How GSM Overtook CDMA: - A Study of CDMA Failure In INDIA

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Abstract: Abstract: - Reliance Infocom's innovative marketing approach is thought to have been the driving force behind CDMA's early success in India. The CDMA's technology benefits both service providers and customers. However, while being perceived as technically superior to GSM, bad management of the technology has almost brought it to a halt. India will have 900 million mobile customers this year, but just 12% of those are CDMA subscribers. According to statistics, CDMA subscribers have been steadily declining in India over the past few years. This study is aimed to figure out the factors responsible for the failure of CDMA technology in India. For the purpose of the study secondary data sources were consulted in addition to the survey. Findings reveal that there are multiple factors responsible for the failure of the technology in India. Absence of Open Market Handsets, Spectrum Issues, Low ARPU, Upcoming 4G technology have emerged out as the main factors responsible for the failure of the technology in India and have undoubtedly brought CDMA to a point where there appears to be no turning back in its phasing out.

Index Terms **-: - CDMA, GSM, LTE, ARPU, Spectrum**

I. INTRODUCTION

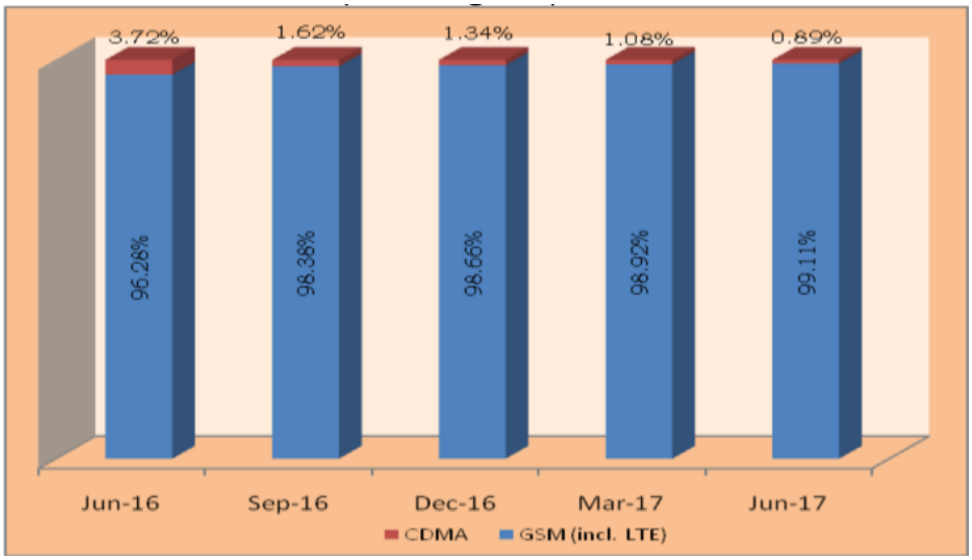
The term "CDMA mobile networks" refers to mobile networks that use code division multiple access as their primary channel allocation method. Spread-spectrum signaling is a technique used by the CDMA channel allocation mechanism to allow several users to use a single channel as opposed to sharing it **[1].** CDMA uses spread- spectrum technology and a coding scheme where each transmitter and receiver is given a code to enable many users to be multiplexed over the same channel, in contrast to TDMA or FDMA where access to the receiver or transmitter over the channel is given on the basis of frequency or time. This method both speeds up the CDMA transmitter and receiver and ensures that the bandwidth is used more effectively **[2].** Professor Dmitriy V. Ageev from the USSR published the first theoretical research paper on the subject around 1935; it was later employed by the USSR military. It's thought that the allied forces employed CDMA to send their signals in a unique way during World War II so they couldn't be intercepted. However, the California-based business Qualcomm took the initiative to use the technology for for-profit mobile communications in the 1980s **[3]**. Later, Nynex, American Tech, Motorola, and AT&T joined QUALCOMM in the technical development that led to the release of the successor IS-95A. A group called CDMA Development Group (CDG) was established by several manufacturers with the goal of promoting the technology as part of the technology's development [**4].** The first company to introduce CDMA was Hutchison Telecom. Asia Pacific IS95 standard was first implemented in North America before being implemented in South America, Africa, the Middle East, and Eastern Europe. The current subscriber base of CDMA stands at over 600 million and is growing with expected subscriber base of 800 million by 2017 **[5].** However preliminary analysis of the CDMA world report published by CDMA development group depicts a gradual change in the CDMA world subscriber distribution order. There has been a gradual shift with increase in percentage of customers in European countries and America in contrast to Asian countries **[6].**

