Society of Business Economists
How should competition authorities and regulators facilitate innovation?

Promoting innovation and competition in mobile telecoms through spectrum allocation

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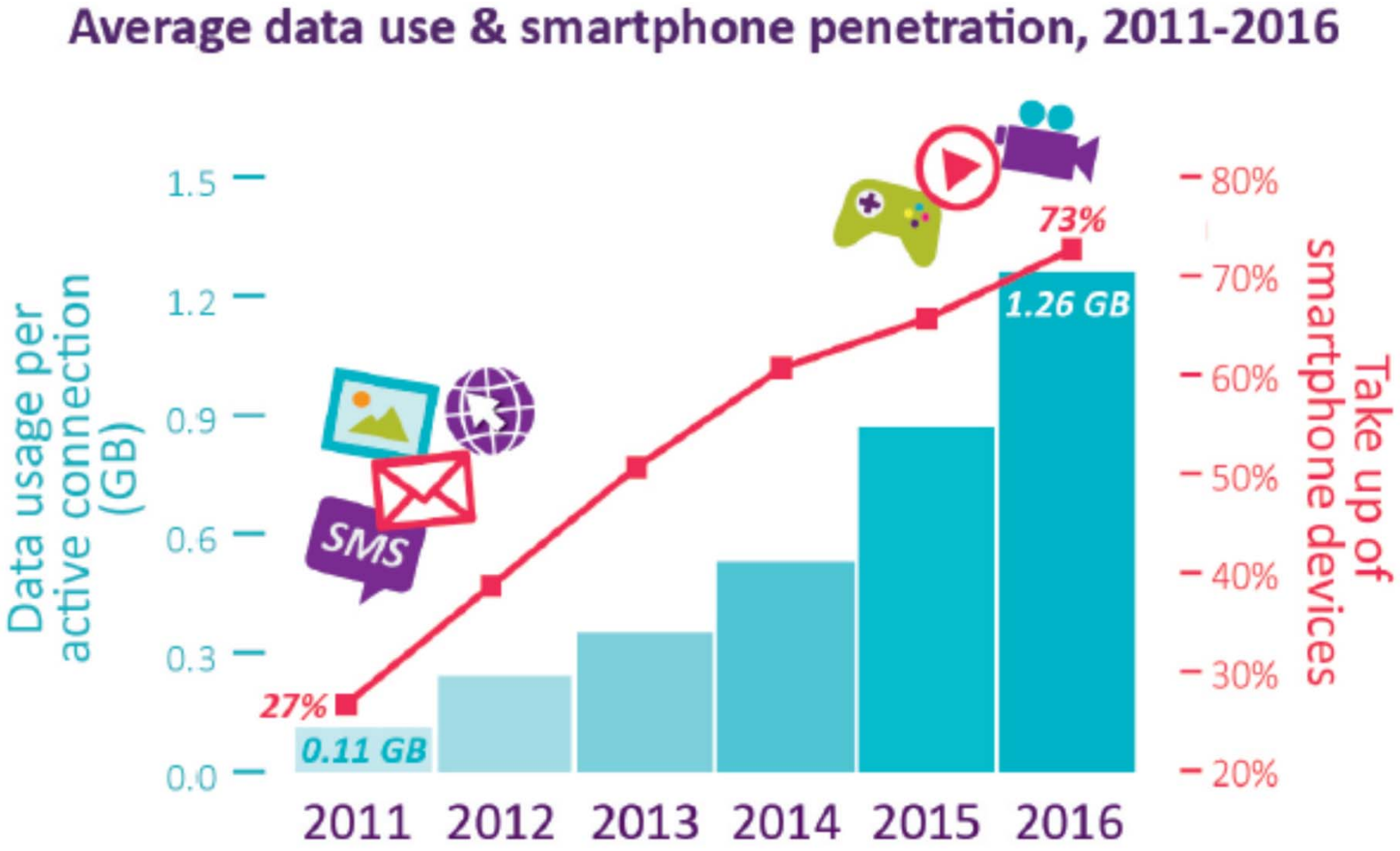
Overview

