

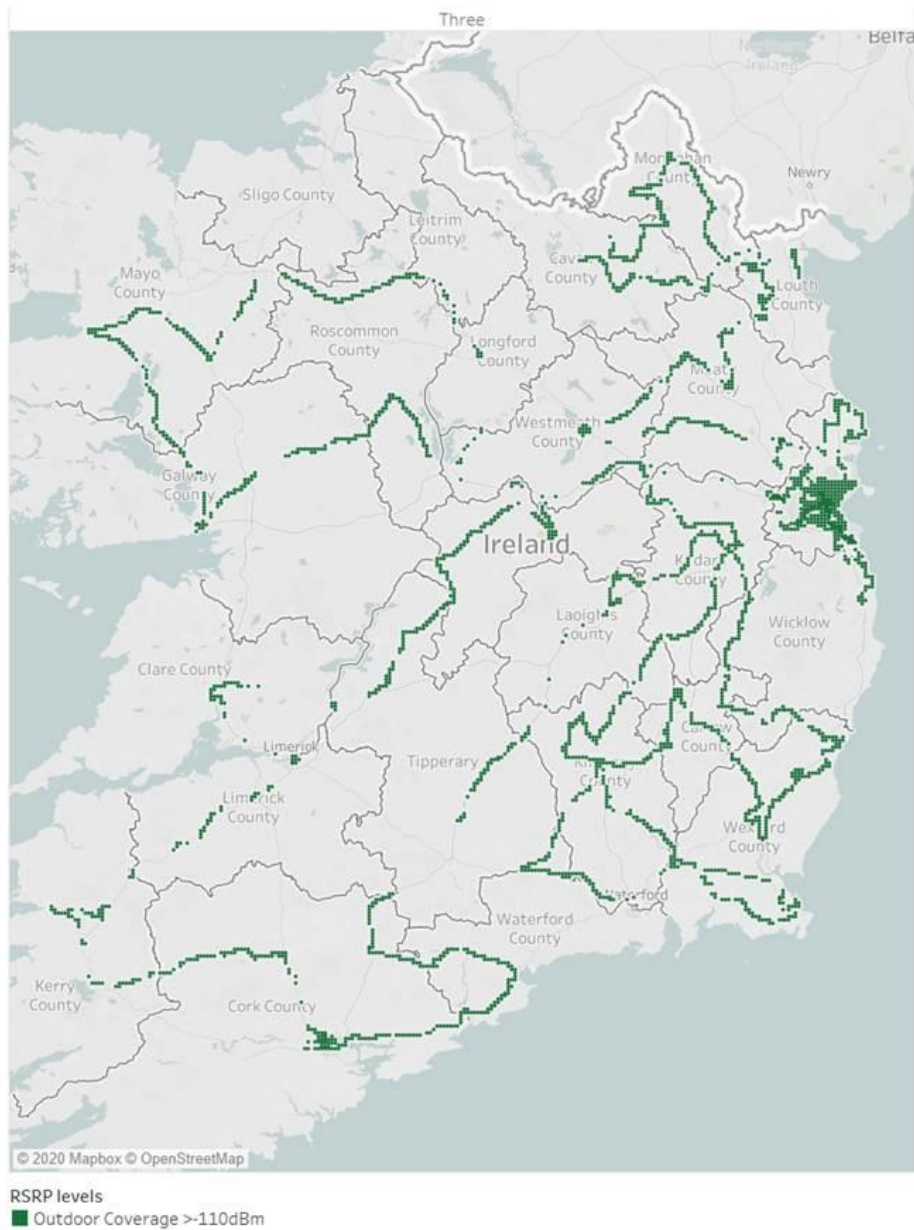
Benchmark Measurements
of 5G coverage in Ireland
show Three as the operator
with the largest 5G network



