Mapping New Zealand's Broadband Infrastructure

NZRS

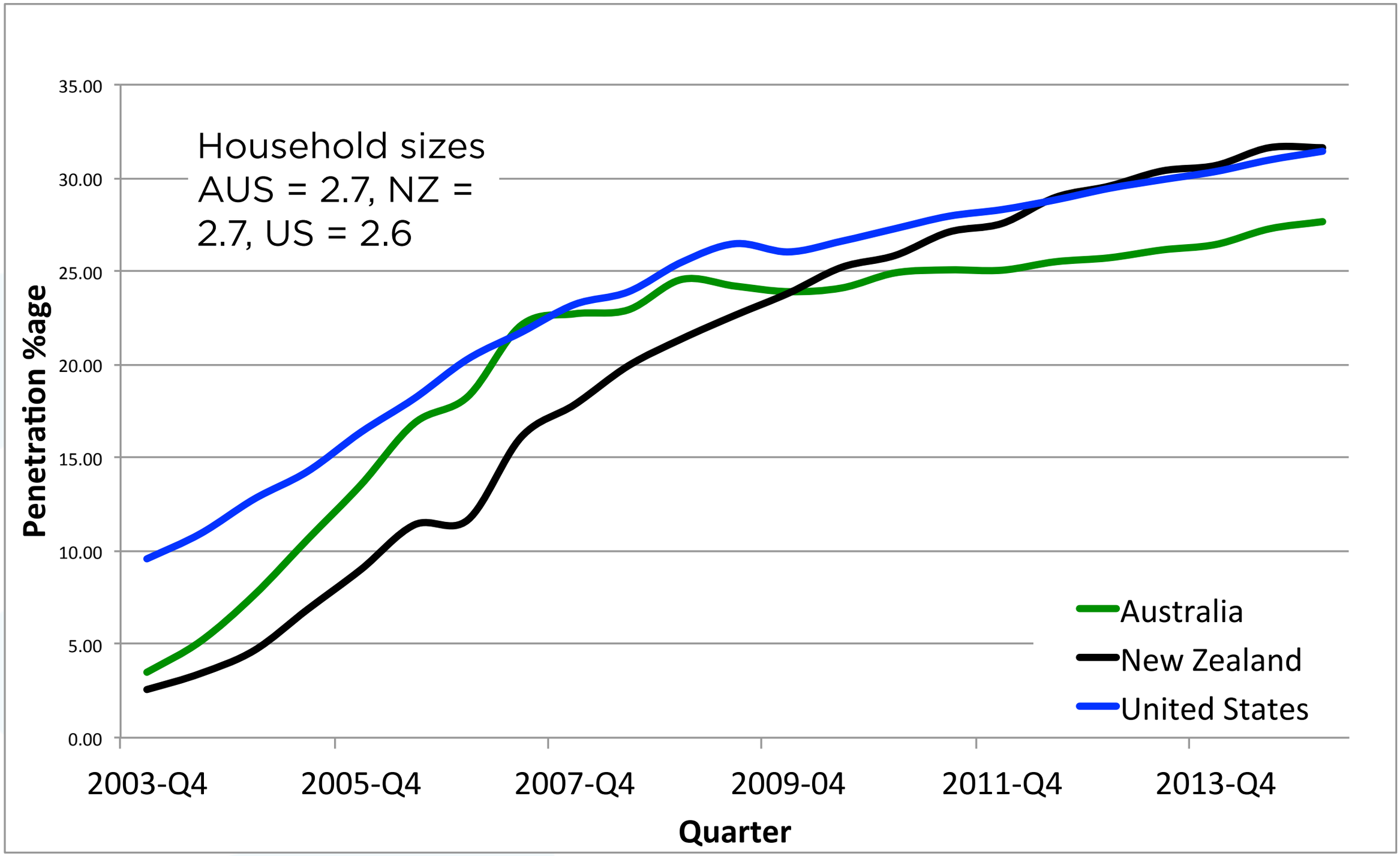
Some Background

NZRS

- Formerly .nz Registry Services
- Provider of:
  - critical Internet infrastructure, and;
  - authoritative Internet data
- Operate the .nz namespace
  - Registry functions
  - DNS operations
- Operate public services
  - NTP servers
  - RPKI validator
  - OpenPGP Key Server

Telecommunications in New Zealand

NZ Broadband Penetration



Source: OECD Broadband Portal

Key Events

- 2004 TelecomNZ launches first home DSL service 256Kbps 10GB cap.
- 2005 - Government mandates Telecom must wholesale an unbundled bitstream (not UCLL).
- 2006 Comprehensive review of telecommunications, unbundled local loop, structural separation of Telecom.
- 2008/2009 FTTH roll out announced to 75% of the population via the Ultrafast Broadband Programme (UFB)

Key Events

- 2011 Full separation of Telecom into wholesale and retail.
- 2011 Rural Broadband Initiative (RBI) rollout begins. xDSL and fixed wireless to the remaining 25% (funded via industry levy).
- 2012 Fibre roll out begins
- 2014 Extension of UFB to 80% of population announced via UFB2
- 2014 Extension and improvement of rural coverage via RBI2 announced

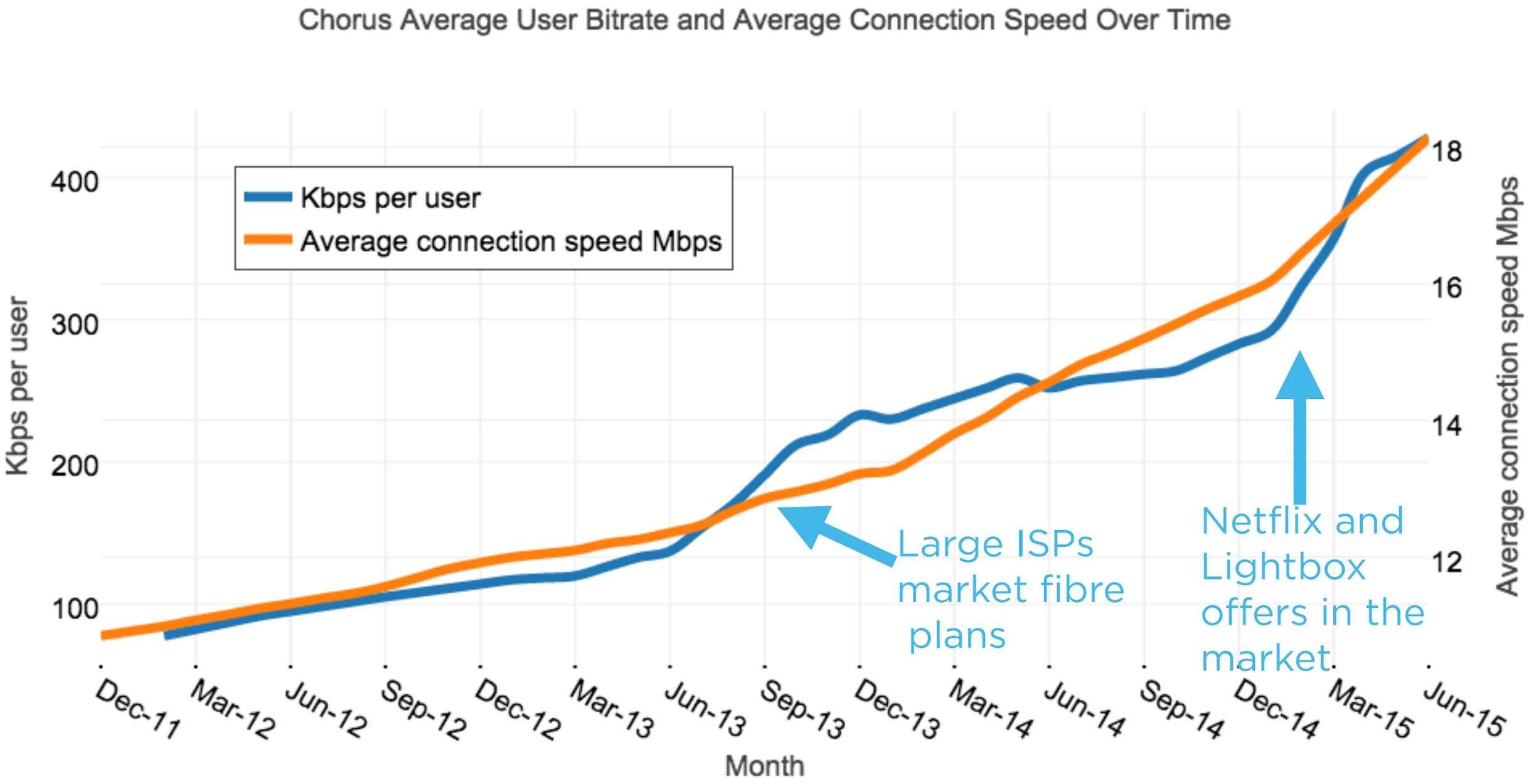
Information Flux

- Things changing
  - Fibre deployment
  - Copper cabinet upgrades
  - New cellular towers
  - New copper cabinets
  - Cellular upgrades
  - Aggressive wireless deployment by 20-30 regional wireless networks

