The evolution of SoC platform in the new mobile paradigm

Ki Soo Hwang
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Core Logic Inc.
Contents

• Mobile Device Market & Technology Overview
• Case Studies
• Future Directions
Semiconductor market is growing

- Semiconductor market has grown continuously through new market creation...and in 2015 we expect...
Semiconductor market for cellular phones

Mobile TV and additional connectivity drive incremental growth in 2H07 and beyond

<Source: Gartner 2007>
Consumer semiconductor market

$22 B Total Market in 2006

- DVD: $3.7B
- Digital TV: $4.4B
- Digital Camera: $4.0B
- STB: $2.5B
- Video Game: $4.0B
- Compressed Audio: $3.5BZ

Source: IDC 2007
Semiconductor industry by five drivers

- Continued Integration
- Increasing Scale of Manufacturing
- Consumer Markets
- Service Provider
- New / Disruptive Technology

Semiconductor Industry Future

<Source: Gartner2007>
Mobile phones
Mobile consumer device
Mobile handset trends

- Multimedia phones are leading the market
- Convergence and multi network devices will be dominant in the market
With the network evolution, various multimedia applications are applied.
## Multimedia Trends

<table>
<thead>
<tr>
<th>Value</th>
<th>Multimedia</th>
<th>Enhanced</th>
<th>Convergence</th>
</tr>
</thead>
<tbody>
<tr>
<td>400k 3D pixels/sec</td>
<td>7M 3D pixels/sec</td>
<td>133M 3D pixels/sec</td>
<td></td>
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<tr>
<td>2Mpixel</td>
<td>3Mpixel</td>
<td>5Mpixel</td>
<td>8Mpixel</td>
</tr>
<tr>
<td>15 fps@QCIF</td>
<td>Record: 15 fps@QCIF</td>
<td>Record: 15 fps@QCIF</td>
<td>Record: 30 fps@QCIF</td>
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<tr>
<td>A-GPS Mode</td>
<td>A-GPS Mode</td>
<td>A-GPS Mode</td>
<td>A-GPS Mode</td>
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<td>Standalone Mode</td>
<td>Standalone Mode</td>
<td>Standalone Mode</td>
<td>Standalone Mode</td>
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<td>Bluetooth1.2</td>
<td>Bluetooth1.2</td>
<td>Bluetooth1.2</td>
<td>Bluetooth2.0 EDR</td>
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<td>WLAN</td>
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<td>Mediacast</td>
<td>Mediacast</td>
<td>Mediacast</td>
<td>Mediacast</td>
</tr>
<tr>
<td>QCIF [176x144]</td>
<td>QCIF+ [176x220]</td>
<td>QVGA [320x240]</td>
<td>VGA [640x480]</td>
</tr>
<tr>
<td>CPU – 50-180MHz QDSP®-75MHz</td>
<td>CPU – 150-225MHz QDSP-75MHz</td>
<td>CPU – 225-300MHz QDSP-90MHz</td>
<td>Dual CPUs 400MHz-1GHz QDSP-250MHz</td>
</tr>
</tbody>
</table>

*Source: Qualcomm 2006*
Connectivity

● Why **connectivity** is so important?
  ▶ Connectivity is the fastest-growing semiconductor revenue segment, 2007-2011
  ▶ WiFi is gaining traction in mobile phones and is expected to have 20% penetration in 3G phones by 2011

![Worldwide Mobile Phone Semiconductor Revenue by Connectivity by type, 2007-2011](chart)

Note: Totals also include consideration for combo chips
Source: IDC 2007

● Chipset vendors will continue to combine radio subsystems into various combo chip solutions
# CDMA (Qualcomm) BB

## Multimedia & All GSM/GPRS Capable

<table>
<thead>
<tr>
<th></th>
<th>CDMA2000</th>
<th>CDMA2000 + GSM - GPRS</th>
<th>WCDMA(UMTS)</th>
<th>All Air Modes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1X</td>
<td>1X</td>
<td>1xEV.DO</td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td>(Rev.0)</td>
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<tr>
<td></td>
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<td>1xEV.DO</td>
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<td></td>
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<td></td>
<td>(Rev.D)</td>
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<td>1xEV.DO</td>
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<td>(Rev.A)</td>
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<tr>
<td>1X</td>
<td>1X</td>
<td>1X</td>
<td>1X</td>
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</tbody>
</table>

