Driving the SoC development for digital consumer electronics

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- **Digital consumer electronics and SoC**
- **Architecture design**
- **Mixed signal technology**
- **Global development management**

Digital consumer electronics and SoC

Exciting Multimedia world with SoC!

The new consumer electronics era has been emerged.
The key technologies are digital multimedia and System on a Chip.

Broadcasting Communication Network

Storage Media

Anywhere

Audio and Video

Better Look
Better Sound
Higher Quality

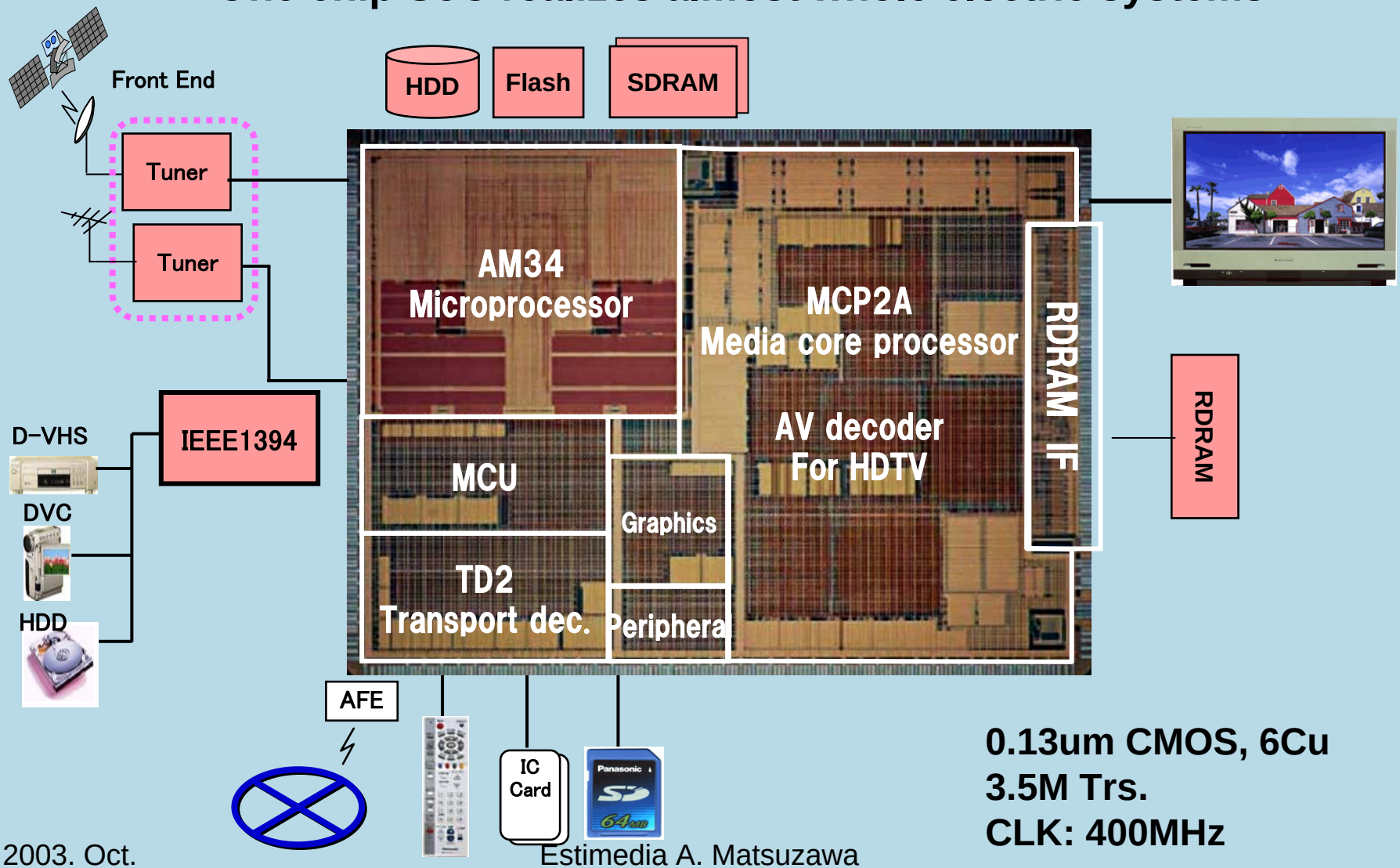
Anytime

Semiconductor Technology

System and Software Technologies

System configuration of Digital high-definition TV

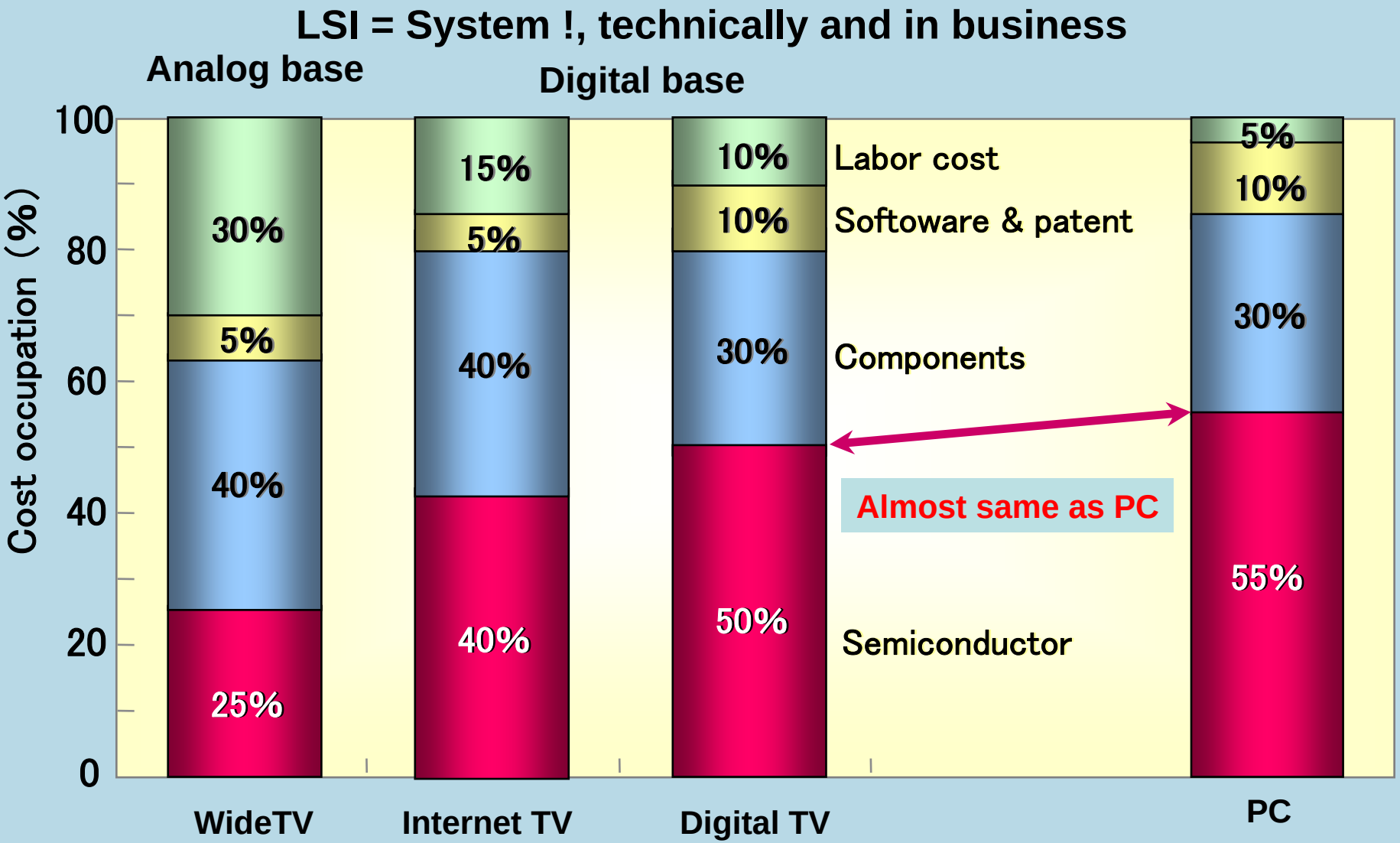
One chip SoC realizes almost whole electric systems



