



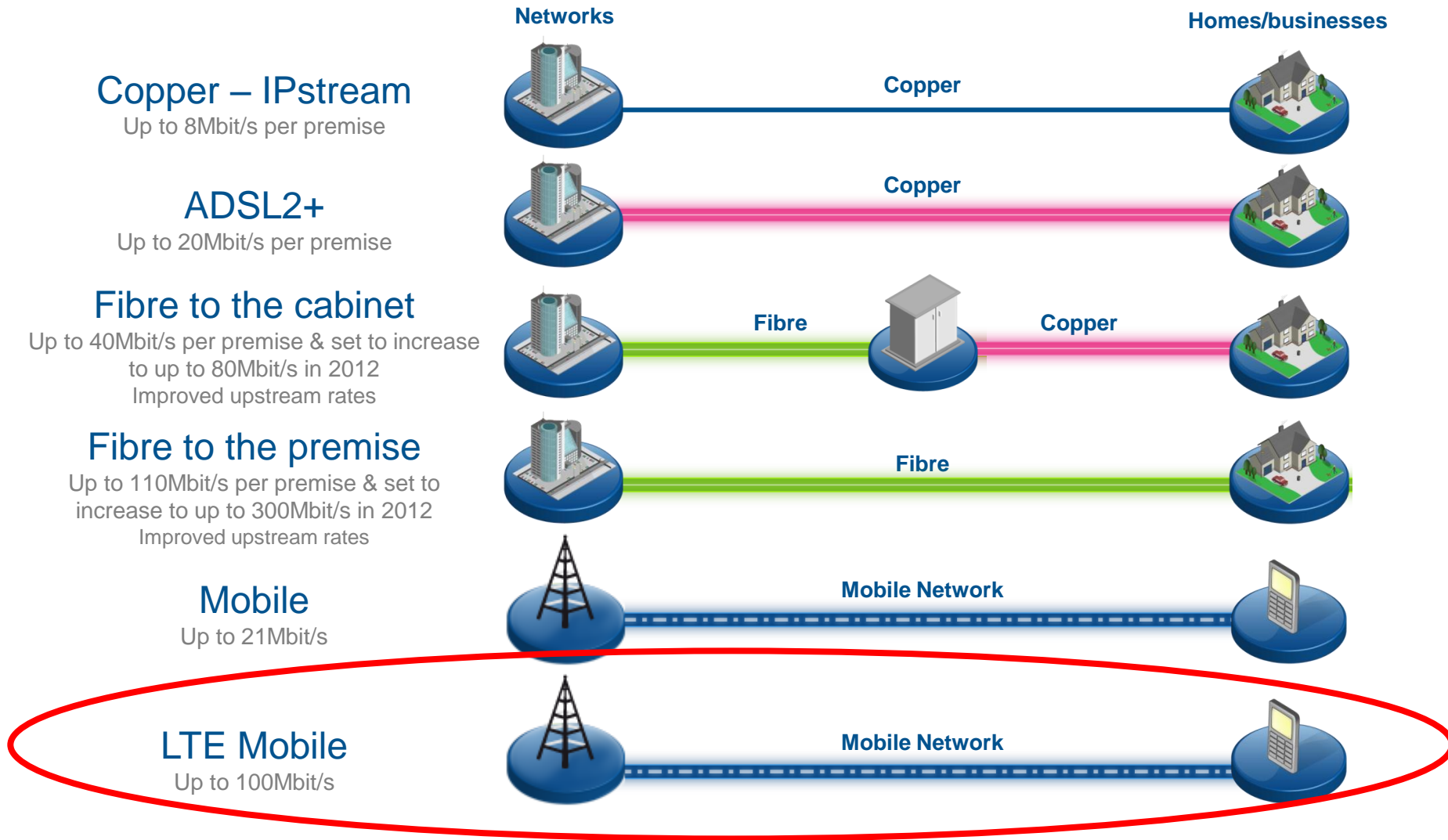
# **LTE Rural Broadband UK'S First Multi-Operator Live Trial**

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Mobility Architect, BT Innovate & Design

**UKNOF, 2<sup>nd</sup> MAY 2012**



# Delivery broadband to UK population will require a mixture of fixed and wireless technologies



# REACHING OUT TO THE 'FINAL THIRD'

Commitment from the government

By 2015

“Our goal is simple: within this parliament we want Britain to have the best superfast broadband network in Europe”

*Jeremy Hunt*

*Secretary of State for Culture, Media and Sport*

- ▶ £830m public funding for rural broadband to 2017
  - ▶ £530m available this Parliament
- ▶ Spurred on by matched local government funding plus private sector investment
- ▶ The challenge is to find real, economic & sustainable broadband solutions