Infrastructure Competition

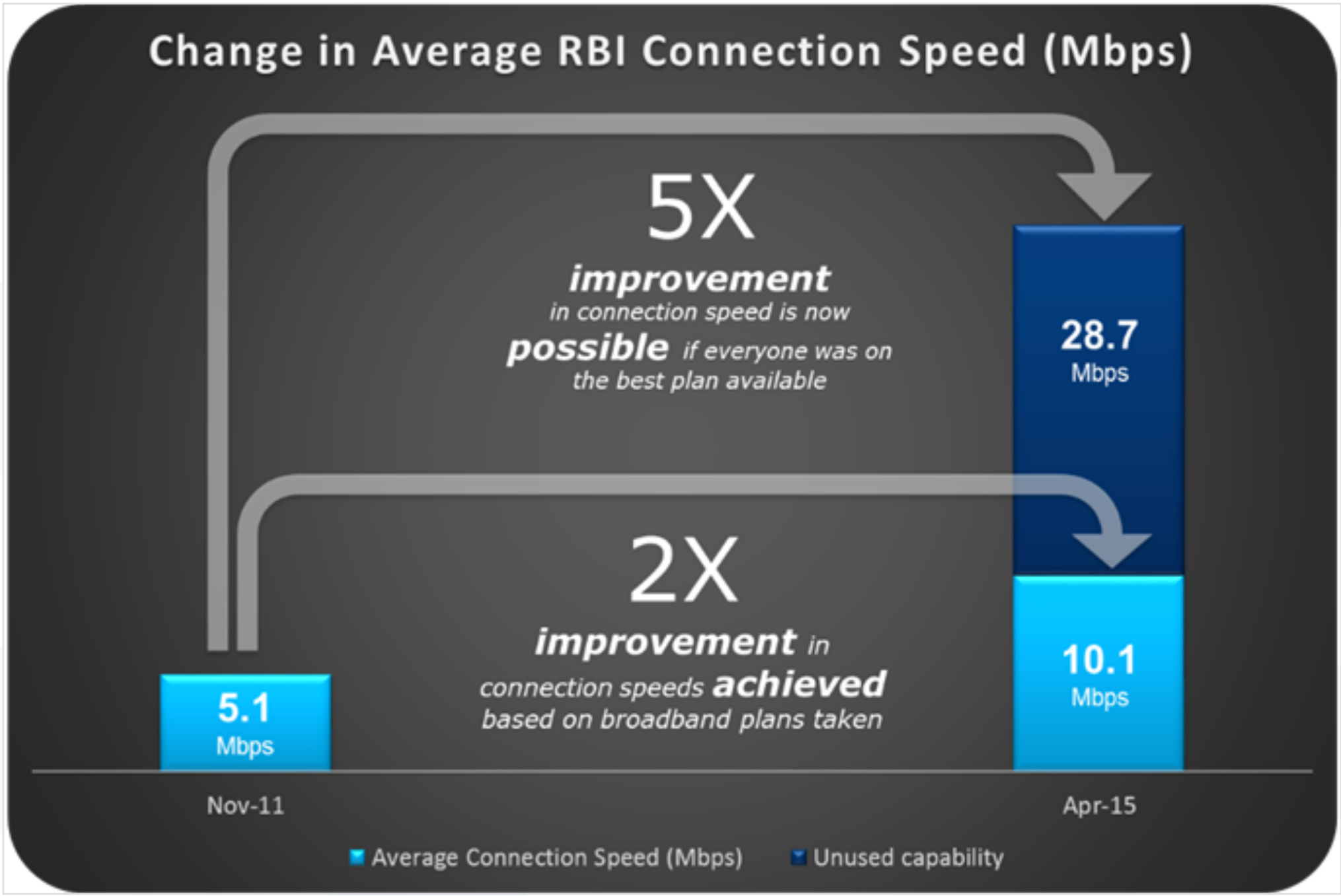
- Fibre
- Wireless
- Cable - HFC
- ADSL
- VDSL
- Cellular

Connection and Usage Growth



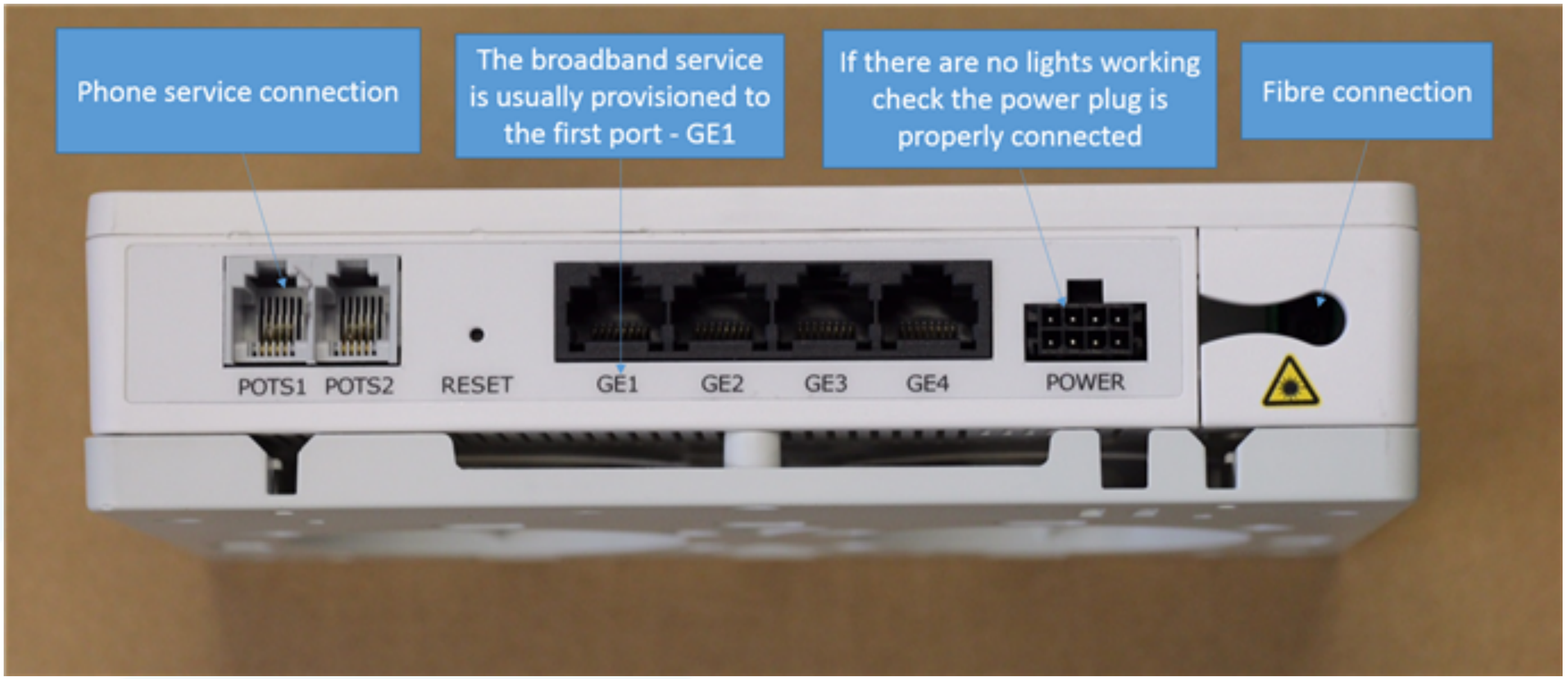
Source: Chorus Market and Insight

Changes in Rural Broadband



Source: Chorus

FTTH - NZ



ONT - Optical Network Termination

Photo - chorus.co.nz

Source: Chorus

Now On To Mapping

- We've pulled together a number of geospatial and temporal-spatial data from networks within New Zealand
  - Collected some
  - Created some
  - Curate some
  - Augment with other data
  - 100 + layers
  - 20-30 used in the National Broadband Map

What do we do with this data?

- Consumer focussed broadband availability tool
- A data service
- Opportunities for research
  - Technical
  - Policy

National Broadband Map

broadbandmap.nz

National Broadband Map

Type address or drop pin

Availability Report

Pin at lat: -41.203553, long: 174.849129

Fibre is Not Available

Cable is Not Available

VDSL is Available

Data from Chorus

Speeds

15-60 Mbps 5-18 Mbps

Next steps

Contact a retailer of the Chorus network, who will check to confirm availability and determine the actual speeds that you are likely to get.

ADSL is Available

Data from Chorus

Speeds

5-10 Mbps 0.5-1.4 Mbps

Next steps

Contact a retailer of the Chorus network, who will check to confirm availability and determine the actual speeds that you are likely to get.

Wireless is Available

Data from Vodafone

Speeds

5-42 Mbps 1-5.8 Mbps

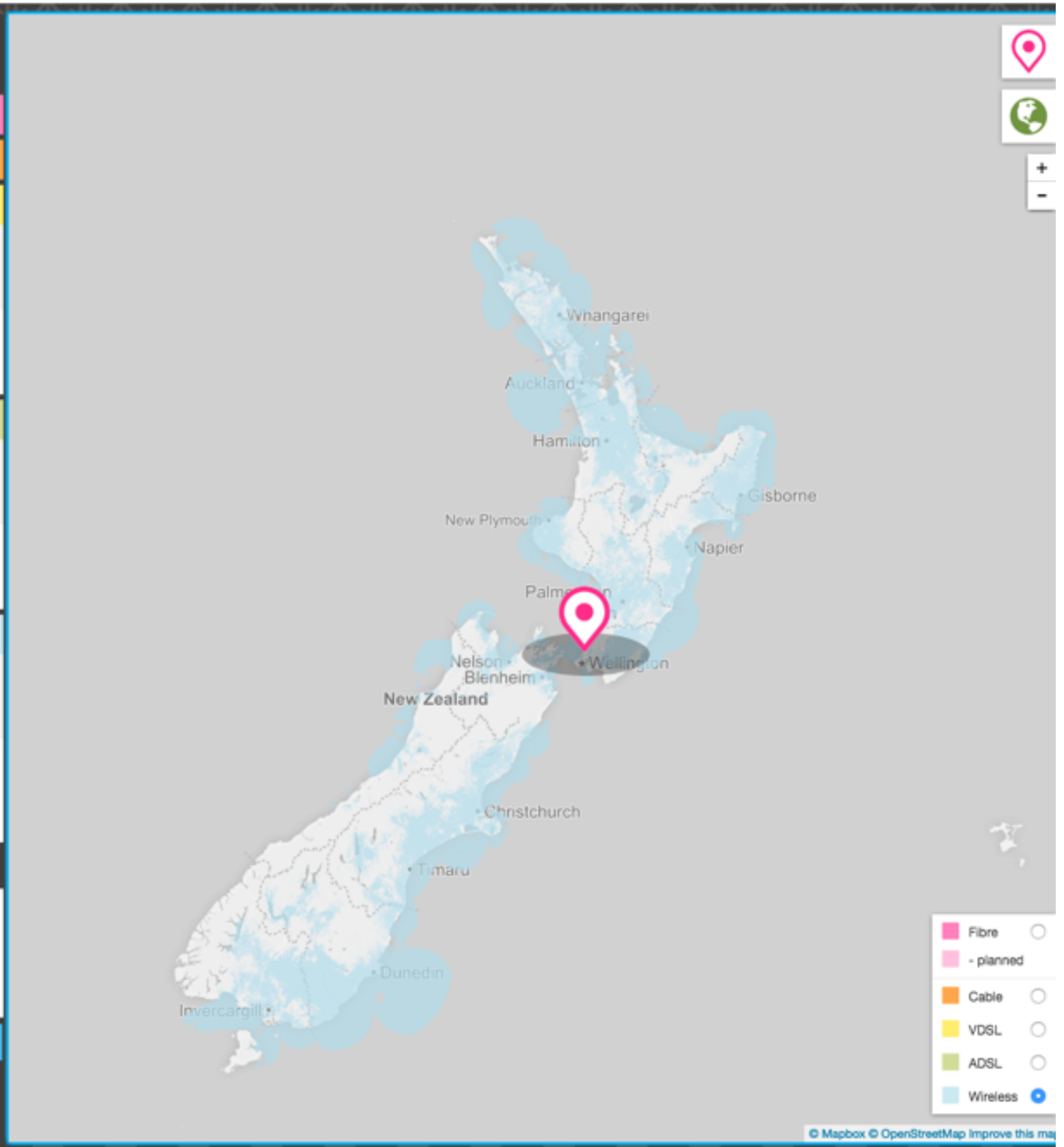
Next steps

Contact Vodafone or a retailer of the Vodafone network, who will check to confirm availability and determine the actual speeds that you are likely to get.

