Embedded Software in Digital Consumer Electronics
Past Innovation and Today’s Requirements

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Panasonic Corporation
Today’s Topics

- Embedded Software Development to Date
- Platform-Based Development Approach
- New Leader’s Role in Embedded Development
- Summing Up
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The Fast-Growing Digital Consumer Electronics Market

DTV, DVD/BD, and DSC continue rapid growth

Annual Sales (millions of units)

- DTV
- DSC
- DVD/BD

Compiled from reports by JEITA, CIPA, IDC, and Gartner
Expanding Role of Embedded Software in Digital Consumer Electronics

Digitalization causes development costs (especially software costs) to be raised up.

Relative development costs (TV)

- Analog design
- Chip design
- Software design

Product: Analog TV (4:3), Wide TV (16:9), Digital TV

- Analog: 90% (Analog), 5% (Chip), 5% (SW)
- Wide TV: 50% (Analog), 40% (Chip), 10% (SW)
- Digital TV: 10% (Analog), 30% (Chip), 60% (SW)

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Japan’s Growing Embedded Software Industry

**Embedded software development cost:** 3.3 trillion yen, ½ of product development costs

Data: 2007 IPA survey

Embedded software is key to superiority of Japan’s manufacturing industry

**Graph:**

- **Embedded product dev. (tril. yen)**
- **Embedded software dev. (tril. yen)**
- **Embedded software share of product development costs**

<table>
<thead>
<tr>
<th>Year</th>
<th>Embedded Product Dev. (tril. yen)</th>
<th>Embedded Software Dev. (tril. yen)</th>
<th>Embedded Software Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>5.72 tril.</td>
<td>2.07 tril.</td>
<td>36.3%</td>
</tr>
<tr>
<td>2005</td>
<td>5.94 tril.</td>
<td>2.41 tril.</td>
<td>40.6%</td>
</tr>
<tr>
<td>2006</td>
<td>6.75 tril.</td>
<td>2.73 tril.</td>
<td>40.4%</td>
</tr>
<tr>
<td>2007</td>
<td>7.77 tril.</td>
<td>3.27 tril.</td>
<td>46.2%</td>
</tr>
</tbody>
</table>

Data: 2007 IPA survey

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Changes Occurring in the 1990s

The digital network revolution

- Switch from analog to digital products
- Standardization lowers barriers to participation
- IT revolutionizes management

Competition on 3 fronts
- Development explosion
- Shorter product cycle
- Rapid drop in prices

In these past 10 years the world of embedded software for digital consumer electronics has become extraordinary competitive.
Embedded Software is Responsible for Time to Market

- **Overcoming with the explosion in development volume**
  
  Software development management innovation should be required.

- **Software development determines the delivery date**
  
  Software becomes main factors and issues among hardware, mechanism, and service.

- **Rapidly emerging new services and business models are accelerating the drop in product prices**
  
  New business models on the Internet are software driven.

- **It is time for embedded software development leaders to show their skills**
The strength of an embedded software engineer
Ability to understand and analyze other software architectures and redesign a new architecture

The aims of an embedded software development leader
Not a leader in development only, but becoming a leader who is able to analyze business strategy and create and/or modify a new architecture for the business strategy

Rapidly emerging new business models are accelerating product competition, resulting in a sharp drop in product prices
Is there an architect who can map the strategy and architectures to new business models?

How is the leader’s role in embedded software development changing?
Three Types “Embedded Software Development Leaders”

1st Stage: Digitally controlled appliances—from 1976 (20 years)
“Project Manager”

2nd Stage: Digital AV—from 1996 (10 years)
“Platform Architect”

3rd Stage: Network appliances—from 2006 (? years)
“??”
Role of Embedded Software Development Leader (1)

1st Stage: Digitally controlled appliances—from 1976

Products
- Home appliances: microwaves, washing machines, refrigerators
- AV/office machines: electronic organs, VCRs, CRT TVs

Leader’s role = project manager

- Design for quality and safety
- Mechanical device control by Software e.g.: neuro control, fuzzy control
- Manager who understands hardware and software
- Create and Observe process approach for software development

Project management

CMM
Role of Embedded Software Development Leader (2)

2nd Stage: Digital AV—from 1996

Products
AV equipment: digital TV, DVD, BD
Communications: fixed cordless phone, cell phone

Leader’s role = **platform architect**

- Must meet delivery deadlines
- Speed up total line up products development
- Selection of platforms and modification for global products
- Global forum **standards compliance**
- Budget management

Requirements

Understanding of each product market
Platform-based development management
CMMI
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Software Platform approach for reducing Development Cost

- Explosion in scale of software for each product
  - Reuse software parts to reduce development volume

- Explosion in software development for many variety of products
  - Use common software assets to optimize overall development

- Increase in features crossing over product categories
  - Share software assets across product categories

Platform-Based Development
Total optimization platform breaking walls between product areas
Better development efficiency and design quality from sharing assets and value across product groups
→ Enhance customer value creation on technology (lateral) value chain

