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19227

Distr.
LIMITED

IPCT.145(SPEC.)
13 November 1991

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

ORIGINAL: ENGLISH

v. 91 p

EMERGING ISSUES IN THE SELECTION AND DISTRIBUTION OF PUBLIC DOMAIN SOFTWARE FOR DEVELOPING COUNTRIES*

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* The views expressed in this document are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO. This document has not been edited.

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V.91 30760

Acknowledgements

The assistance of many professionals and users is gratefully acknowledged. Simson Garfinkel at MIT; Richard Salz of Bolt, Beranek & Newman (BBN); Richard Stallman and Robert Chasell of the Free Software Foundation; Paul Mayer, Bruce Robey, and Randy MacLean of the Association of Shareware Professionals; and the many network users who responded to the questionnaire, offered invaluable suggestions as well as insights into the complex world of public domain and freely distributed software. The responsibility for the contents of this report lies solely with its authors.

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ACRONYMS

BBS - Bulletin Boards

CSW - Commercial Software

email- Electronic Mail

FDSW - Freely distributable software

ftp - file transfer protocol

FSF - Free Software Foundation

FUSW - Free UNIX Software

PDSW - Public domain software

SHSW - Shareware

SW - Software

UUCP - UNIX-to-UNIX Copy Program

GLOSSARY

backbone computer	A major switching computer on a network.
electronic mail	Transmitting files from one computer user to another, usually via communication lines.
file transfer protocol	A protocol that allows a computer user to transfer a file from one computer to another.
gateway	A computer which passes information between machines on different networks
host	A central network computer accessible by other computers on the network.
network	A collection of computers connected in such a way as to allow information to be passed easily from machine to machine.
site	A geographic location where computers are located within an organization. Also often refers to the host computer itself.
TCP/IP	A pair of networking protocols usually used together. TCP is the Transmission Control Protocol and is a standard protocol for transferring information from one computer to another. IP is the Internet Protocol and is a standard protocol for managing connections between one computer and another.
UUCP	A software communications protocol as well as a set of communications programs.
UNIX	A portable multi-user operating system.

EXECUTIVE SUMMARY

Public domain software (PDSW) and freely distributable software (FDSW) could prove important competitive and educational assets as software becomes an essential productivity tool in international competitiveness and a key element in societal learning processes.

This report provides methodological guidelines for establishing an inventory of PDSW distribution points in industrialized countries that could be linked with users in developing countries. By replicating the decentralized nature of organization and distribution of software in the industrialized countries it is hoped that 1) end-users in both developing and industrialized countries will communicate more efficiently, thus facilitating information exchange, debugging, and customization of software as well as learning; and 2) administrative costs will be lower.

Suggestions and recommendations include:

1) Direct links should be set up between key distributors of public domain and freely distributable software in the industrialized countries, and clearing houses and end-user groups in the developing countries.

2) Clearing houses in developing countries should be regionally-based and staffed by local software experts in close contact with business, government, and academic institutions.

3) These clearing houses should encourage contacts among end-users, thus promoting learning and improvements in the software. Efforts should be made to establish bottom-up regional and local networks by providing basic gateway, and low-cost trunk and distribution communication lines.

4) Clearing houses and user groups in developing countries develop catalogues of PDSW which include a description of the program as well as the requirements for using it (operating system, hardware, etc.).

5) The bulk of distribution of PDSW and FUSW will be through the mail given the limited availability and cost of telecommunications networks. Much of the communication among end-users of the software, both internationally and nationally will take place through computer networks, whenever possible. The speed and facility of discussion on networks facilitates communication and learning.

1. Introduction

Over the past decade, as a result of the rapid decline in cost and increase in performance of microprocessors, and the consequent diffusion of microcomputers, the importance of computers in the realization of economic activities has continued to increase. As computers become more widely diffused and penetrate new economic and social activities, people have come to realize the crucial importance of software both for the efficient and effective utilization of computers. However, as computer hardware becomes more of a commodity, the software market has acquired greater strategic importance for both firms and nations.[1] This trend is leading to higher value being placed on software, as firms seek to acquire greater competitive advantage and higher profit margins through software; and as industrialized nations promote stricter control of issues of intellectual property and copyright and launch programs to turn communication and computer networks into strategic national assets. It is against this background that the importance of public domain software for developing nations has to be assessed.

An informal e-mail survey was conducted as part of this project among network users in several industrialized nations and a few newly-industrializing countries. The results reveal that among the main reasons for utilizing freely available software are its quality, cost, availability, functionality and easy of use. Technically-proficient users also singled out access to source code as an important reason.

The major pitfalls are identification of right program, uneven quality of maintenance, reliability, and minor bugs. Users in NICs and Western Europe singled out network connectivity as a major problem both for figuring out what is out there as well as for speedily retrieving programs.

This report examines the characteristics and dynamics of public domain and other low-cost software in the industrialized countries as well as their organization and distribution points. The objective is to propose a set of methodological guidelines for establishing an inventory of public domain software available in industrialized countries as well as to suggest the structure and operation of a clearing house for making the sw available to developing countries.

The conclusion is that the decentralized organization and distribution of the software in the United States [and to a lesser extent Western Europe] contributes positively to the dynamic of the markets -- more specifically, the update, debugging, and customization of publicly available software. Although the distribution is very decentralized, there are key points in the system that act as information clearing houses.

2. Suggestions and Recommendations

Based on the experience of industrialized nations with the selection and diffusion of public domain software and in the light of the

perceived needs and of the technological context of the large majority of developing countries, which either lack affordable high-speed communication and computer networks, our suggestions for transmitting public domain and inexpensive software to the Third World and our recommendations for future research are:

1. That key distribution points in the industrialized countries establish direct contact with distribution points or representative clearinghouses in the developing nations with as little intermediate intervention as possible. It is hoped that such a system will also lower administrative costs and will reduce the amount of "noise" in the communication between the developing country final user and the sw provider.

2. The clearinghouses would preferably be regionally-based, would make use of existing local computer networks and international links, and would be preferably staffed by local software experts in close contact with industry, government at different levels, and academic & educational representatives from a broad array of economic and social activities, so as to insure that the local software needs of industry and society are well defined and provided for.

