

### Content

# ✓ Executive Summary

- ✓ Main Findings
- ✓ Methodology
- ✓ Overall Coverage Summary
- ✓ Per MNO Coverage Summary
- ✓ Appendix





## **Executive Summary**

### **Background:**

The County Council (NCC) commissioned AWTG to conduct an independent benchmark assessment of mobile coverage and user experience across Norfolk.

The benchmarking campaign was conducted between February and March 2018 using a robust four-tier methodology to maximise the extent and breadth of data collection. This included:

- Walk Testing Over 30 locations tested including museums, tourist attractions, camping and caravan sites. .
- Rail Testing From Norwich to Great Yarmouth, to Lowestoft (up to Norfolk border), to London (up to Norfolk border), to Sheringham, to Ely (up to the Norfolk border), King's Lynn to London (up to the Norfolk border)
- Drive Testing over 5,500 kilometres of Trunk, A, B and C class roads driven across Norfolk.
- Stationary Testing Stationary tests were carried out in enterprise zones and 28 Norfolk Broads mooring points

### Scope:

The scope of the campaign covered a detailed assessment of the GSM (2G), UMTS (3G) and LTE (4G) radio network (coverage) performance and received signal strength of the four main mobile network operators in the UK:

- Hutchison 3G UK Limited (3 UK)
- Everything Everywhere (EE)
- Telefónica UK Limited (O2)
- Vodafone UK Limited

Key voice performance metrics such as service availability to initiate voice calls, call attempt success rates, call drop rates and voice quality were measured.

Mobile data quality of user experience was assessed and the key indicators tested included: web browsing success rates, web page load times, file download and upload speeds, data transfer latency and video streaming performance.



### **Test Locations and Routes**



District	Number of Mooring points	Number of Stations	Number of Caravan sites	Number of Tourist Attractions
Breckland		5		3
Broadland	9	7		2
Great Yarmouth	7	1	6	2
King's Lynn and West Norfolk		3	5	1
North Norfolk	7	8	5	4
Norwich	3	1		3
South Norfolk	4	4		

NCC specified a comprehensive set of locations and roads across the county that they wished to baseline in terms of network coverage and user experience. The map opposite illustrates the high level view of the routes that were driven by our team.

The central thesis and framework for the benchmark assessment was anchored on obtaining a 'current state' data set, to help inform all stakeholders of the existing baseline.

#### Over 5600 kilometres of roads driven throughout Norfolk County

Tourism plays an important part in the economy of Norfolk and the council recognise that visitors are demanding more and more in terms of their experience when they're on vacation. People expect to be provided with ubiquitous high quality voice and data service regardless of the location.

The table opposite details the locations that were tested by our teams in areas of high interest and tourist traffic.

- Static test carried out in 30 Mooring points
- Walk test conducted in
  - 29 railway stations
  - 16 caravan sites
  - 15 tourist attractions and museums



### Content

✓ Executive Summary

# ✓ Main Findings

- ✓ Methodology
- ✓ Overall Coverage Summary
- ✓ Per MNO Coverage Summary
- ✓ Appendix





## **Main Findings**

Metric	Summary of Main Findings	
2G Coverage	<ul> <li>98.83% Service availability on test handset based on MNOs defined threshold</li> <li>74.28% Service availability on test handset based on Ofcom defined threshold</li> </ul>	
3G Coverage	<ul> <li>89.74% Service availability on test handset based on MNOs defined threshold</li> <li>65.68% Service availability on test handset based on Ofcom defined threshold</li> </ul>	
4G Coverage	<ul> <li>98.92% Service availability on test handset based on MNOs defined threshold</li> <li>83.38% Service availability on test handset based on Ofcom defined threshold</li> </ul>	
Voice	<ul> <li>Voice performance acceptable when user is within the coverage area.</li> <li>82% call attempt success rate and 98% call completion rate.</li> <li>Average voice quality is 3.93 out of 5</li> <li>Average call setup time is 3.27 seconds</li> </ul>	
Data	<ul> <li>Data performance acceptable when user is within the coverage area.</li> <li>14.54Mbps average DL speed / 7Mbps average UL speed</li> <li>Average download time for webpage is 6.86 seconds</li> <li>86.46% of web browsing tests completed successfully</li> <li>84.90% of video streaming tests completed successfully</li> </ul>	
<b>WTG</b>	Page 6	() ()