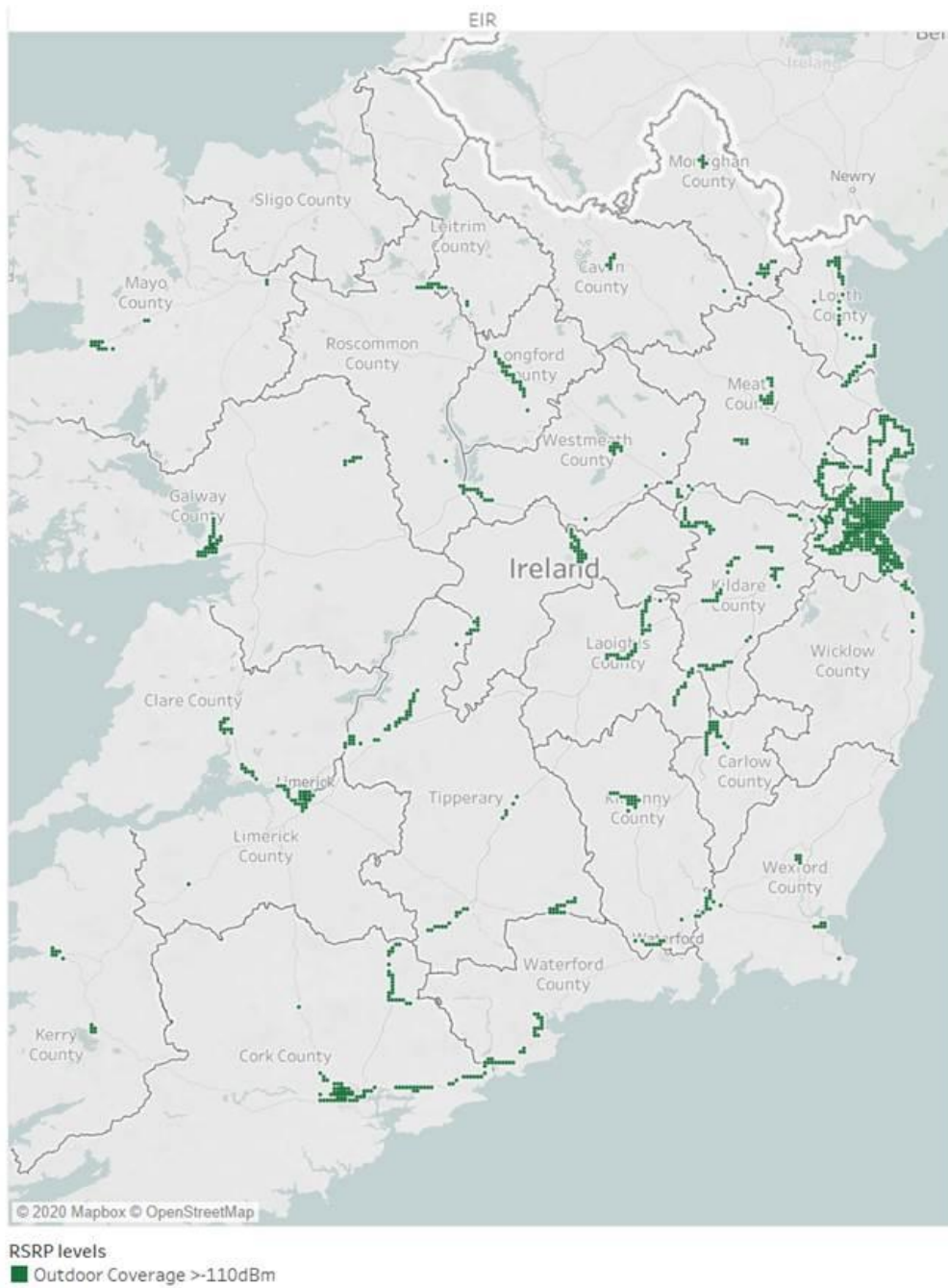
Summary of the Results

In a survey of 5G coverage conducted by Systemics-PAB in Ireland, the network of Three came on top with the largest 5G coverage in the country. While all three operators have a reasonably good coverage of 5G in Dublin and surrounding areas, outside of County Dublin there is a clear coverage advantage for Three over Eir and Vodafone.

