Arun (8/29/14)

Summary: This paper presents a system called Shrink to reduce energy consumption in CDN datacenters by combining server consolidation and network energy optimization techniques. The proposed approach computes the number of servers required to handle the load first, and then selects servers and switches so as to reduce overall power consumption. A subset of the system has been implemented and evaluated using CDN traces to show that Shrink can reduce power compared to not doing anything.

Strengths:

+ Reducing the energy footprint of datacenters is an important, and current problem.

+ Implemented prototype and evaluation based on real traces.

+ Paper suggests that server and switch power optimization are interrelated.

Weaknesses

- Research contribution and novelty not clearly articulated; the techniques seem like a straightforward synthesis of server and network energy reduction approaches.

- Weak evaluation (details below).

- Problem being solved is not precisely articulated, so it is unclear if the proposed approach would be acceptable and how much room there is for improvement.

- The paper makes sweeping, unsubstantiated claims, e.g., that leaving all equipment on is the only approach used in practice today.

Detailed comments:

The paper takes a good stab at an important problem, namely, reducing the power consumed in a datacenter by jointly considering both server and network components while accounting for the impact on user-perceived performance.

However, I am unable to appreciate the novel research contributions here as they are not clearly articulated. The heuristics used to compute the number of servers as well as the policies used to select servers and switches seem fairly straightforward; in fact, it is unclear what other simpler approach one would try for the problem. So perhaps the contribution here is to observe that simple synthesis of existing server and network energy optimization schemes are good enough? I am not sure.

The primary baseline for comparison in the paper seems to be All-On. The paper also aggressively makes the unsupported claim that that is the only strategy used in practice today. First, this is not true. Second, it is irrelevant even if true, given that reducing energy consumption in datacenters has seen over a decade of work.

The incremental benefit over even a naive server-only scheme seems small, e.g., 8%, and it is unclear how representative this number even is. In fact, the reported gains appear to make the case that there is little value to jointly considering server and network components. Instead, one could simply focus on servers.

Alternatively, one could independently employ existing server-only and network-only schemes, but the paper doesn’t clarify the additional improvement of its supposedly “holistic” design over a naive synthesis of well known approaches.

The problem being addresses is not sufficiently crystallized. Almost all of the paper appears to assume a threshold target utilization level of 75%, and computes the power savings and corresponding impact on metrics indirectly impacting user-perceived performance. It is unclear why a median increase of 3% in origin misses is “small”. How does an operator pick this utilization threshold? The paper doesn’t carefully explore the trade-off between power savings and user-perceived performance or wear-and-tear. That would have been an interesting problem to study as alluded to in the “Goals” section, but the body of the paper does not deliver on it.

The paper pays little attention to the impact on SLAs. Whether an x% increase in cache miss rate or user-perceived latency is acceptable depends on the SLA. For example, suppose the SLA specifies that 99% of the requests should be served within y milliseconds with a possible penalty or no-charge agreement for requests violating the SLA, what would be the net impact on the CDN’s bottomline?

The exposition in Section 3 needs significant improvement. It glosses over important details or describes the approach vaguely at places (e.g., 3.3.1 and 3.3.2). Based on the description, it is unclear what aspects of the problem were challenging.

The system has been partly prototyped (with the network portion being vaporware). But from the brief Section 4 and the experiments in Section 6 dominated by simulations, it is unclear what was challenging about and what was learned through the design and implementation effort.

The experiments do not sufficiently focus on user-perceived performance. Most of the results are focused with cache hit rates that, while important, hardly convey the full picture. What is the impact on end-to-end user perceived page load time or video stalling rate? The evaluation therefore does not live up to the claims in the abstract and introductory sections of the paper.

The paper is mostly easy to read. But the English is awkward at several places and must be vetted by a native speaker. For example, missing or misplace articles, incorrect usage of commas, “which”, etc.