WESTERN POWER DISTRIBUTION

INNOVATION

NEXT GENERATION NETWORKS

Next Generation Wireless Telecommunications Project

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Agenda

- Overview of the NIA Next Generation Wireless Project
- Objectives
- Results
- Conclusions
- Network cost
- **Next steps**

Overview of current NIA Wireless project

WPD's network:

- Serves 7.7 million customers
- Covers 55,500 km^2
- Consists of:
  - 92,000km overhead lines
  - 129,000km underground cables
  - 185,000 transformers

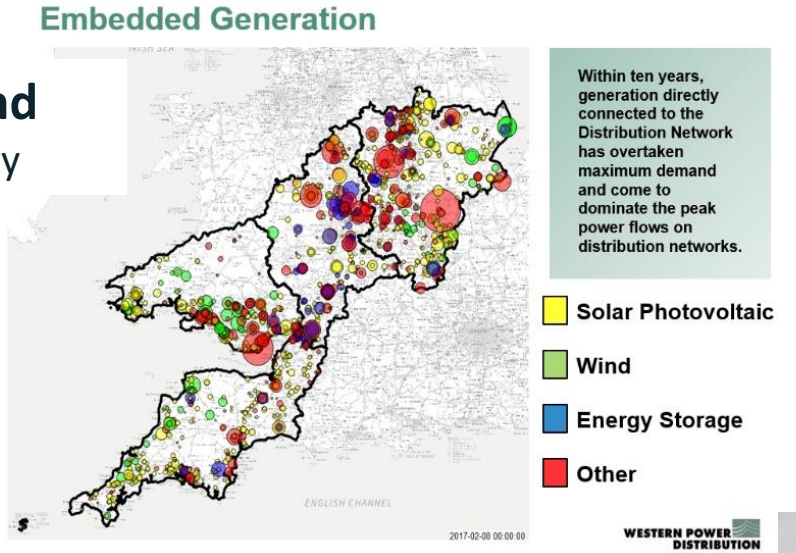
Selected West Midlands & South West as representative of WPD area

Overview of current NIA Wireless project

Increased Diversity of Supply & Demand

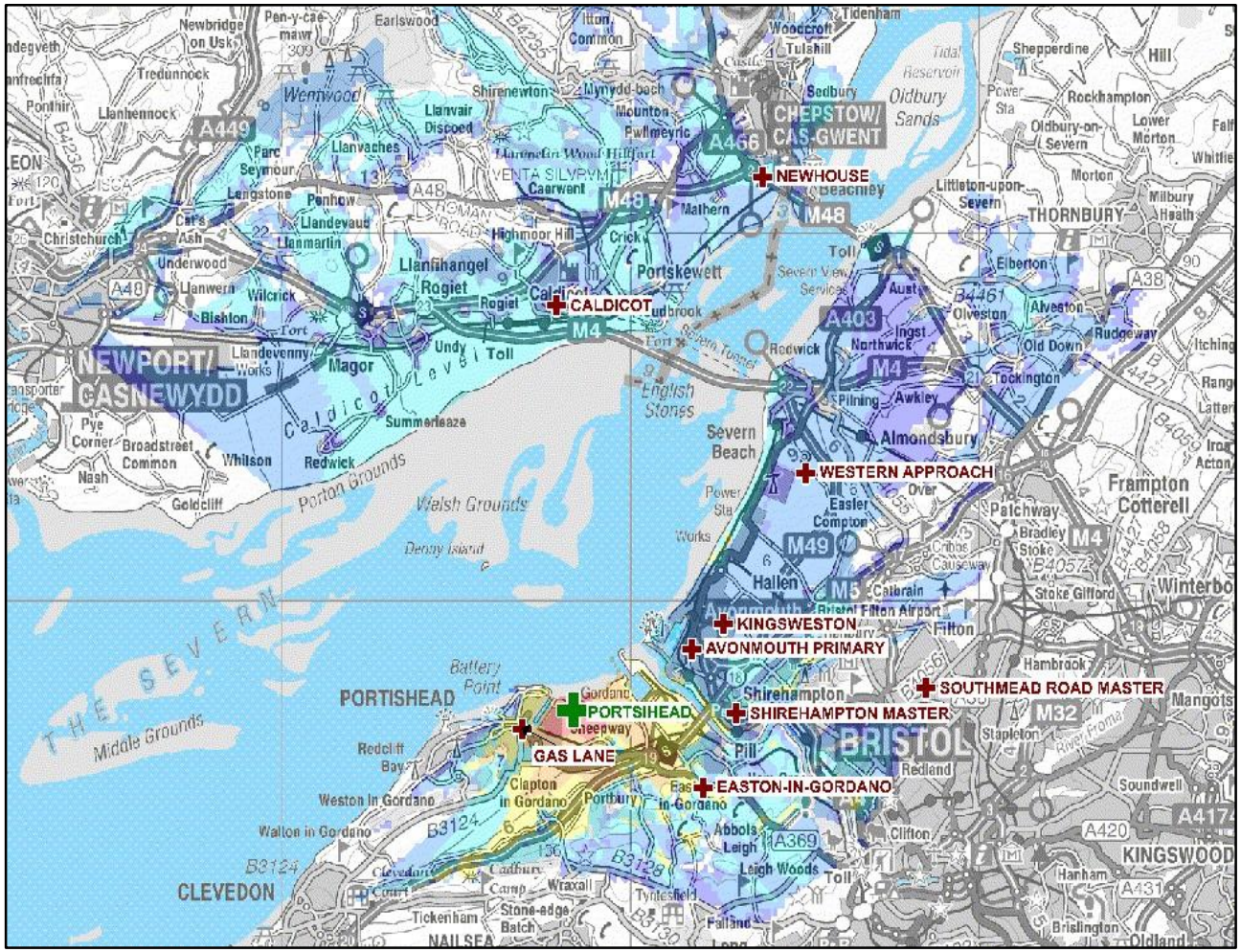
The need for enhanced communications capability

- Distributed Generation
- Enhanced Demand, EVs
- Enhanced asset visibility and control
- Wireless enables rapid and cost-effective deployment
- New technology offers enhanced bandwidths
- Enabling a diversity of data streams from hundreds of thousands of geographically dispersed points



Concluded that as a first approximation to focus connectivity on substations (190,000 of them)

Overview of current NIA Wireless project



Performance based on Tri-sector eLTE trial at Portishead using 3MHz TDD channel at 416 MHz

Overview of current NIA Wireless project

Tri-sector 416 MHz LTE base station mast at Portishead Bulk Supply Point

Diversity reception LTE antennas at Kings Weston primary substation

LTE analysis based on WPD trial around Portishead substation

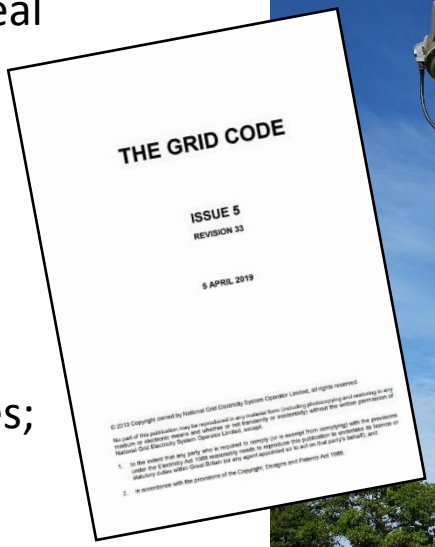
Objectives

Enabling Network Functionality

Facilitating the DNO to DSO Transition

Active Network Management & enhanced real time monitoring;

- Real & reactive power flows at strategic locations in network;
- Direction of power flows for both real & reactive power;
- Voltage magnitude & phase angle;
- Switchgear status, operations and failures;
- Transformer tap positions;
- Protection operations;
- Automation;
- Power quality data capability: and
- Asset condition monitoring.


THE GRID CODE

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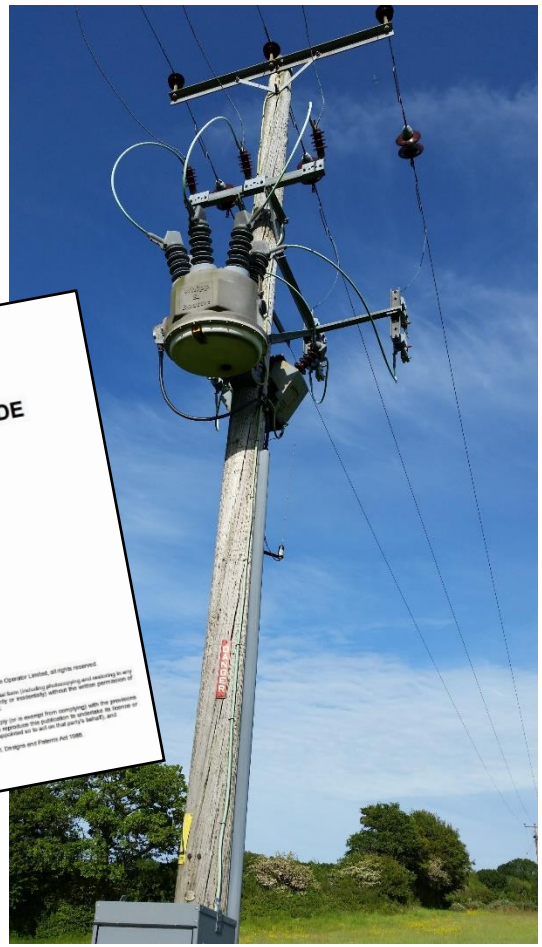


DSO transition requires continuous analogue measurements at more regular intervals than previously plus more alarms & controls

Objectives

Total number of bits:
(6144 bits per 'analogue' measurement)

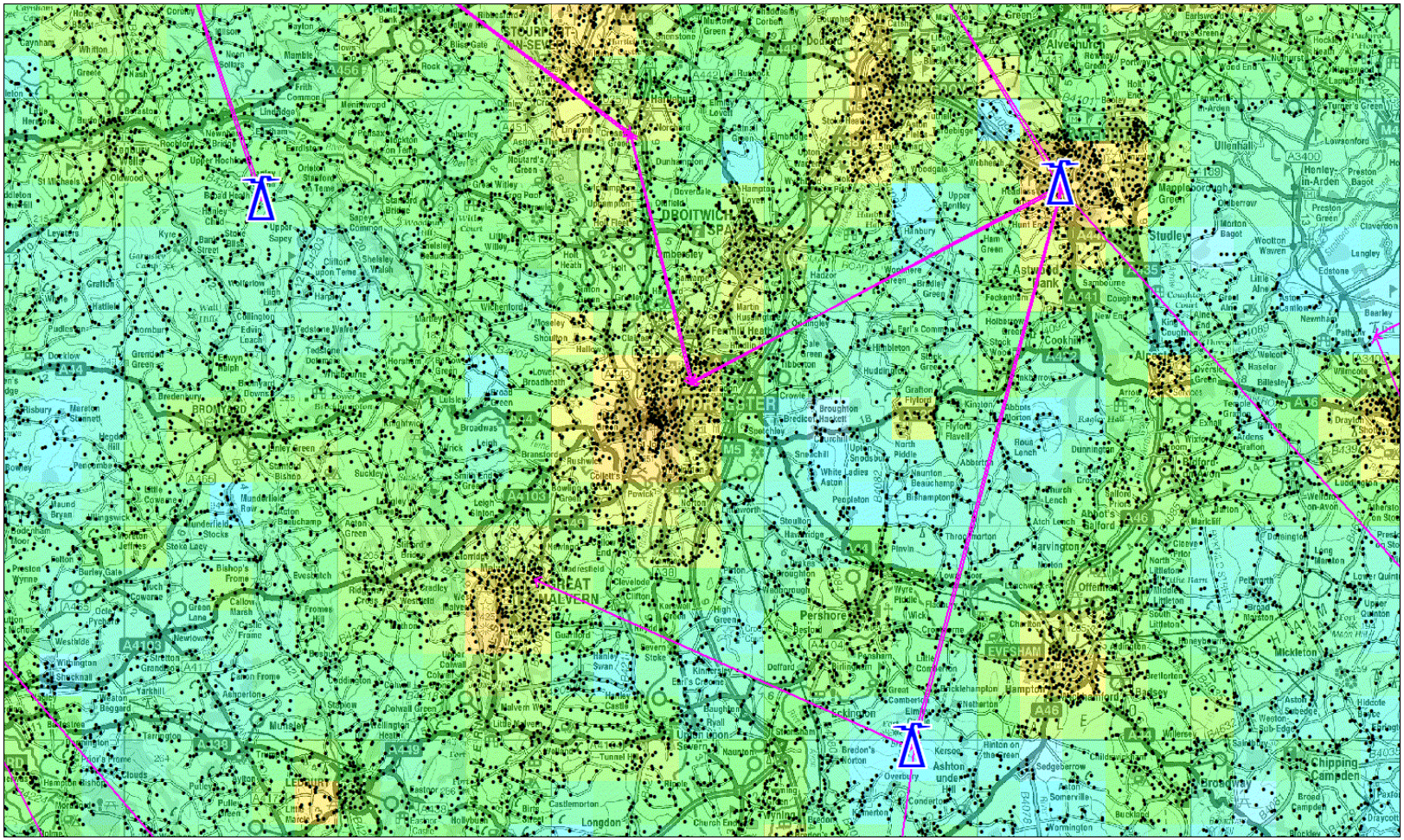
	Number of Sites	Analogue measurements per site	Total Number of Analogue Measurements	Proportion of Total Analogue Measurements	Single Substation kBits	All Substations GBits
Primary Substations	1600	50	80000	1.6%	307.2	0.5
Distribution Substation	193000	25	4825000	98.4%	153.6	29.6
	194600		4905000			30.1

