Value of UWB to the UK Economy

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Format

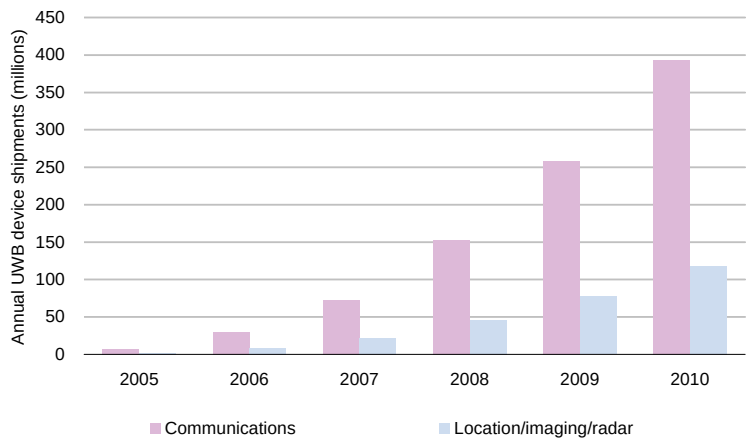
1. Background and approach
2. Estimates of net private benefits
3. Estimates of commercial cost of interference
4. Results and conclusions

UWB in the PAN environment

- Wireless technology capable of transferring large amounts of data wirelessly over short distances (up to 10m)
- Data rates of greater than 110 Mbps
- Particularly Suitable for wireless personal area networking (PAN) – indoor home and office
- Removes the need for cabling between consumer devices for high or low rate applications:
  - USB
  - Audio/video streaming
- Rival technologies include Bluetooth and WiFi
- Annual UWB shipments estimated to be hundreds of millions globally by 2010

Feature	Benefits
High speed throughput	Fast, high-quality data transfer
Low power consumption	Long battery life of portable devices
Silicon based, standards-based radios	Low cost
Multiple streaming	Simultaneous streaming to multiple devices throughout time

Source: Intel



Source: Analysys Consulting and Mason Communications

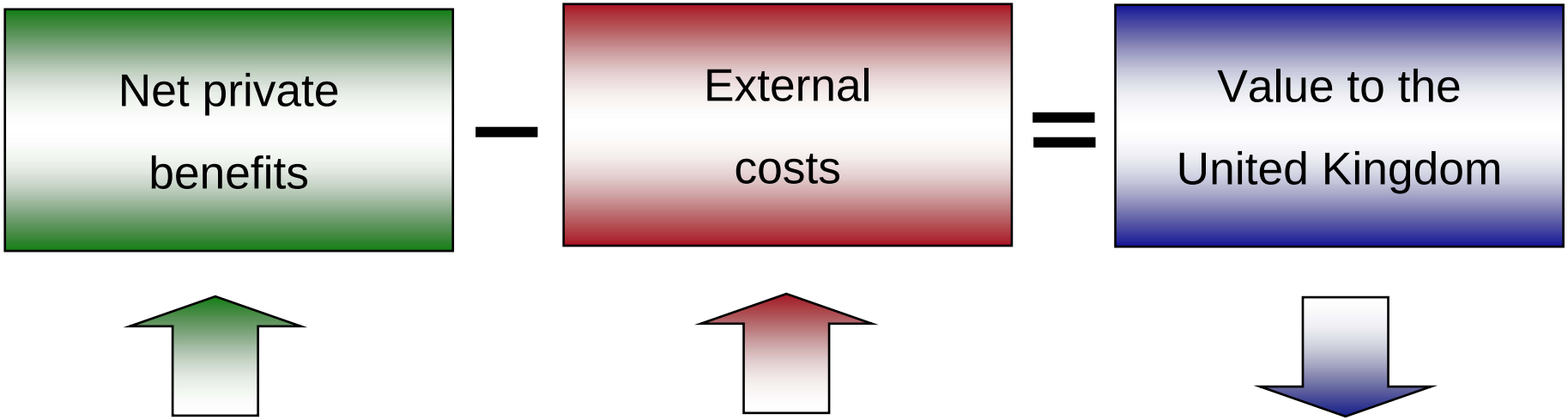
Study objectives

- UK study commissioned by Ofcom to feed into their analysis of whether and under what regulatory conditions to allow UWB
- Cost-benefit analysis of UWB for Personal Area Networking (PAN) applications
  - Evaluate benefits from using UWB in PAN environments
    - Better quality relative to alternatives
    - Lower cost relative to alternatives
  - Evaluate costs from using UWB
    - Interference with other primary radio services
  - Identify net impact on UK society under different regulatory scenarios
  - Consider the impact of alternative UWB techniques
    - Direct sequence versus MB-OFDM

Five regulatory scenarios

FCC Mask	• 3.1 to 10.6 GHz bandwidth • -41.3 dBm/MHz emissions between 3 and 10 GHz
ETSI Mask	• (a) Draft ETSI/CEPT mask (-65 dBm/MHz at 2 GHz) • (b) Revised ETSI/CEPT mask (-85 dBm/MHz at 2 GHz)
UWB limited to Lower Band	• Devices limited to 3 to 5 GHz
UWB limited to Upper Band	• Devices limited to 6 to 10 GHz

