

Comparison of CDMA and GSM

CDMA (Code Division Multiple Access) digital cellular mobile communication technology have many merits such as: large system capacity, strong interference-resistance , high quality voice communication, lower power consumption of handset, etc.

Telecommunication administrator and operators are usually concerned with 6 key factors to determine on the selection of technology and investment, those are Coverage, Capacity, Clarity, Choice, Cost and Customer satisfaction, we always call them "6 C", we will try to give you a comprehensive comparison between GSM and CDMA in this paper

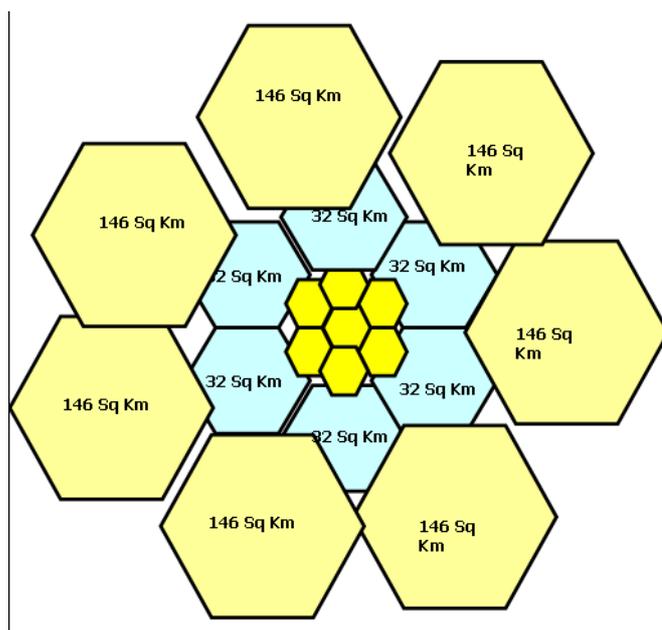
1 · Coverage

It is a basic requirement to supply appropriately coverage area for cellular mobile communication network, WLL (wireless local loop) and PCS (personal communication system) . In fact, the coverage areas of each cell are mainly affected by link budget, especially by reverse link budget. Operator can obtain the comparison with different technology on the radius of cell and the number of BTS required under definitely-specific link budget. Figure 1 shows you the comparison of coverage radius between GSM and CDMA under the same conditions.

Fig 1, coverage comparison between GSM and CDMA

Parameter	Dense urban	Sparse urban	Suburb	countryside
CDMA cell coverage(km2)	3.1~8.1	5.3~13.8	28.3~73.2	254.4~659.1
GSM Cell coverage(km2)	0.6~1.6	1.1~2.8	9.1~23.5	76.4~197.8
CDMA : GSM coverage ratio	5.2 : 1	4.9 : 1	3.1 : 1	3.3 : 1

As figure 1 shown, we can see that the coverage area of CDMA is about 4 times larger than GSM, which means the number of cells for CDMA is 80% less than GSM under the same coverage in theory. In fact, the advantage of CDMA with lager coverage than GSM has been proved practically by numerous CDMA operators around world.



The above figure is an example that showing the coverage of 1000 sq km with 1.9GHz CDMA BTS. The number of CDMA BTS required is just 20, while GSM

will require about 100 BTS to cover this same area,.

2 · Capacity

Radio frequency resource is limited and expensive, therefore high frequency reuse capability will help operators to save investment in frequency spectrum and relational field .as a matter of fact, CDMA has about 10 times larger capacity than AMPS and 5 times larger than GSM. Larger capacity is one of the most important features of CDMA

The capacity comparison of CDMA · GSM · AMPS with 10MHz and 30MHz are shown in figure 2 and figure 3 ° Assumption: CDMA is assigned with 3 carriers in 10 MHz and 11 carriers in 30 MHz, protect band for CDMA is considered, but for GSM and AMPS, protect band aren't considered optimistically °

Fig 2, 10MHz frequency band occupied (5MHz transmitting, 5MHz receiving)

