Spectrum Allocation

An Industry perspective

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Issues

- Spectrum allocations for mobile
- Future developments in technology and the implications for mobile broadband – internationally harmonised spectrum and band plans
- How this relates to the use of UHF in Asia Pacific (698 to 806 MHz and the AWF/APT)
- The importance of the ITU and the need for an IMT Agenda Item at WRC 16



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The need for mobile broadband

- This relates to the cost economics of coverage – a base station and low cost devices is cheaper than laying fibre or upgrading copper local loop – all other things being equal
- But for mobile to be that delivery platform requires that the cost economics be as favourable as possible – to reach as many consumers as possible at the lowest cost to consumers

Region	*3G/Total wireless*[8]	*DSL/Total mainlines*[9]
East Asia & Pacific	18.3%	15.1%
Eastern Europe & Central Asia	10.1%	4.8%
European Union (EU-27)	44.3%	29.1%
Latin America & Caribbean	20.2%	4.0%
Middle East & North Africa	8.9%	6.2%
North America	21.0%	37.9%
South Asia	12.3%	0.2%
Sub-Saharan Africa	7.9%	4.6%
World	21.5%	12.8%

Table 2: Broadband connections relative to voice telecommunications connections (percent), December 2008

wireless data growth in the World Bank

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Why Spectrum is important

- Need to ensure that there is enough spectrum to meet demand – Capacity – various ways to meet capacity such as :
  - Cell splits or Pico cells (higher cell density)
  - Higher spectrum efficiency – GSM/EDGE to UMTS to HSPA to LTE R8 to LTE R10
  - More spectrum

- FCC paper Mobile Broadband: The Benefits of additional spectrum - Oct 10 http://www.fcc.gov/Daily_Releases/Daily_Business/2010/db1027/DOC-302324A1.pdf

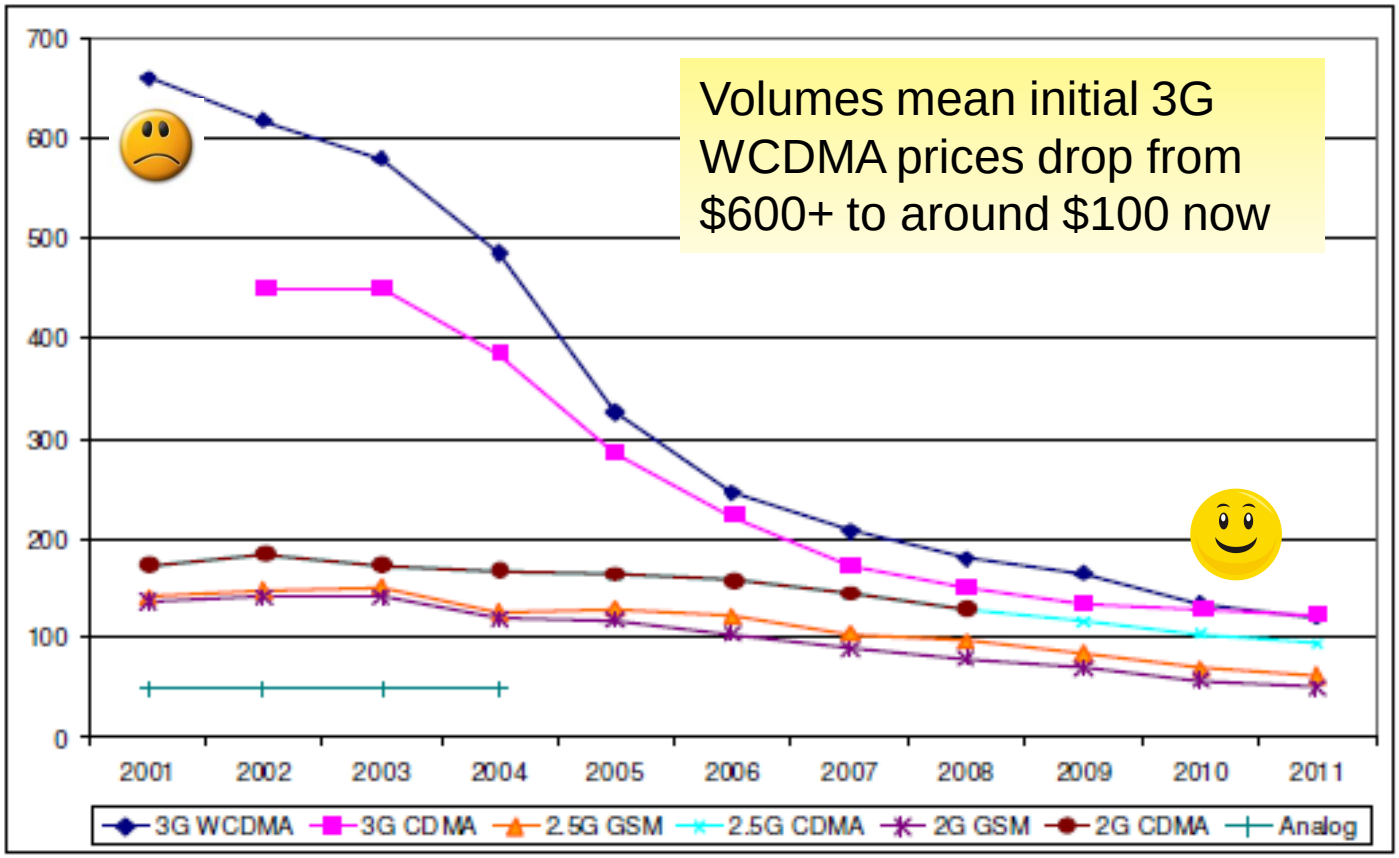
- Benefits of extra spectrum in US of around $100bn over the next 5 years – assuming a baseline of 170 MHz . But 547 MHz available in US can possibly be used under current rules.

