

**Ewaste not:
Linux revives discarded computers for communities?**

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by

Barry G. Wong

Internet: <http://mythanks.tripod.com/>

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I. Summary

The disposal of computer systems is associated with issues and costs for the owners of the discarded computer systems and for communities affected by the disposal.

In some situations, the appropriate use of Linux, LiveCD / LiveDistro technology, and other approaches might help make the computer systems that might otherwise be discarded useful for appropriate groups and individuals in communities. This reuse might result in benefits for the parties discarding the computers and other items regarded as Ewaste, for parties receiving the unEwasted computers and technology, and for communities and society at large.

II. Introduction

Schools, universities, and other organizations and individuals discard many computer systems regarded as no longer appropriate for current use by those computer system owners. The disposal of such computer systems and other items regarded as Ewaste (or [electronic waste](#)) has presented the owners and others with financial, environmental, and other costs and issues. In some situations, changes in market-related circumstances might lead to related complications, including the closure of some disposal-related avenues, such as the use of services formerly provided by local recycling businesses.¹

Approaches that help to address this challenge effectively might help organizational and individual owners of computer systems to address the financial, environmental, and other costs associated with this ongoing or recurrent issue.

Using approaches in this document to unEwaste the computer systems that might otherwise be discarded, one might be able to try to convert a crisis into an opportunity, as indicated in the [Example scenarios](#) section of this document.

III. Approach

A. Context and Goal

1. Selected contextual elements

a. Ongoing desire of owners to dispose of superseded computer systems

¹One example might be the situation described at: Winnipeg schools stuck with high-tech garbage, <http://www.cbc.ca/technology/story/2007/01/11/schools-ewaste.html> , 10:36:07 PM PDT, August 10, 2013

1. Schools, universities, and other organizational and individual owners of computer systems might discover that new versions of application software offer desirable features, such as improvements relating to functionality, capacity, or security. In order to use the new application software versions with the desirable features, these computer system owners might need to access not only the new versions of application software, but also new versions of the operating system software (for example, Microsoft Windows) upon which the new application software versions rely.
2. However, the hardware and firmware in the computer systems used by the computer system owners might not be able to work with the new software versions (efficiently).
3. The computer system owners then purchase computer systems that are expected to be able to work relatively efficiently with the new software versions.
4. Lacking the space and other resources to keep the superseded computer systems, the computer system owners might seek to dispose of the superseded computer systems.
5. The owners preparing to dispose of the superseded computer systems might copy needed information from the superseded computer systems to the new computer systems. The owners might then (for privacy-related reasons) erase the contents of hard disk drives in the superseded computer systems and/or remove those hard disk drives.
6. These owners seeking to dispose of the superseded computer systems face financial, environmental, and other issues relating to that disposal.
7. The marketing of various software and hardware products might focus on ongoing/recurrent upgrades, so this disposal issue might be ongoing/recurrent.

b. Rejection by third parties referring to community members without effective computer system access

➤ In both local and nonlocal communities, some individuals and groups might have limited or no access to computer systems.

– Some individuals, perhaps including lone parents experiencing substantial financial constraints, might be faced with budgets that barely cover food, housing, and similar high-priority survival-related costs, for example. The individual in that situation might regard the purchase or rental of a computer system as a luxury that cannot be accommodated. This situation might put the individual and family members associated with the individual at a disadvantage in relation to education and career development.

– Some community service organizations, faced with declining funding from government and analogous funding sources, might discover that competition for donations can lead to donor fatigue. Such a community organization facing substantive budgetary constraints might be inclined to deprioritize purchases of computer systems. In such situations, staff might have limited access to computer systems, and clients might have restricted or no access to computer systems at the organizations. In some regions, this situation might potentially negatively affect staff effectiveness, service delivery, and the capacity to address changing community needs.

➤ Some computer system owners considering donation of their superseded computer systems to groups and individuals without effective access to computer systems might be deterred by third parties who criticize, saying, “Do not dump your outdated computer garbage on them!”

c. Availability of LiveCD / LiveDistro technology and Linux

➤ A [LiveCD](#) or a LiveDVD or, more generally, a LiveDistro might be, respectively, a CD disc, a DVD disc, or another removable medium that a person uses to start and to run a computer system even when that computer system contains no other operating system software (for example, Microsoft Windows does not need to be present on the computer system).

– The LiveCD or LiveDVD or LiveDistro might contain an entire operating system.