- Introduction
- Promoting innovation and competition in 2G, 3G and 4G
- Conclusions

Demand: rapid growth in mobile data

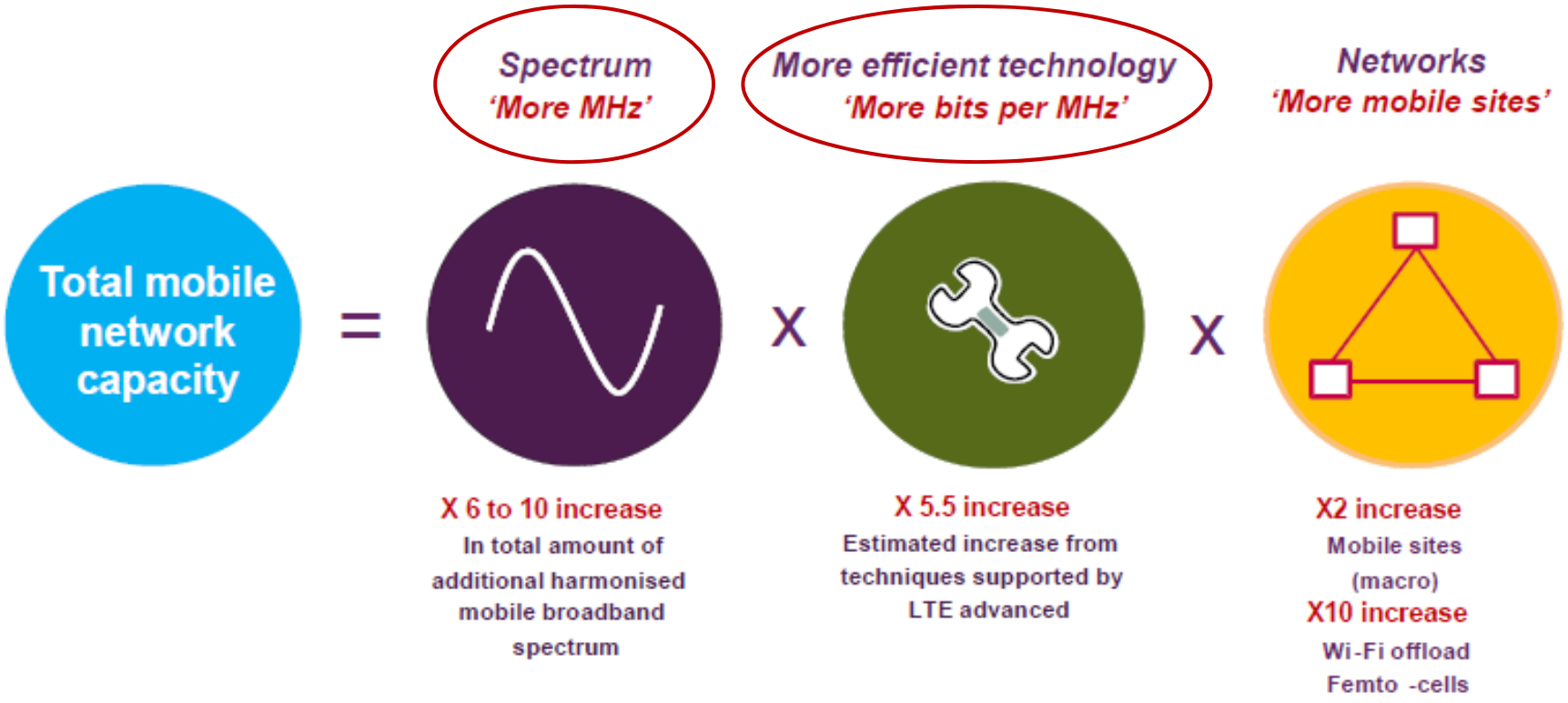
Roughly 50% per annum for last 4 years



Source: Ofcom Connected Nations 2016 Reports and Ofcom Technology Tracker from Q1 of each year 2011-2014, then H1 2015-2016

