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1 Coverage Objectives

The First Responder Network Authority (FirstNet) created a coverage objective map to identify areas where public safety desires persistent coverage and temporary coverage solutions. The map (Figure 1 Coverage Objective Map) includes input from individual states, territories, and tribal nations, when available.

The coverage objective map depicts a one-square-mile grid block for each of the 56 states and territories. The coverage objective map, which covers each of the 56 states and territories, is included within Section J, Attachment J-1 as a shapefile (file titled “Coverage_Objectives_Map_v1.0_AMEND 003.mpk”).

The coverage objective map reflects coverage objectives based on data from the following four categories:

- **FirstNet Baseline** – Original coverage objective map developed by FirstNet, further described in Section 3, Coverage Objective Map Methodology.
- **State Inputs** – Areas of interest identified by states, territories, and tribal nations that were not addressed in FirstNet’s baseline.
- **Federal Inputs** – Areas of interest from federal entities, not identified by the FirstNet baseline or state inputs.
- **On-Demand Temporary** – Areas where there are rare occurrences for the need of coverage.

The FirstNet baseline, as modified by state and federal inputs, indicates areas where persistent coverage is desired. On-demand temporary solutions are adequate for the other areas identified.

The following values are stored as numbers in the attribute table as opposed to text strings for ease of data manipulation.

“State-Local” Attribute Column

- 0 – None (not identified in FirstNet baseline or in State Input)
- 1 – FirstNet Original Baseline
- 2 – State Input
- 3 – State Input LMR or Commercial Coverage

