Successful Entrepreneurship for Microsystems

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Course presented at UCSD CSE 190, Fall Quarter 2015
Guest Speaker – Mike Young, CTO, Classy
Redfin: A Consumer Web/Mobile Case Study

- Home search
- DFJ, Greylock invested in 2007, 2009
- Dec 2015: $70.9MM funding, $700MM valuation
- Web-first, then mobile
Redfin: First Years (2003-2006)

What went right?

- Search “homes on a map”
- Real estate is a HUGE market
- Hired good developers (CTO is now CEO of RichRelevance)
- Technical pioneer of map-based UI (this was pre-Google Maps)
- People in Seattle loved it
Redfin: First Years (2003-2006)

What went wrong?

- Proprietary map platform — Google Maps? Uh oh.
- Seattle-only
- Not built to scale
- Poorly funded: family, friends
- Fire sale to Madrona Ventures
Redfin: First Years Redux (2006-2008)

- Clear mission: #1 national home search
- Expanded to SF, LA, SD, Boston, DC
- Google Maps
- Marketing = redfin.com SEO
- Opened SF office, recruited new dev team from Berkeley, Stanford
- PR campaigns (aka “free”)
Redfin: Housing Downturn (2008-2010)

- 20% layoff in 2008
- We overcame adversity
  - DFJ, Greylock bring VC knowledge
  - SEO: kept growing
  - Profitable: agent efficiency
  - Limited expansion: CHI, PHX, ATL
Redfin: 2015

- 1000+ employees
- 50+ U.S. markets, national brand
- $150MM+ run rate
- Technology focused
  - Responsive Mobile Web design
  - 3D Walkthroughs
  - Native iPhone, iPad, iWatch, Android
Redfin: Key Takeaways

1. **$$ pedigree.** Founders had to sell. New team was able to raise enough money to weather rough times.

2. **Fail fast.** New team: dumped proprietary map platform, focused on scale.

3. **Find your core competency.** Couldn’t compete as a map platform. Focused on what Redfin could be #1 at.

4. **Recruiting is everything.** Opened SF office to recruit Cal and Stanford grads and interns.

5. **Acquisition can be free.** SEO is still a goldmine. (Suggestion: read SEOMoz religiously)

6. **Mobile is now key.** Web-first acquisition strategy. Mobile use cases are sometimes complementary.
Classy: SaaS/Crowdfunding Case Study

- Started in 2006 in San Diego
  - Founders: Scot Chisolm, Pat Walsh, Marshall Peden
  - Charity org to run the “StayClassy” pub crawl (beer!)
- Charity ———> SaaS service (2011)
- Mission: “to mobilize & empower the world for good"
- $50+ MM valuation today
Classy: Keys to Success

- 1st Hire: VP of Design
- Culture = Brand
- Easy to use
- Non-profits ❤️ us
  - Classy was customer #1 (4 years)
  - Crowdfunding is just a feature
  - Marketing = blog to educate non-profits
- Rapid development (mobile-first Web UI, LAMP stack)
Classy: 2015 and beyond

- Rapid sales growth: 1,600+ customers & counting
- $18MM Series B funding
- 120 employees
- Grow: 15 to 40 engineers
- Expand platform to run more of the non-profit's business
- Engagement
- Big data analytics
- Verticals (eg, PTAs)
- APIs, Integration
Questions?

myoung@classy.org
Key Takeaways - Guest Speaker Irwin Zahn (89)…1

Founder, CEO of Moxie Foundation, Innovator, Entrepreneur
...providing opportunities to individuals, and communities so they can change the world

- Wanted to own his own biz from the beginning ~1950
- Worked at a number of companies
- 1954 - bought an Industrial Staples company for $30K ($15 from FF, financed rest, sales were ~$60k/year)
- Espouses “Razor Blade “ business model
- Autosplice company – made connectors for automobiles
- 2007 – wanted to diversify
  - Invented Ni-Ti alloy
  - Looked for applications, sponsored Design contest at SDSU, $4K reward, drip coffee machine, diabetes injection machine, heart stent,..
  - 700 person company worldwide
- 2011 – “Liquidity event” – founded MOXIE Foundation with the proceeds
  - Moxie ➞ “get up and go”
- “Incubators” at SDSU, CUNY, UCSD,....
- UCSD – funded Moxie Center
- UCSD – CSE Ubiquitous Software project – opportunity to pick your own problem
Key Takeaways - Guest Speaker Irwin Zahn (89)…2
…Founder, CEO of Moxie Foundation, Innovator, Entrepreneur
…providing opportunities to individuals, and communities so they can change the world

➢ “Get Started”
   ➢ Start small
   ➢ OK to fail, learn from mistakes, and move on!

