



*QUALIFICATIONS AND MATERIALS USED*

1. My name is Edward W. Felten. I am Associate Professor of Computer Science at Princeton University, where I have taught for six years. I received my B.S. from the California Institute of Technology in 1985 and my Ph.D. in Computer Science and Engineering from the University of Washington in 1993.

2. I have been involved in computing research since 1984. I have published more than fifty articles in the computing research literature, and two books. I have won awards for my research, including a National Young Investigator award from the National Science Foundation, and an Alfred P. Sloan Fellowship. I received an Outstanding Paper Award at the most recent Symposium on Operating Systems Principles, the most prestigious operating systems research conference.

3. My fields of specialization within computer science include operating systems, Internet software, and Internet security.

4. I have been using the Internet personally since 1984. At Princeton I have taught several courses related to the Internet, including (three times) a senior-level Distributed Computing and Networking course that focuses on how the Internet works and how Internet-enabled operating systems are constructed. I have led several research projects, supported by the National Science Foundation, other government agencies, and companies such as Microsoft, Sun Microsystems, and AT&T, related to Internet technology.

5. I have been asked to provide expert opinions on the nature and structure of the Internet, the nature and structure of Usenet groups, open source software development methodology as practiced by the Open Sesame group and other comparable groups, the extent and nature of the participation of commercial enterprises in open source software projects, and related topics.

6. In addition to the documents and Web sites cited in this report, my analysis relied on the Web sites of all companies mentioned in this report, the Internet standards documents relating to Usenet, and the contents of the *comp.os.linux.development.system* newsgroup.

### NATURE OF THE INTERNET

7. The Internet is a global network of computers constructed by patching together many local area networks that use widely varying communication media such as telephone lines, dedicated data cables, and wireless links. The Internet is characterized by its global scope and by the use of certain standard data formats and protocols such as the Transmission Control Protocol and the Internet Protocol (together, "TCP/IP") that ensure that any two computers on the Internet can exchange information with each other.

8. The Internet serves as the basic communication infrastructure for a wide range of electronic information services and activities, including electronic mail, electronic discussion groups, teleconferencing, and remote access by traveling workers to institutional databases.

9. "File transfer protocol" (FTP) is an Internet protocol that allows one computer to make data files available so that any other computer on the Internet can get copies of those files. A computer that makes files available in this way is called an FTP server.

10. The Internet began in California, and it continues to have a very strong presence in California. A series of Georgia Tech surveys of the demographics of Internet users showed that in April 1998, 13.6% of all Internet users were located in California. In October of 1998, this percentage had increased to 14.4%. See *GVU's 10th World Wide Web User Survey* (visited Jan. 26, 2000) <[http://www.gvu.gatech.edu/gvu/user\\_surveys/](http://www.gvu.gatech.edu/gvu/user_surveys/)>.

### NATURE OF USENET

11. "Usenet is a collection of online discussion groups [also called newsgroups] that are accessible from a large number (at least tens of thousands) of Internet sites." *What is Usenet* (visited Feb. 26, 2000) <<http://usenet-addresses.mit.edu/usenet.html>>. An on-line discussion group is a repository of electronic messages collected under a designated name such as *comp.os.linux.development.system*.

12. Physically, a site is a computer connected to the Internet and running special message propagation software to make these

messages available through the Internet to interested subscribers. Such computers are referred to as newsgroup servers.

13. Users create and read messages in a Usenet group by using a software application called a "newsreader."

14. A user subscribes to a Usenet group by configuring his or her newsreader to retrieve from a newsgroup server all electronic messages for that discussion group.

15. Newsreaders typically present the messages in each discussion group in the same way as standard e-mail mailboxes, so that the user can view, save, and forward the messages, and even be notified when new messages for a particular discussion group arrive.

16. Besides viewing, a subscriber can use his newsreader to send or "post" a message to a newsgroup by creating a new message and asking the newsreader to send it to that group. Whether or not the message is added immediately to that discussion group's repositories depends on whether the newsgroup is moderated or unmoderated, as discussed below.

17. Subscribers may choose whether or not to reveal their real identities when posting to a newsgroup.

18. Newsgroups are given names which usually indicate a topic of discussion. For instance, the *comp.os.linux.development.system* discussion group contains messages related to the development of the Linux operating system.

19. A newsgroup name is a series of text strings, separated by periods. The names form a hierarchy. For example, newsgroups whose names start with "comp" have to do with computing, newsgroups whose names start with "comp.os" have to do with computer operating systems, and so on.

