

# Optimal Spectrum Solution for the Harmonized Introduction of IMT-2000 / 3G

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3G Spectrum-Workshop

July 21<sup>st</sup>, 2005, Jakarta

# About The UMTS Forum

## Who are we?

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- An international, cross-sector industry body comprising operators, manufacturers, regulators, application developers, research organisations and IT industry players.

## Our mission...

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- To promote a common vision of the development of 3G/UMTS and of its evolution, and to ensure its worldwide commercial success.

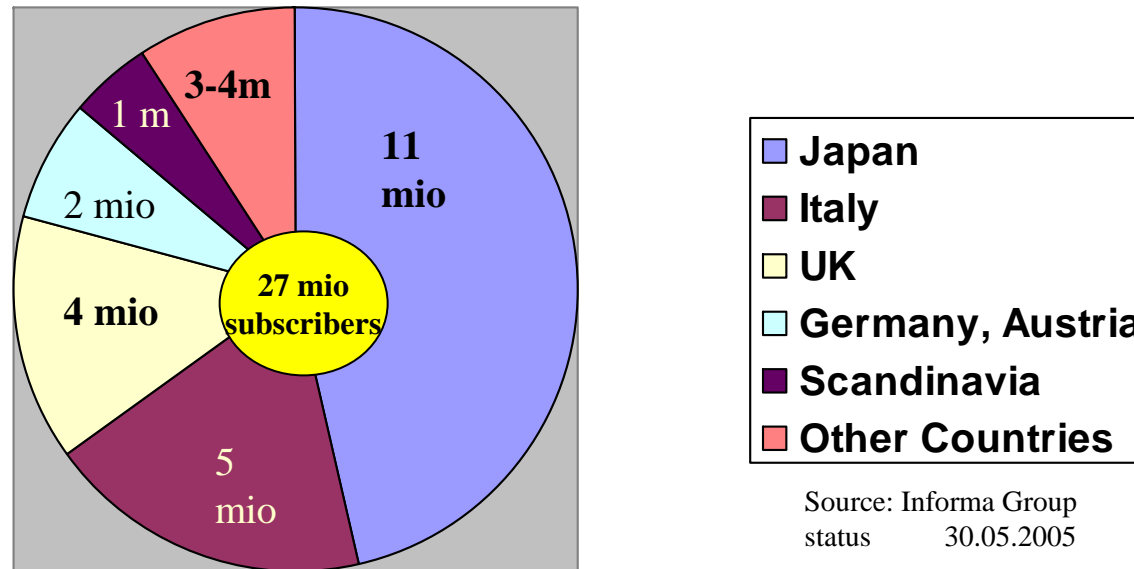
## Spectrum

- Studies and contributions on harmonisation of global spectrum and additional spectrum arrangements for IMT-2000 and its evolution.



