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**Smartphones expected to drive most work from the desktop to 'the cloud':
Most experts surveyed in Pew Internet/Elon University study say cloud computing is taking
over; some warn about security, privacy, spectrum, and choice and control issues**

In a recent survey, nearly 900 Internet experts and highly engaged users said they expect people who use the Internet will "live mostly in the cloud" by 2020, working primarily through the use of cyberspace-based applications on remote servers that we access through our networked devices. This does not mean, however, that most think the desktop will disappear soon. The majority sees a hybrid model continuing.

The Web-based survey, conducted by the Pew Research Center's Internet & American Life Project and the Imagining the Internet Center at Elon University, gathered opinions on 10 important issues from a select group of experts and the highly engaged Internet public. Results from this survey are being released in five major 2010 reports; this is the fourth. (Details about earlier reports can be found here: <http://www.elon.edu/e-web/predictions/expertsurveys/2010survey/default.xhtml>. Deeper details from this report are here: http://www.elon.edu/e-web/predictions/expertsurveys/2010survey/future_cloud_computing.xhtml.)

In this canvassing of a diverse number of experts, 71% agreed with the statement:

"By 2020, most people won't do their work with software running on a general-purpose PC. Instead, they will work in Internet-based applications such as Google Docs, and in applications run from smartphones. Aspiring application developers will develop for smartphone vendors and companies that provide Internet-based applications, because most innovative work will be done in that domain, instead of designing applications that run on a PC operating system."

"Cloud" is a metaphor for the Internet. "Cloud computing" is a phrase that is being used today to describe the act of storing, accessing, and sharing data, applications, and computing power in cyberspace. The concepts of storing data in remote locations or renting the use of tools only when you need them are not new, but the positives and negatives of cloud computing present us with unprecedented opportunities and challenges.

A September 2008 Pew Internet Data Memo reported that 69% of Americans had either stored data online or used Web-based software applications at least once. Today, the number of cloud users has grown; there are 500 million people sharing friendships "in the cloud" on Facebook, and many millions are using the cloud every time they access a Hotmail or Gmail account for email, store browser bookmarks online, maintain a blog on WordPress, or store, link to and view videos and photos on YouTube, Hulu and Flickr.

Most of the people responding to the Future of the Internet survey said cloud computing will continue to expand and come to dominate our information transactions because it offers many advantages, allowing us to have easy, instant, and individualized access to tools and information we need wherever we are, locatable from any networked

device. Some experts noted that people in technology-rich environments will have access to sophisticated-yet-affordable *local* networks that allow them to “have the cloud in their homes.” Some predicted that in the next decade desktop and individual private networks will be able to provide most of the same conveniences as the cloud but with better functionality, overall efficiency and speed.

Most of the experts noted that people want to be able to use many different devices to access data and applications. Many said that the popular adoption of smartphones is driving the move to the cloud. Some referred to a future featuring many more different types of networked appliances, all tied into the “Internet of things” – or a world in which everyday objects have their own IP addresses and can be tied together in the same way that people are now tied together by the Internet. So, for instance, if you misplace your TV remote, you can find it because it is tagged and locatable through the Internet.

Some said that for many individuals the switch to mostly cloud-based work has already occurred, especially through the use of browsers and social networking applications.

Some respondents observed that there are numerous control issues in the cloud. They noted that putting all or most of our faith in remotely accessible tools and data puts a lot of trust in the humans and devices controlling the clouds that hold the access. A number of people said cloud computing presents difficult security problems and further exposes private information to governments, corporations, thieves, opportunists, and human and machine error.

Survey participants noted that there are also quality of service and compatibility hurdles that must be crossed successfully before cloud computing gains more adopters. Among the other limiting factors mentioned were: the lack of broadband spectrum to handle the load if everyone is using the cloud; the variability of cost and access in different parts of the world and the difficulties that lie ahead before we can reach the ideal of affordable access anywhere, anytime; and complex legal issues, including cross-border intellectual property and privacy conflicts.