Our approach to estimating welfare impact of UWB



Quality
Cost
Take-up

UWB relative to alternative technologies e.g. WiFi, Bluetooth

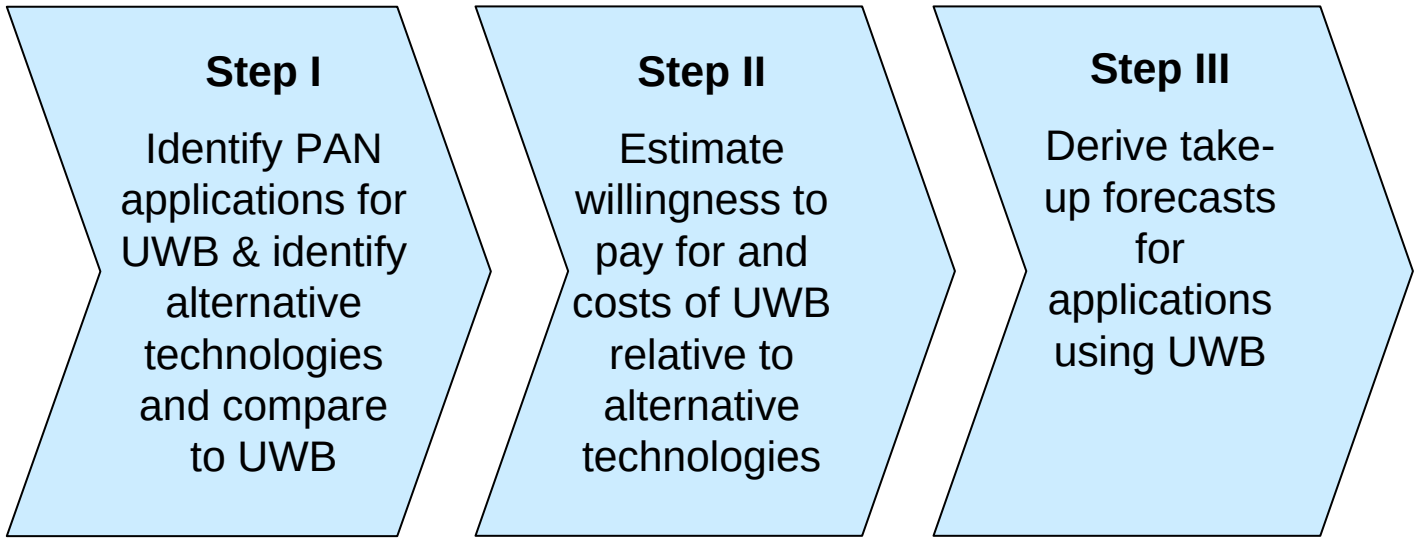
Interference with other services

UMTS
Satellite
Fixed links
Wireless Broadband
PMSE
GPS
Aeronautical
Radio astronomy
Military

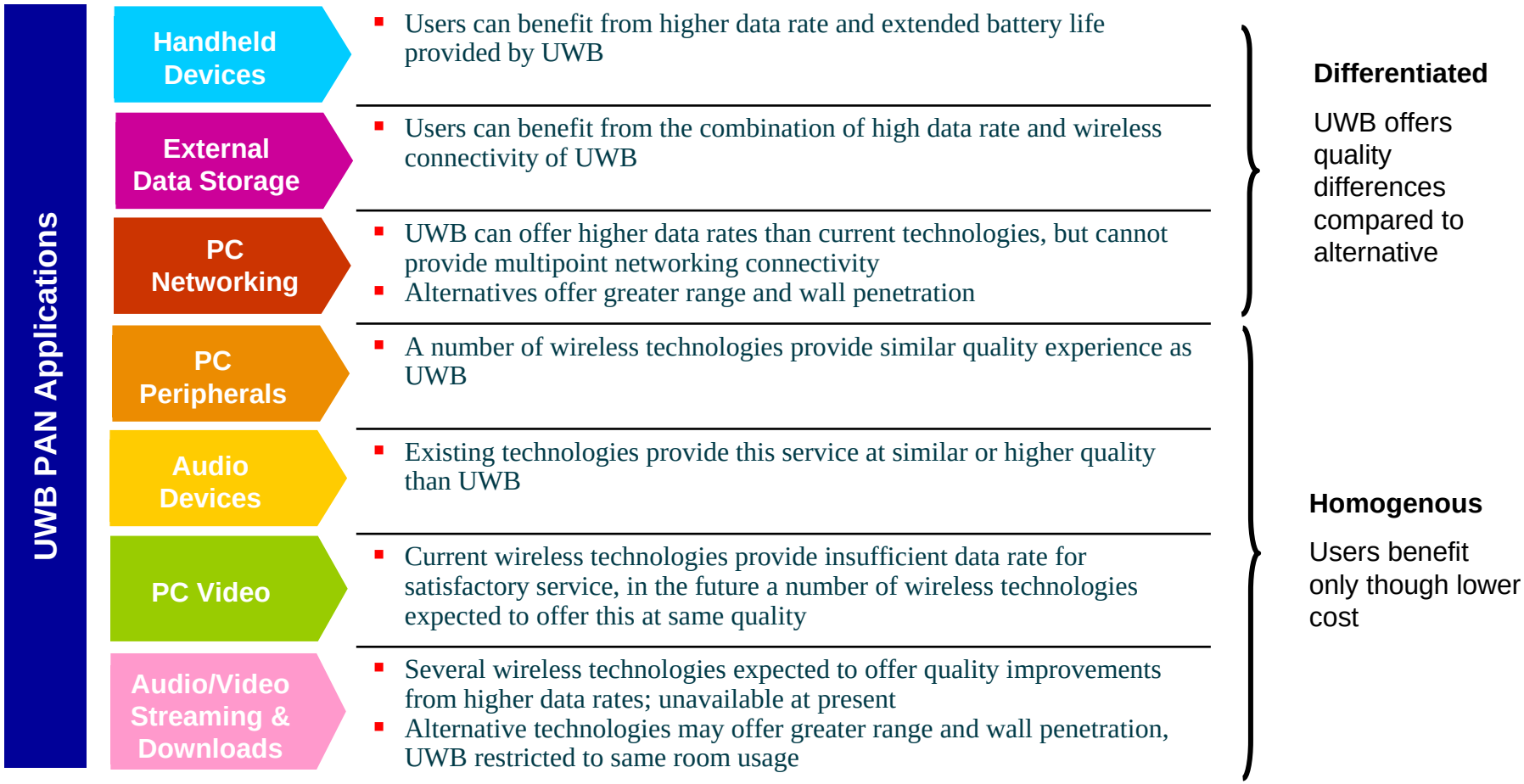
- Positive or negative?
- How large?
- Impact of regulation?
- Sensitivity to assumptions?

