Nodle Network Density Report

Generated using data from 2019-04-10

Overview and Methodology

The following report illustrates the capability of the Nodle Network based on data acquired during a 24-hour experiment on April 10, 2019.

For the experiment, Nodle partnered with several mobile application developers to test how the Nodle's network can locate and connect IoT devices globally and in specific local areas. The developers embedded the Nodle SDK in their apps. Smartphones with the SDK onboard can capture Bluetooth information from nearby IoT devices and relay the information to the Network. The information collected allows to locate and enable communication with any Bluetooth Low Energy-enabled IoT device nearby.

BLE signals can typically be captured within a 50-meter radius. To estimate the density of the network, we divided the world into individual zones of *roughly* 100m x100m (using a Geohash approximation). We looked at how many nodes reported information in these zones and how many BLE devices they located.

The report below shows the data gathered by the network over the course of 24 hours and highlights:

1. The worldwide coverage of the network and how it changes over time throughout the day;
2. Network coverage of specific key areas of focus, how the coverage changes of time, and the likelihood of detecting an IoT device in a specific region or zone.

Worldwide view

The Nodle network is present on 6 continents

The Nodle Network relies on developer partners to embed the Nodle SDK into their mobile applications. The overall network coverage therefore depends on where Nodle partners' audience is located.

During the April 10, 2019 test, 3,053,134 unique nodes equipped with Nodle's SDK were active and contributed to the Nodle Network. These nodes located 63,334,775 IoT devices.

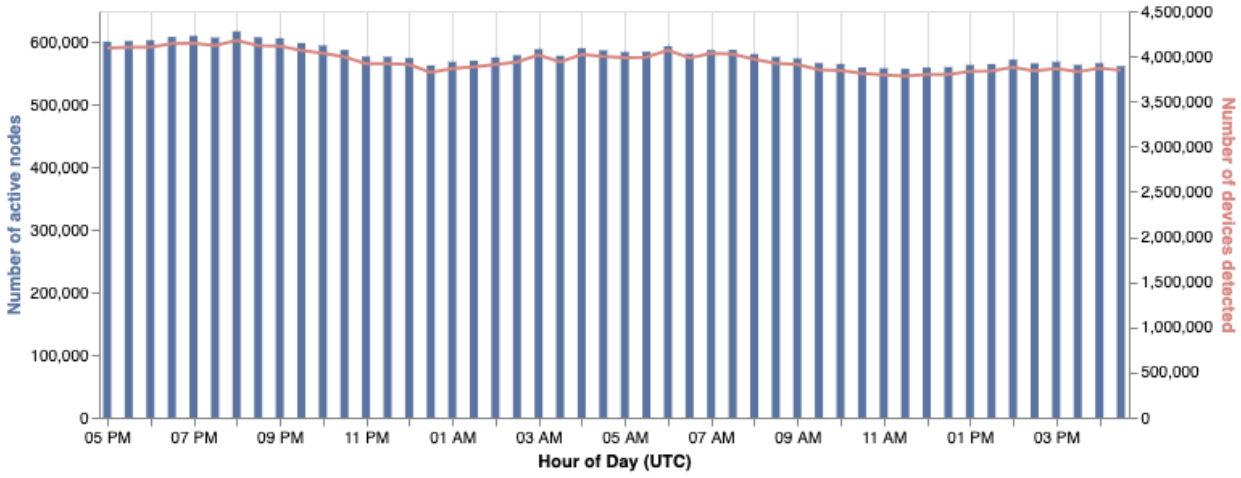
The map below shows the Nodle network coverage worldwide. We can see strong coverage in parts of North, Central and South America, Eastern Europe, the Middle East, North Africa, India, and South-East Asia.

gma

Constant global coverage over 24 hour period

The chart below shows the number of total unique nodes reporting data and the total number of unique IoT devices (identified via their MAC addresses, a unique ID per device) identified per 30-minute intervals during the 24-hour experiment over the world.

Every 30 minutes, about 550,000 unique nodes were active on a fairly consistent basis and located about 4 millions unique IoT devices.



