Celtic-Plus Event
28-29 April 2016, Stockholm

The Smart Sensor
& Semiconductor NVM Switch.

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What makes IoT success?

- Wearable computing
- Home Automation
- Gesture sensing controller
- Bio-Measurement
- Machine-2-machine
- Bluetooth® Low Energy
- Sensor Hubs
- Smart Sensors
- Automotive
- Sensor Network
- Smart Power Grid
- Wireless connectivity
Organisation Profile

- Open: 2009.03.
- Korean Government Funded
- 10 Schools, 23 Tracks,
- 400 Faculty, 5,000 Students
- US152M$ Budget for Schools
Almost all RF/internet protocols need 32-bit MCU to run!

Wireless Connectivity Unit:
- WiFi
- GPS
- BT
- Proprietary RF
- 3G/4G
- VoLTE
- Zigbee...

Data processing
- Flow control
- IO control
- Basic Data analysis
- Data encryption

IoT Device

Processor Unit:
- Microprocessor
- Microcontroller
- DSP
- FPU...

I/O Unit:
- Sensors
- I/Os
- Displays...

thermal
pressure
G-sensor
....
Proposal Introduction / 1. sensor

☞ World class CMOS based smart gas sensor, prototype available at 2017.
☞ Joint R&D development and business.
Configurable device (FPGA) is ideal for future!

SW driven semiconductor/ US6B$ market
R&D on the device switch (NVM)
Seeking partner to joint R&D!

- **Function**: Nonvolatile, reprogrammable, solid-electrolyte switch
- **Performance Target** (SRAM switch)
  - 1/30 area (4F² vs. 120F²)
  - 1/40 turn-on resistance (50Ω vs. 2KΩ)
- **Current Statue**
  1. **1st Gen.**
     - Based on Cu₂S
     - 1 month data retention time
  2. **2nd Gen.**
     - Based on Ta₂O₅
     - Improved turn-on voltage
     - 10 year retention time
     - Compatible with standard logic process

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### Features of Cu₂S solid-electrolyte switch

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Cu₂S NanoBridge</th>
<th>Meet the demand for programmable logic?</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON resistance</td>
<td>OK (&lt;100Ω)</td>
<td></td>
</tr>
<tr>
<td>Switch size</td>
<td>OK (4F²)</td>
<td></td>
</tr>
<tr>
<td>Switching speed</td>
<td>OK (&lt;10μsec)</td>
<td></td>
</tr>
<tr>
<td>Cycling endurance</td>
<td>OK (10⁻³–10⁻⁵)</td>
<td></td>
</tr>
<tr>
<td>Turn-on voltage</td>
<td>NG (~0.2V)</td>
<td></td>
</tr>
<tr>
<td>Retention</td>
<td>NG (&lt;3 month)</td>
<td></td>
</tr>
<tr>
<td>Process compatible</td>
<td>NG</td>
<td></td>
</tr>
<tr>
<td>Switching current</td>
<td>NG (&gt;3mA)</td>
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**Parameter Name**

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<td>OK (&gt;1V)</td>
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<tr>
<td>ON-state duration</td>
<td>NG (&lt;3 month)</td>
<td>OK (&gt;10 years)</td>
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<tr>
<td>Turn-off current</td>
<td>NG (&gt;3mA)</td>
<td>Allowable (~5mA)</td>
</tr>
<tr>
<td>Process Compatibility</td>
<td>NG</td>
<td>OK</td>
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</tbody>
</table>
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