# INNOVATIVE APPROACH

Technology + sharing economics = customer experience

## Technology

- ▶ Technology is 'only' part of the solution
- ▶ The key is how the technology is employed

## Economics of sharing with partner (Everything Everywhere)

- ▶ The rural economic challenge is the same for fixed & mobile networks
- ▶ Network utilisation is key to ensure successful economics

## Trial customer experience

- ▶ Fixed & mobile networks working together
- ▶ Sharing access infrastructure
- ▶ Managing our own customers' experience

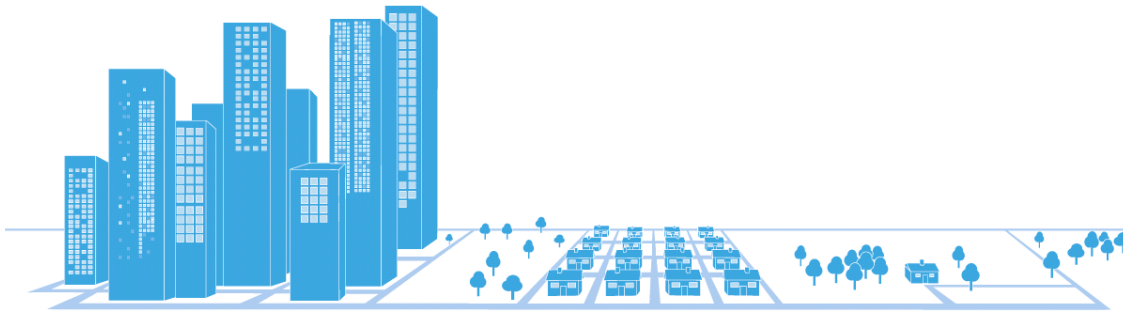
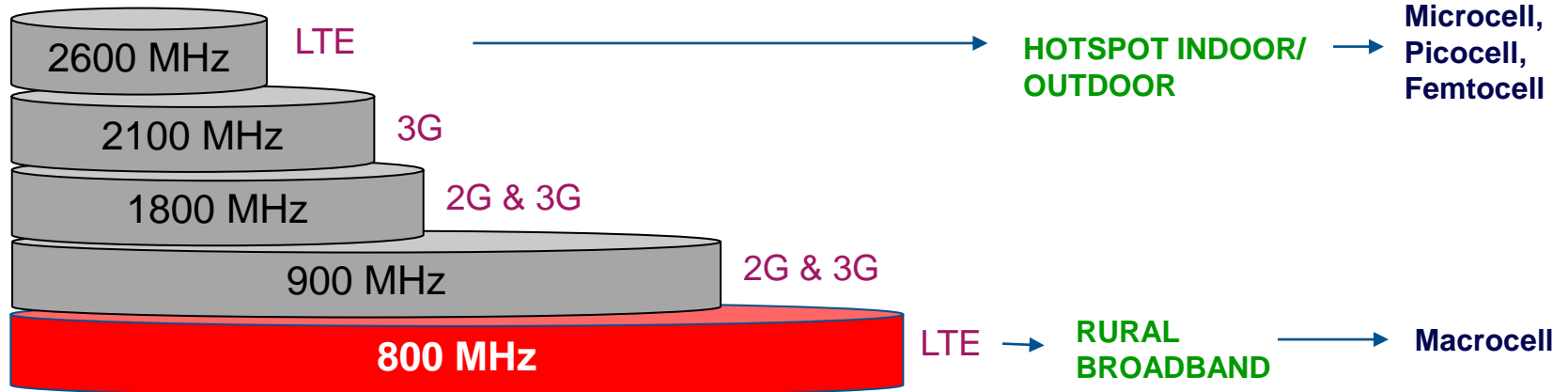


# WHY CORNWALL?

- ▶ Detailed knowledge from BT's superfast fibre roll-out
- ▶ Spectrum availability
  - ▶ Digital TV switch over is complete
- ▶ Real rural profile
  - ▶ Test bed - developing a potential model for other UK rural locations

# ACCESS TO THE RIGHT SPECTRUM IS KEY

- ▶ For a commercial rural LTE service to become a reality
  - ▶ 800MHz enables wider coverage reach & indoor penetration
  - ▶ 2\*10MHz channel bandwidth provides good capacity for consistent customer experience

