Department of Computer Science & Engineering

SOUTHEAST UNIVERSITY

ETE3037: Mobile Communication

GSM VS CDMA

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Contents

Chapter 1

Introduction

Two basic technologies in mobile phones, CDMA and GSM represent a gap you can't cross. They're the reason you can't use many ATNT phones on Verizon's network and vice versa. But what does CDMA vs. GSM really mean for you?

CDMA (Code Division Multiple Access) and GSM (Global System for Mobiles) are shorthand for the two major radio systems used in cell phones. Both acronyms tend to group together a bunch of technologies run by the same entities. In this story, I'll try to explain who uses which technology and what the real differences are.

Chapter 2

The Technology Behind CDMA vs. GSM

CDMA and GSM are both multiple access technologies. They're ways for people to cram multiple phone calls or Internet connections into one radio channel.

GSM came first. It's a "time division" system. Calls take turns. Your voice is transformed into digital data, which is given a channel and a time slot, so three calls on one channel look like this: 123123123123. On the other end, the receiver listens only to the assigned time slot and pieces the call back together.

The pulsing of the time division signal created the notorious "GSM buzz," a buzzing sound whenever you put a GSM phone near a speaker. That's mostly gone now, because 3G GSM (as I explain later) isn't a time division technology.

CDMA required a bit more processing power. It's a "code division" system. Every call's data is encoded with a unique key, then the calls are all transmitted at once; if you have calls 1, 2, and 3 in a channel, the channel would just say 66666666. The receivers each have the unique key to "divide" the combined signal into its individual calls.

Code division turned out to be a more powerful and flexible technology, so "3G GSM" is actually a CDMA technology, called WCDMA (wideband CDMA) or UMTS (Universal Mobile Telephone System). WCDMA requires wider channels than older CDMA systems, as the name implies, but it has more data capacity.

Since its inception, GSM has evolved faster than CDMA. As I mentioned above, WCDMA is considered the 3G version of GSM technology. To further speed things up, the 3GPP (the GSM governing body) released extensions called HSPA, which have sped GSM networks up to as fast as 42Mbps, at least in theory.

Our CDMA networks, meanwhile, are stuck at 3.6Mbps. While faster CDMA technologies exist, U.S. carriers chose not to install them and have instead turned to 4G LTE to be more compatible with global standards.

Chapter 3

CDMA vs. GSM (Dominance)

In the U.S., Sprint, Verizon and U.S. Cellular use CDMA. ATNT and T-Mobile use GSM.

Most of the rest of the world uses GSM. The global spread of GSM came about because in 1987, Europe mandated the technology by law, and because GSM comes from an industry consortium. What we call CDMA, by and large, is owned by chipmaker Qualcomm. This made it less expensive for third parties to build GSM equipment.

There are several variants and options carriers can choose, like toppings on their technological ice cream. In this story we'll focus on U.S. networks.

Chapter 4

Frequency Band

4.0.1 GSM

Multiple (850, 900, 1800, and 1900 MHz)

4.0.2 CDMA

Single (850 MHz)

Chapter 5

Data transfer between GSM and CDMA

In cities and densely populated areas, there are often high concentrations of GSM and CDMA connection bases. In theory, GSM and CDMA are invisible to one another and should "play nice" with one another. In practice, however, this is not the case. High-powered CDMA signals have raised the "noise floor" for GSM receivers, meaning there is less space within the available band to send a clean signal. This sometimes results in dropped calls in areas where there is a high concentration of CDMA technology. Conversely, high-powered GSM signals have been shown to cause overloading and jamming of CDMA receivers due to CDMA reliance upon broadcasting across its entire available band.

The result of this little cross-broadcasting joust has led some cities to pass ordinances limiting the space between cell towers or the height they can reach, giving one technology a distinct advantage over the other. This is something to note when choosing a wireless provider. The distance between towers will severely affect connectivity for GSM-based phones because the phones need constant access to the tower narrow band broadcasting.

Chapter 6

Components and Storage type

6.0.1 GSM

SIM (subscriber identity module) Card

6.0.2 CDMA

Internal Memory

Most of us will never have to think about whether or not our phones are CDMA or GSM-based. These acronyms are meant to be transparent, just like so many other tech standards are. (Most HDTV owners don't really care much if their images are delivered via Component or HDMI cable, nor do most music listeners mind if their music was encoded as a AAC file or an MP3-as long as the quality does not suffer.) But that's not to say that they aren't different.

First, let's get this out of the way: I've been using GSM and CDMA as blanket names for a set of standards that have changed over time. Most new phones on ATNT and T-Mobile actually adhere to both GSM and the newer UMTS (Universal Mobile Telecommunications System) standards. UMTS isn't an official part of the GSM standard, but it is what GSM carriers use for 3G

data transmission. Likewise, CDMA2000, based more directly on its predecessor includes a range of improvements over the original CDMAOne, key among them 3G data speeds. Though both GSM and CDMAOne standards are on their way out, I fully expect their names to live on as shorthands for what comes next. After all, they were the basis of the entire cellular industry as we knew it for decades.

