Challenges in Developing 3G Handsets

ASUSTeK Computer Inc.

Alex Sun, Ph.D.

**March 8th, 2004**

ASUS®

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Evolution of Cellular Mobile Standards
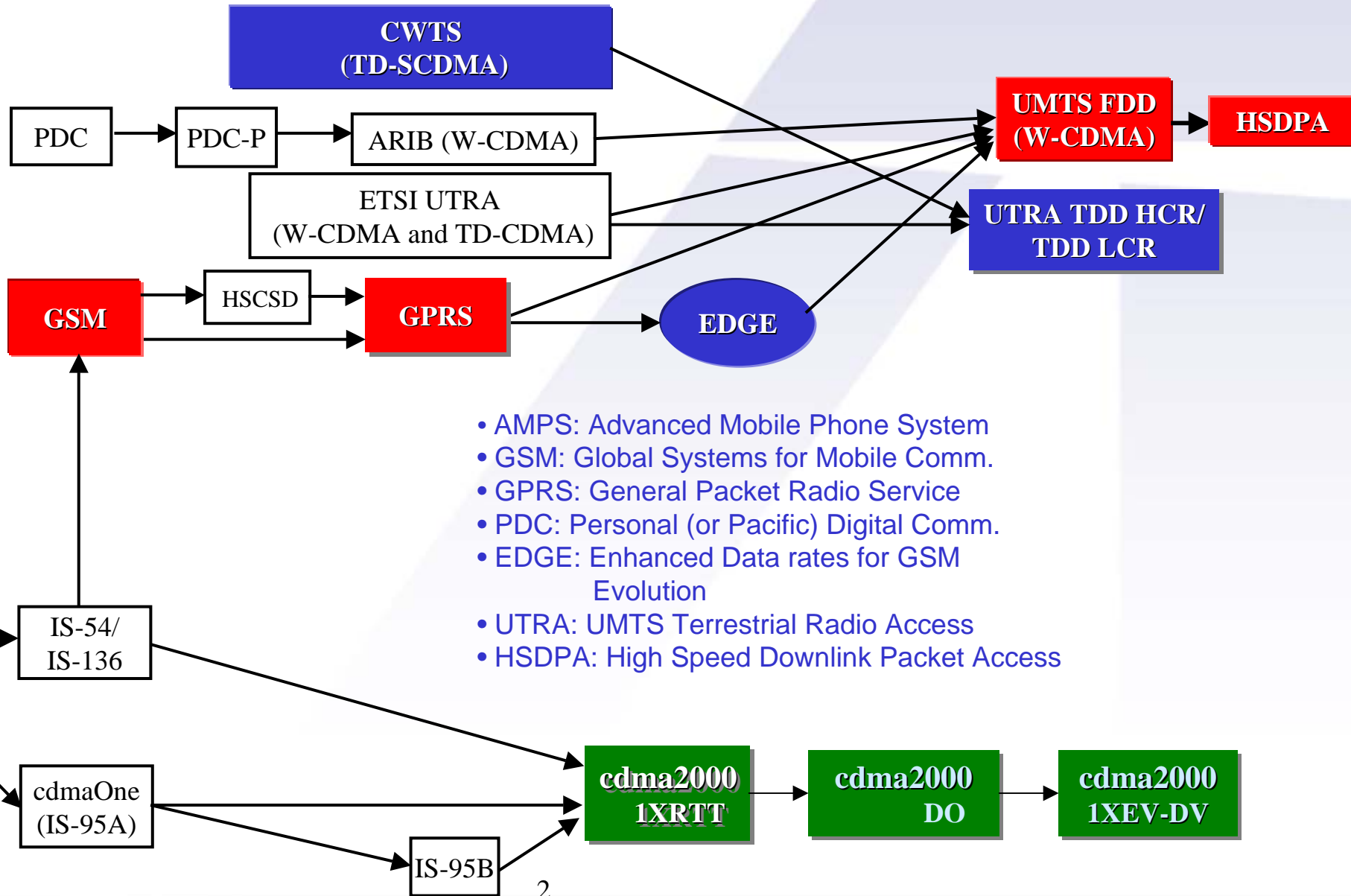
- AMPS: Advanced Mobile Phone System
- GSM: Global Systems for Mobile Comm.
- GPRS: General Packet Radio Service
- PDC: Personal (or Pacific) Digital Comm.
- EDGE: Enhanced Data rates for GSM
          Evolution
- UTRA: UMTS Terrestrial Radio Access
- HSDPA: High Speed Downlink Packet Access

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Worldwide Handset Shipment Forecast

