RESPONSE FROM GSA
- Global mobile Suppliers Association –
to
TRAI Consultation Paper No. 11/2004
on
Spectrum Related Issues
Submitted to TRAI on 15 July 2004

About GSA

GSA - the **G**lobal mobile **S**uppliers **A**ssociation - is the forum for, and represents, the leading GSM/3G suppliers worldwide, and represents over 80% of GSM/3G market share globally. The GSA Executive Committee comprises of the leading GSM/EDGE/WCDMA suppliers - Alcatel, Ericsson, Lucent Technologies, Nokia and Siemens.

GSA plays a significant and expanding role in promoting GSM/EDGE/WCDMA worldwide for the best user experience of mobile voice and advanced mobile data services. Adding value through focused global and regional programs, GSA's reports, research papers, events, seminars and discussion form a contribution to the continuing success of the wireless industry. Current focus areas include the Global Mobile Dialogue™ for information exchange, market updates, industry news and newsletters, organising the GSM Evolution Forum® as a unique opportunity for high-level interaction between GSM/EDGE/WCDMA network operators, administrations/regulators, and GSA Members, and briefings for the media and analysts in all regions.

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A Opening Remarks

The Telecom Regulatory Authority of India seeks responses to its consultation document "Spectrum related issues: Efficient Utilisation, Spectrum Allocation, and Spectrum Pricing (31st May 2004)." TRAI is to be congratulated on this initiative, which brings up many questions and complex and critical issues for the successful development of mobile communications industry in India, and its strategic role in driving the Indian economy forwards in the next decade and more. Questions about spectrum and the pursuant business issues require careful consideration and balancing in order that the important decisions to be taken are fully in the interests of India, within national and international contexts.

GSA - the **G**lobal mobile **S**uppliers **A**ssociation, representing leading mobile equipment manufacturers with business experience in India and globally, is pleased to have the opportunity to study the consultation and as requested by TRAI through our recent discussions, to offer our views in this submission.

The consultation document has a wide scope which covers wide ranging and complex issues, for which more time would be necessary to respond to every point. In view of the relatively short timescale which has been allowed, GSA in this response focuses on the key strategic issues which have been raised. Our key concern is that the development of the mobile communications industry, and with regard to the benefits it brings to consumers, enterprises, teledensity and the economy as a whole, would be severely damaged by short-term opportunism.

The procedures for allocating radio frequency spectrum need to start immediately in India to support the evolution of the GSM and CDMA systems currently in use in India, to third generation (3G) technologies. The shift to 3G is well advanced now around the world, and is highly relevant to India in the short term.

We are most concerned that the path to 3G for GSM and CDMA operators would be ruined if the government allows some of the new 3G/IMT-2000 spectrum to be allocated to be used for 2G services, as has been requested by the CDMA operators. The issues and concerns are explained, together with the proposed solution for India.

B GSM – Global Standard of Choice

Development of mobile communications is gaining pace. India is the most important growth market in the world for cellular communications. India was one of the early adopters of GSM technology which, while initially developed within Europe, has since developed and spread to become the global standard of choice in 207 countries, serving 1046 million customers worldwide (31.3.04), which is around 5.5 times its nearest competitor. In India today there are over 30 million GSM subscribers, an increase of 100 % over last year, and a further 10 million customers on CDMA systems.

Wireless communication, and GSM in particular, is making a very important contribution to raising teledensity in India, such that the number of cellular connections will overtake fixed connections nationally during the coming weeks. It is vital therefore that any decisions which are taken will ensure that the industry continues to grow, and is sustainable for investors and other players. It is also vital that the foundations are laid for India's mobile industry to participate fully in the global 3G mobile services market, to ensure future investment and economic development and prosperity.

C The Shift to 3G is Happening Now Globally

Mobile operators globally are evolving their businesses to exploit 3G technologies, to ensure:

- the best, most consistent user experience of voice and non-voice (i.e. data) services
- improvements in network capacity to support a truly mass market for voice services, at lowest cost of delivery
- faster data speeds and related performance improvements enabling delivery of exciting non-voice services such as rapid file transfers, Internet access, audio/video streaming etc. to drive productivity gains for enterprises, expansion/consumption in the services sector, and needed revenue growth for network operators.

The International Telecommunication Union (ITU), an international organization within the United Nations System where governments and the private sector co-ordinate global telecom networks and services, attaches the highest priority to the role of mobile communications in both developing and developed economies. The ITU has carefully planned for the evolution of today's 2G systems to 3G by specifying what it calls the "IMT-2000 technology family" to deliver such services.