3. Communication among end-users should be strongly encouraged and facilitated. If possible directly, or as second-best option, through the diffusion by the clearinghouse of open, non-mandatory, lists and directories of users of software performing similar functions. These

periodically updated directories could have users' evaluations of programs strengths, weaknesses and major problems. The clearinghouse experts could relay doubts and contributions to user groups and bulletin boards in industrialized countries networks. This arrangement would make distributing and updating the software more efficient and effective, at the same it would create an internal learning effect among end-users in developing countries. Incentives for the formation of vertical and problem-oriented user groups should be given.

4. The actual distribution of public domain software to developing countries' final users should take place primarily through the mail and in some cases, when widely available and costs are low, through national computer network systems such as bulletin boards or national software libraries.

5. In light of the widespread interest on the part of international and regional agencies on issues of diffusion and use of computer databases and networks in developing countries there already exist a number of sector-specific networks (academic R&D, health, space, physics, communications). In a few cases, this virtual networks have begun experimenting with the distribution of public domain software. There is therefore a need to coordinate and learn from these experiences as they develop, assessing their advantages and shortcomings. It is suggested that in certain network-poor areas some of these pre-existing networks could be employed as trunk lines for regional clearinghouses at a lower cost than that of developing dedicated

networks.

6. In addition to the diffusion of computers, efforts should be made to encourage the establishment of bottom-up regional and local networks. This can be achieved through the provision of basic gateway services and low cost trunk and distribution communication lines. At the next stage, efforts should be made to allow for regions in different countries with similar industrial structures and/or social needs be connected in order to enhance the diffusion of public domain software and the learning effect of modifying, and eventually developing software.

7. Identification of actual and potential patterns of software usage and diffusion bottlenecks in developing countries should be carried out through cross-national sectoral surveys as well as through the establishment of few integrated national software diffusion maps. This information would contribute to the design of FDSW distribution strategies complementary to with existing commercial channels.

8. Typically, academics and other R&D personnel are the first to acquire any experience with FDSW in developing countries through their participation in generic (Bitnet, Internet) or specialized networks. An in-depth assessment of their unique usage pattern could provide valuable insights for the extension of their experience to other societal groups in developing countries. The questionaire as well as the developing countries network lists developed in the course of this

report research could serve as the basis for future research efforts in this direction.

9. An assessment could be made of existing programs for the diffusion of FDSW in vertical markets important for developing countries such as the educational market and the Scholastech (page 19) experience. Because these experiences often faced material obstacles similar to those found in developing countries, important lessons can be extracted from them.

10. In the long run, a central database such as Archie (page 29), could be developed, incorporating elements from the initial pattern of FDSW distribution and usage in selected developing countries. The aim would be to provide a speedier and more customized answer to specific developing countries' software needs and to avoid the emergence of duplicate efforts within a same geographical region or country.

3. Structure of the Report

The first section of the report defines and compares the different kinds of free and low cost software available in industrialized countries and briefly discusses their scope and applicability in developing countries. Freely distributable software (FDSW) includes a variety of software that can be copied, distributed, and used by anyone. Public domain software (PDSW) is the most common FDSW and its use and distribution are virtually free of restrictions. However,

there are other kinds of FDSW, often available free-of-charge or at nominal fees, whose use and distribution carry restrictions.

The second section of the report discusses distribution methods in the US and Western Europe, which have centered on computer networks such as distributed bulletin boards; user groups; university and government computer center software libraries, mainly for the scientific and technical communities; and mail for the general PC users as well as those transmitting very large amounts of data.

The third section discusses the applicability of these distribution methods in developing countries, based on their performance in the industrialized countries and taking into account the diverse needs, economic contexts, and communications infrastructure of developing nations. The report suggests that in the near future the mail system will be the primary source for diffusing software data and information, while computer networks will be used for identifying and transmitting the software as well as follow-up work such as debugging, updating and customization. In the short to medium term, computer networks are more likely to be used by the academic, central government and large business communities.

A fourth section will discuss other related issues including the logistics issues pertaining to the use and transfer of inexpensive software to the Third World -- hardware, operating systems, language and cultural barriers, business and social practices, and a compensa-

tion system for small amounts of money involved in distributing software.

4. Toward a Typology of Public Domain Software

There are three basic types of software: commercial software, freely-distributed software (FDWS), and public domain software (PDSW). Commercial software (CSW) is software that has legal protection guaranteeing the rights of the author, the company, or the organization that sells it. CSW cannot be copied without permission and does not provide access to the source code. It is typically much more expensive than the two other types. At the other end of the spectrum is what is generically called PDSW, which in fact encompasses several types. In its purest form, the cost of PDSW is generally limited to distribution expenses.

In light of the shadings from one type of software to the next it is more appropriate to generically define PDSW as freely distributed, inexpensive or free software. Freely distributed software (FDSW) is software that can be freely distributed by anyone, although its use may carry restrictions. The FDSW with no restrictions attached whatsoever is called public domain software (PDSW). Other types of FDSW carry different types of restriction, although these restrictions may often enhance rather than limit its distribution. Within this latter category, two types of software have become more predominant and organized, although there are still other types available. Two of

the more common types of sw include shareware (SHSW) and free UNIX software (FUSW).

In recent years, PDSW moved further from its hobbyist and hacker roots, as the majority of smaller computers users are now businesses. Yet, most of the software in use today is CSW. In contrast, much of the PDSW written over the past few years has been the result of specific projects and it was written for a defined purpose. Since the source code of the most popular operating systems and basic utilities (spreadsheet; wordprocessing, database) is generally not available, most of the PDSW is being written with an aim towards enhancing the ease of use and functionality of these programs and in areas where market demand is too fragmented to justify the development of commercial products. As the software market becomes more commercialized and standards begin to play a greater role, user-supported software authors increasingly rely on shareware-semi-commercial arrangements to diffuse their products. There are, however, important initiatives in the technical segment of UNIX-based systems toward less commercialized and more open software markets.

4.A. Public Domain Software

Public domain software (PDSW) belongs to the public domain which is defined as "the realm embracing property rights that belong to the community at large, are unprotected by copyright or patent, and are subject to appropriation by anyone."[2] In other words, PDSW has no restrictions attached to it and is generally free. Any fees charged usually reflect costs in copying and diffusion, i.e cost of diskette or tape.