Source: IDC, January 2004
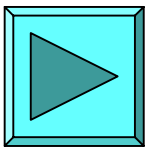
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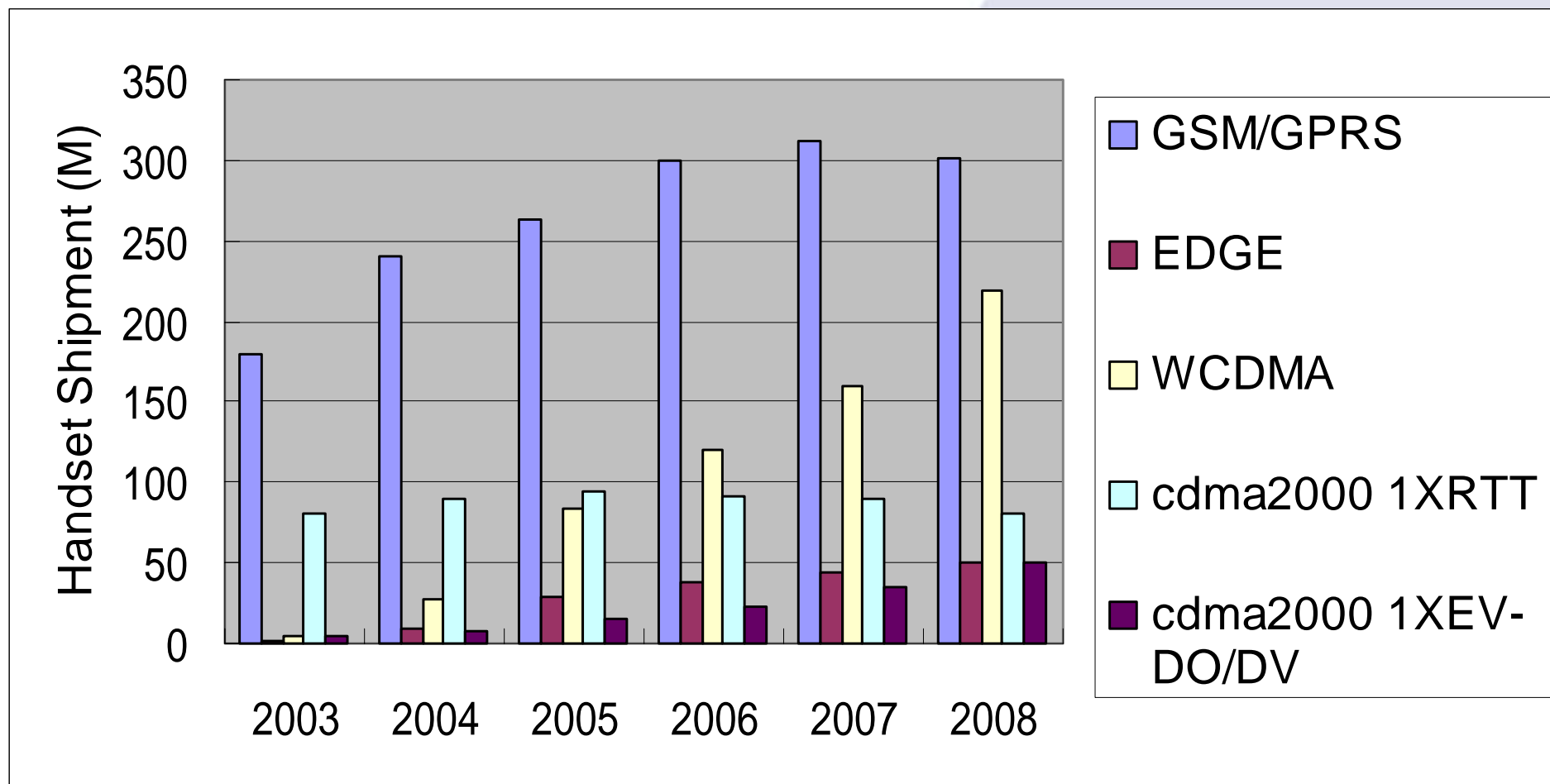
DoCoMo FOMA Subscribers Growth