### Convergence Platform
- Dual CPU, Single Chip

### Enhanced Platform
- Enhanced Multimedia & Graphics

### Multimedia Platform
- Multimedia & 2D/3D Graphics

### Value Platform
- Integrated gpsOne, Voice & Data Voice

- EDGE/HSDPA
- WCDMA(UMTS)
- All Air Modes

- 1X
- 1xEV.DO (Rev.0)
- 1xEV.DO (Rev.D)
- 1xEV.DO (Rev.A)
- GSM/GPRS

<Source: Qualcomm 2006>
TI OMAP AP Roadmap

<table>
<thead>
<tr>
<th>Multimedia Enhanced AP</th>
<th>OMAP 1.1</th>
<th>OMAP 1.2</th>
<th>OMAP 1.3</th>
<th>OMAP 2.0</th>
<th>OMAP 3.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>OMAP151X</td>
<td>OMAP161X</td>
<td>OMAP343</td>
<td>OMAP2420</td>
<td>OMAP2430</td>
<td>OMAP1710</td>
</tr>
<tr>
<td>OMAP310</td>
<td>OMAP331</td>
<td></td>
<td>Helios 1</td>
<td>Helios 2</td>
<td>Future OMAP Processor</td>
</tr>
<tr>
<td>OMAP710</td>
<td>OMAP730</td>
<td>OMAP750</td>
<td>NOMAD</td>
<td>Neptune</td>
<td>Future OMAP Processor</td>
</tr>
<tr>
<td>OMAP343</td>
<td></td>
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<td></td>
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<tr>
<td>OMAP850</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OMAP-DM</td>
<td>OMAP DM270</td>
<td>OMAP DM275</td>
<td>OMAP DM280</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARM-centric AP</td>
<td>OMAP330</td>
<td>OMAP DM275</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integrated device: Modem + AP (3 cores)</td>
<td>OMAP730</td>
<td>OMAP850</td>
<td>NOMAD</td>
<td>Neptune</td>
<td>Future OMAP Processor</td>
</tr>
<tr>
<td>Modem AP (2 cores)</td>
<td>OMAP151X</td>
<td>OMAP161X</td>
<td>OMAP2420</td>
<td>OMAP2430</td>
<td>OMAP1710</td>
</tr>
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<td>OMAP DM280</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: TI Presentation (2005)
Core Logic Product Roadmap

2004
- MECAP
  - 5 Mega Pixel
  - MPEG4 codec

2005
- HERATV
  - TV out
- HERANA
  - Cost effective
  - Bluetooth

2006
- TOPAZ
  - MP4 player
  - USB 2.0
- MUSE
  - Music
  - USB 2.0
- DIVA
  - Mobile TV
  - H.264 Decoder
- ISP2
  - 5 Mega Pixel
  - AE / AF / AWB

2007
- NPL
- MUSE
  - 3 Mega Pixel
  - Low cost
- AEGIS
  - 266MHz
  - D1 MPEG4
- JADE
  - T-DMB Demodulator
- TOPAZ
  - TV out
- MUSE
  - Cost effective
  - Bluetooth
- ISP2
  - 5 Mega Pixel
  - AE / AF / AWB

2008
- JUNO
- NISSI
- PMP-F
- BOBA
- ISP4/NABU

Migration to ISP and AP market
Future Core Logic processors

2005
- PMP-F

2006
- ISP4/NABU

2007
- BOBA

2008
- NISSI
Case Studies
# Software Block Diagram – Smart phone

<table>
<thead>
<tr>
<th>Input Device</th>
<th>Key Input</th>
<th>Touch Panel</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Command set</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Phone platform UI</td>
<td>UI Engine</td>
</tr>
<tr>
<td></td>
<td>Font</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UI</th>
<th>Camera</th>
<th>Camcorder</th>
<th>Music</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Radio</td>
<td>Recorder</td>
<td>E-book</td>
</tr>
<tr>
<td></td>
<td>M-TV</td>
<td>Navigation</td>
<td>Phone App.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Application</th>
<th>T-DMB</th>
<th>CMMB</th>
<th>CAS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DAB-IP</td>
<td>IP-TV</td>
<td>Data Service</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mobile-TV MW</th>
<th>Player</th>
<th>Driver</th>
<th>OS Layer</th>
<th>Boot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>JPEG</td>
<td>MP3</td>
<td>AVS</td>
<td>Master Mode</td>
</tr>
<tr>
<td></td>
<td>H.263</td>
<td>A. Encoder</td>
<td>RMVB</td>
<td>Slave Mode</td>
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<tr>
<td></td>
<td>H.264</td>
<td>A. Decoder</td>
<td>WMV</td>
<td>NAND Boot</td>
</tr>
<tr>
<td></td>
<td>Bluetooth</td>
<td>M-TV Demodulator</td>
<td>GPS module</td>
<td>HIF Boot</td>
</tr>
</tbody>
</table>
Apple * iPhone – Key features

Hardware features

- Screen size: 3.5 inches
- Screen resolution: 320 by 480 at 160 ppi
- Input method: Multi-touch
- Operating system: OS X
- Storage: 4GB or 8GB
- GSM: Quad-band (MHz: 850, 900, 1800, 1900)
- Wireless data: Wi-Fi (802.11b/g) + EDGE + Bluetooth 2.0
- Camera: 2.0 megapixels
- Battery: Up to 5 hours Talk / Video / Browsing
  Up to 16 hours Audio playback
- Dimensions: 4.5 x 2.4 x 0.46 inches / 115 x 61 x 11.6mm
- Weight: 4.8 ounces / 135 grams

