Spark Connect

July 2016

Queenstown Lakes District Council Cellular Overview

John Ratuszny – RF Engineering Manager Spark NZ

- Name - John Ratuszny –
- Position held – Radio Engineering Manager SPARK

Employed by SPARK for last 2yrs as Radio Engineering Manager previously was employed by Alcatel Lucent as ANZPI Wireless Engineering manager for 4 years. Prior to that RF Engineering Lead Telecom 3G role out Alcatel Lucent and RF Engineer in Alcatel Lucent sine 2004.

My role in Spark entails running a team of approx. 32 RF Engineers to Plan, Design and Optimise the current cellular network for the benefit of our customers. I also am responsible for running the Acquisition team who works with the landowners and Council Authorities throughout New Zealand to establish new network elements.

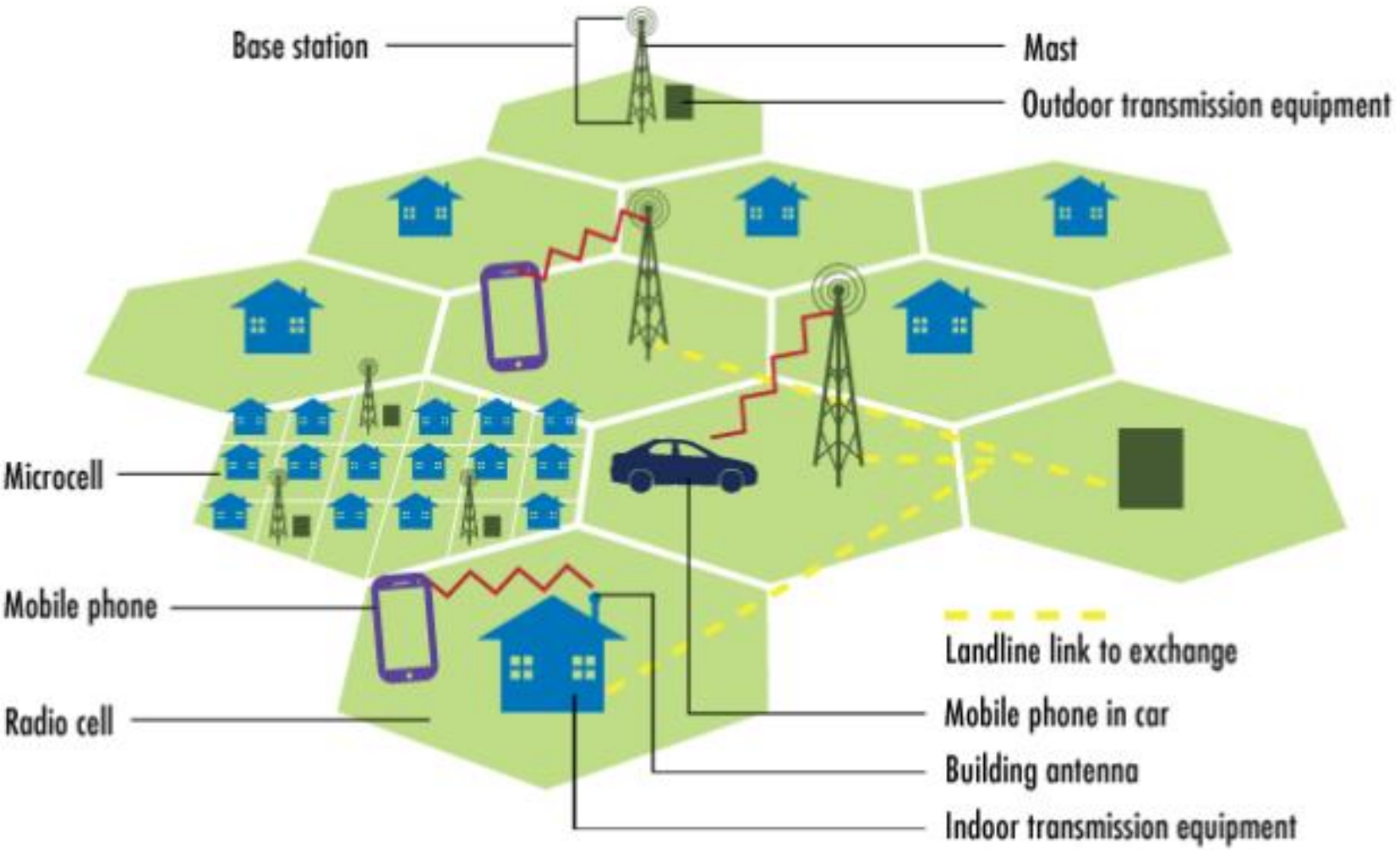
Stephen Holding– Lead RF Engineer South Island Spark NZ

- Name – Stephen Holding
- Position held – Lead Radio Frequency Engineer - South Island