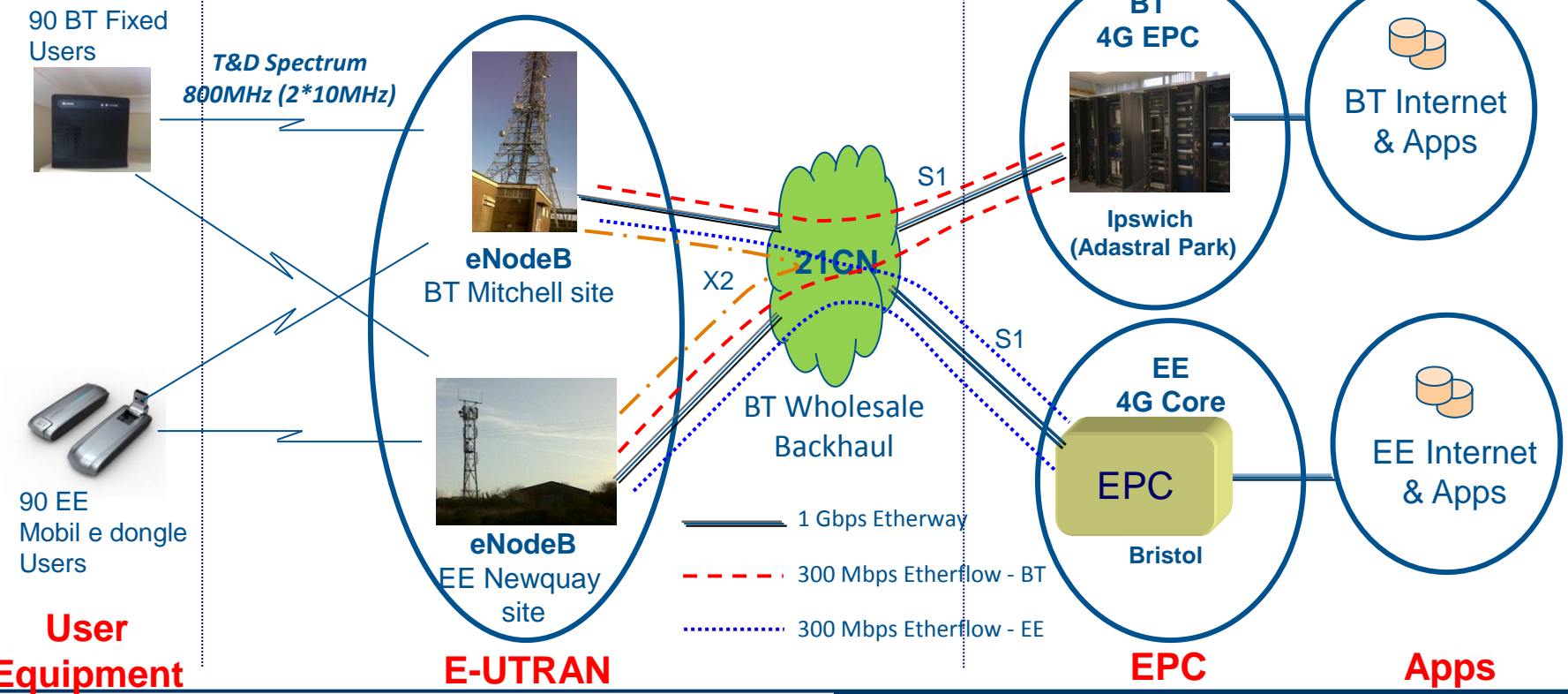


# ARCHITECTURE OVERVIEW

Driving complementary business model

- What's shared?**
- Spectrum
  - Radio infrastructure
  - Backhaul

- What's not shared?**
- Core network
  - Applications
  - Charging/billing
  - Customer experience
  - SIM & devices
  - Network policy
  - Content filtering
  - Reporting