Supply: mobile network capacity

More spectrum is important way to meet increasing demand alongside more sites and more efficient technology



Source: Telecoms briefing for analysts, 18 November 2013, Ofcom, http://media.ofcom.org.uk/files/2013/11/Telecoms-analyst-briefing-November-2013.pdf

Mobile telecoms technologies

New spectrum typically used first for each wave of technology innovation

Static (productive) efficiency: *More spectrally efficient, ie more output from given amount of spectrum*

Dynamic efficiency: *New and better-quality services provided*

- Mature networks: 2G
  - Voice and basic data services
- Mobile data: 3G
  - Richer data services, including mobile broadband
- Faster mobile data: 4G
  - Faster and more responsive, allowing wider range of services and apps

Realising potential static and dynamic gains

- Evolution of mobile technology is
  - global or supra-national process
  - involving complex value chain of industry, international standards bodies, manufacturers of chip sets, network equipment and consumer devices as well as network operators who are the focus of this presentation
- UK spectrum regulators regarded promoting competition as important in realising both static and dynamic efficiency gains, eg dynamic benefits through competition stimulating:
  - Deployment and take-up of new technology
  - New and better services offered on new technology 'platform'
- In terms of Mike Walker's framework, for mobile market, objective to:
  - Keep it close to the top left (static and dynamic efficiency); and
  - Stop it moving to the bottom right (static and dynamic inefficiency)

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Additional spectrum for 2G in 1991

From a 2-player to 4-player market

- First licences for mobile spectrum in 900 MHz band were administratively allocated in 1985 to two operators
  - Now known Vodafone and O2
  - Initial mobile services used 1G (analogue cellular)

- 2G (digital cellular) technology started to be deployed in 1990s
  - In Europe using GSM (Global System for Mobile Communications)
  - The two incumbent UK operators deployed 2G, starting with Vodafone in 1991

- Allocation of additional mobile spectrum in 1991: 1800 MHz band

- 80% of the band was allocated to two new entrant operators (the rest to the two existing operators)
  - One2One (later T-Mobile) and Orange offered 2G services from 1993
    - T-Mobile and Orange later merged to form EE in 2010 (and EE taken over by BT in 2016)

- Allocation of spectrum promoted competition, changing the market structure from 2 to 4 operators: consumers benefited from increase in competition
  - Entrants unusually successful in UK compared to other countries, ultimately achieving similar market shares to the two incumbents
  - Price and non-price benefits of competition, e.g. contributing to rapid growth in mobile take-up from 1.5m subscribers at start of 1993 to more than 27m by the end of 1999