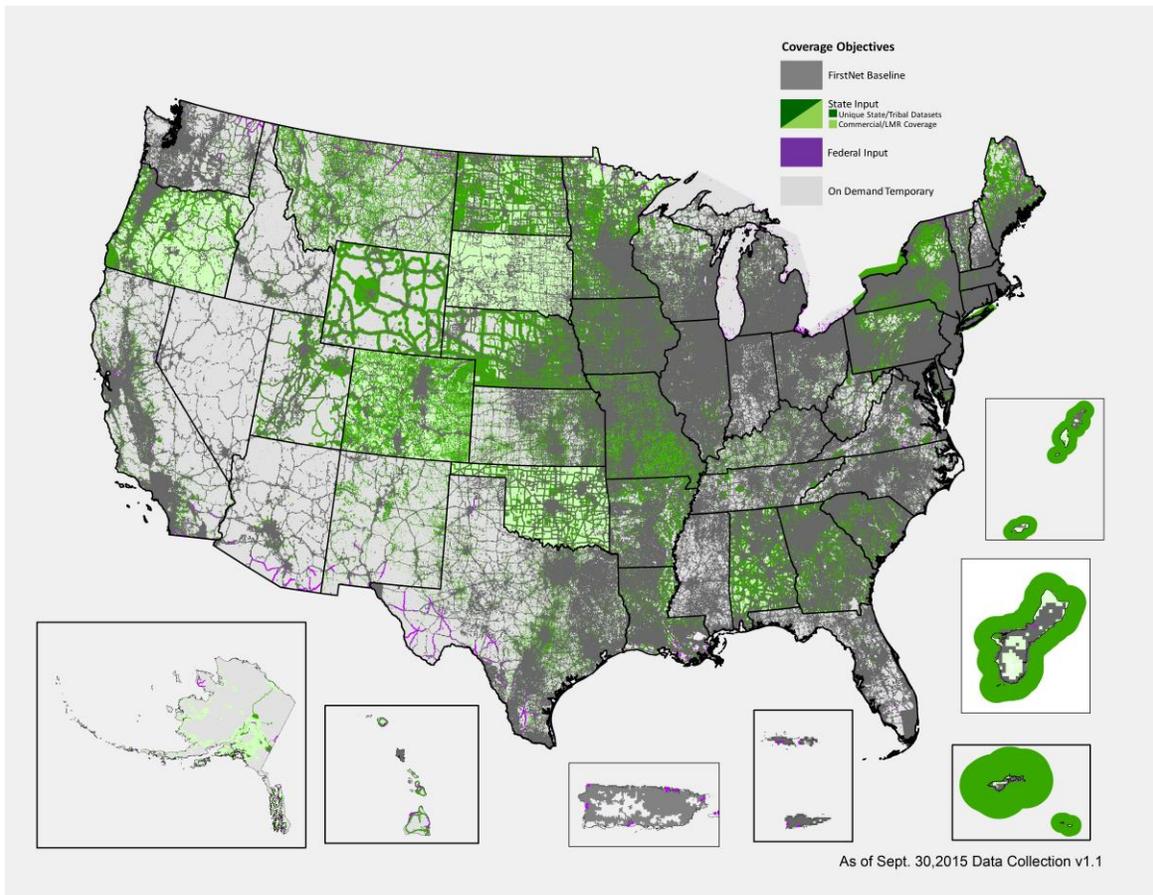


Figure 1 Coverage Objective Map

2 Coverage Definition

Coverage is defined as the geographic area where a base station and mobile device can reliably communicate with each other above a minimum designed data rate.

Persistent and temporary coverage is defined as a Long Term Evolution (LTE) Band 14 network capable of providing cell edge data rates of 256 kbps uplink (UL) and 768 kbps downlink (DL) measured from outdoor stationary User Equipment at three (3) feet from ground level with a 95 percent confidence margin for the cell area with a uniform cell load of 50 percent for the DL and UL. The link budget cell edge data rates (256 kbps UL/768 kbps DL) are primarily minimum design targets used to ensure overlap between cells is sufficient to maintain the minimum grade of service. Most user speeds will be significantly higher as user devices are likely distributed throughout a cell and speeds generally increase closer to the site as coverage increases (as depicted in Figure 2 Cell Edge Data Rate Design Targets). The Offeror should ensure that the peak/average network and user speeds are consistent with 3rd Generation Partnership Project (3GPP) standards for a 10x10 MHz LTE Frequency Division Duplex (FDD) channel and aligned with the 3GPP release feature set being deployed.

As part of the evaluation factors for award specified in Section M, each individual grid block will be assessed for meeting the definition of coverage. Only those grid blocks that have a reasonable amount of coverage will be considered acceptable. The Offeror should also maximize in-building coverage as

well as the amount of area and population covered that meets or exceeds the in-building link budget. The Offeror should use appropriate in-building penetration loss values for Band 14 and the various morphologies being considered.