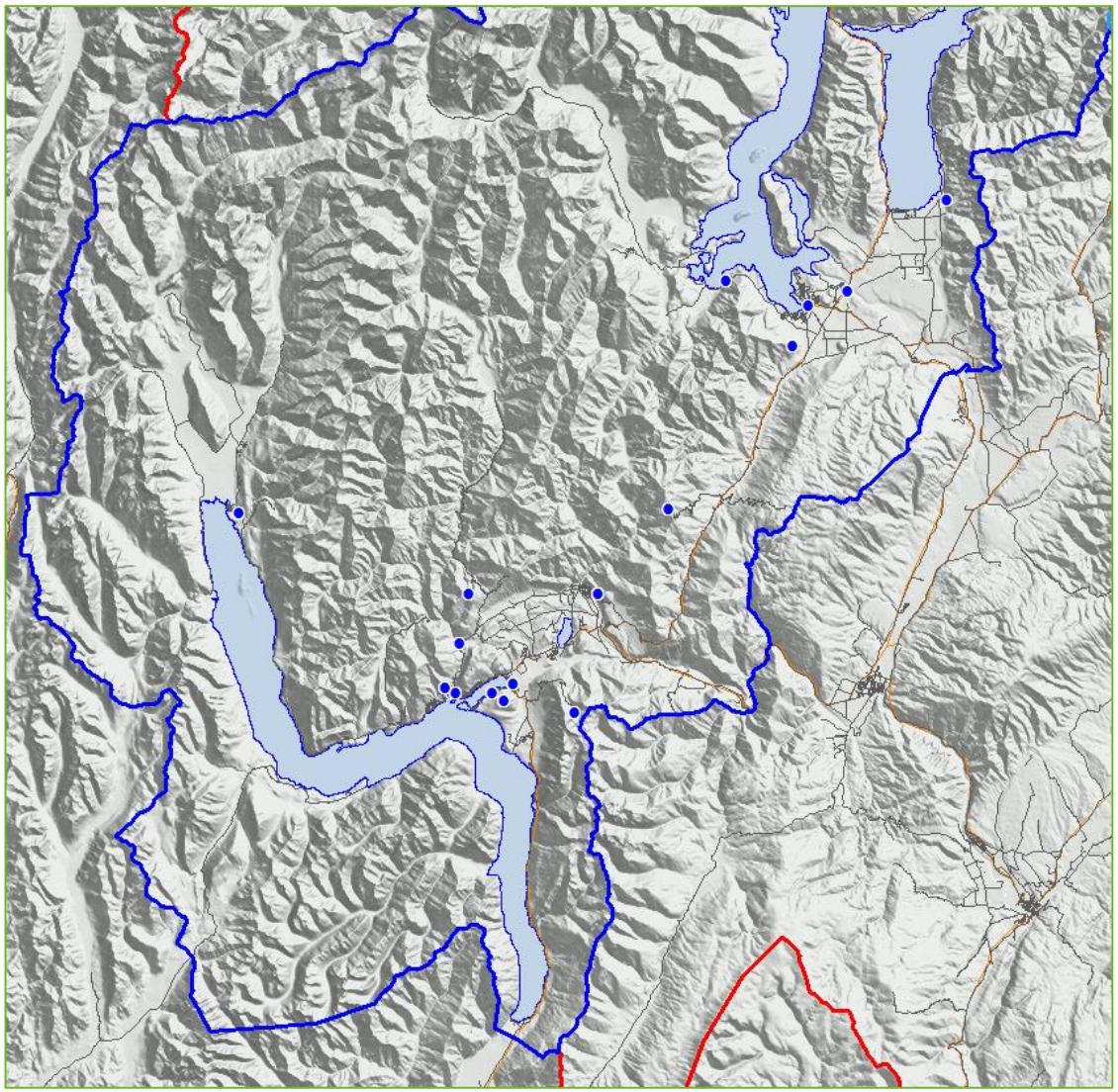
I am the Lead RF Engineer for the South Island at Spark New Zealand Limited, a position I have held since August 2014. Previously, I held the equivalent position at Alcatel-Lucent NZ Ltd for over 4 years before being insourced to Spark. Prior to the Lead roles, I was a Senior RF Engineer at Alcatel-Lucent from 2006 to 2009 and a RF Systems Engineer at Andrew Corporation from 2002 to 2006.

My role at Spark involves technically leading a small team of 5 RF Engineering professionals to Plan, Design and Optimise the 3G & 4G Cellular Network in the South Island to provide the best possible service to the end customer.

Cell Phone Network



Queenstown Spark Network Overview



SPARK Queenstown Network Existing Sites

Alpha	Site Name	Altitude (m)	Site Height (m)
SABTA	Albert Town	283	9
SCARA	Cardrona	1670	8
SGLCA	Glencoe Station	623	8
SGLNA	Glenorchy	366	12
SGLUA	Glendhu Bay	304	9
SHLDA	Hill End	804	27
SLHAA	Lake Hawea	486	8
SMDWA	Mount Dewar	1304	25
SOJMA	Shotover Jet	367	5
SPENA	Peninsula Hill	828	14
SPVRA	Peninsula Reservoir	412	11
SQTCA	Queenstown Central	315	19
SQZAA	Queenstown Airport	342	13
SRSFA	Remarkables Ski Field	1624	6
SSKYA	Skyline	772	7
SWKXA	Wanaka Exchange	294	14