3G auction in 2000

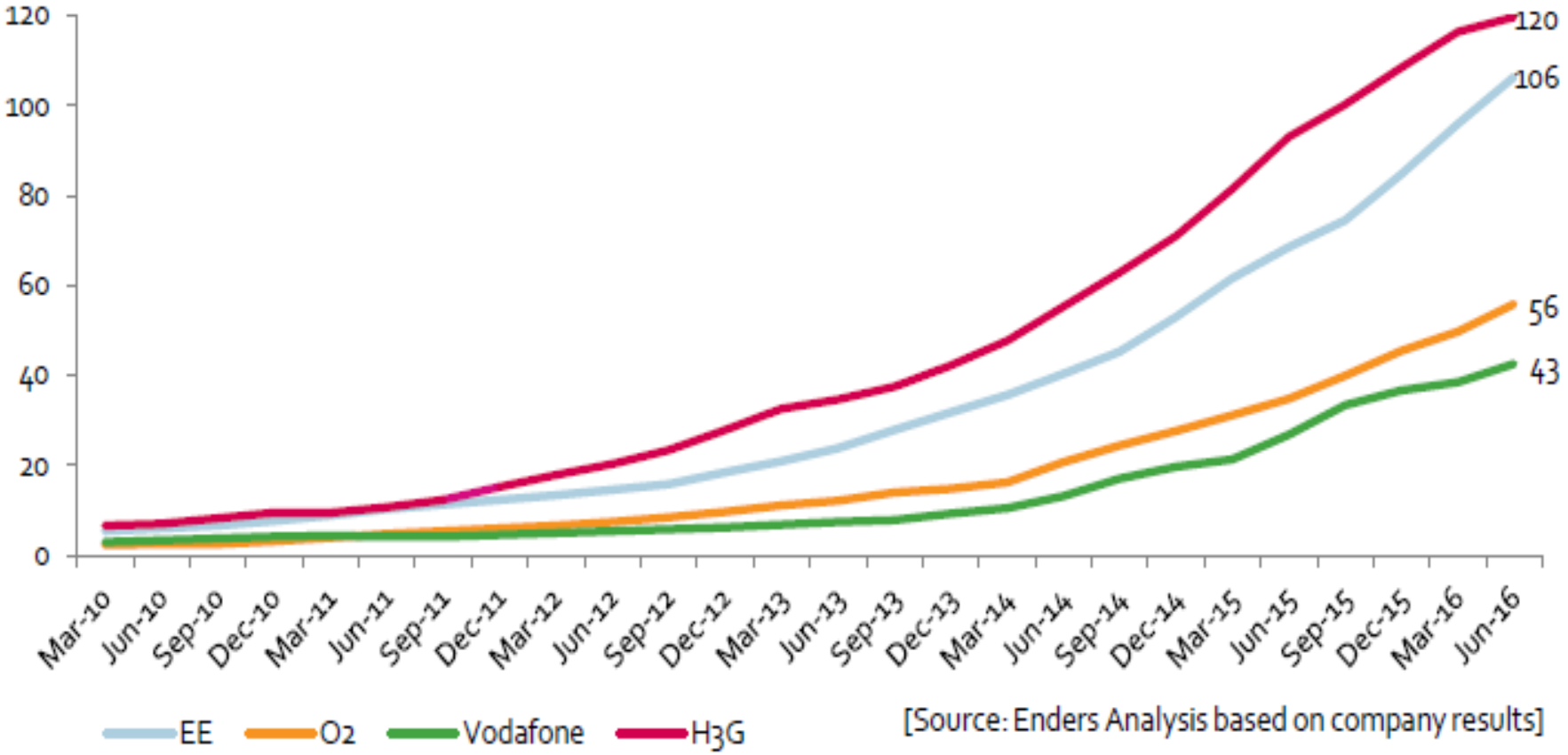
From a 4-player to 5-player market

- Auction of 2.1 GHz band in 2000 ("3G auction") for five licences:
  - 2 larger licences included more spectrum than the other 3 smaller licences
- One of the larger licences was reserved (set aside) for a new entrant, changing market structure from 4 to 5 operators
  - Significant competition for reserved licence: nine potential new entrants in auction
  - Reserved licence was ultimately acquired by Hutchison 3G (H3G)
- First commercial 3G services in UK launched in 2003 by the new entrant, H3G
  - on 3 / 3 / 2003 ("Three")
- 3G auction attracted a lot of publicity as the spectrum sold for more than £22bn
  - Incumbents: about £4bn paid for each of the three smaller licences and about £6bn for larger licence (similar price per MHz)
  - New entrant: about £4bn paid for the reserved larger licence (lower price per MHz by 33%)
- More important for consumers was increase in competition
  - Some consider Three a disruptive or maverick competitor: lower prices, innovation in 3G, video calling, unlimited data bundles etc

See: Binmore and Klemperer (2002), The Biggest Auction Ever: The Sale of the British 3G Telecom Licences, Economic Journal, 122:478, C74-C96

Shares of mobile data

H3G largest operator by data volume despite only having about 11% of subscribers



Source: Figure A7.13 in Award of the 2.3 and 3.4 GHz spectrum bands, Consultation, Ofcom, 21 November 2016, https://www.ofcom.org.uk/__data/assets/pdf_file/0026/93545/award-of-the-spectrum-bands-consultation.pdf

