RTT TECHNOLOGY TOPIC
January 2007

Ultra Low Cost Spectrum

Introducing this month's Technology Topic

First an announcement.

RTT Hot Topics are no longer called Hot Topics but are now called Technology Topics. Many spam filters recognise the word 'Hot' in a header as an indication of unsuitable content, hence the change of description.

In all other respects, RTT Technology Topics remain identical in format and similar in content to previous Hot Topics.

We continue to argue that the telecommunications business is and will always be a technology driven industry. Therefore technology remains as the logical starting point when validating new business models.

The last three RTT Hot Topics have covered Ultra Low Cost Handsets, Ultra Low Cost Smart Phones and Ultra Low Cost Networks.

Governments have an interest in encouraging investment in infrastructure and services that can be shown to deliver a direct gain in gross domestic product.

The cellular industry internationally promotes wireless access as a facilitator for GDP growth, a mechanism for delivering political, social and economic gain.

The Ultra Low Cost Handset initiative is a part of that promotional process, with the specific objective of translating the GDP benefits of wireless access to emerging nations - bridging the digital divide.

However to be of real benefit, Ultra Low Cost Handsets and Ultra Low Cost Networks need access to Ultra Low Cost Spectrum.

In this month's Technology Topic, we explore the impact of governmental regulatory policy on spectral cost and spectral value and suggest that the present enthusiasm for a market led approach to spectral and technology policy making may be misguided.

Defining Low Cost Spectrum
The lowest cost spectrum is free spectrum. Most governments would point to ISM bandwidth availability as an example of governmental largesse and beneficence.

In practice free spectrum is only made available at power levels that prevent its economic deployment in wider area networks.

The availability of low cost spectrum for wide area networks is therefore dependent on national, regional and international regulatory policy. Given that spectrum for wide area networks is usually auctioned rather than allocated, spectral cost is determined by the price that bidders are willing to pay.

The price that bidders are willing to pay is determined by operator return on investment expectations.

Operator return on investment expectations are determined by technology, engineering, market and business assumptions. These assumptions determine the level of visible investment risk and investment opportunity. Invisible risks and invisible opportunities are introduced by unforeseen changes not factored in to the original business model.

Analogies with rural and urban real estate valuation.
Valuing and buying and exploiting spectrum is similar to valuing, buying and exploiting rural and urban real estate.

A farmer might value a hectare of farm land on the basis of introducing intensive farming techniques which will increase crop yields. Provided a market exists for these crops (the market risk) and provided that the market is not over supplied (the business risk) the farmer can expect to achieve a satisfactory return on investment.

A building developer might value a hectare of building land on the same basis.
The assumptions are however broader. For example, it has to be assumed that existing tenants can be moved from existing buildings, the height of the building will be dependent on planning regulations and the specification of the building will be dependent on building regulations. The height will determine how many tenants can be accommodated and the specification will at least partly determine rental income.

Principles of Spectral Valuation
Spectral valuation follows similar principles.

There may be existing tenants who will need to be moved at the new owner's expense, there will be obligations to meet in terms of government requirements as to how the spectrum will be used and the nature and scope of the services to be delivered. There will be 'good neighbour' requirements in terms of output powers and the transmission mask.

Technology and Engineering Choices and the benefit of standards
As with buildings, there are technology and engineering choices that need to be made.

Building technologies and building techniques have of course benefited from several thousand years of relatively rigorous standardisation. The Romans standardized brick dimensions and had standard recommendations both for aggregate mixes and concrete which they invented.

Norman cathedrals could not have been built without standardised approaches to stonemasonry and buttress design.

Today, building technologies are substantially standardised both at component level (bricks, girders, glass materials) and at system level (standardized utility inter connections). Engineering approaches are also substantially standardised, for example, stress and load bearing calculations, heat loss and heat gain calculations and lighting design calculations. Pavements, roads, bridges and railway systems are standardised, street furniture is standardised. The built environment depends on standardisation to achieve cost efficiency and depends on standardisation to deliver consistent usability.

Radio systems in comparison have only had the benefit of one hundred years of standardisation but have become equally dependent on standards making to achieve efficiencies of scale and to deliver a consistent user experience

The value of location

Building location has a direct impact on engineering costs. The geography and geology of the site will determine foundation costs and access will determine building costs.

Building location also largely determines tenant value. A central London location will have higher value than a suburban or rural location. High yield farmland will have a higher value than barren scrub land.

Spectral allocation and spectral location value

Similarly with radio systems, spectral allocation, the equivalent to land allocation for urban or agrarian development, directly influences engineering cost. Higher frequencies require higher more expensive network densities but support more capacity and can therefore yield higher 'tenant' revenue, but engineering costs may also be increased due to non standard duplexing or guard bands.

Spectrum also determines user value. The ability to roam for example is an assumed though expensive privilege; the equivalent of having visitor's or tenants rights when travelling abroad.