There are many kinds of PDSW for virtually every type of hardware and operating system although not all programs are available on all hardware/operating systems. The most popular tend to have the largest number of PDSW available. Often, more-technically oriented operating systems appear to initially generate a greater number of language- and utility-related PDSW given the technical proficiency and greater communication among their users, who share information.

As a general rule, PDSW programs are utility programs. That is, programs for system-related tasks such as making an operating system run smoother or quicker, transfering files (XMODEM; ftp) to organize a directory, or to provide communications to a network (KERMIT; PROCOMM) rather than specific applications (word-processing, spreadsheets, databases). Yet, there is task and function-oriented PDSW for systems with greater public appeal: TxT, a powerful wordprocessing; and a Logo language, in which source codes are often available. Games are also a popular category of PDSW as are valuable add-ons to

existing popular functional programs (Lotus 1-2-3, dBase, PostScript). Adds-on make the program easier to use, give it new capabilities, increase its speed, or permit changes to be made in its interface. These include templates and command files, for example to send printer commands.

PDSW can be copied and used by anyone for any purpose. Some people might take public domain software, package it, and sell it to unsuspecting users who did not know that the same program was available free of charge. While this is not illegal it is considered a moral breach by the sw community. Other people might change or modify a public domain program and sell it as proprietary or commercial software, a risk that is enhanced in developing countries due to the lack of general user access to wider information about types of software. Yet, by changing and then selling the sw, the producer is taking on a variety of responsibilities regarding quality, documentation, and support, which some argue overcome the fact that PDSW is incorporated into the program.

In industrialized nations, particularly in the United States, PDSW is easily available through a variety of sources. These include bulletin board systems (BBSs), local computer clubs (New York Amateur Computer Club), non-profit organizations (SIG/M for CP/M; Macintosh Special Interest Group), software libraries, academic and governmental computer centers, computer societies and associations (e.g. Boston Computer Society; San Diego Computer Society), user groups (Phoenix,

Arizona IBM-PC users; CBASIC; MS-DOS), interest-specific groups, computer retail stores, small companies, computer company-sponsored groups, user group's archives (uunet; Young Minds), public libraries, commercial services (CompuServe; The Source; The Well) and schools to name a few of the most common outlets.

User-groups are organized along a multiplicity of categories - hardware-type, software-type/function, application-type, function-type, language-type, hobby- specific user groups[3]. Many of these put out electronic lists or publish catalogues of PDSW, which are updated periodically. Altogether there are over a few thousand different individual outlets from which PDSW can be obtained. The channels available in each source, the services provided, the quality of the documentation, the ease of obtaining, and the basic costs vary within a small range. Generally a program is available from these outlets with some kind of documentation. At one extreme, some companies might charge a small fee for access to their collection, but may also provide a free demo or sample disk. At the other extreme, academic computer centers offer PDSW that has to be retrieved electronically through computer networks or communication channels about which little information is initially provided, making its identification and evaluation problematic for non-technical users. Some limited support (e.g. start up documentation) may be available from the author, a BBS, or other users, which may require a certain degree of effort on the part of the user in identifying the other right users or the appropriate conference group. As a general rule, however, there are

no formal support systems.

Most PDSW emanates from people who have written programs for their own use and then believe that they may be useful to others. Rather than undergo the burdens related to commercially launching their programs, they put it in the public domain. Others write PDSW because they enjoy it. Some of these people are also motivated to fight against CSW that does not permit users to modify it. The bulk of PDSW, however, comes with little printed documentation. Often authors will include a telephone number and address for support, which may be free or available at a nominal cost.

While PDSW is generally identified on a bulletin board, a computer club list, a review in an interest-specific conference, or a reference in a network discussion, it is usually obtained in the form of diskettes or tapes through the mail, following prior identification. In the past, access to networks was limited to the possession of a costly modem and restricted by cost and quality of telecommunication lines. In recent years, a few academics and certain professional categories have gained increased access to multitudes of interconnected networks. Today, file transfer programs (ftp) allow users to directly access PDSW lists and retrieve programs, in compressed on uncompressed form, and directly from file archives and libraries, both public and private. User groups and other non-profit organizations may charge nominal fees for processing the requests. Commercial ventures may package and improve PDSW and sell either complete

libraries, individual programs, customized programs, or even charge for time of access to their library over phone lines or networks. This latter type is often referred to also as shareware or freeware.

While PDSW may exhibit more problems than csw at the outset, over the long run it might evolve into a product superior to its commercial counterpart. The major problems with PDSW stem from the fact that because they are not commercial products they may not have been as extensively tested. Therefore, a new PDSW program that has not been widely distributed and used is likely to have bugs and small program errors, i.e. hitting a key outside the program capabilities that may disable it.[4] PDSW programs at times may not run on certain versions of operating systems or certain equipment, as they were tailored to run on a particular version or a specific piece of hardware. These problems, however are often counterbalanced by the diversity of support that can be obtained which in the long run makes that popular PDSW because they have been tested and modified by a much greater number of user than commercial equivalents, and thus exhibit superior quality and easy of use.[5] User groups and other organized sources check every PDSW submitted at least once, and will often write short reviews or make small initial improvements.

4.B. Shareware (SHW)

Shareware (SHW) refers to a low-cost or free-of-charge arrangement for distributing software. Under the shareware concept, sw can be freely

copied and passed along to others, or distributed through bulletin boards. SHW, is generally written for personal computers of all brands (PCs), but is rarely written for Unix.[6] SHW is often described as "try before you buy." The author retains the copyright of his/her software but permits copies to be made so that anyone might try it. If a user likes the sw, s/he is expected to register with and pay the author a fee which generally ranges from about US$ 20.00 to US$ 100.00. By registering with the author, the user will usually obtain more complete documentation, a degree of support, as well as a channel to obtain knowledge about solutions of bugs and, more importantly, updates.

The main advantages of the shareware system are that it allows the user to try the sw before paying for it; gives the user an organized access to a much broader base of available programs, and is substantially less expensive than most similar commercial programs. While shareware is based on the honor system it is not free software.

