

**Discussion:**

**Three Topics that Continue to Be Misunderstood  
by the Wireless World**

By:

Jeffrey K. Belk  
Senior Vice President, Marketing  
QUALCOMM Incorporated  
Jbelk1@qualcomm.com

12/2003

## **Table of Contents**

The Three Topics .....	3
The Relationship between “CDMA vs. GSM” and “What is 3G?” .....	3
A Brief History of Wireless Communications.....	5
Answer Not “What is 3G?” But “What Can 3G Do for Everyone?” .....	6
The Truth about “Economies of Scale” in Wireless .....	8
Now See the Wireless World Clearly .....	9
<b>Proof Points</b>	
The Need for Higher Speed Networks Proof Point: Camera Phones .....	10
Business Reality Proof Point: Wireless India .....	12
Wireless Experience Proof Point: Wireless Japan.....	13

### **The Three Topics**

As those of you who were involved in the technology world during the mid '90s know – particularly those involved in the wireless industry – a surefire means for generating controversy and discussion then was to bring up the terms “CDMA” and “GSM” or ask, “What is 3G?” An entire industry was practically born from the conflict between CDMA and GSM and the precise definition of 3G could be argued for hours.

But the world has moved on. In the wireless industry, it has become clear in the last few years that hype and imaginative stories do not build revenues. PowerPoint® presentations pitting the theoretical peak rate of one technology versus another neither add new customers nor bring about new, innovative applications and services to the marketplace. Execution does. That is why “CDMA vs. GSM” and “What is 3G?” are no longer part of a meaningful technology discussion. However, for those who want to explore or demand further explanation, continue reading.

Another issue discussed in this paper is the confusion over the economies of scale to be enjoyed by manufacturers who supply operators along the two primary paths – CDMA2000 and WCDMA (UMTS) – to 3G. If not clarified, it will continue to complicate and misguide the wireless industry decision makers and, in some ways, perpetuate the CDMA vs. GSM issue.

### **The Relationship between “CDMA vs. GSM” and “What is 3G?”**

It is surprising to see where the conflict between CDMA and GSM sometimes appears and who is telling the tale. At a meeting as recently as the summer of 2003, a world-leading technology industry analyst firm shared its view of the wireless landscape. The firm’s forecasts, covering 2003 through 2007, were simply divided into two technologies: CDMA and GSM.

When pressed with questions such as, “CDMA2000 has been deployed on dozens of networks globally – where are your CDMA2000 numbers?” and “WCDMA is being deployed around the world – where are your WCDMA numbers?” the analyst went into a spirited defense of his company’s forecasting methodology, which, for the reasons we will soon discuss, is fundamentally flawed in a manner that many following the wireless industry clearly recognize.

Who would benefit from this perspective?

- Companies that have invested heavily in GSM technology
- Companies that are trying to catch up in developing their own WCDMA products
- Companies that have the most to lose if CDMA continues to grow

Pressed for another 20 minutes, the analyst gave in and acknowledged that the methodology of the forecast was defined by his firm’s largest customers, not by market realities.

To avoid the above problem in the future, we should first define some terms in the context of the pre-3G world. This will help us understand how the wireless world has evolved, and why some of the old-school mindset needs to change with the times.

Before 3G, there were basically two types of commercialized mobile communications technology:

- **Analog Cellular** was known as AMPS in the Americas and TACS or ETACS in other parts of the world. It is now, in hindsight called “1G,” although it wasn’t called that until the industry contemplated “2G.”
- **Digital Cellular** is now widely called “2G.” While it took time for the definition to solidify, the following standards are now all considered 2G or 2.5G: PDC, GSM/GPRS, TDMA (IS-136), and cdmaOne™ (IS-95).

Each of these systems is extremely complex, but can be summarized into three major components: radio-equipped handsets, cell sites for those handsets to transmit to/from and a fabric of communications switches that handle the calls. To make the systems work, companies and standards bodies devised a set of standards which would allow the equipment of many different makers to operate together – so subscribers could actually use the phones. To develop the standards, the vendor community developed, analyzed and agreed upon different technologies to adopt for various parts of the systems.

