Considerations related to the licensing of the 800 MHz band in the UK

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EBU TECHNICAL Workshop

Outline

- Introduction
- Interference mechanisms
- Mitigation measures
- Next steps and conclusions

Background

- In 2008, the European Commission (EC) issued a mandate to CEPT to define technical conditions for use of the 800 MHz Digital Dividend spectrum (790-862 MHz) by fixed/mobile communication networks (MFCNs) and for co-existence between MFCNs and digital terrestrial TV (DTT) networks below 790 MHz.

- In response, the ECC defined a number of frequency arrangements and block edge masks (BEMs) for MFCN base stations (BSs) and terminal stations (TSs) in the 800 MHz band.

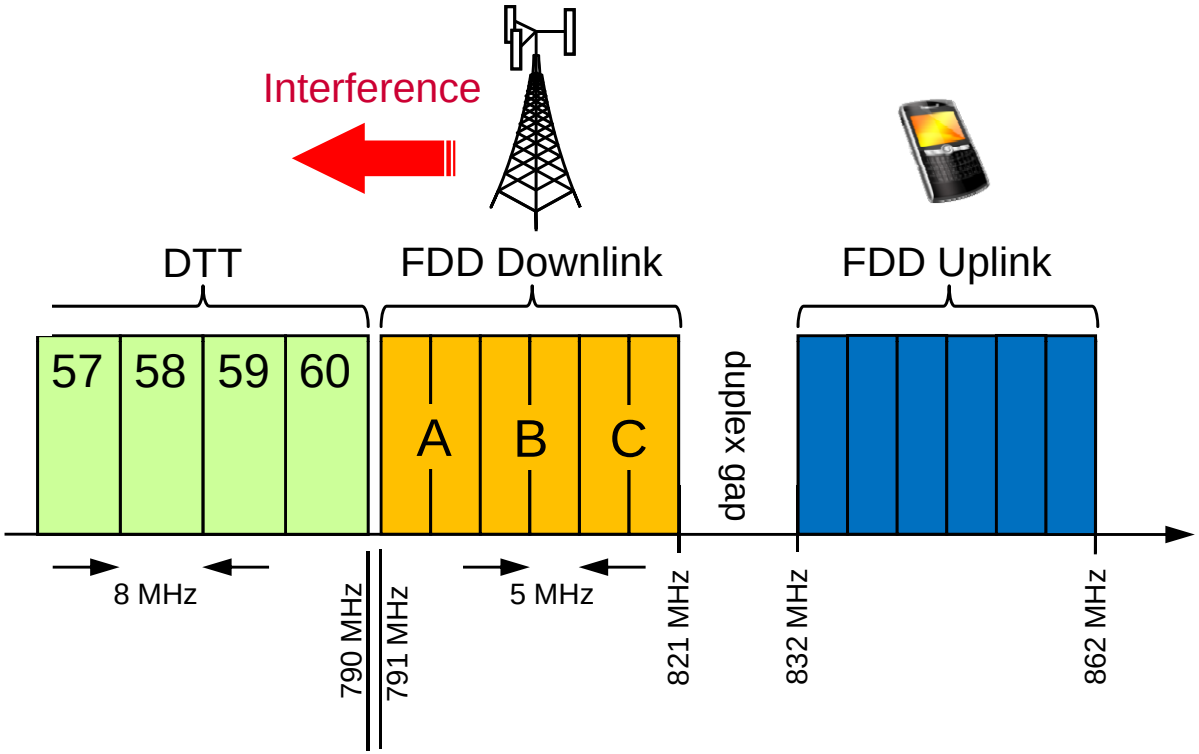
- In October 2009 these were adopted as ECC Decision (09)03. The BS limits were subsequently adopted as an EC Decision, legally binding on all EU member states.

- It was made explicitly clear in the ECC and EC Decisions that the derived BEMs will not provide appropriate levels of protection to victim DTT services in all circumstances, and that *additional mitigation measures* would need to be applied in order to resolve any remaining cases of interference.

- In the UK we refer to such “additional measures” as the *protection clause*.

European (preferred) band-plan

- In response to the EC mandate, the CEPT PT1 project team specified the following European *preferred* harmonized FDD band plan for mobile networks.



- Note: Reverse duplex.

