5G – The Business Case

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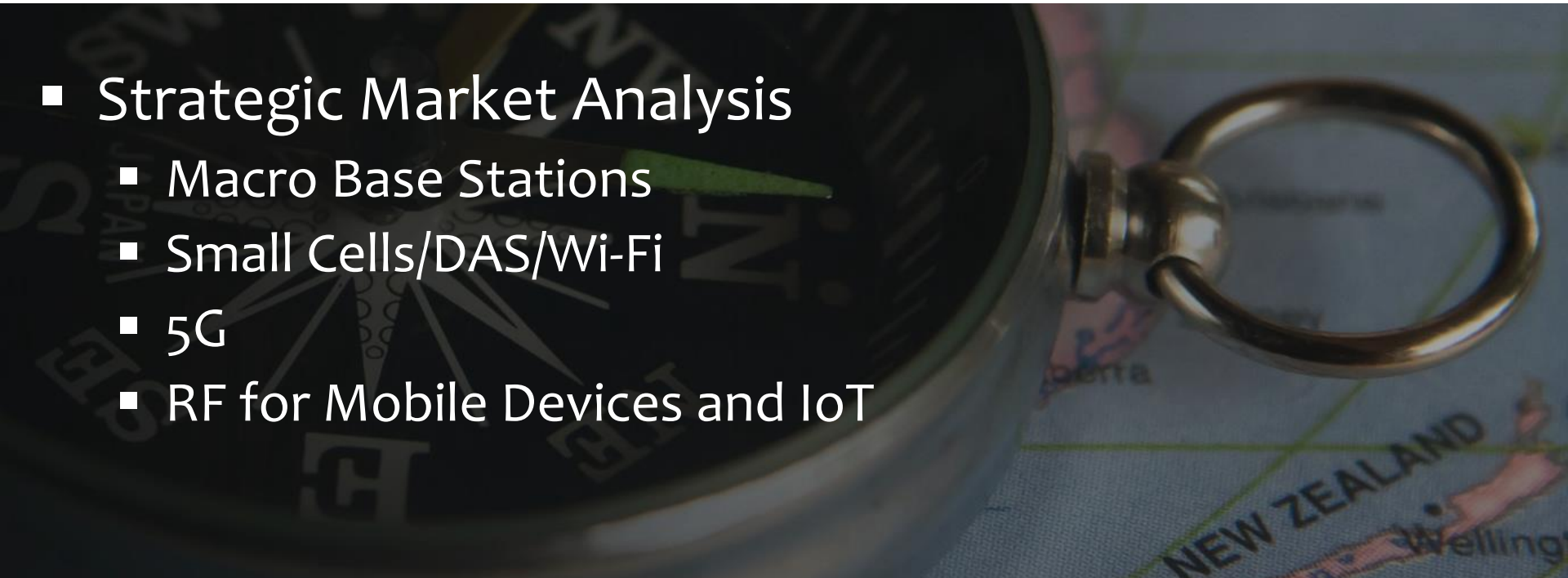
About Mobile Experts

- Market Research focused on wireless
  - 6 Analysts + sales and office staff
  - Based in Silicon Valley, Ottawa, NY, London, Denver
  - Analysts are 20-year experts in their respective topics
  - Deep Technology Analysis coupled to Business Analysis



- Strategic Market Analysis
  - Macro Base Stations
  - Small Cells/DAS/Wi-Fi
  - 5G
  - RF for Mobile Devices and IoT

LTE and 5G

LTE: Foundation Layer

Anchor users on LTE control channels

Pre-5G Fixed Broadband:

