From Server-class to IoT SoCs: Enabling System Companies to Get Back in the Chip Game

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Overview

► Makimoto’s Wave is Washing Over Us!

► A Tale of Three Markets

► How Do We Help?
Makimoto’s Wave: Standardization vs. Customization

My view: latest cycle is delayed – and different – than described
- ASSP SoCs also ruled the most recent period
- Customization wave started again with Apple A4 (2010)
- Curve is steeper than normal!
Rise of Application Specific Standard Products (ASSPs) in consumer-focused markets (mobile, TV/STB)

Complexity, costs & risks drive system companies away from SoCs

Result: extended standardization cycle

- Until 2010…
Wither ASSPs?

Our industry – and this conference – has been dominated by cellular baseband and application processor technologies since 2000

- Highest integration SoCs
- Highest volume SoCs with fast production ramps
- Huge performance and feature increases
- Substantial power/energy issues to overcome

These SoCs drove EDA and IP vendor roadmaps

- Largest design teams have biggest opportunities to improve!
- New methodologies, tools, IP and standards

But most customers have (largely) exited this space

- Too many to list
- Most shocking to me: TI
  - #1 market share in 2010
  - Announced exit in 2012
What Happened to ASSPs?

- Huge investments (up to $200 million/design)
  - 1200-person design teams
  - Millions of lines of software
- Standardization brings competition and commoditization
  - Dozens of vendors give system customers pricing control
- System value is created, but only manufacturing value realized
  - SoCs priced based on $/mm$^2$
- Attempts to expand customers/applications leads to overdesign
  - More peripherals than pins!
- How can system companies differentiate their devices?

**ASSP SoCs became a no-win business for many players**
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How Do We Help?
Market #1: Application Processors

2010
- Looking like a traditional consumer electronics business
- What can you deliver for 50 mm$^2$ (and $10-20$)?
- Apple ships A4

2011
- Apple ships A5: 2.5x larger than normal
- Much higher graphics performance
- Enables much better user experience

2012
- TI, ST exit AP market (joining others)

2014
- Apple, Samsung, Qualcomm & Mediatek dominate market
Market #2: Cellular Basestations

- Traditional approach: boards loaded with multi-core DSPs and separate MCUs
  - *High value ASSP business*
- Increased network speeds and power concerns drove higher integration
  - *Become heterogeneous multi-core SoCs, with complex memory hierarchies*
  - *Development costs escalate*
- Market begins to fragment
  - *Desire for smaller cells (micro/pico/femto)*
  - *Cannot attack all markets with same ASSP*
- ASSP players step back
- *Basestation chips are now ASIC SoCs, again!*
Market #3: Wearables

Wearables: the next billion unit opportunity (0 billion right now)

Stuck in a conundrum:

- Form factor and battery life require high integration
- … but end device requirements unclear
- … so no semiconductor company can build optimized SoCs
- I call this the requirement for “premature integration”

Only system companies are close enough to the consumer to make these economic bets!

For now:

- Rapid learning is required (what features/costs/benefits will sell)
- Targeted silicon is required (unattractive prototypes don’t work)
- Cost will be sacrificed to learn more quickly

Eventually: standardized/commoditized (of course!)
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Enabling the Next Wave of Customization

SoC ASICs will require:
- New methodologies
- New tools
- New subsystems
- … and high efficiency approaches to integration
Wearables present unique challenges:

- Form factor and battery life require high integration
- ... but end device requirements unclear
- ... so rapid prototyping essential
- ... but unattractive prototypes prevent rapid market learning

Concept:

6 weeks to attractive SoC prototypes
- Much better than FPGA or multichip

6 months to cost-optimized production SoCs
Join the Conversation: AgileIC Methodology

https://www.linkedin.com/groups/Agile-IC-Methodology-6761020
SonicsStudio® Director

- Architect’s – and integration team’s – GUI for designing SoCs
- Revolutionary – because it lets you work the way you choose

All at the same time!

- Schematics
- Tables
- Text
- Scripting

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Case Study: Wearable Processor

Is a NoC really needed for such a simple design?

Is it really so simple?

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltages</td>
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<tr>
<td>Switchable Power Domains (top level)</td>
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<tr>
<td>Initiator Ports</td>
<td>21</td>
</tr>
<tr>
<td>Memory Target Ports</td>
<td>6</td>
</tr>
</tbody>
</table>
Case Study: Original Design
Case Study: SonicsGN-based Design

Results:
34% fewer total gates
79% fewer always-on gates
Summary

- Makimoto’s Wave has crashed on us again!
- System companies are enticed/forced to design ASICs again
- Huge opportunity for all of us to help
Thank You