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Sixty Years of Cellular Radio

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Lessons learnt, lessons ignored.
The role of converged handsets in realising future spectral value

Converged handsets are commonly understood to be handsets with integrated Wi Fi and cellular radio functionality.

The proposition is supposed to deliver additional value to the end user which can be translated in some way into additional incremental industry value.

Like a mouse, this version of the converged handset proposition merely nibbles at the edge of a much more deeply rooted problem.

The problem essentially is to find a way in which the cellular industry can make money out of spectrum that is now priced at a level that defies rational explanation.

In this month's Technology Topic we take a journey across 60 years of broadcasting, cellular and public safety radio history to explain how and why we have arrived at this particular hard place and to suggest how converged handsets, defined as handsets that support broadcasting, cellular and public safety radio, are going to rescue us from a sticky and prickly predicament.

Sixty years of cellular, broadcasting and public safety radio history - lessons learnt, lessons ignored
In 1947 Bell labs introduced the concept of cellular radio based on the principal of frequency re use.

It was thirty years before the first VHF networks were deployed and thirty five years before first generation UHF networks were introduced.

This time to market delay was the result of needing to wait for the right enabling technologies to be available, the RF components needed to implement a (relatively) low cost transceiver at 800 or 900 MHz and the microprocessors needed to support power control and handover techniques.

In 1927 the British Broadcasting Corporation was established. Experimental short wave broadcasts to the Empire began from Chelmsford in the same year.

Ninety years later we are deploying digital TV.

In 1947 the commercial two way radio industry was busy repurposing technologies used in the Second World War for commercial public safety applications.

Much had been learnt from the use by the Panzer regiments of UHF for tank to tank communication and VHF for back to base links, the first known example of fully integrated dual band radio controlled warfare, techniques that remain depressingly relevant today.

The reason for this historical excursion is that it helps us to identify technology and engineering time scales in the industry.

This is particularly appropriate given the ongoing discussions about the future of the UHF band and the manifestly false expectation by governments worldwide that large amounts of money will be made by the cellular industry from UHF cellular networks.

In reality the ability to realise value from spectrum is determined by the availability or non availability of performance competitive and price competitive user equipment. In this context this means televisions, cellular phones and two way radio products.

Anecdotally, user equipment time to market delays in the cellular industry are increasing rather than decreasing over time.

This is delaying the point at which a return on a spectral and network investment can be achieved to the point where cellular spectrum at least should be regarded as a liability rather than an asset.

This has profound implications for bid policy for the operator community worldwide.

We flatter ourselves by thinking that technology and engineering innovation is happening faster today than in the past. In reality technology innovation and certainly technology implementation is at best continuing at a stable rate and more likely slowing over time.

This implies the need for structural changes in the industry to achieve the cross industry economies of scale and cross region economies of scale necessary to improve the fiscal efficiency of present technology and engineering spending.

We need to differentiate technology life cycles from engineering life cycles. The two are inter related but different. Technology life cycles are largely determined by standards making and conformance test processes.

Engineering life cycles are largely determined by the way in which spectrum is allocated. Engineering life cycles start at the beginning of the spectrum allocation or auction process.

Whether technology life cycles start at the same time is open to debate. In practice it can take a substantial amount of time before technologies come to market that allow realisable value from auctioned or allocated spectrum.

If spectrum is allocated in such a way that the technology development cycle is lengthened then a serious mismatch occurs.

Broadcasting technology and engineering life cycles - the fifty year turn around.
Taking broadcasting as our first example the engineering life cycle and technology life cycle in the industry is somewhere between 40 and 50 years.

For example in the UK 405 line black and white television lasted for about 50 years as did the VHF spectrum allocation on which the service was initially based.

The introduction of 625 line colour TV in 1967 and the related UHF spectrum on which the services are supported are still current today 40 years on and are only being presently superseded by digital TV.

There are many reasons for this comparatively long technology gestation period not least of which is the need to climb every chimney pot in the country every time a major change is introduced to the band plan.

The other reason is that remarkably the technology can meet user expectations over these extended periods. Many of us are, or at least were, happy with our analogue TV.

