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# How to build a mobile DVB-H TV network

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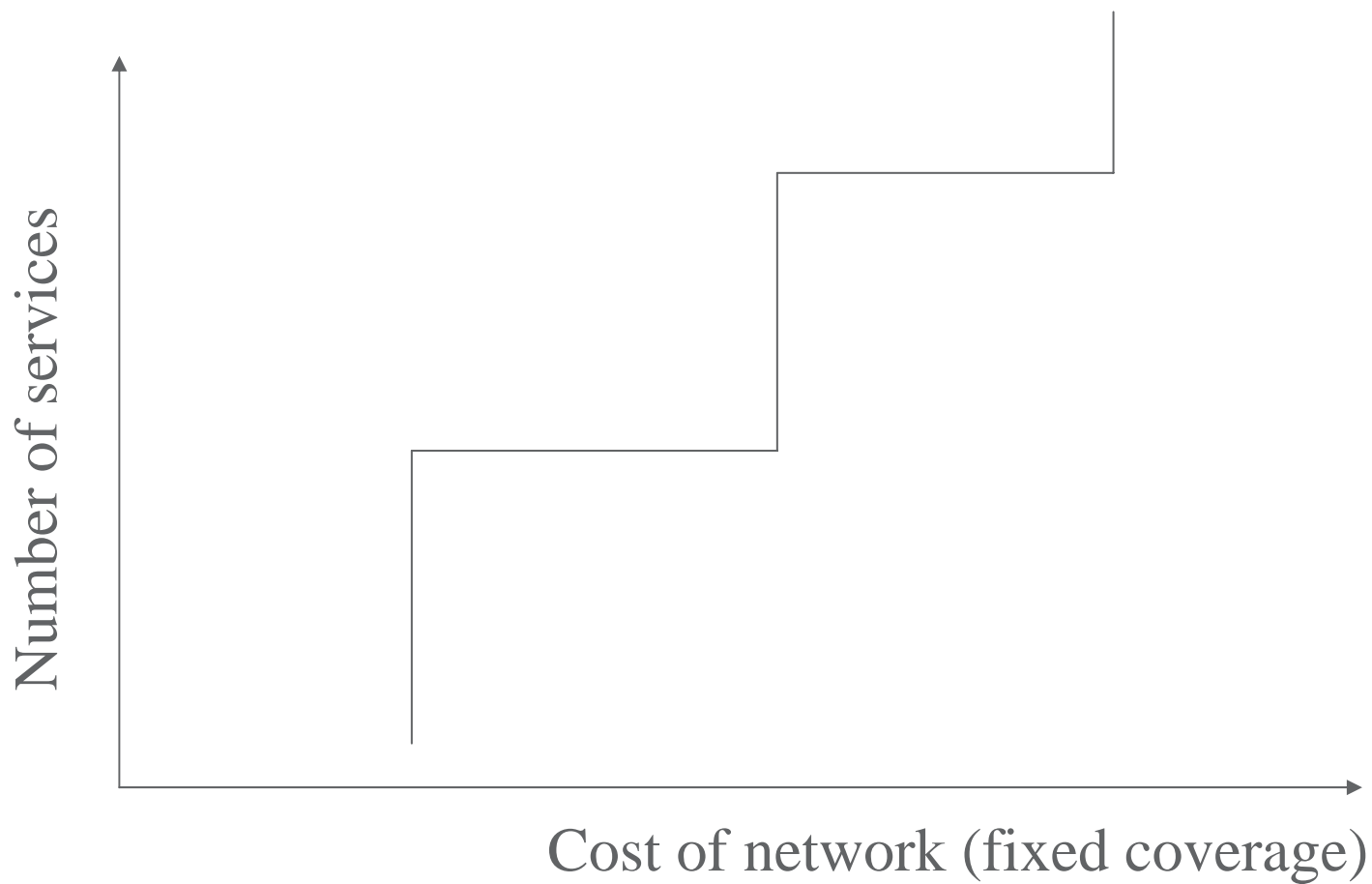
# Topics for today

- What parameters need to be understood to design a mobile TV network?
- Number of live streams v cash and carry
- Cost trends
- Regulation
  - Auctions
  - Sharing spectrum
- Spectrum
  - Propagation
  - International co-ordination
  - DVB-H and single frequency networks
- Target Devices
- Coverage
- Roll out speed
- Conclusions

