Two Types of Wireless Connectivity

Wireless Connectivity Overview
- $4.7B IC Revenue - with PC and access points (same packaging) $6.3B – in 2012

Major Change in Wireless Combo Landscape – Combos peaking in 2014
- Processor-integration of Combo – only a small IC remains (“Combo XCVR”)

Wireless Connectivity OSAT market – 2012 – 2017
- 2013-17 --- unit CAGR 9% -- OSAT revenue CAGR 2% ~$0.7B

Processor-integrated Combos – Significant IC BOM reduction

Wireless Connectivity – Units and OSAT Revenue by Type and Package (2010-2018)

Internet of Things – Forecast Scenarios
- IoT Connectivity OSAT SAM -- $100M by 2018
- BT versus Wi-Fi in IoT and WE
Two Types of Mobile Connectivity

► Mobile Connectivity is wireless “plumbing” that connects mobile devices to the cloud

1. **Cellular connectivity** – a vast and growing IC market – the core of every phone
   - FP BBs
   - SP – SA BB and IP (BB+AP)

2. (Other) **Wireless connectivity** - ~1B Wi-Fi ICs shipped in 2012
   - Wi-Fi
   - BT
   - GPS
   - FM
   - NFC
   - These functions can be discrete (SA IC) or combined (Combo IC)

---

► Wi-Fi connectivity for access points and PCs (NB and DT) **is not included** in the Mobile category
   - Different products (e.g., number of antennas) and technology

► From a packaging point of view they are the same segment – except for large pitch (pitch conversion) – hence access point and PC connectivity are included in our analysis / discussion
Mobile Devices -- 2.9B units in 2013 (6% 13-17 CAGR)
~0.5B of total are other than SP and T

The “Other” category may grow faster than projected below
- “Node” connectivity will likely be
  SiP-packaged (MCU, MEMS, RF ↔ BT mostly)
- Internet traffic will likely be very low
  - A joke although it is close – “All smart meters in the US generate less
    Internet traffic than five teenagers”
Mobile Device Categories -- with PCs and Access Points Added

Mobile Devices
2.9B units in 2013
0.5B other than SP and T in 2013

Source: Gartner, Linley, MI

More expensive ICs – OSAT
ASP's similar to Mobile
Rapid Tablet Adoption to Continue – 13-17 CAGR 28%

- Tablet adoption is expanding beyond Consumer into enterprise and education segments
  - In emerging markets T is often the user’s first computing device – continues to affect PC purchases
- The forecast (shown below) is more aggressive than many other forecasts
  - Main reason for conservative forecasts is due to their persistent underestimates of white-box T market
  - White-box Ts are approaching First Tier quality at a reasonable price

Phablets are emerging as an alternative to SP and T
- Cannibalization has so far been limited (mostly in Mid-end Ts)
- SPs and Ts are becoming screens for Internet / Cloud access

Differences between PCs and Ts are driven by their main intended use (generation versus consumption)
- Differences continue to blur – Google’s Chromebook is a netbook, 2-in-1 PCs, two processor “PC,” other

Definition used:
- PCs -- keyboard in NB PCs is not detachable
- Ts – keyboard, including dock, can be added (at present text input mostly)

Source: IDC, Gartner, Barclays & MI Estimates, Jan 2014
Two Landscape Changes in Wireless Combos

1. Connectivity Combo units anticipated to peak in 2014 – 2014-18 CAGR = <1%
   - This is a truly major industry change – due to integration of Combos into IP-processors trend
     ► In 2011 / 2012 most analyses still projected Combo unit 2012-16 CAGR at 18%
   - The change will impact Combo vendors

2. Connectivity Combo migrated from 65nm to the 40nm node
   - WLP continues to dominate
   - Because of die size reduction the FC package has largely replaced FBGA for pitch conversion
   - Pitch conversion for low-cost PCB boards (largely for Emerging Markets) accounts for about 20% of Combo units
In January 2014 the prestigious Linley Group awarded “Best MP in 2013” to MediaTek