Exploring various locations covered by the Nodle Network

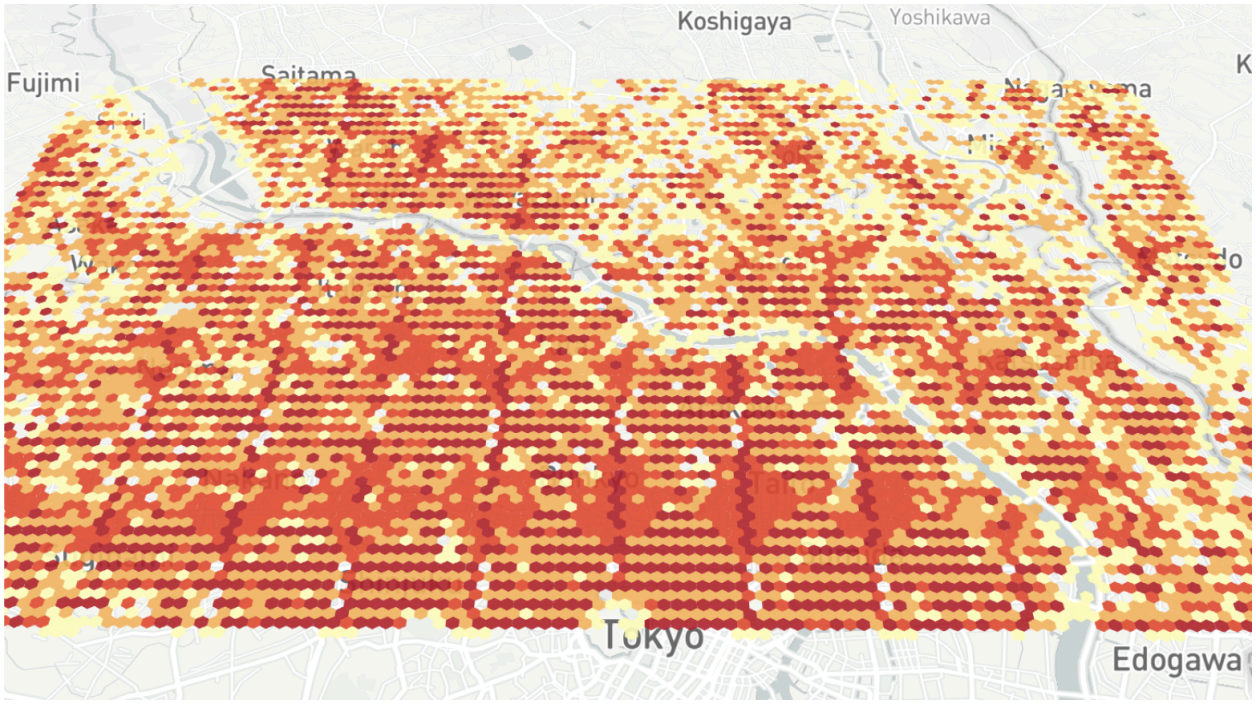
The behavior of the Nodle Network and how effectively it can locate and connect IoT devices depends on the node density.

The more active nodes present in a geographic area, the more IoT devices will be located and connected to the network.

During the test period, the highest number of active nodes were detected in metropolitan areas such as Tokyo, Taipei, San Francisco, and Times Square. Looking at these areas helps understand how the network can behave at a local scale.

