

International Regulatory Framework

By
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Radio Regulations (1)

- International Treaty Governing the use of the Radio Spectrum
- Administered by the ITU
- First Published in 1906
- 9 kHz – 1 000 GHz
(possible extension to 3 000 GHz)
- Over 1000 Pages
- 40 Different Radio Services
- Can only be changed by a WRC

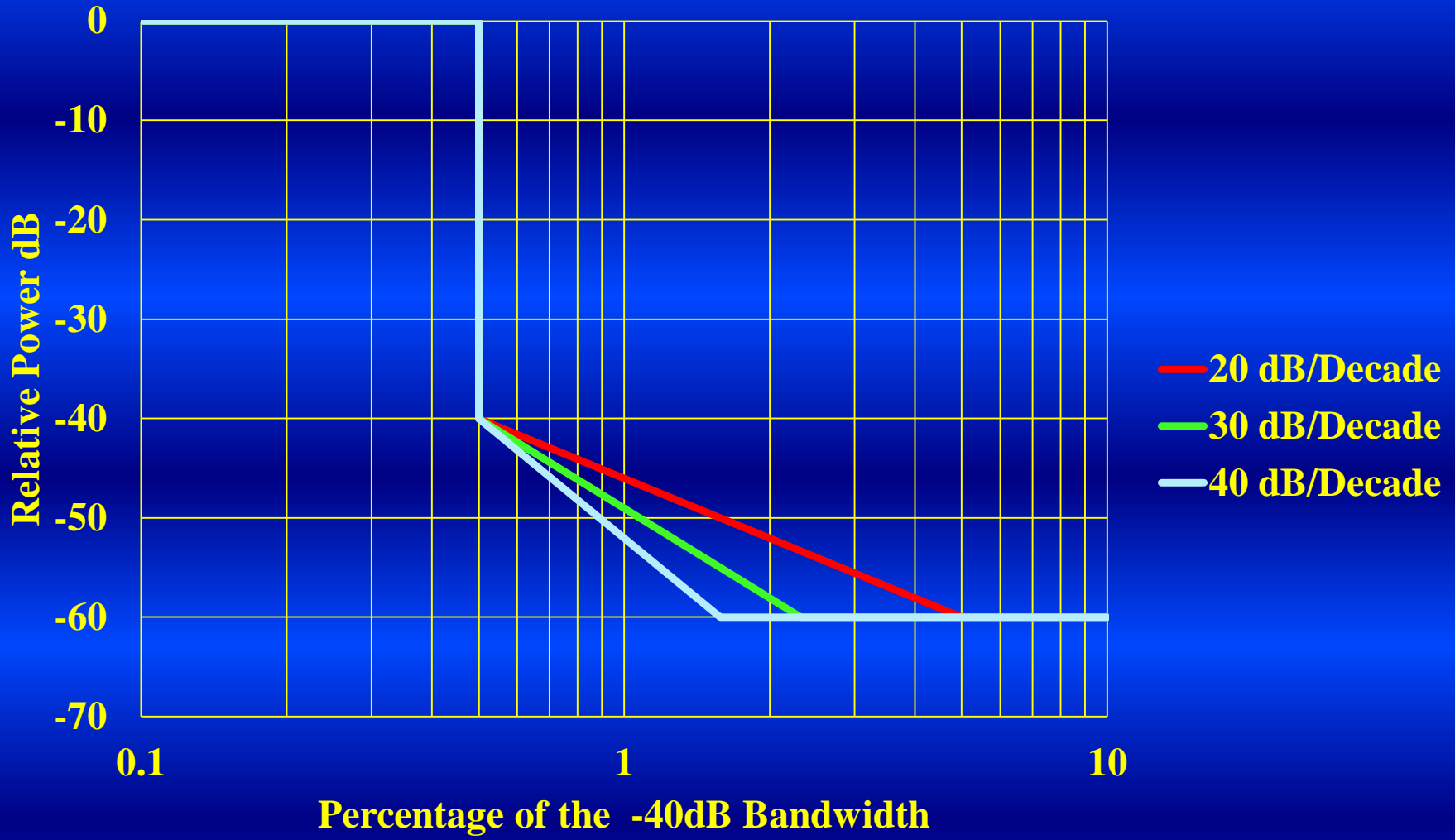


Radio Regulations (2)

