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JUN 7 2017
Connecticut Siting Council

June 6, 2017
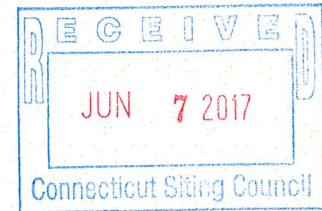
ORIGINAL

VIA ELECTRONIC MAIL AND FIRST CLASS MAIL

Attorney Melanie Bachman
Executive Director
Connecticut Siting Council
Ten Franklin Square
New Britain, CT 06051

      Re: Docket No. 471
             Supplemental Pre-filed Testimony of Ms. Patricia Sorrentino

Dear Attorney Bachman:

    Enclosed please find an original and 15 copies of the supplemental pre-filed testimony of Ms. Patricia Sorrentino.

    Please feel free to contact me if you have any questions. Thank you for your consideration.
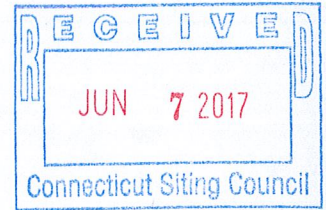
               Respectfully yours,

               By: _____
                     Burton B. Cohen
                     Attorney for Patricia Sorrentino

cc: Service List – Docket No. 471

Murtha Cullina LLP | Attorneys at Law
HARTFORD   BOSTON   NEW HAVEN   STAMFORD   WOBURN   WHITE PLAINS
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STATE OF CONNECTICUT
CONNECTICUT SITING COUNCIL

IN RE: :   DOCKET NO. 471

APPLICATION OF CELLCO PARTNERSHIP   :
D/B/A VERIZON WIRELESS FOR A   :
CERTIFICATE OF ENVIRONMENTAL   :
COMPATIBILITY AND PUBLIC NEED FOR   :
THE CONSTRUCTION, MAINTENANCE AND   :
OPERATION OF A WIRELESS   :
TELECOMMUNICATIONS FACILITY AT   :
208 KIRK ROAD (a/k/a 1075 PARADISE   :
AVENUE) IN HAMDEN, CONNECTICUT   :   June 6, 2017

SUPPLEMENTAL PRE-FILED TESTIMONY OF PATRICIA SORRENTINO

Ms. Sorrentino, what were your impressions of the field visit and hearings in this proceeding held on May 2, 2017 in Hamden?

First of all, I would like to thank the Siting Council members and staff for their consideration and open-mindedness that they demonstrated during the site visit and the portion of the hearing in which they asked questions of the representatives of Verizon Wireless. By their willingness to visit the initial proposed site from my property, I know they obtained a fuller appreciation of my concerns about the proximity of the proposed tower and equipment compound to my house.

Second, I also appreciated the candor of some of the Verizon Wireless witnesses as they were frank about their focus on the proposed site because AT&T had initially identified the site but abandoned it. It was apparent to all who were present at the afternoon hearing that there was no genuine search of alternatives to placing a large tower right next to my house.

Third, the public testimony was overwhelmingly against the proposed site for the tower, which is probably not surprising to the Council. But significantly, not one person testified about any problems with Verizon Wireless service. Some members of the Council seemed skeptical about Verizon's claim of need to construct a tower in the area.

Finally, I am appreciative that Mayor Leng and Representative D'Agostino submitted comments strongly opposing the proposed site. I understand that Representative D'Agostino is also a lawyer and find his discussion of some of the legal standards to be

very helpful to concluding that that the initial proposed site is not appropriate for a heavily residential neighborhood.

What are your reactions to the alternate sites on Mr. Vignola's property?

Alternate site 1 is only slightly better than the original proposed site, but it is still quite close to my house. It still requires a lengthy access road to be constructed, with the same issues relating to tree removal and fuel storage. Alternate site 2 is, again, slightly better from my personal perspective, but again, the access road from Country Club Drive turns our quiet residential neighborhood cul-de-sac into a commercial street, in my opinion. If the Council has to choose between these alternatives, it should still explore access from the end of Kirk Road, as Mr. Vignola operates a logging or firewood business from the end of Kirk Road and there are already commercial vehicles using that for access. I appreciate that alternative sites 1 and 2 may offer reduced tower heights and lower construction costs, but alternative sites 1 and 2 are in close proximity to my home and will also be disruptive to the residential neighborhood, particularly given the proposed access roads.

I am disappointed that Verizon Wireless has indicated that it is not pursuing Alternate site 3. Alternate site 3 is closest to the access road at the end of Kirk Road and, I believe, is at a higher elevation that could result in a shorter tower being constructed. According to the interrogatory response submitted by Verizon Wireless, Mr. Vignola indicated that "he plans to use it for alternate agricultural use (cultivation of hops)." Hops take several years to actually develop. This response seems rather speculative and also suggests that Verizon failed to enter into any meaningful negotiation with Mr. Vignola on Alternate site 3. I would request that the Siting Council strongly recommend to Verizon that it seriously engage in discussions to obtain permission to propose Alternate site 3 if any tower is to be approved for this area. Again, Alternate site 3 would not require the development of any access road from Country Club Drive, and the access to a tower site would be from an area that already is being used for commercial purposes in Mr. Vignola's business. Although the site visit did not include the area where Alternate site 3 would be and the easy access to it, I am confident that the Council would consider that the best choice for the proposed tower if one is to be built in this area.

Do you have any other information that you wish to bring to the attention of the Council.

Well, I am skeptical of the claim that the property owner suddenly intends to grow "hops" specifically in the area of his nearly 10 acres of property where a tower could be sited with minimal intrusion to the entire neighborhood.

In doing some on-line research, I found the attached study by RootMetrics titled "Mobile Network Performance in the US," which shows that call failure rates below 2% were considered to be "Excellent". Mr. Laredo indicated that the test week generated 0.75%

dropped calls in the Hamden 8 area (voice over LTE), and he testified that Verizon finds dropped call rates of 0.95% in this area on average. I also found the attached study by ChangeWave Research titled "Wireless Service Provider Trends" showing dropped call rates as high as 4.5% for Verizon's competitor, AT&T. Therefore, a 0.75% dropped call rate would be well above "excellent" performance; however, Verizon still insists on a more stringent 0.5% dropped call percentage rate according to Mr. Laredo despite the fact that based on my research other carriers see dropped call rates around 4.5%. I respectfully request the Siting Council to carefully examine the actual need for this tower in light of the apparent inconsistency of Verizon's asserted dropped call performance threshold.

Does that complete your supplemental testimony at this time?

Yes, it does. Thank you.

CERTIFICATION

This is to certify that on the 6th day of June, the foregoing Cover Letter and Supplemental Pre-filed Testimony was sent via United States mail, postage prepaid to the following parties of record:

Kenneth C. Baldwin, Esq.
Robinson & Cole LLP
280 Trumbull Street
Hartford, CT 06103-3597

Anthony Befera
Verizon Wireless
99 East River Drive
East Hartford, CT 06108

Burton B. Cohen

(/en-US)

SECOND HALF 2015
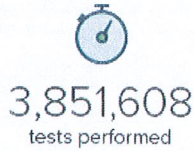
Mobile Network Performance in the US

Consumers today expect a faster and more reliable mobile experience than ever before. The carriers are in a continuous race to expand their LTE footprints, add network capacity, and launch new technologies in order to meet growing consumer demands and offer their subscribers an improved mobile life.
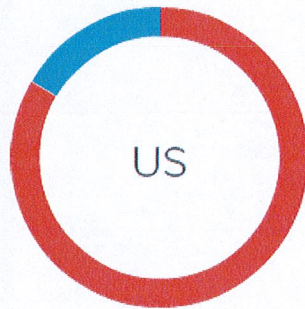
02-18-2016 | Dave Andersen
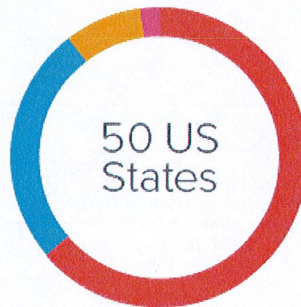
TESTING HIGHLIGHTS AND STATS AT A GLANCE

3,851,608
tests performed

231,941
miles driven

6,607
indoor locations tested

100%
of population covered

First-place finishes

Wins and ties over all levels and categories

US	50 US States	125 Metro Areas

Legend:
- AT&T
- Sprint
- T-Mobile
- Verizon

	US		50 US States		125 Metro Areas
AT&T	1	AT&T	110	AT&T	424
Sprint	0	Sprint	36	Sprint	212
T-Mobile	0	T-Mobile	9	T-Mobile	209
Verizon	6	Verizon	272	Verizon	597

As our smartphones become even more central to our daily lives, the carriers are in a tight race to offer consumers the fastest and most reliable experience possible

It's been another busy year in the US mobile landscape. The networks have continued to enhance their LTE coverage, whether by expanding their existing LTE footprints to areas that previously didn't offer LTE or by adding network capacity to allow for even greater LTE usage.

Why is this important? With our smartphones playing such a large part in our daily lives, we expect fast and reliable mobile performance wherever we are, and we're past the days of using our phones to only make calls or send texts. Data usage in particular has exploded, especially for accessing video content. Consumers want to stream their favorite television shows and movies, download high-definition films, upload videos to the web, and much more.

However, these data-intensive activities place a heavy burden on the networks and require a great deal of network capacity. As consumer demands and expectations have shifted, so have the carriers' priorities for providing a fast and reliable mobile experience. A few short years ago, the carriers were focused on offering geographic coverage to their subscribers. But in today's era of increasing data usage and the growing adoption of new technologies, the carriers must add capacity so that people can have consistent access to the network and do whatever they want to do, whenever they want to do it. The carriers have even changed their data plans in response to the increased consumer demand for access to video content.

To give you an up-to-date and comprehensive look at how the networks performed in the midst of all these changes, our testing looked at performance across the breadth of the United States itself, in each of the 50 states, and within the 125 most populous metro areas across the country. Our latest data shows important changes to the mobile race as the carriers have continued to add capacity, expand their LTE footprints, and deliver improved reliability and speed. These upgrades have a direct impact on how, when, and where you can use your smartphone.

Read on to see how the networks performed from nation to neighborhood and learn what these changes mean for your daily mobile life.
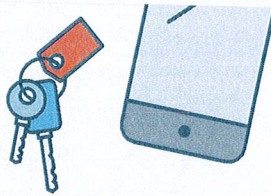
The importance of mobile to daily life

Your smartphone is a fundamental part of your daily life and is likely with you just about everywhere you go and is part of just about everything you do. From completing online banking to finding driving directions to staying in touch with friends or even the office, our smartphones act as extensions of ourselves and are the linchpins for our connected lives.

Your small mobile device is a big expense.
We're aware of how much money a smartphone and service costs. For most of us, having a smartphone isn't optional, but it also isn't cheap. It's easy to spend several thousand dollars per year to stay connected with your smartphone. Even though you have plenty of options for choosing a network that's right for your unique mobile life, the relationship between you and your network is often at least a yearlong commitment. It's an investment that for many people trails only the amount of money paid for housing or a car.

Good coverage isn't a luxury; it's a necessity.
Our growing reliance on our smartphones means that network performance has a direct impact on our daily life. What you can do with your smartphone and how fast you can do it are largely dependent upon your carrier's network performance. When your carrier's network struggles, it's more than an inconvenience; it's a disruption to your mobile life. Bad service means losing productivity, convenience, and even your connection with others.

Building blocks for your daily mobile life

To give you a real-world picture of coverage, we evaluate each network's mobile performance across a wide range of data, call, and text tests. The metrics we collect during testing aren't lifeless numbers or abstract stats. The call failure rates, data speeds, and various other performance markers we gather are the building blocks of your daily mobile life. Our metrics speak to your ability to stream movies, use your smartphone for navigation, make an important business call, send a text, or any of the other countless ways in which you use your phone.
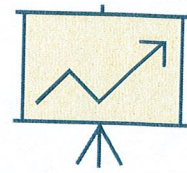
To learn more about how we test, check our methodology (/en-US/methodology).

From nation to neighborhood,
we've brought together the results
of our testing during the second
half of 2015 to give you a
comprehensive look at mobile
network performance across all the
spaces of your daily mobile life.

Performance across the United States

Providing strong coverage across the entirety of the US is a tall order. To earn our United States RootScore Awards, a network needs to offer outstanding performance across all of the different spaces where consumers use their smartphones, from cities and towns of all sizes to highways, rural areas, and all the places in between. Beyond excelling across all the places where consumers use their smartphones, strong mobile performance across the US also means offering network coverage for all the ways in which consumers use their smartphones.

Our United States RootScore Report is a one-of-its-kind performance summary that shows which networks are best answering consumer mobile expectations.

To determine which network is leading the performance race in the second half of 2015, we drove over 231,000 miles while testing performance on highways and in big cities, small towns, and rural areas across the US. To put that in perspective, consider that the distance from New York City to Los Angeles is approximately 2,800 miles, the circumference of the earth is 24,901 miles, and the moon is about 239,000 miles away. While collecting samples for our national report, our professional testers could have driven from NYC to LA about 83 times, circled the earth over nine times, or made it almost all the way to the moon. All told, we collected approximately 3.8 million test samples while testing performance while driving, at stationary outdoor locations, and at more than 6,600 indoor locations.

In short, these aren't anecdotal results or hasty generalizations. Unlike subjective surveys or summaries that rely exclusively on random crowdsourced data, we follow a scientific methodology. In simple terms, that means you can trust our results.

For those of you with a more scientific bent, we use tools such as hypothesis testing, experiment design, and statistics to provide objective, accurate, and unbiased assessments of performance from a consumer's point of view. Unlike crowdsourced studies, our methodology is designed to characterize network performance and illuminate meaningful differences in network performance with a high level of statistical significance. We never settle for collecting a small number of samples and we never draw conclusions that are not backed by scientific rigor. We use randomized spatial sampling techniques to collect data in an unbiased manner, and we collect test samples each day of the week at the times people use their smartphones most often.

