Abstract
Technological developments, such as miniaturization and convergence have a strong impact on the form, function and content of consumer appliances. The appliance makers are struggling with the consequences, especially with the exponential increasing SW effort.

The trends and the impact on consumer appliances are discussed. Then the software effort problem is analyzed and solution directions for the SW productivity problems are explored.
Value chain

Providers
- UPC
- Canal+
- AOL
- AT&T

Retailers
- Fry's
- Dixon

Consumers
- Boonstra
- Peper
- Kok
- Chirac
- Blair
- Pietersen
- Smith
- Jones
- Muller
- Kleisterlee
- v.d. Spijker
- Jansen
- Muller
- Goedkoop

System Integrators
- Sony
- Nokia
- Philips CE-DN
- Philips CE-TV
- Loewe

Component and Platform Suppliers
- Philips Components
- Philips Semiconductors
- ST
- LG
- TI
- Samsung
- Intel
- Microsoft
- Micron
- Liberate
- Samsung

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Convergence

Telecom

Consumer

Computer

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LWAconvergence
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LWAIntegrationAndDiversity

Integration and Diversity

- GSM phone
- firewall
- dvd
- audio microset
- pda
- watch
- sailboat
- surveillance camera
- cable modem
- set top box
- headphone
- pen
- garment
- car
- speech
- mp3
- television
- Communicator
- Ambient Intelligence living room
- car navigation
- computer
- games
- flat display
- television
- games
- flat display
- Communicator
Uncertainty (Dot.Com effect)

AOL

Amazon.com

source: BigChart.com
dd march 19, 2001


source: BigChart.com
dd march 19, 2001
Moore’s law

From: COPA tutorial, Rob van Ommering

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LWAmooreslawRvO
System Integrator Problem Space - Business

- Time to market
- Volume
- Effort

- Infrastructure
- Application
- Personalized (skins, themes)
- Digital TV
- GSM

- Months: 10^1 to 10^2
- Units: 10^3 to 10^6
- Manyear: 10^2 to 10^3

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LWAproblemSpaceBusiness
Problem: increasing SW size, decreasing reliability?

![Graph showing the relationship between software size and typical amount of errors per product over years.](image-url)
Manage large PCP teams of > 1000 people

or

Significantly increase SW productivity

from: Ad Huijser
Philips Software Conference 2001
System profile

Problem space

- months
- units
- manyear
- Operations/s
- Watt
- Byte

- time to market
- volume
- effort
- performance
- power
- storage

- infrastructure
- digital TV
- home server
- personalized (skins, themes)
- performance
- storage

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LWAsystemProfile
PS Technology solutions

Operations/s

Watt

10^{12}

10^9

10^6

gsm

Digital TV

Home server

Motion detector

MIPS

TriMedia

WinCE

ARM

Real

GSM

GPS

USB

RF amp

10^{3}

TCP/IP

pSOS

1394

MP3

WAP

Bluetooth

802.11

802.11

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### Partial Solution: Configurable Component Platform

<table>
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<tr>
<th>Technologies</th>
<th>MIPS</th>
<th>TriMedia</th>
<th>MPEG decoder</th>
<th>ARM</th>
<th>Real</th>
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<th>RF</th>
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- **●** required
- **○** optional

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LWAsystemTechnologyMap
Exploring problem space and solution ingredients

Programmability, flexibility
Increase supplier content
Competitive Performance / cost / power

Solution ingredients
Configurability

Composable Architecture
Family of products

Problem space

Programmability, flexibility

Increase supplier content
Competitive Performance / cost / power

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The Holy Grail: Reuse

**Graph:**
- **Y-axis:** REUSE
- **X-axis:** Time
- **Curves:**
  - **Promise:** Blue line curving upwards
  - **Reality:** Red line curving downwards

**Legend:**
- 

---

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ARtheHolyGrail
"Guiding How" by providing rules for:

1. **Functional Decomposition**

2. **Construction Decomposition**

3. **Allocation**

4. **Infrastructure**

5. **Choice of integrating concepts**

- **Resource usage**
- **Performance**
- **Exception handling**
- **Device abstraction**
- **Pipeline**
Evolution of functionality

customer specific

domain specific applications

domain specific infrastructure

generic infrastructure

year x

year x+2

year x+4

consolidation standardization

enabling, supporting

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SWPinfrastructureEvolution
Existing SW stacks

- DVP
- MHP
- STB
- TV
- VCR
- DVD
- GSM
- 3G
- Bluetooth
- Wireless LAN
- 1394

Customer specific
Domain specific applications
Domain specific infrastructure
Generic infrastructure
But there are much more

- car infotainment
- games
- mediascreen
  - PDA
  - webpad
- PC's
  - modem cable, ADSL, ...
  - firewall
  - residential gateway
  - homeserver
- audio
  - MP3, ...
  - CD, SACD, DVD, ...
- radio
  - jukebox, HD, ...
- security
  - home control
    - webcam
    - videocam
    - photocam
Simplistic Architecting: Digital TV

analog TV  
Set top box  
Digital TV

Digital Video Platform SW

Digital Video Platform SW

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ARdigitalTelevisionSimplisticArchitecture
Available Code Assets

<table>
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"Legacy" code > 500 Myr
Merge problems

Architectural mismatch:
wrappers, translators, conflicting controls

Additional code and complexity,
no added value

Poor performance;
additional resource usage

Problems

Architecture

Reuse

non problem

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ARmergeProblems
Ideal homogeneous situation?

long term dream

Reference Architecture + Sample implementation of Framework and Components

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SWPhomogeneousDream
Today’s reality?

huge amount of glue
Achievable solution?

- internal efficiency: fine grain components
- framework specialization
- guidelines for integrating concept
- reference decomposition/allocation
- interface, format, protocol standards
- prototyping, development environments

Enable components "in the large" nuggets
Software productivity research goals

define vary
create integrate
test maintain
to products faster with less effort

methods tools integration technology component technology
... SW technology standardization partnering strategy
?

and/or
to achieve better faster more functional more reliable safer ...

by means of products
Coarse research plan

- **2001**: learn
  - scope
  - hardware domain
  - application domain
  - customers
  - SW technologies
  - current solutions

- **2002**: explore solutions
  - identify solutions

- **2003**: roadmap, strategic choices

- **2004**: transfer
  - build
  - analyze
  - measure
  - test

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SWPcoarseResearchPlan