essentially-perfect throughput, resource-utilization, and QoS guarantees; and iv) significantly improved energy efficiency, for all link loads %.

III. SCOPE OF RESEARCH

A BE-internet router of size $M \times M$ consists of M input and output ports. Each input port has M VOQs, it stores packets. Where each input port consists of input-filter to filter, police, and classify incoming packets, and a demultiplexer (sends packets to the appropriate VOQ).at the input side, variable-size packets are segmented into the fixed-size and at the output side it gets reconstructed. In each time slot, the VOQ scheduler selects a VOQ for service. A BE internet router use BE scheduler as the VOQ-scheduler.at the output side, for transmission it selects reconstructed packet using WFQ-scheduler.

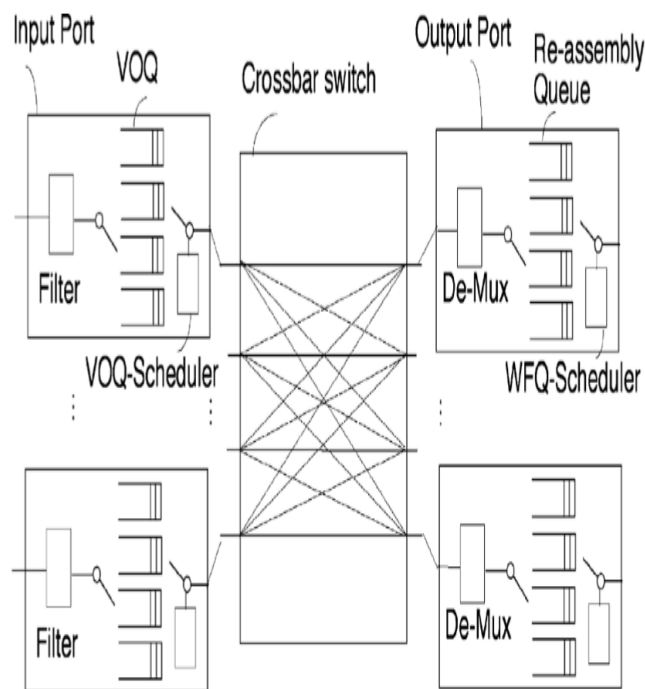


Fig. 1 Best-effort internet router design with VOQs

Best-effort internet router design with VOQs is shown in fig. 1. Consists of input port and output port. The input port consists of police VOQ, VOQ-scheduler input –filter to filter, incoming packets and the output port consists of re-assembly queue, WFQ-scheduler and de-multiplexer to forward packets to the appropriate VOQ, both input and output connected using crossbar switch.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

Enhanced-internet router design

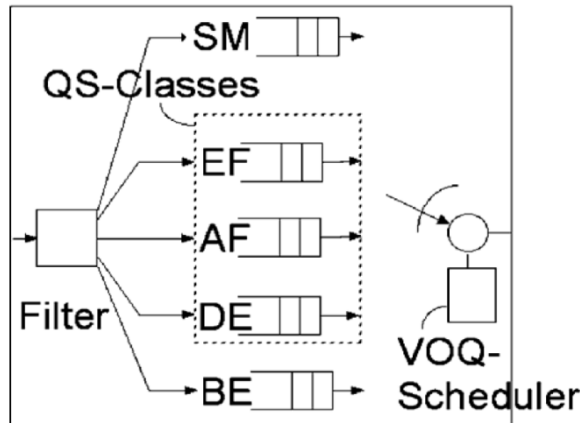


Fig. 2 input port with class-VOQs

Input port with class-VOQs are shown in fig. 2. Contains QS-classes and filter splitted into SM, EF, AF, DE, BE which gives packets with the help of filter using VOQ-scheduler. The smooth VOQ supports low-jitter traffic flows that ranks improved energy efficiency and end-to-end QOS guarantees. To provide backward legacy diffserv and the legacy MPLS_TE traffic types. Server can be controlled by precomputed periodic schedule which is stored in a (LUT) lookup table.

The legacy MPLS-TE traffic types and legacy IETF differentiated-services are executed using quasi-smooth VOQs to provide backward compatibility. This typed doesn't have significant constraints for burstiness. Smooth class are identified by a packet header and it contains very low burstiness value. Here each VOQ is separated into the smooth and BE VOQ and (EF, AF) are three optional Quasi-smooth VOQs.

