US STATE CONNECTIVITY
P3 REPORT FOR CELLULAR NETWORK COVERAGE IN INDIVIDUAL US STATES

DIFFERENT GRADES OF COVERAGE
When your mobile phone indicates it has an active signal, it is connected with the most expensive part of your carrier’s infrastructure - the radio access network with thousands of base stations providing coverage to, ideally, every place you go and want to use your connected devices. Currently you see a compilation of so-called 2G technologies like CDMA or GSM up to LTE technology that we also call 4G. On top of that, what technology you are actually served with may depend on the kind of service you are using. While Verizon, AT&T and T-Mobile have rolled out voice call capability throughout their LTE networks long ago, Sprint has announced an upgrade to their 4G network in the near future. Sprint currently handles voice calls with the 1X CDMA part of their network. The coverage you experience does not only depend on where you are and which carrier you have chosen but also on the type of device you use and whether you are on a phone call or using cellular network data.

The comparison of network coverage consequently requires a detailed consideration of multiple factors. In order to compare the mobile networks, we have to look at two properties that characterize the coverage. First at the availability of a technology, i.e. when a specific technology provides service to an area. Second at the share of users actually connected to this technology within that area.
MOBILE DATA SERVICES COVERAGE – THE EAST-WEST DIVIDE

CARRIERS USE 3G AND 4G TECHNOLOGIES TO DELIVER HIGH SPEED DATA SERVICES. 2G NETWORKS ARE EFFECTIVELY NOT CAPABLE OF SUPPORTING DATA CONNECTIONS WITH SUFFICIENT SPEED. VERIZON HAS ALREADY ABANDONED 3G AND PROVIDES ALL DATA SERVICES OVER 4G.

Looking at the coverage for data services, a clear East-West divide becomes apparent. In many of the eastern states, Verizon and AT&T compete head-to-head, though Verizon has a slight advantage. The Western part of the country is clearly dominated by Verizon. In the East the degree of coverage is significantly higher compared to the West. In most Western states, there is at least one carrier that provides data coverage nearly everywhere consumers roam in these states. Averaged over the whole US test area, there is no clear winner of the data coverage benchmark. However, when looking at each state separately it shows that Verizon wins the benchmark in more individual states.

AT&T is the strongest in Texas, Missouri, Illinois, West Virginia and Nevada. Verizon outperforms AT&T especially in Washington, Montana, Wyoming, Arizona and Vermont.

In the remaining states, Verizon provides slightly better data coverage or is at least on par with AT&T. Sprint and T-Mobile can just watch the two giants competing for data coverage - except for the District of Columbia where all four carriers provide about the same full data coverage.
LTE COVERAGE

LTE is the fastest and most widespread option for the provisioning of mobile data services until 5G becomes available. The LTE map shows a clear dominance by Verizon. West Virginia is the only state where AT&T has a larger LTE footprint than Verizon. In several states, AT&T and Verizon are on par: Illinois, Mississippi, New Mexico, Oklahoma, and Texas. In the rest of the United States, it is clear that Verizon has the lead in LTE coverage. AT&T consumers are much less likely to experience fast LTE speeds than Verizon customers. T-Mobile users are more likely to experience LTE than AT&T users despite of the fact that AT&T has a significantly larger LTE footprint than T-Mobile. AT&T still makes significant use of its 3G layer.

“Verizon clearly has the largest LTE footprint.”
The percentage of LTE covered test area is shown in the upper part. Below, the area-weighted percentage of users actually connected to LTE is shown. Despite the large LTE footprint, AT&T customers are much less likely to experience fast LTE speeds than Verizon customers. T-Mobile users are more likely to experience fast LTE speeds than AT&T users.

<table>
<thead>
<tr>
<th>Network</th>
<th>AT&amp;T</th>
<th>Sprint</th>
<th>T-Mobile</th>
<th>Verizon</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTE coverage (whole US)</td>
<td>96.5</td>
<td>87.0</td>
<td>92.5</td>
<td>98.3</td>
</tr>
<tr>
<td>Portion of test area covered with LTE</td>
<td>87.5</td>
<td>85.0</td>
<td>88.4</td>
<td>96.2</td>
</tr>
<tr>
<td>Share of users in P3 panel connected to 4G in the test area</td>
<td>87.5</td>
<td>85.0</td>
<td>88.4</td>
<td>96.2</td>
</tr>
</tbody>
</table>

To compare each carrier’s coverage, we look at the combined 3G and 4G footprint. We evaluate both the pure network availability and the share of our users connected to a technology in a defined area. Both parameters are combined into one single value.

“Verizon customers have a better LTE experience than customers of any other network.”
VERIZON has the strongest voice coverage in nearly all states.

CELLULAR VOICE COVERAGE

T-Mobile and AT&T use a combination of 3G and 4G technologies to deliver voice services. Sprint announced it was launching Voice-over-LTE (VoLTE) in late 2018 but currently carries the voice traffic on its 1X CDMA network. Verizon has converted into an LTE-only network and provides all voice and data services over the same network. It is worth mentioning that the four big US carriers also have adopted WiFi calling which is especially useful when connected to WiFi in areas with weak carrier coverage. However, this technology currently does not support mobility and is not taken into account in our analysis.