- Choosing MediaTek’s MT6572 2-core 28nm IP targeting $80 and below SPs
- HV production in May 2013 “this chip stands well above its competitors - bringing innovation and value to the rapidly growing market for low-cost smartphones”
- “This processor was the first low-end chip to integrate a full set of smartphone connectivity functions: Wi-Fi, Bluetooth, GPS, and FM radio”

This level of integration reduces several dollars off the total system cost—a huge savings in an $80 SP

Qualcomm and Spreadtrum released low-cost processors with a similar level of integration
Connectivity Combos – Units are Peaking in 2014

Combos:
-- 2014-2018 unit CAGR <1%
-- OSAT revenue <4%

Connectivity Combos dominance is ending
-- Processor integration benefits are
  ► Nodal scalability
  ► Power and silicon (cost) reduction
  ► Reduction of components
  ► For IC vendors – platform control

-- Combo composition is changing also
  ► from WF+BT+FM functional combination
  ► to WF+BT+FM+ NFC and/or WF+BT+FM+GPS

-- Use of discrete WLAN is very low in SPs and Ts
  ► The primary use of discrete WLAN is in PCs and access points

Primary source: Linley Group
Connectivity -- Units and OSAT Rev by Package and Type

Wireless Connectivity **Units** by Package (M)

<table>
<thead>
<tr>
<th>Package Type</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>QFN / QFP / QFN-DR</td>
<td>2000</td>
<td>3000</td>
<td>4000</td>
<td>5000</td>
<td>6000</td>
<td>7000</td>
<td>8000</td>
<td>9000</td>
<td>10000</td>
</tr>
<tr>
<td>FBGA</td>
<td>1000</td>
<td>2000</td>
<td>3000</td>
<td>4000</td>
<td>5000</td>
<td>6000</td>
<td>7000</td>
<td>8000</td>
<td>9000</td>
</tr>
<tr>
<td>WLP</td>
<td>2000</td>
<td>3000</td>
<td>4000</td>
<td>5000</td>
<td>6000</td>
<td>7000</td>
<td>8000</td>
<td>9000</td>
<td>10000</td>
</tr>
<tr>
<td>FC (future eWLB likely)</td>
<td>1000</td>
<td>2000</td>
<td>3000</td>
<td>4000</td>
<td>5000</td>
<td>6000</td>
<td>7000</td>
<td>8000</td>
<td>9000</td>
</tr>
<tr>
<td><strong>Total Units</strong></td>
<td>6000</td>
<td>9000</td>
<td>12000</td>
<td>15000</td>
<td>18000</td>
<td>21000</td>
<td>24000</td>
<td>27000</td>
<td>30000</td>
</tr>
</tbody>
</table>

**13-17 CAGR**
- QFN / QFP / QFN-DR: 13%
- FBGA: -2%
- WLP: 11%
- FC (future eWLB likely): 7%
- **Total Units**: 9%

Wireless Connectivity **OSAT Rev** by Package ($M)

<table>
<thead>
<tr>
<th>Package Type</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>QFN / QFP / QFN-DR</td>
<td>200</td>
<td>300</td>
<td>400</td>
<td>500</td>
<td>600</td>
<td>700</td>
<td>800</td>
<td>900</td>
<td>1000</td>
</tr>
<tr>
<td>FBGA</td>
<td>50</td>
<td>100</td>
<td>150</td>
<td>200</td>
<td>250</td>
<td>300</td>
<td>350</td>
<td>400</td>
<td>450</td>
</tr>
<tr>
<td>WLP</td>
<td>200</td>
<td>300</td>
<td>400</td>
<td>500</td>
<td>600</td>
<td>700</td>
<td>800</td>
<td>900</td>
<td>1000</td>
</tr>
<tr>
<td>FC (possibly eWLB)</td>
<td>100</td>
<td>200</td>
<td>300</td>
<td>400</td>
<td>500</td>
<td>600</td>
<td>700</td>
<td>800</td>
<td>900</td>
</tr>
<tr>
<td><strong>Total OSAT Rev</strong></td>
<td>1000</td>
<td>2000</td>
<td>3000</td>
<td>4000</td>
<td>5000</td>
<td>6000</td>
<td>7000</td>
<td>8000</td>
<td>9000</td>
</tr>
</tbody>
</table>