These are comprehensive, unbiased results that you can trust to give you a complete and accurate picture of mobile network performance across the entirety of the United States. Results from more populous states like California carry far more weight in our national results than those from less populous states like Rhode Island, and within a state, large metro areas carry more weight than small towns or connecting highways. For more on how we test, see our methodology section (http://rootmetrics.com/en-US/methodology).

The United States Winners

ROOTSCORE AWARDS - 2ND HALF 2015

| Overall Performance Verizon | Network Reliability Verizon | Network Speed Verizon | Data Performance Verizon | Call Performance Verizon | Text Performance Verizon/AT&T |

100

80

60

40

20

0

AT&T delivers strong performance at the national level

For the fourth consecutive test period, AT&T was the only carrier other than Verizon to win or share a United States RootScore Award, doing so in the Text RootScore category. In fact, this marks the fourth straight time that AT&T has won or shared the United States Text RootScore Award.

AT&T finished a close second to Verizon in four out of the five remaining categories, including the more holistic areas of overall performance, network reliability, and network speed. AT&T also narrowly trailed Verizon in the Data RootScore category. The only category in which AT&T didn't rank second behind Verizon was in the Call RootScore category, where Sprint narrowly edged past AT&T to rank second.

In short, even though Verizon led the way in terms of award total at the national level, AT&T wasn't far behind in a majority of categories. Indeed, AT&T has consistently remained a strong number two performer behind Verizon in a majority of categories in our United States testing for five consecutive test periods.

Sprint stays in the mix, finishing second or third in four out of six categories

Sprint showed a great deal of improvement in our metro area and state testing, and the network improved at the United States level as well. While Sprint didn't win any United States RootScore Awards, the network improved its results in the Call RootScore category from a second-place tie with AT&T in first-half testing to ranking second outright in this test period. Sprint remained in third place in our Overall performance and Network Reliability RootScore categories.

As we note below, Sprint has improved its LTE coverage significantly in metropolitan markets, and Sprint's results showed a marked improvement in our metro area testing in the second half of 2015. If Sprint can continue its LTE expansion efforts beyond metro areas, Sprint could close the gap with the other networks in multiple categories at the United States level.

T-Mobile's rankings remain consistent in each half of 2015

T-Mobile's relative national rankings in our testing across the United States were identical to what we found in the first half of 2015. While T-Mobile didn't win any United States RootScore Awards in this test period, the network narrowly trailed AT&T for third place in our Network Speed RootScore category. We've noted before that T-Mobile typically performs much better in metro areas compared to state or national levels, and this was again the case in the second half of 2015.

T-Mobile offered fast speeds and strong data reliability in metropolitan markets. If you primarily use your smartphone in a major metropolitan area, T-Mobile remains a strong choice. Even though urban areas carry more weight in our results, it appears that T-Mobile currently lacks broad enough coverage to excel in our National or State RootScore studies. In the second half of 2015, the devices we used for testing were T-Mobile 700 MHz capable. Note that we did not enable VoLTE on T-Mobile for call testing in the second half of 2015. However, VoLTE will be the default call experience for T-Mobile testing in the first half of 2016, as VoLTE is gaining significant consumer adoption.

Verizon shines on the national stage

Verizon's performance in our testing of the United States was outstanding. Verizon won or shared United States RootScore Awards across all six RootScore categories: Overall performance, Network Reliability, Network Speed, Data performance, Call performance, and Text performance. In our previous test period, Verizon won five out of six United States RootScore Awards; the lone exception was in the Text RootScore category, in which AT&T won the award outright. In this test period, however, Verizon and AT&T shared the Text RootScore Award, allowing Verizon to win or share RootScore Awards in all six test categories. What's more, Verizon won the United States Overall RootScore Award for the fifth consecutive time.

While the scoring between Verizon and AT&T was relatively close in the categories of overall performance, network reliability, and data performance, Verizon again offered outstanding results in our United States RootScore testing. And as you'll see below, Verizon also offered excellent performances in our State and Metro Area testing.

National results in perspective

To give you a comprehensive view of mobile network performance, we test much more than just performance at the national level. We also test to see how the networks compare within the 125 most populous metro areas across the US and within each of the 50 states.

Our testing methodology is unique to the different spaces and challenges found within each of these different areas (metro area, state, and nation). Just because a network performed well in our United States testing doesn't necessarily mean that it will also be the strongest performer when looking at a particular metro area or state. For more on our testing methodology, please see the methodology section (http://rootmetrics.com/en-US/methodology) on our website.

Performance across the 50 states

TOTAL ROOTSCORE AWARDS
Won outright or tied

AT&T	Sprint	T-Mobile	Verizon
110	36	9	272

	AT&T		Sprint		T-Mobile		Verizon	
	Outright	Ties	Outright	Ties	Outright	Ties	Outright	Ties
Overall RootScore Award	4	7	0	0	0	0	39	7
Network Reliability RootScore Award	3	17	0	0	0	0	30	17
Network Speed RootScore Award	7	3	0	0	2	1	37	4
Data RootScore Award	6	3	0	0	0	0	41	3
Call RootScore Award	3	20	0	18	0	2	19	26
Text RootScore Award	0	37	0	18	0	4	10	39
	23	87	0	36	2	7	176	96

Expectations for mobile coverage have shifted.

Just a few years ago, consumers might have accepted that data speeds would lag or that finding a signal would be difficult in areas beyond major metros. That's changed. With our smartphones becoming an increasingly central part of our daily life, we want to be able to access our network at all times and be able to call, text, stream videos, and much more no matter where we are.

Providing coverage across an entire state isn't an easy task for the networks. Excelling in dense urban areas doesn't guarantee coverage will also be strong in other areas of the state. These various spaces often have vastly different network demands and require a variety of approaches to provision adequately.

Much more than simply summarizing results from the biggest metro areas, our State RootScore Reports balance results from dense urban areas, highways, smaller towns, and more rural spaces to paint a complete picture of the consumer mobile experience. Higher population areas carry more weight in the scoring, but all of these various spaces play a part in our final results. It's a comprehensive testing methodology to give you a one-of-its-kind look at mobile network operator performance across each of the 50 states.

AT&T increases total of State RootScore Awards

AT&T won or shared 110 State RootScore Awards in this test period, an increase from 95 in first-half testing. AT&T's tally of State RootScore Awards trailed that of only Verizon (272), but was far more than the totals of either Sprint (36) or T-Mobile (9). Although AT&T's tally of Overall RootScore Awards at state-level testing declined by one in this test period, AT&T's award totals in all other categories increased since first-half testing. In fact, no other network increased its award tally in more categories than AT&T. And in the holistic categories of network reliability and network speed, AT&T increased its award totals by five and three, respectively.

AT&T's state-level performance in text testing remained relatively similar to what we found in first-half testing, but AT&T's award gains generally came in the categories that hold the most relevance to consumers: network reliability, network speed, data performance, and call performance.

Sprint improves state-level call and text performances

Sprint's total of State RootScore Awards increased from 25 in first-half testing to 36 in this test period, and all of Sprint's improvements came in the call and text performance categories. Sprint's tally of State Text RootScore Awards increased marginally, jumping from 15 (all ties) to 18 (all ties). However, Sprint's total of State Call RootScore Awards increased more markedly, jumping from seven (won outright or shared) to 18 (all shared). Beyond the state level, Sprint also improved its Call and Text RootScore Award totals in metro area testing.

Sprint's results in the Network Reliability RootScore category at the state level, meanwhile, declined slightly since first-half testing. In our last report (http://www.rootmetrics.com/us/blog/special-reports/2015-1h-national-us), we noted that Sprint had improved its reliability at the state level, winning or sharing Network Reliability Awards in three states (Kansas, Ohio, and Virginia). However, in this test period, Sprint failed to win any Network Reliability Awards at a state level. In Kansas, Ohio, and Virginia, Sprint again delivered strong reliability results, tying for second place in each state, but Verizon improved markedly in these states, allowing Verizon to win the Network Reliability RootScore Award outright in all three states.

Even though Sprint increased its state-level RootScore Award total, Sprint finished third in State RootScore Awards by a wide margin. However, if Sprint can continue to expand its LTE coverage beyond major metropolitan areas and echo the improvements we've seen at the metro level, Sprint could close the gap with AT&T and Verizon in our state testing.

T-Mobile shows improvement in state testing

In the first half of 2015, T-Mobile didn't win any State RootScore Awards and was the only network shut out of awards at the state level. But in this test period, T-Mobile showed progress, winning or sharing nine State RootScore Awards. T-Mobile has long been known for providing fast speeds in metro areas, and the carrier showed a modest improvement to its speed results at the state level as well. Specifically, T-Mobile won or shared Network Speed RootScore Awards in three states. T-Mobile also shared two State Call RootScore Awards and four State Text RootScore Awards.

As you might have heard, T-Mobile has invested heavily in adding 700 MHz spectrum to its LTE network to complement its existing AWS and 1900 MHz spectrum. While the smartphones we used for testing in the second half of 2015 were T-Mobile 700 MHz capable, our tests are designed to reflect the consumer mobile experience and not focus on one spectrum band in particular. Please see our T-Mobile 700 MHz blog (http://rootmetrics.com/en-US/content/t-mobile-s-700-mhz-band-spectrum) for a directional look at how the 700 MHz rollout may be impacting T-Mobile's performance.

Verizon excellent in state-level testing

Verizon won or shared 272 State RootScore Awards in this test period, an increase from 253 in first-half testing. Verizon's award total was well over twice as many as that of the next-highest network, AT&T, with 110. Further, Verizon had the highest award total in each of our six test categories. While Verizon's total of State Call RootScore Awards remained identical compared to first-half testing, Verizon increased its award totals in the categories of network reliability and text performance. However, Verizon's totals in the other categories dropped marginally. Verizon's award tally decreased in the Network Speed RootScore category; Verizon's total of awards in the category (won outright or shared) slightly slipped from 44 to 41. That said, Verizon's total of 41 Network Speed RootScore Awards (won outright or

shared) was still by far the highest of any network. The next-highest total of Network Speed RootScore Awards was earned by AT&T with 10 (7 outright and 3 ties).

In short, Verizon dominated awards at the state level in the second half of 2015.

Other networks are making improvements in an effort to close the gap, but Verizon continues to lead the pack.

State results in perspective

To give you a comprehensive view of mobile network performance, we test much more than just performance at a state level. We also test to see how the networks compare within the 125 most populous metro areas and across the breadth of the US itself.

Our testing methodology is unique to the different spaces and challenges found within each of these different areas (metro area, state, and nation). Just because a network performed well in our state testing doesn't necessarily mean that it will also be the strongest performer when looking at metro areas or across the entirety of the US itself. For more on how we measure network performance, please see the methodology section (http://rootmetrics.com/en-US/methodology) on our website.

Metro Area RootScore Awards

TOTAL ROOTSCORE AWARDS
Won outright or tied

AT&T	Sprint	T-Mobile	Verizon
424	212	209	597

AWARD BREAKDOWN

Overall

Reliability

Speed

Data

Call

Text

AT&T	68	
	50	
Sprint	7	
	6	
T-Mobile	27	
	17	
Verizon	110	
	104	

1st Half 2015   2nd Half 2015   Outright   / / / Ties

ROOTMetrics®
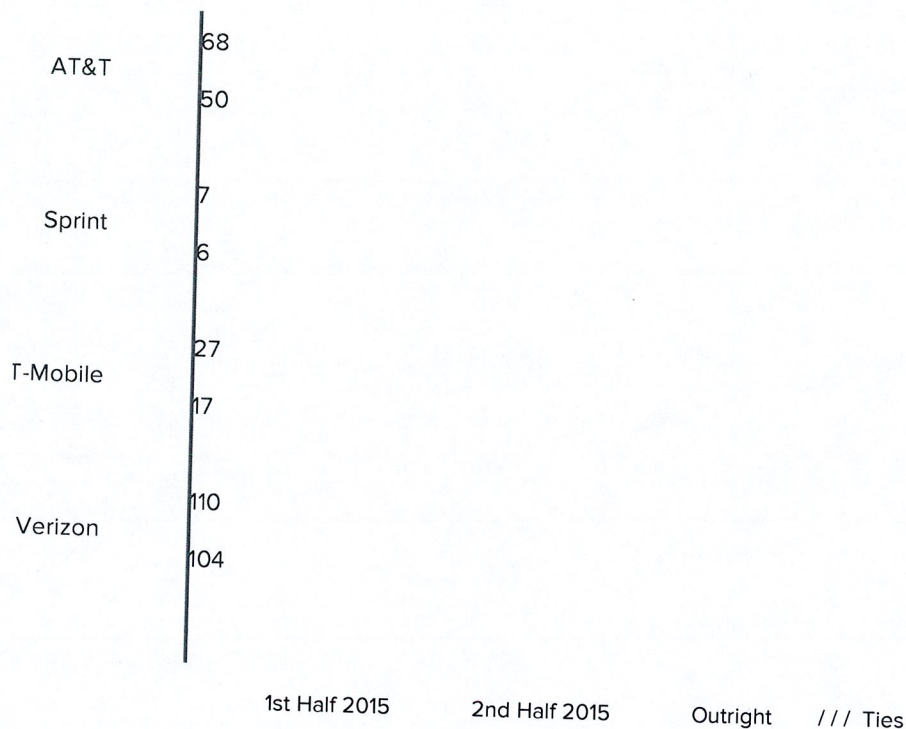
Major metropolitan areas are much more than just city centers. They also include residential suburbs, business districts, recreational areas, and the highways that connect them. Consumers expect strong coverage, fast speeds, and reliable mobile performance, whether they're relaxing at home, commuting to work, or traveling across town.