If we look at analog cellular and deconstruct the system into its components, it would look like this:

<u>Standard Name</u>	<u>Network</u>	<u>Radio</u>
• AMPS	IS-41	AMPS
• ETACS	IS-41 (variant)	ETACS
• TACS	IS-41 (variant)	TACS

Note the pattern. Forms of IS-41, now known as ANSI 41, were the basis of the network standards for *all* of the analog systems of the '80s and '90s. And relevant to some statements below, analog still exists in the U.S., Europe and many other parts of the world.

Digital cellular, now known as 2G or 2.5G, looks like this:

<u>Standard Name</u>
• cdmaOne (known previously as IS-95 and later as ANSI 95, or often just CDMA)
• GSM
• U.S. TDMA (known also as IS-54 and later as IS-136)

Now that we have defined the key terminology used in the pre-3G world, we should review some wireless history, which will tell us something obvious about buyer behavior

and, in turn, prove that the CDMA-GSM conflict is irrelevant. This history check will also put to rest the question “What is 3G?”

### **A Brief History of Wireless Communications**

In the early '90s, analog cellular (AMPS) was beginning to take off in the U.S. (Analog usage rates eventually grew to be the highest in the U.S. before digital wireless arrived.) In Europe, a patchwork of analog systems (TACS and ETACS) was hitting the capacity and interoperability wall, and wireless network operators were preparing for full commercial deployment of GSM. Even though wireless standards bodies were discussing something called “3G” (third generation) wireless, the general public was unaware of the term.

Consider the attributes of analog phones and services, at least in North America, during that time period. Phones were large, often weighing 200-300 grams or more. They had single-line LED or LCD monochrome displays and operated on lead acid or NiCad batteries that exhibited undesirable “memory” characteristics (i.e. the battery life was poor because the battery was prone to “remember” your typical usage and consider itself drained long before the life specified by the manufacturer). Wireless service, due to the fact that analog was very spectrally inefficient (in hindsight), was very costly. Coverage was spotty but improving. People did not leave their phones “on” because they feared that someone would actually call them. Receiving an unnecessary call was not good, since service was often in the \$0.70/min. range – on phones that operated on fast-dying batteries. Cloning – stealing someone’s cell phone number – was rampant, with massive fraud losses for wireless operators. Even with these constraints, the freedom, flexibility and convenience of having a wireless phone drove adoption rates. By the mid ‘90s, analog cellular was growing rapidly in North, Central and South America – the U.S. wireless market alone was dominated by analog cellular (AMPS), with tens of millions of users.

Digital systems arrived in the U.S. in the early ‘90s, with the first U.S. TDMA system launching in 1993 and the first U.S. GSM systems in 1995. In 1996, the first cdmaOne systems were launched. To consumers, a digital phone meant:

- Smaller phones
- Better battery life
- Better user interfaces
- The beginning of wireless Internet access
- Excellent voice quality
- Fewer dropped calls
- Lower tariffs for voice calls
- Short Message Services (SMS)
- More extensive selections of devices and service plans
- Data access in North America at 9.6 Kbps (GSM networks) or 14.4 Kbps (cdmaOne networks)
- Data access in Europe at 20-40 Kbps (GPRS networks) on black & white display phones.

By the mid to late '90s, “digital migration” began in earnest in the U.S. At first it was just a trickle. Then cell phone users by the millions, then by tens of millions, moved to digital wireless services. Many were migrating from their analog phones; others, who had been on the sidelines, were enticed into getting a wireless phone for the first time because of features listed above. Note that not one of these tens of millions of users migrated from analog to digital in the mid to late '90s because they wanted a “2G phone.”

Why? Because the wireless industry at the time was only discussing “3G.” Moreover, there was no classification of the Gs (1G, 2G or 3G); there was no “G” nomenclature yet. Hence “3G” and “What is 3G?” did not exist in the minds of wireless device users. The reason why users shifted from analog service to digital service was because one or more of the features listed above created a compelling reason to buy a new phone and go with a new technology. The devices and the services were different and, in many cases, better.