### Content

- ✓ Executive Summary
- ✓ Main Findings

# ✓ Methodology

- ✓ Overall Coverage Summary
- ✓ Per MNO Coverage Summary
- ✓ Appendix





### **METHODOLOGY**

#### Walk and Rail Testing:

The walk test units were set to automatic network selection mode and were able to latch on to the respective network operator's 2G, 3G or 4G network depending on coverage availability and signal strength levels as well as the type of test performed at that point in time (i.e. either voice or data section of the test script)

#### **Drive Testing:**

For the drive test, voice performance was assessed with a dedicated test unit locked to 2G and 3G mode for each network operator to enable us to provide comprehensive coverage maps for each technology. For data user experience, two test units were used per operator, one locked exclusively to 3G and the other locked to 4G, the 4G data test units were conducting one VoLTE (Voice over LTE) test per cycle.

#### **Voice and Data Test Scripts**

Voice Cycle						
Pause (s)	Call set up time (s)	Call duration (s)	Reselection wait (s)			
5	10	***60/75/90	10			

\*60 sec for short calls (accessibility test), \*\*75 sec medium calls, \*\*\*90 sec for long calls (handover performance test)

3G Data Cycle							
PDP always on	HTTP DL (3MB File)	HTTP UL (1MB File)	YouTube Streaming	Ping*	Web Browsing*	Wait	
0	20s	20s	15 sec video	10s	30s	10s	

4G Data Cycle							
PDP always on	HTTP DL (10MB File)	HTTP UL (5MB File)	YouTube Streaming	Ping*	Web Browsing*	VoLTE	Resele ction wait
0	20s	20s	30 sec video	10s	30s	60s	10s

\* A total of five different websites were browsed and the latency to each site measured





### DRIVE TEST EQUIPMENT NEMO INVEX II

A high capacity measurement server (Nemo Invex II) was installed in a specially adapted drive test vehicle and was used to control 15 Cat6 test units running scripted voice, VoLTE and data testing across 2G, 3G and 4G technologies. A multi-band radio frequency scanner was installed with two antennas mounted on the roof of the drive test car, at a height of 1.5 metres from the ground. This was used to receive and log the strength and quality and absolute signal strength of the mobile network operators' radio network without penetration loss. The scanner was configured to log a received sample every 100 milliseconds.

- 4 x Samsung Galaxy S8 test units connected to the measurement server conducting 4G data tests + VoLTE calls
- 1 x GPS Receiver
- 1 x Multi-band radio frequency scanner [Scanner was used to measure the actual outdoor radio coverage without any penetration loss]
- 4 x Samsung Galaxy S4 units connected to Nemo Outdoor software to terminate the VoLTE calls and process voice quality scores
- 7 X landlines connected to POLQA server to terminate the voice calls and process voice quality scores



12 Samsung Galaxy Note 4 handsets located in the car



Nemo Invex II + Multi-band radio scanner



8 Samsung Galaxy S4 connected to Nemo Outdoor to receive calls





### RAIL/WALK TEST EQUIPMENT NEMO WALKER AIR

The walk and rail testing was performed using a specialised test back pack containing 5 Cat6 mobile test units running scripted voice, VoLTE and data tests. Similar to the drive test, the data tests focused on speed, latency, browsing success rates and video experience while voice performance was assessed by capturing call success rates, call setup times and voice quality.