Cellular Technology and Engineering Life Cycles
Cellular is different in that the engineering life cycles are de facto defined by the life of the license which is typically twenty years.

Thus technologies should ideally be capable of ensuring that cost competitive performance competitive user products are available at the start of the license period.

The fact that this does not happen remains a surprise to many operators who for whatever reason choose to believe vendor assurances that products are just around the corner.

In practice it was 5 years before AMPS or ETACS or NMT analogue phones worked adequately, defining adequately as delivering a user experience that met with user expectations at that particular moment in time.

In was five years before GSM phones worked adequately, defining adequately as being as good as or better than analogue phones in terms of voice quality, battery life, size, weight and cost. God Send Mobiles was one operator's bitter comment on GSM product availability and suitability.

We have in the past rather tritely described this observable process as the Pain Pleasure Perfection cycle. The first five years of network roll out suffers from handsets that do not work very well, the second five years enters a pleasure phase where phones work rather better than expected followed by a third five year perfection phase where the opportunities to further performance or cost optimise the product gradually decline.

Why we think technology life cycles in the cellular industry are getting longer
It now seems that this rather crude but observable rule of thumb model is no longer valid and that in fact the technology life cycle is lengthening

Certainly this would appear to be anecdotally true. Five years, actually now six years after launching 3 G networks there is still a significant shortage of 3G handsets that meet present user experience expectations.

The reasons for this include an increased in standards complexity and standards diversity. It did not help that the sums of money invested in 3 G license acquisition resulted in redundancy notices for about 250,000 engineers between 2002 and 2005.

Additionally there was and still is a false assumption that a 'let the market decide' policy of technology neutrality in spectrum allocation is somehow a good idea. Contrary to the intended outcome, this policy creates disastrous design dissipation.

This is compounded by the present enthusiasm for allocating and auctioning spectrum that is quite frankly not fit for purpose and should come with a government health warning attached.

The most dramatic present example is the resale of UHF TV spectrum where the proximate presence of powerful TV transmissions combined with vulnerable portable TV receivers makes the spectrum more or less unusable for the cellular community.

Certainly it is hard to achieve band utilisation ratios that even approach 40% of the total allocated or auctioned bandwidth. Put another way, 60% of the bandwidth which you are expected to pay for will be effectively fallow spectrum.

This particular example is replicated in other bands including AWS in the US

Additionally a regulatory failure to agree even basic cross region harmonisation of the cellular band plan compounds the design dissipation already implicit in technology neutrality.

Thus we have the absurd situation that a trillion dollar industry with a 140 billion dollar R and D budget does not have sufficient design and engineering resource to bring cost and performance competitive products to market to support new 'non standard' spectral investment.

This inflicts eye watering pain on operator return on investment expectations.

Our colleagues at The Mobile World and the Shosteck Group point out that the most successful European operator will only recoup their 3 G spectral investment by 2013 and that this excludes hardware capital spending. The lack of cost competitive and performance competitive handsets has been a major factor in this failure to recover investment.

If we are right in our thesis that technology and engineering life cycle are lengthening and that the observable 15 year cycle is increasing say towards twenty years then this suggests that a return on investment will only be achievable in the second half or possibly even the fourth quarter of a 20 year license.

This definitely implies that spectrum should be treated as a liability rather than an

asset on the balance sheet.

So what's the solution?
It would be naïve to think that the regulatory community will rethink their present position on technology neutrality or that their enthusiasm for auctioning dodgy spectrum will disappear though it would help if the industry stopped bidding such irrational sums for a product which like a stick of Brighton or Blackpool rock candy has caveat emptor written right through it.

The solution may bizarrely be hiding in the public safety sector.

Technology and Engineering Life Cycles in the Public Safety Sector
Post 9/11 and Katrina in the US and post 7/7 in the UK there has been a significantly increased focus on public safety radio. This has resulted in the allocation of new spectrum for public safety and disaster relief in the US where 24 MHz of UHF spectrum has been made available for broadband service.

In Europe there have been parallel proposals to encourage the integration of public service terrestrial television broadcasting with two way radio emergency service provision.

