

SATELLITE AND SPACE COMMUNICATIONS

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SSC Newsletter

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The Satellite and Space Communications (SSC) Committee is a volunteer group actively involved in advancing satellite and space communication technologies within the IEEE. This committee is approved by the IEEE Communications Society and is governed by the constitution and bylaws of the IEEE as well as the other twenty Technical Committees in the Society.

SATELLITE & SPACE

- JOIN US -

All conference attendees are welcome to join us in the SSC Committee meeting.

Hotel: The Fairmont
Room: Garden
Date: Wednesday Nov. 29th
Time: 7:30 am - 9:00 am

GLOBECOM 2000 SSC Committee Activities

Tutorial T-13, Broadband Satellite Systems
 Monday Morning, Half Day, Prof. Catherine Rosenberg

Realizing the Future Broadband Satellite
 Communications Services, Panel S1
 Tuesday 2:00 – 5:00 pm

Wednesday, 29 November, 07:30 - 09:00, Breakfast
 SSC Technical Committee Meeting

Satellite Network Protocols and IP QoS, Session S2
 Wednesday 8:30 – 11:30 am

LEO Network Architectures & Analysis, Session S3
 Wednesday 1:30 – 5:00 pm

Future SSC Meetings

June 2001	Helsinki
November 2001	San Antonio
June 2002	New York



SSC COMMITTEE OFFICERS

CHAIR

Dr. Iwao Sasase
Department of Information and
Computer Science
Keio University
3-14-1, Hiyoshi, Kohoku-ku,
Yokohama, Kanagawa 223-8522
Japan
Tel: +81 45 566 1755
Fax: +81 45 566 1747
Email sasase@sasase.ics.keio.ac.jp

PAST CHAIR

Mr. Walter J. Ciesluk
The MITRE Corporation
202 Burlington Road
Bedford, MA, USA 01730-1420
Tel: +1 781 271 6997
Fax: +1 781 271 6170
Email: wciesluk@mitre.org

VICE CHAIR

Dr. Ron P. Smith
TRW Space & Electronics
One Space Park, O2/2322
Redondo Beach, CA, USA 90278
Tel: +1 310 812 9395
Fax: +1 310 813 7562
Email: ron.p.smith@trw.com

COMMITTEE HISTORIAN

Mr. Louis Pollack
c/o Pollack Associates
15321 Delphinium Lane
Rockville, MD, USA 20853
Tel: +1 301 929 1295

SECRETARY / EDITOR

Dr. Abbas Jamalipour
School of Electrical & Information
Engineering
University of Sydney
Sydney NSW 2006, Australia
Tel: +61 2 9351 2843
Fax: +61 2 9351 3847
Email: a.jamalipour@ieee.org

COMMITTEE ADVISOR

Dr. Desmond P. Taylor
Dept. of Electrical & Electronic
Engineering
University of Cantterbury
Private Bag 4800
Christchurch, New Zealand
Tel: +64 3 364 2213
Fax: +64 3 364 2761
Email: taylor@elec.canterbury.ac.nz

MESSAGE FROM THE CHAIR

Iwao Sasase

The Satellite and Space Communications Technical Committee (SSC TC) is a volunteer group actively involved in advancing satellite and space communication technologies within the IEEE. SSC TC is approved by the IEEE Communications Society (ComSoc) and is governed by the constitution and bylaws of the IEEE as well as the other twenty Technical Committees in the Society. The goal of SSC TC is to be actively on top of the new and revolutionary developments taking place in the field and to make sure that they are made visible to the IEEE ComSoc community via the various conferences and media. In addition, the SSC TC provides a forum to facilitate technical interchange among those working in the field. Toward this objective, we are in the process of formulating plans to attract new members particularly from the industries and organizations at the forefront of these new developments. Currently the SSC TC has around 100 members from academia and industry. The new SSC offices, Iwao Sasase for Chair, Ron P. Smith for Vice Chair, and Abbas Jamalipour for Secretary, were elected at ICC in June 2000.

