

Question 12: do you agree with our assessment that nine SD services can operate on Multiplex 2? If not, do you have an alternative proposal?

Summary

- The current configuration of Multiplex A is similar to how Ofcom is proposing that Multiplex 2 be re-configured
- In order to carry nine SD services on Multiplex 2 (including Five and S4C) video bitrates may need to be 14% lower than those currently used on Multiplex A
- This would require a very optimistic improvement in encoder efficiency, especially as Multiplex A already uses long GOPs for most services
- The BBC service displaced from Multiplex B would need to be allocated a higher bitrate than other services on Multiplex 2 to avoid quality loss
- Blind viewing tests should be undertaken to ensure any changes to Multiplex 2 do not result in lower picture quality

Alternative assessment

Ofcom's assessment is based on extrapolating of the efficiency improvements that might be expected if longer GOPs and a bigger stat-mux pool were used on Multiplex 2. I propose a simpler assessment which compares the current configuration of Multiplex A with Ofcom's proposed configuration for Multiplex 2.

Multiplex A is currently configured with a nine service stat-mux pool, in which seven of these services operate using long GOPs. This is very similar to how Ofcom proposes Multiplex 2 being configured, which means that there is no need to estimate the benefits bigger stat-mux pools and long GOPs will provide as we already have a real world example of the level of picture quality we can expect from this multiplex configuration.

Having established the similarities between the Multiplex A and Ofcom's proposal for Multiplex 2, the bitrates used on Multiplex A should be compared to an estimate of bitrates proposed for Multiplex 2. This will give an idea of the level of efficiency improvement that will be required to achieve a similar picture quality currently provided on Multiplex A.

Current Bitrates

Tables 1 and 2 show the current bitrates used on Multiplex 2 and A. These are based on my own observations taken from the Mendip transmitter and are broadly in line with the ZetaCast report¹. Due to the use of statistical multiplexing it is not possible to say what video bitrate an individual service uses. I have made an assumption that full-resolution video streams (720*576 or 704*576) have a bitrate requirement one third higher than reduced resolution video streams (544*576) – which is in line with my own observations – and that all other demands are equal.

¹ <http://www.ofcom.org.uk/consult/condocs/dttfuture/report.pdf>

Table 1 Current Multiplex 2 configuration (November 2007)

Service	Resolution	Long GOP	Video (Mbit/s)	Audio (kbit/s)	Total (Mbit/s)
ITV1	704*576	No	2.73	256	9.84
ITV2	544*576	No	2.05	256	
ITV3	544*576	No	2.05	256	
ITV4	544*576	No	2.05	192	
Channel 4	704*576	No	2.81	256	10.15
Channel 4+1	544*576	No	2.11	256	
E4	544*576	No	2.11	256	
More4	544*576	No	2.11	256	
Other data	-	-	-	-	2.97
Null packets	-	-	-	-	1.17
Total	-	-	-	-	24.13

Table 2 Current Multiplex A configuration (November 2007)

Service	Resolution	Long GOP	Video (Mbit/s)	Audio (kbit/s)	Total (Mbit/s)
Five	720*576	No	2.69	256	20.47
Five Life	544*576	Yes	2.02	192	
Five US	544*576	Yes	2.02	256	
UKTV Gold	544*576	Yes	2.02	128	
Setanta Sports	544*576	Yes	2.02	128	
Bid TV	544*576	Yes	2.02	192	
Price-drop TV	544*576	Yes	2.02	192	
QVC	544*576	No	2.02	128	
Nuts TV	544*576	Yes	2.02	192	
Other data	-	-	-	-	
Null packets	-	-	-	-	0.79
Total	-	-	-	-	24.13

Notes:

- The audio bitrate includes the bandwidth required for audio descriptors
- “Other data” includes SI data, radio, text services, packet overheads (including the packet overhead used by video and audio streams) and anything else not explicitly mentioned in the table

Proposed bitrates

Table 3 shows the likely bitrates resulting from Ofcom’s proposal for re-configuring Multiplex 2. An assumption has been made that null packets can be reduced to the level that they currently are on Multiplex A and that “other data” usage would remain as it currently is on Multiplex 2. In this scenario, I estimate that video bitrates will need to be 14% lower than those currently used on Multiplex A.

Table 3 Ofcom's proposal for reconfiguring Multiplex 2

Service	Resolution	Long GOP	Video (Mbit/s)	Audio (kbit/s)	Total (Mbit/s)
ITV1	704*576	Yes	2.31	256	20.37
ITV2	544*576	Yes	1.73	256	
ITV3	544*576	Yes	1.73	256	
Channel 4	704*576	Yes	2.31	256	
E4	544*576	Yes	1.73	256	
More4	544*576	Yes	1.73	256	
Five	720*576	Yes	2.31	256	
S4C ² / other	720*576	Yes	2.31	576	
BBC Parliament	544*576	Yes	1.73	128	
Other data	-	-	-	-	2.97
Null packets	-	-	-	-	0.79
Total	-	-	-	-	24.13

Relative picture quality between Multiplex 2, A and B.

Table 4 shows my subjective opinion of the picture quality between different services found on multiplex 2, A and B. As the picture quality of each service varies depending on the content being broadcast (especially with the lower bitrate services) my assessment may be unduly influenced by my viewing habits.