4G and competition

1800 MHz and 4G auction

- Leading up to 2013 spectrum auction, 4G technology was ready to be deployed first in following frequency bands:
  - 1800 MHz: at that time being used for 2G
  - 800 MHz and 2.6 GHz: the spectrum in 2013 auction ("4G auction")

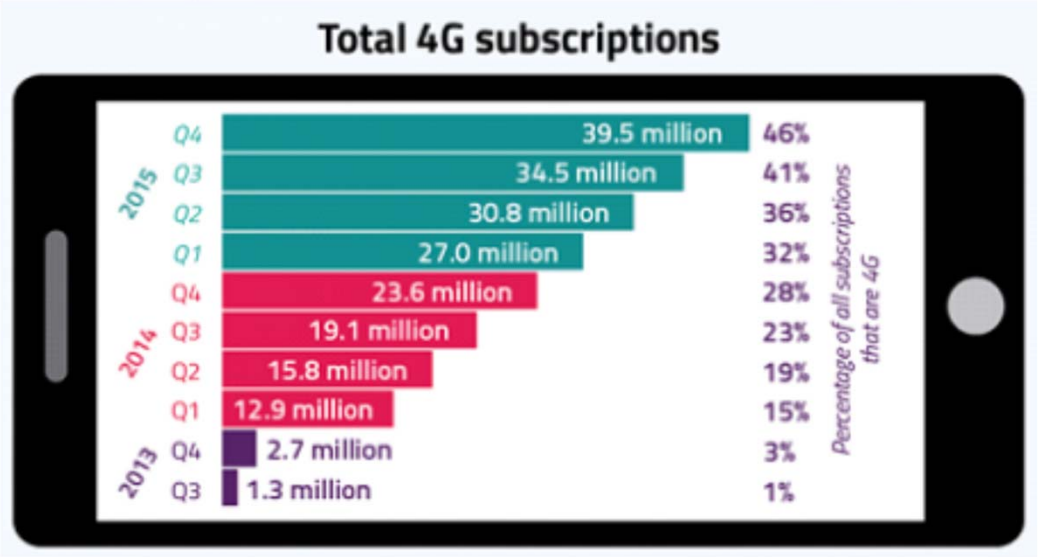
- Analysis of competition affected Ofcom's decisions in relation to both 1800 MHz and 4G auction

- 1800 MHz: Ofcom liberalised spectrum licences to allow deployment of 4G, recognising this would allow EE a head start in 4G (given asymmetric holdings of 1800 MHz band)
  - EE launched 4G services in October 2012, Vodafone and O2 in August 2013 and Three in December 2013
  - Incentives for EE to roll out and for competitors to catch up may have stimulated faster UK roll-out of 4G
  - Most growth in 4G subscribers was after all 4 operators launched 4G services

