DIGITALEUROPE

Comments on the JRC report on Analysis of material efficiency requirements of enterprise servers

Brussels, 16 December 2014

DIGITALEUROPE regrets that there was no opportunity to comment on the JRC report on the material efficiency of enterprise servers before its final publication. We have serious concerns with the fundamentals such as technical feasibility, economic and environmental viability. We are also concerned with the formulae, rationale, in addition to the specific recommendations. Due to possible misinterpretations and omissions, we are issuing this unsolicited comment.

The report notices the scarcity of available research on material efficiency of servers (p.15) and tends in consequence to use general IT equipment or even WEEE based publications and project information (e.g. p.26.ff on the GreenElect project or pages 23-26 on ITIA-CNR) that does not represent adequately the server situation. A case in point is the figure on page 20 displaying the role of independent operators in the ICT equipment sector: in the case of servers OEMs refurbish and sell the refurbished servers with guarantees to customers themselves. This is not reflected in the graph.

Rather than drawing on general publications it would have been interesting to concretely trace existing reuse/refurbishment practices (and estimate reuse percentages for specific spare parts of high value) and EoL collection and recovery depending on the data centre operators (OEM controlled as well as typical operators such as Telcos, etc). As servers are B2B products, partly under lease or OEM ownership, collection rate and material recovery are much higher than for other ICT equipment. OEMs estimate that the total recovery rate is at about 97%. From our perspective the JRC missed an opportunity to provide interesting and valuable insights in to server reuse and recycling.

Technical Feasibility

- We do not understand why the study is recommending energy efficiency standards for refurbished servers. These servers will have already been released to the market under some set of energy efficiency requirements (except for those servers refurbished immediately after the regulation is released) and will have met the energy efficiency requirements for its generation of products. If it is determined that there is value in refurbishing and reusing servers, then those servers should be allowed to be marketed and sold without further energy efficiency requirements.

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- We question that some of the suggestions can actually be implemented for servers without impacting the compatibility and interoperability of the refurbished server. We therefore recommend that further feasibility assessments be conducted, which include interviews and discussions with manufacturers and data center operators who procure refurbished servers, to insure that the issues and constraints associated with the use of refurbished are properly understood.
- Reworking and Re-using of server motherboards is only reasonable for repair and only applicable when the resultant system is interoperable with the pool of servers deployed. Re-introducing a 2-3yr old server to an existing pool may render the system unusable or may degrade operations of other systems across the network.
- The Firmware discussion (page 20-21) needs to be reworded as the section as presented does not properly represent how firmware operates or the purposes for which it is updated. Bugs, fixes, and updates are part of existing operations and not caused by intentionally embedded issues in the firmware.
    - There are multiple instances of firmware on servers, which run on the Baseboard Management Controller (BMC) or Flexible Server Processor (FSP). There is also code, which runs on the processors and code that runs the operating system (o/s) partitions. Some OEMs ship updates separately for each component, others release them as a package. If you wanted support for a particular adaptor for instance, you would load firmware Level A off from a company web site. It would include all the firmware needed for the different instances of the firmware and would load all at the same time so that no incompatibilities exist.
    - Receiving a used server that had been re-purposed, the client would update the code level to the desired level. There are releases and then "dot" releases within the main release. Each release has a release note that indicates the support, defect fixes, etc. in it. Most big customers have banks of computers that are on different releases, but when they put a new computer into a cluster, they update it to whatever release level that the cluster is on. This is to make sure all computers being used for that cluster purpose have the same capabilities and limitations.
    - Now, as you go through time, do you need to update the firmware to keep the system running? You do not. However, there are defects that are fixed with every firmware release. When you run into a defect that you want fixed, you will need to update the firmware. OEMs maintain firmware releases for a specified period of time based on the number of updates released and their support window for a given machine type. Some customers, understandably, never want to load new firmware. But they may run into the situation where their firmware release level is old and no longer supported. They then need to migrate to a new release level if they want to assure they have support, access to new capability and/or the ability to get a defect fixed. If a server is operating on firmware which is back several levels from the current release, it may be necessary to do multiple migrations to get to the new level, which can take hours or even days.

- As discussed, these firmware updates are available. They may require a license or a service agreement to be able to access the firmware but it will be available.