Estimates of Net Private Benefits

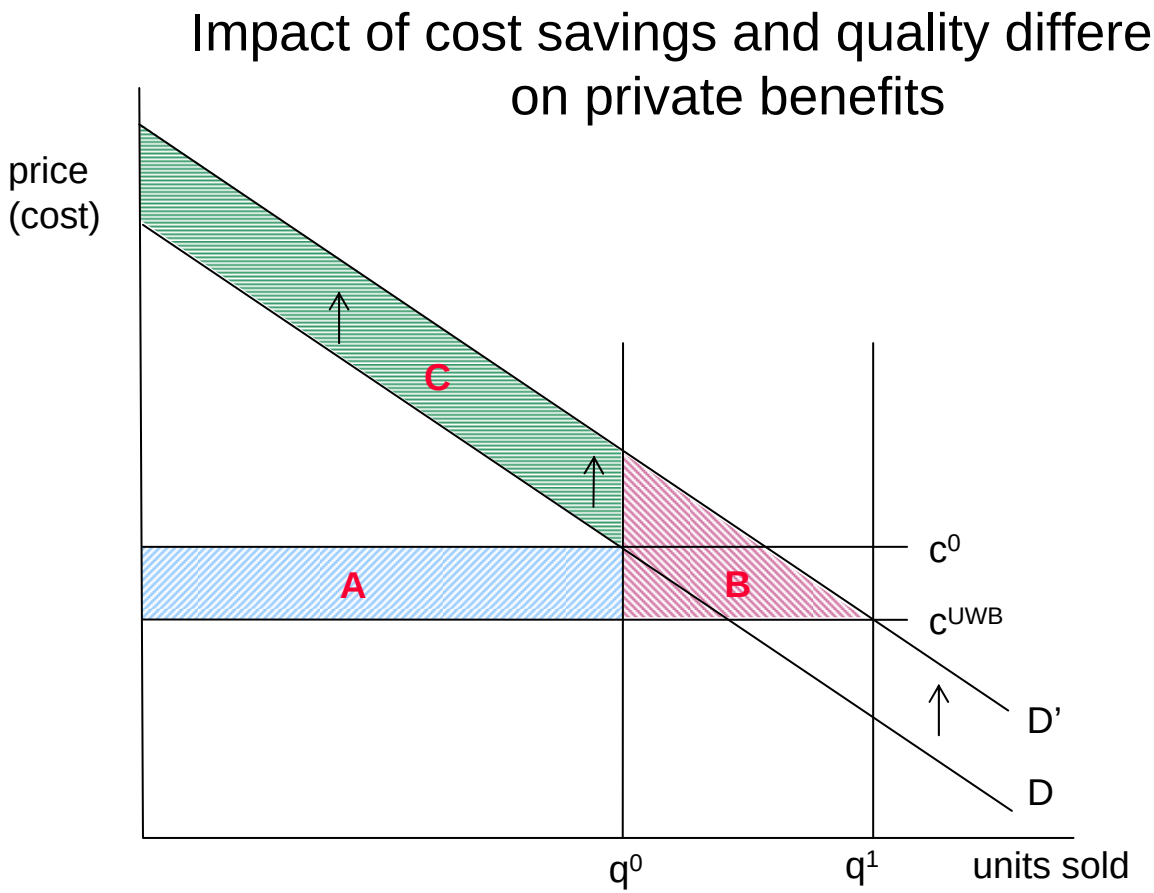
Methodology for estimating net private benefits



Step 1: UWB versus alternative technologies



Step 2: Willingness to pay and cost of UWB



A. Cost saving on units that would be sold under both technologies

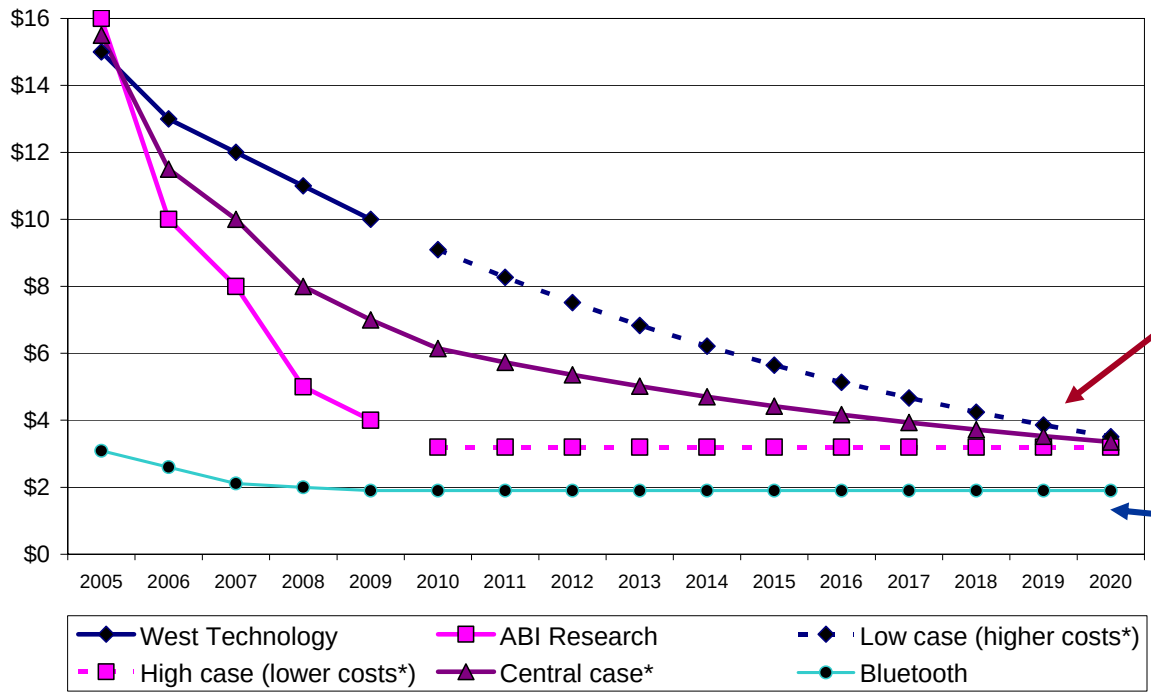
B. Effect of increased take-up owing to lower prices *and* increased willingness to pay

C. Effect of increased quality on willingness to pay on units that would be sold under both technologies

We also considered the case where quality increases but cost also rises relative to alternatives