Table 1: - CDMA Subscriber Base Across Globe [6]

Asia Pacific	**374500000**
North America	184900000
Caribbean and Latin America	26000000
Europe	7800000
Middle East	5900000
Africa	27200000
Total	626300000

II. CDMA in India and Its present scenario: - In India the first major breakthrough in CDMA was in December 2002 when reliance infocom with a brand name of reliance India limited started its CDMA services with a slogan of "Karlo Duniya Muthhi mein" (Take the world in your hand) [7]. Due the innovative marketing strategy like one nation one-rupee tariff plan of Reliance and with the entry of other players in the CDMA market the CDMA subscriber base in India in few years crossed 100 million mark. Reliance with 54.49 million subscribers continues to be the largest CDMA Service Provider in India [8].. Among all the CDMA service providers only Sistema showed a positive growth, rest of the service providers recorded decline in subscribers. Tata Docomo lost 1.02 million CDMA connections over a three-month period from September to December 2016, MTS lost 0.84 million connections, and BSNL lost 0.04 million connections [9]. In December 2016, there were 15.07 million CDMA connections, down 11% from September 2016, when there were 16.97 million CDMA connections in India, according to TRAI data. The number of GSM connections, which includes LTE, climbed to 1.11 billion in December 2016, up 7.7% from 1.03 billion connections in September 2016. It is hardly surprising that CDMA subscriptions are declining in India [10]. Competing Telco's are focusing more on 4G expansion following the launch of Reliance Jio, a 4G only operator in 22 circles, which is causing a reduction in CDMA and 2G services. headed by Anil Ambani RCOM recently closed its lucrative CDMA division in order to concentrate on 4G. In the upcoming months, RCOM is also anticipated to combine MTS's clients with its own clientele. The 4G networks of Airtel, Idea, and Vodafone are also being expanded with financial investments. Connections by access type as a percentage by the end of December 2016, the wireline segment had 24.4 million connections, while the wireless segment had 1.12 billion connections, accounting for 97.88% of the market [20].

Fig 1: - CDMA and GSM market share (2016-17) [25]



A quarterly gain of 1.62% was seen in the number of GSM (including LTE) subscribers, which went from 1,157,59 million at the end of Mar-17 to 1,176,31 million at the end of Jun-17. The biggest GSM mobile operator is still Bharti, with 280.65 million subscribers, followed by Vodafone (211.94 million). During the quarter ending in June 2017, there was a net growth of 18.72 million GSM customers. Over the same time period, M/s Reliance Jio's GSM(LTE) customer base saw the most net increase (14.68 million), whereas Tata Teleservices' GSM subscriber base experienced the largest decline (4.06 million).

Only three telecom service providers offered CDMA services in the six-month period that ended in June 2017. With a quarterly fall rate of 16.37%, the CDMA subscriber base decreased from 12.59 million at the end of March 2017 to 10.53 million at the end of June 2017. Tata Teleservices, which has 5.67 million users, has surpassed all other CDMA service providers.

Table 2: - Market Share within CDMA operators (2017) [25]

Service Provider	As on 31st March, 2017		As on 30th June, 2017		Net Addition/ decline during the quarter (in million)
	No of Subscribers (in million)	Market Share (%)	No of Subscribers (in million)	Market Share (%)	
Tata	6.90	54.83	5.67	53.87	-1.23
Sistema	4.91	39.01	4.13	39.23	-0.78
BSNL	0.78	6.16	0.73	6.90	-0.05
Total	**12.59**	**100**	**10.53**	**100**	**-2.06**

The quarter ending in June 2017 saw a net loss of 2.06 million CDMA subscribers. All three service providers saw a reduction in CDMA subscribers during the quarter in terms of net additions. The overall amount of cellular data used during the Q.E. June 2017 was 4,206,415 terabytes. A total of 100,390 terabytes of 2G data, 690,743 terabytes of 3G data, 3,999,012 terabytes of 4G data, and 16,270 terabytes of CDMA data were used.