D GSM/WCDMA – the Most Adopted and Deployed GSM/3G Mobile Solution

There are industry agreed and supported evolution paths from GSM and CDMA for their respective 3G technologies. The GSM operators, who today are serving over 1 billion users globally, are evolving to "WCDMA", one of the official ITU/IMT-2000 3G radio access standards. CDMA operators broadly will evolve to "CDMA2000", another of the official ITU/IMT-2000 3G radio access standards; however a number have decided to abandon CDMA altogether and migrate to WCDMA (e.g. in Korea and the Americas). Internationally, there are 120 licensed WCDMA operators building networks in 40 countries. To date, 37 WCDMA network operators have launched commercial service, a figure expected to double by end 2004. A further 13 networks are in the pre-commercial phase.

E ITU 3G/IMT-2000 Spectrum Plan

New spectrum has been identified by the ITU for 3G systems within which a "core band" for terrestrial services of 1920 – 1980 MHz paired with 2110 – 2170 MHz is allocated (i.e. 2 x 60 MHz). This band plan is adopted by virtually all countries of the world for the deployment of 3G/IMT-2000 systems, including in Asia and many countries in Latin America. The European Union has also adopted the ITU IMT-2000 frequency plan; therefore any misalignment between the EU and India, and indeed other countries and India, would make communication more difficult and costly. This would in the longer term have an adverse effect for all parties, as people would not in the future be able to access their 3G services while roaming. Better communication will bring India, Asia, the EU and all countries closer together, and facilitate investment, which is why it is in everyone's interest to adopt the same frequency allocation.

The IMT-2000 technologies are designed to co-exist and to not interfere with each other. Designation of the "core band" ensures that manufacturers can produce equipment working in standard internationally agreed frequency to minimise complexity, and lower cost. For users, it guarantees the possibility of automatic international roaming, as enjoyed today by hundreds of millions of GSM subscribers. The convenience to GSM users of having one

phone, one telephone number and one bill, and being able to make and receive calls not only on their home network but also in China, throughout Asia, Europe, Africa, the Americas, etc., indeed globally, must be guaranteed and preserved for future users of enhanced voice and data services delivered by 3G networks.

F Allocating 3G Frequencies for PCS 1900 Would Block Future Growth in IMT-2000

A decision by India to allow any part of the 3G spectrum to be used by 2G technology operators would destroy the evolution path to 3G/IMT-2000 systems for all GSM and CDMA operators. As we understand the current proposal, TRAI is contemplating the allocation of frequencies in the 1900 MHz region - the so-called North American PCS 1900 band, to 2G/CDMA operators. However, this spectrum is situated within the 3G/IMT-2000 core band as defined above. Allocation in the 1900 MHz band would block the evolution path for the GSM operators, who are supporting tens of millions of customer already, and who need to evolve quickly to WCDMA for voice capacity expansion and new revenue growth from enhanced data services.

A 2G CDMA network in the same band as WCDMA cannot be operated in the same geographical area due to interference. This is a very serious issue and would be a major loss for Indian consumers and operators, severely upset economic development, investment and productivity, and cause a negative market impact over the next 10-15 years. Huge international roaming income would be at risk. No country in the world to our knowledge has deployed 2G systems at 1900 MHz alongside 3G/IMT-2000 systems.

It is critical therefore to fully understand the technical and business impacts that would result from such a scenario, which only the commissioning and completion of a comprehensive field study could provide. Overcoming such intereference would as a minimum add cost, and require the establishment of "guard bands" between CDMA and 3G/IMT-2000 systems, resulting in large portions of the 3G band being unusable and its value diminished. This issue and the related considerations and consequences are discussed in detail in the paper by GSA India Chapter "Approach to Frequency Spectrum Allocation ", included in Annex 1 to this response.

GSA's view is that allocating spectrum in the 1900 MHz band for anything other than 3G/IMT-2000 technologies must be avoided at any cost. In view of the risk and uncertainty of pursuing a mixed 2G/3G technology approach, India has the time and the opportunity to secure the use of the core IMT-2000 band for 3G and future 4G evolution of its wireless networks. With penetration rapidly building in the major cities including New Delhi and Mumbai, and expected to reach 50% penetration in New Delhi during 2005 (source: TRAI) it is obvious that urgent steps are required to ensure 3G is market reality in India in the next 1-2 years maximum.