➢ MIN – Most Important NOW

➢ Do a Little bit More

➢ Passion

➢ Perseverance

➢ Always looking for Customer problems and Solutions (Creativity, Ingenuity)
OUTSOURCING

- When to use
  - Not your core-competency
  - Need quick entry/service
  - Conserve capital
  - Does not compromise your IP

- Some ‘watchouts’
  - “Make” vs “Buy”
  - Margin stacking
  - Supplier Management
    - Meet your goals for Schedule, Performance, Quality, Reliability,…
Margin Stacking
COT Outsourced Margin Stacking – SoC GDSII Handoff

**Company X**
SoC IC

parts

gdsII

“General Contractor”

![Diagram](image)

Supplier Cost:
- 1 m
- 1 d
- 1 a
- 1 p
- 1 t
- 1 s

Marked-up Cost (typ):
- 1.1 m
- 1.3 d
- 1.1 a
- 1.1 p
- 1.1 t
- 1 s

Price for Company X: 1.3\(^a\) x [ 1.1 m 1.3 d 1.1 a 1.1 p 1.1 t 1 s ]

**Notes:**
- \(^a\) this markup could vary (1.0 - 1.3), depending on price negotiation
- m mask cost, could be amortized over unit volume
- d die cost
- a assembly cost
- p package cost
- t test cost
- s product and other support cost
Mark-up vs Margin

**MARKUP** = \( \frac{[P-C]}{C} \)

or, \( P = [1 + MU] \times C \)

**MARGIN** = \( \frac{[P-C]}{P} \)

or, \( P = \frac{C}{[1 - GM]} \)

*aka* Gross Profit Margin

**Example:**

\( C = $10 \)

\( MU = 30\% \)

\( P = $13 \)

Margin = ?
Lifecycle of a Startup development – the 4 phases

Global Planning

Design

Prototyping

Production

Grants, Incubators, FFF...

Angel

Series A

Series B
Lifecycle of a Fabless IC development – activity highlights

“System” Architecture / Design / Simulation / Verification

- FPGA Implementation
- Reference Design
- Customer Evaluation “Proof of Concept”

Global Planning
- High Level Design
- Floor Planning

IC Design
- Chip Design
  - RTL
  - NL
- Physical Design
  - NL
  - GDSII
- Analog IP Design

IC Prototyping
- IC Qualification
- Prod. Ramp
- Debug

IC Production
- Hi volume

Series A

Series B

30 – 50% of TTS

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Manage your Internal Development Schedule

Typical ASIC Development Cycle

- Start Design
- Tapeout
- ES
- QS
- Prod HW/SW
- Launch

Year 0
Year 1
Year 2

ASIC DESIGN
Proto
Prod Ramp
Hi Volume

Software
α
Software
β
Software
Prod.

Initial Silicon
Initial Silicon Ramp
Initial Product Ramp
Volume Production
Manage Development Schedules – Internal and Customer’s
System vs. IC Development Cycle

a. At the System company:

Start Product Design

Launch

Concept

HW/SW Dev

Demo

Qual

Trial Mkt

Build

Hi Volume

Year 0

Year 1

Year 2


b. At the Fabless IC company:

FPGA Ref Board

Start Design

Tapeout

ES

QS

Prod HW/SW

Launch

Volume Orders

ASIC DESIGN

Proto

Prod Ramp

Hi Volume

Year 0

Year 1

Year 2

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Value Chain using “Strategic”/”Partnership” approach

Fabless success depends on a strong Eco-system of suppliers and partners
Multi-Tiers of Value Chain and Ecosystems

PP Supplier’s Supplier → PP’s Supplier → Product Provider → Customer → Customer’s Customer

Value Chain ↔ Supply Chain

Technology

PCB Foundry Packages

MANY Opportunities for Innovation & Electronics Development
Electronics Value Chain...Auto Nav System

Display
Touchscreen Overlay
MCU 32 bit 32 MHz 1 MB Flash 64 KB RAM
16-Channel 10-bit ADC
Regulator DC_DC converter
Power Management IC

OMAP Processor, ARM11
Dual core 400 MHz
MCU 32-bit 32 MHz 128 I/Os
MCU 32-bit 400 MHz
Gyroscope
GPS Receiver
Flash 8GB MLC
Flash 4GB
CD/DVD Drive