Table 4 Subjective relative picture quality for services on multiplexes 2, A and B

Subjective picture quality	Service
Better	BBC Four
↑	ITV1, Channel 4, Five
↓	301, 302, BBC Parliament
Worse	ITV2, ITV3, ITV4, E4, More 4, Five US, Five Life

I believe that the services on Multiplex 2 and A offer a comparable picture quality while those on Multiplex B are a higher quality. This means that the displaced BBC service on Multiplex 2 will need to be allocated a higher bitrate compared to other services in order to avoid any quality loss.

It should be noted that considering the size of the stat-mux pool and use of long GOPs that one might expect the picture quality of Multiplex A to be better than that of Multiplex 2. The fact that I do not think that this is the case suggests that there are other factors that have a bigger effect on picture quality. Ofcom should therefore be cautious about the level efficiency improvement that will be provided by the use of log GOPs and bigger stat-mux pools.

Conclusion

I estimate that an encoder efficiency improvement of at least 14% will be needed to carry nine services on Multiplex 2, which falls into ZetaCast's "optimistic" scenario for encoder improvements. Even if it were possible to increase the video stat-mux pool by 1 Mbit/s (ie by reducing the bitrate of non-video services) there would still need to be a 9% encoder efficiency improvement in order to maintain existing picture quality. Considering that this level

² I am not able to receive S4C where I live, but I have been informed that it broadcasts at 720*576 and includes two audio streams at 256 kbit/s (Welsh and English – although the English steam is presently identical to the Welsh) and a 64 kbit/s audio descriptor.

of improvement is relative to the encoders in use on Multiplex A – which already use long GOP technology on most services – this is still an optimistic scenario.

The current picture quality of most of the services on Multiplex 2 is already amongst the lowest found on the DTT platform and any further reduction in picture quality would be highly undesirable. Considering the level of uncertainty surrounding the improvement new encoders provide Ofcom should conduct blind viewing tests to ensure that any changes to Multiplex 2 do not result in reduced picture quality.

It may be the case that the content carried on Multiplex A requires a higher bitrate than the content on Multiplex 2. This would mean that the level of encoder efficiency required would be less than my estimation, however Ofcom should assume that broadcasters may change their content in the future and therefore ensure the bitrate used is high enough to cope with any changes.

Question 17: do you agree with the proposal that HD broadcasting on the DTT platform should use the more efficient progressive format, rather than the interlaced format?

Referring to the 720p format as “more efficient” is disingenuous; 720p is a lower quality than 1080i, hence the reason a lower bitrate can be used. However, I do not have a problem with its use as long as it can be demonstrated that it will provide a picture quality beyond what can be achieved by increasing the bitrate of current MPEG-2 SD services on DTT.

Any HD service should provide a picture quality better than what can be expected from a typical SD DVD. It is reasonable for someone who owns a film on DVD to expect a better picture quality when it is broadcast in HD on DTT.

Blind viewing tests should be used to verify that 720p at the proposed bitrates will provide better picture quality than high quality MPEG-2 SD. It is not enough to assume that higher resolution will always result in a better picture quality. Excessive compression artefacts or heavy temporal and spatial filtering can sometimes look worse than a lower resolution.

Even if the picture quality is good, the use of 720p instead of 1080i may still harm the perceived image of DTT if consumers end up believing that it does not provide the same “full” HD quality available on satellite or cable.

Question 18: do you agree with the proposal that Ofcom should not mandate the use of the capacity for any particular service type (SD or HD) but allow the broadcasters to make proposals?

Ofcom should mandate that the majority of output is free-to-air HD whilst allowing broadcasters the flexibility to occasionally use their HD capacity to broadcast multiple SD services. The capacity should not be allowed to be used for encrypted services.

Question 19: do you agree with the proposal that the capacity should be allocated in three UK-wide blocks initially, rising to four blocks at DSO?

Yes, but only if blind viewing tests prove that it is possible to broadcast three high quality HD channels in the available capacity. Tests should also be conducted to ensure that if a broadcaster switches to multiple SD services that this will not harm the quality of the remaining HD services.

The introduction of the fourth block should only occur when tests have proven that it can be achieved without harming the quality of existing services. There should be no timescale for this event, nor should it be allowed to happen in order to appease broadcasters who missed out in the first round of bidding.

Additional comments

I believe there is a very real risk of a worse case scenario occurring where the quality of existing SD services is lowered in order to introduce sub-standard HD services. Since the purpose of HD is to provide better picture quality it is essential that high technical standards are maintained. It would be an unfortunate irony if the introduction of HD on DTT resulted in the picture quality of many existing services being lowered (even more so if the HD services fall short of expectations).

Broadcasters must not be allowed to introduce HD services just to tick boxes. Any proposals to introduce HD must be proven to provide an improved picture quality whilst not harming the quality of existing services. It would be a serious regulatory failure if changes are made to the DTT platform with the aim of improving picture quality that result in the opposite outcome for many viewers.

Ofcom should conduct independent blind viewing tests to determine whether any proposed changes are feasible and not base any decisions on hypothetical models. Once a decision is made to introduce these new services it will become difficult to change it if it turns out that encoder technology is not as good as had been predicted.