May 9, 2008

To: Rebecca Duff
ICF International

CC: Andrew Fanara
United States Environmental Protection Agency

Re: Hewlett-Packard Response to the *ENERGY STAR® Revised Definitions for Computer Servers based on Draft 1 Specification Comments*

From: Hewlett-Packard Company (HP), Enterprise Storage and Servers Business Unit

This document may be published on the Energy Star website.

Changes from Draft 1 appear to be an attempt to include lower-end computers into the server specification. While this is understandable, it strengthens HP's assertion that Tier I of this specification must include a fully-described taxonomy of servers, reflecting the many types of servers available today and in the near future. Without this taxonomy, we are very concerned that Energy Star will attempt to unfairly equate server types that are superficially and/or mechanically similar, but electrically and functionally quite different.

Section 1: Definitions

The descriptions in this section of the *ENERGY STAR® Revised Definitions for Computer Servers based on Draft 1 Specification Comments* (Energy Star Revised Definitions) document are all quite brief and are not generally thorough enough to describe the items that they attempt to define.

Notes on this section indicate that there are no finalized definitions of the types of servers that should be separated into different categories. HP has provided guidance in the past on this subject, and we again provide that guidance below. *Appendix A* also illustrates how HP server product families map onto the proposed Computer Server taxonomy.

- Definitions in this specification should cover business servers that are of more complexity than the "desktop-derived servers" defined in the *Energy Star for Computers* specification. Many types of servers will need to be described in enough detail to determine whether they will be included or excluded from participation in the Tier I requirements.
- The focus of the draft 1 specification appears to be narrowly defined and does not cover the entire span of business and enterprise servers. Several types and subtypes of business and enterprise servers need to be defined, so that the ranges of their features can be comprehended in current or future *Energy Star* specifications. Even if version 1.0 of the *Energy Star for Computer Servers* specification excludes many types of servers, those server types need to be described in this section.

May 9, 2008

***Energy Star* Server Proposed Taxonomy**:

§ The natural world has the taxonomy hierarchy of **Kingdom**, **Phylum**, **Class**, **Order**, **Family**, **Genus**, and **Species**. The *Energy Star* program needs to borrow that taxonomy to describe the program's areas of coverage.

- *Energy Star Kingdoms* might be Homes, Appliances, Commercial Buildings, Office Equipment, Home Electronics, etc.
    - Within the Office Equipment Kingdom, the *Phylums* could be defined as Computers, Monitors, Printers, Storage, Networking, etc.

§ The Computer Phylum has already been divided into the two Classes that have (or soon will have) *Energy Star* specifications: 1) Computer Servers, and 2) Client Computers (desktop, notebook, workstation, et al. client computer systems). Following this taxonomy, the Class of Computer Servers should have several Orders of server types defined in the *Energy Star for Computer Servers* specification.

§ Computer server Orders tend to be defined by their varying general use environments and computer room densities. Although not a complete list, some of the computer server Orders could generally be classified as:

- Industry Standard Pedestal Servers
- Industry Standard Rack Servers
- Server Blades
- Blade Enclosures
- High-reliability Servers

§ Each one of these computer server Orders has the need for more than one Family in each Order that describe substantive differences in capacities and size. The Families may be divided into Genuses and Species that have differences in their capacity and/or scalability. Section 2 of the specification (Qualifying Products) can select inclusion and exclusion at any level of Order, Family, Genus or Species.

§ Below are the five server Orders listed above with their generic Family and Genus hierarchies. These structural hierarchies are illustrated with HP product examples in *Appendix A*. Further descriptions of HP server products described in *Appendix A* are available at the following Hewlett-Packard product website: http://welcome.hp.com/country/us/en/prodserv/servers.html .

§ **Order: Industry Standard Pedestal Server**

A pedestal server is capable of being a stand-alone computer without a data center infrastructure. "Industry Standard" refers to the use of x86 instruction set microprocessor(s). Pedestal servers often provide enough capacity and features to handle the compute server and storage needs of the business that it serves. The definitive differences in Families of Pedestal Servers are compute, memory and storage capacities.

- Families based upon RASM feature differentiation
  - € Genuses based upon number of CPU sockets
    - § Species based upon memory and storage capacities

§ **Order: Industry Standard Rack Server**

A rack server is physically mounted in a rack or cabinet with other information technology (IT) equipment and shares power distribution, cooling and communications infrastructure with other IT equipment in a data center. "Industry Standard" refers to the use of x86 instruction set microprocessor(s). Some of its storage may be located in a separate powered enclosure, but traditionally this type of server has the capability to boot off of its own local storage and provide enough storage for applications running on the server.

