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Research: 4G: Carriers, IT Pros Square Off

Exclusive research of **230** IT pros and **68** carriers providing 4G services shows that while customers are pleased with service now, the future looks far less certain.

By Peter Rysavy

Report ID: R6031113

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Peter Rysavy
InformationWeek Reports

Peter Rysavy is the president of wireless consulting company Rysavy Research and the executive director of the Portable Computer and Communications Association, a nonprofit industry association that addresses key wireless-technology developments.

EXECUTIVE SUMMARY

Mobile broadband is becoming prevalent, a core component of the communications fabric that is transforming how businesses operate and how people live their lives. Accelerating adoption are highly capable smartphones and tablets, as well as the increased use of cloud computing in all forms. It would be a communications nirvana, but IT faces serious challenges, including mobile OS fragmentation, high costs, uneven reliability and spotty coverage.

To help better understand where the market stands, we performed a two-part survey, one with IT managers responsible for overseeing mobile services and one with operators who provide mobiles services. We wanted to understand what IT loves about mobile broadband as well as the areas where operators could do better. We report on that in detail. For the most part, IT is happy with 4G capabilities and costs, but just barely, and unless costs come down and capacity and coverage improve on a steady basis, IT will run into difficulties as it fields bandwidth-hungry applications. Future expansion of capacity to meet market demands will rely heavily on new spectrum becoming available, a process that fortunately is happening, although more slowly and with greater complexity than many in the industry would like.

SYNOPSIS

RESEARCH

Survey Name *InformationWeek* 4G and the Future of Mobility Survey

Survey Date October 2012

Region North America

Number of Respondents 230

Purpose To examine mobility strategies and trends in the enterprise

Methodology *InformationWeek* surveyed business technology decision-makers at North American companies. Respondents employed by telecommunications providers or ISPs were removed from the final results. The survey was conducted online, and respondents were recruited via an email invitation containing an embedded link to the survey. The email invitation was sent to qualified *InformationWeek* subscribers.

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To contact us, write to managing director **Art Wittmann** at *art.wittmann@ubm.com,* content director **Lorna Garey** at *lorna.garey@ubm.com* and research managing editor **Heather Vallis** at *heather.vallis@ubm.com.*

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SYNOPSIS

RESEARCH

Survey Name *Light Reading/Heavy Reading* Survey on 4G Trends

Survey Date October 2012

Region North America

Number of Respondents 68

Purpose To examine 4G services and devices, perspectives, strategies and trends of mobile network operators.

Methodology *Light Reading* surveyed 60 North American mobile network operator respondents regarding their 4G services and devices offered to enterprise customers. The survey was conducted online, and respondents were recruited via an email invitation containing an embedded link to the survey. The email invitation was sent to qualified *Light Reading* subscribers.

Adoption And Usage

There's no question that mobile broadband is taking off, driven largely by smartphones. In InformationWeek's poll, 54% of business technology pros predicted that 50% or more of their users will take advantage of smartphones, and 58% of respondents said they plan to increase spending on 4G over the next three years, whereas only just 3% predicted a decrease in spending.

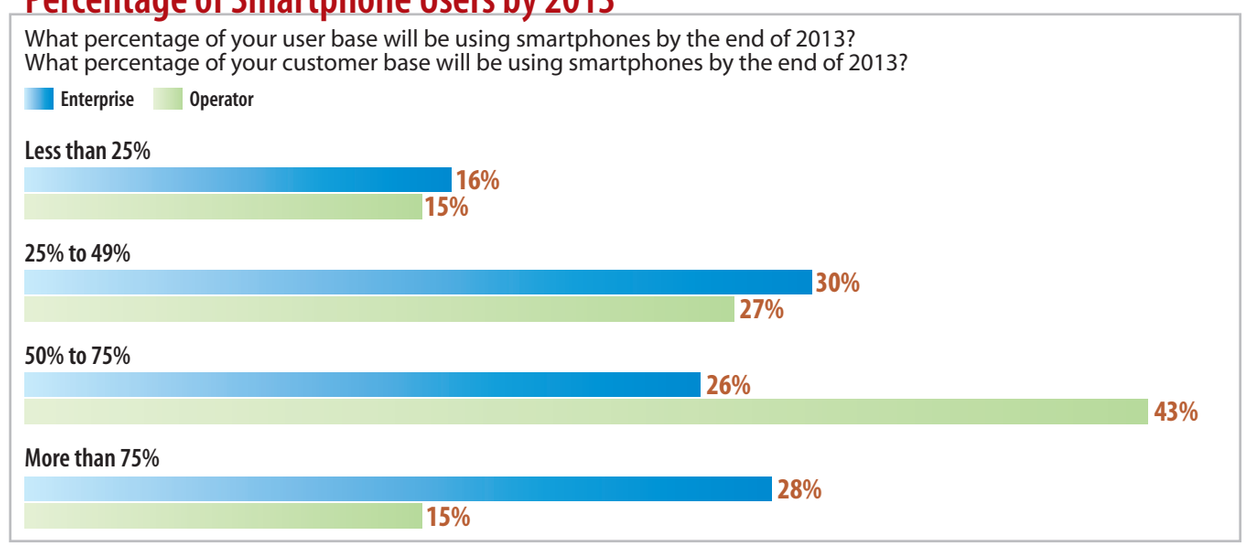
IT managers are lucky — or perhaps cursed, as per the ancient curse — to be living in these interesting times in the United States, which leads the world in mobile broadband. The two dominant mobile operating systems, Android and iPhone, are both from U.S. companies, as are leading cloud computing developments from companies such as Amazon, Apple, Dropbox, Google and Microsoft. The U.S. is also a leader in adoption of Long Term Evolution. According to 4G Americas, North America represents 56% of the 27.7 million global LTE subscribers.

All these phones, tablets and mobile-broadband-enabled notebooks are resulting in a massive increase in data consumption. CTIA-The Wireless Association reported in its semiannual study that data consumption increased 104% in the July 2011 to June 2012 period. For those excited by large numbers, users communicated 1.1 billion GB, or in the new language of big data, 1.1 exabytes.

With great devices, more than a million mobile apps and superfast speeds, what's not too like? For example, test reports regularly measure throughput rates of greater than 10 Mbps.

Figure 1

Percentage of Smartphone Users by 2013



Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals and *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012

R6031112-C/26

(For example, see here.) IT is happy with speeds. In our poll, 65% of respondents considered 4G throughput performance to be just where it needs to be, 17% thought it was even more than they needed and 18% found performance lower than what their applications needed.

Here is the conundrum though: Speeds on 4G networks, particularly LTE, are high because the networks are still not excessively loaded. But 100% growth in data consumption is changing that picture quickly. Verizon, for instance, reports that just 12% of its subscriber base that is on LTE is consuming 35% of all its data, according to Maravedis Rethink.

Faster speeds mean users can consume data more quickly, and the problem is that the networks can only deliver so much data. LTE is spectrally more efficient than previous technologies such as EV-DO and HSPA, but not that much more so — only 40% in the downlink, as per this report for 4G Americas, "Mobile Broadband Explosion." That's not all. Wireless networks have inherently low capacity compared with wireline links. Current LTE deployments use at most a 10-MHz radio channel on the downlink and 10 MHz on the uplink. On the downlink, with average spectral efficiency over the coverage area of 1.4 bps/Hz, that's aggregate (meaning shared) capacity of 14 Mbps. In an urban area, that 14 Mbps might cover three city blocks. With video consuming anywhere from 200 Kbps to

FAST FACT

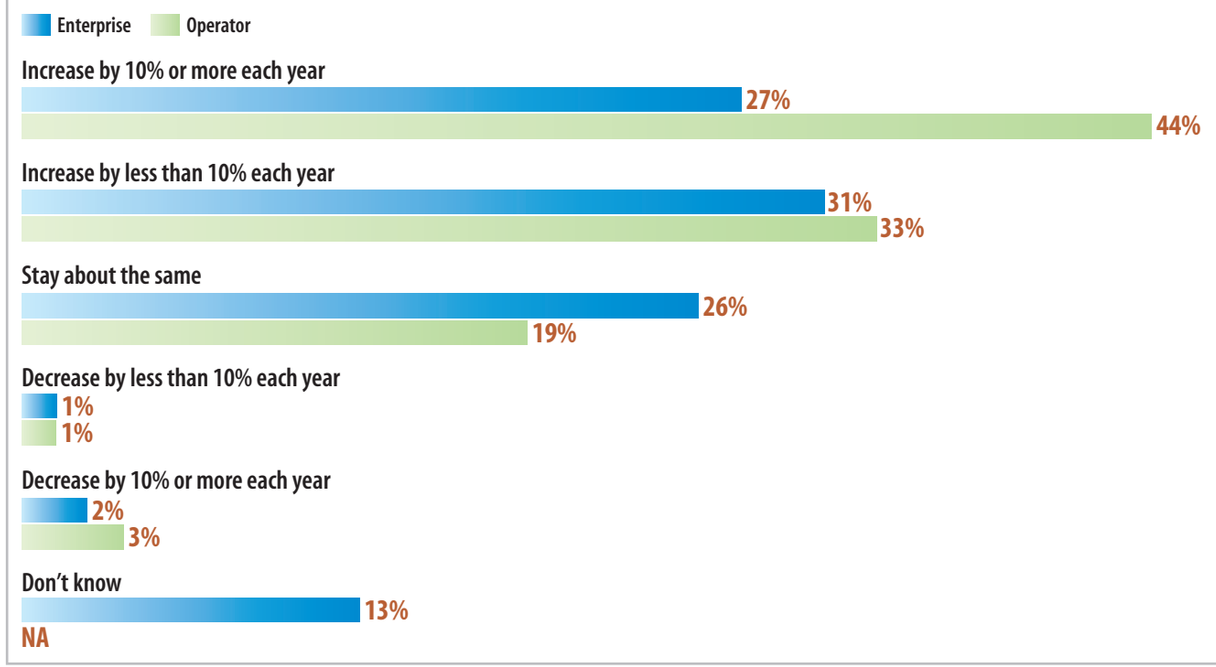
58%

of our poll respondents said they planned to increase spending on 4G over the next three years.

Figure 2

Future Spending on 4G Mobile Broadband Services

How will your organization's spending on 4G mobile broadband services change over the next three years?
How will your company's capex budget for 4G networks change over the next three years?



Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals and *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012

R6031112-C/33

5 Mbps per user, it only takes a small number of video streams (or audio streams, for that matter) to exhaust capacity.

And that is precisely what terrifies the operators. It's hugely ironic that they have built networks that are great for applications like video and cloud computing, yet it's precisely these applications that will destroy performance for everybody once too many people partake. Anybody who has waited more than 10 seconds for a Web page to load on a phone has likely experienced network congestion. It's for this reason that operators are scrambling for more spectrum. It's also why operators will augment their LTE capacity by deploying additional radio channels in bands such as Advanced Wireless Services at 1.7 GHz and Wireless Communications Service at 2.3 GHz.

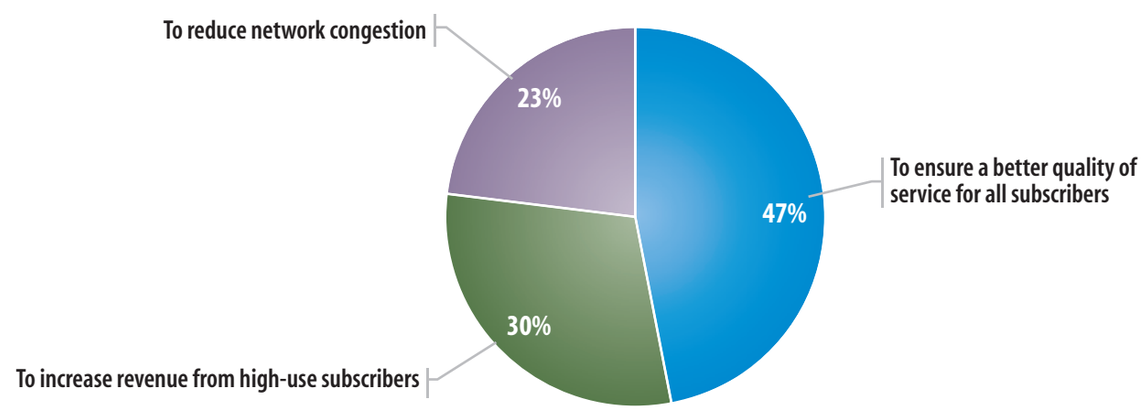
Costs: Unlimited To Tiers

What can operators do to control consumption? For starters, offer anything but unlimited plans. These were great to get the market moving — even today they provide a competitive option for operators like Sprint, which is trying to distinguish itself from AT&T and Verizon. But basically, all operators realize they have to charge for how much data users consume. The simplest way to do this today is through tiers in which there is essentially a cost per gigabyte consumed. Once users have to pay for how much data they use, they become much more careful about how much data they consume. That applies to both consumers and business users. New this year are also shared data plans from AT&T, C Spire and Verizon with which multiple devices under the account use data from a common data pool. This type of plan may make sense for some businesses as it represents a way of averag-

Figure 3

Primary Reason to Implement Mobile Data Caps

What is the biggest reason to implement data caps for mobile data services?



Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/5

ing data use across multiple users and potentially paying less per gigabyte by buying larger buckets of data.

Longer term, operators may implement more nuanced plans, such as charging specifically for video or certain video applications, or conversely discounting plans that don't enable video. LTE has a sophisticated policy-based quality-of-service architecture that makes such plans possible, though at this time operators have not ventured into this potentially tricky pricing realm.

While users might understand the need for tiers, that doesn't mean they like them. The majority of respondents in our poll (57%) had a negative view of carrier plans to implement mobile data service caps and tiers.

As for pricing itself, respondents were evenly split at 50% between those who think mobile data services prices are too high and those who think they're at the right level. None of the respondents said prices were too low. Similarly, about half (49%) said mobile voice prices were too high, another 49% said they were at the right level and 2% thought they were too low.

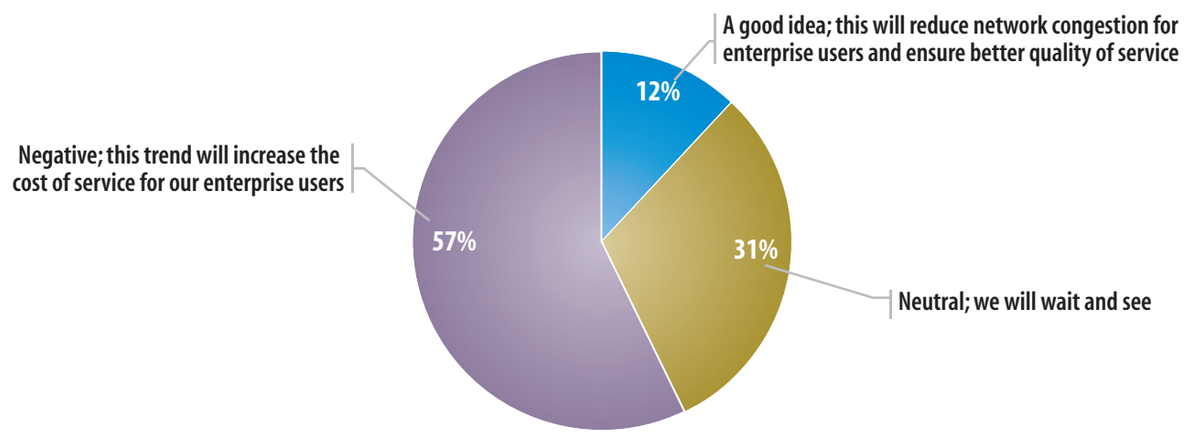
As for whether the pricing and tiers affect applications, 6% said current data caps and tiers are adequate for their applications and 43% said they are OK for the moment, but they foresaw issues. Meanwhile, 37% had a negative view, saying current caps and tiers restrict the types of applications they can use.

