
行動電話的現況發展與 未來趨勢

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Outlines

- 行動電話系統的演進
- 製作需要哪些人呢?
- 行動電話的硬體規格
- Smartphone的軟體規格
- 市場現況

1G

- First Generation
- Analog telecommunications
- AMPS (Advanced Mobile Phone System)
- FDMA (Frequency-division multiple access)

Motorola DynaTAC 8000X AMPS mobile phone



2G/2.5G/2.75G

Family	2G	2.5/2.75G
GSM/3GPP	GSM	GPRS/EDGE
3GPP2	CdmaOne (IS-95)	CDMA2000 1xRTT (IS-2000)
Others	PHS(小靈通)	None

1G→2G? (Capacity, acoustic quality, security, etc.)

2G→2.5/2.75G?

GSM

- Global System for Mobile Communications
- Channel: TDMA
- Duplex: FDD
- GMSK
- Voice codecs
 - Enhanced Full Rate (EFR)
 - Half Rate (HR)
- CSD (Circuit Switched Data)
 - 9.6kbps



GSM bands

Band	Name	Channel (ARFCN)	UP link frequency	DL link frequency
GSM 850	GSM 850	128 - 251	824-849	869-894
GSM 900	PGSM	1-124	890-915	935-960
	EGSM	975 - 1023	880-890	925-935
GSM1800	DCS	512 - 885	1710-1785	1805-1880
GSM1900	PCS	512 - 810	1850-1910	1930-1990

GPRS

- General Packet Radio Service
- Services offered
 - "Always on" internet access
 - MMS (Multimedia messaging service)
 - PTT (Push to talk)
 - WAP (wireless application protocol)
- Max Data rate 115kbps
 - 80kbps for class 10 (CS4 and 4+1)

EDGE

- Enhanced Data rates for GSM Evolution
- Enhanced GPRS (EGPRS)
- Max data rate 473.6kbps (59.2x8)

Coding and modulation scheme (MCS)	Bit Rate (kbit/s/slot)	Modulation
MCS-1	8.80	GMSK
MCS-2	11.2	GMSK
MCS-3	14.8	GMSK
MCS-4	17.6	GMSK
MCS-5	22.4	8-PSK
MCS-6	29.6	8-PSK
MCS-7	44.8	8-PSK
MCS-8	54.4	8-PSK
MCS-9	59.2	8-PSK

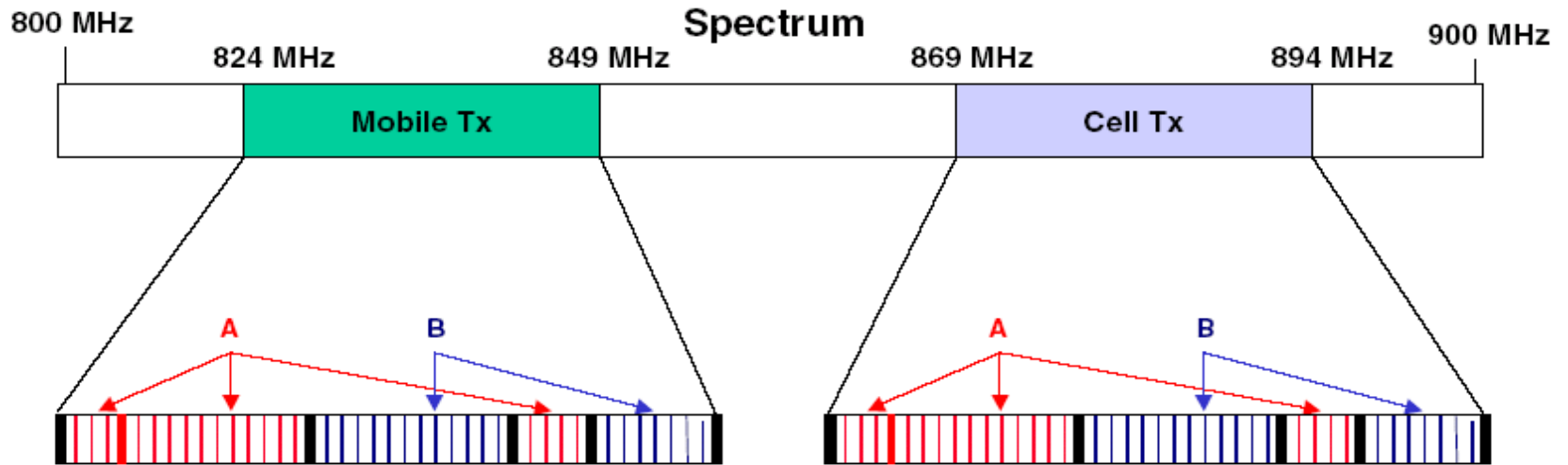
cdmaOne (IS-95) and CDMA2000 (IS-2000)

- The first CDMA-based digital cellular standard pioneered by Qualcomm
- Radio channels are 1.25MHz wide and Chip rate of 1.2288Mcps
- 64kbps for cdmaOne and 153kbps for CDMA2000