Digital data discounted from initial analysis as insignificant compared to analogue requirements.

Average data volume 154.9 kbits per substation

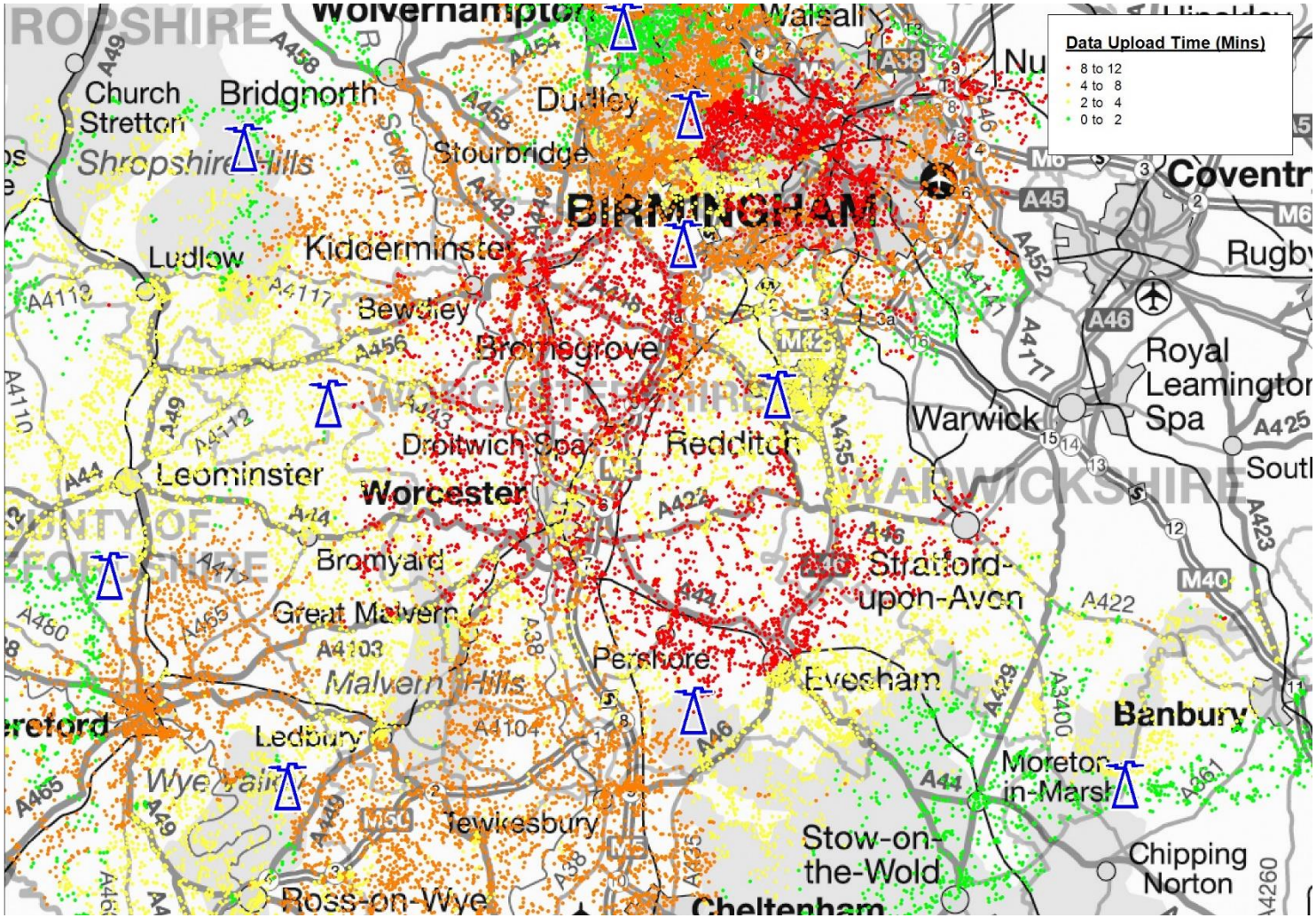
Estimate of the amount of data required to be uploaded when connectivity is restored following an interruption