0.13um CMOS, 6Cu
3.5M Trs.
CLK: 400MHz

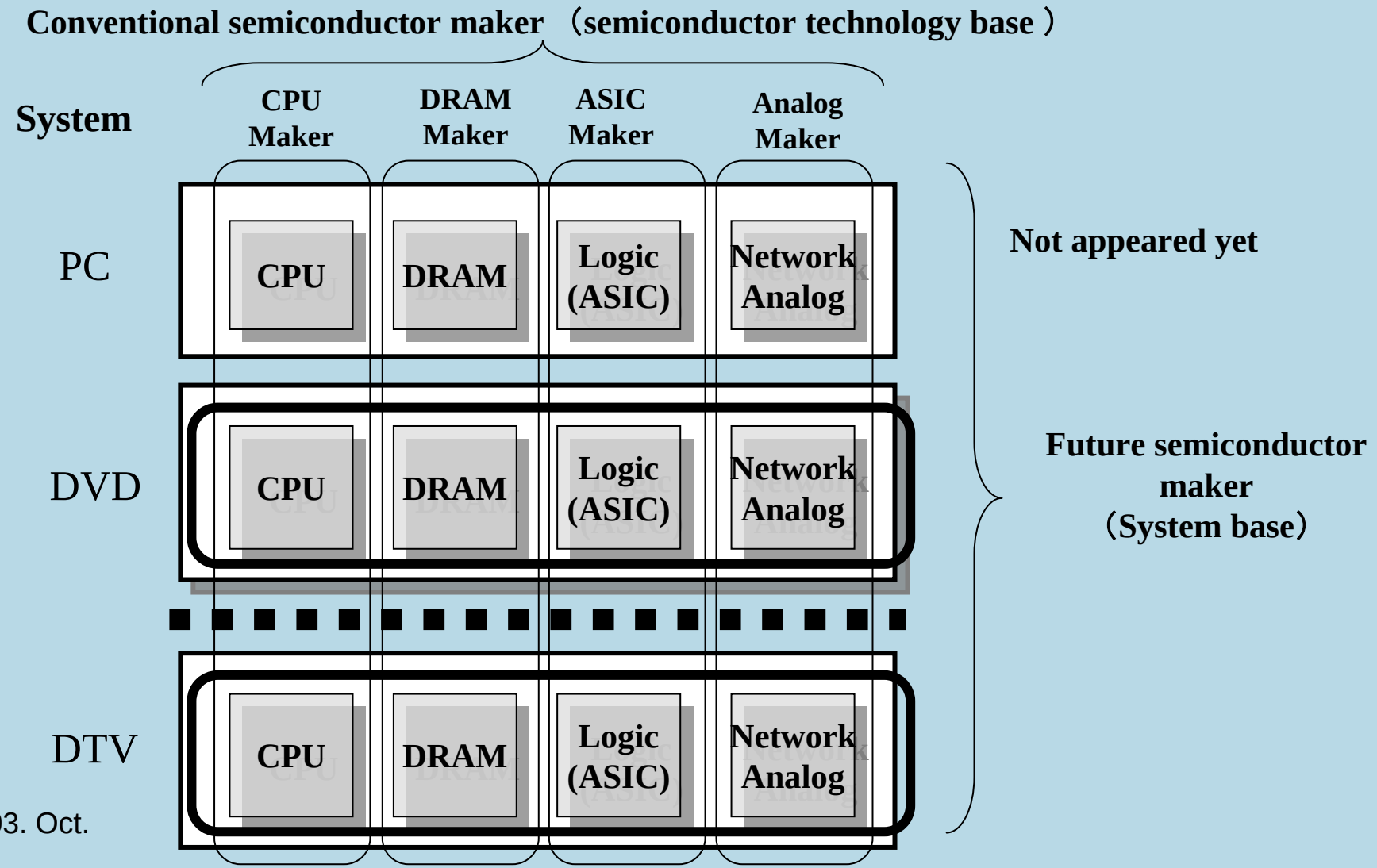
SD Memory card

Impact of digital tech. on consumer business



New semiconductor business scheme

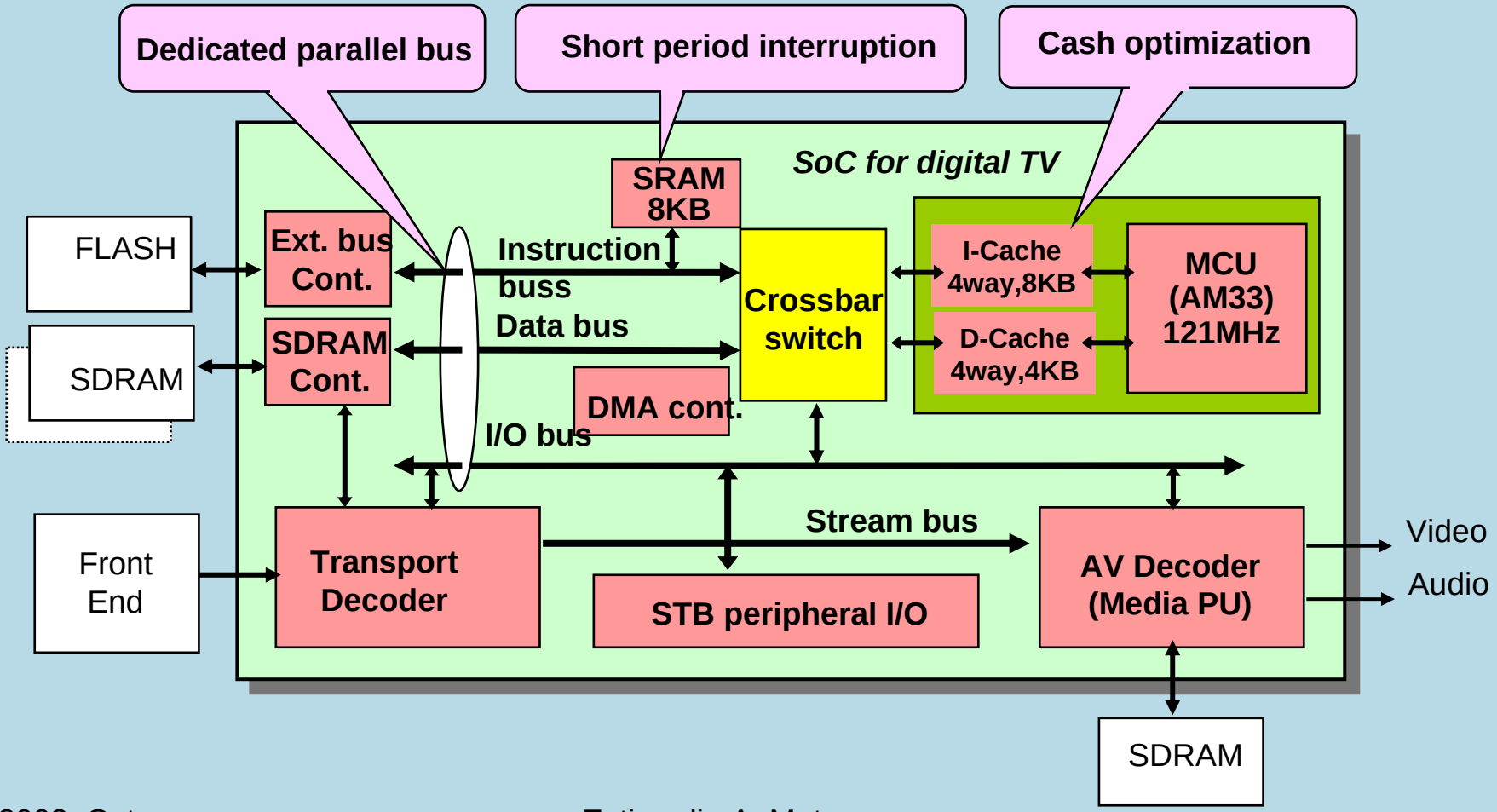
SoC will reform the semiconductor business scheme from vertical to horizontal.



Architecture design

Architecture design

The architecture optimization based on a system analysis is a key.

