Developing RFID ICs and solutions in a complex environment.

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Agenda

- Basics and definitions
- R&D challenges & evolution
- Applications
- Conclusion
RFID

Basics and definitions
RFID - some definitions

Radio Frequency Identification ICs:

- store and remotely retrieve data
- can be read (written) over up to several meters
- without direct visual contact
- applied to, or incorporated into objects, animals or people
RFID Tag

- Passive
  - getting power from reader via RF
    - small, robust

- Semi-passive
  - battery in package (not for emission)
    - increased physical and chemical constraints

- *Not just an ID, - some RFID devices can record, store and tell stories...*
Three key functions for RFID ICs

RFID tags in their most basic form are EEPROM with RF interface and Logic

ST using:
- High quality and robust automotive grade EEPROM technology
- 40 year data retention at 55°C
- Up to 1 Million cycles
What data to needs to be stored?

- **Part** of the tag RFID storage remains unchanged
  - The IC Mfg. generates a unique code, equivalent to the bar-code. E.g.: EPC,…

- **Part** of the RFID Tag data will be **modified** during the lifetime of the IC.
  - Standardization for memory mapping with codification, level of security and accepted by all the users in the chain is required. E.g.: IATA, AIAG,…

Bank A: TID/UID ROM
- **UNIQUE ID CODE**
- 64 bits

Bank B: EEPROM
- CODE
- 400 bits

Bank C: EEPROM
- DATA
- 64K bits

Bank D: RESERVED
- Protocol
- 64 bits
## RFID Frequencies / Antennas

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Antenna</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>LF 125 kHz</td>
<td>inductor</td>
<td>3D wound coil</td>
</tr>
<tr>
<td>HF 13.56 MHz</td>
<td>inductor</td>
<td>2D printed coil</td>
</tr>
<tr>
<td>UHF 900 MHz band</td>
<td>dipole</td>
<td>2D printed dipole</td>
</tr>
</tbody>
</table>

- Physical Tag Environment
- Directivity
- Size being influenced by frequency and antenna design
RFID-Devices - Form factor

13.56 MHz
RFID

R&D challenges & evolution
Three “laws” dictating evolution …

Heinrich R. Hertz
~1887

Gordon E. Moore
~1965

Standards

PS
RE
PR(L) NVM ES
ADAPT
T

ISO
Other points influencing evolution ...
RFID Tag – a device: “recording, storing and telling stories...”

- memory access control
- data protection / encryption
- anti-tampering
- privacy
- sensing...

...are or may be required!
RFID - there is another “law” ...

Heinrich R. Hertz ~1887

Joel’s Law
\[ P = \frac{1}{2} CV^2 \times f \]

Gordon E. Moore ~1965
RFID Chip design: dealing with contradictions

Consumption

- Crypto
- Long term retention

Cost

- Access control

Required Memory

- Transmission speed & distance
- Compliance standards

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Summing up: RFID R&D topics
(just to mention a few...)

- Passive Tag
  - Rewritable large Memory
  - Enhanced security:
    - password lock, authentication, cryptography
  - Cost reduction
  - Printable antenna
  - Polymer Silicon

- Semi-passive Tag
  - Low power and low consumption microprocessor
  - Integrated sensor
  - Built-in power source:
    - flexible battery, energy scavenging
  - System in package
  - Data processing capabilities
RFID Applications trend

- Large rewriteable memory with security feature
  - Memory Extension:
  - Improved security schemes

- Battery assisted
  - Enhanced performances in harsh environment

- Simple cheap label
  - Market prices
  - RF compliance

- Platform with sensor, power capability and data processing intelligence
  - Monitor physical event and send command

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Closing remarks

- Hertz is keeping antenna designers under pressure
  - remember $\lambda/2$
- Joule is challenging performance increase
  - “more MIPS means more Watt”
- Moore is driving IC cost reduction, but:
  - overall optimization (IC, antenna, protocols ...) is key
  - one needs top class architects and designers
- Widely adopted standards are driving the market pervasion; interoperability is key
Thank you