Mobile technology development

Spark Connect

Voice capacity

2G

150kbps data

2.5G

Feature phones E-mail

smartphones

384kbps

2Mbps

3G

21Mbps

3.5G

150Mbps

4G

FWA

1Gbps

4.5G

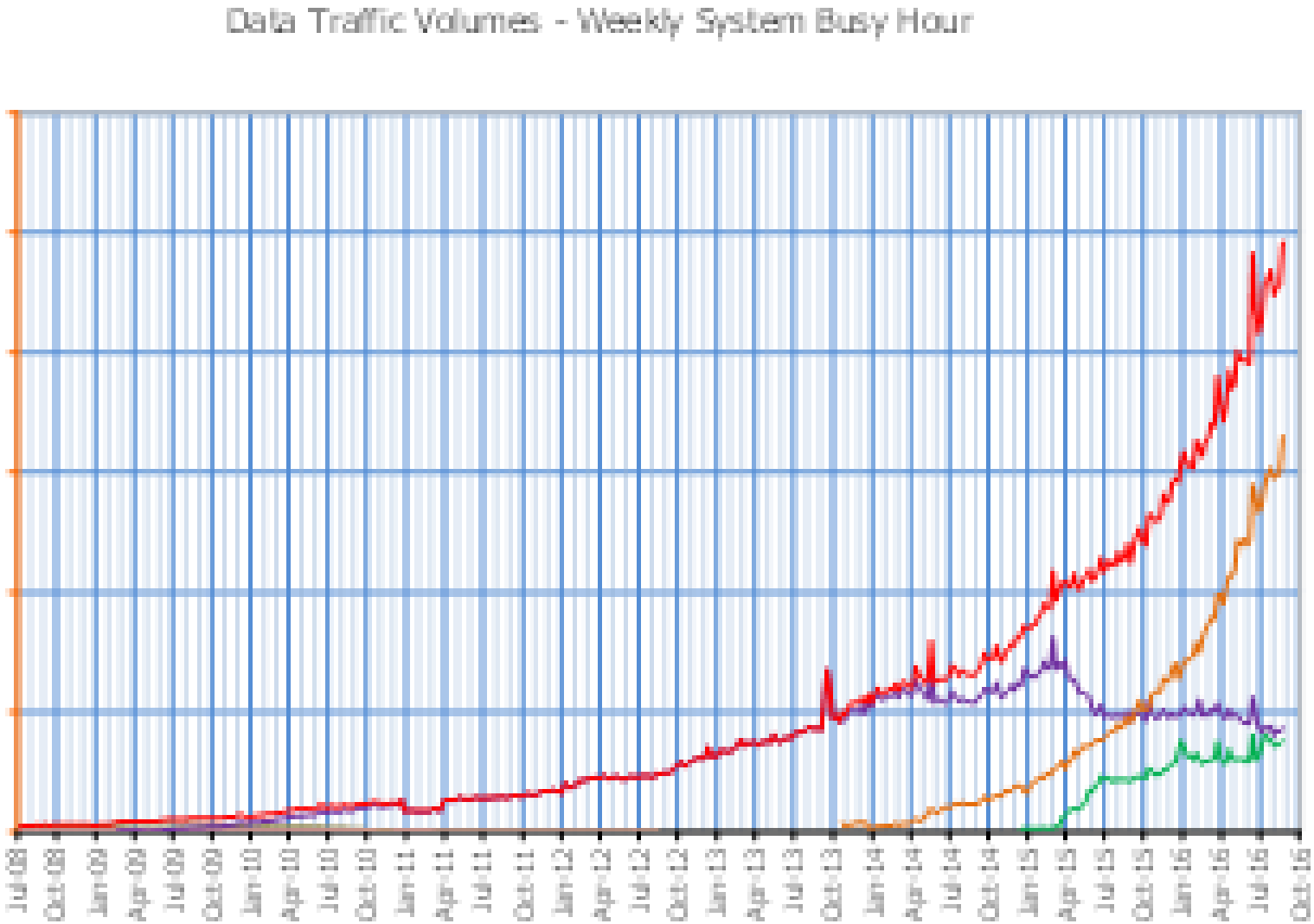
4k HD-TV

100Gbps

5G

1995	2001	2008	2013	2018	2020
850MHz	850MHz	850MHz	850MHz	850MHz	850MHz
		2100MHz	2100MHz	2100MHz	2100MHz
			700MHz	700MHz	700MHz
			1800MHz	1800MHz	1800MHz
			2600MHz	2600MHz	2600MHz
			2300MHz	2300MHz	2300MHz
					3500MHz

Customer Data Volume Increase



2G + 3G cell sites (2008)

Spark Connect

2G (CDMA 850)

3G (UMTS 2100)

3G (UMTS 850)

- 2 port antennas
- No multi-band antennas
- Separate antenna per technology
- Typically 3 antennas per sector and 3 sectors per mast

Emerging Mobile Technology

Spark Connect

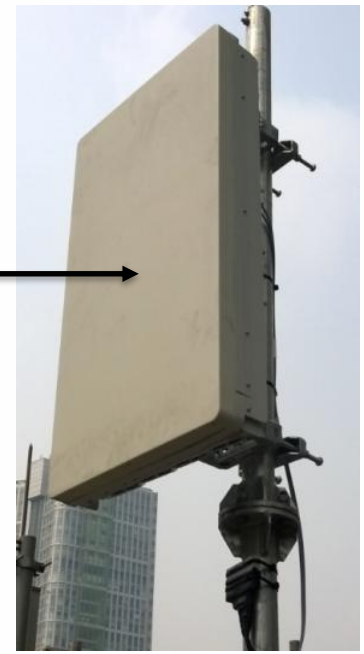
4G

- RRU per band + combiners into multi-port antennas
- Up to 8x8MIMO needs 8 ports
- 1800, 2100, 2300, 2600 combined
- 700+850 combined per LB port
- 10 to 12 ports per antenna

