

BBC National DAB Network Coverage & Indicative Expansion Plans

**A BBC Input to the Ofcom consultation on the
Approach to planning DAB build-out**

14 June 2011



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& Indicative Expansion Plans

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Introduction

As part of the work of the Coverage and Spectrum Planning Group of the Digital Radio Action Plan, the BBC has been working closely with Ofcom and Arqiva to develop a common set of planning assumptions and to apply those assumptions across all the UK's DAB multiplexes.

The Ofcom consultation to which this report forms an Annex presents current and planned coverage for each of the local multiplexes. This report shows the BBC's current national DAB coverage, and some early thoughts on future expansion plans.

The BBC's national DAB network has been operating since 1995, and has been expanded in phases since then. The current phase of expansion will result in indoor coverage for around 93% of the UK population by the end of 2011.

At the time of writing, plans are being put into place to extend that coverage to around 97%, subject to agreeing satisfactory commercial terms and formal sign-off by the BBC Executive and Trust. Indicative plans for the coverage which this expanded network is likely to provide are also shown, although it should be noted that the final choice of sites and the resulting coverage will be subject to further detailed design work by the BBC and its chosen transmission network provider.

Expansion of the BBC's national DAB network to be equivalent to that offered by the BBC national FM networks is discussed, although there is not yet a transmitter plan in place that will deliver that.

Disclaimer

All indications of coverage in this document, in both tabular and graphical form, are based on computer predictions. While the prediction model used has been checked and, as far as possible, verified, coverage in any particular location cannot be guaranteed.

The implementation of future coverage is also subject to financial approvals and suitable contractual arrangements being put into place. Details of the sites used may well vary from those shown.

The BBC DAB network is subject to international frequency coordination, and must as a result be conformant with the relevant entry in the Geneva 2006 Plan. The BBC network plan to the end of 2011 has been coordinated within the Geneva Plan. No attempt has yet been made to check the 97% coverage network is conformant with the Geneva Plan.

Prediction Method and Coverage Definitions

All predictions shown in this document have been made according to the prediction method and definitions of coverage shown elsewhere in this consultation. These are summarised below:

Mobile coverage	>99% locations, 99% time	Measured in km of roads covered
Indoor coverage	>95% locations, 99% time, plus 80 – 95% locations, 95% time, counted proportionally	Measured in households

The Limitations of Large SFNs

The BBC's national DAB network is operated across the UK as a single-frequency network (SFN). While this is a highly-efficient use of frequency resource, it does suffer from one major limitation.

The SFN mode specified for use by DAB has a guard interval of 246 μ s, equivalent to an "SFN Distance" of just under 74 km. This means, in practise, that any signal arriving from a transmitter more than 74 km away has the potential to cause interference to signals from nearby transmitters. While this is not normally a problem in local multiplexes (where generally transmitters are separated by less than 74 km), in large local, regional or national networks, this can start to be problematic. As more transmitters are added to a network, the potential for interference increases. While this can be, and is, mitigated by the use of "static timing" (whereby signals from more distant transmitters are advanced relative to those from nearby transmitters), this technique only offers partial relief.

The BBC network has already reached the stage where its coverage is, in places, being limited by self-interference. This is particularly obvious in the patchy coverage visible in Map A1 in the East Anglia area. As more transmitters are added to the network to improve coverage, the interference regime increases, paradoxically making coverage improvements harder.

Over the coming months, the BBC will be investigating various methods by which this effect could be mitigated, but it has not been possible to resolve this in time for the publication of this report.

Coverage in June 2011

As of 1 June 2011, the BBC DAB network consists of 196 transmitters across the UK, which provide the following coverages:

A list of sites which are on air on 1 June 2011 is given as Annex II.1.

Coverage Type	Nation	Population Coverage	Percentage Coverage	Map Reference
Indoor 99% time	All UK	26,151,305 hh	92.2%	A1
	England	22,187,177 hh	94.2%	
	Wales	1,094,365 hh	77.7%	
	Scotland	2,243,586 hh	86.9%	
	N Ireland	626,177 hh	78.6%	
Mobile 99% time	All UK	38,820.3 km	73.4%	A2
	England	29,186.8 km	82.1%	
	Wales	2,299.0 km	53.1%	
	Scotland	5,805.9 km	54.7%	
	N Ireland	1,528.4 km	64.1%	

Coverage by the end of 2011

By the end of 2011, the BBC expects to have brought a further 34 transmitters on-air, which will extend the network's coverage to 230 sites. Orders for these sites have been placed, and they are in the process of being built. In addition, the antenna at Belmont, in Lincolnshire, is being changed to enhance coverage towards the east coast.

A list of sites expected on air between June and December 2011, and which contribute to the expansion of coverage in that period, is shown in Annex II.2.

Coverage Type	Nation	Population Coverage	Percentage Coverage	Map Reference
Indoor 99% time	All UK	26,601,693 hh	93.8%	B1
	England	22,401,044 hh	95.1%	
	Wales	1,194,766 hh	84.8%	
	Scotland	2,337,206 hh	90.6%	
	N Ireland	668,677 hh	83.9%	
Mobile 99% time	All UK	40,530.6 km	76.6%	B2
	England	29,814.6 km	83.8%	
	Wales	2,661.9 km	61.5%	
	Scotland	6,361.8 km	60.0%	
	N Ireland	1,692.2 km	71.0%	

Coverage Expansion to around 97%

As part of its licence fee settlement with the Government in October 2010, the BBC has agreed to “enhance its national DAB coverage in the period of this agreement and to match FM coverage as a switchover date draws near.”

