

# 3G Wireless

## *from an Operator's Perspective*

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**Technology Development**

## Introduction

- Background
- CDMA Evolution
- Services and Market Issues
- Technology Issues
- Spectrum Issues
- Network Evolution
- Summary and Conclusions

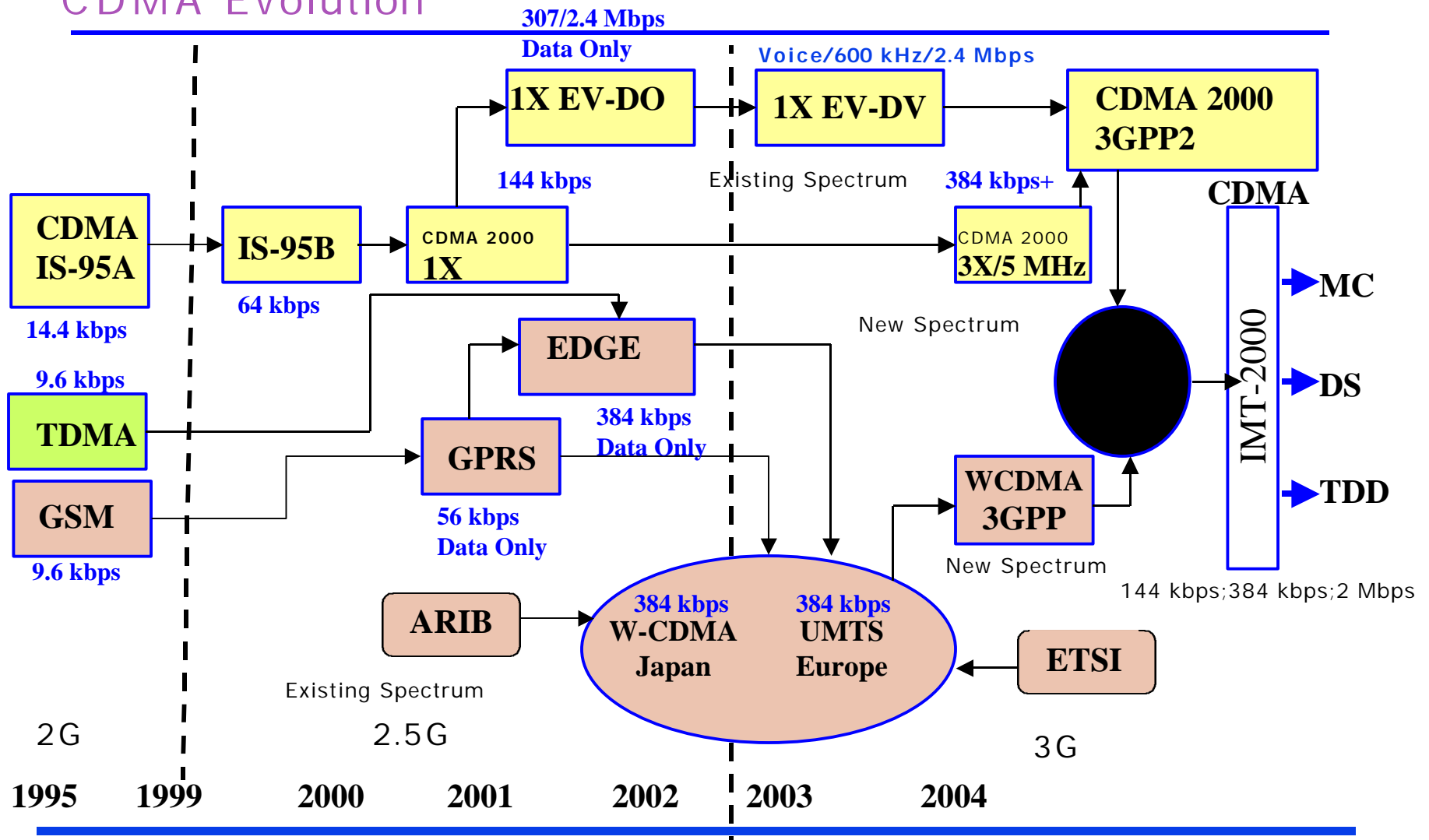
## IMT-2000 Background

- ITU-R Task Group 8/1, in 1999 Issued Recommendations ITU-R M for 3rd Generation Wireless Systems, Designated IMT-2000. These Include:
- **A high degree of commonality of design world wide**
- **Accommodation of a variety of types of terminals and connection of mobile users to other mobile users or fixed users worldwide**
- **Availability to mobile users of a range of voice and non-voice services**
- **High quality and integrity, comparable to the fixed network**
- **Efficient use of the radio spectrum consistent with providing service at acceptable cost**
- **An open architecture which will permit easy introduction of advances in technology and of different applications**
- WRC-92 has identified the bands 1 885 - 2 025 and 2 110 - 2 200 MHz, on a global basis for 3G including the bands 1 980 - 2 010 and 2 170 - 2 200 MHz for the satellite component of IMT 2000

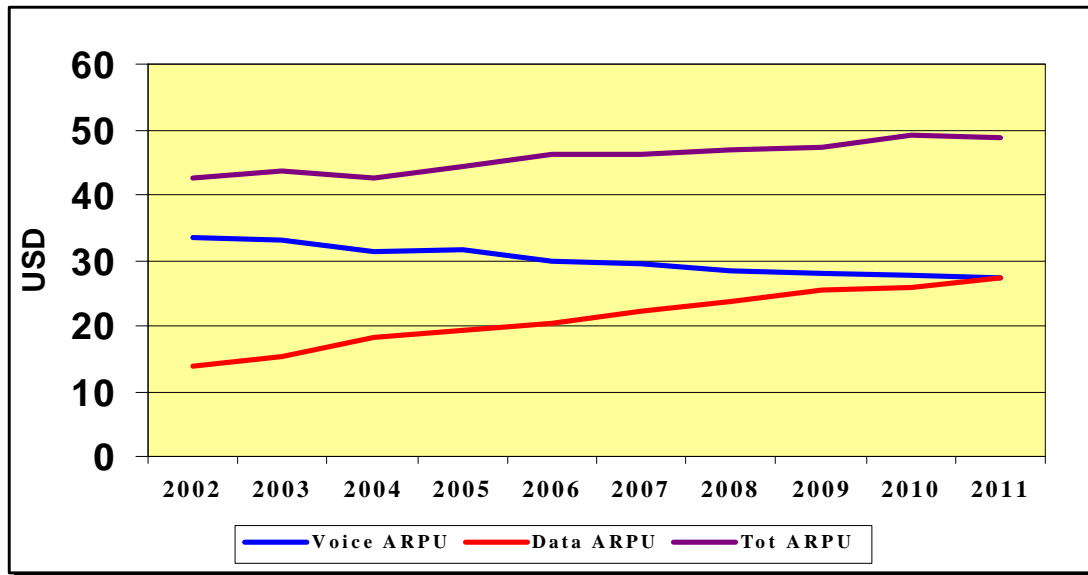
## Key Objectives of IMT-2000

- **Worldwide *Common Frequency band***
- Higher Data Rates -144kb/s, 384 kb/s Pedestrian Full Mobility to 2 Mb/s Indoors
- Symmetrical and Asymmetrical Rates on Forward and Reverse Paths
- Voice, Circuit Switched, Packet Switched Data Services, IP and Streaming Video Services
- Improved Voice and Data Capacity
- Improved Spectrum Efficiency
- Multiple Simultaneous Services to End Users