Chrysler 300
Hyundai Sonata

Source: IHI Electronics360 130813

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Smartphones – Looking Inside

Source: iFixit iPhone 5
Electronics Value Chain ...Smartphones
BoM (Bill of Materials) ...iPhone5 S

<table>
<thead>
<tr>
<th>Components / Hardware Elements</th>
<th>Details</th>
<th>16GB</th>
<th>32GB</th>
<th>64GB</th>
</tr>
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<tbody>
<tr>
<td>Pricing without contract</td>
<td></td>
<td>$649.00</td>
<td>$749.00</td>
<td>$849.00</td>
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<tr>
<td>Implied Margin</td>
<td></td>
<td>69%</td>
<td>72%</td>
<td>74%</td>
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<tr>
<td>Total BOM Cost</td>
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<td>$190.70</td>
<td>$200.10</td>
<td>$210.30</td>
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<tr>
<td>Manufacturing Cost</td>
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<td>$8.00</td>
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<td>$8.00</td>
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<tr>
<td>BOM + Manufacturing</td>
<td></td>
<td>$198.70</td>
<td>$208.10</td>
<td>$218.30</td>
</tr>
</tbody>
</table>

Major Cost Drivers

Memory

NAND Flash                        | 1GB LPDDR3                           | $9.40  | $18.80 | $29.00 |
DRAM                             | 1GB LPDDR3                           | $11.00 | $11.00 | $11.00 |
Display & Touch Screen           | 4" Retina Display w/ Touch          | $41.00 | $41.00 | $41.00 |
Processor                       | 64-Bit A7 Processor + M7 Co-Processor | $19.00 | $19.00 | $19.00 |
Camera(s)                        | 8MP (1.5-micron) + 1.2MP             | $13.00 | $13.00 | $13.00 |
Wireless Section - BB/RF/PA      | Qualcomm MDM9615M+WTR1605L+Front End | $32.00 | $32.00 | $32.00 |
User Interface & Sensors         | Includes fingerprint sensor assembly | $15.00 | $15.00 | $15.00 |
WLAN / BT / FM / GPS             | Murata Dual-Band Wireless-N Module   | $4.20  | $4.20  | $4.20  |
Power Management                 | Dialog + Qualcomm                    | $7.50  | $7.50  | $7.50  |
Battery                          | 3.8V~1560mAh                         | $3.60  | $3.60  | $3.60  |
Mechanical / Electro-Mechanical  |                                      | $28.00 | $28.00 | $28.00 |
Box Contents                     |                                      | $7.00  | $7.00  | $7.00  |

Source: IHS, September 2013
Electronics Value Chain ... Smartphones
BoM (Bill of Materials)... iPhone5

<table>
<thead>
<tr>
<th>Components / Hardware Elements</th>
<th>iPhone 5 Hardware Comments</th>
<th>16GByte</th>
<th>32GByte</th>
<th>64GByte</th>
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<td>Pricing without Contract</td>
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<td>$649</td>
<td>$749</td>
<td>$849</td>
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<tr>
<td>Total BOM Cost</td>
<td></td>
<td>$199</td>
<td>$209</td>
<td>$230</td>
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<tr>
<td>Manufacturing Cost</td>
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<td>$8.00</td>
<td>$8.00</td>
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<tr>
<td>BOM + Manufacturing</td>
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<td>$207</td>
<td>$217</td>
<td>$238</td>
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<table>
<thead>
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<th>Major Cost Drivers</th>
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<tbody>
<tr>
<td>Memory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NAND Flash</td>
<td></td>
<td>$10.40</td>
<td>$20.80</td>
<td>$41.60</td>
</tr>
<tr>
<td>DRAM</td>
<td>1GByte LPDDR2</td>
<td>$10.45</td>
<td>$10.45</td>
<td>$10.45</td>
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<tr>
<td>Display &amp; Touchscreen</td>
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<td>$44.00</td>
<td>$44.00</td>
<td>$44.00</td>
</tr>
<tr>
<td>Processor</td>
<td>A6 Processor</td>
<td>$17.50</td>
<td>$17.50</td>
<td>$17.50</td>
</tr>
<tr>
<td>Camera(s)</td>
<td>8 Megapixel + 1.2 Megapixel</td>
<td>$18.00</td>
<td>$18.00</td>
<td>$18.00</td>
</tr>
<tr>
<td>Wireless Section - BB/RF/PA</td>
<td></td>
<td>Qualcomm MDM9615+RTR8600+Front End*</td>
<td>$34.00</td>
<td>$34.00</td>
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<tr>
<td>User Interface &amp; Sensors</td>
<td></td>
<td>$6.50</td>
<td>$6.50</td>
<td>$6.50</td>
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<tr>
<td>BT / WLAN</td>
<td>BTv4.0 + Dual-Band Wireless-N</td>
<td>$5.00</td>
<td>$5.00</td>
<td>$5.00</td>
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<td>Power Management</td>
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<td>$8.50</td>
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<tr>
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<td>$33.00</td>
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<td>$7.00</td>
<td>$7.00</td>
<td>$7.00</td>
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</table>