The long-term trend on pricing has been downward. From a historical point of view, there have been huge declines. The first cellular Internet system in the early 1990s, Cellular Digital Packet Data, was priced at 10 cents per kilobyte, which equates to $100,000 per gigabyte. Compare that with recent tiered pricing of $10 per gigabyte. Recently, however, prices have stalled and are not likely to go down without significant expansion in capacity. This is essentially a supply and demand

Figure 4

Carrier Plans to Implement Caps and Tiers for Mobile Data Services

What is your opinion of carrier plans to implement caps and tiers for mobile data services?



Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/2

issue and does not represent any long-term reason for prices not do go down further in the future. It's just going to take time, so we don't expect much pricing change over the next couple of years.

Before we discuss how operators can expand capacity through technology and spectrum, it's worth noting what is driving demand.

FAST FACT

13%

already use a lot of video, while 36% said mobile video is up but still modest.

Video And Cloud

The two biggest drivers we see for increased data consumption are video and cloud computing. While consumers are clobbering the networks with YouTube, Netflix and Facebook videos, businesses are also using video for training, videoconferencing, field service, telemedicine and news. In our poll, about half of respondents were using video. Thirteen percent already used a lot of video, while 36% said mobile video is up but still modest.

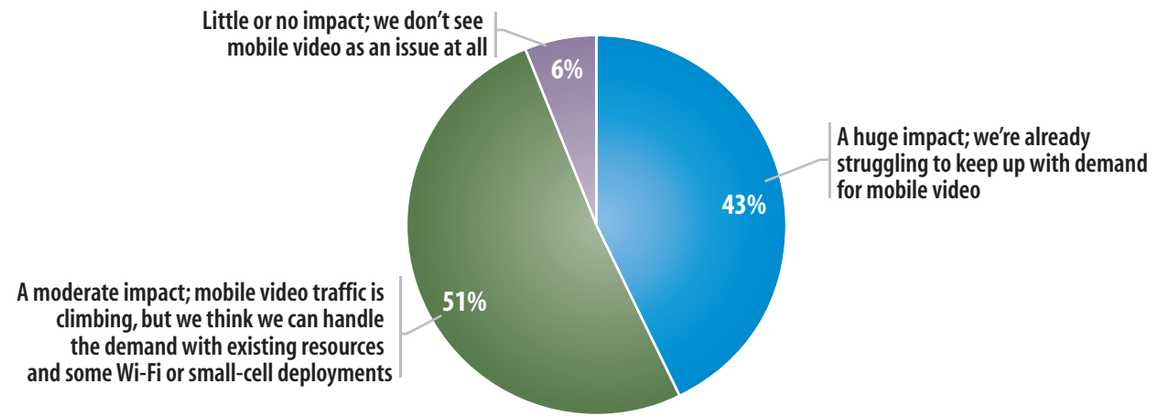
It doesn't take much video to consume large amounts of data. According to the Verizon data-consumption calculator, just 10 minutes of 4G video streaming data a day will consume 2 GB of data per month. Go to a tablet and choose high-definition video streaming over 4G, and that's suddenly a whopping 5 GB per month. That's a lot less than the hundreds of gigabytes you might consume each month streaming Netflix at high definition night after night over your cable connection, but it still represents serious data usage. With typical plans in the range of 1 to 5 GB per month, IT needs to take a close look at how it intends to use video over 4G to see how expensive that may prove.

The other big and rapidly increasing data consumer is cloud computing. I use many cloud services, including Dropbox, Microsoft SkyDrive, Google Drive, Amazon Cloud Player and Microsoft Office 365. The convenience of

Figure 5

Impact of Mobile Video Traffic

What impact will mobile video traffic have on your network over the next year?



Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/19

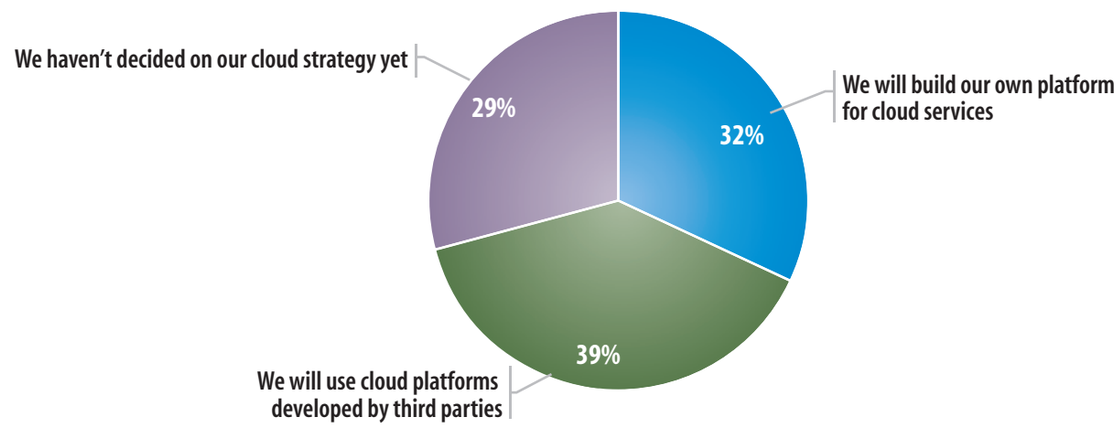
having all my personal and business content synchronized across multiple devices is wonderful, and our poll respondents agree. Seventy-eight percent said mobile access to cloud services will have a huge (24%) or moderate (54%) impact on the way IT services are delivered and consumed. More than one-third (38%) pointed to improved employee productivity and efficiency as the most important reason to implement mobile cloud services. Twenty-two percent said mobile cloud services will simplify application deployment.

As to whether enterprises will look to wireless carriers for cloud services, the majority (60%) said it depends on the service, while 26% weren't looking to do more business with the carriers.

Figure 6

Means of Adding Cloud Services to Portfolio

How will your company add cloud services to its portfolio?



Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/17

Capacity Expansion — Technology, Cells, And Off-Load

The amount of capacity in a network is determined by how efficient the wireless technology is, how many cell sites there are, whether data can be off-loaded and how much spectrum operators have. Operators are already deploying the most efficient technology available to them, LTE, and beginning in 2013, LTE-Advanced. Further gains in spectral efficiency will happen mostly through higher-order Multiple Input/Multiple Output. MIMO is a smart-antenna technology that enables radio signals to propagate through the environment across multiple paths simultaneously, thereby not only increasing throughput rates but boosting spectral efficiency. Current LTE networks use 2X2 MIMO. Four transmit antennas at the base station (4X2 MIMO) could improve downlink spectral efficiency, but it comes at significant cost to the carrier network and only provides a 20% gain in efficiency.

The biggest gains, long term, will be through

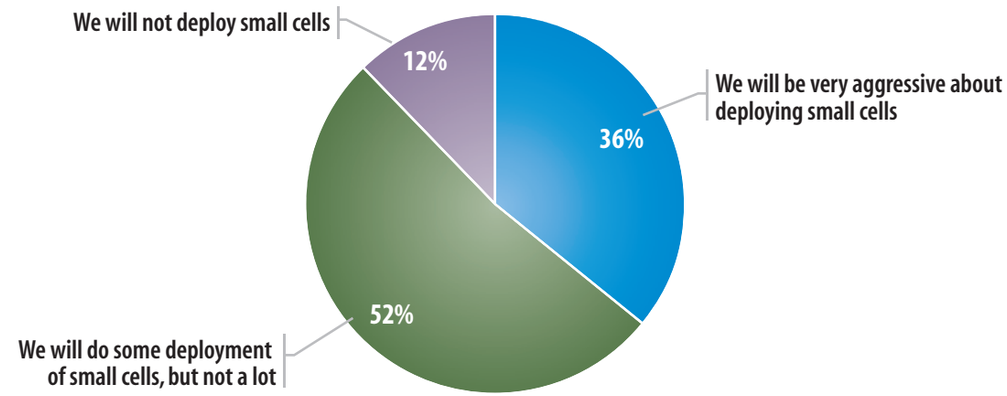
a development called heterogeneous networks, in which operators combine large area cells with what are known as "small cells." These small cells might only cover a city block (picocell) or just one building (femtocell). Since the small cell serves a much smaller number of users for the same amount of spectrum as a macrocell, it can deliver higher capacity per user. This is the precise reason that Wi-Fi can typically offer higher throughputs than cellular. Unfortunately, there are huge technical problems to resolve with small-cell architectures. Sprint's CTO recently stated that in theory small cells look great but the challenge is physical deployment, including power sources, backhaul and network integration.

One of the biggest issues is backhaul. How do operators connect hundreds of thousands of new cells back to their core networks? Since LTE radios run at such high speeds, backhaul connections need to be high speed, usually fiber or microwave, both of which are hard to do for hundreds of thousands of cells where fiber may not be readily available or where there is no line of sight for microwave.

Figure 7

Femtocell Deployment Plans

What are your company's plans regarding small-cell deployment over the next 12 months?



Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/13

Even upgrading the backhaul for macrocells has been challenging for operators.

Beyond backhaul for small cells are challenges related to management and interference coordination. In many deployments, the small cell and the macro cell will use the same radio channels. Much of the effort in current LTE standards work is coming up with complex methods to coordinate communication and to control interference among the different types of cells. That part is solvable, but the frequency-coordination technology is so complex that it is simply not ready for prime time.

Bottom line, small-cell architectures will definitely augment capacity significantly, but it may take several years before they play a

significant role. Despite the challenges they pose, however, they are an important part of operator plans. For example, AT&T in November announced plans to deploy more than 40,000 small cells.

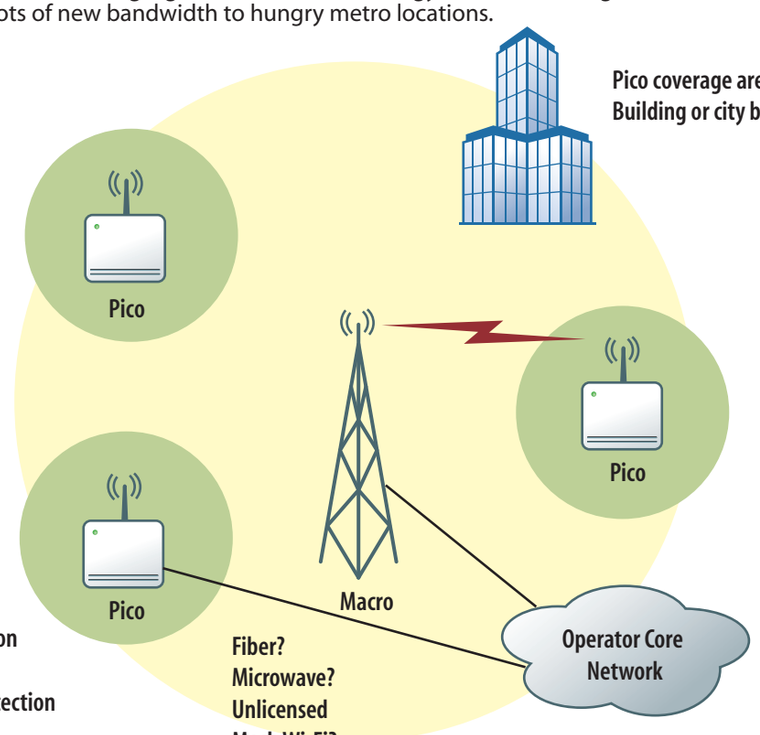
Respondents were also concerned about capacity: 25% said their carriers' mobile data access infrastructure was in very good shape and that it meets their needs; the rest find it adequate but in need of more mobile data capacity (52%), or lacking and in need of significant improvements (23%). In addition, just 20% said 4G alone will provide the necessary performance and coverage over the next three years; the majority said 4G will require some (52%) or extensive (28%) access to Wi-Fi and small cells to supplement 4G.

All the major operators have some form of off-load strategy. AT&T, T-Mobile and Verizon all lean heavily on Wi-Fi, whereas Sprint plans to off-load heavy LTE traffic onto spectrum that is currently owned by Clearwire, but will become Sprint's if it completes its recently announced plans to purchase Clearwire. Thirty-two percent of our respondents plan to take

Figure 8

Smaller Cells, Bigger Bandwidth

By using smaller cells, spectrum can be reused many times in a compact area like and urban block or even within a building. Managing spectrum use between macro and micro or pico cells is a tough engineering problem that's yet to be solved. In many instances, finding a good backhaul technology is also a challenge. But if solved, pico cells could be the best way to bring lots of new bandwidth to hungry metro locations.



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advantage of their carriers' Wi-Fi off-load over the next 12 months, although 26% would prefer to keep application traffic on the cellular network and not use off-load. The remaining 42% were unsure. In the past, Wi-Fi was a consistently faster option than cellular, but with today's congested airport and hotel Internet service, 4G is often the faster solution.

IT managers might consider not blindly depending on how their carrier networks perform the off-load but should actively be aware of where and when off-load occurs. It's not just throughput considerations but also that the handover between Wi-Fi and 4G is not seamless, generally entailing a new IP address, which can break application sessions. Future off-load technologies will make the experience more seamless, as we explain in wrote our report "Convergence of 3G/4G and Wi-Fi."

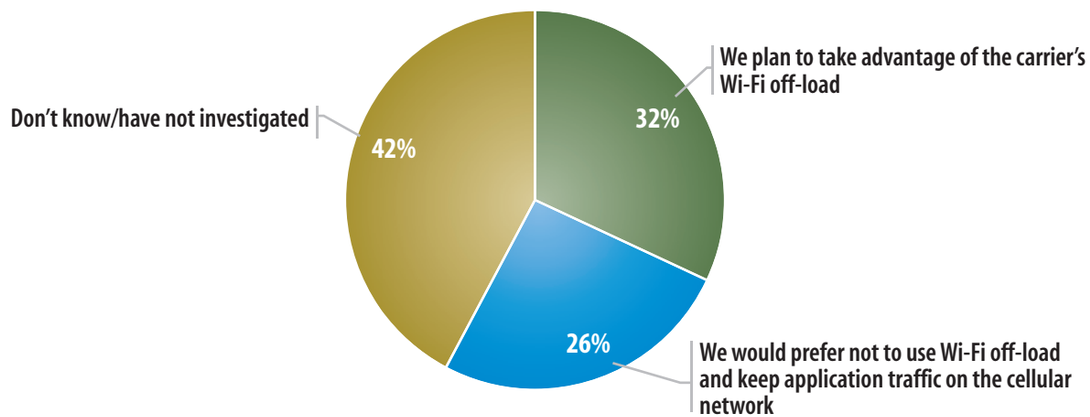
Until then, recommendations for IT include making conscious decisions on whether or not to enable Wi-Fi on user smartphones, testing for Wi-Fi performance in locations where users may need to perform critical job functions and perhaps even measuring how much data users consume when in 4G coverage versus Wi-Fi coverage to determine what service plan (namely how many gigabytes to pay for each month) makes the most sense. Users with laptops that need a more seamless experience between Wi-Fi and 4G can always consider a mobile VPN from the likes of NetMotion Wireless or Cisco.