It is important that this discussion be updated to accurately reflect the process by which firmware is managed by the OEMs and server operators.

Economic and ecological viability and efficacy

The discussion of the GHG and material tradeoffs (use vs. manufacturing) does not accurately assess the benefits and risks of reusing systems. As noted in previous industry presentations, the unintended consequence of maintaining old equipment (e.g. >5yrs) is the loss in energy efficiency, e.g. large energy losses with little productivity gains. Therefore, stretching the server life to 7 or 10 years could result in a missed opportunity to reduce energy use and associated GHG emissions, which far exceed the energy use and emissions associated with the manufacture of the new server. There are several scenarios to consider.

- In some cases a data center operator will retain an older server, or purchase a refurbished server, to maintain a legacy application, which operates on a specific server technology generation and for which the cost of upgrading the application to be compatible is not justified.
- An older technology server supports the applications that a data center operator is seeking to run, is compatible with the other equipment in the data center, enables some consolidation to drive improved capacity management and reduce energy use, and it offers economic benefits acceptable given the risks of an earlier failure of a refurbished, versus new, server.
- The compute capacity of server roughly doubles with each new technology generation, which has typically been released every 18-24months. A typical technology refresh cycle for a data center operator is 3-5 years, or 2-3 technology generations. In addition, many servers are showing an increased range of power use, i.e. lower idle power, with each new technology generation. Purchase of a new server at the refresh delivers 4x to 8x+ performance gain for the same energy expenditure and a reduction in net energy use while enabling the consolidation of two to eight existing servers onto the new server through increased virtualization capabilities. Recognizing that the use phase represents 80 to 95% of the life cycle GHG emissions of servers, there are significant benefits to refreshing and consolidating with new technologies.

There are numerous conditions to consider when evaluating server reuse. These three scenarios highlight the types of considerations and tradeoffs that go into evaluating whether or not a refurbished server should be used. There is no simple answer, and in many cases virtualizing and consolidating workloads onto a single new server offers the most energy efficient solution.

Operability

The report neglects to investigate or address several technical and operational criteria that need to be considered when evaluating whether or not reuse of an existing or refurbished server is technically and economically justified and the current state of what is a very robust reuse and recycle process for servers.

- The report does not adequately list or consider other important drivers for and limitations on replacing systems.
    - Data privacy requirements, including legal requirements for privacy of medical records and other documents, and attendant storage needs become an issue for combined server & storage systems.
    - Component (e.g. HDD) failure rates may limit the ability to reuse servers in applications, which require high reliability or have limited failover mechanisms.
    - Software transitions which require expanded system capabilities may necessitate purchase of new technologies, and
- There appears to be limited assessment input from actual recyclers- some of the potential reuse or recovery methods listed in the document are not consistent with what the industry has heard from recyclers during other activities such as the preliminary assessment of reuse options for the updated EPEAT requirements.
- The report does not mention current or new take-back requirements mandated by EU regulation and the fact that capture rates on servers are typically higher than other systems because there are significant economic value in the server reuse and recycle process. Recyclers and end users claim that most servers and professional equipment enjoy a high value reuse opportunity, pending upgrades to the latest enterprise OS and/or applications. We think that the report should highlight the current state of the market and identify the processes that are currently in place and working effectively so that:
    - Any regulations proposed based on the study build on the aspects of the current system that are already working effectively.
    - Any regulations proposed based on the report do not directly or indirectly impede the current system where it is working effectively.

Formulae (p.58- 67):

The proposed metric is inappropriate as key data centre-based recycling factors aren't part of the formula. The proposed formulae was developed for single user consumer products and cannot simply be transferred to more complex products that are in usage always part of systems. For example, interoperability requirements are a primary, not a secondary consideration; failure to consider compatibility of the reused/refurbished server with the existing data center equipment renders the formulae results inaccurate and misleading,

leading to e.g. identifying opportunities and advantages where there are none.

Requirement 1 - The reuse of components in servers

The report models servers like PC's and assumes one can just reuse a number of components. The authors come up with a reuse index as though these pieces are interchangeable. This is not generally or practically true and integration/compatibility in the data centre is a large concern as servers generally don't work in isolation and many servers are designed to operate, and are exhaustively tested and qualified, with a specific set of component parts.