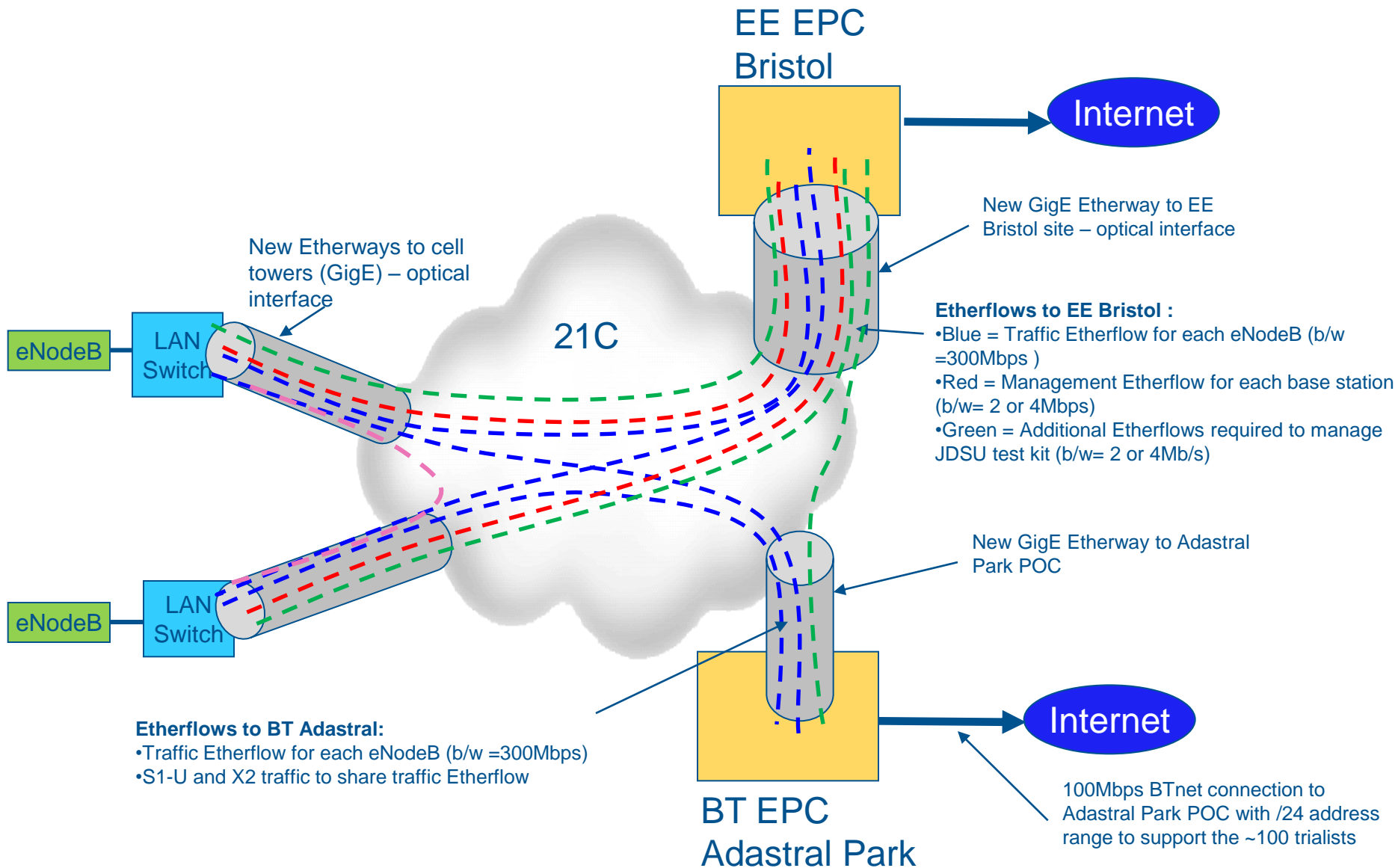


# SHARED RADIO ACCESS NETWORK (RAN)

- ▶ Sharing of RAN is enabled by **Multi-Operator Core Network (MOCN)**
- ▶ MOCN provides sharing of eNodeB & spectrum (2\*10MHz) with multiple core networks
- ▶ Radio resource allocation is set to 50:50
  - ▶ Other settings (e.g. 70:30) is currently under testing
- ▶ Each operator can assign its own settings on eNodeB
  - ▶ PLMN-id
  - ▶ Tracking Area Code (TAC)
  - ▶ Cell-id
  - ▶ QoS parameters (QCI, ARP, MBR & GBR)