Carrier Aggregation on top of LTE

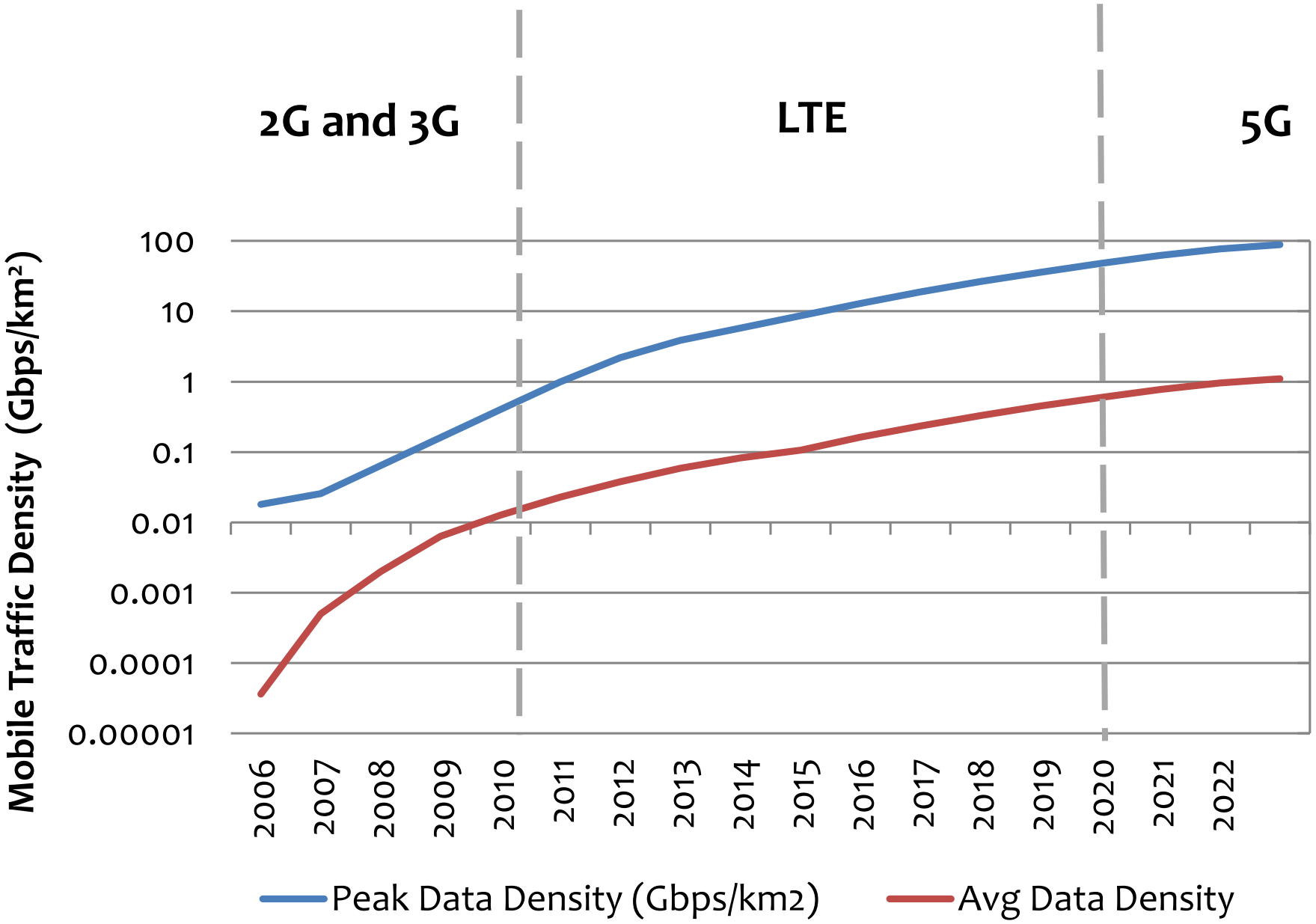
5G is NOT a stand-alone mobile network

5G Mobile Broadband:

Carrier Aggregation on top of LTE

Bands below 6 GHz will be important

Migration will happen over time



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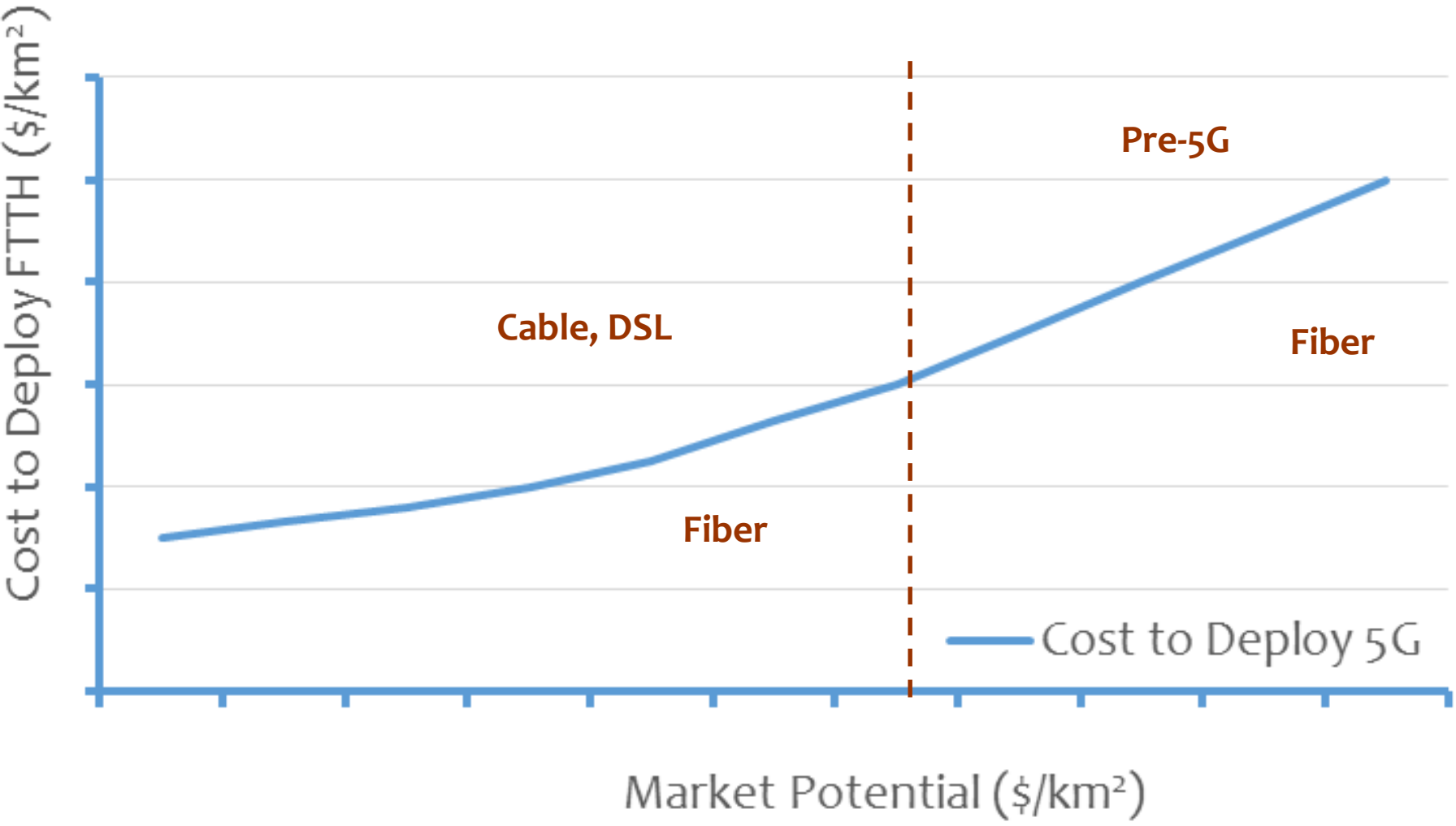
Where pre-5G can win in Fixed Broadband