- This *170 MHz vs 547 MHz* highlights the impact of harmonisation on device costs and ***usable spectrum***

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Impact of Economies of Scale on device costs

Figure 4: Average selling price for handsets (ASP)



Volumes mean initial 3G WCDMA prices drop from $600+ to around $100 now

Source: LECG analysis of data from Strategy Analytics and Yankee Group.

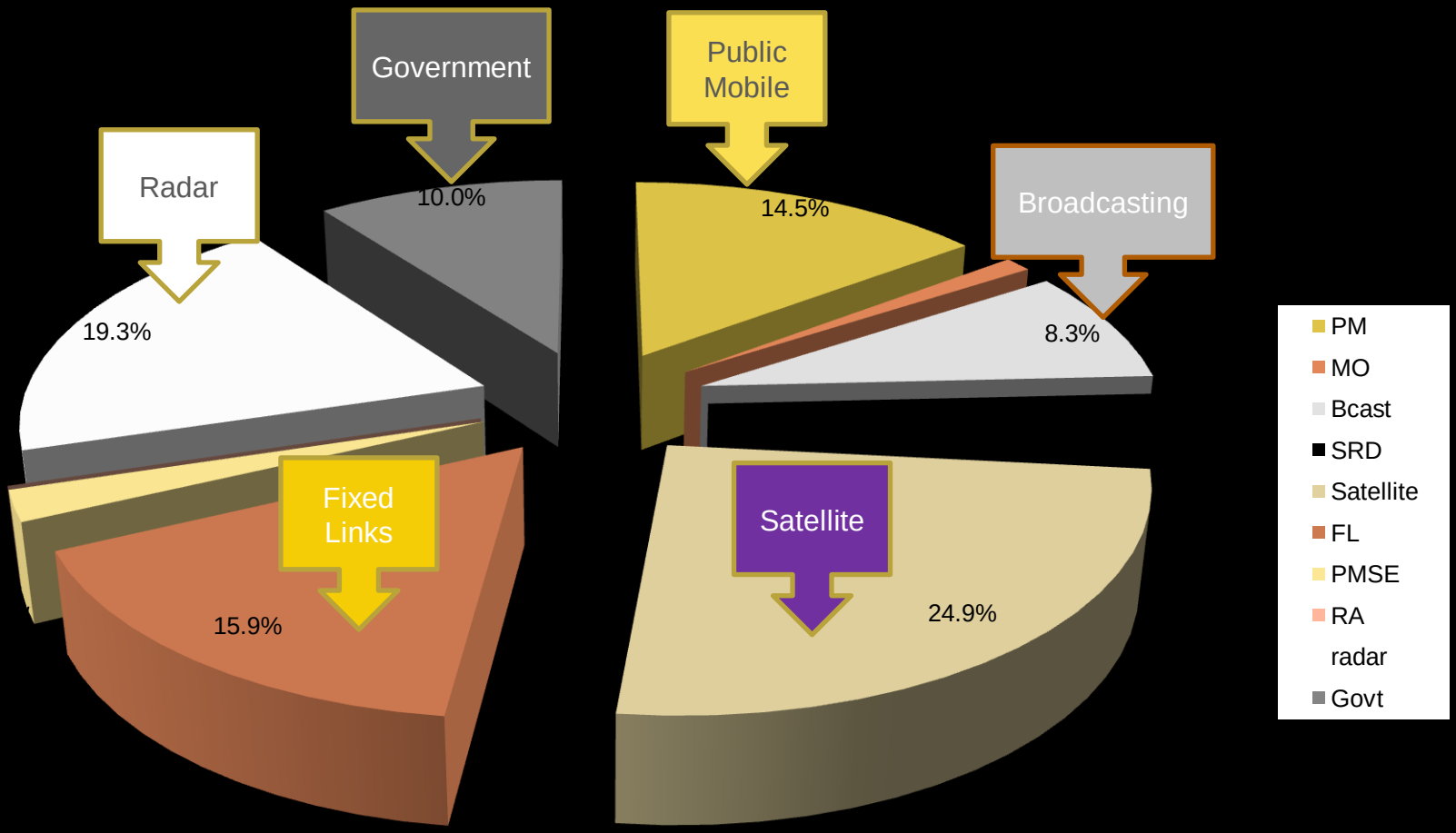
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How is spectrum allocated between various services

