

Internet fuels shocking load requests



Internet traffic growth doubles about every year, and sometimes grows at even faster rates. That means more computers, more servers, and a growing demand for power. But inadequate generation is not the only problem. Some Internet companies are consuming 50 W/ft² and that may grow to 100 W/ft². This leaves the local providers scrambling to meet the demand with distribution systems designed to provide 4 to 8 W/ft².

By Tom Grahame and David Kathan

Just how serious is load growth from Internet build-out? In August 2000, high-tech customers near Seattle, Wash., told Puget Sound Energy (PSE) that their load might increase by a total of 445 MW. Within a month, requests from other customers pushed the amount up to 700 MW.

This potential demand (equal to over 10% of PSE's peak demand) was unforeseen nine months earlier and did not appear in PSE's December 1999 Integrated Resource Plan.

And, why do the customers need the extra 700 MW? Primarily to power new Internet data centers, which have rack after vertical rack of servers that enable Web hosting, co-location, information caching, application service provision, and other Internet services. The need for intensive air conditioning in these facilities pushes the power demand even higher.

While Seattle is one obvious place to look for server farms, rapid Internet load growth is occurring in many places across the US, such as Chicago, Ill., New York, N.Y., Washington, D.C., and California. Pacific Gas & Electric Co. (PG&E), San Francisco, Calif., recently announced that high-tech companies in its territory are requesting 1271 MW over

the next four years for new data centers. With almost half of the requests occurring after Sept. 1, 2000, the rapidity of new growth is stunning (table). As of April 2001, requests have increased still further to 1600 MW, including one 180 MW data center (the largest yet) recently approved by the San Jose city government.

These large, electricity-intensive data centers (also known as telecom hotels—see box) may become common. To ensure adequate power for the local and national economy and sufficient transmission and distribution capacity, utilities need to better understand the electricity demands of the Internet in general—and server farms in particular.

Drivers of electric growth

The Internet actually affects demand growth both directly (telecom hotels) and indirectly (as an enabler of productivity growth). So, predicting the Internet's overall impact on demand is complicated. But, in some areas, the

picture is clearer.

There are approximately 34 areas in the US that presently have what is needed to attract companies that build Internet centers (large fiberoptic backbone carriers and large Internet loads). In 17 jurisdictions, an average of at least 200 MW of new load is likely to be built. But this does not tell the whole story. Growth over the next four years could be at least double that in several of these areas.

What are Internet data centers?

What are data centers, or telecom hotels? A data center is commercial space devoted to Web hosting, server farms, co-location, information caching, application service providers, and other Internet uses. The growth of these services depends on centralized data centers, for a couple of reasons. Data centers are more efficient and lower the cost for services—and therefore increase the demand for Internet services. In addition, the cost of Web hosting in a data center can be as much as 80% lower than Web hosting in-house. And, many companies do not have the physical space or the IT professionals required to perform Internet functions in-house.

These centers typically have multiple vertical racks of servers, connected to high-speed fiberoptic nodes. To ensure that Web sites, networks, and e-commerce transactions have

continuous access to data and information, data centers install multiple layers of redundancy, including battery backup, power conditioning equipment, on-site backup generators, HVAC equipment, and security systems.

Once built, data centers tend to have a relatively low labor requirement, which has become an issue in several cities. Politicians, concerned about downtown districts turning into "ghost towns," are proposing policies and ordinances to limit the number of data centers in downtown business districts.

"First generation" data centers, which started operation about two years ago, tend to be quite small, requiring perhaps 2 to 4 MW, and may use no more than about 35 W/ft². In contrast, newer centers are requesting up to 180 MW, with requests of 20 to 30 MW common. Developers of data

centers now typically plan to use 100 W/ft² or more (assuming they will use the more power-dense servers now coming to market). For comparison, large office buildings usually draw between 4 and 8 W/ft².

Data centers tend to be located in areas with lots of Internet/new economy firms and large fiberoptic "backbone" lines. Quick access to trained technicians and maintenance personnel is also a key consideration for the location of these facilities, particularly co-location facilities.

Presently, the greatest demand for data centers are in such locations as Seattle, Wash.; San Francisco/Silicon Valley, Los Angeles, Calif.; the New York metro area, northern Virginia/Washington, DC; and about 30 other locations that meet these criteria—such as Miami, Fla.; Dallas/Ft. Worth, Tex.; greater Boston, Mass.; and Chicago, Ill.

