Delivering Smartphone Capabilities to the Battlefield

Josh Dixon, Capt./USMC
Naval Postgraduate School
Delivering Smartphone Capabilities to the Battlefield

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• Overview of the Environment, Industry, and Technology
• Proposed Concepts
  • Handset
  • Service
  • Infrastructure
• Cost Savings
Industry Overview

Global Mobility Industry

Regional Mobility Industry

Handset Industry

Application Industry

Hardware Industry

Component Industry

Operating System Industry

Service Provider Industry

MNO Industry

MVNO Industry

Infrastrucure Industry
Handheld Solutions

COTS
Motorola i1 (MIL-STD 810F)

GOTS
Blackberry (Curve 8900)
General Dynamics (Sectera Edge)

No military security specifications built into design

$150 - $4000 - $4000

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*Images from vendors website
Outline

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    - Handset
    - Service
    - Infrastructure
  - Cost Savings

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## Handset Cost (drivers)

<table>
<thead>
<tr>
<th>Component</th>
<th>Manufacturer</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseband Processor</td>
<td>Qualcomm</td>
<td>1GHz CPU, 600MHz Digital Signal Processor</td>
<td>$30.50</td>
</tr>
<tr>
<td>RF Transceiver</td>
<td>Qualcomm</td>
<td>RF Transceiver (2f, Quad-Band GSM/EDGE, Tri-Band WCDMA/HSDPA)</td>
<td>$2.50</td>
</tr>
<tr>
<td>Display</td>
<td>Samsung</td>
<td>Mobile Display Display (3.7&quot; AM-OLED)</td>
<td>$23.50</td>
</tr>
<tr>
<td>Touchscreen</td>
<td>Synaptics</td>
<td>Touchscreen Assembly (Capacitive Multitouch)</td>
<td>$17.50</td>
</tr>
<tr>
<td>Memory</td>
<td>Samsung</td>
<td>Multichip Package (4Gbit NAND Flash + 4Gbit Mobile Double Data Rate (DDR) DRAM)</td>
<td>$20.40</td>
</tr>
<tr>
<td>Power Management</td>
<td>Qualcomm</td>
<td>Power Management IC (w/ integrated USB transceiver)</td>
<td>$2.50</td>
</tr>
<tr>
<td>Power Management</td>
<td>Texas Instruments</td>
<td>Integrated Power Management IC &amp; Li-ion Charger</td>
<td>$1.20</td>
</tr>
<tr>
<td>Power Amplifier</td>
<td>Skyworks &amp; Others</td>
<td>4 Power Amplifier Modules</td>
<td>$2.20</td>
</tr>
<tr>
<td>Bluetooth/WLAN/Broadcom</td>
<td>Broadcom</td>
<td>Bluetooth/WLAN/FM Transmitter/Receiver (802.11a/b/g/n, Bluetooth V2.1+EDR, 65nm)</td>
<td>$8.20</td>
</tr>
<tr>
<td>Electrical</td>
<td></td>
<td>Misc. Electrical Components (Small IC's, Discrete Semiconductors, Passives, etc.)</td>
<td>$16.30</td>
</tr>
<tr>
<td>Camera</td>
<td></td>
<td>Camera (5.0 MP Auto focus)</td>
<td>$12.50</td>
</tr>
<tr>
<td>MicroSD Card</td>
<td>MicroSD Card</td>
<td>(4GB)</td>
<td>$8.50</td>
</tr>
<tr>
<td>Electro-Mechanical</td>
<td>Misc. Electronmechanical Components, PCB’s</td>
<td>$14.10</td>
<td></td>
</tr>
<tr>
<td>Mechanical</td>
<td>Misc. Mechanical Components</td>
<td>$6.20</td>
<td></td>
</tr>
<tr>
<td>Battery</td>
<td>Battery (1400mAh, 3.7V)</td>
<td>$5.25</td>
<td></td>
</tr>
<tr>
<td>Mechanical</td>
<td>Main Enclosure Housing (Machined Aluminum Unibody)</td>
<td>$2.80</td>
<td></td>
</tr>
</tbody>
</table>

**Total Estimated Cost**: $174.15

**Avg. wholesale**: $323.07

**Avg. retail (2 year plan)**: $179.00

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*images from www.ifixit.com
*cost figures from www.isuppli.com
**according to ABI Research Firm (as of June 2010)
Limitations

- Virtualization delays
  - Mitigated through multiple processors
  - Hardware virtualization vice software
- Added cost

Advantages

- Higher level of assurances
- Run multiple instances of COTS Operating Systems
- Separate OS from hardware
- Trusted applications receive dedicated resources
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DoD Wireless Procurements

* FY2005-06 – AAFPA and NMCI data estimates based on trends
**commercial market trend line referencing carriers combine revenue as reported on annual financial records
***procurement data derived from the federal procurement data system (public access)
• DoD (domestic) voice cost (calculate per minute rate)
  
  Average: $0.06 per minute
  
  Std. Dev.: $0.03 (majority of plans range $0.03 – $0.09 per min.)

