wavemobile
The Network for Not-Spots

Reflections on the challenges and lessons learned drawing on the wavemobile experience so far.

Commercial in Confidence

About wavemobile

- wavemobile is a small privately owned British MVNO who specialise in solving complex coverage issues in difficult to reach areas. With our partners at cellXica we design systems which are often bespoke and need particular features often unobtainable via conventional vendors. We also work alongside other operators, such as VMO2, on specialist projects.

- Based out of Surrey, our UK network is operating using completely home-grown technology with both software and hardware created entirely in the UK.

- Mixture of assets including numbering resources (IMSIs, MSISDNs, Global Titles, roaming agreements, core network infrastructure, RAN and expertise) combine to provide answers to most customer projects and form the backbone of wavemobile's connectivity.

- We have MAP and DIAMETER interconnects with a number of GSMA providers, and this supports our neutral host operations in the United Kingdom and other bespoke markets overseas.

- We do not use JOTS/NHIB/NHOD and strive for a true all-network Neutral Host solution.

UK Successes

- Cells deployed in rural Total Not-Spots with the majority in Wales and Scotland.

- Since our first cell went live in 2015 there has been:

Unique devices:	3,225,949
Calls Answered:	234,456
SMS's Sent:	230,148
Data Downloaded:	38.8TB
Data Uploaded:	8.14TB

- Over 180 Emergency calls, many of which have despatched Coastguard and Mountain Rescue.

- We seeing a million new devices a year across the network.

- The biggest growth came from the co-funded DSIT 5GDRIVE project in 2024.
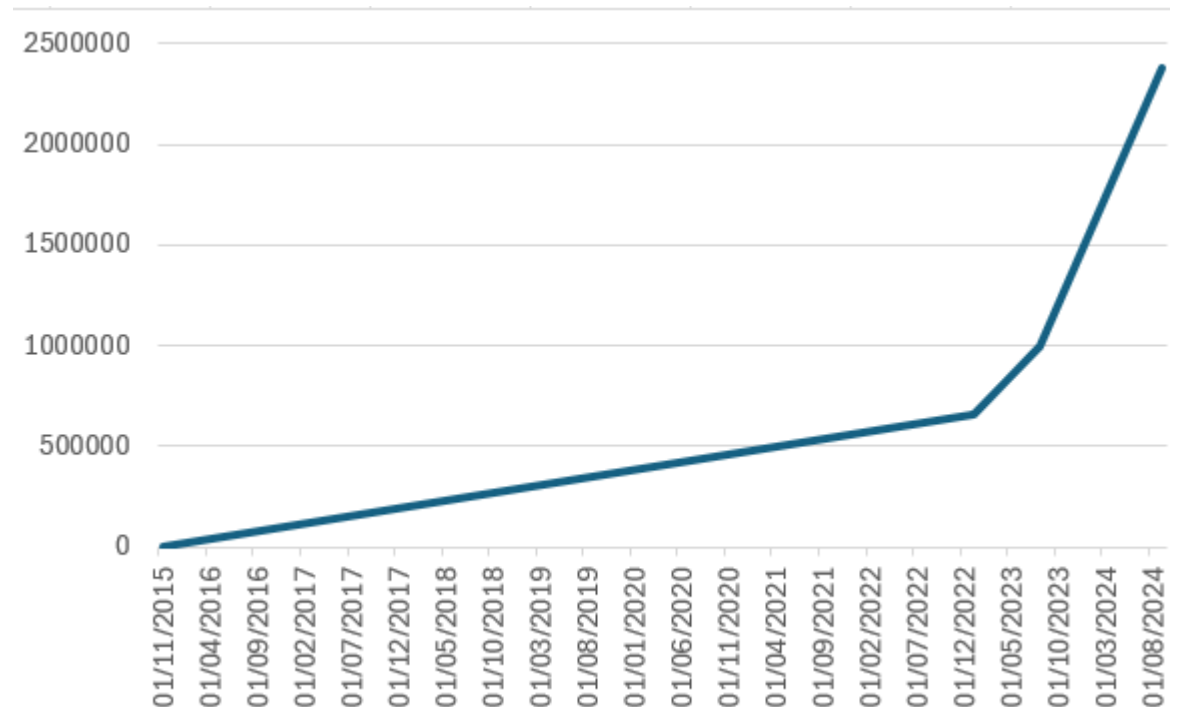
What we deploy

- cellXica M3Q 4G+2G 48 User cell and optionally a cellXica M5Q 5G SA 96 User cell (n77).