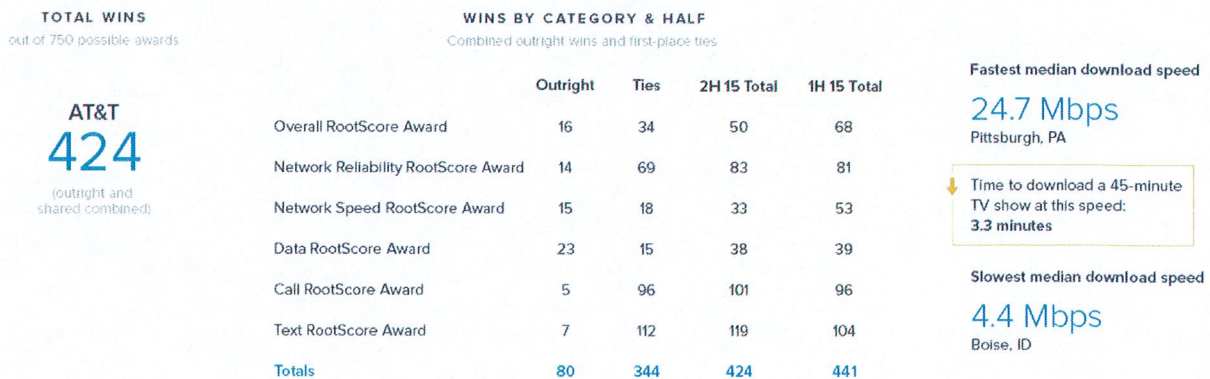Our scientific testing of the four major networks is well established, with multiple years and millions of tests completed. We've brought together individual network highlights, detailed performance information for the second half of 2015, and comparisons to the first half of 2015 to give you a sense of potential performance trends.

We've provided network-by-network summaries of performance, and within each network section, we'll show how long it would take you to download an episode of your favorite television show (at a file size of 600 MB). Read on for in-depth performance information for each carrier, including trend information and individual highlights for each network.

AT&T: fast speeds, excellent reliability, and a consistent RootScore Award tally

TOTAL WINS
out of 750 possible awards

AT&T
424
(outright and shared combined)

WINS BY CATEGORY & HALF
Combined outright wins and first-place ties

	Outright	Ties	2H 15 Total	1H 15 Total
Overall RootScore Award	16	34	50	68
Network Reliability RootScore Award	14	69	83	81
Network Speed RootScore Award	15	18	33	53
Data RootScore Award	23	15	38	39
Call RootScore Award	5	96	101	96
Text RootScore Award	7	112	119	104
Totals	80	344	424	441

Fastest median download speed
24.7 Mbps
Pittsburgh, PA

↓ Time to download a 45-minute TV show at this speed: 3.3 minutes

Slowest median download speed
4.4 Mbps
Boise, ID

In our last report (http://www.rootmetrics.com/us/blog/special-reports/2015-1h-national-us#metro-overview), we noted that AT&T was a solid number two performer behind Verizon. This was once again the case in the second half of 2015. Though AT&T's award total declined by 17 compared to first-half testing, AT&T's tally of 424 Metro Area RootScore Awards (won or shared) trailed that of only Verizon and was again far higher than the totals earned by Sprint or T-Mobile.

Even though AT&T's award total declined compared to first-half testing, AT&T's results in our metro area testing were still quite strong. AT&T won or shared more Text RootScore Awards than Verizon and finished second to Verizon in every other category except for network speed performance. And while AT&T's total of 33 Network Speed RootScore Awards (outright or shared) trailed the totals of T-Mobile (49) and Verizon (83), it was far more than that of Sprint (3).

The primary drivers behind AT&T's decrease in awards were in the Overall performance and Network Speed RootScore categories. In fact, all four networks earned fewer Overall RootScore Awards compared to first-half testing. In the Network Speed RootScore category, AT&T's drop of 20 awards (outright or shared) corresponded with strong improvements from T-Mobile and Verizon.

AT&T did, however, improve its tally of Text RootScore Awards by 15 (won outright or shared) compared to first-half testing. AT&T also delivered outstanding data and call reliability, while offering faster median download speeds in many metro areas compared to our previous test period.

As we begin to see more parity across the mobile landscape at the metro level, we'll keep an eye on AT&T's award total in the face of stronger competition from the other networks.

Reliability recap

Our reliability testing looks at the two hallmarks of your network experience: can you connect to the network, and can you then stay connected until your data task or call is complete (i.e., did you experience a failure)? We use a high bar in our reliability testing. For data testing, we look for networks to offer at least a 97% success rate in our web/app testing for both getting connected and staying connected. This 97% threshold reflects performance that would pose little to no noticeable disruptions in your everyday mobile life. For call testing, we look for networks to offer blocked and dropped call rates below 2%.

To give you an easy, at-a-glance look at reliability, we've marked call failure rates below 2% and web/app success rates for getting connected and staying connected above 97% as "Excellent."

Continuing a trend we've seen in previous reports, AT&T offered outstanding reliability across our metro area testing in the second half of 2015. AT&T increased its total of Network Reliability RootScore Awards by two since first-half testing. Notably, AT&T was the only network that improved its award total in the Network Reliability RootScore category. AT&T's total of 83 Network Reliability Awards (won or shared) was far higher than those of Sprint (24) and T-Mobile (16), but fell short of Verizon's total of 111 awards (won or shared).

AT&T's call reliability results were superb. For the second consecutive test period, AT&T reached our threshold of excellence for both blocked and dropped call reliability in all 125 metro areas we tested. Sprint and Verizon also achieved our threshold of excellence for blocked and dropped call reliability in all 125 metro areas, but AT&T's consistency of delivering excellent call reliability across test periods was matched by only Verizon.

AT&T's data reliability results were also outstanding. For the second consecutive report, AT&T reached our mark of excellence for both getting connected and staying connected in every metro area we visited. Verizon was the only other network to achieve this feat. While Sprint and T-Mobile have each made progress in our data reliability testing over the past year, AT&T's data reliability in metro areas remains much stronger than those of either network. AT&T's stellar data reliability is on par with that of only Verizon.

If reliability is important to your mobile life, AT&T remains an excellent choice.

AT&T call and data reliability performance

Number of markets achieving Excellent call and web/app reliability

	Excellent call reliability		Excellent web/app reliability	
	Blocked calls below 2%	Dropped calls below 2%	Getting connected over 97% of the time	Staying connected over 97% of the time
1H 2015	125	125	123	125
2H 2015	125	125	125	125

Speed specifics

AT&T's median download speeds improved compared to our previous test period. As the speed interval table below shows, AT&T decreased its number of markets in the 5-10 Mbps median download speed range from 33
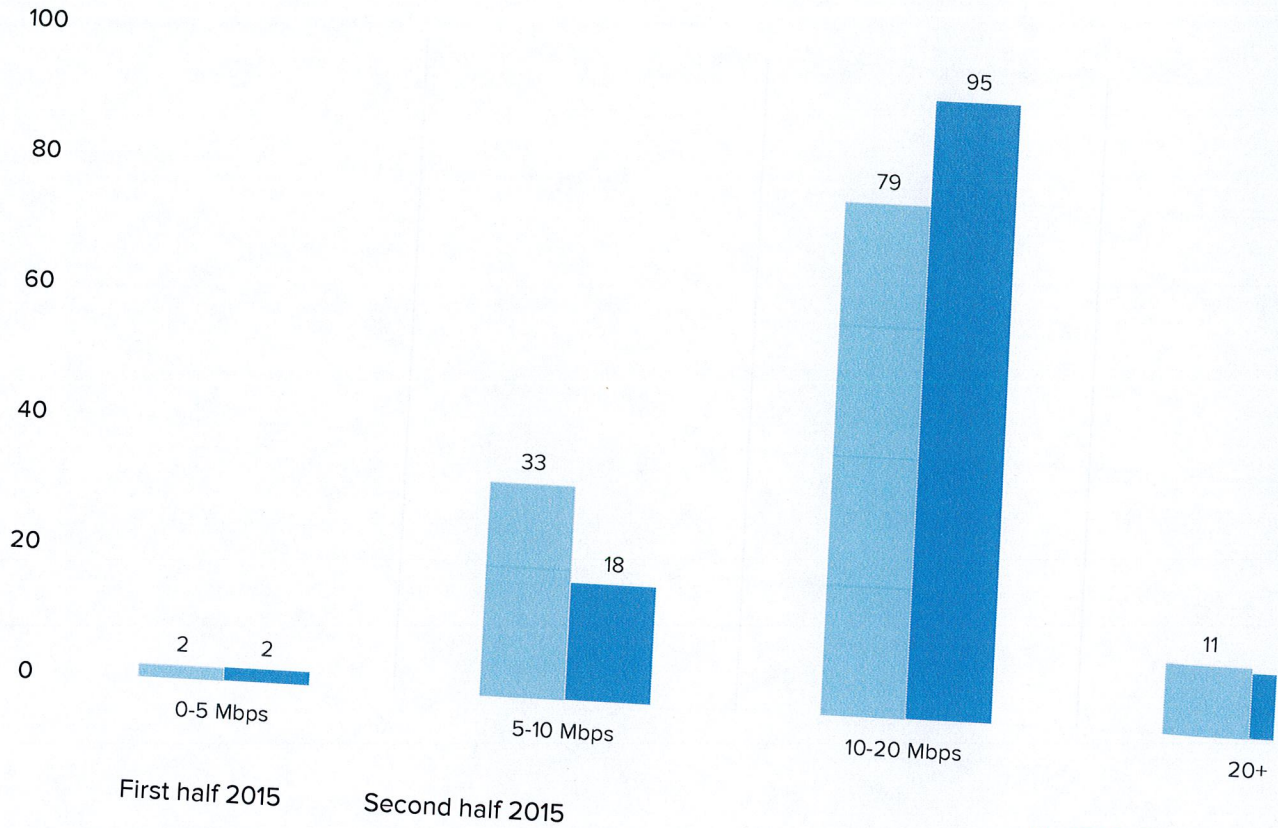
to 18 in this test cycle. More importantly for consumers, AT&T increased its number of markets in the 10-20 Mbps median download speed range from 79 to 95 since first-half testing. AT&T's speeds in the other two speed intervals remained relatively unchanged.

Looking at the two fastest speed intervals together, AT&T delivered median download speeds of at least 10 Mbps in 105 out of 125 markets. The only network to offer median download speeds of at least 10 Mbps in more markets than AT&T was Verizon, which did so in 110 metro areas. AT&T is, however, gaining ground on Verizon. In our last test period, AT&T recorded median download speeds faster than 10 Mbps in 90 markets, while Verizon did so in 121 markets. In short, AT&T has made progress in closing the gap with Verizon when it comes to delivering fast download speeds. Not surprisingly, AT&T and Verizon were the only networks to record at least 90% of their download tests on LTE in all 125 markets we tested.

At these speeds, AT&T subscribers should be able to perform data activities on their smartphones with ease. Check our speed chart () for some real-world examples that show what data speeds mean for your daily mobile life.

AT&T median download speed tally
Number of markets that fell within each median download speed range

100

80   95

60   79

40

33

20   18

                                                                                        11
0
        2   2
      0-5 Mbps   5-10 Mbps   10-20 Mbps   20+

First half 2015   Second half 2015

ROOT Metrics®

AT&T LTE footprint

Number of markets we were able to connect to AT&T's LTE network during download testing at the specific intervals shown

	Below 80%	80 - 90%	90 -100%
1H 2015	0	0	125
2H 2015	0	0	125

Sprint: faster speeds, strong reliability, and an increased award total

TOTAL WINS
out of 750 possible awards

WINS BY CATEGORY & HALF
Combined outright wins and first-place ties

Sprint

212

(outright and
shared combined)

	Outright	Ties	2H 15 Total	1H 15 Total
Overall RootScore Award	0	6	6	7
Network Reliability RootScore Award	0	24	24	30
Network Speed RootScore Award	2	1	3	4
Data RootScore Award	1	1	2	1
Call RootScore Award	0	80	80	61
Text RootScore Award	4	93	97	77
Totals	7	205	212	180

Fastest median download speed

29.8 Mbps
Flint, MI

↓ Time to download a 45-minute
TV show at this speed:
2.7 minutes

Slowest median download speed

0.7 Mbps
El Paso, TX

Sprint has continued to expand its LTE service across metropolitan markets nationwide. Sprint has also introduced its "LTE Plus network," which utilizes carrier aggregation (http://www.rootmetrics.com/en-US/content/capacity-carrier-aggregation-and-an-improved-consumer-experience) and other technologies to deliver faster speeds and improved reliability. It's clear that Sprint's investments are paying dividends for consumers. In our last report (http://www.rootmetrics.com/us/blog/special-reports/2015-1h-national-us#metro-overview), we noted that Sprint had improved its total of Metro Area RootScore Awards from 135 to 180 since the second half of 2014, while offering improved speeds and stronger reliability. Sprint's story of improvement continued in second-half metro area testing.

Sprint increased its tally of Metro Area RootScore Awards from 180 to 212, offered strong reliability, and improved its median download speeds considerably compared to first-half testing.

The majority of Sprint's improved Metro Area RootScore Award total was due to improved performances in the Call and Text RootScore categories. Sprint won or shared an additional 19 Call RootScore Awards and an additional 20 Text RootScore Awards compared to first-half testing. While Sprint's total of Network Reliability RootScore Awards declined by six, the network's totals in the remaining test categories remained relatively unchanged compared to our last test cycle.

