The RAIN RFID Market

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IDTechEx: Brief Overview of RFID Capability

IDTechEx is an independent technology and market analyst company

- IDTechEx has covered the RFID market since 1999

- IDTechEx continuously interviews all leading suppliers in addition to innovative start-ups

- Our analysis is global with research conducted in Asia, Europe and the US

- Coverage includes passive RFID, NFC, active RFID, BLE beacons, sensor technologies, smart packaging, IoT, RFID and IoT infrastructure

- Our data is widely cited in major media on RFID, used in M&A activities, and we have consulted or provided data for companies across the supply chain

www.idtechex.com
### Cumulative sales of RFID tags to 2017 (millions)

<table>
<thead>
<tr>
<th>Application</th>
<th>Number (millions)</th>
<th>Biggest markets by number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical / Healthcare</td>
<td>1,077</td>
<td>mostly RAIN</td>
</tr>
<tr>
<td>Retail apparel</td>
<td>20,550</td>
<td>1 – mostly RAIN</td>
</tr>
<tr>
<td>Retail consumer goods</td>
<td>690</td>
<td>mostly RAIN</td>
</tr>
<tr>
<td>Books</td>
<td>2,000</td>
<td>7 – mostly HF</td>
</tr>
<tr>
<td>Assets, Parts, Post</td>
<td>3,686</td>
<td>4 – mostly RAIN</td>
</tr>
<tr>
<td>Smartcards / Payment key fobs</td>
<td>14,448</td>
<td>2 – mostly HF</td>
</tr>
<tr>
<td>Smart tickets</td>
<td>5,065</td>
<td>3 – mostly HF</td>
</tr>
<tr>
<td>Air baggage</td>
<td>712</td>
<td>mostly RAIN</td>
</tr>
<tr>
<td>Conveyances / Pallets / Cases / Rollcages</td>
<td>3,395</td>
<td>5 – mostly RAIN</td>
</tr>
<tr>
<td>Animals (Livestock and Pets)</td>
<td>2,466</td>
<td>6 – mostly LF</td>
</tr>
<tr>
<td>People (excludes other sectors)</td>
<td>180</td>
<td></td>
</tr>
<tr>
<td>Vehicles (incl. car clickers)</td>
<td>1,152</td>
<td>8 – LF and RAIN</td>
</tr>
<tr>
<td>Passports / Secure documents</td>
<td>904</td>
<td></td>
</tr>
<tr>
<td>Leisure</td>
<td>426</td>
<td></td>
</tr>
<tr>
<td>Other NFC applications</td>
<td>750</td>
<td></td>
</tr>
<tr>
<td>Other tag applications</td>
<td>1,395</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>59,510</strong></td>
<td></td>
</tr>
</tbody>
</table>

- **ALL FREQUENCIES shown**, passive and active, labels, fobs and cards
- RFID is used in very diverse, unrelated applications, addressing different problems
- Room for different technologies
- Total of 10.8 Billion tags sold in 2015
- Total of 15.2 Billion tags sold in 2016
- However, RAIN RFID (also known as UHF RFID) dominates in terms of numbers sold and growth
Key forces that continue to drive adoption - technology

1. Robust standards with Gen2:
   - Interoperability, multiple sourcing
   - Standardization of communications protocols and infrastructure
   - Standardization of EPC tag types
   - Common frequencies globally

2. UHF RFID performance has evolved at a Moore's law pace and continues to do so – high performance, reliable systems
   - Tag sensitivity has improved over 10% / year on average
   - UHF RFID performance is opening opportunities
Key forces that continue to drive adoption - confidence

3. Established value chain

- Less fragmentation than before in the value chain
- High growth reported in public company financials
- ASP of RFID hardware has consistently reduced as volumes grow
- Successful IPO, mature supplier base with large and small players globally