Objectives



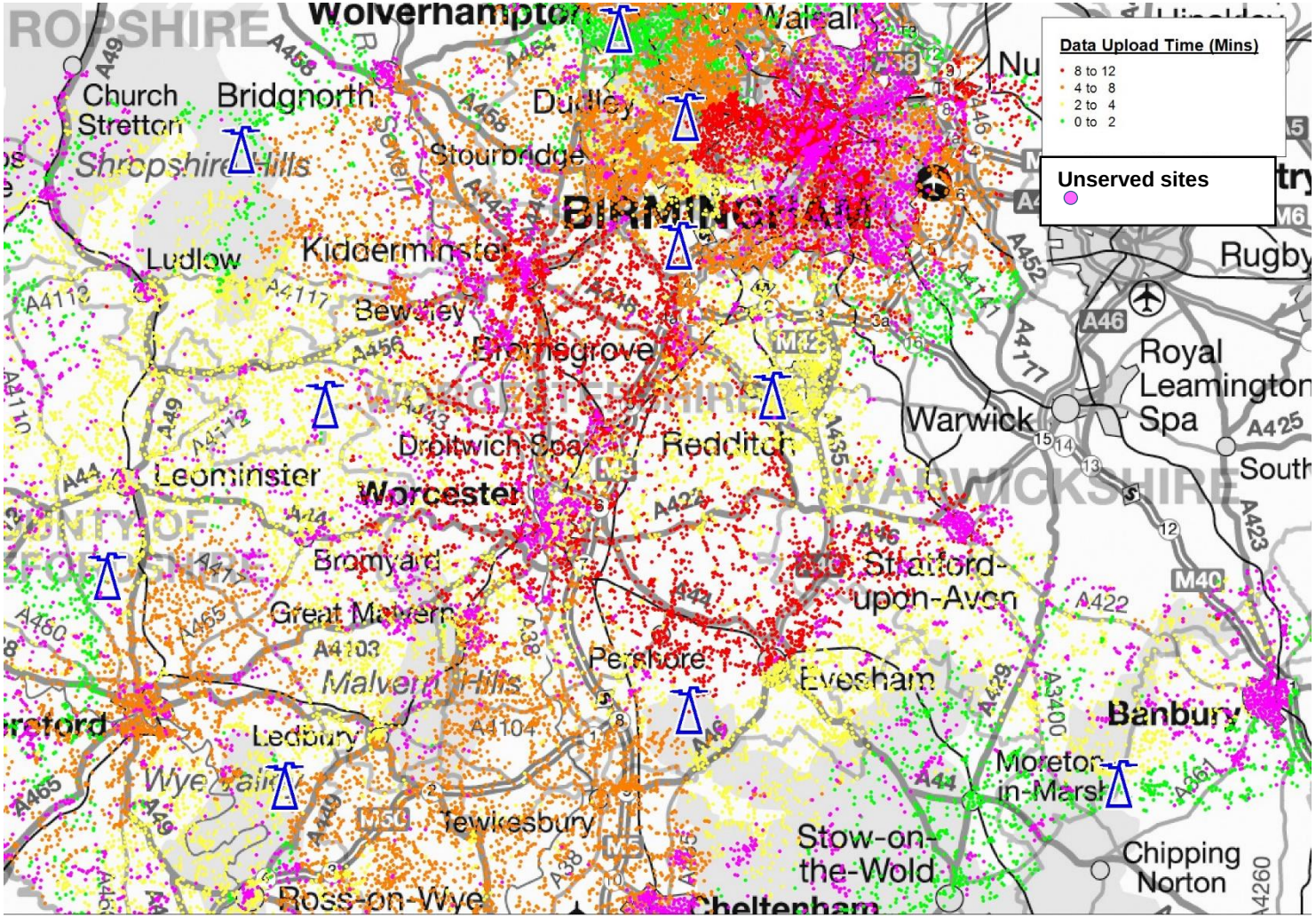
All substations mapped together with existing WPD telecoms assets to assess how to provide connectivity

