Light Weight Architecture revisited: the way of the future?

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Abstract

Technological developments change the consumer electronics market into a very dynamic market. CE manufacturers are used to realize product innovation by means of standardization, inside products as well as between products. Standardization and innovation are often conflicting activities. An approach is discussed to optimize the balance, based on ”light-weight architectures”.

The weight of an architecture determines how easy an architecture can be realized, changed and applied. An heavy architecture has many mandatory rules, which apply always and everywhere, with a large degree of detail. An heavy architecture provides a lot of certainties and control, but is more difficult to adapt to changing circumstances.
What is Architecture?

Understanding Why
Describing What
Guiding How

Do the right things

Do the things right
1. Do the right things; The Dynamic Market

Understanding
Why

Describing
What

Guiding
How

2. Do the things right; Light-weight Architecture

On/Off

25 Kg

This appliance may only be used for non commercial use
accuracy +/- 200 g
Part 1:
Do the right things;
The Dynamic Market
Value chain
Convergence

Telecom

Consumer

Computer

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Uncertainty (Dot.Com effect)

source: BigChart.com
dd march 19, 2001

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version: 0.0
September 9, 2018
LWAdotcom
Moore’s law

From: COPA tutorial, Rob van Ommering
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LWAproblemSpaceBusiness
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LWAsystemProfile
Semiconductors Technology solutions

Operations/s

10^12

home server

digital TV

10^9

GSM

10^6

performance

Watt

10^3

10^{-3}

digital TV

home server

GSM

motion detector

MIPS

TriMedia

Motion detector

GSM

10^9

digital TV

GSM

10^9

10^6

power

TCP/IP

pSOS

1394

MP3

Real

WAP

Bluetooth

GSM

GSM

USB

GSM

RF amp

802.11

TriMedia

MIPS

ARM

WinCE

MP3

GSM

RF amp

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LWA solution Space Technology

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## Partial Solution: Configurable Component Platform

<table>
<thead>
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<th>Technologies</th>
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<th>TriMedia</th>
<th>MPEG decoder</th>
<th>ARM</th>
<th>Real</th>
<th>GSM</th>
<th>RF amp</th>
<th>Bluetooth</th>
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</tbody>
</table>

● required
○ optional

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Exploring problem space and solution ingredients

Programmability, flexibility

Increase supplier content

Competitive Performance / cost / power

Solution ingredients

Configurability

Family of products

Composable Architecture

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LWAfromStakeholderToQualities
Architecture only works if the complementary viewpoints are addressed consistently.
Conclusions Part 1

Understanding
Why
dynamic market convergence integration diversity

Describing
What
configurable component platform portfolio and family architecture

Guiding
How

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LWA2conclusionsPart1
Part 2:
Do the things right: light-weight architecture; Architectural Chaos or Bureaucratic Control?
Architecture Weight

weight(architecture) = \sum_{all \ rules} weight(rule)

weight (rule) = f (level of enforcement, scope (impact), size, level of coupling or number of dependencies)

| guideline | conditional rule | mandatory rule |
| component | product | portfolio |
| single-line | multi-line | multi-page |
| stand-alone | builds on many rules |

- low weight
- high
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Criterions for an Architecture

- **Customer**
  - being informed
  - functionality
  - performance
  - timely available
  - acceptable cost

- **Open**
- **Solution Freedom**
  - implementation
  - decoupling
  - solution freedom

- **Suppliers**
- **Feedback Responsiveness**

- **Architectures**
  - Business manager
    - bottomline
    - future growth

- **Evolution**
  - guidance
  - understandability
  - accessibility
  - product feasibility

- **Engineers**

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Weight versus Effectiveness

For dynamic markets and fast changing technologies:

- **Manageability**
  - Integration
  - Interoperability
  - Providing control

- **Flexibility**
  - Evolution
  - Responsiveness
  - Maintenance

The diagram illustrates the relationship between architecture weight and effectiveness. It shows that as architecture weight increases, manageability improves, while flexibility decreases. This suggests that for dynamic markets and fast changing technologies, light weight architectures may be more suitable.
Conclusion Part 2

Effectiveness

architecture

weight

(for dynamic markets and fast changing technologies)

very low

low

medium

high

overall effectiveness = Flexibility * Manageability

Manageability

Flexibility

Effectiveness

very low low medium high

= Flexibility * Manageability

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LWAeffectiveness
Light Weight How- To

weight(architecture) = \sum_{\text{all rules}} \text{weight}(\text{rule})

1. Reduce the rule set to the (business) essential

Understand
- your customer
- your customer's customer
- etcetera

2. Minimize the weight per rule
Minimize Rule Weight

weight(rule) =

\[ f(\text{level of enforcement}, \text{scope (impact)}, \text{size}, \text{level of coupling or number of dependencies}) \]

- minimize number of mandatory rules
- empower, delegate
- minimize implementation details
- focus on essential concepts
- Apply design principles on architecture
- Multi-view architecting
1. Reduce the rule set to the (business) essential

Every processor will be:

- ARM 9
- ARM 922T
- ISA compatible
- able to run VxWorks
- OS compatible
- no constraint

by the way, is this rule essential?

minimize implementation details

focus on essential concepts
Scope example

**scope** (impact), empower, delegate

use ARM ISA compatible processor for:

- heavy: all programmable functionality
- medium: all programmable control
- light: SW control > 10 kloc
- no constraint
Example product scope of rules

and what about OS:
PalmOS, Symbian, WindowsCE, Linux, VxWorks, dedicated kernel, ...

and what about programming language, storage, network, power, protocols, formats, user interface, ...
1. Dynamic Market: Understand Your Customer

2. Optimal architecture: