

cdma2000 1X – Asian lessons and prospects

In contrast to the delays, confusion and general bad press surrounding the W-CDMA business case, the CDMA world has been surging forward with CDMA2000 1X deployments and generating mountains of publicity about the huge subscriber base, new services and positive effect on revenues of this technology. The GSM/W-CDMA camp was also wrong footed by the CDMA vendors demonstrating high voice capacity gains with cheap, low-end devices.

How far can this go? Do developments in Asia herald a full-scale shift away from W-CDMA to CDMA2000 as the preferred 3G technology? Does CDMA's current lead really matter?

Ovum's research director in Asia-Pacific, John Davison, explores the issues.

Key messages

cdma2000 is leading the way...

There is a perception that cdma2000 is leading the way in the development of 3G. This perception has been generated, or at least greatly assisted, by the CDMA vendors and the media, and with some justification, given the success of the cdma2000 1X launches in the region. cdma2000 is often positioned against W-CDMA, and the differences in timescales and success between the two are evident and stark.

A better comparison, however, would be to compare the fortunes of GPRS and EDGE – still a disappointing comparison at present, but the speed and scale of movement in these areas in the GSM/W-CDMA camp will restore much of the comparability of the two technologies in a relatively short timeframe.

...but the differences are not that large

The applications and services used in the showcase CDMA countries – South Korea and Japan – are further ahead in execution of new applications than much of Europe, but are not fundamentally different. Similarly, the extent of non-voice revenue growth in these countries is not out of step with the GSM/W-CDMA world. Vodafone subsidiaries in Europe, for example, have achieved 10–15% of revenues from non-voice services. This is primarily SMS, which has taken time to grow, but is extremely profitable.

Operators must make some short-term strategic decisions

The evident short-term success of cdma2000 1X cannot be ignored. Operators have to make decisions on how to deploy, adopt or compete with cdma2000 1X in the short term, and for many operators these are difficult decisions on the scale, scope and speed of network upgrade and service development. This will be particularly apparent in those markets where the two technology camps are in direct opposition.

The questions are not simple; the answers even less so

The heart of the current debate is the balance between capex, capability and timing for the GSM/W-CDMA and CDMA migration routes. Simple views on capex are not helpful – much depends on individual circumstances, of course, and playing with business case assumptions can affect the figures to a great degree. Regulatory requirements, government policy, strategic direction and cultural loyalties all play a part too.

It's not about cdma2000 or GSM/W-CDMA...

There is a differential in capabilities, but this differential will be relatively short lived. Although we face a messy couple of years where the respective vendor camps argue

about the relative merits of their technologies, these arguments aren't the most important ones.

Few operators will fundamentally change their network migration path. They may have to prioritise developments differently, work nimbly to counter a technology advantage of a rival operator, make limited deployments of alternative technologies for short-term competitive advantage, or use a technology for specific purposes, but the overall fundamental technology landscape will not change.

The dream combination of a low-cost, high-capability, rapidly-deployed network does not guarantee market success (although it would be a good start). Much depends on the downstream activities of applications and service development, distribution, marketing, customer support and, in the end, the level of customer awareness and willingness to adopt.

Technical superiority does not, in any market, guarantee commercial success – Betamax anyone?

...the real debate is about applications

Much of the real debate about the acceptance and deployment of different technologies centres around the experience of the end user, the applications they require and will pay for, and the way in which these can be satisfied by the different technologies.

In general, there is no 'killer application' for wireless data. When you look at the popular applications in Japan or South Korea, you see the same simple mix of messaging, ringtones and basic graphics download that is seen in other markets. The only exception to this is the widespread and rapid adoption of picture messaging that this is often accompanied by extensive subsidy, at least in the case of KDDI.

Asia faces special challenges

Compared with Europe or the US, Asia faces special challenges:

- it is more fragmented, geographically, culturally and developmentally
- technology choices are less concrete, certainly than in Western Europe, and the evaluation of alternatives is very active
- markets are highly competitive, which, in the current economic climate, focuses attention on to short-term wins rather than longer-term strategic visions
- visible successes in China, Japan and South Korea are more relevant – simply because they're close, or because they're culturally relevant.

While CDMA is under evaluation within Asia, there are several factors that will maintain the GSM/W-CDMA route as the dominant 3G path:

- in most advanced markets such as Singapore and Hong Kong, GSM dominates. In these highly saturated markets, the focus is on increasing customer value and retention. This places interoperability and roaming as key hygiene factors, which plays to GSM's standardised strength

- national roaming will play a large part. In developing markets where an incumbent has a clear GSM/W-CDMA migration path to 3G, second and third tier players wanting to interconnect outside urban areas will be less willing to adopt a variant technology path.

Nevertheless, CDMA will remain a competing force in the region. The window of opportunity lies in the developing markets, where there is a high growth opportunity, increasing competition and the focus on short-term national wins rather than longer-term strategic gains.

The fact that CDMA promotes increased voice capacity with cheap, entry-level devices as well as high-end models means that it is attractive to a voice-led and subscriber growth strategy.

CDMA is also being evaluated and used as a means of achieving regional coverage in large land areas for geographically fragmented markets, driven by political demand to reduce the urban/rural digital divide.

The main factors that will affect CDMA take up include:

- whether South Korean operators significantly shift the time frame for commercial rollout of W-CDMA
- the scale of CDMA adoption in Latin America, the Middle East and Eastern Europe, which will ease fears of isolation and poor economies of scale
- any significant shift to CDMA by an operator in the region previously committed to W-CDMA. Many operators – even those of the GSM-based networks – have publicly said that they are evaluating CDMA, but we have not seen a major defection... yet
- as a negative, a swing back in sentiment towards EDGE and W-CDMA, driven by uptake of MMS and commitments/rollout of EDGE, which boosts the GSM/W-CDMA-based business case.

The window of opportunity

The wireless industry is facing difficult times. The relative maturity of many markets, the difficulty operators face in raising finance, and the uncertainty of revenues from new services all mean that the wireless industry is seen as a less attractive option for investors than only a couple of years ago.

The focus is now on the short term, and a good return on investment is seen as more important when balanced against the longer-term strategic position. This lends CDMA vendors a window of opportunity, but one that is problematic.

Prognosis

CDMA as an evident short term winner

CDMA is an evident short-term winner, with its smooth upgrade path from IS41/IS95, faster time to market and very visible success in key markets. A charitable view would look at W-CDMA delays as the natural growing pains of a relatively immature technology – something that will be overcome given time. 3G, whatever the technology base, will provide operators with more efficient, flexible, scalable and higher capacity networks.

However, for CDMA, fear of isolation is still there. Longer term, when W-CDMA networks are firmly established, the cdma2000 community will still find itself in a minority. At such a time, operators may need to make a technology decision again. However, many are intent on making as much use of CDMA as possible in the short term, worrying about the longer term later.