(thousand)
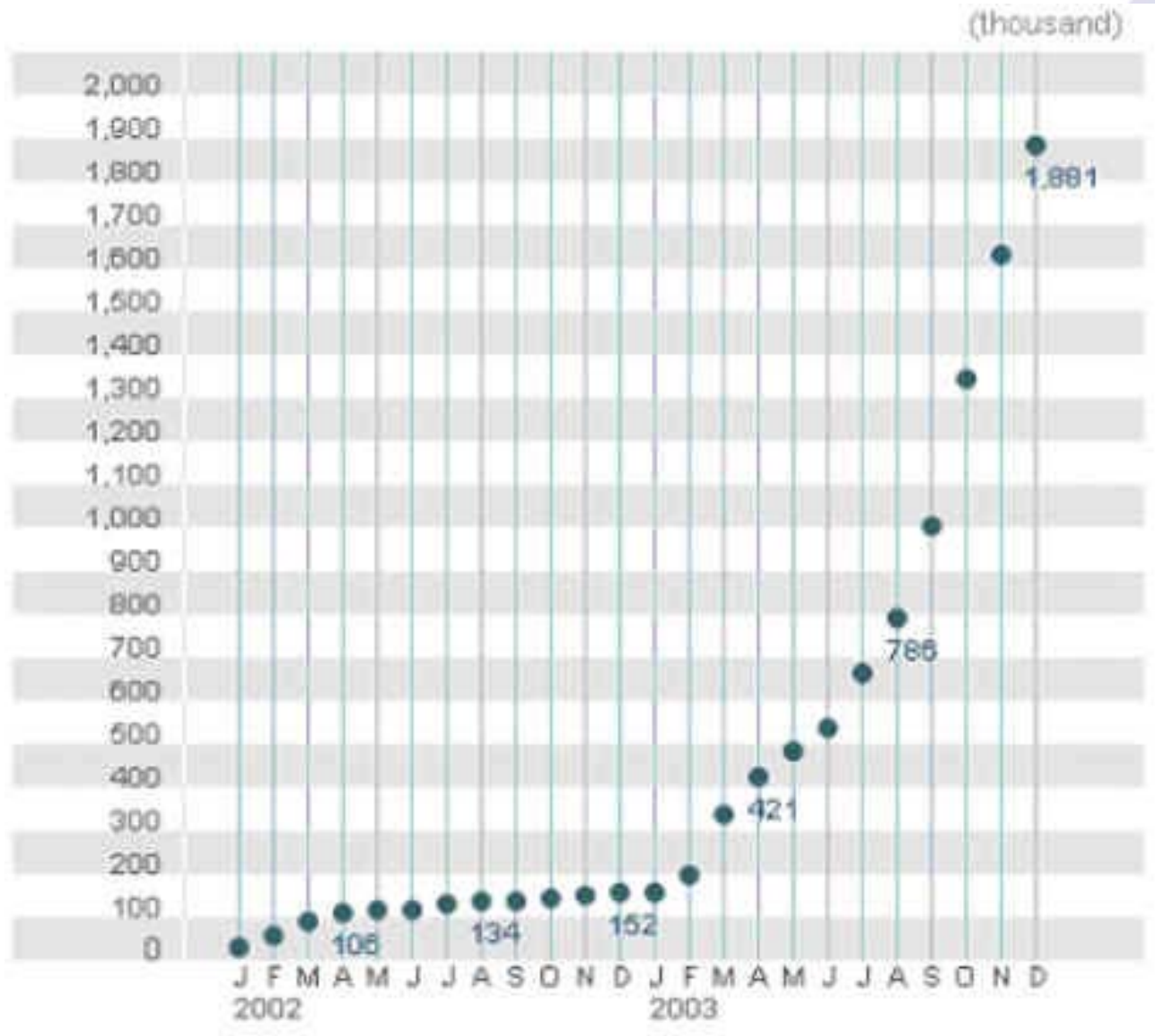
- **Higher Network Coverage**
- **Better Handsets**
  - **Power consumption**
  - **Complexity**
  - **Features**
  - **Cost**
- **Lower Tariff**

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Complexity Comparisons of 3G with 2.5G Handsets

	NEC e606 (W-CDMA)	Moto A830 (W-CDMA)	Nokia 6650 (W-CDMA)	EDGE Phone (2003)
IC Count	108	68	29	13
Silicon Die Size	17.33 cm^2	7.70 cm^2	4.54 cm^2	1.93 cm^2
Total Component Count	1421	935	629	381
Connection Density	49.5/cm^2	28/cm^2	25.5/cm^2	26.5/cm^2
Source: Portelligent Inc. (2004)				

e606 (NEC)

Motorola A830

Nokia 6650

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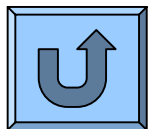
Illustration of Handsets Hardware Structure

RF Module

Antenna

PA

Transceivers

Analog Baseband
- A/D, D/A
- Codec

Baseband Processor
- MCU (RTOS)
- DSP
- HW Accelerator
- Peripherals

Application Processor
- MCU (High level OS)
- *DSP*
- Peripherals

Memories (Flash/SRAM)