## CDMA Evolution



## Services and Market Issues - Why 3G?

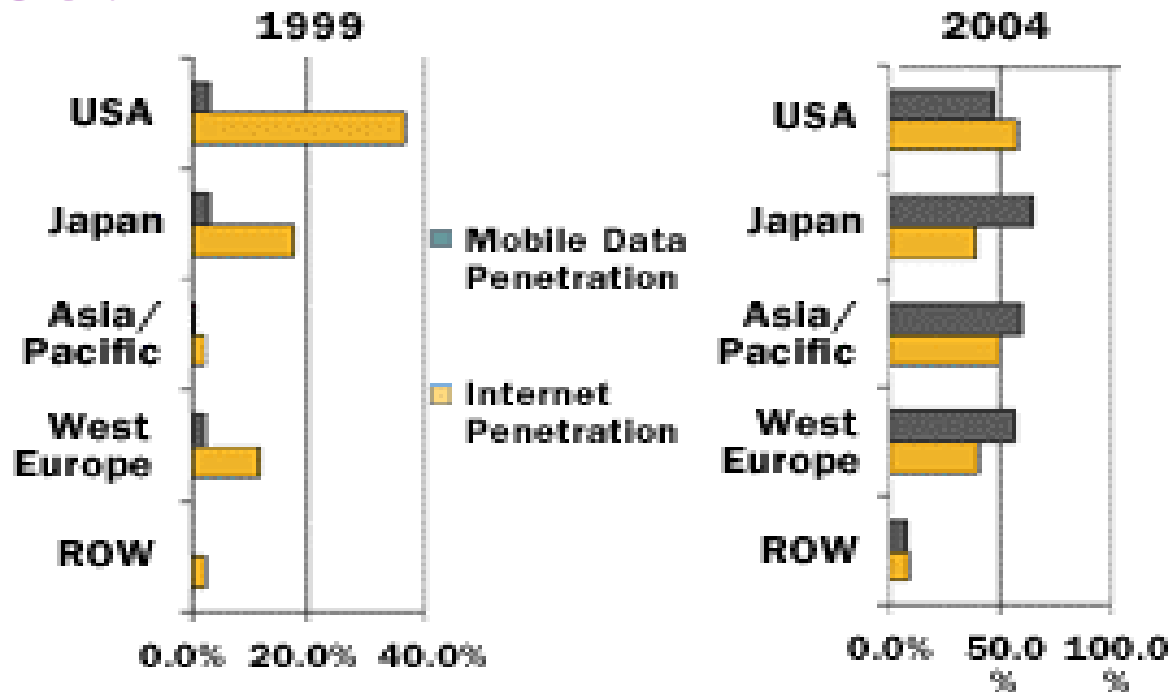


Voice vs Data ARPU

Source: Ericsson

- Voice and Data Volumes Increasing
- Voice ARPU is Decreasing - Capacity Efficiencies Required
- Data ARPU is Increasing - Packet Data Services Required