One question is whether the minority is large enough to be self-sustaining, or whether it will ultimately go the way of IS-136. It probably is large enough. Of course, one way around the problem would be to produce a phone that supported all standards. It's not available now, nor will it be next week, but Moore's Law is working in favour of this. If such a phone existed, would anyone care about standards? The answer is yes, because of service availability across networks – the application level question again.

There is a differential in capabilities, but this differential will be relatively short lived and, although we face a messy couple of years where the respective vendor camps argue about the relative merits of their technologies, these arguments aren't ultimately the most important ones.

Few operators will fundamentally change their network migration path. They may have to prioritise developments differently, work nimbly to counter a technology advantage of a rival operator, or make limited deployments of alternative technologies for short-term competitive advantage, but the overall fundamental technology landscape will not change.

However, the dream combination of low-cost, high-capability, rapidly-deployed network does not guarantee market success (although it would be a good start). Much depends on the downstream activities of applications and service development, distribution, marketing, customer support and, in the end, the level of customer awareness and willingness to adopt.

W-CDMA will be slow, but GSM refocuses on EDGE

Although operators are reluctant to disclose precise launch dates for their 3G networks, many operators have 3G networks in place, and are looking to soft launch these networks in 2003. However, all evidence suggests that this process will take a long time. A number of technical issues will contribute to this, including problems with testing and sizing networks, and with handover to existing networks.

The GSM/W-CDMA vendors are regrouping around EDGE. Nokia has recently (September 2002) fully and publicly committed itself to EDGE, announcing that it is to ship network equipment in volumes across all GSM frequency bands.

Just as cdma2000 1X has been accepted as a 3G standard, so too is EDGE part of the ITU family of 3G standards and part of the 3GPP process. EDGE offers many of the benefits achieved by cdma2000 to the GSM/W-CDMA world – Nokia claims a threefold increase in data speed and capacity, as well as backwards compatibility to GSM and GPRS services, with future work on enhancing voice capacity.

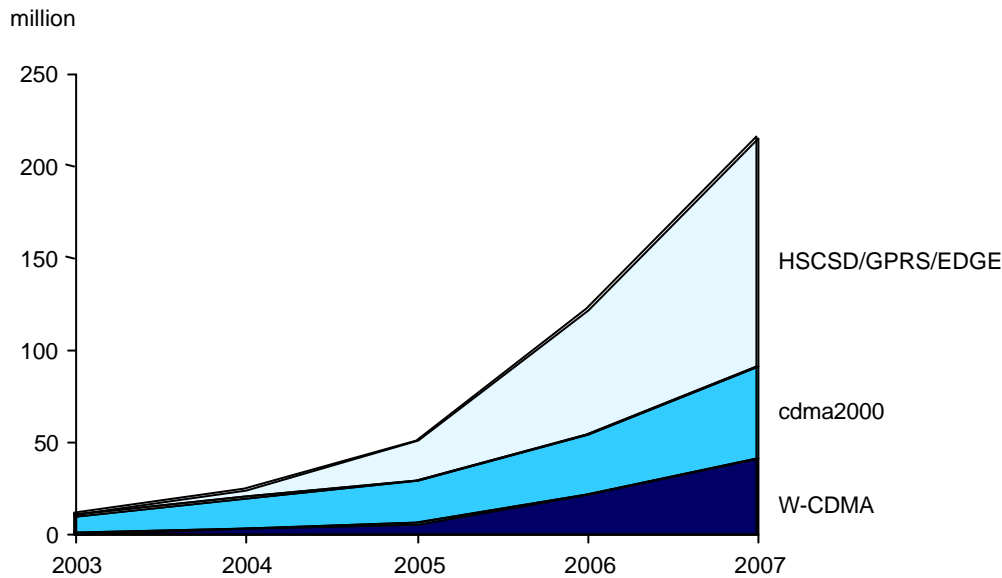
EDGE is now being positioned as the natural next step extension of the GSM world towards 3G, a change from its initial position two or three years ago, where it was seen as an unnecessary interim step on the route to W-CDMA.

Scenarios

There are two basic scenarios affecting the development of CDMA as a viable alternative to the GSM/W-CDMA migration path. The first describes a wholesale, but unlikely, adoption of cdma2000 as a preferred 3G technology; the second a resurgence in GSM/W-CDMA fortunes relegating the upstart CDMA to its former obscurity.

As always with scenarios, neither is a full description of the outcome in any one place or at any one time. The future holds elements of both. Overall, whilst we see a medium-term outlook where the merits of each technology are hotly debated, trialled and marketed, the final balance of the technology landscape will remain fundamentally undisturbed. CDMA will make gains – some short term, some in developing markets, but there will not be a fundamental shift away from the GSM/W-CDMA hegemony. Total regional HSCSD/GPRS/EDGE/W-CDMA connections will overtake cdma2000 during 2004. *Figure 1* illustrates our infrastructure forecast views.

Figure 1 Asia-Pacific next-generation connections



Source: Ovum

Scenario 1: the CDMA juggernaut

In this scenario, cdma2000 continues to gain momentum, and those operators that had not made a firm technology decision decide to leap on this short-term bandwagon. This has the potential to create a substantial network for CDMA operators, at least in Asia-Pacific, and also in the Americas and Eastern Europe.

A number of factors could lend weight to this scenario:

- if regulators relax the licence rollout deadlines and technology limitations in Europe and elsewhere, and if finance for network build remains a constraint for operators
- adoption of CDMA in the US continues to push Latin American operators to go down the CDMA route
- the CDMA vendors continue their aggressive marketing campaign, widely publicising the voice capacity, time to market and cost benefits of CDMA technology
- South Korea postpones W-CDMA launches. We have already seen a number of announcements from South Korean operators stating or hinting at delays in the launch of W-CDMA. The operators are looking to maximise revenues from their existing networks, and appreciate that they need to get their business models on these networks right

The above factors collectively make cdma2000 the upgrade route for India, Latin America, the Middle East and Eastern Europe, where operators of older analogue networks opt for CDMA instead of GSM/W-CDMA.

A combination of these factors would provide CDMA with a strong established base in high growth, emerging markets. Continued delay or faltering W-CDMA in advanced markets such as South Korea and Japan would also provide fuel for the cdma2000 fire.

However, in this scenario, the development of advanced services and sophisticated handsets would be slowed by the low ARPU for value-added services in developing markets. Although the CDMA vendors are continuing to talk about the benefits of integration across the range of handsets, this would affect the economies of scale of the higher-end handsets.