Bottom line, operators are reaching the limits of what they can do with technology to address customer demands for bandwidth. The only answer is increased spectrum. If you thought wireless technology was complex, that's nothing compared to the politics of spectrum reassignment.

Figure 9

Plans for Wi-Fi Services

What are your organization's plans regarding Wi-Fi services offered by your carrier over the next 12 months?



Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/12

Spectrum Developments

FCC chairman Julius Genachowski said in a statement on Oct. 2, "Yet, today, virtually every expert confirms the vital need to free up new spectrum, because demand is rapidly exceeding supply." He adds, "The spectrum crunch is a major headache for consumers, who have to deal with dropped connections or spinning pinwheels when they're checking the Web on the go."

There are various efforts to free up spectrum, but each is fraught with complexity. The biggest current project is the broadcast television spectrum incentive auction. This will be the most challenging auction ever held because it has to be conducted in three stages. The first stage is a reverse auction in which broadcasters with TV UHF channels in the 600 MHz bands will participate, with options to either keep broadcasting, to share a TV channel with another broadcaster or to relinquish it with compensation. This is a little strange, given that they never paid for it in the first place; however, the spectrum does nowadays have considerable economic value, so seizing it from broadcasters is not politically an option. The compensation amount depends on how many broadcasters want to sell in each market — the more that do, the lower the price they will obtain.

The operators who remain will likely have to move to different channels as the FCC repacks the spectrum to create new 4G bands during the second stage. It will then finally auction in the third stage. The repacking process itself will be complicated, especially since the amount of spectrum in each market will depend on how many broadcasters give up their spectrum.

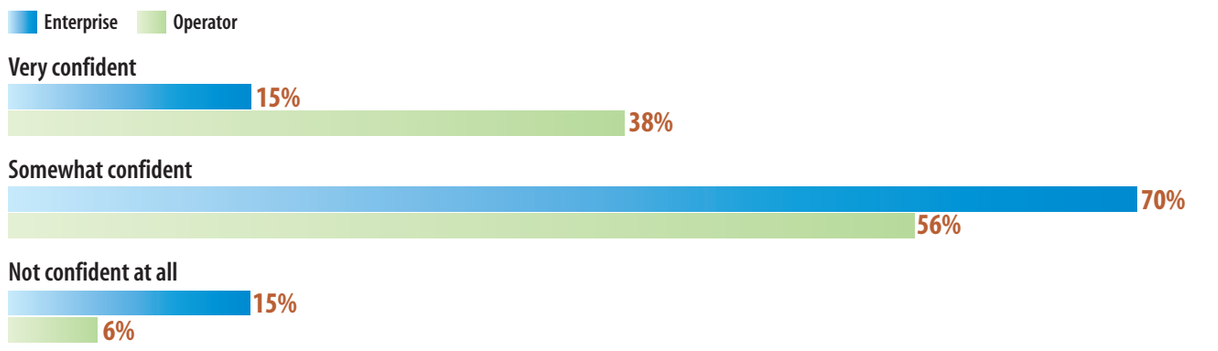
If you want to understand how this entire process may work, feel free to peruse the 205-page Notice of Proposed Rule Making.

In another sign that the days of readily available spectrum that can be reallocated are over, in July President's Council of Advisors on Science and Technology issued a report titled,

Figure 10

Confidence in Carriers' Ability to Deliver Network Capacity and Performance

How confident are you that carriers can get the spectrum needed to deliver the network capacity and performance your business will need over the next five years?
How confident is your company that 4G will deliver the network capacity and performance it will need over the next five years?



Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals and *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012

R6031112-C/31

"Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth." The core tenet of this report is that moving forward, spectrum should be shared between the government and commercial interests. The basis is that many government applications only use spectrum occasionally, or only in a subset of the terrain, and hence nongovernmental systems should be able to take advantage of the spectrum.

This sounds good in theory, but as we've explained in the report "Spectrum Sharing — The Promise and the Reality," this will prove to be extremely challenging, a process that will take possibly well over 10 years before any significant amount of spectrum can be made available through this process. The fundamental difficulty is characterizing the exact needs of the multiple systems sharing spectrum, developing systems that coordinate spectrum access (such as elaborate databases), integrating existing systems with such coordination systems and testing for compliance. The complexity is magnified by the large number of government systems that occupy the bands of interest, all with different spectrum requirements.

FAST FACT

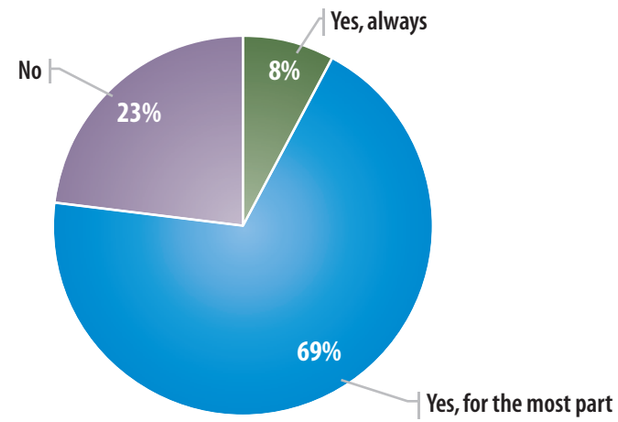
8%

of respondents found reliability and throughput consistency always sufficient for the needs of their applications, while 69% found these mostly sufficient.

Figure 11

4G Connection Reliability and Throughput Consistency

Is 4G connection reliability and throughput consistency sufficient for the needs of your applications?



Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/22

Confidence In Carriers And Networks

We also asked how confident IT feels about the networks and carriers. Eight percent of respondents found reliability and throughput consistency always sufficient for the needs of their applications, while 69% found these mostly sufficient. That's three-quarters who are generally satisfied with network performance, although it did leave 23% who said they weren't.

As for the biggest challenge that respondents say their organizations face regarding mobile data services, 46% said it's having cov-

erage in remote areas. Having any coverage at all, at least 3G, is clearly critical. But knowing where to expect 4G is also a challenge. Fortunately all the major carriers are expanding their 4G footprints as quickly as possible. AT&T and Verizon should both have most of the U.S. covered with LTE by the end of 2013. Verizon is a global leader in LTE deployment, and as of October, according to the Verizon LTE Web page, had three-quarters of the U.S. population covered. Sprint and T-Mobile lag in LTE, however T-Mobile has a strong HSPA+ network that comes close to LTE in performance, and Sprint offers WiMAX, although it's moving to LTE quickly.

Even though IT is adopting 4G broadly, respondents were not completely satisfied with the overall service they are obtaining. Just 10% said their service providers meet their needs very well, 74% said there is room for improvement and 14% need to see significant improvement.

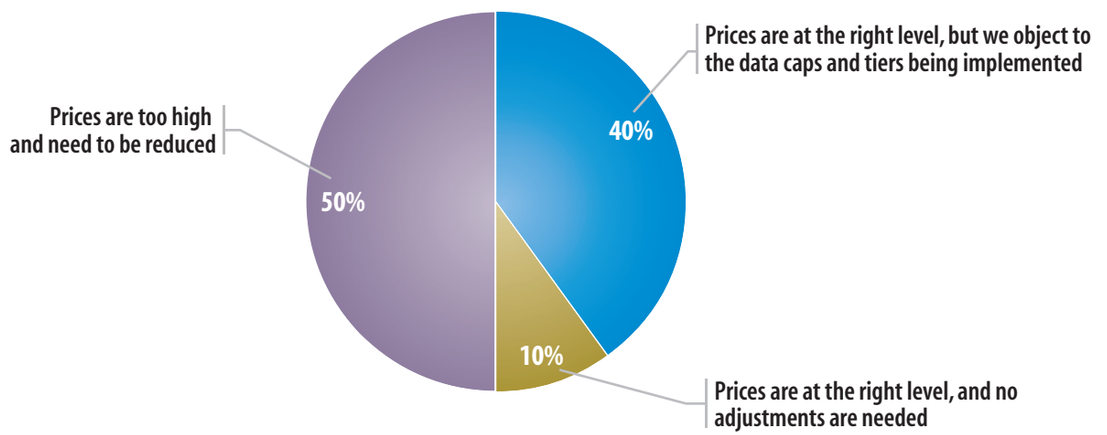
Looking forward, however, IT expressed reasonable confidence about carriers: 15% said they were very confident and 70% somewhat confident in their carriers' ability to obtain spectrum to deliver the network capacity and performance their businesses will need over the next five years. Carriers are certainly trying with new technologies, more sites and off-load, but it's not completely in their hands. Here's hoping the government does its part in making available sufficient spectrum so that carriers can expand capacity to meet increasing demand.

APPENDIX

Figure 12

Perception of Mobile Data Price Plans

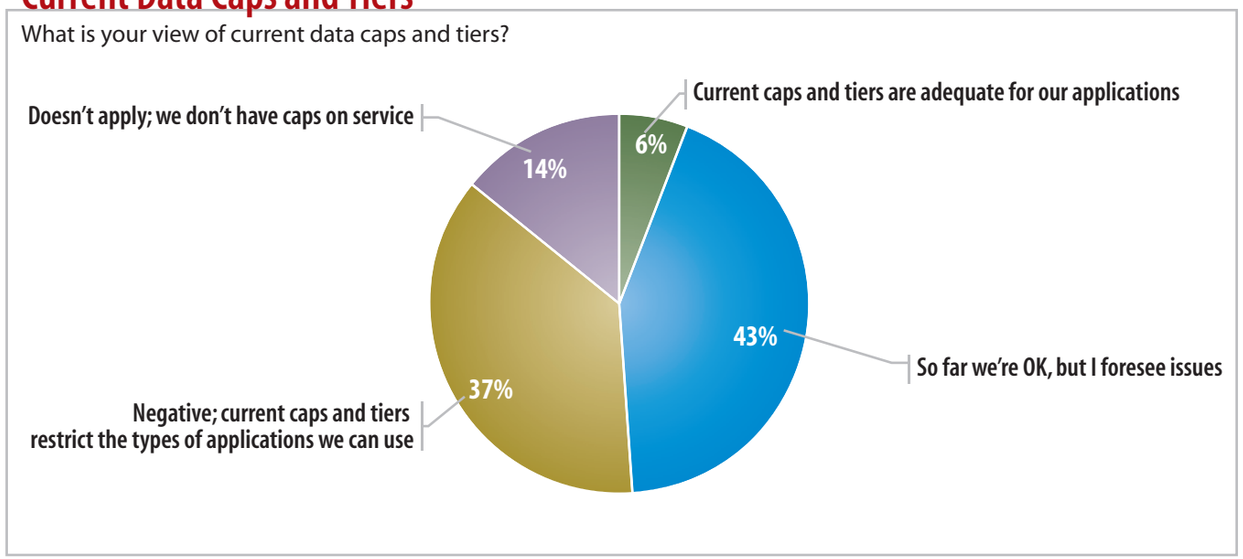
What is your organization's view of the current price plans offered by providers for mobile data service?



Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/1

Figure 13

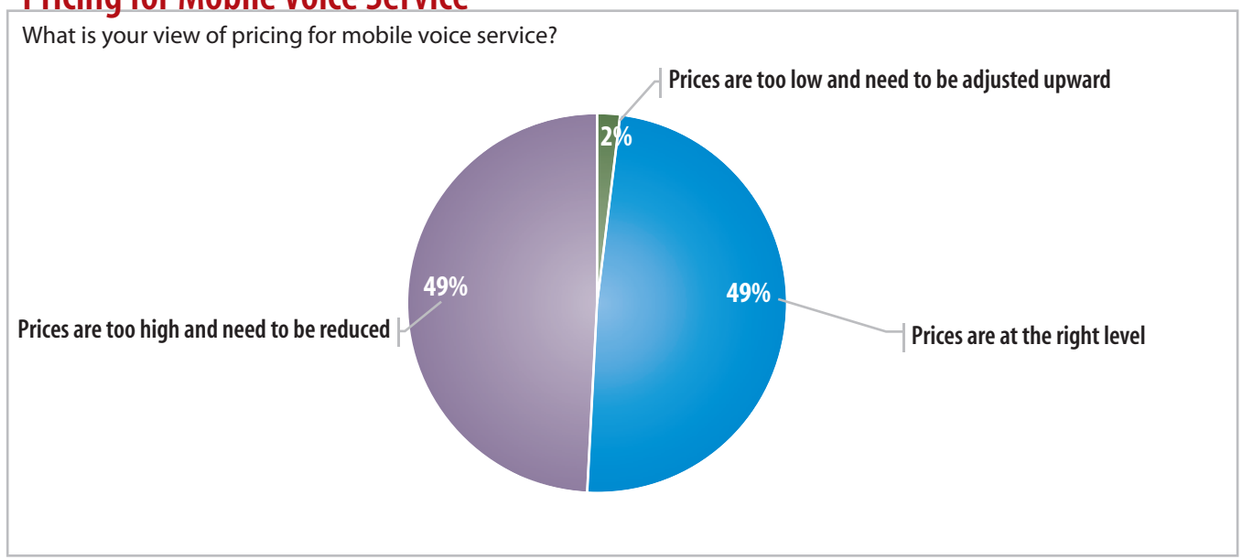
Current Data Caps and Tiers



Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/3

Figure 14

Pricing for Mobile Voice Service

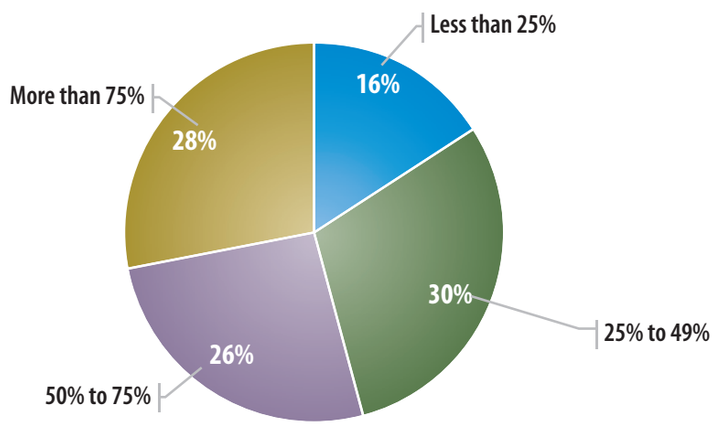


Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/4

Figure 15

Percentage of Users With Smartphones by 2013

What percentage of your user base will be using smartphones by the end of 2013?



Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/5

Figure 16

Popularity of Smartphone Operating Systems

Please rank these smartphone operating systems in order of popularity among your user base over the next 12 months, where 1 is "most popular" and 4 is "least popular."