20. Newsgroups can be used as repositories of information (in the form of messages). This information may contain Web addresses (URLs) or other references to material available on-line by FTP or other means.

21. Newsgroups are made available to millions of individuals via the process of message propagation. The process works as follows: each newsgroup server has a list of newsgroups it "carries." This list is simply a set of newsgroups of which the administrators of that server choose to keep track. A newsgroup server may also know the Internet addresses of other newsgroup servers. If two servers know

each other's Internet addresses and have at least one discussion group they both carry, then they negotiate a message exchange link such that any message posted to the common discussion groups on either one are also forwarded to the other.

22. For example, if two newsgroup servers, *A* and *B*, have a newsgroup message exchange link set up and both carry *comp.os.linux.development.system*, then when a subscriber to *A* posts a message to *comp.os.linux.development.system*, this message will be added to the repository on *A* and automatically forwarded to *B*, to be added to its repository. This process works in a slightly different way for moderated groups, but I omit the details since none of the groups discussed in this report are moderated.

23. A message posted to a newsgroup on one newsgroup server will spread from server to server across thousands of individual message links, until it has reached every newsgroup server in the world. Thus, a message posted anywhere in the world is available worldwide.

24. There are thousands of newsgroups on the Internet. Anyone with a computer that is connected to the Internet, and has newsgroup server software installed on it, can create new newsgroups and can decide which other groups he or she chooses to carry.

25. The mere fact that someone has created a new newsgroup does not mean that the new newsgroup will automatically be carried by all the other newsgroup servers in the world.

26. However, there is a common set of newsgroups that are carried by the majority of newsgroup servers in the world. This set is sometimes referred to as the "standard" Usenet newsgroup hierarchy. These are the newsgroups whose names begin with *comp*, *humanities*, *misc*, *news*, *rec*, *sci*, *soc*, and *talk*. See Greg Woods, *Guidelines for Usenet Group Creation* (visited Jan. 27, 2000) <[ftp://rtfm.mit.edu/pub/usenet/news.groups/How\\_to\\_Create\\_a\\_New\\_Usenet\\_Newsgroup](ftp://rtfm.mit.edu/pub/usenet/news.groups/How_to_Create_a_New_Usenet_Newsgroup)>.

27. Because the newsgroups in the standard hierarchy have such a wide distribution, there is a formalized process for adding a new newsgroup to that hierarchy. This is a multi-step process that involves voting by members of the Usenet community, as discussed below.

28. Individuals who wish to create a newsgroup without going through this formalized process may create an "alternative group," whose name usually begins with "alt." Any single individual may create an alternative group without requiring approval or assistance from anybody. Alternative newsgroups typically have a limited scope of distribution because of the practical difficulty in convincing other newsgroup administrators to carry them.

29. If a small group of people wants to communicate via Usenet, the most convenient way to do this is to set up an alternative newsgroup and then configure each of their newsgroup servers to carry that newsgroup. The effort required to set up a newsgroup in the main hierarchy is only worthwhile if the group is expected to be large and geographically dispersed.

30. A newsgroup can be moderated or unmoderated. For unmoderated newsgroups, any message posted to the newsgroup is immediately propagated to all the servers that carry the newsgroup. On the other hand, each moderated newsgroup has a member, designated as the moderator, who must approve any message before it is propagated to the group.

31. The methodology for creating a newsgroup in the standard hierarchy is defined in a document entitled "How to Format and Submit a New Group Proposal." A party interested in forming a new newsgroup in the standard hierarchy must:

1. Post a Request For Discussion (RFD) proposing the creation of the newsgroup to *news.announce.newgroups*, *news.groups*, and any other newsgroups or mailing lists at all related to the proposed topic. The newsgroup *news.announce.newgroups* is a moderated newsgroup. The proposal must follow a designated format and must include at least (a) a proposed newsgroup name, (b) a charter that describes what topics should be discussed in the newsgroup, (c) the name and e-mail address of the proposed moderator(s), or a statement that the newsgroup will be unmoderated, and (d) proposal sponsor information that includes the names and e-mail addresses of all the proponents of the proposal.
2. Allow thirty days for discussions of the particulars of the proposed newsgroup.

3. Post a Call For Votes on *news.announce.newgroups* and all the other newsgroups and mailing lists on which the RFD was posted.
4. Arrange a neutral vote taker to collect and count the votes.