- Three example countries in prime bands – 400 MHz to 5 GHz:
  - Malaysia
  - UK
  - US

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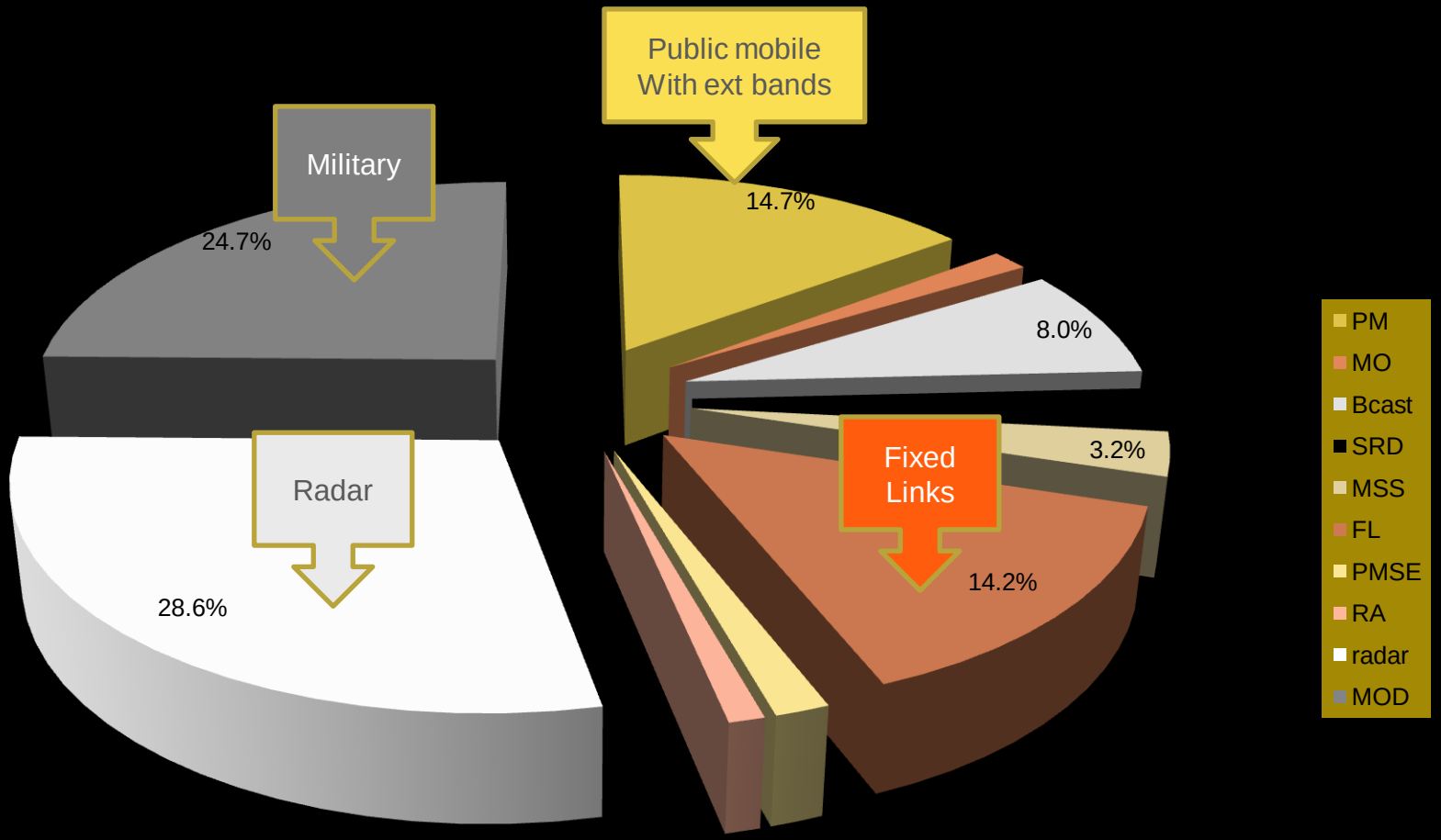
Spectrum use in Malaysia – 400 MHz to 5 GHz



