Server Farms

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Research Paper

In order to facilitate a common understanding of this research paper, a definition of the relevant items and brief discussion of the history of server farms is necessary. A server is just a computer that's been selected and probably optimized to perform a specific task in service to others, such as printer servers, database servers, and web servers. In this paper the terms server farm and data center will be used to mean the same thing. They both consolidate servers in a central facility; however, there is a fine distinction. In a server farm, you would generally only see a person when an installation or repair was performed, while in the data center, operators would be sitting at consoles, putting paper in printers and possibly moving disks and tapes from one place to another. This research paper will discuss how server farms became established in the marketplace; the strengths and weaknesses of this technology; and businesses trends and strategies.

Data centers are not a new concept; IBM and Electronic Data Systems were building them in the late 1960s. Data centers are finally starting to recover from the DOT com bust in 2000-2001. What caused this turnaround in the server farms? Dick Slansky, analyst at the ARC Advisory Group, a market research and consulting firm in Dedham, MA stated, "What made server farms mushroom was the capacity [enterprises] needed to run Internet-based businesses. Web servers make up a big chunk of any server farm (Konrad 2001)."

Another more relevant factor contributing to the growth of server farms is the revolution currently taking place in the $120 billion software industry. Software that traditionally has been installed on personal computers – from word processing and e-mail to heavy duty accounting applications – is going online. Google in 2006 released an online spreadsheet and purchased a web-based word-processing program called Writely. In order to support these commitments, companies are investing heavily in server farms. Analysts say the three companies: Microsoft, Google, and Yahoo combined will invest approximately $4.7 billion dollars to capital expenditures (Mehta 2006).

Low cost and high value contributed to establishing server farms as the industry standard for web based information processing. The startup costs to establish a small server farm are relatively low. Servers nowadays are so inexpensive (about $7,000 for basic model and higher up to $20,000 depending on functions) that they can be acquired with discretionary petty cash in company departments (Morgan 2005). Phil Nail AISO.net co-founder said that establishing a small data center with zero energy bills cost about $100,000 (Woody 2007). Mainframes have a reputation for reliability and stability, but due to the high start up cost most companies aren’t interested. The minimum list price for just a mainframe Integrated Facility for Linux (IFL) is $95,000 per central processor. For many mainframe models, the IFL is priced at $125,000 per processor dedicated to Linux. In addition, there are on-going ancillary costs associated with this purchase that are unappealing for companies such as server subscription costs.

The downside to this technology is that server farms consume an enormous amount of energy. The total energy consumed by the Internet information technology sector--from silicon manufacturing to wireless networks, cooling systems, desktop PCs and server farms--is an estimated 8 percent to 13 percent of the nation's electricity, according to data from the Energy Information Administration. This data may be based on server farms operating 24 hours a day at a constant temperature of about 68 degrees at full capacity. But servers do not always run at full

capacity because they are frequently idle. Therefore, the estimated 8-13 percent figure may not be entirely accurate (Konrad 2001).

The enormous amounts of energy used to operate server farms, translates into significant operating costs for businesses. And it's not only businesses that deal with the energy issues. Server farms are in nearly every sector of the economy: everything from business to academia to every level of government. A data centre power consumption study by technology analysts IDC suggests that for each dollar spent on hardware, another 50 cents is spent on energy costs. By 2001, that ratio will rise to 71 cents per dollar (Harvey 2008).

Most communities can't cope with the infrastructure demands of a massive server farm. The local utility just doesn't have enough surplus power to give these facilities. Power consumption on that level is like supplying power to a city within the city, they just don't have the resources for that. The infrastructure demand as well as the energy cost is driving Microsoft and others to resource rich areas like eastern Washington where hydro electricity is plentiful. Municipalities aren't exactly welcoming these large server farms into their communities. Server farms just don't generate a lot of jobs. They are designed to operate with a minimum of personnel. Google's super server farm in Oregon is only expected to add 50 to 100 jobs to the local economy, according to press reports (Mehta 2006).

A byproduct of the growth of server farms is that the environment is impacted by the increasing number of server farms. Studies show that between 2002 and 2006, carbon emissions from data farms doubled. This may be due in small part to the emergency backup power –usually diesel generators, but is more likely a result of the power they draw from the local utilities. Essentially, the reduction of data centers would decrease air pollution and waste (Konrad 2001). Vendors such as HP and IBM have spent more than $1-billion each to consolidate their data centers. HP went from 85 data centers globally to 6. IBM cut 150 centers down to 12.

