Unused Licensed Spectrum

Case TD-CDMA

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Abstract

Data services introduced by mobile operators have by and large been ignored. The promise of challenge using fixed wireless access has evaporated.

Fixed and mobile operators are re-evaluationg their network deployment options under unprecedented constraints.

For fixed operators for example the prospect of adding mobility to broadband wireless access using alternative technologies has created a new evolutionary strategy.

Recent developments in the highly competitive markets support this strategy, which allows fixed operators to challenge mobile operators on country or regional basis.

Keywords: regulation, spectrum, fixed-mobile convergence, alternative mobile broadband access

1. The Converging Telecoms

During 2004, Western Europe will hand over its crown as the world's largest mobile region, a title it received from the US in 1998.

Driven largely by the strength of the Japanese and Korean mobile markets, the Asia-Pacific region is emerging as the largest cellular market in the world.

Revenue driving developed markets shall not be overlooked by players in the global wireless industry. Japan and Korea are creating new business without precedents anywhere else in the world.

Telecom operators worldwide need new value added services in order to differentiate in the stiff competition, since flat broadband pipes to the internet for instance bring low-margins at best.

"Fixed-mobile convergence" has been the buzzword in Asian telecommunications in 2004 as telecom operators are looking to find ways of linking wired and wireless networks.

"The way industry competes is changing" says Patrick Liot, VP from Alcatel. [1] "It used to be that mobile companies competed with mobile companies, fixed with fixed and ISPs with ISPs but now this is no longer the case, so it's like these industries are converging into a single telecoms industry."

Korea Telecom's One-Phone is an example f the latest converged concepts to hit the market, but similar plans have been voiced by Japanese broadband operators. The service is based on a CDMA2000 1x EV-DO portable handset, which is Bluetooth-enabled.

The calls are automatically switched from the mobile network to KT's local network whenever the subscriber comes within the range (of about 20m) is his or her landline access device.

While the key drivers and barriers to convergence could be identified as technology, regulation, operator strategies and market trends, the interactions between these key drivers and barriers are extremely complex.

This paper sets a stage for understanding some market dynamics in the converging telecommunications industry. It concentrates on regulation and industrial policy reflecting the consequences of these policies on operator and technology strategies.

2. Regulatory Developments

Although the heavy hand of regulation has been lifted from the telecommunications industry in many regions of the world, it continues to exert a significant influence on the industry.

The importance and influence of regulation is felt especially through its impact on operators' technology choices.

Taking wireless technologies as an example, regulation will influence which technologies can be deployed on which part of the spectrum, as well as how these technologies are licensed and managed.

2.1 Mandating the Technology

The practice of mandating a specific technology for deployment on specific licensed spectrum has been common in many countries, to ensure compatibility and minimize interference.

In Europe, the harmonization of spectrum usage and exclusive licensing of GSM technology for mobile telecommunications, was mandated by the European Comission in the early 1990s.

This lead to significant advantages to both operators and vendors in terms of economies of scale, interoperability and international roaming, and is widely accepted as a key reason for the success of GSM technology.

2.2 Technology Neutral Approach

In U.S., a technology neutral approach was adopted by the FCC for the PCS Auctions, and this approach was facilitated by two factors.

First, in contrast to Europe, the U.S. licenses "services" and not "networks", which means there's inherently less emphasis on networks.

Second, U.S. regulatory agencies, although nominally independent, are more subject to political pressures than their European counterparts.

If dissatisfied with regulatory decisions, powerful members of congress regardless of party can hold budgets of the agencies as hostage, which has encouraged the FCC to "compromise" and serve disparate commercial interests of different vendors.

2.3 New Regulatory Framework

It is ironic that it was the technology neutral approach of U.S. that attracted much criticism and was for long blamed for slowing down the development of the U.S. mobile market.

It is correct, that U.S. has suffered problems of infrastructure and handset interoperability, but it has been proven, that technology-neutral licenses open the opportunities for entrepreneurial innovation.

Without technology neutral licenses, CDMA probably would not have succeeded, to spur the rapid development of EDGE, or HSDPA.

Nor would the market, in the advent of 3.5G, be full of U.S. start-ups offering a range of competitive products from mobile technologies, e.g. TD-CDMA, to broadband wireless access, e.g. WIMAX.