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Pre-5G ROI

3 Key Factors

- **Spectrum Cost**
- **Link Distance**
- **Density of Customers**

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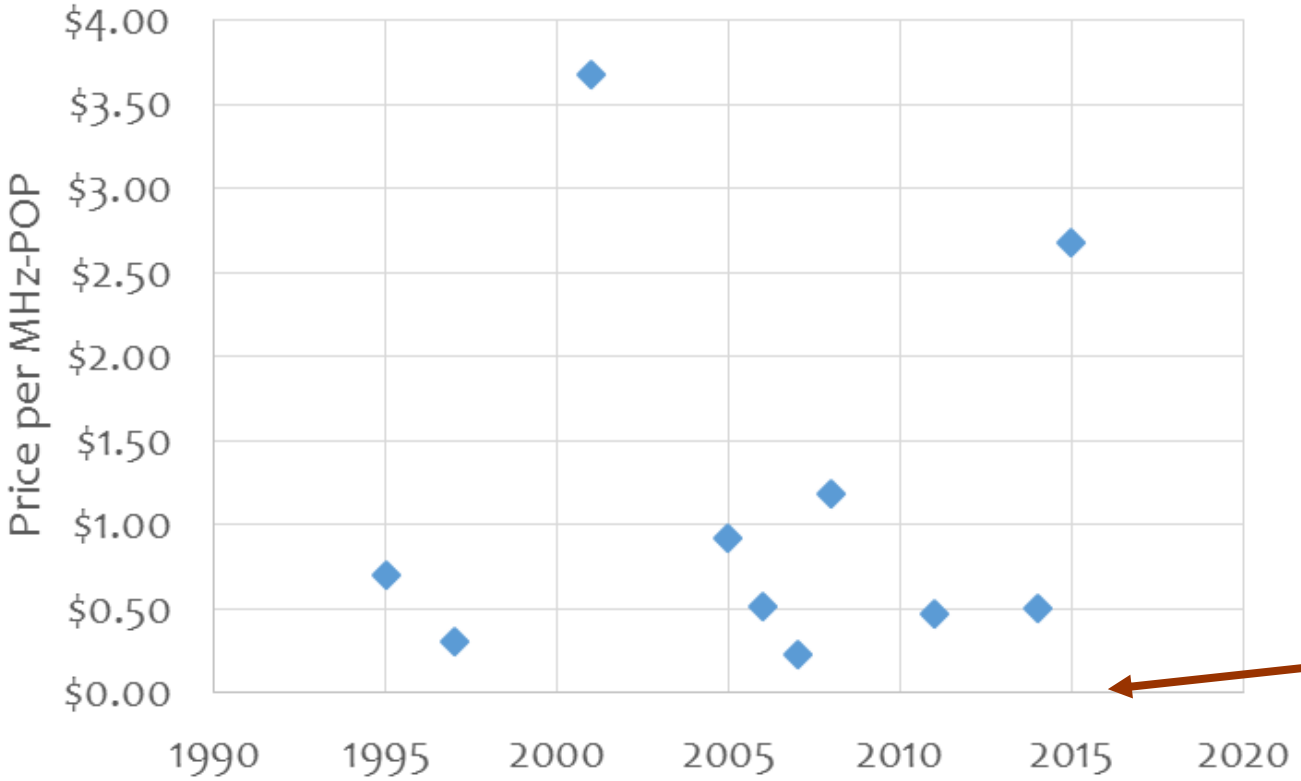
Spectrum Cost



Verizon/XO:
$0.02 to $0.04

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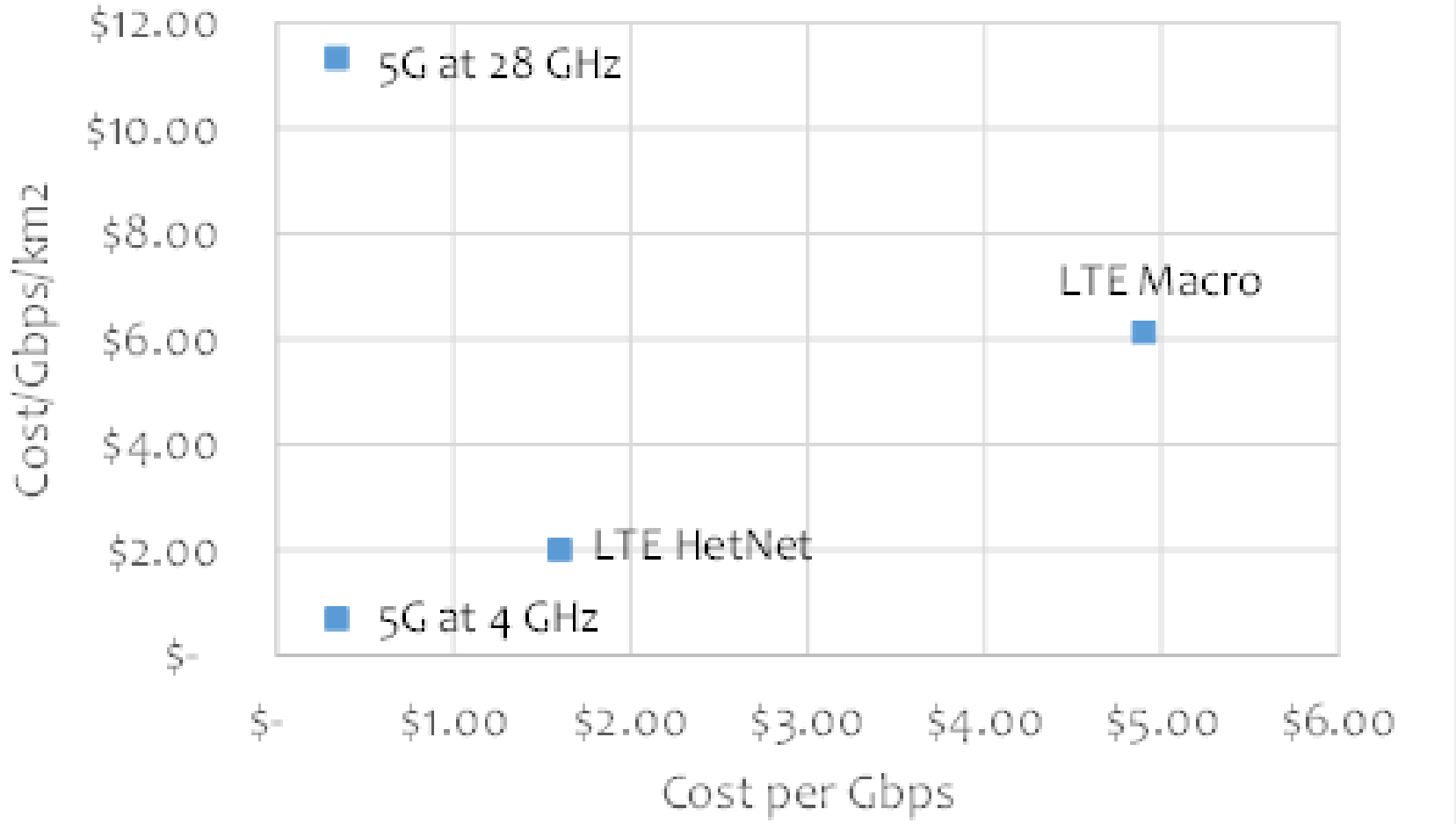
Coverage vs. Capacity