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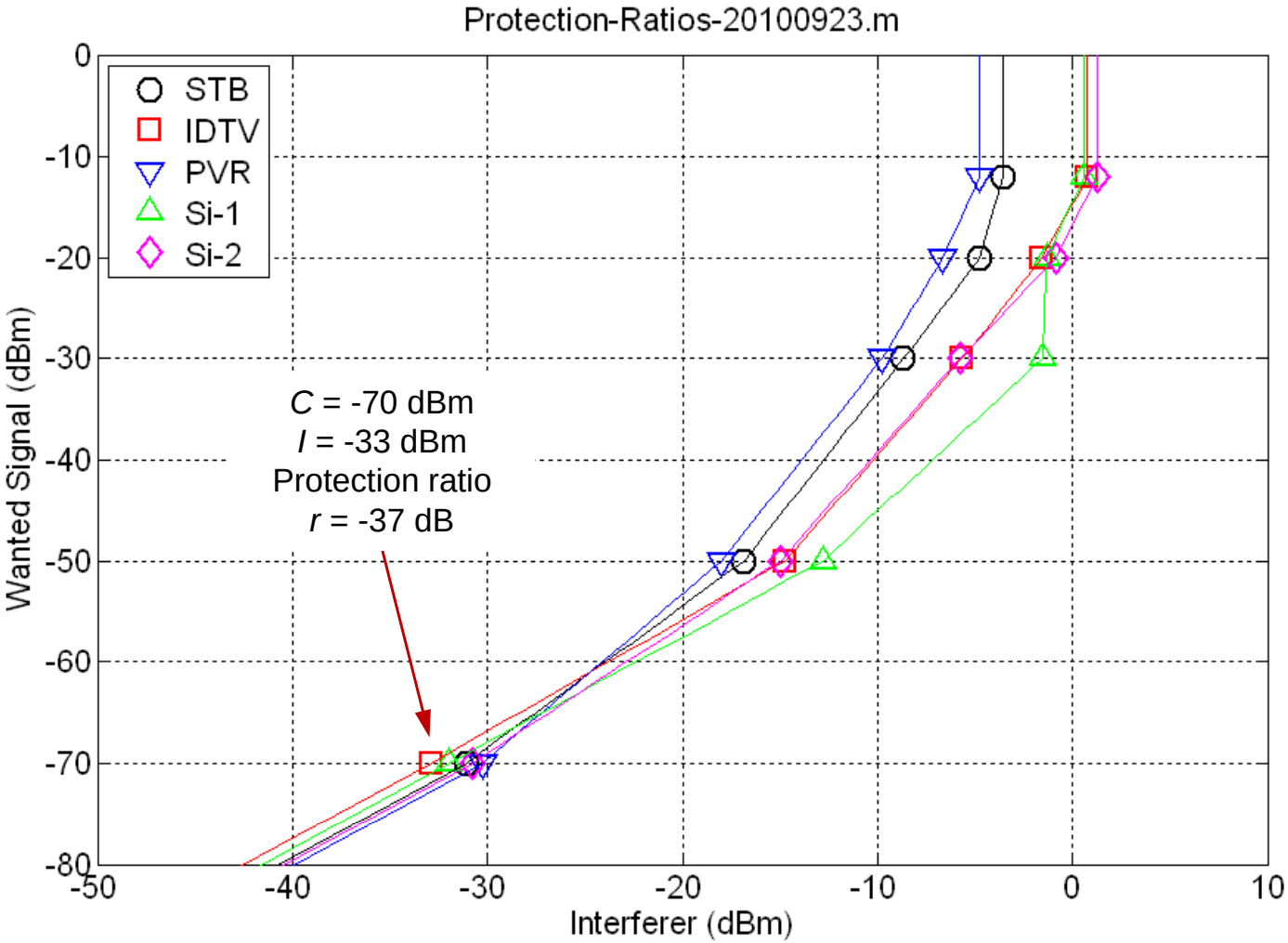