Table 3: - CDMA Key Indicators 2016-17 [25]

Parameters	QE Jun-17	QE Mar-17	QE Jun-16	QoQ change (%)	YoY change (%)
Subscriber Base (in Millions*)	8.88	9.78	32.50	-9.21	-72.67
Share of Prepaid (%)	86.84	85.66	88.67	1.37	-2.07
Incoming MOUs per subscriber per month	141.67	137.40	97.77	3.11	44.91
Outgoing MOUs per subscriber per month	104.74	112.43	129.95	-6.84	-19.40
Outgoing SMS per subs per month	2.18	2.66	6.85	-18.11	-68.26
ARPU (₹ per month)	124.49	131.34	98.51	-5.22	26.37

All additional CDMA spectrum above 2.5 MHz in all Indian telecom circles, with the exception of Delhi and Mumbai, was given up by Tata Docomo. Recently, Tata Docomo also made the decision to shut down its Andhra Pradesh CDMA network. All of MTNL's CDMA spectrum in Mumbai and Delhi has been turned over. The actions of Tata Docomo and MTNL are irrelevant; Reliance Communications and MTS have dealt CDMA its heaviest blow. The process to merge with itself and MTS has already started at Reliance Communications. Reliance Communications is in the process of liberalizing all of its CDMA spectrum holdings in India so they can be utilised for 4G, in addition to integrating MTS with itself. Reliance Communications intends to trade or share its CDMA spectrum holdings with Reliance Jio in a few select areas after the liberalization of the spectrum market, and the two companies intend to use the airwaves for 4G. Users all around India have thus begun to get emails and messages from Reliance Communications urging them to either update their CDMA sim to 4G or switch to GSM. Reliance Communications intends to reuse the CDMA airwaves for 4G while gradually decommissioning its entire CDMA network throughout India.

While Reliance and MTS together held the great majority of CDMA subscribers in India, the number of CDMA users would substantially decrease when Reliance Communications, MTS, and MTNL totally shut down their CDMA networks in a few months. The two remaining CDMA carriers in India are BSNL and Tata Docomo, both of which are struggling financially.

III Factors influencing decline of CDMA in India: -

a) **Limited Operators**: - There are a finite amount of CDMA providers. The assigned spectrum and operators here demonstrate that there are more than three times as many GSM operators as CDMA network providers in each circle. Hence, fewer options could lead to a higher percentage of consumers choosing GSM as opposed to CDMA, which would force network providers to focus on GSM devices. Our ability to use both GSM and CDMA on phones has increased the availability of CDMA phones, like the Samsung Duos and Motorola XT 800. Once more, it is making the GSM network, which is already more well-known, more accessible. With the lower number of CDMA operators compared to GSM providers, CDMA users have a more limited selection than GSM users. The main players are BSNL, Reliance, and Tata Teleservices, along with a few others.

b) **Limited Handset Options**: - New, entry-level phones frequently have CDMA technology. The CDMA market has been further hampered by the lack of newer and smarter phones as we enter the smartphone era and customers start asking for innovative technologies. Since the Open Market Handset (OMH) initiative was started to improve the CDMA environment, things have changed. The dual GSM+CDMA section was only then updated with improved phones. A few more expensive models were introduced, although there weren't many of them. Both GSM and CDMA slots were present in the most current and much publicized Apple 4S. The iPhone 4S (Airtel and Aircel) and a number of BlackBerry phones are the only higher-end CDMA phones available (Reliance and Tata Indicom). Also, if you look closely, Reliance specifically targeted rural areas, with BSNL and Reliance providing services there. In rural areas, people are less likely to be shopping for smartphones than for reasonable plans and cheap phones. It will require exclusivity of devices with a reasonable price tag if it wants to sell more in markets with strong economies. The Open Market Handset (OMH) was designed to give the CDMA ecosystem more flexibility. OMH sought to make it easier for the CDMA base to use voice and data services by improving handset and operator ease.. For instance, the Samsung Galaxy Pop advertises that all you need to use the phone is an OMH SIM card from any operator, and MNP can further assist you keep the same number. Higher grade CDMA phones didn't join the market or give users flexibility until the Open Market handset entered the picture. We must keep in mind, though, that leading CDMA providers like Reliance and Tata Teleservices had already started offering GSM services alongside CDMA before the regulations were put into place, which reduced the number of CDMA subscribers once more. Since that 4G and LTE standards are widely used in industrialized countries, it shouldn't take long for 4G services to become popular in India.

c) **Other Factors**: - Circumstances in India have always been favorable for GSM, which currently holds a market share of more than 89%. When leading CDMA operators began to acquire GSM licenses and offer GSM service, the Technologies began to suffer greatly. According to the most recent Performance Indicator Report from India's Telecom Regulatory Authority, GSM generates more income per unit than code division multiple access does on average. The trend in GSM towards higher income per unit has been ongoing for a few years. This could also be a major motivator for CDMA operators to switch to GSM. Unexpectedly, the minutes of usage per subscriber per month for GSM are also higher than the minutes of consumption per subscriber per month for code division multiple access. According to the most recent performance indicator report released by the Telecom Regulatory Authority of India, the average revenue per unit for code division multiple access services increased slightly in the last quarter of 2012 by 3.8%, but minutes of usage per subscriber in that quarter of 2012 decreased by 1.4%. Charges for code division multiple access could somewhat increase as a result of fewer minutes of usage per subscriber per month and higher average revenue per unit.