**13-17 CAGR**
- QFN / QFP / QFN-DR: 8%
- FBGA: -5%
- WLP: 5%
- FC (possibly eWLB): 1%
- **Total OSAT Rev**: 2%

Wireless Connectivity **Units** by Type (M)

<table>
<thead>
<tr>
<th>Type</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combo Wi-Fi</td>
<td>2000</td>
<td>3000</td>
<td>4000</td>
<td>5000</td>
<td>6000</td>
<td>7000</td>
<td>8000</td>
<td>9000</td>
<td>10000</td>
</tr>
<tr>
<td>MP-integr Wi-Fi</td>
<td>1000</td>
<td>2000</td>
<td>3000</td>
<td>4000</td>
<td>5000</td>
<td>6000</td>
<td>7000</td>
<td>8000</td>
<td>9000</td>
</tr>
<tr>
<td>Discrete Wi-Fi</td>
<td>500</td>
<td>1000</td>
<td>1500</td>
<td>2000</td>
<td>2500</td>
<td>3000</td>
<td>3500</td>
<td>4000</td>
<td>4500</td>
</tr>
<tr>
<td>Discrete BT</td>
<td>200</td>
<td>300</td>
<td>400</td>
<td>500</td>
<td>600</td>
<td>700</td>
<td>800</td>
<td>900</td>
<td>1000</td>
</tr>
<tr>
<td>Discrete/Combo GPS</td>
<td>100</td>
<td>200</td>
<td>300</td>
<td>400</td>
<td>500</td>
<td>600</td>
<td>700</td>
<td>800</td>
<td>900</td>
</tr>
<tr>
<td><strong>Total Units</strong></td>
<td>7000</td>
<td>10000</td>
<td>13000</td>
<td>16000</td>
<td>19000</td>
<td>22000</td>
<td>25000</td>
<td>28000</td>
<td>31000</td>
</tr>
</tbody>
</table>

**13-17 CAGR**
- Combo Wi-Fi: 2%
- MP-integr Wi-Fi: 92%
- Discrete Wi-Fi: 0%
- Discrete BT: 3%
- Discrete/Combo GPS: 5%
- **Total Units**: 9%

Wireless Connectivity **OSAT Rev** by Type ($M)

<table>
<thead>
<tr>
<th>Type</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combo Wi-Fi</td>
<td>200</td>
<td>300</td>
<td>400</td>
<td>500</td>
<td>600</td>
<td>700</td>
<td>800</td>
<td>900</td>
<td>1000</td>
</tr>
<tr>
<td>MP-integr Wi-Fi</td>
<td>1000</td>
<td>2000</td>
<td>3000</td>
<td>4000</td>
<td>5000</td>
<td>6000</td>
<td>7000</td>
<td>8000</td>
<td>9000</td>
</tr>
<tr>
<td>Discrete Wi-Fi</td>
<td>500</td>
<td>1000</td>
<td>1500</td>
<td>2000</td>
<td>2500</td>
<td>3000</td>
<td>3500</td>
<td>4000</td>
<td>4500</td>
</tr>
<tr>
<td>Discrete BT</td>
<td>200</td>
<td>300</td>
<td>400</td>
<td>500</td>
<td>600</td>
<td>700</td>
<td>800</td>
<td>900</td>
<td>1000</td>
</tr>
<tr>
<td>Discrete/Combo GPS</td>
<td>100</td>
<td>200</td>
<td>300</td>
<td>400</td>
<td>500</td>
<td>600</td>
<td>700</td>
<td>800</td>
<td>900</td>
</tr>
<tr>
<td><strong>Total OSAT Rev</strong></td>
<td>1100</td>
<td>2200</td>
<td>3300</td>
<td>4400</td>
<td>5500</td>
<td>6600</td>
<td>7700</td>
<td>8800</td>
<td>9900</td>
</tr>
</tbody>
</table>