Feedback Form

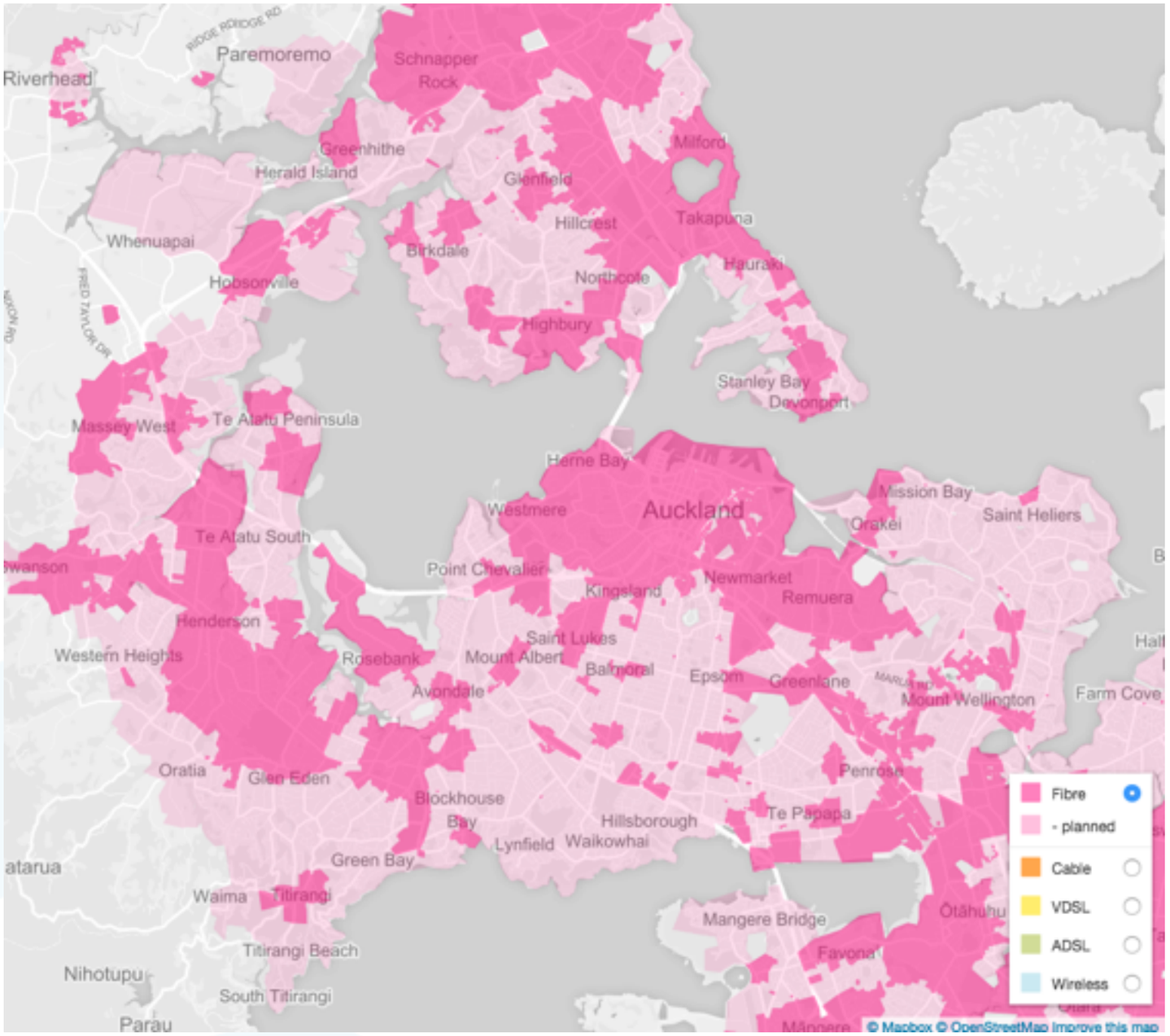
Help us improve this site by giving feedback here...

Send feedback

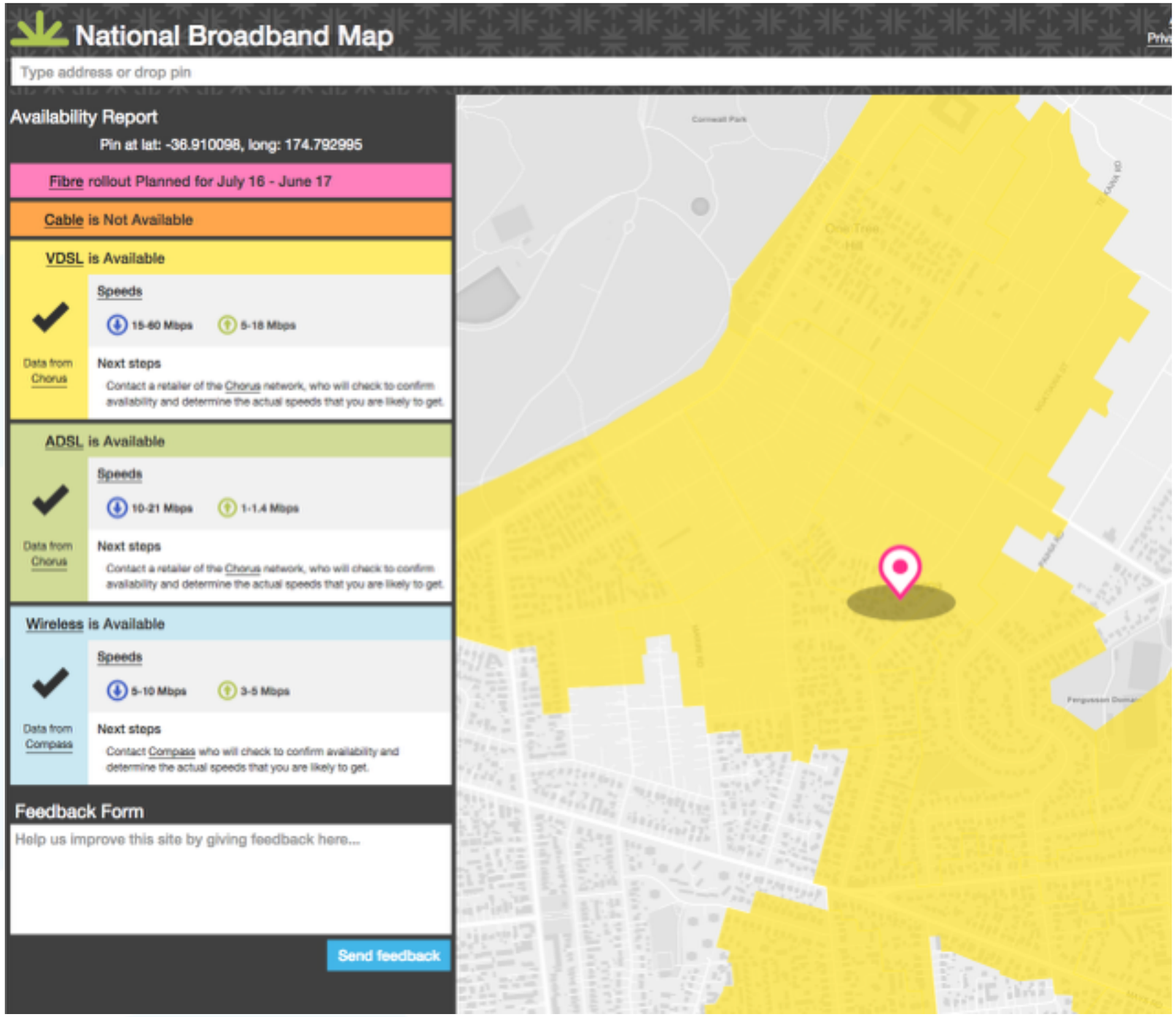


NZRS an InternetNZ company

Visually Represent Broadband Coverage and Timing



Also provide more meaningful textual Information...



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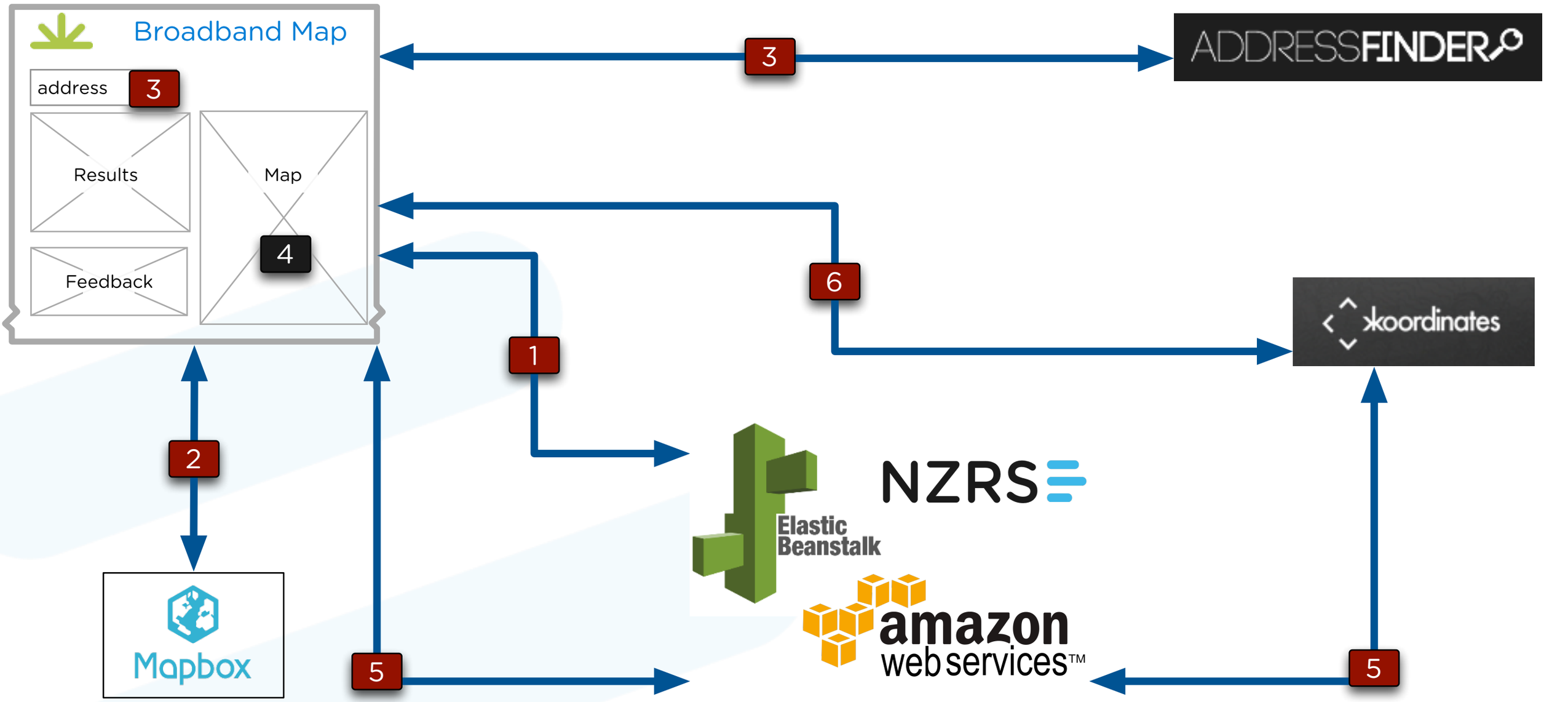
Some interest