Power Management IC

Mechanical Components

Key Components
- LCD(s)
- Camera
- Battery
- Bluetooth chipset
- Memory card
- others
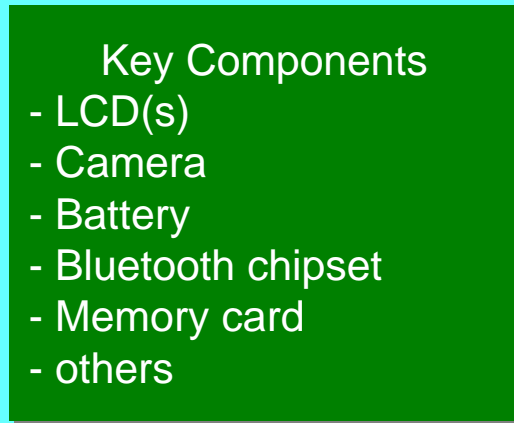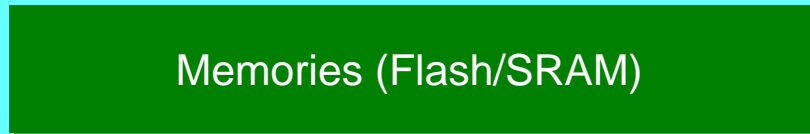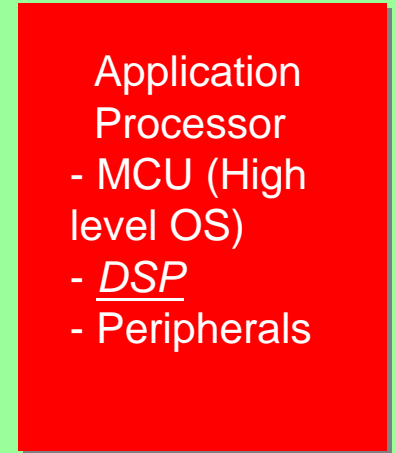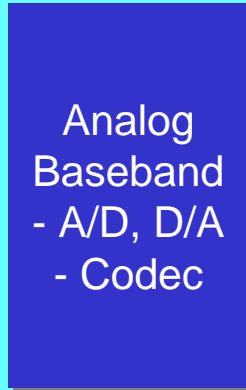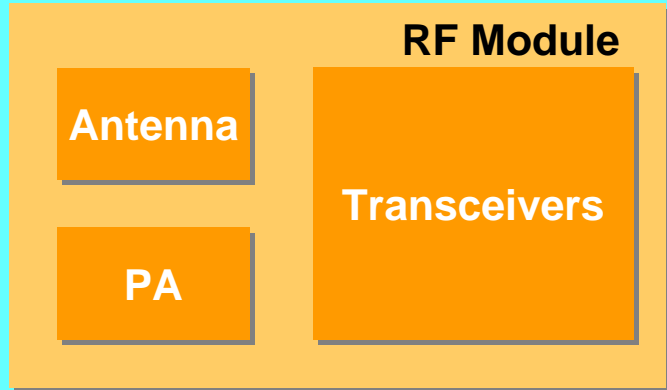
One-Chip Solution (Feature Phone)

**Two-Chip Solution
(Smart Phone/PDA Phone)**

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Illustration of Mobile Applications Evolution