Some notable are IPWireless (TD-CDMA), Flarion Technologies (Flash-OFDM), Navini Networks (TD-SCDMA (MC)), ArrayComm (iBURST), InterDigital Communications (WTDD), NextNet Wireless (OFDMA) and Broadstorm Telecommunications (OFDMA) only to name a few.

Given the dramatic changes in the market in the last few years, and those related to development of financial markets, shorter technology lifecycles and higher speed data technologies, also the European Commission has been forced to adopt a technology neutral stance.

The consequences of this are huge. For example, the 3G license holders may be able to use technologies such as CDMA2000, UMTS-TDD, WIMAX or other proprietary technologies such as Flash-OFDM, alongside W-CDMA.

The EC is also reviewing the issue of secondary trading of spectrum rights, which too would bring tremendous benefits in terms of flexibility, more efficient use of spectrum and innovation in the wireless industry.

Together, these two changes are expected to facilitate convergence in the telecommunications industry, as well as competition, introducing innovative products and services to the market.

3. An Unexpected Landscape

The promise of new high revenue data services was the catalyst behind the 3G bidding frenzy that engulfed the mobile world in the late 1990s. But as new data services introduced by operators have by and large been ignored, the reality has turned out somewhat different.

A major part of the problem has been in the over-promising of the capabilities of technology.

Wideband Code Division Multiple Access (WCDMA) was from the outset a compromise designed to ensure a

smooth upgrade path for GSM operators, who were the most significant customer group.

To accommodate all different technological proposals ETSI decided to adopt WCDMA in two different flavors. FDD was designed to operate in the paired and TDD in the unpaired spectrum.

Comparisons between TDD and FDD showed early on, that although TDD offered relatively larger user capacity, is seemed not to be suitable for large cells, since the need for finite guard times limited the cell size. (As technology has developed this is not considered to be a real issue.)

It was then recognized that TDD-based systems would complement the FDD-based systems in environments, where cell sizes would be smaller but transmission rates higher, for example serving urban hotspots.

In Europe, the majority of operators were allocated both with their licenses, 2 x 15MHz of paired and 5 MHz of unpaired spectrum, but without exception all of them determined that their initial deployment would be with the former technology.

Operator	**Freq. /MHz**	**Total /MHz**
Sonera Mobile Networks Oy	1900,0 - 1904,8 1964,9 - 1979,7 2154,9 - 2169,7	4,8 (TDD) 29,6 (FDD)
Oy Pearl 3g Ab	1905,0 - 1909,8 1950,1 - 1964,9 2140,1 - 2154,9	4,8 (TDD) 29,6 (FDD)
Radiolinja Origo Oy	1910,0 - 1914,8 1935,3 - 1950,1 2153,3 - 2140,1	4,8 (TDD) 29,6 (FDD)
Suomen 3G Oy	1915,0 – 1919,8 1920,3 – 1935,3 2110,3 – 2125,3	4,8 (TDD) 30,0 (FDD)
Song Networks Oy	1905,0 – 1909,8 1950,1 – 1964,9 2140,1 – 2154,9	4,8 (TDD) 29,6 (FDD)
Ålands Mobiltelefon Ab	1915,0 – 1919,8 1920,3 – 1935,3 2110,3 – 2125,3	4,8 (TDD) 30,0 (FDD)

Table 1 License holders and licensed spectrum for 3G networks in Finland [2]

3.1 Conflicting requirements

The problem is that WCDMA FDD is an uneasy mix of packet and circuit switched technologies designed to fit into existing GSM/GPRS platforms. It provides operators with huge amounts of voice capacity, but is less good at delivering high speed data.

On the other hand, TDD is asymmetric and ideally suited for Internet access and large file download, exactly the data services that operators now see as providing them with the revenues they would desperately need. However, this technological fact presents the operators with a major dilemma.

They are mandated by their licenses to deploy WCDMA FDD and have been committing large sums of money to deploy this technology. And now they are being told that their technology is unable to deliver the kind of services which they would need.

This puts operators in an “impasse”. They don’t have the financial or engineering resources to deploy both, but unless they deploy an alternative technology they will not be able to deliver high speed data services, at least at reasonable cost.