Share technology, assets

Cell phones
Platform A

Personal AV
Platform B

Car AV
Platform C

Home AV
Platform D

Home Safety
Platform E

Create new value by porting features across product categories

Cell phones

Communication, network

Personal AV
Camera, SD, 1-seg DTV

Car AV
SD

Home AV
DVD, DTV

Home Safety

Integrated platform UniPhier®
“System on Chip” Aggregating Technology

Panasonic technology integrated on single chips

Common hardware architecture across product areas (3 implementations)

High-def AV
- High-efficiency CODEC technology

Low power use
- System and chip expertise

Real time
- Optimal distributed processing by CPU and media processor

Secure
- Hardware and software-based flexible, robust, secure framework

UniPhier® processor

Basic structure of UniPhier SoC

Deployed on optimized SoC

UniPhierM
- Mobile SoC

UniPhierP
- SoC for personal AV

UniPhierH
- SoC for car/home AV

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Panasonic’s Software Platform

Linux for home electronics field developed as *UniPhier®* software base
Common use of middleware across product areas

Total of 41 series, 127 models (as of July 2008)

Uniform software architecture

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DTV application | Personal AV application | Car AV application | Home AV application | Home safety application

Middleware | Middleware | Middleware | Middleware | Middleware

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Linux embedded OS

Device driver | Device driver | Device driver | Device driver | Device driver
Software Categories

The UniPhier software platform is divided into the four categories below.

- **Original Software**
  - e.g., GUI, drivers

- **License Software**
  - e.g., BD-J

- **Licensed Software**
  - e.g., Browser

- **Open Source Software**
  - e.g., Linux (kernel, glibc)

The category adopted for each software module depends on each company’s business model.
A Platform Architect is a Leader of CE Products

Build necessary platform for efficient product strategy
→ Development leader who understands hardware, software, mechanism
Software development leader increasingly becoming overall leader

Product Strategy
Consider platform for implementing strategy

Platform Architect

Management
Present requirements

Technology
Build platform

Platform
Hardware Software Mechanism Design

Organization methodology (DPIM, etc.)

Development methodology (CMM, etc.)
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Issues Faced

The answer = global business strategy

- Are global standards and national standards adopted?
- Are the specifications met with country’s market needs?

- Are the country’s environmental regulations being met?
- What steps are being taken to reduce power consumption?

- Is open source being utilized?
- What software parts are being sourced from other companies?

- Is there a failsafe design based on the country’s regulation?
- What consideration is made for product lifetime?

The ecology

- Are the country’s environmental regulations being met?
- What steps are being taken to reduce power consumption?
Role of Today’s Embedded Software Development Leader

3rd Stage: Promote development of network appliances—from 2006

Understand and promote global business strategy as solution to issues faced

Leader’s role = System architect guided by global business strategy

Software strategy based on digital consumer electronics business strategy

Requirement

- Stick to global deadlines and budget

- Global business strategy
- Alliances
- Networking
- The environment
- Design for safety and quality
System Architect Guided by Global Business Strategy

Understanding both management and technology
- Responsible for technology, also for proposing good design strategy to management

Global Business Strategy

Product Strategy

Cost Profit Time Quality Environment

System architect guided by global business strategy

Management
Present requirements
Technology
Understand

Propose
Build platform
Example: Global Marketing of DTV

- Products for each country based on global DTV platform
- Assisting and following Local Standardization based on global DTV standard are required

Support local standardization based on global standards, and build products accordingly

- Ability to plan and develop market-specific products
- Sales organization suited to regional characteristics

Insist on developing optimal products for each country
DTV Platform with Country-Specific Models

(1) Create a platform

UniPhier Platform

<table>
<thead>
<tr>
<th>Devices</th>
<th>Software: Screen display</th>
<th>Software: Audio control</th>
<th>Software: Video control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEAKS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(2) Deploy as country-specific models

<table>
<thead>
<tr>
<th>Devices</th>
<th>Country</th>
<th>Region</th>
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<tbody>
<tr>
<td>2006</td>
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<td>✔</td>
</tr>
<tr>
<td>2008</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>2009</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

From global standards

To national standards

Module

Software: PEAKS

Devices: Screen display

Devices: Audio control

Devices: Video control

Country:

Region:

Europe

Asia

South America

Other

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Four Standpoints both on Management and on Technology

Profit and cost
Invest in developing software that can be concentrated on aspects that deliver value

Time
Achieve efficient software development to win out in increasingly fierce short-term competition

Quality
Establish assurance, safety, high quality, high security

Ecology
Be sure to achieve energy-saving performance, in compliance with regional standards
Networking and Environment: Energy Saving Plus Convenience

- Pursuit of convenience based on energy-saving foundation

Convenience
- Communication
- Internet service
- Proximity network
- Storage

Energy saving
- HEMS (Home Energy Management System)

Optimal energy-saving model
- Society-based energy system

- (1) Personal storage keeping mementos
- (2) Convenience of personalized content
- (3) Common portal
- (4) SNS, community
- (5) Visualization of energy use
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- Establishment of platform architect
- Adoption of software development methodologies that ensure continual process reform
- Fostering embedded software development leaders that can talk in terms of management indicators
- Ability to propose solutions to new issues such as global business strategy and environmental matters

It becomes very important to boost development strength and engineer’s leadership.

*The key is how to create and train new leaders for a new era who can efficiently bring software innovation.*
Thanks for your kind attention.