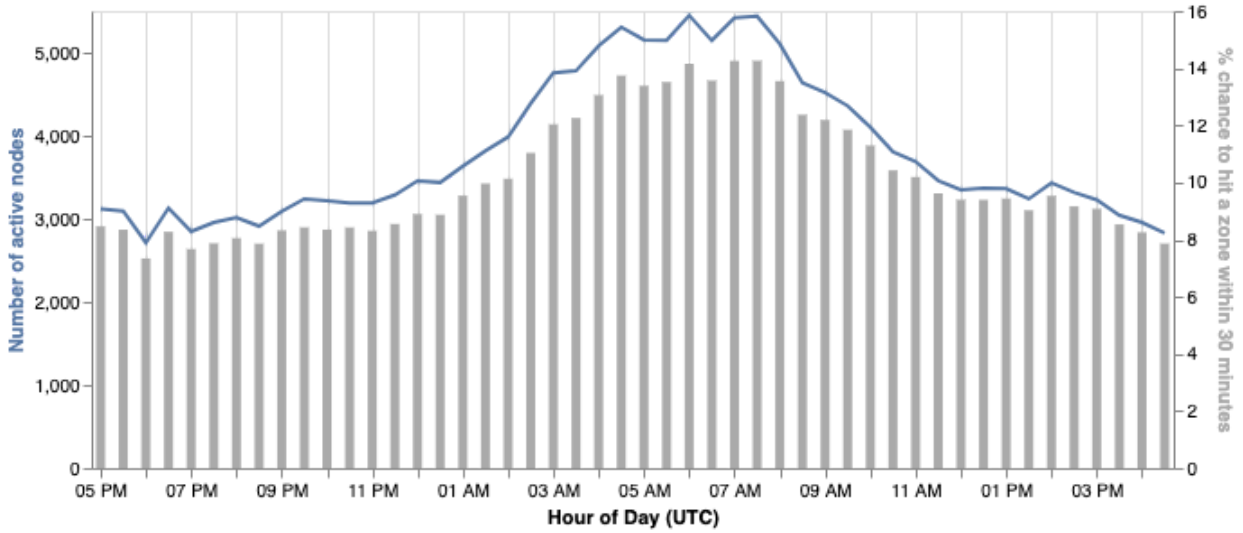
Tokyo North

In North Tokyo, 39,795 unique active nodes (devices where the Nodle SDK is running) contributed to the Nodle Network. These nodes located 716,487 unique IoT devices over the 24 hour time period and covered 63.56% of Northern Tokyo.



The chart below shows the number of unique active nodes and the percentage probability of a random 50x50m zone in Tokyo North to be hit within a 30-minute interval, over a 24-hour period (time in UTC).

The Nodle Network coverage depends on smartphones being active. In Tokyo, the network was most active during the day time, between 12pm (3am UTC) and 6pm (9am UTC). During that time period, the number of active nodes per 30 minutes ranged from 4,500 to 5,500, and a random 50x50m zone would have a 12% to 14% chance of being covered by the network within 30 minutes.



With our asset tracking and delay tolerant communication use cases, the time interval between two consecutive hits is an important parameter. The table below shows the average, standard deviation, minimum, 25/50/75th percentiles and maximum time between two 'hits' for five random 50x50m zones.

We can see that different zones will have different coverage.

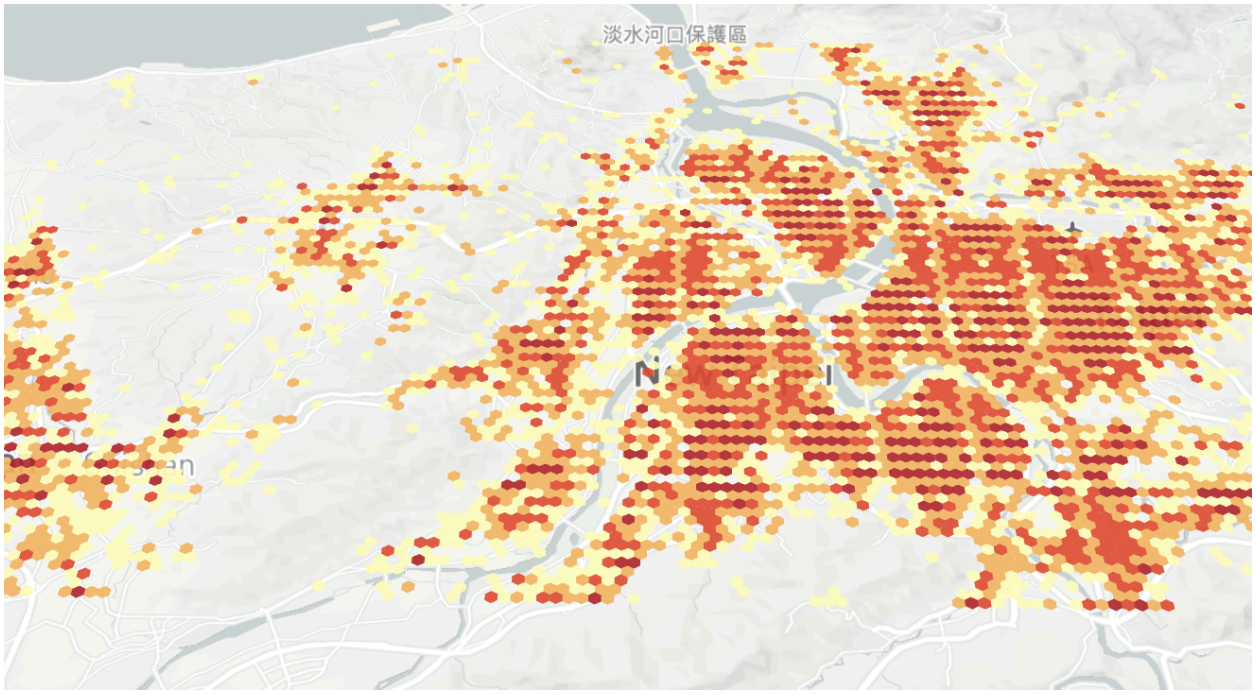
For example, zone 4 was “hit” 120 times that day, with an average 11 minutes 50 seconds between two hits. 25% of the time, it took less than 1 minute and 38 seconds between two hits, and 50% of the time less than 5 minutes and 1 second, 75% of the time less than 6 minutes and 40 seconds.