Chapter 7

Mobile Network and Coverage

Network coverage doesn't depend on whether it is GSM or CDMA network, but rather on the infrastructure the carrier has in place. GSM networks are far more popular globally, but in the US, Verizon Wireless, a CDMA network, boasts the highest number of subscribers in the country

Back in 1995, CDMA was an insurgent standard trying to supplant the dominant GSM, and the differences between the two technologies were more obvious. Old-school, 2G GSM phones worked better inside of buildings (neat trick: If you're having trouble getting a signal indoors, switch off your 3G), but caused interference in unshielded speakers (side-effect of aforementioned 'neat' trick). At the same time, CDMA phones had a slightly more refined method for handing off calls from tower to tower, so they dropped fewer calls. This is still true. It's also still true that 2G GSM networks can offer better coverage in mountainous terrain, since they utilize taller cell towers, though range of said towers is otherwise a bit shorter. Additionally, GSM (and UMTS) phones can send and receive data packets while making a call, which most CDMA networks still don't support.

Such were the arguments for and against CDMA when it barged into the scene in 1995, at time when GSM was the only game in town and most people didn't even own cellphones. So it follows that these original performance differ-

ences, which were striking at the time, now don't matter matter quite so much anymore. If a Droid gets better reception at your house than an iPhone, it's not because one is a CDMA2000 phone and the other is a GSM/UMTS phone. It's most likely because Verizon has a tower closer to your pad, and the backhaul to support your calls.

Chapter 8

International Roaming

In your home market, it doesn't matter what kind of network it is, with the focus instead on the available coverage. However, when it comes to international roaming, GSM has the upper hand, with their being a lot more GSM networks around the world, along with roaming deals between these providers. With a GSM phone, you also have the advantage of picking up a local SIM card wherever you are, assuming that you have an unlocked device. You may not get full access to data connectivity, depending on the device and network compatibility though.

CDMA2000 operators offer international roaming to their customers in major travel destinations either through agreements with other CDMA (cdmaOneTM and CDMA2000) operators, WCDMA or GSM carriers. CDMA2000 operators have taken the lead in offering true global roaming by introducing multi-mode, multi-band phones that work on GSM and CDMA networks.

With nearly 300 networks in over 100 countries, CDMA has the presence in key global markets to support international roaming. CDMA to CDMA roaming is available in many countries across North America, Latin America, the Caribbean, Asia and the Middle East. Many CDMA2000 operators have also established agreements with GSM operators, enabling them to offer international

roaming in GSM markets. With the introduction of WorldModeTM multi-mode, multi-band phones, CDMA2000 operators can now provide transparent roaming across CDMA2000 and GSM networks with a single device.

The CDG has established the International Roaming Team (IRT) to lead the industry's effort in providing subscribers with the ability to enjoy the benefits of CDMA service globally. The charter of the team is to develop tools and recommend best practices to assist operators in the deployment, maintenance and marketing of international roaming services.

Chapter 9

Global Market Share

9.0.1 CDMA

25

9.0.2 GSM

75

Chapter 10

Future Of This Technologies

With the advent of 4G and the adoption of LTE and LTE-Advanced as the standard by the majority of network carriers worldwide, the debate of GSM vs CDMA matters less everyday. You may have noticed the latest smartphones intended for CDMA networks also coming with SIM card slots, to take advantage of the network's 4G LTE capabilities. While GSM and CDMA devices cannot be interchanged even now, and will never be cross-compatible, that won't make a difference as we continue to make a push towards 4G LTE. Unless international roaming is a factor, as far as your voice call and 3G data needs are concerned, both GSM and CDMA networks are equally good, with factors like availability, coverage, customer service, and price, more at play here.

The CDMA vs. GSM gap will close eventually as everyone moves to 4G LTE, but that doesn't mean everyone's phones will be compatible. LTE, or "Long Term Evolution," is the new globally accepted 4G wireless standard. All of the U.S. carriers are turning it on. For more, see 3G vs. 4G: What's the Difference?

The problem is, they're turning it on in different frequency bands, with different 3G backup systems, and even, in the case of the new Sprint Spark network, using an LTE variant (TD-LTE) that doesn't work with any other U.S. carrier's phones. There are very few phones that support all of the carriers' LTE bands.

Verizon has said it aims to start selling LTE-only phones in 2015, but for now, those will require special Verizon software to make voice calls, so that move won't make it any easier to switch carriers with your phone. Even without CDMA, the CDMA philosophy of carrier control of your phone will remain intact.

A growing number of phones support all of these standards, but it can be hard to tell which ones. The iPhone 6, the iPhone 6 Plus and the Google Nexus 6 are the most flexible. iPhone 6 and 6 Plus units from ATnT, T-Mobile, and Verizon can all be used on all three carriers, but they lack Sprint's special LTE bands. Sprint iPhones have all the bands, but Sprint has strict unlocking policies. Nexus 6 phones will technically work on all four carriers, but Sprint only allows phones purchased from Google or Sprint on its network.

HTC One (M8) and Samsung Galaxy S5 phones from Verizon will work somewhat on ATnT's and T-Mobile's networks, albeit with limited coverage because while they have CDMA, GSM and LTE, they don't have all the frequency bands ATnT and T-Mobile use. Variants of those same models sold by ATnT and T-Mobile won't work on Verizon at all, because they lack the CDMA radio needed for Verizon. It's a mess.

So what does all of this mean for you? If you want to switch phones often, use your phone in Europe, or use imported phones, just go with GSM. Otherwise, pick your carrier based on coverage and call quality in your area and assume you'll probably need a new phone if you switch carriers. Our Readers' Choice and Fastest Mobile Networks awards are a great place to start.