Parameter	CDMA	GSM	AMPS
Channel bandwidth	1.25MHz	0.20MHz	0.03MHz
The number of channel	3	25*	167*
frequency reuse	1/1	3/9**	7/21
effective channel	3/1=3	25/3=8.3	167/7=23.8
voice call/channel	25 to 40+	7.25***	1
voice call/cell	75 to 120+	7.25×8.3=60.2	23.8
sector/cell	3	3	3
voice call/sector	75 to 120+	60.2/3=20.0	23.8/3=7.9
Erlangs/sector****	64 to 107E	13.2E	3.6E
*under optimization condition, no protecting bandwidth, **Qualcomm's opinion: It is nearly impossible to deploy practically, Italian GSM network adopt 4/12 in Europe so far, ***0.175 less than 8 voice calls/channel, used to realize Control and Pilot function,**** 2% chock rate °			

Fig 3, 30MHz frequency band occupied (15MHz transmitting, 15MHz receiving)

Parameter	CDMA	GSM	AMPS
Channel bandwidth	1.25MHz	0.20MHz	0.03MHz
The number of channel	11	75*	500*
frequency reuse	1/1	3/9**	7/21
effective channel	11/1=11	75/3=25	500/7=71.4
voice call/channel	25 to 40+	7.25***	1
voice call/cell	275 to 440+	7.25×25=181	71.4
sector/cell	3	3	3

voice call/sector	275 to 440+	181/3=60.4	71.4/3=23.8
Erlangs/sector****	261 to 426E	50E	16E
*under optimization condition, no protecting bandwidth, **Qualcomm's opinion: It is nearly impossible to deploy practically, Italian GSM network adopt 4/12 in Europe so far, ***0.175 less than 8 voice calls/channel, used to realize Control and Pilot function,**** 2% chock rate °			

We can learn from two above figures that the capacity of CDMA in 10 MHz is 64 Erl/sector, 4.8 times larger than GSM and 17 times larger than AMPS, Even if protect band is considered. As for 30 MHz, the capacity of CDMA is nearly 5.2 times larger than GSM and 16 times larger than AMPS, in other words, the capacity of CDMA in 10 MHz is 128% than the capacity of GSM in 30 MHz

3、COST

Usually, the initial investments of network construction include system equipment, power supplier, transmission equipments, installation, network planning, etc,

As mentioned above, the number of CDMA BTS required is about 80% less than GSM BTS in the same coverage, so the system equipment investment will be saved, meanwhile all the accessory facility investment will decrease obviously, too.

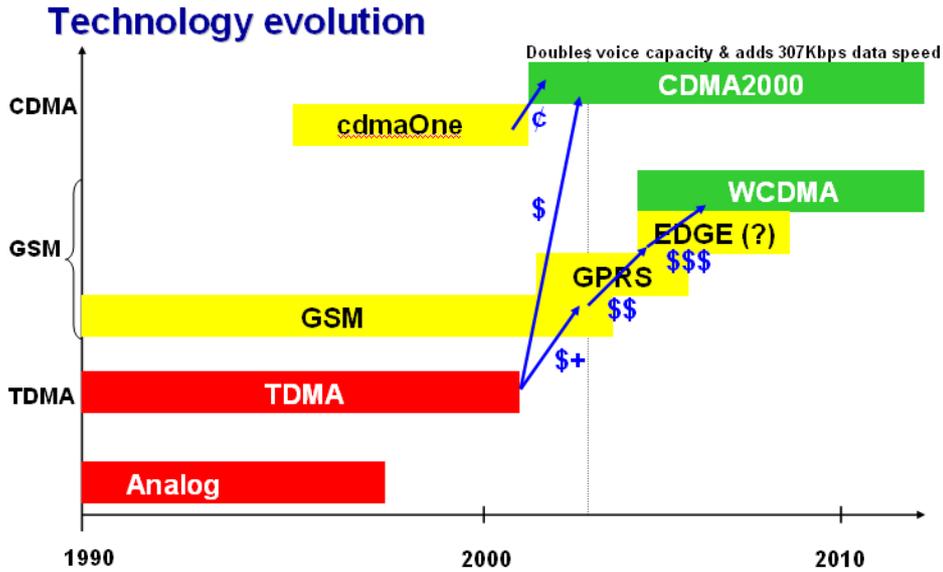
In addition, the frequency reuse coefficient of CDMA is 1 compared with 3/9 of GSM, therefore CDMA network planning is easier than GSM, so and the corresponding investment will decrease.

Sometimes, cost will be influenced by the time of entrance market market entry, the less network planning and BTS required, the more time taken before entrance market the faster to capture the market.