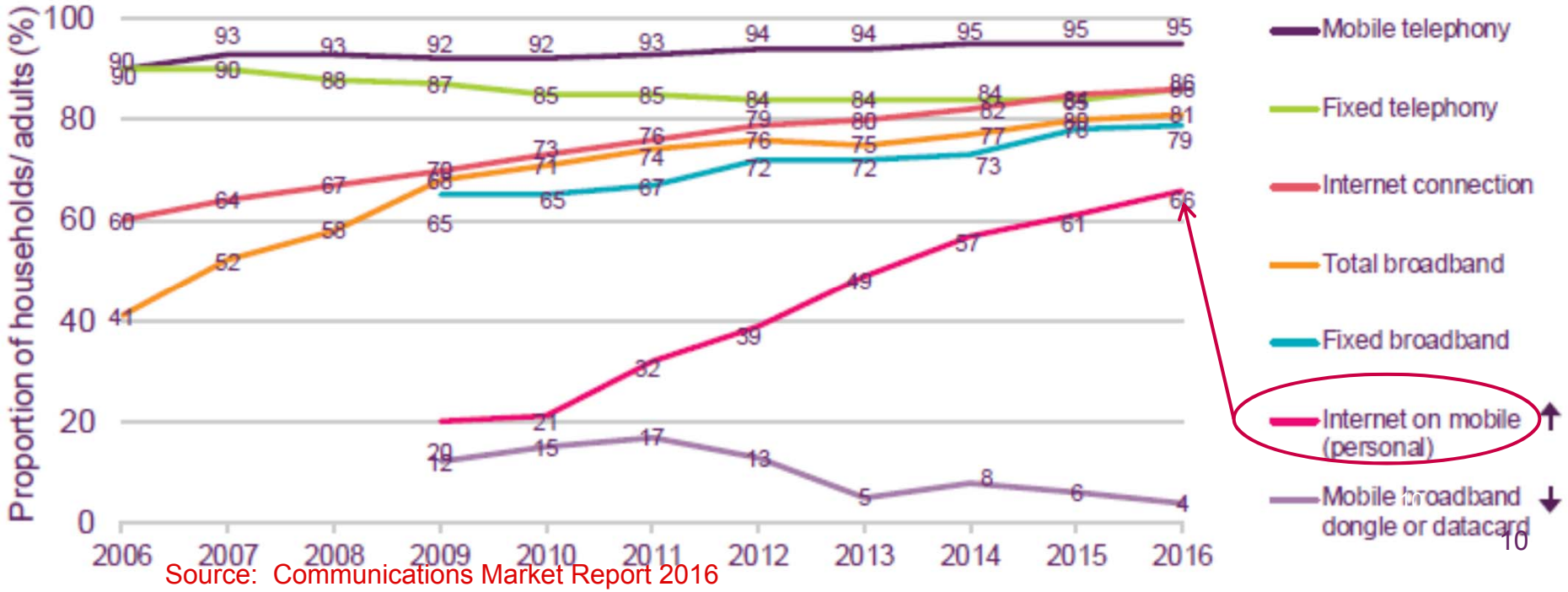
- 4G auction: competition measures to at least maintain market structure
  - EE merger in 2010 meant there was a 4-player market before 4G auction
  - Spectrum reserved for 4th national operator to promote competition (Three or new entrant): acquired by Three

Take-up of 4G in UK

Figure 4.25 Total 4G subscription numbers



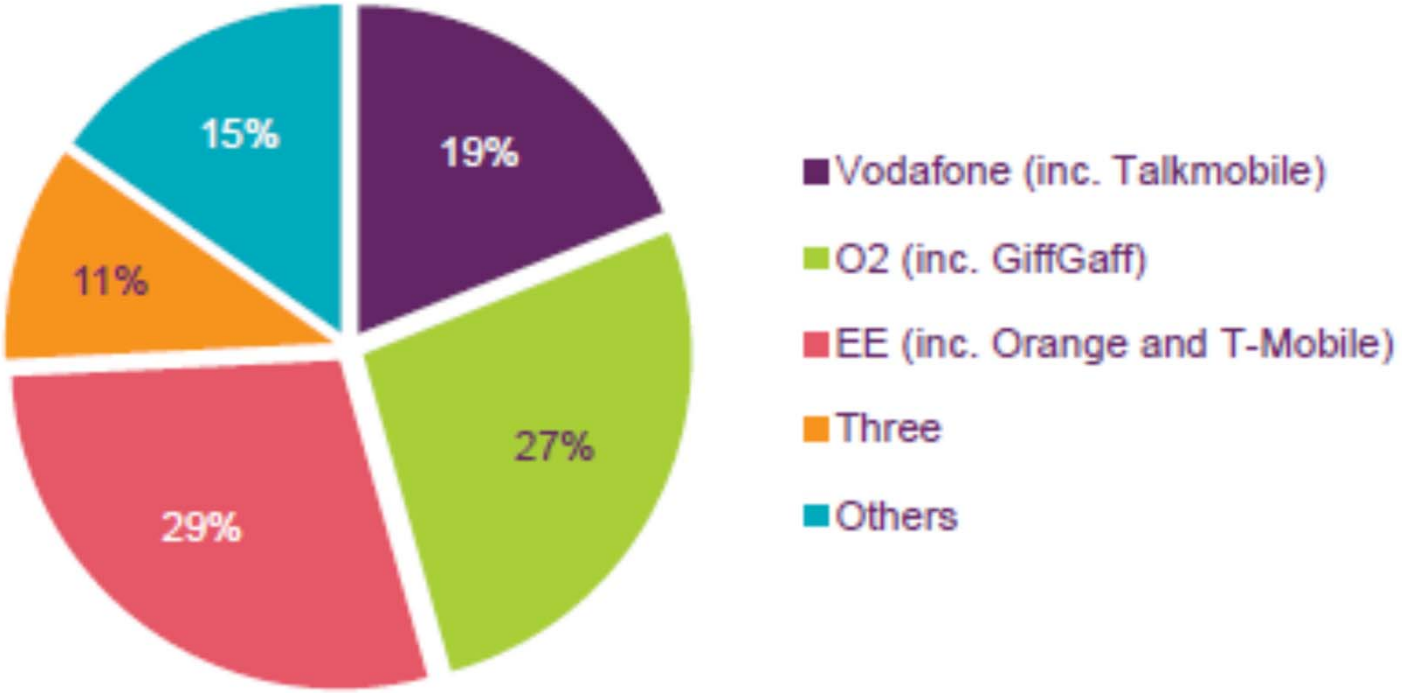
Continued growth of internet access on smartphones etc