**13-17 CAGR**
- Combo Wi-Fi: -4%
- MP-integr Wi-Fi: 81%
- Discrete Wi-Fi: -3%
- Discrete BT: -2%
- Discrete/Combo GPS: -1%
- **Total OSAT Rev**: 2%
Wireless Connectivity OSAT Packaging ~$700M Market

- Wireless Connectivity OSAT market remains an important segment of the Mobile IC market

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wireless Connectivity</strong></td>
<td>713</td>
<td>696</td>
<td>694</td>
<td>741</td>
<td>780</td>
<td>835</td>
<td>2%</td>
</tr>
<tr>
<td><strong>IoT Wireless Connect.</strong></td>
<td>17</td>
<td>25</td>
<td>42</td>
<td>60</td>
<td>80</td>
<td>106</td>
<td>44%</td>
</tr>
</tbody>
</table>

- WB and WLP will continue to dominate Wireless Connectivity packaging

The above is also true for the embryonic IoT market -- dominated by QFN and modules (die in WLP)

- There is an increasing interest in module packaging
  - Modules may become a preferred packaging choice in the IoT and WE markets
  - Leading OSATs have module/SiP packaging capabilities
Connectivity Processor-integration – Limited OSAT Impact

► System economics of processor integration is particularly favorable in the Mainstream segment where Combo is integrated into an IP-processor
  – Platform vendors (Qualcomm, MediaTek, Spreadtrum) versus stand-alone Combo vendors
  – SA Combo growth has ceased – the market will remain significant in size because of continuous new standard introduction

► Processor-integration of WLAN Combos represents a major change in wireless connectivity
  – Processor-integration significantly reduces system cost and power
    ▶ More than $4 or 10-15% reduction of IC BOM in Mainstream SPs
  – OSAT implications are much more limited
    ▶ About $0.17 (when in FC) versus ~$0.08 (remaining Combo-residual RF IC)

► A new connectivity segment has emerged – “Combo XCVR” (a la cell BB XCVR)
  – WLP at QTI, QFN at MTK

► Leading platform and AP vendors are likely to adopt a processor-integration approach

► IoT is a high-growth emerging segment
  – Primary connectivity IC suppliers will be the same as in wireless connectivity
  – All three main IoT components (connectivity (BT), processor and sensor) will be WB, WLP or module packaged
Internet of Things

(IoT = IoE = M2M)
Internet of Things (IoT)

- The IoT refers to devices that can monitor their environment, report their status, receive instructions, and even take action based on the information they receive
  - Unlike SPs or Ts, IoT devices have a limited user interface and exist solely to collect and send data to other devices
  - The three basic functionalities in IoT devices are sensor, wireless connectivity and processor

Qualcomm Swarm Lab at US Berkeley projects 1000 radios per person on Earth by 2025
  - *Trillions* of connected devices

Bosch projects *7 trillion* devices in sensory “swarms” – 1000 sensors per person
  - At present advanced cars have up to 100 sensors, medical diagnostics uses 10s of different sensors

IoT is projected to eventually become the largest growth opportunity in the history of business
  - Smart systems (fusion of computing, communication and sensing)
  - Connecting and interacting with people, things (M2M), information, places ➔ IoE

Sources of this optimistic IoT projection are composite - BII, Gartner, IDC, SA
Descending Trillion Sensor by 2020 IoT Hype Mountain

► IoT will more likely become 1.2B+ unit market by 2018 – most IoT growth after 2020
  – In a Base Case model installed base of IoT in 2018 is ~3.5B devices
  – 1.2B+ additional IoT connectivity devices is addition to ~4.5B wireless connectivity units by 2018
  – Primarily in fragmented vertical commercial and consumer applications
    ► In 2013 there will be 4.5B 32-bit MCUs and 1.3B AP (SP+T) shipped (25% and 20% 12-18 CAGR)

 IoT Unit Growth Scenarios (M)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hi Case</td>
<td>300</td>
<td>360</td>
<td>490</td>
<td>666</td>
<td>906</td>
<td>1233</td>
<td>1677</td>
<td>2668</td>
<td>41%</td>
</tr>
<tr>
<td>Base Case</td>
<td>70</td>
<td>100</td>
<td>140</td>
<td>220</td>
<td>400</td>
<td>600</td>
<td>850</td>
<td>1200</td>
<td>53%</td>
</tr>
<tr>
<td>Lo Case</td>
<td>70</td>
<td>100</td>
<td>140</td>
<td>220</td>
<td>400</td>
<td>600</td>
<td>800</td>
<td>1000</td>
<td>46%</td>
</tr>
</tbody>
</table>