High Technology
Overview

UI multi-touch functions

- **Flick**: For scrolling lists
- **Stop**: Tap and hold to stop the moving list, while scrolling up/down
- **Double click**: Zoom-in and -out (all apps), zooms in (maps)
- **Click**: Selecting items
- **Pinch in**: Zoom-out of photos, maps, Safari
- **Spread out**: Opposition of pinching, for zoom-in

- Four major buttons at the bottom of the screen:
  - call, e-mail, Safari, iPod

- Multitasking support:
  - fire up a song on the iPod
  - return to the home screen and check some e-mail
  - go load a few web pages in Safari and while those are loading
  - go back and make a phone call

- **iPhone always saves whatever you are doing**
Apple * iPhone – Key features

- **Hardware features**

- Die 1: Intel flash memory-40Mbytes
- Die 2: Winbond p-SRM Memory-4Mbytes
- Main processor & Nand Flash
- B/B Processor
- GSM/EDGE RF Transceiver
- Quad-band GSM/EDGE RF
- Power Amplifier Module
- Single Chip WiFi
- Bluetooth

*Source: [http://www.embedded.com]*
Apple * iPhone – Key features

- Hardware features
  - Functional layout II of the Apple 339S0030 (Samsung S5L8900B01) application processor founded in the iPhone

<Source: http://www.embedded.com>
Google * Android – Key features

- **Hardware features**

  - Qualcomm MSM 7X00

  - Wistron, Chinese design house announced GW4 runs on Android
    GW4 is based on a TI OMAP 1710 with
    - A 216 MHz processor
    - 64MB of program memory

- **Graphic:** NVIDIA
- **Touchscreen:** Synaptics
- **Voice Recognition:** Nuance
- **Webbrowser:** Open-source WEBKIT application framework

- **Google Map – SiRF**
- **Connectivity:** WiFi
What is Android Platform?

- **Android** is a software stack for mobile devices that includes an operating system, middleware and key applications. This early look at the Android SDK provides the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language.

- **Android – The first complete, open, and free mobile platform**
  - An Open Handset Alliance Project (30 mobile companies)
  - Application framework enabling reuse and replacement of components
  - Dalvik virtual machine optimized for mobile devices
  - Integrated browser based on the open source engine
  - Optimized graphics powered by a custom 2D and 3D graphics
  - Media support for MPEG4, H.264, MP3, AAC, AMR, JPG, PNG, GIF
  - Bluetooth, EDGE, 3G, and WiFi (hardware dependent)
  - Camera, GPS, compass, and accelerometer (hardware dependent)
  - Rich development environment
**iPhone Vs. Gphone: Overview**

**iPhone**
- Available: 2007 June
- Price: 500~600 USD
- Size: 4.5H x 2.4W x 0.46T
- Display: 3.5 inch, WVGA (480 x 320)
- EDGE/Wifi (AT&T)
- Multi touch screen
- Max OS
- 2MP camera
- Accelerometer
- 5GB/8GB internal memory
- BT 2.0
- A.P: S3C 2443

**GPhone**
- Available: 2008 1Q
- 3G/WiFi (multi network)
- Linux OS (Openmoko)
- Wider display w/ touch screen
- High resolution camera editing feature
- External memory
- BT2.0 a2DP, USB 2.0(OTG)
- A.P: OMAP, MSM7xxx for next model
Future Directions
User Interface (UI)

- It is all about **UI**
  - UI = Quality of product
Qualcomm Vs. Intel

Pocketable computer

Anchorage

Snapdragon Processor

Vs.

MID

Menlow Architecture

Silverthorne Processor

<Nokia’s N800 Internet Tablet>

<Menlow-based UMPC platform>

<Mac Air>

Intel Core 2 Duo

Standard size in MacBook Air
The evolution of SoC platform

- System level design for faster time to market and efficient products
- Increasing Verification complexity and time
- Development of standard platform solution with flexible architecture
  - Semiconductor companies need to be able to move fast with flexibility – need reuse based on standards at all levels in development flow
- Ideal Core development

New optimized processing block for multimedia and connectivity

Effectiveness (Dimensions/Power consumption)
Multi-core applications

- Multi-core application on a single chip platform solution
Conclusions

**Tradeoff factors**
- Power consumption
- Performance: CPU, Multimedia Codec, Connectivity
- Architecture

**UI**
- Multimedia for last 10 years, UI for next 10 years

**Complete SoC Platform for System Solution**
- Time to Market
- More Software for applications and services

**More PC-like functions into Mobile Devices**
- UMPC vs. Smart Phones
- Mobile Internet Devices
Thank you