## Services and Market Issues - Why 3G?

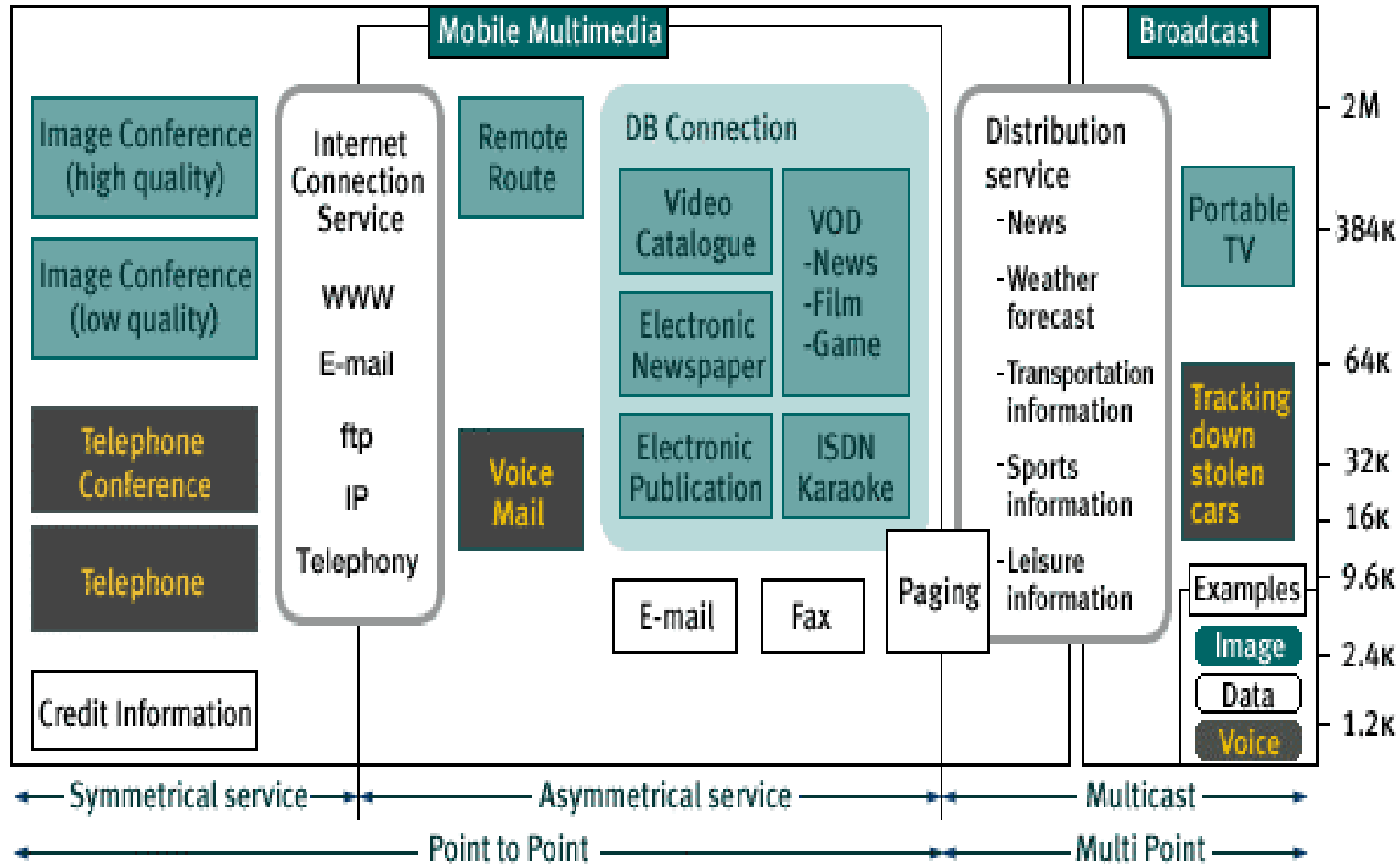


Internet and Mobile Data Growth

Source: Qualcomm