Source: Communications Market Report 2016

UK still has competitive market structure

Figure 4.21 Retail mobile subscription shares, by provider: Q4 2015



Source: Communications Market Report 2016

European Commission (EC) blocked proposed merger between Three and O2 in May 2016, concluding that it would eliminate competition between two strong players with adverse effects on consumers including reduced choice and quality of service, and higher prices.
EC assessed and rejected a range of claims by the parties of efficiencies, both static (cost savings) and dynamic (increased investment, higher network quality).
http://ec.europa.eu/competition/mergers/cases/decisions/m7612_6415_10.pdf

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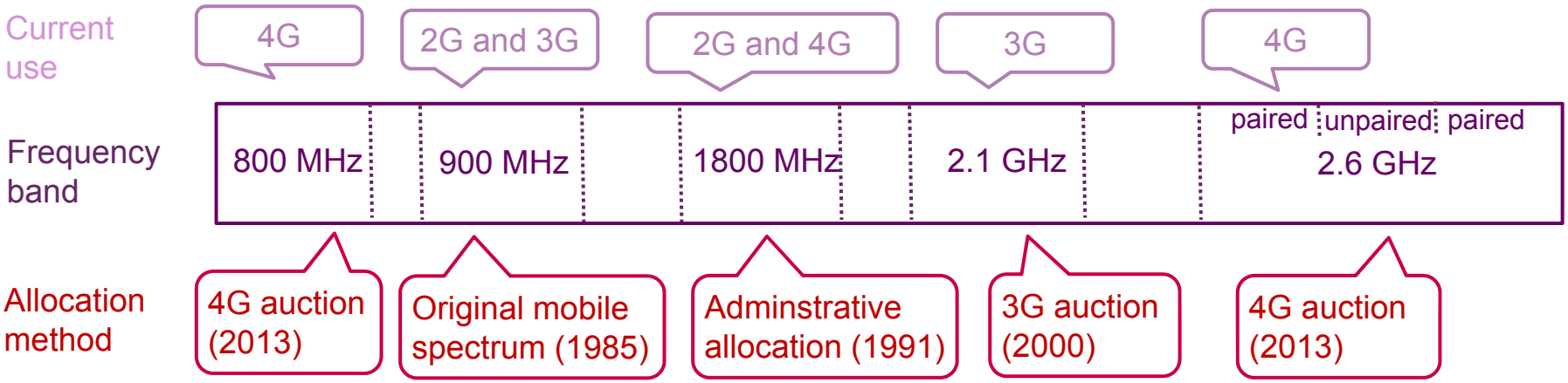
Summary

- With each evolution of mobile technology the UK spectrum regulators (Ofcom and its predecessors) have promoted competition and innovation through the allocation of spectrum