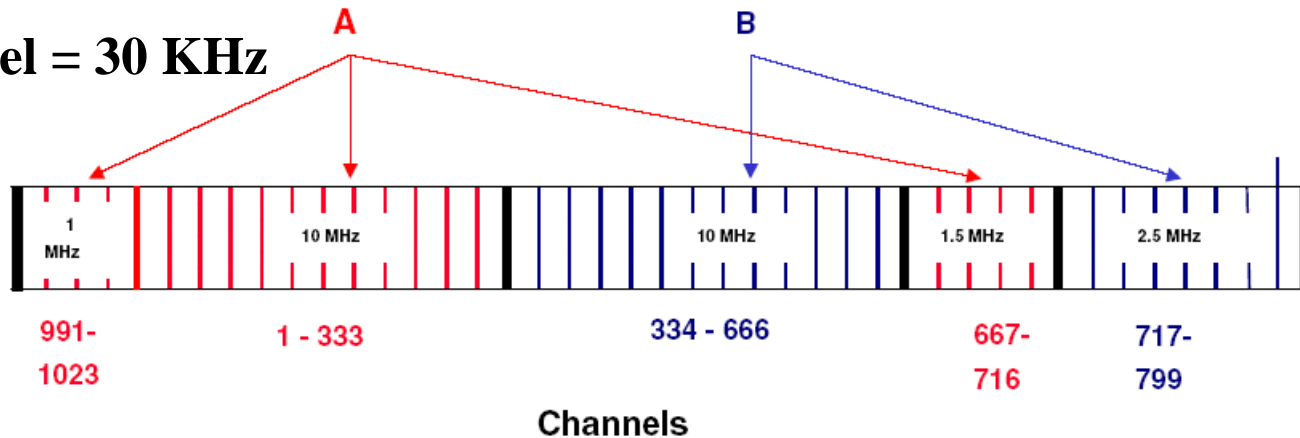


	Forward link	Reverse link
IS-95	(Dual)BPSK	OQPSK
CDMA2000	QPSK	HPSK

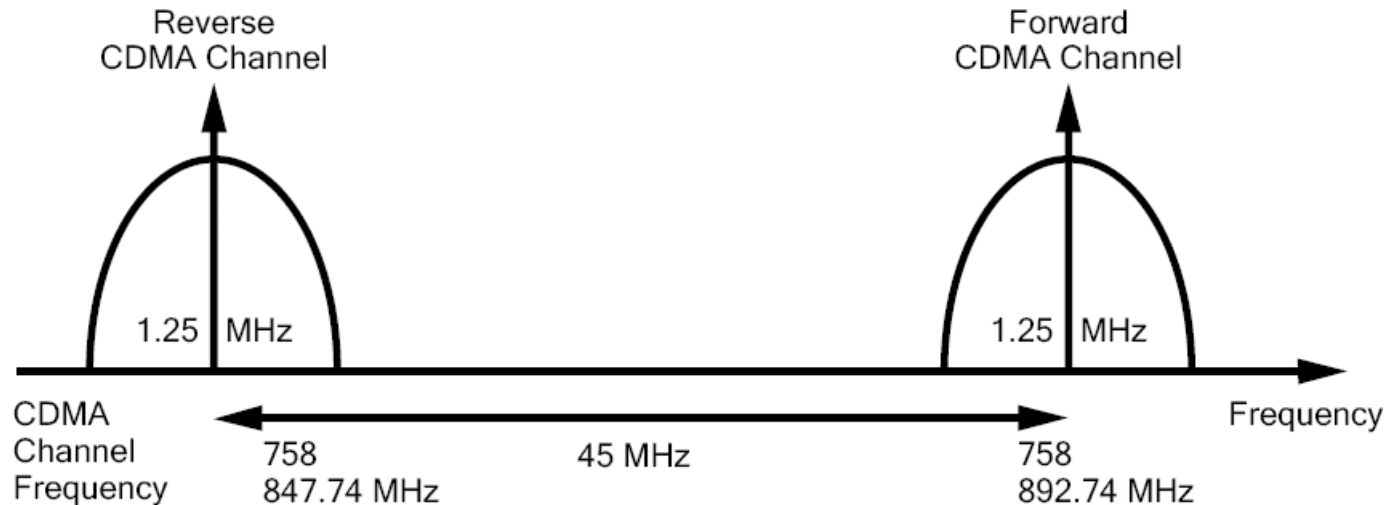
Cellular band



Each channel = 30 KHz



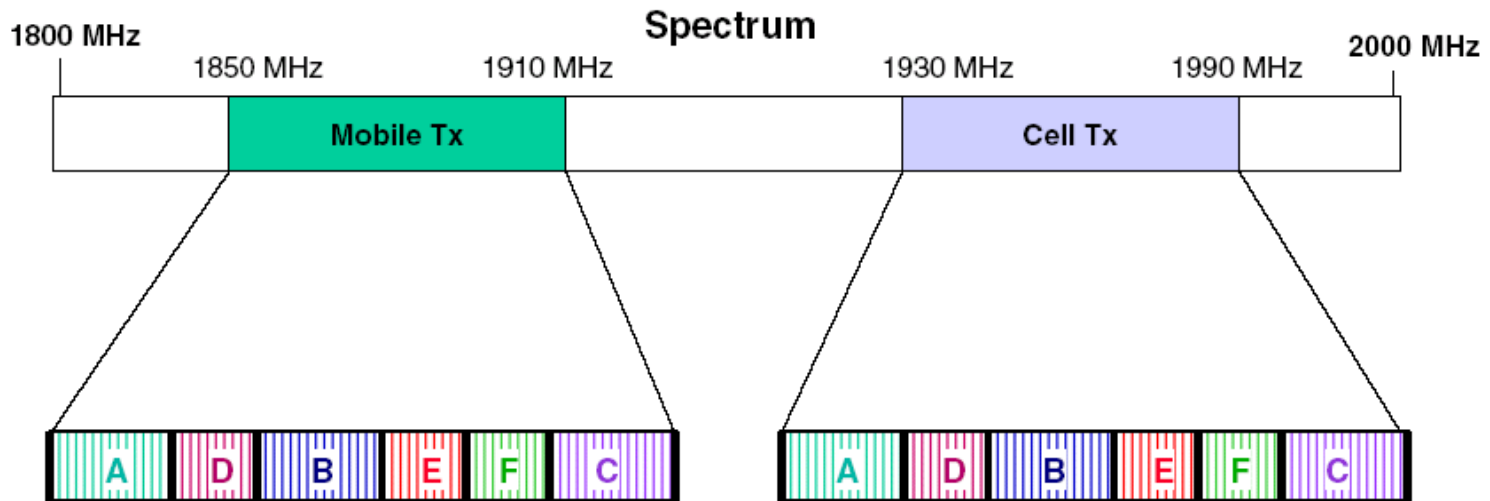
Cellular band (cont.)