The Land Value Business Model

Unsurprisingly there are close parallels between land value business models and spectrum valuation models.

Urban land value business models are based on technology research and development, engineering research and development, market research and development and business research and development.

Technology research for example includes fundamental research into environmentally friendly low cost building materials and the development of those materials to meet mass market requirements.

Engineering research includes fundamental research into new construction techniques and the development of those techniques to meet mass market requirements.

Market research includes fundamental research into tenant requirements and the development of services to meet and realise value from those requirements.

Business research includes fundamental research into competitive offerings and the development of business partnerships to deliver competitive advantage.

Agrarian land valuation follows similar principles. Modern farming is essentially a technology driven industry combined with standardised agricultural engineering good practice.

The spectral value business model

In a spectral business model, technology research covers fundamental research on component technologies and the development of those technologies to meet mass market requirements.

The purpose of technology research and development is to produce technologies that are potentially capable of delivering efficiency gains, improvements in functionality and reductions in cost.

Engineering research and development is the process by which these potential efficiencies and functional benefits are realised in practice.

The difference between technology and engineering can be likened to the difference between Pure Maths and Applied Maths. Pure maths postulates theoretical potentially practical outcomes. Applied maths proves and implements those outcomes to achieve a planned result.

This differentiation is important and is commonly misunderstood in both micro and macro economic modelling.

Technologies when first introduced have the potential to be efficient but require significant engineering effort in order for those efficiency benefits to be realised.

Market research is the process of defining target users and user needs. Market development is the process of attracting those users to your network.

Business research includes fundamental research into competitive offerings and the development of business partnerships to deliver competitive advantage.

The Mobility Premium

Competitive advantage is a composite of cost advantage and a differentiated user proposition.

The user proposition in cellular networks is a complex composite of connectivity quality , blocked call rates, dropped call rates, data rates, latency, voice quality, packet loss, packet delay and access rights.

Access rights including an assumption of security as a right rather than a privilege and the assumption of connectivity being available anywhere under a wide range of operational conditions.

A challenging example has been the provision of consistent cellular voice services to passengers travelling in high speed trains.

The technology needs to be designed to do this and the engineering effort needs to be applied to ensure the technology actually works.

As an example, GSM was specified as a technology capable of supporting users travelling at up to 250 kph later extended to 500 kph. This operational requirement had a significant 'technology' related system cost in terms of signal processing and signalling bandwidth overhead.

The dynamic range of the operating conditions to which the technology needs to respond therefore has a direct impact on spectral efficiency and therefore by implication, spectral cost.

Engineering overheads include the development of suitable application specific handover algorithms to maintain acceptable call/session completion rates.

The composite cost of spectrum

So the cost of spectrum is a composite of the original bid price, the cost of meeting any specific regulatory requirements, the cost and potential efficiency of the technology needed to access the spectrum, the cost of the engineering needed to make the technology work as intended and required, marketing cost and business cost.

The impact of standards on technology cost

Standards have a direct impact on technology costs.

It is presently fashionable to argue the benefits of a market driven approach to technology standardisation. This is like letting Bob the Builder decide on brick shapes and sizes and is generally a bad idea. It is a particularly bad idea when an industry is engineering resource constrained. A team of fifteen hundred hardware and software engineers working on a single technology implies scale efficiency and an effective and efficient concentration of design resource. A team of fifteen hundred hardware and software engineers working on multiple technologies implies a dangerous level of design dissipation.

The impact of spectral policy on engineering costs

Spectral policy has a direct impact on engineering costs.

It is presently fashionable to argue the benefits of a market driven approach to spectral allocation. This is like letting Bob the Builder decide on international transport policy and is generally a bad idea. It is a particularly bad idea when an industry is engineering resource constrained. A team of fifteen hundred RF engineers working on globally harmonised spectral allocations implies scale efficiency and an effective and efficient concentration of design resource. A team of fifteen hundred hardware and software engineers working on a muddled mix of standard and non standard regional and country specific band allocations implies a dangerous level of design dissipation.

A failure to mandate technology and spectral policy is an abdication of governmental and regulatory responsibility.

Governmental and regulatory responsibilities

It depends on a naïve faith in the ability of the 'market' to determine technology and spectral policy on any basis other than short term shareholder interest.

A failure to mandate technology policy adds directly to technology cost.

A failure to mandate spectral policy adds directly to engineering cost.

Market driven approaches to technology and spectral policy making directly frustrate possible initiatives to deliver Ultra Low Cost Spectrum.

Without Ultra Low Cost Spectrum, Ultra Low Cost Handsets and Ultra Low Cost Networks are really rather pointless.

About RTT Technology Topics

RTT Technology Topics reflect areas of research that we are presently working on.

We aim to introduce new terminology and new ideas to clarify present and future technology and business issues.

Do pass these Technology Topics on to your colleagues, encourage them to join our Push List and to respond with comments.

Contact RTT

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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