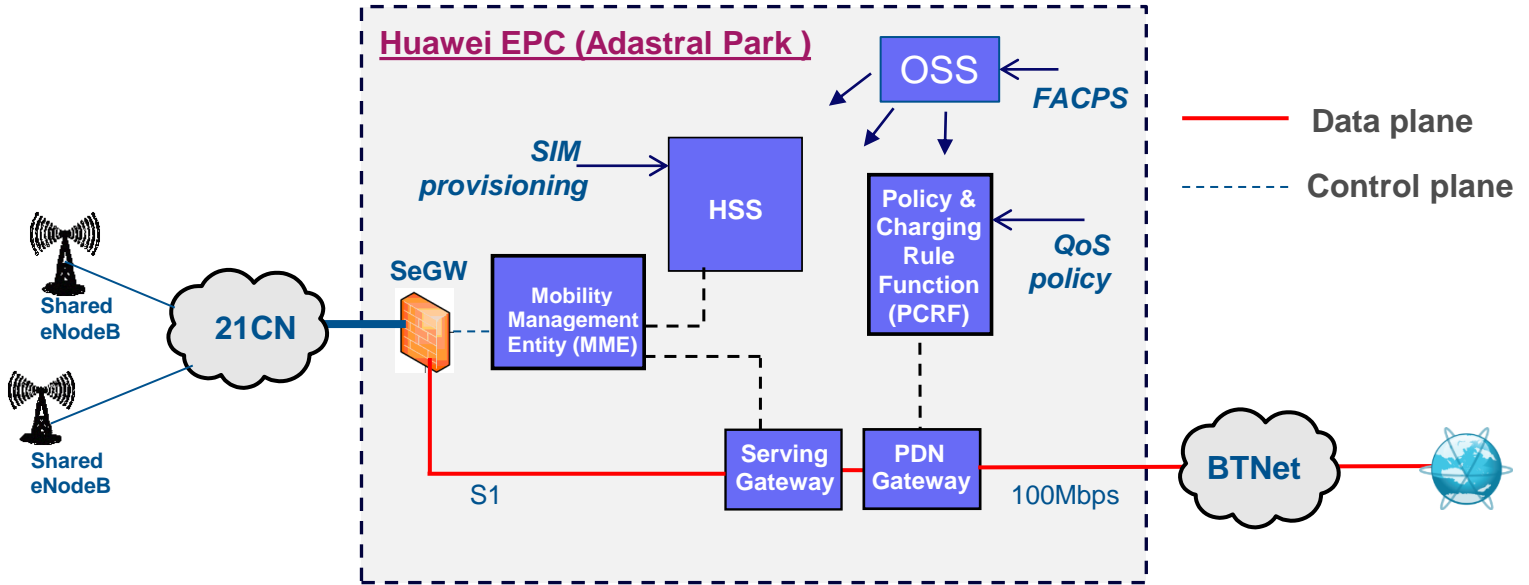


# SHARED ETHERNET BACKHAUL



# BT dedicated Evolved Packet Core (EPC)

BT Fixed Users



# GETTING THE SETTINGS RIGHT

ACHIEVING A CONSISTENT CUSTOMER EXPERIENCE IS KEY

Low

RADIO  
RESOURCE



High

## ▶ External Antenna

- ▶ When and where to deploy?
- ▶ How much improvement it provides?

## ▶ Rate Capping

- ▶ Controversial
- ▶ We tried 4Mb – 8Mb – 16Mb – 25Mb - Unlimited
- ▶ More consistent experience can be achieved for fixed by managing throughput against base station proximity but this does not work for mobile

