Example of technologies push in the embedded market

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Agenda

- The embedded market
- Synchronous languages and Scade experience between 90 and
- Abstract interpretation and Polyspace experience
- When a caramel salesman settles dentist: model based design and code verification
The software embedded market

- 260 000 developers
- Tools for the embedded market (IDE, model based design, test and verification tools): 600 M$
- RTOS: 1100 M$
- => Niche market
Design and test tools: same market

<table>
<thead>
<tr>
<th>in M€</th>
<th>OS</th>
<th>Development tools</th>
<th>Design tools</th>
<th>Test tools</th>
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<tbody>
<tr>
<td>• AED</td>
<td>91</td>
<td>154</td>
<td>49</td>
<td>60</td>
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<tr>
<td>• Telecom / DataCom</td>
<td>178</td>
<td>267</td>
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<td>74</td>
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<td>• Automotive</td>
<td>29</td>
<td>54</td>
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<td>46</td>
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<td>• Consumer Electronics</td>
<td>378</td>
<td>729</td>
<td>46</td>
<td>57</td>
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<tr>
<td>• Others</td>
<td>229</td>
<td>332</td>
<td>57</td>
<td>39</td>
</tr>
<tr>
<td>TOTAL</td>
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<td>1536</td>
<td>248</td>
<td>276</td>
</tr>
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Scade Experience

- 1990: Common project between Schneider, Aerospatiale, Verilog with the help of Verimag
- Main idea: replacement of Saga, SAO with a common tool based on Lustre Language
Scade Experience

- Needs and constraints
  - Must be compatible with Saga and SAO
  - The code generator must be DO178-B qualifiable
First customers (CSEE, SAAB, Messier Bugatti, Eurocopter) in 1996

The capability of Verilog investment between 1995-1999 was very low

After 2000, thanks to Esterel Technologies, it was a new story
In 1996, Alain Deutsch develops the IABC prototype.

Alain used the prototype for the Ariane 5 software.

EADS Launcher, CNES support the idea of a product based on this technology.

INRIA Transfert, I-Source, RAC and Trinova was present at the first round table.
Company Profile

- Established in 99
- 5,5 M€ Revenues in 2005
- 40% automotive, 35%AED, 15% consumer electronic
- ≈ 2000 licences used on ≈ 300 industrial projects
- Users in 18 countries
PolySpace Solution

Color-coded Source Code

Green
- Safe

Grey
- Dead Code

Red
- Bug

Orange
- Warning
Model based design and verification tools

- **Facts:**
  - C, C++ or Ada Hand-writing code is present in the models
  - The semantic of arithmetic operations (for example) is based on the target language semantic
  - Run time errors occur
Node `counter () returns (count : integer, pan : bool);`

```plaintext
let
count = 0->pre(count)+1;
pan = (count = 3)
tel;
```

---

Plagiarism: the Counter Node

*Vite, il n’y a pas un instant à perdre!...*

*Un...*

*Deux...*

*Et trois!...*
And the nightmare begins

- Location of the runtime error in the C(or C++) code
- Location at the model level
Static analysis with model based design approach

- Usage of Polyspace on code generated by scade:
  - The quality of analysis depends on the code generation option
  - Nuclear plant application with the option –blockexp: 93% of selectivity, 1200 oranges for 35,000 lines of code
  - Avionic application with the opt –noexp: 600 oranges for 7000 lines of code
Static analysis with model based design approach

- Usage of Polyspace on code generated around Mathworks model:
  - The quality of analysis depends on the code generation option
  - Selectivity is better than scade generated code: 50 oranges for 10,000 lines of code (targetlink application)
- Feedback on the model: specific Polyspace tools
PolySpace addresses this new need by launching a new offer: PolySpace for model-based design.
Conclusion

- Model based design and verification tools:
  - Analysis of the code with model informations: Use of specific algorithms well suited (Example Astree)
  - Code generated specifically for analysis purpose (Misra code for example)
Conclusion

- Scade and Polyspace success factors:
  - Existence of motivated industrial partners
  - First class technologies with a real breakthrough
  - Significant money investments
A large part of my professional life is dedicated to technology transfer.

This choice was influenced by Paul’s attitude on industrial problems.
But the main Paul’s result is:
- Computation of the optimized launch of table tennis ball during the service
- Two days of work:
- 1 Meter is the best