Results – West Midlands



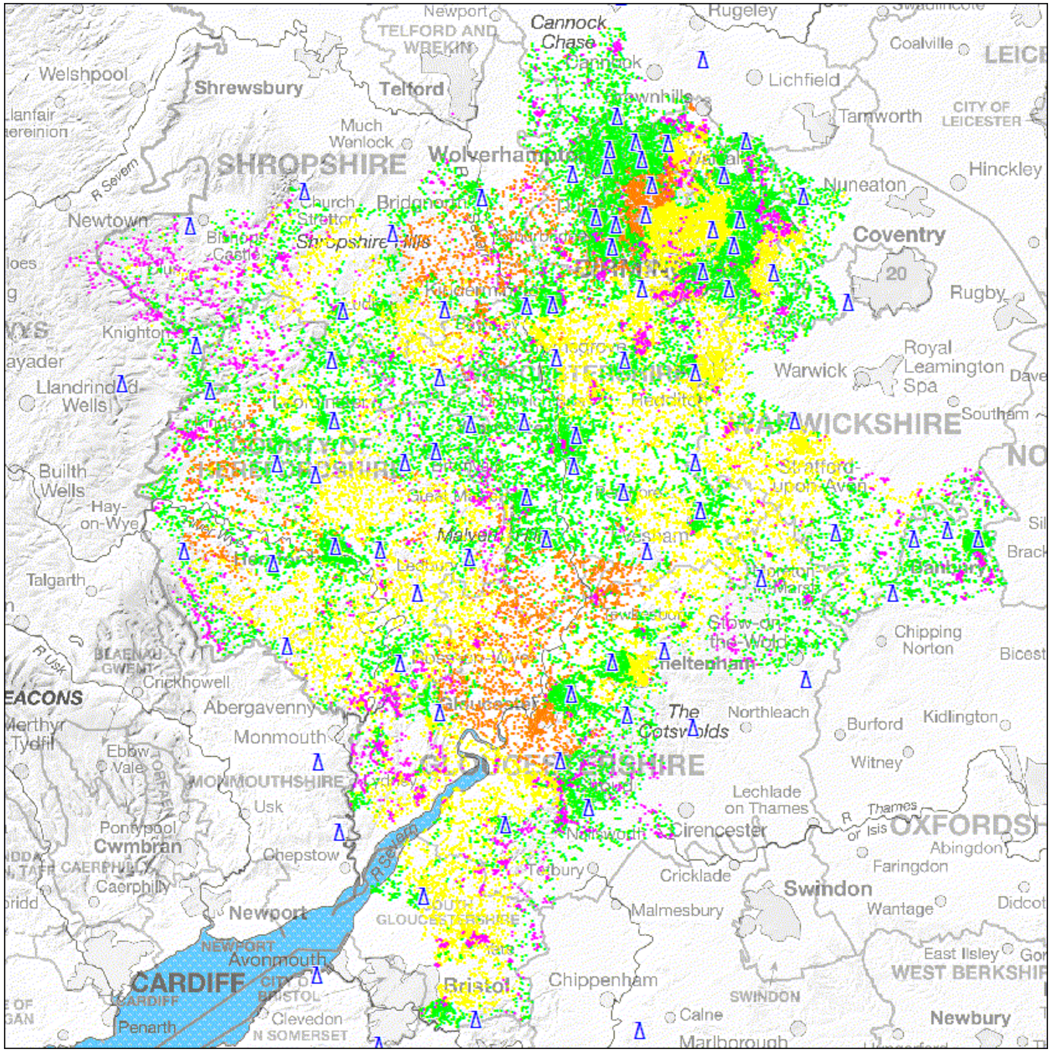
Initial analysis of Birmingham area illustrating capacity issues

Results – West Midlands



Initial analysis of Birmingham area illustrating coverage issues

Results – West Midlands

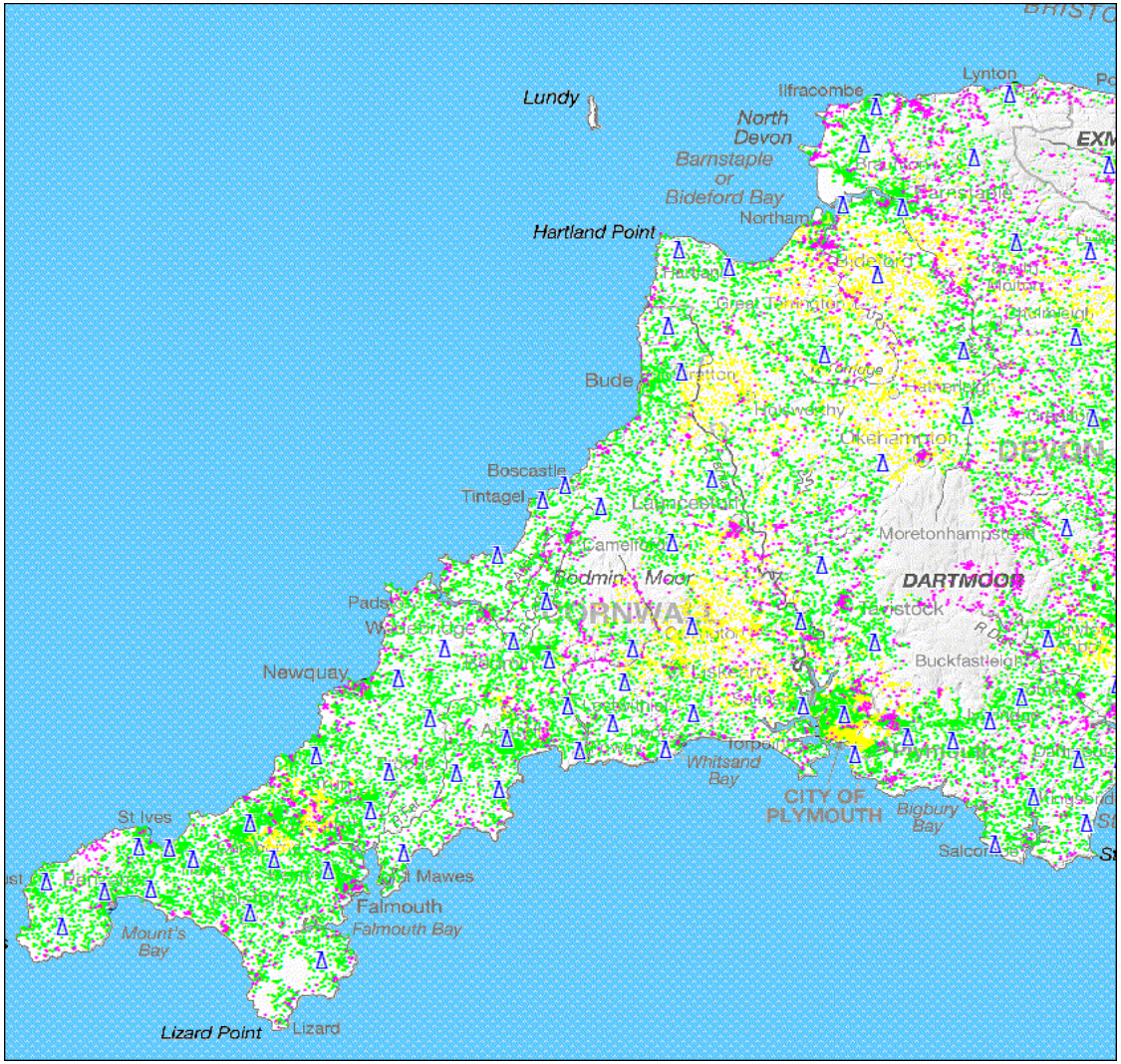


Upload Time (Mins)