Total Cost of Ownership shown over 8 years

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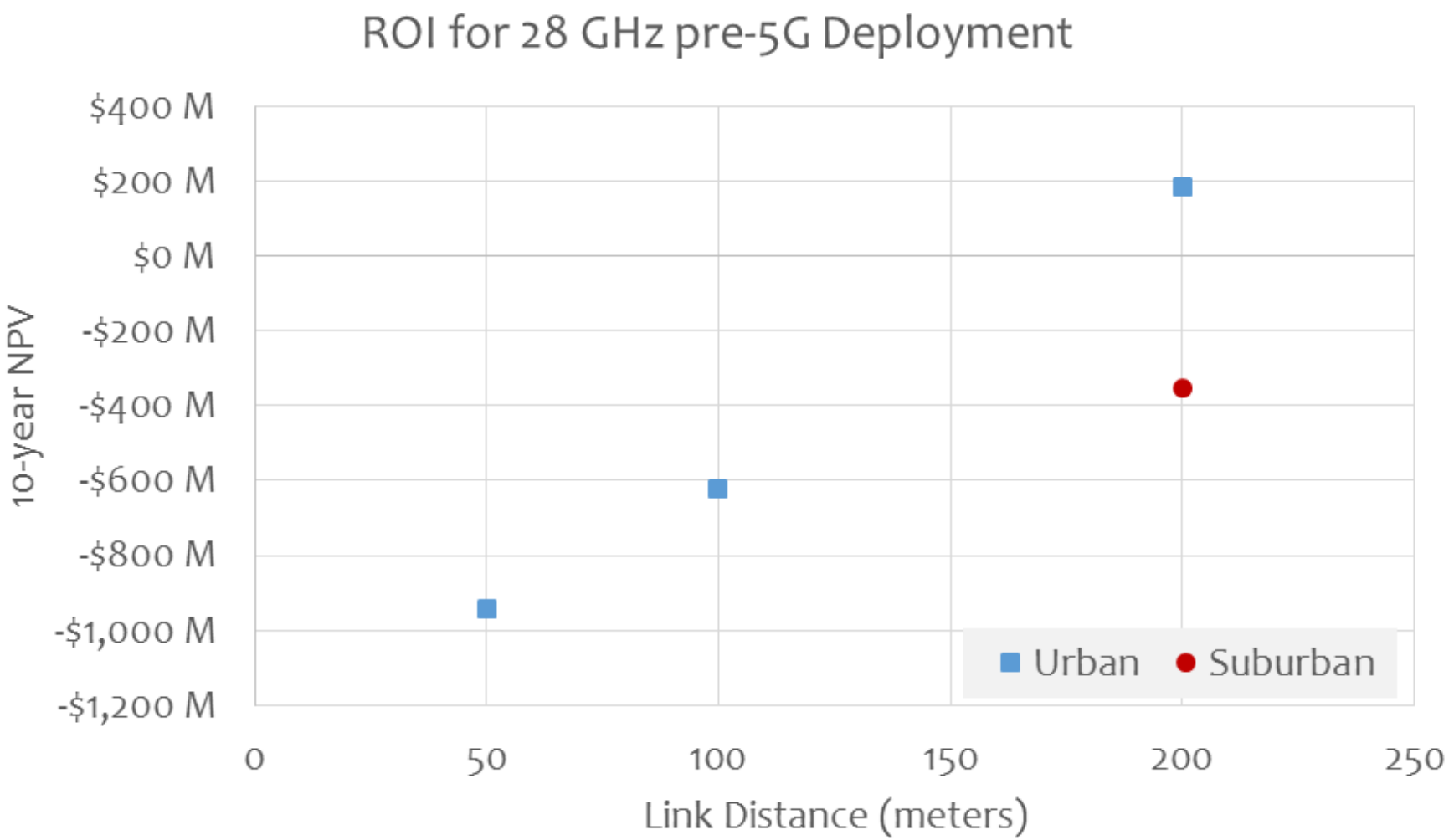
Density Impacts the ROI