- Released July 23 2015
- New Zealand is dinky
- 60,000 visits in the first two hours
- 150,000 visits to the site since launch
- Lead tech story on major news sites

National Broadband Map - Basic Architecture



1. Static page and Javascript served from Amazon Elastic Beanstalk
2. Base map tiles served by Mapbox (soon to be LINZ)
3. User inputs an address and AddressFinder called to get XY coordinate; or
4. User drops a pin and XY determined by that
5. Query to NZRS API which queries Koordinates to find available networks at that coordinate, supplementary data augmented to the Koordinates response and returned
6. Network coverage tiles requested and served by Koordinates to update the map

We Access Various Interfaces

- AddressFinder
  - Geocoding of addresses
- Koordinates
  - Vector query
  - Web Map Tile Services (WMTS)
- NZRS
  - Augments Koordinates Data with stuff we know

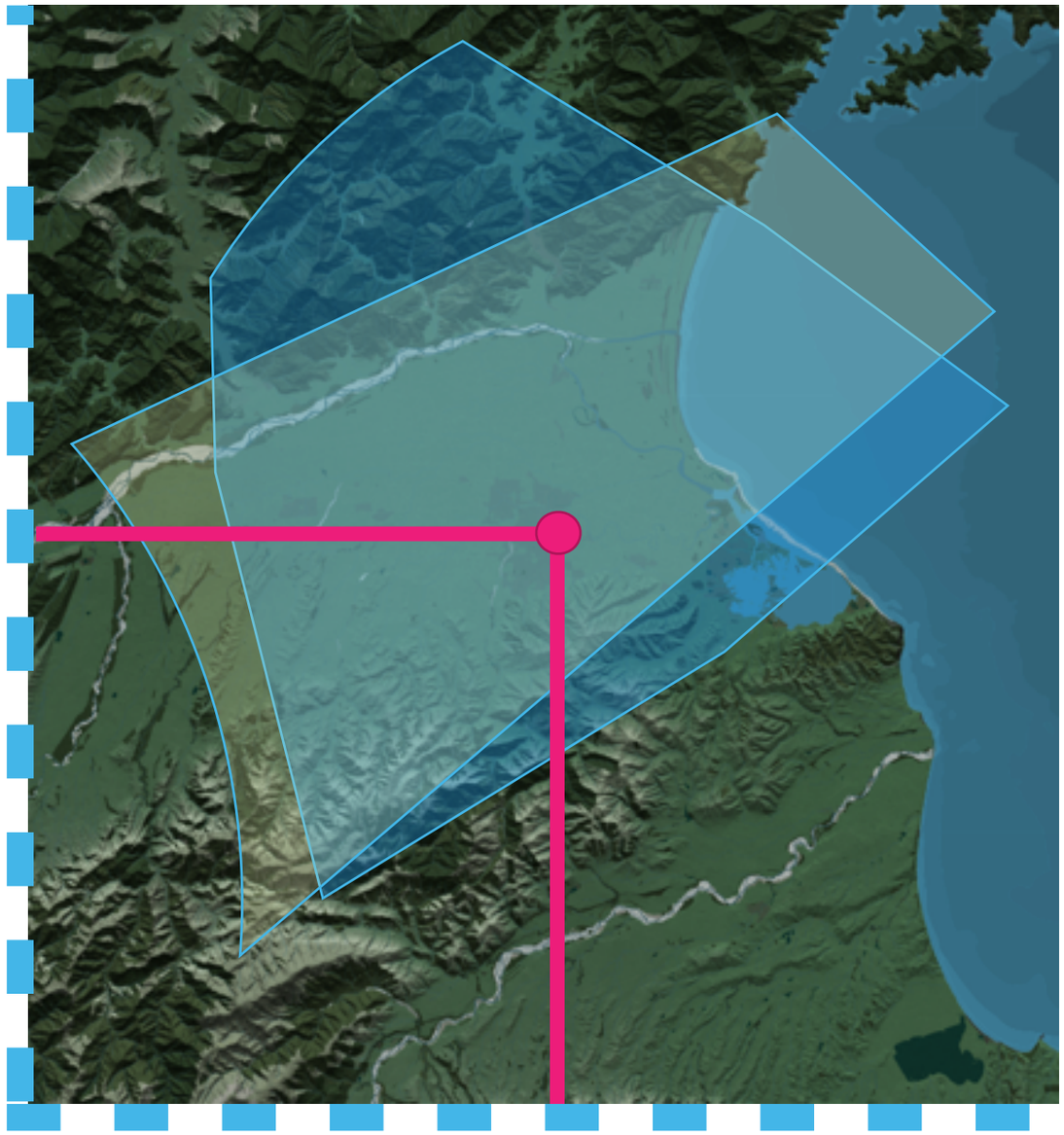
Address Finder

ADDRESSFINDER

- Converts an address to an XY coordinate
- Based off of authoritative NZ address data
- Accessed via a javascript widget

Point in Polygon Query

- We ask a web service if a particular coordinate intersects a network we hold data on

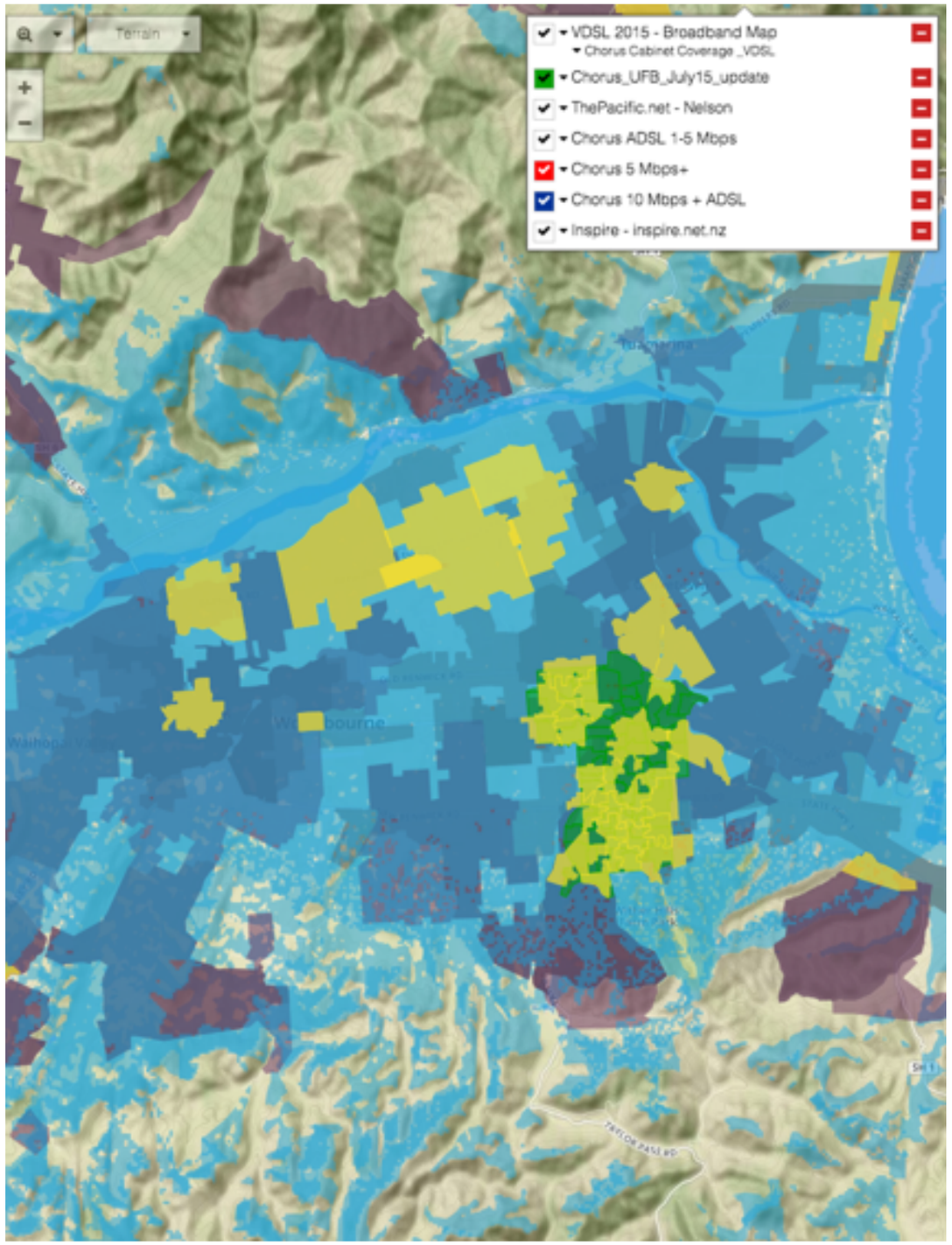


koordinates

https://data.nzrs.net.nz/services/query/v1/vector.json?key=<MY_API_KEY>&layer=7910&x=168.5258101344461&y=-46.81635478996266 6&max_results=3&with_field_names=true

Lots of Networks to Query

- Multiple networks are available at different points
- Aggregated at the National Broadband Map by technology
  - ADSL
  - VDSL
  - Fibre
  - Wireless
  - Cable (HFC)