► Wireless connectivity in IoT is dominated by WB (large PCB pitch) and modules (allow 0.4mm WLP)
  – Qualcomm IoE platforms introduced in Sept. 2013
    ► QCA4002 -- 7x7mm 58pin QFN; QCA4004 (with MCU) 8x8mm 68pin QFN – 802.11n Wi-Fi
  – BCM4390 WICED (Wireless Connectivity for Embedded Device) - introduced May 2013
    ► BCM4390 SoC (die is in WLP) is packaged in a module
      – It contains 802.11b,g,n Wi-Fi -- with plans for BT, GPS, NFC and other options
      – Like many other vendors, BRCM offers WICED™ - a development system for OEMs – to facilitate adding wireless connectivity to embedded devices (MCUs with more and more A/M-S components)
    – TI SimpleLink Wi-Fi CC3000 is a “self-contained 802.11 network processor” that minimizes the effort involved in making devices internet-aware ➯ QFN packaged
## IoT Connectivity OSAT SAM -- $100M+ by 2018 (for 1.2B devices)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total IoT (M)</th>
<th>OSAT A ($)</th>
<th>OSAT T ($)</th>
<th>OSAT ASP ($)</th>
<th>IoT Conn. SAM (M$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>100</td>
<td>0.09</td>
<td>0.03</td>
<td>0.12</td>
<td>17</td>
</tr>
<tr>
<td>2013</td>
<td>140</td>
<td>0.085</td>
<td>0.028</td>
<td>0.113</td>
<td>25</td>
</tr>
<tr>
<td>2014</td>
<td>220</td>
<td>0.08</td>
<td>0.027</td>
<td>0.106</td>
<td>42</td>
</tr>
<tr>
<td>2015</td>
<td>400</td>
<td>0.075</td>
<td>0.025</td>
<td>0.094</td>
<td>60</td>
</tr>
<tr>
<td>2016</td>
<td>600</td>
<td>0.07</td>
<td>0.023</td>
<td>0.088</td>
<td>80</td>
</tr>
<tr>
<td>2017</td>
<td>850</td>
<td>0.066</td>
<td>0.022</td>
<td></td>
<td>106</td>
</tr>
<tr>
<td>2018</td>
<td>1200</td>
<td>-6%</td>
<td>-6%</td>
<td>-6%</td>
<td>44%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>53%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- IoT wireless connectivity OSAT is a high-growth new segment – WB and, if in module, WLP
  - An additional $100M+ is in 32-bit MCU packaging – nearly all in WB
  - There is an additional $100-$200M MEMS packaging – mostly WB and SAM is function of sensor type and number of sensor
- In general demand for modules is increasing

### IoT Devices Growth

<table>
<thead>
<tr>
<th>Year</th>
<th>IoT Commercial</th>
<th>IoT Consumer</th>
<th>&quot;Things&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>100</td>
<td>20</td>
<td>0.3</td>
</tr>
<tr>
<td>2013</td>
<td>120</td>
<td>60</td>
<td>5</td>
</tr>
<tr>
<td>2014</td>
<td>150</td>
<td>120</td>
<td>54</td>
</tr>
<tr>
<td>2015</td>
<td>220</td>
<td>200</td>
<td>119</td>
</tr>
<tr>
<td>2016</td>
<td>300</td>
<td>300</td>
<td>166</td>
</tr>
<tr>
<td>2017</td>
<td>350</td>
<td>350</td>
<td>217</td>
</tr>
<tr>
<td>2018</td>
<td>400</td>
<td>400</td>
<td>221</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>42%</td>
</tr>
<tr>
<td></td>
<td>2012 2013 2014</td>
<td>2015 2016 2017</td>
<td>2018</td>
</tr>
<tr>
<td></td>
<td>100 140 220</td>
<td>400 600 850</td>
<td>1200</td>
</tr>
</tbody>
</table>