3G

2.5G

2G

Voice

SMS

SS

UART   STK

IrDA   USSD

FM Radio   CSD

EMS   MMS

WAP   E-mail

JAVA   MP3

Native Games   MPEG4

Camera   Bluetooth

USB   Memory Card

M-commerce   Streaming Video

Multi-player Games   Video Telephony

Push-to-Talk   Video Conference

Instant Messaging   Location Base Services

WLAN   TV

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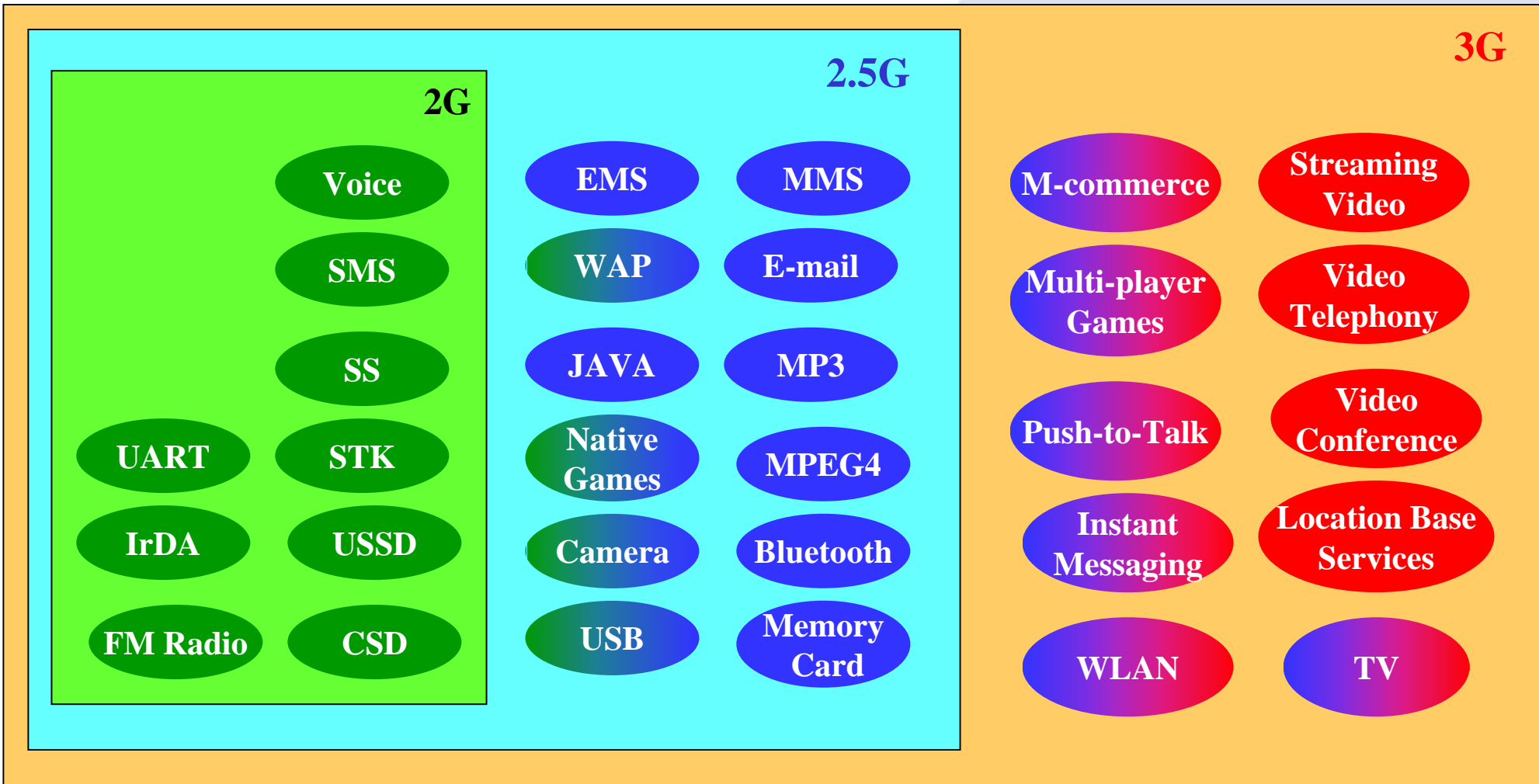
Illustration of Handsets SW Structure

Applications

- CC/SMS
- UMA
- PTT
- Phonebook
- Camera
- Browser
- Setting
- Media Player
- Games
- Flight Mode
- PIM

…

- MMS
- WAP
- Java VM
- HTTP
- Email
- SIP
- TCP/IP

…

Adaptation Layer

Device Management

Layer 2/3

Layer 1

Device Drivers

HW Platform

RTOS

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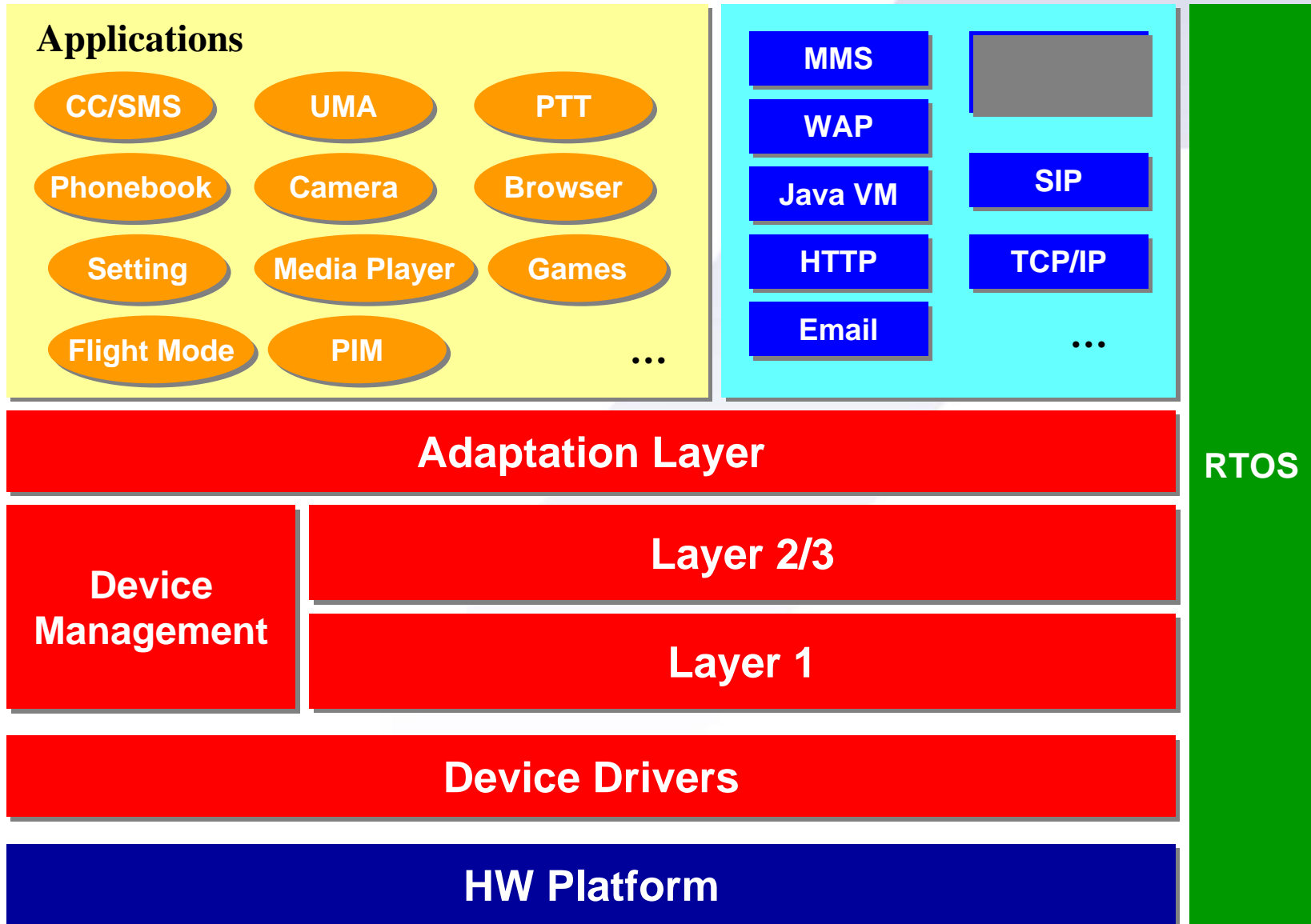
**Dual-mode
W-CDMA/GSM/GPRS
Protocol Stack
Structure**