14.5% to mobile, but this includes 2.6 GHz extension band, currently used for BWA – without this only 10.2%

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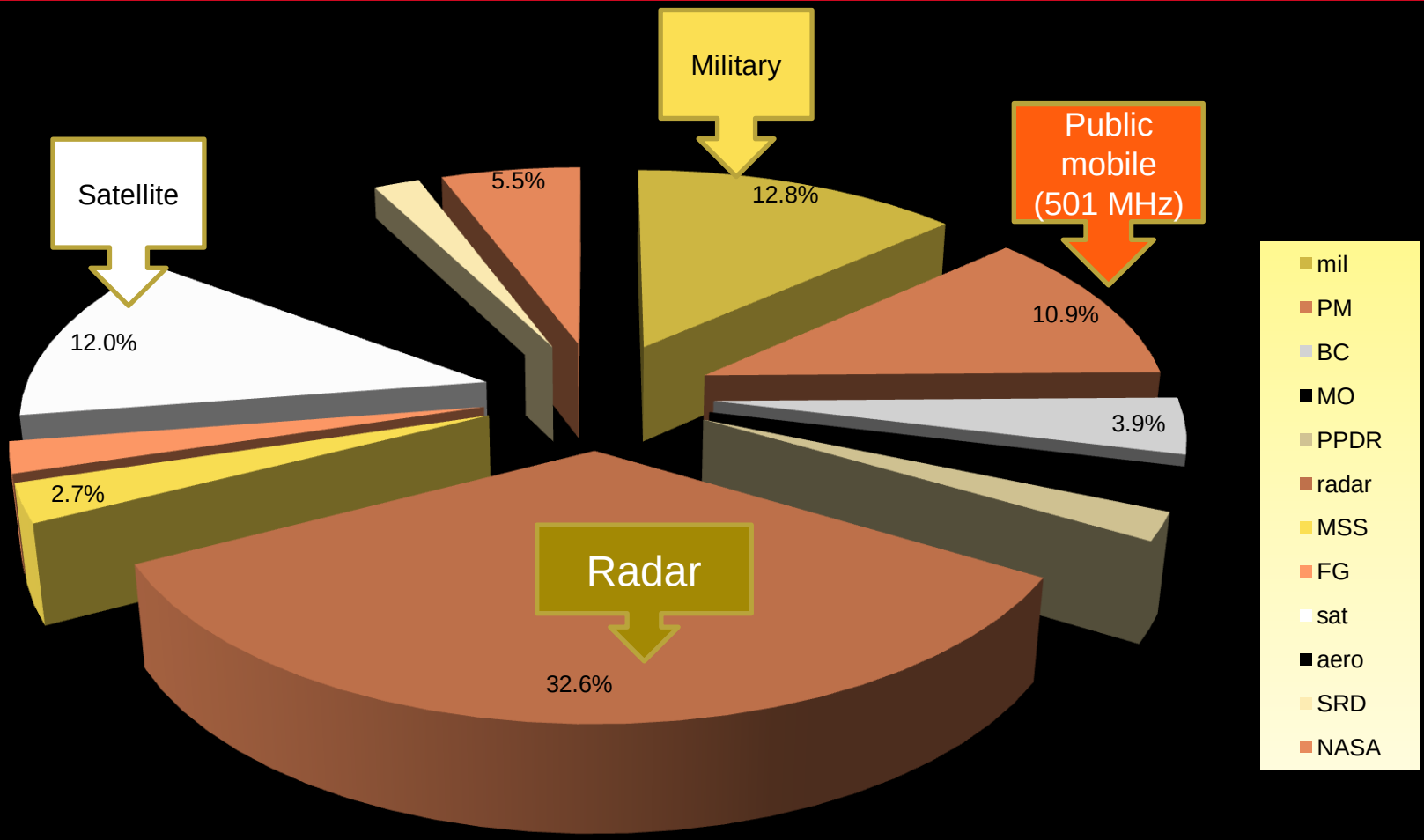
UK Spectrum use 400 to 5000 MHz