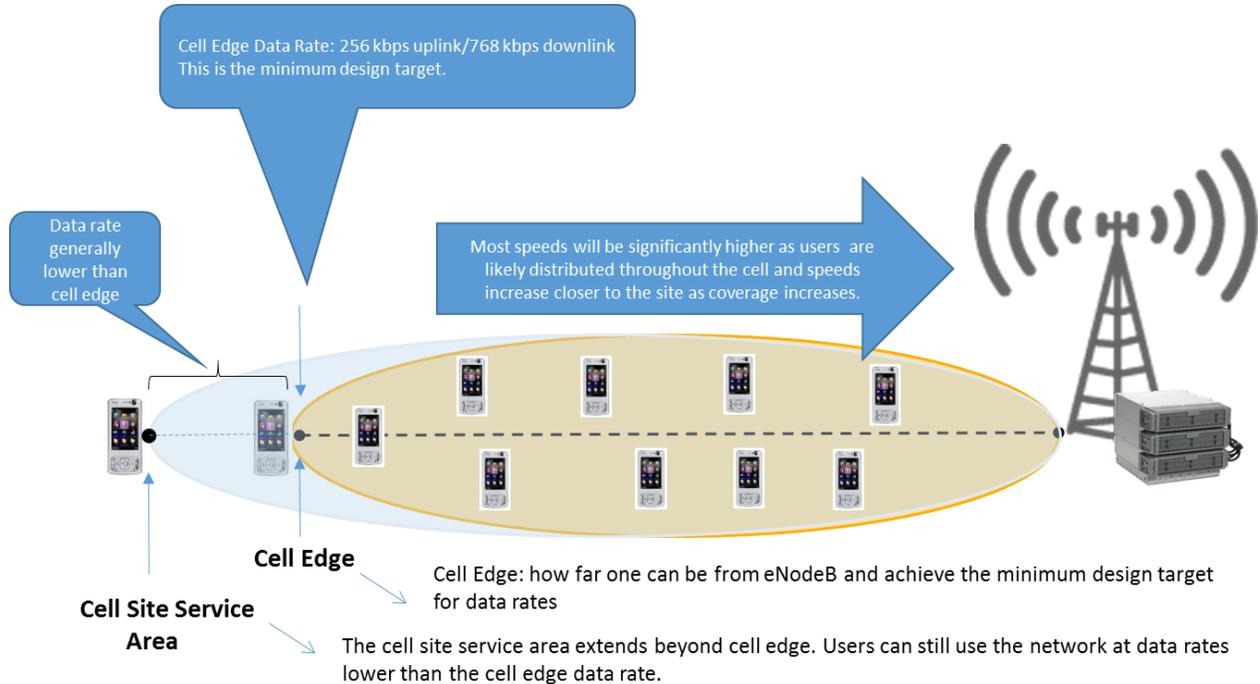


Figure 2 Cell Edge Data Rate Design Targets

3 Coverage Objective Map Methodology

The FirstNet baseline version of the coverage objective map was created from five distinct data sets and identifies areas that are likely to require a public safety response. This map was updated to incorporate state, territory, and tribal inputs, when available. FirstNet understands that a public safety response could be required anywhere. However, areas with a lower probability for a response would be identified as needing on-demand temporary or extended range coverage and capacity solutions.

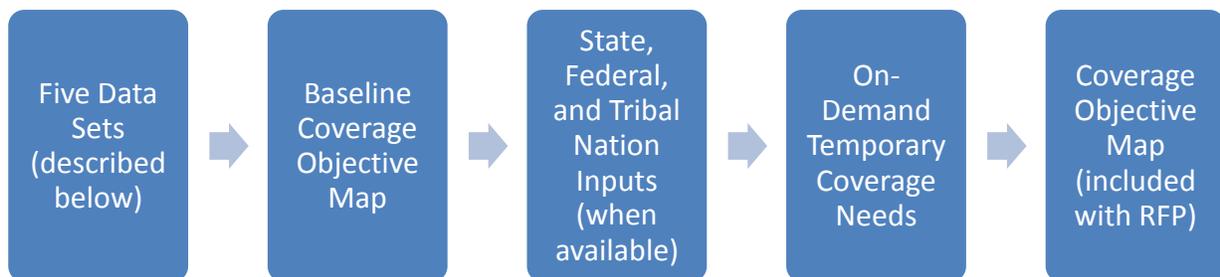


Figure 3 Baseline Coverage Objective Map Creation Methodology

The five data sets that were used to create the FirstNet baseline version of the coverage objective map are shown in Figure 4 Baseline Coverage Objective Map Data Sets. Each of the five data sets was combined into a single map and displayed in one-square-mile grid blocks.

