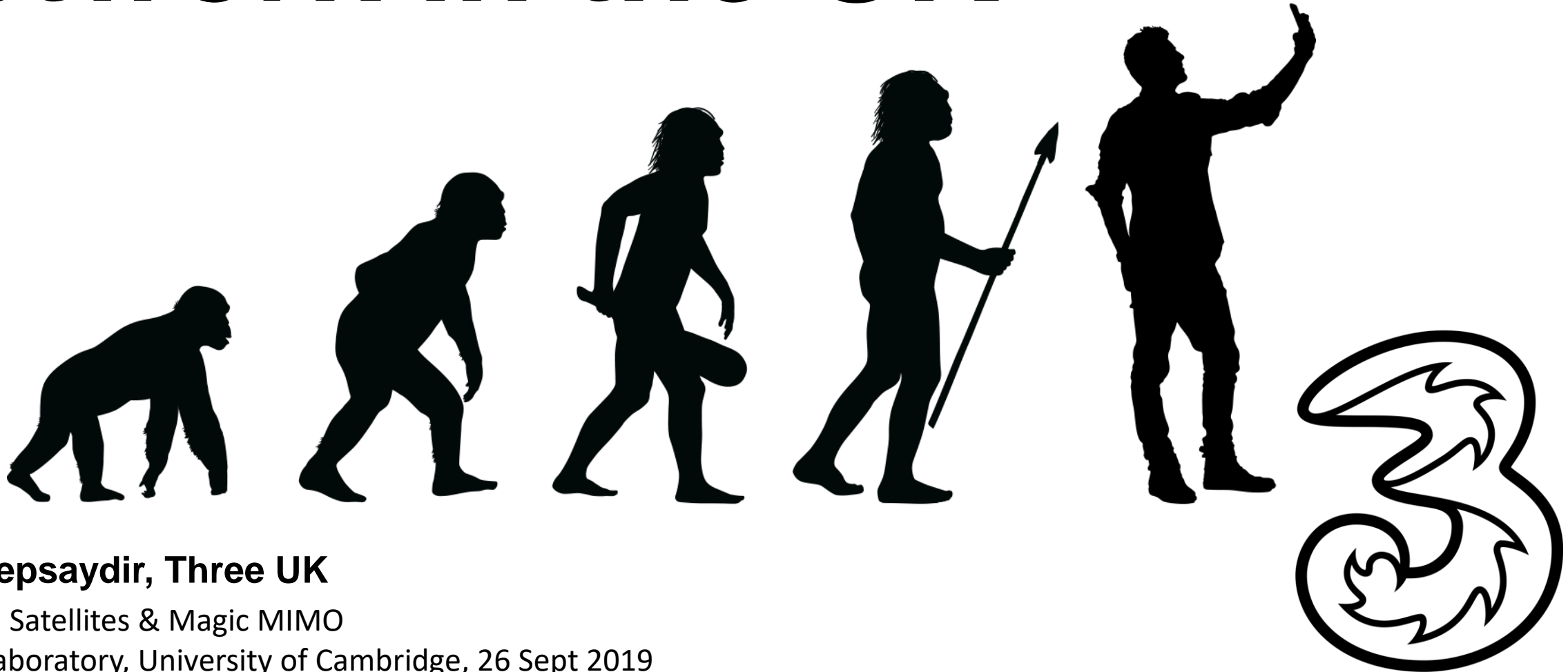


Building the fastest 5G network in the UK



Dr Erol Hepsaydir, Three UK

CW TEC: 5G, Satellites & Magic MIMO

Computer Laboratory, University of Cambridge, 26 Sept 2019

The UK's challenger brand

Letting our customers do more

10m

Customers

>10GB

Average monthly
customer data usage

3.5x

More data usage than
the industry average

99%

Population coverage

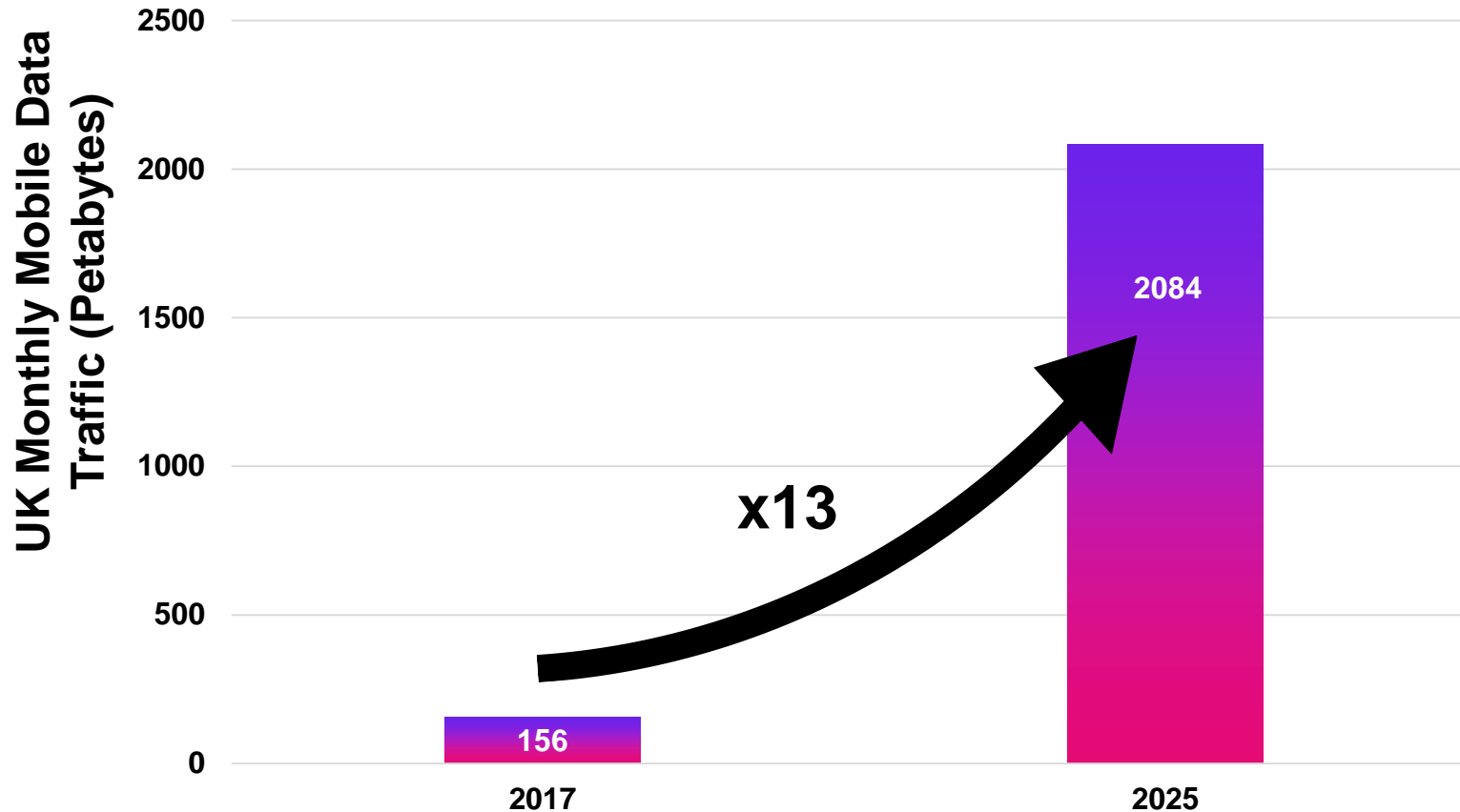
+15

Net Promoter Score;
Highest of any MNO

+23

Employee Net
Promoter Score

Customer demand for mobile data



Source: Ofcom's Mobile Data Strategy, June 2016

At current Ofcom projections, an average Three UK customer will use **90GB** per month by 2025

The industry needs to change to meet this exponential demand



Three Broadband

- No landline
- Only sell where it works
- Fair pricing model
- Plug and Play

Competitively priced