Power requests by data centers

Region	Utilities contacted	Max no. of MW requested at time of inquiry
West Coast	Pacific Gas & Electric Co Silicon Valley Power Los Angeles Dept of Water & Power Southern California Edison Co Seattle City Light, Puget Sound Energy	3970*
East Coast	Consolidated Edison Co of NY Inc Public Service Electric & Gas Co NSTAR Dominion Resources, Pepco Florida Power & Light Co	3800*
Rest of US	Commonwealth Edison Co Texas Utilities Austin Energy Georgia Power Co (for Atlanta) Arizona Public Service Co (for much of Phoenix)	1530*

*Requests still coming in

Note: Regions/cities listed as part of a major fiberoptic carrier's US network, but not yet contacted Philadelphia, Pa.; Houston, Tex.; Cleveland/Ohio; Denver, Colo.; Salt Lake City, Utah; El Paso, Tex.; Columbus, Ohio; Orlando, Fla.; Minneapolis, Minn.; Rochester, NY; Kansas City, Mo.; Indianapolis, Ind.; Memphis, Tenn.; Charlotte (NC) area; Portland, Ore.; St. Louis, Mo.; Detroit, Mich.

Of course, if the tech implosion continues for several quarters, corporate IT spending ramps further downward, and tech spending in general stays below recent forecasts, then the need for data center space is also likely to grow more slowly than forecasted.

Some 5 to 10 GW could be needed to power the centers likely to be in operation within three to four years across the US.

At a 95% load factor, 5 GW is equal to about 42-billion kWh. Over four years, this would add about a quarter of 1% to the

estimated US electricity growth rate each year: 10 GW would be half of 1%. While this is not a huge figure from a national perspective, it could be quite significant in selected coastal regions already short of power.

Predict the future

In the medium term (four to six years) and the long term (more than seven years), predictions are more difficult.

Further research is needed before utility planners will really understand the electricity needs of various aspects of optical transport and use

One consulting company, Ryan, Hankin & Kent, San Francisco, forecasts that Internet traffic will increase by a factor of 43 between 1999 and 2003 (from 350,000 terabytes per month to over 15-million terabytes per month). So it looks like we are in for a rough ride. There is one positive note: Servers, and perhaps data center designs, are likely to become more efficient over time.

This is what is known: Currently, optical transmission is used almost exclusively in the "backbone" of data transmission. These are the large (in capacity, not physical size) fiber-optic cables that transport data across the US or undersea to Europe and Japan. Electricity still powers the lasers that send the photons flying, but a laser uses much less power (per unit of information sent) than equivalent electrical transmitters.

The optical signals must be regenerated every 100 miles or so, using small amounts of electricity each time. Starting in 2001, however, optical packets will be able to travel up to 3000 miles without electric regeneration, thanks to newly commercialized technologies. Corvis, Columbia, Md., a manufacturer of optical switching devices, claims it can now reduce the electricity needs for switching optical transmission by a factor of four.

The present trend toward metropolitan area networks (MAN) may also reduce demand growth in the future. And, as optical networks replace electronic ones in the MANs, less electricity will be required, at least in that part of the network.

Eventually, optical transmission might replace less efficient metal wires in the "last mile" of service. This is just beginning to occur in offices and apartment buildings and perhaps will extend to homes as well.

Finally, some companies are studying the possibility of optical data storage.

Given that much of this technology hasn't been commercially developed yet, it is difficult to quantitatively evaluate the effect of optical systems on future electricity usage. That said, following are some predictions:

■ In the short term (up to four

years), there will be a jump in electricity demand, particularly in a few specific regions and cities. This increase could result in continued electricity shortages in some areas. Whether this trend will continue or not is unclear.

■ Short-term growth will require investments and upgrades in generation, distribution, and transmission facilities that potentially could become stranded. Existing line extensions, dedicated facilities, policies, and tariffs will need to be examined for adequacy.

■ Limited distribution systems may be bottlenecks, preventing development. If it takes 12 to 18 months to hook up large new load, the development of Web hosting, off-site storage, and broadband services may be delayed. At a minimum, distribution capacity will affect which areas "win" in the data center build-out race.

■ It is likely that the new economy will be a major market for distributed generation. This will mostly be in the form of on-site emergency generators, but it will also include parallel generation facilities operated by customers. The extent to which this occurs will depend on how quickly distributed generation equipment can be delivered, and on whether server farms have room on site for new types of distributed generation.

■ If power shortages lead to significant use of diesel powered back-up generators, then rising demand and the move toward distributed generation may affect national and local environmental-quality requirements.

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