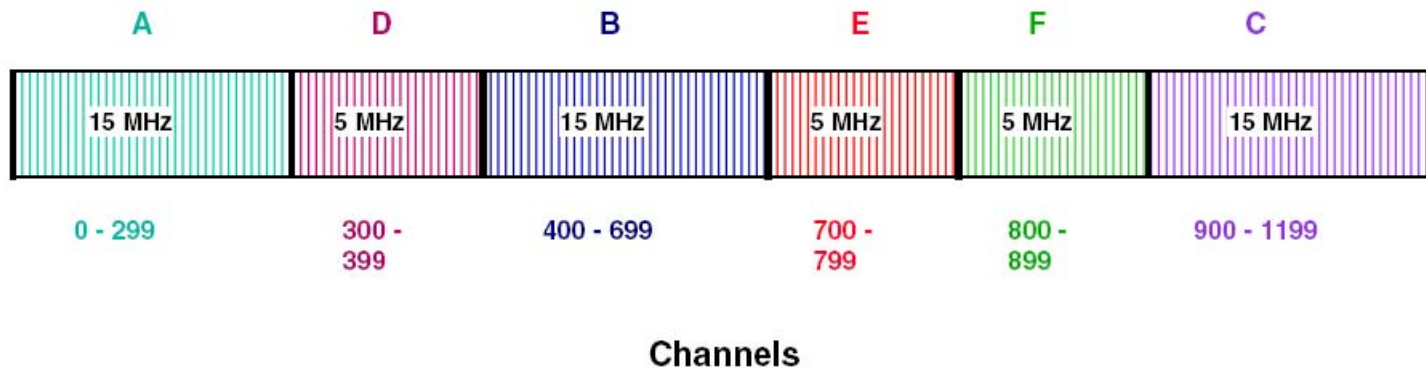
1-4. CDMA Preferred Set of Frequency Assignments for Band Class 0

System Designator	Preferred Set Channel Numbers
A	283 (Primary) and 691 (Secondary)
B	384 (Primary) and 777 (Secondary)

PCS band



Each channel = 50 KHz



PCS band (cont.)

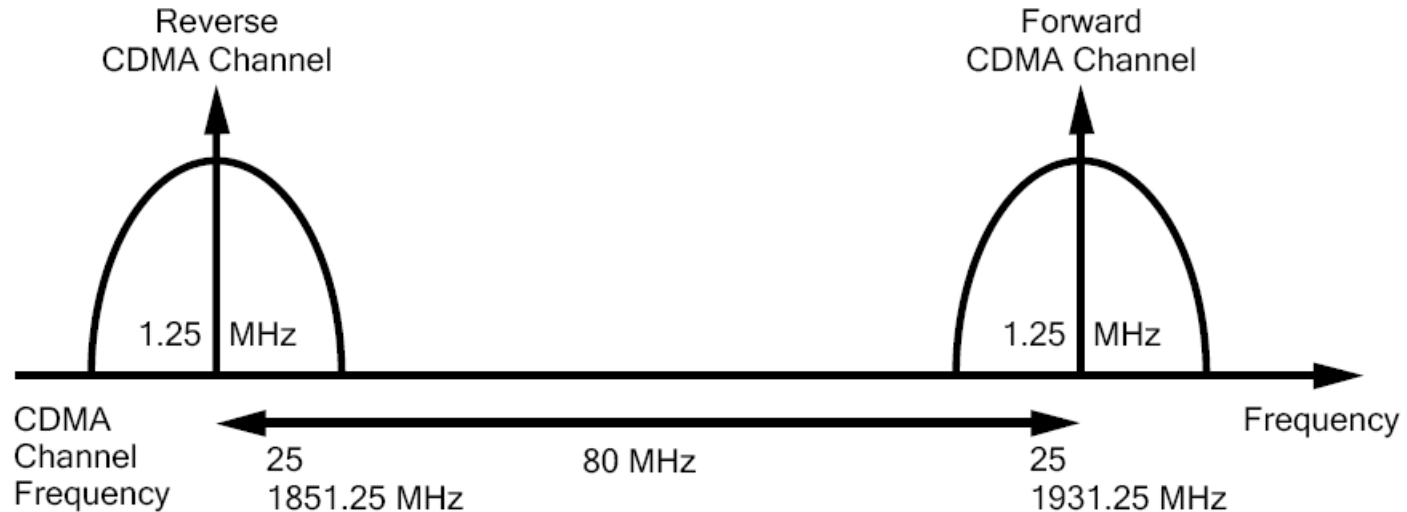


Table 6.1.1.1.2-4. CDMA Preferred Set of Frequency Assignments for Band Class 1

Block Designator	Preferred Set Channel Numbers
A	25, 50, 75, 100, 125, 150, 175, 200, 225, 250, 275
D	325, 350, 375
B	425, 450, 475, 500, 525, 550, 575, 600, 625, 650, 675
E	725, 750, 775
F	825, 850, 875
C	925, 950, 975, 1000, 1025, 1050, 1075, 1100, 1125, 1150, 1175