	Rank
Apple iOS	1
Google Android	2
RIM BlackBerry	3
Windows 8	4

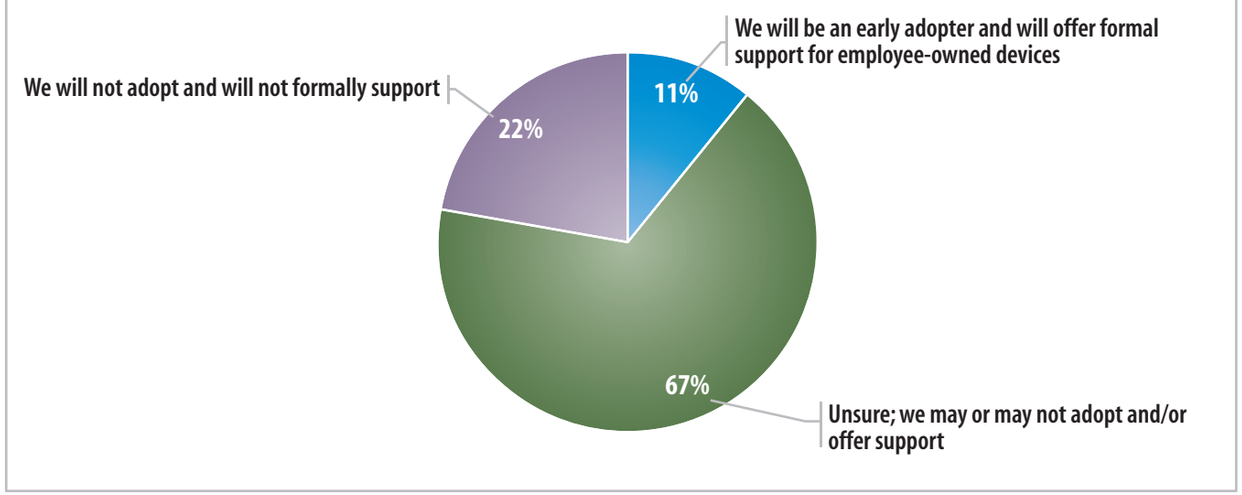
Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012

R6031112/6

Figure 17

Windows Phone 8 Adoption Plans

What is your organization's current thinking about Microsoft Windows Phone 8?

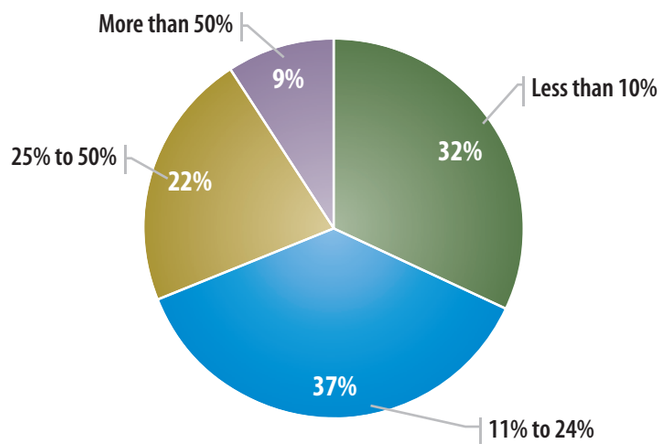


Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/7

Figure 18

Percentage of Users With Tablets by 2013

What percentage of your employee base will use tablets by the end of 2013?

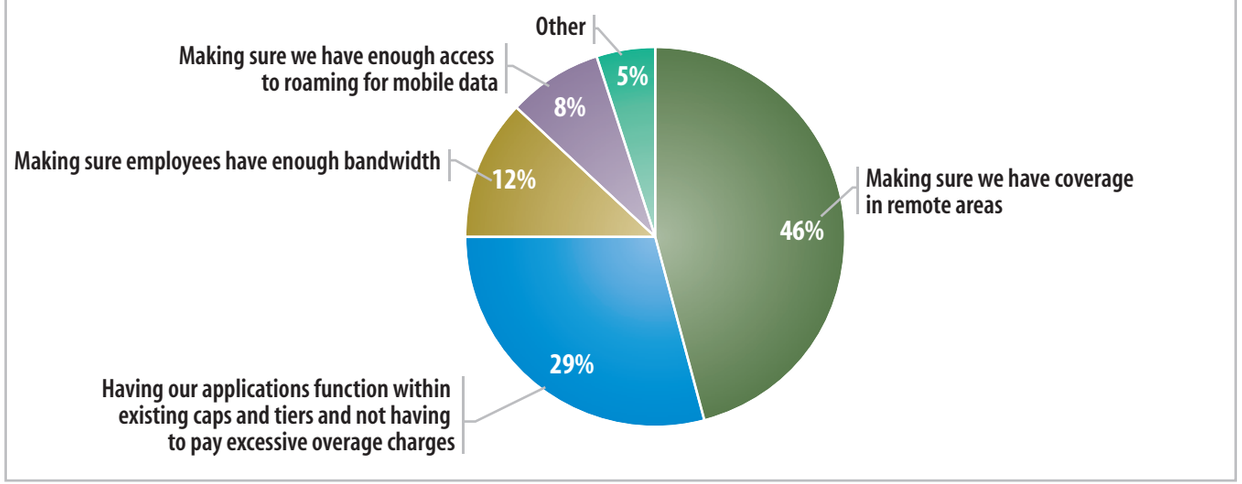


Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/8

Figure 19

Biggest Mobile Data Services Challenge

What is the biggest challenge your organization faces regarding mobile data services?

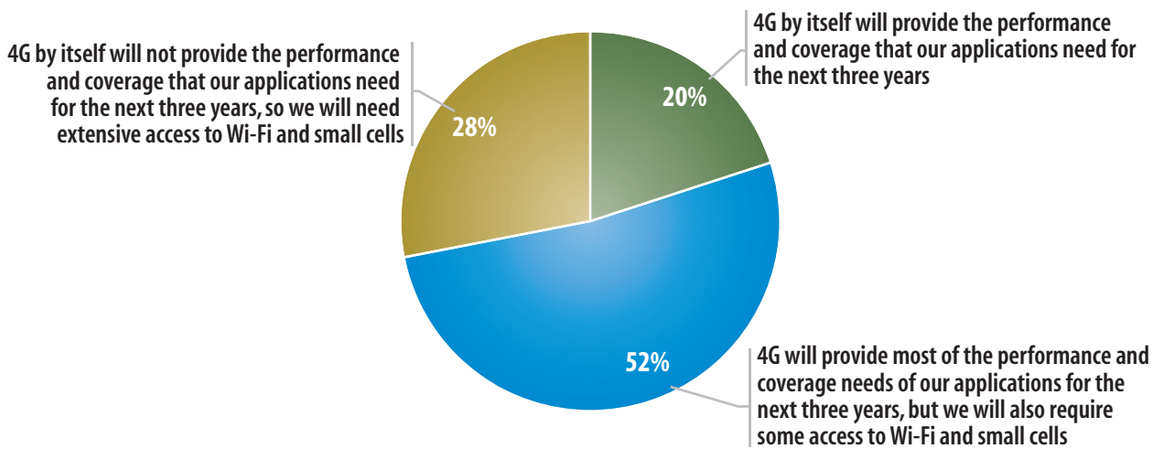


Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/10

Figure 20

Impact of 4G on Ability to Meet Mobile Data Service Demands

What impact does 4G have on your organization's ability to meet demand for mobile data service?

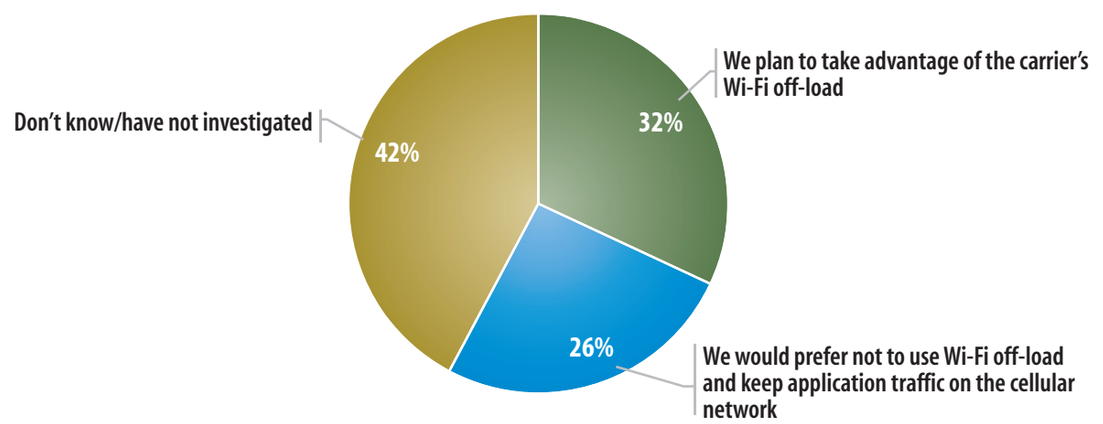


Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/11

Figure 21

Plans for Wi-Fi Services

What are your organization's plans regarding Wi-Fi services offered by your carrier over the next 12 months?

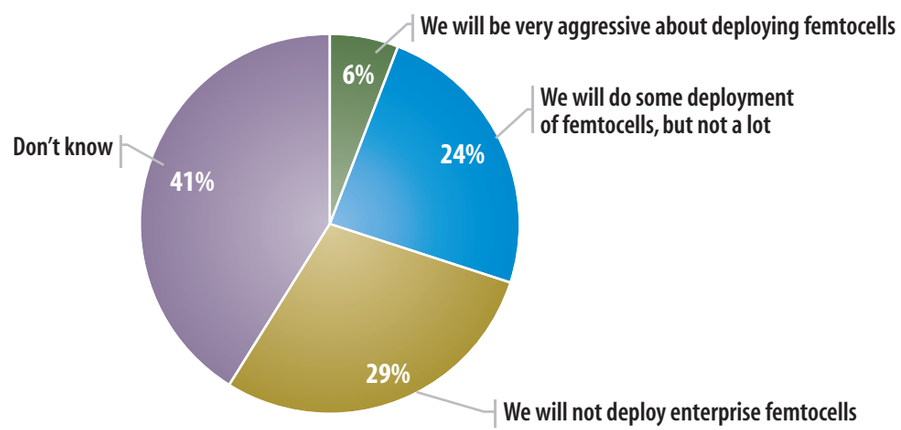


Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/12

Figure 22

Enterprise Femtocell Deployment Plans

What are your organization's plans regarding enterprise small-cell (femtocell) deployment over the next 12 months?

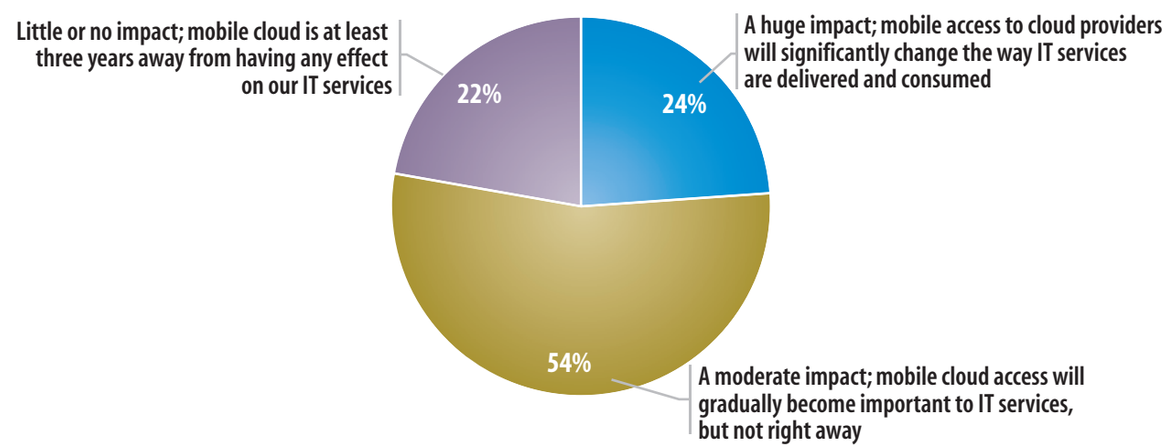


Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/13

Figure 23

Impact of Mobile Access to Cloud Services

What impact will mobile access to cloud services have on enterprise IT services over the next three years?

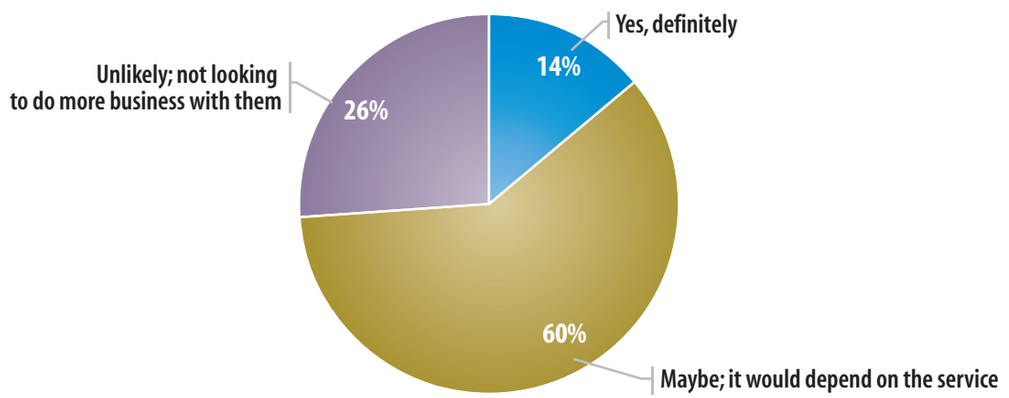


Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/14

Figure 24

Likelihood to Consider Wireless Carriers' Cloud Services

Would you consider cloud services offered by your wireless carrier?

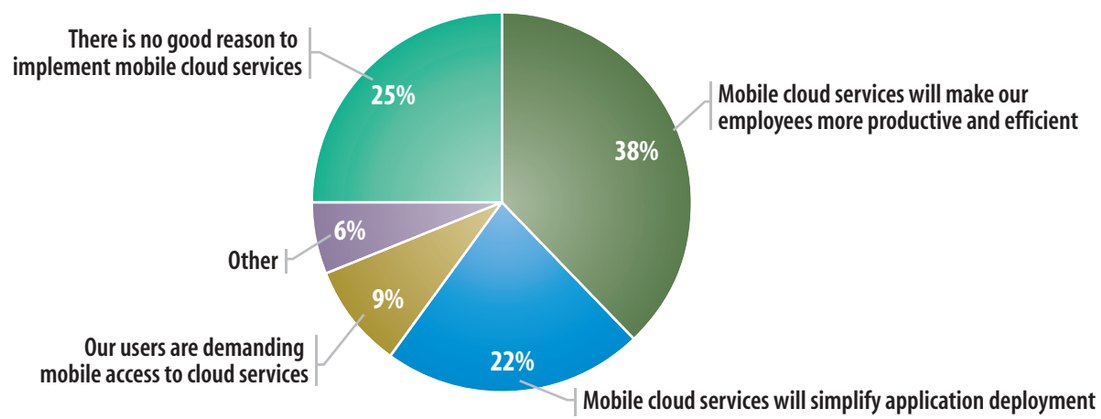


Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/15

Figure 25

Primary Reason to Implement Mobile Cloud Services

What is the most important reason for implementing mobile cloud services for your organization?