3.2 New Players in the Industry

One’s problem is another’s opportunity. Alternative vendors and alternative operators have come on to the scene. And many of these technologies have already seen commercial deployments.

With the exception of Flarion’s Flash-OFDM, all of the alternative systems mentioned are based on TDD technology. Some use technologies which are standardized, others proprietary solutions, while pursuing to integrate their technologies into 802.16, or 802.20 standards.

The technologies are usually being offered as straight-forward bolt-ons to FDD networks and they operate in spectrum which the operators in most cases own. The use of IP technology is a key element in all the technologies.

All the vendors claim to be targeting mobile operators, but to date there has been little interest from the operator community. As mobile operators seem to be unable to seize the opportunity for wireless broadband data services, they face increasing threat from fixed operators.

Looking at the deployments, some of the notable are Personal Broadband Australia’s (PBA) launch in Sydney-based on ArrayComm’s iBurst technology, or the “PortableDSL” services from Airdata in Stuttgart or Woosh Wireless in New Zealand, which are based on IPWireless TD-CDMA.

Already looking at the vendor profile, there seems to be

a case for TDD in the mobile broadband wireless access market. The end user offer is a PCMCIA card delivering multi-megabit speeds, which can be "self-installed" into the laptop for nomadic usage.

The benefit of the approach over Wi-Fi is wide area coverage and handover between adjacent cells. Wireless networks can be rapidly deployed and are easily scalable. And the cost of wireless deployment is only a fraction of DSL deployment.

3.3 The Significance of Frequency Arrangements

As enhancements of existing systems don't seem to satisfy the anticipated need for higher bandwidth services, there will be a need for additional spectrum to provide for the alternative technologies.

Additional spectrum for use by IMT-2000 has already been identified in the WRC-2000 conference and final decisions on these arrangements are scheduled to be negoatiated at WRC-2007.

In particular, the band 2500-2690MHz has been identified. The important issue under consideration is how the spectrum should be allocated between FDD and TDD modes.

Freq. block	**A 2500 MHZ**	**B**	**C**	**D 2690 MHZ**
Scenario 1	FDD UL	TDD	TDD	FDD DL (2.5GHz)
Scenario 2	FDD UL	FDD DL (out)	FDD DL (out)	FDD DL (2.5GHz)
Scenario 3	FDD DL (out)	FDD DL (out)	TDD	TDD
Scenario 4	TDD	TDD	TDD	TDD
Scenario 5	FDD DL (out)	FDD DL (out)	FDD DL (out)	FDD DL (out)

Table 2 Scenarios in the 2500-2690 MHz band according to ITU-R [4]

These are important considerations for the new vendors of mobile broadband access solutions based on TDD. Strategic positions concerning these arrangements are currently being discussed at national levels.

The key question is how far the conventional symmetrical paired spectrum arrangements that were suitable for voice are still appropriate. European positions concerning the arrangements are scheduled for 2005.

But proposals to make additional TDD spectrum available has encountered considerable opposition. FDD proponents strongly argue that asymmetry levels between 2:1 and 3:1 can be accommodated and capacity can be increased using HSxPA.

4. Conclusions

In the end, much depends on costs and many larger operators are starting to look for ways to push costs down on country or regional basis. In this development alternative radio technologies are likely to play an important part.

Reciprocity of channel characteristics in TDD-mode of operation enables much easier implementation of advanced technologies, such as joint detection technologies combined with smart antenna technology to reduce multi-user interference.

Only one set of electronics is required at mobile and base stations, which contributes to design simplicity and lower costs. TDD is already widely used in low-power end, for example by Bluetooth and WLAN in ad-hoc networking in unlicensed spectrum.

According to Prof. Masao Nakagawa from Keio University, to whom much can be attributed of UTRA-TDD becoming a 3GPP standard, FDD was a compromise from the start, and TDD is going to dominate in 4G mobile systems.

5. Case TD-CDMA: Softbank BB

[This case will be introduced in the presentation, but is not discussed in this document. [5]]

References

[1] "Fixed-Mobile Convergence", Telecomasia, May, 2004.

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[5] "Wireless Strategy and Business Model", Softbank BB Corp., 11.8.2004.