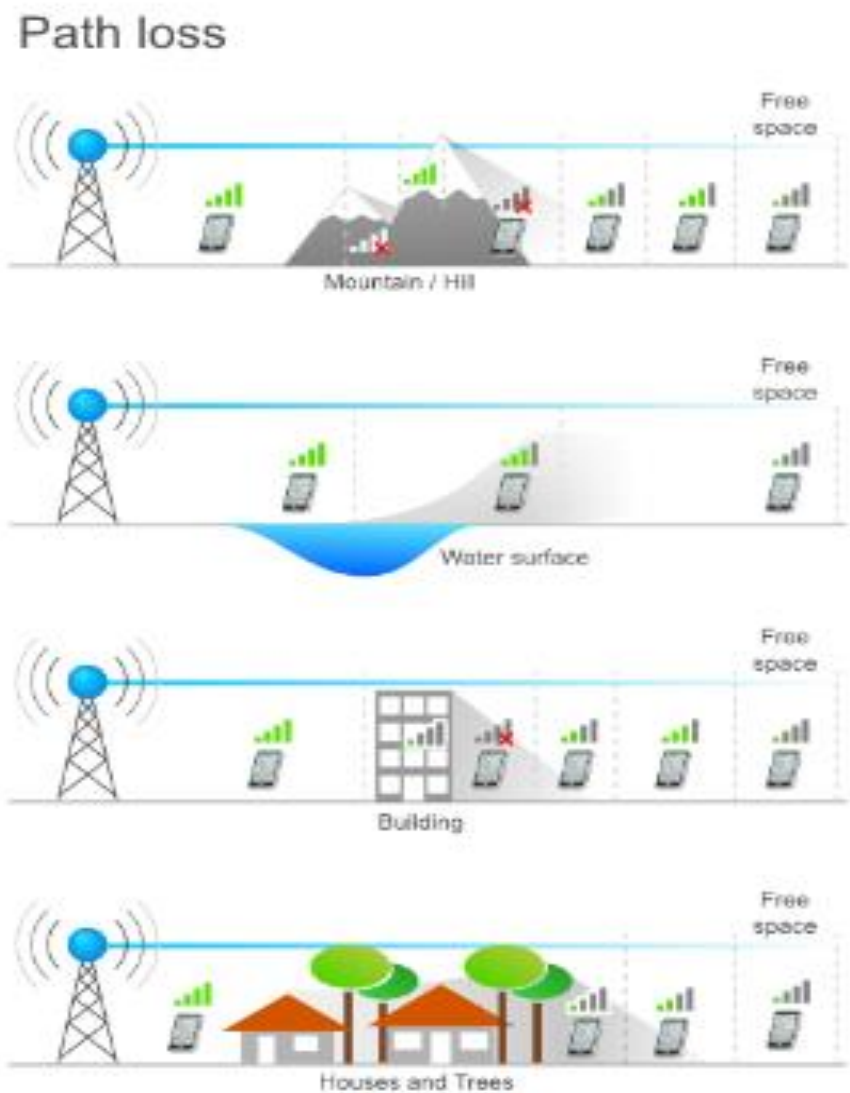
Multi-port passive antenna typically 2m high x 0.35m wide

RRU per band

5G active array antenna panel



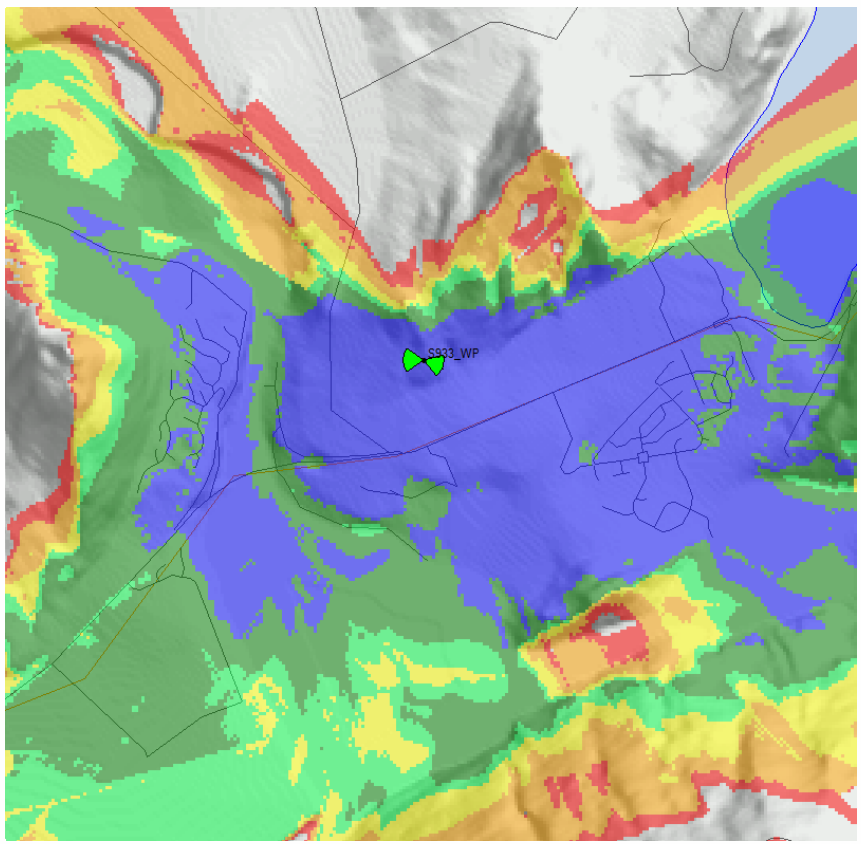
- Separate active array panel per 5G band
- includes TX/RX so no additional RRU's
- Approx 0.8m high by 0.5m wide