75Mbps

Super-Fast Unlimited

- Unlimited data
- No connection fee
- Same-day delivery
- Connectivity around the home



The background of the slide is a photograph of a calm ocean at sunset or sunrise. The sky is a gradient of soft colors, from a pale pink and orange near the horizon to a light blue at the top. The water's surface is still, reflecting the colors of the sky. In the lower right foreground, there are two dark, jagged rocks protruding from the water. The text is overlaid on the left side of the image.

**We have a five-year strategy
to fundamentally change our
business**

Strategy to execution

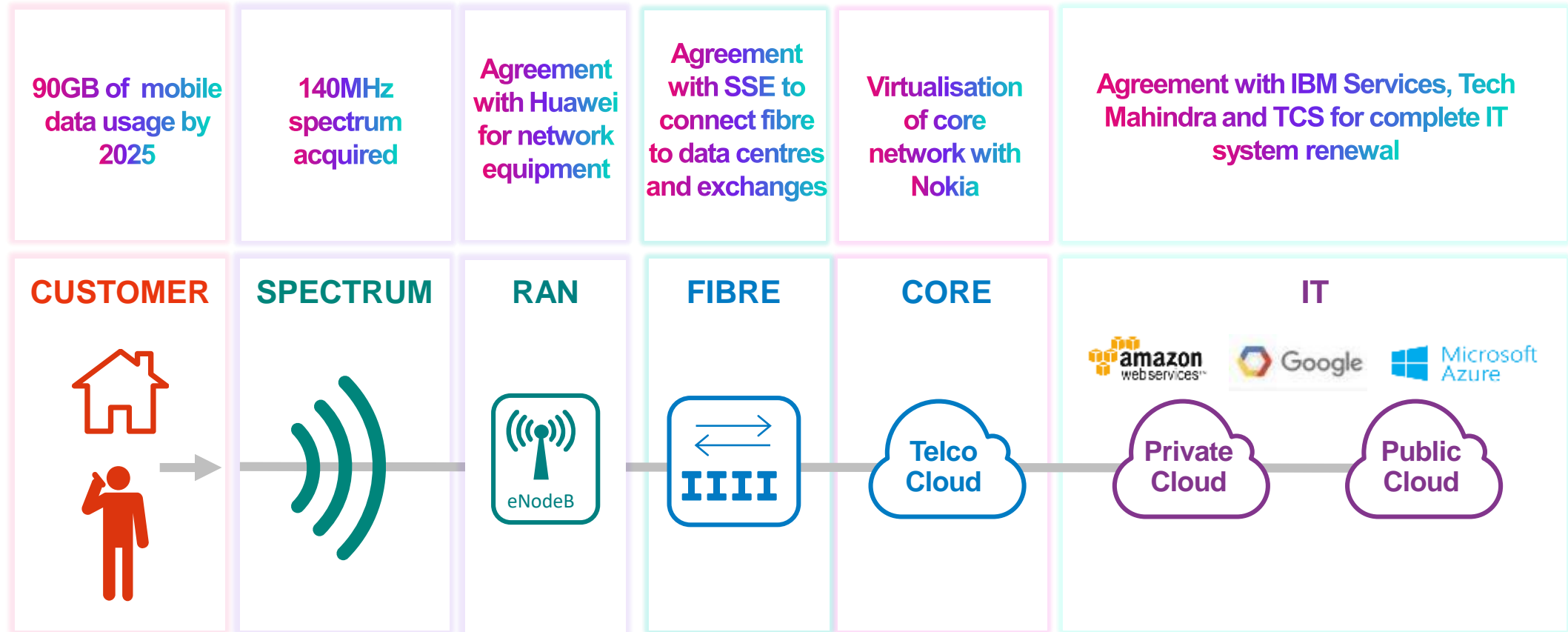
How we operate is key to our success.

- It isn't just a change to the technology or the organisation design, it is a change to the way the whole business operates.
- The business has to think and operate differently to be a success.