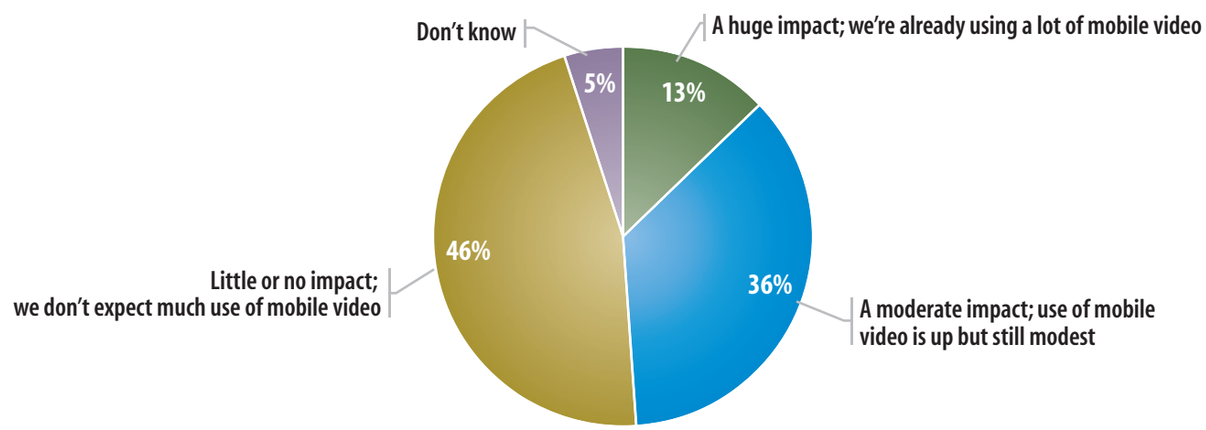


Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/16

Figure 26

Impact of Mobile Video Traffic

What impact will mobile video traffic have on your business over the next year?

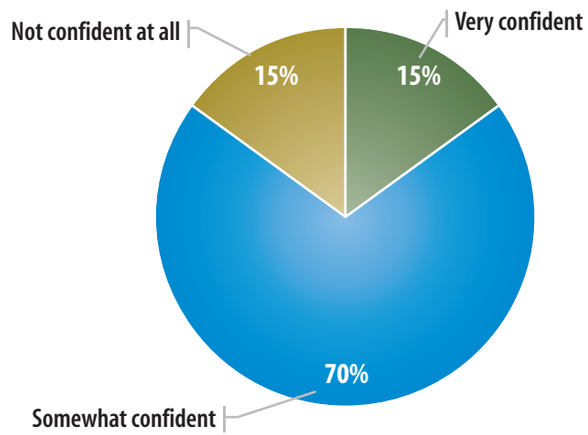


Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/17

Figure 27

Confidence in Carriers' Ability to Deliver Network Capacity and Performance

How confident are you that carriers can get the spectrum needed to deliver the network capacity and performance your business will need over the next five years?

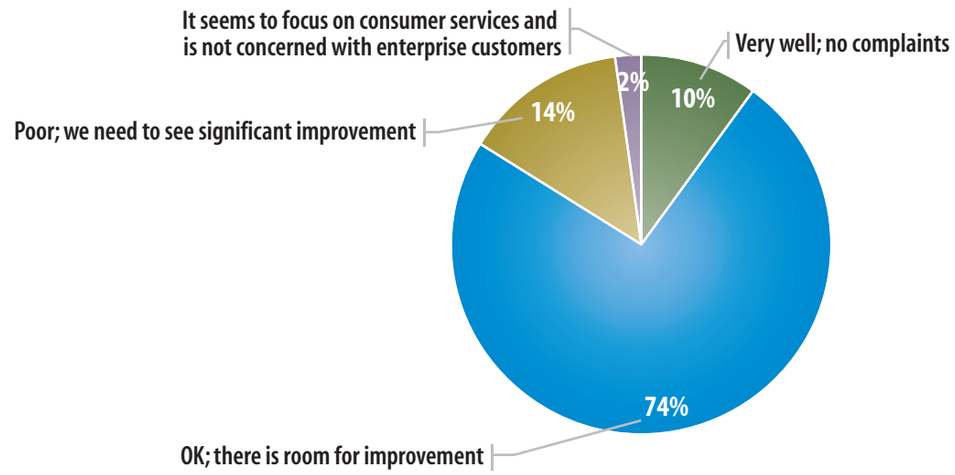


Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/18

Figure 28

Needs Met?

How well does your service provider(s) meet your overall needs?

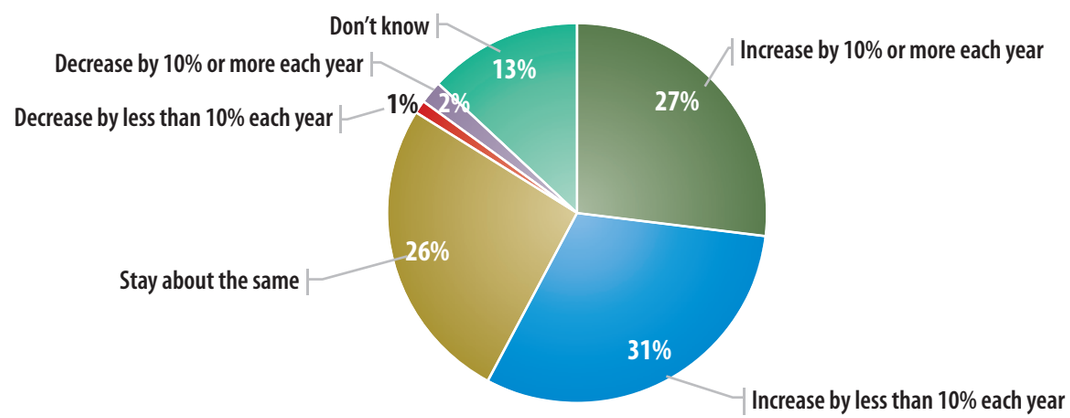


Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/19

Figure 29

Future Spending on 4G Mobile Broadband Services

How will your organization's spending on 4G mobile broadband services change over the next three years?

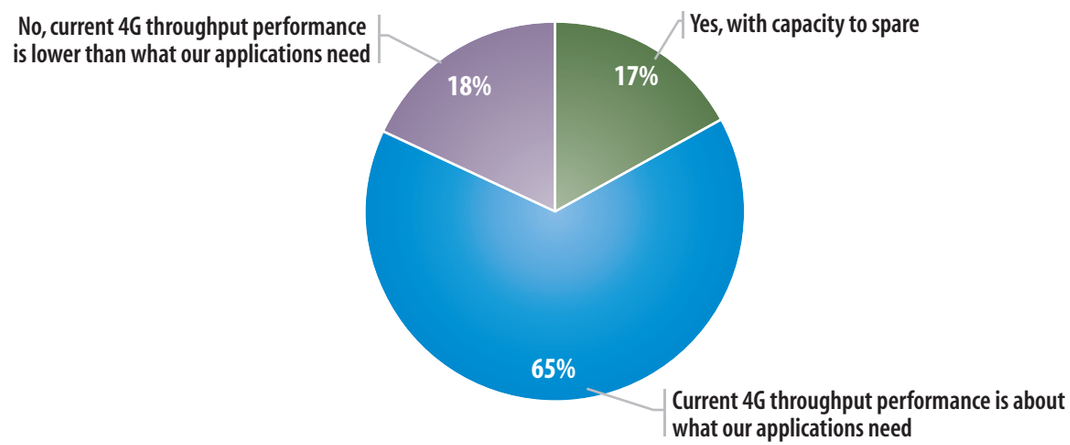


Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/20

Figure 30

4G Throughput vs. Application Performance Needs

Does your 4G throughput accommodate the performance needs of your applications?

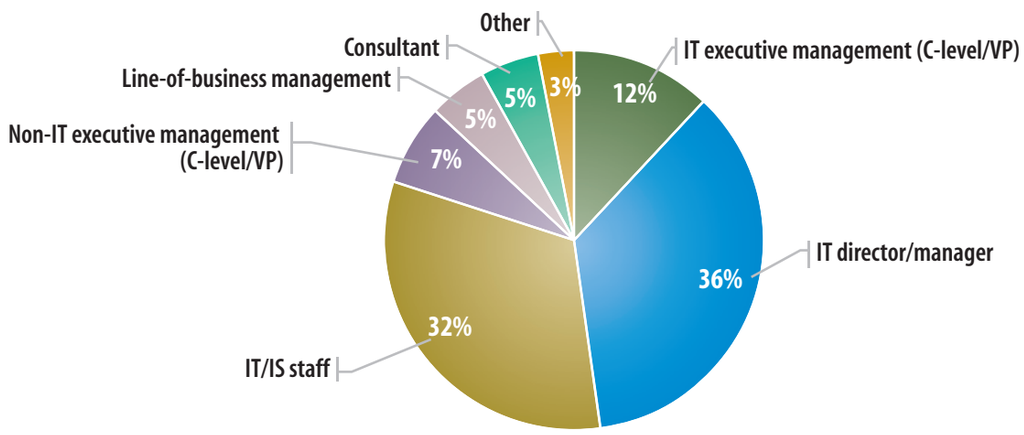


Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/21

Figure 31

Job Title

Which of the following best describes your job title?

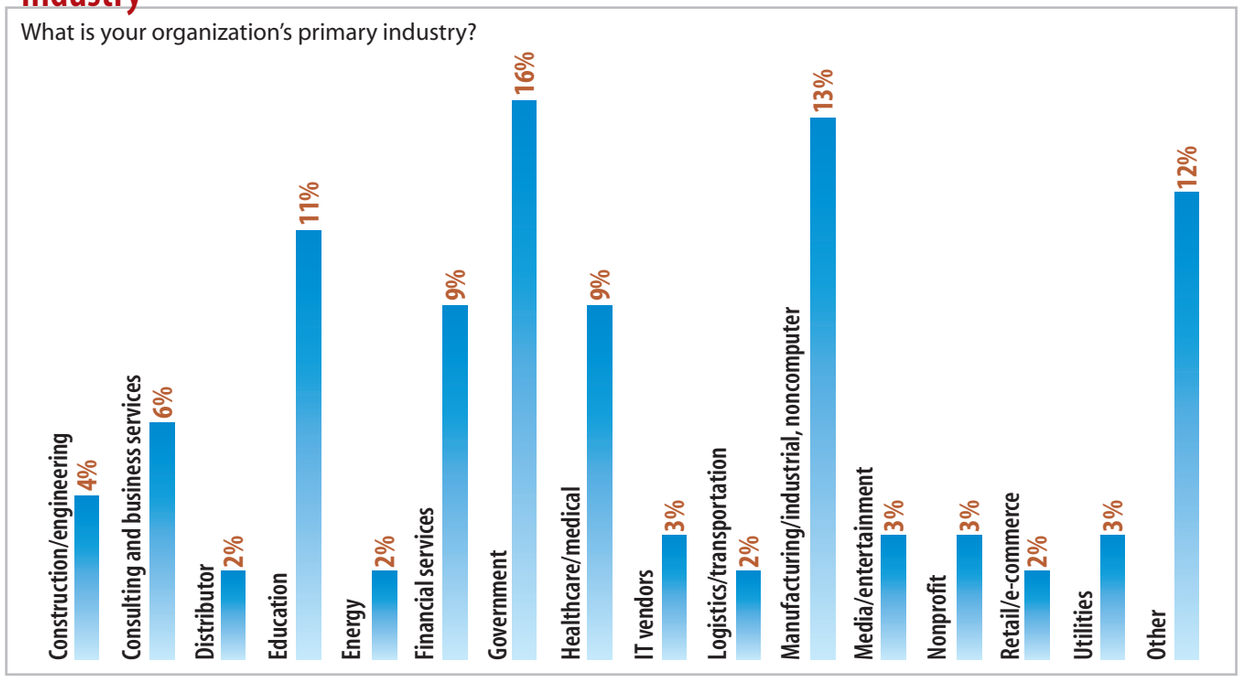


Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/23

Figure 32

Industry

What is your organization's primary industry?

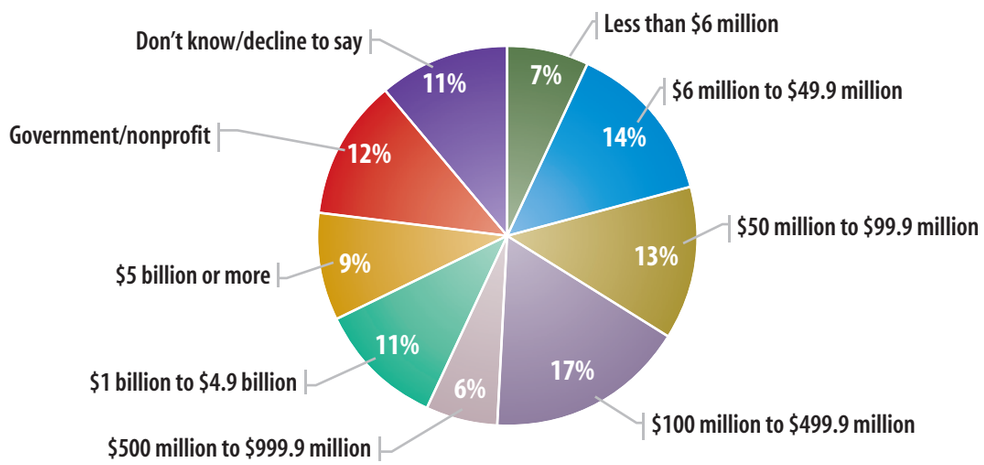


Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/24

Figure 33

Revenue

Which of the following dollar ranges includes the annual revenue of your entire organization?

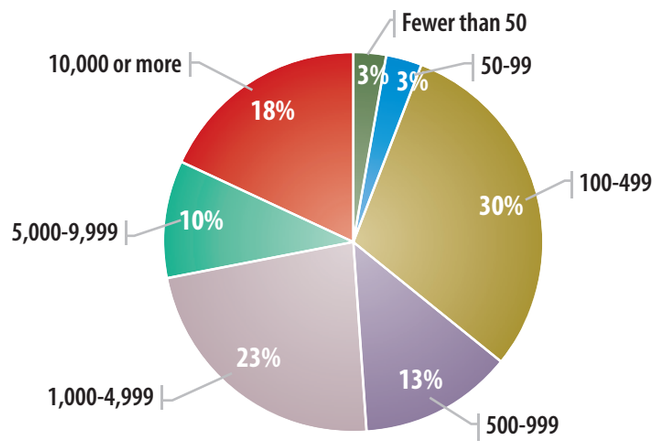


Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/25

Figure 34

Company Size

Approximately how many employees are in your organization?