- Transmits our wavemobile 23404 PLMN code.

- Operates on Band 3 (1800MHz) for maximum compatibility with handsets, with a specialised GiLTE waveform to support both 4G+2G in limited (3.2MHz) spectrum.

- Backhaul is typically Starlink, WISP or locally provided fibre.

- As a Total Not-Spot solution, devices roam onto our network when there is no other coverage available and not until this case is satisfied.

- Whilst not presently seamless roving in and out of the big four, it is a truly shared "ultra rural" neutral-host network.

Once you have identified an indoor location that has a coverage issue, the main questions are:

- Who pays for it?

- How do you connect it to the MNO's?

- Obtaining spectrum to facilitate coverage.

- Is the current model optimal for ALL scenarios?

Indoor coverage challenges

Commercial...

Question	Possible Answers	Risks

Who owns the RAN?	• The building owner?
	    hotel
	    hospital
	    offices
	    stadiums and arenas
	
	• A Service Provider?
	    vehicle charging or parking operator
	    special event organizer (Arena)
	
	• The RAN operator?
	    wavemobile
	    Freshwave
	    Cellnex
	
	• The parent MNO?
	    VF3, O2, EE
		• How to get the initial CAPEX repaid.
		
		• How to get ongoing OPEX paid.
		
		• How to monetise the utilisation of the installation.

Indoor coverage challenges

Control…

Question	Possible Answers	Risks
Who ultimately controls the RAN?	If it is JOTS/NHIB/NHOD, then it is the parent MNO.	• You are an extension to the parent MNO, using their spectrum and their configuration. • The parent MNO can turn off sites at any time if there is a dispute. • The parent MNO decides on the SLA terms and you must comply.
	If it is a roaming based NH solution, then it is the MNO who installs the system, such as wavemobile.	• Domestic roaming is presently a challenge. Working with MVNO's is a good first step. • SAL spectrum can be capacity limited, LAL is sparsely available.

Indoor coverage challenges

Option: JOTS single network vs Roaming multi-network…

Technology Option	Upside	Downside
JOTS	• At least one radio per operator provides for ultra dense environments and multiple blocks of spectrum facilitate capacity, redundancy and consumer choice (ie: EE has coverage inside my local pub). • When it works well, it is effectively the MNO but operated by a third-party. The end user should not even know they are on a third-party network.	• Costly as each radio is a separate device, potentially with it's own antenna or combining technology. • Each radio is a separate power consuming entity, and without advanced power management and staging will be generating heat and costing per KW/h 24/7. • Potentially inefficient Carbon Footprint due to replication of networks to maintain independence from each other.

Indoor coverage challenges

Option: JOTS single network vs Roaming multi-network…

Technology Option	Upside	Downside
Roaming	• As few as one radio per ALL operators, with capacity layers (dynamically) added as needed. • Flexibility of radio equipment as the interfacing is at DIAMETER/SEPP not S1/NGAP. • Very power efficient vs four radio equivalence on JOTS (unless JOTS MNO's deploy a new single channel for MOCN working).	• Presently no in/outbound reselection as not on the MNO's cell plan. "No Service" bump required first. • User sees a different network name so may question what is happening. • This is a full MNO, so there is a lot more to cost in the initial deployment for the various core network and billing elements.

Indoor coverage challenges

Domestic Roaming… can it be done?

Technology Option	Initial Setup	Final Phase
3 launch (2006)	• 3 did not have UK-wide coverage so used O2 to fill in the blanks.	• 3's coverage is good enough that it doesn't need roaming (until 2025…)
Orange plus T-Mobile becomes EE (2009)	• T-Mobile can roam to Orange. • Orange can roam to T-Mobile.	• T-Mobile renames to EE. • Old Orange code still can roam on EE.
Vodafone plus Three become VF3? (2025…)	• Vodafone will roam to 3. • 3 will roam to VF.	• One of the networks will become the dominant provider (PLMN). • Old VF/3 SIM's will continue to roam on final network configuration.
NTN/DTC (2025…)	• One or more UK networks will allocate a PLMN to an NTN (or NTN will apply for it's own). • Roaming will be established between terrestrial MNO and NTN beaming signal into UK territory.	• Devices roam to NTN when out of terrestrial coverage.