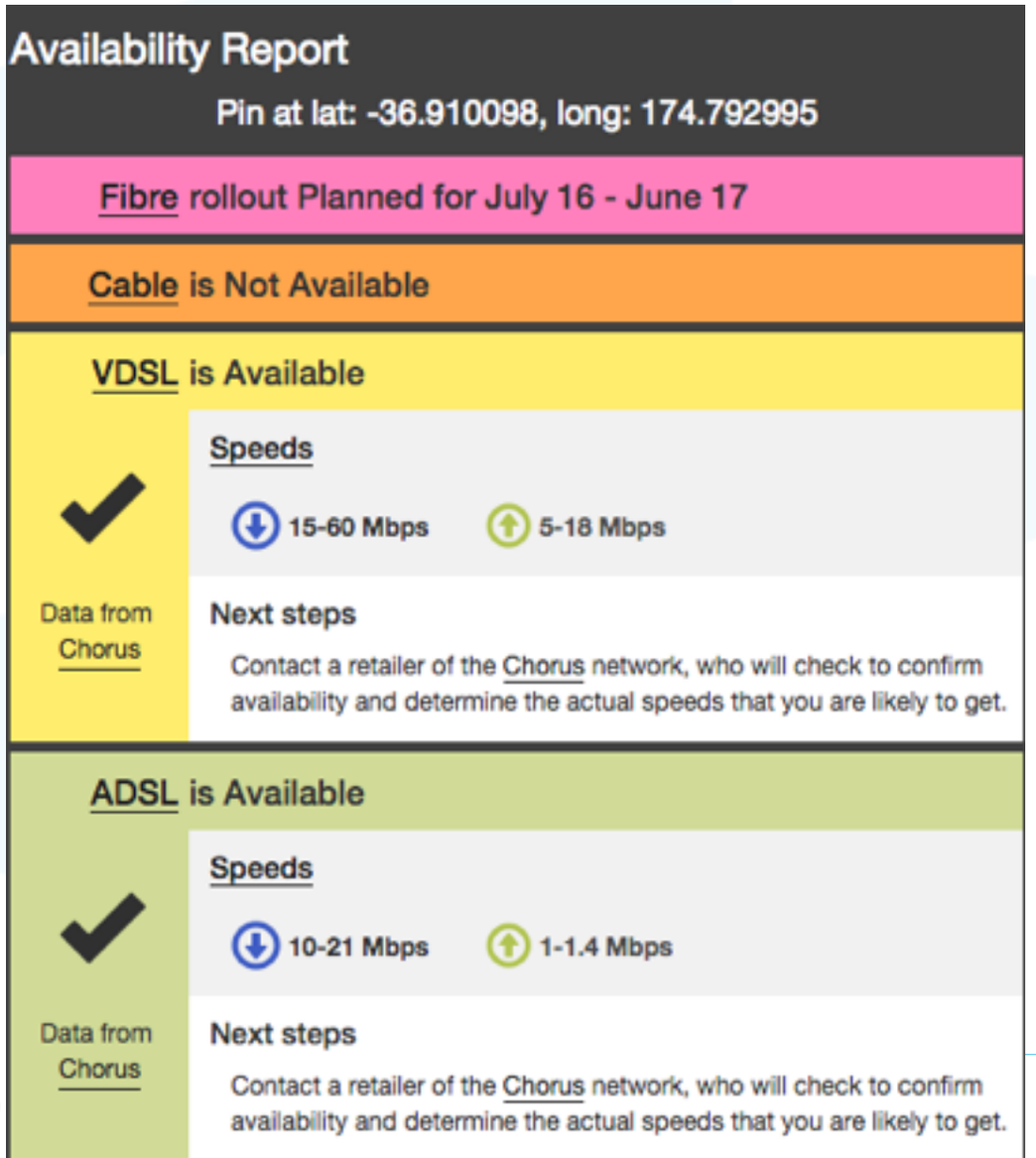


JSON Response

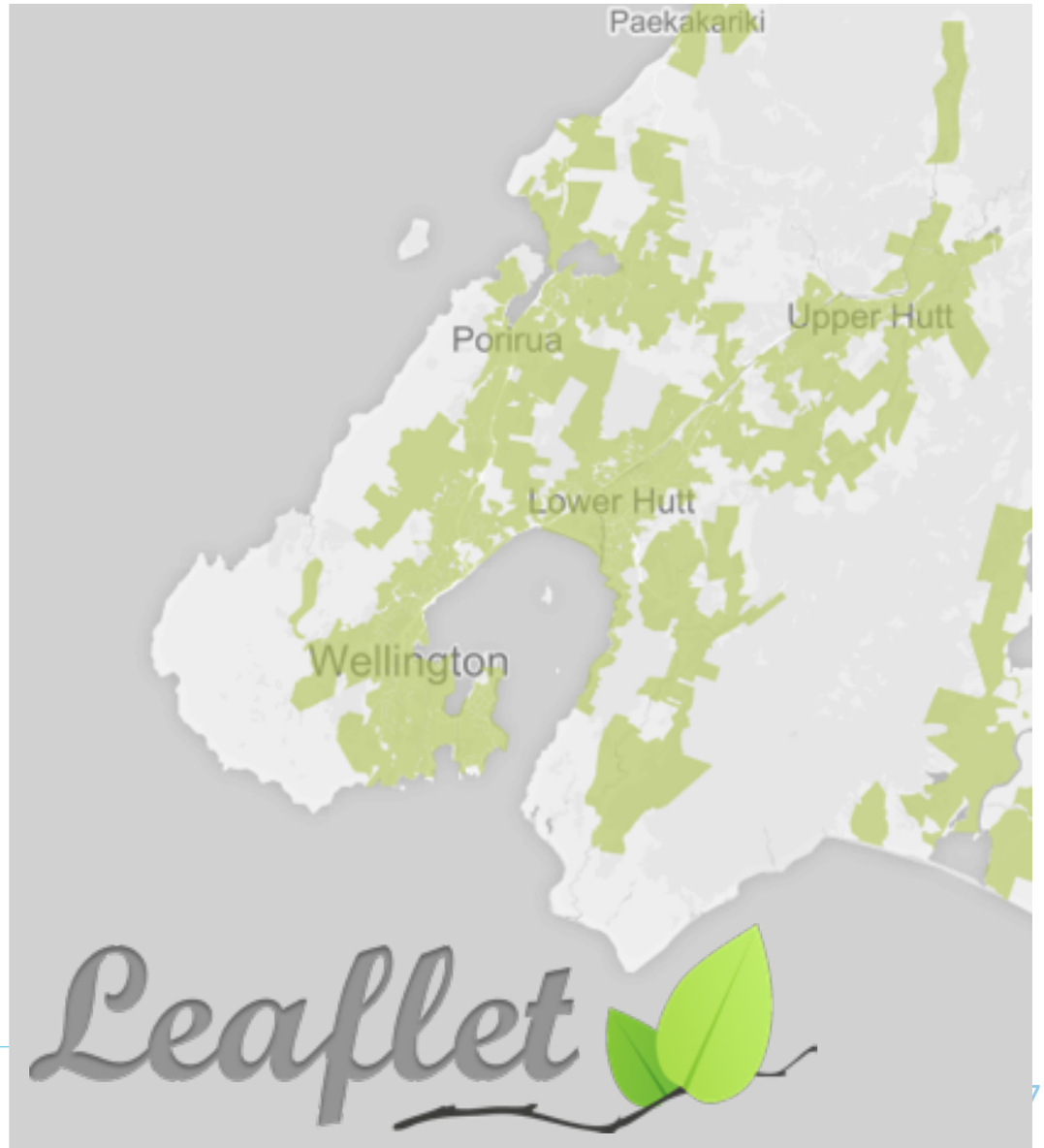

```
{
  "results": [
    {
      "technology": "Fibre",
      "availability": "Planned",
      "completion": "Available by 2019",
      "set_id": 1822,
      "providers" : [
        {
          "network_name": "Chorus",
          "wholesale_network": "Yes",
          "URL": "https:\/\/chorus.co.nz\/",
          "bandwidth_up_max_mbps": 1000,
          "bandwidth_min_mbps": 50,
          "bandwidth_max_mbps": 1000,
          "bandwidth_up_min_mbps": 10
        }
      ]
    },
    {
      "technology": "VDSL",
      "availability": "Available",
      "set_id": 1773,
      "providers": [
        {
          "network_name": "Chorus",
```

Networks Available Returned

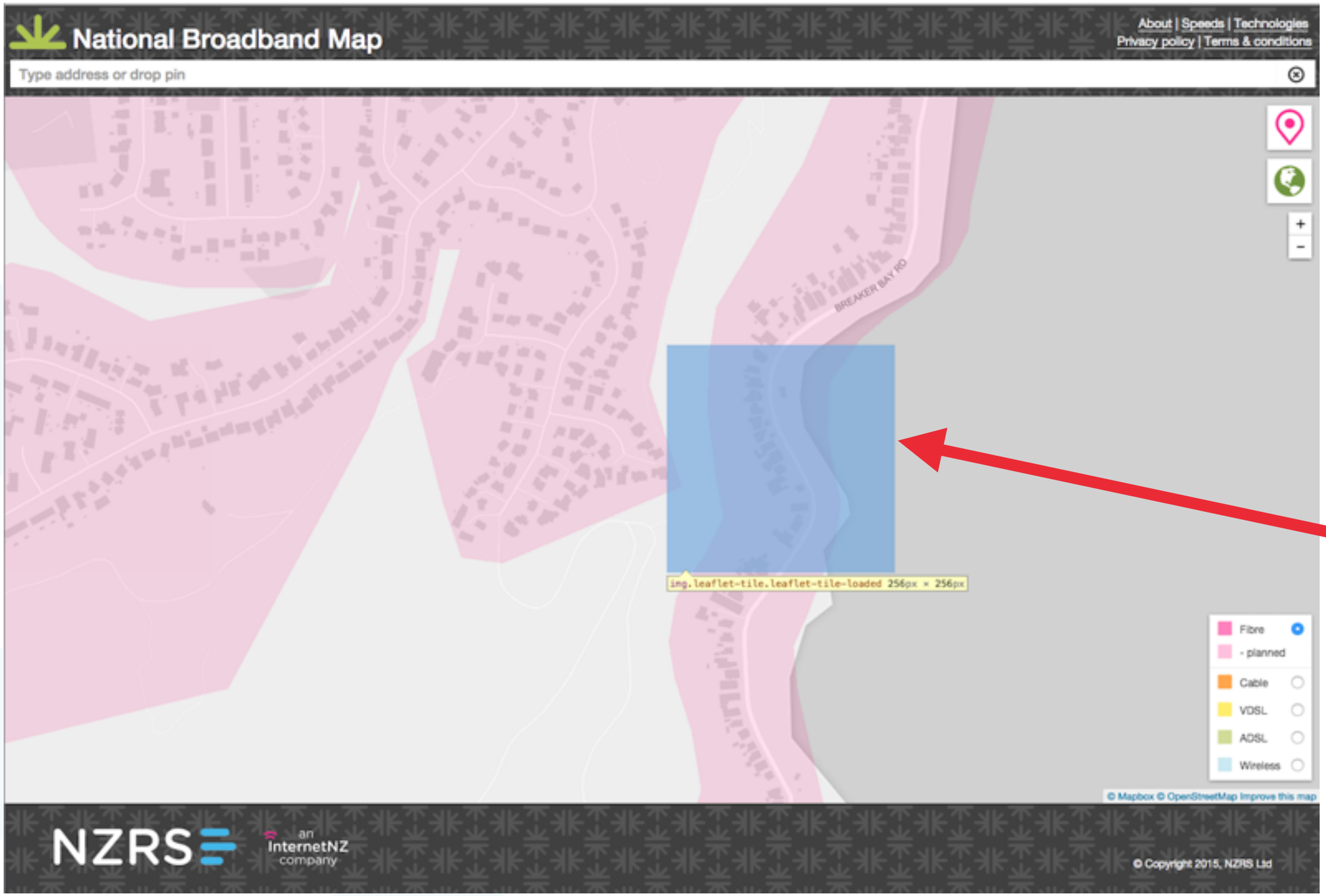
- From this we can display what is available and;



- We can tell leaflet.js to pull tiles in from the tile service



Map Tile


National Broadband Map
About | Speeds | Technologies
Privacy policy | Terms & conditions
Type address or drop pin
BREAKER BAY RD
img.leaflet-tile.leaflet-tile-loaded 256px × 256px
Fibre
- planned
Cable
VDSL
ADSL
Wireless
© Mapbox © OpenStreetMap Improve this map
NZRS
an InternetNZ company
© Copyright 2015, NZRS Ltd