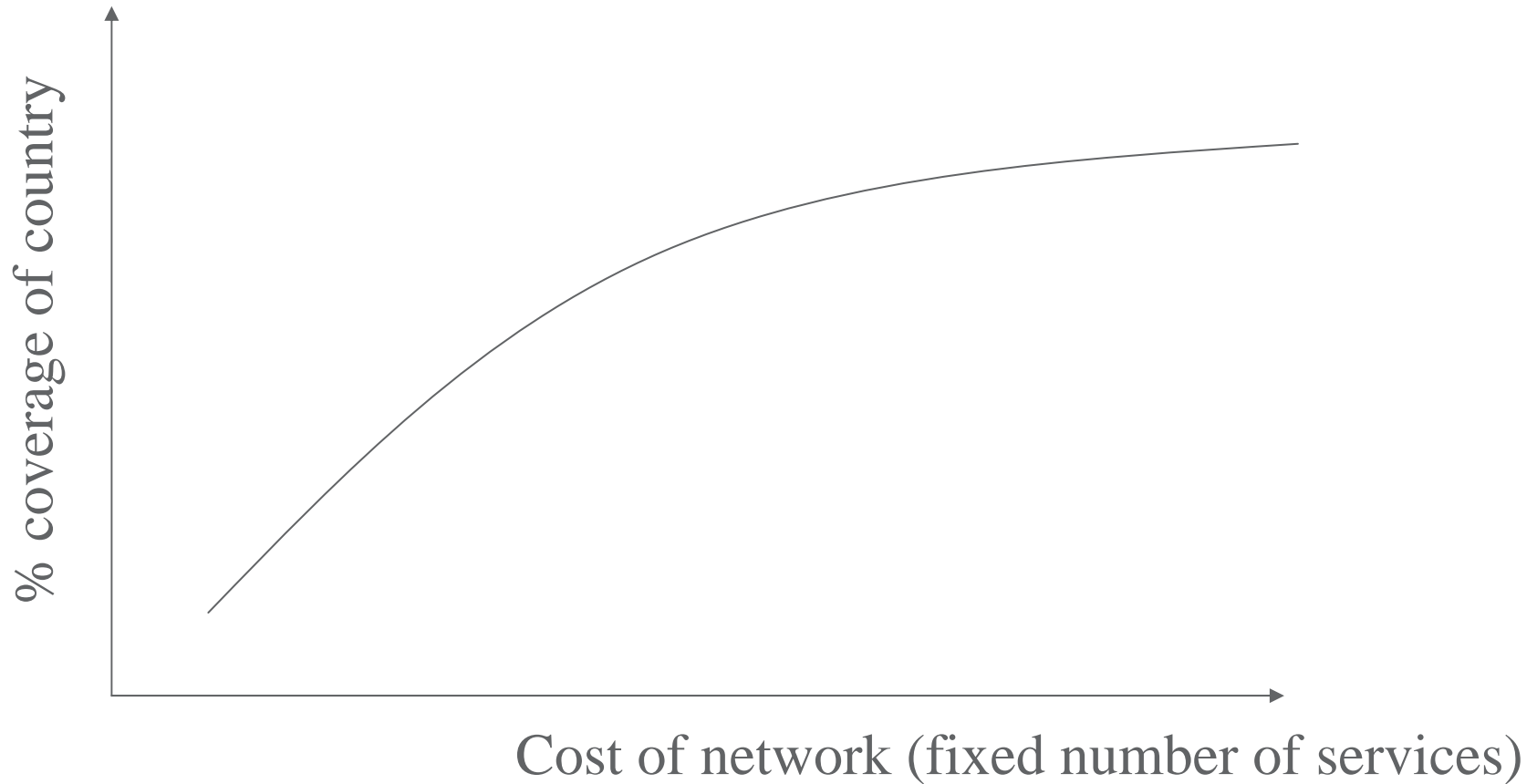
# Number of services

- How many live streams do you need to keep 90% of the population happy for 90% of time?
  - Everyone has a different view
- From Arqiva trials we believe that over time that the number of live streams will drop as the consumer becomes more and more comfortable with cached content
- Cached content will come in different forms:
  - Broadcast push over mobile TV networks
  - Consumer pull over 3G and WiFi networks
  - Taking content from the home store
- Arqiva believes that the number of live streams to launch an optimum service needs to be 10 or more.
- The more streams required has a direct relationship on spectrum required for the service.