Scenario 2: W-CDMA light rekindled

The GSM/W-CDMA world is not standing still, and despite its setbacks (or perhaps because of them) there is a renewed effort to get things moving. There are several factors that will contribute to the fortunes of the GSM/W-CDMA migration path:

- in the GSM/W-CDMA world, much is riding on the success of MMS. Most operators have rolled out a GPRS network, but few have seen returns of anything like the scale of DoCoMo's with i-Mode. If MMS provides the fuel to drive data ARPU still further in the GSM/W-CDMA operator community, at anything like the scale of adoption of picture messaging in Japan and South Korea, this will do much to restore the faith in sustainable business models for the GSM/W-CDMA route
- GPRS deployments gain subscriber numbers and user experience on basic applications is not too far away from the CDMA equivalent. Applications and service development platforms will be key in this environment. The rapid development and widespread portability of applications is one thing that potentially differentiates the GSM/W-CDMA camp – at least for now
- there is sufficient long-term doubt about the viability of cdma2000 as a global technology – enough to cause many operators to further delay technology decisions, preferring not to invest, or to invest in short-term technologies that will maximise revenues from existing services, including voice
- the increased attention given to EDGE by the major vendors may result in a shift in the balance of investment, but even the more committed vendors such as Nokia appear to be pitching EDGE as having volume availability after that of W-CDMA. This might just be a cautious position for now, not wanting to cannibalise W-CDMA investment by holding out the prospect of early availability of EDGE outside the US.

Strategies

Why is this important now?

The last twelve months have seen a change in industry dynamics. Following the disappointing launch of FOMA in Japan, and continued delays and confusion elsewhere, many in the financial world, the media and the industry itself are questioning the assumption that W-CDMA is the natural standard for the development of 3G networks. cdma2000 launches and related developments, particularly in Asia and the US, have meant that the balance of power (or at least visibility) has, at least for the time being, shifted away from the established GSM/W-CDMA network vendors.

The established and visible developments in South Korea, Japan, China and the US have led to many industry observers, including operator strategists, to view cdma2000 as an increasingly viable way of growing out higher value services in a short timeframe. In the light of delays and financial difficulties in the W-CDMA camp, there is a media rush to '3G bashing' at the moment. While this is part of the general technology development cycle that most new technologies go through, its timing and severity are particularly unfortunate.

Not surprisingly, the established GSM/W-CDMA vendors are watching these developments with unease. Operators are making decisions on short- to medium-term investment, and do not generally have the established loyalty to technology in Asia that is so much a factor in Western Europe.

cdma2000 1X found initial success in what can be regarded as relatively closed or isolated markets – South Korea and Japan. Others used CDMA as a low-cost upgrade path, or a way of solving particular issues. Telstra's use of CDMA to provide rural coverage, always a political sore point in Australia, is one such case.

cdma2000 has long been seen as an isolated technology, but there is now strong evidence that regional blocs are developing. The communication and co-operation between South Korea, Japan and China is one very obvious example of this. This co-operation has developed at both a governmental and operator level, and involves technology transfer and roaming deals, as well as more general and high level statements of intent.

Regional issues – different strokes for different folks

In Europe, the technology choice is relatively fixed – the 3G licences are technology-dependent, and there is very little likelihood of a major desertion from the GSM/W-CDMA mainstream.

In the Americas, the free market attitude to technology choice means that CDMA has found adherents in Sprint and Verizon, both of which are happy to proclaim the

benefits of their technology. TDMA operators in Latin America see CDMA as a viable upgrade path, rather than waiting for the W-CDMA route to firm up.

However, in Asia-Pacific, the technology choices are less fixed, and the markets are either highly competitive or newly developing, both of which environments form the basis for some potentially mould-breaking decisions.

In such competitive markets, in an environment focusing increasingly on ROI, operators are looking to provide value-added services as a way of increasing ARPU, but are also concerned about costs – capital and operational. This low-cost functionality is one of the key reasons why 1X is so interesting. It's worth noting, however, that Starhub used similar reasoning in its launch of EDGE trials.

Figure 2 segments the Asian markets by growth potential and technology base, using the country categorisation from our core forecast methodology.

Figure 2 Asian markets

	GSM	Mixed	CDMA
Low subscriber growth potential (<10% penetration increase) Focus on value/margin enhancement	Taiwan	Hong Kong	
Medium subscriber growth potential (10–30 % penetration increase) Mixed focus	Malaysia Singapore Vietnam	New Zealand Australia China	South Korea
High subscriber growth potential (>30% penetration increase) Focus on subscriber growth	Philippines	Thailand Indonesia Japan India	

Source: Ovum

It's evident that the Asian landscape is very much a patchwork, within which it is difficult and foolhardy to make generalisations. The circumstances in each individual country will depend on more than just raw subscriber potential and penetration, with regulation, government direction and cultural loyalties all influencing the outcome. However, there are some key dynamics that can be drawn out.

Subscriber growth strategies

Many of the markets seen as potential openings for CDMA are relatively new or undeveloped markets, where the focus of attention in the short term is likely to be on basic voice services rather than advanced data services. This means that much of the

attention will focus on the increases in voice capacity, rather than the data services that have driven revenue increases elsewhere.

The fact that cdma2000 1X can point to voice capacity gains right across the subscriber base, with cheap entry-level devices as well as high-end models, means that it is attractive to a voice-led, subscriber growth strategy. However, such markets will not focus, at least short term, on the development of higher-value advanced services. This doesn't mean that there is anything wrong with this strategy, or that CDMA is an inappropriate technology, just that the rules are different.

A number of operators in high growth countries will be looking to use the capacity gains and cheap upgrade path of CDMA to fuel subscriber growth. Indonesia and India are examples of where CDMA is used as a fixed local loop substitute, but builds on cdma2000 1X to provide higher value service capability downstream. KDDI's rapid increase in market share after launching cdma2000 1X is also a good example of subscriber growth – this time involving advanced services and heavy subsidy.

These markets will have to shift strategy eventually, as subscriber growth matures and continued revenue growth becomes more important.

Mixed value/subscriber growth strategies

In more mature markets, subscriber growth is balanced by the requirement to raise revenues or margins from existing customers.

In markets such as Australia and New Zealand, CDMA plays a more ambiguous role. There is potential for subscriber growth, but CDMA currently plays a rather specialised role in both countries. In Australia, CDMA is used by Telstra primarily to provide rural coverage, whilst its mainstream GSM network targets urban dwellers. Telstra's challenge is to position the two in a complementary way, avoiding cannibalisation. In New Zealand, TCNZ's new cdma2000 1X network is currently targeted primarily at high-spending business users, positioned as a more effective alternative to GPRS (or landline).

In Malaysia and Singapore, both strong GSM countries, CDMA has, at first sight, little presence or role. Given Singapore's positioning as a regional hub, the importance of roaming capabilities means that operators will be less inclined to stray away from the GSM/W-CDMA mainstream. In Malaysia, Telekom Malaysia has begun using CDMA to provide fixed wireless services in Sabah and Sarawak, and sees the service as a tool to narrow the 'digital divide' in less developed and more remote areas, in line with government policy. The Malaysian government has a strong influence on the Malaysian telecommunications industry and frequently provides input on strategic direction.

Value growth strategies

In highly penetrated markets, the potential for further direct subscriber growth is low and the focus is on revenue growth. Interworking and the prospect of operator consolidation both work against major technology changes.