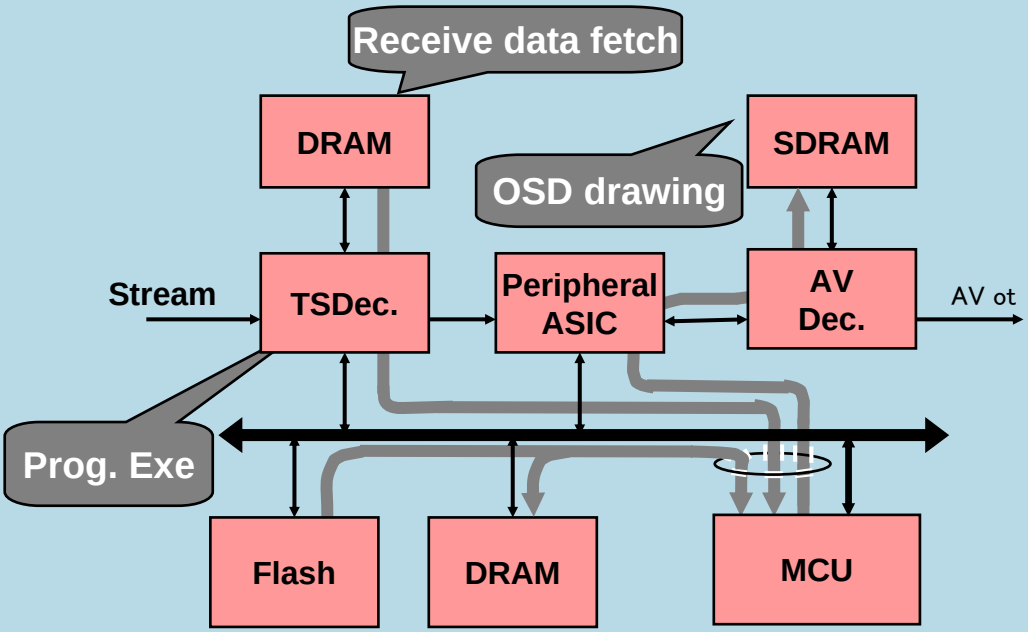


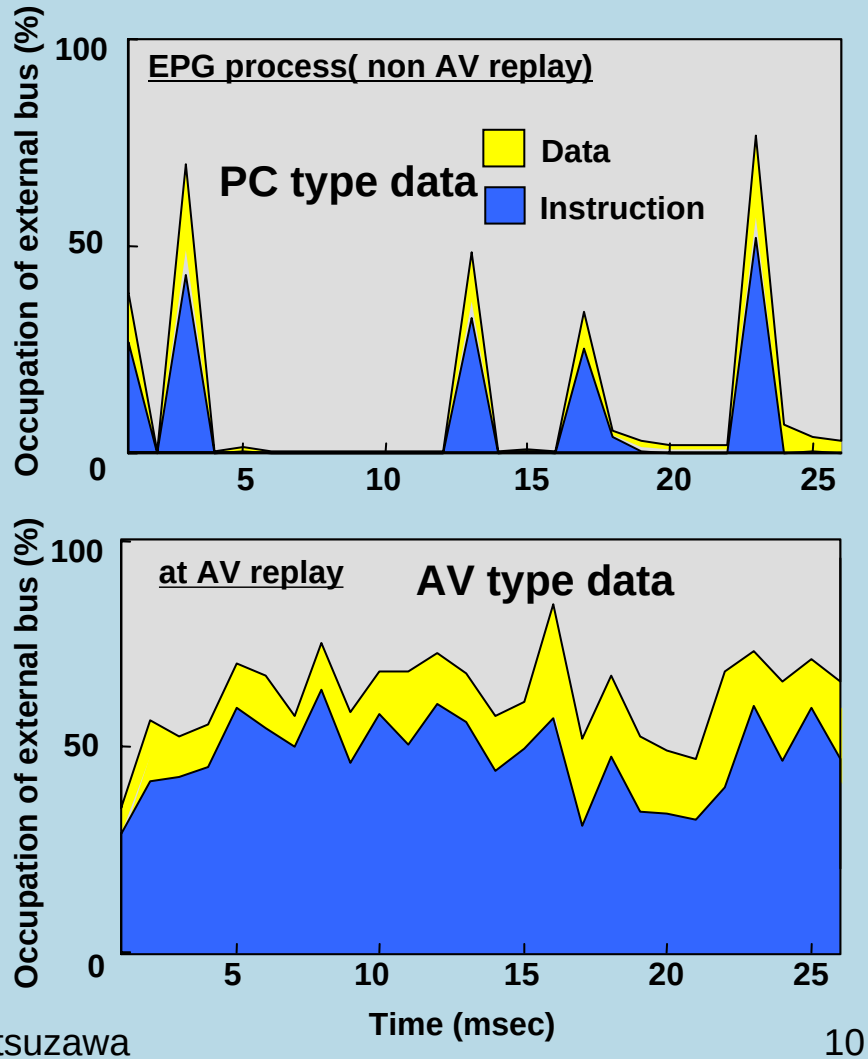
System analysis 1: External bus

Bus occupation increases at AV replay

Conventional PC bus can't be used

New bus architecture is needed