– In addition, the LiveCD or LiveDVD or LiveDistro might contain additional application software that a person can use (for example, to browse the Internet, to send e-mail, to carry out word processing, to view photographs, to listen to music, and to watch videos).

– In many situations, the LiveCD or LiveDVD or LiveDistro can be used effectively on a computer system regardless whether that computer system has a hard disk drive.

➤ In some situations, a [Linux distribution](#) intended for use as an operating system on an end-user's computer system (for example, a desktop computer or a notebook computer) can perhaps be freely downloaded and recorded onto a removable medium to make a LiveCD or a LiveDVD or a LiveDistro.

2. Goal

a. Goal definition

One goal definition, which might be relatively general, might be:

In What Ways Might We (or IWWMW) effectively address electronic waste?

b. Problem definition

One problem definition, which might be relatively specific, might be:

In What Ways Might We use Linux and LiveCD / LiveDistro technology to address electronic waste effectively such that the results are helpful for the parties involved, for society at large, and for the environment?

B. Plan

An example of a plan that might help to unEwaste computer systems effectively might include the following or analogous steps:

1. An initial working group of interested parties (“Initial Working Group for unEwaste”) is established, including (interested participants who represent or are)
 - appropriate groups and/or individuals [“unEwasted-item Donor(s)”] wanting to dispose of numerous computer systems deemed to be no longer appropriate for those groups and/or individuals
 - appropriate groups and/or perhaps individuals [“unEwasted-item Recipient(s)”] who work to improve the community, society, or other appropriate context and whose budgetary constraints prevent acquisition and use of computer or information technology that might enhance the improvement work
 - other parties if/as appropriate
2. If/Where appropriate, the plan is adapted to the specific context of the specific Initial Working Group for unEwaste.
3. Appropriate preparation for a (perhaps relatively-small-scale, likely-to-succeed) pilot project is initiated. For example:
 - unEwasted-item Donors might select an initial subset of computer systems to be donated and appropriately address personal information and privacy and related issues (relating, for example, to content stored on those computer systems)
 - unEwasted-item Recipient organizations might implement meetings/workshops where front-facing staff, volunteers, and, wherever

feasible/appropriate, clients generate and then prioritize ideas for potential projects where the donated unEwasted computers and items might be effectively used

- unEwasted-item Recipient organizations might select in-house trainers (and if/as appropriate, other relevant personnel) from, as appropriate, interested staff, volunteers, and clients

- resources, funding, and in-kind support might derive from various sources; for example:

- appropriate funding might be obtained via redirection of funds that unEwasted-item Donors would have otherwise spent on recycling-related transportation and recycling of the unEwasted items

- volunteers who might not otherwise contribute to some unEwasted-item Recipient organizations might consider contributing time and work to the project (for example, perhaps some [Linux user group](#) participants and some software developers might not be interested in communicating with the clientèle of some unEwasted-item Recipient organizations, but might be interested in the technical challenges involved in the appropriate deployment of Linux LiveDistros on unEwasted-items)

- business entities seeking viable solutions that might eventually help address the business entities' Ewaste issues might donate funds and/or staff time and/or other appropriate resources to the project

- if/as necessary, discussions/activities simulating project elements might be carried out to help determine potential issues, and work is done, as/where appropriate, to address the issues

4. An appropriate coordinator who can and will, as appropriate, implement and/or coordinate the implementation of the pilot project begins work on the pilot project, and the pilot project is implemented. The work might include

- provision of appropriate train-the-trainer activities for in-house trainers in unEwasted-item Recipient organizations

- acquisition and/or, as appropriate, development of and deployment of appropriate training and support materials/content

- provision of relevant development and support for Recipients

- relevant communication/collaboration with the Initial Working Group for unEwaste

- relevant communication with unEwasted-item Donors

–other activities and work as appropriate

5. After evaluation of the pilot project (via, for example, summative evaluation and, if/as appropriate, formative evaluations), work is carried out to determine if/how the project might be appropriately developed further and expanded.

C. Example scenarios

The names and contexts in the following fictitious example scenarios are fictitious.

1. New – to me – here

Before immigrating, Jen was a successful primary-care physician, but the local medical professional association where Jen now lives does not recognize her academic or professional credentials. Jen, who faces English as an Additional Language, currently works at part-time / survival jobs in local restaurants where her employers can speak her native language and dialect.

One of Jen's co-workers refers Jen to a local immigrant-services organization, where an in-house trainer then interviews Jen.