Where revenue growth is driven by the adoption of more advanced, non-voice services, the simple differentiators of one technology over another are balanced against the requirements and benefits of interworking with other networks. SMS in Hong Kong is one prime example of this effect where the long-awaited interworking agreements had an immediate and visible effect on traffic and revenues.

The prospect of consolidation is one that also works to maintain the *status quo*, as operators choosing to take a different technology route lose the opportunity to benefit from industry consolidation.

The questions – operators and vendors

The question of the importance of cdma2000 1X is not a simple one and operates at many levels – technical, commercial and, to some extent, philosophical. cdma2000 1X is usually positioned against W-CDMA as a 3G technology – and it's certainly been a successful marketing exercise to get cdma2000 1X viewed in this way. However, it's more appropriate to consider cdma2000 1X as a competitor to GPRS or EDGE. It's these technologies that are going head-to-head in the marketplace, and it's the difference between their investment requirements, their technical strengths and weaknesses, and their performance perceived by the end user that will determine their success or failure.

Western Europe has not been used to seeing mixed standard competition, and until the move to data in other markets, the two key technology camps have been reasonably in step in both costs and functionality. However, in recent times, the evident cdma2000 1X capabilities and deployment, and the accompanying marketing effort, have outstripped the GSM/W-CDMA world, knocked back on its heels by a series of failures and delays. The fiasco of WAP marketing, delays in GPRS handset availability, the poor early performance of FOMA and the evident reluctance of most operators to launch W-CDMA quickly have all contributed to an increasing perception gap in the minds of many observers.

Operators – a question in three parts

Operators have difficult choices to make with respect to cdma2000 1X. Few can ignore it completely – even in the GSM/W-CDMA heartland of Western Europe, and certainly in the more technology agnostic Asia-Pacific, the visible success of South Korean and Japanese CDMA are causing many to at least reconsider their strategies.

Analysis usually concentrates on the issue of technology choice, of migration – but there are other issues. In competitive, multi-standard markets, and markets where new 3G operators are looking to make a mark, issues of roaming, interoperability and competitive positioning all play a part.

Migration

Operators are under pressure. All have suffered from the downturn in the technology sector, and many are still plagued by high prices paid for 3G spectrum. Given the financial constraints, and the scepticism of the investment community, many are looking to delay capex on new networks for as long as possible. At the same time, however, that same investment community, together with the regulators in many cases, are putting pressure on operators to launch new, profitable services quickly. Having not paid such high prices for 3G licences, Asian operators aren't generally under the same pressure to launch, but they don't escape. There is at least re-evaluation of the usability of CDMA, even in GSM-rich countries. Malaysia and Taiwan are two countries where this is happening.

Then there is the new subscriber growth adoption, where CDMA is being used in preference to terrestrial networks as a means of providing fixed local loop services (in India, Malaysia and Indonesia, for example).

National and international roaming

New 3G operators are well aware that coverage is an important factor in the initial success or failure of their networks – users regard coverage as a basic hygiene factor in most markets. National roaming is a key part of this, as greenfield 3G operators are looking to urban rollout, coupled with either network sharing or roaming agreements to achieve coverage. It is unlikely that such operators will make a technology choice that will prevent them implementing successful roaming agreements with other 3G operators or with established 2G operators. This tends to maintain the technology *status quo*.

International roaming is a consideration for operators, particularly in areas like Singapore and Hong Kong where, as in many areas of Western Europe, international trade and mobility is important.

Competition

First mover advantage is keenly sought in competitive markets. This is true in Asia, the Americas and in Europe. The ability to address key, high spending customer groups with new services and applications is seen as a key advantage. Much of this advantage is in the mindshare it captures in the ever important investment and media communities. The trick is to be able to back up the first move with sustained success, where the GSM/W-CDMA camp has a less than perfect record – think WAP and early FOMA.

The current perceived capability gap between CDMA and GSM/W-CDMA is a key competitive stress in mixed markets such as Japan and New Zealand. Operators have to find the right marketing mix to deal with new launches of 1X, either in positioning their CDMA offerings against a non-CDMA competitor with superior subscriber numbers, or as a defensive move from a non-CDMA operator against a cdma2000 1X launch.

Vendors

GSM/W-CDMA – fortress Europe

For the vendors, the major issue is one of infrastructure migration. Investment in 2G infrastructure is declining and anything that threatens the well-being of the GSM/W-CDMA world, its unity of purpose in moving to 3G and its strength in numbers, is viewed as a huge threat.

In the face of the smooth upgrade path for CDMA, the GSM/W-CDMA camp could do much to publicise its own development plans, in particular the upgrade from GPRS to EDGE. EDGE has been a secondary development until late, sandwiched uncomfortably between the short-term pragmatism of GPRS and the next-generation 'sexiness' of W-CDMA. Apart from its utility in giving the US an upgrade path for GSM, it had little visibility.

The delays to W-CDMA – whether technology-based or the result of commercial reluctance on the part of operators – have rekindled interest in EDGE as a mainstream upgrade technology.

CDMA – the push continues

For its part, Qualcomm, together with the rest of the CDMA vendor community, sees a huge opportunity to position cdma2000 as the 3G technology of choice, and is stepping up its already considerable marketing activity to this end.

In addition to pushing CDMA technology in its own right, Qualcomm is also pushing BREW, its application platform in both CDMA and GSM/W-CDMA markets. CDMA operators fear technical isolation, and a key task of the CDMA community must be to widen their base as far as possible, both in terms of network implementations and at the application level. It must also reassure customers about the future viability of the technology. The first worries are appearing with the slow uptake of EV-DO in South Korea.

The CDMA community's marketing activities are heavily focused on the short-term opportunities rather than 'blue sky' futures, and are geared to the revenue opportunities and cost benefits of the technology.

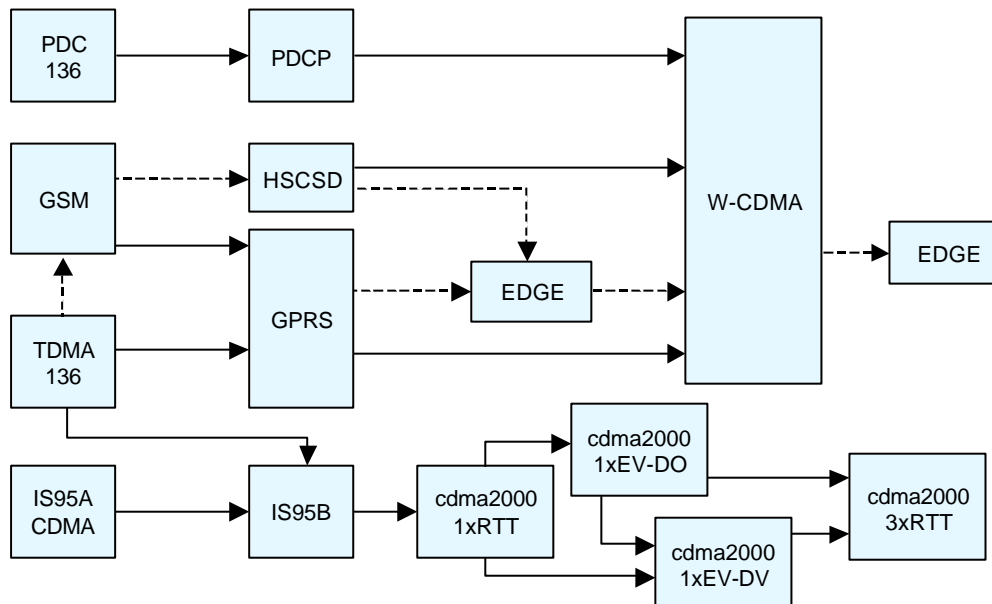
What the debate is not, or should not be

Much of the debate about 3G has been regarding data rates, but 3G is more about capacity and cost effectiveness than high-bandwidth applications. Much of the adverse publicity towards 3G in general, and W-CDMA in particular, could have been avoided had operators and vendors restrained their marketing of 3G multimedia potential.