From the wireless operators’ perspective, the incentive to migrate to digital came from the need to expand voice capacity. Plus, the economics to operators were fundamentally different, allowing innovation in service plans and segmentation. Finally, new manufacturer entrants and growing phone volumes increased operator choice, improved handset selection and reduced prices for consumers.

Then sometime during the late '90s, “3G” went from a label for the next generation of wireless technology to the basis for controversy driven by business interests – even as digital technologies such as cdmaOne, GSM and TDMA (all 2G) were being deployed. The fight for market share, based on technology distinctions, began. Some perceived it as a war – CDMA vs. GSM vs. TDMA. Within the wireless industry, these battles were called “the technology holy wars.”

These wars, particularly the “CDMA vs. GSM” conflict, were irrelevant to businesses and consumers. Why? Because, similar to the irrelevance of 1G/2G/3G classifications, people simply selected (and will continue to select) the technology that delivered a fundamentally *better wireless experience* than they had with the phones they were replacing, not for reasons of claimed capabilities or alphabet soup (G, GSM, TDMA, CDMA, etc.).

Adoption and revenues were not driven by press releases, interviews, white papers or slick presentations; they were driven by *real execution* and the *real sales* generated by the *real products and services* for which *real consumers and businesses* were willing to pay.

### **Answer Not “What is 3G?” But “What Can 3G Do for Everyone?”**

While the majority of those working in the wireless industry welcomed the concept of 3G and the end of the “holy wars,” the great debate, “Which technologies are 3G?” still rages in the media and at analyst firms in many regions across the globe.

For the original definition of “3G,” go to [www.imt-2000.com](http://www.imt-2000.com). The International Telecommunications Union (ITU), the telecom arm of the United Nations, in conjunction with regulatory and standards bodies worldwide, defined 3G first. It chose a “family of standards” approach, in which *both* CDMA2000 and WCDMA were classified as 3G and fell under the CDMA family. EDGE is technically classified as 3G, but falls under a TDMA system migration that was not followed by any operator in the world. It is not classified as 3G within the GSM migration path.

Some within the industry, however, find it more convenient to change the definition as they go along, to meet their business imperatives. Others go as far as to say 3G does not yet exist or 3G is not necessary.

For instance, consider the following attempt at self-serving definitions by one wireless vendor at the October 2003 International Telecommunications Union (ITU) show in Geneva. This vendor provided a reporter from a top-tier global business publication a hand-drawn table that illustrated the vendor’s definition of 3G. It read as follows:

<b>2G</b>	<b>2.5G</b>	<b>2.75G</b>	<b>3G</b>
GSM	GPRS	EDGE	3GSM
IS-95	CDMA2000	1xEV-DO	1xEV-DV

The problems with this hand-drawn chart are obvious. First, whoever crafted it was attempting to keep the reporter from focusing on the key 3G issues:

- What are operators able to sell?
- What are people buying?
- Is it driving revenues for the operator?

In the case of GPRS, it’s not selling to enterprise customers – it can’t handle the capacity and it’s considered slow by users.

In the case of EDGE (Enhanced Data for GSM Evolution), it’s still not living up to the promised bit rates – after five years of press releases touting speeds of 473 Kbps and then 384 Kbps, the latest claims are “average speeds” of 100-130 Kbps. (Our tests with a commercial EDGE system in Indianapolis revealed speeds nowhere near 100-130 Kbps.)

In the case of “3GSM,” it is a term beginning to be seen in wireless industry presentations and white papers. Recall the aforementioned section about the role of standards? The 3G standard now being deployed around the world by many GSM operators is called either UMTS or WCDMA. These terms have been defined by the ITU and “3GSM” is simply a marketing construct, it is not a standard.

Another definition of 3G that should be considered more closely: a combination of devices, services and applications so appealing and so different from the prior devices and services, that consumers or business professionals are compelled to buy new phones, try new services, and are willing to continue paying for those services over time. The

same way tens of millions of people switched from 1G to 2G before the “G” nomenclature ever showed up.

This definition is appealing because it is forward-looking and does not state any specifications subject to over-analysis. This definition has the potential to actually accelerate the growth of 3G and the entire wireless industry.

