UEFI topics for the manufacturing efficiency

Spring 2019 UEFI Plugfest
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Presented by Rafael R. Machado (Flex Inst. of Technology)

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Agenda

• Introduction
• Manufacturing Process 101
• Hardware Diagnostics
• HW vs. FW Issues
• Manufacturing Needs
• Questions

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Who am I? Where I come from?

- Rafael R. Machado
- Computer Engineer
- MSc Computer Science
- Researcher at FIT
  - FIT is part of Flex (Flextronics) ecosystem
- Professor at FACENS

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Manufacturing Process 101

- ODM - Product/Parts Design
- OEM - Product Design
- EMS - Manufacturing - Assembly - Packing
- OEM - Sales - Marketing
The Manufacturing Challenges

- Assemble a large number of devices
  - Make it fast
  - Make it with high quality
  - Make it with low cost
  - Zero Waste
Reliability Engineering

- Infant Mortality
  - ICs problems
  - Failure by defects
- Random Failures
  - Stress exceeding strength
  - User fault
- Wearout
  - Common degradation due time usage
  - Corrosion / Oxidation

Bathtub Curve [1][3]
Reliability Engineering

Bathtub Curve

h(t)

Infant Mortality

Random Failures

Wearout Failures

ODM, OEM, IBV and EMS Responsibility

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Stressing the Product

- **Design**
  - Accelerated Life Testing (ALT)
  - Highly Accelerated Life Test (HALT)
  - Highly Accelerated Stress Test (HAST)
  - Highly Accelerated Stress Screen (HASS)

- **Manufacturing**
  - Highly Accelerated Stress Audit (HASA)
  - Burn-in
Stressing the Product – Why?

Most failures happen during the first year of usage [2] (H)Accelerated Life Testing tries to find these devices

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UEFI Tools and the Manufacturing

• More control of the hardware (User Space vs. Kernel Space)
• No OS overhead
• Cheaper (No OS license required)
• Faster to BOOT (as for today)
UEFI Spec Evolution for MFG – Network (2.0 vs 2.7)
Is it a HW or FW issue?

• Manufacturing Nightmare
• FW issues can stop an entire manufacturing line
  – Normally happens with BIOS updates
• FW issues can brick a system (like a HW issue does)
## FW x HW Issue – LBA Mode

### Table 1: Command Details
<table>
<thead>
<tr>
<th>Command</th>
<th>Input (H)</th>
<th>F</th>
<th>Command</th>
<th>SecCount (D)</th>
<th>LBA (H)</th>
<th>CEV (H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>46 593 587 293 (6)</td>
<td>6x42: Read Verify Sectors Ext</td>
<td></td>
<td>420D001000000000</td>
<td>1</td>
<td>000016F1FE04</td>
<td>0</td>
</tr>
</tbody>
</table>

### Table 2: Protocol Details
<table>
<thead>
<tr>
<th>Protocol</th>
<th>Status</th>
<th>Metrics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0x00: Normal Output</td>
<td>0x00: Non Data</td>
<td>0x02: Error</td>
<td></td>
</tr>
</tbody>
</table>

### Diagram 1: Transport Details
1. Device (H) LBA Low (exp) (H) LBA Mid (exp) (H) LBA High (exp) (H) Features (exp) (H) Sector Count (exp) (H) Sector Count (exp) (H) CRC (H) Duration
2. PM Port (H) LBA Low (exp) (H) LBA Mid (exp) (H) LBA High (exp) (H) Features (exp) (H) Sector Count (exp) (H) Sector Count (exp) (H) CRC (H) Duration

### Diagram 2: Transport Details
1. Device (H) LBA Low (exp) (H) LBA Mid (exp) (H) LBA High (exp) (H) Features (exp) (H) Sector Count (exp) (H) Sector Count (exp) (H) CRC (H) Duration
2. PM Port (H) LBA Low (exp) (H) LBA Mid (exp) (H) LBA High (exp) (H) Features (exp) (H) Sector Count (exp) (H) Sector Count (exp) (H) CRC (H) Duration

### Diagram 3: Transport Details
1. Device (H) LBA Low (exp) (H) LBA Mid (exp) (H) LBA High (exp) (H) Features (exp) (H) Sector Count (exp) (H) Sector Count (exp) (H) CRC (H) Duration
2. PM Port (H) LBA Low (exp) (H) LBA Mid (exp) (H) LBA High (exp) (H) Features (exp) (H) Sector Count (exp) (H) Sector Count (exp) (H) CRC (H) Duration
FW vs HW Issue – LBA Mode

• Results
  – 32K HDD devices failing
  – Manufacturing delay
  – 32K possible calls to the support team
FW vs HW Issue – Touch Support

This is a desktop connected to a simple LCD monitor

- No touch hardware is present
- User may think touch hardware is failing
**FW vs HW Issue – Touch Support**

- **Results**
  - User believes the hardware is not working
  - Additional checks needed at application level
  - New Product Introduction (NPI) delay due to BIOS update required
Other Problems

• Handles that point to nowhere
• Unnecessary Drivers at the BIOS
  – Consuming space that could be used by other tools like Diagnostic tools
  – It’s also a problem related to manufacturing attacks
• Network Stack with problems
  – Specially PXE
Check-list for Efficient Manufacturing

- Follow existing Specs (USB, PCIe, UEFI, ACPI, ...)
  - MFG and Diagnostic tools rely on the Specs
- Remove unnecessary binaries from BIOS image
  - Boot faster
  - BIOS update faster (download during MFG time)
- Network + UEFI is crucial for MFG!
What does MFG need at the UEFI Spec?

- GPU Protocol
- Battery Protocol
- Multi-touch Protocol
- Audio Protocol
  - https://github.com/RafaelRMachado/Msc_UefiHda_PreOs_Accessibility
- Fan Protocol
What is the MFG dream?

- Pxe/HTTP Boot over WiFi
  - Faster to create new manufacturing lines
  - Cheaper to create infrastructure
Questions ?
Thanks!

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References

Thanks for attending the 2019 Spring UEFI Plugfest

For more information on UEFI Forum and UEFI Specifications, visit http://www.uefi.org

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