



# TSTC TECH BRIEF

TEXAS STATE TECHNICAL COLLEGE • FORECASTING

## CLOUD COMPUTING

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### IN THIS ISSUE

Cloud computing refers to the increasingly common practice of using virtualization to deliver scalable information computer services. The popularity of this business practice is generating new demand for technical competencies across a number of existing occupations including: systems and network administrators, software developers, and information architects. The distributed and customer-focused nature of these services requires employees with strong communication, teamwork, and analytical skills as well as an understanding of the business implications of technical decisions. College IT programs should update curriculum modules to prepare students for administering cloud services in datacenter operations as well as software development within virtualized environments. IT professionals currently unemployed or displaced will benefit from additional certifications in virtualization and other relevant competencies discussed in this issue. ■

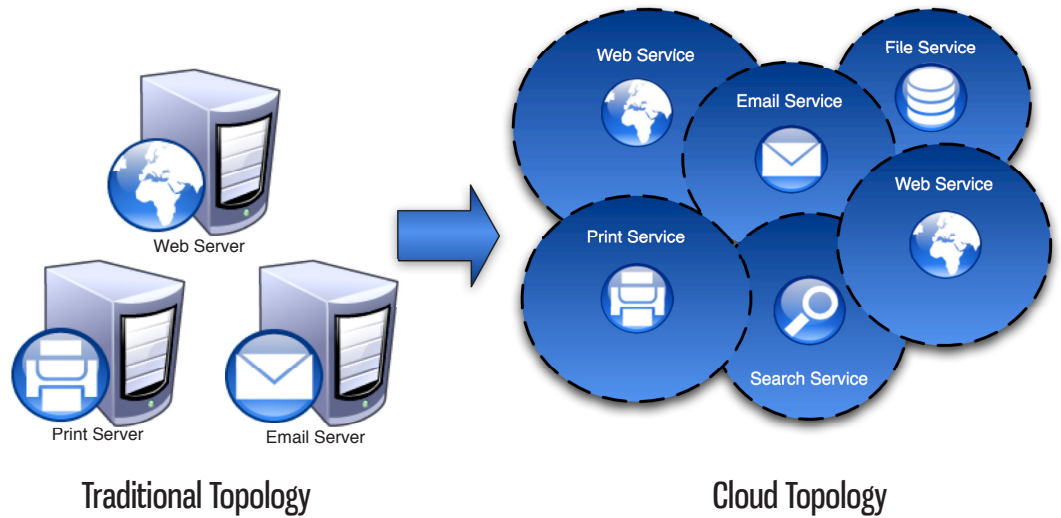
The exact definition of cloud computing varies. Some industry stalwarts even criticize the use of the term as unnecessary marketing hype. Traditionally, computer services like email, file services, and web hosting each run on a dedicated server. This is expensive and inefficient because it requires maintaining separate hardware installations and does not allow computer resources to be shared between applications. By distributing applications across a number of servers, computer hardware resources can be shared dynamically as required by each service. Put simply, cloud computing enables more flexible and cost effective access to IT resources.

A recent *InfoWorld* article summarizes that cloud computing is “a way to increase capacity or add capabilities on the fly without investing in new infrastructure, training new personnel, or licensing new software” and that “cloud computing encompasses any subscription-based or pay-per-use service

that, in real time over the Internet, extends IT’s existing capabilities.”<sup>1</sup>. This notion of IT resources as a service or utility rather than a capital expenditure sets cloud computing apart from more established terms like clusters or distributed computing.

Cloud computing has its roots in technologies and practices developed for datacenters like those that power familiar services such as Google, Yahoo, YouTube, and Amazon. These all run in large distributed datacenters that enable fast and easy access through Internet browsers or, increasingly, mobile devices. Behind the scene are racks of servers running various operating systems, middleware, and applications connected through networks of switches and load balancers. These are, in turn, protected by firewalls and VPNs. All require significant amounts of air conditioning to keep cool and electricity that must be carefully managed to ensure systems are up and running smoothly.

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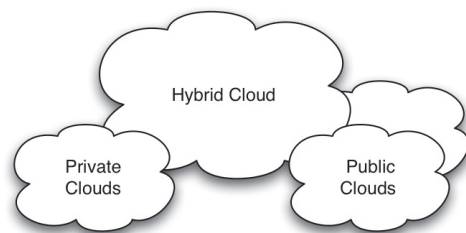


“The bottom line is that IT use of the cloud is growing very quickly, and demand for skills to enable that growth is climbing as a result. If you have skills related to IT operations, application administration/operations, or software development, now may be the time to dive into the cloud.”