	count	mean	std	min	25%	50%	75%	max
0	58	24:16	21:08	0:04	7:32	18:52	34:51	1:32:52
1	36	37:09	37:04	0:11	14:26	30:18	41:22	3:18:23
2	5	1:30:59	22:17	1:01:14	1:16:37	1:35:27	1:44:06	1:57:30
3	9	2:06:15	2:24:54	3:39	8:44	26:39	3:04:24	5:55:00
4	120	11:50	50:51	4 milliseconds	1:38	5:01	6:40	9:12:04

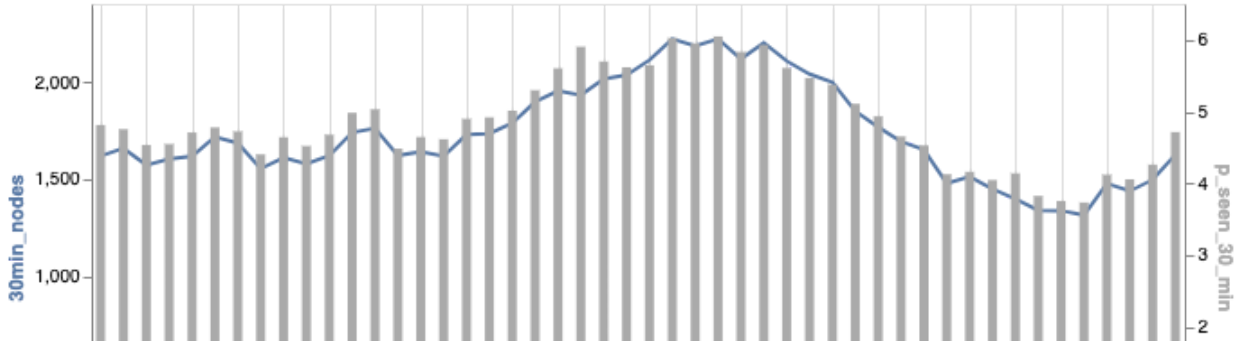
In Northern Tokyo, across all covered 50x50m zones, the median time to receive network coverage consecutively was 2 hours and 15 minutes on average.

Taipei

On 2019-04-10, 12,676 unique nodes (devices where the Nodle SDK is running) were active in Taipei. These nodes referenced 326,157 unique IoT devices over 24 hours. 29.60% of Taipei was covered by the network that day.