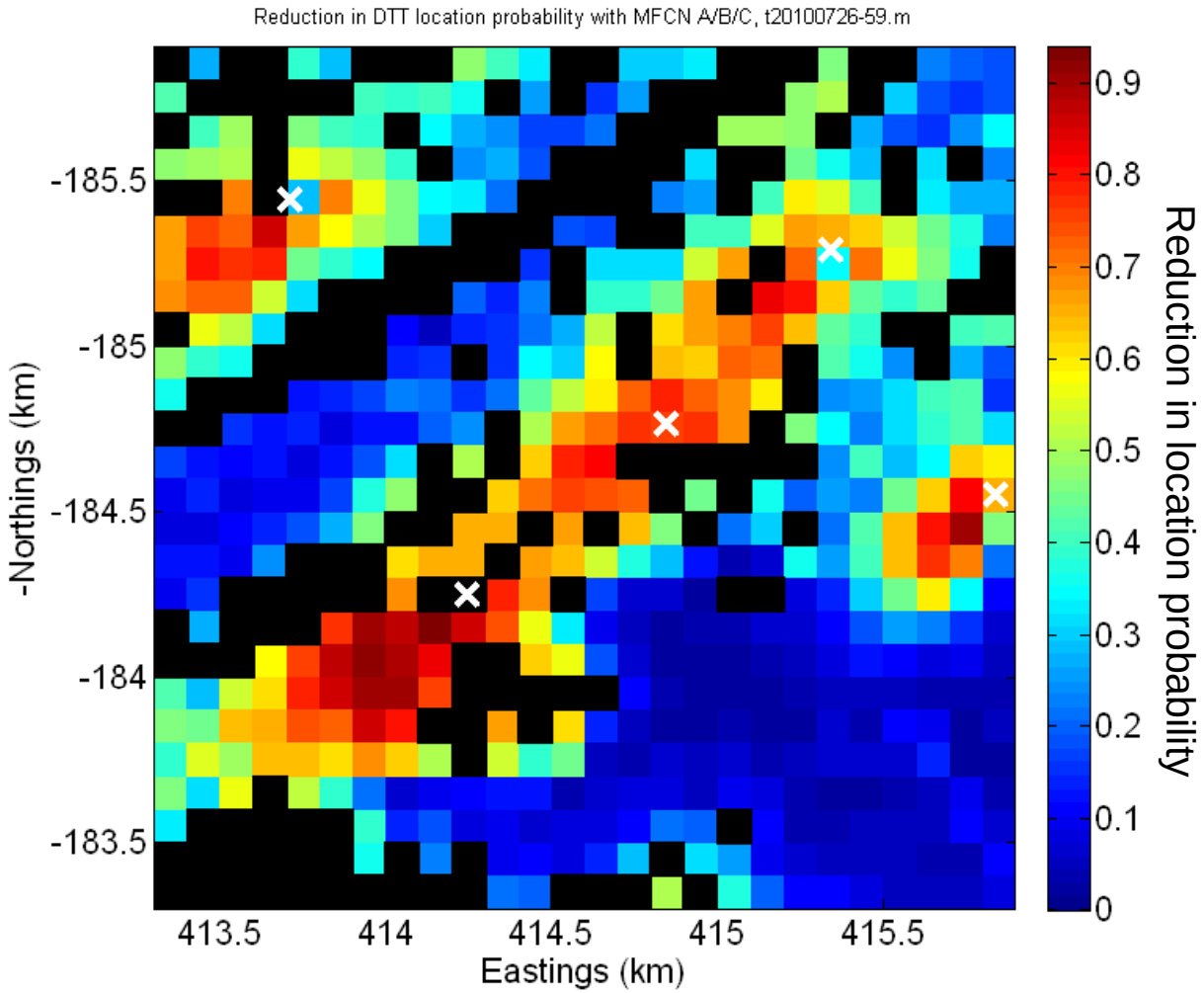
Degradation in SINR and overload