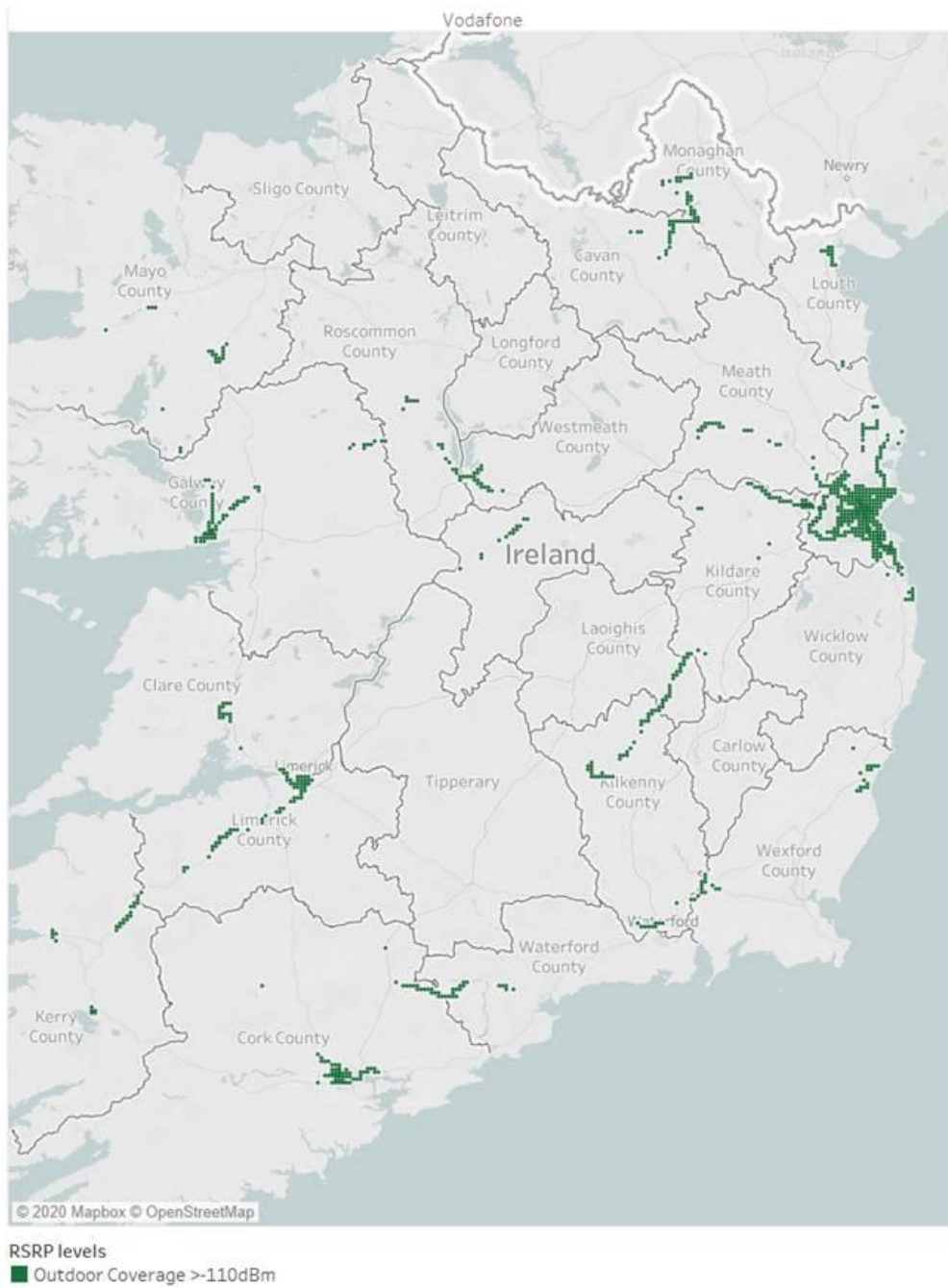
Picture 1 – 5G Coverage of Three



Picture 2 – 5G Coverage of Eir



Picture 3 – 5G Coverage of Vodafone



Geographical coverage of the measurements

Our aim was to do a comprehensive survey of 5G coverage throughout Ireland. In our test route we included the largest cities – Dublin, Cork, Galway and Limerick and wide selection of roads and towns covering most of the counties and most populous urban centres in Ireland. When designing the route we also used publicly available information from operators' web sites related to advertised 5G coverage. Relative density of the roads in a given area is meant to reflect population density in that area. The driveroute outside of main cities covered more than 2,700 km and is shown in the picture below.