G There Is a Solution – IMT-2000

The 3G/IMT-2000 core band is internationally standardized to accommodate the 3G/IMT-2000 technologies including WCDMA and CDMA2000, without interfering with each other. This scenario of mutually compatible 3G/IMT-2000 technology co-existence is the situation you see today in Japan, and will occur in Korea. 3G/IMT-2000 is the future of mobile. Both GSM and CDMA operators will be able to address any short term capacity needs for both voice and data services, as soon as the 3G IMT-2000 core band is allocated and operating licenses issued, allowing efficient migration to 3G/IMT-2000 capabilities with WCDMA and CDMA2000 respectively. Indian consumers and businesses will benefit, investment will come, and sustained economic growth will follow.

The 3G wave is ready to come to India – opening up the road to future 4G evolution. Already in the major cities, user penetration is building rapidly. 3G is needed as market acceptance accelerates, to ensure adequate capacity for voice and data services. India must seize the 3G opportunity now to ensure the lowest cost systems and terminals, and drive widest service adoption.

Procedures for allocating radio frequency spectrum need to start immediately in India to support the evolution of the GSM and CDMA systems currently in use in India, to third generation (3G) technologies. The shift to 3G is well advanced now around the world, and is highly relevant to India in the short term.

Any application for assigning additional 2G frequencies must be fully justified, and should only be contemplated once all technical and engineering avenues have been fully considered and implemented within existing allocations. Mixing up 2G technology as proposed by the CDMA operators in the 3G/IMT-2000 band would ruin the evolution path for all GSM and CDMA operators, resulting in huge domestic and international disappointment, and restricting investment, especially from overseas. GSA believes it is vital that the technical, business and economic consequences of such a policy be fully understood through a field trial before such decision could be considered.

The best solution for all parties is to move to 3G with IMT-2000 systems in IMT-2000 core band spectrtum as quickly as possible. If the need for additional spectrum for short term needs of CDMA can be justified we would point out that there are solutions for infrastructure and handsets already commercially available in Korea in the 1700 MHz band, which would preserve the IMT-2000 band exclusively for 3G IMT-2000 systems, in accordance with international agreement.

We trust that our comments will assist TRAI in its deliberations and policy decisions. In conclusion, GSA wishes to thank TRAI for the opportunity to review, discuss and respond to this consultation. We remain at your disposal to assist with answers to any questions you may have at this time, and to consider any requests for additional assistance, should this be required.

Yours Sincerely,

Alan Hadden

President, GSA

Global mobile **S**uppliers **A**ssociation

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Annex 1

GSA India Chapter
"Approach to Frequency Spectrum Allocation"

Introduction

GSA India Chapter expresses its perspectives through this submission, on how the mobile market potential in India can be maximized, while securing a level playing field for all operators irrespective of technology. India is one of the fastest growing and most competitive mobile markets in the world, with one of the lowest voice and data tariffs. These achievements provide a sound basis on which further developments can take place.

The objective of this paper is to bring forward the point that any allocation of PCS 1900 MHz frequency now will have a longterm negative impact on India telecom growth.

3G evolution is a market reality for 120 operators in 40 countries

The 3G evolution is a market reality for GSM operators across the world today. 40 countries have given IMT2000 core band WCDMA licence to 120 operators, which have a user base of over 500 Million. 37 operators offer commercial WCDMA services today, and around 60 operators are expected to be commercial before the end of 2004. There are over 6 Million live subscribers getting benefited from these services.

The logical evolution path for the GSM operators is 3G WCDMA, in the IMT2000 core band.

The benefits of 3G are obvious for both operators and consumers:

- ?? High voice quality drives usage and image - consumers enjoy good service
- ?? Very low cost of voice capacity – higher voice minute volumes at reduced costs
- ?? Impressive data speeds of up to 14 Mbps – broadband anywhere in India and abroad
- ?? Very low cost of data capacity - high-volume everyday data at affordable prices

From 2005 onwards the WCDMA operators can upgrade systems, with software only, to support HSDPA/HSUPA (High Speed Downlink/Uplink Packet Access). With these enhancements the consumers can reach up to 14.4 Mbps peak bit rates in downlink and 5.8 Mbps in uplink, clearly superior to any other technology roadmap.

To upgrade from GSM to 3G network, most of the existing network assets can be reused and only a small number of sites need to be deployed to achive a good coverage. Also, The WCDMA supply market operates at high volumes and is extremely competitive, enabling low deployment cost. Further, 3G improves spectral efficiency and reduces the cost of capacity for both voice and data. These three factors ensure that 3G presents a sound business case for the operators.