* - Assumed

Source: IHS iSuppli Research, September 2012
# iPhone5 vs, iPhone4 Bill of Materials ("BoM")

### IHS iSuppli Table: Preliminary iPhone 5 vs. iPhone 4S Cost Estimates

<table>
<thead>
<tr>
<th>Components / Hardware Elements</th>
<th>Apple iPhone 5 (Pricing as of Sept, 2012)</th>
<th>Apple iPhone 4S (Pricing as of Oct, 2011)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>16GB3</td>
<td>32GB4</td>
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<td>Pricing without Contract</td>
<td>$649</td>
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<tr>
<td>Implied Margin</td>
<td>68%</td>
<td>71%</td>
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<tr>
<td>Total BOM Cost</td>
<td>$199</td>
<td>$209</td>
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<tr>
<td>Manufacturing Cost</td>
<td>$8.00</td>
<td>$8.00</td>
</tr>
<tr>
<td>BOM + Manufacturing</td>
<td>$207</td>
<td>$217</td>
</tr>
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</table>

### Major Cost Drivers

<table>
<thead>
<tr>
<th>Memory</th>
<th>16GB3</th>
<th>32GB4</th>
<th>64GB5</th>
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<tbody>
<tr>
<td>NAND Flash</td>
<td>$10.40</td>
<td>$20.80</td>
<td>$41.60</td>
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<tr>
<td>DRAM</td>
<td>$10.45</td>
<td>$10.45</td>
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</table>

<table>
<thead>
<tr>
<th>Display &amp; Touchscreen</th>
<th>$44.00</th>
<th>$44.00</th>
<th>$44.00</th>
<th>$37.00</th>
<th>$37.00</th>
<th>$37.00</th>
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<tbody>
<tr>
<td>4” Retina Display w/ In-Cell Touch</td>
<td>$512MB LPDDR2</td>
<td>$9.10</td>
<td>$9.10</td>
<td>$9.10</td>
<td></td>
<td></td>
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<tr>
<td>3.5” Retina Display w/ Touch</td>
<td>$37.00</td>
<td>$37.00</td>
<td>$37.00</td>
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<td></td>
<td></td>
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<table>
<thead>
<tr>
<th>Processor</th>
<th>$17.50</th>
<th>$17.50</th>
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<th>$15.00</th>
<th>$15.00</th>
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</thead>
<tbody>
<tr>
<td>A6 Processor</td>
<td>$18.00</td>
<td>$18.00</td>
<td>$18.00</td>
<td>$17.60</td>
<td>$17.60</td>
<td>$17.60</td>
</tr>
<tr>
<td>A5 Processor</td>
<td>$15.00</td>
<td>$15.00</td>
<td>$15.00</td>
<td></td>
<td></td>
<td></td>
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<table>
<thead>
<tr>
<th>Camera(s)</th>
<th>$34.00</th>
<th>$34.00</th>
<th>$34.00</th>
<th>$23.50</th>
<th>$23.50</th>
<th>$23.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>8MP + 1.2MP</td>
<td>$34.00</td>
<td>$34.00</td>
<td>$34.00</td>
<td>$23.50</td>
<td>$23.50</td>
<td>$23.50</td>
</tr>
<tr>
<td>Qualcomm MDM9615M + RTR8600 + Front End</td>
<td>$512MB LPDDR2</td>
<td>$9.10</td>
<td>$9.10</td>
<td>$9.10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>User Interface &amp; Sensors</th>
<th>$6.50</th>
<th>$6.50</th>
<th>$6.50</th>
<th>$6.85</th>
<th>$6.85</th>
<th>$6.85</th>
</tr>
</thead>
<tbody>
<tr>
<td>WLAN / BT / FM / GPS</td>
<td>$5.00</td>
<td>$5.00</td>
<td>$5.00</td>
<td>$6.50</td>
<td>$6.50</td>
<td>$6.50</td>
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<tr>
<td>Power Management</td>
<td>$8.50</td>
<td>$8.50</td>
<td>$8.50</td>
<td>$7.20</td>
<td>$7.20</td>
<td>$7.20</td>
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<tr>
<td>Battery</td>
<td>$4.50</td>
<td>$4.50</td>
<td>$4.50</td>
<td>$5.90</td>
<td>$5.90</td>
<td>$5.90</td>
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<tr>
<td>Mechanical / Electro-Mechanical</td>
<td>$33.00</td>
<td>$33.00</td>
<td>$33.00</td>
<td>$33.00</td>
<td>$33.00</td>
<td>$33.00</td>
</tr>
<tr>
<td>Box Contents</td>
<td>$7.00</td>
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<td>$7.00</td>
<td>$7.00</td>
<td>$7.00</td>
<td>$7.00</td>
</tr>
</tbody>
</table>