Sprint finished third in total awards in our metro testing, but Sprint's improvement of 32 Metro Area RootScore Awards trailed the improvement of only Verizon, which improved by 85 awards (won or shared). In comparison, the Metro Area RootScore Award totals of both AT&T and T-Mobile declined since our last test period.

Sprint's improvements were especially evident in our most recent testing of Denver. In the first half of 2015, Sprint shared the Network Speed RootScore Award with T-Mobile and Verizon but finished second in every other category. In our most recent visit to Denver (http://rootmetrics.com/en-US/rootscore/map/metro/denver-co/2015/2H), however, Sprint won or shared RootScore Awards in five out of six categories, including a shared Overall RootScore Award and an outright win in the Network Speed RootScore category. The only award category in which Sprint didn't rank first was in call performance, where Sprint was locked in a three-way tie for second place.

Reliability recap

Our reliability testing looks at the two hallmarks of your network experience: can you connect to the network, and can you then stay connected until your data task or call is complete (i.e., did you experience a failure)? We use a high bar in our reliability testing. For data testing, we look for networks to offer at least a 97% success rate in our web/app testing for both getting connected and staying connected. This 97% threshold reflects performance that would pose little to no noticeable disruptions in your everyday mobile life. For call testing, we look for networks to offer blocked and dropped call rates below 2%.

To give you an easy, at-a-glance look at reliability, we've marked call failure rates below 2% and web/app success rates for getting connected and staying connected above 97% as "Excellent."

While Sprint's total of Network Reliability RootScore Awards decreased by six since our last test period, this doesn't tell the whole story of Sprint's reliability results in our metro area testing. Sprint's call reliability results were outstanding and on par with those of AT&T and Verizon. Sprint achieved our threshold of excellence for both blocked and dropped call reliability across all 125 metro areas we visited. Notably, this marks the second consecutive test period that Sprint has reached our threshold of excellence for blocked

call reliability in all 125 markets we tested. Further, Sprint increased the number of markets in which it achieved Excellent dropped call reliability from 122 in first-half testing to 125.

Sprint's data reliability was strong and similar to what we found in the first half of 2015. Sprint reached our threshold of excellence for getting connected in 102 markets and achieved Excellent for staying connected in 121 markets. In the vast majority of markets where Sprint fell short of Excellent for either getting connected or staying connected, Sprint missed our 97% connection rate threshold by very narrow margins.

Looking back one full year to the second half of 2014, Sprint has made tremendous strides to its data reliability results. In roughly one year, Sprint has increased the number of markets in which it scored Excellent for getting connected from 77 to 102 and for staying connected connected from 108 to 121. We'll keep a close eye on Sprint's reliability results going forward to see whether the carrier's story of improvement carries into 2016 and beyond.

Sprint call and data reliability performance

Number of markets achieving Excellent call and web/app reliability

	Excellent call reliability		Excellent web/app reliability	
	Blocked calls below 2%	Dropped calls below 2%	Getting connected over 97% of the time	Staying connected over 97% of the time
1H 2015	125	122	106	119
2H 2015	125	125	102	121

Speed specifics

Sprint showed significantly improved data speeds in this test period. Specifically, Sprint decreased its number of markets in the 0-5 Mbps and 5-10 Mbps median download speed ranges by a total of 18 since first-half testing, while increasing its number of markets in the 10-20 Mbps and 20+ Mbps median download speed intervals. These improved speeds are great news and could have a dramatic impact on the time it takes Sprint's subscribers to perform data activities with their smartphones.

Prior to the second half of 2015, Sprint hadn't recorded a median download speed faster than 20 Mbps in any market we'd ever tested. In this test period, however, Sprint recorded median download speeds of 20 Mbps or better in 14 markets. This is a huge degree of improvement and shows the impact of Sprint's continued efforts to expand its LTE presence in metropolitan markets nationwide. Indeed, Sprint's 14 total markets in the 20+ Mbps speed interval surpassed AT&T's total of 10 markets in the same speed interval. AT&T had long held an advantage over Sprint for delivering median download speeds faster than 20 Mbps, but the results of our second-half testing suggest that Sprint's network improvements have changed the mobile landscape and are improving the mobile lives of Sprint users.

For example, in Rockford, IL, Sprint recorded a median download speed of 16.8 Mbps in the first half of 2015. It would take about 4.8 minutes to download a 600 MB television show at this speed. However, at Sprint's second-half median download speed of 24.6 Mbps in Rockford (http://rootmetrics.com/en-US/rootscore/map/metro/rockford-il/2015/2H), downloading the same television show would take about about 3.3 minutes. In short, at Sprint's faster speeds, consumers should be able to perform data-intensive activities much more quickly.
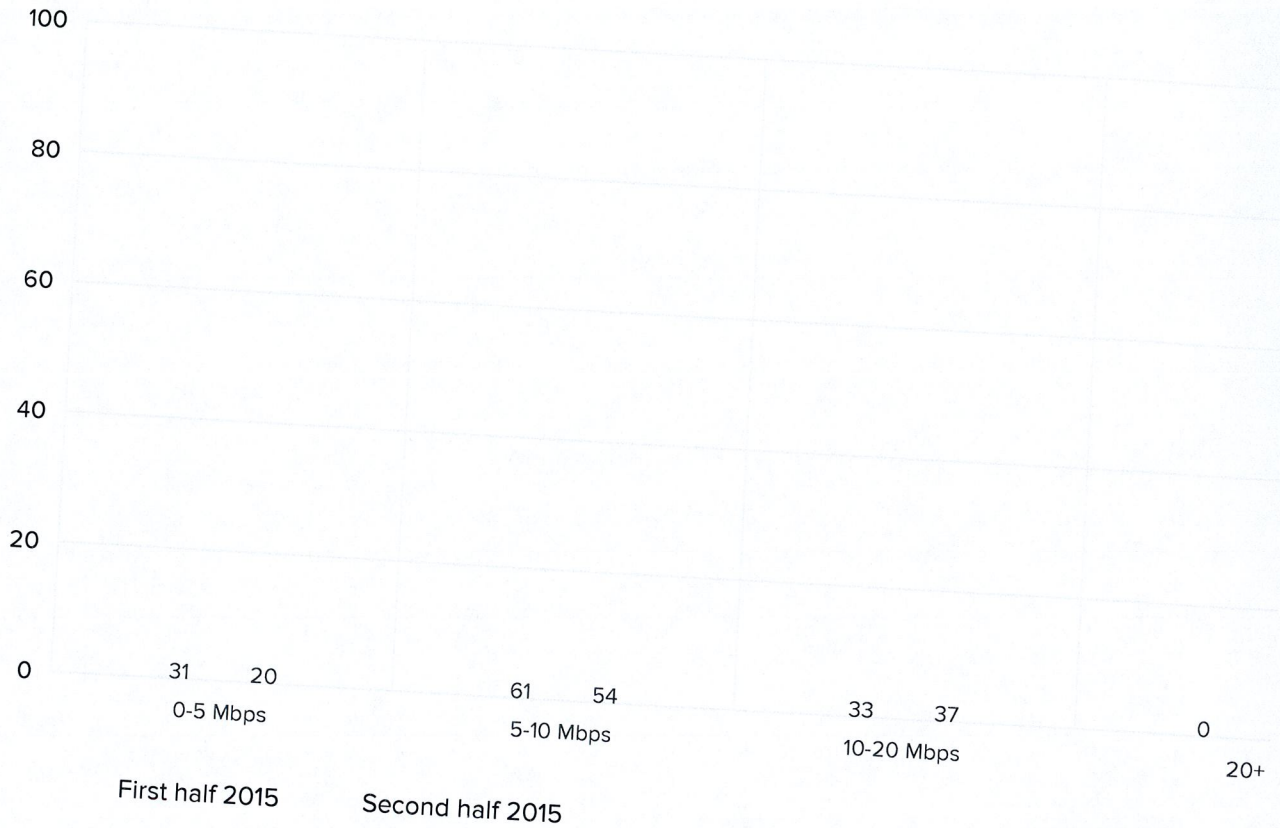
Even though Sprint's number of Network Speed RootScore Awards declined by one since first-half testing, Sprint's expanded LTE coverage in this test period appears to have benefited Sprint's subscribers. In our last test period, we were able to connect to Sprint's LTE network during download testing

over 90% of the time in 77 markets. But in this test period, we connected to Sprint's LTE network in more than 90% of our tests in 103 markets. The increased time spent on LTE is clearly corresponding to faster speeds from Sprint.

As Sprint continues to expand its LTE footprint, deliver faster speeds and strong reliability, the network's story of improvement could be a prelude to even stronger results to come.

Sprint median download speed tally

Number of markets that fell within each median download speed range

100

80

60

40

20

0

| 31 | 20 | | 61 | 54 | | 33 | 37 | | 0 |
| 0-5 Mbps | | | 5-10 Mbps | | | 10-20 Mbps | | | 20+ |

First half 2015   Second half 2015

ROOT Metrics®

Sprint LTE footprint

Number of markets we were able to connect to Sprint's LTE network during download testing at the specific intervals shown

	Below 80%	80 - 90%	90 -100%
1H 2015	10	38	77
2H 2015	6	16	103

T-Mobile: fast speeds and improved data reliability

TOTAL WINS
out of 750 possible awards

T-Mobile

209

(outright and
shared combined)

WINS BY CATEGORY & HALF
Combined outright wins and first-place ties

	Outright	Ties	2H 15 Total	1H 15 Total
Overall RootScore Award	0	17	17	27
Network Reliability RootScore Award	0	16	16	31
Network Speed RootScore Award	16	33	49	42
Data RootScore Award	14	13	27	20
Call RootScore Award	0	19	19	48
Text RootScore Award	0	81	81	53
Totals	30	179	209	221

Fastest median download speed

44.9 Mbps
Lansing, MI

↓ Time to download a 45-minute
TV show at this speed:
1.8 minutes

Slowest median download speed

2.2 Mbps
McAllen, TX

Fast speeds in metro areas have long been a hallmark of T-Mobile's performance, and this trend continued in our most recent test period. While T-Mobile's tally of Metro Area RootScore Awards decreased by 12 compared to first-half testing, T-Mobile improved its number of Network Speed RootScore Awards from 42 in first-half testing to 49. Notably, T-Mobile and Verizon were the only two carriers to improve their tally of Network Speed RootScore Awards since our last test period.

T-Mobile also increased its total of Data RootScore Awards by seven (won outright or shared) compared to first-half testing. Although Verizon won or shared the most Data RootScore Awards of any network with 83, T-Mobile narrowed the gap with AT&T in this test period. T-Mobile won or shared 27 Data RootScore Awards in second-half testing, while AT&T won or shared 38. T-Mobile also won 28 additional Text RootScore Awards in this test period.

Not all news was positive, however; T-Mobile's total of Call RootScore Awards declined by 29 since our last test cycle. Note that our T-Mobile call testing in the second half of 2015 was conducted on T-Mobile's circuit-switched call network, where the vast majority of T-Mobile subscribers make calls. However, in the first half of 2016, we will be testing T-Mobile's VoLTE network; we will be watching the carrier's blocked and dropped call reliability with interest. For more on VoLTE, please see our recent blog post. (http://rootmetrics.com/en-US/content/volte-a-rootmetrics-primer)

T-Mobile's award totals in the more holistic RootScore categories of Overall performance and Network Reliability decreased by 10 and 15, respectively, since first-half testing primarily because of additional blocked calls, but the network still offered very fast speeds and improved data reliability results.

Reliability recap

Our reliability testing looks at the two hallmarks of your network experience: can you connect to the network, and can you then stay connected until your data task or call is complete (i.e., did you experience a failure)? We use a high bar in our reliability testing. For data testing, we look for networks to offer at least a 97% success rate in our web/app testing for both getting connected and staying connected. This 97% threshold reflects performance that would pose little to no noticeable disruptions in your everyday mobile life. For call testing, we look for networks to offer blocked and dropped call rates below 2%.

To give you an easy, at-a-glance look at reliability, we've marked call failure rates below 2% and web/app success rates for getting connected and staying connected above 97% as "Excellent."

Reversing an improvement trend we noted in our last report, T-Mobile's total of Network Reliability RootScore Awards dropped from 31 to 16 (all ties) compared to first-half testing, which was largely due to a decline in blocked call reliability.

T-Mobile achieved Excellent blocked call reliability in 109 metro areas, a drop from 117 in the first half of the year. In dropped call testing, on the other hand, T-Mobile showed a modest improvement, increasing the number of markets in which it achieved Excellent from 122 to 124.

In data reliability testing, meanwhile, T-Mobile showed solid improvements compared to first-half testing. T-Mobile reached our threshold of excellence for getting connected in 103 markets in this test period, a substantial jump from 62 in first-half testing. T-Mobile also improved its ability to stay connected, though to a lesser degree; T-Mobile achieved Excellent for

staying connected in 121 markets, an increase from 111 in our last test cycle. This is great news for consumers who want both fast and reliable data service in metro areas.