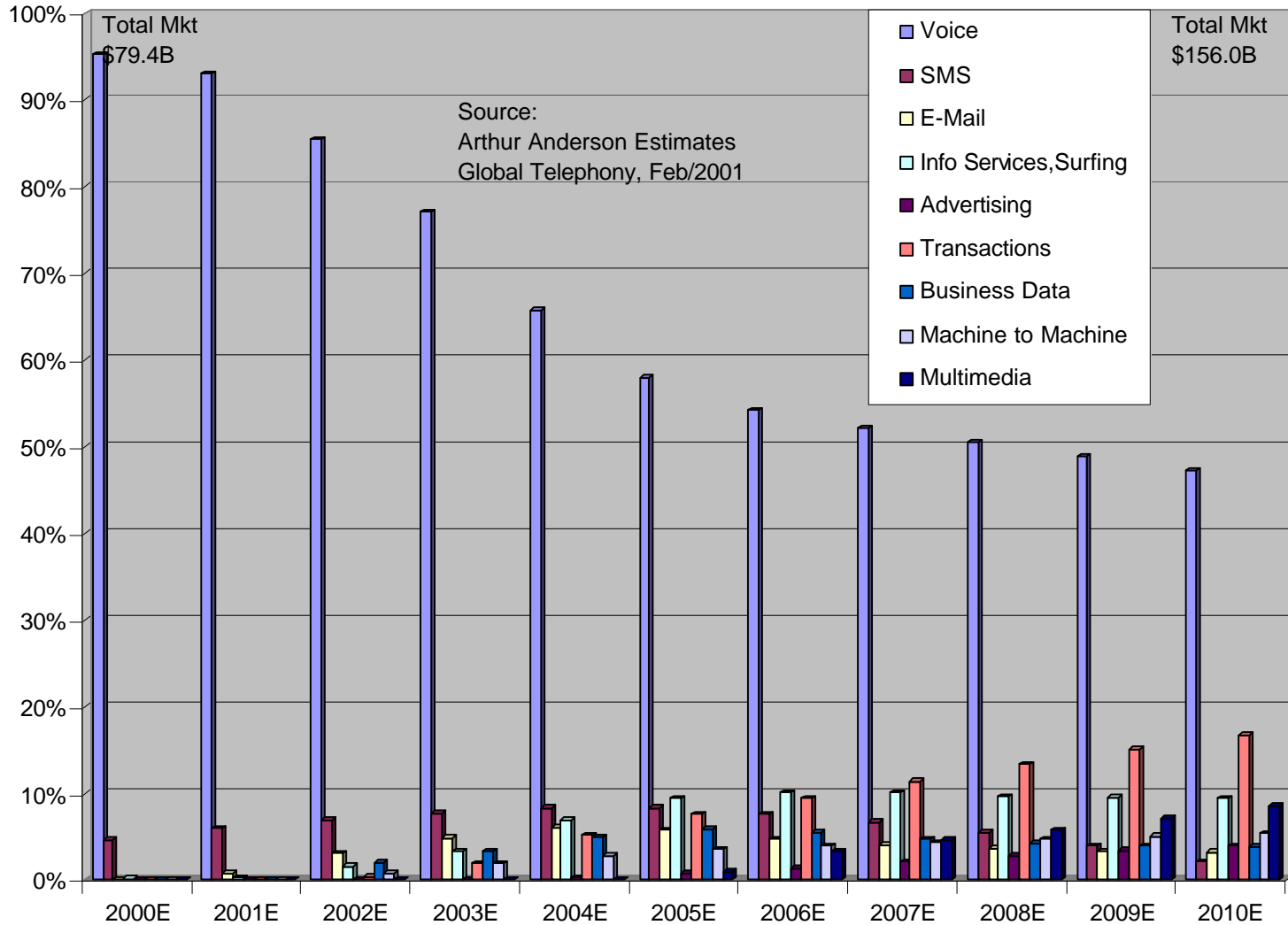
- Wireless Access to the Internet will Exceed Landline Access Everywhere Except the U.S. (and Canada)