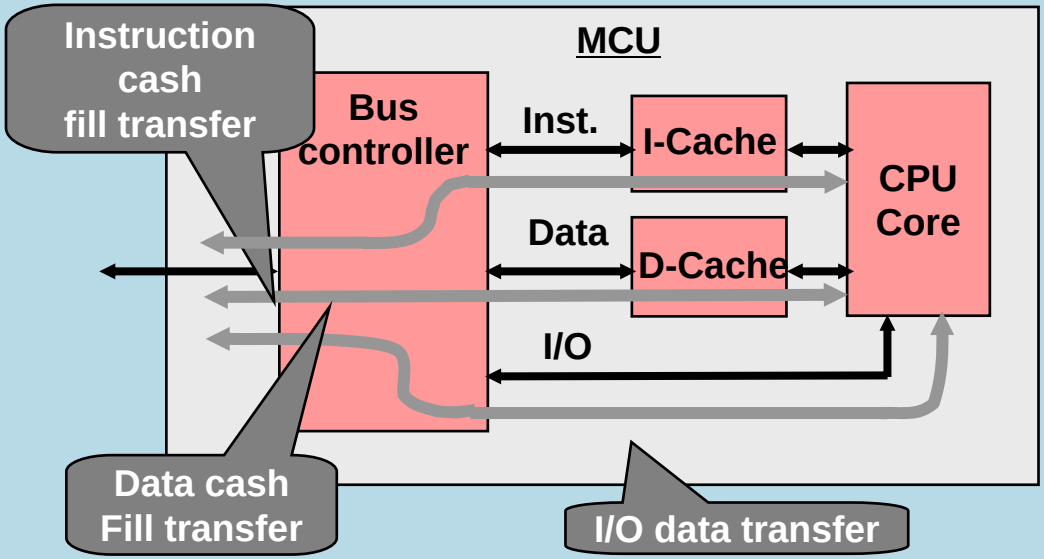




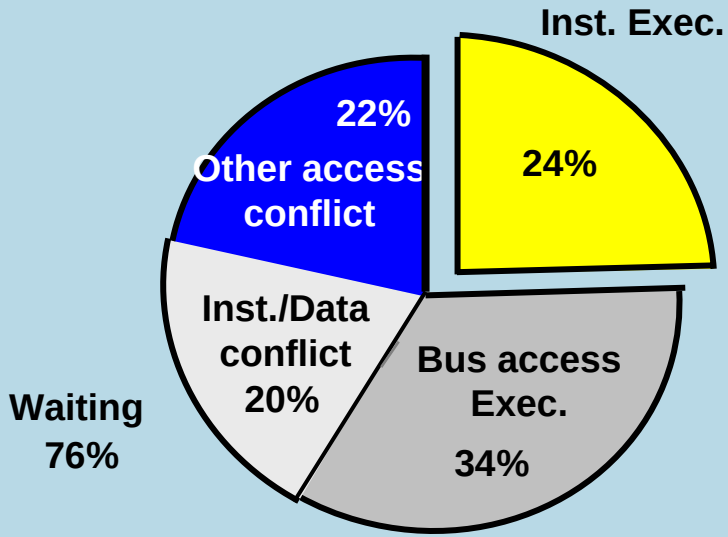
System analysis 2: Internal bus

Instruction execution is only 1/4

Many conflicts between data and instructions