*James Urquart,  
Cisco*

This scene is repeated throughout the world in massive interconnected datacenters over redundant fiber backbones. Cloud computing enables customers to tap into these resources and only pay for what they use, rather than shouldering the expense of a dedicated datacenter.

Private clouds are hosted within an enterprise and offer greater control with associated infrastructure costs. Public clouds are owned and operated by third parties and provide increased scalability and flexibility without upfront capital expenditures. More recently, hybrid cloud computing services integrate both customer-owned and third party infrastructures.



The growing importance of cloud computing is evidenced in the recent bidding war between Dell and HP for control over utility storage company 3Par. This company’s expansion from predominately data storage into cloud computing, utility computing, and virtualization made it an attractive acquisition for quick entry into the cloud computing market. Gartner estimates the 2009 market for cloud services at \$46.4 billion and forecasts a 224% increase to \$150.1 billion by 2013.<sup>2</sup> There is some debate about the exact size of the market due to varying definitions. Regardless, it is clear that cloud computing is growing rapidly as a subsector of information technology. More importantly for our readership, this growth is generating new job demand and marketable competencies worthy of attention by college administrators and faculty.

## EMPLOYABILITY

Cloud computing commentator James Urquart of Cisco Systems states, “The bottom line is that IT use of the cloud is growing very

quickly, and demand for skills to enable that growth is climbing as a result. If you have skills related to IT operations, application administration and operations, or software development, now may be the time to dive into the cloud.”<sup>3</sup> A search of Monster.com produced over 200 job openings in Texas that include cloud-based skills in the required responsibilities. San Antonio-based data hosting and cloud computing provider RackSpace lists 148 Texas job postings alone at the time of this analysis. Like many other emerging technologies we have studied in the past, this innovation drives new competencies within existing occupational categories. Target occupations include traditional IT titles such as network administrators, systems administrators, database administrators, and customer support technicians as well as information architects, solutions architects, and business analysts. There are also a number of new sales and marketing and management positions posted for cloud-related services. The resulting productivity gains realized by cloud computing also reduce IT staffing needs in some instances.

Employability requires both deep technical expertise as well as strong analytical and communication skills. As we have seen in previous tech brief topics, the convergence of various technologies is driving demand for technical expertise across multiple fields and with a big picture view of how systems work together in order to troubleshoot and anticipate issues. Cloud computing jobs require employees with strong teamwork and communication skills who can collaborate with peers and work directly with customers. Myopic technicians and, conversely, managers lacking technical expertise need not apply. College programs should address these competency requirements through project-based learning and interdisciplinary teams that mimic the realities of today’s 21<sup>st</sup> century workplace.

## EARNINGS

An analysis of current job postings by Simply Hired places the average salary for cloud computing jobs in Texas at \$98,000<sup>4</sup>.

## AVERAGE SALARIES FOR CLOUD-RELATED JOBS IN TEXAS

Network and Computer Systems Administrators	\$67,642
Network Systems and Data Communications Analysts	\$76,419
Computer Specialists	\$77,022
Computer Support Specialists	\$47,341
Database Administrators	47,341

Source: Texas Workforce Commission

Salaries will vary by company and based on location, industry, certifications, and years of previous experience. Traditional labor market data does not include a job classification specifically for cloud computing; however, the table above provides LMI data for cloud-related IT occupations.

## COMPETENCIES

The exact competency mix for cloud computing varies by company and the specific target occupation. Employer interviews and job postings indicate a strong need for **system administrators** with a preference for the Linux operating system as well as Microsoft, Unix, and Solaris. Technical competencies include: deep knowledge of associated file systems and partitioning; kernel settings and working at the command line; web services like Apache; email fundamentals (SMTP, POP, IMAP) and related services; databases like MySQL; security and encryption technologies including SSL and public/private key management; authentication and directory services such as LDAP/Active Directory; as well as scripting (php, perl, python) and basic HTML for developing and debugging web applications. System administrators must also have fundamental knowledge of networking.

**Network administrators** require advanced knowledge, including: configuration of switches, routers, concentrators, and the use of associated management tools; DNS and zoning; IPSEC and IPv6; routing tables, traffic management, and load balancing (Zeus, F5,

A10, Cisco); VPN and firewall configuration; monitoring tools like SolarWinds; knowledge of TCP/IP ports and services; and other more specialized knowledge based on the employer's infrastructure. Network administrators must also have basic understanding of the same competencies as system administrators.