Bill Dupley, HP Canada's IT strategist, says based on HP's own experience in consolidation, reorganizing a database should be recognized as smart business, not as an IT project. "We promised a 43-per-cent annual return on an investment of $1-billion," he says, adding that it was those upfront numbers that got the project fast-tracked. "We delivered $300-million right off the top in lower network costs. The rest will come over three years in terms of needing 50 per cent fewer staff and savings in power consumption and cooling costs (Harvey 2008)."

The current trend in server farms is to go green. The rapid growth of server farms established by major corporations such as Microsoft, Google, and Yahoo is tempered by the high operating cost from powering these server farms as well as a growing consciousness of its negative effect on the environment. In large part this is due to businesses trying to increase their gross margin and perhaps to a lesser extent to gain public favor. As a result, businesses have sought ways recently to pare down their racks of servers, trim power consumption and reduce carbon footprints – and at the same time increase the efficiency of their servers so they can accommodate the never-ending stream of data.

The high energy costs of running a server farm isn't just from powering the servers. Almost half the energy cost of operating a server farm is from cooling the equipment. Vericenter, an operator

of data centers, says a rack of "blade" servers can get as hot as a seven-foot tower of toaster ovens. It gets hot enough that for every dollar a company spends to power a typical server, it spends another dollar on a/c to keep it cool (Mehta 2006).

The hardware approach to this problem is to produce devices for servers that emit less heat and use less energy. Hardware manufacturers from microchips to disk-drive are producing products that are energy efficient. A server blade is a server that fits on a single circuit board, including CPU, memory, and perhaps a local hard disk. It requires less floor space and electricity than a typical server (Wood 2002). Server racks with cold water running through its frame to cool the servers have been considered as a possible solution. Advanced Micro Devices, is heavily promoting its Opteron chips as an energy-efficient solution for data centers. It is even appealing to the green factor with billboards in Times Square and Silicon Valley as an environmentally friendly company.

The software approach is to maximize the use of servers when it is in an idle state, thereby using fewer servers and consequently decrease energy costs. Virtualization software is used to create virtual storage partitions on a single machine. Users can install programs on each partition, including operating systems, and run several different processes concurrently. So instead of using four different machines to perform four different tasks (and running at barely 15 or 20 per cent efficiency), businesses can run all four tasks on a single machine (Harvey 2008).

Another innovative approach which may be effective for small server farms is through a combination of the above with energy efficient infrastructures. A small server-farm company called AISO.net (for "affordable Internet services online") dropped its $3,000 a month electric bill to zero. Its server farm is located inside a 2,000-square-foot building. AISO.net has two banks of ground-mounted solar panels, which generate 12 kilowatts of electricity. Batteries store the juice for nighttime operation. AISO.net switched from 120 individual servers to four IBM blades running virtualization software. The air conditioner only operates for about 10 minutes an hour. When the external temperature drops to 60 degrees, air is sucked into the building to cool the servers. Solar tubes built into the roof illuminate the facility's interior.

Larger data centers can't reduce costs so drastically using the above methods; however, as mentioned previously, businesses with multiple server farms can reduce the number by consolidation. Sun Microsystems recently slashed power consumption by 61% through consolidating its Silicon Valley servers into a single state-of-the-art facility (Woody 2007).

The final approach to reduce energy costs is to build server farms in cheap abundant energy locations. Yahoo, Google, and Microsoft are building their server farms in the Pacific Northwest, near hydroelectric power plants selling cheap electricity. "If I saved just $10 in the operation of each of those servers, that's $10 million per year," says Greg Papadopolous, chief technology officer of Sun Microsystems. "So how much would you be willing to invest in order to save $10 per server? This is exactly the discussion companies had around the time of the Industrial Revolution (Mehta 2006)"

The greatest weakness to this technology is the high cost to power and cool down all the servers as well as the carbon byproduct from the backup generators. However, technology is rapidly

advancing to meet this challenge through improved hardware and software innovations. Businesses are rapidly developing strategies and implementing plans to cut costs and reduce its impact on the environment. The adoption of the server farm as the preferred technology by software giants such as Microsoft, Google, and Yahoo bodes well for the future of this technology…at least until the next emerging technology comes along to supplant it.

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