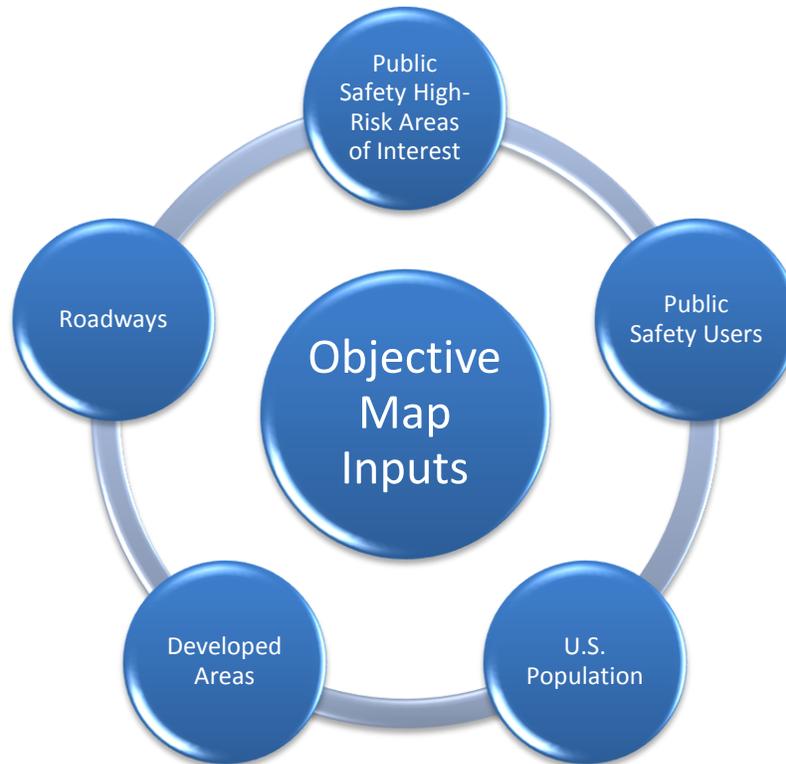


Figure 4 Baseline Coverage Objective Map Data Sets

3.1 Public Safety Users

This data set identifies the foundational user base for the network, which consists of law enforcement, fire, and emergency medical services users. The map distributes these users over their jurisdictional areas (i.e., city users are distributed throughout their respective cities, county users are distributed throughout their respective counties, and state users are distributed throughout their respective states).

3.2 Public Safety High-Risk Areas of Interest

This data set identifies key facilities, infrastructure, and locations that may be of particular interest to public safety users, such as public safety agencies, correctional facilities, airports, emergency operations centers, hospitals, schools, manufacturing facilities, energy plants, and large public venues.

3.3 U.S. Population

This data set identifies where people live using 2010 U.S. Census data.

3.4 Developed Areas

This data set helps determine response areas by identifying where people work as well as businesses and structures that may require response. The map includes areas classified as dense, medium, light, or open developed areas. This data can be found at http://www.mrlc.gov/nlcd11_data.php.

3.5 Roadways

This data set identifies commonly navigated roadways and significant secondary roadways using data from the National Highway System and annual average daily traffic counts.

4 Information for Coverage and Capacity Sub-Factor Evaluation

For the purpose of quantifying the coverage and capacity and rural coverage solutions specified in Section L, Instructions, Conditions, and Notices to Offerors or Respondents, the Offeror should use the following data sets.

4.1 Population Map

FirstNet is providing a population map that contains the U.S. 2010 Census population data on a one-square-mile grid map (see Figure 5 Population Map). The population map, which covers each of the 56 states and territories, is included within Section J, Attachment J-1 as a shapefile (file titled “2010_Pop_Map_v1.0.mpk”).

The Offeror shall provide population coverage maps in accordance with instructions in Section L, Instructions, Conditions, and Notices to Offerors or Respondents, Section L.3.2.1.1.2, Non-Band 14 Population Coverage, and Section L.3.2.1.1.4, Band 14 Population Coverage.