### **The Truth about “Economies of Scale” in Wireless**

Economies of scale are achieved when the cost of products drop as production volumes rise. Since mobile phones of all technologies share many of the same components, economies of scale have allowed all mobile phones to come down in price over time.

The UMTS Forum, a trade organization dedicated to the adoption of UMTS (WCDMA) technology, published a white paper in August 2003 titled, “*Mobile Evolution: Shaping the Future.*” On page 17, it states:

It could be assumed that the cost of 3G handsets will be high. This is revealed not to be the case when the individual cost elements of a handset are examined. The overall cost may be divided into two categories: the part supporting radio functions such as GSM/GPRS, EDGE, or WCDMA; and the part supporting applications, including colour displays, application processors, camera and expanded memories. In reality, it is the cost of this second element that dominates in high-tier, feature-rich models.

Research indicates that the lower-end WCDMA segment will be only marginally more expensive than a 2.5G handset. In view of the customer’s total spending on mobile services, this may not be significant.

The most important price factor for handsets is volume. Due to higher market volumes, GSM handsets are less expensive than CDMA equivalents. With 3G, this volume effect suggests that handsets in the GSM/WCDMA family, will, taking a longer-term perspective, be substantially cheaper than CDMA2000 handsets.

The UMTS Forum is correct in that phones have much in common. However, the UMTS Forum’s assertion that WCDMA will be less expensive than CDMA2000 because of large GSM volumes is flawed. The hardware and feature characteristics of CDMA2000 devices have more in common with WCDMA devices than WCDMA devices have with GSM devices.

Consider this: A wireless device consists of radio and digital content housed on an array of semiconductors on the device. This typically consists of +/- 60% or so of the device manufacturing costs. The other +/- 40% of the wireless devices are components such as the plastics, battery, LCD, memory, keypad, antenna, screws, passive components, etc.

The economies of scale of these devices are predicated not on the volumes of any given technology such as GSM, but rather on global wireless volumes – currently more than 400 million units per year for all technologies such as analog, TDMA, GSM, cdmaOne, CDMA2000, etc. A battery or LCD does not know or care what wireless technology is in a phone.

Now take a closer look at a GSM phone. The radio side of a GSM phone is a TDMA device – the same family of radio technology now being abandoned by U.S. operators. There is very little of this GSM phone that will translate into economies of scale for a WCDMA single mode device.

WCDMA single mode devices use a CDMA-based radio and WCDMA/GSM dual mode devices will need to have both a CDMA-based radio and a TDMA-based radio, resulting in higher costs.

By the middle of this decade and beyond, as WCDMA begins to ship in volume, we expect that the volumes of both CDMA2000-based devices and WCDMA-based devices will be shipping in significant enough numbers for both to reach a “cost floor,” producing compelling economies of scale. The advantage at that time will still be marginally in favor of CDMA2000 due to lower technical complexity and the projected need for WCDMA devices to be dual or tri-mode GSM/GPRS/WCDMA.

Additionally, we expect that by the middle of the decade and beyond, “multistandard” silicon from QUALCOMM and others will create a new class of devices that make problems with true global roaming a thing of the past.

Lastly, in the largely misguided debate about economies of scale, a key point gets lost. Ask which costs the least among pre-3G technologies. The answer could be GSM. However, the real answer is *analog*. Although GSM will still enjoy high volumes for the next several years for its voice, roaming and limited messaging capabilities, the fact remains that GSM/GPRS will *not* deliver the same type of compelling consumer/enterprise experience or compelling operator business models as 3G services and devices based on CDMA2000 and WCDMA. The behaviors, shown by both consumers and operators during the transition from analog systems around the world to early digital-based systems will be repeated, and may dramatically accelerate the adoption of all forms of 3G CDMA.

### **Now See the Wireless World Clearly**

As readers can see, the conventional wisdoms of “CDMA vs. GSM,” “What is 3G?” and economies of scale are misguided, at best. If readers look at the wireless world through the lens we have put forward, it leads to a different view of wireless device forecasts – forecasts from reputable industry analyst firms that actually break out their predictions by actual technologies (PDC, GSM, cdmaOne, CDMA2000, WCDMA) and do not use marketing constructs like “3GSM.”