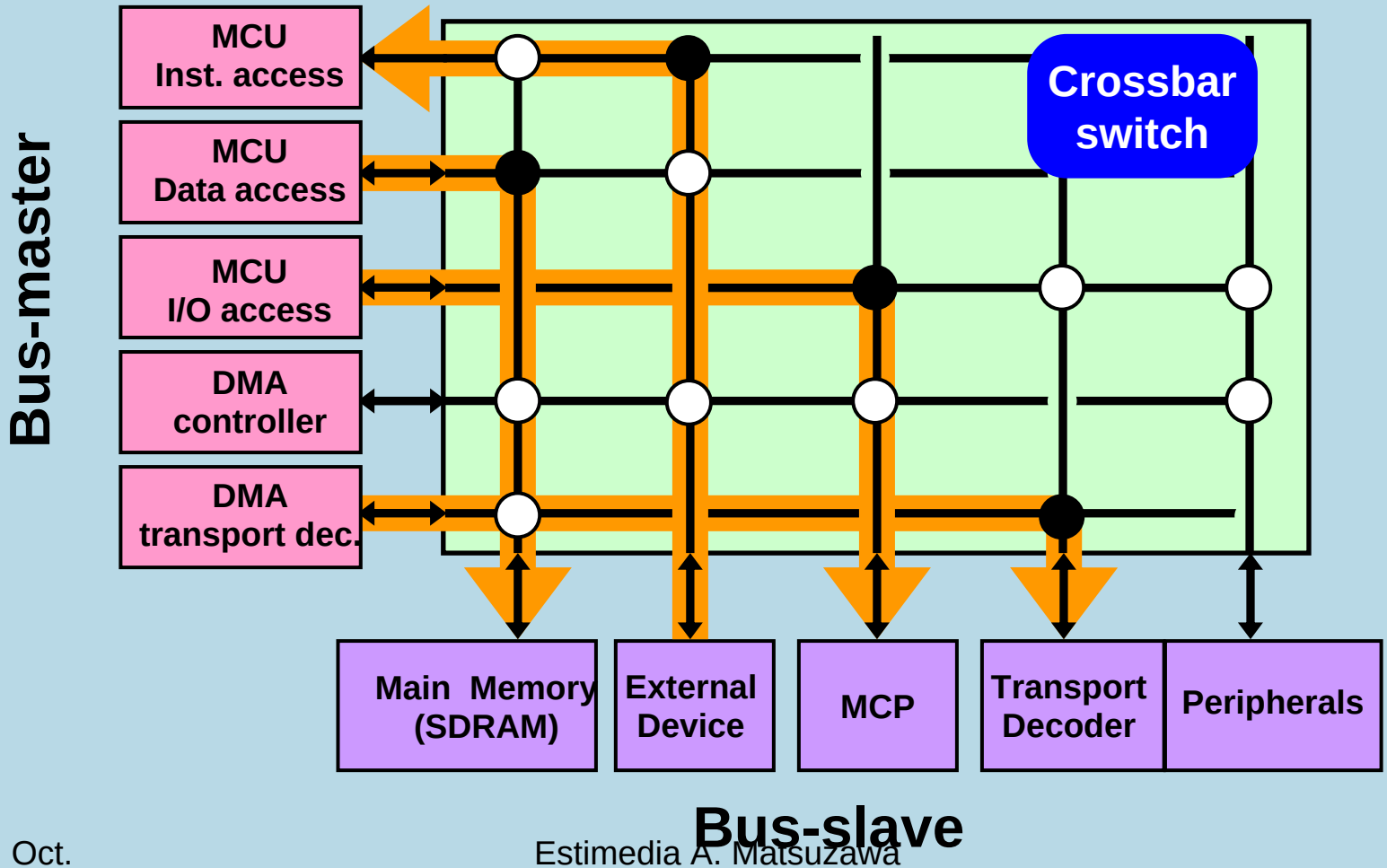
Access conflicts



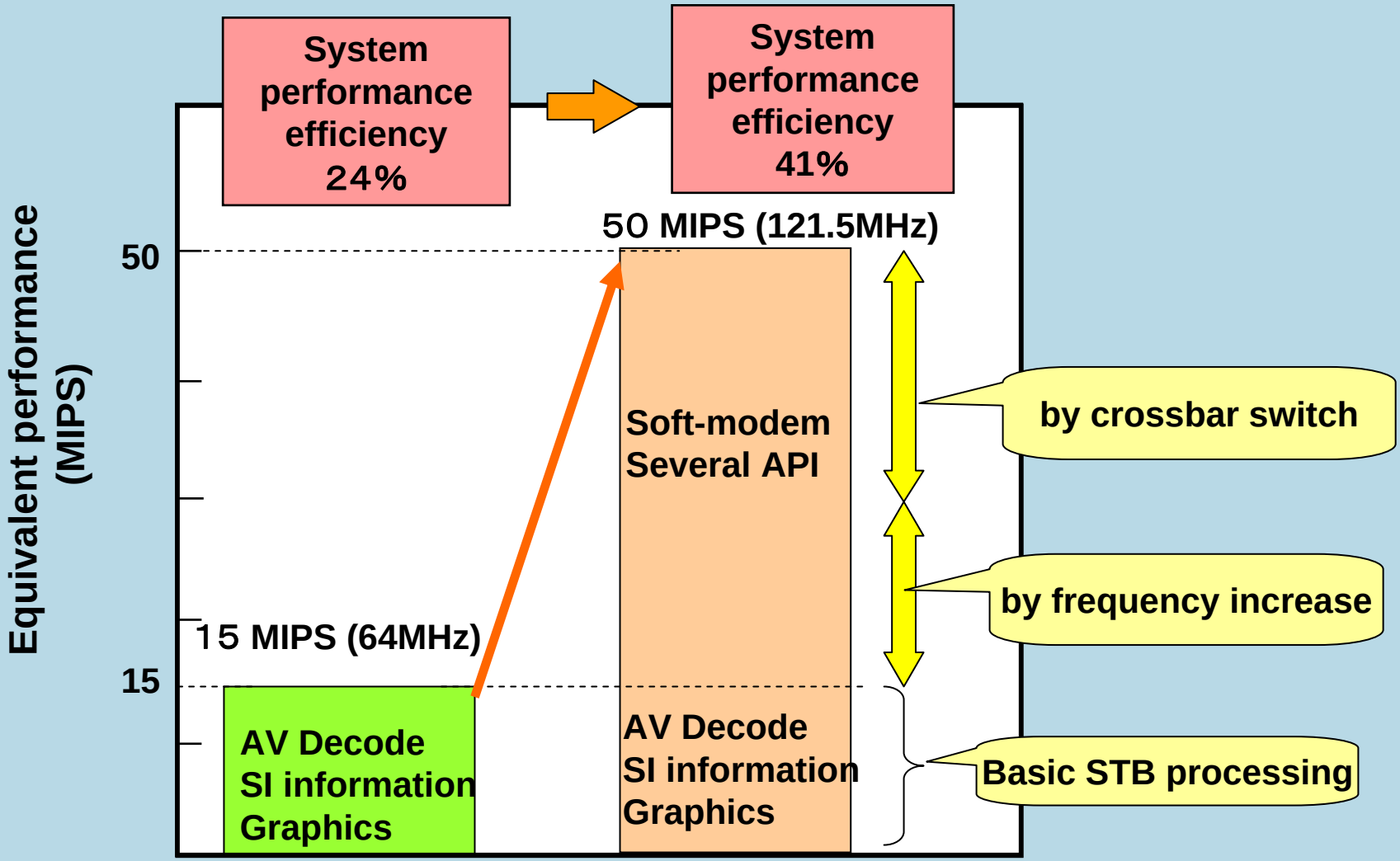
Internal status in MCU

Solution: Crossbar switch

Bus-master can access to bus slave in each, independently