- Families based upon RASM feature differentiation
  - o Genuses based upon number of CPU sockets
    - § Species based upon memory and storage capacities

§ **Order: Server Blade**

A blade server is differentiated by higher density servers that have a dependence on a surrounding blade enclosure that provides cooling, network connection, management and direct current (DC) power to many blades, with the ability to easily add a blade server to a blade enclosure. Relative to rack servers, the high-density of blade servers causes some limitations on the scalability and capacities of CPU, memory, storage and I/O devices in each blade.

- o Families based upon blade interchange compatibility type (e.g. HP c-Class BladeSystem, HP p-Class BladeSystem, AdvancedTCA, etc.)
  - § Genuses based upon number of CPU sockets
    - € Species based upon how many blade enclosure slots a single blade product occupies

- **Order: Blade Enclosure**

  Blade enclosures house multiple blades. Typically, the blades are all part of the same Family of compatibility (e.g. HP c-Class BladeSystem). A blade enclosure may hold a variety of sizes of both Server Blades and Storage Blades. Blade enclosures provide ACØDC power conversion, DC power distribution, intra-blade connectivity and networking, uplink networking, power management, and management for hot-pluggable blades and network resources.

    - Families based upon blade interchange compatibility type
      - Genuses based upon number of blade slots in the enclosure
        - Species based upon backplane interconnect differences

- **Order: High-reliability Server**

  A high-reliability server has many physical sizes from small rackable servers to large multi-rack servers. A key difference in these types of products is the product lifetimes. Customers demand 3-5 years of longevity for smaller servers and 7-10 years for the larger servers of this Order. Installed systems are highly likely to receive field upgrades of processors, memory, storage and I/O. Sales volumes are currently much smaller than the sales volumes of most industry standard servers.

  Ultra-reliable compute capacity is a prime differentiator, along with larger memory capacities. Some storage may be in the system, but storage is also likely to be in a separate or remote resource, so I/O bandwidth is an important differentiator.

    - Families based upon business usage models
      - Genuses based upon number of CPU cores
        - Species based upon memory size and aggregate I/O capacity to support external storage and networking devices.

With its focus on power supply efficiency, version 1.0 of *Energy Star for Computer Servers* may have less need for this taxonomy than would a subsequent Energy Star version that is energy performance-based, but it will be very useful to get the definitions written now. With a full taxonomy, Tier I will be able to define specifically which Orders, Families, Genuses and Species of servers are included and excluded, and Tier II will be better prepared for its differentiated development. How *Energy Star for*

Computer Servers transitions from version 1.0 to 2.0, etc. should differ from one Order and Family to the next in both requirements and acceptable frequency of change.

HP Feedback on sections of the "Energy Star Revised Definitions" document

Section 1A: Computer Server Definition

- This section of the draft attempts to define the term "Computer Server", but rather than describe the full range of possible Computer Servers, there is just a list of common attributes.
- HP suggests that this Computer Server definition section describes the computer server taxonomy (see above) and then let the "Qualifying Products" section limit which specific types of computer servers will be allowed to participate in the Tier I specification. E.g. the choice of limiting the number of processor sockets to four should be in the Qualifying Products section.
- A baseboard management controller (BMC) is a feature required by enterprise servers, but perhaps not required by other types of servers. EMC Class A requirement is also one of the differentiating features for enterprise servers versus office and home computers that would be required to pass the stricter Class B electromagnetic interference standard. These are examples of features that lead to different server classifications and are major parts of the RASM features that are included as part of the taxonomy choices.

Section 1B: Blade Chassis Definition

- No major issues, but the last sentence is not entirely accurate. It would be more accurate for that sentence to read "A blade chassis contains multiple slots which can be populated with blades." As previously written, the sentence presumes functionality that is not a general feature in all blade chassis's in the industry.

Section 1C: Blade Server Definition

- No issues.

Section 1D: Blade Storage Definition

- No issues.

Section 1E: Direct Current (Dc) Server Definition

- No major issues.
- "Dc" is usually written "DC" or "dc".

May 9, 2008

Section 1F: Server Appliance Definition

- No major issues on the description, but there may be some objection to including server appliances as a qualifying product under the Tier I specification. This is another differentiator in the overall server taxonomy.

Section 1G: Storage Equipment Definition

- No major issues on the description, but storage equipment (i.e. storage servers) should have its own specification apart from the computer server specification.

Section 1H: Network Equipment Definition

- No major issues on the description, but network equipment should have its own specification apart from the computer server specification.

Section 1I: Computer Server Power Supply Definition

- It is unclear if low-end servers have power supplies that meet the definition that they are separable from the main system. While it is possible to open the box and remove the power supply from low-end systems, they might not be hot-pluggable power supplies and they might not be easy to remove. What was the intention of the wording that sys that power supplies must be “separable from the main system”?