Recently, significant advances in video compression and data protocol enhancement technology have made new and many previously very expensive satellite communications services such as digital direct broadcast satellite (DBS), digital direct-to-home (DTH), and Internet Access available at lower cost. At the same time, we are entering a new and potentially revolutionary era in satellite

communications. A large number of commercial systems are being planned and introduced to provide a wide array of voice, data, and video services that promise to radically change global telecommunications. These include narrow band systems, such as Globalstar, ICO etc., which intend to provide cellular telephone-like services in *L/S*-band. There are also a host of wide band systems being planned for *Ka*-band, such as Astrolink, Spaceway and Teledesic, which intend to provide multimedia services to desktop computer-size terminals starting around 2000. Both the narrowband and wideband systems appear attractive because they offer much higher capacity and relatively low user costs compared to traditional systems. In the latter part of 1997, several companies announced proposals to build satellite systems in the *Q* and *V* bands to supplement the *Ka*-band wide band systems now in various stages of development.

The SSC TC meeting is held semi-annually at the ICC and GLOBECOM conferences. The SSC TC has been sponsored many technical sessions, tutorials or workshops on satellite and space communications at ICC, GLOBECOM, MILCOM, and other major IEEE conferences. At GLOBECOM 2000, the SSC TC and Communications System Integration and Modeling (CSIM) TC have jointly organized a symposium titled "Satellite Communications for the New Millennium", and organize two sessions on LEO systems and TCP/IP, and one panel on Future Satellite Communication. Member Sastri Kota is the

SSC Newsletter

Chair of the symposium and Vice Chair Ron P. Smith and C. K. Toh serve as Vice Chairs of the symposium. The SSC Newsletter is published twice a year and distributed in ICC and GLOBECOM and also electronically at the SSC web site. Secretary Abbas Jamalipour is serving as an Editor and working actively to improve the contents of the SSC Newsletter and SSC Homepage. From this issue of the SSC Newsletter, a perspective section on new research and development in satellite communications is added.

The SSC TC has also been actively promoting satellite communications systems and technology via professional journals, transactions, and magazine publications. Advisor Desmond Taylor continues to serve as a Senior Editor of the IEEE Journal on Selected Areas in Communications. Member Michel Bousquet serves on the editorial panel of the International Journal of Satellite Communications. Member Marie-Jose Montpetit and Chair Iwao Sasase serve as area editors in radio and satellite communications for the IEEE Communications Surveys Electronic Magazine. The SSC TC encourages proposals for features in the IEEE Communications Magazine, and "Laser and broadband satellite communications" topics are in development now. A special issue on "Information Systems" published recently covers mobile and future satellite communications systems.

The SSC TC continues to provide a forum to facilitate technical interchange among those working in the field. The current emphases are on the evolution of new satellite and space-based systems and on the applications of emerging technologies to satellite and space communications. Because of the broad range of the technologies involved, and the necessity of integrating and interfacing satellite communications with other networks, the committee has attempted to develop liaisons with other technical committees such as Multimedia Communications, Personal Communications (PC), and CSIM. Vice Chair Ron P. Smith has been established active working relationship with the American Institute of Aeronautics and Astronautics (AIAA) with the objective of co-sponsoring an annual conference on satellite communications. Since Ron P. Smith is also

serving as the Vice Chair of the AIAA Technical Committee on Communications Systems (TCCS), he is very active in the committee formulating plans for 2001 AIAA International Communications Satellite System Conference (ICSSC-19) to be held in Toulouse, France in April 2001. Member Michel Bousquet is the General Chair of this conference. Chair Iwao Sasase establishes working relationship with IEICE (Institute of Electronics, Information and Communication Engineers of Japan) Technical Groups on Communications Systems and Satellite Communications, since he also serves as the Vice Chair of IEICE Communications Systems Technical Group.

In addition the committee maintains a keen interest in the development and maintenance of standards for communication and is particularly concerned with those that effect satellite and space communications. Specific technologies of current interest include:

- Satellite based personal and mobile communications systems
- ISDN and BISDN satellite applications and networks
- Advanced modulation/demodulation and on-board signal processing
- Direct broadcast and high definition television
- Very small aperture and handheld satellite systems and networks
- *Ka/Q/V* band satellite communications systems

Clearly, the field of satellite communications continues to grow rapidly and remains interesting and exciting. We encourage all who are interested in this field to join our committee. Visit our website (<http://www.comsoc.org/socstr/techcom/ssc/>) where you can get all information on SSC TC activities including SSC Charter, Overview, Newsletter, Meeting Minutes, Operating Procedure, SSC Membership, SSC Reviewers, TC Survey, Call for Papers, events, upcoming meetings, and interact with committee.