**Virtualization** is the core enabling technology of cloud-based services. Put simply, virtualization enables applications, platforms, operating systems, and hardware to run independently of one another. VMware is the current market leader in virtualization. Microsoft's competing platform is Hyper-V. Xen is a popular open source option. Citrix is a leader in desktop virtualization. Given the increasingly pervasive nature of virtualization, it is clear that some aspect of virtualization should now be a de facto component of any information technology curriculum. A useful summary of over 100 virtualization vendors can be found at [www.virtualization.info](http://www.virtualization.info). In some cases, cloud providers provide web frontends that enable clients to scale up and down various services as needed and at various price levels, effectively automating the backend virtualization process.

Because Texas is home to a large number of datacenters, there is also a unique demand for **hardware specialists**. Texas State Technical College's high performance computing (HPC) program was developed to specifically target staffing needs for large datacenter environments. According to department chair Walton Yantis, hardware specialists must have competencies in electrical wiring, electrical maintenance and

Virtualization is the core enabling technology of cloud-based services.

repair, power management, refrigeration and other specialized training required to operate large computer installations—the functional backend of cloud computing.

In addition to these technical competencies, job postings and employers clearly underscore the need for **21<sup>st</sup> century skills**, including: the ability to resolving complex customer issues; conduct creative problem-solving to identify the source of problems; listen to the needs of customers and clearly anticipate and communicate possible issues; work closely with others as part of a team; advise on potential pitfalls that a customer may experience; and suggest alternatives that may better serve the stability and security of the customer's solution.

## EMPLOYER PERSPECTIVE

Jay Bathershell, managing principal of ClearView, a Dallas based company with a network of data centers, says their organization requires employees with multiple specializations, including network technicians, systems administration at various levels, all the way up to information architects or infrastructure architects.<sup>5</sup> ClearView looks for employees who can do more than support servers and other hardware; they look for project managers capable of big picture thinking, people who can understand and communicate the impact of implementing various technology strategies. He recommends an understanding of business analysis as well as technical mastery. In other words, these are not your average “rack and stack” technicians.

Bathershell is not alone in seeing a need for interdisciplinary knowledge in the growing virtual marketplace. According to *Educause*, future growth in cloud computing will have extended implications for professionals across multiple disciplines: “IT professionals, business professions, lawyers, auditors, and others will need new skills to manage an infrastructure and service portfolio that

is hosted elsewhere or is merely invoked as needed as an Internet service. Skills such as contract management, the creation of service level agreements, and security management change as the portfolio changes.”<sup>6</sup> The IT Infrastructure Library (ITIL) certification addresses many of these competencies and was mentioned in a handful of job postings reviewed for this brief.

Tech blogger and Blue Mountain Labs founder David Linthicum suggests that cloud computing is actively transforming systems administration as a career. Says Linthicum: “We’ll morph into system managers, not system operators. Thus, we can focus on the business, not replacing failed storage servers, or swapping out power supplies. Moreover, we’ll be much better at leveraging existing services, thus we’ll again be more focused on the business functionality, and not as much the technology.”<sup>7</sup> Systems architect Frédéric Faure writes, “The systems administrator’s craft is therefore evolving between a physical infrastructure and an Amazon Web Services-type Cloud infrastructure: he is becoming more and more of a developer.” Faure goes on to caution that cloud services will not replace systems administrators for most organizations, but will likely change the roles they play.<sup>8</sup>

Looney and Bathershell see a major logistical change on the horizon, driven by technologies like cloud computing. Says Bathershell, “As I look in to the future, more and more I see the concept of the virtual worker, being able to work anywhere at any time. Being able to work with different countries, and to work remotely.” Looney offers an example from their own field in the area of server management; until now one administrator could manage a maximum 20 to 25 servers in most cases. He says, “With the advent of virtualization, that is going north of 75 maybe one to 100. You are reducing your headcount. That person may be paid more, but it will be less people than before.” Both recommend that educational institutions add exercises in remote computing services, as well as collaboration in virtual teams.

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# IN OUR NEXT ISSUE

Smart phones and mobile apps are now fully integrated into our daily lives. There are apps for social networking, discovering a new place to eat, checking a bank balance, getting directions, and—the most popular—playing games. Consumers increasingly expect companies to enable easy and convenient access to their services through a mobile device. Even local governments and schools are launching apps of their own. In our next TechBrief we look at mobile applications, explain the differences between native apps and mobile web apps, and make recommendations on steps colleges should take to ensure their graduates have an advantage in this growing industry sector.

# SUGGEST A TOPIC

Do you have a technology or occupation you would like TSTC Forecasting to consider researching? Submit your topic online at [www.forecasting.tstc.edu](http://www.forecasting.tstc.edu).