On the other hand, with the large scale deployment of CDMA in the world, the number and type of CDMA handset has increased rapidly, the trends of handset price is much lower. Many familiar brand terminals, such as MOTOROLA, LG, SAMSUNG, ZTE, are easily obtained from market, there are more than 200 commercial 3G CDMA devices from over 30 different vendors are commercially available nowadays.

Most of all, CDMA is an technology with excellent backward and forward compatibility, but GSM isn't, because WCDMA, which is the 3G evolvment evolution destination of GSM, adopt CDMA technology but GSM is TDMA, most of GSM network components should be replaced by new equipments when migration migrating to 3G, so the investment of evolvment is huge. Figure 4 is shows the technology evolution routes and investments analysis.

Fig. 4 Technology evolution routes and investments



On the contrary, when upgrading CDMA network, what CDMA have to do is just to adding another 3G channel boards in BTS rack, all the other components of CDMA network ~~needn't~~ does not need to be changed,. Therefore for CDMA technology, the cost of ~~evolvment~~ evolution is much cheaper than GSM

So far, CDMA is a cost effective voice solution in every environment and enables rich data services, CDMA can offers a competitive advantage for operators vs. GSM/GPRS. CDMA enables lower costs and higher margins as well as greater flexibility in pricing and service offerings.

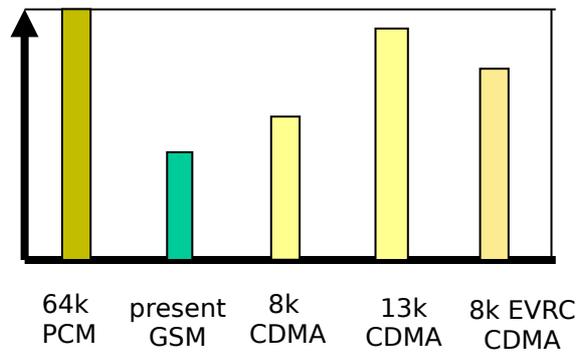
4 · Quality of service

As we all known, GSM adopts TDMA technology,.due to limited bandwidth, GSM has more-relatively weak forward correct encoding capability than CDMA. Therefore CDMA's voice quality improves better. In addition, CDMA adopt many advanced technology such as: spread spectrum, time diversity, space diversity, RAKE receiver, advanced vocoding algorithm and soft handoff and even softer handoff, which guarantee the high voice quality.

At the same time, due to CDMA having adopted variable rate encoding algorithm , for example, 8KQCELP, 13k QCELP, 8KEVRC, which can help operator to provide different grade of service for different customers. Figure 5 is the voice quality of three different encoding algorithm compared d with different technology.

Fig. 5 voice quality comparison in different technology

Voice quality



We can learn from above figures that voice quality of CDMA 8k is similar to GSM 13k, quality of CDMA 13k is close to PCM 64K.

5 \ Choice

CDMA technology can provide several vocoding rate, for example: 13kQCELP, 8kQCELP, 8kEVRC, so CDMA will give operator more flexible choices than GSM to meet different customers' need.

What is more-, CDMA 1X can supply diverse services such as :high quality voice service, high speed packet data service, Asynchronous data, G3 fax ,short message ,etc. CDMA can supply peak rate up to 307.2 kbps high speed packet data-,_which will help operators to supply mobile commerce, VOD, high speed access internet, position location, etc.

6 \ Customer satisfaction

CDMA can supply better voice quality than GSM and AMPS. in addition, due to adopted power control technology, CDMA terminals' average transmitting power are 2mW, which is much lower than GSM's 200mW, so CDMA terminals have extended battery life and lower radiation power, so which give CDMA terminals the have a nickname "green mobile".

what is more Besides, CDMA terminals are diversity and more than 200 commercial 3G CDMA devices from over 30 different vendors are commercially available nowadays. Figure 6 is some low-end CDMA mobile easily available from market .

Fig 6. some low-end CDMA mobiles



In addition, CDMA can also supply diversified telecommunication service, some are explained as following follows.

1. Mobile telephone services, emergency call service, and fax service and other services.
2. Supplementary services
3. Packet data services
4. Short message service
5. Wireless location service
6. Wireless intelligent services

In a word, with CDMA as 3G mainstream technology, the customer's satisfactions are guaranteed.