3G/3.5G

Family	3G	3.5G
3GPP	WCDMA TDS-CDMA	HSDPA HSUPA HSPA+
3GPP2	CDMA2000 1x- EVDO	EV-DO Rev. A EV-DO Rev. B

3GPP

- 3rd Generation Partnership Project
- 3GPP的目標是在ITU的IMT-2000計劃範圍內製訂和實現全球性的（第三代）行動電話系統規範
- 歐洲的ETSI、日本的ARIB和TTC、中國的CCSA、韓國的TTA和北美的ATIS

3GPP standards released

Version	Released	Air interface	Data rate
Release 99	2000 Q1	WCDMA	DL:384kbps UP:384kbps
Release 5	2002 Q1	HSDPA	DL:14.4Mbps UP:384kbps
Release 6	2004 Q4	HSUPA	DL:14.4Mbps UP:5.76Mbps
Release 7	2007 Q4	HSPA+(ph1)	DL:42Mbps UP:11Mbps
Release 8	Frozen Dec 2008	HSPA+(ph2)	DL:42Mbps UP:22Mbps
Release 9	In progress	LTE	DL:100Mbps UP:50Mbps
Release 10	In progress	LTE Advanced	DL:100Mbps UP:50Mbps

ITU

- International Telecommunication Union
- 主要負責確立國際無線電和電信的管理制度和標準(聯合國機構)
- IMT-2000 (International Mobile Telecommunications-2000) (3G)
- IMT Advanced (4G)

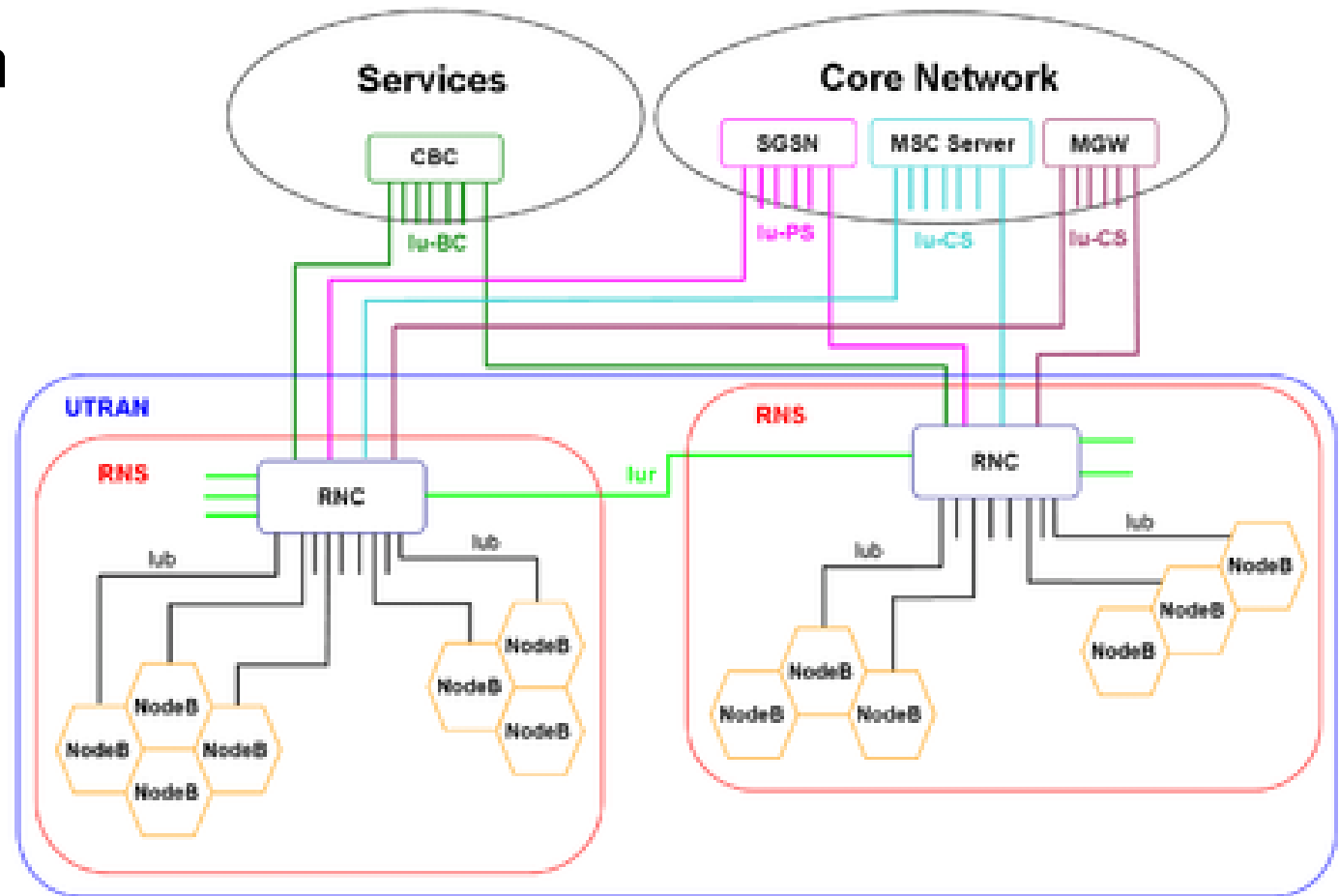


3GPP2

- 3rd Generation Partnership Project 2
- 3GPP2致力於使ITU的 IMT-2000計劃中的（3G）行動電話系統規範在全球的發展
- **TIA**（北美），**CCSA**（中國），**ARIB/TTC**（日本）和**TTA**（韓國）