The report fails to comprehend or even to demonstrate the backend life (e.g. EoL, rationale, impact on the collective [never just 1server], or even existing enterprise environments). Industry would challenge that the implied process may not even be feasible. The basic majority EOL disposing options are:

- Reuse, Refurbishment, or upgrade for resale as server product.
- Resale of FRU components for use as spare parts; *FRU= Field Replaceable Unit—which then needs to be identified
- Material recovery

We believe that the re-use rate of servers (resale as a server product) represented by the base cases lies at a minimum of 30%. The base cases provided by DIGITALEUROPE to the Lot 9 preparatory study consultants assume new servers are used four years until they reach the end of their first life. At the end of their first life, these servers still have significant value as they can be used in applications that require a lower service level for their second and potentially more lives.

To this point, HP's Financial Service business operates an asset recovery service (ARS) and a lease program (shown as "EOL" or "end-of-leases" in the table). The server re-use rates from these programs are approximately as follows-

		% Resold	% Recycled
ARS	Servers	77%	23%
EOL	Servers	88%	12%
ARS	Storage	31%	69%
EOL	Storage	33%	67%

Table 3: HP server re-usage rate

Note that the storage "% resold" rate is much lower than for servers, presumably because of data security issues, the mechanical failure modes of hard-drive based storage technology and the longer, initial useful life of storage products which make second life uses less attractive.

Requirement 2 Design for disassembly, reuse and recycling, and recovery

It is important to know that enterprise servers are essentially a B2B product, manufactured in a highly concentrated market. All manufacturers have own take-back and asset recovery schemes. As a consequence, servers and professional equipment are designed for efficient maintenance to allow for the products to be repaired, updated and reconfigured. This product development practice already enables disassembly for reuse, recycling and recovery. Instructions on sequence of steps how to extract critical components are usually part of our repair instructions; however there are concerns on liability if non-qualified personnel follow steps and break their device or injure themselves. Formal requirements will risk hampering the development of even more efficient designs because of technology changes and system modifications rather than promote them.

Requirement 3 Provision of technical information

In our experience, experienced recyclers have few problems disassembling professional equipment in an efficient way. We've also seen that further documentation on build and disassembly operation would likely not be used. Information on components that require special handling in accordance with existing WEEE requirements will already be provided. The inclusion of an exploded diagram to show the location of critical components risks violating strict confidentiality for proprietary technologies and configurations. Also a requirement to make firmware available to test critical components is problematic: such software, where it exists, is likely to be strictly proprietary and firmware upgrades are often part of service contracts. Firmware updates typically requires specialist training to be performed effectively and would be most effectively completed by the administrative staff of the data centre operator that purchases the equipment.

Requirement 4 Provision of information concerning critical raw materials

The usage of critical raw materials is to a high degree related to certain components. E.g. gallium is normally found in a LED and magnets often contain neodymium. All these components are easy to recognize, and if the recycler is motivated, can be disassembled from the server/mother board. General knowledge on what component that usually contains certain Rare Earth Metals or Critical Raw Materials is sufficient.

The following are URLs with articles/whitepaper on the recovery of Rare earth minerals in high tech, HDD, and the ability to recycle/extract minerals from devices. Extraction can be done, but can cost more to recycle than to mine new rare earth minerals

- http://ensia.com/features/why-rare-earth-recycling-is-rare-and-what-we-can-do-about-it/
- http://www.hitachi.com/rev/pdf/2013/r2013_08_105.pdf

A constructive suggestion for improvements in recycling would perhaps be to consider to develop a guidance document that identifies what materials that are likely to be found in each type of component. The Bills of Materials for the base cases, shown in the prep study Task 5 report, offer examples of the material listing that could be created for representative equipment and used as a base to assess the full range of configurations and machine types.

Apart from the initial work to develop the document, such a guidance document would likely have little administrative burden on EU Commission, the industry and recyclers.

We recommend to develop a primer on existing EoL practices and to establish a desired lifecycle process proven by practice to take advantage of the technology changes and IT demand growth.

Finally, we should leave other optimization opportunities to EU Data Centre Code of Conduct, which aids in the efficient operation of the entire data centre. The EU Data Centre CoC reflects the various options that can be applied while comprehending the variety of application targets being employed across different data centres.

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