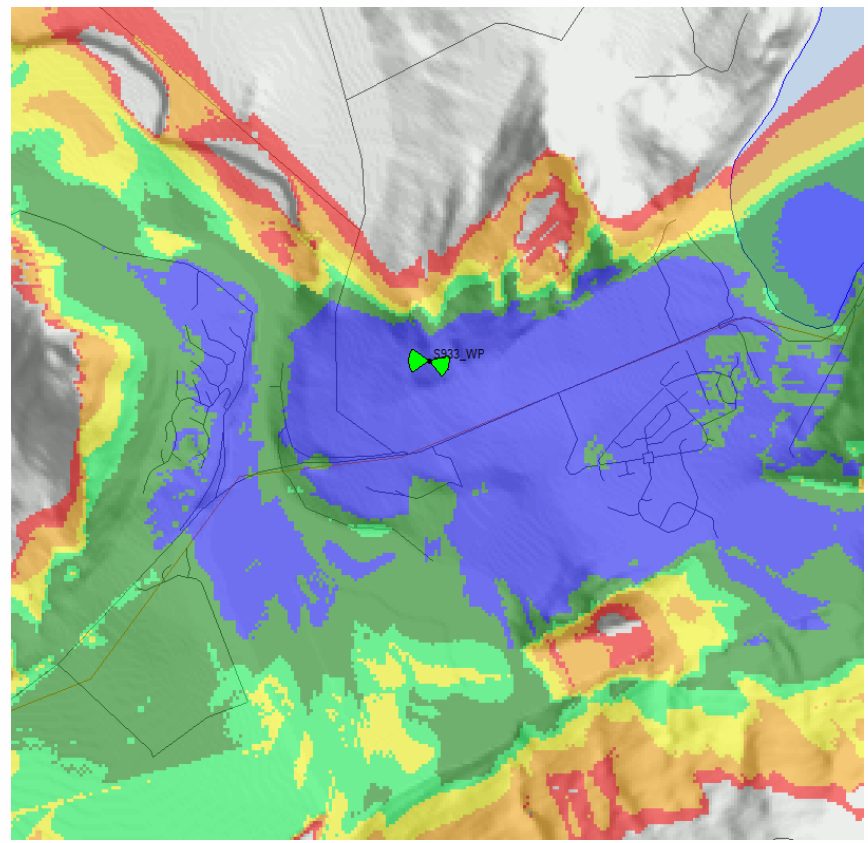
Radio Propagation

Mast Heights vs Coverage

In a good location which is above the local clutter and rolling terrain, tower height is not as critical. Elevation of the antenna is provided by the ground height



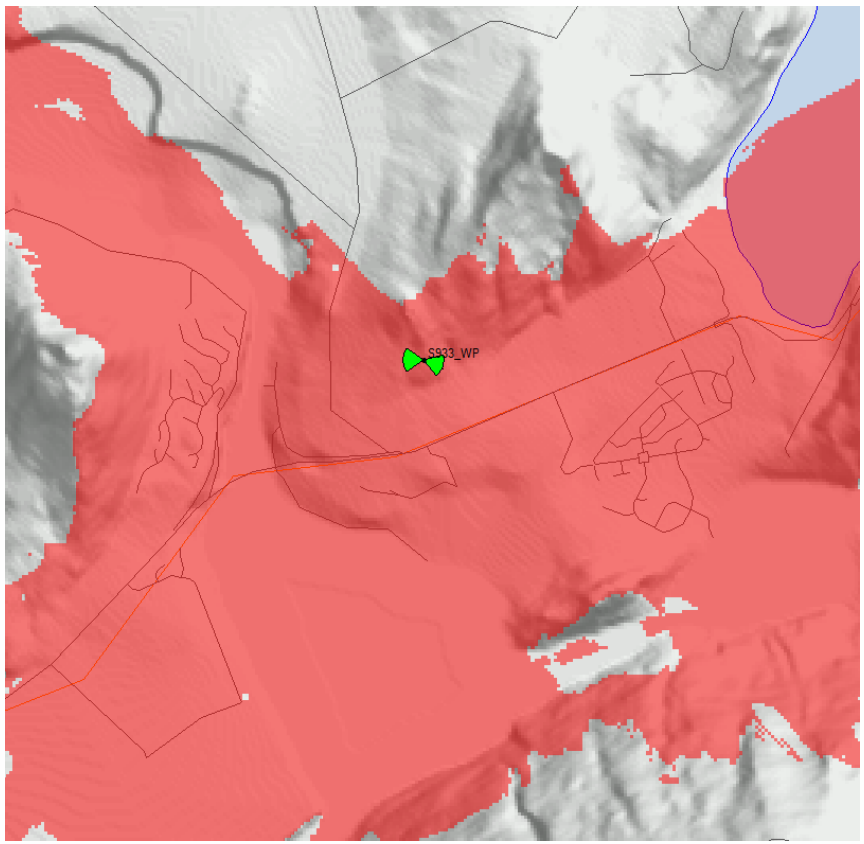
15m Tower Height – Signal Strength



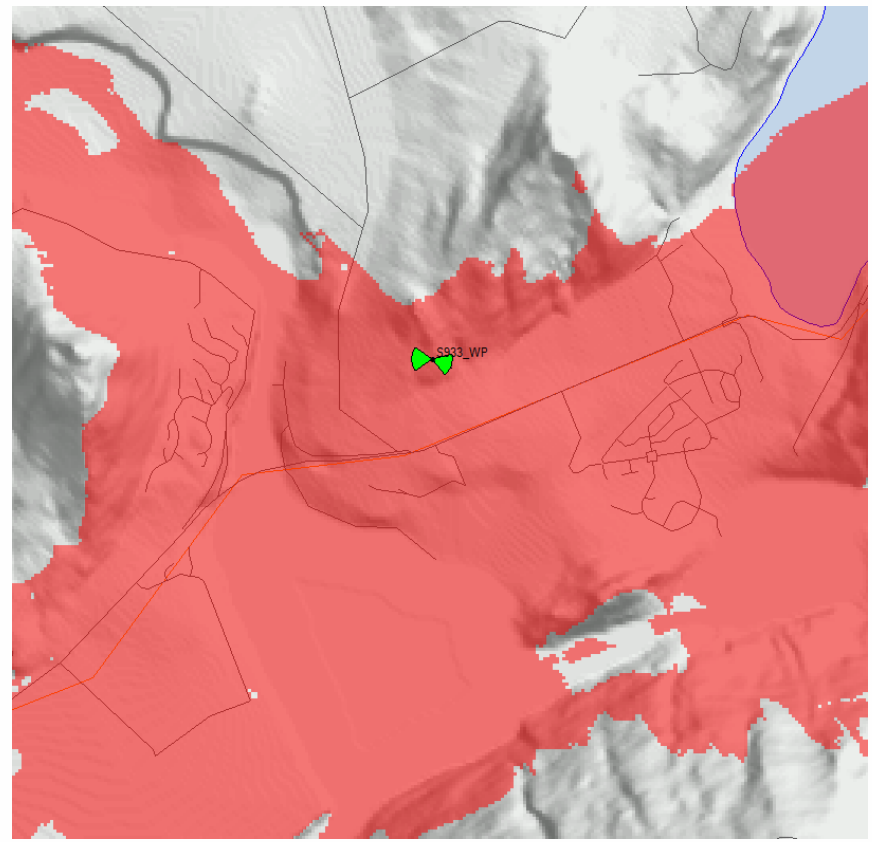
8m Tower Height – Signal Strength

Mast Heights vs Coverage

In a good location which is above the local clutter and rolling terrain, tower height is not as critical.