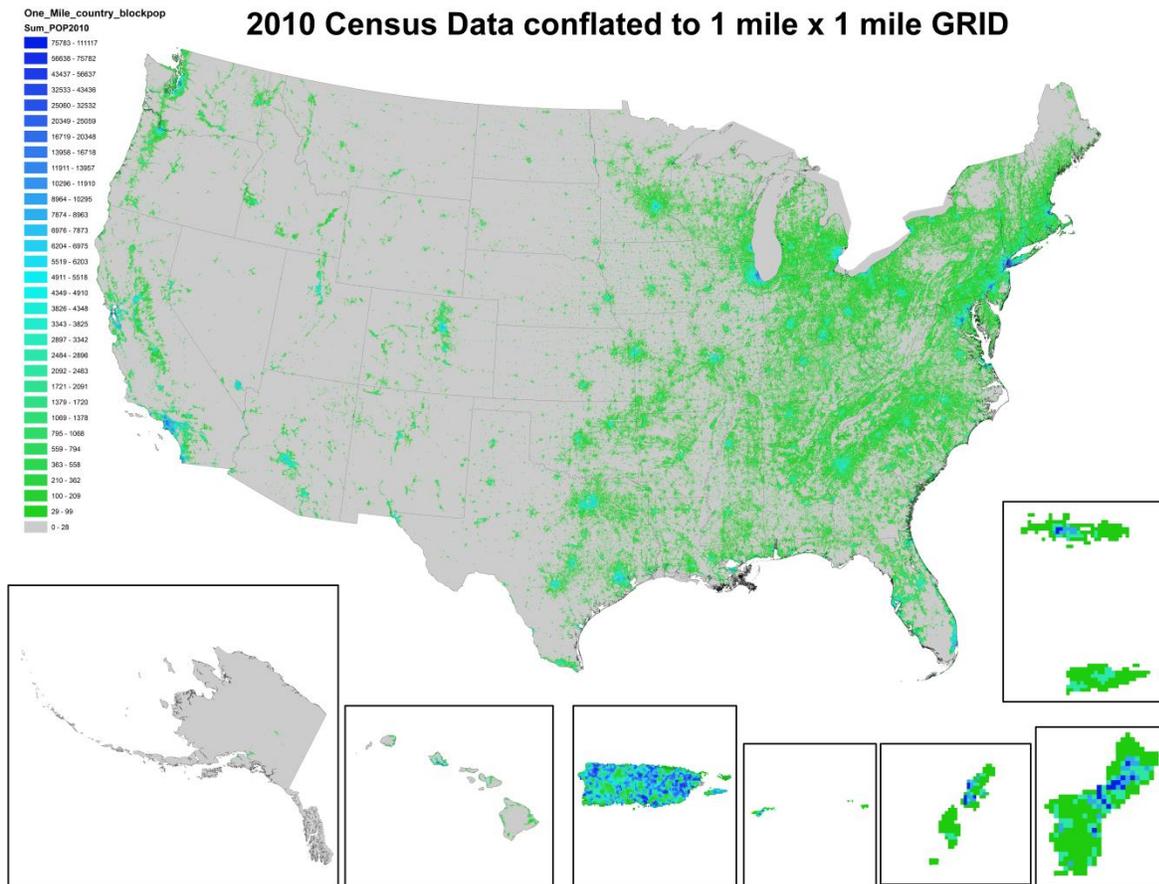


Figure 5 Population Map

4.2 Rural Definition Map

FirstNet is providing a rural definition map as shown in Figure 6 Rural Definition Map. See Section J, Attachment J-14, Terms of Reference, which summarizes the definition of “rural” found in the Rural Electrification Act of 1936. The rural definition map, which covers each of the 56 states and territories, is included within Section J, Attachment J-1 as a shapefile (file titled “Urban-Rural_Map_v1.0.mpk”). The Offeror should use this map to propose rural and non-rural coverage for the nation as a whole and for each of the 56 states and territories for the Initial Operational Capability (IOC)/Final Operational Capability (FOC) milestones, as explained in Section L, Instructions, Conditions, and Notices to Offerors or Respondents, Section L.3.2.1.3.2, Rural Coverage and Non-Rural Coverage.