10-year NPV shown for deployment of 2000 pre-5G sites

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Pre-5G Fixed Broadband ROI

3 Key Factors

- **Spectrum Cost:**
  LMDS licenses are a sweet deal
- **Link Distance:**
  200m+ is key
- **Density of Customers:**
  Urban areas will be targeted

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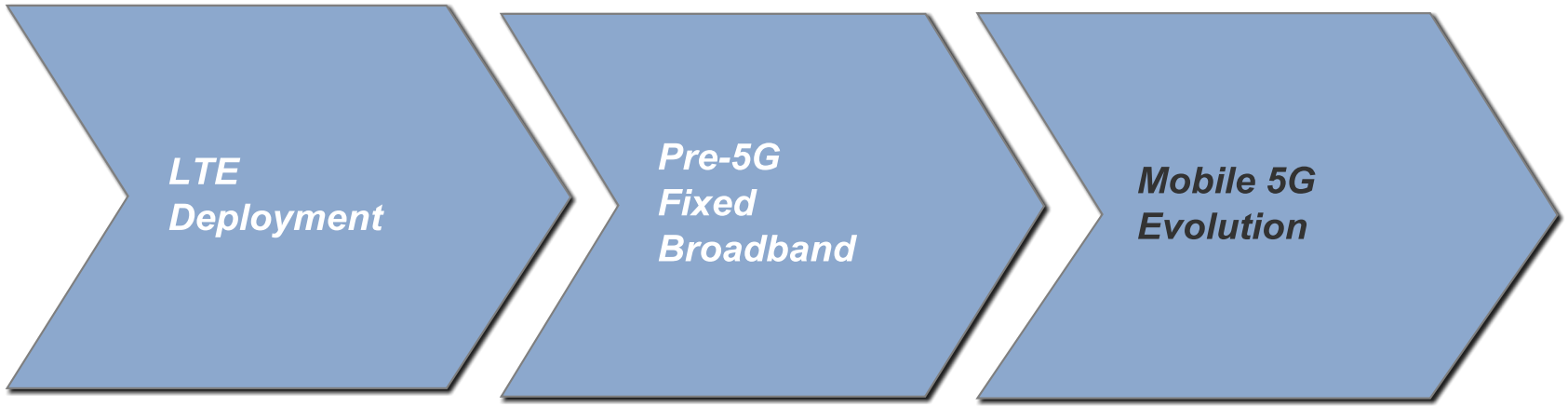
5G Evolution



- *Centralized RAN*
- *Establish fiber to sites*
- *Virtualize the Core*

- *No Mobility Features*
- *Highly Targeted*

- *Add Mobility*
- *Wider Coverage*
- *Sub 6 GHz bands necessary*

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What could go wrong?

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Power

Item	Value
Output power from Base Station (dBm)	48
Gain for base station antenna (dBi)	30
Path loss at 200m, outdoor case only, (dB)	-140
Margin for rain and near-field effects (dB)	-6
Gain for handset antenna (dBi)	5
Noise Figure of terminal Rx (dB)	-12
Required SINR for high throughput (dB)	-20
Effective Rx power (dBm)	-95
Effective noise power at 28 GHz and 1 GHz BW (dBm)	-95

High power is necessary to achieve high SNR

Heat Dissipation

A 60 W RRH will produce 500W+ of heat

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Conclusions

- 5G Spectrum cost must be lower than 4G
- Radios will transmit high power and will run hot
- CPEs will be outdoors/in windows
- mm-wave 5G will be highly targeted
- Sub-6 GHz 5G will work better for mobile service


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Mobile Experts
provides long-term vision
….not fluff.