The immigrant services organization has several unEwasted computer systems. One of those computer systems has enough RAM (random access memory) to run any of various [LiveCDs](#) or LiveDVDs, such as the multilingual [Ubuntu Desktop Edition](#), including the [LibreOffice](#) software suite and the [Mozilla Firefox](#) Internet browser software. Another of the computer systems at the organization, however, has a relatively small amount of RAM, but could still be used with some LiveCDs.

Jen, who wants to continue to improve her use of the English language and her computer-related skills, and the in-house trainer together decide that Jen might start learning with the English-language version of the [Puppy Linux](#) LiveCD.

With appropriate help and encouragement from the in-house trainer, Jen soon downloads a copy of Puppy Linux, makes a Puppy Linux LiveCD, and uses that LiveCD to start (or to boot) an unEwasted computer at the organization.

Jen connects her portable media player to a USB connector on the unEwasted computer system running the Puppy Linux LiveCD. Among all the unEwasted computer systems in the organization, that computer system also happens to be the computer system with the least amount of RAM. Jen quickly discovers that she can easily drag-and-drop music and data files between her portable media player and the computer system using the Puppy Linux LiveCD.

Using the [AbiWord](#) software on the Puppy Linux LiveCD, Jen finds that she can make a résumé that can be read via other word processing software in other computers at the organization. Jen quickly discovers she can use AbiWord to save her résumé as a PDF (Portable

Document Format) file that she can e-mail to prospective employers or print onto paper.

One of Jen's professional interests has been epidemiological research, so Jen soon begins exploring the functions and functionality, including the chart functionality, provided in the [Gnumeric](#) software included with the Puppy Linux LiveCD. She discovers that she can save a copy of the resulting spreadsheet in a format that can be used with spreadsheet software other than Gnumeric. She also learns that she can save a copy of the spreadsheet in HTML format and then view the result in the browser included as part of the [SeaMonkey](#) software suite on the Puppy Linux LiveCD. She finds she can also view the resulting HTML file via other browser software on computer systems nearby.

While learning about the SeaMonkey software suite on the Puppy Linux LiveCD, Jen finds that she can quickly use Composer, the HTML editor software application in SeaMonkey, to make basic Web pages.

After seeing the e-mail software application in the SeaMonkey suite, Jen recalls that Jen's niece has been talking about instant messaging. Jen asks the in-house trainer about instant messaging software for Jen's niece. The in-house trainer shows Jen the instant messaging software that is included with the Puppy Linux LiveCD. The in-house trainer explains that Jen's niece might download the Puppy Linux software and find out about the Puppy Linux LiveCD.

The in-house trainer suggests to Jen that Jen might also show Jen's niece how to begin to draw using the [Inkscape](#)Lite software included on the Puppy Linux LiveCD.

The in-house trainer mentions that Jen might consider trying to use a [LiveUSB](#) instead of a LiveCD especially when Jen is at a computer that cannot play CD or DVD or similar discs.

Jen begins using the photograph-editing and paint software, [mtPaint](#), included on the Puppy Linux LiveCD.

However, Jen is initially puzzled by the [mhWaveEdit](#) software that is included on the Puppy Linux LiveCD. Surjit, sitting at the unEwasted computer next to Jen, explains to Jen that the mhWaveEdit software can be used to edit audio, for example, to make a shortened version of an aural h/story interview recording. Jen thanks Surjit and muses that Jen might show mhWaveEdit to Jen's younger sister, who is interested in music and sound recording.

2. Learning, sharing, sharing learning

Brenda is currently a resident in a transition house / shelter / refuge. With the help of the transition house's in-house trainer using appropriate hands-on (kinesthetic/tactile learning) approaches, Brenda learns how to download and to make a [Porteus](#) (Linux) [LiveCD](#). Using the Porteus LiveCD, Brenda starts (or boots) an unEwasted computer system at the transition house. Received as a donation years ago, that computer system does not have a hard disk drive, but that computer system works well when the Porteus LiveCD is used at that computer system.

Brenda soon learns how to use [Mozilla Firefox](#), which is software included on the Porteus LiveCD, to view World Wide Web-based resources.

Then, using the software included with Porteus, Brenda learns basic word processing. Practising and expanding her word processing skills, Brenda is soon helping fellow residents learning to write cover letters for future job applications.

Using software included with Porteus, Brenda, still with appropriate support from the in-house trainer, then begins learning how to make software-based presentations. Using Porteus on the unEwasted computer system, Brenda delivers a presentation introducing a small group of fellow residents to some of the works of art from one aboriginal / indigenous community. Taking turns, the other members of the group also deliver presentations.