## ▶ User Priority

- ▶ Gold, Silver & Bronze

## ▶ Dedicated Bearer

- ▶ Prioritises real time traffic

## ▶ Radio Resource Block Optimisation

- ▶ 50:50, 70:30

High

CUSTOMER  
EXPERIENCE



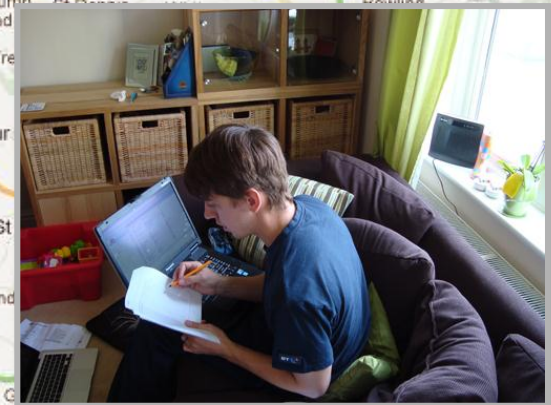
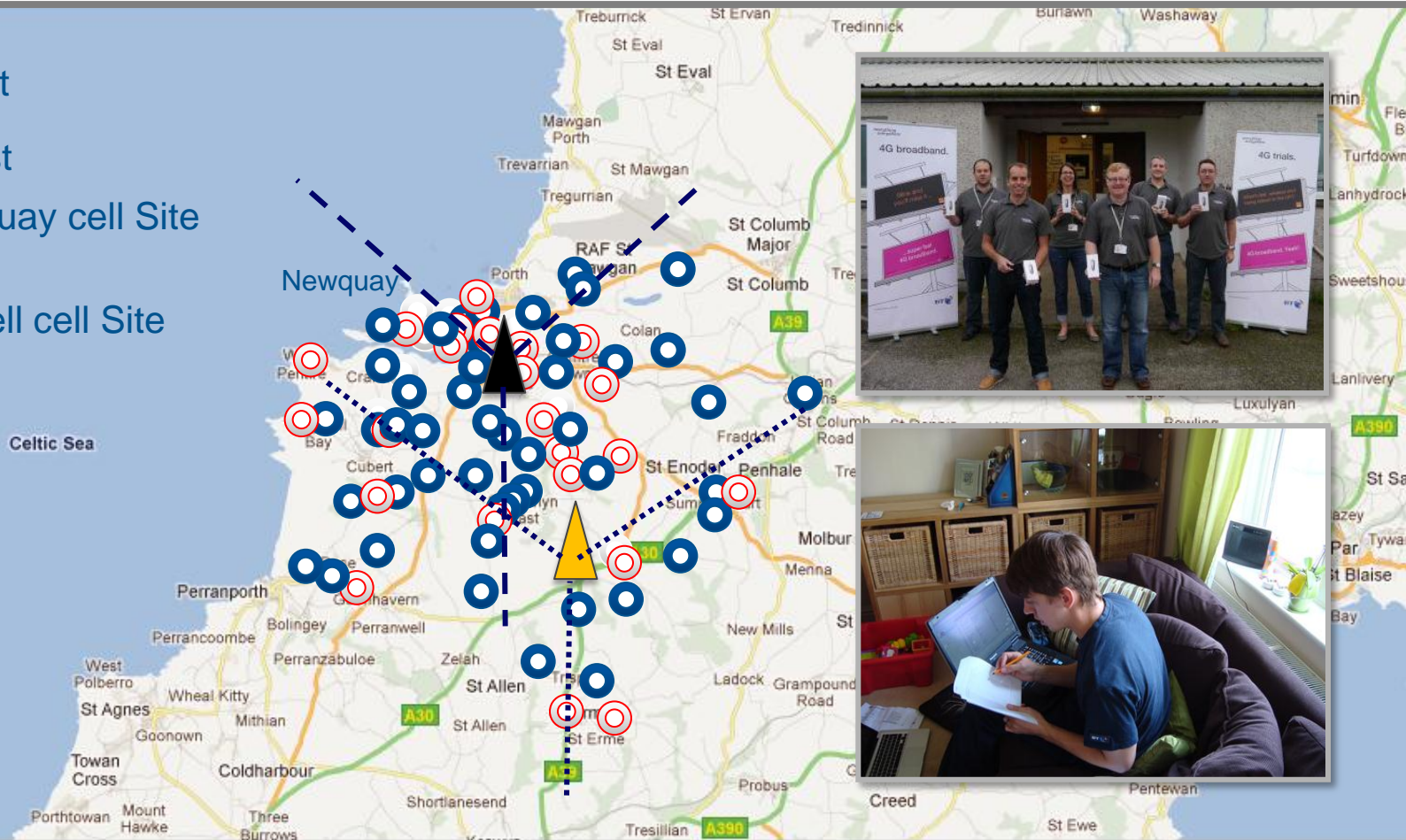
Low

COMMERCIAL VIABILITY



# OUR TRIALISTS

-  BT Trialist
-  EE Trialist
-  EE Newquay cell Site (NSN)
-  BT Mitchell cell Site (Huawei)



BT trialist max distance ~ 4 miles

# LTE TRIAL CUSTOMER EQUIPMENT



Aimed at providing a fixed customer experience

- ▶ LTE hub
- ▶ Ethernet & WiFi
- ▶ Multiple device connectivity
- ▶ Antenna options
  - ▶ Internal
  - ▶ Internal hub dipoles
  - ▶ External wall-mounted



*everything  
everywhere™*



Aimed at providing a mobile customer experience

- ▶ LTE USB dongle
- ▶ Single laptop



# End User Performance

## ▶ Live Trialists : ~90 Fixed, ~90 Mobile

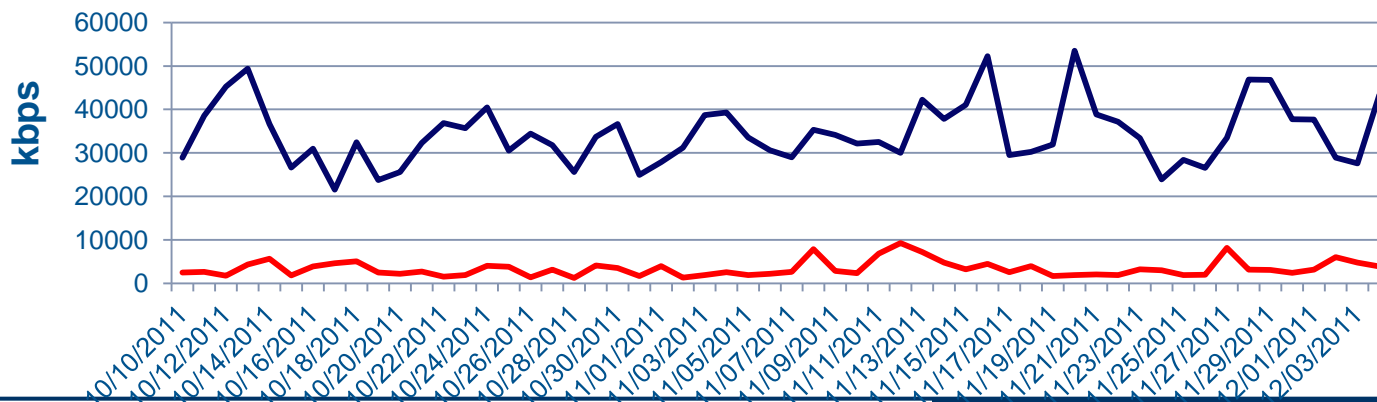
- ▶ For fixed 10 dipole, 16 external aerial (20%), 60 internal hub only