T-Mobile call and data reliability performance

Number of markets achieving Excellent call and web/app reliability

	Excellent call reliability		Excellent web/app reliability	
	Blocked calls below 2%	Dropped calls below 2%	Getting connected over 97% of the time	Staying connected over 97% of the time
1H 2015	117	122	62	111
2H 2015	109	124	103	121

Speed specifics

T-Mobile continued to deliver outstanding data speeds in most metro areas in the second half of 2015. Notably, T-Mobile recorded the fastest median download speed we've recorded in any metropolitan market we've tested to date at 44.9 Mbps in Lansing, Michigan. Trailing only leader Verizon, T-Mobile won or shared 49 Network Speed RootScore Awards in second-half testing, while also delivering improved median download speeds. T-Mobile decreased its number of markets in the 0-5 Mbps median download speed range from six to one (2.2 Mbps in McAllen, TX) in this test period, while increasing its number of markets in the 10-20 Mbps median download speed range from 57 to 62. Although T-Mobile's number of markets in the 20+ Mbps median download speed range declined by seven markets since first-half testing, the carrier's total of 38 markets in this range was second behind only Verizon.
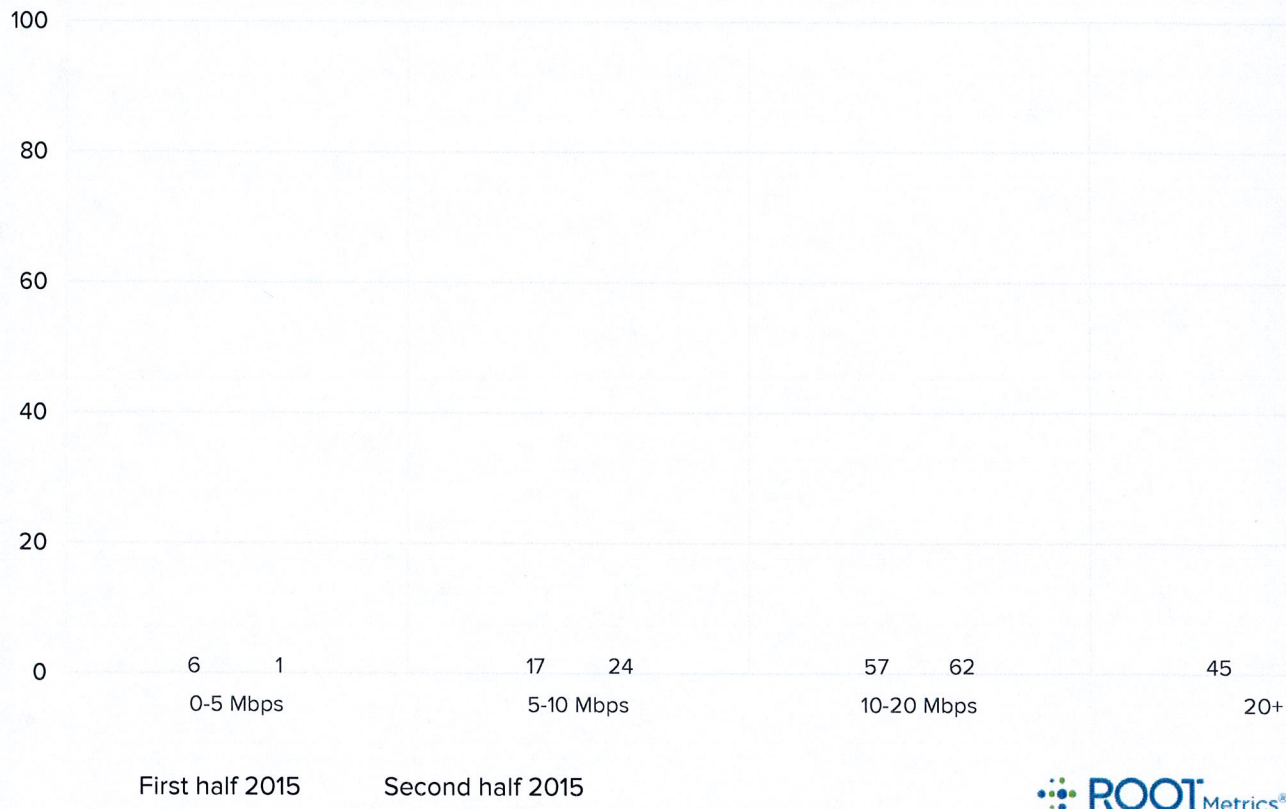
Combining the two fastest speed intervals, T-Mobile offered median download speeds of at least 10 Mbps in 100 markets in this test period; this total was slightly behind those of AT&T (105) and Verizon (110), but nearly twice as many as Sprint's total of 51.

T-Mobile's improved speeds correlate to the network's slightly improved LTE coverage in this round of testing. This improved LTE coverage in metro areas may be due to T-Mobile's rollout of 700 MHz spectrum. We connected to T-Mobile's LTE network during download testing at least 90% of the time in 111 markets, an increase from 105 in first-half testing. While T-Mobile also improved its LTE coverage in the lower percentage tier (below 80%), it's worth noting that we didn't connect to T-Mobile's LTE network in Des Moines, IA, during any of our download tests in either half of 2015. Despite the absence of LTE in Des Moines, T-Mobile's legacy HSPA+42 network still delivered a respectable median download speed of 6.4 Mbps along with Excellent reliability for both getting connected and staying connected.

If T-Mobile can improve its blocked call reliability and continue to expand and enhance its LTE network, T-Mobile could close the gap with the other carriers in terms of Metro Area RootScore Awards.

T-Mobile median download speed tally

Number of markets that fell within each median download speed range

	0-5 Mbps	5-10 Mbps	10-20 Mbps	20+
First half 2015	6	17	57	
Second half 2015	1	24	62	45

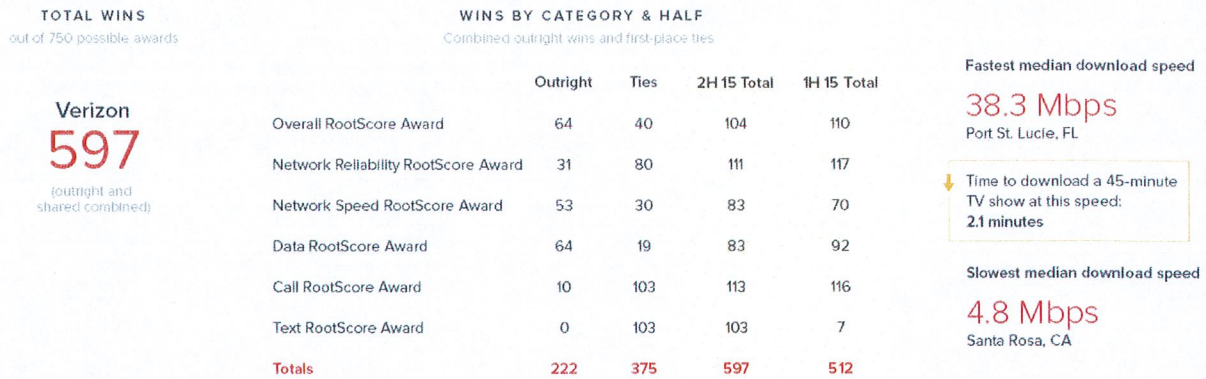First half 2015   Second half 2015

·:· ROOT Metrics®

T-Mobile LTE footprint

Number of markets we were able to connect to T-Mobile's LTE network during download testing at the specific intervals shown

	Below 80%	80 - 90%	90 -100%
1H 2015	8	12	105
2H 2015	5	9	111

Verizon: fast speeds, excellent reliability, and the most RootScore Awards of any network

TOTAL WINS
out of 750 possible awards

WINS BY CATEGORY & HALF
Combined outright wins and first-place ties

Verizon

597

(outright and
shared combined)

	Outright	Ties	2H 15 Total	1H 15 Total
Overall RootScore Award	64	40	104	110
Network Reliability RootScore Award	31	80	111	117
Network Speed RootScore Award	53	30	83	70
Data RootScore Award	64	19	83	92
Call RootScore Award	10	103	113	116
Text RootScore Award	0	103	103	7
Totals	**222**	**375**	**597**	**512**

Fastest median download speed

38.3 Mbps
Port St. Lucie, FL

Time to download a 45-minute
TV show at this speed:
2.1 minutes

Slowest median download speed

4.8 Mbps
Santa Rosa, CA

Verizon's performance in metro area testing in the second half of 2015 echoes what we've seen from the network in previous test periods, and that's a good thing: Verizon won more Metro Area RootScore Awards than any other network, delivered outstanding reliability results, and recorded consistently fast data speeds. The only category in which Verizon didn't win the most RootScore Awards was in the text performance category, where Verizon narrowly trailed AT&T. AT&T won or shared 119 Text RootScore Awards, while Verizon shared 103 such awards.

Verizon's total of Metro Area RootScore Awards increased by 85 (won or shared) since our last test cycle, easily the highest increase among all networks. The majority of Verizon's award gains were in the Text RootScore category. Verizon's total of Text RootScore Awards increased from seven in first-half testing to 103 (all ties). However, since data speeds are such an integral part of consumers' daily mobile lives, Verizon's improved total of Network Speed RootScore Awards was even more impressive: Verizon increased its award total from 70 to 83 (won or shared) since first-half testing.

Even though Verizon's award total in all RootScore categories except for Network Speed and Text performance declined marginally since first-half testing, Verizon's award tally in each category was still remarkable. Of the

125 markets we tested in the second half of 2015, Verizon won or shared 104 Overall RootScore Awards, 111 Network Reliability RootScore Awards, 83 Network Speed RootScore Awards, and 83 Data RootScore Awards.

To put this in context, Verizon's next-closest competitor in five out of six categories was AT&T, which won or shared 50 Overall RootScore Awards, 83 Network Reliability RootScore Awards, and 38 Data RootScore Awards. T-Mobile, Verizon's next-closest competitor in the Network Speed RootScore category, won or shared 49 Network Speed RootScore Awards.

Reliability recap

Our reliability testing looks at the two hallmarks of your network experience: can you connect to the network, and can you then stay connected until your data task or call is complete (i.e., did you experience a failure)? We use a high bar in our reliability testing. For data testing, we look for networks to offer at least a 97% success rate in our web/app testing for both getting connected and staying connected. This 97% threshold reflects performance that would pose little to no noticeable disruptions in your everyday mobile life. For call testing, we look for networks to offer blocked and dropped call rates below 2%.

To give you an easy, at-a-glance look at reliability, we've marked call failure rates below 2% and web/app success rates for getting connected and staying connected above 97% as "Excellent."

Verizon's reliability performance across metro area testing in the second half of 2015 was outstanding. Although Verizon's total of Network Reliability RootScore Awards declined by six compared to first-half testing, Verizon still won or shared 111 Network Reliability RootScore Awards, by far the highest total among all networks.

Verizon also delivered outstanding call and data reliability results in our metro area testing. Verizon reached our threshold of excellence in all 125 markets for both blocked and dropped call reliability. What's more, for the second consecutive test period, Verizon reached our threshold of

excellence for both getting connected and staying connected in all 125 markets. Verizon was the only network to achieve this feat in both halves of 2015, but AT&T came very close.

Verizon's ability to deliver consistently outstanding reliability results in both call and data reliability testing has been nothing short of remarkable.

Verizon call and data reliability performance

Number of markets achieving Excellent call and web/app reliability

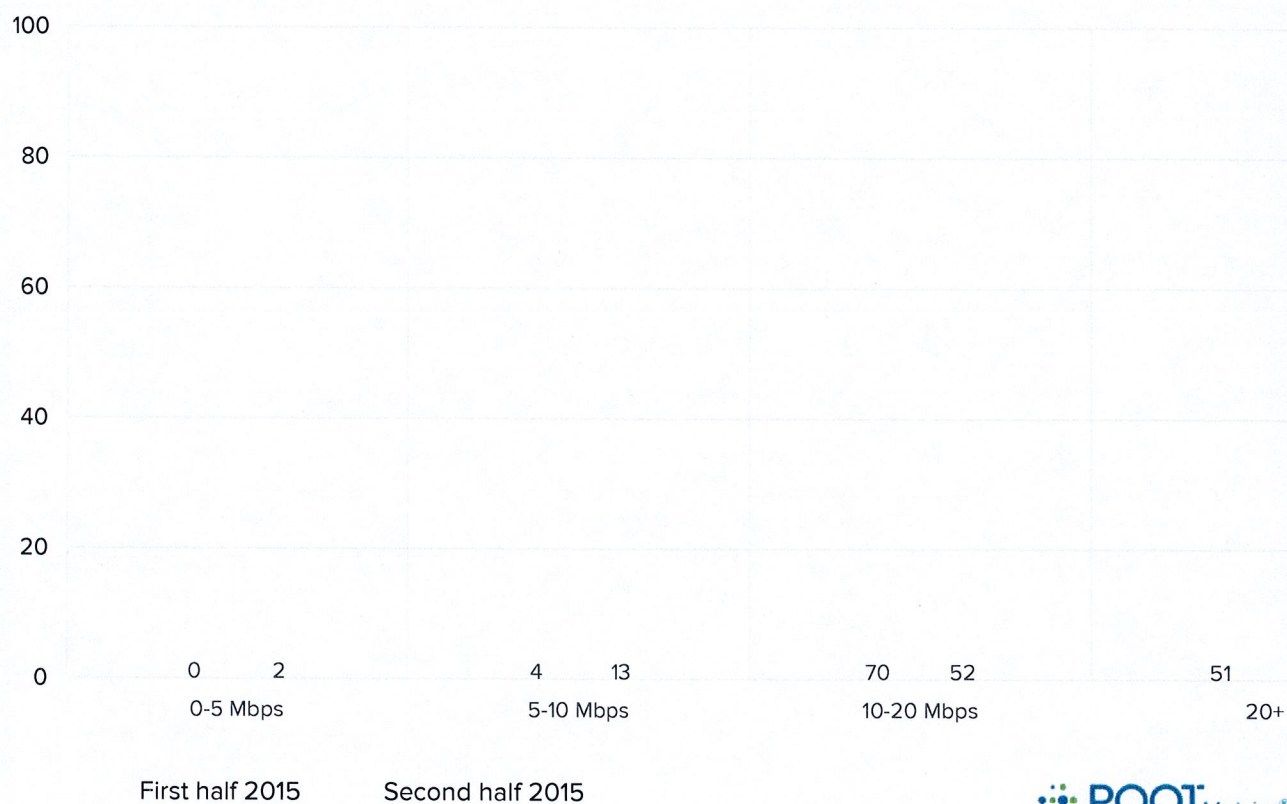|	Excellent call reliability		Excellent web/app reliability	
	Blocked calls below 2%	Dropped calls below 2%	Getting connected over 97% of the time	Staying connected over 97% of the time
1H 2015	125	124	125	125
2H 2015	125	125	125	125

Speed specifics

In addition to Verizon's outstanding reliability, Verizon also offered extremely fast speeds in metro areas. Verizon was the only network other than AT&T to record at least 90% of its download tests on LTE in every market we tested. Verizon did, however, show very slight regression when looking at its speeds in the 0-5 Mbps median download speed range. Specifically, Verizon recorded median download speeds in the 0-5 Mbps range in two markets (McAllen, TX and Santa Rosa, CA) in this test period, compared to zero in first-half testing.