*Prof. Iwao Sasase, Chair
Satellite and Space Communications
Technical Committee*

SCANNING THE WORLD

Ron P. Smith

Satellite communication activities in the year 2000 have moved forward along various paths. The following information is drawn from print and on-line news sources. Identification of specific systems or companies is for illustrative example only, inclusion or omission is not meant to endorse or discredit.

The traditional GSO transponder businesses continue to be strong. New and replacement satellites are planned to extend service into Ka-band, utilizing spot-beams for additional capacity through frequency reuse and in some cases on-board digital switching. These developments foreshadow future broadband processed systems discussed below.

New services in the direct satellite radio market are emerging from the two major competitors, Sirius and XM. Similar services are planned from both NGSO and GSO systems supplemented by terrestrial repeaters in urban areas. These systems seek to provide CD quality sound to automobiles through subscription sales. Progress has been made both in the space segment through satellite production and launches as well as the ground segment through chip set deliveries to radio manufacturers. Radio sales are planned through alliances with automobile manufacturers and through consumer electronics outlets. Subscription service is planned to begin in 2001.

The satellite telephone industry moves forward after the financial failure of Iridium. Globalstar has completed the launch of its NGSO constellation and is rolling out service with handsets available through multiple manufacturers. Regional GSO satellite telephone systems are also in operation, in some cases after delays caused by Asian financial market crashes in the late 1990's. Success of these systems largely depends upon the rate of customer subscription sales.

Broadband satellite data services are nearing deployment. Both GSO and NGSO systems are planned using Ka-band for wide bandwidth, spot-beams with frequency reuse, on-board digital demodulation and switching for efficient network connectivity, and in some cases intersatellite links.

GSO systems plan for initial regional service to be available in 2002-2003 followed shortly by global coverage. NGSO systems are also planned, but start dates are uncertain at this point. Future systems using the higher frequencies of Q- and V-bands are also in the license and concept definition stage. The Ka-band broadband satellite data networks have the potential to dramatically change the structure of communication around the world, working in conjunction with fiber-optic networks where they are available and bringing high data rate capabilities to the vast areas of the globe not serviced by fiber.

Research and development of hardware technologies, networking protocols and network management are active in industry, academia and international standards organizations. Some key examples are phased array and multibeam antennas, turbo codes, and modifications of Internet protocols for high bandwidth-delay links. The Satellite and Space Communications TC is actively involved in all of these areas through support of conferences and publications. Some committee members are directly involved in research and development of these systems as well as serving on international standards organizations. Please join us if you would like to lend your support to this fascinating technology.

*Dr. Ron Smith, Vice Chair
Satellite and Space Communications
Technical Committee*

FORTHCOMING GLOBECOM AND ICC CONFERENCES

ICC 2001
June 11 - 15, 2001,
Helsinki, Finland

Globecom 2001
Nov. 25-29, 2001,
San Antonio, USA

ICC 2002
June, 2002,
New York, USA

COSPONSORING / RELATED CONFERENCES AND WORKSHOPS

Milcom 2001 (Oct. 28 - 31, 2000, McLean, VA, USA)
MILCOM 2001 is soliciting both unclassified and classified papers on military communications. The conference theme for 2001 is "Communications for Network-Centric Operations: Creating the Information Force". Abstracts due is January 12, 2001 and draft papers due is February 23, 2001. There will be related topics of "SATCOM-Military and Commercial," "SATCOM Internet Access" and many more.

ICSSC 2001 (April 17 - 20, 2001, Toulouse, France)
The 19th AIAA International Communication Satellite Systems Conference is a pre-eminent technical conference in the field of satellite communication. The conference will be held in Toulouse, France, and will focus on Internet and broadband communications, digital broadcasting, personal communications and positioning services.