Section 1J: Ac-Dc Power Supply Definition

- No major issues on the description, but AC and DC are usually written as either both capital letters or both lower case letters.

Section 1K: Dc-Dc Power Supply Definition

- No major issues on the description, but DC is usually written as either both capital letters or both lower case letters.

Section 1L: Single Voltage Power Supply Definition

- No major issues on the description.

Section 1M: Multi-Voltage Power Supply Definition

- No major issues on the description, but we re-iterate that this is not a power supply used in enterprise servers.

May 9, 2008

Section 2: Qualifying Products

As written, Section 2 of the Energy Star Revised Definitions document has very little detail. The first line refers to server definitions in Section 1, but Section 1 does not yet fully describe the Orders and Families of servers that are possible and Section 1 should describe more Orders and Families than are prudent to promote for Energy Star Tier I.

Fleshing out the server definitions in Section 1 and helping to choose the correct qualifying server types in Section 2 are among the most important tasks in this review. Section 2 definitions of "qualifying products" should be a subset of all server Orders and Families defined in Section 1.

Recommendations for inclusion and exclusion of product Orders and Families

- The Order of "high-reliability servers" should be excluded from the Tier I specification. The type of power supplies typically implemented in this type of server is often substantially different in capacity and type from smaller computer systems and the range of power loads do not vary widely, so the Table 1 power supply load variables do not apply. These systems should be re-examined for inclusion in Tier II.
- Non-computer servers and blade servers should be excluded from this specification (e.g. storage servers, networking devices, etc.)
- While the Order of Blade Enclosures is easily covered by the Tier I specification, additional work will need to be done to define how to qualify DC-powered Blade Servers for *Energy Star*, separately from their Blade Enclosure.
- With the exception of server types noted for exclusion above, HP has no objection to other Orders and Families of computer servers participating in the Tier I specification, although there may need to be different requirements for different Computer Server Orders and Families.
    a. If the Tier I specification chooses to focus on smaller form-factor high-volume server types, then the highest priorities for coverage would be those server Orders defined as 1) the Order of *Industry Standard Rack Servers*, 2) the Order of *Blade Enclosures*, and 3) the Order of *Industry Standard Pedestal Servers.*

May 9, 2008

Appendix A — *Energy Star* Server Taxonomy Mapped to HP Server Products

This appendix will illustrate how the Hewlett-Packard server product line maps into the taxonomy outlined above.

Order: Pedestal Servers

In the HP ProLiant product line all servers with a prefix of "ML" are in the Order of Industry Standard Pedestal Servers. Sizes are not necessarily equivalent to rack mount servers, although some pedestal servers can optionally be mounted in racks, so the rack server sizing terms of 1U, 2U or 4U height have no meaning when the server is free-standing.

Family: ML100 Series

The ML100 series generally has fewer RASM features than the ML300 and ML500 series. Functionality is also typically higher than what the *Energy Star for Computers* specification would define as desktop-derived servers.

Genus: CPU socket capacity = 1

Example: ML110

Example: ML115

Genus: CPU socket capacity = 2

Example: ML150

Family: ML300/DL500 Series

ML300 and ML500 series servers have additional RASM and on-board disk storage features.

Genus: CPU socket capacity = 1

Example: ML310

Genus: CPU socket capacity = 2

Example: ML350

Example: ML370

Genus: CPU socket capacity = 4

Example: ML570

May 9, 2008

Order: Industry Standard Rack Servers

In the HP ProLiant product line, all servers with a prefix of "DL" are in the Order of Industry Standard Rack Servers.

Family: DL100 Series

The DL100 series provides dual CPU socket compute capacity with a minimum of server hardware and software features. Low cost is the primary motivator for purchasers of the DL100 series.

Genus: CPU socket capacity = 1

Species: Internal storage drive bays = 2

Example: DL120 (1U)

Genus: CPU socket capacity = 2

Species: Internal storage drive bays = 2

Example: DL140 (1U)

Example: DL145 (1U)

Species: Internal storage drive bays • 4

Example: DL160 (1U)

Species: Internal storage drive bays • 12

Example: DL180 (2U)

Example: DL185 (2U)

Family: DL300/DL500 Series

The DL300 and DL500 series servers include many world-class data center features, like hot-plug hard drives, hot-plug fans, hot-plug power supplies, and value-added management subsystems. Added reliability and availability features, ease-of-use, ease-of-deployment, ease-of-management and ease-of-upgrade are several ProLiant advantages that differentiate DL300 and DL500 series servers from both the DL100 series and competitors' servers.