However, and more importantly for consumers, Verizon's number of markets in the 20+ Mbps median download speed range increased from 51 to 58. No other network offered topline speeds (those exceeding 20 Mbps) in as many markets as Verizon. What's more, among the 125 metro areas we tested, Verizon recorded median download speeds of 10 Mbps or faster in 110 markets—the highest total among all networks.

Verizon has proven consistently fast and reliable in our metro area testing. The question remains: will this be the case in 2016, or will the other networks catch up?

Verizon median download speed tally

Number of markets that fell within each median download speed range

100							
80							
60							
40							
20							
0	0	2	4	13	70	52	51
	0-5 Mbps		5-10 Mbps		10-20 Mbps		20+

First half 2015   Second half 2015

·:·ROOT Metrics®

Verizon LTE footprint

Number of markets we were able to connect to Verizon's LTE network during download testing at the specific intervals shown

	Below 80%	80 - 90%	90 -100%
1H 2015	0	0	125
2H 2015	0	0	125

Metros Areas in perspective

To give you a comprehensive view of mobile network performance, we test much more than just performance at the metro level. We also test to see how the networks compare within each of the 50 states and across the breadth of the US itself.

Our testing methodology is unique to the different spaces and challenges found within each of these different areas (metro area, state, and nation). Just because a network performed well in our metro area testing doesn't necessarily mean that it will also be the strongest performer when looking at a state or across the entirety of the US. For more on how we measure performance, please see the methodology section (http://rootmetrics.com/en-US/methodology) on our website.

A flexible, evolutionary framework

RootMetrics continually evaluates our testing and scoring methodologies to ensure that they continue to reflect the consumer mobile experience as accurately as possible. When advances in mobile technology alter the landscape or consumer behavior changes markedly, we adjust our methodologies and scoring accordingly. Changes are made so that we continue to capture the true consumer experience.

provides such written consent, the approved use must prominently incorporate a statement that uses information and terms similar to the following (as approved by RootMetrics):

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April 27, 2010

ChangeWaveResearch

Wireless Service Provider Trends
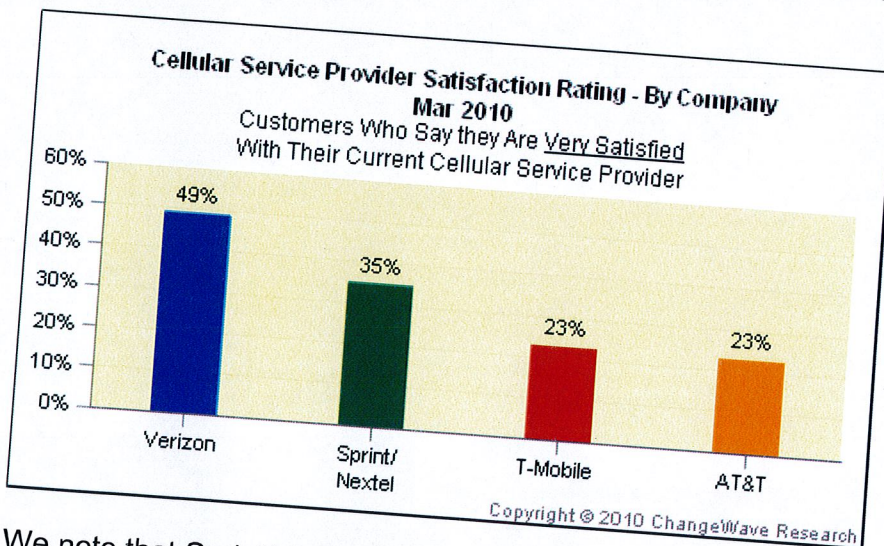## New Survey Looks At Ongoing Battle Among Industry Leaders

Andy Golub and Paul Carton

Overview: During March ChangeWave surveyed 4,040 consumers on their attitudes towards the wireless service provider industry – including trends in customer satisfaction and loyalty, future market share demand, and the issue of dropped calls.

The survey – conducted immediately before the latest Verizon iPhone rumors – also took a close-up look at the potential industry impact if Verizon were to offer the Apple iPhone.

Customer Satisfaction

As in previous ChangeWave surveys, Verizon remains the clear industry leader in customer satisfaction – with nearly half of Verizon's customers (49%) saying they are *Very Satisfied* with their cellular service.

Cellular Service Provider Satisfaction Rating - By Company
Mar 2010
Customers Who Say they Are <u>Very Satisfied</u>
With Their Current Cellular Service Provider

Verizon	49%
Sprint/Nextel	35%
T-Mobile	23%
AT&T	23%

Copyright © 2010 ChangeWave Research

We note that Sprint/Nextel (35%) is now second in terms of customer satisfaction, with T-Mobile (23%) and AT&T (23%) lagging well behind.

Dropped Calls. Verizon also ranks best in terms of number of dropped calls, with Verizon customers reporting only 1.5% of their calls being dropped over the past 3 months. This compares to 2.4% for Sprint/Nextel, 2.8% for T-Mobile and 4.5% for AT&T customers.

Percentage of Dropped Calls Over Past 90 Days - By Company
Mar 2010
Over the past 90 days, how frequently have you experienced a "dropped call" on your cell phone?

Verizon — 1.5%
Sprint/Nextel — 2.4%
T-Mobile — 2.8%
AT&T — 4.5%

Copyright © 2010 ChangeWave Research

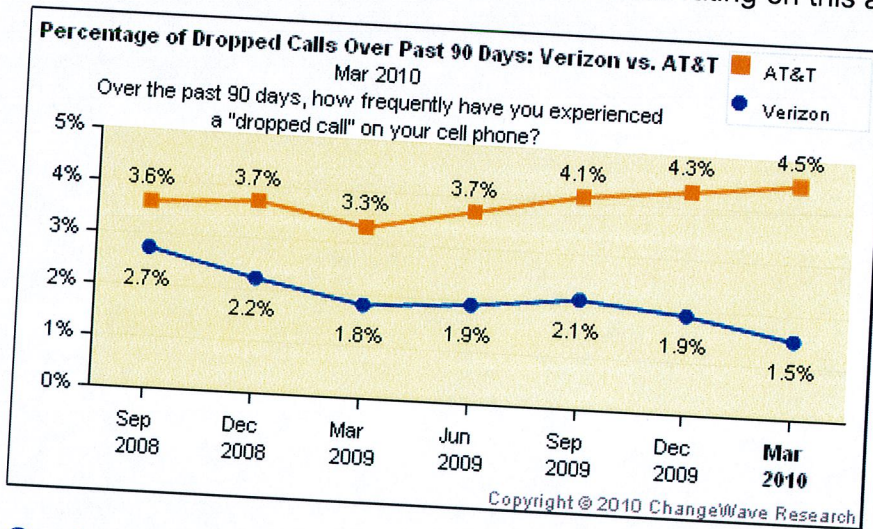Importantly, while Verizon has its all-time best dropped call rating in the current ChangeWave survey, AT&T has just reached its all time worst rating on this all important measure.

Percentage of Dropped Calls Over Past 90 Days: Verizon vs. AT&T
Mar 2010
Over the past 90 days, how frequently have you experienced a "dropped call" on your cell phone?

AT&T
Verizon

AT&T: 3.6%, 3.7%, 3.3%, 3.7%, 4.1%, 4.3%, 4.5%
Verizon: 2.7%, 2.2%, 1.8%, 1.9%, 2.1%, 1.9%, 1.5%

Sep 2008, Dec 2008, Mar 2009, Jun 2009, Sep 2009, Dec 2009, Mar 2010

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Customer Loyalty

To measure subscriber churn rates, we asked respondents how likely they are to switch wireless providers over the next 90 days. Only 8% say they plan to make a change – matching the lowest level recorded in a ChangeWave survey.

At the provider level, 7% of Verizon's customers and 8% of AT&T's say they'll switch. Sprint/Nextel (10%) and T-Mobile (14%) lag behind the two industry leaders.

Plans to Switch - By Company
March 2010
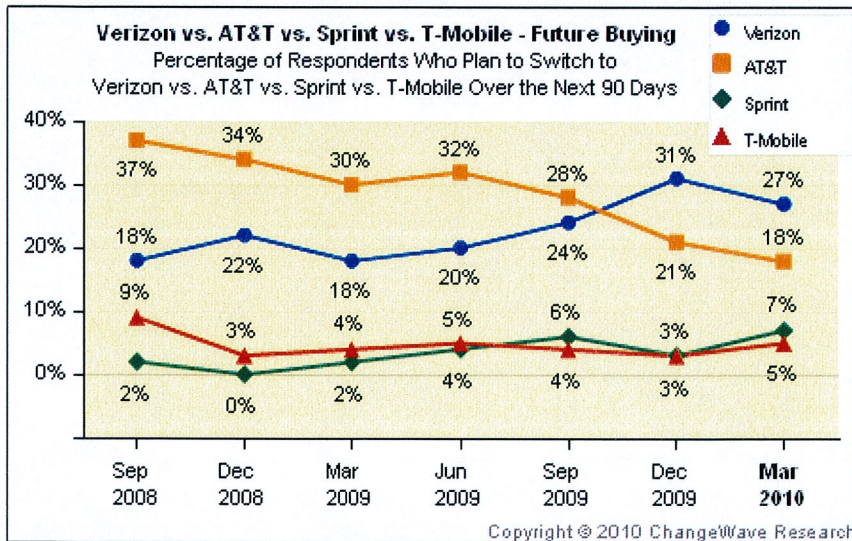Customers Who Say They are Very/Somewhat Likely to
Switch Cellular Service Providers in the Next 90 Days

Company	Value
Verizon	7%
AT&T	8%
Sprint	10%
T-Mobile	14%

AT&T's low churn rate – despite its relatively poor *Very Satisfied* rating and its high percentage of dropped calls – is attributable to the huge advantage it continues to maintain as the exclusive U.S. service provider for the Apple iPhone.

Which Provider Gains Most From Customer Switching?

Thanks largely to a huge influx of Motorola Droid buyers, Verizon showed a leap in new customers in our previous survey. In the current survey, the percentage of customers who say they'll switch to Verizon has settled back a bit – dipping 4-pts to 27%. Nonetheless they still hold a sizable lead over their top competitor – AT&T (18%) – which is 3-pts lower than last quarter and a full 14-pts lower than 9 months ago.

Verizon vs. AT&T vs. Sprint vs. T-Mobile - Future Buying
Percentage of Respondents Who Plan to Switch to
Verizon vs. AT&T vs. Sprint vs. T-Mobile Over the Next 90 Days

Legend: Verizon, AT&T, Sprint, T-Mobile

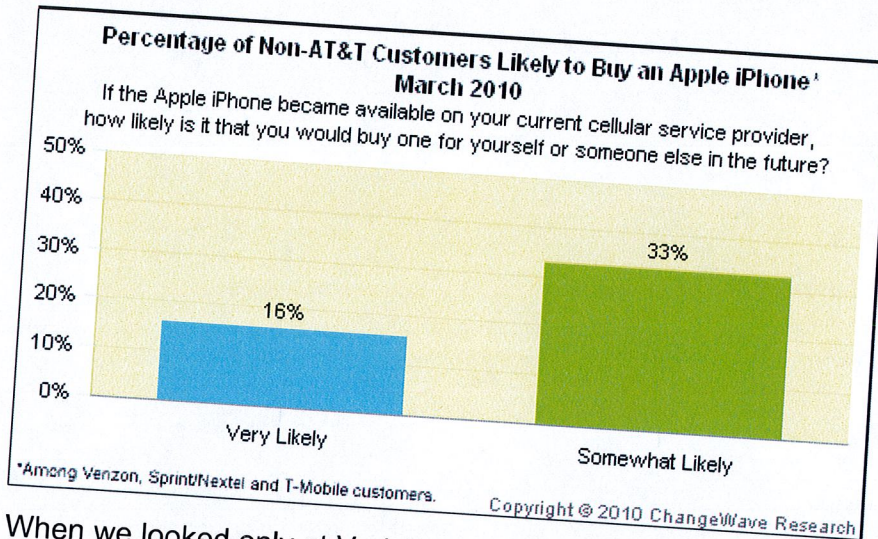|	Sep 2008	Dec 2008	Mar 2009	Jun 2009	Sep 2009	Dec 2009	Mar 2010
AT&T	37%	34%	30%	32%	28%	21%	18%
Verizon	18%	22%	18%	20%	24%	31%	27%
T-Mobile	9%	3%	4%	5%	6%	3%	7%
Sprint	2%	0%	2%	4%	4%	3%	5%