Brenda feels that, with her growing computer skills and the interpersonal networking that have developed at the transition house, Brenda has a chance to get work with pay and working conditions that are better than the pay and working conditions that Brenda had experienced in her past.

One Friday evening, Brenda takes the bus to visit a friend, Grazyna. While waiting for Grazyna to return, Brenda overhears Grazyna's partner boasting over the telephone about how he has been secretly using keylogger software to reveal Grazyna's passwords on the Microsoft Windows computer system that Grazyna uses. Brenda overhears Grazyna's partner sneering angrily at some of Grazyna's personal e-mail that he has thus surreptitiously viewed. After Grazyna's partner leaves, Brenda explains to Grazyna what Brenda has overheard and the privacy violation that Grazyna's partner has been carrying out against Grazyna. Grazyna, who is worried about the already increasingly abusive behavior of Grazyna's partner, is alarmed at Brenda's report about the computer-eavesdropping.

Brenda pulls a [miniDVD disc](#) out of Brenda's handbag. Brenda shows Grazyna how to use that disc, which is a Porteus LiveDVD, to boot the computer system that Grazyna has been using. Brenda explains that, while the computer is using the Porteus LiveDVD in this way, the computer is not using Microsoft Windows, so Brenda and Grazyna are temporarily shielded from the spying by the keylogger software that was used against Grazyna while that computer was using Microsoft Windows. Brenda explains that, while using the Porteus LiveDVD and thus temporarily preventing the keylogger software from working, Grazyna perhaps might relatively safely change passwords, view Websites intended to help stop domestic violence, use Web-based e-mail, and do word processing, for example – without the privacy violation by Grazyna's partner.

With Brenda's help, Grazyna downloads and makes and uses a Porteus LiveDVD.

Grazyna shows Brenda a USB flash drive that Grazyna bought for herself today. Grazyna tells Brenda that Grazyna's partner is not aware that Grazyna bought a USB flash drive. Grazyna removes the USB flash drive from the packaging and asks Brenda how to use the new USB flash

drive, which looks like a small piece of jewellery.

Brenda pauses briefly – and then answers: [Puppy Linux](#). With Brenda guiding Grazyna through the steps, Grazyna downloads and makes a Puppy Linux LiveCD and uses that Puppy Linux LiveCD to boot the computer. Grazyna, with Brenda's guidance, then tells Puppy Linux to make an appropriate small partition in the USB flash drive and to use a Linux-oriented filesystem called ext2 in that partition. Then, still with Brenda's guidance, Grazyna prepares to shut down Puppy Linux and, when asked to save into a special file the information from Grazyna's session with Puppy Linux, Grazyna selects strong encryption – and Brenda steps away briefly, so Grazyna can choose an appropriate password privately – and Grazyna thus encrypts the information in the special file being saved into the partition that Grazyna made. Brenda and Grazyna then check – and confirm that the Puppy Linux results work properly.

Brenda summarizes the benefits that this Puppy Linux approach provides to Grazyna. Brenda says that, even if Grazyna's partner found Grazyna's USB flash drive, Grazyna's partner using Microsoft Windows might not even realize that the space on the USB flash drive has been divided into multiple partitions – and that one of those partitions is hidden from Grazyna's partner when using Microsoft Windows – and that a file is in one of those hidden partitions. Brenda adds that, even if Grazyna's partner somehow found that hidden file containing Grazyna's information, Grazyna's partner still might not know what is in that file because Grazyna's partner does not know the password that Grazyna used when encrypting the information in that file.

Brenda adds that Grazyna might optionally save some innocuous information – such as perhaps a dessert recipe or a shopping list showing fruits and vegetables – into some files that are in the USB flash drive but that are not in the hidden partition there. Then, if Grazyna's partner finds Grazyna's flash drive, Grazyna's partner using Microsoft Windows perhaps might immediately notice that innocuous information, then assume that information on that USB flash drive would not be of interest to him, and not investigate the USB flash drive further.

Grazyna logs out from Puppy Linux, and the computer then reboots into Microsoft Windows – and the computer shows little or no trace of Brenda's and Grazyna's LiveDVD-based and LiveCD-based use of that computer system.