As a first phase in this enhancement, the BBC is working on plans to expand its national indoor DAB coverage to around 97% of the UK population. Note that this plan is still subject to detailed technical review, satisfactory contractual arrangements and to agreement from the BBC Trust. Information is given here to show the state of the plan as of 14 June 2011.

Where possible, sites have been selected from the local plans presented elsewhere in the Ofcom consultation. This allows maximum reuse of infrastructure between national and local networks, and hence reduces the costs for each. Only where a significant deficiency in coverage cannot be filled by one of these sites is an entirely new site proposed. The latest working list of sites expected to be included in this expansion of coverage to 97% is shown as Annex II.3. The local plan from which each is drawn, where applicable, is shown for cross-referencing purpose.

Coverage Type	Nation	Population Coverage	Percentage Coverage	Map Reference
Indoor 99% time	All UK	27,549,156 hh	97.2%	C1
	England	23,118,401 hh	98.1%	
	Wales	1,289,750 hh	91.6%	
	Scotland	2,448,424 hh	94.9%	
	N Ireland	692,581 hh	86.9%	
Mobile 99% time	All UK	43,563.8 km	82.4%	C2
	England	31,840.7 km	89.5%	
	Wales	3,093.4 km	71.5%	
	Scotland	6,913.2km	65.2%	
	N Ireland	1,716.4 km	72.0%	




It is proving increasingly difficult to identify deficiencies in the network coverage which can easily be filled without adding significantly to the existing intra-SFN interference. The effect of this is that any additional site, while adding population coverage in its immediate vicinity, can detract from coverage elsewhere in the network.

“FM Equivalence”

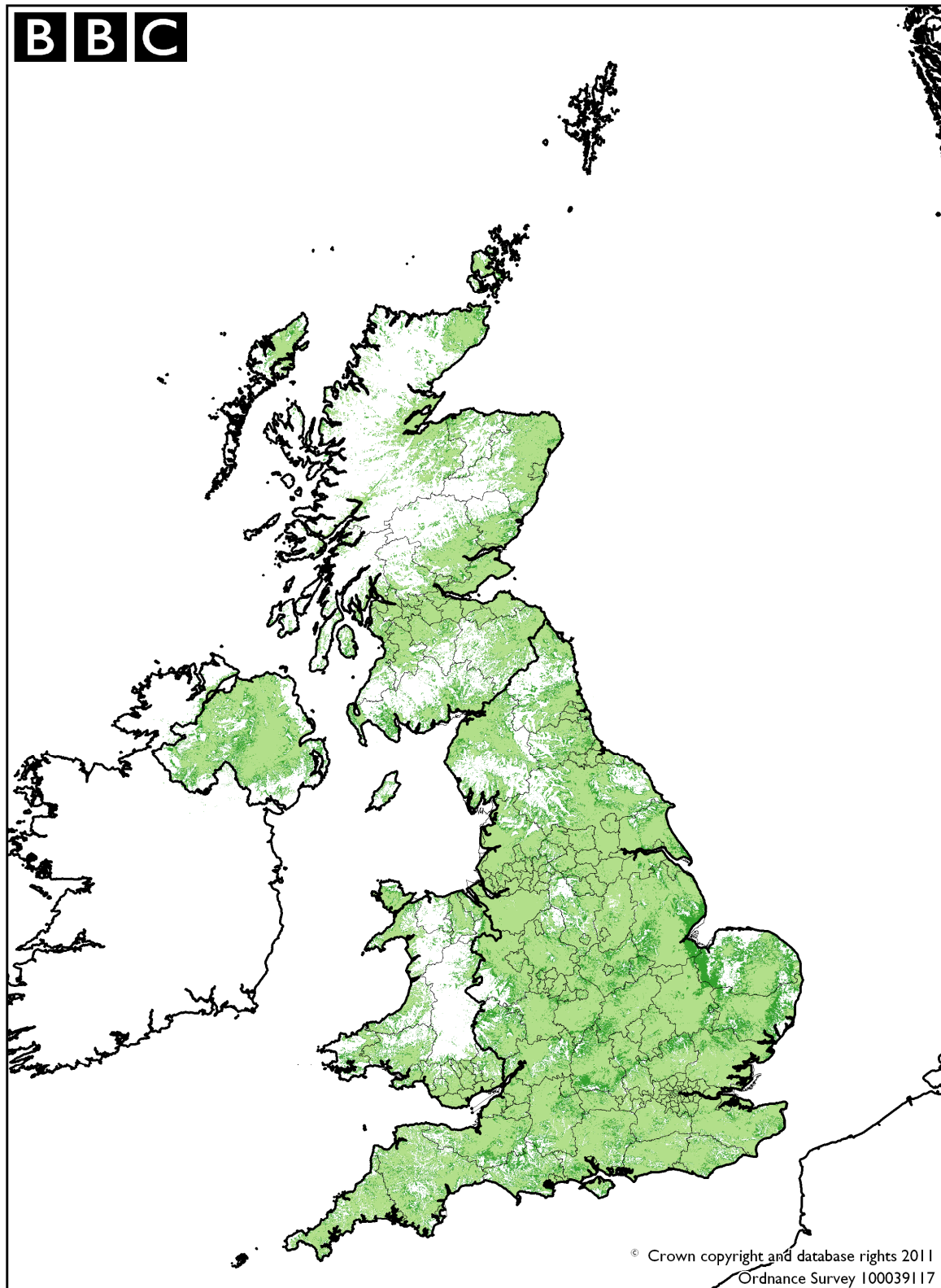
Ofcom predictions of the coverage offered by the BBC’s network radio services on FM show that BBC Radio 2 reaches 99.1% of the UK population, and covers 95.7% of the major road network.