Different paths to the same end

There are many ways to get to 3G, the most common of which are illustrated in *Figure 3*. Given the technology repositioning of recent times, where both the CDMA and GSM/W-CDMA vendors have positioned their upgrade technologies – cdma2000 1X and EDGE – as 3G technologies, the debate as to whether any particular technology is 2G or 3G is now an empty one. The technologies will co-exist for some time, and it is their relative costs, capabilities and ease of migration that are important in helping or hindering the fortunes of operators

Figure 3 3G migration paths



Source: Ovum

The CDMA route

The part of the CDMA migration path that has captured much of the recent attention has been the upgrade from cdmaOne (IS95A or B) to cdma2000 1X. This upgrade provides operators with a substantial increase in data speeds, coupled with a doubling of voice capacity, all within the existing spectrum and using existing infrastructure.

Deployment of 1X in South Korea, and more recently in China, Japan and the US, has raised visibility of this technology route, particularly when it is compared to the slow development of 2.5G data services on GSM.

Key vendors in the CDMA market include Qualcomm, Lucent Technologies, Motorola, Nortel Networks and a number of South Korean players including Samsung Electronics, Hyundai and LG Electronics. Even traditional GSM/W-CDMA vendors are looking at CDMA; for example, Ericsson has deployed 1X equipment in the US and China. Of the vendors, Qualcomm is the strongest CDMA advocate, not only providing infrastructure and programming platforms (BREW), but also funding and incubating many CDMA-related applications providers and other start-ups, such as Wingcast and Jamdat Mobile.

The GSM/W-CDMA route

The core of the GSM/W-CDMA upgrade path is the route from GSM, through GPRS and EDGE, to (eventually) W-CDMA. EDGE is now being positioned firmly as a 3G technology.

Some of GSM/W-CDMA's problems come from the sheer size of its success. Although adherence to standards features heavily, the GSM/W-CDMA community has difficulty in moving quickly and, as with any standards-based activity, there is room for variation. Java is a good example of this, and does not yet stand well against the slick packaging of BREW, where operators are offered a complete (but substantially proprietary) package of applications platform, development community and business model.

The speed of implementation of non-voice services in GSM has been disappointingly slow. GPRS has been around for nearly two years, and EDGE has been discussed since 1998, but EDGE handsets will only appear in volume in the third quarter of 2003.

In addition, GSM is widely seen as a euro-centric standard. Europe is GSM's home base and much of its marketing activity reflects this. There is little sense of GSM community in Asia, for example, where many of the interesting service developments are located.

How the technology camps face off

For all the early and visible successes of cdma2000, there are strengths and weaknesses on both sides, both technologically and commercially.

The key issue for operators and vendors is how great these differences are, how much they will affect the commercial success or failure of any new venture, and for how long they will last.

Figure 4 summarises the key differences in the technology and commercial approaches.

Figure 4 Key technical and commercial differences

Attribute	GSM/W-CDMA route	CDMA route
Summary	<p>The GSM/W-CDMA world has a number of strengths:</p> <ul style="list-style-type: none"> • size of the user base • the strength of its standardisation <p>The non-voice revenue effects of the relatively slow build-up of SMS and GPRS have not been well publicised</p> <p>Its sheer size, however, means that the GSM/W-CDMA world has difficulty in moving quickly and coherently</p>	<p>CDMA draws its strengths from its smooth and rapid development path, and the immediate and visible effect it has on revenues and costs</p> <p>Benefits from a strong advocate in Qualcomm</p>
Data speed	<p>Realistic throughput under market conditions</p> <p>GPRS = 25–40kbit/s</p> <p>EDGE = 80 –160kbit/s</p> <p>W-CDMA = 64–200kbit/s, 500–900kbit/s with Release 4</p>	<p>Realistic throughput under market conditions</p> <p>cdma2000 1X = 50–80kbit/s</p> <p>cdma2000 EV-DO = 600–700kbit/s</p>
Time to market	<p>GPRS widely deployed but slow in market development</p> <p>Slow handset availability and service adoption</p> <p>WAP legacy – user (and operator) backlash on poor experiences with early services</p> <p>Waiting for EDGE</p> <p>W-CDMA widely in development</p>	<p>Now well established in some markets</p> <p>Many operators with established 1X, many more rolling out. Early implementations of EV-DO</p> <p>The CDG claims that there are nearly 200 cdma2000 devices available, most of which are cdma2000 1X, with a small number of to1X EV-DO devices</p>
Voice capacity	<p>GPRS/EDGE requires existing capacity but offers QoS on data services</p> <p>Capacity gains through developments such as AMR – but will require compliant handsets in volume</p> <p>Vendors claim that capacity gains of 20–30% per year are achievable</p>	<p>Upgrade to cdma2000 1X delivers a doubling of voice capacity, but offers ‘best effort’ data</p> <p>The availability of chipsets across the range of handsets, from entry level upwards, means that capacity gains are realised</p>
Capex requirement	<p>DoCoMo W-CDMA \$10.9 billion</p> <p>J-Phone W-CDMA \$3.5 billion</p> <p>CSL GPRS \$0.2 billion</p> <p>AT&T GPRS/EDGE/W-CDMA US\$ 4.4bn</p> <p>(Morgan Stanley estimates, June 2002)</p>	<p>SKT 1X (inc EV-DO) \$2.4 billion</p> <p>KTF 1X (inc EV-DO) \$1.2 billion</p> <p>Sprint PCS 1X (inc EV-DO) \$1.6 billion</p> <p>(Morgan Stanley estimates, June 2002)</p>

Figure 4 Key technical and commercial differences (continued)