Innovation and competition

2G: 2 → 4 players

3G: 4 → 5 players

4G: Maintaining competitive market structure

4G rollout (head start and catch up)

Postcript on 5G

- 5G technology and business cases being developed, with spectrum implications subject to current debate

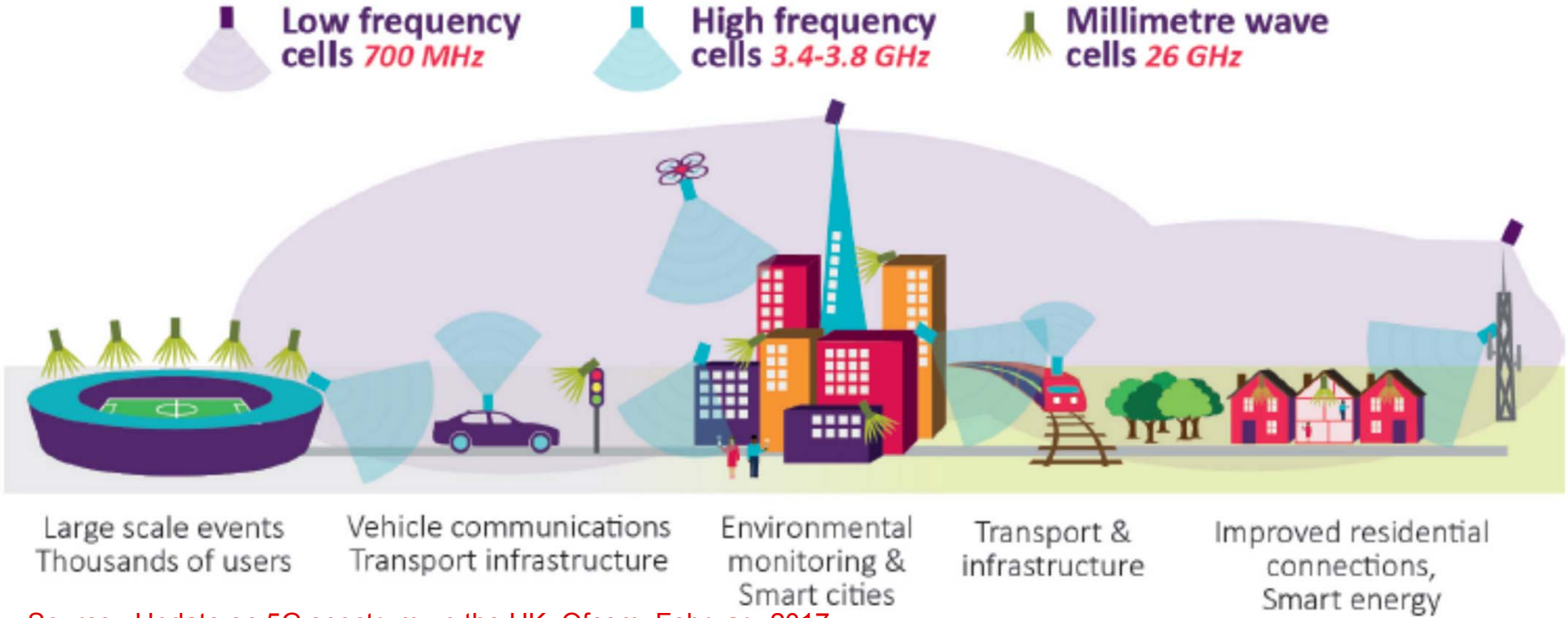
Three classes of services

Enhanced mobile broadband
- eg virtual reality

Massive machine communications
- Internet of Things

Ultra-reliable and low latency communications
- eg driverless cars, remote surgery, "wireless fibre"

Expected early spectrum bands for 5G and illustrations of services



Source: Update on 5G spectrum un the UK, Ofcom, February 2017, https://www.ofcom.org.uk/__data/assets/pdf_file/0021/97023/5G-update-08022017.pdf