NZRS Data Service

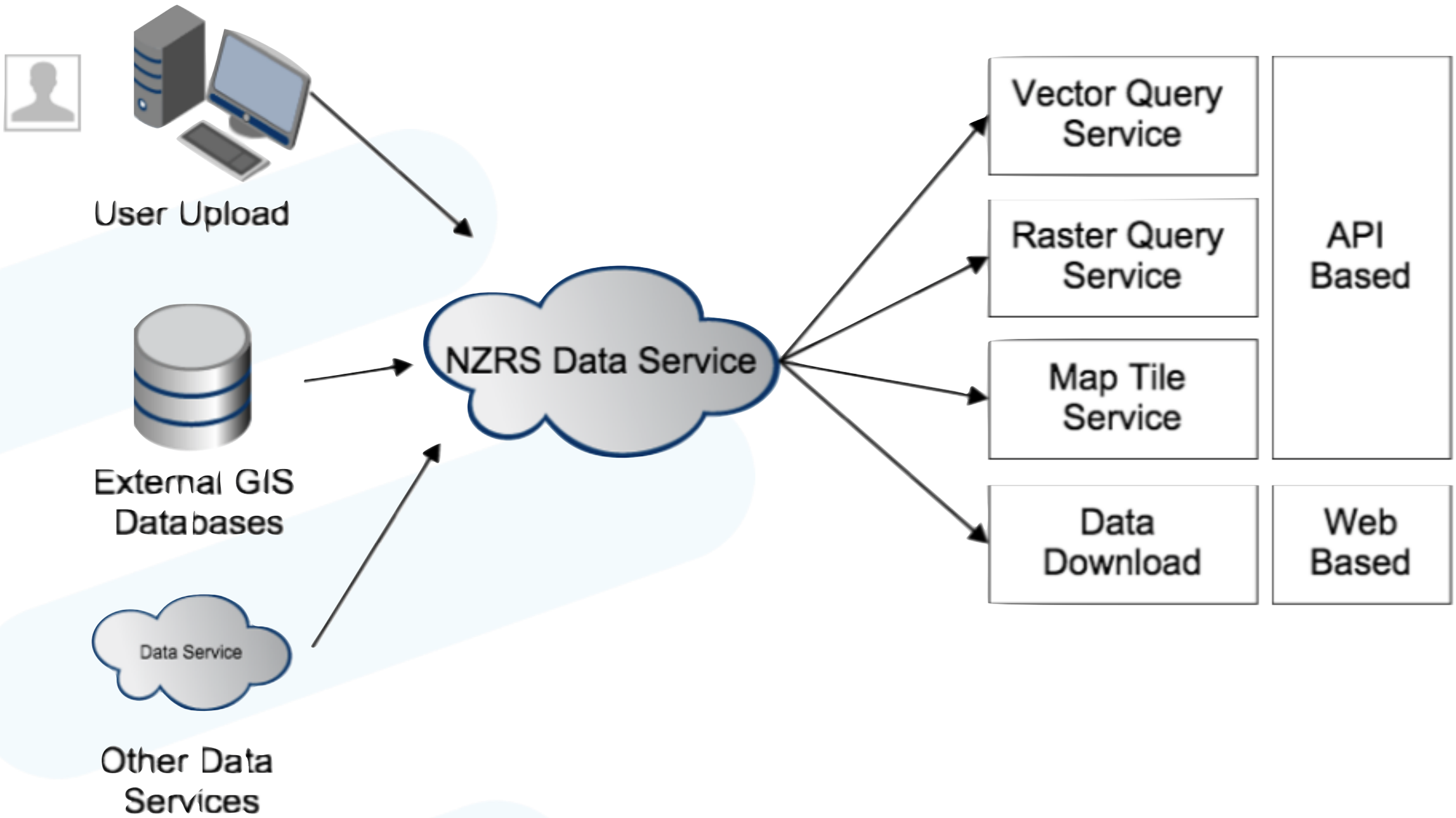
NZRS Data Service

- Its what drives the Broadband Map
- We would like as much data to be open for reuse by others
  - We have a platform to allow that
  - Its not actually NZRS data so we need permission to release the data
  - We can expose the APIs, tile services and allow direct download of the data

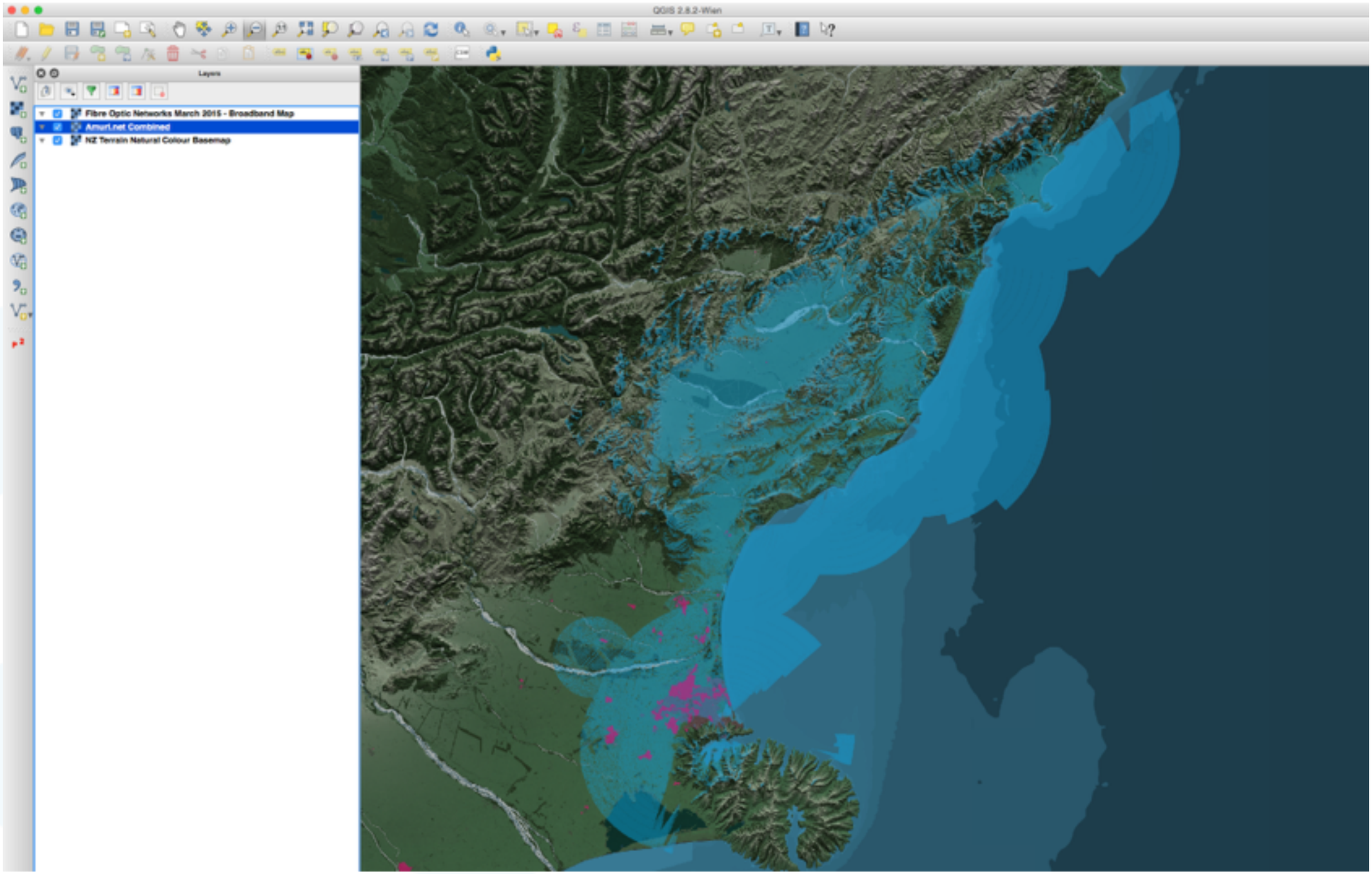
NZRS Data Service

- Enables
  - Vector querying
  - Tile services
  - Storage
  - Permissions
  - Metadata management
  - Distribution

Data Service Architecture



Can Be Consumed in Desktop GIS



Sourcing the Data

The Data

- Over 20 providers of data
- Data is coverage area, not statistical areas
- We work with the providers to understand the data, and;
- Help them generate the data if required

How do we get the data?

- Ask nicely.
- Don’t misrepresent the providers.
- Calling people names does not work.
- It can be a long game.
- Launching broadbandmap.nz increased enthusiasm to participate.
- Support from industry is very important

Feedback Loops

- We have helped improve some suppliers data from issues we notice.
- Lots of eyeballs means a bit more motivation to get things right from some providers.
- We get better data as a result.
- This will only continue.

Wireless Propagation Data

Wireless Networks in NZ

- There are a number of wireless networks in New Zealand.
- Of size 20-30 is a reasonable estimate
- Typically filling a rural and remote niche and specific applications
- Smaller operations
- Know their networks well
- Communicating coverage has been problematic
- Where coverage does exist it is often in non GIS formats

A couple of approaches we took

- Converting images geo-referenced with KML to Shapefiles, useful for outputs from:
  - RadioMobile
  - TowerCoverage.com
- Generating coverage using elevation data and Longley Rice Prediction Model.
  - Wavetrace - NZRS Open Source Software