The BBC does not yet have a technical plan for replicating this coverage with DAB. As discussed at the beginning of this document and elsewhere in the consultation, self-interference within the network is expected to become increasingly dominant as the network expands. Countering this will be a major challenge should the current definitions of coverage (in terms of percentage of locations required to be served, or percentage of time for which they must remain protected from interference) be retained.

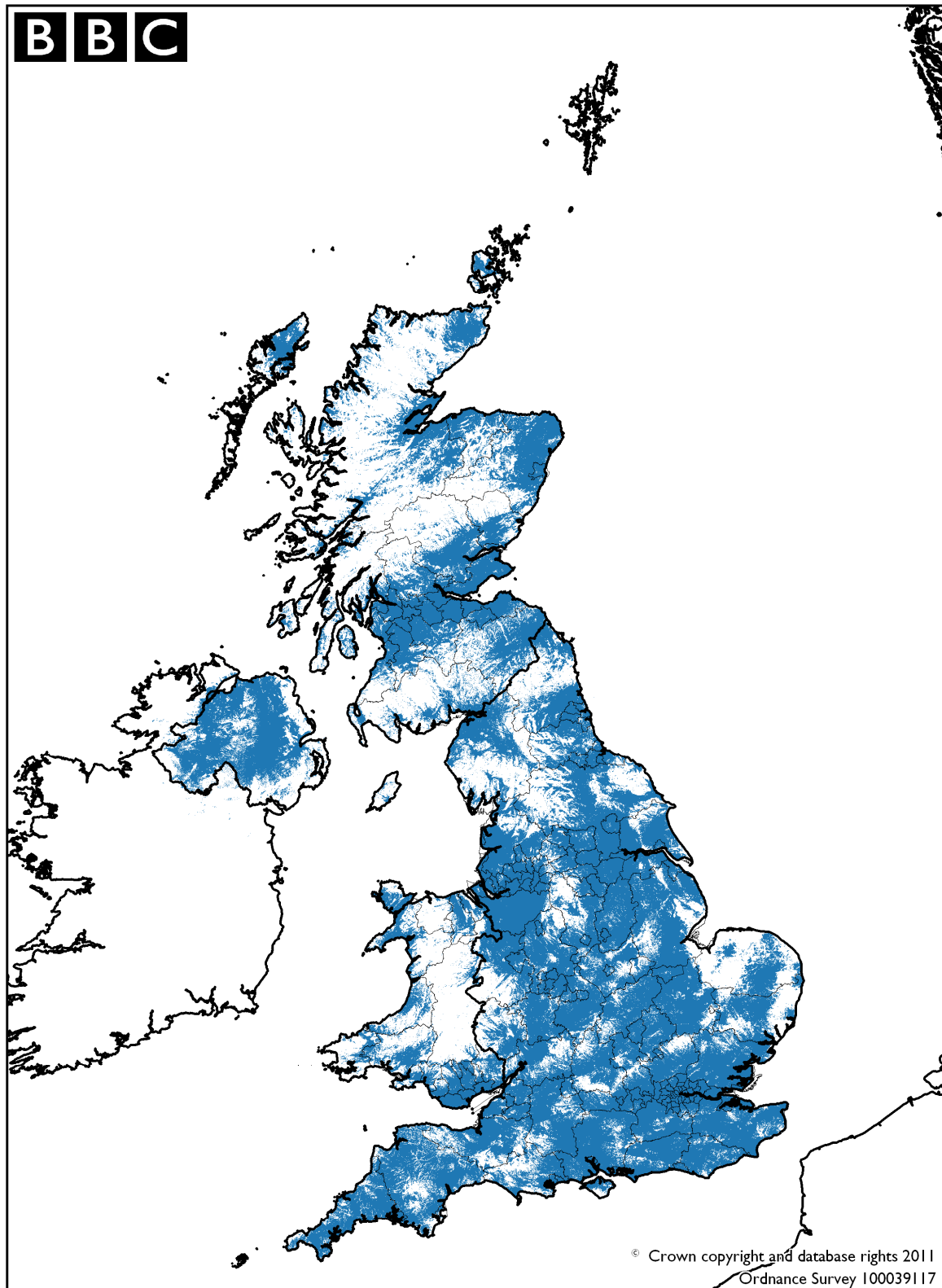
Key to Maps

	Good indoor Between 80% and 95% locations		Robust indoor Over 95% locations		Mobile Over 99% locations
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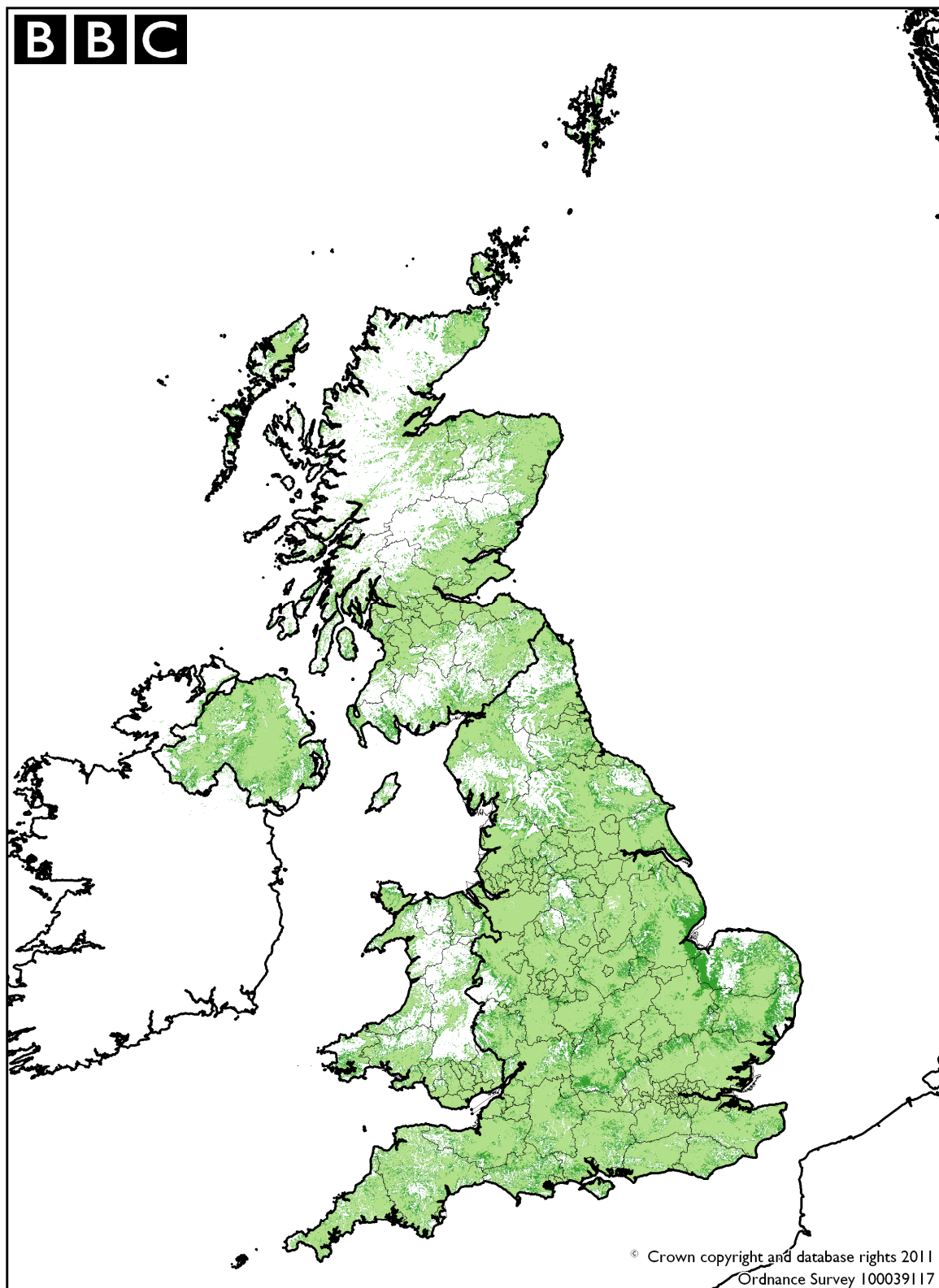
Annex I: Coverage Maps