What readers will find is that CDMA2000 has a volume advantage over WCDMA until typically somewhere in the 2007-08 timeframe. But if one adds up 3G CDMA volumes – CDMA2000 *and* WCDMA – global 3G unit volumes approach 50% of total volume in that same timeframe. This leads us to *aggregate revenue*.

As stated, CDMA2000 and WCDMA may constitute 50% of total global unit volume of a forecast. Average selling price of a wireless phone (ex-factory, not operator subsidized price) by wireless technology is harder to find. However, dedicated research will reveal that somewhere between 60% and 70% of *aggregate revenue* of wireless handset manufacturers could be driven by CDMA2000 and WCDMA devices by 2007-08. And the revenue of the “others,” GSM/GPRS only devices, GSM/GPRS/EDGE, PDC, TDMA, cdmaOne, TACS, ETACS, NMT, etc. have either gone to technological oblivion, or have, *in aggregate*, a decreasing share of the wireless unit and revenue pie.

Note that this framework has been discussed with *dozens* of industry analysts from most of the global wireless industry analyst firms. Not one firm has been able to provide evidentiary proof (bills of materials, comparative ex-factory pricing, etc.) – no PowerPoint presentations, opinions, theoretical behavior studies, or unsupported claims – that says otherwise. Nobody has challenged this framework in any manner for any year before 2007, but that has not stopped many firms from continuing to propagate the flawed viewpoint mentioned above regarding economies of scale.

After 2007, it's not really clear whether there will be a cost differential between WCDMA and CDMA2000; whether an increasing percentage of handsets will have both technologies built-in (plus GPS, plus Bluetooth, etc), making the question irrelevant; whether the technological differences from the development and production of devices is so minor at that point that any ex-factory device cost difference is likely to be trivial.

### **Proof Points**

Now we will “deconstruct” three topical subjects – camera phones, wireless in India and wireless in Japan – as “proof points” for the perspective offered in this paper regarding “CDMA vs. GSM,” “What is 3G?,” and economies of scale.

### **The Need for Higher Speed Networks Proof Point: Camera Phones**

The advent of the camera phone, combined with Moore's Law, is accelerating the need for 3G networks as cell phone makers are incorporating higher and higher resolution cameras.

Consider the following: Would a camera phone be successful on a black & white bitmap or single line LED or LCD display on phones from five or six years ago? Without any memory in your phone to store the photos? Without a wireless network with the ability to transmit the pictures from one phone to another, or from a phone to a PC via email? The answer is “no” to all these questions.

The success of camera phones is a function of a broad range of developments that have occurred in wireless devices and networks over the past two years – CCD (charge

coupled device, the camera itself), higher resolution active-matrix LCDs, more memory and network capabilities that allow a consumer to actually use the service.

Then came color phones. The first ones were small and the displays were tiny. They were low-resolution passive-matrix LCD. They had small memories and slow, high-latency wireless Internet browsers, connected to slow networks. In reality, the limitations of these displays kept users from doing anything really new with the phones. Regardless, manufacturers marketed color phones aggressively in magazine ads and airport displays.

Then phones got brighter, bigger, higher resolution displays and more memory to store photos. The user interfaces improved. Wireless networks were upgraded to 3G – CDMA2000 and WCDMA. Faster networks allowed more bits to move through the air, which enabled network operators to charge more reasonable tariffs and encourage consumers to use their camera phones.

Consider this: If consumers have lousy camera phones, connected to a lousy network, on phones with substandard low-resolution color screens, do they use them? Do they pay recurring revenues for the service? No. Evidence over time demonstrates this fact.

Conversely, if consumers have camera phones and services that they like, they use them. And when they buy new phones in the following 12-18 months, they don't ask for phones with less memory that take fuzzier pictures and cost them more to send photos. Instead, they go to their local electronics stores and purchase phones with better cameras, more memory to store photos and better displays for photos, gaming and applications readability. The same dynamic occurred in the PC world and is occurring now with digital cameras.