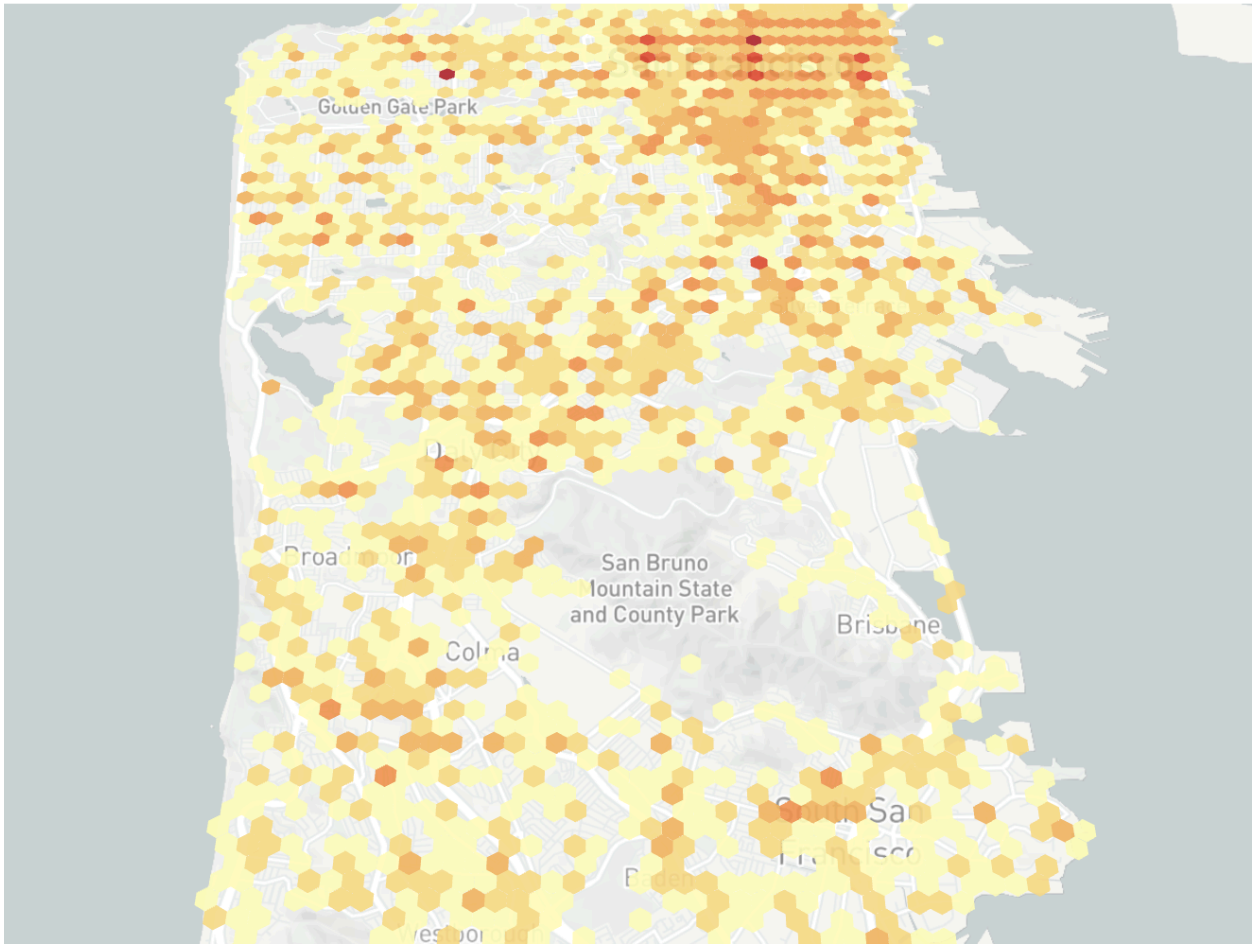
Like it does in Tokyo, the Nodle Network coverage varies based on the time of the day in Taipei, with between nearly 1,500 active nodes per 30 minutes and 2100 active nodes per 30 minutes, with the most active time being during between 11am and 5pm.