Wearable electronics (WE) is an adjacent segment to IoT
- Typically WE is a “companion” device tethered to SP by BT
  - Bracelets (a sub-segment of WE) might not have any connectivity (a rudimentary display instead)
BT in Wearable Electronics – Wi-Fi Dominance in IoT Likely

- IoT devices are typically networked in a hierarchy of networks and processing nodes
  - Sensor nodes ("motes") are connected to processor nodes (data fusion, encryption) via Zigbee or Wi-Fi which are then connected to central control nodes / cloud by 3G/4G cellular, Wi-Fi or Ethernet

- Most MCU, Analog and Wireless Connectivity IC vendors are pursuing the IoT market
  - But also Murata (acquired Sychip – Wi-Fi S/W vendor)
  - A very large number of start-ups are pursuing IoT solutions:
    - Dust Networks (acquired by Linear)
    - Ember (outdoor municipal lights) – acquired by Silicon Labs
    - E&H Process Solutions (Switzerland) using Dust technology
    - Electric Imp (ex-Apple and Google team) – a Wi-Fi card in wall power socket

- The canonical commercial (M2M) application is smart meters
  - Electronic link allowing utility monitoring usage and increasing efficiency
    - In the US there are ~150M residential and commercial electricity meters
    - ~25% (~35M) have converted to smart meters --- worldwide there are more than 2B electric meters

- Smart parking systems monitor and guide drivers to parking spaces
  - Capacity utilization increases to ~100% (from typically 80%)
    - In the US there are more than 100M for-pay parking spots

- More than 1B vehicles and ~17M shipping containers are used WW
  - A small GPS receiver and wireless connection can track the location of valuable mobile assets

- Control of street lights – China now builds entire new cities with mandated LED lighting control
IoT – Fragmented Market – Many Types of Things (Gartner)

By 2017, 50% of Internet of Things solutions will originate in startups less than three years old.

- Expect 10 billion shipments in 2020
- Many smart versions of existing product markets
- Few are very high volume; most are small and fragmented
- Key challenge: where to focus?

The Internet of (Very Different) Things

<table>
<thead>
<tr>
<th>Shipment in 2020 (Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connected LED Lamps</td>
</tr>
<tr>
<td>Digital set top box</td>
</tr>
<tr>
<td>Security cameras</td>
</tr>
<tr>
<td>Smoke alarms</td>
</tr>
<tr>
<td>Point of sale terminals</td>
</tr>
<tr>
<td>Smart household appliances</td>
</tr>
<tr>
<td>Toys</td>
</tr>
<tr>
<td>Wearable fitness sensors</td>
</tr>
<tr>
<td>Parking meters</td>
</tr>
<tr>
<td>Bike / activity cameras</td>
</tr>
<tr>
<td>Hotel door locks</td>
</tr>
</tbody>
</table>

How Gartner Arrives to $262B IoT Market in 2020

<table>
<thead>
<tr>
<th>Consumers</th>
<th>Enterprises</th>
<th>Revenue (2020)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 5: Analytics</td>
<td>Big data, user analytics</td>
<td>$262B</td>
</tr>
<tr>
<td>Level 4: Apps and services</td>
<td>Baby monitoring service or app, home security service</td>
<td></td>
</tr>
<tr>
<td>Level 3: Computing and storage</td>
<td>Data centers, servers, storage</td>
<td></td>
</tr>
<tr>
<td>Level 2: Comms &amp; networking</td>
<td>Aggregation and security</td>
<td></td>
</tr>
<tr>
<td>Level 1: “Things”</td>
<td>M2M Communications: cellular, mesh, WiFi, ZigBee, TV White Space, …</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aggregation and security</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Baby monitor, home automation devices</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vending machine, hotel room door lock</td>
<td></td>
</tr>
</tbody>
</table>

Billions of Units (Installed base)

<table>
<thead>
<tr>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
</tr>
<tr>
<td>2020</td>
</tr>
</tbody>
</table>

* Preliminary, September 2013