Genus: CPU socket capacity = 1

Species: Internal storage drive bays = 2

Example: DL320 (1U)

Species: Internal storage drive bays • 4

Example: DL320p (1U)

Species: Internal storage drive bays • 14

Example: DL320s (2U)

Genus: CPU socket capacity = 2

Species: Internal storage drive bays = 6

Example: DL360 (1U)

Example: DL365 (1U)

Species: Internal storage drive bays • 8

Example: DL380 (2U)

Example: DL385 (2U)

Genus: CPU socket capacity = 4

Species: Memory capacity = 16 DIMMs

Example: DL580G4 (4U)

Example: DL585G2 (4U)

Species: Memory capacity • 32 DIMMs

Example: DL580G5 (4U)

Family: DL700 Series

The DL700 family supports larger CPU socket counts with larger internal disk arrays, memory capacities and I/O bandwidth.

Genus: CPU Socket capacity = 4

Example: DL750 (7U)

Genus: CPU socket capacity = 8

Example: DL760 (7U)

Order: Blade Enclosures

Because server, storage and other sorts of blades may be plugged into many different sizes of blade enclosures, the blades and blade enclosures need to be categorized separately. Since *Energy Star for Computer Servers* version 1.0 will be focused on thresholds for power supply efficiency and blade enclosures hold the power supply infrastructure for multiple blades, it makes sense for Blade Enclosures to receive separate Energy Star ratings from the blades that plug into them. Defining a procedure for certifying specific server blades for *Energy Star for Computer Servers* version 1.0 may be difficult, while the certification requirements for blade enclosures is more easily defined.

HP has multiple Genuses of c-Class BladeSystem Family enclosures (e.g. c3000 and c7000) that are optimized for different numbers of blades and different types of data centers. They have dramatically different power supply capacity, availability and reliability requirements. However, the same types of server blades, storage blades, network switches and management subsystems can be plugged into both the c3000 and c7000 enclosures.

May 9, 2008

Family: HP c-Class BladeSystem

Genus: Blade Enclosure — Blade slots = 8

Example: BladeSystem c3000 (6U)

Genus: Blade Enclosure — Blade slots = 16

Example: BladeSystem c7000 (10U)

Family: HP p-Class BladeSystem

Genus: Blade Enclosure — Blade slots = 8

Genus: Blade Enclosure — Blade slots = 16

Order: Server Blades

Family: c-Class BladeSystem

Genus: CPU socket capacity = 2

Species: Size = 1 blade slot

Example: BL460c

Example: BL465c

Species: Size = 2 blade slots

Example: BL480c

Example: BL860c

Genus: CPU socket capacity = 4

Species: Size = 2 blade slots

Example: BL680c

Example: BL685c

Species: Size = 4 blade slots

Example: BL870c

Order: Storage Blades (and other non-server blades)

Family: c-Class BladeSystem

Storage Blades should be excluded from *Energy Star for Computer Servers* v1.0. However, given the rapid growth of storage and the significant energy consumption of storage, storage devices deserve their own *Energy Star* Phylum and need one or more *Energy Star* Class specifications.

May 9, 2008

Order: High-reliability Servers

HP recommends that the *Energy Star for Computer Servers* version 1.0 specification exclude the High-reliability Order of servers.

Server products with high-reliability have several defining features:

- Microprocessor families with native 64-bit instruction sets, i.e. other than Intel/AMD x86.
- Large memory capacity relative to the number of CPU sockets.
- Large aggregate I/O bandwidth, measured by how many I/O slots are available per CPU socket and the throughput capacity of those I/O slots
- High levels of security, virtualization, reliability, availability, serviceability and management features.

Family: *Integrity* entry-level and midrange series servers

Genus: CPU core capacity = 4

Species: Memory capacity = 8 DIMMs

Example: rx2660 (2U)

Species: Memory capacity = 24 DIMMs

Example: rx3600 (4U)

Genus: CPU core capacity = 8

Species: Memory capacity = 48 DIMMs

Example: rx6600 (7U)

Genus: CPU core capacity = 8

Species: Memory capacity = 32 DIMMs

Example: rx7620 (10U)

Genus: CPU core capacity = 16

Species: Memory capacity = 32 DIMMs

Example: rx7640 (10U)

Species: Memory capacity = 64 DIMMs

Example: rx8620 (17U)

Genus: CPU core capacity = 32

Species: Memory capacity = 64 DIMMs

Example: rx8640 (17U)

May 9, 2008

Family: Integrity Superdome

Genus: CPU core capacity = 64

Species: Memory capacity = 256 DIMMs

Genus: CPU core capacity = 128

Species: Memory capacity = 512 DIMMs

Family: Integrity NonStop