To substantiate the arguments a short survey was conducted. For the purpose a questionnaire instrument was prepared and one hundred CDMA subscribers were interviewed telephonically. The respondents were chosen using the convenient sampling method. The demographics of the respondents were as following.

Table 4: - Respondents Demographics (Gender)

Gender	Number
Male	68
Female	32

Table 5: - Respondents Demographics (Age)

Age	Number
20-40	56
40-60	31
>60	13

Table 6: - Respondents Demographics (Operator)

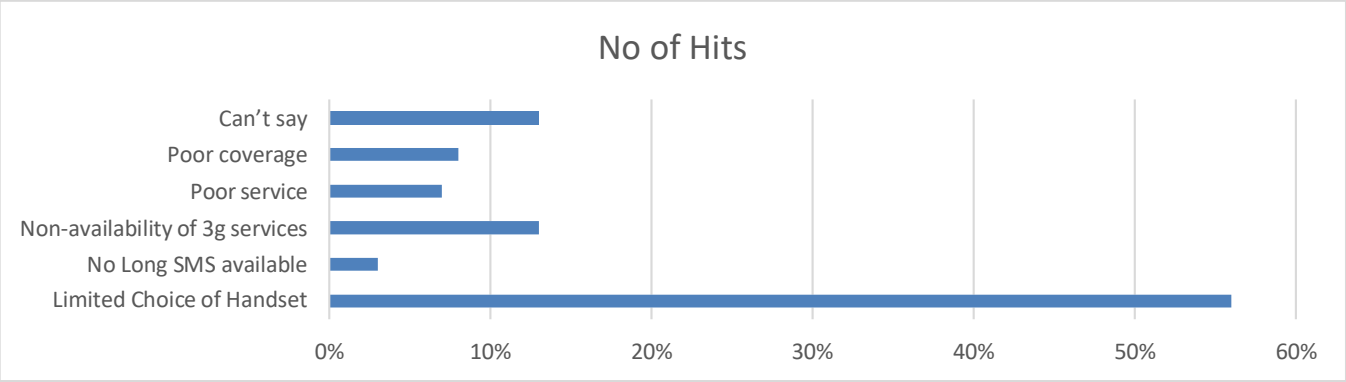
Age	Number
Reliance	73
Tata Teleservices	20
Others	7

The respondents were asked to choose from then given factors as the reason for the Decline of CDMA in India. The responses were as following.

Table 7: - Respondents choices for the factors responsible for decline of CDMA

Factor	No of Hits
Limited Choice of Handset	56%
No Long SMS available	3%
Non-availability of 3g services	13%
Poor service	7%
Poor coverage	8%
Can't say	13%

Fig 2: - Infographic showing respondents choices for the factors responsible for decline of CDMA



When respondents were asked to about to suggest any additional factors on their own, many respondents reported that because CDMA denies users flexibility and choice, it has failed. Unlike to the US, where users are bound by contracts with mobile operators, customers in India are free to select any provider. As a result, CDMA creates a psychological barrier for customers in countries where they are bound by operators.

Some of the respondents gave a strange reason of subscribers not being able to own a NOKIA phone. It is pertinent to mention here that Nokia had a stranglehold on the market and it had very few CDMA models in its portfolio.

Some of the respondents also blamed the Mismanagement of the operators as the main reason of failure of the technology. Bad marketing strategy was also reported as the causes of failure of the technology. Respondents reported that the operators failed to understand that the technology was for customers who didn't owned a phone yet as there was no reason for the existing GSM subscriber to change the handset. They also reported that the operators had neither convincing reason to make a GSM subscriber switch to CDMA.