SHW, as a general rule, does not include the source codes (like most commercial software). As a result, it may be difficult for the user him/herself to iron out bugs in the sw or customize it. In comparison to CSW, however, it is easier to contact the author. Because the SHW distribution system is more informal than that of CSW bugs may be ironed out more quickly. Shareware can be compared to commercial software in the following manner. If SHW is bought from a vendor (which usually charges US$1.00 to US$ 6.00 per disk) or directly from

the author (through a recommendation from the trade association, for example) the SHW may well be of equal or even better quality than its commercial counterpart. Some commercial vendors of shareware may also provide some support. This support could be as good as that offered by a commercial sw package with the exception that the user is likely to talk directly with the author or someone who has worked on the SHW. SHW can also be freely copied and passed on to friends. While this would be illegal with commercial sw, SHW producers encourage it as a way to divulge the sw. It is essentially a free distribution network for the SHW producer. Of course, if a user likes the program, s/he should register with the author and pay the fee.

If SHW can match many of the benefits of commercial sw, then why do the authors not set up commercial production and distribution? The most common reasons are that authors do not have the expertise, time or capital to set up commercial operation -- overhead, marketing, distribution, and advertising are expensive. They do not sell their sw to a commercial venture because they want to keep the rights over it and believe that they can make money through the SHW distribution system.

The most successful shareware typically has a mass appeal in terms of functionality, it is low cost, offers some sort of support (telephone or good documentation) and has been around for a while. The quality of SHW is attested to by the fact that in the North America, as well as in Brazil, where it has been divulged only over the past couple of

years, many users are businesses, large and small, and a variety of educational and social organizations.

SHW authors may offer additional regular support at an extra fee. As shareware programs become very popular, their authors develop a distribution system closer to that of traditional commercial vendors. Thus, PC-File's latest version, a popular shareware database, is sold through software retail stores and, for a fee, will provide telephone support to new buyers.

4.C. Freely-Available UNIX-based software

Freely-available UNIX software (FUSW) is principally designed for minicomputers and workstations, and increasingly for PC networks, local and regional. Most of the software distributed in Unix networks is of the type that the author retains the copyright, and the ability to control it.[7]

There is very limited FUSW programs based on the shareware production/distribution system.[8] FUSW programs are mainly computer system administration-level and utility programs.

Among the best-known and highest quality FUSW is that of the Free Software Foundation (FSF). Its founder, R. Stallman, encourages software from the foundation to be freely copied and distributed with source code. Furthermore, FSF sw is "copylefted." This means that it

can be changed, but it cannot be sold. Once it is incorporated into any sw, that sw cannot be copyrighted. While some argue that this may eventually hamper the widespread adoption of FSF sw, FSF hopes that its quality and transparency (availability of source code) will make its use more widespread.[9] Stallman says that the "Free" of FSF refers to freedom, not price.

The FSF plans to develop sw that can replace and hopefully improve upon existing UNIX sw, thus allowing users to modify and improve the sw, as well as write with greater ease, because of access to source code, tailored applications. Part of this task has been accomplished: a program editor (GNU EMACS), a compiler (GCC) as well as other utilities have already been written. The group is working on a database, spreadsheet, and wordprocessing program which should be done in the next few years.[10] Much of the success of these utility programs stems from the availability of the source code which permits programmers from all over the world to improve and diffuse FST sw. GNU's ultimate objective is to allow anyone to run a Unix-compatible system free and have the source code as well.

Another source of FUSW is the UNIX-like software produced by Berkeley's Computer Systems Research Group (CSRG), which is arguably freer than that of FSF. CSRG's efforts have been directed at rewriting the source code for UNIX, still controlled by AT&T, and making it available without any restrictions whatsoever to individuals, companies and organizations which in turn can modify and resell it without providing

the source code to the final user.[11]

There are other sources of free UNIX software which may hold varying types of restrictions.[12] These sources are available through a few hundred archives and the programs are extremely varied. As a general rule, UNIX users are connected to some kind of BBS, and corrections and tips regarding the use of the software flow much more quickly and freely than they do in the commercial realm. Because users of FUSW are more technically proficient than the average computer user, programs are more complex and the dialogue among users more sophisticated.

4.D. Courseware & Government-produced Software

Another type of inexpensive software is courseware, commercially produced educational software. Because the writing of courseware is often subsidized by foundations and other non-profit organizations, much of the courseware available is inexpensive or given to the public domain. Furthermore, because of its objectives documentation tends to be of high quality.

For example, a non-profit organization called Scholastech has been involved in public domain courseware for many years. As part of its mission, the organization develops an argument that PDSW and some shareware actually belongs in a democratic educational system. The organization has screened several PDSW programs and has developed and

given away a number of others with the objective of stimulating student creativity. Scholastech also has application-oriented objectives. Because educational budgets are often limited, schools often purchase second-hand equipment or accept a variety of equipment donations, which leads to incompatible hardware. Thus one of Scholastech's objectives has been to port courseware into different systems.

Government-produced or supported software is usually available for free or for a minimum set-up charge. However, to obtain this type of software one must qualify under the specific rules and regulations of the government agency in question. For example, the Center for Disease Control (CDC) has a library of PDSW in the area of epidemiology accessible to collaborating institutions and researchers.

5. Distributing PDSW

There are a multitude of distribution networks for FUSW, generically referred to as PDSW, in North America where the system is most developed. As a general rule they are organized by types of users, hardware, and/or applications. This discussion, however, will be organized by generic-type of software, consistent with the descriptions given above. While there are PDSW sources in most European countries, their access tends to be restricted to more technical users.

5.A. Distributing Public Domain Software

Public domain software (PDSW) is easily available in the

United States, Canada and Australia, and to a less extent in Western Europe (particularly the United Kingdom), through user groups, public libraries, schools, universities, stores that sell computer hardware and software, catalogue houses, professional group networks, and bulletin board systems. Some of the most popular sources of PDSW are university computer centers. Other non-profit organizations and government research institutes maintain large or specialized PDSW libraries which are accessible through the several academic and research networks as well as private services. For example, MIT's AI Lab maintains a library of PDSW for the area which is accessible even from Europe (**prep.ai.mit.edu**).

Another example is CERN, based in Switzerland, which maintains a library of PDSW programs for the high energy physics area (CERNLIB). There are over 450 packages offered in both source code and object code form, 80% written in FORTRAN and the remainder in assembly code. As mentioned above, CERN as many other organizations of its type has a strict set of regulations for access to its PDSW library. Collaborating institutions and university physics departments in member states can receive the programs and documentation free-of-charge. Commercial enterprises in member states may obtain the sw for a fee. Enterprises in non-member states or intending to use the sw for military applications are not permitted access to the library. The programs cannot be redistributed and CERN retains the copyright.