Here are three more examples of other emerging applications/services that have the same dynamic:

- **Downloadable Applications** – The first BREW™ applications a few years ago were downloaded onto monochrome, bit-mapped displays. Most early BREW apps were 12-45 KB. Two years later, most applications are in the hundreds of KB and growing. As these ever-growing-in-size, ever-more-appealing applications marry to better displays, better multimedia capabilities in the chips, larger memory in the phones, better network capabilities for economic high-speed data access, this dynamic will only accelerate.
- **Video (download)** – Although a lot of attention in the WCDMA world is focused on video telephony, the majority of people are not paying attention to what's happening *quickly* in other parts of the world – the download of larger, richer, video and audio content to wireless devices with faster network access, better displays and more internal memory. In South Korea and Japan, downloading 15-second low-resolution video clips used to be the norm. It has evolved into downloading multi-megabyte video files (such as music videos, sports info and

movie trailers, etc.) in a way that is usable by the consumer and economical for both the consumer and the wireless operator.

- **Internet access via PC Card** – Looking at things from an enterprise perspective, IT departments want ubiquitous access, the fastest data rates possible and the lowest costs given those two constraints. Wireless operators want to keep their customers, to maximize their revenues and reduce their costs. They do not want data services to cause nasty, harmful things to happen to their voice networks. The advantage here remains on every point for CDMA2000 systems today migrating to 1xEV-DO and to WCDMA systems migrating to HSDPA (High Speed Downlink Packet Access).

We'll stop here in the interest of available space. But the full list of examples goes on and on.

The bottom line is that Moore's Law is working just as effectively in the mobile phone world as it has been in the PC world. New CDMA2000 and WCDMA networks allow large photo and multimedia files and applications to be transmitted at ever-lowering costs. More efficient networks, more differentiated services for the operator to offer, less cost to the operator, cool new products and services users are willing to buy because prices are reasonable. . . Don't let anyone tell you that you do not need 3G.

There's another point to raise here, one that refers back to the economies of scale section of our discussion. We've mentioned ever-higher resolution CCD cameras, advanced LCD displays, memory and more. Keep in mind that all of these costly components will decline in price due to aggregate volumes of *all* phone manufacturers making phones for various regions and technologies. It's a fairly safe wager that the economies of scale on megapixel camera phones, 15-30 frame/sec. videophones, and other advanced functionality are *not* going to be driven by GSM/GPRS devices. GSM/WCDMA, yes. CDMA2000, yes. GSM/GPRS, no.

### **Business Reality Proof Point: Wireless India**

To begin on this point, keep in mind the following five facts about India from a telecom perspective:

- 1) India has very low teledensity. India's number of phone lines per thousand people, both wireline and wireless in aggregate, is well under 10%.
- 2) India has high price elasticity on services. The lower the prices, the more folks are willing to buy services. It's similar to other places around the world, but even more pronounced than in most other markets.
- 3) India has scarce spectrum. Both GSM and CDMA2000 operators are very limited on the amount of spectrum to which they have access. In the case of the CDMA2000 operators, they are often limited to 5 MHz transmit, 5 MHz receive. This means that all Indian wireless network operators have to use their spectrum as efficiently as possible.

- 4) India has an amazingly technical workforce. The people in India do their research and have the ability to get the most out of a technology, often in less than ideal situations.
- 5) India is very far away from the U.S.

Fact #5 is particularly important because it relates to Fact #4. Because India's workforce is so technically savvy, they are immune to marketing spin from the predominantly Western companies. They are not reading the same business magazines as we do in the West. They are not spending entirely too much time at trade events.

What they are trying to do, within the constraints of Facts #1, #2 and #3, is *radically* reshape the communications landscape in India and ultimately reshape and grow their country. Hence, they are doing their research.

Many of the operators have both GSM and CDMA2000. Two of the largest operators – Reliance and Tata – work with both systems. In a scarce spectrum situation, they are trying radically to raise teledensity in a massively price elastic marketplace. They are introducing advanced voice and data services – services many parts of the world are without – into the hands of the Indian population. Although they complain to CDMA2000 vendors that they would like the voice-only CDMA2000 phones to be in the same price range or lower than comparable GSM phones, they are investing heavily in CDMA2000.