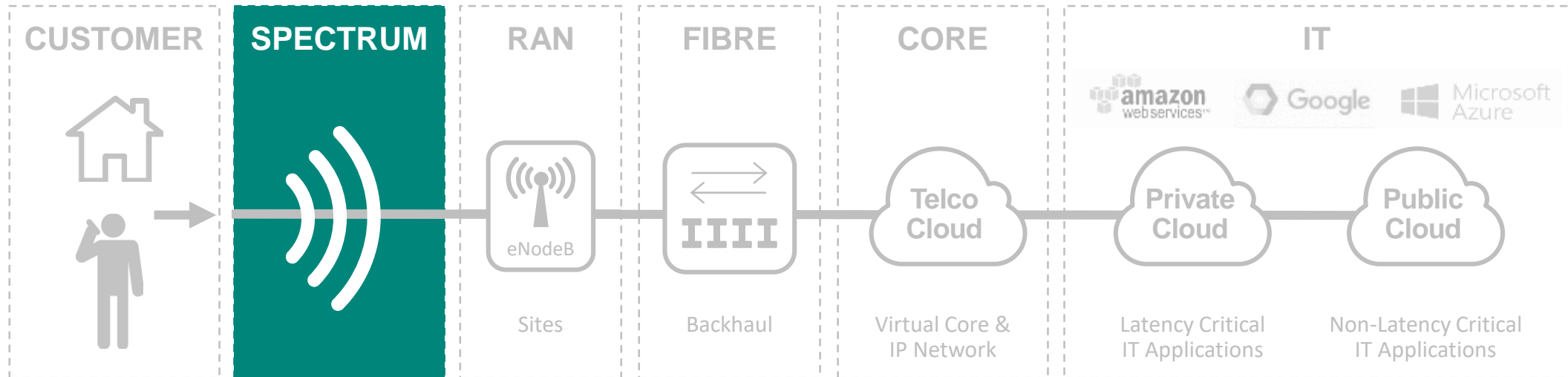


Building on 5G foundations

End-to-end TECHNOLOGY delivery is critical



Serving the customer



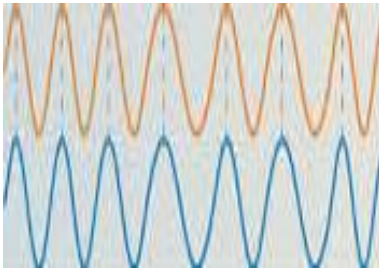
Each of these elements have their role to play