Probably the major source of PDSW, in binary and source format, for

microcomputers is the SIMTEL20., on MILNET.[13] SIMTEL20 is also accessible through an Internet bulletin board, Info-IBM PC, which is a forum for technical discussion of the IBM-and compatible-PCs. The library accepts donations of source codes as long as they do not carry any restrictions, i.e. no fees, contributions, licensing agreements are required or requested.

Every major non-profit computer network also has at least one PDSW library at its management site. Often there will be several libraries distributed over several sites. The three main networks are: BITNET, Internet and DECNet Internet. Other, virtual network such as USENET and UUCP-based networks are discussed below.

BITNET (Because It's Time Network), the worldwide academic and research network connecting academic institutions and collaborating research institutions, maintains a PDSW library. BITNET includes the U.S. and Mexican constituencies, NetNorth (Canada) and EARN (European Academic Research Network) and is composed of about 500 member institutions, with 100 new members added each year. Together they form a logical network that employs the same protocols and routing mechanism. All together the network serves over 6,000 computers in 35 countries, including the larger NICs such as Korea, Singapore, Taiwan, Hong Kong, Argentina, Brazil, Chile, Mexico, Colombia, Saudi Arabia, Egypt and the Ivory Coast.

BITNET sites are limited to communication through file transfer and

email. Files from its archives can be retrieved directly through ftp or a dial-up connection. Gateways exist to all other major networks. The BINET Network Information Center (BITNIC) maintains PDSW archives. Information about its archives as well as some PDSW that is not in BITNIC can be gleaned from over 1,000 discussion groups. PDSW files can be transferred on BITNET.

EARN, the associated European network, is already connected to the Ivory Coast and connections are pending to six Middle Eastern countries: Algeria, Cyprus, Jordan, Morocco, Syria and Tunisia. Two other participating developing countries outside EARN's geographical area are India and Pakistan. The network supports over 100,000 users connected by more than 800 nodes. EARN provides PDSW programs to enhance EARN usage. It also provides access and file transfer to other PDSW libraries through a specialized server (TRICKLE) for microcomputers stored at SIMTEL20.

Internet is a worldwide network which allows the transfer of email, file transfers between computers, and interactive logins between machines. Internet was from the very beginning a large structure connecting many smaller networks, a structure that persists today. Internet utilizes the TCP/IP transmission protocol. In fact, Internet today is a logical network connecting more than 2,000 networks. It includes wide-area networks, such as NSFNET, MILNET, CSNET and ESnet; midlevel and regional networks, such as the MRNet (Minnesota Regional Network) or THEnet (Texas Higher Education Network), NORDUnet and

SURAnet; and campus and organization local area networks, such as UTnet (Texas at Austin Network). Geographically, Internet links over 100,000 computers spread in networks in North America (including Mexico), Western Europe, Japan, New Zealand and Australia.

DECnet Internet is the name of a worldwide collection of autonomous but cooperatively managed, regional, national, and international networks based on Digital Equipment Corporation's (DEC) Decnet protocols. It is an important network for scientific and technical communities. The centerpiece networks include the U.S. Space Physics Analysis Network (US-SPAN) and the European High Energy Physics Network (E-HEPnet); and numerous university, state, national, and international networks, such as portions of the internordic network (NORDUnet) and portions of THEnet. Application services include email and remote file access and transfer, as well as interactive terminal-to-terminal communication. The specialized sub-networks maintain PDSW libraries with restricted access to participating institutions.

Other important network sources for the distribution of PDSW are the USENET virtual network, the microcomputer network FIDONET and several other regional, metropolitan, and professionally-focused networks throughout the United States and Canada. For example, USENET's PDSW libraries have specialized sections on different hardware and software types, including GNU.

In Western European countries, various sites have PDSW libraries,

often with programs from major global sources (such as USENET's comp.sources) and locally developed programs. One such site in the United Kingdom is at Lancaster University (LANCS.PDSOFT), on JANET, the United Kingdom Joint Academic Network. In Switzerland, the iam.unibe.cha has a good library of object-oriented programs, accessible through the Internet gateway to EARN.

UNESCO's Division of Software Development and Applications has also been developing PDSW, primarily for scientific and technical information systems. Several institutes in developing countries use UNESCO's CDS/ISIS, and information storage and retrieval system adapted to minicomputers and microcomputers.

A major source for obtaining PDSW, or at least more specialized information about it, are BBSs. There are hundreds of bulletin boards over the dozens of existing public, semi-public and private networks. Just about everything is discussed in these BBSs: from agricultural research, to biotechnology, to epidemiology, to social services, to computer science. There are BBS discussion or conference groups dedicated to specific types of hardware (IBM-PC; Amiga); operating system software (MS-DOS; UNIX); or languages (C; Assembler; Fortran). Some BBSs are organized geographically. For example, Brazilian, Argentine, Egyptian, and Indian students and researchers abroad maintain discussions with their home country and expatriate counterparts. Not all BBSs offer direct software downloading capabilities, but a majority of the larger ones do. Even if a BBS does not offer

PDSW directly, it is likely to provide information about new and interesting area-specific PDSW.

Regionally and locally, an important source of PDSW, particularly for IBM-PCs are user groups (Boston Computer Society is one of the largest). As a general rule, software from user's groups is sent through the mail, copied and passed around at meetings, or sent over BBSs through telephone lines and a modem connection.

5.B. Distributing Shareware

SHW is distributed principally through vendors, but also informally among friends and acquaintances. Conceivably, distribution could also take place through many of the same mechanisms as the PDSW. Vendors set up mail order businesses where they maintain up-to-date archives and send out copies of SHW for nominal fees.

There are about 500 vendors of SHW in the United States -- they charge anywhere from US$1.00 to US$ 6.00 to copy and mail a disk, and may also sell manuals of the most popular programs (PC-Write; PC-File).[14] The end-user is still responsible for registering with the author. Vendors do not provide follow-up.