India is ready to move into 3G

With the tremendous success of GSM in India over last one year, India is ready for next step of adopting 3G services. In line with the rest of the world, 3G evolution should happen in the IMT2000 core band, so that India can benefit from the lowest cost systems and terminals, and thus the fastest and broadest service adoption can be reached. This will also ensure that India continuous to part of the global telecom evolution and is not left aloof.

The mobile broadband and high-quality voice services could have a large positive impact not only on the mobile market, but on the overall India economic output as well. However, a proper service market in country of India's size can only happen, if multiple operators can participate to ensure the services are available to India consumers at the right level. This in turn requires that 3G evolution path is secured for all technology families.

Any PCS 1900 band allocation would destroy WCDMA evolution path

As we understand, India Government is considering the option to allocate PCS 1900 to operators. All of the above 3G benefits to the consumers, operators and economy could be taken away, in case India decides to issue the PCS 1900 MHz frequencies. **In fact, any allocation of PCS 1900 would block the WCDMA evolution path from GSM operators. The reason:** ***a cdma network in 1900 MHz band and a WCDMA network in IMT2000 core band cannot be operated in the same geographical area, due to interference (more in next section).*** In case of any PCS 1900 spectrum allocation one of the following scenarios would follow:

- If CDMA 1900 networks were deployed, then Indian GSM operators would not be able to deploy any WCDMA networks. This would be a major loss for the Indian consumers and operators alike, and would cause a major negative market impact over the next 10-15 years.

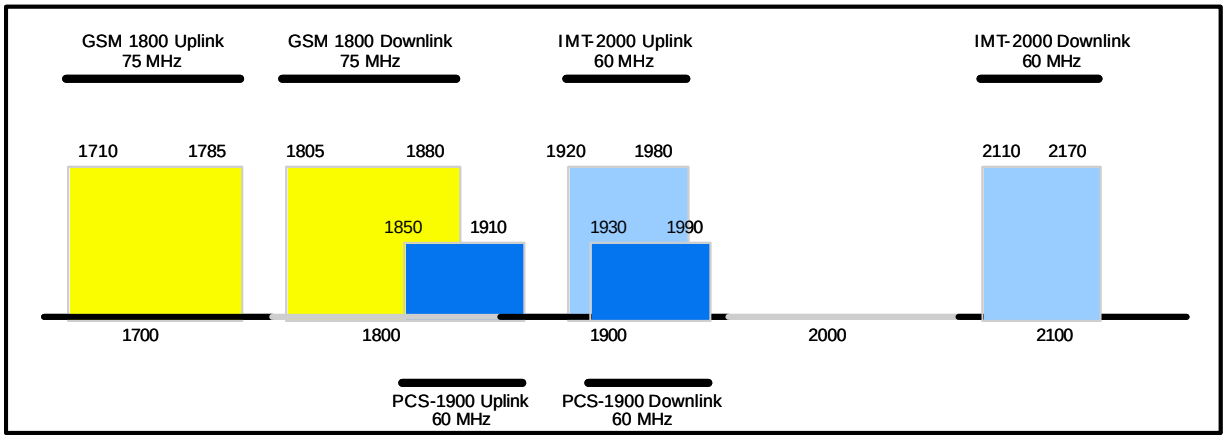
Or,

- Potentially millions of cdma 1900 handsets would have to be called back from the hands of the consumers, and the cdma 1900 networks would have to be dismantled. The PCS1900 band would have to be deleted (like will happen in China). After this the WCDMA networks could be deployed.

It is easy to conclude that both of the above options would be major growth inhibitors for the Indian market development and push India back on its telecom growth. A simple conclusion is that the PCS-1900 allocation should be avoided at any cost.

The Interference issue cannot be mitigated

The IMT2000 core band uplink and the PCS 1900 band downlink are overlapping almost fully with each other (50 MHz out of 60 MHz).



The specifications of terminals and network systems do not take into account the situation where both technologies would co-exist. As a result, two severe interference mechanisms arise:

1. Handsets interfering with each other

- *Single WCDMA terminal transmission can block all cdma1900 terminal receivers within the radius of up to 200 meters.*
- It is not possible to mitigate this mechanism, since the internal filters in terminals cannot reduce the interference as much as would be required.
- Naturally, the consumers cannot be instructed to keep a certain minimum distance from other people who are talking to a mobile phone.