Spectrum

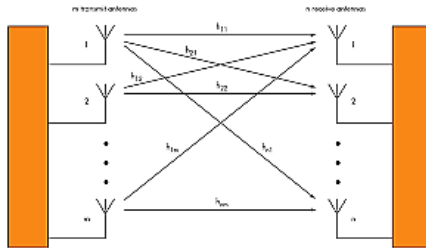
Shannon's Theoretical Upper Limit

$$C \approx W \cdot n \cdot \log_2(1 + \text{SINR})$$

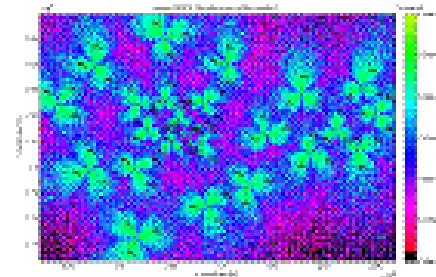
More Spectrum



More Antennas



Interference Management

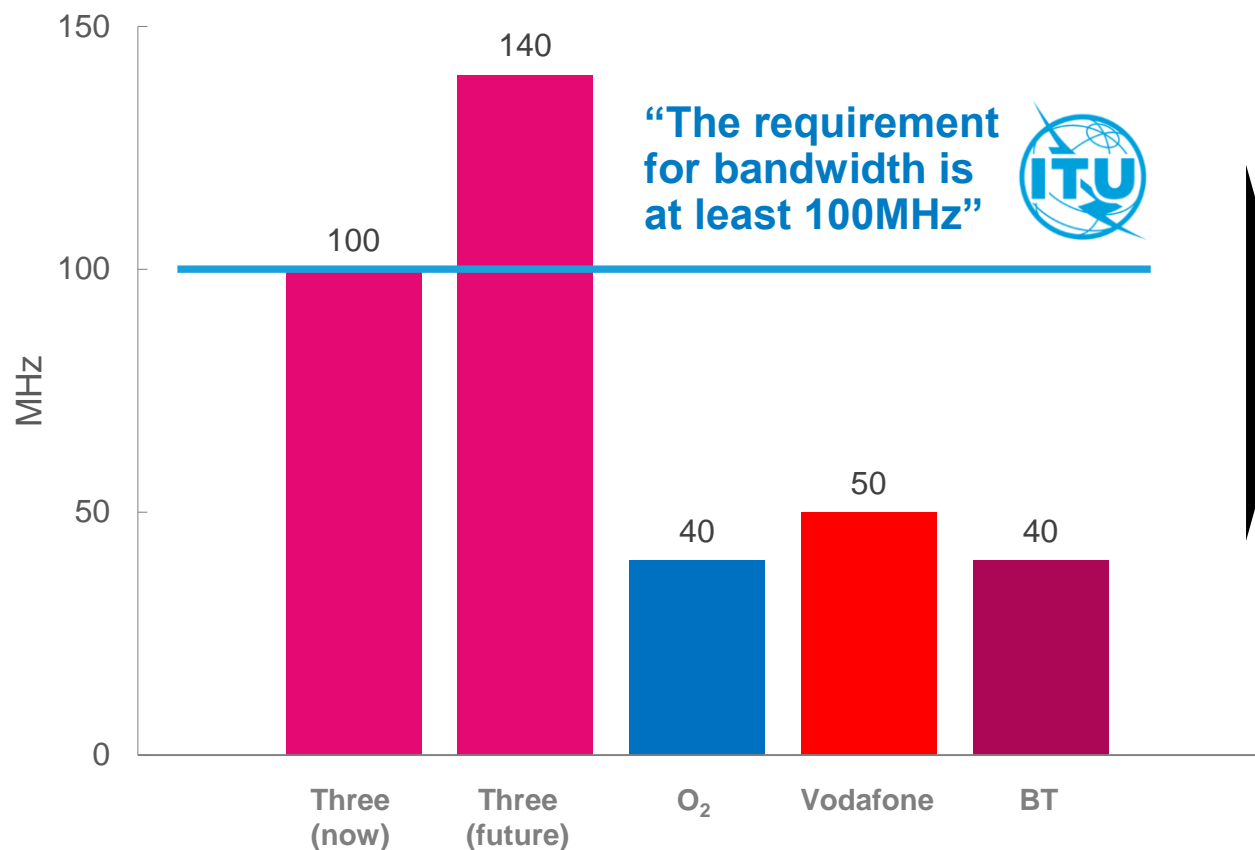


Larger spectrum offer larger capacity

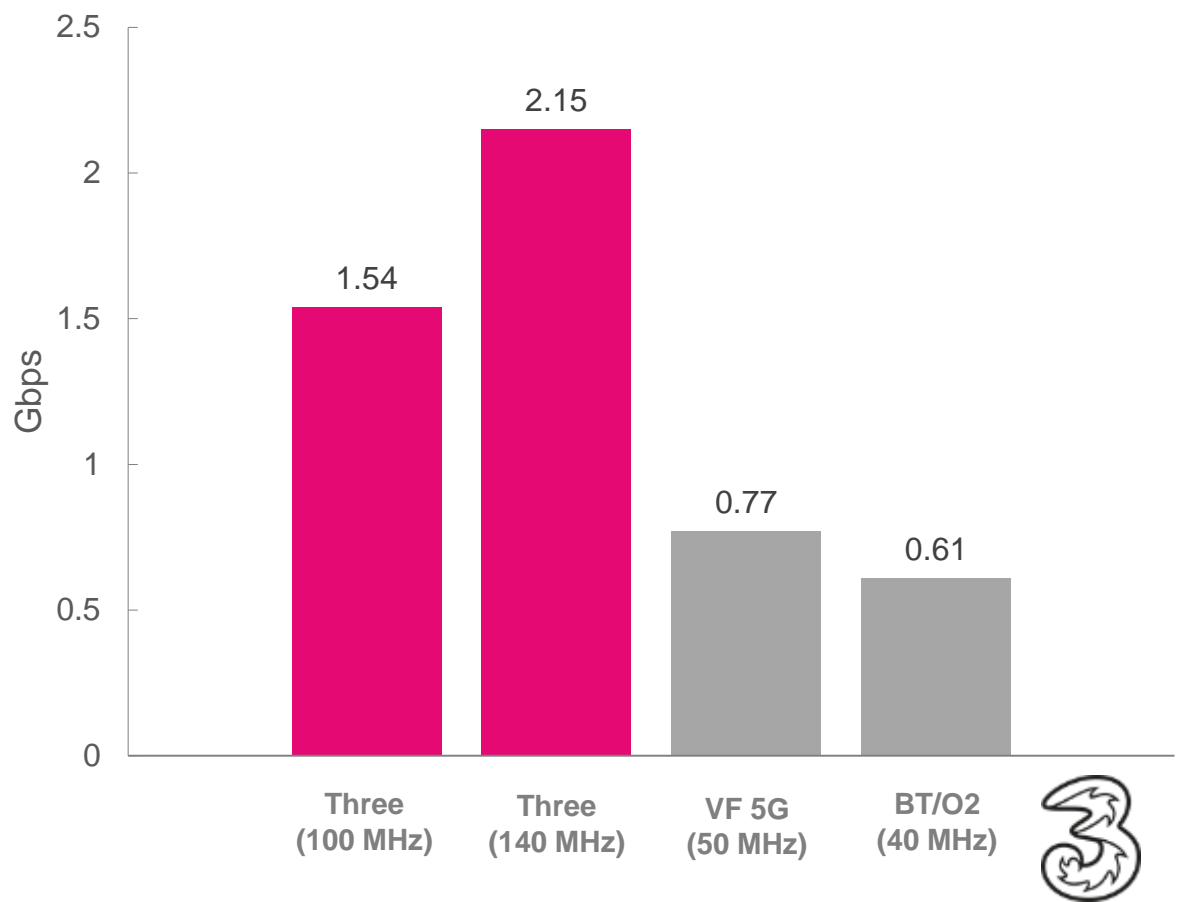
We are in an incredible position

Three's 100 MHz contiguous bandwidth sets the benchmark for 5G speeds in the UK

5G Spectrum Position

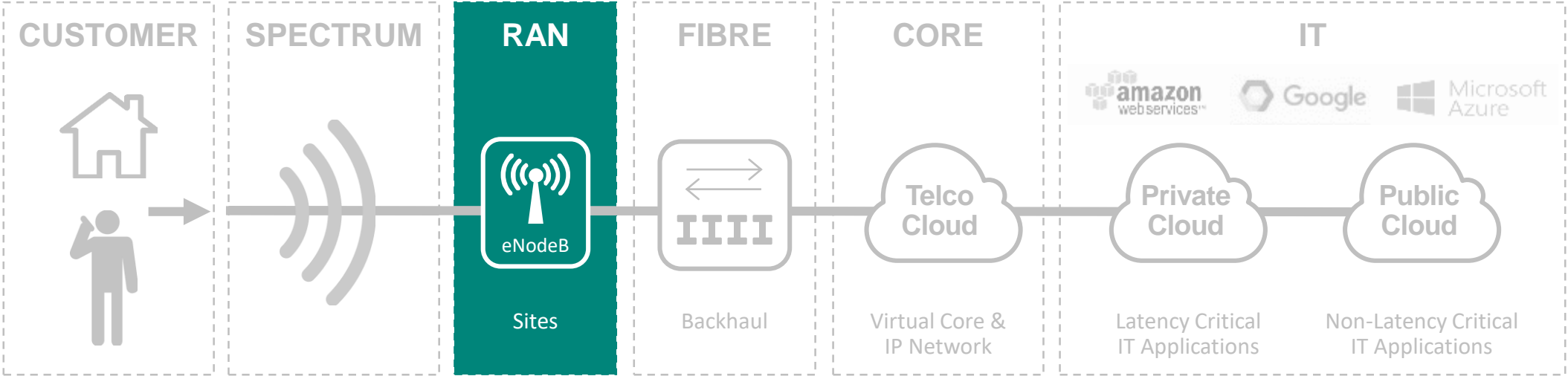


Peak 5G Speeds (by 2020)