# Market Status (05/2005)

## IMT2000 Core Band Use

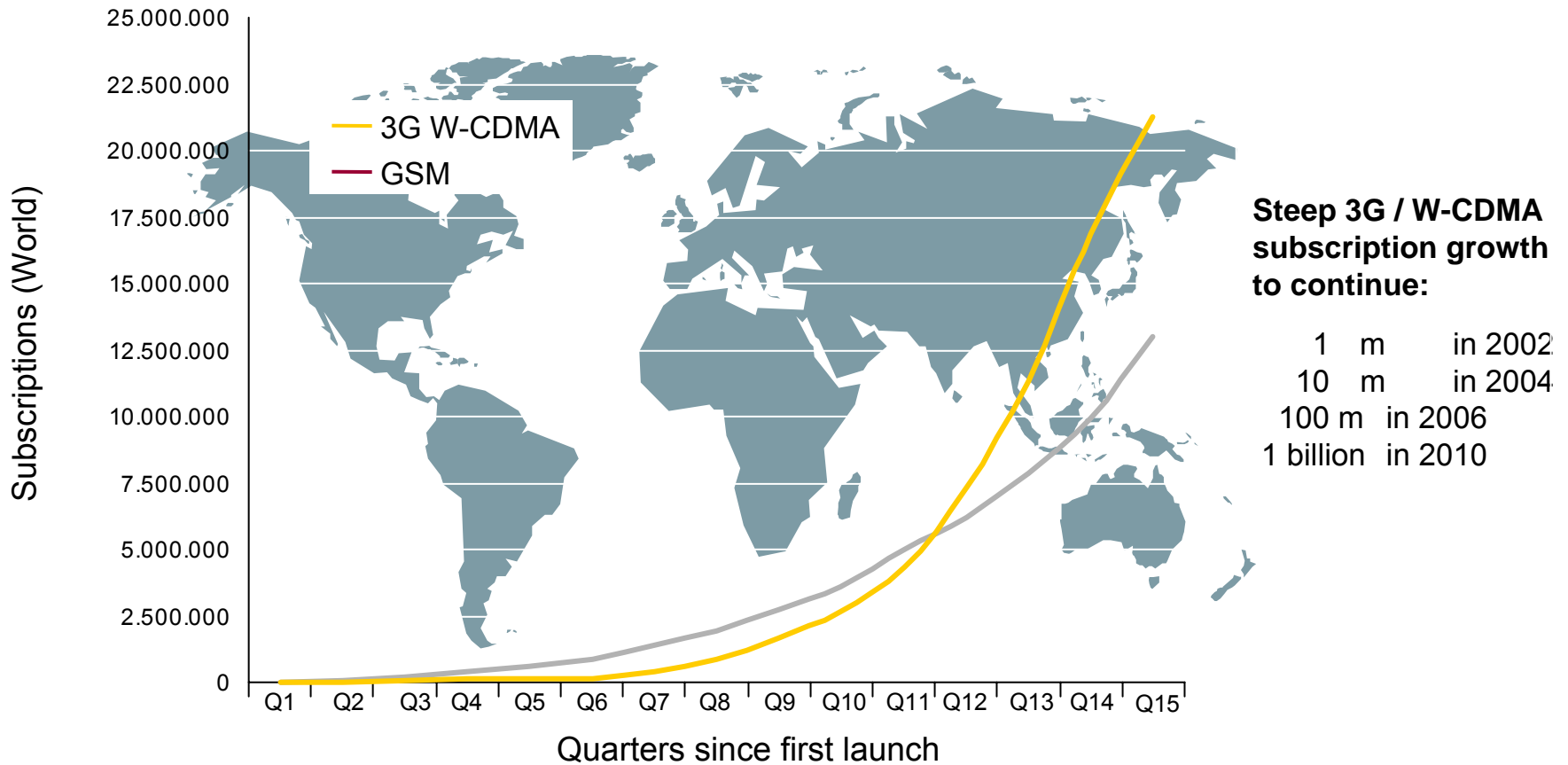


- 135 Core Band Licenses granted in 50 countries
- 75 Operators in pre-/commercial operation
- 27 Million subscribers as of end of May 2005



# Early GSM vs. W-CDMA Growth Comparison

## Steep W-CDMA subscriptions growth



Status: March 2005



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# 3G/UMTS Terminals



UMTS  
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- 150+ 3G/UMTS terminals and PC cards commercially available or announced by a growing range of European, Asian and US manufacturers
- Latest models compare with 2G handsets in terms of battery life, weight and size