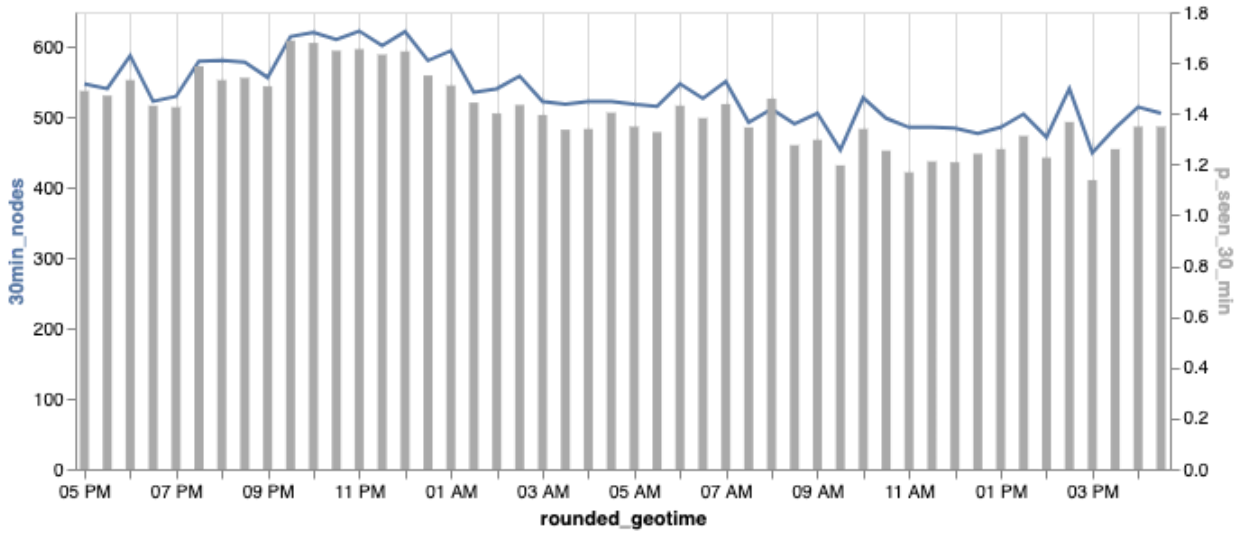
The average median time between two consecutive “hits” in a zone is 1 hour 52 minutes on average.

San Francisco

On 2019-04-10, 3,578 unique nodes were active in San Francisco. These nodes referenced 124,174 unique IoT devices over 24 hours. 10.36% of San Francisco was covered by the network that day. Many of the zones that did not receive coverage are uninhabited hills, parks, beaches, and industrial areas.



The chart below shows the number of unique nodes active and the percentage probability of a random 50x50m zone to be hit per 30-minute interval over a 24-hour period (time in UTC).



The average median time between two consecutive “hits” in a covered zone is 2 hours on average.

New York City Region

On 2019-04-10, 31,601 unique nodes were active in New York City. These nodes referenced 1,025,224 unique IoT devices over 24 hours. 19.45% of New York City was covered by the network that day (this number would be higher excluding rivers and lakes).