Step 2: Willingness to pay and cost of UWB

- Hedonic prices used to calculate additional willingness to pay for UWB relative to alternative technologies
- Results for all applications extrapolated from survey of handheld devices and network cards
- Cost of UWB relative to alternative technologies estimated by extrapolating industry forecasts over the forecast period

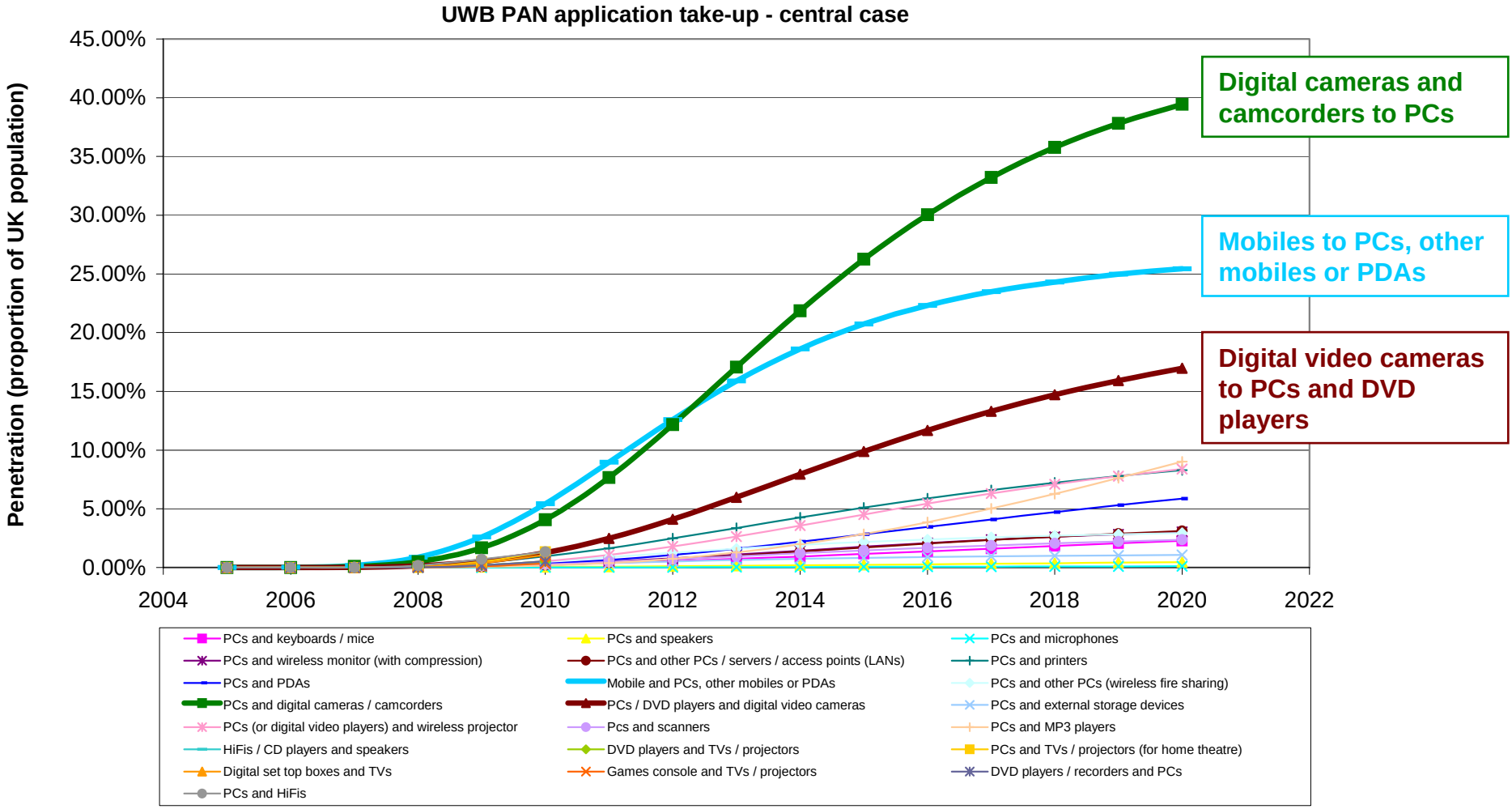


Cost per UWB chipset, US$

Cost per Bluetooth chipset, US$

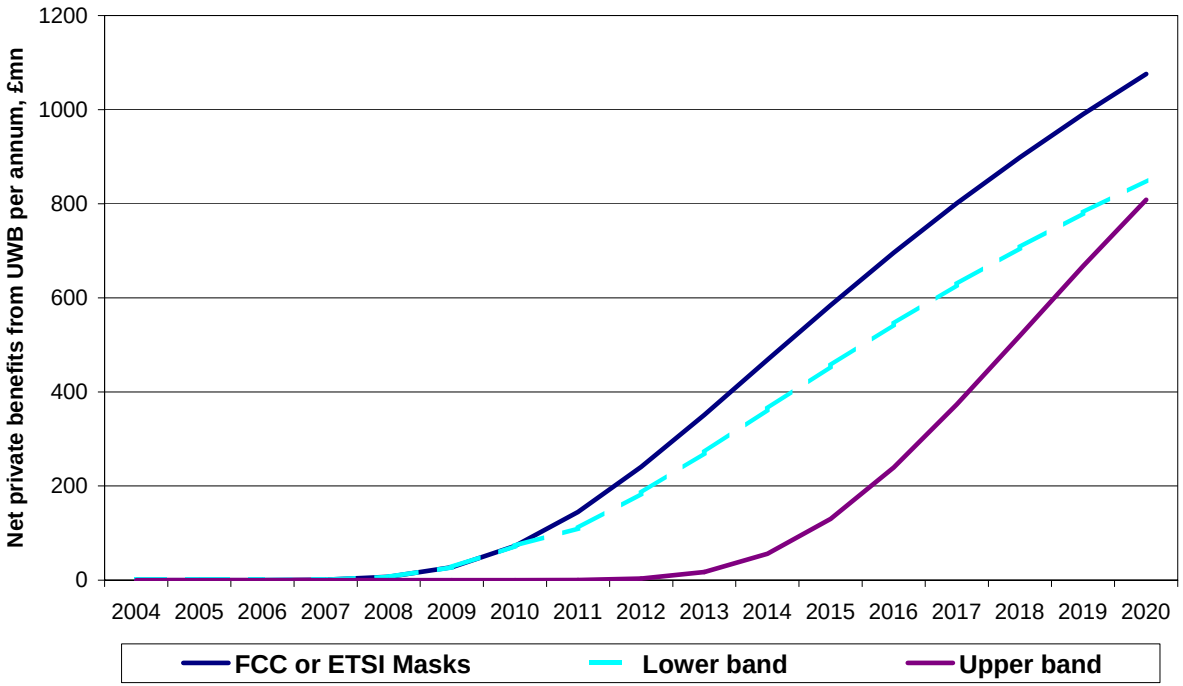
Step III: Take up of applications using UWB