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# IMT-2000 Family Concept

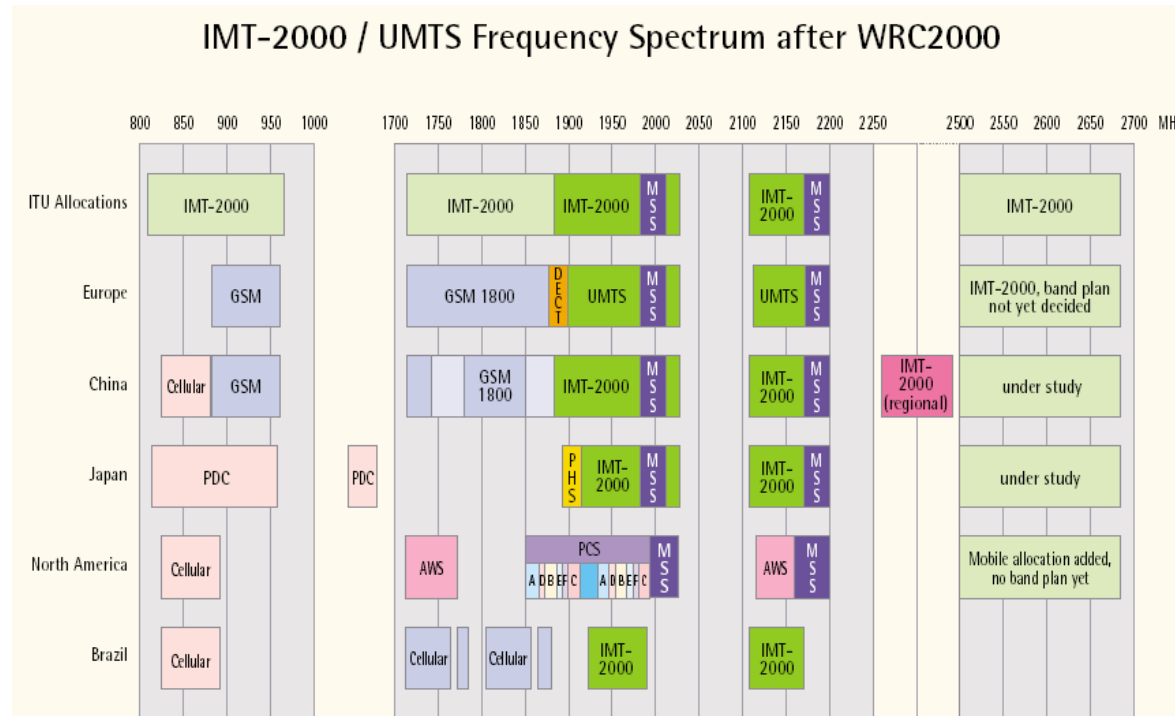
ITU-ITU-R Recommendation M.1457 lists the IMT-2000 technologies as follows:

- IMT-2000 CDMA Direct Spread = UMTS-FDD
- IMT-2000 CDMA Multi-Carrier = cdma2000
- IMT-2000 CDMA TDD = UMTS-TDD
- IMT-2000 TDMA Single-Carrier not relevant
- IMT-2000 FDMA/TDMA. not relevant

Co-existence of all IMT-2000 equipment inside the WARC-92 band plan is supported by 3GPP/3GPP2 standards without any need for additional filters and/or site coordination.