Picture 4 – Drive route



How the survey was conducted

The measurements were conducted by a measurement car equipped with a Rohde & Schwarz TSME-6 radio scanner collecting radio signal samples in all frequencies allocated to 5G in Ireland. Scanner antenna was placed on the roof of the car.

Measurements were performed at the end of October and beginning of November 2020.

Test results

Radio scanner detected 5G radio networks in the following bands:

- Eir – 1800 MHz, 3500 MHz
- Three – 1800 MHz, 3500 MHz
- Vodafone – 2100 MHz, 3500 MHz

While 3500 MHz is used by all three operators in Dublin and other main cities, lower frequency bands are deployed predominantly outside of city centres.

The 3500 MHz band has a much wider carrier bandwidth allocated, while in lower frequencies the observed carrier bandwidth is much smaller. Table below summarises it.

Table 1 – Bandwidth allocated to 5G

	1800 MHz	2100 MHz	3500 MHz
Eir	15 MHz		80 MHz
Three	15 MHz		100 MHz
Vodafone		10 MHz	80 and 100 MHz

5G Carrier bandwidth is directly linked with the throughput that can be carried over 5G radio network. Using 5G in 3500 MHz band a user can achieve significant data throughput increase compared to 4G, while lower frequency bands – 1800 MHz and 2100 MHz are mainly used for expanding 5G coverage.

Evaluating the scanner results we combined all the radio signal samples with RSRP level of -110 dBm and above. RSRP is a measure of radio signal strength and the threshold of -110 dBm corresponds to outdoor coverage for stationary use of 5G. Below that threshold the network would most likely redirect the user to 4G network.

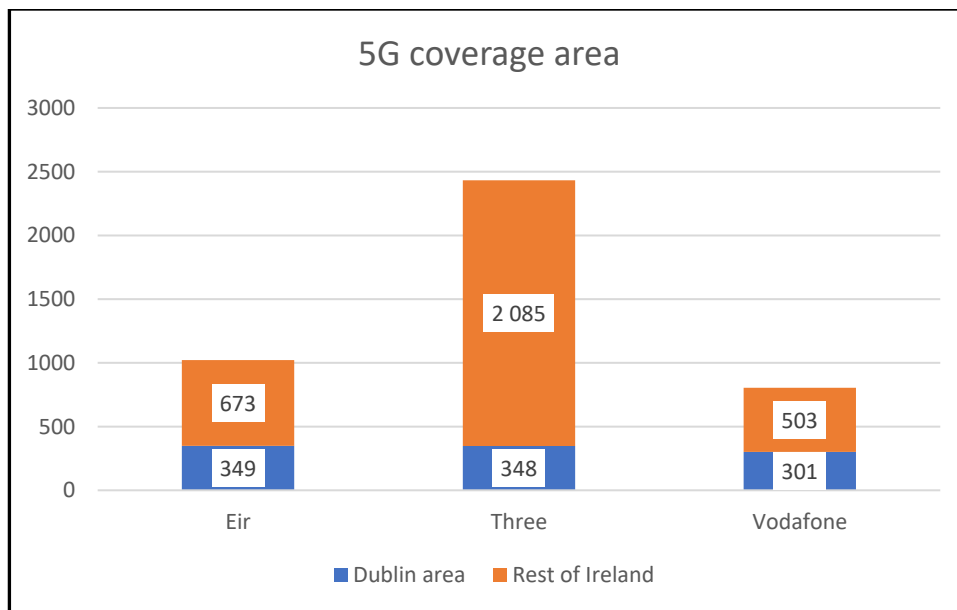
Radio scanner collects radio signal samples with a frequency of around one second. With the measurement car moving at 50-60 km/h we collect a radio sample every 15 metres of the driveroute. To visualise these results on the map, we combine radio samples in a grid of

squares 1000 m x 1000 m. For all samples within a given square an average RSRP value is calculated and a dot representing the center of such a square is placed on the map. Individual dots do not reflect the same amount of samples in a given square, they are meant to represent extent of 5G radio coverage, but not the density of 5G network in a given location. Green dots on the map depict those areas where the average RSRP value for 5G radio is -110 dBm or more.