UMTS

- Universal Mobile Telecommunications System



WCDMA

- Wideband Code Division Multiple Access
- Radio channels are 5MHz wide and Chip rate of 3.84Mcps, FDD
- QPSK (Max data rate 384kbps)
- Multiuser detection and smart antennas can be used to increase capacity and coverage.
- soft handoff (handover), softer handoff and hard handoff.

WCDMA bands

Band	UL frequency (MHz)	DL frequency (MHz)	Alias	Region
I (1)	1920 to 1980	2110 to 2170	IMT2000	Japan, Europe, Asia
II (2)	1850 to 1910	1930 to 1990	PCS	Canada, United States, Latin America
III (3)	1710 to 1785	1805 to 1880	DCS 1800	Finland, HK
IV (4)	1710 to 1755	2110 to 2155	AWS	Canada, US, Latin America
V (5)	824 to 849	869 to 894	UMTS850	Canada, US, Australia
VI (6)	830 to 840	875 to 885	UMTS800	Japan
VII (7)	2500 to 2570	2620 to 2690	IMT-E	EU
VIII (8)	880 to 915	925 to 960	UMTS900	EU, Latin America

TDS-CDMA

- Time Division Synchronous Code Division Multiple Access
- 中國制定的3G標準(ITU批准的3G標準)
- TDD
- This reduces the number of users in each timeslot, which reduces the implementation complexity of multiuser detection and beamforming schemes, but the non-continuous transmission also **reduces coverage** (because of the higher peak power needed), **mobility** (because of lower power control frequency) and **complicates radio resource management algorithms**.

HSDPA

- High Speed Downlink Packet Access
- Adaptive modulation and coding (16QAM)
- HS-DSCH channel (High-Speed Downlink Shared Channel)
- Fast packet scheduling
- HARQ (Hybrid automatic repeat-request)

HSDPA (cont.)

Category	HS-DSCH	Modulation	DL data rate (Mbps)
1	5	QPSK and 16-QAM	1.2
2	5	QPSK and 16-QAM	1.2
3	5	QPSK and 16-QAM	1.8
4	5	QPSK and 16-QAM	1.8
5	5	QPSK and 16-QAM	3.6
6	5	QPSK and 16-QAM	3.6
7	10	QPSK and 16-QAM	7.2
8	10	QPSK and 16-QAM	7.2
9	15	QPSK and 16-QAM	10.1
10	15	QPSK and 16-QAM	14

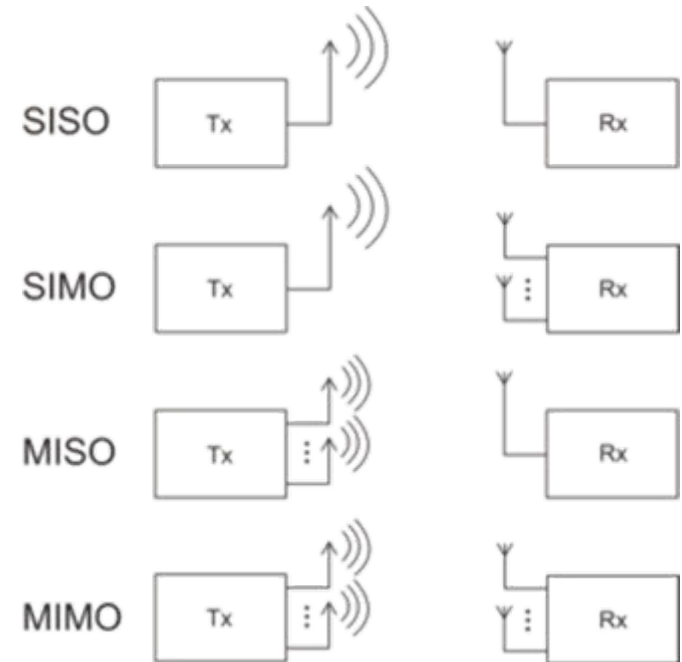
HSUPA

- High-Speed Uplink Packet Access
- E-DCH (an uplink enhanced dedicated channel)
- HARQ

Category	UL data rate (Mbps)
1	0.73
2	1.46
3	1.46
4	2.93
5	2.00
6	5.76
7	11.5

HSPA+

- HSPA Evolution
- MIMO (multiple-input and multiple-output)
- 64QAM
- 56Mbps for DL and 22Mbps for UL



CDMA2000 1x-EVDO

- Evolution-Data Optimized or Evolution-Data only (BW=1.25M Hz)

DRC Index	Modulation	DL data rate (kbps)
1	QPSK	38.4
2	QPSK	76.8
3	QPSK	153.6
4	QPSK	307.2
5	QPSK	307.2
6	QPSK	614.4
7	QPSK	614.4
8	8PSK	921.6
9	QPSK	1228.8
10	16QAM	1228.8
11	8PSK	1843.2
12	16QAM	2457.6

EV-DO Rev. A and EV-DO Rev. B

- Rev. A

DRC Index	Modulation	DL data rate (kbps)
13	16QAM	1536
14	16QAM	3072

- Rev. B has data rate $4.9 \times N$ Mbps for DL (N is the number of 1.25 MHz chunks of spectrum used. Not yet deployed.)