- 4 to 8
- 2 to 4
- 0 to 2
- Unserved

Analysis of West Midlands area showing final solution

Results – Devon & Cornwall



Analysis of far South-West showing final solution

Results

	Scanning Telemetry	DMR	Primary Substation	WPD Depot	Microwave Link	New/Third Party	Total
West Midlands	28	15	40	1	2	4	90
South West	38	6	69	1	0	25	139

Base stations sites required to achieve roughly 90% coverage of all substations in an area can still be mainly based on WPD assets

Results

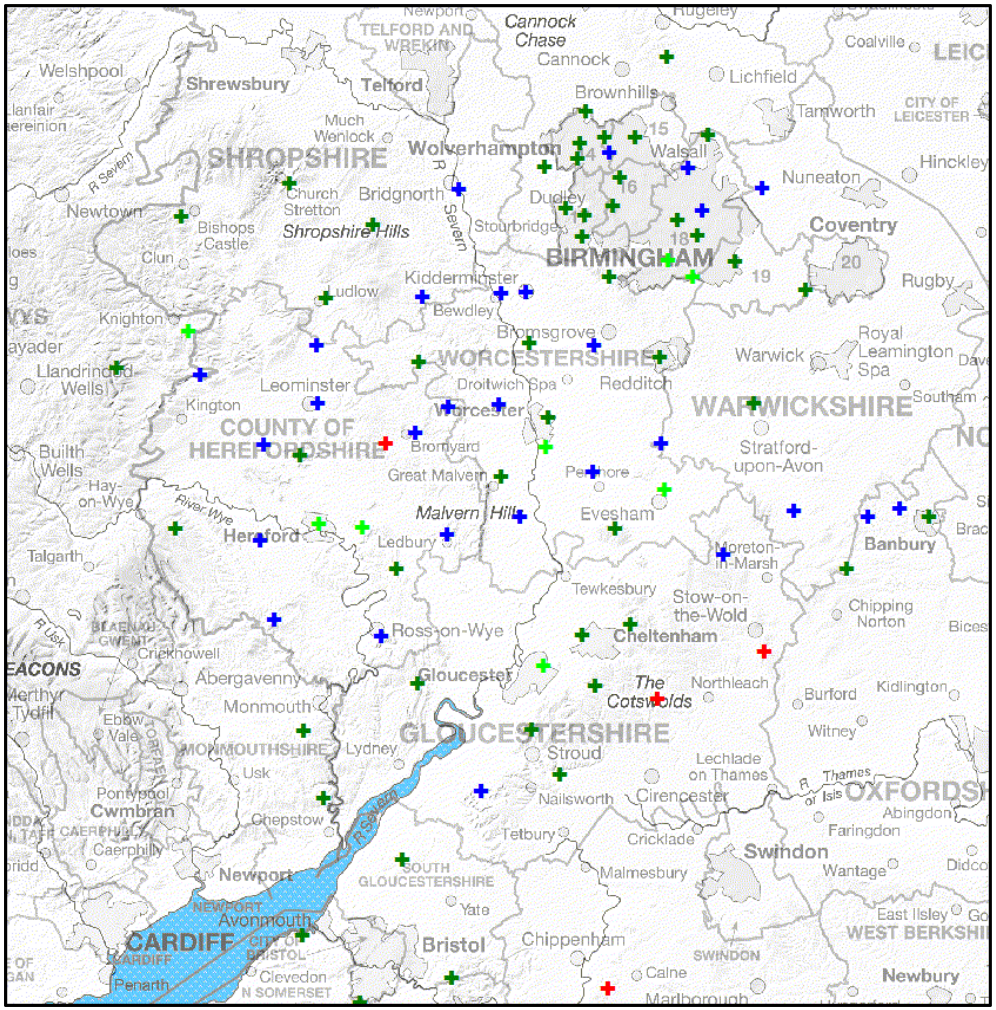
West Midlands	Primary	Distribution	Total
No. of Substations	198	40863	41061
Served: Antenna 2m agl			
249 Sectors	**Primary**	**Distribution**	**Total**
	183	37232	37415
	92.4 %	91.1 %	91.1 %

South West	Primary	Distribution	Total
No. of Substations	545	53036	53581
Served: Antenna 2m agl antenna			
403 Sectors	**Primary**	**Distribution**	**Total**
	510	47123	47633
	93.6 %	88.9 %	88.9 %

NOTE: Transmitters are defined in terms of 'sectors' not base stations (which may have up to six sectors)