Wavetrace

Longley-Rice based coverage prediction

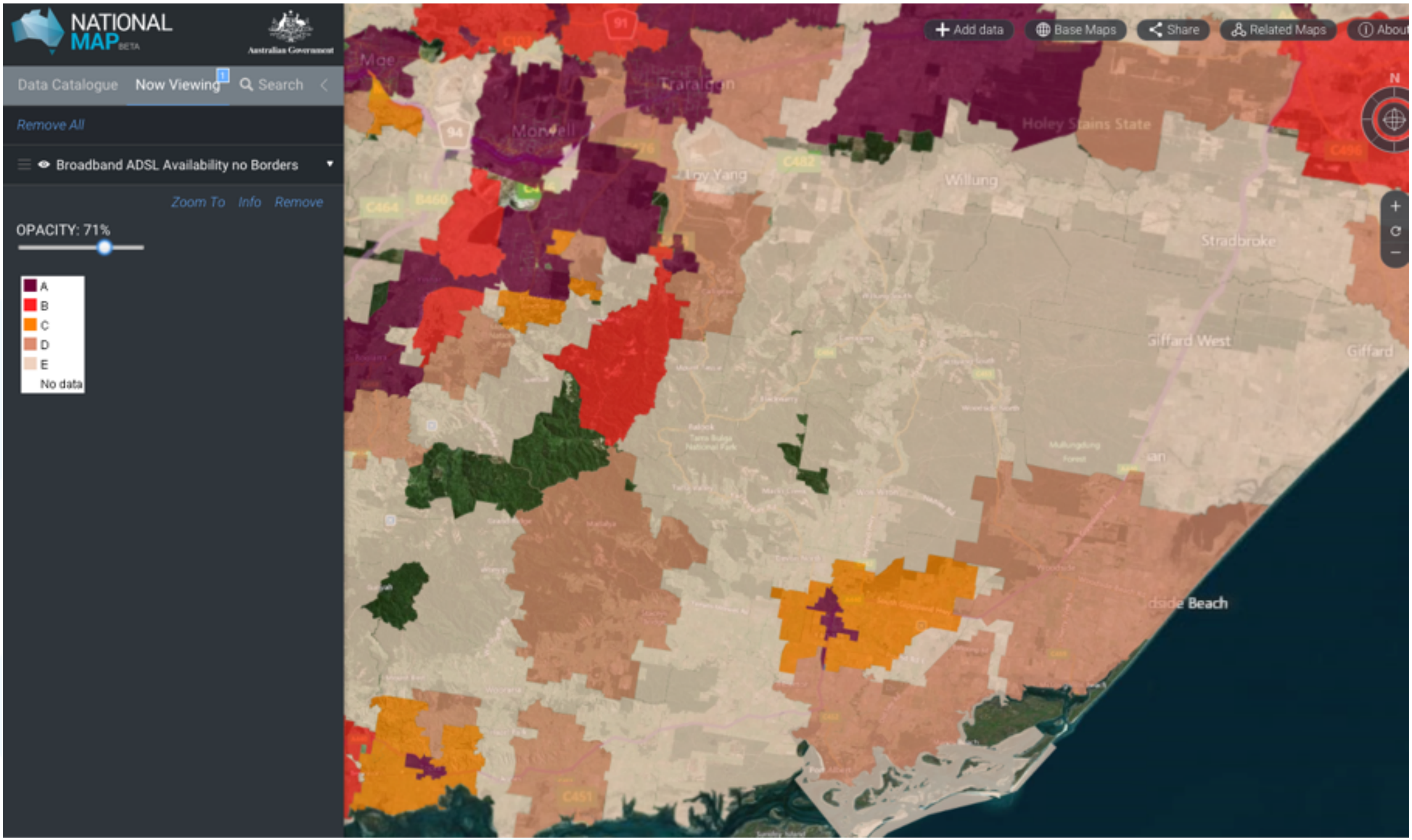
INPUTS

- Digital elevation model*
- Network details*
- Latitude*
- Longitude*
- Antenna height above ground level*
- Frequency (MHz)*
- Power (EIRP)*
- Polarisation
- Bearing
- Horizontal beam width
- Vertical beam width
- Antenna downtilt
- Clutter**
- Receive antenna height above ground level**

* Mandatory input
** Constant at present

https://github.com/NZRS/wavetrace

Wavetrace - Imaginary Network



Some sites

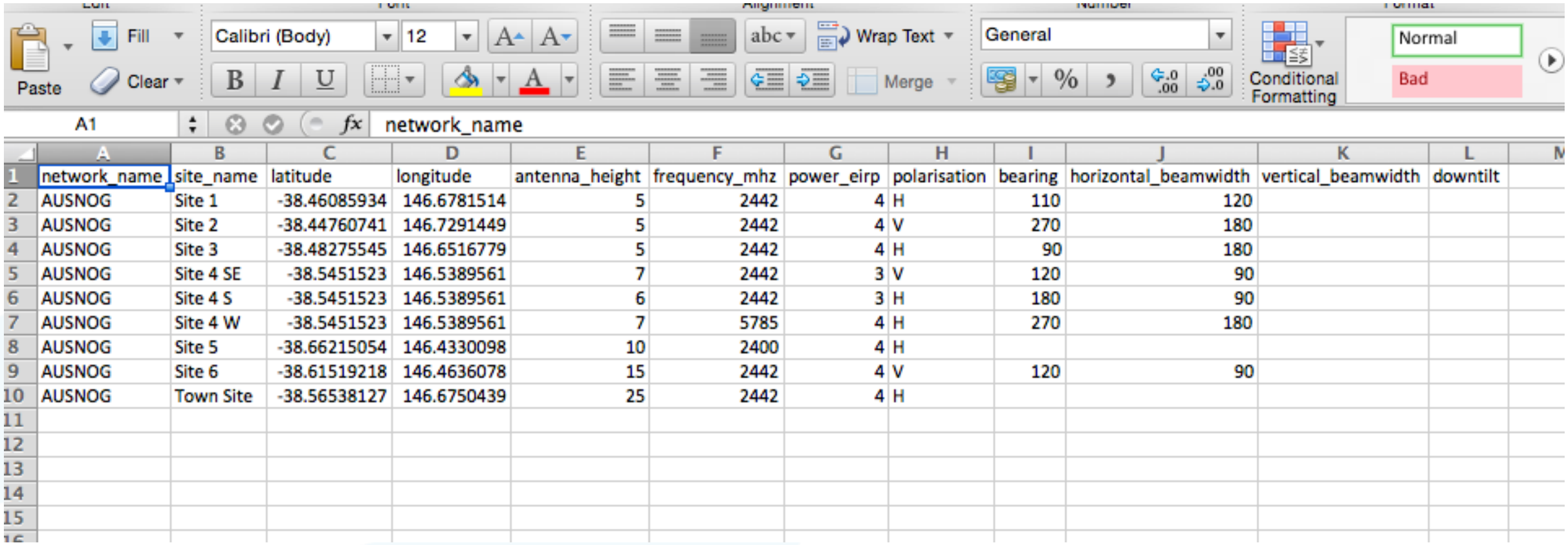

Hazelwood North
Churchill
Balook
Site 1
Site 2
Site 3
Won Wron
Devon North
Site 4
Ya
Town Site
Binginwarri
Site 6
Alberton
Gelliondale
Site 5
Welshpool
Port Albert
Port Welshpool
© 2015 Google

Get Some Terrain Data

- The -h switch gives high definition

```
# python get_data.py
or for Australia
# python get_data_aus.py
# python get_data_aus.py -h
```

Populate Your Spreadsheet



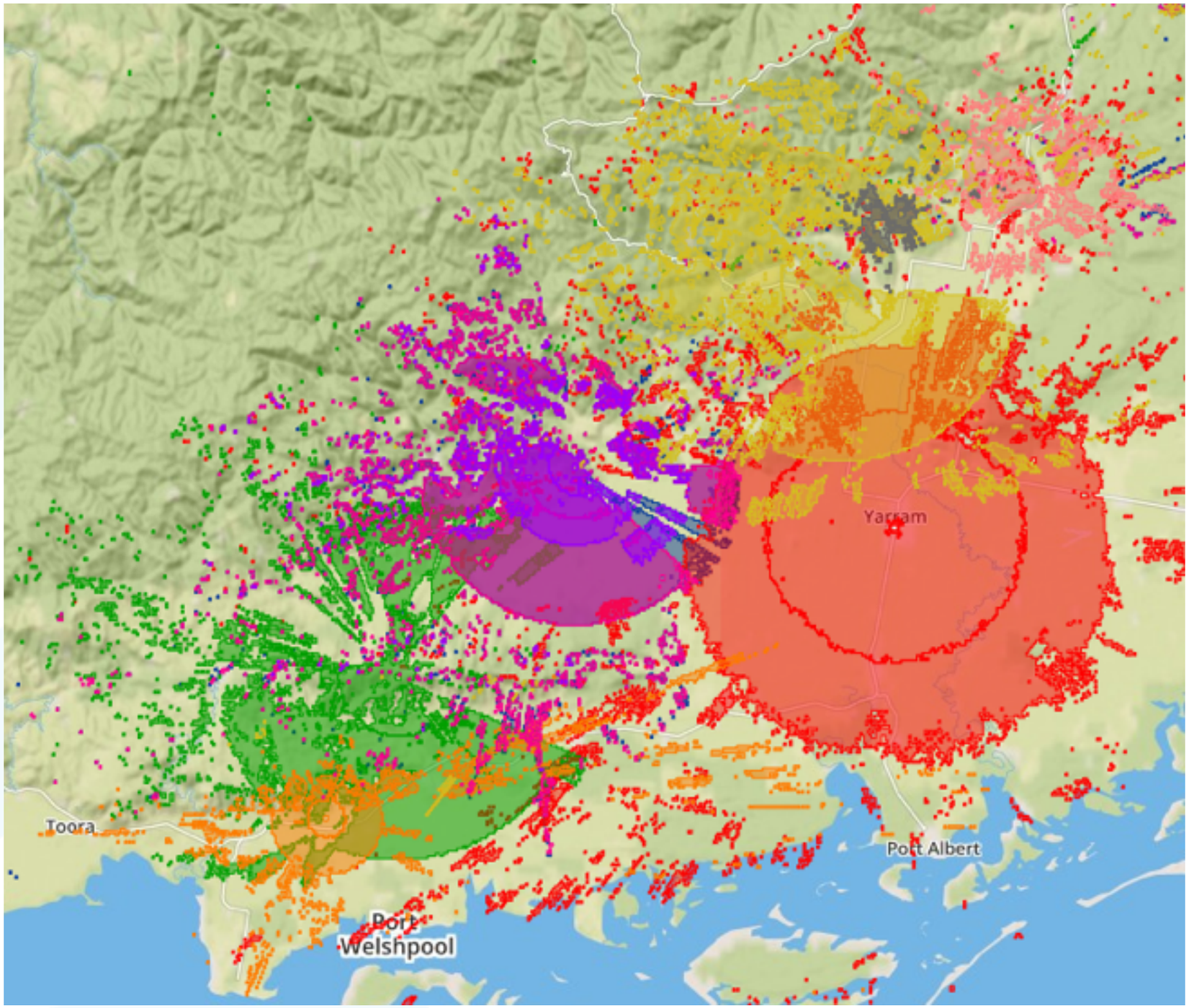
	A	B	C	D	E	F	G	H	I	J	K	L
1	network_name	site_name	latitude	longitude	antenna_height	frequency_mhz	power_eirp	polarisation	bearing	horizontal_beamwidth	vertical_beamwidth	downtilt
2	AUSNOG	Site 1	-38.46085934	146.6781514	5	2442	4	H	110	120		
3	AUSNOG	Site 2	-38.44760741	146.7291449	5	2442	4	V	270	180		
4	AUSNOG	Site 3	-38.48275545	146.6516779	5	2442	4	H	90	180		
5	AUSNOG	Site 4 SE	-38.5451523	146.5389561	7	2442	3	V	120	90		
6	AUSNOG	Site 4 S	-38.5451523	146.5389561	6	2442	3	H	180	90		
7	AUSNOG	Site 4 W	-38.5451523	146.5389561	7	5785	4	H	270	180		
8	AUSNOG	Site 5	-38.66215054	146.4330098	10	2400	4	H				
9	AUSNOG	Site 6	-38.61519218	146.4636078	15	2442	4	V	120	90		
10	AUSNOG	Town Site	-38.56538127	146.6750439	25	2442	4	H				
11												
12												
13												
14												
15												