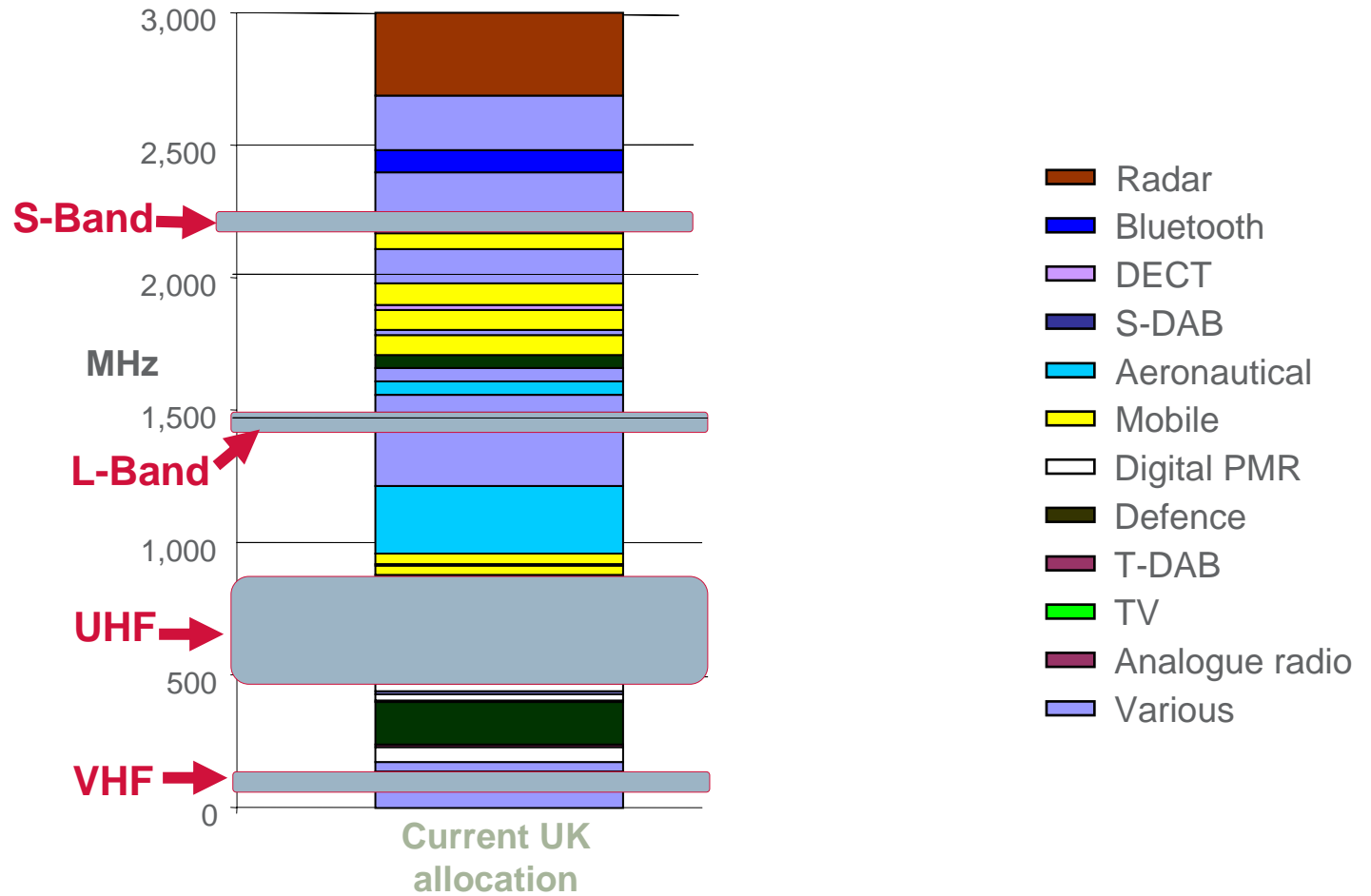
# Business model



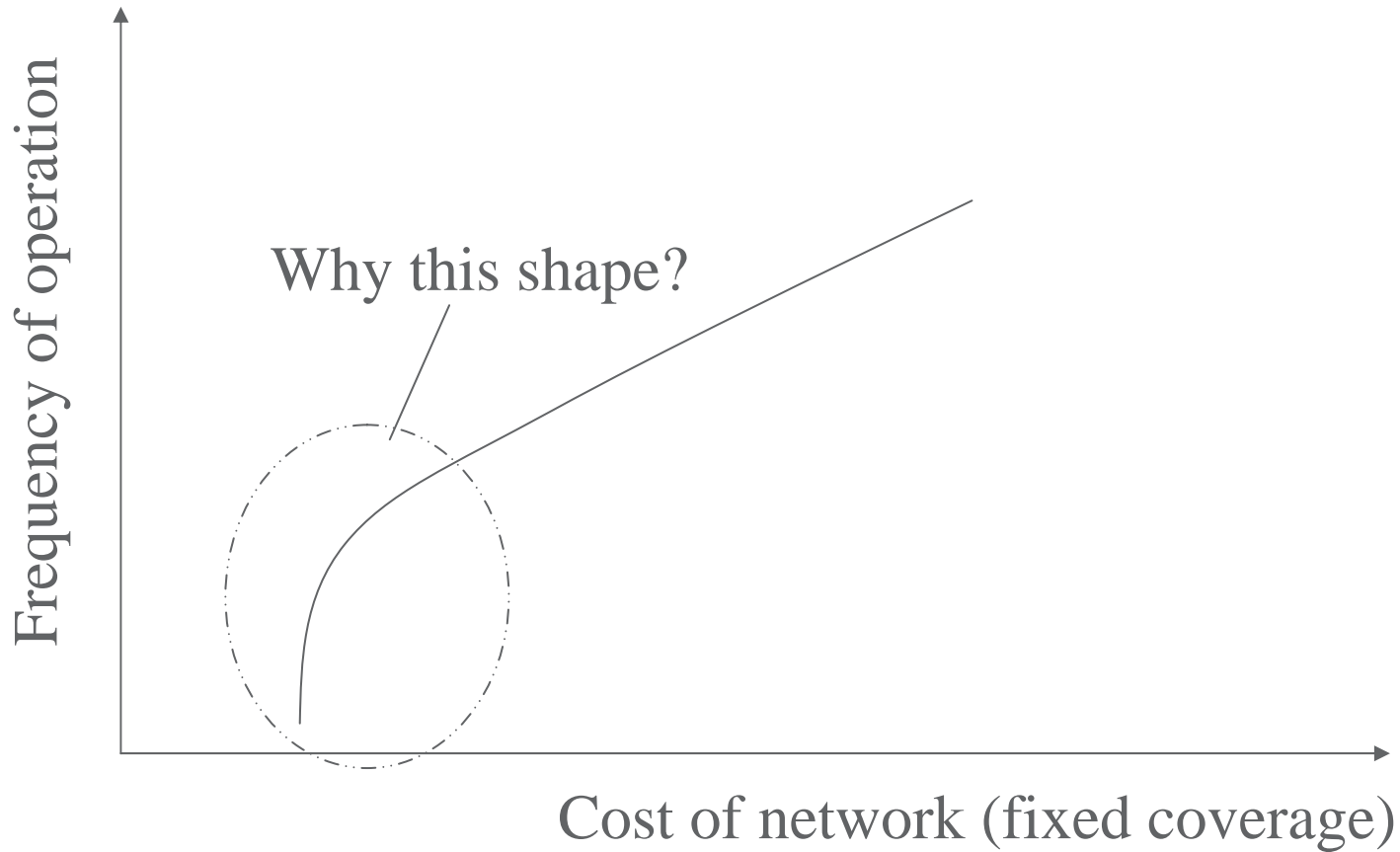
# Business model



# Spectrum for mobile TV

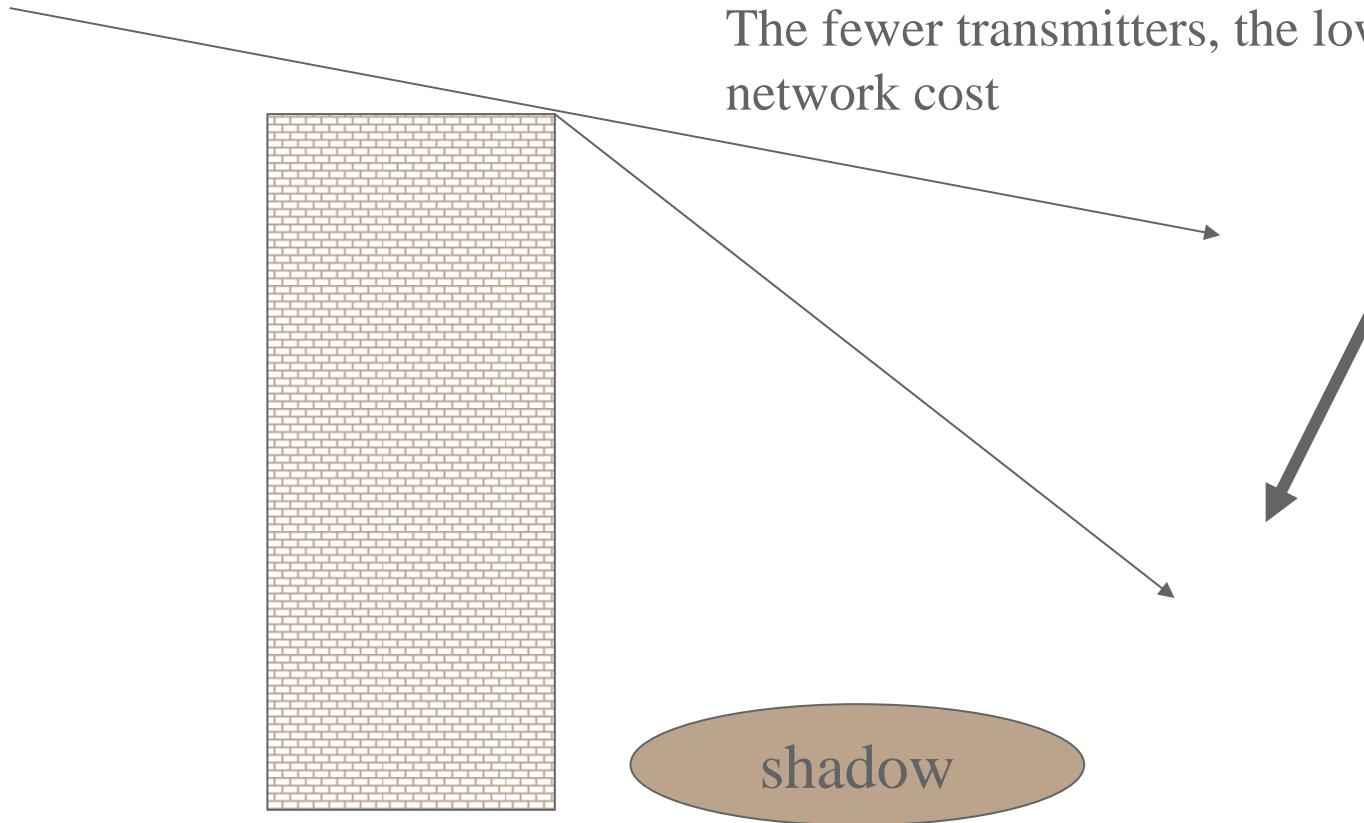