14.7% to mobile, but this includes 2.6 GHz extension band, currently not available for mobile – without this only 10.3% - **this 10.3% generates 50% of the economic benefit of all spectrum use in the UK**

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Spectrum use in the US – 400 to 5000 MHz



Over 500 MHz identified for mobile – but most of the traffic on 170 MHz spectrum according to FCC paper

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US National Broadband Plan identifies future spectrum

Exhibit 5-E: Actions and Timeline to Fulfill 300 Megahertz Goal by 2015

Band	Key Actions and Timing	Megahertz Made Available for Terrestrial Broadband
WCS	2010—Order	20
AWS 2/3[61]	2010—Order 2011—Auction	60
D Block	2010—Order 2011—Auction	10
Mobile Satellite Services (MSS)	2010—L-Band and Big LEO Orders 2011—S-Band Order	90
Broadcast TV[62]	2011—Order 2012/13—Auction 2015—Band transition/clearing	120
Total		300

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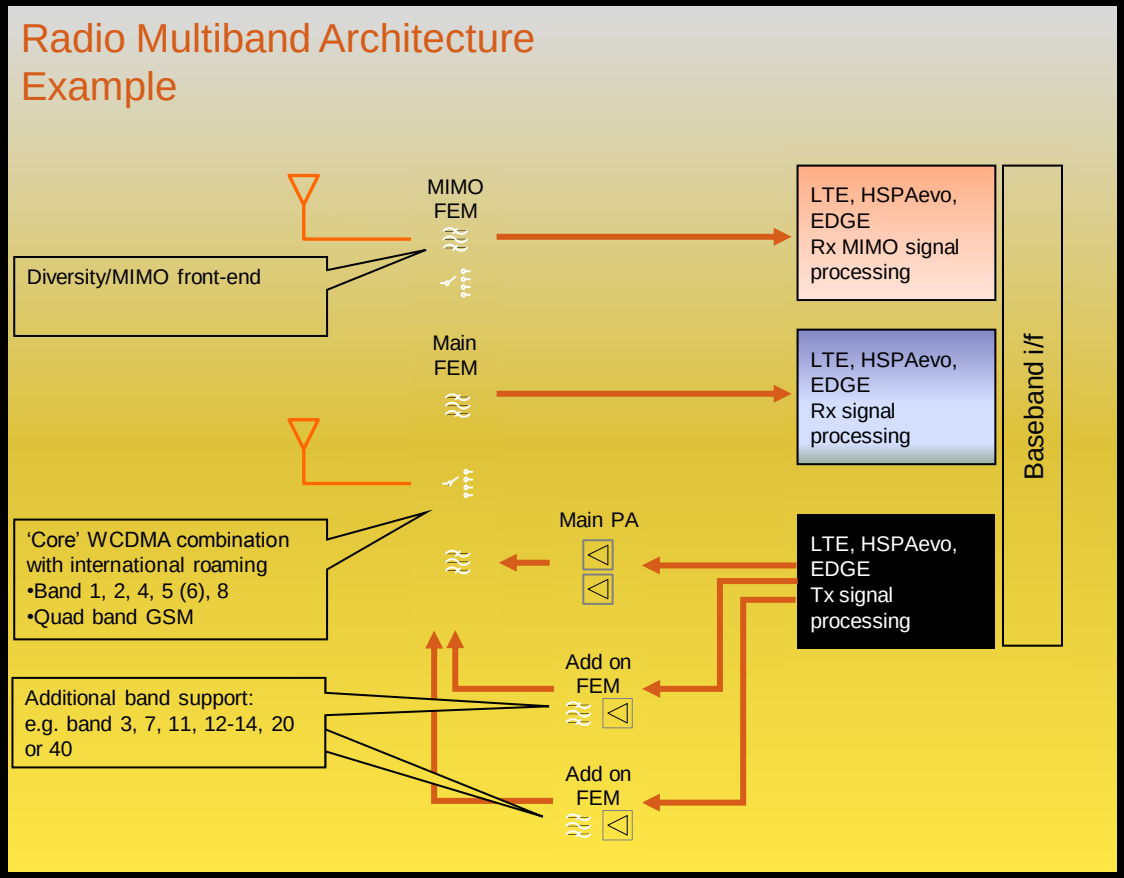
How does current technology add new bands