The Association of Shareware Professionals is such an alternative source of SHW. It reviews the sw to make sure that it is not trivial (defined as a program that could not quickly be created by a program-

mer); creates and ensures contact with the SHW author for follow-up support; and consistent with SHW's "try before you buy" philosophy, makes sure that the program is not "crippled" which means ensuring that the the program can be fully tested. This avoids situations where the author might provide only part of a large data base's capacity and require the user to register before receiving the rest of the sw.

5.C. Sources of Freely Distributed UNIX-based Software

Bulletin board systems (BBSs) are an important part of exchanging information about, obtaining, and diffusing UNIX-based FUSW. The most popular BBSs and archives for FUSW are in USENET, an international distributed bulletin board and discussion network. USENET, a virtual network within Internet, has over one-half-million readers from 17 countries in all continents of the globe and routinely carries discussions on almost 400 topics, organized hierarchically into newsgroups, which send and process articles. In fact, USENET is a sort of multi-topic bulletin board which a user can access to contribute and retrieve information, including PDSW. Participants from other networks, such as BITNET or UUCP (through UUNET, for example) may also access USENET, but direct retrieval of PDSW files is often time consuming and erratic.

USENET's **alt.sources** and **comp.sources** archives contain thousands of FUSW programs. The FUSW programs in these archives, and more special-

ized ones such as comp.sources.unix are also available from a variety of sites in the United States and Western Europe. Some sites will mail tapes. Solutions to bugs and upgrades are posted in comp.sources.bug or are relayed in the newsgroups.

The only costs associated with USENET are the communication costs as the software required to install a gateway to USENET is also in the public domain. In countries other than the United States, access to USENET is often made through a central location which pays for the long-haul communications link to a central node. These systems may have an average, per-site cost to join, as in Europe. Other popular links to Usenet are Internet and commercial-900 number gateways.

Access to USENET archives may occur through a variety of nodes and gateways. One of the most popular is UUNET, a large and specialized site run by a commercial nonprofit organization which also has over 600 megabytes of PDSW available for direct access on tape. UUNET also provides an alternative access to Internet and UUCP mail through its dedicated communications relay computer, uunet.uu.net. Transfer of PDSW files from USENET archives may be made either with the UUCP transport protocol or TCP/IP protocol.

There are still other BBS sources for FUSW. BITNET automatic retrieval service will soon be available and work is being done to make the archives available to the general public via anonymous UUCP. UUNET permits subscribers to access and retrieve files directly. Some sites

will include other PDSW archives such as games, X windows and GNU. A few companies in the United States (Motorola; Pyramid Technology) maintain copies of the archives and offer limited access.

As mentioned above, the Free Software Foundation archives provide free GNU software which can be accessed from any of the major academic and research networks, as well as commercial services. An interesting new network source for PDSW is Archie, an Internet Archive Server Listing Service. Recognizing the difficulty of finding appropriate PDSW in today's multitude of networks and other PDSW sources in different sites and under different systems and protocols, McGill's School of Computer Science set up Archie, a dedicated-database of PDSW with over 2,600 entries which allows direct ftp. The archive lists the name of the PDSW program, document or package followed by a short description. The database hopes to incorporate non-Unix info on PDSW in the future.

6. Diffusing PDSW in Developing Countries

6.A. Selecting SW for Developing Countries

There are a few basic issues to consider when weighing the advantages and disadvantages of a particular type of software:

- Quality of sw.
- Ease of use.
- Hardware compatibility.

- Operating system compatibility.
- Program language.
- Auxiliary software requirements.
- Size of the program.
- Computer memory requirements
- Media availability (i.e. size of diskette)
- Price of the software.
- Tutorial availability.
- Access to source codes, which permits a user to modify and debug a program, and eventually provide updates.
- Access to user support which permits a user to contact someone who can help sort out problems related to the use of the program.
- User group existence which often permits faster debugging and informal help with program operation.
- Quality of manuals and other documentation.
- Restrictions related to its use.
- Restrictions related to its further distribution.

The main issue when judging the applicability of any FDSW or PDSW is the available hardware and operating system. PDSW and SHW can operate on many types of PCs, while UNIX-based sw works most effectively on workstations.

The best operating system is a hotly debated issue in the industrialized countries -- UNIX-based systems are considered technically superior, however, PCs run by DOS continue to be used by most people.

One estimate, from a shareware vendor, states that in industrialized countries only about 5 percent of the users have access to a workstation and UNIX; approximately 80 to 85 percent of users use IBM-compatible with DOS; approximately 8 to 10 percent use Apple-based systems; and CP/M and other operating systems are used on the balance.[15] Similar figures are not available for developing countries.

The performance of software is intimately tied to the user capability of clearly defining his/her own needs and selecting the appropriate program to perform the task. From this perspective, it is crucial to put as much information at the user's disposal as possible, assuming that the average user in developing countries is not necessarily technically proficient in computers and software as its counterparts in the industrialized world or its academic and research counterparts in the country.

Governmental administrative and service provider users (health, education, transportation) and private sector organization users, at all levels and particularly those in touch with the citizen or final consumer, are quite capable of defining their needs better than any computer expert. It is therefore crucial in the selection process to get as much information about the available PDSW to them as possible. Given the limitations of computer networks and even telecommunications lines in the majority of the developing countries, this information should be made available in printed support such as catalogues, directories and specialized lists. Great attention should be taken in

organizing these lists so that they are easy to use and facilitate the selection and access to the needed PDSW.

As it is done in sw catalogues in industrialized nations, some listings of PDSW found in the network archives provide some information about the program. Copies of these lists could be made available to more-technically-proficient organizations in developing countries. In general, however, the PDSW products listed should be arranged in indexes arranged alphabetically, according to applications, according to system compatibility, and a cross of system compatibility/applications. Each item entry would include title, sub-title, type (PDSW; SHW; FUSW, other) version number, release date, last upgrade date (which together with the previous data may help assess reliability of item), author(s), email, phone or address for contact, newsgroups/discussion groups/users' groups referenced, compatible hardware, microprocessor, operating system, required language(s), memory requirements, auxiliary programs required, type of support, price of program (in case of SHW), price of documentation, cost of support (e.g. cost per call), descriptive annotation. Some of the major applications heading would include accounting, agriculture, business management, construction, architecture, desktop publishing, engineering and science, food and lodging services, general services, health services, social services, databases, insurance; inventory, purchasing and invoicing, libary services, manufacturing, media, medical, personal computing, programming tools, real estate, spreadsheets, communications, and wordprocessing.