Attribute	GSM/W-CDMA route	CDMA route
Spectrum requirement	GPRS/EDGE in existing spectrum W-CDMA requires new spectrum	cdma2000 1X in existing spectrum
Market size – scale economies	Worldwide subscribers = 747.5 million 669 GSM Association members in 184 countries According to the GSM Association in October 2002, GSM accounts for 71.2% of the world's digital cellular market and 69.2% of the world's wireless market	Worldwide subscribers = 130 million, 17 million cdma2000 subscribers 110 members in the CDG as of October 2002 The CDG reports that as of the end of August 2002, there were 22 commercial CDMA networks deployed worldwide, with a further 19 scheduled to be deployed in the next year
Standardisation	Much of the strength of GSM development is in its adherence to standards, resulting in interoperable services throughout the GSM area, such as SMS messaging. This commitment to standards also results in delay	Whilst having its own standardisation programme in 3GPP2, much of the service and application development is proprietary
Development speed	The WAP legacy, together with W-CDMA delays and financial difficulties, creates negative perceptions amongst the media, investors, end users and operators themselves The W-CDMA story has not been helped by the relative lack of success of FOMA – the W-CDMA implementation in Japan – where the deployment of single-mode handsets, together with business customer positioning, has resulted in relatively low adoption	CDMA works on a number of frequency plans and many of the developments that enable services on cdma2000 are proprietary. This restricts their ability to port onto other implementations. In turn, there is an effect on handset availability and interoperability There is collaboration between 3GPP and 3GPP2 to look specifically at interworking issues, from the adoption of MMS on CDMA to the harmonisation of HSDPA and 1x EV-DV
Smooth migration	Migration to W-CDMA is not smooth GPRS/EDGE increments smooth development somewhat and increase capability while retaining backwards compatibility	A key claim of the cdma2000 to upgrade path is its smoothness, simplicity and backwards compatibility However, although the move from cdmaOne to cdma2000 1X has clearly defined benefits, further moves to EV-DO or DV are less clear in commercial terms
Unity of purpose	Outside western Europe, GSM/W-CDMA world does not have the same sense of community Europe enjoys. This is particularly evident in Asia, and is a particular vulnerability, given that cdma2000 successes are primarily seen in this region However, the GSM Association is becoming increasingly active in marketing the activities of its members	The primary focus for marketing activities in the CDMA world is the CDG, which is active and evangelical about the benefits of the technology This activity is supported by the vendors, notably Qualcomm.

Source: Ovum

Where the action is

Asia-Pacific is the key battleground

For all the attention paid to CDMA developments in the US, a key area of development for CDMA is Asia-Pacific, where the large-scale deployment alongside GSM in China meets the advanced services being developed and deployed in Japan and South Korea. New Zealand lends its own spin to the debate with its focus on enterprise applications; Australia wrestles with the complexities of developing both CDMA and GSM under a single operator; whilst India and Indonesia look at CDMA for low-cost subscriber growth.

South Korea

South Korea is in many ways the spiritual home of CDMA. CDMA networks were launched in South Korea in 1996, and all mobile phone services in the country are based on this technology. The operators began the move to cdma2000 1X in late 2000 with the launch of the network from SK.

Like Japan, development in South Korea is aided by a high level of government intervention and close relationships between manufacturers and operators. It also helps that the South Korean people are very technology aware, and are enthusiastic adopters of new innovations.

Figure 5 illustrates the development of CDMA subscribers in South Korea.

Figure 5 Mobile subscribers in South Korea, 2000-2007

	2000	2001	2002	2003*	2004*	2005*	2006*	2007*
Total (000s)	24,134	26,732	29,250	31,200	32,400	33,221	33,526	33,814
Year-on-year growth (%)	–	10	9	6	4	2	1	1
Penetration (%)	51.0	56.0	62.0	65.7	67.9	69.2	69.4	69.7

Note: all figures taken at year beginning. The number of mobile subscribers in South Korea declined slightly during 2000, after the MIC temporarily banned handset subsidies

* Ovum forecast

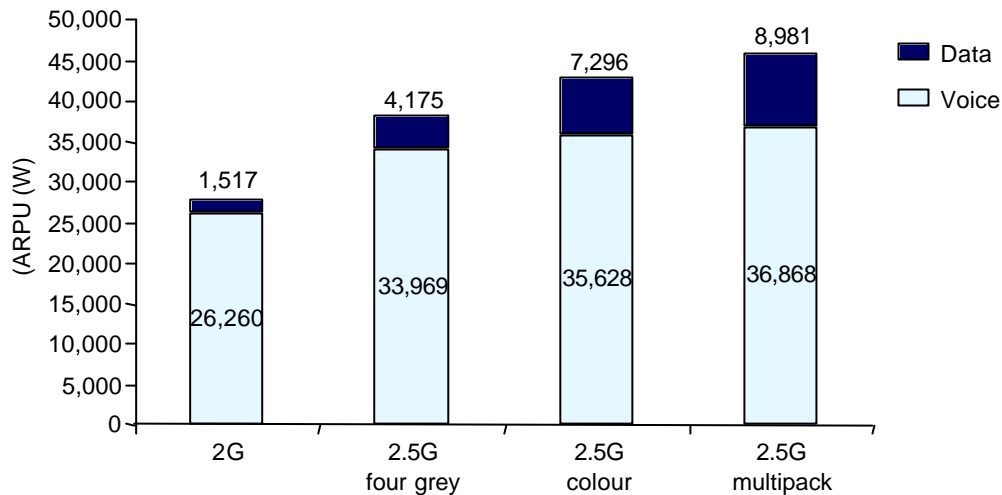
Source: Ovum

Wireless data services were launched in South Korea in 1999 and, as in Japan, have had a positive effect on ARPU. The move to cdma2000 1X, coupled with the use of colour screens, appears to have resulted in an increase in ARPU, as shown in *Figure 6*.

It is dangerous to link cause and effect in quite such a simple way. For instance, one common effect is that it is the keen users, the high-spending users, who migrate to a

new technology first. It would not be surprising to see the 1X revenues stabilise, or even decline, as the lower-spending masses migrate through.

Figure 6 ARPU increase through 1X deployment, colour screens and BREW



Source: KTF

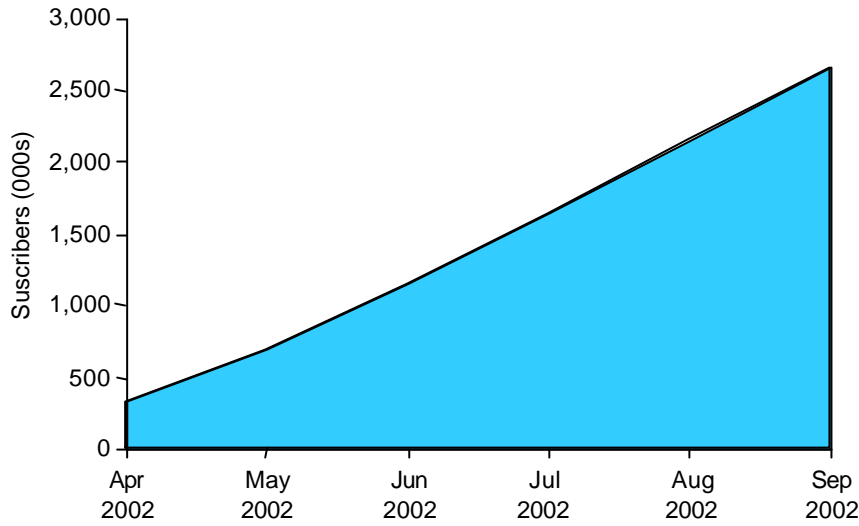
Japan

Japan led the world in the development of wireless services with the launch of DoCoMo's i-Mode in 1999. The service, based on the existing PDC network, achieved phenomenal success with its easy to use consumer services for a public that had little experience of the wider Internet.