Summing up the green dots on the map, that correspond to 1000 m x 1000 m squares with average values of RSRP for 5G radio of -110 dBm or more we get the following results.

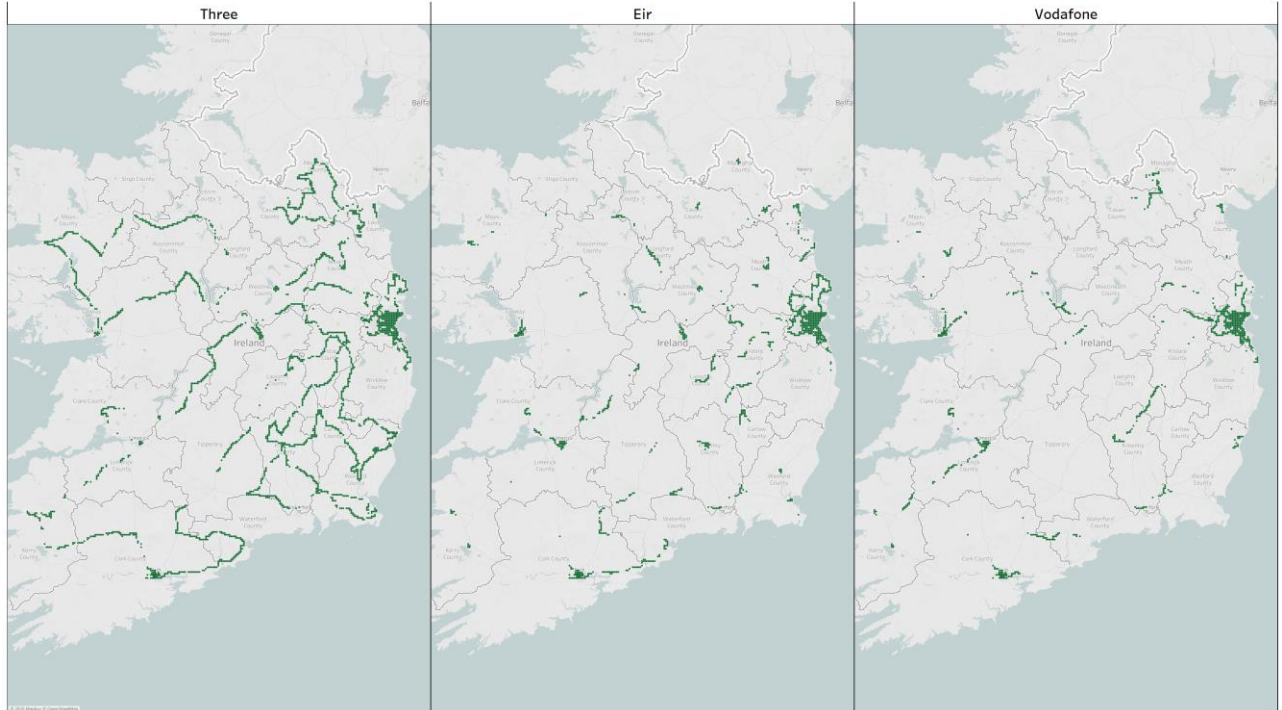
Table 2 – 5G coverage, number of 1000 x 1000 metre squares with RSRP value for 5G radio -110 dBm and above

	Eir	Three	Vodafone
Dublin area	349	348	301
Rest of Ireland	673	2 085	503
Total	1 022	2 433	804