Application Layer

SAT/USAT | ATC | PPP

USIM

O&M | Service Provider API (SPAPI)

CC | SS | SMS/GSMS | SM | SNDCP | RABM

MM | GMM/UMM | LLC

RR | GRR | URRC

BMC | PDCP

Circuit Switched Data Service | LAPDm | GRLC | URLC

GMAC | UMAC

GSM/GPRS Layer 1 | UMTS Layer 1
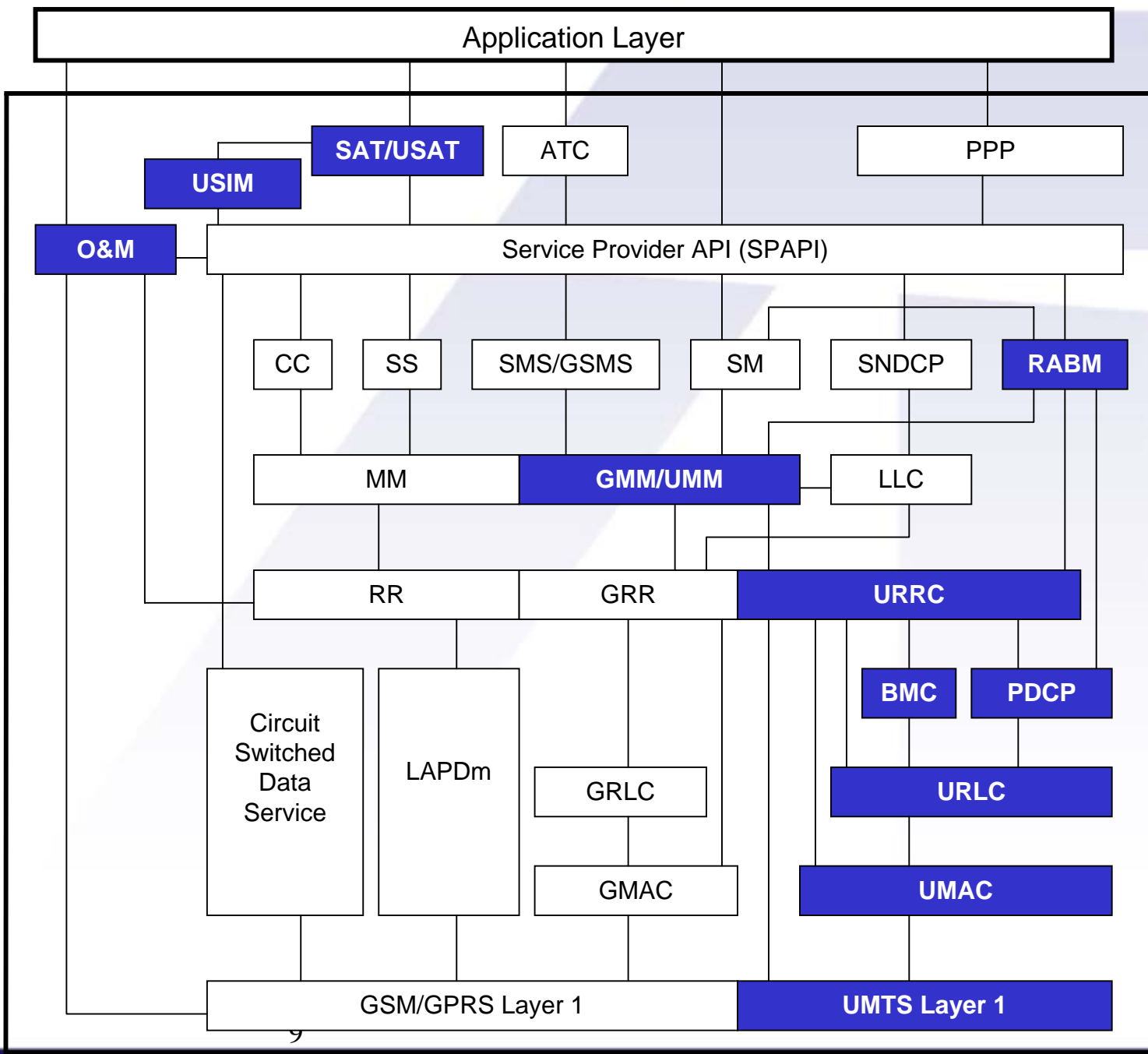
Challenges in Developing 3G Handsets