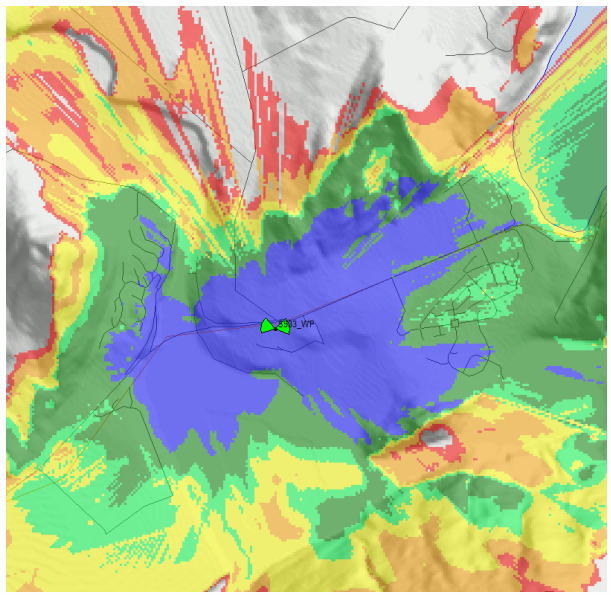
15m Tower Height – Indoor Coverage



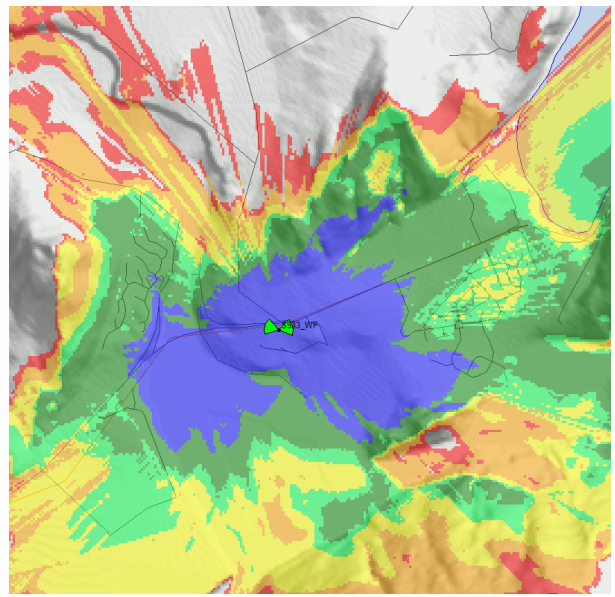
8m Tower Height – Indoor Coverage

Mast Heights vs Coverage*

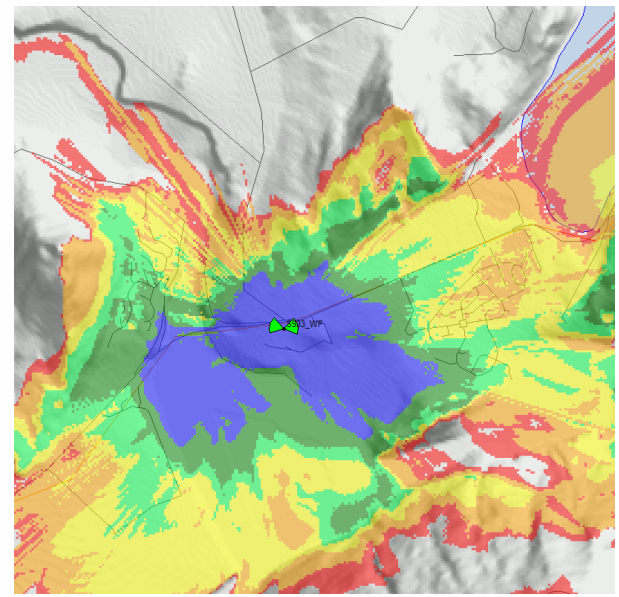
For street level or compromised locations (i.e Non-LOS) tower height is extremely important to get above the local clutter otherwise additional sites would be required to provide the same level of coverage.