2. Networks interfering with each other

- *Cdma base station transmission blocks the WCDMA base station receiver.*
- This would require large guard bands, large-size filters, site co-ordination and increased base station density for all operators. In practise, however, the required solutions
  - would be too complex to build and operate,
  - would pose severe limitations to potential site locations,
  - would roughly double the 3G coverage build costs for all operators.
  - would lead to large amount of waste spectrum because of guard bands
- In practice the operators would not be able to execute this approach in a competitive environment.
- Naturally, this scenario will never happen, as the terminal interference issue prevents this scenario from happening.

No country has deployed both PCS1900 and IMT2000 core band systems

Taking the above aspects into consideration, no country has in parallel deployed the cdma 1900 MHz and IMT2000 core band systems in the same area.

For example, China has for a few years had 1900 band in use for PHS technology but the Administration there has decided to close the system and delete the PCS-1900 band, so that systems in IMT2000 core band will able to operate. The PCS-1900 band systems already had to be removed from Mainland China areas close to Hong Kong, due to interference with Hong Kong-based WCDMA services. The India Administration may wish to engage in a discussion with their counterparts in China, as they have been evaluating these issues already a long time.

PCS 1900 could destroy 60+60 MHz IMT2000 core band, and should not be allocated

Even if a small part of PCS-1900 band was allocated, the cdma 1900 terminals would start entering the market. This would make the introduction of WCDMA impossible without dismantling the cdma 1900 network and calling back the terminals. In short, allocation of PCS1900 could lead to a waste of the full 60+60 MHz of commercially viable IMT2000 core spectrum.

The Solution for short and long term: IMT2000 core band for both technologies

Luckily, there is a solution for the problem. The IMT2000 core band is standardized to accommodate both WCDMA and CDMA2000 technologies, and there are no harmful interference mechanisms between the two technologies, when deployed in the IMT2000 core band. In fact, both WCDMA and cdma systems have been in commercial operation e.g. in Japan since 2003, in the IMT2000 core band.

While this may mean a change in the originally planned IMT2000 allocation schedule, we can assure the Government that such change will serve the industry, and the Nation, in the best possible way.

- Both GSM and cdma operators will be able to address the short term capacity needs for both voice and data, as soon as the band is allocated to them.
- Since no frequency band is wasted, both GSM and cdma operators will have a much greater amount of band available to meet the future needs.
- All operators compete in a truly level playing field, with enough capacity and with access to their logical evolution path, with equal terms.
- The above points together will stimulate competition yet to a new level. Thus the Indian consumers and businesses will benefit, and help the economy to grow further.

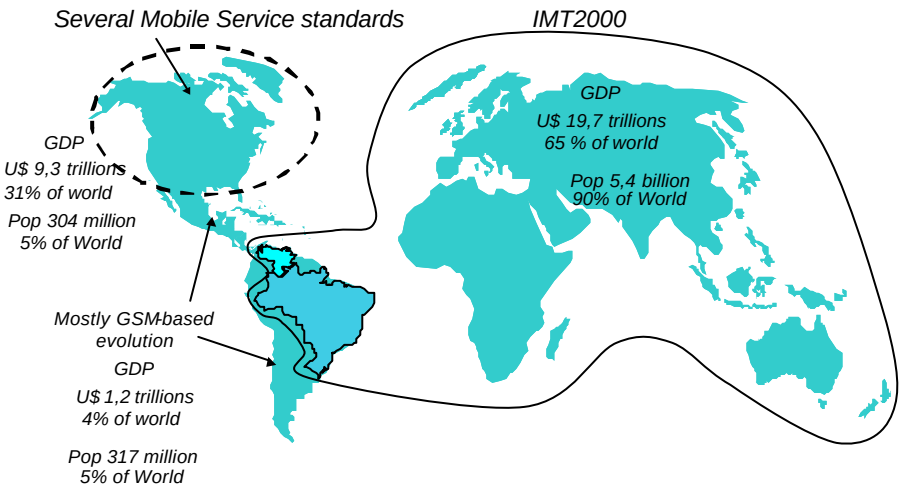
Countries with half of global population plan IMT2000 for both WCDMA and cdma

In addition to India, there is a number of other major countries, where spectrum allocation for both GSM and cdma operators is relevant. All such countries have allocated or reserved IMT2000 core band for this purpose. Japan already has commercial services. Korea has allocated the IMT2000 core band for both WCDMA and cdma services. It is very likely that China and Brazil will also do the same. The mentioned countries, together with India, have almost half of the world's population. The economies of scale will be guaranteed for both WCDMA and cdma operators alike. The systems and terminals are already commercial for both WCDMA and cdma, and are ready to be used in Indian market. Based on public-domain information, there are close to 10 network and terminal suppliers for each WCDMA and cdma in IMT2000 core band.