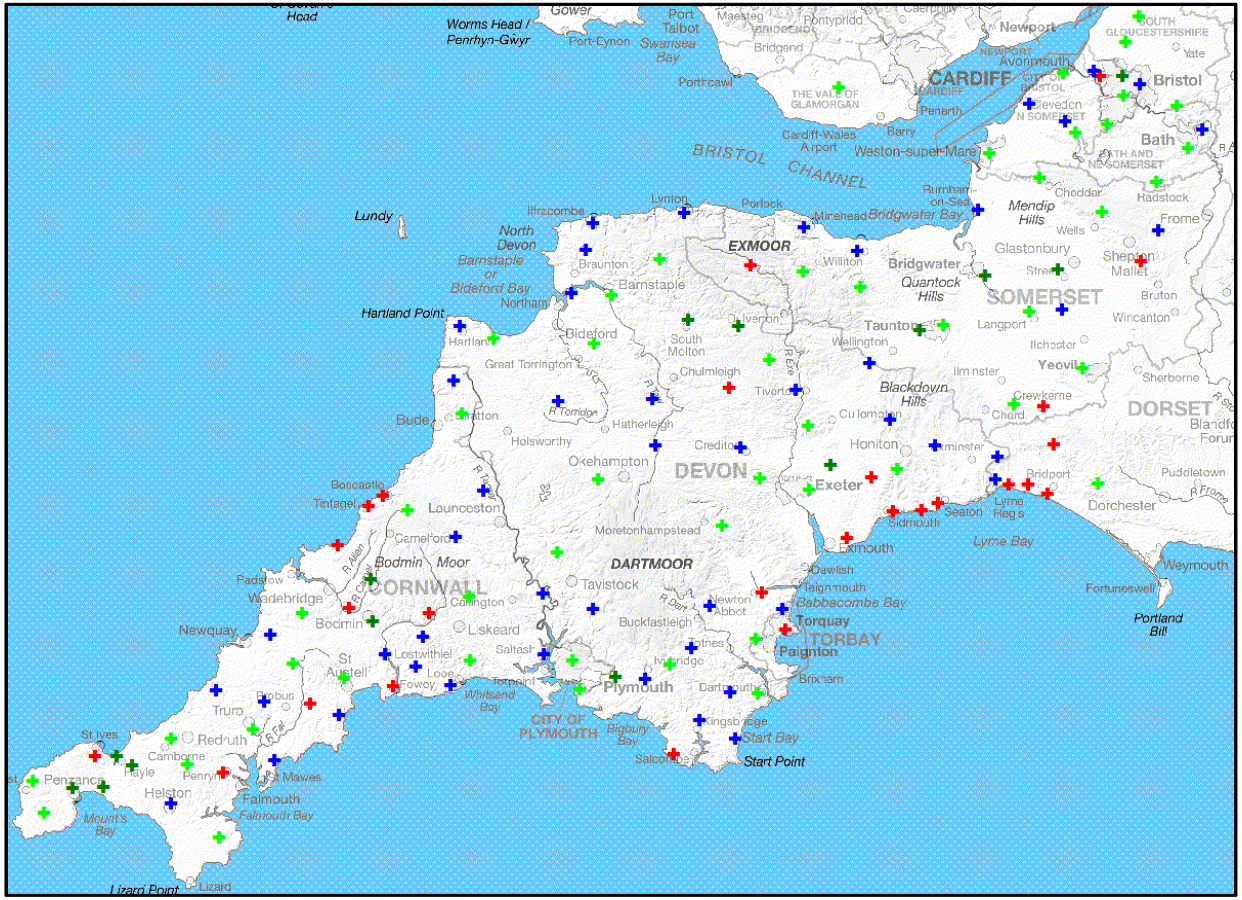
Target of 90% coverage of all substations can be achieved

Results – backhaul



Backhaul is manageable in West Midlands

Results – backhaul



Backhaul Feed Status

- Existing Microwave Link
- Existing Fibre Link
- Link Solution Required
- New Microwave Link Possible

Backhaul is more challenging in South-West

Conclusions

- Coverage more of an issue in rural areas, capacity in urban areas.
- Current model predicts coverage of 90% of all WPD substations.
- Majority of radio sites required for the new wireless network can be sourced from existing WPD estate, leveraging existing WPD assets, easing ‘out of hours’ access when required, and making it easier to deliver redundant backhaul routing and resilient power supplies.
- Directional antennas at outstations not favoured due to installation costs, vandalism concerns and possible loss of resilience.
- Outstation antenna height of 2m above ground level used for analysis.
- Serving remaining 10% of sites will require careful judgement between benefit of the data recovered from remote sites, cost of additional base stations and use of directional antennas at increased height.
- Additional sites & backhaul carry added benefits as WPD need these for increased SCADA in any eventuality.
- 2 x 3 MHz for LTE (or 1 x 5 MHz for eLTE) required for wireless network.[5MHz TDD channel to avoid installing MIMO antennas at outstations & interferen

Conclusions - antennas

Typical Ground-mounted 11kV – 400/230V distribution substation

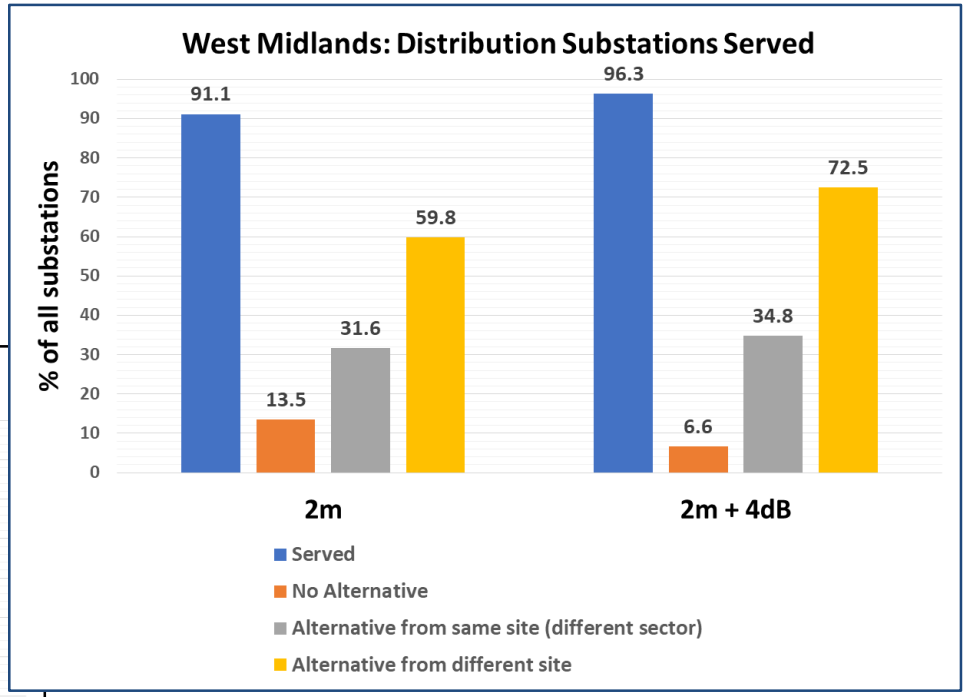
Flat profile antenna mounted on roof of GRP cabinet