Measured LTE to DVB-T protection ratios for a carrier-to-carrier separation of 10 MHz (e.g., block A to channel 60).

Example LTE-800 deployment in Swindon (Ch. 60)

HHs served without MFCNs = 9881
MFCN EIRP = 59 dBm/(10 MHz)



Pixels without DTT coverage (i.e., with $q < 0.7$).

	HHs affected
Block A	3215 (32.5%)
Block B	1835 (18.6%)
Block C	1804 (18.3%)
Blocks A+B+C	4119 (41.7%)

Caution:

Swindon has poor DTT coverage. Therefore, the impact of interference is magnified.

Over the whole of the coverage area of the Oxford transmitter, the % of HHs affected due to interference from blocks A+B+C is roughly 7%.

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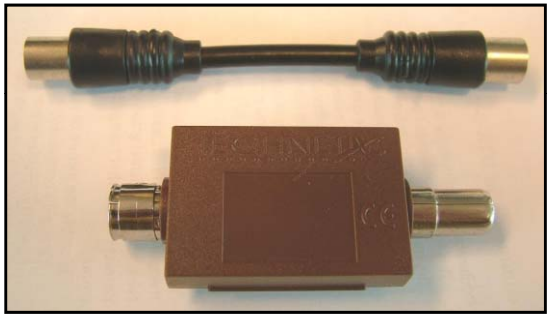
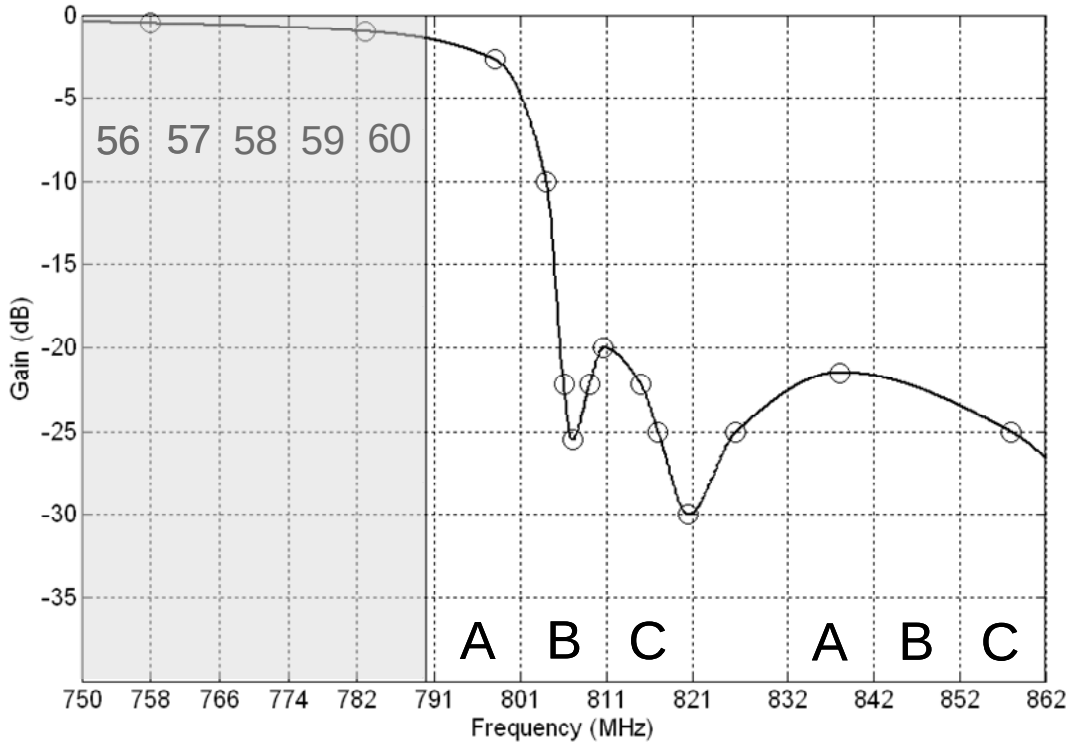
Filtering at the DTT receiver

- Low-pass filtering at the input of a DTT receiver is a robust mitigation measure, and broadly eliminates harmful interference in channels 58 and below.
- Filtering is not effective in mitigating against interference from block A into channel 60. This is due to the inadequate frequency separation between interferer and victim and the need to achieve a low insertion loss.



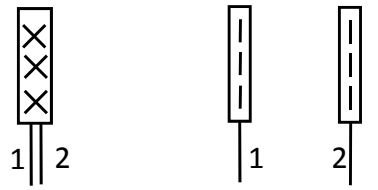
Prototype by Technetix.

Type-60 filter to protect channel 60.