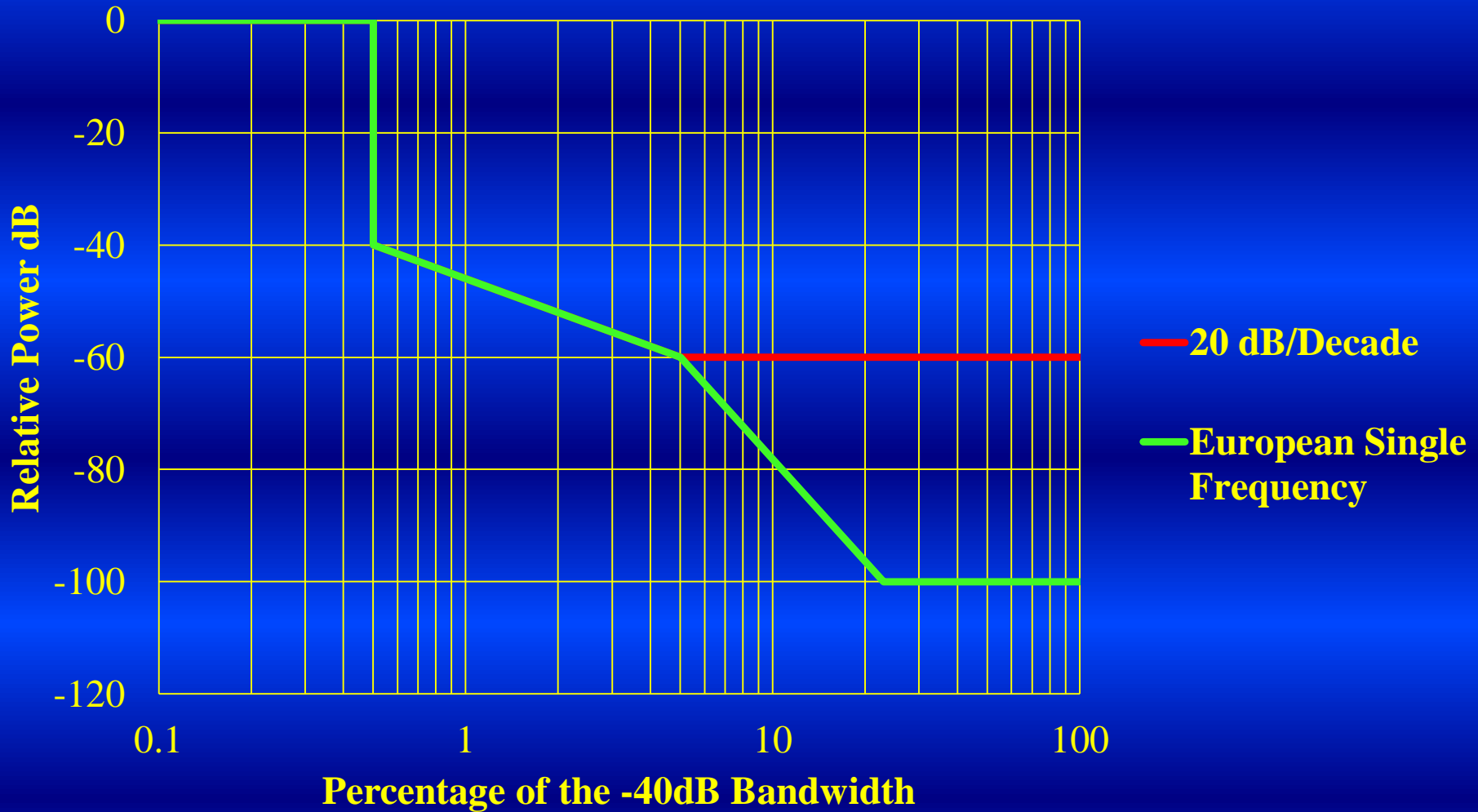
- Frequency bands available for the various services
- Whether those services are primary or secondary
- Restrictions on Use
- How to co-ordinate
- What constitutes
 - Necessary bandwidth
 - Unwanted emissions (spurious & out-of-band)
- How to define an Emission
- Levels of unwanted emissions