# IMT-2000 spectrum

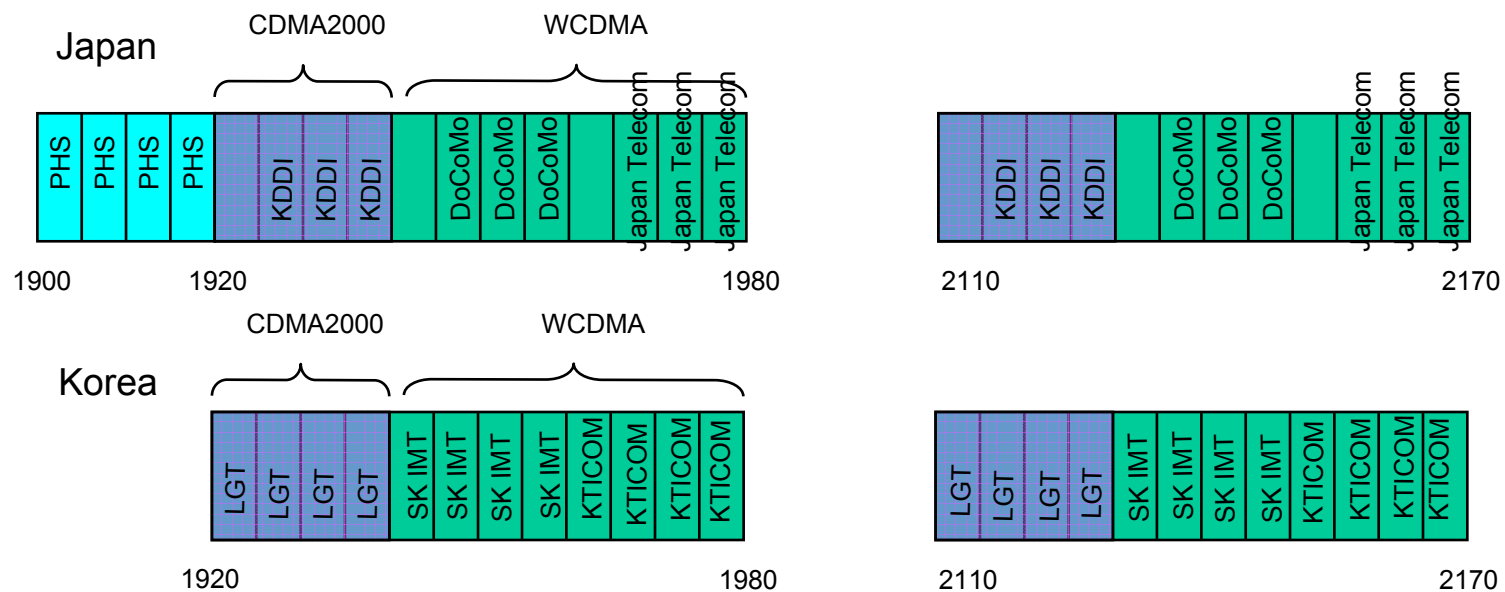


- The World Radio Administrative Conference in 1992 (WARC-92) identified the frequency bands 1885 - 2025 MHz and 2110 - 2200 MHz for use by IMT-2000.
- From the WARC-92 bands, the frequency bands 1885 – 1980 MHz, 2010 – 2025 MHz and 2110 – 2170 MHz are identified for terrestrial IMT-2000. Today's 2G cellular systems operate at 800 MHz, 900 MHz, 1800 MHz & 1900 MHz bands. These bands and the band 2500 – 2690 MHz were also identified for IMT-2000 in WRC-2000.



# Examples of IMT-2000 Licensing

Japan and South Korea have given licenses for both WCDMA and cdma2000 technologies in the IMT2000 core band. The same is planned at least in China.



# Mixed PCS – Core Band Operation



- **Present Indonesian Licenses from 1880 – 2025 MHz:**
  - = 2 x 30 MHz PCS + 2 x 40 MHz Core Band + 15 MHz TDD
  - = No guard band separates PCS and Core Band and TDD
  - = Size of guard bands and filtering is unclear
- **The main conflict is because of reversed duplex directions – no country in the world has therefore deployed PCS and Core Band in parallel**
- **FDD / TDD and GSM 1800 border has to be considered as well**
- **PCS Equipment Standards from 1850 – 1910 / 1930 – 1990 MHz interfere with Equipment Standards for Core Band from 1920 – 1980 / 2210 – 2170 MHz.**

**Key Interferers:**

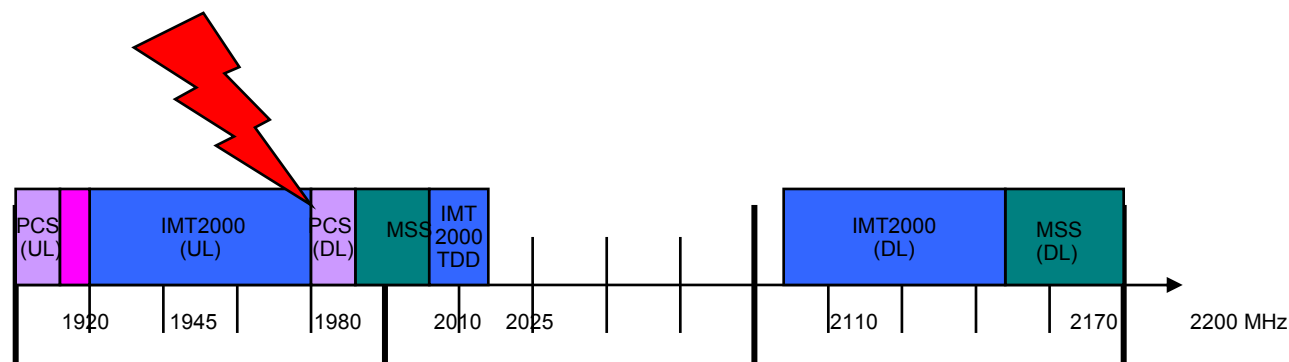
  - CDMA Base Station transmitter blocks WCDMA Base Station receiver, spurious emissions from CDMA BS fall into WCDMA BS
  - WCDMA terminal blocks CDMA terminal receiver within radius of 200 meters
  - spurious emissions reduce QoS
- **With PCS deployments, up to 60 MHz spectrum is wasted (2110 – 2170 MHz)**