3.9G/4G

Family	3.9G	4G
3GPP	LTE	LTE Advanced
3GPP2	UMB	None
WiMAX	IEEE 802.16e	IEEE 802.16m

LTE

- Long Term Evolution
- LTE supports scalable carrier bandwidths, from 20 MHz down to 1.4 MHz and supports both FDD and TDD
- OFDM (Orthogonal frequency-division multiplexing)
- 2x2 and 4x4 MIMO
- 100Mbps for DL and 50Mbps for UL (BW=20MHz)

LTE bands

Band	UL frequency (MHz)	DL frequency (MHz)	Channel BW (MHz)	Region
I (1)	1920 to 1980	2110 to 2170	5, 10, 15, 20	Japan, Europe, Asia
II (2)	1850 to 1910	1930 to 1990	1.4, 3, 5, 10, 15, 20	Canada, United States, Latin America
III (3)	1710 to 1785	1805 to 1880	1.4, 3, 5, 10, 15, 20	Finland, HK
IV (4)	1710 to 1755	2110 to 2155	1.4, 3, 5, 10, 15, 20	Canada, US, Latin America
V (5)	824 to 849	869 to 894	1.4, 3, 5, 10	Canada, US, Australia
VI (6)	830 to 840	875 to 885	5, 10	Japan
VII (7)	2500 to 2570	2620 to 2690	5, 10, 15, 20	EU
VIII (8)	880 to 915	925 to 960	1.4, 3, 5, 10	EU, Latin America

LTE Advanced

- 100 Mbit/s for high mobility and 1 Gbit/s for low mobility
- In the research phase...

UMB

- Ultra Mobile Broadband
- In November 2008, Qualcomm announced it was **ending development** of the technology, favoring **LTE** instead.

WiMAX (802.16e)

- Worldwide Interoperability for Microwave Access
- 由Intel所主導，在概念上類似WiFi，但WiMAX改善了性能，並允許使用更大傳送距離 (OFDM)
- WiMAX較適合於低人口密度及平坦區域發展 (實際上，用戶在 2 km範圍內只能以 10 Mbps 的速率傳輸，理想值為70 Mbps)
- Sprint Nextel等業者已經開台使用

WiMAX (802.16m)

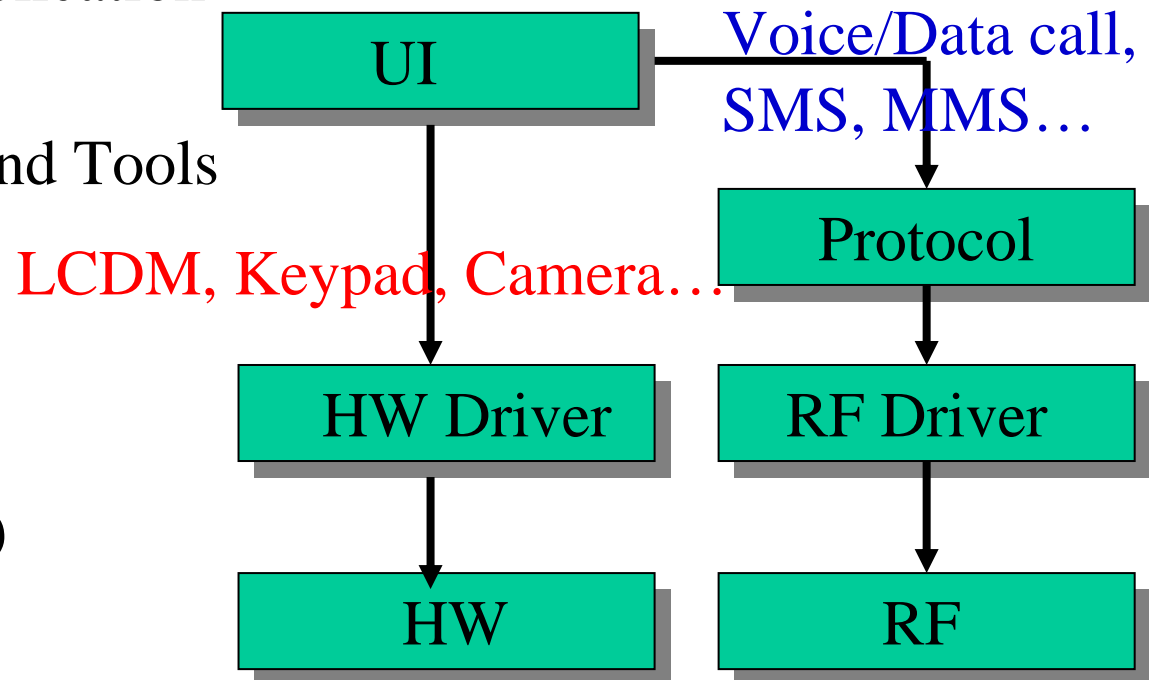
- Advanced Air Interface with data rates of 100 Mbit/s mobile & 1 Gbit/s fixed
- In the research phase...