There is of course a sting in the tail. Both in the US and Europe governments are encouraging commercial entities to bid for allocated public safety spectrum and then deploy networks at their own expense to provide a fixed price service to public safety users, part of the global trend to private finance initiatives in the public sector.

This implies a critical requirement both to understand specialist user needs but also to find a way of translating cellular economies of scale to public safety radio system solutions.

Specialist users have specialist needs including press to talk and group calling functionality and ruggedised and/or waterproof and/or dustproof user equipment.

To date these specialist requirements have justified significantly higher price points for user equipment but over time the scale economies implicit in cellular handsets have increased the cost gap to a point where it must be considered unsustainable over the short to medium term.

As an example, a bill of materials (BOM) of say 30 dollars in a cellular handset delivers similar functionality to a specialist radio with a BOM of 300 dollars or more.

There is thus an obvious and increasing imperative to find a way of translating the economies of scale achieved in cellular radio to specialist radio products including non civilian radio systems.

Possible common handset RF platforms across public safety radio, broadcasting and cellular - the extended converged handset proposition

Similarly the initiatives to encourage or possibly enforce public service broadcasters to fulfil perceived public service and public safety obligations suggests a need to find

a low cost route to providing conventional TV reception in user devices.

Note this is not mobile TV but portable TV based on existing TV multiplexes, either ATSC in the US or DVB in Europe. Not DVB H, not Media FLO. Both DVB H and Media FLO will become increasingly irrelevant over time.

ATSC in the US has a mandate to develop existing TV terrestrial transmission bandwidth for mobile service.

The BBC have an emergency plan to broadcast a single channel, Radio 15 (the numeric addition of Radios 1,2,3, 4 and 5) in the event of a national emergency.

This suggests a clear opportunity to develop cross platform commonality between existing terrestrial broadcast technologies, terrestrial two way radio technologies and terrestrial cellular technologies thus sharing handset economies of scale across three traditionally separate industries.

This is attractive for global markets where UHF spectrum will potentially be co shared between broadcast and cellular users. The availability of user equipment hardware platform that offers commonality across broadcast and cellular users will provide an incentive to the broadcasting community to help resolve present UHF co sharing and co existence issues.

It is additionally attractive for markets where UHF spectrum will potentially be co shared between broadcast, two way radio/public safety users and cellular.

The availability of user equipment hardware platform that offers commonality across broadcast, public safety two way radio and cellular users will provide an incentive to the broadcasting community and public safety community to help resolve UHF co sharing and co existence issues.

Commonality of user equipment hardware platforms across all three traditionally separate user communities might also encourage greater spectral harmonisation across presently unique UHF regional band plans.

Thus the handset, the cause of the technology and engineering time cycle 'problem' becomes the solution to the problem.

This rationale of cross technology user hardware harmonisation is not necessarily specific to UHF and could be extended to help resolve spectral allocation and technology choice issues in other bands.

Summary - the next 60 years of cellular, the future converged handset proposition

It is a sound axiom that the distance you want to look forward determines the distance over which you need to look back.

Thus a 60 year window on cellular history provides us with the means to predict a possible forward 60 year product and user plan.

This is not absurd when considered in the context of traditional TV technology and engineering life cycles.

The continuing narrative in the story, the language running through the stick of Brighton or Blackpool Rock is that the progress of any industry depends on technology and engineering keeping pace with user experience expectation.

This can only happen if the regulatory environment is structured to encourage rather than emasculate the process.

Converged handsets that integrate cellular, broadcasting and public safety radio functionality will provide a long term common purpose for three traditionally separate industries which will necessarily need to transcend presently parochial industry preoccupations.

Converged handsets will deliver user experience and user life benefits irrespective of user nation status - developing and developed nations have a common need for converged communication.

Converged handsets are therefore more than a passing fad - essentially they are the passport to our future.

ENDS
Converged handsets represent just one area of present RTT research on the impact of technology and engineering change on spectral and corporate value.

If you would like more details of other study work presently under way or are interested in commissioning bespoke research or advice on technology, engineering, market or business issues then please contact;

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