Services and Market Issues - 3G Enables Many New Services, but Which Ones Will Generate Sufficient Revenues?





## % of Global Wireless Revenues



## Services and Market Issues - The Challenges

- Maintain Voice Quality, Introduce High Revenue Wireless Data Services at Acceptable Cost
  - Huge Investments Required for Spectrum and Infra -Impact Pricing and Penetration Rates. Estimated \$100B paid to date for Auctioned Spectrum
  - Faster Data Rates but Small Screen, Awkward Interface for Data Services may slow adoption. Better Terminals coming, but premium priced
  - NTT I-Mode a Success. Can it be Duplicated Here? - Social/Cultural Factors
- Uncertainty of Bandwidth vs. Mobility Requirements
  - High BW Apps Tend to be Visual. Are these compatible with vehicular mobility?
  - Only Video Streaming Need Higher Rates than 2.5G - Market?
  - Business Laptop User Opportunities - Network Capacity Impact?
- Intro of Payment /Transaction Processing/Transaction Security Required
- For Portable Services, Must Compete with Fixed Wireless Solutions
  - Cellular Operators Have Coverage, Roaming, Billing Capability Advantages

## Technology Issues - CDMA 2000 vs. WCDMA

- Worldwide, GSM Provides WCDMA with a Large Potential Market Share of Subscribers

	Subscribers	Market Share
GSM TDMA (3GPP to WCDMA )	473M	69%
IS-95 CDMA (3GPP2 to CDMA 20001X, EV, 3X )	88M	13%
IS-136 TDMA (U.S.)	70M	10%
PDC	52M	8%
Total Digital Subscribers	684M	100%

- Impacts
  - Handset Availability and Cost per Unit
  - Development of Services and Speed to Market
  - Roaming Market
- Standards
  - GSM/UMTS has standardized the air interface, network, satellite and internet interfaces. cdma2000 is still developing the other interface standards.**
- Can Advanced Technology/Services of CDMA 2000EV in Yr 2003 Overcome Planned Intro of WCDMA in Yr 2004/2005?**

## Technology Issues - CDMA 2000

- Variable Data Rate/Variable Walsh Length/Variable Coding Gain
  - Non-Congruent Service Areas.
  - Marketing and Network Optimization Issues?
  - Smart Antenna Solution?
- Shared Data/Voice Carrier vs. Separate Carriers
- 1XEV-DO and DV Asymmetric Data Capacity
  - May Impact Certain Business Applications
- WCDMA vs. CDMA 2000 1XEV Implementation Risks?
  - QPSK/5 MHz vs. 1XEV-DO 8/16 QAM and 1XEV-DV 16/64 QAM in 1.25 MHz
  - **Frame-by Frame Selection of Coding Rate and Modulation Scheme**
  - **However, Required Processing speeds much lower than Fixed Microwave, SONET Networks**
  - **Linearity, Power Consumption, Cost are issues.**