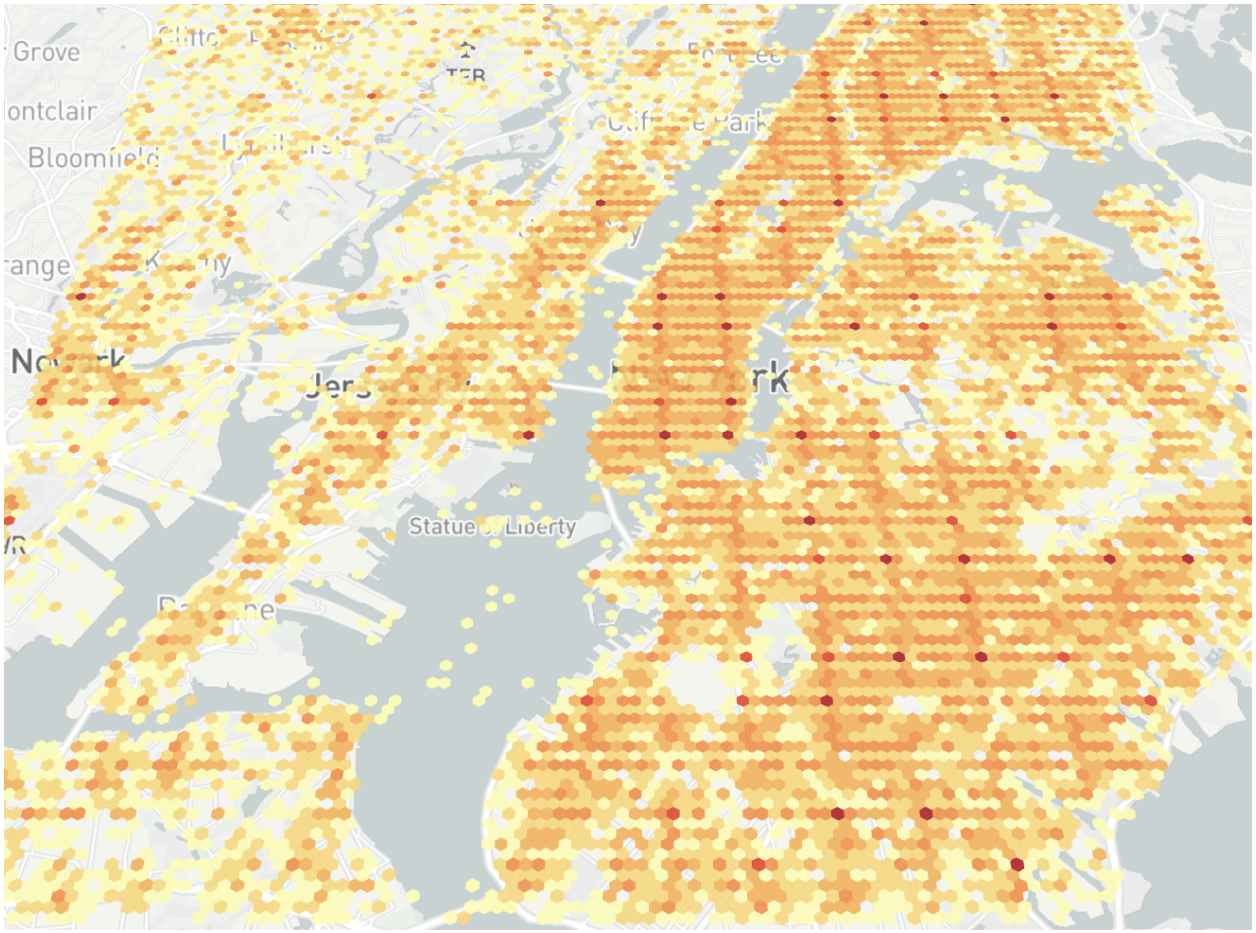
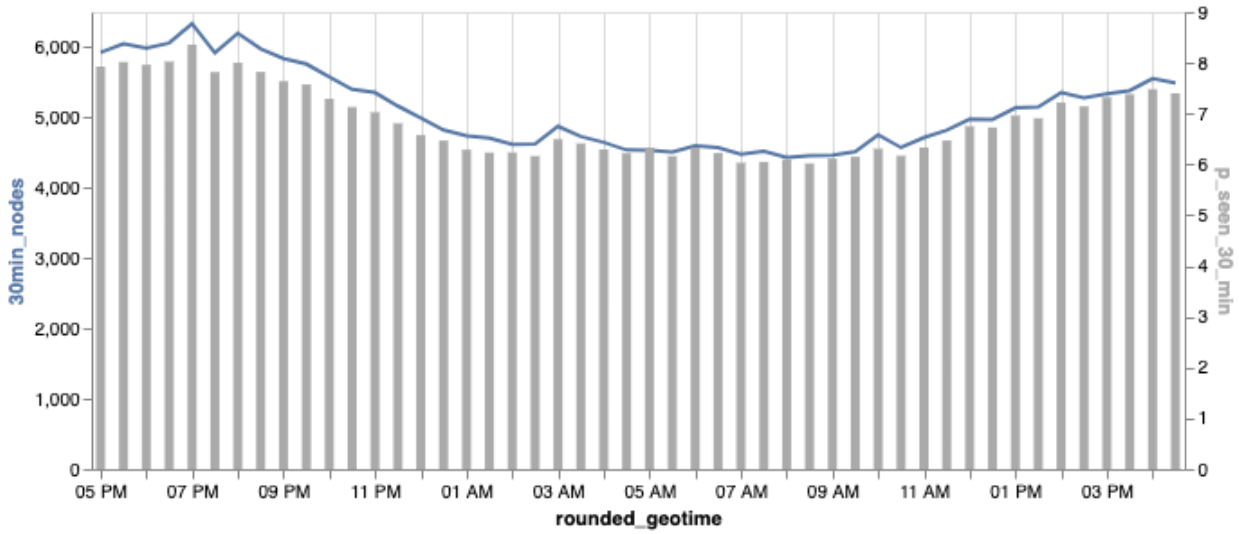
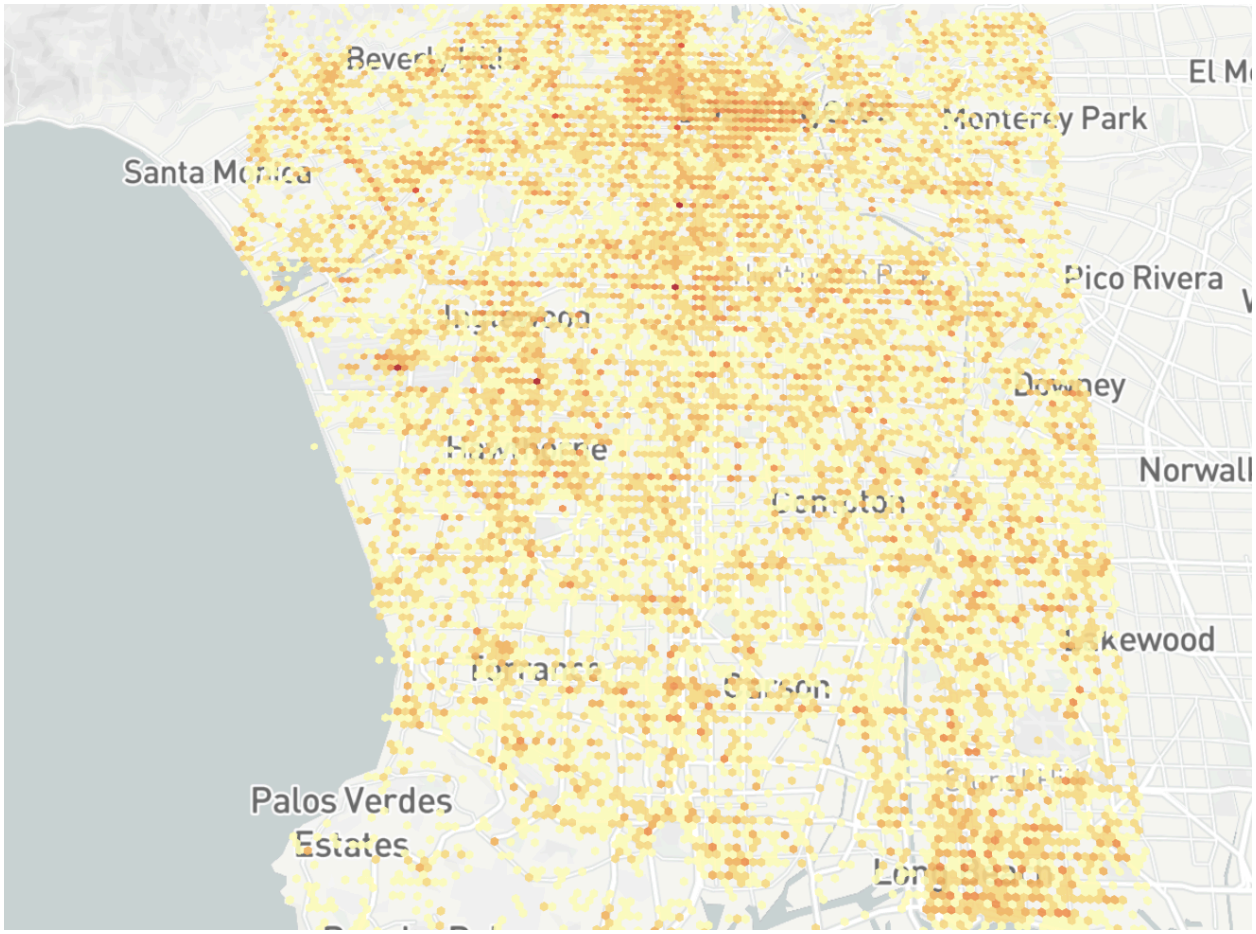


Chart over time

The chart below shows the number of unique nodes active and the percentage probability of a random 50x50m zone to be hit per 30-minute interval over a 24-hour period (time in UTC).


30min_nodes
6,000
5,000
4,000
3,000
2,000
1,000
0
p_seen_30_min
9
8
7
6
5
4
3
2
1
0
05 PM
07 PM
09 PM
11 PM
01 AM
03 AM
05 AM
07 AM
09 AM
11 AM
01 PM
03 PM
rounded_geotime

Los Angeles



Dallas