We note that Sprint/Nextel (7%; up 4-pts) is experiencing an uptick in terms of future share, which could be due to their new 4G wireless offer combined with some of the lowest price plans in the industry. It remains to be seen, however, whether Sprint's latest rise will have staying power.
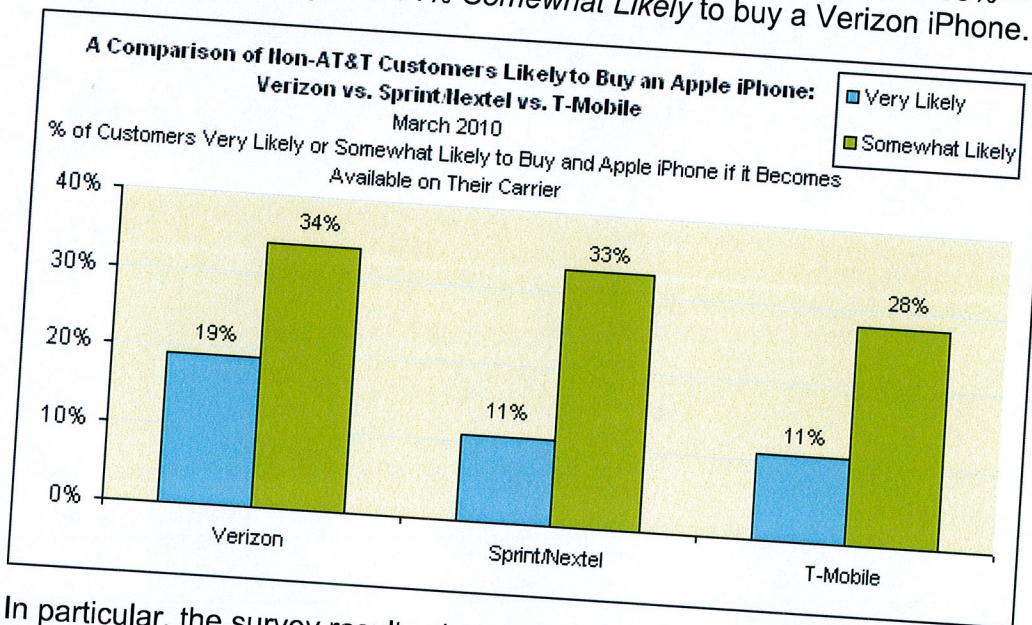
Potential Impact of a Verizon iPhone

The current survey was conducted before the latest Verizon iPhone rumors kicked up again. But one of the most interesting findings involves how likely non-AT&T customers would be to buy an Apple iPhone if it becomes available on their current provider:

Among Verizon, Sprint/Nextel and T-Mobile subscribers, an astonishing 49% say they're *Very* or *Somewhat Likely* to buy an iPhone for themselves or someone else if it becomes available on their carrier.

Percentage of Non-AT&T Customers Likely to Buy an Apple iPhone*
March 2010
If the Apple iPhone became available on your current cellular service provider, how likely is it that you would buy one for yourself or someone else in the future?

*Among Verizon, Sprint/Nextel and T-Mobile customers.
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When we looked only at Verizon subscribers, that number rises to 53% – with 19% saying they'd be *Very Likely* and 34% *Somewhat Likely* to buy a Verizon iPhone.

A Comparison of Non-AT&T Customers Likely to Buy an Apple iPhone: Verizon vs. Sprint/Nextel vs. T-Mobile
March 2010
% of Customers Very Likely or Somewhat Likely to Buy and Apple iPhone if it Becomes Available on Their Carrier

■ Very Likely
■ Somewhat Likely

In particular, the survey results show an unprecedented level of pent up demand for the iPhone among Verizon subscribers. If Verizon were ever to offer the iPhone, the evidence points to it having a profound and likely transformational impact on the industry.

In comparison, 11% of Sprint/Nextel customers say they're *Very Likely* and 33% *Somewhat Likely* to buy an iPhone if it becomes available. Among T-Mobile customers, 11% say they're *Very Likely* and 28% *Somewhat Likely*.

Bottom Line: Overall, the wireless service provider market appears quite stable.

Verizon remains the leader in customer satisfaction and loyalty, and its customers report the lowest number of dropped calls. It also appears positioned to pick-up future market share.

While AT&T is clearly struggling in these same areas, it holds the biggest trump card in the industry – the Apple iPhone. But AT&T's greatest strength may yet prove transitory. As the possibility of a Verizon iPhone grows, so does the potential for a huge new wave of demand that would alter the playing field between the top two industry leaders.

We'll take another look at the potential impact of a Verizon iPhone in an upcoming ChangeWave smart phone survey.

Summary of Key Findings

The Battle Between Industry Leaders	Customer Loyalty	Is the iPhone a Trump Card for the Industry?
Percentage of Customers Who Are Very Satisfied with their Service Provider • Verizon (49%) • Sprint/Nextel (35%) • T-Mobile (23%) • AT&T (23%) **Percentage of Dropped Calls Reported by Customers** • Verizon (1.5%) • Sprint/Nextel (2.4%) • T-Mobile (2.8%) • AT&T (4.5%)	**Likelihood of Switching:** • Verizon (7%) • AT&T (8%) • Sprint/Nextel (10%) • T-Mobile (14%) **Future Share – Next 90 Days:** • Verizon (27%) • AT&T (18%) • Sprint/Nextel (7%) • T-Mobile (5%)	**Percentage of Non-AT&T customers likely to buy an iPhone if it becomes available on their current provider** • Verizon Customers -- 19% Very Likely -- 34% Somewhat Likely • Sprint Customers -- 11% Very Likely -- 33% Somewhat Likely • T-Mobile Customers -- 11% Very Likely -- 28% Somewhat Likely

The ChangeWave Research Network is a group of 25,000 highly qualified business, technology, and medical professionals – as well as early adopter consumers – who work in leading companies of select industries. They are credentialed professionals who spend their everyday lives on the frontline of technological change. ChangeWave surveys its Network members weekly on a range of business and consumer topics, and converts the information into a series of proprietary quantitative and qualitative reports.

ChangeWave Research

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The Findings

Introduction: During March ChangeWave surveyed 4,040 consumers on their attitudes towards the wireless service provider industry – including trends in customer satisfaction and loyalty, future market share demand, and the issue of dropped calls.

The survey – conducted immediately before the latest Verizon iPhone rumors – also took a close-up look at the potential industry impact if Verizon were to offer the Apple iPhone.

Customer Satisfaction

As in previous ChangeWave surveys, Verizon remains the clear industry leader in customer satisfaction – with nearly half of Verizon's customers (49%) saying they are *Very Satisfied* with their cellular service.

How satisfied are you with your current cellular service provider?

Current Survey (March 2010) – Satisfaction Breakout by Service Provider

	Total	Verizon	Sprint/ Nextel	T-Mobile	AT&T	Rogers/ Fido
Very Satisfied	33%	49%	35%	23%	23%	28%
Somewhat Satisfied	52%	44%	52%	62%	55%	52%
Somewhat Unsatisfied	11%	5%	10%	13%	17%	17%
Very Unsatisfied	3%	1%	2%	2%	5%	3%
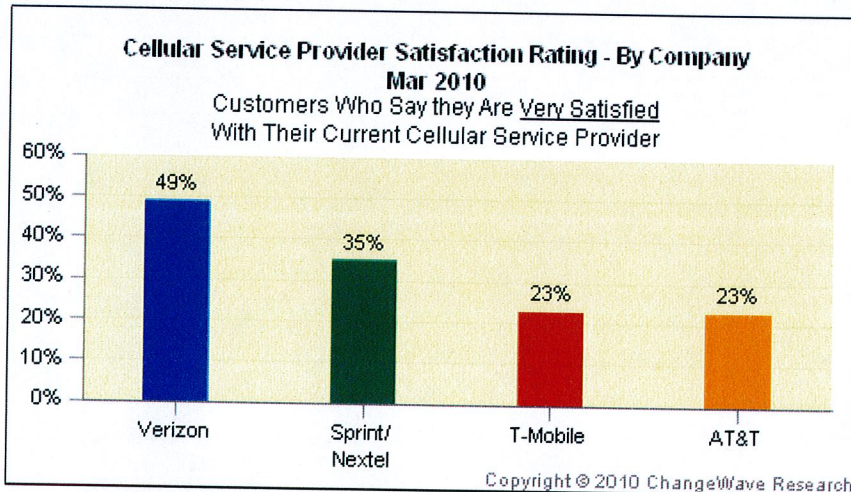
We note that Sprint/Nextel (35%) is now second in terms of customer satisfaction, with T-Mobile (23%) and AT&T (23%) lagging well behind.

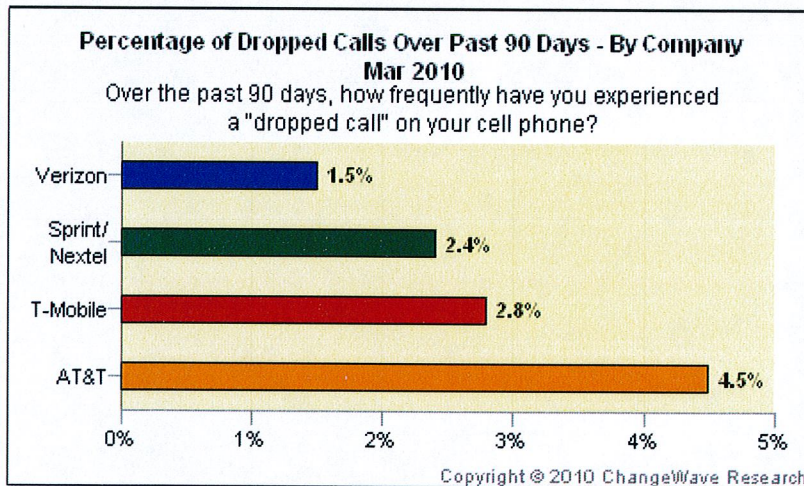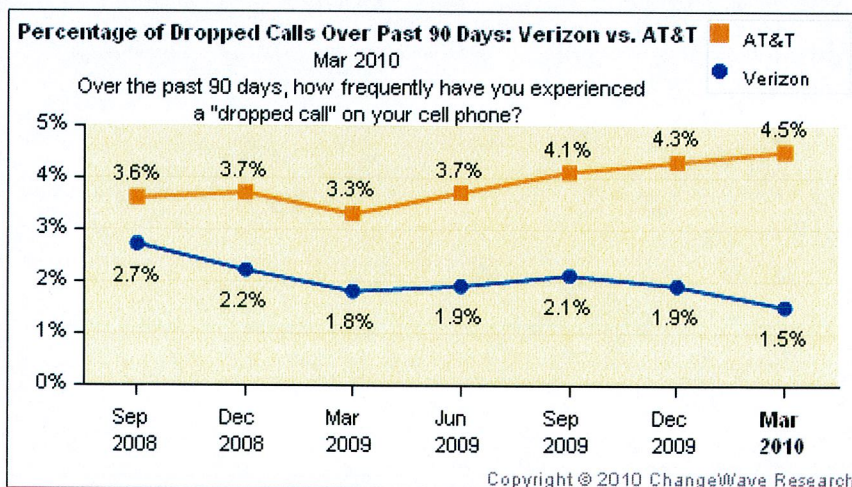**Dropped Calls.** Verizon also ranks best in terms of number of dropped calls, with Verizon customers reporting only 1.5% of their calls being dropped over the past 3 months. This compares to 2.4% for Sprint/Nextel, 2.8% for T-Mobile and 4.5% for AT&T customers.

Over the past 90 days, how frequently have you experienced a "dropped call" on your cell phone?

	Current Survey Mar '10	Previous Survey Dec '09	Previous Survey Sep '09	Previous Survey Jun '09	Previous Survey Mar '09	Previous Survey Dec '08	Previous Survey Sep '08
Total	**2.8%**	**3.2%**	**2.7%**	**2.8%**	**2.5%**	**2.6%**	**3.1%**
Verizon	1.5%	1.9%	2.1%	1.9%	1.8%	2.2%	2.7%
Sprint/Nextel	2.4%	3.1%	3.3%	3.9%	2.9%	3.4%	4.4%
T-Mobile	2.8%	3.9%	2.9%	4.1%	5.8%	4.0%	4.5%
AT&T	4.5%	4.3%	4.1%	3.7%	3.3%	3.7%	3.6%

Percentage of Dropped Calls Over Past 90 Days - By Company
Mar 2010
Over the past 90 days, how frequently have you experienced
a "dropped call" on your cell phone?

- Verizon — 1.5%
- Sprint/Nextel — 2.4%
- T-Mobile — 2.8%
- AT&T — 4.5%

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Importantly, while Verizon has its all-time best dropped call rating in the current ChangeWave survey, AT&T has just reached its all time worst rating on this all important measure.

Percentage of Dropped Calls Over Past 90 Days: Verizon vs. AT&T
■ AT&T   ● Verizon
Mar 2010
Over the past 90 days, how frequently have you experienced
a "dropped call" on your cell phone?

AT&T: 3.6% (Sep 2008), 3.7% (Dec 2008), 3.3% (Mar 2009), 3.7% (Jun 2009), 4.1% (Sep 2009), 4.3% (Dec 2009), 4.5% (Mar 2010)

Verizon: 2.7% (Sep 2008), 2.2% (Dec 2008), 1.8% (Mar 2009), 1.9% (Jun 2009), 2.1% (Sep 2009), 1.9% (Dec 2009), 1.5% (Mar 2010)

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Here's another look at a breakout of respondents in terms of dropped calls over the past 90 days.