# Business model

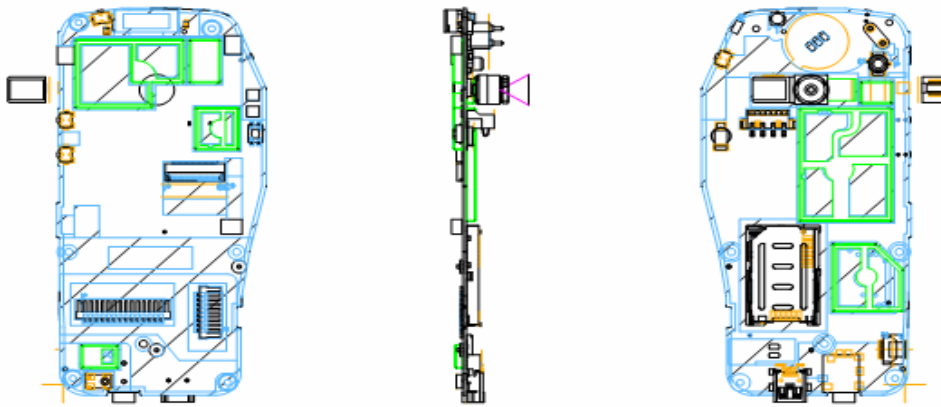


# Diffraction

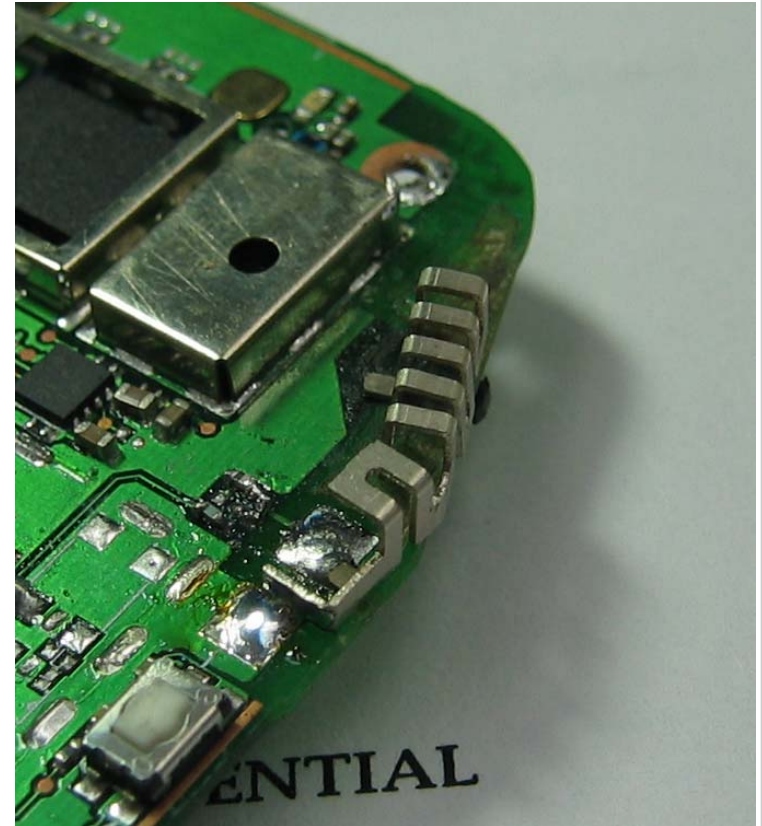
The lower the frequency  
the more bending the less shadow  
The fewer transmitters, the lower  
network cost



# Antennas in handsets



For hand held devices VHF antennas can not be integrated at a reasonable antenna gain.