- W-CDMA Essential IPR (Intellectual Property Right)
- Interoperability Test (IOT) of Dual-mode Handset
- Complexity of 3G Applications SW

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W-CDMA Essential IPRs

- Not like in CDMA world, lots of companies own W-CDMA essential IPRs
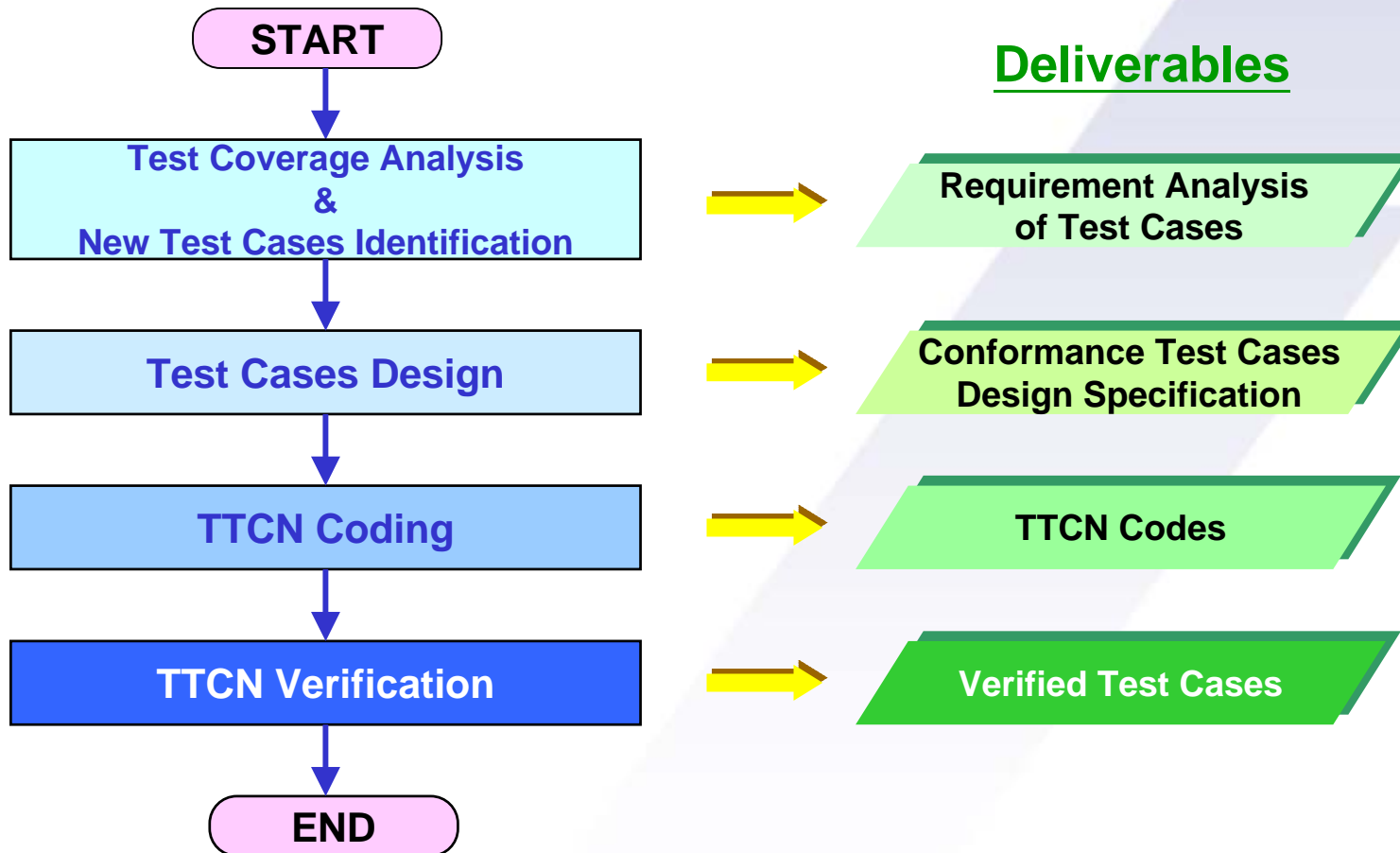
- 3G Patents (originally called 3G3P) is a member-managed company that intends to   provide services for evaluating, certifying, identifying and licensing essential patents for realizing third generation (3G) mobile communication systems
  - But major 3G essential IPRs owned companies, such as Ericsson, Nokia, Motorola and Qualcomm, do not join them as yet