Countries adding to 90% of World population support IMT2000

By taking a look into the World map of 3G standards, one can conclude that IMT2000 is *the* global standard of the future, covering today countries with 90% of all population. The rest of the countries are naturally covered with GSM/EDGE. Supporting fully the global standards will help India considerably in its plans to emerge as one the chief economies globally.

- Countries with 90% of Word's population support the IMT2000 core band plan
- In Asia and Europe, virtually all countries support IMT2000 core band plan
- Part of Latin America is already in IMT2000 plan, and most operators (~80%) evolve with GSM. GSM roaming is today available in all countries, excluding one.
- In the USA GSM is has added the most subscribers of standards during 2004, GSM roaming is available nationwide today.



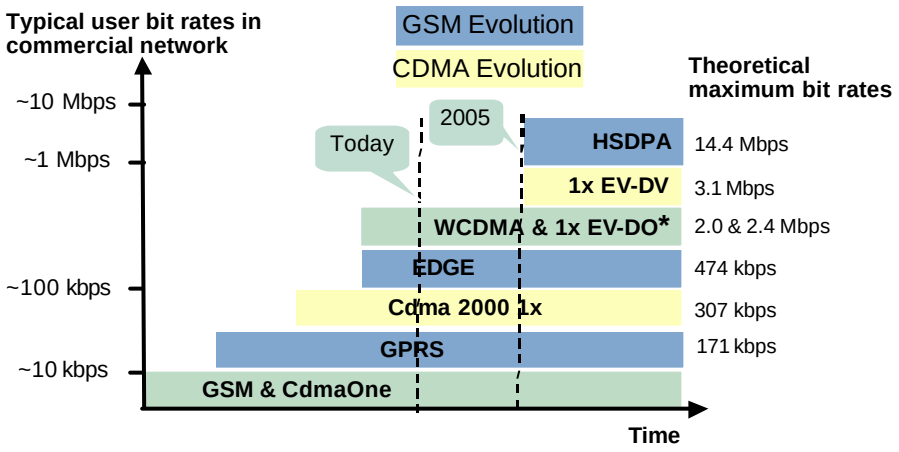
TECHNOLOGY EVOLUTION ROADMAPS

It is clear in India as elsewhere in the world, that part of the revenue growth must, and will come from non-voice i.e. data services including so-called third generation services. Some operators in India have acted on this by deployment of a wide range of non-voice services to an enthusiastic market, including EDGE-based services. Many leading GSM operators are getting ready to develop the capability to the next level, i.e. 3G.

The benefits of 3G are obvious and clear for both operators – and consumers.

- ?? Enhanced voice quality stimulates image and usage - consumers enjoy good service
- ?? Very low cost of voice capacity – higher voice minute volumes at lower expense
- ?? Impressive data speeds of up to 14 Mbps – broadband anywhere in India or abroad
- ?? Very low cost of data capacity - high-volume everyday data at low expense

GSM family – the highest performing roadmap



*Spectrum and hardware allocated to EV-DO can provide data-only service, while all other technologies manage dynamically voice and data

The performance evolution of the GSM roadmap, offers many valuable aspects for India's mobile market and economy as a whole.

a. EDGE (**E**nhanced **D**ata rates for **G**lobal **E**volution) produces practical end-user bit rates of 100-150 kbps and a very high spectral efficiency. In comparison to cdma2000-1x EDGE provides over 50% higher performance.