# Mixed band plans at 2 GHz

Countries that have parts of the PCS1900 band plan in use may see the idea of 'mixed PCS1900 – WARC-92 band allocation' as an attractive alternative to ensure the future development for all technologies.

This will, however, lead to severe interference cases, as the PCS1900 downlink band is adjacent to the IMT-2000 uplink band in the WARC-92 bands. The main interference mechanisms are the blocking of the IMT-2000 BS and spurious emissions from the PCS1900 BS .



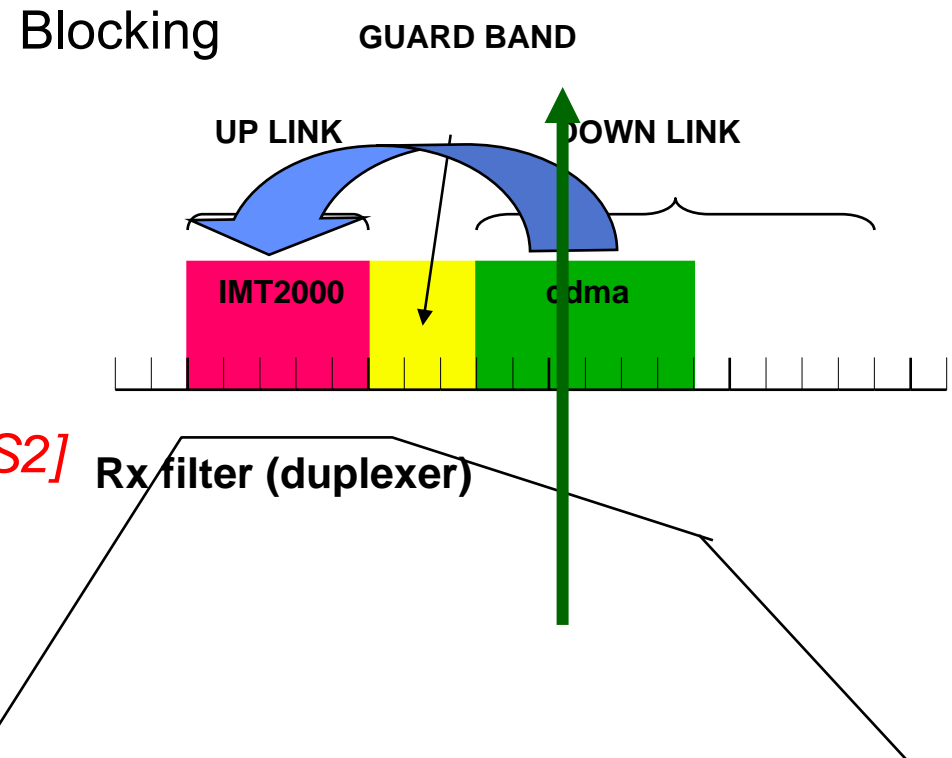
# Blocking of WCDMA BS

- WCDMA RX filter has very little attenuation across 1980 – 1990 MHz, i.e. not designed for this case  
→ -40 dBm blocking requirement applies

- Required isolation:

$$43\text{dBm}[\text{cdma Tx power}] - 57\text{dB}[\text{ACS2}] - (-110)\text{dBm} = 96\text{ dB}$$

- *without coordination* (30 dB MCL assumptions)  
WCDMA external filters need to provide 66 dB attenuations *at each site*