ITU Unwanted Emissions



European Emission Mask



Current International Activity



- Europe and ITU
 - Roll-Off
 - Can the roll-off rate be improved?
 - Can emissions be roll-off to a lower level?
 - Use of Absolute Levels
 - Should unwanted emission levels be defined in absolute terms?
 - If so how single or multiple levels?
(e.g. one for harmonics, second for quiescent noise)
- IEC
 - Update of the maritime radar certification standard IEC 62388

Radio Regulations Article 3.3



Transmitting and receiving equipment intended to be used in a given part of the frequency spectrum should be designed to take into account the technical characteristics of transmitting and receiving equipment likely to be employed in neighbouring and other parts of the spectrum, provided that all technically and economically justifiable measures have been taken to reduce the level of unwanted emissions from the latter transmitting equipment and to reduce the susceptibility to interference of the latter receiving equipment

Adjacent Band Broadband Compatibility Around 3 GHz

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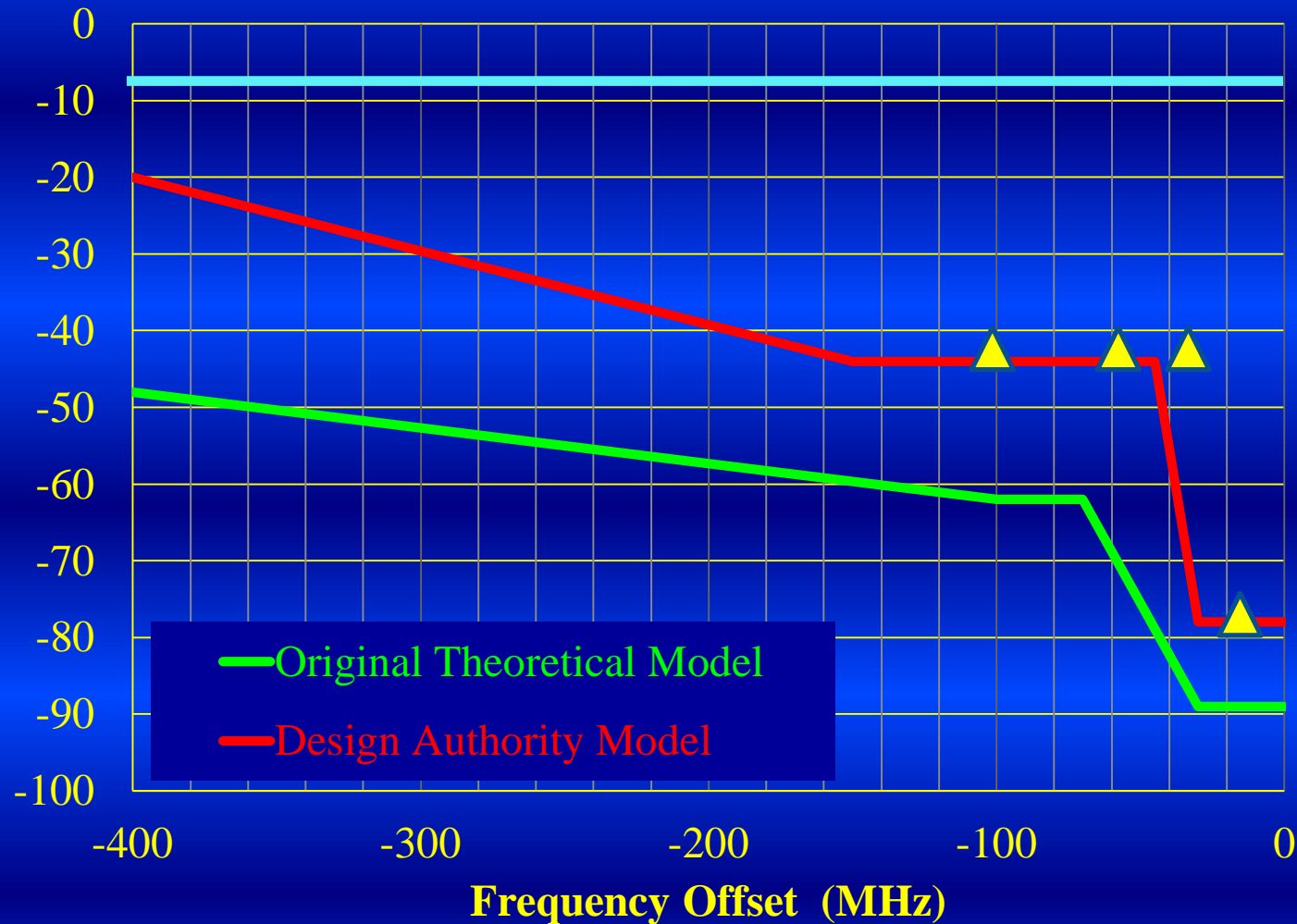