20m Tower Height – Signal Strength



14m Tower Height – Signal Strength

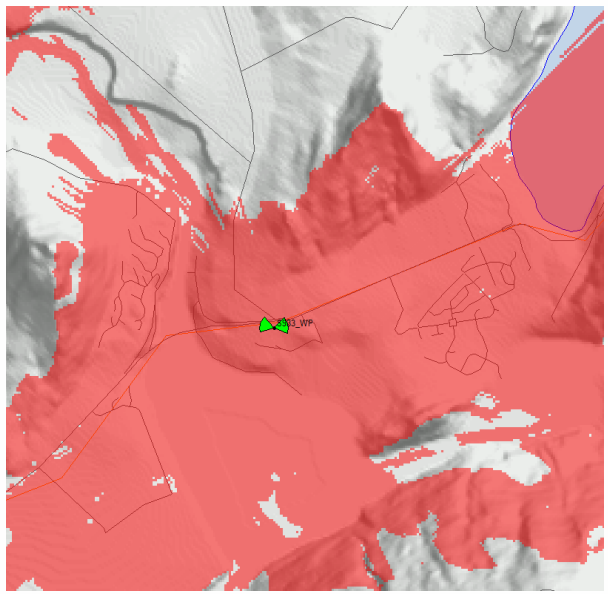


8m Tower Height – Signal Strength

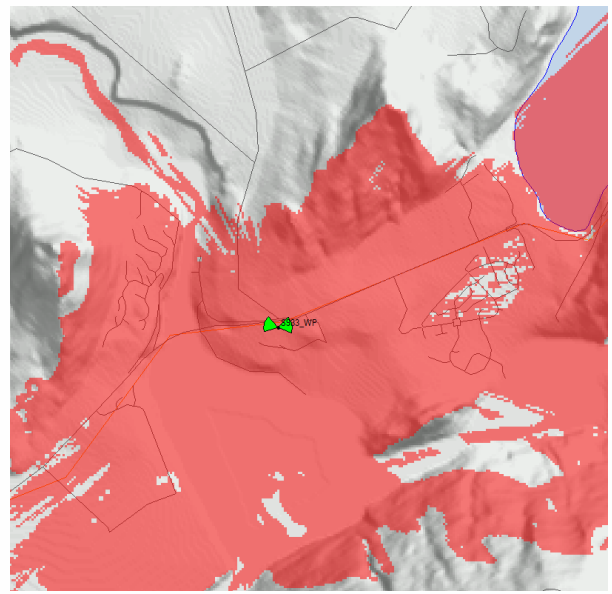
*850MHz prediction shown – Higher frequency bands (>1.8GHz) would suffer more in non-LOS scenarios, resulting in bigger coverage holes.

Mast Heights vs Coverage*

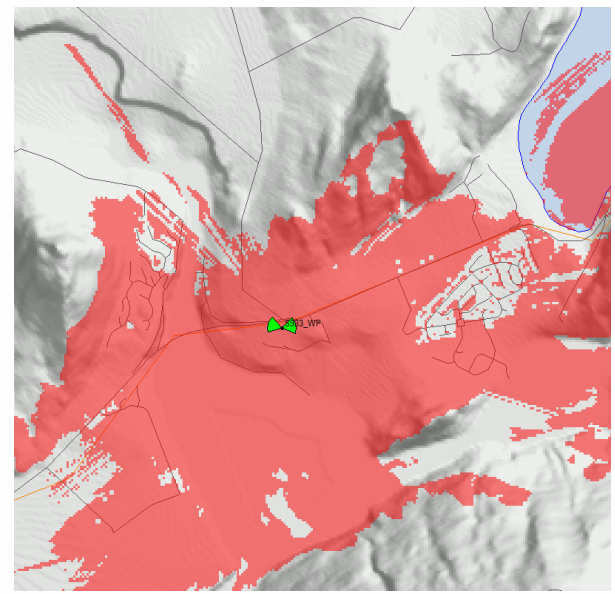
For street level or compromised locations (i.e Non-LOS) tower height is extremely important to get above the local clutter otherwise additional sites would be required to provide the same level of coverage.



20m Tower Height – Indoor Coverage



14m Tower Height – Indoor Coverage

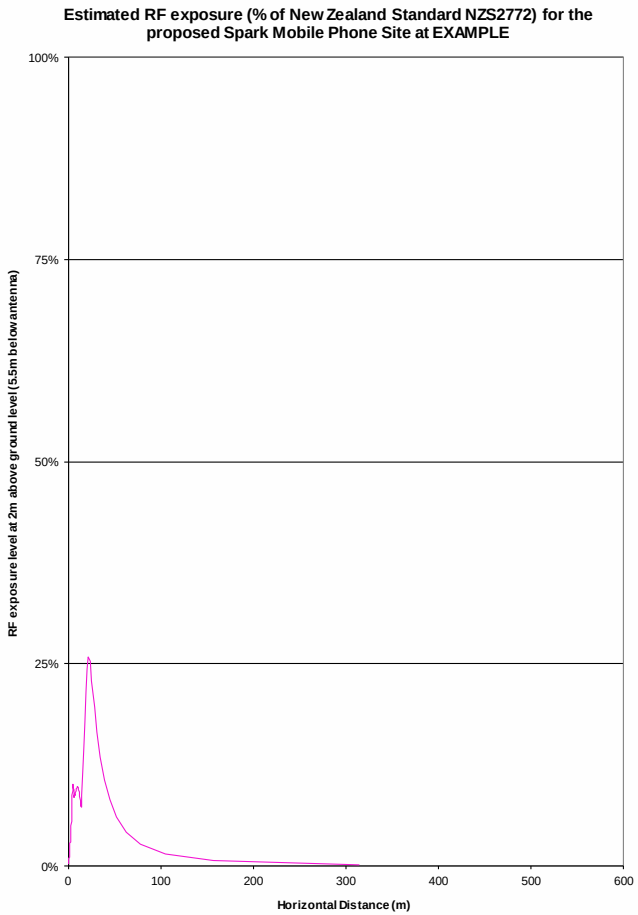


8m Tower Height – Indoor Coverage

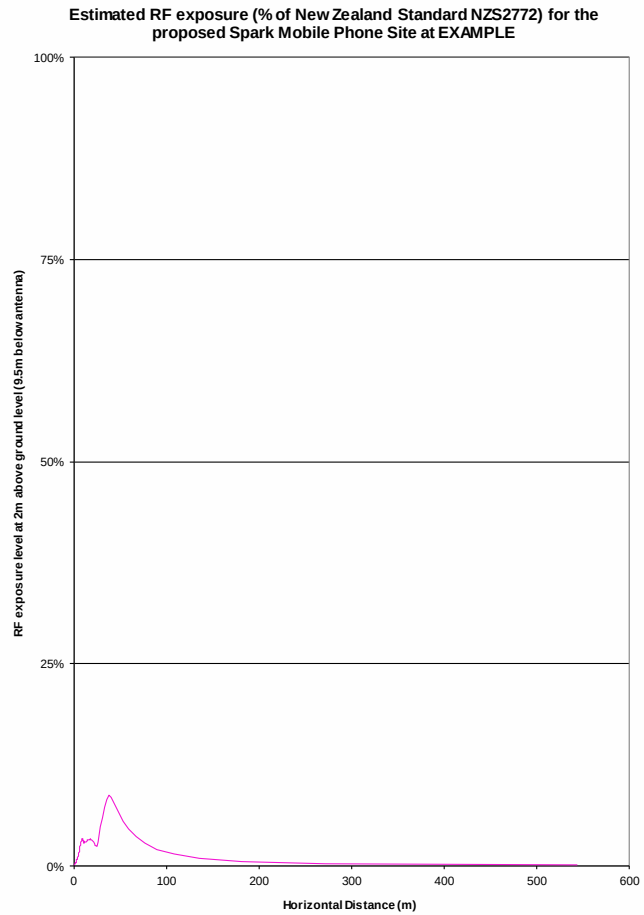
***850MHz prediction shown – Higher frequency bands (>1.8GHz) would suffer more in non-LOS scenarios, resulting in bigger coverage holes.**