Here is a sampling of respondents’ remarks:

“I predict most people will do their work on ‘screens connected to the Web,’ There won't be any sort of ‘computer’ anymore.” —**Davis Fields**, product manager, Nokia

“The PC as we know it is slowly dying due to increased desire of the marketplace to be mobile. In mobility, the key factors will be the user experience, not the underlying application. Lightweight platforms (both physically and software) are not just a requirement, they will be the expectation of the next generation of users.” —**Tom Golway**, Global technology director at Thomson Reuters

“Forget PCs: we'll be wanting smaller, truly portable devices to access all the glory in the cloud. Here's another prediction: We won't call it the ‘cloud,’ because it will be everywhere at once – both local and distant, both shapeless and hard-edged. We won't need a word for it.” —**Susan Crawford**, former member of President Obama’s National Economic Council, now on the law faculty at the University of Michigan

“In the future, we will live in a transparent 3D mobile media cloud that surrounds us everywhere. This cloud gives us transparent information and real-time access. The cloud will consist of a white part (trusted and checked information), a grey part (question mark) and a black part (crap information: untrusted, unchecked, violent, fraudulent). In this media cloud, you are boss. The mobile phone will be your key instrument for navigating, for getting safe access, to check and self-check

all claims made on the street, in the supermarket, at school, etc.” –**Marcel Bullinga**, futurist and author of “Welcome to the Future Cloud”

“Information retrieval and use is increasingly becoming device-independent. 2020 will see a mix of handheld devices, public kiosks, and personal/workplace PCs, all tied into the cloud for most routine apps.” –**Reva Basch**, consultant for Aubergine Information Systems (online research expert)

“The ‘desktop’ and current operating systems will be quaint metaphors the same way we look back at 8-track tapes, phones with dials, typewriters, etc. Shrinking size of computing machines, embedded smartness in everything from clothes to appliances, and more ubiquitous always-on networked devices will mean we have a whole suite of new integrated technologies that allow us to have access to tools and data when/where we need it – not that we need to go to a place or device to do computing. There ought to be an environment of small virtual applications that we easily swap in and out, rather than monolithic-like, closed, boxed software we are currently used to. The network will be the PC for sure.” – **Alan Levine**, VP and CTO of The New Media Consortium

“Trust not the cloud for reliability, security, privacy.” –**Barry Wellman**, professor of sociology and Netlab director, University of Toronto

“We’ll have a huge blow up with terrorism in the cloud and the PC will regain its full glory. People will lose confidence as cyber attacks cripple major systems. In fact, cloud will be there but we’ll be stuck in hybrid mode for the next 40 years as people live with some level of fear.” –**R. Ray Wang**, partner in The Altimeter Group, blogger on enterprise strategy

“We’ll just barely be using clouds by 2020. I think a big issue will be information privacy. How do you really control access to your valuable data if it is in the cloud? How do you retrieve your prized novel or your business records if the cloud fails?” –**Craig Partridge**, chief scientist, BBN Technologies

“It will not replace the PC, but the desire of everyone to access information from anywhere using any device drives toward the cloud. The impact on privacy may give us pause. There are almost no protections for sensitive information stored in the cloud. Privacy rules were designed with the assumption that privacy protections were most reasonable at the ends (Electronic Communications Privacy Act). Reform efforts, we hope, will be successful.” –**Jerry Berman**, founder and chair of the board of the Center for Democracy and Technology, an Internet public policy organization

“The drive will be to make money, and the most efficient way to do that is to build cloud computing whereby vendors can charge per application’s use. This is already happening in the smartphone realm.” –**Bill Leikam**, Leikam Enterprises, LLC