Serving the customer

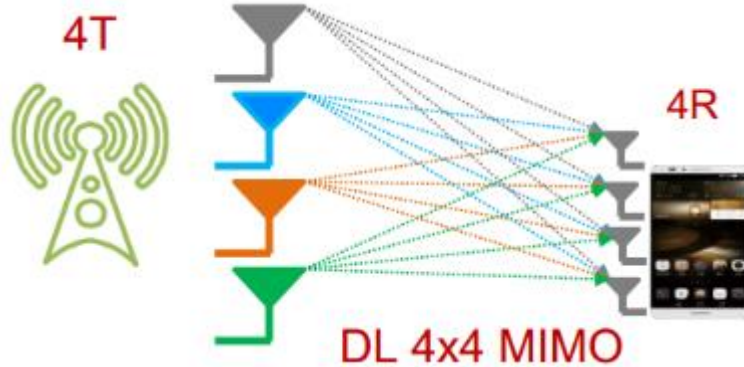
Building 5G with Huawei



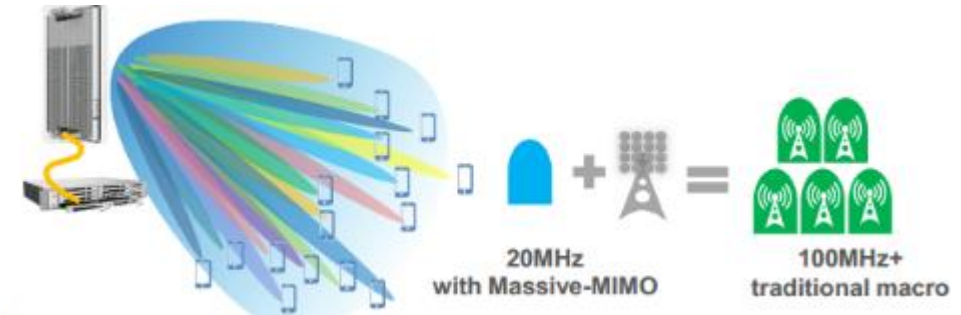
End-to-end delivery is critical

Antenna technology

4T4R



M-MIMO



3.4/3.6 Ghz

2T2R

4T4R

64T64R Beam Forming

Coverage

No
improvement

Small
improvement

Nearly matches
1.8Ghz

Capacity

1x

1.7x

3-5x

Site evolution

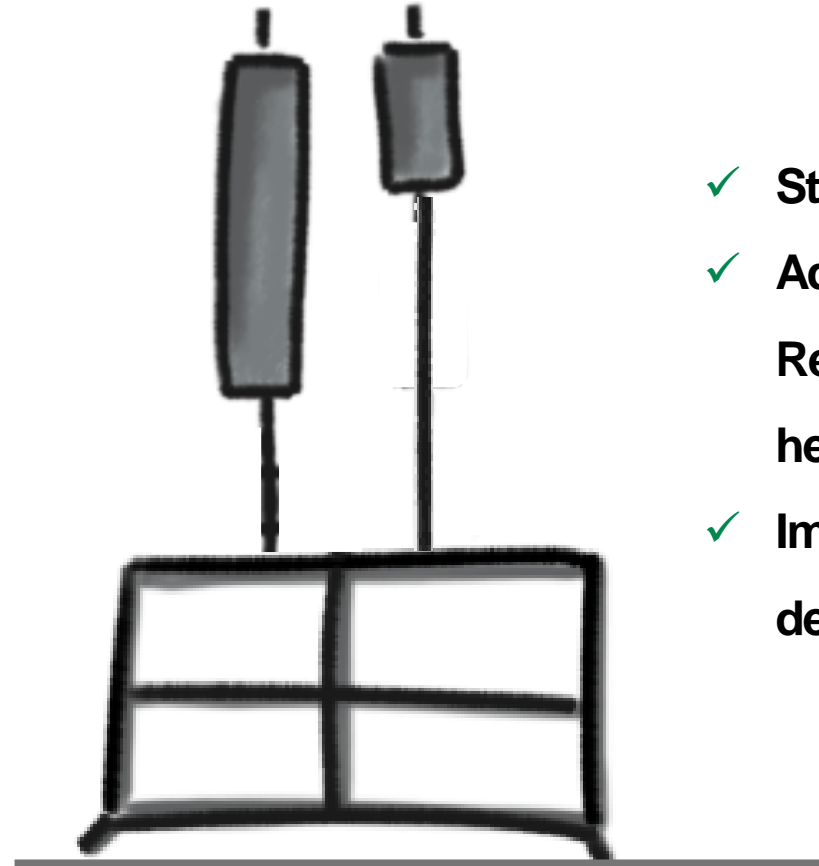
From 2-Band 3G, 4G antenna...