## Technology Issues : Predicting 1X Voice and Data Capacity Requirements

### Fundamental Channels Required per Sector - A Queuing Problem

- % of SMB, Corporate, Consumer and Prepaid Users
- % Mix of Laptop and Browser Users
- No. of BH Sessions, Session Length, Transfers per Session
- Session Type:
  - % Laptop: Voice, WWW, FTP, E-Mail, Telnet, FAX, SMS
  - % Handheld Browser: Voice, WAP, E-Mail, SMS
- Holding Time and GOS Required
- No. of Subs by Year in Market Area

### Supplemental Channel Data Capacity Required

- File Sizes, Transfer Times, Burst Rates Required for each Session Type
- % of Available Carrier Power Required - % of Carrier Exhausted

### Carrier Exhaust is Very Sensitive to:

- % of Laptop Users - Market Driven, Price Sensitive
- File Sizes, Transfer Times Required - Market Driven, Price Sensitive
- Optimum Holding Time - Under Discussion

## Technology Issues - Handsets

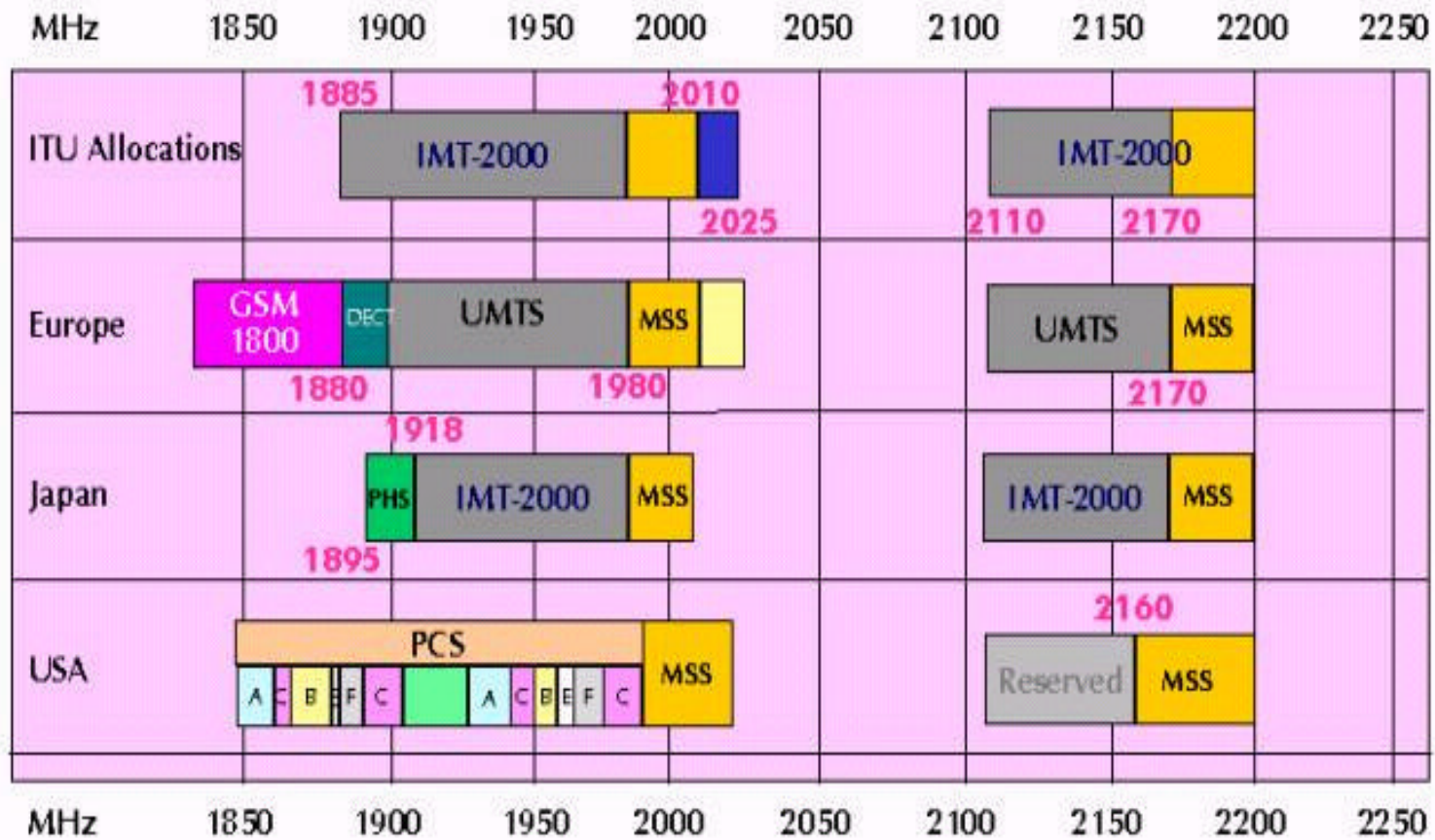
- Harmonization of Standards and Spectrum will Lower Costs, Facilitate Global Roaming
- Mature Standard and Large User Market Required to Make Vendors Commit to Development of Handsets
- Software Defined Handset (SWDH) May Support Two Standards
  - Cost, Power Drain May be a Problem
  - Dormant, Dynamically Programmable DSP's May Reduce Power Drain and Costs.
- Currently, CDMA 2000 Needs SWDH More Than UMTS
  - Mature IMT-2000 Spectrum Plan
- Personalized SIM Card - UMTS Advantage