- Forecasts for take-up of and usage of all applications developed using industry data



Step IV: Estimating aggregate net private benefits

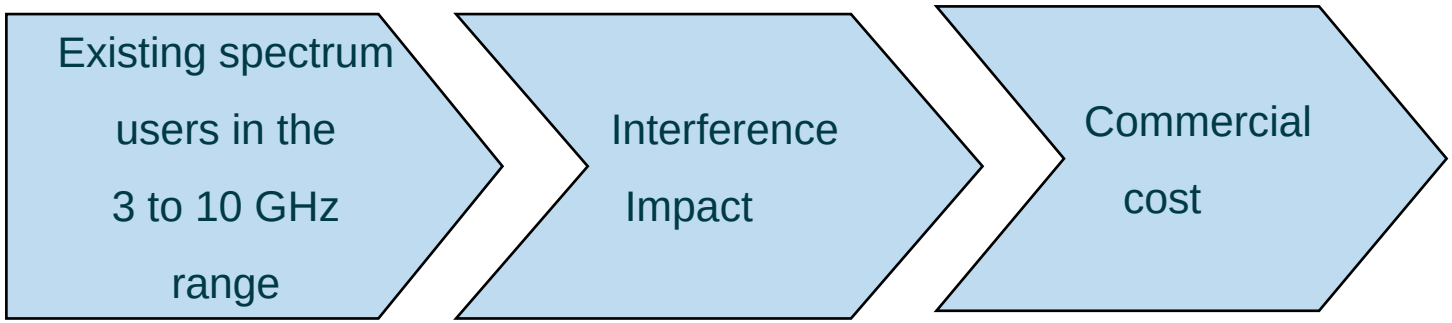
- Potential net private benefits from UWB very large
- Benefits sensitive to take-up assumptions, but still significant even under low case scenario
- Large-scale benefits only from 2011, once UWB reaches mass market
- Benefits greatest under either FCC or ETSI masks (assumes that initial chipsets meet both standards)
- Lower band restriction may reduce future benefits
- Upper band restriction significantly delays and reduces benefits

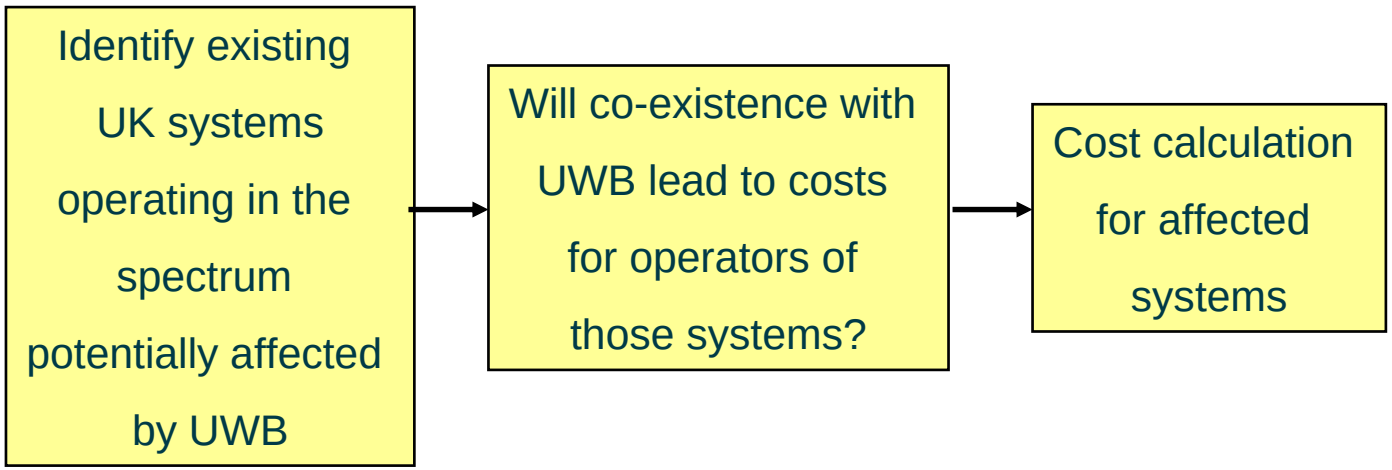


NPB from UWB under different regulatory scenarios, per annum (£mn)

Estimates of External Costs

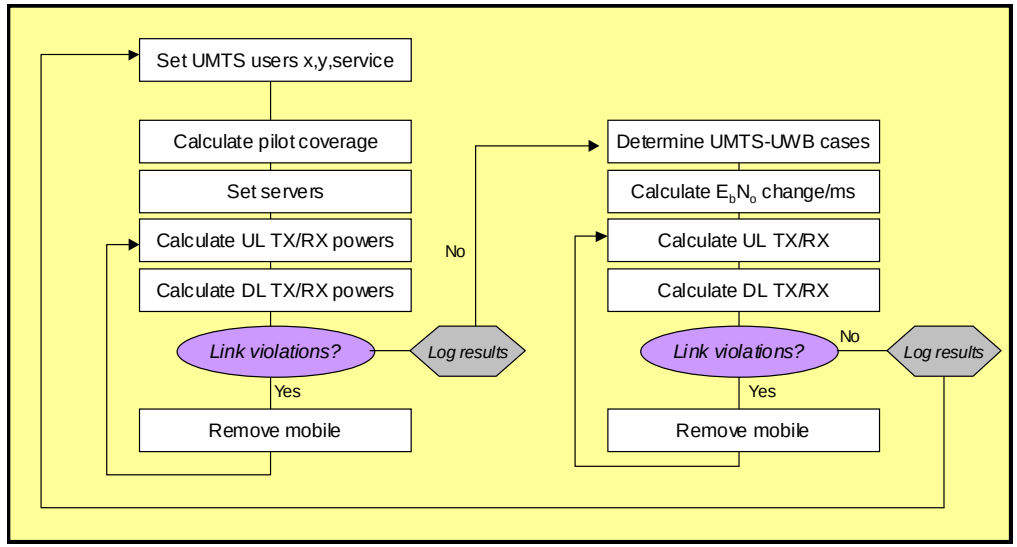
Methodology for calculating external costs