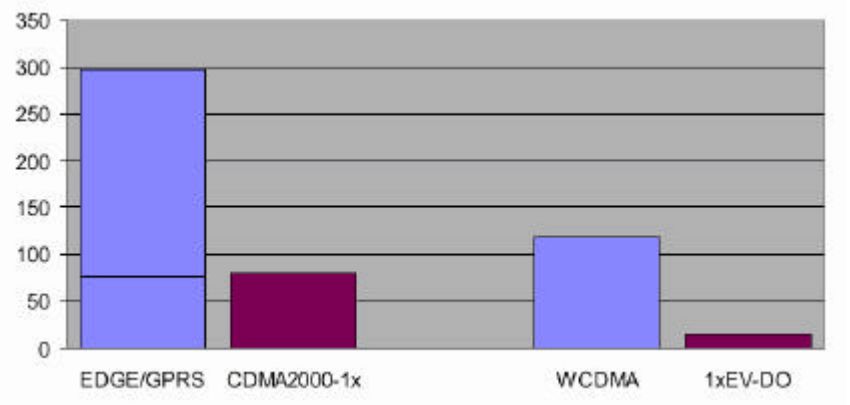
b. WCDMA provides typical bit rates of around 300-350 kbps in commercial networks, based on live network measurements. WCDMA also supports *QoS management, bit rate guarantee and low latency (= fast roundtrip time)*, and thus WCDMA supports virtually any data service. It is to be noted that EV-DO provides radio bearers only on a *best-effort basis,* and thus real time services require 50%-150% over-dimensioning, which reduces spectral efficiency.

WCDMA is also a highly efficient voice platform. Therefore operators can easily justify a broad-area coverage build with WCDMA, an important consideration for the nationwide coverage of advanced services. In comparison, 1xEV-DO supports only data, and thus operators tend to be less able to justify larger area coverage investments.

c. HSDPA (High Speed Downlink Packet Access, commercially available 2005), which is an enhancement to WCDMA (as EDGE is an enhancement to GPRS) provides significant bit rate improvements. HSDPA provides a clearly outstanding performance in comparison to any other cellular technology. The typical average bit rates range between 1.0-3.0 Mbps in commercial networks, with peak bit rates up to 14.4 Mbps.

Both peak and typical bit rates are 2-3 times higher in HSDPA, compared to 1x/EV-DV (or to the future enhancements of 1x/EV-DO). HSDPA and EV-DV technologies are in certain respects similar, and employ some of the same modulation and error correction mechanisms. The main difference is that HSDPA takes advantage of the wideband (5 MHz) signal, as opposed to the narrowband (1.25 MHz) signal in EV-DV, and thus is able to deliver higher bit rates and efficiency.

d. In each technology evolution step the acceptance among the operators is broad for the GSM roadmap. The following numbers illustrate the situation.



- There are today **over 1 billion GSM users**. The operators who are in the GSM technology roadmap (but still have e.g. TDMA, PDC and CDMA users) had a combined user base of approximately 1.15 billion in April 2004, or over 80% of all mobile users (source: EMC April 7, 2004

- There are **close to 300** operators using GPRS, of which **81** in **55** countries have announced support also for EDGE (source: GSA June 14, 2004). In the equivalent CDMA step, there are 80 operators supporting cdma2000-1x (source CDG Apr 7, 2004).

- There are **120 operators** which have a IMT2000 frequency license for WCDMA, of which 37 are commercial. These operators had a subscriber-base of over 500 Million in April 2004, which ensures that rapid WCDMA technology adoption will occur in the near future. In the equivalent CDMA step there are **15 operators** with announced support for 1x/EV-DO (source CDG Apr 7, 2004), of which less than 10 are commercial.

- It is expected that all WCDMA operators will implement HSDPA, to enable data rates up to 14.4 Mbps. The upgrade path from WCDMA to HSDPA is very easy, as only require software upgrade is needed. The result is that today's scale economies of GSM will be available in HSDPA. In comparison, so far, there is one announced EVDV operator.

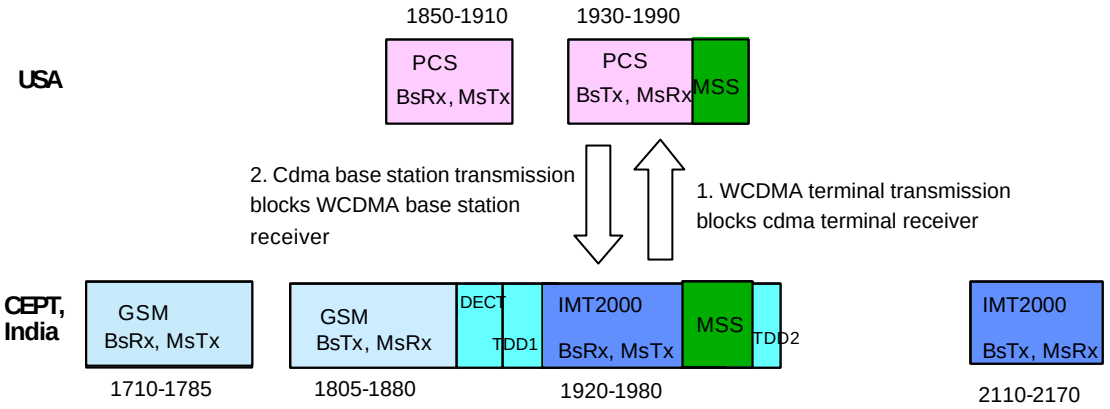
IMT2000 core band is a mandatory requirement for GSM operators.