Looking at the coverage for voice services, there are similarities to the data coverage. A clear East-West divide indicates that there is still a lot of room for improvement in the middle of the Unites States. At the same time, Verizon dominates the voice coverage benchmark by far. As Sprint announced the launch of VoLTE in the near future, we also looked at the potential of that technology for Sprint. Sprint’s LTE coverage already shows the potential to catch up with the competition in many states like Connecticut, Delaware, District of Columbia, Florida, Illinois, Indiana, Iowa, Missouri, New Jersey and Wisconsin. In West Virginia, Sprint could win the voice coverage contest if it had VoLTE enabled today.

Coverage for Voice Services

The graphics shows the best network with respect to fulfilling/meeting the P3 coverage requirements for voice services. The numbers indicate the degree of fulfillment of the coverage targets. Grey indicates that at least two carriers are on par providing about the same coverage for voice services with respect to the P3 coverage requirements. The analysis was completed estimating Sprint’s coverage of VoLTE.
Consumers are more likely to get LTE on T-Mobile than on AT&T.

SUMMARY

OUR COVERAGE BENCHMARK COMPARING THE FOUR LARGEST CARRIERS SHOWS THAT VERIZON DOMINATES IN ALL DISCIPLINES IN MOST STATES. IN A FEW STATES WE SEE A COMPETITION BETWEEN VERIZON AND AT&T. SPRINT AND T-MOBILE CAN JUST WATCH THE TWO GIANTS COMPETING FOR COVERAGE.

Verizon and AT&T compete for data service coverage head-to-head in many of the Eastern states while the Western part of the country is dominated by Verizon. Overall, Verizon wins the benchmark in more individual states. Moreover, Verizon’s lead in data coverage goes along with an outstanding LTE footprint. Consequently, Verizon customers are much more likely to have a better LTE experience than customers of any other network. Similar to data service coverage, there is a clear East-West divide with regards to voice coverage. While there is decent availability of mobile voice services in the East, there is still a lot of room for improvement in the middle and western parts of the United States. Verizon also has the strongest voice coverage in nearly all of the United States.
METHODOLOGY

WITH MORE THAN 15 YEARS OF EXPERIENCE IN BENCHMARKING MOBILE NETWORKS ALL OVER THE WORLD, P3 AGGREGATES DATA INTO MEANINGFUL METRICS, PROVIDING A BALANCED AND INDEPENDANT PICTURE OF THE COMPETITIVE SITUATION ACROSS DIFFERENT MARKETS.

The P3 solution is integrated into 800+ very diverse Android apps and collects data passively in the background. If one of the applications is installed on the end-user’s phone, the data collection takes place continuously - 24/7/365 - on this device. Other data solutions from other sources have a very technical user base. Thus, their results are typically skewed towards high-end and high volume data users. With the integration into diverse apps covering different market segments, the dataset used is much more representative and tamper-proof than data from classical speed test apps. The unique user base and dataset allows P3 to collect data about real-world customer experience – wherever and whenever customers use their phones.

IMPOSSIBLE TO MANIPULATE

In the US, about 2.3 million consumers contribute to P3’s dataset. This equals about one out of every 140 inhabitants in the United States. This is one of the biggest mobile experience databases in the world, adding billions of measurements every month. The dataset is the most realistic and diverse that is currently available in the market in terms of locations, geography, devices, subscriptions, networks, technologies and smartphone usage patterns. And, just like in blockchain, P3 has designed their technology with a complex security layer that makes it impossible to manipulate the data. P3 applies advanced data analytics to find the relevant information from the bulk data, transferring it to the P3 Big Data Platform. Automated aggregation with P3 developed software provides us flexibility and control. P3 has gained extensive experience in collecting, storing and analyzing large data sets. P3 can provide information for the optimization of networks and show whether networks live up to consumers’ expectations. P3 data scientists can drill down into large data sets and analyze them on a global scale. The information gathered and processed by P3 can be purchased by interested parties in an anonymized format. This can provide valuable insights for network improvements.

“Sprint about to catch-up when launching VoLTE.”
REPORT FACTS

- **39,359,819,776** samples
- **2,313,376** users
- **3 months, April to June 2018** data collection time period

**Test Area**
- **equals 6 times the 'build-up area'** *

**96% of the US 'build-up area'** *

*build-up area refers to the area where at least 50% of a 1km × 1km area contains man-made structures.*
EVALUATING COVERAGE

In our analysis, coverage is always considered with respect to the area where the particular properties of network coverage could be observed. The statistics are based on small area segments, called tiles, of 550×550 yards. This way, metrics like the percentage of area where LTE is available can be derived from the measurement data. The comparison of the four networks is executed on the common footprint of users in the P3 dataset, in areas where the data shows that users of all four carriers under investigation have stayed during the 3 months of the observation period. Availability is determined by the fact that the P3 crowd data shows that devices receive a signal from their network. As described above, carriers may serve the same area with different technologies in parallel leading to the fact that different consumers at the same location might be served by different technologies (2G/3G/4G). As a result, the pure availability does not show the true picture of coverage for a particular location. Therefore, we also look at the share of users that are actually connected to a particular technology at a particular location.

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