	Total	Verizon	AT&T	Sprint/Nextel	T-Mobile
Never	23%	26%	14%	22%	26%
Less Than 1% of Calls	30%	35%	25%	33%	29%
1% to 5% of Calls	33%	30%	38%	30%	32%
6% to 10% of Calls	2%	0%	3%	3%	2%
More Than 10% of Calls	10%	4%	18%	8%	8%

Customer Loyalty

To measure subscriber churn rates, we asked respondents how likely they are to switch wireless providers over the next 90 days. Only 8% say they plan to make a change – matching the lowest level recorded in a ChangeWave survey.
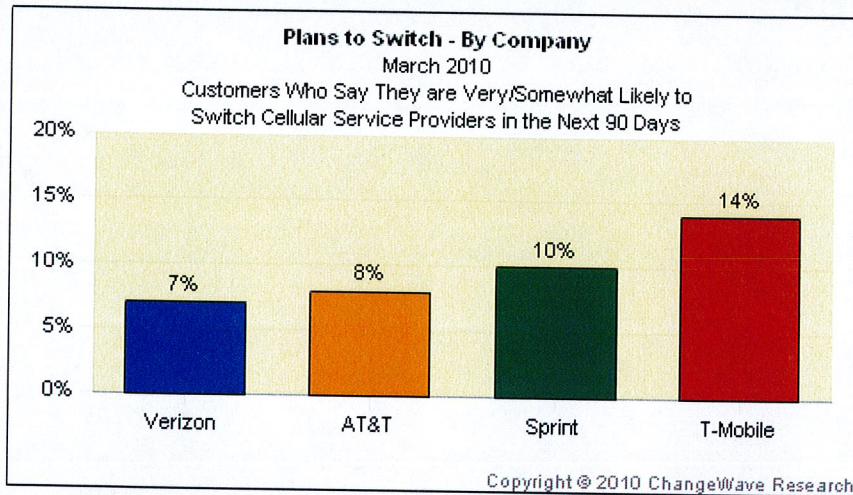
At the provider level, 7% of Verizon's customers and 8% of AT&T's say they'll switch. Sprint/Nextel (10%) and T-Mobile (14%) lag behind the two industry leaders.

How likely is it that you will change cellular service providers within the next 90 days?

	Current Survey Mar '10	Previous Survey Dec '09	Previous Survey Sep '09	Previous Survey Jun '09	Previous Survey Mar '09	Previous Survey Dec '08	Previous Survey Sep '08
Very Likely	3%	4%	3%	4%	3%	3%	4%
Somewhat Likely	5%	5%	5%	6%	5%	5%	7%
Unlikely	86%	86%	87%	86%	88%	87%	83%
Don't Know	3%	3%	3%	3%	2%	3%	3%
Not Applicable	2%	2%	2%	1%	2%	2%	2%

Breakdown of Respondents by Provider

	Total	Verizon	AT&T	Sprint/Nextel	T-Mobile	Rogers/Fido
Very/Somewhat Likely	8%	7%	8%	10%	14%	9%
Unlikely	86%	88%	88%	86%	81%	85%

Plans to Switch - By Company
March 2010
Customers Who Say They are Very/Somewhat Likely to
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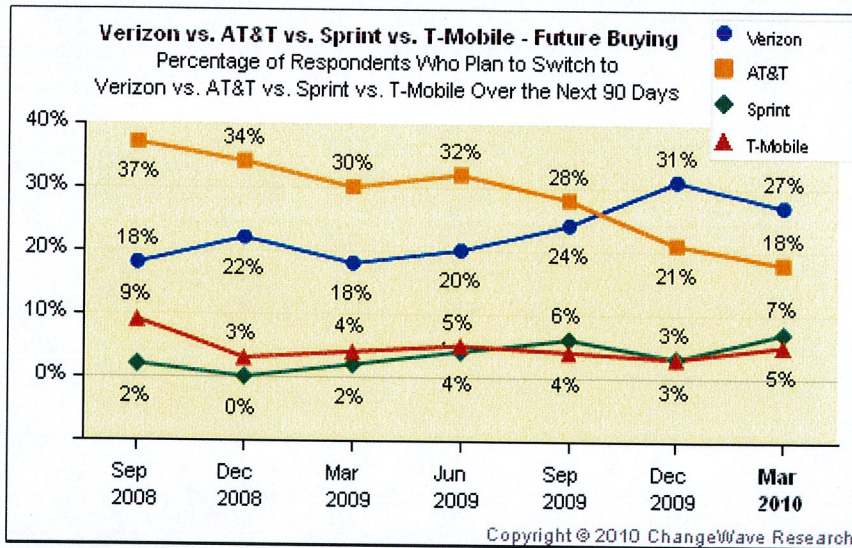## Which Provider Gains Most From Customer Switching?

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For those of you who are likely to change cellular service providers, which company are you most likely to switch to?

	Current Survey Mar '10	Previous Survey Dec '09	Previous Survey Sep '09	Previous Survey Jun '09	Previous Survey Mar '09	Previous Survey Dec '08	Previous Survey Sep '08
Verizon (incl. Alltel)	27%	31%	24%	20%	18%	22%	18%
AT&T	18%	21%	28%	32%	30%	34%	37%
Sprint/Nextel	7%	3%	6%	4%	2%	0%	2%
T-Mobile	5%	3%	4%	5%	4%	3%	9%
Rogers/Fido	2%	1%	2%	4%	4%	2%	2%
Don't Know/ NA/Other	39%	41%	35%	35%	40%	40%	30%

Here's another look at future market share trends for Verizon, AT&T, Sprint/Nextel and T-Mobile:
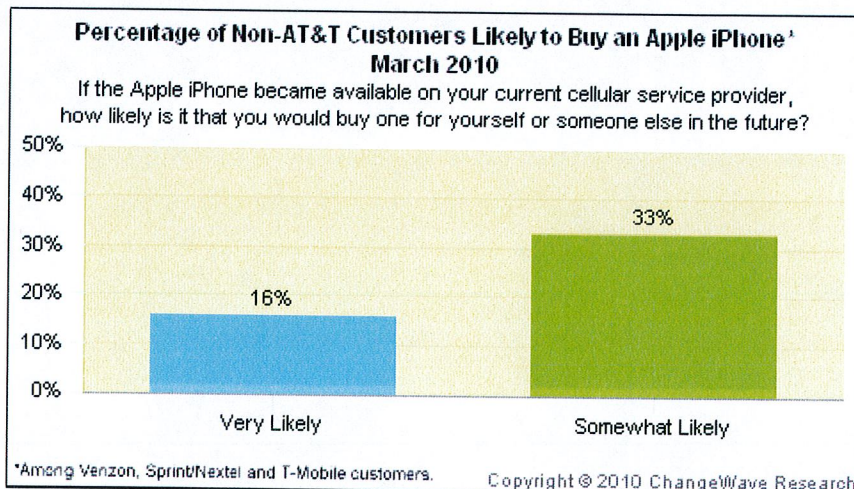

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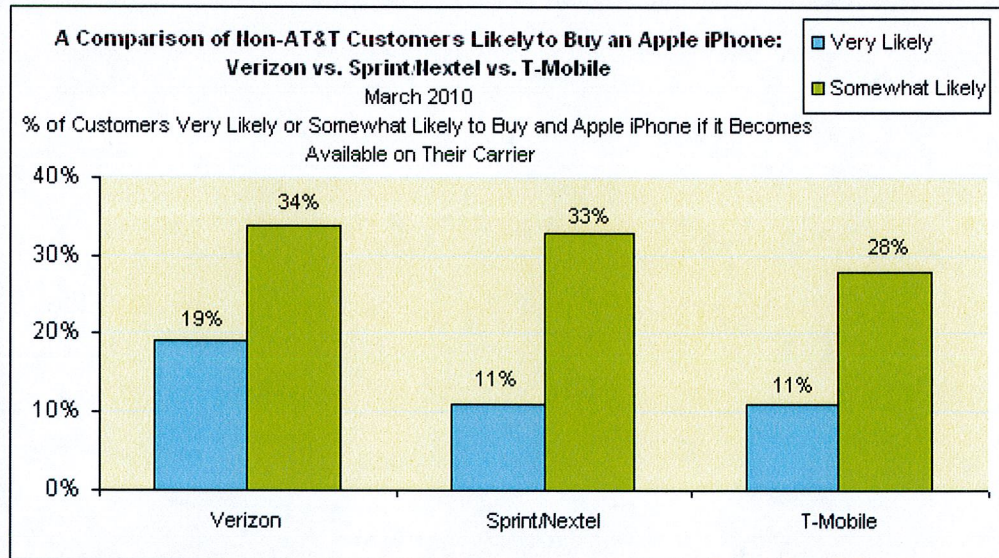
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Among Verizon, Sprint/Nextel and T-Mobile subscribers, an astonishing 49% say they're *Very* or *Somewhat Likely* to buy an iPhone for themselves or someone else if it becomes available on their carrier.

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A Comparison of Non-AT&T Customers Likely to Buy an Apple iPhone:
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% of Customers Very Likely or Somewhat Likely to Buy and Apple iPhone if it Becomes Available on Their Carrier

In particular, the survey results show an unprecedented level of pent up demand for the iPhone among Verizon subscribers. If Verizon were ever to offer the iPhone, the evidence points to it having a profound and likely transformational impact on the industry.

In comparison, 11% of Sprint/Nextel customers say they're *Very Likely* and 33% *Somewhat Likely* to buy an iPhone if it becomes available. Among T-Mobile customers, 11% say they're *Very Likely* and 28% *Somewhat Likely*.

To better understand those who are not interested in buying an iPhone even if it became available on their service provider, we asked:

***And for those who would not consider** buying an Apple iPhone even if it were available on your current cellular service provider, what's the most important reason **why not**?*

	Current Survey Mar '10	Previous Survey Dec '09
No Need - Current Cell Phone is Sufficient	56%	55%
Monthly Service Fees are Too Expensive	14%	14%
Cost of iPhone is Too High	8%	10%
Don't Like iPhone Features, Appearance and/or Touch Screen Interface	5%	4%
Corporate Policy Restrictions	4%	4%
Because of Current Economic Conditions	1%	1%
Other	9%	7%
No Answer	2%	4%

More than half (56%) say their current cell phone is sufficient, while another 14% say the monthly service fees are too expensive.

Current Market Share

In terms of current market share, AT&T (33%; down 1-pt) is edging out Verizon (32%; unchanged) for the top spot among the major wireless service providers.

Who is your cellular service provider?

	Current Survey Mar '10	Previous Survey Dec '09	Previous Survey Sep '09	Previous Survey Jun '09	Previous Survey Mar '09	Previous Survey Dec '08	Previous Survey Sep '08
AT&T	33%	34%	33%	31%	31%	31%	30%
Verizon (incl. Alltel)	32%	32%	32%	31%	30%	30%	29%
Sprint/Nextel	9%	9%	9%	10%	10%	10%	11%
T-Mobile	8%	8%	9%	10%	9%	10%	10%
Rogers/Fido	3%	3%	3%	3%	3%	3%	3%
Other/NA	13%	13%	14%	15%	16%	15%	17%

Extra Services Offered By Providers

Many cellular service providers offer additional services for an extra charge. Which of the following extra services - if any - do you currently <u>pay for</u>? (Check All That Apply)

And over the next 90 days, which of the following extra services - if any - do you think you'll subscribe to <u>for the first time</u>? (Check All That Apply)

	Currently Pay For	Will Subscribe for First Time – Next 90 Days
Text Messaging Plan	42%	4%
Data Plan/Internet Access	38%	7%
Email	16%	4%
GPS Navigation	6%	5%
Music/MP3's	3%	1%
Ringtones/ Ringback Tones	3%	1%
Downloaded Games	3%	0%
Streaming Data (e.g., Sports Scores, Stock Tickers)	2%	2%
Streaming Video (e.g., V-Cast, Mobile TV)	2%	1%
Other Location-Based GPS Services	1%	1%
Wallpaper	1%	0%
Other	3%	4%

Corporate Market: Wireless Service Providers

ChangeWave also conducts business spending surveys, and during February 2010 we took a look at Corporate Wireless Service providers. A total of 880 respondents involved with IT spending in their organization participated.

Who is your company's cellular service provider?

	Current Survey Feb '10	Current Survey May '08	Current Survey Aug '07	Previous Survey May '07
AT&T	33%	32%	25%	23%
Verizon (incl. Alltel)	33%	32%	33%	32%
Sprint/Nextel	10%	12%	12%	13%
T-Mobile	5%	5%	7%	9%
Rogers/Fido	4%	2%	5%	4%
Other/NA	16%	14%	17%	17%

How satisfied is your company with its current cellular service provider?

	Total	Verizon	Sprint/ Nextel	AT&T
Very Satisfied	27%	45%	23%	15%
Somewhat Satisfied	55%	45%	54%	66%
Somewhat Unsatisfied	11%	6%	12%	14%
Very Unsatisfied	3%	1%	5%	4%
Don't Know	3%	3%	5%	1%
Not Applicable	1%	1%	0%	1%

How likely is it that your company will change its cellular service provider within the next 6 months?

	Total		Verizon	Sprint/ Nextel	AT&T
Very Likely	3%		3%	4%	4%
Somewhat Likely	9%		4%	9%	12%
Unlikely	79%		85%	75%	77%
Don't Know	8%		8%	12%	7%
Not Applicable	1%		0%	0%	1%

ChangeWave Research Methodology

This report presents the findings of a recent ChangeWave Research survey on Wireless Service Providers. The survey was conducted March 16-23, 2010, and a total of 4,040 members participated. Additional findings on the Corporate Wireless Service Providers market are the result of a February 9-23 survey of 880 respondents involved with IT spending in their company.

ChangeWave's proprietary research and business intelligence gathering system is based upon the systematic gathering of valuable business and investment information directly over the Internet from accredited members.

The Research Network is assembled from senior technology and business executives in leading companies of select industries. More than half of members (53%) have advanced degrees (e.g., Master's or Ph.D.) and 91% have at least a four-year bachelor's degree.

The business and investment intelligence provided by ChangeWave provides a real-time view of companies, technologies and business trends in key market sectors, along with an in-depth perspective of the macro economy – well in advance of other available sources.

About ChangeWave Research

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