# Spurious Emissions from CDMA falling into IMT-2000 WARC-92 Band

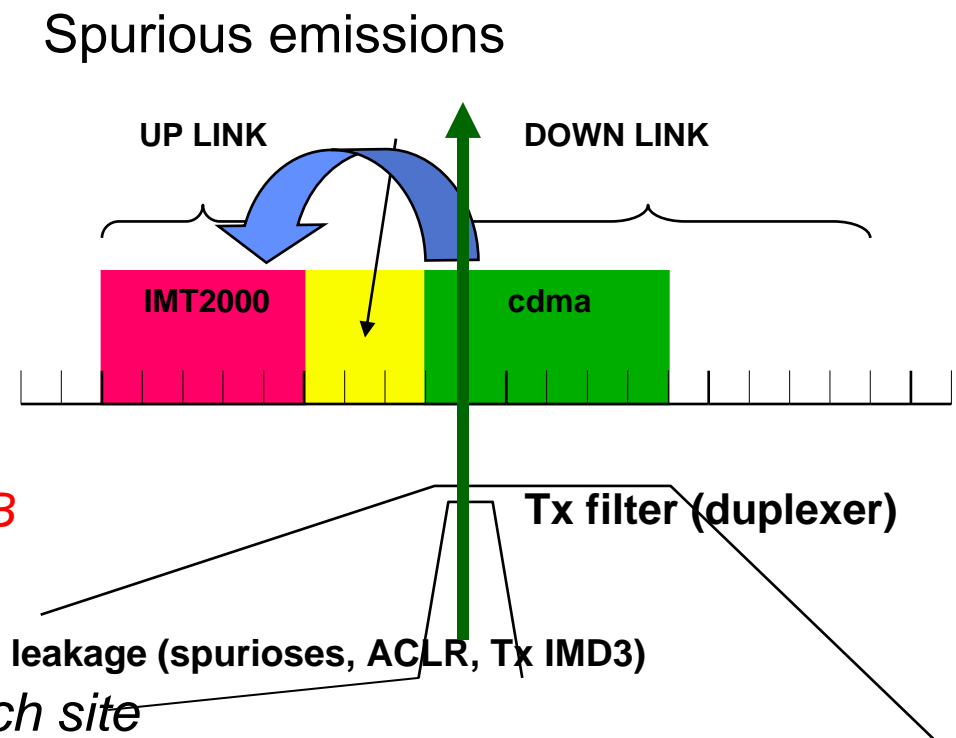
- for offsets > 2.25 MHz, cdma2000 spurious levels still are > -7 dBm/3.84 MHz
- normal PCS1900 full-band duplexer filter will provide no attenuation across most of the IMT-2000 RX band

- Required isolation:

$$-7\text{dBm}/3.84\text{ MHz} - (-110)\text{dBm} = 103\text{ dB}$$

- *without coordination* (30 dB MCL)

CDMA2000 external filters need PA leakage (spurioses, ACLR, Tx IMD3) to provide 73 dB attenuation *at each site*



# Mitigation Requirements

- As the spurious emissions from the PCS1900 BSTX of  $-7$  dBm/3.84 MHz cover the band 1930-1960 MHz, external filters at each PCS1900 BS are the only way to minimize the interference to IMT-2000 BSRX.
- The external filters for PCS1900 BS need to provide 73 dB attenuation. In addition, IMT-2000 BS need to have external filters to prevent blocking. The size of the guard band (for the slope) determines the cost and complexity of the filters.
- A minimum guard band for the provision of 73 dB attenuation is of the order of 5 – 10 MHz. With 5 MHz guard band the added insertion loss would be around 1 dB, this would result in the addition of 15% more IMT-2000 base stations to keep the same coverage. 10 MHz guard band would result in 0.5 dB IL and the amount of additional IMT-2000 base stations is around 5%.