Current and foreseeable handset technology needs a new RF front end per band . This need for separate analogue components with high selectivity (Q) factor means that the number of bands that can be supported is limited.

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Why international harmonisation matters

- Because of the need for analogue components in the RF chain, effectively means a new RF front end module per frequency band. But this is complex and can impact on RF performance (as well as costs).



Number of bands a handset can support is limited.

As the number of bands goes up the RF efficiency goes down.

Every new FEM adds to complexity

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Impact on quality of service

Static Sensivity dBm	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	
-110													
-109													
-108													
-107								X	X				
-106							X			X		X	
-105						X					X		X
-104					X								
-103				X									
-102			X										
-101		X											
-100	X												

Volume Based Performance Gains*
typically 1 dB per year

Introduction of smaller form factor phones, dual band, tri-band, direct conversion.

Intro-duction of GPRS

Sources: Ad Hoc measurements by RTT.
Industry sources 1992 to 2000.

The gain historically has been 1 dB per year : or 17% more sites for the same coverage !!

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How frequency bands are fragmenting

FDD

Band	"Identifier"	Frequencies (MHz)
1	**IMT Core Band**	1920-1980/2110-2170
2	**PCS 1900**	1850-1910/1930-1990
3	**GSM 1800**	1710-1785/1805-1880
4	**AWS (US & other)**	1710-1755/2110-2155
5	**850**	824-849/869-894
6	**850 (Japan)**	830-840/875-885
7	**IMT Extension**	2500-2570/2620-2690
8	**GSM 900**	880-915/925-960
9	**1700 (Japan)**	1750-1785/1845-1880
10	**3G Americas**	1710-1770/2110-2170
11	**UMTS1500**	1428-1453/1476-1501
12,	***US 700***	*698-716/728-746*
13,	***US 700***	*776-788/746-758*
14	***US 700***	*788-798/758-768*
17	***US 700***	*704-716/734-746*

TDD

Band	"Identifier"	Frequencies (MHz)
33,34	**TDD 2000**	1900-1920 2010-2025
35,36	**TDD 1900**	1850-1910 1930-1990
37	**PCS center gap**	(1915) 1910-1930
38	**IMT extension center gap**	2570-2620
39	**China TDD**	1880-1920
40	***2.3 TDD***	*2300-2400*

Additional FDD and TDD		
	3.5 GHz	*3400-3600*
	3.7 GHz	*3600-3800*
	Additional FDD	
	800 MHz	*790-862*

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Digital Dividend

- A practical example of the importance of frequency harmonisation

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Effect of frequency on range and capex