CONFERENCE CALENDAR

Conference	Date / Location	Information
ICPWC 2000 International Conference on Personal Wireless Communications	Dec. 17-20, 2000 Hyderabad, India	Dr. Ram Gopal Gupta Dept. of Electronics, Govt. of India 6 CGO Complex, Lodhi Rd. New Delhi 100 003, India E-mail: guptarg@xm.doe.ernet.in http://www.citr.ece.uvic.ca/icpwc2000
ICSSC 2001 19th AIAA International Communication Satellite Systems Conference	April 17-20, 2001 Toulouse, France	Prof. Michel Bousquet SUPAERO, B.P. 4032 31055 Toulouse Cedex 4, France Tel: +33 62 178086, Fax: +33 62 178330 E-mail: bousquet@supaero.fr
INFOCOM 2001 The IEEE major conference on computer communications and networking	April 22-26, 2001 Anchorage, Alaska, USA	Program Committee Co-Chair Rene L. Cruz, UCSD, USA E-mail: cruz@ece.ucsd.edu http://www.ieee-infocom.org/2001/
VTC 2001 Spring IEEE Semiannual Vehicular Technology Conference	May 6-9, 2001 Tel Aviv, Israel	Dan Knassim Ltd. P.O. Box 1931 Ramat Gan 52118, ISRAEL E-mail: vtc2001@congress.co.il http://www.congress.co.il/iee_new
ICC 2001 International Conference on Communications	June 11-15, 2001 Helsinki, Finland	TPC: Prof. Savo Glisic University of Oulu http://www.icc2001.com
VTC 2001 Fall IEEE Semiannual Vehicular Technology Conference	Oct. 7-11, 2001 Atlantic City, NJ, USA	Mr. Arthur Greenberg 50 Boonstra Dr. Wayne, NJ 07470 E-mail: a.h.greenberg@ieee.org
MILCOM 2001 IEEE Military Communications Conference	Oct. 28-31, 2001 McLean, VA, USA	TPC: Dr. Stephen D. Huffman MITRE Corporation shuffman@mitre.org http://www.milcom.org/2001/
GLOBECOM 2001 IEEE Global Telecommunications Conference	Nov. 25-29, 2001 San Antonio, TX, USA	TPC: Arthur Henley, P.E. E-mail: ahenley@comsoc.org http://www.globecom2001.com/

To all SSC members: If your postal or e-mail addresses, telephone or fax numbers have changed, please update them with the committee secretary. You can review our current records on our web page at www.comsoc.org/socstr/techcom/ssc

Quality of Service over TCP/IP-Based Satellite Networks: Experience of an ASI/CNIT Project

*Davide Adami, °Mario Marchese, °°Luca Simone Ronga
CNIT - Italian National Consortium for Telecommunications

*CNIT Pisa Research Unit, Dept. of Information Engineering, University of Pisa, Via Diotisalvi, 2 56100 Pisa (Italy). Phone: +39-050-568522 - Fax: +39-050-568661, E-Mail: davide.adami@cnit.it

° CNIT Genoa Research Unit, Dept. of Communications, Computer and System Science (DIST), University of Genoa, Via Opera Pia 13, 16145 Genova (Italy), Phone: +39-010-3532985 - Fax: +39-010-3532154, E-Mail: mario.marchese@cnit.it

°° CNIT Firenze Research Unit, EE Dept – University of Firenze, Via di Santa Marta 3, 50139 Firenze, (Italy) Phone: +39-055-4796485 - Fax: +39-055-4796485, E-Mail: luca.ronga@cnit.it

The recent evolution of the satellite networks and of the Internet and the widespread of networked multimedia applications has highlighted the need to investigate techniques, tools and device configurations to guarantee a certain level of Quality of Service (QoS) to the end users over TCP/IP-based satellite networks.

TCP/IP protocols, on which the Internet is based, have not been designed to provide a guaranteed quality of service. The Internet is a “best-effort” network and it only does its best to provide a service. It is characterized by heterogeneity both from the point of view of algorithms and management, and from the point of view of physical links. There are high-speed channels, low speed phone links, wireless multi-access channels and satellite portions. Moreover, many organizations and providers manage the Internet. In the meanwhile, its development has been incremental and the number of services and applications are growing more and more.