# Interference 1920-1990 MHz Analysis MS - MS

**Spurious emissions from Core Band-MS Tx into the PCS Band-MS Rx cannot be filtered out in proximity of < 200 m:**

- Core Band-MS Tx carriers cause PCS-MS receiver densitization due to insufficient blocking
- Criteria:
  - Distance from other MS, geographical distribution of MS
  - Noise floor 1dB with 5 MHz guard band, 0.5 dB with 10 MHz
  - PCS-MS Tx power and spurious transmissions
  - Additional filtering at the BS and size of guard band



# WCDMA-CDMA Interference Summary

## 1920 – 1990 MHz



### 1. Inter- Terminal Interference

- CDMA 2000 Terminal receiver is blocked from WCDMA (MSS) terminal transmitter!  
CDMA downlink is destroyed, when the distance is  $\leq 200\text{m}$   
(with 5MHz guard band, it is  $\leq 100\text{m}$ )
- Users cannot be instructed to keep a certain distance from other people using a mobile phone

### 2. Inter- Base Station Interference

- CDMA 2000 BS transmitter blocks WCDMA BS receiver + spurious emissions

### 3. Roaming:

- GSM 1800 – WCDMA Intersystem Handovers are destroyed
- GSM – WCDMA coverage synergies are lost!

**Impact:** Coverage loss, dropped calls, 2G - 3G handover impacts, customer complaints

**Measure:** more base stations, additional filtering on both sides + guard band, in dense areas -site coordination is required,



# Consequences

- Mixed allocations plan would cause additional cost and need for coordination to all operators in both bands due to
  - External filters to all BS
  - Additional BS due to the increased Insertion Loss because of the external filters
- In addition, 5 – 10 MHz will be lost for the guard bands
- National regulations need to impose significantly tighter emission limits on the PCS1900 BS than are currently specified in 3GPP2
- User Terminal Interference PCS-WCDMA cannot be mitigated - degradation of service and coverage loss



# Other Interference

- 1880 MHz border (GSM – CDMA):

Inter-Terminal-, Inter-Base-Station Interference:

coverage loss, dropped calls, higher costs, guard band

- 1900 – 1920 MHz (PCS – TDD):

Inter-Terminal-, Inter-Base-Station Interference:

QoS reduction, capacity loss, guard band site coordination needed



# Impact on ITU-R IMT-2000 Satellite Bands



## WRC-2000 decided Resolution [COM 126]:

1. That the bands 1980-2010 MHz and 2170-2200 MHz are identified for use by the satellite component of IMT2000 through No. S 5.388 and Resolution 212 (Rev.WRC-97)
2. This is valid at least for Region 1 (Europe, Africa etc) and Region 3 (Asia Pacific)

**The PCS plan overlaps with IMT-2000 MSS  
in Indonesia – MSS is regional, has priority!**



# ITU Radio Regulations

- No Band Arrangement with reversed duplex directions is considered
- Sufficient separation between Tx and Rx frequencies exists
- Guard Bands are minimized to avoid wasting spectrum
- Satellite bands are regional – avoid impact



# The Indian Case

- **1991:** 0.34 mio mobile users
- **1994:** First GSM licenses awarded in Metros, Beauty contest
- **2001:** WLL licenses awarded with „limited mobility“;  
Regulatory change to Revenue sharing model
- **2003:** Unified Licensing Regime: same license fee for spectrum  
„irrespective of technology or service“
- **2004:** TRAI Consultation on spectrum and  
viability of mixed PCS/Core Band plan:  
more than 40 responses, total >2000 pages
- **2005:** TRAI final Recommendation:  
2GHz spectrum clean for IMT-2000 / no mixed band plan
- **Today:** 53 mio mobile users (GSM = 41 mio, CDMA = 12 mio)



# The Indian 3G Recommendation

TRAI India, May 2005:

- It is evident that mixed band allocation is not feasible ...
- 3G allocation should be made only in one of the two bands viz. 2GHz and PCS1900
- It is recommended that the IMT-2000 2GHz band (ITU-R B1,B4) should be allocated for IMT-2000 services



# Mixed Band Plan Consequences

Special Regulations will be needed for 3G in Indonesia:

- Detailed technical analysis on:
  - additional filtering and guard band
  - improved spectrum plan
  - Site coordination
  - eventually PCS-BS Tx Power limitation
- Consensus on specific technical conditions according to Indonesia spectrum plan – test procedures for Type Approval



# Our Recommendation

All IMT-2000 technologies can be licensed in the WARC-92 band without external filtering and guard bands

Indonesia will be isolated from mobile communications in Asia, if the mixed band plan would be continued



**For more information...**

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