## Technology Issues - SIM Cards - a GSM /UMTS Advantage

- **A Personalization Tool to store removable User Profiles**
- **Enables secure transactions via encryption/decryption & controlled access to Data and m-commerce**
- **Facilitates Roaming**
- **Vendors are banking on SIM (Subscriber Identity Module) cards to adapt a phone's personality to its operating system.**
- **Enabler of conducting secure payment transactions**
- **Enables the WSP's to use inter- industry "open" specs developed by Financial Institutions and others**
- **Enables the handset to be used as an "empowered" tool for user access to multiple applications.**

## Spectrum Issues

### Worldwide Frequency Plans for IMT-2000 Bands





## Spectrum Issues

- Europe, Japan Are Clearing 1920-1980/2110-2170 MHz for IMT-2000 3G Terrestrial Core Spectrum per WRC'92.
- FCC PCS Band Occupies 1850-1910/1930-1990 MHz. Note that the PCS Downlink Conflicts with the IMT-2000 Uplink Band.
- Additional 160 MHz Required Worldwide by 2010. WRC 2000 Identified 698-960,1710-1885 and 2500-2690 MHz to Meet this Need.
- There is a need for North American Operators to Use this Spectrum earlier as existing 2G Spectrum exhausts. GSM/WCDMA Operators in Europe and Asia can use their IMT-2000 Core Spectrum first.
- No Assurance that Region 1 and 3 GSM/WCDMA Operators later use of Non-Core Spectrum in 698-960/1710-1885/2500-2690 will Harmonize with band plans in N.America.
- Software Defined Mobile Terminals may be a solution, but less pressure on GSM/WCDMA Operators to adopt,with GSM/WCDMA Penetration in N. America. Cost of Handset Increases.

## Network Evolution - In a Fluid Technology Environment

### Some Network Investment Decision Triggers:

- A significant difference in the cost and availability of compatible mobile terminals
- A significant difference in the available applications/services that can be offered and time to market
- A significant difference in the availability and cost of 3G SIM cards and associated services
- A significant delay in the commercial penetration of WCDMA or CDMA 2000 EV
- A significant difference within North America and Globally in roaming capability.
- Availability of 5+5 MHz Blocks of worldwide common spectrum and which standard is widely deployed in that Spectrum

## Summary and Conclusions

The Canadian wireless industry is part of a much larger North American Market and will continue to be influenced by FCC rulings and industry trends in North America. CDMA Operators will need to:

- Extract maximum value of IS-95 investment through current CDMA 2000 1X technology upgrades and beyond.
- Have speed, agility and flexibility in recognizing and capturing early revenue opportunities. Currently No Single Killer Data Application with Revenues Comparable to Voice.
- Position to deliver content and not just transport capacity.
- Enhance systems which support both Voice and Data
- Push the limits of speech technology for identification, authentication and user friendly service delivery
- Watch the Triggers. Adopt a Flexible Strategy on technology investments based on a reliable assessment of performance, risk and market windows.