*Source: IHS iSuppli Research, September 2012*
# Samsung Galaxy S4/S3 Bill of Materials ("BoM")

<table>
<thead>
<tr>
<th>Major Cost Drivers</th>
<th>Samsung Galaxy S4 (HSPA Version)</th>
<th>Samsung Galaxy S4 (LTE Version)</th>
<th>Samsung Galaxy S3 (HSPA Version)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total BOM Cost</strong></td>
<td>$236</td>
<td>$233</td>
<td>$205</td>
</tr>
<tr>
<td><strong>Manufacturing Cost</strong></td>
<td>$8.50</td>
<td>$8.50</td>
<td>$8.00</td>
</tr>
<tr>
<td><strong>BOM + Manufacturing</strong></td>
<td>$244</td>
<td>$241</td>
<td>$213</td>
</tr>
<tr>
<td><strong>Memory (NAND Flash + DRAM)</strong></td>
<td>16GB eMMC + 2GB LPDDR3</td>
<td>16GB eMMC + 2GB LPDDR3</td>
<td>16GB eMMC + 1GB LPDDR2</td>
</tr>
<tr>
<td><strong>Display &amp; Touchscreen</strong></td>
<td>5&quot; 1920x1080 Super AMOLED (441ppi), w/ Gorilla®Glass3 by Corning</td>
<td>5&quot; 1920x1080 Super AMOLED (441ppi), w/ Gorilla®Glass3 by Corning</td>
<td>4.8&quot; 1280x720 Super AMOLED, w/ Gorilla®Glass2 by Corning</td>
</tr>
<tr>
<td><strong>Processor</strong></td>
<td>Samsung Exynos 5 Octa (5410)</td>
<td>Qualcomm Snapdragon 600 (APQ8064AT) - Quad-Core</td>
<td>Samsung Exynos 4 Quad</td>
</tr>
<tr>
<td><strong>Camera(s)</strong></td>
<td>13MP + 2MP</td>
<td>13MP + 2MP</td>
<td>8MP + 1.9MP</td>
</tr>
<tr>
<td><strong>Wireless Section - BB/RF/PA</strong></td>
<td>Possibly contains Intel PMB9820 + PMB5745 + Front End</td>
<td>Possibly contains MDM9615 + WTR1605L + Front End</td>
<td>Contains Intel PMB9811 + PMB5712 + Front End</td>
</tr>
<tr>
<td><strong>User Interface &amp; Sensors</strong></td>
<td>Contains accelerometer, RGB Light, e-compass, Gyro, Barometer, Temperature &amp; Humidity, IR Gesture</td>
<td>Contains accelerometer, RGB Light, e-compass, Gyro, Barometer, Temperature &amp; Humidity, IR Gesture</td>
<td>Contains Capella CM3663 ALS / Proximity, ST LSM330DLC Accelerometer / Gyro, AKM AK8975C e-Compass, &amp; ST LP331AP Barometer Sensors</td>
</tr>
<tr>
<td><strong>WLAN / BT / FM / GPS</strong></td>
<td>Possibly contains Broadcom BCM4335 + BCM47521</td>
<td>Possibly contains Qualcomm Atheros WCN3680</td>
<td>Contains Broadcom BCM4334 + BCM47511</td>
</tr>
<tr>
<td><strong>Power Management</strong></td>
<td>Samsung PMIC (TBD)</td>
<td>Qualcomm PMICs</td>
<td>Contains Maxim PMIC</td>
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<tr>
<td><strong>Battery</strong></td>
<td>3.8V, 2600mAh w/ NFC Antenna (TBD)</td>
<td>3.8V, 2600mAh w/ NFC Antenna (TBD)</td>
<td>3.8V, 2100mAh w/ NFC Antenna</td>
</tr>
<tr>
<td><strong>Mechanical / Electro-Mechanical</strong></td>
<td>$22.00</td>
<td>$22.00</td>
<td>$21.40</td>
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<tr>
<td><strong>Box Contents</strong></td>
<td>$6.00</td>
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</tbody>
</table>