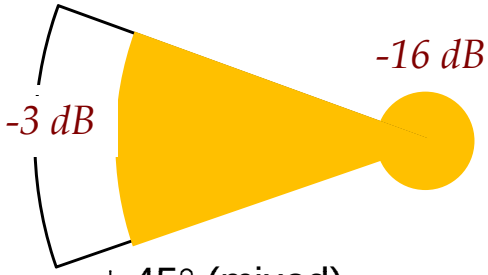
- We envisage the need for type-60, type-59, and type-58 filters.

Polarization discrimination



- DTT signals are either polarised vertically or horizontally. If the MFCN networks use opposite-to-DTT polarization, then interference experienced by DTT receivers would be reduced. The angular discrimination of the TV antenna in response to different MFCN polarisations changes as follows:

Same-as-DTT polarization



± 45° (mixed) polarization

Opposite-to-DTT polarization

- Opposite-to-DTT polarization virtually eliminates DTT receiver overloading.
- As compared to ±45° polarization, opposite-to-DTT polarisation reduces the number of HHs affected by a factor of between 2 to 4.
- Challenge: To save space, modern MFCN BSs use ±45° polarization for Tx diversity. Many MFCN masts are too small to support spatially separated vertically polarised antennas.

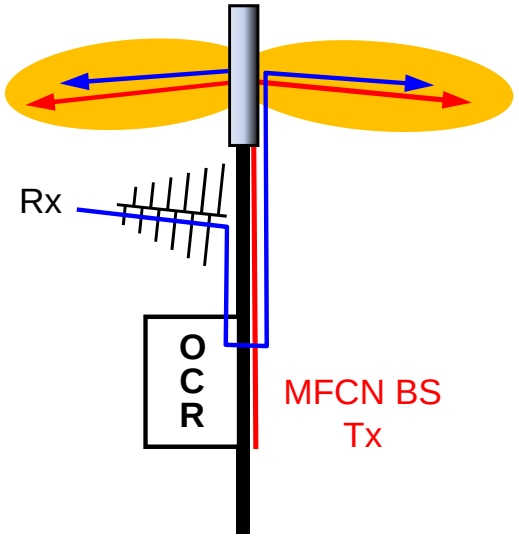
On-channel repeaters

- An OCR receives the DTT signal off-the-air, amplifies it, and re-radiates it. By increasing the DTT signal power at the victim DTT receiver, the OCR repairs the degradation in SINR. An OCR cannot cure DTT receiver overload.

- Co-siting the OCR with the MFCN Bs is the preferred approach: the propagation from both the OCR and the BS to the DTT receiver would be the same.
  This has the following benefits:

  - Gives the best chance of repairing the damage caused by the MFCN BS.
  - The OCR EIRP can be low (equal to the BS EIRP minus the protection ratio).
  - Re-pointing of the TV antennas is not necessary.

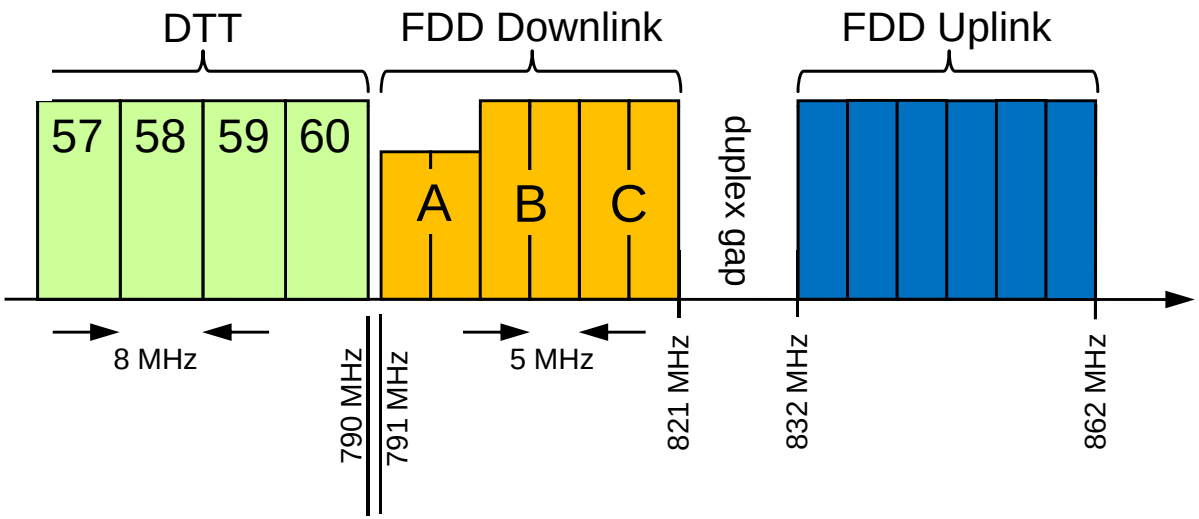
- Challenge: The OCR would need to operate in presence of adjacent-channel high-power MFCN BS. This requires good echo cancellation in the OCR, and high isolation (e.g., ~70 dB) between OCR Rx and BS Tx.