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- Smartphone的軟體規格
- 市場現況

Handset department

- PM (project manager)/Sales
- ID (Industrial design)
- ME (mechanism)
- UI (user interface)/Application
- Protocol
- Driver (HW and RF) and Tools
- HW and RF
- Antenna
- Testing
- QA (quality assurance)
- PE (product engineer)



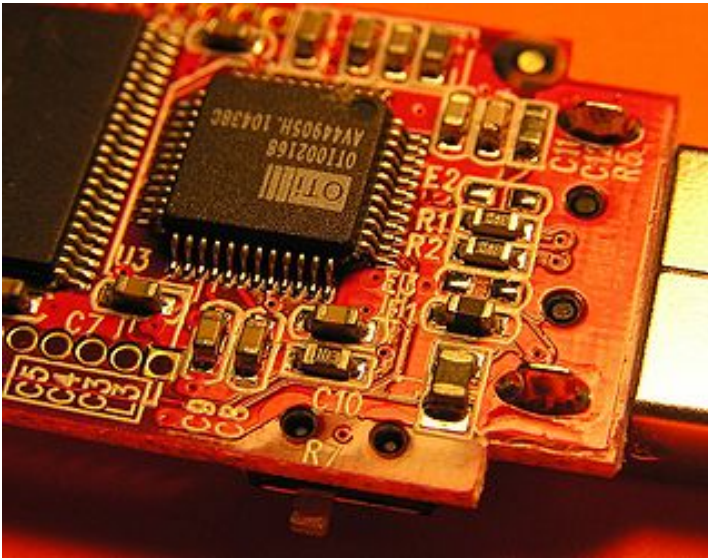
Handset certification

- CE mark → 歐盟
- FCC (Federal Communications Commission) 聯邦通信委員會
- IC (United States Intelligence Community) 加拿大

- GCF (Global Certification Forum)
- PTCRB (PCS Type Certification Review Board)
- IOT (InterOperability test)
 - Ericsson
 - AT&T
 - NTT docomo
- NCC (National Communications Commission)

Handset manufacture procedure

- SMT (Surface-mount technology)



Handset manufacture procedure (cont.)

- Calibration
- Function test @ board
- Assembly
- Function test @ handset
- IMEI, Bluetooth address, Wi-Fi address,
- Clearing then Packing

Handset Manufacturer in Taiwan

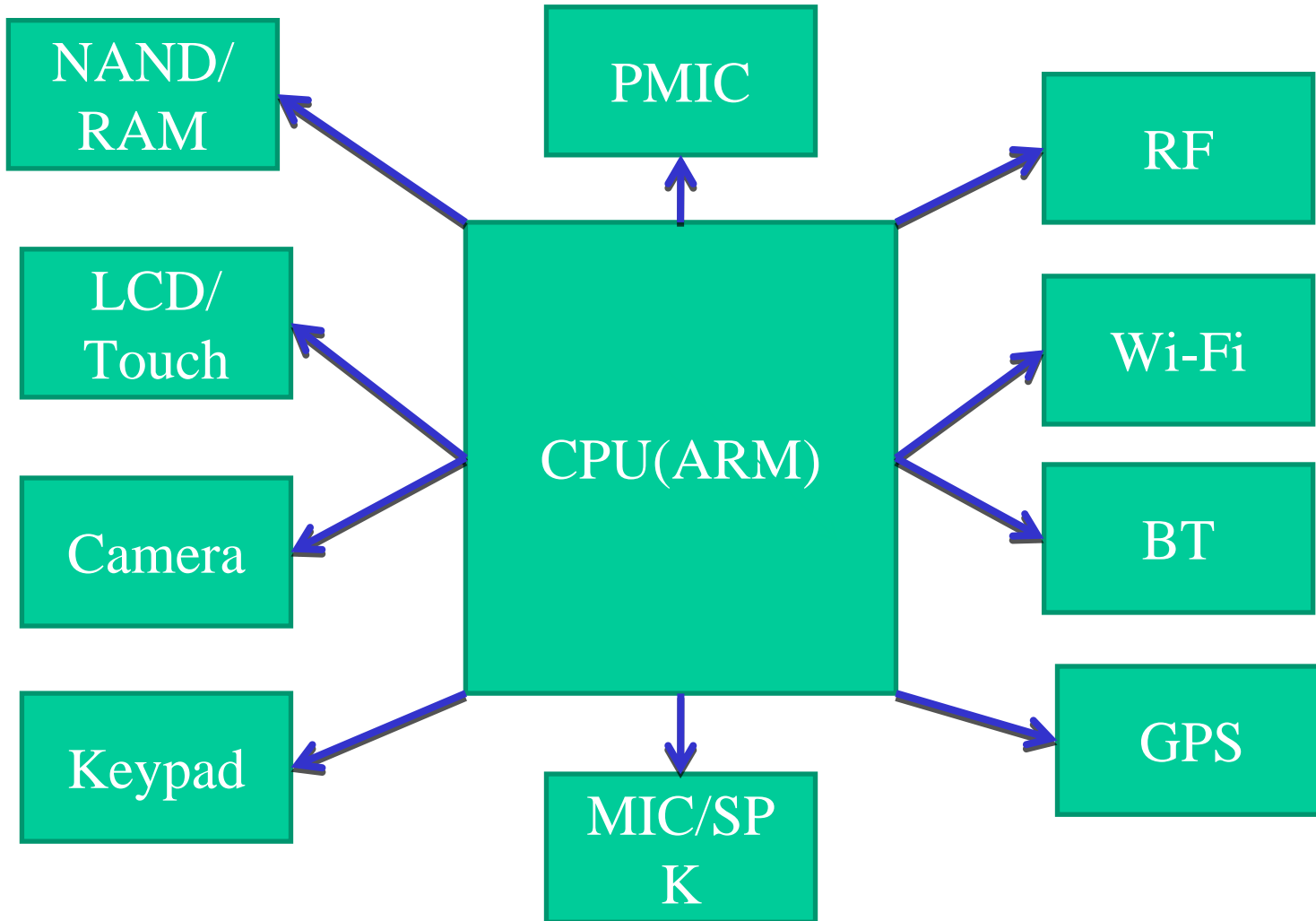
- BenQ (明基電通) → Qisda (佳世達)
- HTC (宏達國際電子)/鉅瞻
- 奇美通訊/Foxconn(富士康)/鴻海
- ASUS(華碩)/和碩聯合
- Compal (華寶)/仁寶
- Arima (華冠)
- Quanta (廣達)
- GSmart(集嘉通訊)
- 啓碁
- **MediaTek (聯發科)**