Since then, the other operators have responded with their own services. J-Phone launched its own picture messaging and wireless Internet service, known as sha-mail, and more recently, KDDI launched its own service based on cdma2000 1X, achieving very rapid growth in the first few months of service.

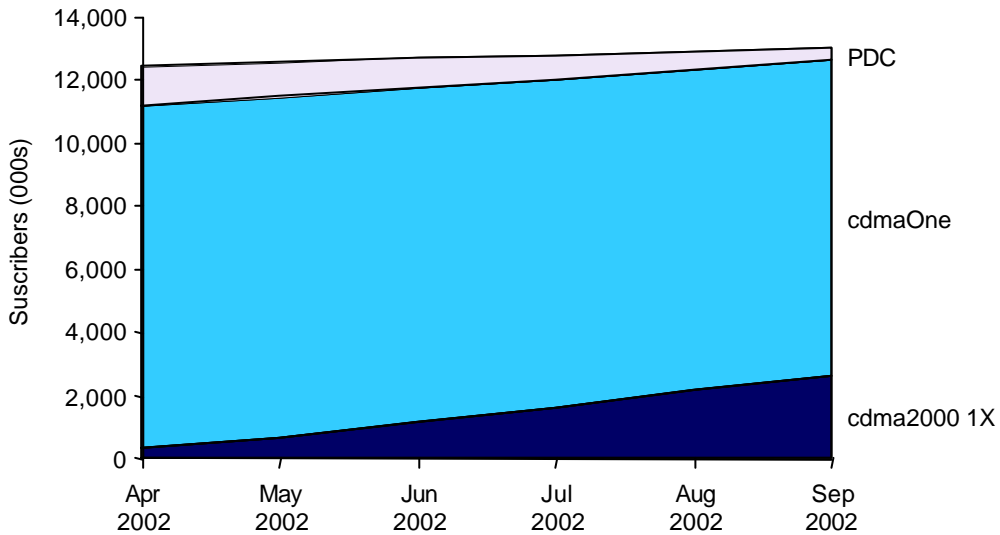
However, subscriber growth has been gained at the expense of extensive handsets subsidy, and some cannibalisation of existing subscribers. CSFB estimated in July 2002 that the company was selling handsets for ¥9,000 (\$73), compared to a wholesale price of ¥46,000 (\$375). At the end of June 2002 there were 1.15 million cdma2000 1X subscribers, equating to a subsidy of \$355 million. *Figures 7 and 8* illustrate the growth of cdma2000 1X subscribers and their relationship to total subscriber numbers.

Figure 7 KDDI cdma2000 1X subscriber growth



Source: KDDI

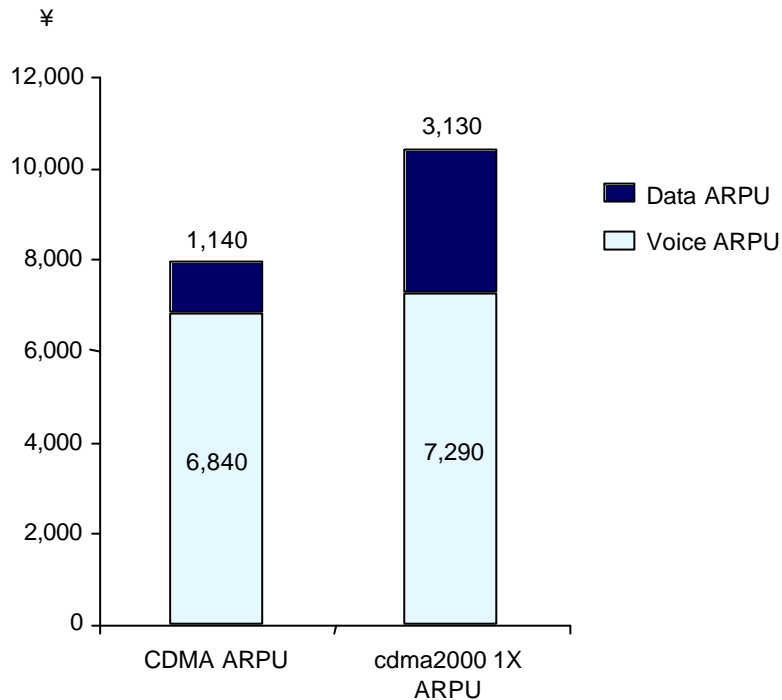
Figure 8 KDDI total subscriber numbers



Source: KDDI

KDDI forecasts that total ARPU will fall from ¥8,080 (\$66) in March 2002 to ¥7,900 (\$64) in March 2003, while data ARPU is forecast to rise from ¥890 (\$7) to ¥1,200 (\$10) over the same period. *Figure 9* shows relative ARPUs for CDMA and cdma2000 1X in the first quarter of 2002.

Figure 9 ARPU in the first quarter of 2002



Source: KDDI

China

The scale of China's mobile market is staggering. During 2001, the average monthly subscriber increase was over 4.5 million. Whilst much of the market is GSM based, China Unicom launched a CDMA network in 2001. After a relatively slow start, China Unicom reported that it passed 1 million users at the end of May 2002. It claimed during July 2002 that it was increasing users at the rate of more than 15,000 per day.

In October 2002, China Unicom signed a contract with Ericsson valued at more than \$150 million to upgrade China Unicom's existing CDMA networks to cdma2000 1X. cdma2000 1X deployment is expected to be commercial by the end of 2002.

The prospects for cdma2000 and W-CDMA were tarnished slightly at the end of October 2002, when the Chinese government announced 3G spectrum allocations. Alongside 60MHz blocks for these two technologies, the government allocated 55MHz, plus a further reserved 100MHz for TD-SCDMA, China's homegrown 3G

standard, developed in conjunction with Siemens. This move signals a clear intention to develop a domestic capability in 3G. The major western vendors, together with the larger domestic vendors, such as Huawei, have invested significantly in the development of cdma2000 and W-CDMA in China.

New Zealand

In New Zealand, Telecom New Zealand launched its cdma2000 1X network in 2002, known as Mobile Jetstream. TCNZ is unusual in the 1X world in positioning its network firstly in the enterprise market, and has worked hard to bring into play a network of integrators and distributors. Consumer offerings will come later, when handset availability and pricing is more favourable

TCNZ's CDMA offer is purely volume-based, providing budgetary control for enterprise customers, but potentially limiting usage.