# Channel band width

- Spectrum is broken up into channels
- UHF in Europe is on an 8 MHz channel raster
- VHF in Europe is on a 7 MHz channel raster
- L-band in Europe is on a 1.7 MHz channel raster
  - In the UK Ofcom are considering allowing triples so allowing 5 MHz channels
- DVB-H can work in 5, 6, 7 and 8 MHz channels.
- The number of video services is directly proportional to channel band width

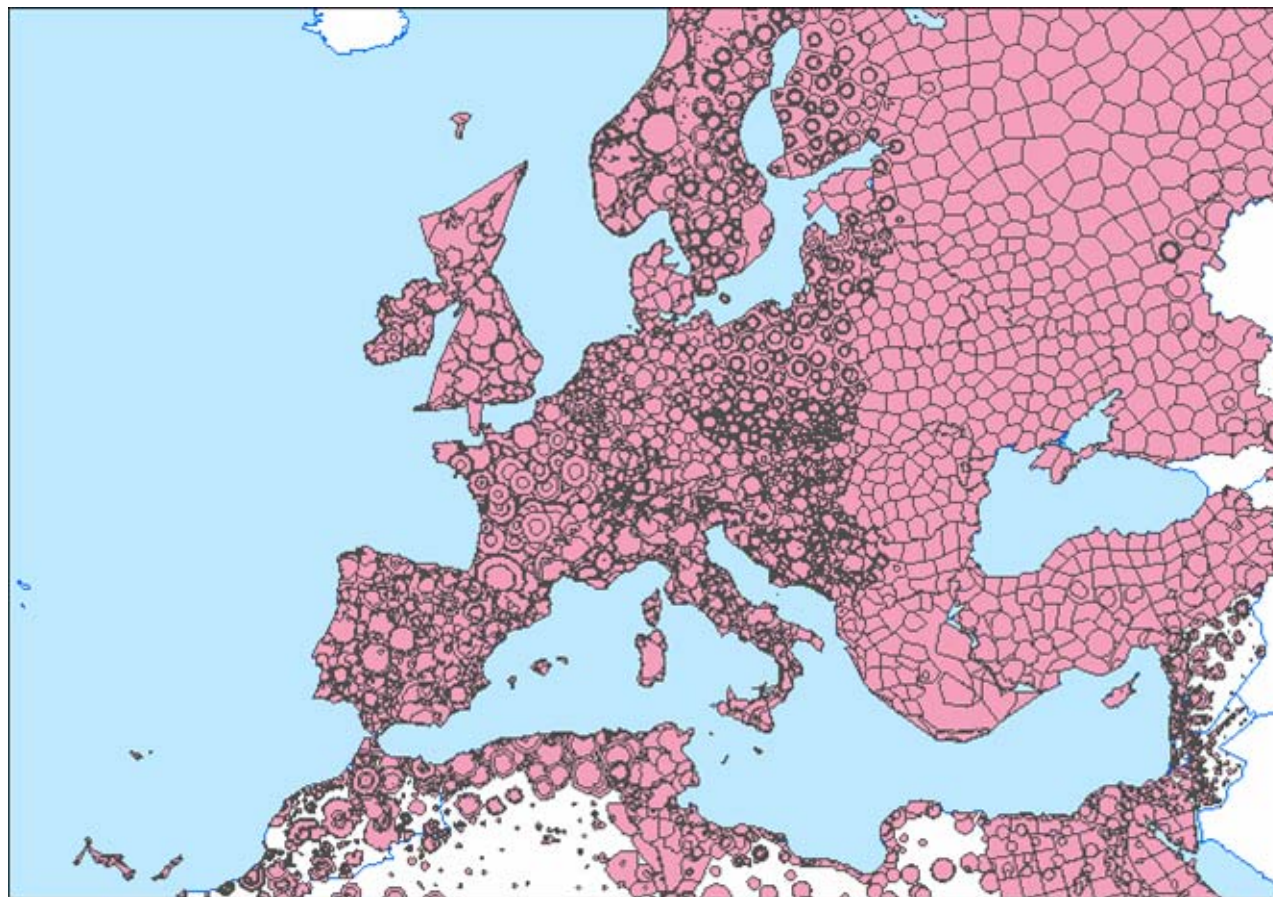
# Video services v channel bandwidth

Channel size MHz	Number of 256 kbits/s video services
5	10
6	12
7	14
8	16

# Regulation

- In the UK Ofcom are selling spectrum to the highest bidder
  - Technology neutral
- There are issues
  - How is interference managed?
  - How can different technologies share the same band?
  - Broadcast (uni directional, down link only) does not sit well with bi directional technologies (up link and down link)
  - How can you bid for spectrum if you can not work out the investment (capital cost) ?