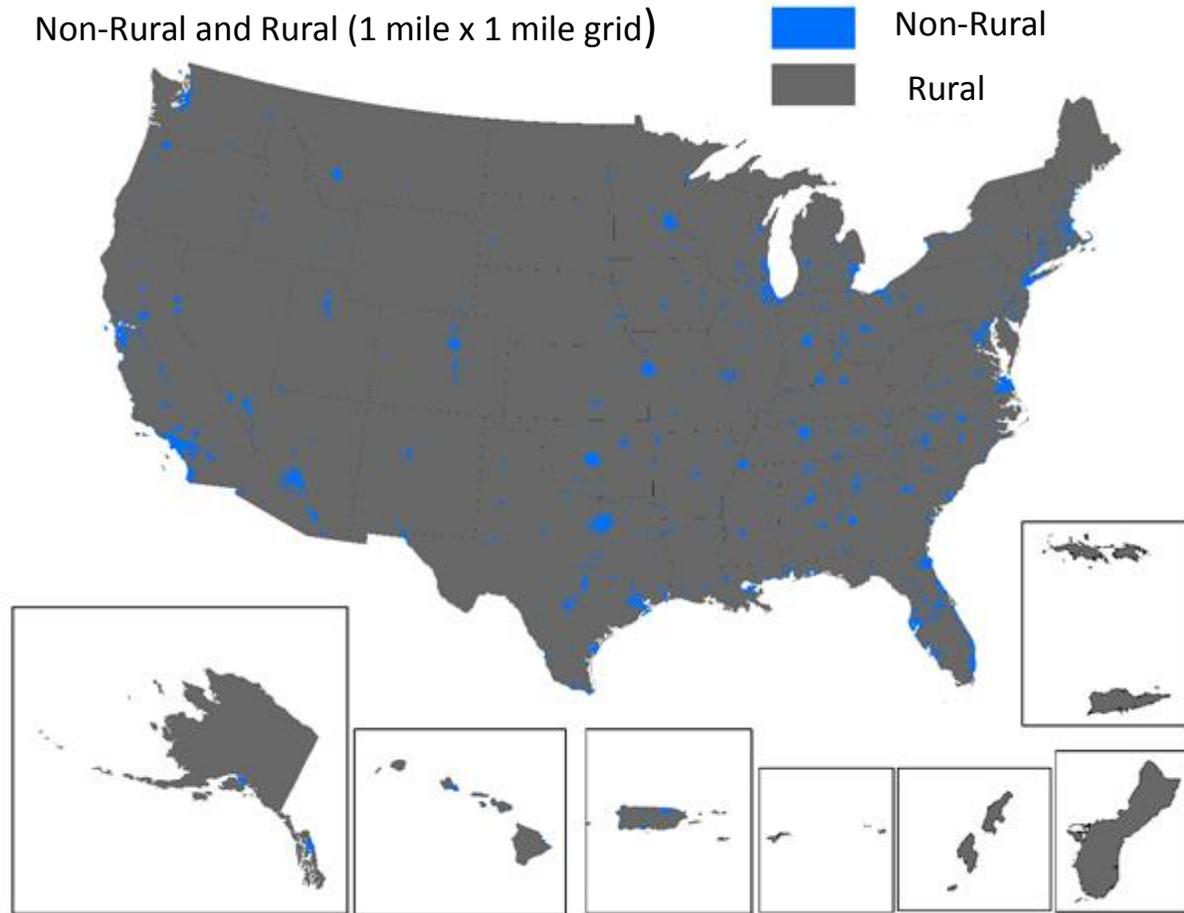


Figure 6 Rural Definition Map

4.3 Demand Map

FirstNet has aggregated stakeholder data to produce a nationwide view that estimates coverage demand at the county level. The demand maps include the number of devices used by those personnel, an estimate of eligible public safety users, and total monthly tonnage as of 2015. They can be seen in Figure 7 Heat Map by County/State/Territory – Device Density, Figure 8 Heat Map by County/State/Territory – Tonnage Density, and Figure 9 Heat Map by County/State/Territory – User Density. The maps were developed based on input from states, territories, tribal nations, and federal agencies, as well as FirstNet estimates. The demand maps are included within Section J, Attachment J-1 as shapefiles (files titled “Device_Demand_Map_v1.3.mpk,” “Tonnage_Demand_Map_v1.3.mpk,” and “User_Demand_Map_v1.3.mpk”), and as an Excel spreadsheet (file titled “Tonnage_User_Device_by_County.xls”).

The Offeror should use these maps to quantify the Band 14 county-level capacity for each IOC and FOC milestone, as explained in Section L, Instructions, Conditions, and Notices to Offerors or Respondents, Section L.3.2.1.1.5, Band 14 Network Capacity.