The satellites offer clear advantages with respect to cable networks. The architecture is scalable: a new user can join a satellite communication by acquiring the necessary technical instrument, no area shall be cabled to get the service. The diffusion throughout the land is wide: a satellite network overcomes simply the geographical obstacles, which will make difficult the installation of a cable network of equivalent quality; moreover the satellite can cover isolated areas. The bandwidth availability: satellite bandwidth, in particular in the Ka-band (20-30 GHz), which is the object of many experiments and also the object of the tests reported in this contribution, is less affected by congestion than terrestrial networks. The multicast service is very simple, being the satellite inherently a broadcasting tool. Finally, satellite links are often private lines, unlike submarine and overland networks. A private network has the advantage of being managed by few people so to avoid many problems about the property and managing of different portions of the network. As a consequence it offers the opportunity to apply efficiently control mechanisms and algorithms. In this context, the convergence between the Internet and the satellite communities represents a real opportunity to offer QoS-guaranteed user services.

Different approaches have been proposed in dependence of the functional level where to act: the network level (IP - Internet Protocol), the transport level (TCP - Transmission Control Protocol) or the application level. IP is implemented hop-by-hop and it is responsible for switching and routing data throughout a network. The first step to obtain a QoS-guaranteed network based on TCP/IP is to enhance the IP features to offer different services to single traffic flows or to groups of traffic flows. Two different approaches have been introduced: Differentiated and Integrated Services. The latter uses a signaling protocol called ReSerVation Protocol - RSVP to communicate the bandwidth reservations.

Transport protocols, such as TCP, act on end-to-end basis; as a consequence, they permit some flow control but they cannot guarantee specific requirements to each flow. Nevertheless, their modification and adaptation is precious and may really increase the efficiency of the communication and the quality perceived by the users, in particular in satellite networks.

Approaches acting at the application level are affected by the same drawbacks: they allow setting all the parameters at application level but delegate the control problem to the network borders (end-to-end). They cannot guarantee any precise requirements but only adjust the amount of traffic entering the network. They are very important because they often take into account the real quality of service perceived by the users (Perceived – Quality of Service, P-QoS), which is frequently ignored when objective metrics are adopted. The problems envisaged are made worse if a portion of the path is composed by Geostationary Orbit (GEO) satellite links, whose round-trip delay and general characteristics heavily affect the performance of the protocols at every functional level.

TCP (or UDP - User Datagram Protocol, a simple protocol of the same stack, for audio and video transmission) has been chosen as transport protocol for the application environment described above. TCP has not been designed for a GEO satellite network environment: the high delay to receive acknowledgements decreases performance and

makes the quality perceived by the users really poor. Possible solutions to improve performance of the protocol over satellite links may be applied.

The contribution describes the activity performed in the three-year project "Integration of Multimedia Services on Heterogeneous Satellite Networks", funded by the Italian Space Agency (ASI) and carried out by the Italian National Consortium for Telecommunications (CNIT). The project is aimed at highlighting the problems, the findings and the solutions to utilize TCP/IP-based services and applications, as audio-video transmission and web browsing, via satellite channels.

The project uses an experimental approach to provide Quality of Service (QoS) guarantees and to improve the performance of the TCP (Transmission Control Protocol) over a satellite network based on the TCP/IP suite. The aim is to obtain a proper environment for data, voice and video transmission oriented to a Distance Learning service that uses both audio-video applications and web-based tools. The experimental scenario is made up of three remote LANs (Local Area Networks), located in the cities of Firenze, Genova and Pisa, and it is shown in Fig. 1. Two of them are connected through a Geostationary Orbit (GEO) satellite link in the Ka-band (20-30 GHz). The other LAN, located in a site where no satellite station is available, is connected through an ISDN (Integrated Service Digital Network) link at 512 kbits/s.