## ▶ Fixed user performance

- ▶ DL 30GB/UL 7GB per day per eNodeB
- ▶ Download: 4 – 42Mbps
- ▶ Upload: 0.9 – 35Mbps
- ▶ RTT delay (average 44ms) & jitter (average 5ms) is consistent
- ▶ Worst performance at cell edge @ 4 miles is around 4 Mbps
- ▶ Average EE & BT traffic ratio of up to 10:1
  - ▶ BT Hub supporting multiple devices – laptops, smartphones, gaming
  - ▶ Mobile USB dongle limited to one laptop device

## ▶ Fixed Faults reported by 20% trialists

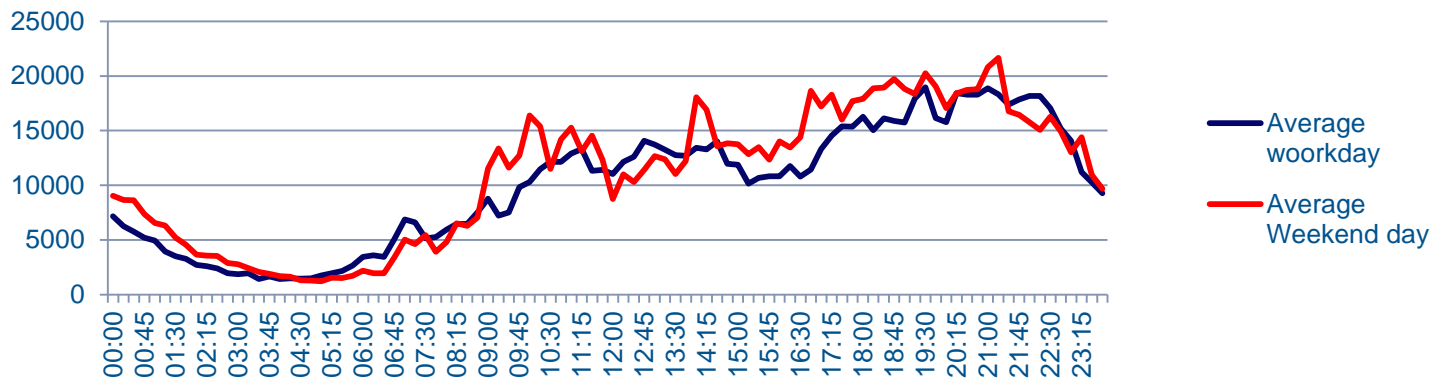
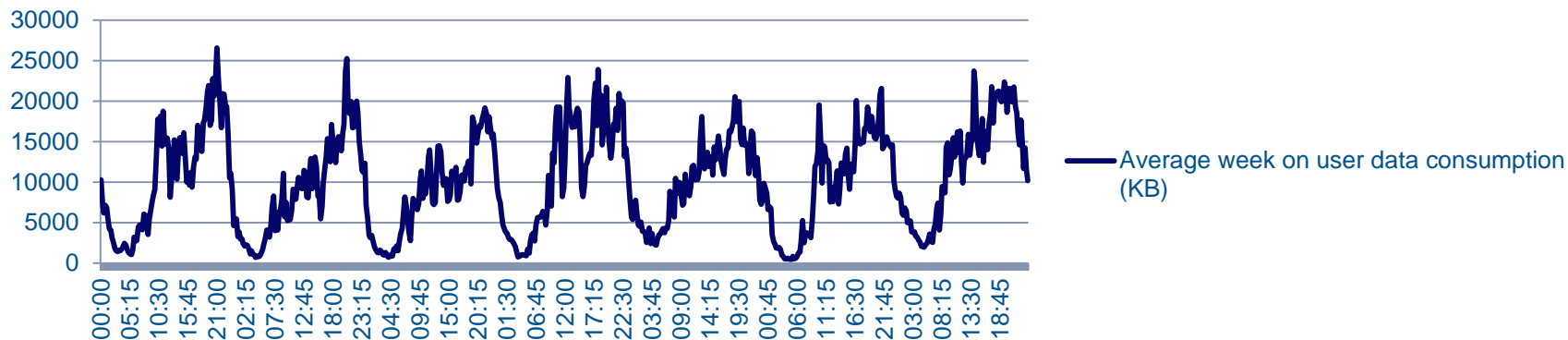
- ▶ Email, Wi-Fi, variable data rates, Sky TV repeater, Cell Hopping