The Start

- 2500-2690 MHz Allocated Mobile Service (WRC-2000)
- EC Decision on Implementation
- Ofcom Draft Invitation to Tender (Spring 08)
- Radar Testing Using a TWT Watchman(Summer 08)
 - Measure out of band spurious
 - Interference to Radar
- CAA Shown the Test Results (Autumn 08)

Adjacent Band Susceptibility

1dB Compression Point as
Measured at the LNA Input



Interfering
signal at the
LNA
(Calculated)

▲ Measured
Data

Flight Trials Results

Interfering Signal	Equivalent Interference Level at the LNA Input	Probability of Detection	
		Normal Radar	Ground Clutter Filter
CW	Off	95%	90%
	-15 dBm	0%	19%
	-30 dBm	91%	82%
	-45 dBm	92%	76%
AWGN 10 MHz	-15 dBm	0%	
	-30 dBm	69%	65%
	-45 dBm	92%	
WiMAX 80%	-15 dBm	0%	
	-30 dBm	88%	
	-45 dBm	95.5%	

UK Approach for Resolution



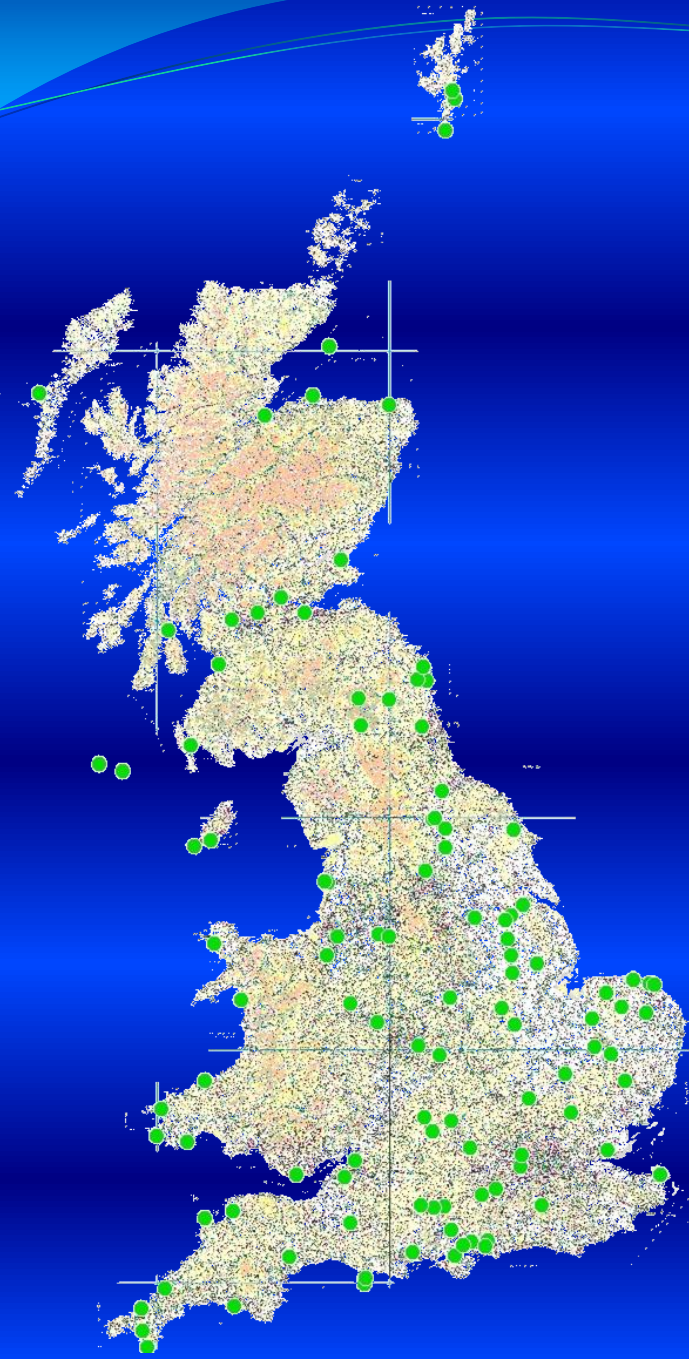
- Delay Sale and Roll out of LTE/WiMAX
- Aviation
 - Fund research into the definition of the issues to be resolved
 - Fund development of solution
 - Part fund implementation
 - Roll out of solution tailored to LTE/WiMAX roll-out
- Maritime
 - Assessment of whether there are any issues
 - MCA Carry out own investigation
- Military
 - Identify and resolve their own issues

Identified Issues

- Adjacent Band Suppression is Insufficient (≈ 40 dB disparity)
- That the 1dB Compression Point is not Defined by LNA
 - Solid State Radar ≈ -28 dBm previous -20 dBm
 - Older Radar ≈ -42 dBm previous -20 dBm
- WiMAX/LTE Regulatory limit for Unwanted Emissions Will Cause Interference (-30 dBm)
 - Base Stations can be regulated nationally
 - User Equipment needs change to international standards
- Need for Better Defined Radar Standards

Size of the Task

- 119 Land Based Radars
 - 43 Civil
 - 19 Solid State
 - 13 Magnetron
 - 11 TWT
 - 68 Military
 - 6 Air Defence
 - 62 Airfield & Other Cleared Sites
 - 8 Maritime
 - 1 Meteorological