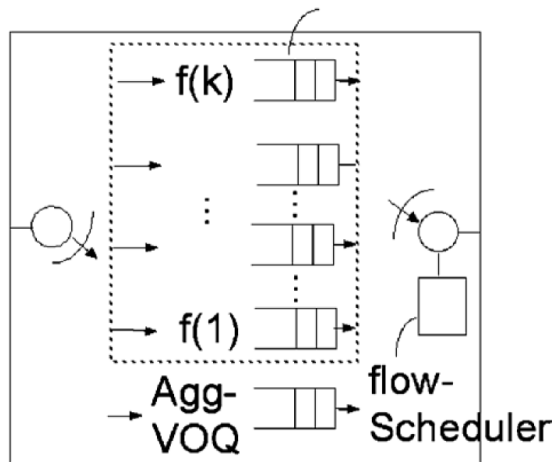


Fig. 3 class-VOQ into flow VOQs and aggregate-VOQ

Class-VOQ partitioned into flow-VOQs and one aggregate-VOQ shown in fig. 3. Here each class is partitioned into a fine-grain and course-grain. Each flow sends multiple flows and receives GR services in each router

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

and scheduling frame is used to meet aggregate rate wants by an traffic flows for aggregate-VOQ. In fig, the flow scheduler uses flow-schedule, in which it identified at one flow-VOQ for service in time-slot. It is subdivided into fine-grain flow-VOQ and a course-grain aggregate-VOQ. In each router and scheduling, the fine-grain flow handles one flow and receive GR-service for that flow. Via the aggregate VOQ handles multiple flows and receive GR-service for that flow. In each time-slot, the flow scheduler is used as a flow schedule, which is identified as one flow-VOQ for service.

Flow-based control plane

Diffserv presents resource management to enhance traditional diffserv. TSPEC (traffic specification) specified to establish diffserv connections with nominal bit rate. The average bit rate and the maximum burst size are specified by a diffserv TSPECs. It supports fine-grain Qos model and course-grain Qos model.

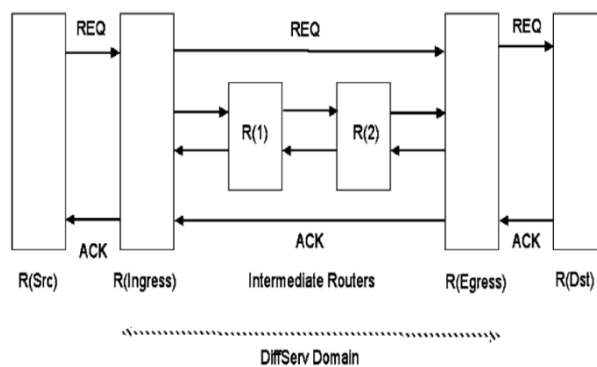


Fig. 4 signaling within an NSIS diffserv domain

Signaling within a NSIS diffserv domain as shown in fig. 4. Smooth class consists of diffserv traffic flow f with a TSPEC is published between source and destination using fine-grain QOS model. To establish connection, diffserv control plane can signal the routers in network. Source and destination establish suitable end-to-end path p using constraint-based algorithm.

Using fine-grain Qos model, the traffic flow in the smooth class with TSPEC are established between $R(src)$ and $R(dst)$. A path between source and destination will be precomputed using constraint-based routing algorithm. The crossbar switch can be unbuffered or crosspoint buffering, it can be Clos topology. The time axis separated into scheduling frames, which consists of F time-slots, it supports delivery of fixed-size packet from input to output port. The perfect minimum-jitter scheduling problem observe that a sequence of zero-jitter packet departure time can be rotated a frame and remain scheduled. It is stated as in eqn.,(1) :

$$J^* = \sum_{f \in F} \sum_{i=1}^{R(f)} (|D(i, f) - D(i-1, f)|) \quad \text{-----(1)}$$

The bounded normalized-jitter scheduling problem relaxes the previous scheduling problem so that the time-slots is acceptable. Constraints allow a packet to depart within time-slots of ideal time. This problem can be stated as:

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

$$J^* = \sum_{f \in F} \sum_{i=1}^{r(f)} (|D(i, f, k) - D(i-1, f, k)|) \quad \text{-----(2)}$$

The polynomial-time approximation algorithm as in eqn.(2), allows the low-jitter guaranteed-rate scheduling algorithm that accept substochastic or stochastic traffic rate matrix in a fair manner.the number of time-slot reservations wants between input and output port of an IQ router in frame with F time-slots.the problem is decomposed into two smaller problems eqn.(3), are as follows:

$$J^* = \sum_{i=1}^N \sum_{j=1}^N (|T_1(i, j) - T_2(i, j)|). \quad \text{-----(3)}$$

The static-GPS flow selection is used for an schedule flows for service. Flow schedules are periodic, it is computed once and reused for subsequent scheduling frames.where flow rates remain static, it is not work conserving.the dynamic-GPS algorithm, when the VOQ has several nonempty flows, the selected next flow is empty.when VOQ is nonempty, the VOQ server will remain idle. Dynamic-GPS flow scheduling algorithm is used to improve the queuing performance.the random flow selection consider random flow selection policy. It is work conserving. Here when VOQ receive service, any nonempty flow also selected at random to receive service.it also increase the worst-case queue sizes, and it also cannot guarantee every flow.

IV. EXPERIMENTAL RESULTS

A. Queue schedule:

The result of the recursive application is to compute queue schedule. Packets are inserted into the networks at ideal transmission time. The exit time of an packets are illustrated by an time slots. Before insertion, packets can never depart. So departures are illustrated with an help of dots. The exit time of packets leaving network expressed in normalized time. Every flow of the packets depart at perfect normalized deparure times. The measured time of succesive packet departures are indicated by an time-slots defined as jitter. The normalized jitter expressed in an normalized time.

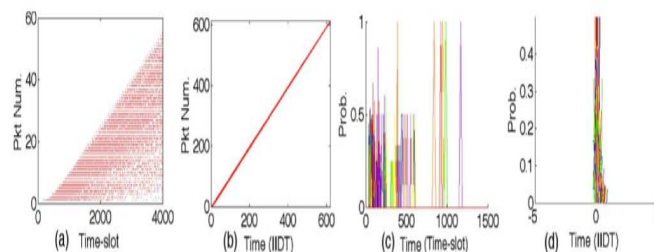


Fig. 5 performance of the bounded normalized jitter scheduling problem

Performance of the bounded normalized jitter scheduling problem is shown in fig. 5. (a) exit time expressed in real time, it illustrates exit time of the packets, which is expressed in an real time, it means to an time-slots. Before insertion packets never gets depart in fig, right side of the diagonal departures are represented using dots. (b) exit time expressed in normalized time, i.e exit times of packets are expressed using normalized time(IIDTS), packets experienced essentially-perfect service with very little queueing within the routers. (c) jitter expressed in real time, here jitter express the measured time between successive packet departures specified in real time. (d) jitter expressed in

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

normalized time which means the time between the successive packet departures in a flow indicating essentially-perfect service for all flows.

B. Flow schedules:

Three different flow-scheduling algorithms are used whenever the VOQ is activated, it is used to select the flow for service from the VOQ. Using network configuration we may represent an external point in the capacity region of the network. Steady state are illustrated for an static-GPS flow-scheduler, dynamic-GPS flow-scheduler and the random flow-scheduler. The end-to-end delay for all flows are expressed in normalized time. The flow-VOQ size distribution consists of 5140 individual plots superimposed, representing 514 flow-VOQ and there are 160 individual plots, representing 16 VOQ's in each router.

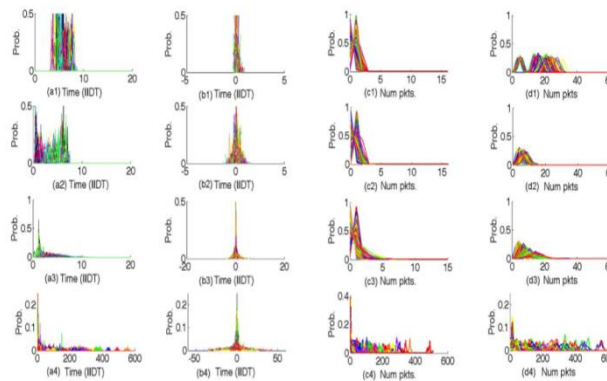


Fig. 6 performance of flow scheduling algorithms

Performance of flow-scheduling algorithm are shown in fig. 6. Which consists of four algorithms such as static-GPS, dynamic-GPS and random. (a1)-(a4) end-to-end delay expressed in normalized time for the four algorithm. (b1)-(b4) end-to-end age deviation from mean expressed in normalized time for the four algorithm. (c1)-(c4) flow-VOQ size distribution for the four algorithms. (d1)-(d4) VOQ size distribution for the four algorithm.