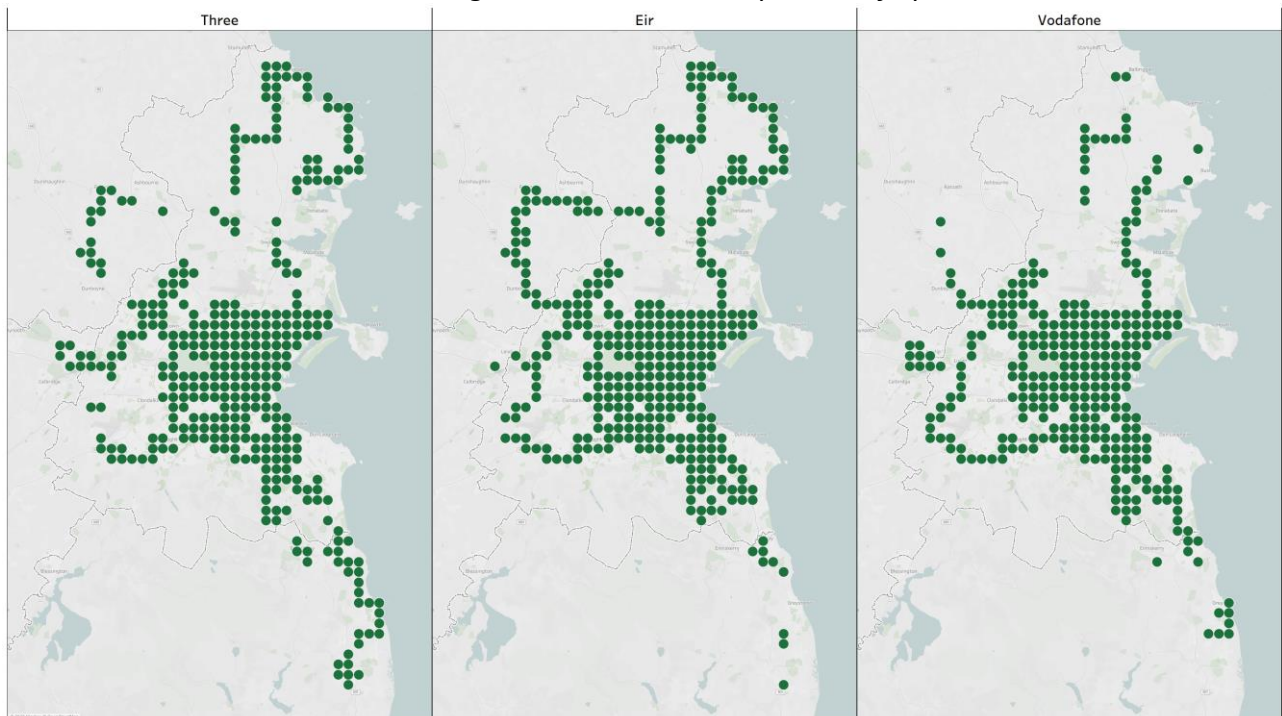


The total numbers shown in the table and chart above represent country wide area coverage of 5G that we measured in our survey. As we can see Three is the clear leader in terms of 5G coverage in Ireland right now measured geographically and in terms of population.

Results shown in the maps in the summary section of this report are repeated here to show the 5G coverage maps of all three operators side by side. In addition we also present the close-up of Dublin area results.



Picture 6 – 5G Coverage in Dublin area, comparison of operators



Systemics-PAB

Systemics-PAB is a leading provider of independent Quality of Experience benchmarking services for mobile operators and regulators. We have conducted various benchmarking campaigns of mobile networks in more than 50 countries representing among others Eurasia, Middle East, Africa, and Australia.

Our mission is to assist customers to understand and address the variety of issues affecting quality in mobile and fixed telecommunication networks. Expert know-how developed over many years, combined with large-scale operations and efficient cloud-based data post processing, gives us an unparalleled flexibility in conducting high-quality and complex projects in multiple countries worldwide. From 2017 Systemics-PAB is a certified partner of Rohde & Schwarz in the mobile networks testing domain. Systemics-PAB has also been a contributing member of ETSI working group developing guidance for Quality of Services testing in mobile networks.