See *How to Format and Submit a New Group Proposal* (visited Feb. 26, 2000) <<http://saturn.las.ox.ac.uk/internet/news/faq/archive/usenet.creating-newsgroups.rfd.html>>.

The voting period lasts at least twenty-one days and no more than thirty-one days. The vote taker posts the results on *news.announce.newgroups*. If at least two-thirds of the votes are in favor of creation and if the number of YES votes exceeds the number of NO votes by at least 100, then the proposed newsgroup is added to the standard hierarchy. Proposals that fail cannot be brought to a vote again until six months have elapsed since the previous vote.

#### *OPEN SOURCE SOFTWARE DEVELOPMENT*

32. An open source software (OSS) product is a software product that is made available free of charge, in source code form (and perhaps in other forms), to all parties who assent to a simple license agreement. There are many OSS products.

33. Open Sesame is an OSS product.

34. Other examples of OSS products include the Linux and FreeBSD operating systems, the KDE and GNOME graphical user interfaces, and the Apache Web server.

35. OSS products are typically developed through collaboration among a physically dispersed group of software developers.

36. The Internet plays an important role in the development of OSS products by facilitating collaboration among large, worldwide groups of software developers.

37. Because every user of an OSS has the source code for the product, users can modify the product (or hire someone to modify it) in order to improve it or fix flaws in it.

38. Users who have improved an OSS product are typically encouraged to contribute their improvements to the product so that others may benefit from them.

39. Typically, a small group of volunteers provides quality control for an OSS product by examining the modifications contributed by members, and designating which of these modifications are to be included in the next version of the product.

#### *SIMILARITIES BETWEEN OPEN SESAME AND LINUX*

40. The organization of the Open Sesame group follows the typical pattern described above. In the case of Open Sesame, modifications are contributed, and official versions are released, by sending messages to the *comp.os.open-sesame* Usenet group.

41. Open Sesame is also made available on an FTP server that is accessible from anywhere in the world. When a new version of Open Sesame is made available on the FTP server, this fact is announced via a message to the *comp.os.open-sesame* newsgroup.

42. Like Open Sesame, the group developing the Linux operating system follows the typical organization for OSS product developers, as described above.

43. The main difference in organization between the Open Sesame and Linux groups is that the members of the Open Sesame group go to unusual lengths to maintain their anonymity.

44. Most Usenet messages, with the possible exception of messages on controversial or fringe groups, reveal the identity (i.e. the real name) and the sponsoring organization of the person who wrote them. For example, if we examine the 434 messages most recently sent (as of October 14, 1999) to the *comp.os.linux.development* Usenet newsgroup (the closest analog to *comp.os.open-sesame*), we find that 93.3% of the messages reveal the identity of their author.

45. By contrast, members of the Open Sesame newsgroup *always* hide their real identity and sponsoring organization.

#### *MOTIVATION FOR OPEN SOURCE OPERATING SYSTEMS*

46. OSS products are attractive to commercial customers for several reasons. First, they can be freely modified by each customer to meet that customer's needs, with no need to wait for the product's vendor to do anything. Second, customers can quickly benefit from

improvements made by other customers.

47. OSS products provide many profit-making opportunities to software developers and others in the computer hardware and software businesses.

48. For example, Linux has a very significant commercial impact. There is a large and growing commercial sector devoted to Linux.

49. Computer manufacturers profit from Linux by selling computers with Linux and related software pre-installed. Examples include companies that specialize in Linux-based computers, such as VA Linux Systems and Telenet Systems, and larger computer makers such as Hewlett-Packard.

50. Several companies profit from Linux by selling a bundle containing Linux, other software, documentation, and a specialized installation facility, and by providing support to customers in the process of installing Linux. Examples of such companies include Red Hat, Inc. and Caldera Systems.

51. Many companies profit from Linux by selling application programs designed to run on Linux. For example, most of the major vendors of business database software, including Oracle, Informix, and Sybase, offer versions of their products that run on Linux.

52. Companies like Cygnus Solutions profit from Linux by selling technical support services to users of Linux.

53. In the near future, companies will be making profits from Open Sesame in the same ways the companies listed above are making profits from Linux.

54. Companies that make profits from an OSS product have an economic incentive to contribute to that product. It is common for commercial enterprises (acting through their employees) to participate in the development of an OSS product.

55. Since the members of the Open Sesame group hide their identities, there is no basis for any claim that the members are noncommercial entities or are not motivated by profit. Indeed, given the size and apparent diversity of the group, the participation of commercial entities seems likely.

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