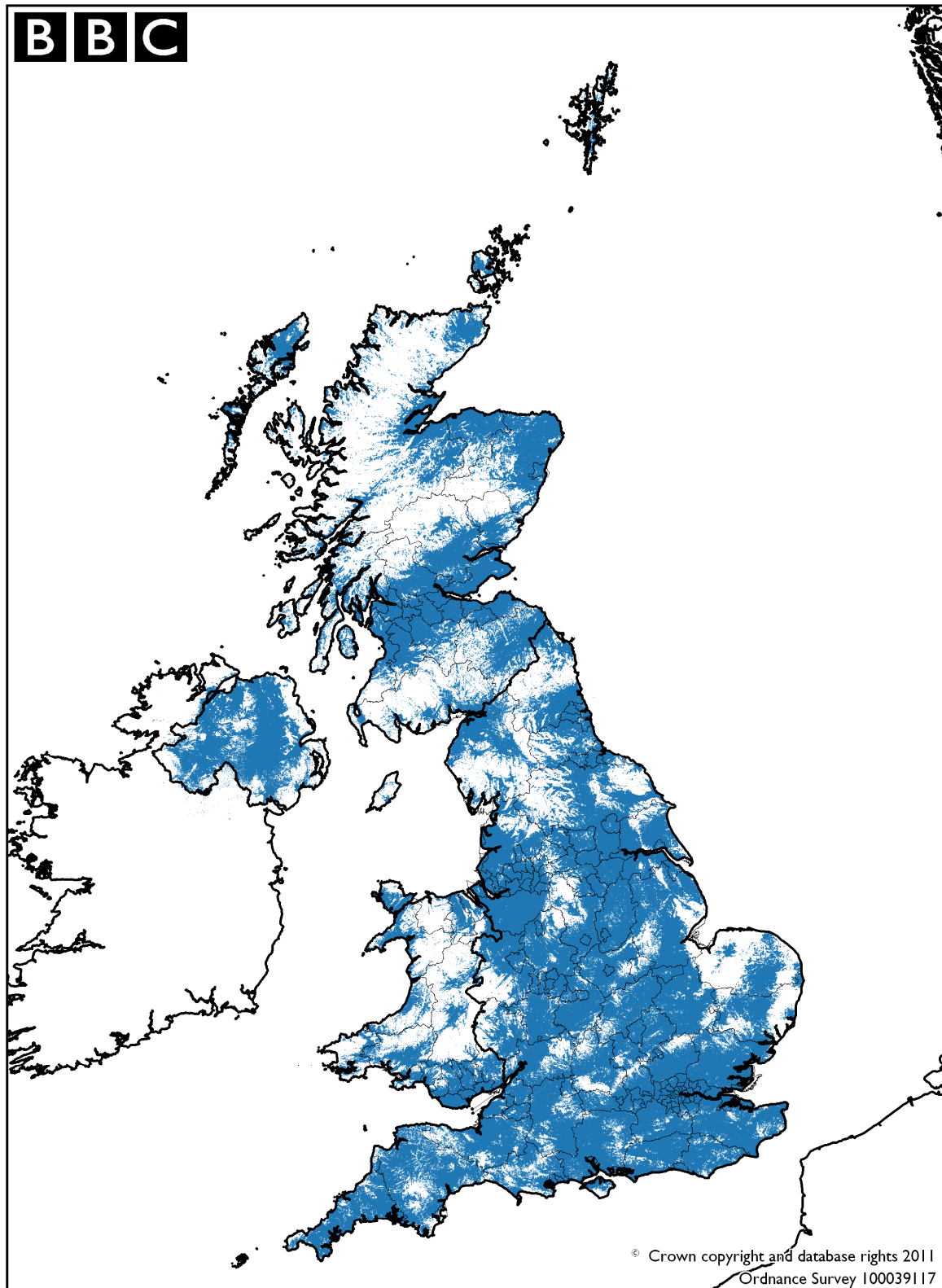
Map A1: BBC Network DAB Coverage, June 2011
Indoor Coverage, 99% time



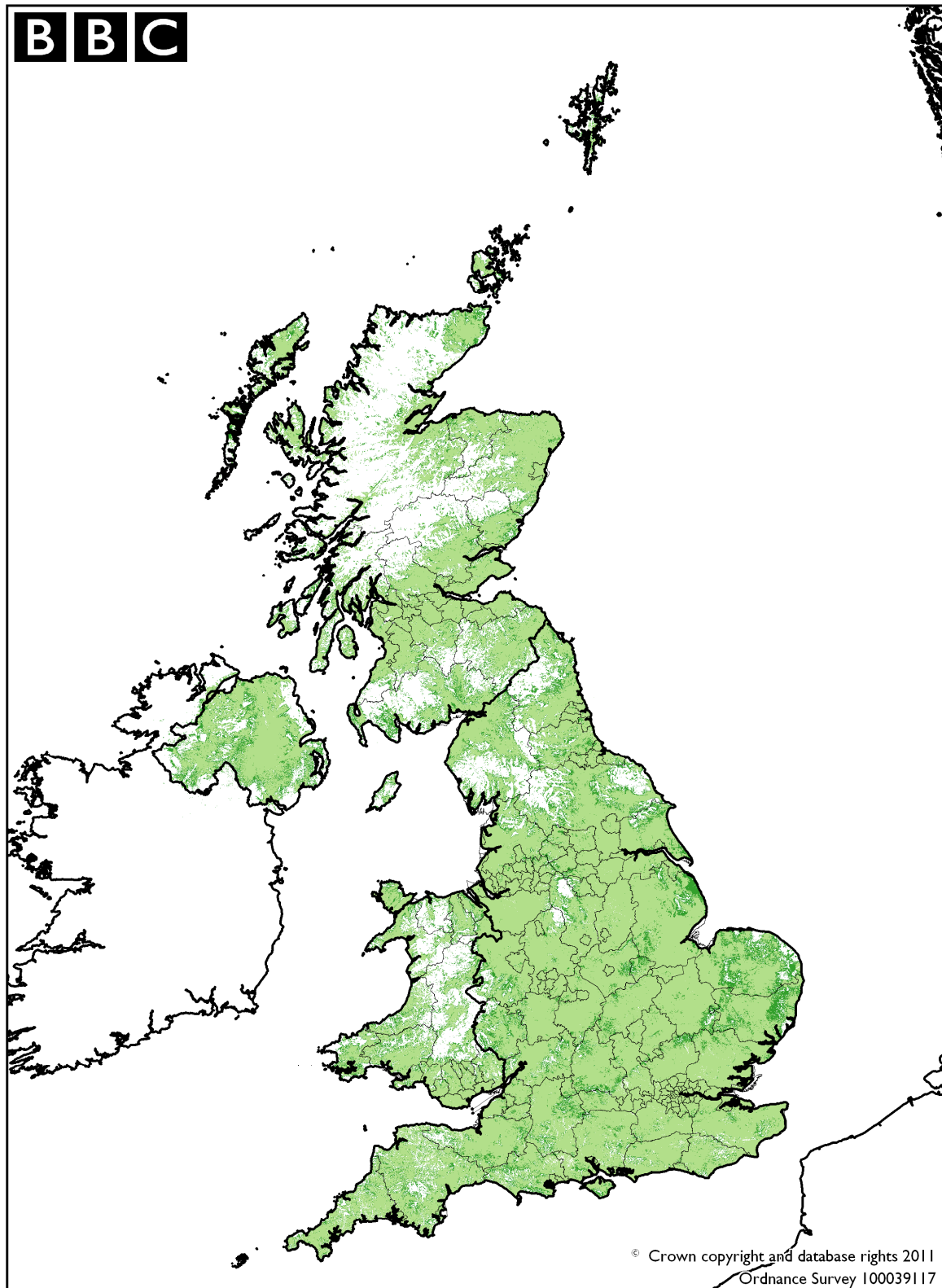
Map A2: BBC Network DAB Coverage, June 2011
Mobile Coverage, 99% time