Run the Model

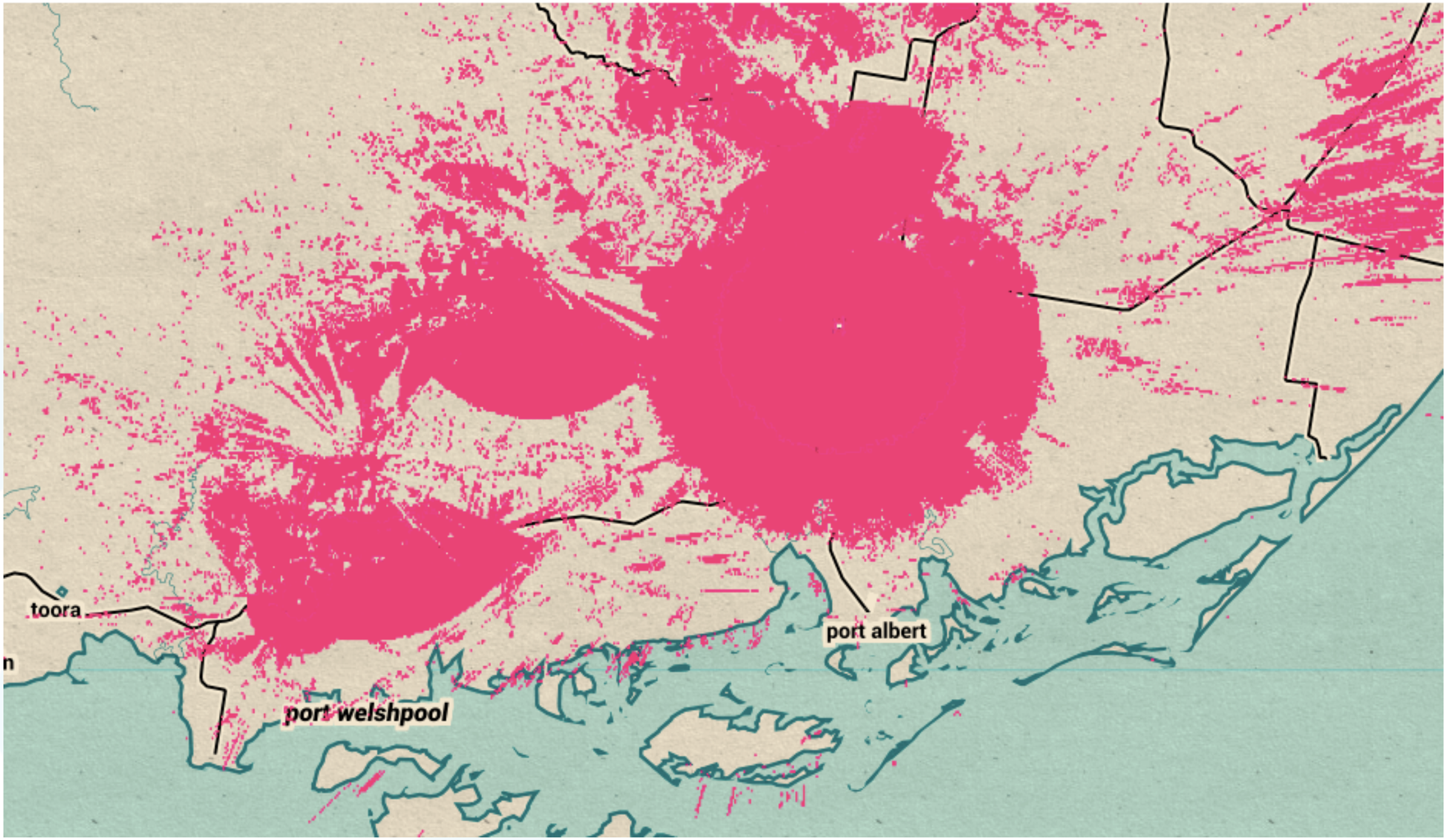
```
# python make_files.py
# python create_output_from_dir.py
```

```
Loading "-39:-38:217:218.sdf" into page 1... Done!
Loading "-39:-38:216:217.sdf" into page 2... Done!
Loading "-38:-37:216:217.sdf" into page 3... Done!
Loading "-38:-37:217:218.sdf" into page 4... Done!
Region  "-39:-38:218:219" assumed as sea-level into page 5... Done!
Region  "-38:-37:218:219" assumed as sea-level into page 6... Done!

Computing ITWOM signal power level contours of "AUSNOG_Warrnambool1"
out to a radius of 40.81 kilometers with an RX antenna at 8.00 meters AGL...

 0% to  25% .o0o.o0o.o0o.o0o.o0o.o0o.o0o.o0o.o0o.o0o.o0o.o0o.o0o.o0o.o0o.o0o
25% to  50% .o0o.o0o.o0o.o0o.o0o.o0o.o0o.o0o.o0o.o0o.o0o.o0o.o0o.o0o.o0o.o0o
50% to  75% .o0o.o0o.o0o.o0o.o0o.o0o.o0o
```

Now we can do stuff



Build Maps From the Tile Services



https://github.com/NZRS/ausnog

An Analysis Example

Batch Point in Polygon Query Using PostGIS

- PostGIS is PostGres with GIS extensions

```
-- Enable PostGIS (includes raster)
CREATE EXTENSION postgis;
```

- Other software can do Point in Polygon querying (e.g. QGIS, ARCGIS).

Question

- In Taranaki - what addresses cannot receive a 5 Mbps + copper based service but can receive a fixed wireless access product from Primo Wireless?

How

- Download coverage data from NZRS data service (http://data.nzrs.net.nz)
- Download electoral address points from Land Information New Zealand data service (http://data.linz.govt.nz)

Write some SQL

```
SELECT <DISTINCT> sq1.gid, sq2.gid, sq1.geom, sq1.address,
sq1.house_numb, sq1.road_name, sq1.locality, sq1.territoria
FROM

(SELECT electoral_street_address.gid as gid,
electoral_street_address.geom as geom,
electoral_street_address.address,
electoral_street_address.house_numb,
electoral_street_address.road_name,
electoral_street_address.locality,
electoral_street_address.territoria FROM
electoral_street_address
JOIN primo ON ST_Contains(primo.geom,
electoral_street_address.geom)) sq1
LEFT JOIN

(SELECT electoral_street_address.gid as gid,
electoral_street_address.geom as geom FROM
electoral_street_address
JOIN dsl ON ST_Contains(dsl.geom,
electoral_street_address.geom)) sq2
ON (sq1.gid = sq2.gid)
WHERE sq2.gid IS NULL
```

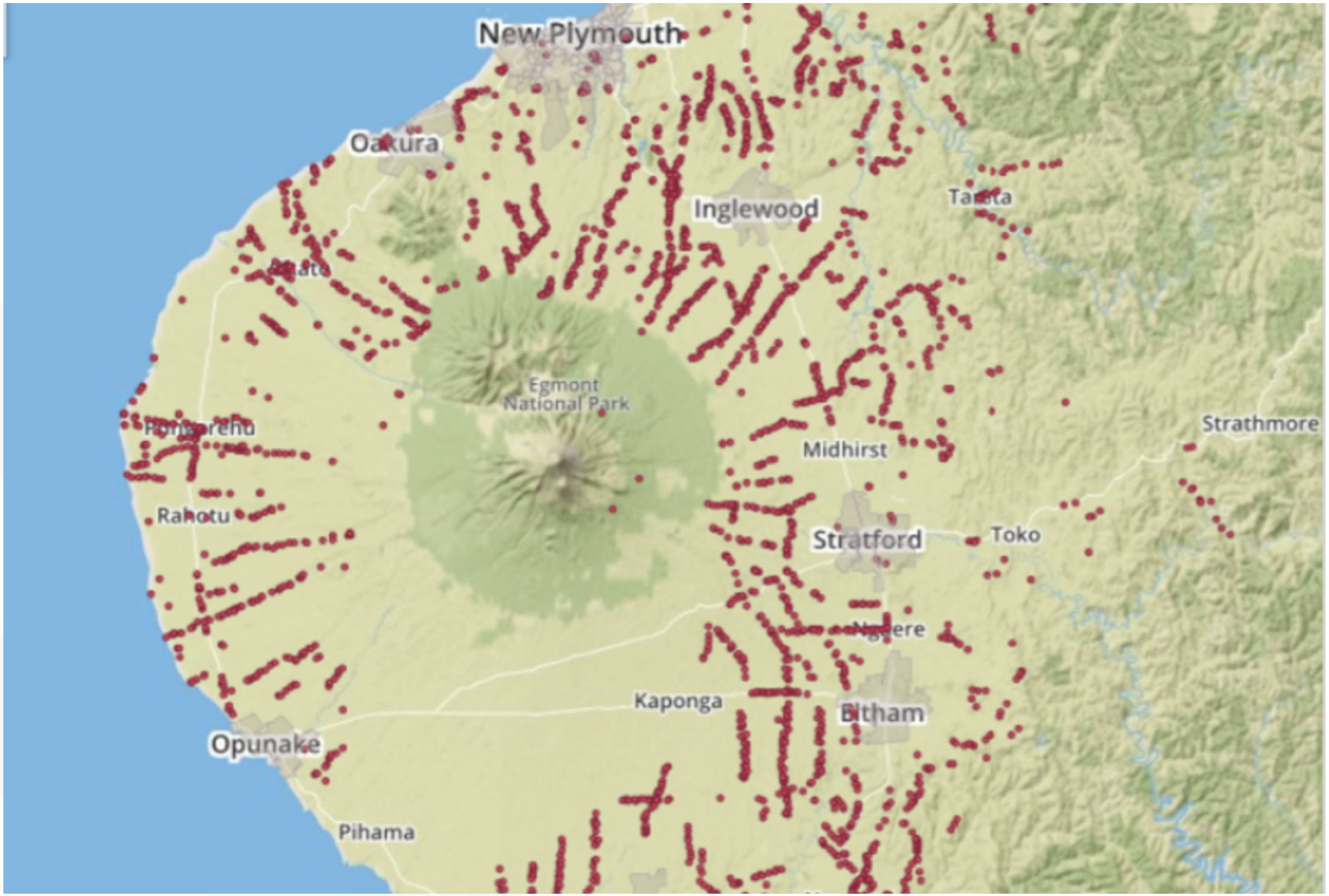
Addresses Returned

About | Data Table | Analytics | History | Services | Comments (0)

Search in data | Options

ADDRESS	HOUSE_NUMB	ROAD_NAME	LOCALITY	TERRITORIA
Bosworth Street	1	Bosworth Street	Egmont Village	New Plymouth
Browne Street	1	Browne Street	Normanby	South Tarana
Butler Street	1	Butler Street	Normanby	South Tarana
Coast Road	1	Coast Road	Pungarehu	South Tarana
Cumming Street	1	Cumming Street	Okato	New Plymouth
Dunn Street	1	Dunn Street	Egmont Village	New Plymouth
Fergusson Street	1	Fergusson Street	Normanby	South Tarana
Hobson Street	1	Hobson Street	Normanby	South Tarana
Linda Street	1	Linda Street	Oakura	New Plymouth
Olson Street	1	Olson Street	Egmont Village	New Plymouth

Geometry Returned



Conclusion

- From raw data to user friendly application there is a lot of work.
- Collaboration, Collaboration, Collaboration - its all about working with people.
- This is replicable with the right data.
- The potential to expand industry understanding could be large.