VI. CONCLUSION

An enhanced-internet supports two traffic classes namely smooth and best-effort classes. In smooth class, the traffic flows are transported over guaranteed-rate virtual-circuit-switched connections achieve end-to-end low latencies and QoS guarantees and improve energy efficiency. Last 40 years the best-effort TCP/IP internet are developed to run on enhanced-internet without any changes. Improved cloud services used new and highly efficient smooth class to improve performance and energy efficiency. The improved technologies may: 1) reduce requirements of buffer and router latency; 2) increase the capacity of internet; 3) it lowers the internet's capital and operating cost and lower data centers; and 4) using improved energy efficiency, it lowers the greenhouse gas emission.

REFERENCES

- [1] R. Bolla, R. Bruschi, F. Davoli, and F. Cucchietti, "Energy efficiency in the future internet: A survey of existing approaches and trends in energy-aware fixed network infrastructures," *IEEE Commun. Surveys Tuts.*, vol. 13, no. 2, pp. 223–244, 2nd Quart., 2011.
- [2] X. Xiao and L. M. Ni, "Internet QoS: A big picture," *IEEE Netw.*, vol. 13, no. 2, pp. 8–18, Mar.–Apr. 1999.
- [3] P. Gevros, J. Crowcroft, P. Kerstein, and S. Bhatti, "Congestion control mechanisms and the best-effort service model," *IEEE Netw.*, vol. 15, no. 3, pp. 16–26, May–Jun. 2001.
- [4] A. Meddeb, "Internet QoS: Pieces of the puzzle," *IEEE Comm. Mag.*, vol. 48, no. 1, pp. 86–94, Jan. 2010.
- [5] L. Georgiadis, R. Guerin, V. Peris, and K. N. Sivarajan, "Efficient network QoS provisioning based on per node traffic shaping," *IEEE/ACM Trans. Netw.*, vol. 4, no. 4, pp. 482–501, Aug. 1996.
- [6] S. Shenker, "Fundamental design issues for the future Internet," *IEEE J. Sel. Areas Commun.*, vol. 13, no. 7, pp. 1176–1188, Sep. 1995.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

- [7] N. Shetty, G. Schwartz, and J. Walrand, "Internet QoS and regulations," *IEEE/ACM Trans. Netw.*, vol. 18, no. 6, pp. 1725–1737, Dec. 2010.
- [8] V. Firoiu, J. Y. Le Boudec, D. Towsley, and Z. L. Zhang, "Theories and models for Internet quality of service," *Proc. IEEE*, vol. 90, no. 9, pp. 1565–1591, Sep. 2002.
- [9] Ciena Networks, Hanover, MD, USA, "Ultra-low-latency networking: Milliseconds can mean millions," 2013 [Online]. Available: <http://www.ciena.com>.
- [10] IETF, "Specification of guaranteed quality of service," IETF RFC 2212, Sep. 1997.
- [11] IETF, "A differentiated services code point (DSCP) for capacity-admitted traffic," IETF RFC 5865, May 2010.
- [12] IETF, "NSIS signaling layer protocol (NSLP) for quality-of-service signaling," IETF RFC 5974, Oct. 2010.
- [13] IETF RFC 5977, Oct. 2010 [Online]. Available: <http://www.ietf.org>.
- [14] H. Kim and N. Feamster, "Improving network management with software defined networking," *IEEE Commun. Mag.*, vol. 5, no. 2, pp. 114–119, Feb. 2013.
- [15] N. McKeown *et al.*, "OpenFlow: Enabling innovation in campus networks," *Comput. Commun. Rev.*, vol. 38, no. 2, pp. 69–74, 2008.