- 1 x Android master tablet
- 5 x Samsung Galaxy Note 4 test units with specialized test software
- 1x GPS unit
- 4 x Samsung Galaxy S4 test units connected to Nemo Outdoor to receive VoLTE calls



Samsung Galaxy Note 4 handsets located in backpack



Engineer walking through areas and gather data



4 Samsung Galaxy S8 connected to Nemo Outdoor to receive calls





### Content

- ✓ Executive Summary
- ✓ Main Findings
- ✓ Methodology

# ✓ Overall Coverage Summary

- ✓ Per MNO Coverage Summary
- ✓ Appendix





# **Overall Coverage Summary (1 of 6)**

### **2G Coverage Performance**

### 2G Coverage by Scanner Operator's defined Threshold



### 2G Coverage by Scanner Ofcom's defined Threshold







# **Overall Coverage Summary (2 of 6)**

### **2G Coverage Performance**

### 2G Coverage by Handset Operator's defined Threshold



### 2G Coverage by Handset Ofcom's defined Threshold







# **Overall Coverage Summary (3 of 6)**

### **2G Coverage Performance**

### **3G Coverage by Scanner Operator's defined Threshold**

#### **3G Coverage by Scanner Ofcom's defined Threshold**







## **Overall Coverage Summary (4 of 6)**

**2G Coverage Performance** 



### **3G Coverage by Handset Ofcom's defined Threshold**





# **Overall Coverage Summary (5 of 6)**

**2G Coverage Performance** 



### 4G Coverage by Scanner Operator's defined Threshold

### 4G Coverage by Scanner Ofcom's defined Threshold





## **Overall Coverage Summary (6 of 6)**

**2G Coverage Performance** 

4G Coverage by Handset Operator's defined Threshold 4G Coverage by Handset Ofcom's defined Threshold







### Content

- ✓ Executive Summary
- ✓ Main Findings
- ✓ Methodology
- ✓ Overall Coverage Summary

# ✓ Per MNO Coverage Summary

✓ Appendix





# Per MNO Coverage Summary (1 of 6)

**2G Coverage Performance by Scanner** 





# Per MNO Coverage Summary (2 of 6) 2G Coverage Performance by Test Handsets





# Per MNO Coverage Summary (3 of 6)

**3G Coverage Performance by Scanner** 







# Per MNO Coverage Summary (3 of 6)

**3G Coverage Performance by Test Handsets** 





# Per MNO Coverage Summary (5 of 6)

**4G Coverage Performance by Scanner** 





## Per MNO Coverage Summary (6 of 6)

**4G Coverage Performance by Test Handsets** 







### Content

- ✓ Executive Summary
- ✓ Main Findings
- ✓ Methodology
- ✓ Overall Coverage Summary
- ✓ Per MNO Coverage Summary







### **2G Coverage by Scanner**







### **2G Coverage by Handsets**







### **3G Coverage by Scanner**





### **3G Coverage by Handsets**







### **4G Coverage by Scanner**





### **4G Coverage by Handsets**



### **SAWTG**





# **Coverage Heatmaps as Walk Test Locations**

2G/3G/4G Coverage by Handsets

# <u>2G</u> <u>3UK does not offer 2G</u>



RSRP [dBm] [Time/s]

< -65 and >= -75

< -75 and >= -85 < -85 and >= -95

< -95 and >= -105

< -105 and >= -115

>= -65

Hemsby

Caister on Sea

Lowestoft

Mundesley

Bungay Beccles

North

Walshan





### **Coverage Heatmaps as Walk Test Locations** 2G/3G/4G Coverage by Handsets



E







## **Coverage Heatmaps as Walk Test Locations** 2G/3G/4G Coverage by Handsets







# $O_2$



### **Coverage Heatmaps as Walk Test Locations** 2G/3G/4G Coverage by Handsets











# Thank You



Registered in UK No. 5793772HQ in London UK Office: +44 (0) 208 601 7150 Fax: +44 (0) 208 728 9610 www.awtg.co.uk