H 1.5m x W 0.35m x D 0.15m



...to 3G, 4G and 5G massiveMIMO

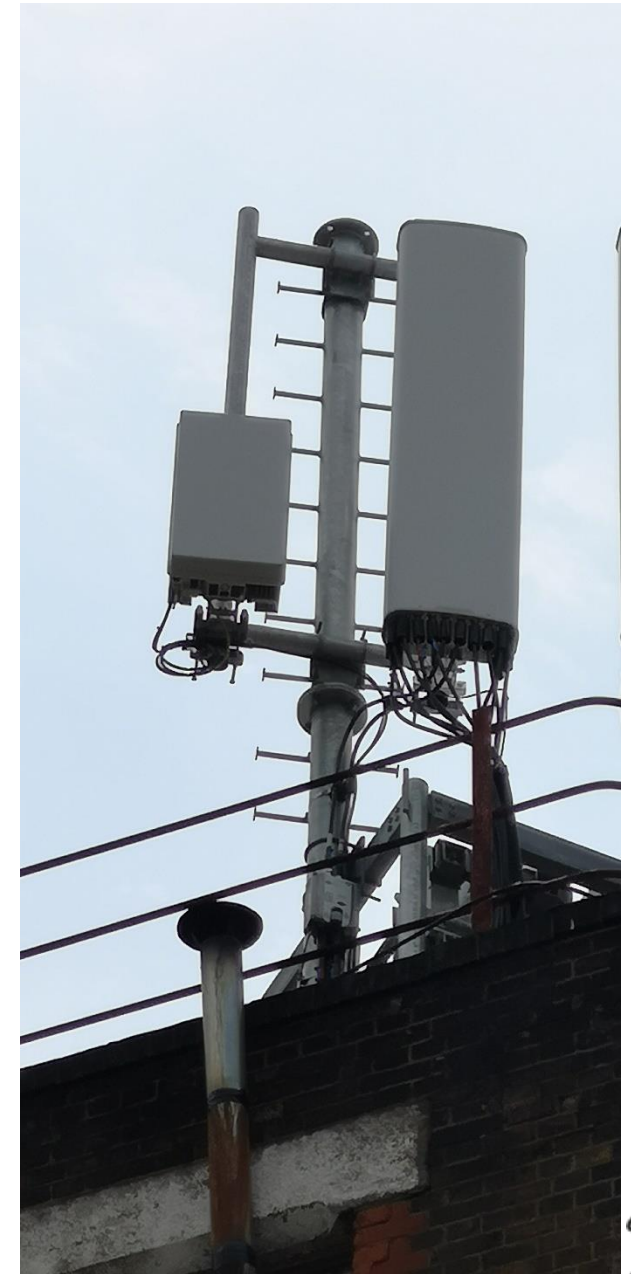
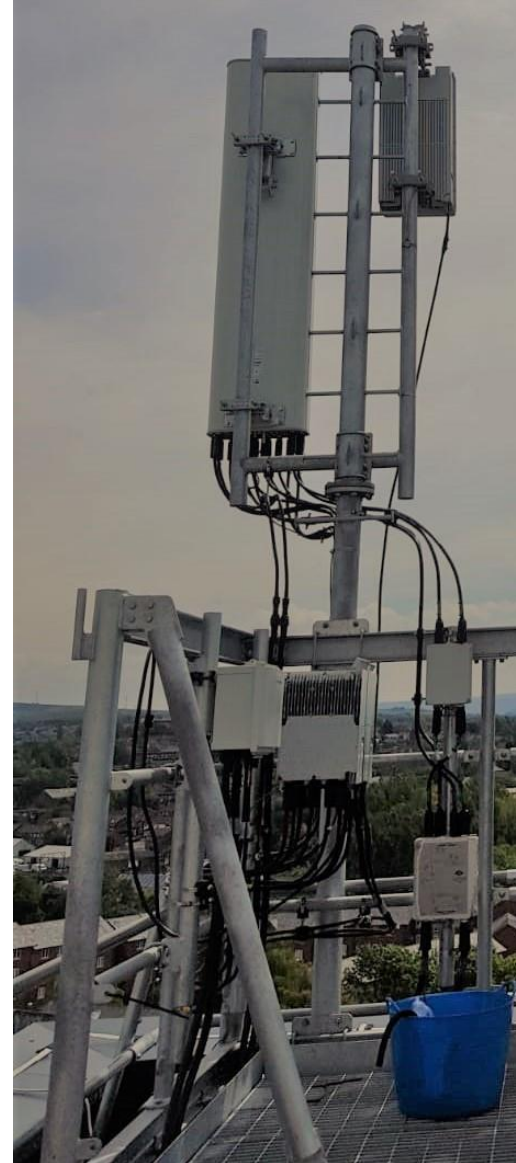
H 2-2.7m x W 0.45m x D 0.2m



H 1m x W 2.1m

- ✓ Strengthen masts
- ✓ Added M-MIMO and Remote radio heads
- ✓ Improved power delivery