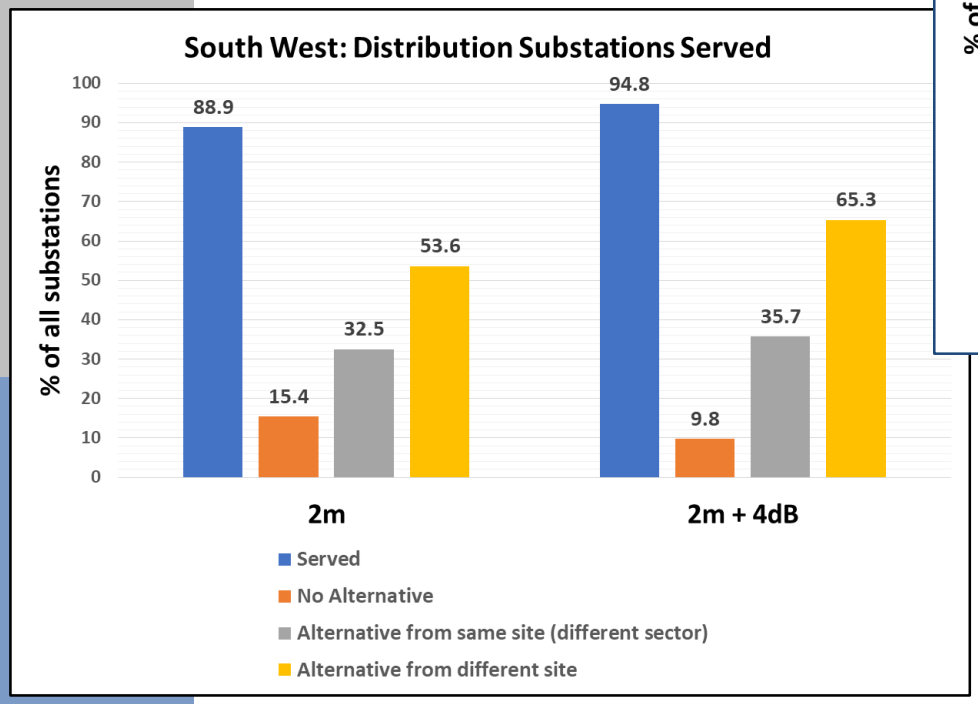
Whip antenna mounted on pole below live electrical apparatus

Pole-mounted 11kV – 400/230V distribution substation

Height and form of outstation antenna major influence on coverage

Conclusions - resilience





Omni-directional outstation antennas will provide greater resilience

Network cost

- *CPE (Customer Premise Equipment) dominate network costs.*
- *Outstation (CPE) roll-out and costs will be aligned with other network investments, eg active network management.*
- *If LTE chosen, outstation costs will be similar even if a commercial network used instead of a private network.*
- *Outstations investment will be more beneficial if served by highly available private network rather than lower availability public carrier.*
- *May be opportunity to leverage private LTE solution to facilitate local network switching via tablets and wide area voice.*
- *Rollout can be prioritised on constrained areas (Bulk Supply Points) if required.*
- *Network infrastructure costs will be a minor element of the overall smart grid investment.*

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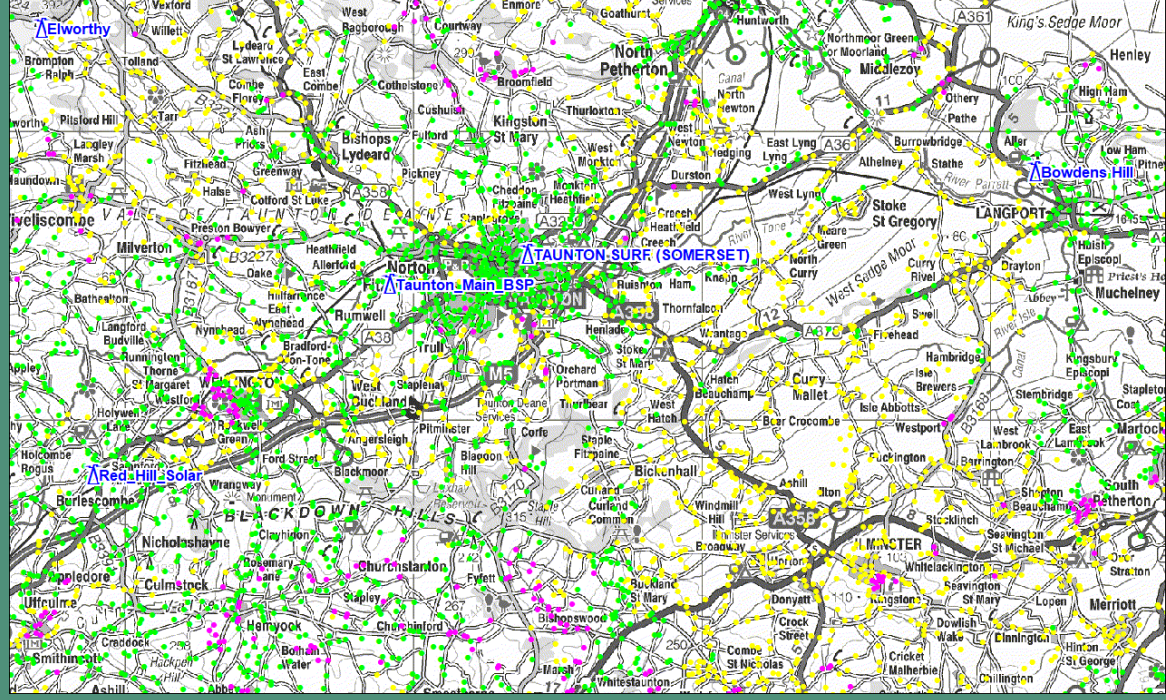

Next steps

- Further LTE trial in Taunton area to:
  - Validate coverage modelling and data rate assumptions
  - Investigate interference effects from overlapping coverage
  - Trial multi-vendor interworking
  - Assess potential for mobile data & wide-area voice operation
- Engaged with Ofcom, Government & other utilities to facilitate spectrum access
- Compare data requirements with other DNO analyses

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QUESTIONS?

Next Generation Wireless Telecoms Project Team