6.B. Distribution Issues

There are a few well-established user groups that accept institutional memberships. In the United States the principal ones are in Boston and California. Memberships between local sites in the Third World and the User groups could be set up. The membership fees usually include extensive documentation of the society's activities, access to new software, and timely updates and debugging information on PDSW. Alternatively, a UN-supported clearinghouses and/or regional software distribution centers could have one membership and then distribute the software to local sites in the Third World. The former option, because it diminishes the middle-people could promote better contact between the user groups in the industrialized countries and the end-user in the Third World. Conceivably the UN could negotiate "group-institutional rates" for Third World organizations that are educational or research oriented.

There is no question that shareware vendors would welcome the opportunity to sell diskettes of shw to the Third World and also serve as distribution points for Third World sw in the US. There are already some cases of this with the Soviet Union.

User groups and Shareware vendors involve exchanging sw for relatively modest sums. The problem here is that the cost of exchanging the currency frequently outweighs the amounts of payment involved. Some

sort of compensation system would be critical to getting low-cost and free-of-charge sw to the Third World.

Another barrier to the free flow of sw is the language in which the program commands and the documentation is written. One way is to facilitate links with sw user groups/vendors in countries within industrialized and developing countries that speak the same language. Additionally, the UN could fund programs for translating PDSW in developing countries into languages other than English.

6.C. Electronic Transmission Issues

There are three fundamental means of transferring sw data from one place to another: by air, by phone, or through the mail. Air, or satellite transmission, has proved very complicated and costly in the United States. High-capacity phone networks needed for effective distribution of PDSW are expensive and therefore will be even less widespread and available in the Third World, except for academic and research applications. The mail system is slow, however, it is a good option for inexpensively distributing software and/or large amounts of data that would be costly and tie up phone lines.

6.C.I. Satellite Systems

Little is known about Stargate, an experiment to transmit UNIX sw by cable. It used the transmission facilities of a cable company and

end-users had to buy a decoder, estimated between US$ 200 - 500 to be able to receive and decode the messages.

There were many technical problems: the signal was not always strong and properly tuned; the decoders were not always reliable (in part because there are no standards for this equipment). Errors were frequent and it was time-consuming to retransmit data and tune the signal. Furthermore, satellite time can be expensive.

Many of these problems are likely to be even more complicated in most Third World locations. Furthermore, cable television is not as common in developing countries and satellite dishes would have to be used thus increasing the amount of hardware and the expense of the end-user. The system appears to be too expensive, unproven and complicated to be feasible for the diffusion of PDSW in developing countries.

6.C.II. Computer Networks -- Bulletin Board Systems

Computer networks are an important source of PDSW and related information, although this is not their primary function. PDSW and other freely distributed sw is discussed and exchanged typically as a result of individual contacts among researchers with similar interests rather than as an activity in itself.

Computer networks are commonly used by academic and research communities to exchange information, documents, and programs; access databas-

es; and send messages. The networks are organized internationally, regionally, and functionally, and may or may not include private firms. Many of these networks are connected by email gateways. The large national systems frequently restrict communications to those of a noncommercial nature thus prohibiting commercial exchanges that might occur in some regional networks.

Many of these networks, including those in the developing countries, received start-up finds and equipment from IBM and later other large computer manufacturers. In some cases, these large manufacturers continue to fund the venture. In most cases, however, the networks are funded by membership and user fees and possibly government funds.

With the recent establishment of CREN (Corporation for Research and Educational Network), which resulted from the fusion of the CSNET and BITNET networks, the main global networks have moved to become closely interconnected. CREN's daily activities are managed by a non-profit consortium called EDUCOM, based in Washington, D.C.. BITNET provides access and command retrieval of programs from PDSW libraries in sites at other major networks and meta-networks.

In Europe, the principal network is the European Academic Research Network (EARN). The EARN network will soon have operational links to Turkey and Egypt. EUnet is a cooperative computer network run by the European UNIX Users Group. In Canada, the principal computer network

is NetNorth.

A similar pattern is likely to emerge in developing countries, at least regarding international computer network linkages. In the Ivory Coast, for example, the first EARN linkage in Africa, the site is to act as a channel for West Africa to computer networks in the industrialized countries.[16]

It does not appear feasible to set up a computer network exclusively for exchanging FDSW. The network, in most cases, has to be funded by members and users, and it is unlikely that users who are exclusively interested in FDSW can afford high fees. Furthermore, in the Third World, many of these projects are funded by international organizations such as AID or the World Bank. These projects aim to transfer specific technologies, many of which are commercial. This does not preclude the use of the computer network for FDSW but this objective would take a back seat to the principle goals of the project.[17] Computer networks, as in the industrialized countries, are likely to prove an efficient source of FDSW because of the organization of the network along users with similar interests or functions. Existing networks, as in the industrialized countries, are likely to become one conduit for FDSW related to the specific goals of the computer network members rather than a general conduit.

Some of the larger and more advanced developing countries are currently in the process of modernizing and extending their academic and

research computer networks. Mexico's CONACYT has began to implement a high-capacity satellite-based Mexican Academic Network (RAM), which will be connected to NSFNET. RAM will eventually incorporate into a REDMEX the two existing satellite-based Mexican networks centered at UNAM (Mexican National University) and ITESM (Monterrey Institute of Technology). Two other parallel network projects going on in Mexico are REDLAED, organized by the United Nations, and the Columbus Project.

Brazil's National Research Network (RNP) is in the process of implementing an academic and research network which will replace the collection of ad-hoc BITNET connections that currently exist. The RNP also plans to install a distributed software library which will offer PDSW and flat tariff software, in the areas of engineering, medicine, social sciences, and education.

In related developments, recently, the UNDP contracted a non-profit socially-oriented network, PeaceNet, to set up an inexpensive, yet cumbersome, UUCP-based academic and research network in Bolivia and Cuba.

There are also about 300 BBS on Latin America alone, some connected to their home country. These mailing lists offer an important channel for the diffusion information about and transfer of PDSW among the community of expatriate Latin American students in the United States, Canada, Western Europe and Japan. Some of these mailing lists are

devoted to technical issues in computer sciences but they discuss general issues and exchange news and information.