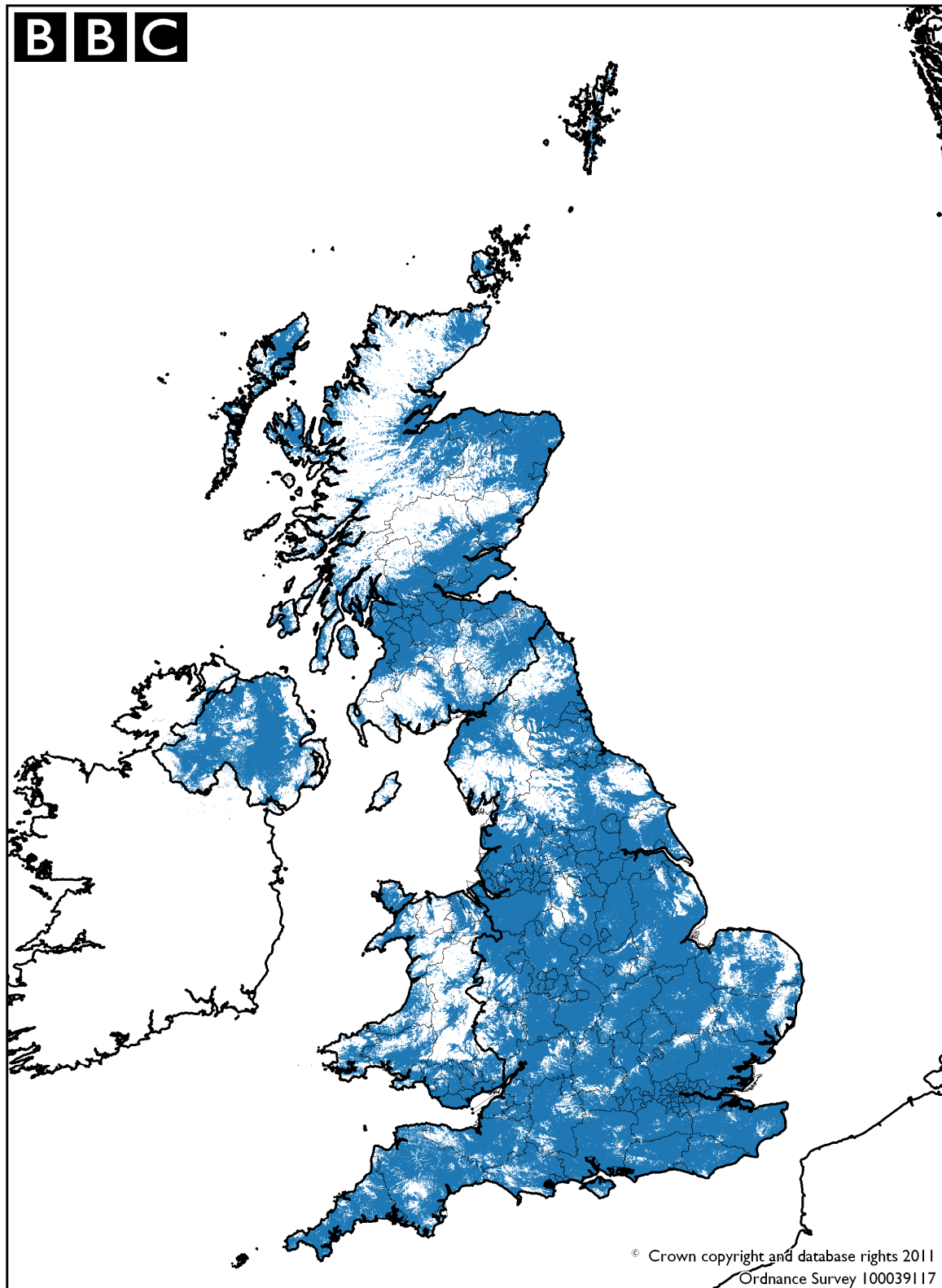
Map B1: BBC Network DAB Coverage, End 2011
Indoor Coverage, 99% time