4. High confidence from industry (retailers, brands, airlines, manufacturers, automotive etc)

- Roll-out is in “cookie cutter” style for some applications (apparel, asset management etc)
- Excellent understanding of RFID solution value – leveraging RFID to fix problems
Key forces that continue to drive adoption - IoT

RFID is at the bottom of the pyramid – lowest cost, highest volume

Number of wirelessly connected things

<table>
<thead>
<tr>
<th>2020: 31 Billion</th>
<th>2020: 1.9 Billion</th>
<th>2020: 2.6 Billion</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFID</td>
<td>IP Based Sensor Nodes</td>
<td>Personal Electronics: Phones, Laptops, TV</td>
</tr>
</tbody>
</table>

Sold in 2020

Broad applications including retail, pharma, payments

Energy, Security and Healthcare strongest growth areas

IP based nodes
RAIN RFID sales in 2016

RAIN IC Shipments

- Alien Technology
- EM Microelectronic
- Impinj
- NXP
- Others (e.g. in China)

Inlay Creation

- Many including
  - Alien Technology
  - Arizon
  - Avery Dennison
  - Boing Tech
  - Invengo
  - Shang Yang
  - Smartrac
  - Others…

Conversion

Customer

10.6 Billion RAIN ICs sold in 2016
However, the RAIN RFID market size in 2016 in terms of money spent by customers on RAIN tags is measured here→

This number lags IC numbers due to:
• Time to ship, store and apply the IC from the wafer to the inlay
• Where applicable, further conversion time
• Yield losses
• Stockpiling
IDTechEx accounts for these e.g. by assessing Q4 2015 shipments sold in labels in Q1 2016

Note that customers may also add a further delay in application before the tag is actually used, but this is not accounted for.
RAIN RFID sales in 2016

10.6 Billion RAIN ICs sold in 2016 (vs 6.2 Billion in 2015)

9.4 Billion RAIN tags/labels sold in 2016 (vs 5.6 Billion in 2015)

Note: As a percentage more ICs were converted to tags/labels in 2015 than 2016 – a sign of stockpiling for future demand
RAIN RFID – where are they going? (Sales, millions)
RAIN RFID – Tag Value, $ Millions
RAIN RFID Readers: An Opportunity Awaits

2017 market size for UHF RAIN readers

<table>
<thead>
<tr>
<th>Type</th>
<th>Number (millions)</th>
<th>Market size ($ millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UHF Fixed portal</td>
<td>0.09</td>
<td>98</td>
</tr>
<tr>
<td>Excludes external antenna value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UHF Embedded and handheld</td>
<td>0.49</td>
<td>257</td>
</tr>
</tbody>
</table>

- The end game is adoption of RAIN RFID readers in cellphones (~2 billion a year), drastically opening up the opportunities for consumers to engage with UHF as a B2C tool.
- Today there are RAIN Reader SD cards and RAIN cell phone cases. First integrated uses of RAIN enabled smart phones in B2B sectors.
- Consumer phone time frame: 4 to 6 years for first adoption due to cost and complexity versus NFC readers.
RAIN RFID growth is propelling new innovation and broader reach such as RFID Sensors

Google and Novartis are working to replace 30 billion glucose test stripes used each year.

Detecting moisture / leaks in hybrid/EV structures in the manufacturing process with battery RFID moisture sensors

Temperature monitoring to differentiate on quality, minimize waste, tackle supply chain problems using battery assisted RAIN sensor labels
Total RFID Market $ billion

- Active RFID/RTLS Systems
- Passive RFID Interrogators
- Passive RFID Services, Networking, Software
- Passive RFID Tags
New IDTechEx Research
Covering the Entire Market

- RFID Forecasts, Players and Opportunities 2017-2027
- Forecasts by application, technology, territory, value chain and more

www.IDTechEx.com/RFID

The most comprehensive research into RFID markets, with over 100 tables dissecting the entire RFID industry – historic and forecast sales and analysis of trends, suppliers and technologies.