Why? Because CDMA2000 networks enable them to meet their business objectives in ways that their GSM networks cannot. If the spectrum was available, WCDMA could allow the same services to be delivered, but the spectrum is not available. In India, it is not a technology debate that interests the wireless industry, it's the business reality.

This is not about the CDMA-GSM conflict; this is about delivering services, at price points and efficiencies that work for both the consumer and operator. In India, it is about the capabilities of 2G vs. 3G, even when the focus is on voice services and expanding teledensity.

### **Wireless Experience Proof Point: Wireless Japan**

Despite what some industry advocacy groups' recent marketing materials say, Japan has *never* had a GSM system. Prior to their 3G evolution, Japanese operators used PDC (Personal Digital Cellular) and PHS (Personal Handyphone System). PDC, which is a close cousin to the U.S. TDMA networks, is now being classified as a GSM system by certain trade groups because it makes their numbers look more impressive.

DoCoMo launched the country's first 3G network in October 2001. As the network has matured, as the services have stabilized, as the handset selection has grown, as handset size has shrunk and battery life has improved, traction has occurred, and will continue to occur in 2004 and beyond. Note that this is not success from PowerPoint presentations and white papers, but rather through focus on users and execution.

KDDI launched their CDMA2000 network in 2001. Since that time, they've introduced ever more innovative handsets and services. Vodafone KK (formerly J-Phone) has launched their WCDMA network, with an ever increasing number of handsets, including dual mode multiband handsets with GSM/GPRS/WCDMA for international travelers.

Our proof point is a question and a challenge. There are two WCDMA networks in Japan, and another that is CDMA2000. All three networks are expected to grow subscribers and continue to add innovative services. In the case of KDDI, they have also launched CDMA2000 1xEV-DO for the majority of Japan's population on Nov. 28, 2003. What happened to the cdmaOne (2G) subscribers? Per KDDI's published numbers, the majority has already migrated to CDMA2000 (3G). Readers might be wondering how this can be, since KDDI has *never* marketed its services as "3G" to consumers. KDDI did nothing short of a phenomenal job of popularizing an amazing array of new devices and services – without mentioning or making issue of the "Gs."

And what is happening to the PDC subscribers on multiple networks in Japan? Review the chart below. PDC is not a growth industry.

### Current Japanese Subscriber Numbers (April 30, 2004)

System	Groups	April 2004		March 2004
		Increase	Total	Total
<b>PDC</b>	NTT DoCoMo Group	-346,100	42,535,500	42,881,600
	TU-KA Group	-7,300	3,624,500	3,631,800
	Vodafone Group	10,900	14,875,600	14,864,700
	PDC Subtotal	-342,500	61,035,600	61,378,100
<b>cdmaOne</b>	au Group	-200,800	3,248,800	3,449,600
<b>WCDMA</b>	NTT DoCoMo Group	530,500	3,575,700	3,045,100
	Vodafone Group	13,700	151,400	137,700
	WCDMA Subtotal	544,300	3,727,100	3,182,800
<b>CDMA2000 1X</b>	au Group	488,600	13,997,800	13,509,200
<b>Mobile Telephone Total</b>		<b>489,600</b>	<b>82,009,300</b>	<b>81,519,700</b>

Source: Telecommunications Carriers Association, [www.tca.or.jp](http://www.tca.or.jp)

In a hyper-competitive market like Japan, wireless network operators will be competing with one another on the basis of innovation, cool devices, services, applications, enterprise marketing and customer service. It's not about "CDMA vs. GSM," or "CDMA2000 Theory vs. WCDMA Theory." The market for new devices will rapidly evolve to CDMA2000 + WCDMA > PDC + PHS.

So how does this lesson apply to GSM/GPRS markets where there are competing CDMA2000 networks, emerging WCDMA networks, or both? It's obvious. Sales of

2/2.5G handsets and systems have been large, but will be declining businesses, especially with handsets, as 2/2.5G connectivity increasingly becomes a “mode” in a 3G CDMA2000 or WCDMA handset.

###