Reduced in-block EIRP

- An obvious mitigation measure is for the MFCN BSs to use low EIRPs.
  This would, of course, affect the downlink data rates in the MFCN.

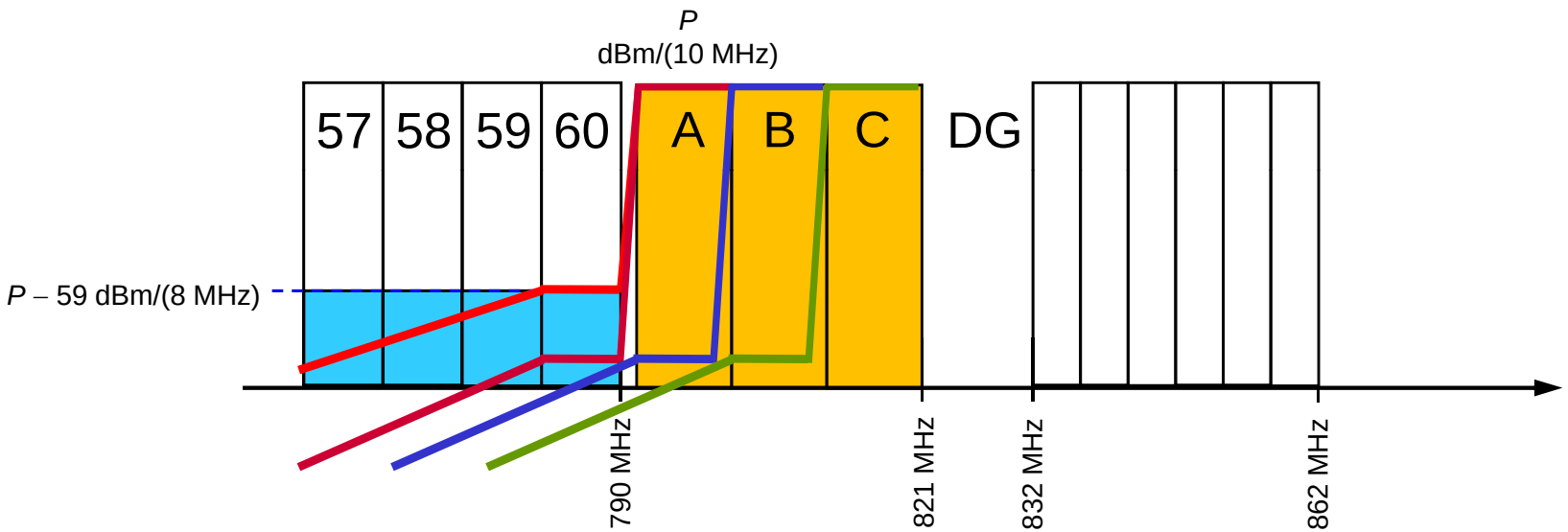
- Taking the idea to its extreme implies guard-bands in susceptible DTT coverage areas (e.g., channel 60).



Reduced out-of-block EIRP

- The MSFN BS out-of-block EIRP is specified in the EC Decision as ACLR of 59 dB. This is legally binding and member states are not permitted to impose more stringent limits.

- However, BS equipment can radiate with ACLRs that are a greater than 59 dB. This is particularly the case in blocks B and C.