Colocation and RF Standard Issues – RF Exposure = Street Level

Typical site with 700/850/1800 & 2100 technologies



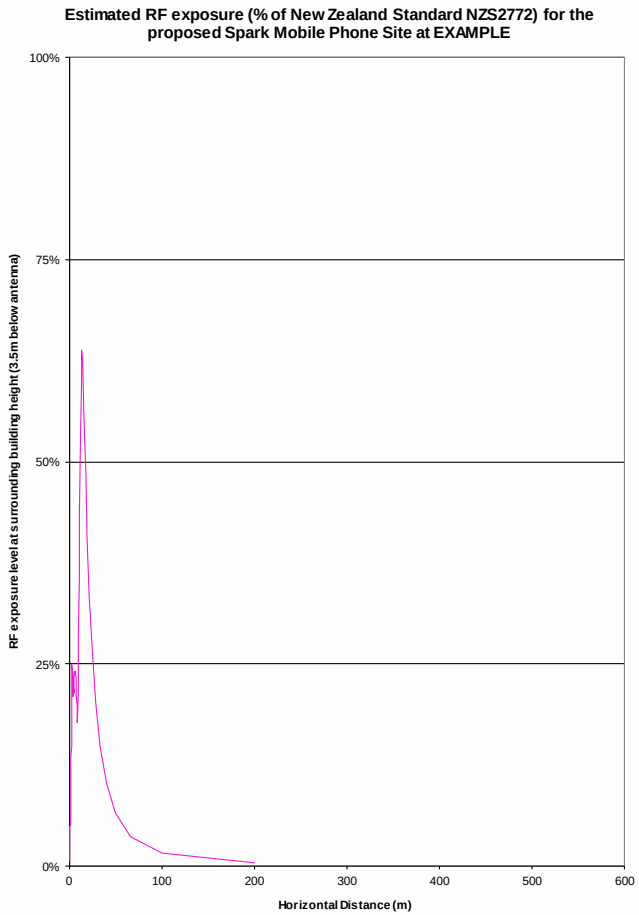
8m Tower



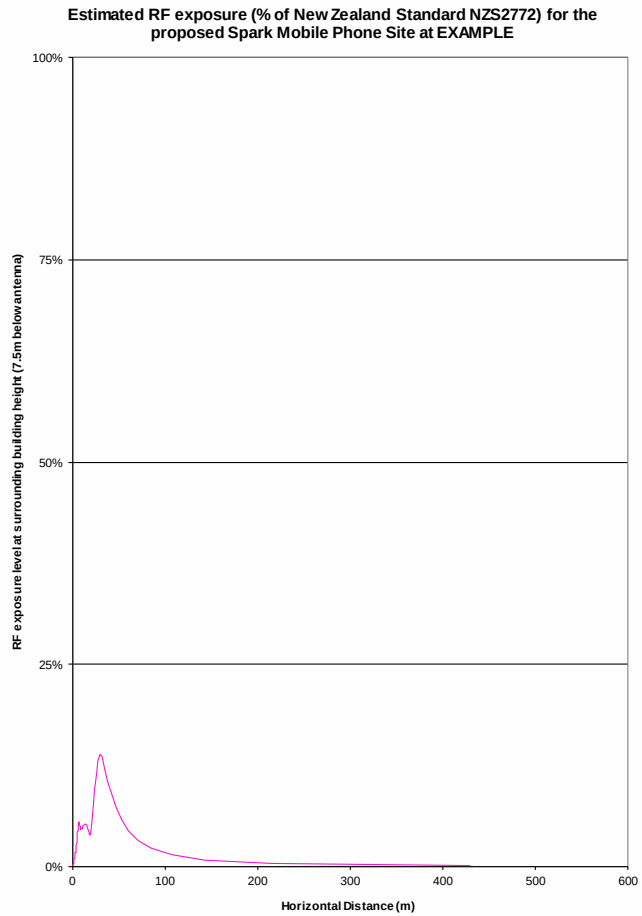
11.5m Tower

Colocation and RF Standard Issues – RF Exposure = Building @ 4m

Typical site with 700/850/1800 & 2100 technologies.



8m Tower



11.5m Tower

Future Mast / Antenna requirements

Spark Connect

3G + 4G

- Typically 2 passive antennas per sector
- 2.6m high x 0.35m wide
- 4 or 5 bands across 10 ports
- Several RRU per sector

5G

- 1 or 2 active array antenna panels per sector
- Approx 0.8m high by 0.5m wide each

Conclusions

Mobile Data Growth is fuelling a requirement for network development and enhancement to keep pace

With the addition of more and more frequency bands to support this growth there will be a possible requirement for more antennas at sites

Antenna manufacturers are now combining low and high bands onto single antennas but there is a physical limit to how much this can continue

Active antennas with massive MIMO will be required in the next 4 - 6 years to cope with extremely high data volumes anticipated

There are new standards being released that open up more frequency bands in the future which will also add to the numbers of antennas required

The End