Map B2: BBC Network DAB Coverage, End 2011
Mobile Coverage, 99% time



Map CI: BBC Network DAB "97%" Coverage
Indoor Coverage, 99% time



Map C2: BBC Network DAB "97%" Coverage
Mobile Coverage, 99% time

Annex II: Transmitter Lists

A II.1 June 2011 Network

Abergavenny	Danbury	Lancaster	Redruth
Abertillery	Darvel	Lark Stoke	Reigate
Acklam Wold	Daventry	Larne	Rhondda
Aldeburgh	Divis	Limavady	Rhymney
Alexandra Palace	Douglas	Littleborough	Ridge Hill
Alsagers Bank	Dover	Llanddona	Rosneath
Angus	Drumcarrow Craig	Llandecwyn	Rothsay
Arfon	Dumfries South	Llangollen VHF	Rowridge
Armagh	Durris	Londonderry	Rumster Forest
Ashford	Dursley	Long Mountain	Salisbury
Athelstaneford	Ebbw Vale	Maddybenny More	Sandale
Balgownie	Eitshal	Madingley	Sandy Heath
Barskeoch Hill	Emley Moor	Malvern	Selkirk
Bath	Enniskillen	Manningtree	Sergeants Law
Beacon Hill B	Eston Nab	Mapperley Ridge	Sewards End
Beecroft Hill	Exeter St Thomas	Massingham	Sheffield
Belmont	Eyemouth	Meldrum	St Austell
Bilsdale	Fenham	Membury	Stanton Moor
Bincombe Hill	Fishguard	Mendip	Stockland Hill
Blaenplwyf	Fishponds Hill	Mendlesham	Stoke D'Abernon
Bluebell Hill	Foel Fynyddau	Midhurst	Stoke Holy Cross
Blunsdon	Geddington	Millburn Muir	Strabane
Bow Brickhill	Grantown	Moel y Parc	Stranraer
Braid Hill	Great Yarmouth	Monmouth	Sunley Building
Bridlington	Guildford	Morecambe Bay	Sutton Coldfield
Bridport	Hannington	Mormond Hill	Tacolneston
Bromsgrove	Haslingden	Morpeth	Taunton
Brougner Mountain	Hastings	Mounteagle	Tay Bridge
Burton Down	Heathfield	Mow Cop	Thanet
Buxton	Helston	Mynydd Baedan	The Wrekin
Cambret Hill	Hemdean	Mynydd Machan	Tiverton
Caradon Hill	Hemel Hempstead	Naish Hill	Toot Hill
Carmel	High Hunsley	Newhaven	Truleigh Hill
Carnmoney Hill	Holcombe Down	North Hessary Tor	Truro
Cefn Eglwysilan	Holme Moss	Oban	Tully Quarry
Charing Hill	Holyhead South Stack	Olivers Mount	Tunbridge Wells
Chartham	Hungry Hill	Oulton	Turners Hill
Chatton	Huntshaw Cross	Oxford	Waltham
Chepping Wycombe	Idle	Penaligon Down	Wenvoe
Chesterfield	Ivybridge	Pendle Forest	West Runton
Christchurch	Keelylang Hill	Penmaen Rhos	Wharfedale
Churchdown Hill	Keighley	Penrith	Whitby Business Park
Clifton	Kendal	Peterborough	Whitehaven UHF
Cow Hill	Keswick	Plympton	Whitehawk Hill
Crabwood Farm	Kilvey Hill	Pontop Pike	Wickhambrook
Craigkelly	Kingsbridge	Poole	Windermere
Crieff	Kingussie	Presely	Winter Hill
Crockerton	Kirk O'Shotts	Pur Down	Wrotham
Crystal Palace	Kirkton Mailer	Puttocks Hill	Zouches Farm

A II.2 Additional Sites by End 2011

Ben Gullipen
Bressay
Broughton Moor
BT Tower London
Camlough
Carmarthen
Clee Hill
Clettraval
Coker Hill
Copt Oak
Crumhaugh Hill
Earl's Hill
Epping Green
Great Ormes Head
Greenhill
Heolgerrig
Knock More
Knott Hall Farm
Les Platons
Llandinam
Llandrindod Wells
Llanelli
Newcastle
Pitlochry
Pontypool
Quarndon
Shaftesbury
South Knapdale
St. Mawes Water Tower
Stockend Wood
Sunderland Hendon
Salloway
Trencreek
Varteg Hill

**BBC National DAB Network Coverage
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A II.3 Additional Sites for 97% Coverage