“The mobile carriers show little evidence that they understand the need to morph from phone companies to data companies – even with Apple’s iPhone success screaming ‘this is the future’ at them. A core ideal for all Internet devices is what Jonathan Zittrain (in his book *The Future of the Internet – and How to Stop It*) calls *generativity*, which is maximized encouragement of innovation in both hardware and software. Today generativity in mobile devices varies a great deal. The iPhone, for example, is highly generative for software, but not for hardware (only Apple makes iPhones). And even the iPhone’s software market is sphinctered by Apple’s requirement that every app pass to market only through Apple’s ‘store,’ which operates only through Apple’s iTunes, which runs only on Macs and PCs (no Linux or other OSes). On top of all that are Apple’s restrictive partnerships with AT&T (in the U.S.) and Rogers (in Canada). While AT&T allows unlimited data usage on the iPhone, Rogers still has a 6Gb limit. Bottom line: Handhelds will be no smarter than the systems built to contain them. The market will open widest – and devices will get smartest – when anybody can make a smartphone (or any other mobile device), and use it on any network they please, without worrying about data usage limits or getting hit with \$1000+ bills because they forgot to turn off ‘push notifications’ or ‘location services’ when they roamed

out of their primary carrier's network footprint. In other words, the future will be brightest when mobile systems get Net-native." —**Doc Searls**, fellow, Berkman Center at Harvard Law School

"If we continue moving towards app-store mentalities that require unique development for each platform, I'm not sure that Web service models are viable. We must double-down on open standards that have wide vendor support." —**Fred Stutzman**, Ph.D candidate, researcher and teaching fellow, School of Information and Library Science, UNC-Chapel Hill

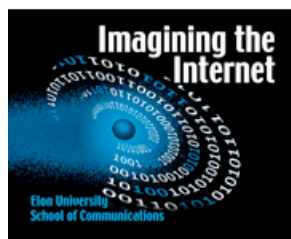
"By 2020 we'll still be feeling pulled in two directions: wanting the convenience of the cloud and the enhanced privacy, security, and speed of the local. But the local won't be confined to the desktop and general-purpose PCs. That paradigm will be exploded by ubiquitous computing, IPv6 and the primacy of mobile broadband, which will define the local in terms of our personal space. Cloud computing will become important enough to transfer Internet gate-keeping powers from ISPs to firms like Google and Apple. By 2020, Google's vast array of well-made (and still largely free) products will create walled gardens based on customer consent rather than lock-in. The old-fashioned concepts of the desktop and general-purpose PC will fade away, hastening the demise of Microsoft, which will continue to lose share in growth sectors like mobile broadband. The iPhone and App Store will be the models for another kind of gate-keeping, in the local space – not in the cloud through MobileMe, because Apple's consumer appeal will remain rooted in its physical products. Apple's influence over application developers will continue to cross back and forth over the line between opportunity and exploitation." —**David Ellis**, director of communication studies at York University, Toronto, and author of the first Canadian book on the roots of the Internet

"The correct answer is 'both.' I do not think by 2020 people will want to give up the autonomy and control they get by having software and data on their own device, but many of the services that we will expect (just as we 'expect' Google today) will require the power of a cloud supercomputer. I do not believe that a browser will be adequate as a window into the full Internet experience. But I do think that the PC as the central platform that defines the consumer experience will be eroded (but not displaced) by mobile devices." —**David D. Clark**, senior research scientist, MIT

Many additional thought-provoking responses to the question on cloud computing can be found here:

<http://www.pewInternet.org>

http://www.elon.edu/e-web/predictions/expertsurveys/2010survey/future_cloud_computing.xhtml



The Imagining the Internet Center (www.imaginingtheInternet.org) is an initiative of Elon University's School of Communications. The center's research holds a mirror to humanity's use of communications technologies, informs policy development, exposes potential futures and provides a historic record. Among the spectrum of issues addressed are power, politics, privacy, property, augmented and virtual reality, control and the rapid changes spurred by accelerating technology. Imagining the Internet is

directed by Janna Quitney Anderson, an associate professor of communications at Elon.



The Pew Research Center's Internet & American Life Project

(<http://www.pewInternet.org>), directed by Lee Rainie, is a nonprofit, non-partisan "fact tank" that provides information on the issues, attitudes and trends shaping America and the world. It produces reports exploring the impact of the Internet on families,

communities, work and home, daily life, education, health care and civic and political life. It is one of seven projects of the Pew Research Center, a nonpartisan, nonprofit organization.