Site design



5G Coverage Strategy

Network

Massive MIMO

Beamforming

Diversity gain

Enhancement features

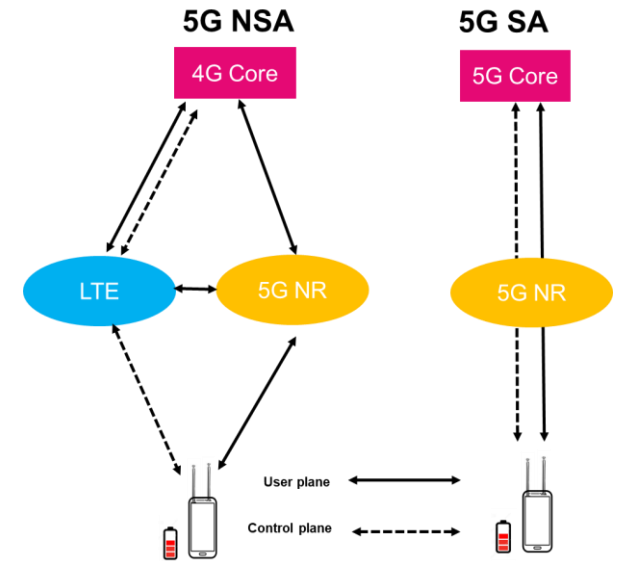
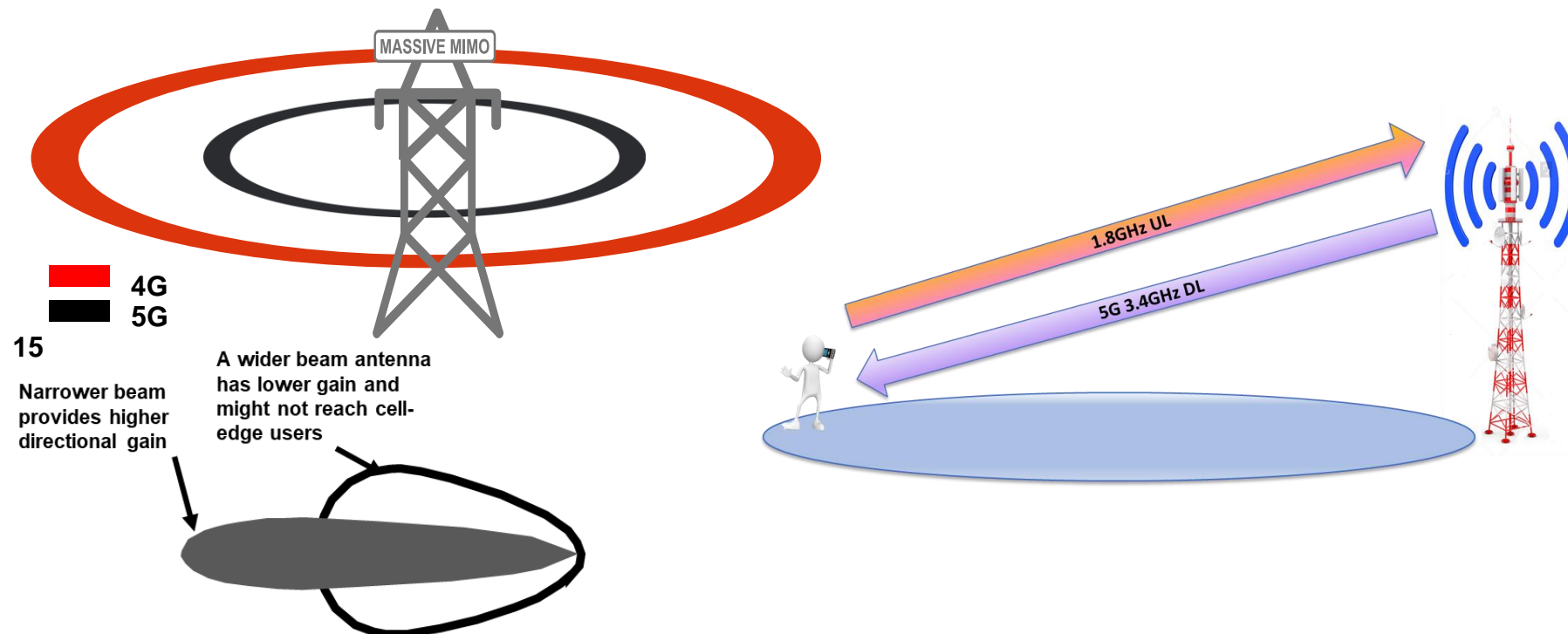
UL/DL decoupling/SUL