— KPI - eNB DL Throughput (BT)  
— KPI - eNB DL Throughput (EE)

# Busy Hour resembles fixed broadband usage pattern

BT Average week on user data consumption (KB)



# Speedtest results from January

(based on 50% feedback from BT trialists)

- ▶ Average speeds, 11.6Mbps downlink 4.7Mbps uplink
  - ▶ Maximum reported DL speed: 26.52 Mbps
  - ▶ Maximum reported UL speed: 15.98 Mbps
  
- ▶ Downlink:
  - ▶ 79.41% get over 6Mbps
  - ▶ 58.82% get over 8Mbps
  
- ▶ Uplink:
  - ▶ 79.41% get over 2Mbps
  - ▶ 44.12% get over 4Mbps



# Improvements to low speed users at cell edge

1 customer speed was improved by a hub swap (still verifying is old hub had any malfunction), 5 more by installing external antennas.

user	Old DL	Old UL	New DL	New UL
user1	2.36 Mbps	0.87 Mbps	18 Mbps	7 Mbps
user2	1.46 Mbps	0.74 Mbps	10 Mbps	2.1 Mbps
user3	2.35 Mbps	0.90 Mbps	11.3 Mbps	5.5 Mbps
user4	2.23 Mbps	1.12 Mbps	14.9 Mbps	13 Mbps
user5	1.1 Mbps	0.43 Mbps	12.1 Mbps	12.8 Mbps
user6 (swap)	3.8 Mbps	2 Mbps	9.8 Mbps	4.5 Mbps
<b>Average</b>	2.21 Mbps	1.01 Mbps	12.68 Mbps	7.49 Mbps

This makes the speed average move from 12.05 Mbps/5.05Mbps to 13.12 Mbps/5.72Mbps

# What are the trialists doing?

Up to 10 devices attached to LTE hubs via WiFi

- ▶ TV on-demand
- ▶ HD video content
- ▶ VoIP services
- ▶ On-line backup
- ▶ Photograph sharing services
- ▶ On-line gaming
- ▶ On-line learning/training
- ▶ Working from home



# MAKING A DIFFERENCE



- ▶ Farming – Trialist tracking cattle movements on the DEFRA website & undertaking business tasks for example, submitting VAT returns



- ▶ Homework – Trialist's children participating in school on-line homework schemes



- ▶ Software Developer – Trialist working from home can download software development kits & other large files

# UK'S FIRST MULTI-OPERATOR LTE LIVE TRIAL

Trialists' feedback

"I am able to watch YouTube videos that previously would not load without stopping to buffer. Skype is also much better as it supports a video and audio link."

"I look forward to the service being commercially available. I shall certainly subscribe."



# UK'S FIRST MULTI-OPERATOR LTE LIVE TRIAL

Trialists' feedback

“At the end of the trial please don't leave us in e-poverty again. Hoping that we will always have LTE.”

“Smooth internet for everything I have used it for. It's great for this rural area and makes life a lot easier.”



# UK'S FIRST MULTI-OPERATOR LTE LIVE TRIAL

Trialists' feedback

“Before I couldn't work from home as the internet wasn't fast enough.”

“My husband is now able to watch video tutorials. This has completely changed his use of the internet.”



# UK'S FIRST MULTI-OPERATOR LTE LIVE TRIAL

Trialists' feedback

“A fantastic speed really does improve the experience.”

“I've been able to back-up my movie collection online which would have taken ages previously.”



# UK'S FIRST MULTI-OPERATOR LTE LIVE TRIAL

Trialists' feedback

“I now use Facetime on my iPhone all the time.”

“I'll probably need psychological counselling when you take these boxes out.”





# UK'S FIRST MULTI-OPERATOR LTE LIVE TRIAL

## Key Messages

### Rural

- ▶ We are committed to deliver broadband to 'challenging' rural areas

### Economics of sharing using partnership model

- ▶ We have proven LTE can provide the right user experience using the right techniques to enable economies of scale

### Real

- ▶ Live networks, real customers & a genuine customer experience



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# Questions?

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