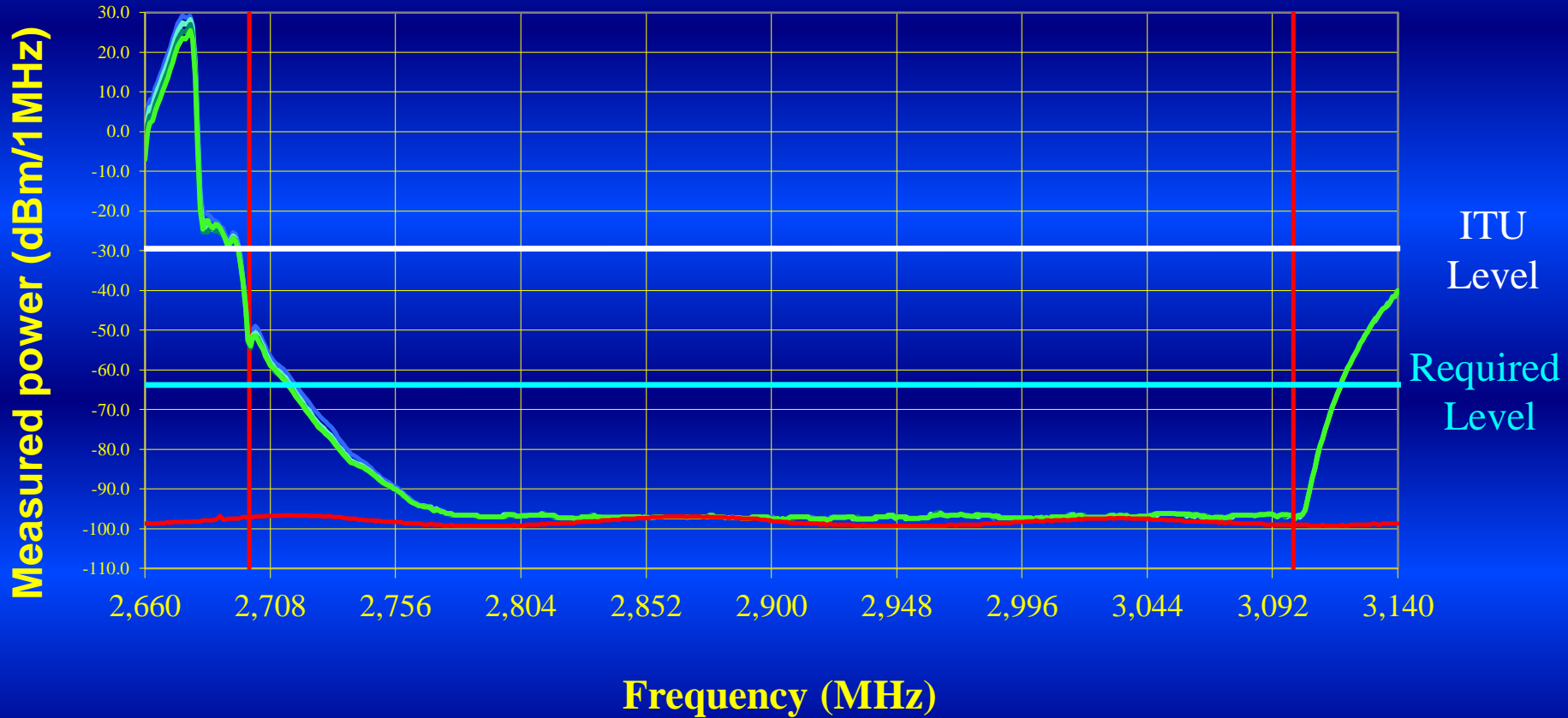
Example Adjacent Band Calculation

	LTE/WiMAX	
	Base Station	User Equipment
TX Power (dBm)	44	23
Multiple Base Stations/ Single Mask	15.8	12
Antenna Gain (dBi)	17	0
Free Space Path Loss for 1km (dB)	101	
Multipath Gain (dB)	6	
LTE Peak to Average Signal Ratio (dB)	14	
Polarisation (dB)	3	
Radar Antenna Gain (dBi)	34	
Receiver Filter Rejection (dB)	0	
Received Signal at LNA (dBm)	26.8	-15
1dB Compression Point (dBm)	-28	
Indicative Interference Margin (dB)	-54.8	-13

Example Out-of-Band Calculation

	LTE/WiMAX	
	Base Station	User Equipment
TX Power (dBm)	-30	-30
Antenna Gain (dBi)	17	0
Free Space Path Loss for 1km (dB)	101	
Multipath Gain (dB)	6	
IF Bandwidth Correction Factor (dB)	0.8	
Polarisation (dB)	3	
Radar Antenna Gain (dBi)	34	
Receiver Filter Rejection (dB)	0	
Received Signal at LNA (dBm)	-76.2	-93.2
Minimum Discernable Signal (dBm)	-112	
Indicative Interference Margin (dB)	-35.8	-18.8

LTE Measured Unwanted Emissions



Summary

- LTE/WiMAX Can Cause Interference
- Additional Radar Receiver Filtering Required
 - 40-50 dB additional suppression of the adjacent band
 - 2700 – 2740 MHz needs to be cleared
- LTE/WiMAX Unwanted Emission specifications needs to Be Tightened
- UK will Continue to:
 - Work with the International community on the Issue
 - Share Information Where Possible