Coverage of rural areas at about 30% of the cost of 2100 MHz

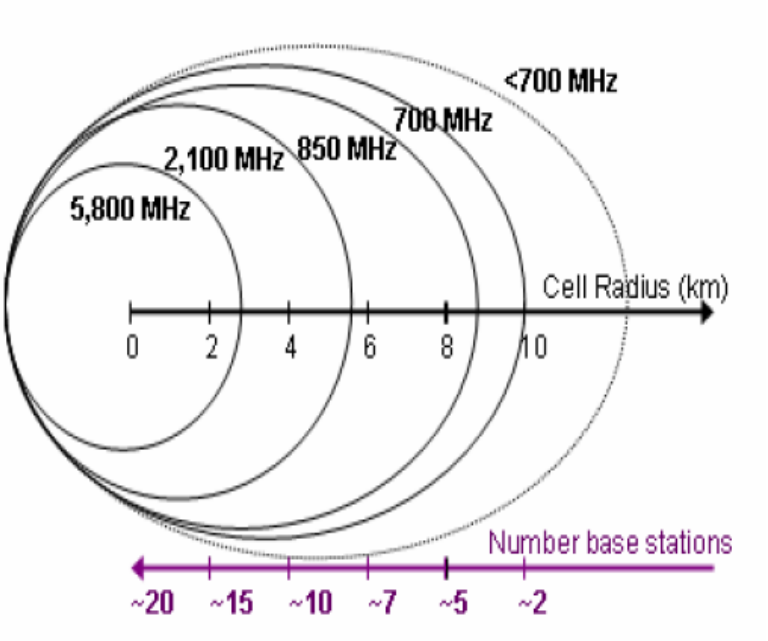
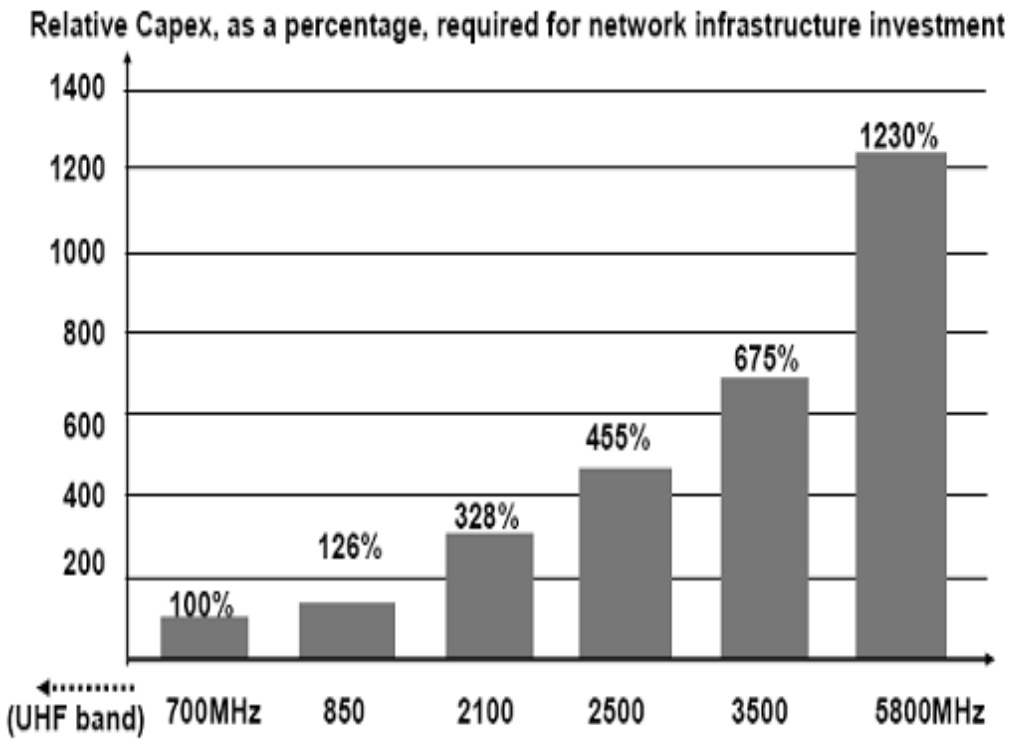


Figure 2. The propagation characteristics of spectrum

Source: BBC R&D.