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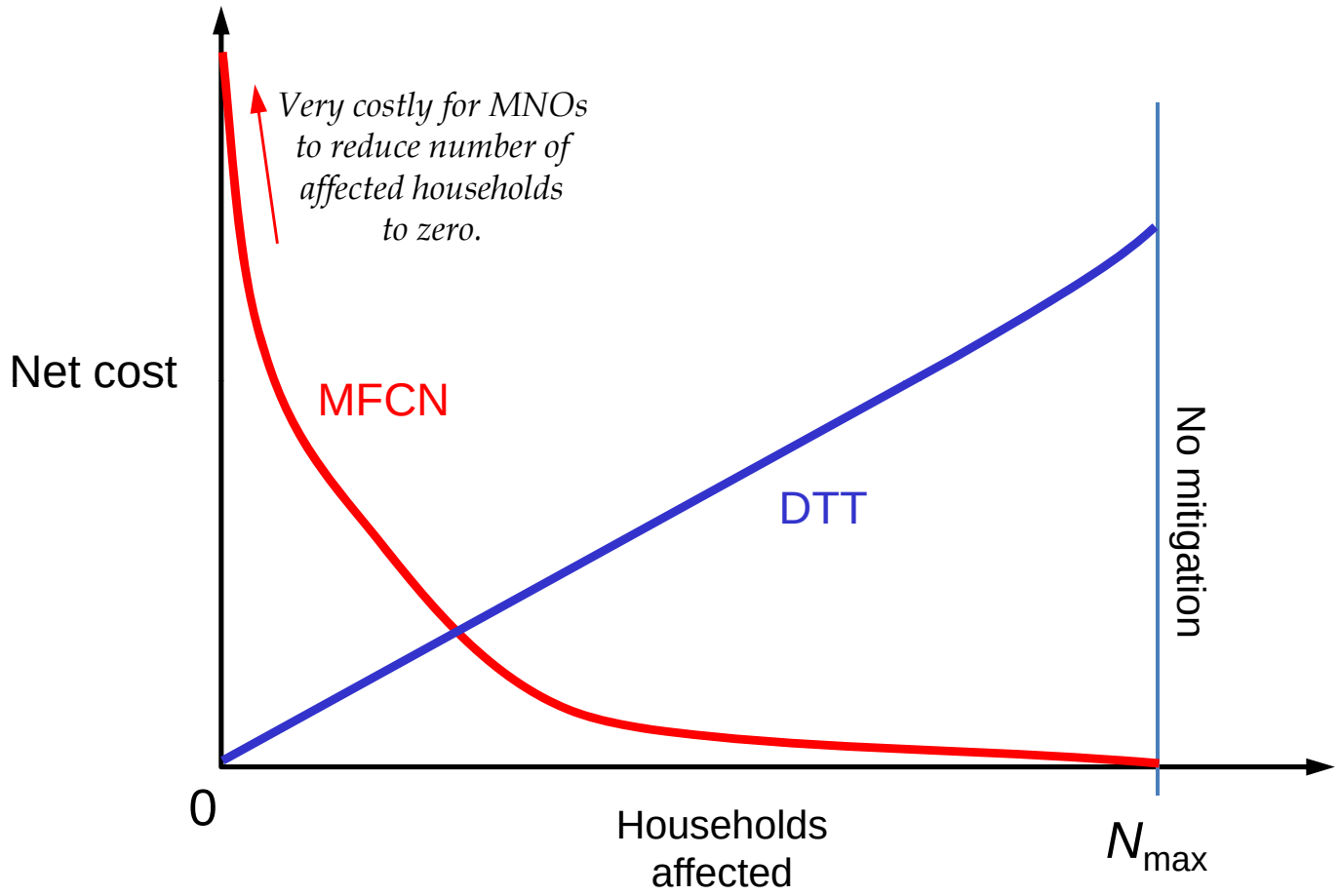
Conclusions

- Since finalisation of the CEPT studies in 2009, we have performed extensive technical work to evaluate the impact of interference from the 800 MHz band to DTT services in the UK.
- We are undertaking a field trial (Sep. 2010 to Mar. 2011) to assess the effectiveness of various mitigation measures, in particular that of OCRs.
- We have been sharing the results of our technical findings with stakeholders via a *Technical Working Group* which meets every two weeks by conference call.
- We will consult on the award of the 800 MHz band in early 2011.
- The 800 MHz band will be awarded via auction jointly with the 2.6 GHz band. This is likely to take place in early 2012.

Techno-economic analysis

- It boils down to minimising the net (cash and non-cash) cost to society.



Thank you!

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