# Allotments & Assignments (International co-ordination)

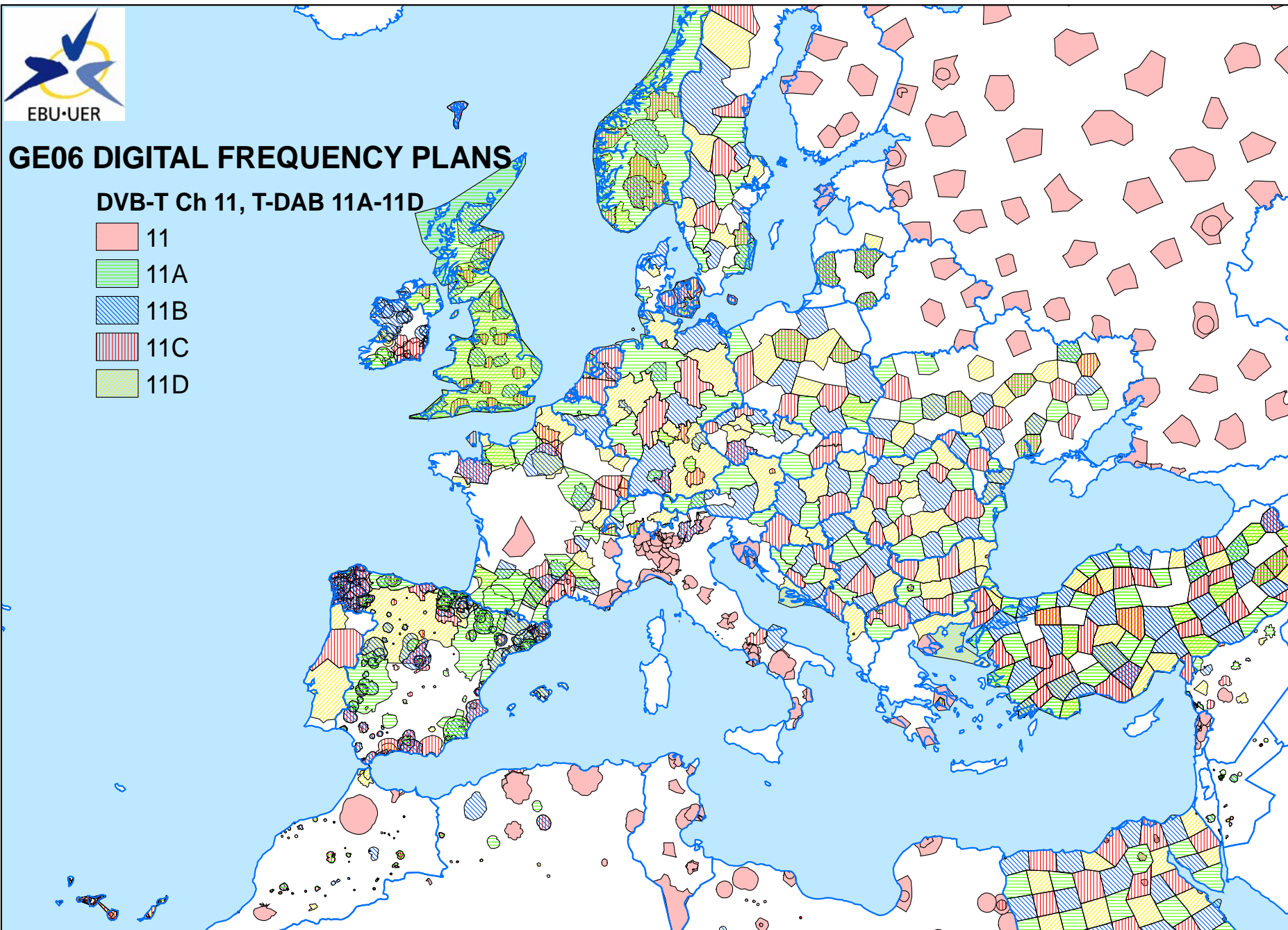




# GE06 DIGITAL FREQUENCY PLANS

DVB-T Ch 11, T-DAB 11A-11D

-  11
-  11A
-  11B
-  11C
-  11D



# International co-ordination

- If the constraints on outgoing power are high due to a neighbouring territory using the same frequency there are two basic strategies
  - Put transmitters close to the border with very directional antennas firing away from the boarder
  - Or build a network with low power low height transmitter sites
- Both options put additional cost on the network build
- The other issue that needs to be considered is how much interference will come in from neighbouring territories and the impact on the coverage of the network.
  - The more interference the greater the reduction in coverage

# DVB-H and single frequency networks

- All modern digital broadcast systems have the ability to put multiple transmitters on the same frequency. This is known as a single frequency network or SFN.
- In AM and FM this is not possible because the transmitters interfere with each other and 'mush areas occur' where there is signal from both transmitters but the receiver can not decode it.
- With DVB-H transmitter can co-exist on the same frequency and where the signals overlap they add together and the receiver can decode them.
- This has a significant advantage in saving spectrum and allows networks to be built with very tailored coverage specifically around boarder areas or targeting areas of high population
- To do this a common time and frequency reference is required the best way to do this is using GPS.
- Only draw back of SFNs if too much radiated power is used it may go too far and cause self interference in the network