IV Start of the end: - All additional CDMA spectrum above 2.5 MHz in all Indian telecom circles, with the exception of Delhi and Mumbai, was given up by Tata Docomo. Recently, Tata Docomo also made the decision to shut down its Andhra Pradesh CDMA network. All of MTNL's CDMA spectrum in Mumbai and Delhi has been turned over. The actions of Tata Docomo and MTNL are irrelevant; Reliance Communications and MTS have dealt CDMA its heaviest blow. The process to merge with itself and MTS has already started at Reliance Communications. Reliance Communications is in the process of liberalizing all of its CDMA spectrum holdings in India so they can be utilised for 4G, in addition to integrating MTS with itself. Reliance Communications intends to trade or share its CDMA spectrum holdings with Reliance Jio in a few select areas after the liberalization of the spectrum market, and the two companies intend to use the airwaves for 4G. Users all around India have thus begun to get emails and messages from Reliance Communications urging them to either update their CDMA sim to 4G or switch to GSM. Reliance Communications intends to reframe the CDMA airwaves for 4G while gradually decommissioning its entire CDMA network throughout India.

While Reliance and MTS together held the great majority of CDMA subscribers in India, the number of CDMA users would substantially decrease when Reliance Communications, MTS, and MTNL totally shut down their CDMA networks in a few months. The two remaining CDMA carriers in India are BSNL and Tata Docomo, both of which are struggling financially. The majority of data card users presently utilize their CDMA network, but it's impossible to imagine how they wouldn't switch if Reliance Jio joins the market with such extra capacity in the form of 20 MHz of pan-India 2300 MHz spectrum.

Spectrum is a limited resource, and the issue is especially serious in India because telecom companies there often have far less spectrum than their counterparts outside. The rational course of action is to disband a technology once it reaches a certain age and use the spectrum allotted to it for newer innovations.

Perhaps CDMA's greatest accomplishment in India was lowering the cost of mobile technology. When RCom introduced CDMA devices in 2002 for as cheap as 500 Indian rupees ($7.47), it drove other service providers to lower their rates and made mobile services more affordable for more people. Indian ARPUs are currently some of the lowest in the world.

V) Suggestions:- In India's dynamic telecom industry, operators must adapt and innovate to remain competitive. As 5G technology looms on the horizon, embracing this transformation becomes pivotal. Investing in 5G infrastructure is essential to prepare networks for unprecedented speed and connectivity, unlocking opportunities in IoT, augmented reality, and beyond. However, operators should not side-line their 4G networks. Expanding 4G coverage in rural areas, coupled with affordable data plans, is crucial. Simultaneously, offering high-speed broadband for homes and businesses is imperative.

Maintaining network quality and consistent coverage remains a top priority. Infrastructural investments should enhance network coverage, minimize dropped calls, and accelerate data speeds. Implementing advanced technologies like MIMO (Multiple Input, Multiple Output) is crucial for optimized performance. Customer satisfaction is paramount. Improving customer service, simplifying support accessibility, and prompt issue resolution must be central. Chatbots and AI-driven solutions can significantly enhance customer experience. Diversifying data plans to cater to various needs, from light users to data-intensive consumers, ensures customer trust with transparent pricing.

Bridging the digital divide is paramount. Offering affordable smartphones and data plans, particularly in underserved regions, is a prime focus. Investing in IoT infrastructure and collaborating with businesses to harness its potential is pivotal. Sustainable practices, like using energy-efficient equipment and renewable energy sources, reduce the carbon footprint and offer marketing advantages. Content partnerships with streaming services, educational content providers, and OTT platforms can attract and retain customers. Cybersecurity and data privacy must be prioritized. Robust security measures and a commitment to data privacy build trust.

Value-added services beyond voice and data should be introduced, including mobile payment services, health apps, and cloud storage. Staying attuned to market trends is vital. The rural market holds untapped potential, demanding cost-effective strategies for network expansion and tailored packages. Diversifying network services, including fixed-line broadband, DTH television, and bundled offerings, enhances customer retention and revenue. Optimizing spectrum utilization and acquiring additional spectrum when necessary boosts capacity. Collaborating with the government in rural connectivity initiatives is strategic. Sustainable revenue models balancing affordability and profitability are pivotal.

Implementing data analytics and AI for personalized services and data-driven decisions is paramount. Regulatory compliance is vital. Innovation should be fostered, and competitive pricing structures are crucial. Network security, collaborations with strategic partners, digital transformation, personalized recommendations, community engagement, support for local causes, improved international roaming, employee training, and cost-reduction strategies are essential. Adapting to post-pandemic consumer behaviour and monitoring competitors to outperform in key areas are pivotal.

By implementing these strategies, Indian telecom operators can navigate the industry's complexities, meet diverse customer needs, and position themselves for long-term success. Adaptability, innovation, and a customer-centric approach are key to thriving in the ever-evolving telecom sector.

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