- Solutions
  - Prepare to pay the essential IPR fees
  - Try to own W-CDMA essential IPRs

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IOT of Dual-mod Handsets

- Scope of Handsets Verification and Validation (V&V) Works
  - Unit Test, Integration Test, Field Trials, FTA, IOT, Regulatory (EMC/EMI, SAR, etc) Test, Customer Acceptance Test

- IOT Problems in Early Deployment Stage
  - Infrastructure vendors may have different interpretation of 3GPP specifications
  - Coverage of 3GPP conformance test cases (TCs) is not sufficient

- Solutions
  - Find bugs in field trials
  - Try to develop 3G Test Cases

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TTCN Test Cases Design Flow

```
START
  │
  ▼
Test Coverage Analysis
&                          ──▶   Requirement Analysis
New Test Cases Identification        of Test Cases
  │
  ▼
Test Cases Design          ──▶   Conformance Test Cases
                                 Design Specification
  │
  ▼
TTCN Coding                ──▶   TTCN Codes
  │
  ▼
TTCN Verification          ──▶   Verified Test Cases
  │
  ▼
END
```

Nokia 6650

- TTCN = Tree and Tabular Combined Notation (ISO/IEC 9646-3)
- TTCN is for the specification of tests for real-time and communication systems
- TTCN is abstract in the sense of being test system independent

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Complexity of 3G Applications

- Challenges:
  - More and more applications will be added into 3G phones
  - 3G can support several teleservices (ex, AMR call, FTP download, File transfer, etc) simultaneously
  - Handset applications may run concurrently

- Solutions:
  - SW engineering discipline, complete test cases and automatic testing → SW Complexity
  - Object Oriented SW Architecture → Concurrent applications

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Thank You

Also sincerely thanks for MOEA's budget support in ASUSTeK's 3G project

ASUSTeK is Active in 3GPP Standardization Works

- ***79 contributions*** (Change Requests (CRs) and technical proposals) have been accepted in RAN2 and T1 meetings up to October 2003

- One of the significant contributors worldwide in 3GPP RAN2 (Radio Access Network 2) group
  - In 2002, ranked 6th by the number of CR's agreed in RAN2
  - In 2001, ranked 7th by the number of CR's agreed in RAN2

- Aims to own *3G essential IPRs*
  - ***More than 50 patents*** related to 3GPP L2/L3 protocol stacks have been filed
  - ***Over 20*** of the them can become 3G essential IPRs
  - ***Has been granted Nine*** 3G essential IPRs from Taiwan and USA

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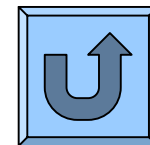
Agreed CR's in 2002 in RAN2, FDD, Release 99 by Companies

Company	25.321	25.322	25.323	25.331	others	Sum
Ericsson	3.00	3.00		48.08	6.60	60.68
Qualcomm	3.00	0.50		22.33	0.10	25.93
Nokia				20.25	4.10	24.35
Motorola				20.08	0.50	20.58
Nortel	1.00	1.50		15.00	0.60	18.10
ASUS		4.00	2.00	10.83	1.00	17.83
Siemens			0.50	6.83	4.00	11.33
TTPCom				10.00	0.10	10.10
LG	1.00	1.50	0.50	0.50	2.50	6.00
Alcatel				4.08	1.00	5.08
DoCoMo		0.50		2.00	0.50	3.00
Philips				1.50	1.00	2.50
others	1.00			9.51	4.00	14.51
Total	9.0	11.0	3.0	171.0	26.0	220.00

- TS 25.321: UMAC
- TS 25.322: URLC
- TS 25.331: URRC
- TS 25.323: PDCP

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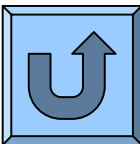
Coverage Analysis of W-CDMA TCs

	UMAC	URLC	PDCP	RFC2507	BMC	URRC	Total
TS 34.123-1 V4.2.0	22	46	9	0	7	239	323
ASUSTeK Added	12	126	52	45	0	266	501

Source: ASUSTeK Computer Inc.

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