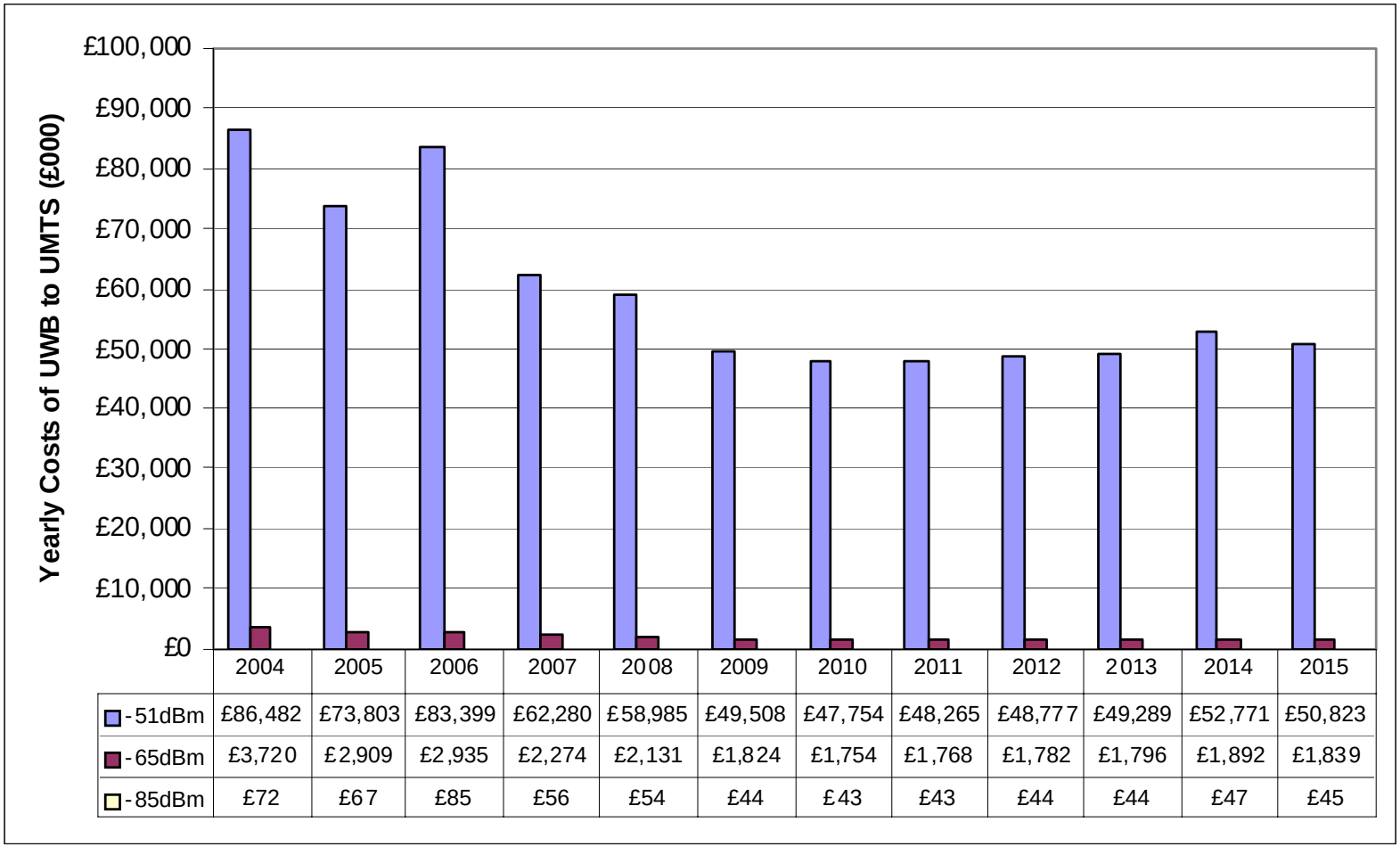
Two engineering models developed for the study

- UMTS
  - Modified version of the Monte Carlo model developed by Mason for earlier work for the UK Radiocommunications Agency (as presented to CEPT and ITU)
  - Simulate lost of quality of service in the presence of UWB
  - Costs estimated for restoring the quality of service
- FS, FSS and FWA
  - Bespoke Monte Carlo model
  - Estimate the noise impact on 'Probability of Error' at the affected link
- Both models draw extensively on ITU-R studies for input parameters
  - UWB characteristics
  - Interference scenarios



UMTS Monte Carlo model algorithm

Costs per UK UMTS operator



	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
-51dBm	£86,482	£73,803	£83,399	£62,280	£58,985	£49,508	£47,754	£48,265	£48,777	£49,289	£52,771	£50,823
-65dBm	£3,720	£2,909	£2,935	£2,274	£2,131	£1,824	£1,754	£1,768	£1,782	£1,796	£1,892	£1,839
-85dBm	£72	£67	£85	£56	£54	£44	£43	£43	£44	£44	£47	£45