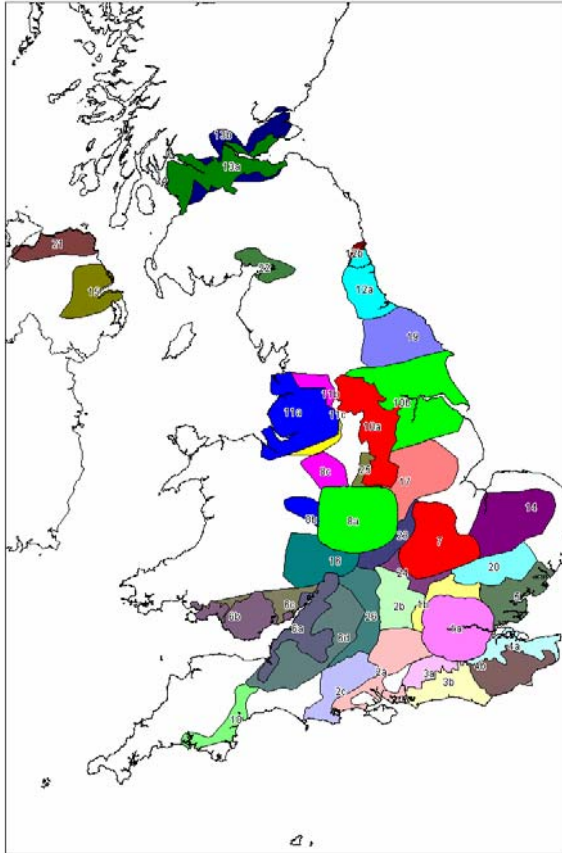
# Target Devices

- You must know your device
  - Screen size of the device is directly proportional to the bit rate required to keep the video quality constant
    - Bigger the screen the more pixels, the higher the video bit rate
  - Antenna performance
    - The lower the antenna performance the more power need in the transmitter network, the greater the capital investment
  - The more technologies in the device, the more difficult to make a device with a low noise figure, the higher the noise figure the higher the power required in the transmitter network

# Coverage

- Where are people going to watch mobile TV?
  - Outdoors or indoors?
  - If indoors do you expect it to work everywhere?
  - Will it work on the train? Or in the car?
- If you want it to work indoors you will need 20 times more power (13dB) with respect to just working outdoors
- What percentage of the territory do you want to cover?
- Can you cover close to the border with other countries?
- Do you need more than one frequency to get country wide coverage?
- Is there enough spectrum?

# Target population



Phase	Area	Total Population Census 2001	Cumulative Population	Cumulative %UK	%UK
1a	London	9462397	9462397	16.1%	15.3%
8a	Birmingham, Wolverhampton, Stafford, Lichfield, Leicester, Coventry, Rugby, Bromsgrove, Kidderminster	4616010	14078407	23.9%	22.7%
11a	Northwest England	5770807	19849214	33.8%	32.1%
10a	Leeds and Bradford	4705597	24554811	41.8%	39.7%

# Indoor coverage

- To achieve indoor coverage the mobile TV network will use roof top sites in the urban and sub urban areas to achieve coverage in people homes and offices
- How many locations does the device have to work?
  - Everywhere?
  - Or will the user accept having to walk toward the window to make it work?
  - The same coverage as a mobile phone network?
    - 90% locations?
    - 99% locations?
    - The higher the value the more cost in the network

# Roll out speed

- There will be effects on roll out speed depending on the frequency of operation.
- This depends on how quickly the spectrum is cleared for the new use of mobile TV.
- In the UHF band this is driven by the speed of digitalisation for terrestrial TV.
- If this goes slowly, the released spectrum (digital dividend) may not become available until 2015 and then either other technologies or other spectrum will have been used for mobile TV.

# Link budget

		DVB-H L Band	DVB-H L Band
		QPSK 1/2	16 QAM 1/2
Technology	C/N (Ped channel)	8.5	14
Receiver	Thermal Noise floor	-174	-174
	Signal Bandwidth (3dB)	4.75	4.75
	Noise floor	-107.2	-107.2
	RX Noise figure	7	7
	Injected sensitivity	-91.7	-86.2
Antenna	Antenna Gain	-4	-4
	Self induced EMI margin	2	2
Radiated sensitivity	Radiated sensitivity	-85.7	-80.2
	Field strength	55	61

## Planning criteria

Height Loss (dB)	20
Standard deviation (dB)	8.14
Percentage locations	90.0%
Location variation (dB)	10.4
Building penetration loss (dB)	14.0

## Planning criteria [2]

Tech	Mode	C/N (dB)	Min FS (dBuV/m)	Planning FS (dBuV/m)
DVB-H	QPSK 1/2	8.5	55	99.43
DVB-H	16QAM 1/2	14	61	105.43

# Conclusion

- Decide on the number of services and the video quality, each piece of spectrum has a different channel bandwidth so allowing a different number of services
- Know your receiver and its performance
- Where is your target market going to receive your service
- What will your consumer accept with respect to video quality and the number of locations where the device will work inside a building? Both will drive up the cost of the network or reduce the number of services
- What are the constraints on the frequency?
  - Internationally
  - Adjacent to you in your country
  - Co-channel in your country
- SFNs allow the same frequency to be used by transmitters in the network but do not 'shout too loud' (not too much power) or the network will self-interfere.



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Thank you [simon.mason@arqiva.com](mailto:simon.mason@arqiva.com)

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