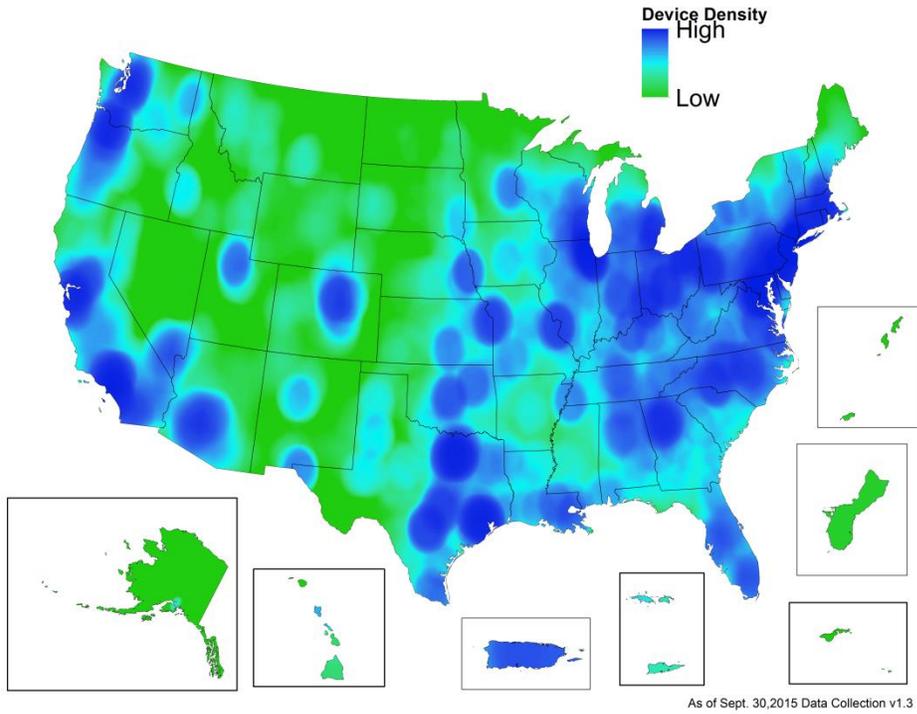


Figure 7 Heat Map by County/State/Territory – Device Density

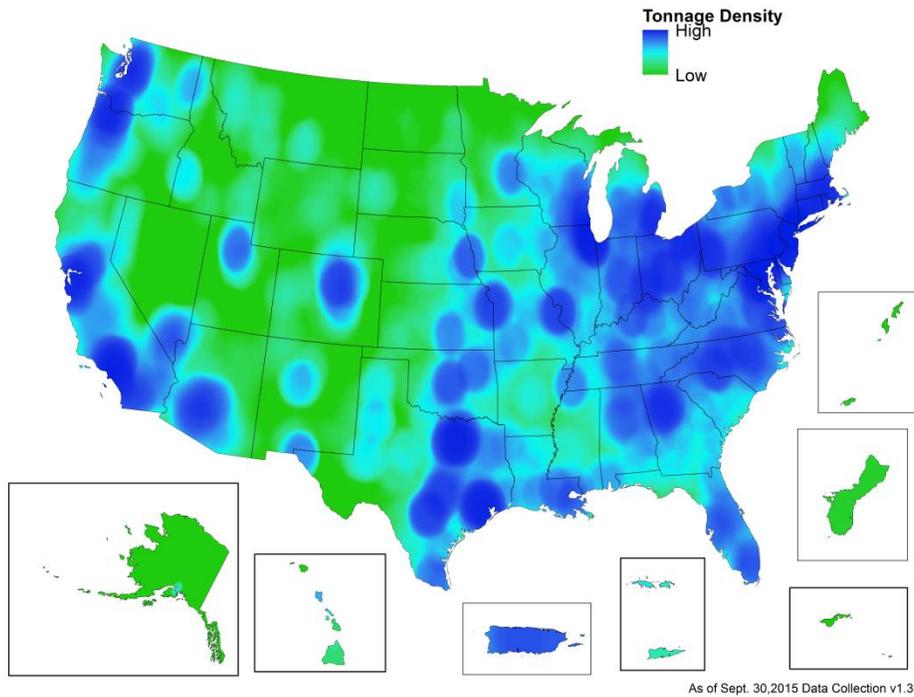


Figure 8 Heat Map by County/State/Territory – Tonnage Density

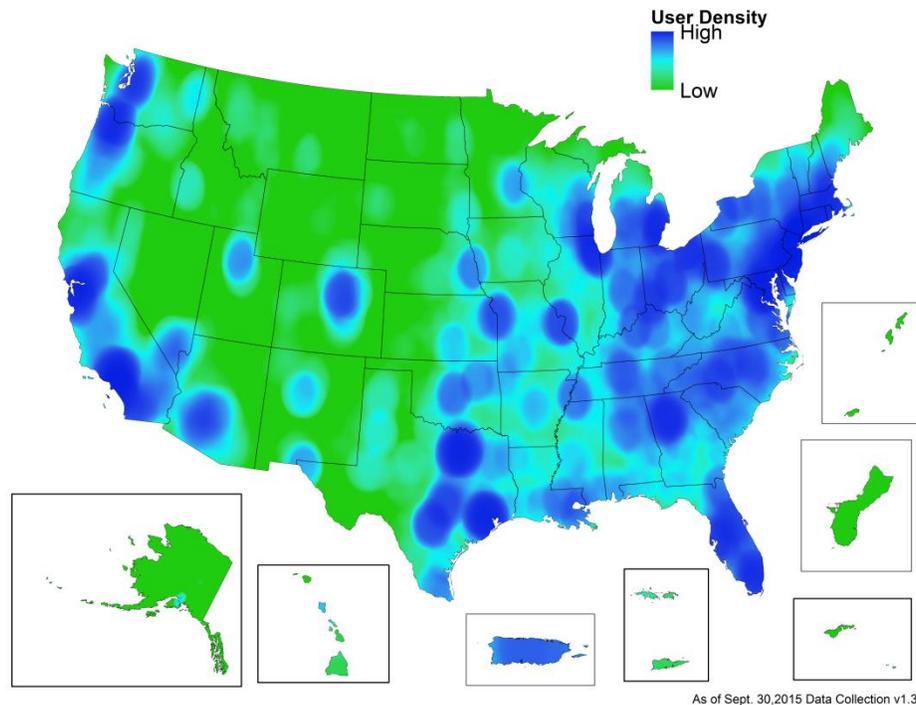


Figure 9 Heat Map by County/State/Territory – User Density

5 Definitions for LTE Analysis Layers

Below are the definitions of the LTE analysis layers requested in Section L, Instructions, Conditions, and Notices to Offerors or Respondents.

- **Reference Signal Received Power (RSRP)** – This layer provides the RSRP for the best carrier at each bin.
- **Best Server** – This layer provides the DL coverage area for the sector, which provides either the best RSRP or the best Reference Signal Received Quality (RSRQ) per the selection made in the network analysis options.
- **Downlink Signal-to-Interference-Plus-Noise Ratio (SINR)** – This layer provides the DL $C/(N+I)$ or carrier to interference plus noise ratio (CINR) of the best carrier.
- **Uplink SINR** – This layer provides the UL $C/(N+I)$ value of the best carrier.
- **Modulation and Coding Scheme (MCS)** – This layer provides information on the DL modulation that has the highest spectral efficiency (i.e., the modulation that provides the highest useful bits per symbol ratio) and where the coverage probability is above the defined target cell edge coverage probability.
- **Downlink Average Data Rate** – This layer provides the DL average data rate that could be achieved at any given location. It is the sum of the maximum data rate for all DL data paths, including all modulations present in a given location. Because the calculation of the layer includes all DL modulations, the layer may show higher values than the DL maximum achievable data rate layer.

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- **Uplink Average Data Rate** – This layer provides the average UL data rate that could be achieved at any given location. It is the sum of the maximum data rate for all UL data paths, including all modulations present in a given location.
 - **Composite Coverage Map** – This layer provides the extent of coverage. Where there is no coverage, the layer indicates whether the DL or the UL is the limiting factor.