The 3G evolution is a market reality for GSM operators across the world today. 37 operators offer commercial WCDMA services today, with around 60 operators expected to be commercial by the end of 2004. The 3G wave is getting ready to move into India. In line with the rest of the operators, the 3G evolution has to happen in the harmonised IMT2000 core band, so that India can gain lowest cost systems and terminals, and drive widest service adoption.

INTER-TERMINAL INTERFERENCE EVALUATION IN MIXED BAND ENVIRONMENT

Introduction

The PSC1900 band terminal receiver (1930-1990 MHz) overlaps to large extent with IMT2000 core band terminal transmitter (1920-1980 MHz). The two kinds of terminals are not specified to operate in the same area. If they are implemented in the same area, severe interference mechanisms arise.



- WCDMA mobile transmission blocks the cdma mobile receiver.
- A single WCDMA mobile can destroy the reception of all cdma 1900 mobiles within a 200m radius form the WCDMA mobile.
- It is obivous that cdma1900 and WCDMA2100 cannot operate in the same geographical area in a practical scenario

Description of the terminal interference problem

The interference levels depend on the Rx-filters (receiver) of cdma and Tx-filters (Transmission) of WCDMA. The performance of WCDMA Tx-filters can be found in 3GPP specification 25.101.

- Per specification, in the adjacent 5 MHz band (carrier) the attenuation must be 33 dB (on 5 MHz).
- After the filtering for the adjacent 5 MHz, the attenuation is slower. In the following 5 MHz the attenuation must be 43 dB (i.e. 10dB more).
- There is significant interference potential across the cdma receive band

Calculation principles

The severity of the interference depends on 3 things

- The distance of the WCDMA mobile from the BTS (-> high Tx power)
- The distance of the cdma mobile from the BTS (-> Rx-power low)
- The distance between the two mobiles (-> Low attenuation)

It is assumed that the WCDMA Tx-filtering is the limiting factor in interference estimations (I.e. it is more relaxed than the cdma rx-filter).

- The maximum output power of a WCDMA mobile is 21 dBm (this is utilised at the cell edge). The new specifications will increse the power to 24 dBm, however this calculation assumes 21 dBm.
- The pathloss between two mobiles is given by the formula (assuming 0 dB antenna gains): pathloss = 20*log10(distance_in_metres)+37
- The noise power is –105 dBm (law of nature) for cdma

- It is assumed that downlink of cdma is destroyed if the interference of WCDMA is 10 dB above the noise power

Calculation results

The follwing results are available based on the mentioned assumptions:

- The interference from a WCDMA mobile destroys the cdma downlink when the distance is 200m or less, assuming adjacent frequency deployment
- The minimum distance reduces to ~100m, if 5 MHz guard band is assumed
- It is possible that no amount of guard band is able to provide interference-free operation for mobiles which are close to each other, as the path loss for the two mobiles is very low.

Based on the above it can be concluded that WCDMA and cdma 1900 cannot operate in the same area, in a practical scenario.

Calculation formulas

Below is a formula to calculate the minimum required pathloss between the two mobiles:

- pathloss_min = tx_power – filter_cdma_band - max_allowed_interference

The required distance in metres can then be calculated with the formula

- distance_min = 10^[(pathloss_min-37)/20],

In other words, by combining the above formulas:

- Distance_min = 10^[(tx_power – filter_cdma_band - max_allowed_interference – 37)/20]

The variables in the formulas are the following:

- The value of filter_cdma_band is 43 if no guardband is assumed
- The value of max_allowed_interference is –95
- The value of the tx_power is 21

All of the above variables are random variables with a distribution depending on many things, mainly the site density.

Path loss (dB) as a function of distance (m) is shown in the following chart.

- The interference potential between the two mobiles grows in a very rapid pace, as distance get smaller.
- E.g. the path loss between the mobiles which are within 10m distance or less from each other is 20 dB smaller than path loss of mobiles within 100m from each other.. This means that the interference signal level is 100 times larger in 10 meters distance compared to 100meters distance.
- When two people speak next to each other, e.g. in an office or a public facility, the path loss is very small, and thus the level of interfering signal is very high.