## GROWING PAINS

As with any new innovation, there are some challenges facing cloud computing worthy of consideration. For Frank Dzubeck, an industry commentator for NetworkWorld.com, these boil down to five key questions that must be answered.<sup>9</sup> *Security*—data theft has become a lucrative criminal activity, and cloud servers often store sensitive information that must be carefully protected. *Performance*—service level agreements must account for availability, legal, budget and insurance requirements depending on clients' unique requirements. *Management*—interoperability among various internally and externally hosted cloud services introduces new complexity that must be considered to minimize inefficiencies. Vendor lock-in is also an issue in some cases. *Governance and Regulatory Compliance*—a large portion of the information traveling through the cloud is subject to regional and national governance and differences in standards and oversight can make data storage and transfer a complicated prospect, especially when multiple nations are involved. And finally, *Financial*—Dzubeck points out that organizations may need to consider how to classify cloud computing costs as variable or fixed IT cost.

Despite these growing pains, as a recent Infoworld article states, “among big metatrends, cloud computing is the hardest one to argue with in the long term.”<sup>10</sup>

## RECOMMENDATIONS FOR COLLEGES

*Update existing IT programs.* Colleges can best respond to the emergence of cloud computing with modifications to existing IT programs in systems administration, network administration, network security, software development, and information architecture with particular emphasis on virtualization fundamentals and certification.

*Offer fast track options.* Colleges should consider offering compressed workshops, boot camps, and other “fast track” style training leading to technical skills mastery and industry certifications when applicable. Current IT professionals, including workers displaced by recent economic trends, will find these training options an invaluable means of keeping skills up to date. A number of companies have created cloud computing training seminars; for example, platform management company RightScale hosts regular webinars and archive previous sessions on their websites, and Stratos Learning both introductory courses and specialized training.<sup>11</sup> Prof. Brad Armosky, of UT-Austin's Texas Advanced Computing Center, recommends free, online systems such as HPC University, CI Tutor, and MIT Open Courseware.

Texas State Technical College Forecasting is charged with identifying emerging technology trends, evaluating potential workforce implications, and providing Texas colleges analysis of potential new training opportunities. Our mission is to strengthen the competitiveness of Texas by ensuring employers have a highly skilled workforce. Visit us online at [www.forecasting.tstc.edu](http://www.forecasting.tstc.edu) for the latest forecasts and to submit your comments and research topic suggestions.

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## SOURCES

<sup>1</sup> Eric Knorr and Galen Gruman, "What cloud computing really means: The next big trend sounds nebulous, but it's not so fuzzy when you view the value proposition from the perspective of IT professionals." <http://www.infoworld.com/d/cloud-computing/what-cloud-computing-really-means-031>.

<sup>2</sup> Ben Pring, Robert H. Brown, Andrew Frank, Simon Hayward, and Lydia Leong, "Forecast: sizing the cloud; understanding the opportunities in cloud services." (Gartner 2009). <http://www.gartner.com/DisplayDocument?id=914826>

<sup>3</sup> James Urquhart, "Exploring a healthy cloud-computing job market." [http://news.cnet.com/8301-19413\\_3-20015267-240.html?part=rss&tag=feed&subj=TheWisdomofClouds](http://news.cnet.com/8301-19413_3-20015267-240.html?part=rss&tag=feed&subj=TheWisdomofClouds)

<sup>4</sup> Simply Hired. Retrieved from <http://www.simplyhired.com/a/salary/search/q-cloud+computing/l-texas>

<sup>5</sup> Jay Bathershell and Jay Looney, phone interview with the authors, Sept. 2, 2010

<sup>6</sup> Richard N. Katz, "Looking at Clouds from All Sides Now." *Educause Review*. (May/

June 2010): 33-43.

<sup>7</sup> David Linthicum, E-mail interview, July 22, 2010

<sup>8</sup> Frédéric Faure, "Cloud AWS Infrastructure vs. Physical Infrastructure". Highscalability.com,

<http://highscalability.com/blog/2010/7/8/cloud-aws-infrastructure-vs-physical-infrastructure.html>

<sup>9</sup> Frank Dzubeck, "Five Cloud Computing Questions." *Network World.com* <http://www.networkworld.com/columnists/2008/080508-dzubeck.html>, par. 11-12.

<sup>10</sup> Todd R. Weiss, "Big Guns for Hire: supercomputing in the Cloud." *Computerworld.com*, [http://www.computerworld.com/s/article/9178932/Big\\_guns\\_for\\_hire\\_Supercomputing\\_in\\_the\\_cloud?taxonomyId=159&pageNumber=1](http://www.computerworld.com/s/article/9178932/Big_guns_for_hire_Supercomputing_in_the_cloud?taxonomyId=159&pageNumber=1).

<sup>11</sup> Rights Scale. "News and Events" [http://www.rightscale.com/news\\_events/events.php](http://www.rightscale.com/news_events/events.php).