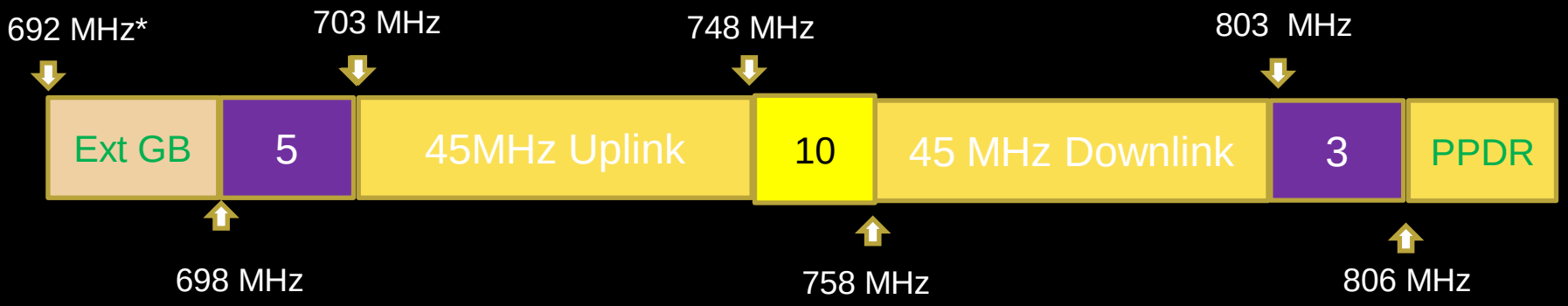
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UHF and Digital Dividend

- To ensure cost effective coverage in rural areas and will be required to boost mobile broadband coverage
- The initial bands (72 MHz in Europe and 108 MHz in US) may not be enough and more spectrum may be required in the longer term
  - US national broadband plan has identified 120 MHz more UHF from broadcasting
  - Study by EU Commission suggested that extending the band to 698 MHz may offer the best outcome for consumers and economic well being
- Figures vary but the impact on capex in rural areas can be around a 70% saving on 2 GHz core bands – 3dB link budget advantage

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AWF/APT and Digital Dividend – 2 x 45 MHz FDD



Internal guard band

Centre Gap

Ext GB

external guard band with broadcasting

*692 MHz due to China – PRC Broadcasting plan

Source AWF9-/OUT-13 – Seoul Sept. 10 (also includes a TDD option)

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AWF process importance to UHF band plan

- With support from Asia-Pacific (over half world's population) it has enough scale to drive down costs
- The GSMA understands that China has a preference for the inclusion of a TDD band
- In general the industry has a preference for FDD in this band (as it has a preference for TDD in 2.3/2.4 GHz band)
- Indian submission to AWF has noted the benefit of FDD in this band for improved rural coverage (*AWF-7/INP-47 (Rev.1)*)**.**
- Support for the AWF band UHF plan/s will boost the chance of success in achieving the necessary economies of scale.
- Without support from R3 Administrations ,the danger is fragmentation and that only US or EU (FDD) equipment will be available.
- **An AWF FDD band plan may advantage R3 manufacturers**

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WRC12 and WRC16 – GSMA objectives

- New Agenda item for approval at WRC12 to be discussed at WRC16

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WRC and more IMT Spectrum

- GSMA proposes that an Agenda item for WRC16 on IMT spectrum
- Specifically for WRC12 Agenda Item 8.2, that for the WRC 16 agenda : **"*To consider the frequency bands identified for IMT with a view to rationalising, consolidating, and expanding these as appropriate, with the objective of achieving internationally harmonised bands, preferably on a global basis.*"**
- GSMA has submitted this to CEPT (PTA) and is developing a draft resolution, and will submit a proposal to APG in December as well as to other regional groups, and has been proposed in Citel
- GSMA and industry generally believes that WRC12 needs to ensure that there is an Agenda item for WRC to consider the issue

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Why the industry believes this is needed

- Mismatch between bands in some regions (R1 UHF 790-862 MHz and R2/R3)
- Complex structure of footnotes and rules
- More spectrum may well be required for mobile in the time frame of the year 2020 (when WRC16 identification may become available nationally)
- The industry is undertaking studies to look at demand and supply factors on spectrum (technology, regulation, and demand curves)
- GSMA believes that a number of R3 countries might support such a proposed Agenda Item.

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Conclusion

- Spectrum is important factor in costs of supplying mobile broadband
- Not only the amount of spectrum, but where it is in the band and the number of countries that will support it
- Strong signals from Administrations (WRC/AWF etc) are required to provide the stimulus for industry to commit to development costs
- The current and likely future design of RF kit (especially handsets) will limit the number of bands and air interfaces that can be supported
- This ***band aggregation*** issue, means that bands need to “compete” for space in handsets

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