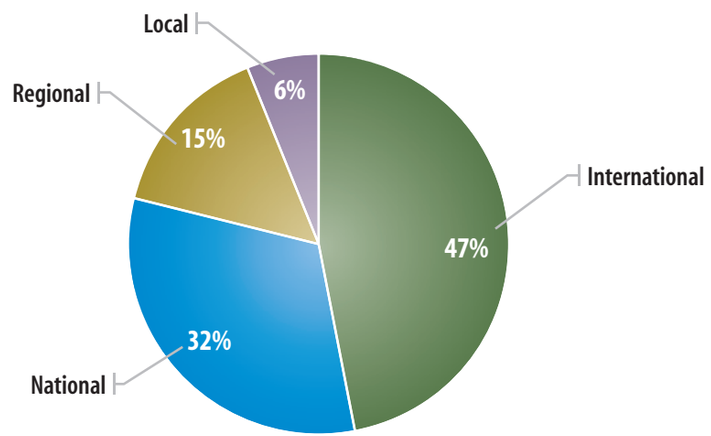
Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals, October 2012 R6031112/26

APPENDIX 2

Figure 35

Service Coverage

Which of the following best describes your company's mobile service reach?



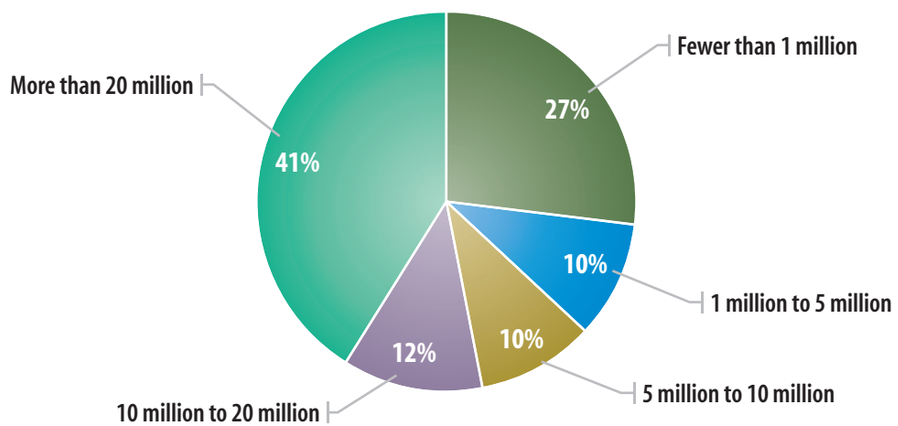
Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012

R6031112-C/1

Figure 36

Mobile Subscribers

How many mobile subscribers does your company have?

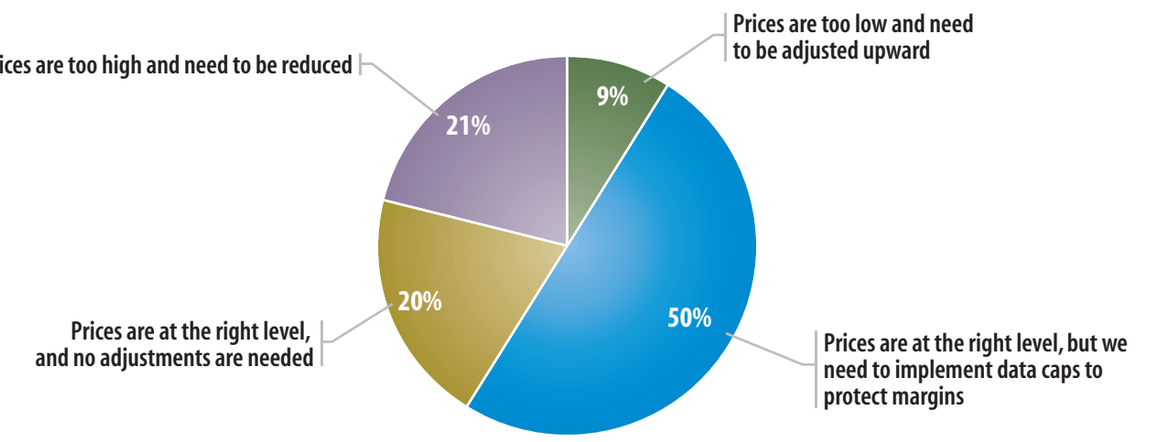


Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/2

Figure 37

Perception of Mobile Data Price Plans

What is your company's view of its current price plans for mobile data service?

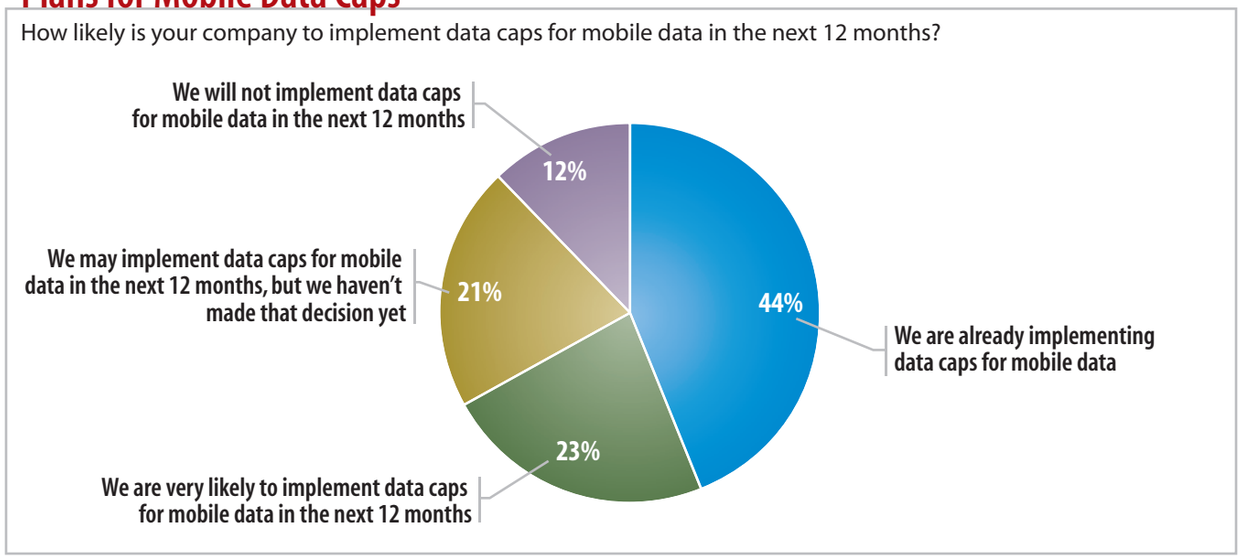


Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/3

Figure 38

Plans for Mobile Data Caps

How likely is your company to implement data caps for mobile data in the next 12 months?

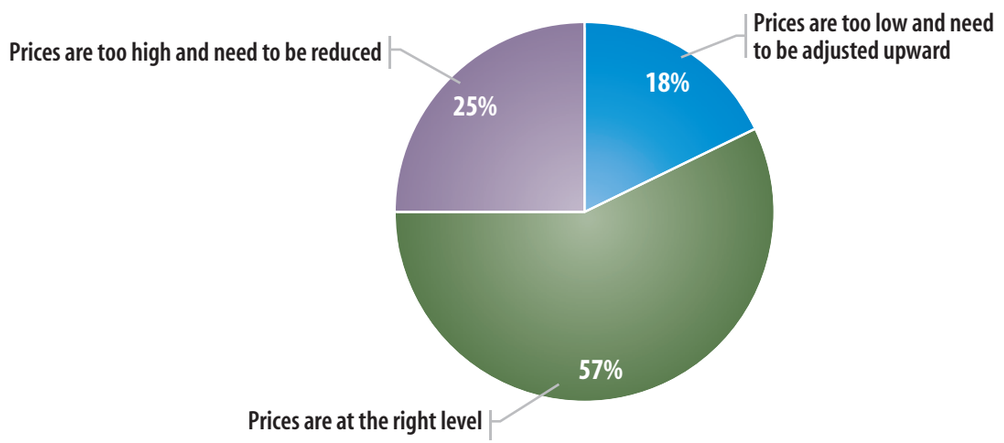


Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/4

Figure 39

Perception of Mobile Voice Price Plans

What is your company's view of its current price plans for mobile voice service?

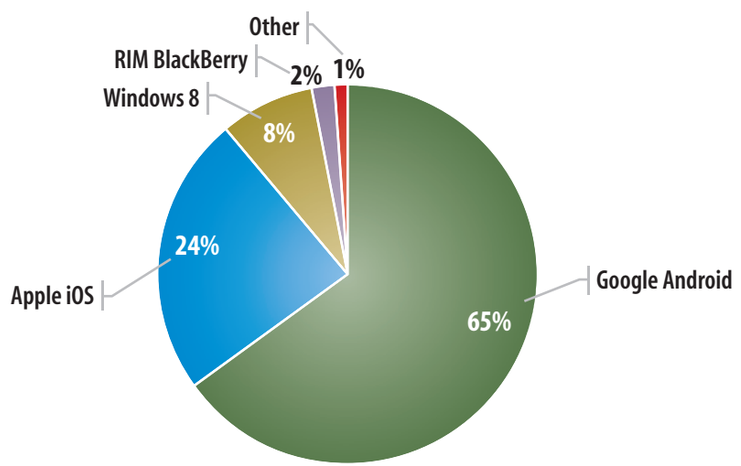


Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/6

Figure 40

Fastest-Growing Smartphone Operating System

Which smartphone operating system will grow faster among your customers over the next 12 months?

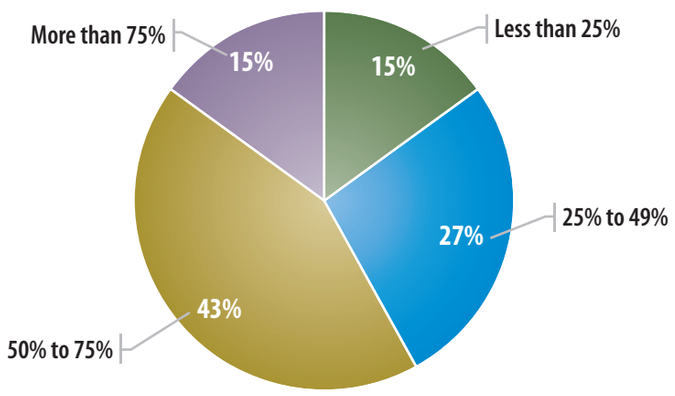


Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/7

Figure 41

Percentage of Customer Base Using Smartphones by 2013

What percentage of your customer base will be using smartphones by the end of 2013?

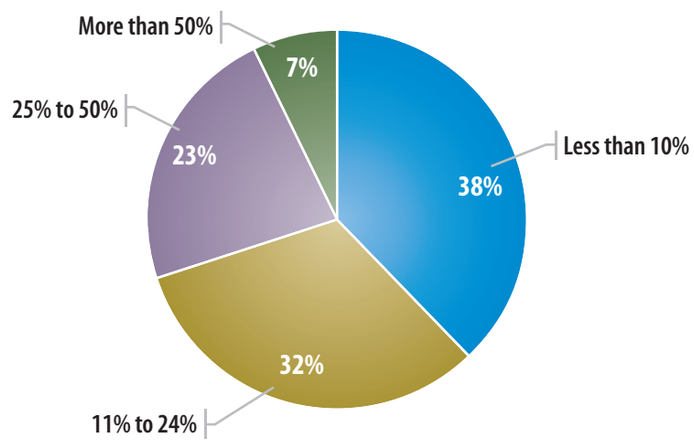


Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/8

Figure 42

Percentage of Customer Base Using Tablets by 2013

What percentage of your customer base will be using tablets by the end of 2013?

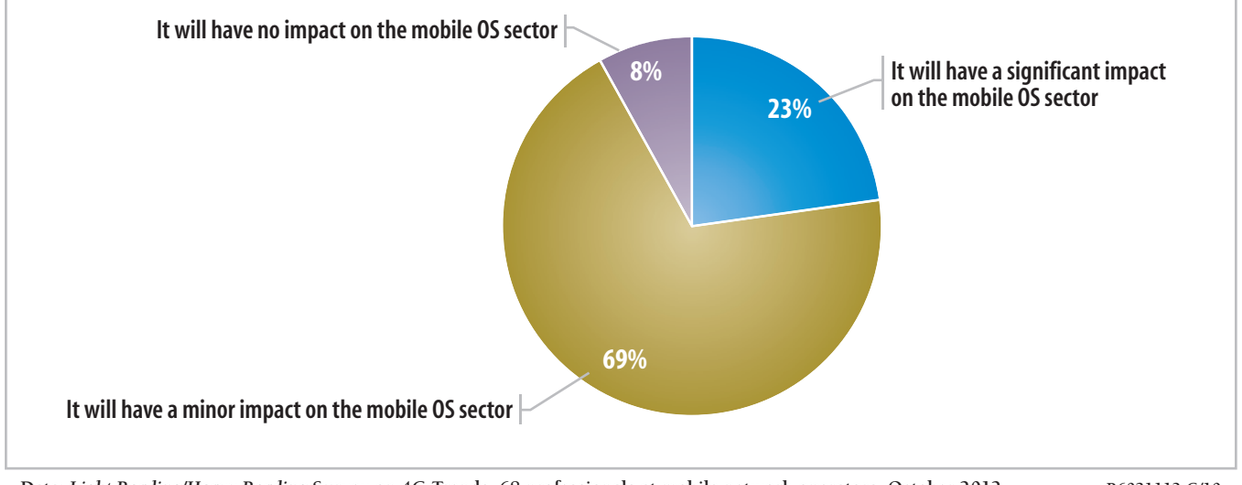


Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/9

Figure 43

Impact of Microsoft Windows Phone 8

What is your company's current thinking about Microsoft Windows Phone 8?



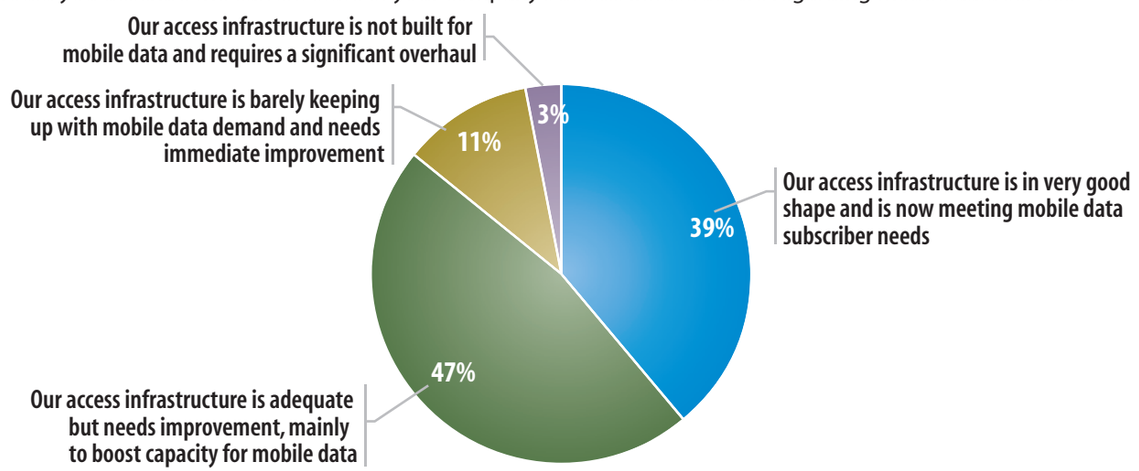
Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012

R6031112-C/10

Figure 44

Mobile Data Access Infrastructure

How would you describe the current state of your company's access infrastructure regarding mobile data service?