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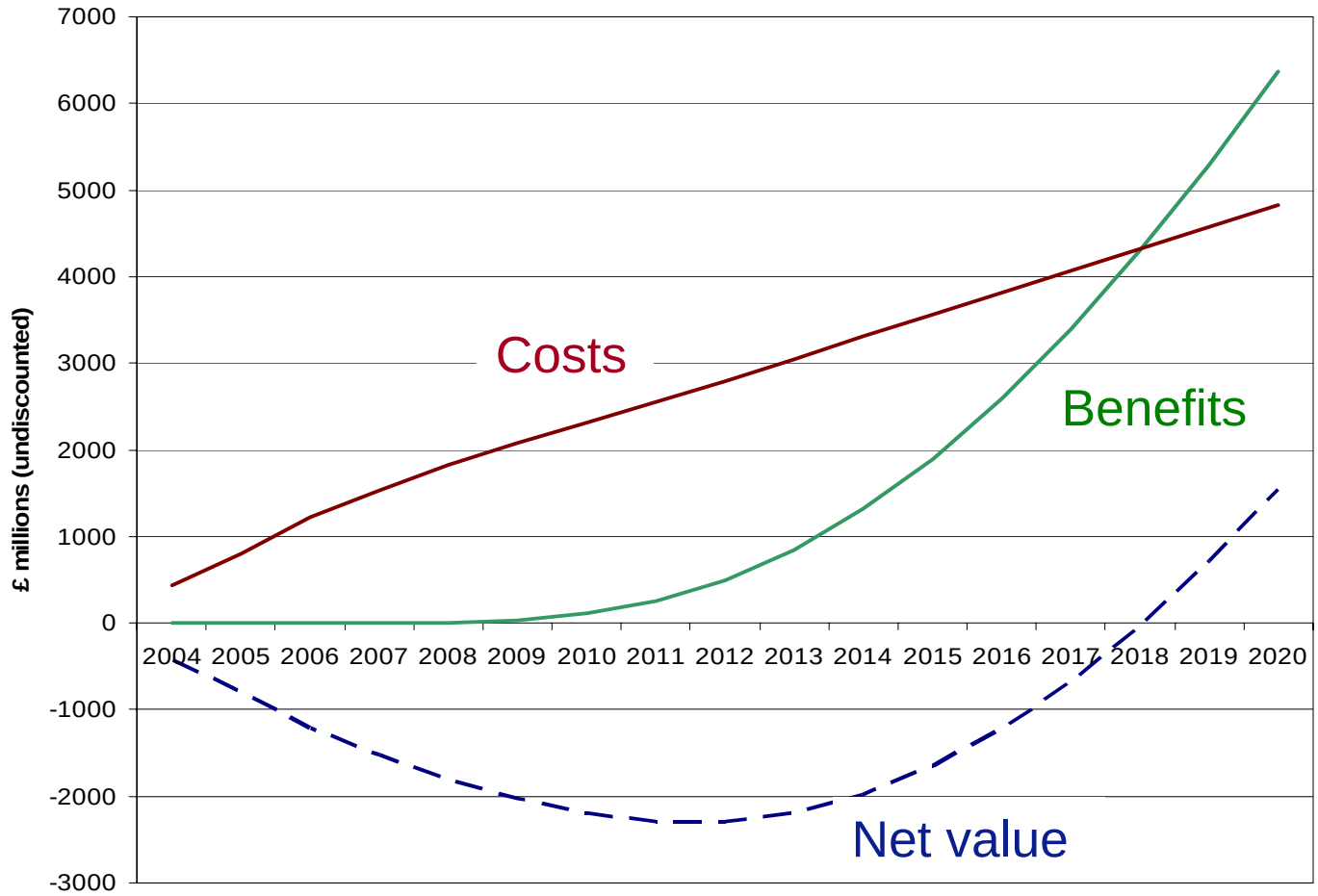
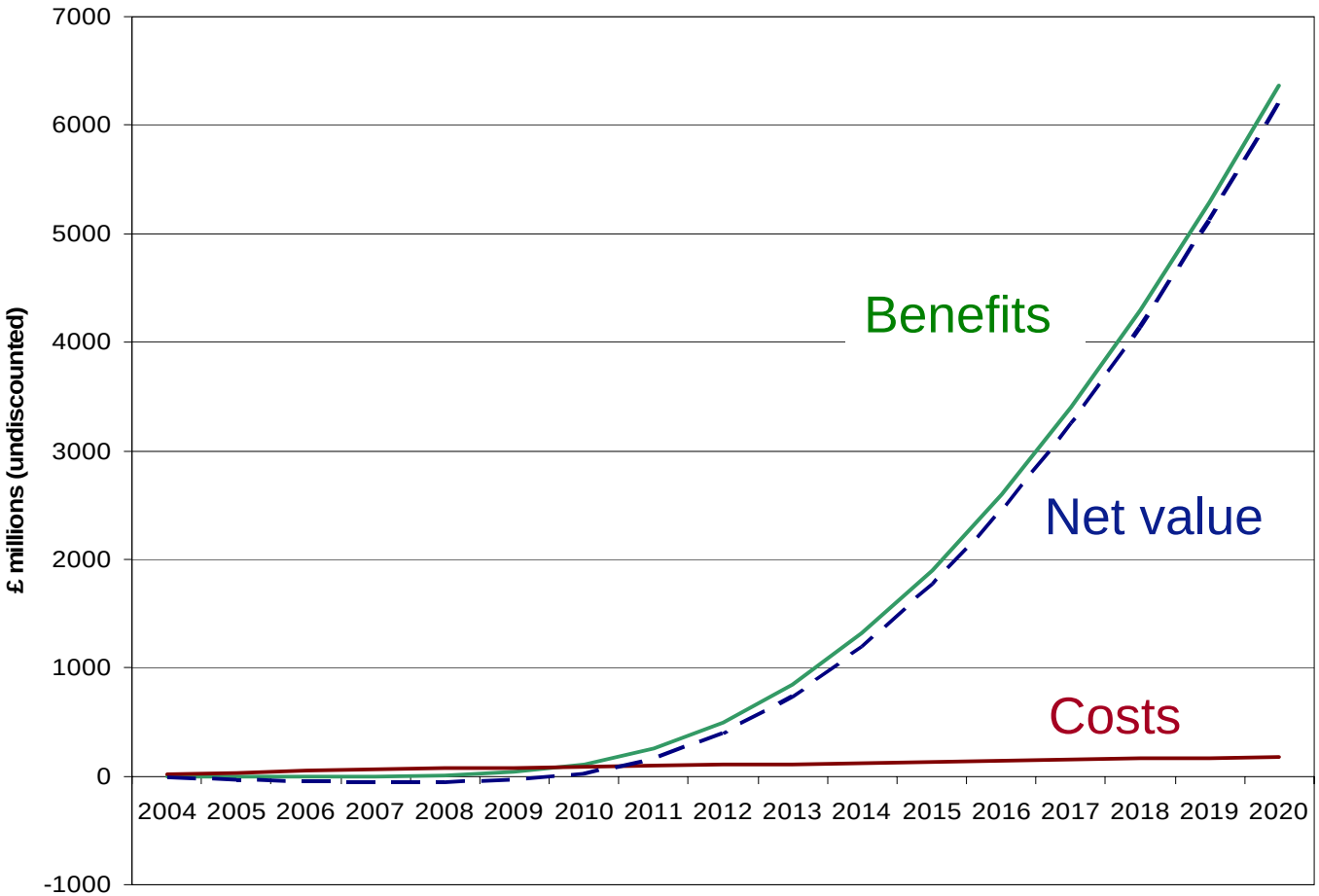
Results and Conclusions