• Carriers cost
  
  Roaming Cost (FCC 2009 Report): $0.03 per minute
DoD Cost per Region FY09

*data derived from the federal procurement data system (public access)

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Spectrum Trade-off

Sell-Off Spectrum and Lease Back
Cost to government
- Cost to lease spectrum
- Loss of dedicated spectrum
  - Lower capacity (smaller channels)

Maintain Spectrum
Cost to government
- No fiscal expenses
- Opportunity Cost (Gov’t)
  - revenue from selling spectrum
  - commercial industry builds around spectrum
  - shared R&D burden
  - standards built around spectrum

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*DoD UCR 2008/2010 Section 6.1 (Unique Deployed Requirement)
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Tethered Solutions

Requirement - Integrate MILS Separation Kernel

USB Dongle

• Limitations
  • USB Host
  • Limited Mobility
  • Power Inefficiencies

• Advantages
  • No commercial signal emissions
  • Low Cost
  • Shorter procurement timeline

Sleeve

• Limitations
  • Added hardware to handset
  • Procure sleeve hardware for each handset (customized per phone model)

• Advantages
  • Transmit across military signals
  • Potential for Type 1 encryption module or Suite B client
  • Low Cost in comparison

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Lockheed Martin (MONAX)

*images from vendors website
Secure (Encryption) WiFi

- Limitations
  - Added hardware
  - Not LPD/LPI/LPE signal

- Advantages
  - Operates on a non-licensed band
  - Provides suite B link encryption

- Cost ($6-8K per squad)

Commercial cellular (fixed cites)

- Limitations
  - High opportunity cost for concentrated areas
  - Coverage gaps
  - Reoccurring usage cost
  - Not LPD/LPI/LPE signal

- Advantages
  - Preexisting network (no setup, maintenance/support)
  - Shared cost burden with commercial market

Cost (avg. monthly service cost $25 - $30 per user)*

*Current cost ($60 - $70 per user)
**Mobile Base Stations (Tactical design)**

- **Limitations**
  - Higher Cost (limited market)
  - Scalability
  - Not LPD/LPI/LPE signal

- **Advantages**
  - Ruggedized
  - All-in-one Solutions

- **Cost**
  - Equipment: $15K – $250K+ (6 – 80 simultaneous users)
  - Frequency lease: $5K – $6K

**Modified Tactical Radio (host cellular signal)**

- **Limitations**
  - High Cost
  - Not LPD/LPI/LPE signal
  - Modifications not on roadmap

- **Advantages**
  - No added hardware for infrastructure

*Images from vendors website*
Infrastructure Security Trade-off

SIZE = LEVEL OF SECURITY

Cost (Millions)

Time (Years)
Overview of the Environment, Industry, and Technology

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- Cost Savings
## Estimated Current Costs

### Secure Comms Cost
- **Service**
  - $1500 \times \$70 \times 12 = \$1.25\ Million
- **Handset**
  - $1500 \times \$3000 = \$4.5\ Million
- **Infrastructure**
  - $750\ Thousand
- **R&D**
  - $50\ Million

### Unsecure Comms
- **Service**
  - $280K \times \$70 \times 12\ text{mo} = \$240\ Million
- **Handset/Data Cards**
  - $600\ Thousand

### Total

<table>
<thead>
<tr>
<th>Secure Comms</th>
<th>Unsecure Comms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
</tr>
<tr>
<td>$56.5\ Million\ annually</td>
<td>$240.6\ Million\ annually</td>
</tr>
</tbody>
</table>

$2.56B\ NPV\ (rough\ estimate\ 10\ yrs)$
Proposed Savings

- **Spectrum**
  - $165 \times $5000 \times 12 = 10\text{ Million}

- **Leased / Owned Infrastructure**
  - $165 \times 50\text{ K} = 50\text{ Million}

- **Handset**
  - $450K \times $300 = 135\text{ Million}
  - (hardware and software cost)

- **Service**
  - $140K \times $30 \times 12\text{ mo} = 50\text{ Million}

- **R&D**
  - 25 Million

**Current Cost**

- $2.56\text{ B (280K users)}$

**Proposed Cost**

- $2.16\text{ B (450K users)}$

**Savings:** $400\text{MM (across 10 yrs)}$

Increased Coverage

Increased Capability

Total: $270 Million annually
Questions

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