There are over 100 BITNET nodes in Latin America, the large majority in academic institutions. Brazil and Mexico have the largest number of nodes. In contrast, Argentina has over 100 UUCP nodes in academic and research institutions, as well as private enterprises and government departments. UUCP is relatively inexpensive compared to other network transport protocols (e.g. TCP/IP). The problem with UUCP, however, is that its routing structure does not allow for either remote login or real-time file transfer, making it unsuitable for the distribution of PDSW over long distances.

6.C.III. Mail -- a "virtual network"

A "virtual network" or "pseudo-networks" is a fancy way of saying that people would mail tapes and floppies to each other. Although slower than a network, it is a low-cost means of getting the job done. Catalogue houses and user groups in the industrialized countries could send their catalogues to user groups /universities /schools /firms /libraries in the Third World. The software could be purchased by the institution in the Third World and then it could be copied by individual users. Support for maintenance would be slow, but not insurmountable. As the sw spread in the Third World, users in the particular locale could get together and work out problems themselves, thus creating invaluable skills.

7. Evaluating a PDSW Distribution Systems for Developing Countries

The central goal in setting up a distribution system should be to take advantage of the existing networks in the industrialized countries and the main existing gateways in developing countries to these networks. While the different networks could be connected to a clearing house in the UN, a better solution would be to connect the clearing house directly to the locale in the Third world.

Direct contact between the end-user in the Third World and the distributors and producers could preserve much of the inter-user contact which has been important to the dynamism of these sw markets in the industrialized countries.

While the mail is likely to be the most cost effective way of getting the sw to users in the Third World, vis-a-vis a network, it does have some disadvantages. One disadvantage is that the user cannot ask for and quickly receive problem-solving help on specific issues. This, however, is not unsurmountable. Not too many users in the developing countries currently have sufficient expertise in installing and maintaining workstation sw. Even in the industrialized countries, it is common to retain "problem-solvers" or consultants to teach the system and customize it for the user. While consultants could handle the larger problems for a few, the smaller problems could be dealt with through an appeal on a local, regional, or international computer network.

A more serious drawback of relying on the mail system rather than a network system is that the user in the developing country will be unable to contribute his/her knowledge or participate in the international hackers' interactions. While his/her participation may be limited at the moment, it also represents lost opportunities for learning. Under the economic constraints, however, the mail system is likely to outweigh the more expensive computer network system.

8. Issues for Future Research

- Type, diffusion and trends in operating systems (OS) in the Third World: Is DOS most prevalent now? What will happen in the near future? Should the UN do anything regarding OS distribution?

- Logistical issues, apparently small issues that can create large obstacles in developing countries. Two that have been briefly discussed above and could be further explored in the context of different national settings are: translation and compensating checks. The latter is important anytime a transaction is made. Even free software will entail very modest distribution fees to cover the costs of the medium as well as mailing. The former is particularly critical for applications-oriented programs, less so for utilities.

- Upcoming patent legislation -- threatens all software, but certainly free distributed. A major potential issue with many recent threats. However, several factors will delay its impact. First, the

international trade negotiations in services that have put intellectual property rights high up in their agenda appear to be stalled. Second, the courts in the United States have entangled the issue so much that it is unlikely that any final interpretations that could affect the production and diffusion of PDSW will emerge in the near future.

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NOTES

1.The U.S. Department of Commerce (1991) estimates that in 1990 sales of packaged software alone by U.S. software firms were $ 20 billion, or 40 percent of the global market. Firms dependent on software revenues have pointed out that half of all software in use has been illegally copied. The Software Publisher's Association (SPA) has estimated that lost revenues derived from illegal software copying exceeds $ 2 billion a year.

2.Definition from Webster's Seventh New Collegiate Dictionary.

3.Estimates are that only in North America there are over 3,000 user groups.

4.As a general rule every software has some bugs in it, even commercial products, particularly when first introduced. Of course, larger and more complex programs will exhibit a greater number and variety of bugs, calling forth a more systematic maintenance.

5.S. Nutting, a well-known propagandist of PDSW says: "The public domain is a collection of literally tens of thousands of hours of experimentation with the computer. Taken as a whole, it is a database of computer technique. The programs may or may note solve your problem, but by golly they will show you what that computer can do. It is a bubbling, burgeoning cauldron of uncontrolled experimentation, and it is absolutely marvelous."

6.In spite of much talk about opportunities for developing countries of UNIX as the standard of the future, the promise is still far from reality as today UNIX accounts for less than 15 percent of the U.S. software market. For a discussion of the inflated promises of UNIX see A. Botelho (1989).

7.It is suggested that the minimum serious investment needed to use UNIX-based sw is a 386 co-processor and at least 150 megabyte hard disk. This, however, would only permit a limited degree of utilization of the UNIX-based sw.

8.Shareware has not become an important avenue for distribution of workstation/UNIX sw probably because not many average individuals outside the technical and academic spheres own workstations. As the price of workstations declines rapidly, there is talk that workstations will be tomorrow's PCs and UNIX the ultimate standard.

9.S. L. Garfinkel, "Programs to the People," Technology Review, February/March 1991: 53-60. See also, "Hacker's return," The Economist, July 15, 1989: 81-82.

10.GNU stands for a recursive acronym meaning GNU's Not UNIX. GNU is not UNIX but all GNU software can be run on UNIX. GNU EMACS has been adapted to a variety of computer systems, from supercomputers to desktop machines.

11.CSRG's most popular program is a UNIX networking software that has been incorporated into products sold by a variety of companies, including ICs.

12.D. Fiedler in "Free Software!" (Byte, June 1990), cites the example of where one author restricted the use of his UNIX sw to non-military sites.

13.MILNET is the unclassified operational military network that resulted from the dissolution of ARPANET in the late 1980s.

14.PC-Write, for example, has about 50,000 people registered out of 100,000 who purchased diskettes, and has sold over 90,000 manuals.

15.The president of the Shareware Producers Association (United States) states that SHW has been unjustly accused of spreading viruses. There are no statistics on this, but there is no reason that SHW should be anymore responsible than disgruntled employees in commercial ventures or malevolent hackers over networks.

16.Efforts in this directyion can learn from programs for regional cooperation in telecommunications which is alreday being promoted with mixed success in two regions of Africa. See Rothery, Toure and Sharp (1989).

17.For a recent discussion see Bruce (1989).