Site Name	Local Plan	Site Name	Local Plan
Aberdare	South East Wales	Creteway Down	Kent
Ainley Top	West Yorkshire	Daffy Green	Norfolk
Aldbourn Farm	Herts, Beds, Bucks	Dartmouth	South East Devon
Alton UHF	Surrey	Darwen	Central Lancashire
Ardovie Quarry	Perth and Dundee	Deiniolen	North West Wales
Ashbourne	Derby	Dolgellau	North West Wales
Ashburton	South East Devon	Dunkirk	Kent
Bagillt	Liverpool	East Grinstead	Sussex
Bala	North West Wales	Eastbourne	Sussex
Ballycastle	Northern Ireland	Ely Cathedral	Cambridge
Bampton	South East Devon	Felixstowe Docks	Suffolk
Bangor (NI)	Not in local plan	Findon	Sussex
Barrow Town Hall	Cumbria	Girvan	Glasgow
Basingstoke	Reading and Basingstoke	Glasgow Hilton	Glasgow
Beccles	Suffolk	Glossop	Manchester
Beer	South East Devon	Grantham	Lincolnshire
Benfleet	Essex	Grove	Nottinghamshire
Betws y Coed	North West Wales	Harlow (Rye Hill)	Essex
Bexwell	Norfolk	Harrogate Hildebrand	North Yorkshire
Biggar	Glasgow	Hartshill Quarry	Coventry
Birch Vale	Manchester	Haslemere	Surrey
Bishops Stortford	Herts, Beds, Bucks	Haverfordwest	Not in local plan
Blythburgh	Suffolk	Haydon Bridge	Tyne and Wear
Boars Hill	Oxfordshire	Hazler Hill	Wolverhampton & Shropshire
Bolehill	Derby	Heacham	Not in local plan
Boston Wyberton	Lincolnshire	Hebden Bridge	West Yorkshire
Bourne South Fen	Peterborough	Heyshaw	Not in local plan
Braintree	Essex	Hill of Foudland	Aberdeen
Brandon	Suffolk	Horsham	Sussex
Brecon VHF	West and Mid Wales	Hutton	Bristol and Bath
Bretch Hill	Oxfordshire	Hythe	Kent
Brixham	Not in local plan	Icomb Hill	Gloucestershire
Brown Carrick Hill	Glasgow	Innerleithen	Edinburgh
Bude	Cornwall	Jedburgh	Edinburgh
Budleigh Salterton	South East Devon	Kenley	London
Bungay	Suffolk	Kings Lynn	Norfolk
Burnham	Not in local plan	Kinross	Edinburgh
Calver Peak	Not in local plan	Kirkconnel	Dumfries
Cambeltown	Glasgow	Knebworth	Not in local plan
Cefn Mawr	Not in local plan	Ladder Hill	Not in local plan
Chard	Somerset	Langholm	Dumfries
Chesham	London	Leamington Spa	Coventry
Chudleigh	South East Devon	Leek	Stoke on Trent
Clun	Wolverhampton & Shropshire	Leicester Cardinal	Leicestershire
Clyro	West and Mid Wales	Les Touillets	Not in local plan
Colkirk	Not in local plan	Letchworth	Not in local plan
Conway	Not in local plan	Lickey Hills	Birmingham
Coppid Beach	Reading and Basingstoke	Lincoln Clayton Rd	Lincolnshire
Coxbank Farm	Stoke on Trent	Little Oxenden	Leicestershire
Crawley	Sussex	Llandyfriog	West and Mid Wales

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Site Name	Local Plan	Site Name	Local Plan
Llanidloes	North West Wales	Scunthorpe VHF	Lincolnshire
Luddenden	West Yorkshire	Sedgley Beacon	Birmingham
Ludlow	Wolverhampton & Shropshire	Shilbottle	Tyne and Wear
Lyme Regis	South East Devon	Sidmouth	South East Devon
Machynlleth	North West Wales	Skegness Candlesby	Lincolnshire
Maesteg	Swansea	Skinningrove	Teeside
Maidenhead	Reading and Basingstoke	Skipton UHF	North Yorkshire
Melvaig	Inverness	Skriaig	Inverness
Mickleham	Surrey	Slapton	Plymouth
Moffat North	Dumfries	St Catherine's Hill	Bournemouth
Mynydd Pencarreg	West and Mid Wales	St Erth	Cornwall
Mynydd Sylen	Swansea	St John's Beacon	Liverpool
Nebo	North West Wales	St Just	Cornwall
Newton	Tyne and Wear	Stamford Old Quarry	Peterborough
Newtonards	Not in local plan	Stocksbridge	South Yorkshire
Nine Barrow Down	Bournemouth	Sudbury	Suffolk
Northampton	Northampton	Swaffham	Not in local plan
North Walsham	Not in local plan	Swingate	Kent
Ogmore Vale	Swansea	Tenby	Swansea
Okehampton	North Devon	Thetford	Norfolk
Peebles	Edinburgh	Thornhill	Dumfries
Penicuik	Edinburgh	Todmorden	West Yorkshire
Peterlee	Tyne and Wear	Tullich	Aberdeen
Poron	Cornwall	Ventnor	South Hampshire
Port Ellen	Inverness	Warbreck	Central Lancashire
Port St Mary	Not in local plan	Warren Heath	Suffolk
Portsdown Hill	South Hampshire	Weardale	Teeside
Pye Green	Stoke on Trent	Wells next the Sea	Norfolk
Quainton	Herts, Beds, Bucks	West Wycombe	Herts, Beds, Bucks
Ramsey	Not in local plan	Whalley	Central Lancashire
Redmoss	Aberdeen	Whitworth	Manchester
Rheola	Swansea	Winchcombe	Gloucestershire
Rhosfach Farm	Wolverhampton & Shropshire	Winterborne Stickland	Bournemouth
Romaldkirk	Teeside	Wisbech	Peterborough
Rye	Sussex	Woldingham	London
Saddleworth	Manchester	Woodbridge	Suffolk
Samuel Vale House	Coventry	Wrexham Rhos	Not in local plan