HPUE

UL MIMO

5G architecture

5G SA provide better coverage than 5G NSA

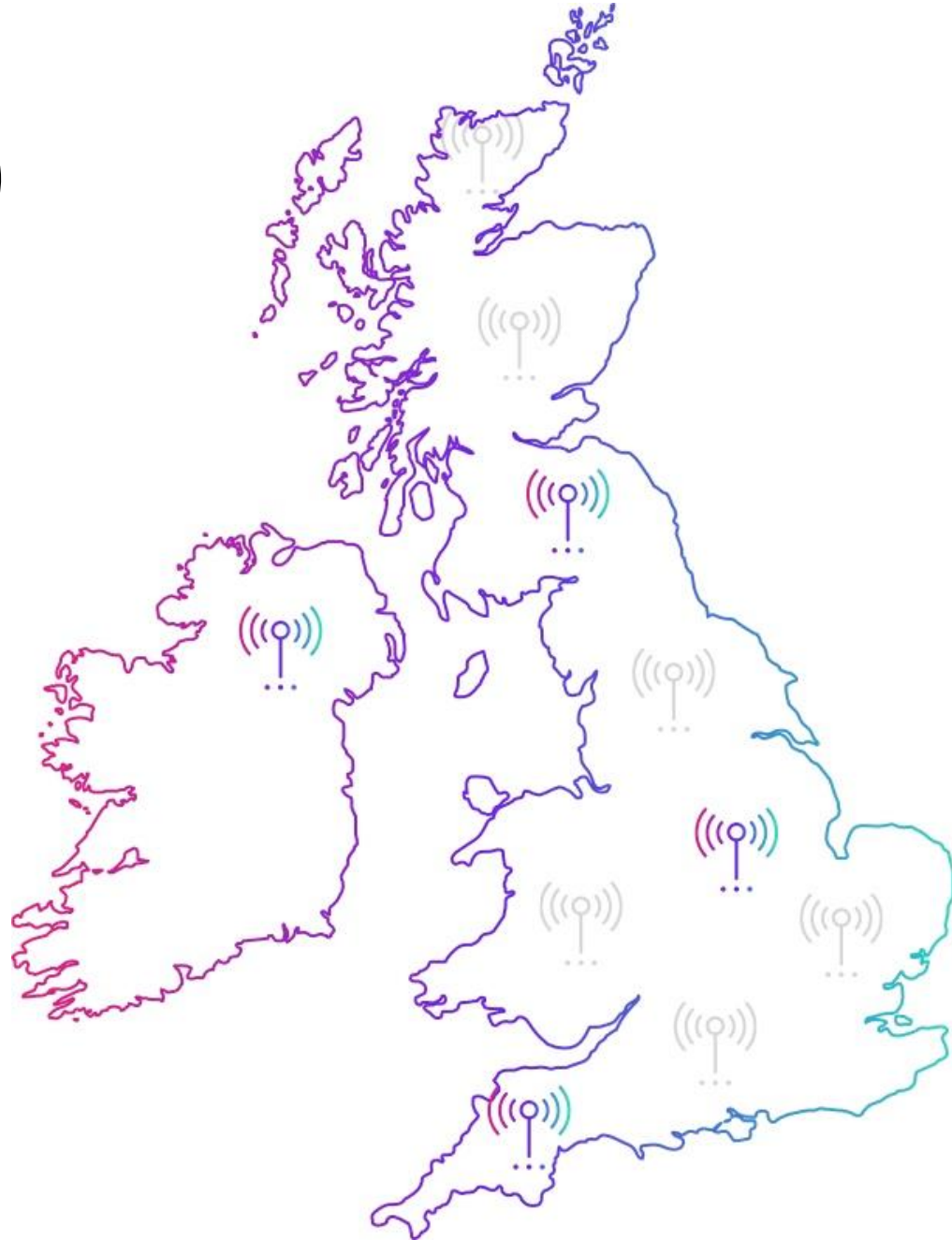


5G Rollout – Launching H2 2019

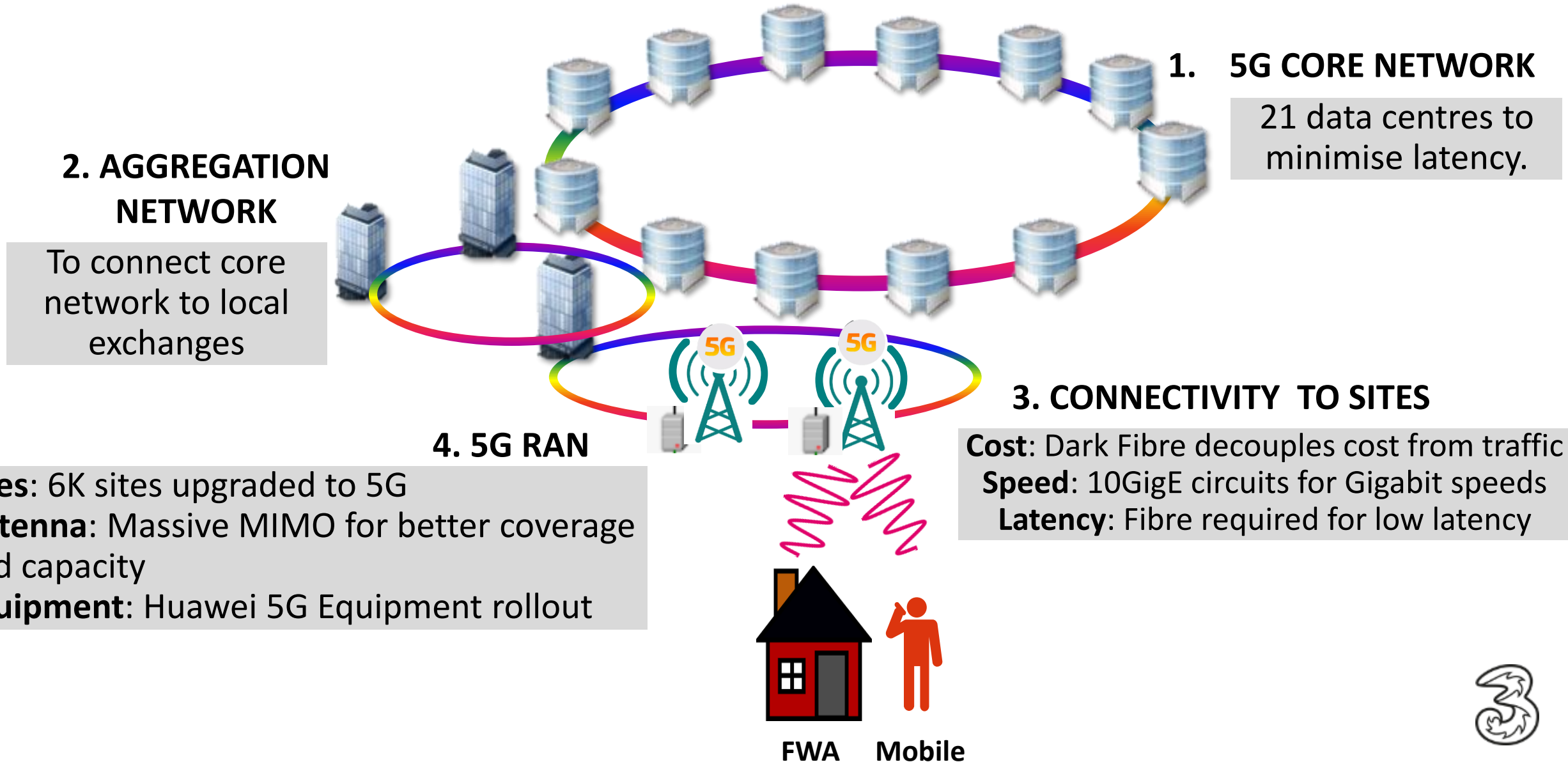
Initial rollout on
6,000 sites which
carry

80%

of Three's traffic in
major urban areas



Network building blocks towards 5G.



Performance



File Transfer test (Mbps)

Download speed recorded (Mbps)

Upload speed recorded (Mbps)

S1

S2

S3

942.00

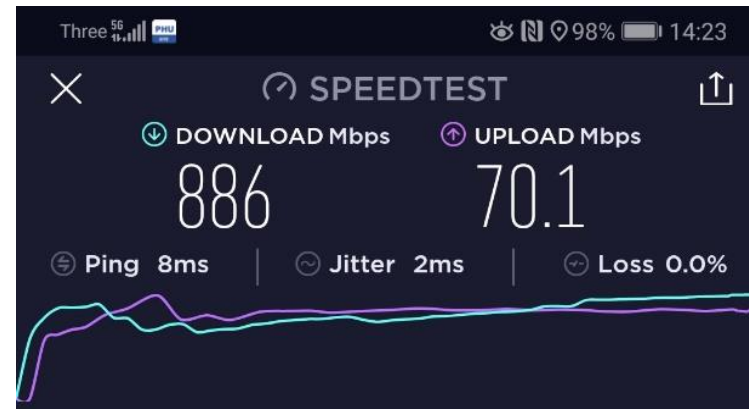
886.00

783.00

69.40

70.10

39.00



What do all mean for the customer

- Superfast downloads
- High-definition video streaming
- Lower latency – responsive games and browsing
- 5G home broadband
- Faster customer fault fixes
- New service features



First 5G Video Call in Nov 2018

From Oxford St Flagship Store to China



Three brings 5G to the catwalk

Central St Martins UAL – Feb 2019



Final Words

- Launched **5G home broadband** in Central London in 2019
- The improvements will deliver **a faster, more reliable mobile phone service for customers**
- **Wireless 5G home broadband** will be a real alternative to fixed line services

