RTT TECHNOLOGY TOPIC
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3G TV

The delivery of content is presently being promoted as a value opportunity by the cellular operator community. However, as information bandwidth increases, information value decreases. As information value decreases, the value of delivery bandwidth goes down (the decline of spectral value).

This month's hot topic analyses how and why 3G TV will contribute to this value transition and identifies associated value ownership issues .

WHAT IS 3G TV?

1G TV was analogue black and white (VHF – Band III), 2G TV was analogue colour (UHF). 3G TV includes digital audio (DAB) and digital video (DVB). DAB and DVB together exploit higher level modulation and multiplexing techniques to deliver bandwidth gain from both new and existing spectral allocations. (DAB VHF, DVB UHF).

Digital audio broadcasting is shoe-horned into a modest 1.536 MHz between 221.296 MHz and 222.832 MHz (just above the Band III Sub Band III allocation).

The carrier bandwidth is sub-divided (using a fast Fourier transform) into 1536 discrete sub-carriers, each sub-carrier being 1 kHz wide. Across the whole 1.536 MHz, the gross transmission rate is 2.304 M/bits, each sub-carrier is therefore supporting a symbol rate of less than a kilo-symbol per second – the symbol period and guard period are therefore long compared to any echo or multipath delay.

No of Carriers	**1536**	**768**	**384**	**192**
Modulation Interval	1.246 m/s	0.623 m/s	0.312 m/s	0.156 m/s
Guard Interval	0.246 m/s	0.123 m/s	0.062 m/s	0.031 m/s
Modulation	QPSK	QPSK	QPSK	QPSK

The advantage for the network operator is that he can implement a single frequency network over which he can deliver up to six stereo audio programmes (at 192 k/bits) or a mix of audio and data streams. The advantage to the user ought to be that he gets a relatively robust (ie fading resilient) signal at up to 130 km/h, ie delivery bandwidth capable of delivering complex content.

The same principle applies to digital video broadcasting except that here we have over 380 MHz to play with!

The broadcasting spectrum in the UK runs from 471.25 MHz to 853.25 MHz – allocations differ in other countries. In the US, for example, AMPS and SMR occupy the 800 MHz bands but in all countries, the broadcasting community generally has access to large amounts of spectrum.

Digital video broadcasting divides down into DVB-S (satellite), DVB-C (cable) and DVB-T terrestrial). All three access technologies use common clock and carrier recovery techniques but differ in terms of the modulation used. DVB-T shares RF bandwidth with the existing analogue TV channels, for example in the UK, channels 21 to 68 (471.25 to 853.25 MHz)

Digital terrestrial channels divide each 8 MHz down into either 8000 or 2000 carriers (8K or 2k). Like digital audio broadcasting, this means a low symbol rate on each carrier. The frequency spacing is orthogonal (although the carriers overlap in the frequency domain).

The low symbol rate makes the modulation multiplex resilient to multipath delay – because the signal is similar to flat noise it is also fairly benign to the proximate analogue channels.

Modulation options include QPSK giving 10.6 Mbits/s, 16 QAM giving 21 Mbits/s and 64 QAM giving 30 Mbits/s. As the bit rate increases, the robustness of the signal decreases, i.e. the network density and/or transmitted power needs to increase. DVB-S, using QPSK on a single 6, 7 or 8 MHz carrier, with less shadowing than the terrestrial system, can deliver a peak rate of 38 Mbits/s. The US ATSC standard is of course) completely different – known as 8 VSB, it's a single carrier system delivering 19.3 Mbits/s

MODULATION OPTIONS	**CHANNEL RATE**	**CHANNEL QUALITY**
QPSK	10.6 Mbit/s	More Robust (less network density)
16 QAM	21 Mbit/s	
64 QAM	30 Mbit/s	More Robust (less network density)

DVB-T comes in various quality flavours from low definition through to high definition (1080 lines, 1920 pixels per line).

LDTV	Low definition (video quality) – multiple channel stream.
SDTV	Standard definition – multiple channel stream
EDTV	Enhanced definition – multiple channel stream
HDTV	High Definition – single channel stream 1080 lines – 1920 pixels per line.

MMBD	Multi-media data broadcasting (including software distribution).

However, the high definition signal needs 64 QAM and about 10 to 12 dB additional signal strength (which is why it hasn't happened yet). The following chart gives a comparison of the C/I needed as you move from 16 to 64 level QAM with various channel coding options.

"2 K Carrier Comparisons (NTL)

Modulation	Code Rate	Failure Point (C/I Needed)	Information Rate(after channel coding)
16 QAM	1/2	12 dB	12 Mbits/s
16 QAM	3/4	16.5 dB	18 Mbits/s
64 QAM	2/3	20 dB	24 Mbits/s

The multi-media data delivery standard (MMBD). covers the delivery of data including software distribution.

Data is divided down into data containers – fixed length containers each containing 188 bytes of data, and compressed using M-PEG2. ATM is used as a switch fabric to carry the M-PEG2 signal between transmitters (at 155 Mbits/s).

Channel coding includes block coding (1/2, 3/4 or 2/3), interleaving and a pilot channel to provide channel sounding to correct for Rayleigh fading – moving objects in the signal path. The intention is to provide longer term support for mobile users (actually the lower bit rate services really work quite well in a mobile environment).

For interactive TV, there is a wide choice of Return Channel options both wireline (PSTN, ISDN, CATV) and wireless (GSM, DECT, DVB-T and LMDS). Note however, that even without a return channel, you can build services that give the illusion of interactivity and information customisation – ie just like teletext, all the available information bandwidth is continuously downloaded to be discriminated in the receiving device.

So what does this mean? It means that potentially there is well over 300 MHz of broadcasting bandwidth available (and over 200 MHz of cable bandwidth for DVB-C)), optimised for the delivery of complex content.

This can be regarded either as a challenge or an opportunity for the cellular network operator. The challenge is that 3G TV effectively disenfranchises the potential value of information content delivery – the broadcasters can do it at lower cost and have better access to 'product' and 'production'. But they don't know where their subscribers are (geographically), I hear you say. Well no, but with a return channel they do.

At the very least, 3G TV will create cross elasticity in the pricing of content delivery which risks invalidating the business model of network operators presently regarding content as a profit opportunity.

Alternatively, 3G (3G C) cellular network operators could consider using 3G TV as a (30 Mbit!) downlink and build a robust business model on (device resident) memory bandwidth.

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RTT, the Shosteck Group and The Mobile World are presently working on a number of research and forecasting projects in the cellular, two way radio, satellite and broadcasting industry.

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