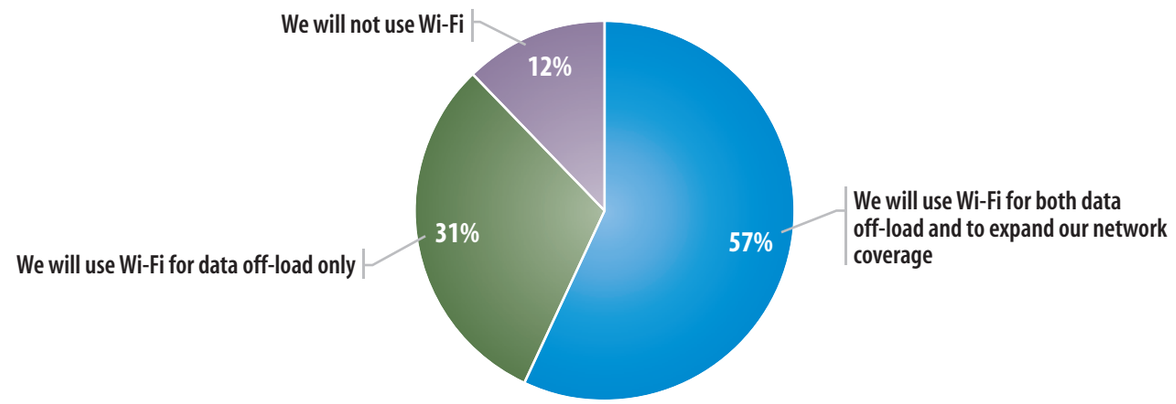


Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/11

Figure 45

Plans for Wi-Fi Services

What are your company's plans regarding Wi-Fi deployment over the next 12 months?

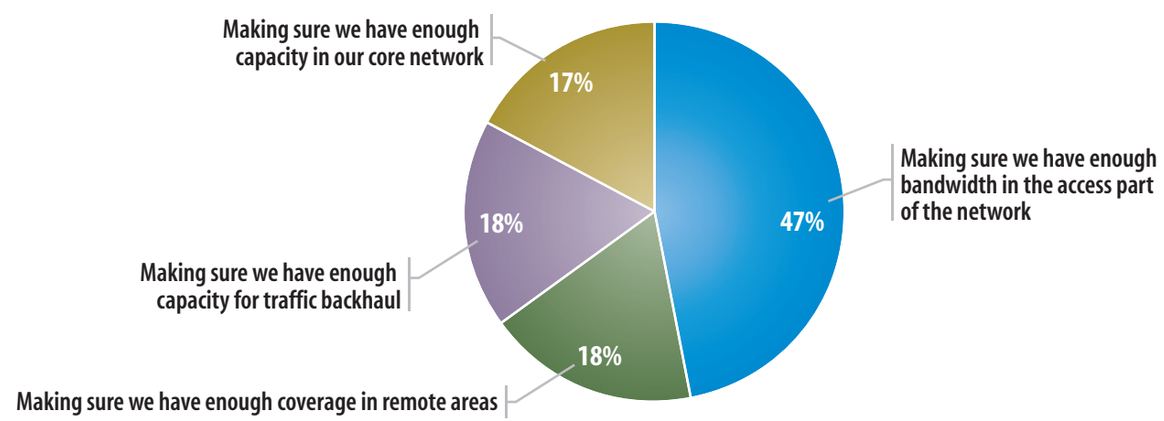


Data: Light Reading/Heavy Reading Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/12

Figure 46

Biggest Mobile Data Services Challenge

What is the biggest challenge your company faces regarding mobile data services?

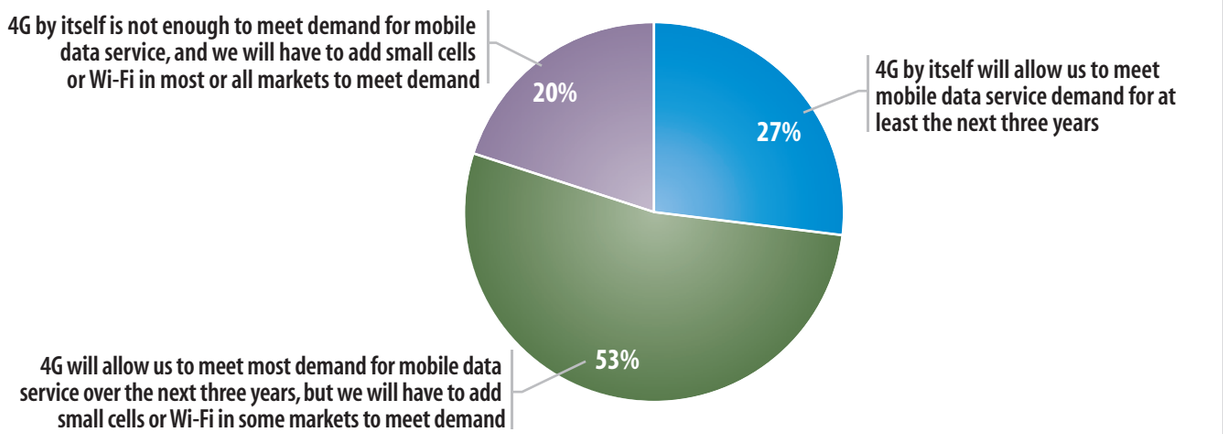


Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/14

Figure 47

Impact of 4G on Ability to Meet Mobile Data Service Demands

What impact does 4G have on your company's ability to meet demand for mobile data service?

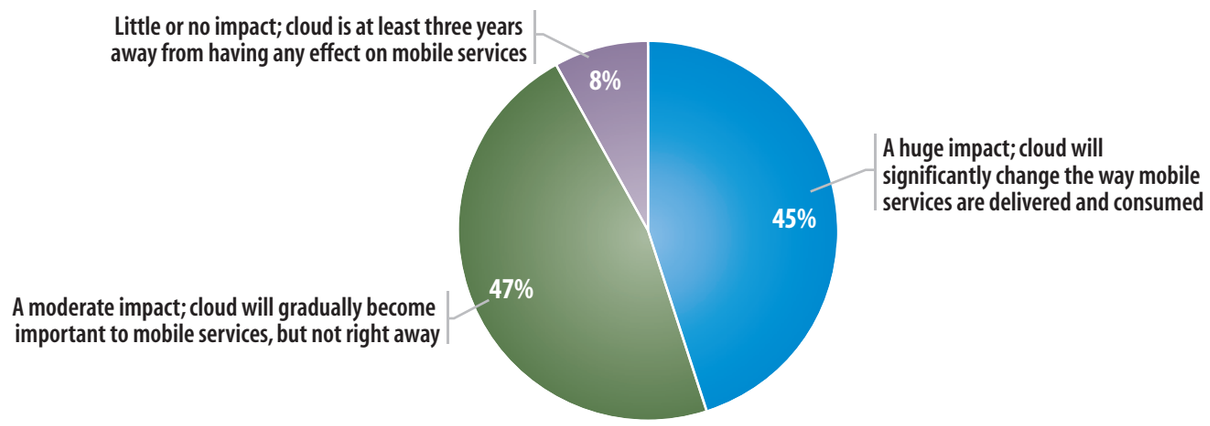


Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/15

Figure 48

Impact of Cloud Technologies on Mobile Service

What impact will cloud technologies have on mobile services over the next three years?

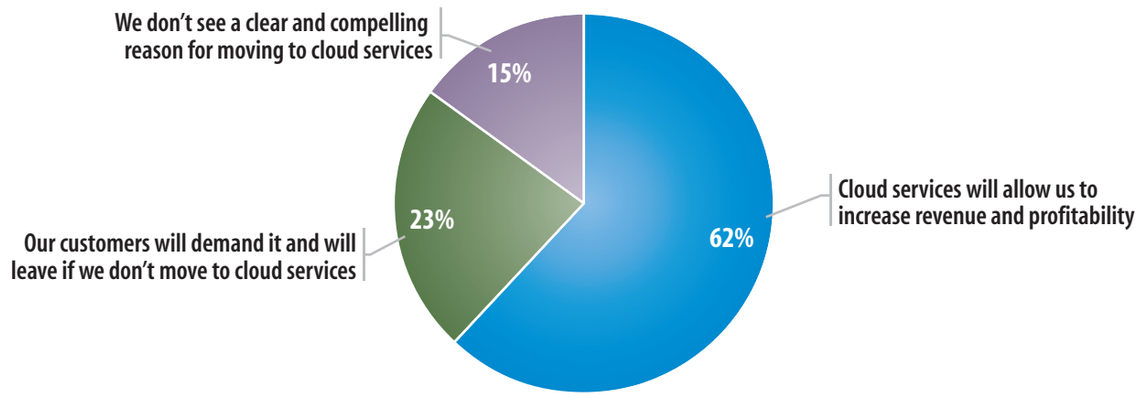


Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/16

Figure 49

Primary Reason for Moving to Cloud Services

What is the most important reason for moving to cloud services for your company?

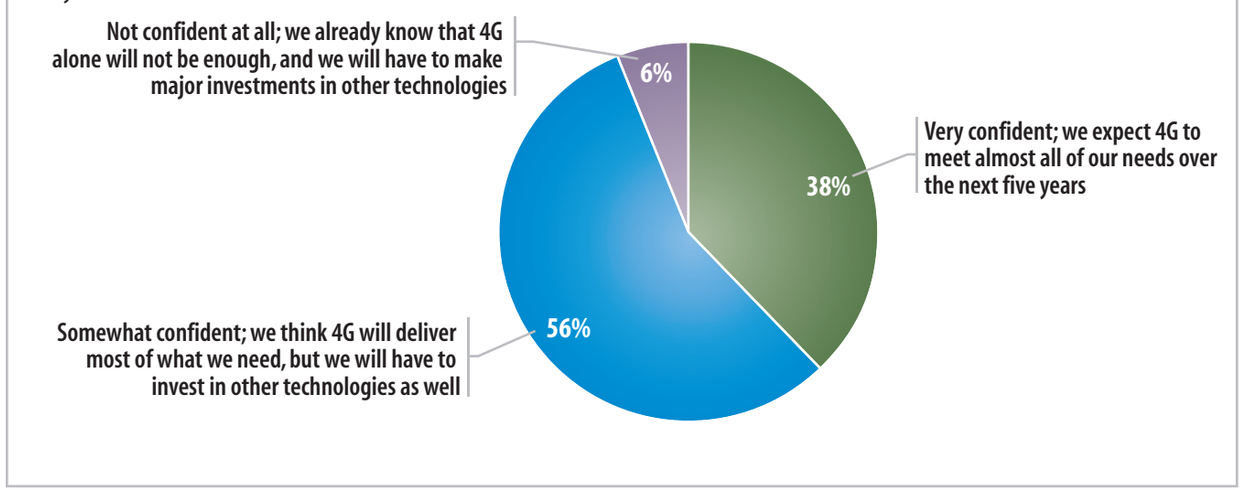


Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/18

Figure 50

Confidence in 4G Network Capacity and Performance

How confident is your company that 4G will deliver the network capacity and performance it will need over the next five years?

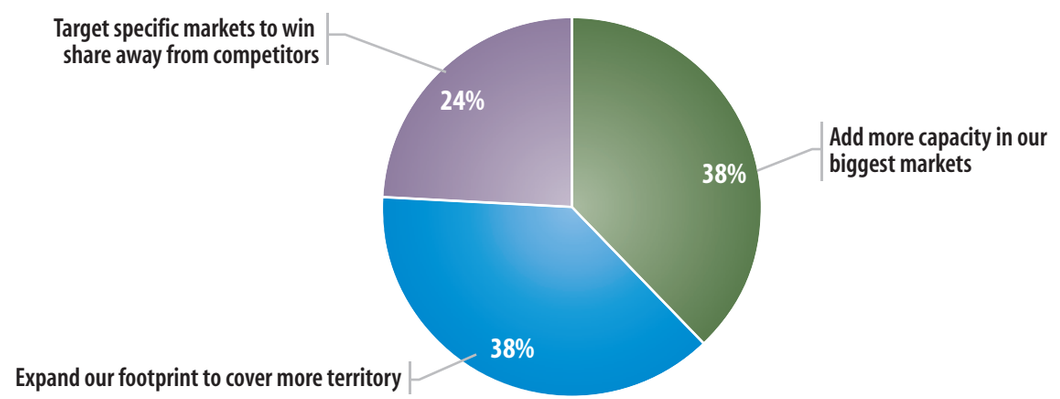


Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/20

Figure 51

Top Network and Service Expansion Priority

How confident is your company that 4G will deliver the network capacity and performance it will need over the next five years?

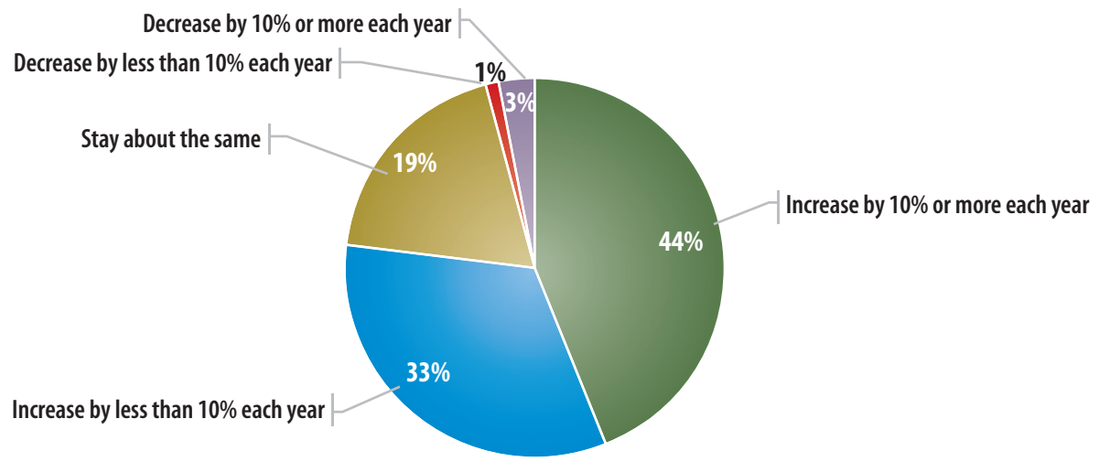


Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/21

Figure 52

Future Budget for 4G Networks

How will your company's capex budget for 4G networks change over the next three years?