The BenQ logo is displayed in a bold, purple, sans-serif font.

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- 市場現況

HW block diagram



Chipset

- 2G
 - MTK
 - TI
 - Qualcomm
- 3G/3.5G
 - Qualcomm (dual core)
 - TI + Freescale (飛思卡爾)
 - TI + infineon (英飛凌)
 - EMP

Memory type

- Flash
 - NOR
 - NAND
- RAM
 - PSRAM
 - SDRAM
 - DDR
- Combo (Flash+RAM)
 - Samsung, Hynix

Display type

- CSTN (Color Super Twist Nematic)
- TFT (Thin Film Transistor)
- LTPS (Low Temperature Poly Silicon)
- OLED (Organic Light Emitting Diode)

Other components

- Camera sensor (CMOS, CCD)
- Camera lens (ZEISS, 大立光)
- Touchscreen (電阻/電容式)
- microphone/receiver/speaker
- SIM
- Micro SD
- BT/Wi-Fi
- GSP/AGPS

Other components (cont.)

- USB (2.0, OTG)
- IR (Infrared Radiation) sensor
- G (gravity) sensor/Accelerometer
 - 目前裝置的傾斜角度
- m (magnet) sensor/Compass sensor
- Light sensor
- Hall sensor
- Temperature sensor

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Smartphone OS

	Symbian	Windows Mobile	iphone OS	BlackBerry OS	Android
developer	Symbian Foundation	Microsoft	Apple Inc.	Research In Motion (RIM)	Open Handset Alliance
Programmed	C++	C++	C	C++	C
OS family	Embedded operating systems	Windows CE	Mac OS X/Unix-like	Mobile operating systems	Linux
Source model	open	closed	Closed source (with open source components)	closed	open
Supported platforms	ARM/x86	ARM	ARM	BlackBerry line of mobile devices	ARM/x86
Kernel type	Microkernel	Windows CE 5.2	Hybrid (Darwin)	Java based	Monolithic (modified Linux kernel)

Windows Mobile

	Windows Mobile 6.1	Windows Mobile 6.5	Windows Phone 7 Series
Released date	2008/04/01	2009/05/11	2010/02/16
Kernel version	Windows CE 5.2	Windows CE 5.2/6.0	Windows CE 7.0
Pocket PC (Without Mobile)	Windows Mobile 6.1 Classic	N/A	?
Pocket PC (With Mobile Phone)	Windows Mobile 6.1 Professional	Windows Mobile 6.5 Professional	?
Smartphone (Without Touch Screen)	Windows Mobile 6.1 Standard	Windows Mobile 6.5 Standard	?

Windows Mobile 6.x will not be upgradeable to 7 Series.

Windows Mobile (cont.)



WM 5.0 today



WM 6.1 today

Windows Mobile (cont.)



WM 6.5.1 today



WM 6.5.3 today



Windows Phone 7 Series



Android

- Google於2005年併購了成立僅22個月的高科技企業Android → Open Handset Alliance
- Android系統都將以食物命名
 - Cupcake (1.5)
 - Donut (1.6)
 - Éclair (2.0/2.1)
 - FroYo
 - Gingerbread
- CTS

Android Donut (20090915 released)

- An improved Android Market experience
- Updated Voice Search
- Updated Technology support for CDMA/EVDO, 802.1x, VPN
- Support for WVGA(800x480) resolutions

- App Store
- BlackBerry App World

Android Éclair (20091026 released)

- Support for more screen sizes and resolutions
- Revamped UI
- New browser UI and HTML5 support
- New contact lists
- Improved Google Maps 3.1.2
- Microsoft Exchange support
- Built in flash support for Camera
- Digital Zoom
- Improved virtual keyboard
- Bluetooth 2.1
- Live Wallpapers

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LTE未來發展探討

- 採用何種頻譜?
 - GSM協會建議: 698-806MHz for Asia and America, 790~862MHz for Europe and Africa
 - 頻率較高的頻段，遇到建築物阻隔後，訊號衰減幅度大增→Femtocell
- 骨幹網路整合程度
 - 3G/3.5G基地台的骨幹網路頻寬約8Mbps
- 如何傳遞語音
- HSPA+?

Q&A

Thanks for your participation !