*Source: IHS iSuppli Research, March 2013*
# iPhone5 vs, iPhone4 Bill of Materials (“BoM”)

<table>
<thead>
<tr>
<th>Components / Hardware Elements</th>
<th>iPhone 5 Hardware Comments</th>
<th>16GB3</th>
<th>32GB4</th>
<th>64GB5</th>
<th>iPhone 4S Hardware Comments</th>
<th>16GB32</th>
<th>32GB43</th>
<th>64GB54</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pricing without Contract</td>
<td></td>
<td>$649</td>
<td>$749</td>
<td>$849</td>
<td></td>
<td>$649</td>
<td>$749</td>
<td>$849</td>
</tr>
<tr>
<td>Implied Margin</td>
<td></td>
<td>66%</td>
<td>71%</td>
<td>72%</td>
<td></td>
<td>70%</td>
<td>71%</td>
<td>70%</td>
</tr>
<tr>
<td>Total BOM Cost</td>
<td></td>
<td>$199</td>
<td>$209</td>
<td>$230</td>
<td></td>
<td>$188</td>
<td>$207</td>
<td>$245</td>
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<tr>
<td>Manufacturing Cost</td>
<td></td>
<td>$8.00</td>
<td>$8.00</td>
<td>$8.00</td>
<td></td>
<td>$8.00</td>
<td>$8.00</td>
<td>$8.00</td>
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<tr>
<td>BOM + Manufacturing</td>
<td></td>
<td>$207</td>
<td>$217</td>
<td>$238</td>
<td></td>
<td>$196</td>
<td>$215</td>
<td>$253</td>
</tr>
</tbody>
</table>

**Major Cost Drivers**

### Memory
- NAND Flash: 1GB LPDDR2
  - iPhone 5: $10.40, $20.80, $41.60
  - iPhone 4S: $19.20, $38.40, $76.80
- DRAM: 1GB LPDDR2
  - iPhone 5: $10.45, $10.45, $10.45
  - iPhone 4S: $9.10, $9.10, $9.10
- Display & Touchscreen: 4" Retina Display w/ In-Cell Touch
  - iPhone 5: $44.00, $44.00, $44.00
  - iPhone 4S: $37.00, $37.00, $37.00
- Processor: A6 Processor
  - iPhone 5: $17.50, $17.50, $17.50
  - iPhone 4S: $15.00, $15.00, $15.00
- Camera(s): 8MP + 1.2MP
  - iPhone 5: $18.00, $18.00, $18.00
  - iPhone 4S: $17.60, $17.60, $17.60

### Wireless Section - BB/RF/PA
- Qualcomm MDM9615M+RTR8600 +Front End
  - iPhone 5: $34.00, $34.00, $34.00
  - iPhone 4S: $23.50, $23.50, $23.50

### User Interface & Sensors
- 6.50, 6.50, 6.50
  - iPhone 5: $6.85, $6.85, $6.85

### WLAN / BT / FM / GPS
- Murata Dual-Band Wireless-N Module
  - iPhone 5: $5.00, $5.00, $5.00
  - iPhone 4S: $6.50, $6.50, $6.50

### Power Management
- Dialog + Qualcomm
  - iPhone 5: $8.50, $8.50, $8.50
  - iPhone 4S: $7.20, $7.20, $7.20

### Battery
- 3.8V ~1400mAh
  - iPhone 5: $4.50, $4.50, $4.50
  - iPhone 4S: $5.90, $5.90, $5.90

### Mechanical / Electro-Mechanical
- $33.00, $33.00, $33.00

### Box Contents
- $7.00, $7.00, $7.00

*Source: IHS iSuppli Research, September 2012*
Fabless Eco-system Alignment Across Entire Value Chain is Required
HW 9 – Value Chain

...Due Thursday, November 20th
...This is a TEAM project. Only one submission per team is required.

➢ Create a Value Chain for your Project
   ➢ Identify the suppliers including any “sub-contracting” work
   ➢ What do you consider as the top 3 Risk areas?
List the 3 most important learnings from today’s lecture