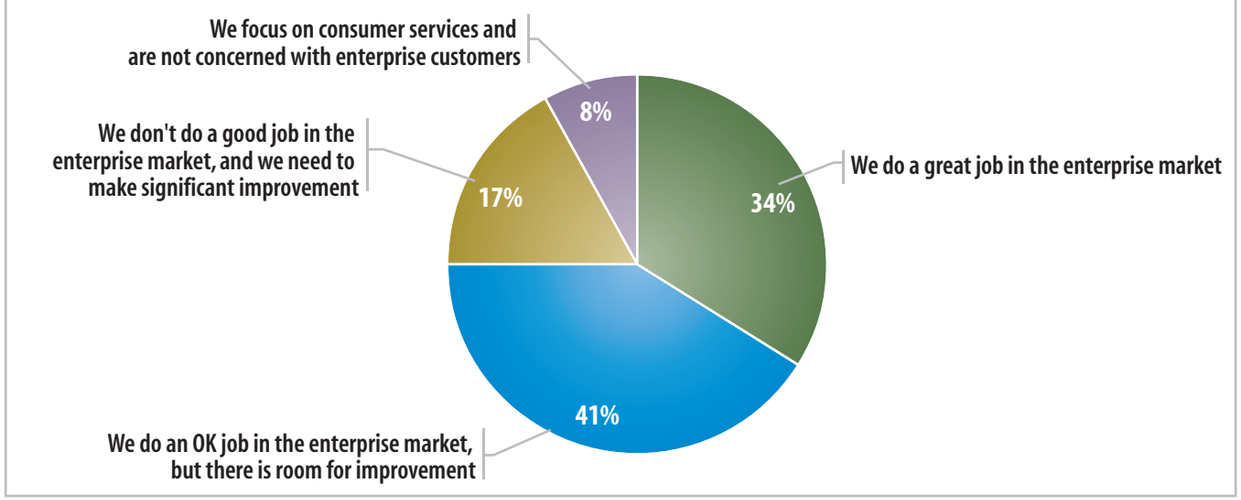


Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/22

Figure 53

Needs Met?

How well does your company meet the needs of its enterprise customers?

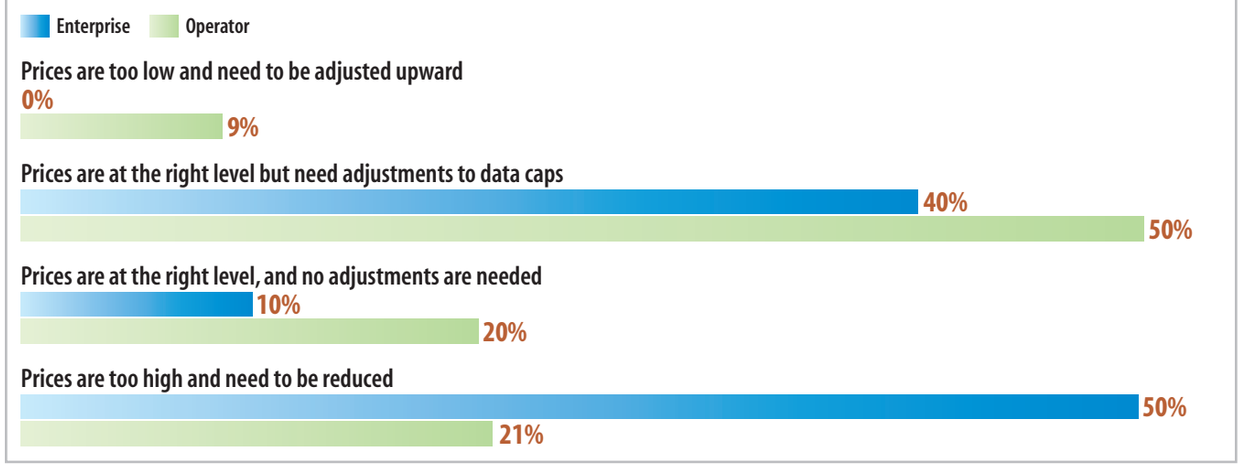


Data: *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012 R6031112-C/23

Figure 54

Perception of Mobile Data Price Plans

What is your organization's view of the current price plans for mobile data service?

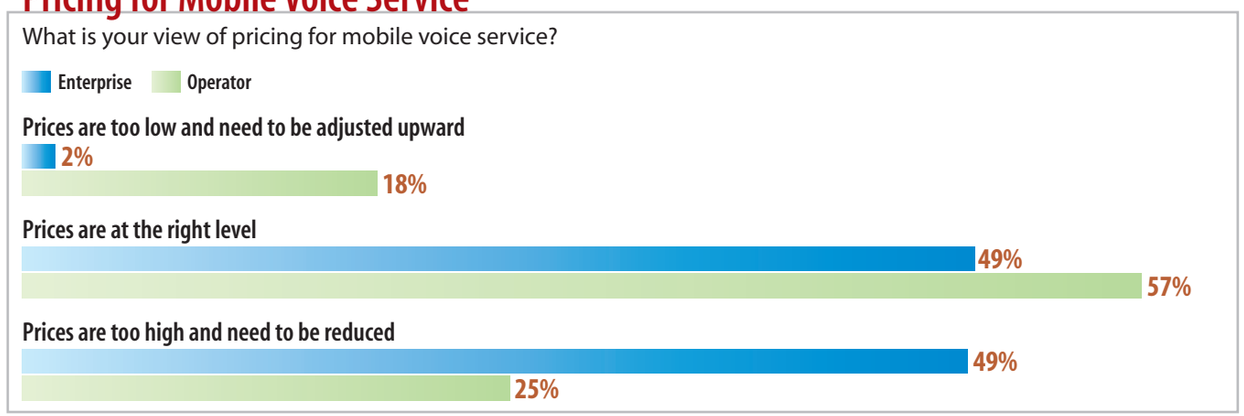


Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals and *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012

R6031112-C/24

Figure 55

Pricing for Mobile Voice Service



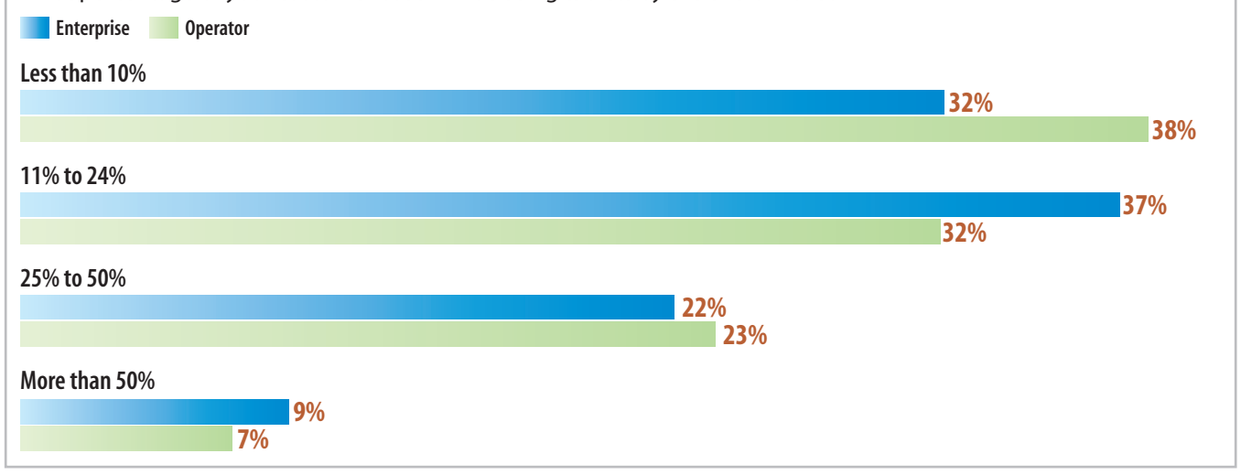
Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals and *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012

R6031112-C/25

Figure 56

Percentage of Tablet Users by 2013

What percentage of your employee base will be using tablets by the end of 2013?
What percentage of your customer base will be using tablets by the end of 2013?



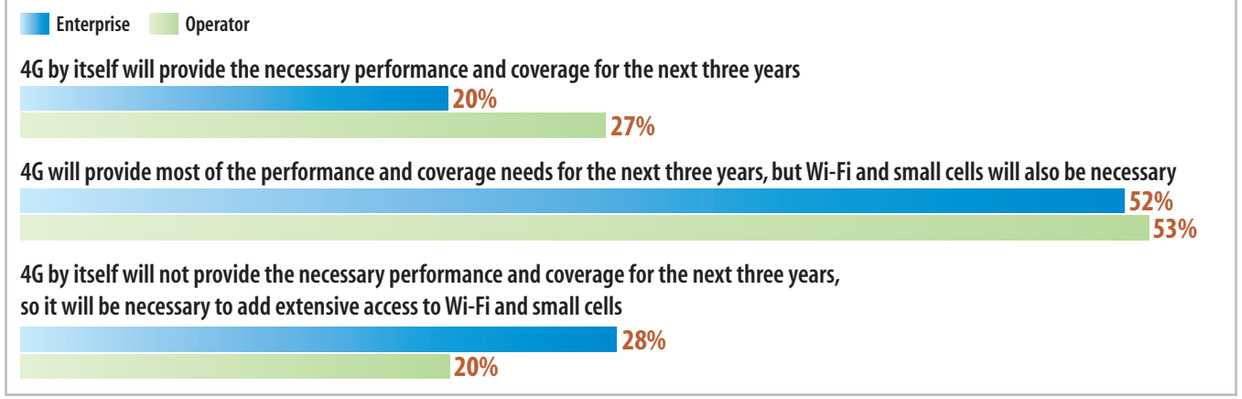
Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals and *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012

R6031112-C/27

Figure 57

Impact of 4G on Ability to Meet Mobile Data Service Demands

What impact does 4G have on your organization's ability to meet demand for mobile data service?



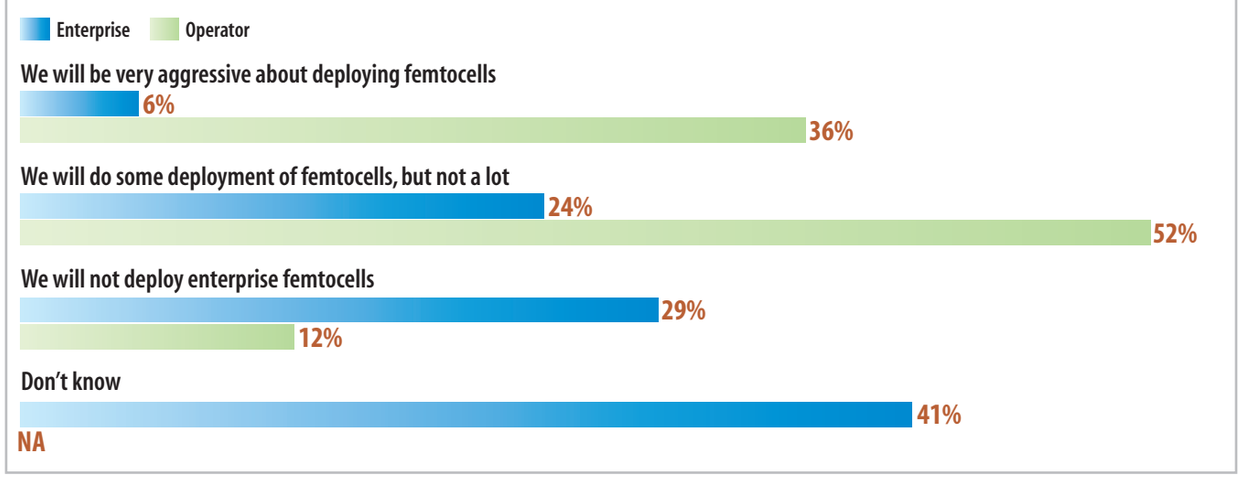
Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals and *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012

R6031112-C/29

Figure 58

Femtocell Deployment Plans

What are your organization's plans regarding enterprise small-cell (femtocell) deployment over the next 12 months?



Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals and *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012

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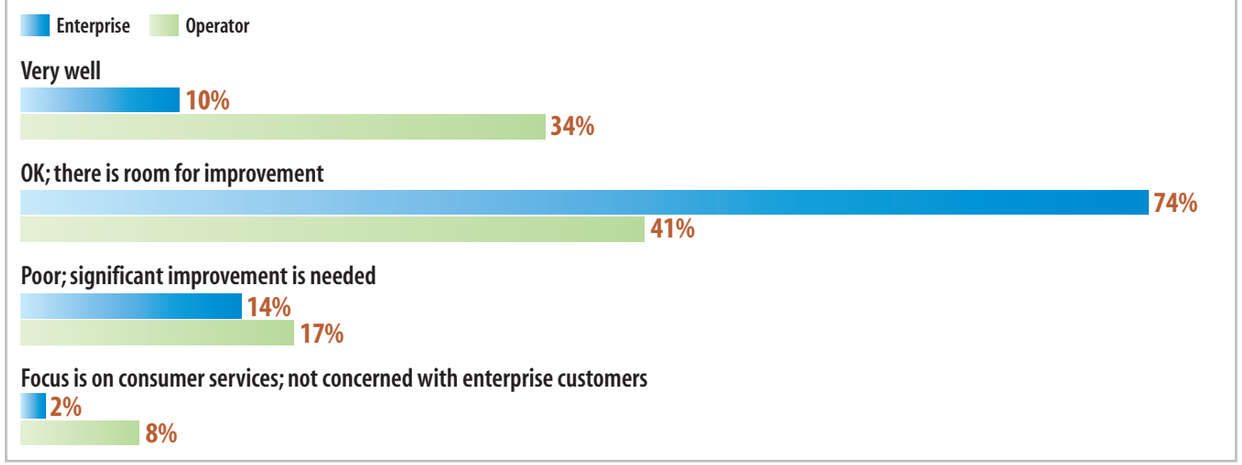
Figure 59

Needs Met?

How well does your service provider(s) meet your overall needs?
How well does your company meet the needs of its enterprise customers?



Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals and *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012

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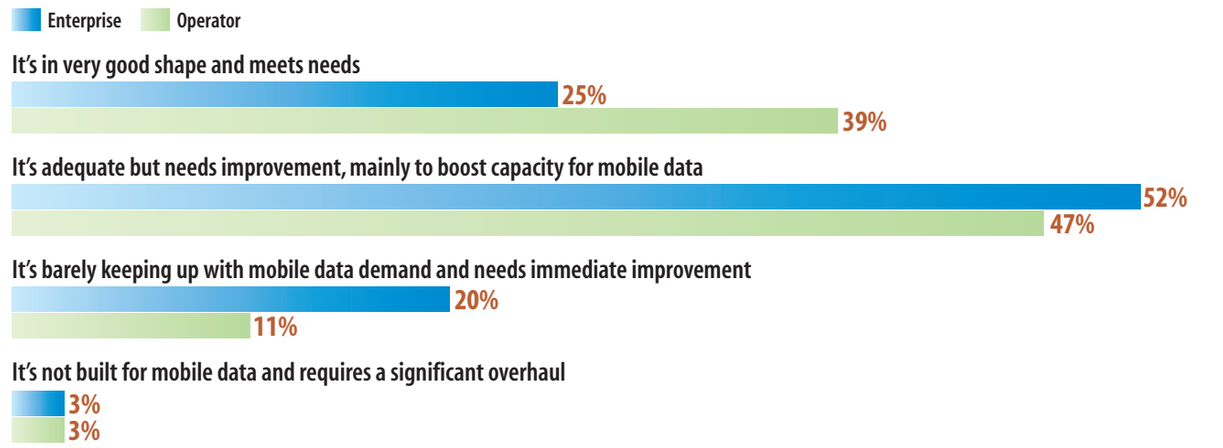
Figure 60

Mobile Data Access Infrastructure

How would you describe the current state of your carrier's mobile data access infrastructure?
How would you describe the current state of your company's access infrastructure regarding mobile data service?



Data: *InformationWeek* 4G and the Future of Mobility Survey of 230 business technology professionals and *Light Reading/Heavy Reading* Survey on 4G Trends, 68 professionals at mobile network operators, October 2012

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