3. Communities benefiting from community-oriented computing facilities

a. A library / community centre – and Edubuntu

In one smaller community, some neighbors wanting to support the local library / community centre ask in a larger urban centre some shops and interested individuals to donate computers that would otherwise be discarded. The neighbors find that some of the donated computers appear to be somewhat out-of-date. The neighbors want to try to connect the out-of-date computers to a more capable computer appropriately, so people can use the out-of-date

computers as terminals that are mainly intended to access the more capable computer.

The neighbors download [Edubuntu](#) and, via an Edubuntu LiveDVD, use [LTSP Live](#) to learn how to use [LTSP](#) to help the out-of-date computers and the more capable computer to work together.

Combining the computer equipment that has been donated, the neighbors assemble the more capable computer, which has an appropriately large amount of RAM (or random access memory) and a hard disk drive with an appropriately large amount of storage space.

The neighbors explain to the library / community centre staff that, with Edubuntu, the [more capable computer can become an LTSP server](#) and the [out-of-date computers can become LTSP thin clients](#).

The neighbors appropriately make connections – and successfully confirm that the LTSP thin client computers and the LTSP server computer work properly together.

The result is a very useful network of computers – with clear benefits for the library / community centre and for the community served by that library / community centre.

A person who is seated – or standing – at one of the out-of-date computers situated at convenient locations across the library / community centre site uses the helpful software on the more capable computer that is in another room, which is locked. The out-of-date computers visually appear out-of-date – and are thus less likely to appeal to a potential thief wanting to sell a stolen computer with a high resale value. However, each of those out-of-date computers enables a person to use up-to-date software on the more capable computer.

The neighbors and staff members who maintain and upgrade the network focus resources almost exclusively on only one computer – the more capable computer that is the LTSP server computer – and rarely need to spend much time or money on the various out-of-date computers that are the LTSP thin client computers. This centralized focus helps the library / community centre team, especially when prioritizing amidst budget constraints. An upgrade at the LTSP server computer helps each person who uses any of the LTSP thin client computers across the library / community centre site – without time-consuming and costly travel to and upgrades of all of those out-of-date computers.

As a result, people visiting a library / community centre in one smaller community are now benefiting from a very capable network of unEwasted computer systems.

- On Wednesday evenings, the network is used for a course teaching [Blender](#) and related 3D (three-dimensional) animation-related endeavors. Other courses, including continuing education courses on topics that do not ostensibly focus on computers, also frequently use the network.
- A group of volunteers from the local community use the network for workshops helping people to develop locally culturally-appropriate content,

including presentations and multimedia productions that can be shared via the Internet.

- Lee and Sandy, two secondary school students inspired by what they have discovered about the network, about the [Stone Soupercomputer](#), and about [Beowulf](#), use unEwasted computers and other scavenged or donated parts to make a community supercomputer as part of a science fair project. Working with a school and a [community network](#), Lee and Sandy donate the community supercomputer – and are curious to see what supercomputer-compatible problems might be submitted to the community supercomputer. Already a group of amateur astronomers in another country and several postgraduate students in various fields in the local region and in various countries have e-mailed enquiries in response to the community supercomputer Website. In addition, another e-mail message has been received from a community multimedia group who, inspired by the community supercomputer Website, have downloaded [dyne:bolic](#) (Linux LiveCD) for use with unEwasted computers to make a [render farm](#) for community productions.

b. A general store / shop – and a Freedom Toaster

A few hundred kilometres away from the nearest urban centre, access to the Internet is expensive or uses relatively slow telephone dial-up connections, so access to downloadable software and digital content has been somewhat restricted – until a [Freedom Toaster](#) became available nearby. Having found an [earlier brochure about a Freedom Toaster](#) and [earlier instructions indicating how to make a Freedom Toaster](#), local volunteers and non-local volunteers have used an unEwasted computer system from an urban centre to build a Freedom Toaster. Now located in the local general store / shop, that Freedom Toaster is dispensing free digital content, such as software, photography, literature, and music, to anyone inserting blank writable CD or DVD discs into the Freedom Toaster. People also use the Freedom Toaster to access locally-developed and regionally-developed information from local governments, community groups, and other sources.

IV. Conclusion

Effective use of LiveCD / LiveDVD / LiveDistro technology and Linux might help schools, postsecondary institutions, and other entities to address financial, environmental, and other issues, when those entities unEwaste computer systems that were previously intended for disposal. The resulting societal benefits, as publicly illustrated in appropriate testimonials and case studies, might perhaps also help entities with effective unEwaste programs to secure a public relations advantage over other entities who have not yet deployed such programs effectively.

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