Australia

In Australia, Telstra has operated a CDMA network since 1999. This network was seen as an effective means of providing rural communications, always a politically hot issue in Australia.

Australia is unusual in operating both CDMA and GSM networks in tandem and, given its long-term commitment to the GSM/W-CDMA migration path, it has to be extremely careful in its positioning of cdma2000 1X against GPRS and EDGE. So far, it has studiously avoided differentiating the two networks at a branding/pricing level. It has committed itself, albeit cautiously, to both technologies, but has given little indication as to the pace of development.

India

India has primarily used CDMA as a WLL technology, but more recently, in October 2002, Lucent announced two contracts with Indian operators (Reliance and Tata) for the provision of cdma2000 1X networks, but these are still relatively small-scale activities.

Within the cellular industry (and frequently across the telecommunications industry as a whole), India has often been categorised alongside China as one of the prime growth areas for global players, and whilst China is largely living up to its anticipated potential, this is not the case for India.

Commercial issues

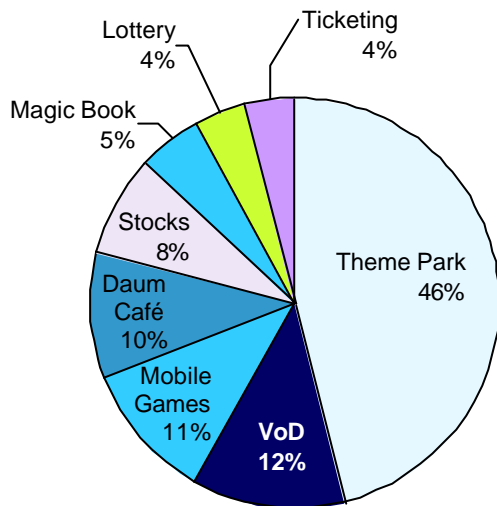
Applications and services

Much of the real debate about the acceptance and deployment of different technologies centres around the experience of the end user, the applications they

require and will pay for, and the way in which these can be satisfied by the different technologies.

In general, there is no killer application for wireless data. When you look at the popular applications in Japan or South Korea, you see the same simple mix of messaging, ringtones and basic graphics downloads that is seen in other markets, as shown in *Figure 10*. The only exception to this is the widespread and rapid adoption of picture messaging in Japan and South Korea, which is often accompanied by extensive subsidy, at least in the case of KDDI.

Figure 10 Popular applications in South Korea – KTF example, March 2002



Source: KTF

Similarly, the 'next big thing' in the GSM world is MMS. The ability to send pictures and other multimedia messages to other phones and e-mail addresses is a tantalising capability. Of course, the CDMA operators have been able to do this for some time, but the difference is that these implementations are largely proprietary. CDMA vendors are looking to MMS solutions by the end of 2002, but widespread availability will take time.

There are many popular games and pastimes in both markets, but their portability outside their own culture is in many cases doubtful. Wherever you look, business models are not mature, and in particular are constrained by the partnership between developers and operators.

This partnership is central to the development of a wireless data market, and relies on the development of applications platforms, billing systems and customer support systems, all of which are lacking or limited in most markets.

Business model issues

Costs

The CDMA vendors, especially Qualcomm, make a great deal out of the lower capital expenditure for CDMA upgrades, even without taking into account licence fees paid for spectrum. Reports of \$14 billion spent on W-CDMA in Japan, compared with \$4 billion spent on cdma2000 in South Korea are commonly seen.

In theory, the economies of scale for CDMA continue to increase in the short term as the deployment races ahead in the US, China and Japan. In the longer term, W-CDMA would show the same economies of scale, and we would expect that it will be at least 2005 before this becomes evident.

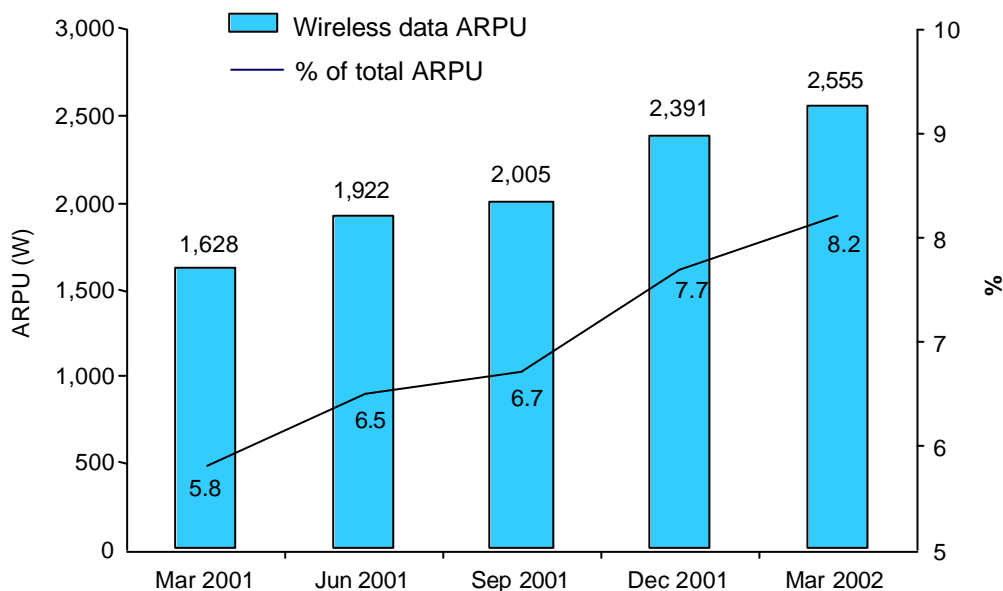
GPRS/EDGE rather than W-CDMA is a better comparison with cdma2000, both in terms of short-term performance and in terms of cost of deployment.

Revenues

CDMA operators and vendors will make much of the higher ARPU generated by cdma2000, but in reality there are many factors in play. In both South Korea and Japan, operators can point to a rise in ARPU following cdma2000 deployment

Figure 11 illustrates the proportion of overall revenues derived from data services for the South Korean operator, KTF.

Figure 11 **Wireless data ARPU and percentage of total ARPU for KTF**



Source: KTF

However, typically at the same time, colour handsets were introduced, heavy subsidies were applied and large sums were spent on marketing the advantages of a shift to new services. It is difficult to separate the effects of all these, and to determine the precise effect that, for example, an increase in air interface speed had on end-user revenues.

It's also to be expected that, over time, the ARPU of cdma2000 users might stabilise, or actually decline, as the lower spending 2G laggards finally upgrade and dilute the revenues achieved from the high spending early adopters.

It's also worth noting that the growth in non-voice revenues achieved in South Korea is more than matched by the percentages achieved by European operators. Vodafone subsidiaries in Europe, for example, have achieved 10–15% of revenue from non-voice services. This is primarily SMS, which, although it has taken time to grow, is extremely profitable.