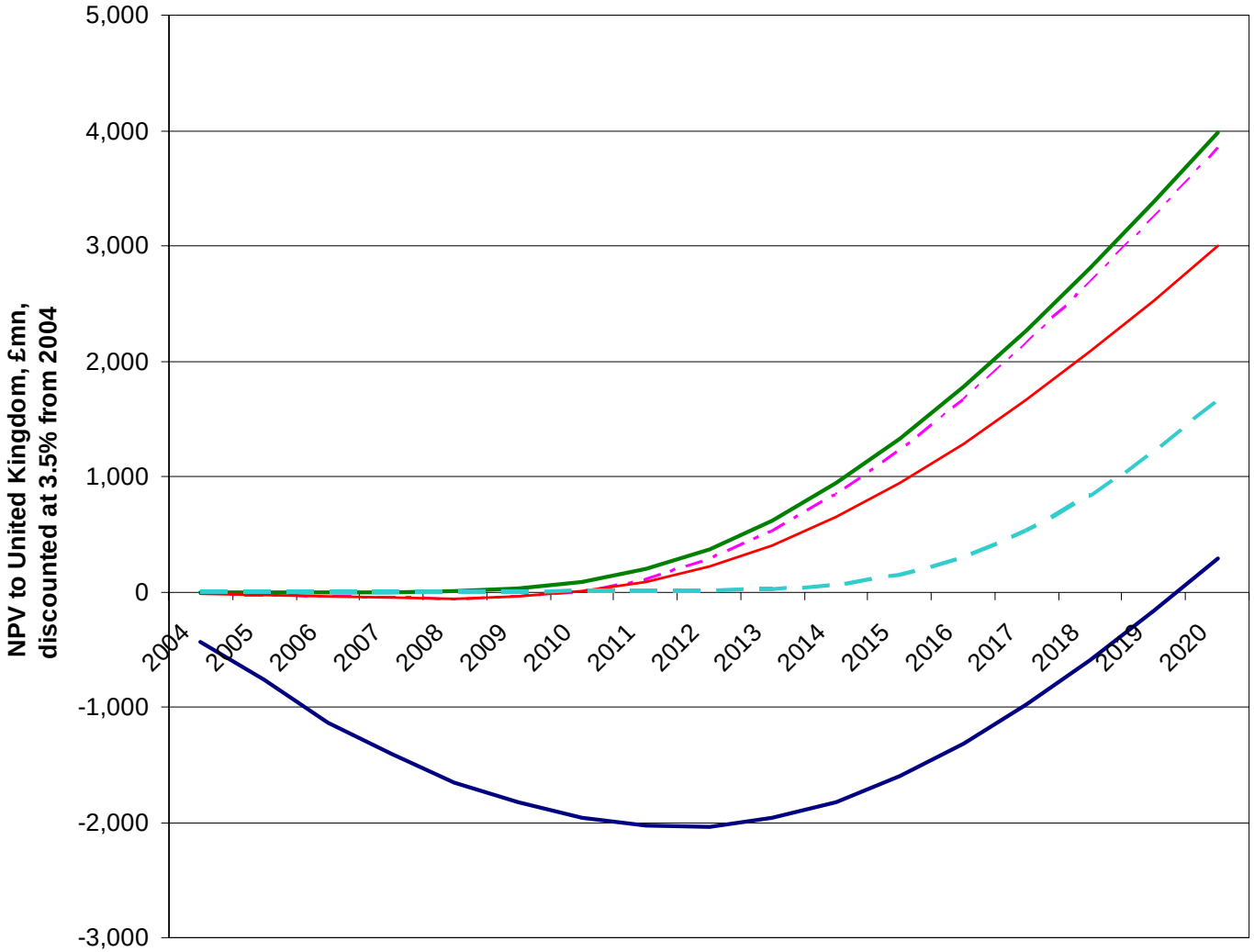
Results for the FCC mask regulatory scenario



Results for the ETSI mask (-65dBm/MHz)



Net Value of UWB under different regulatory approaches



ETSI (-85dBm/MHz)

ETSI (-65dBm/MHz)

Lower band

Upper band

FCC Mask

Conclusions

- Draft ETSI mask represents better solution for the UK than FCC mask
  - Net private benefits are identical (based on our understanding that initial chipsets meet both standards)
  - External costs (interference) significantly lower under ETSI mask
- Scope for tightening the roll off of the draft ETSI mask to a level of –85 dBm/MHz at 2.1GHz to protect UMTS
  - External costs on UMTS providers are minimal under this scenario
  - Benefits unaffected provided that initial chipsets are compatible
- Both upper and lower bands should be made available for UWB
  - A lower band restriction may constrain future quality improvements for no clear benefits
  - An upper band restriction would delay launch of UWB by five years or more and reduce quality

Interpreting our results

- Our numbers are indicative:
  - Long-term forecasts (15 years) are inherently uncertain
  - Modelling new services is particularly difficult, requiring many assumptions
  - Lack of data restricted scope for quantitative analysis of costs for sectors other than UMTS
  - We do not consider possible future uses of the spectrum
- The relative magnitude of our results for different scenarios is much more important than specific levels
- We focus on the size of costs and benefits, *not* on their distribution and any related effects (including knock-on effects of interference on end prices or take-up of affected services)

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