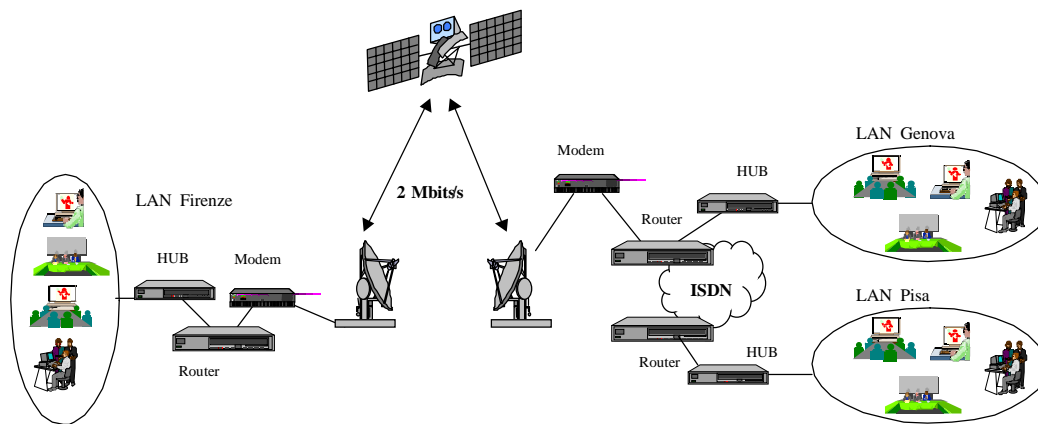


Figure 1. Network scenario.

The Integrated Services approach along with the ReSerVation Protocol (RSVP) has been chosen to reserve the network resources at IP (Internet Protocol) level. A modified version of the TCP has been proposed and utilized to reduce the download time during web browsing and ftp sessions. The measures reported have been obtained by real operative sessions.

A Mean Opinion Score (MOS) metric has been used to evaluate the performance of the system and to get proper configurations able to guarantee a high quality of service perceived by the users (P-QoS – Perceived Quality of Service). Fig. 2 summarizes the most important results obtained. The overall Distance Learning service is evaluated by measuring the QoS perceived by the users both concerning the audio-video transmission (on the left in Fig. 2) and the web browsing (on the right).

Two QoS-oriented solutions (Integrated Services with RSVP, for the IP layer) and a modified version of TCP (concerning the transport layer) have been utilized. The videoconference service is evaluated versus the video bit-rate (128, 256, 384, 512 kbits/s). The web browsing is evaluated concerning both the overall service and the two separated components: file transfer and image download.

The difference in the user perception and the improvements obtained may be seen in the graphs.

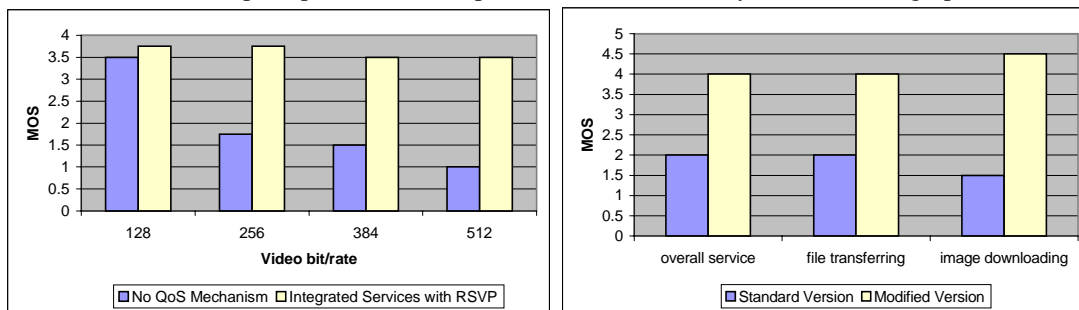


Figure 2. Distance Learning: P-QoS evaluation of videoconference and web browsing.

SSC COMMITTEE MEMBERSHIP APPLICATION

You can participate in the SSC Committee as a member by attending the SSC Committee meeting which is held twice a year during ICC and GLOBECOM conferences or you can participate as an associate member by filling in and mailing the application form below (preferably send an e-mail with the same information). Please note there is no difference between a member and an associate member except that an associate member has never attended an SSC Committee meeting.

The members and associate members can receive various information through the SSC newsletter and on our web page at www.comsoc.org/socstr/techcom/ssc, and also may propose hot topics, workshops and tutorials as well as provide paper reviews for conferences and publications. The members and associate members may provide regional conference / workshop information to the Editor which may appear in the SSC newsletter and on our web page if it is applicable to the committee's charter.

Place
Stamp
Here

Dr. Abbas Jamalipour

**School of Electrical & Information Engineering
The University of Sydney
Sydney NSW 2006, AUSTRALIA**

Tel: +61 2 9351 2843
Fax: +61 2 9351 3847
E-mail: a.jamalipour@ieee.org

Name _____

Title _____

Affiliation _____

Business Address _____

Tel _____ Fax _____ E-mail _____

Paper topics you would like to review (optional) _____

Please Note: Your contact information will appear on our web page unless requested otherwise.