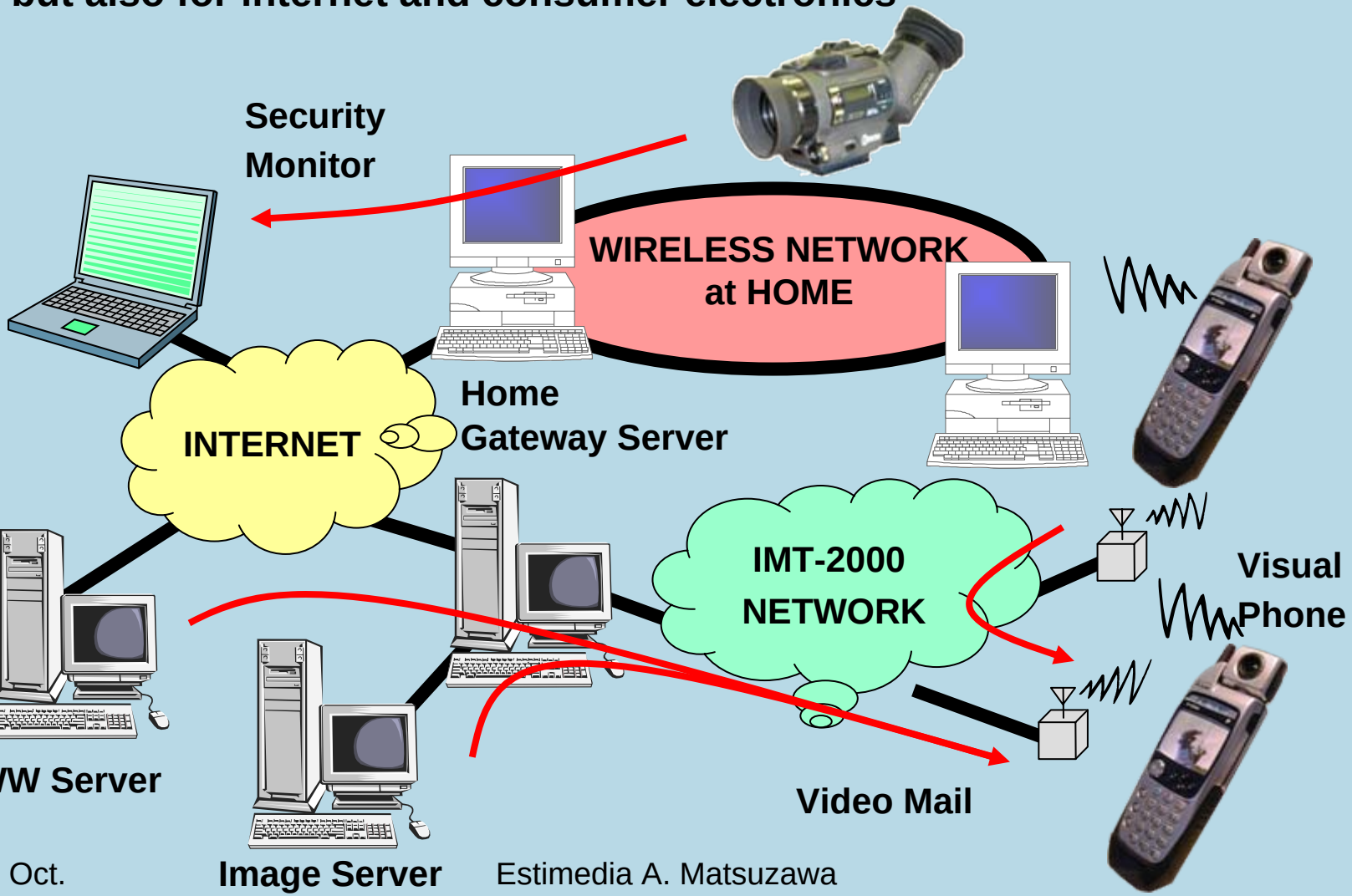


Performance improvement



MPEG4 World

The MPEG4 technology are going to be used not only for a cellular phone, but also for internet and consumer electronics

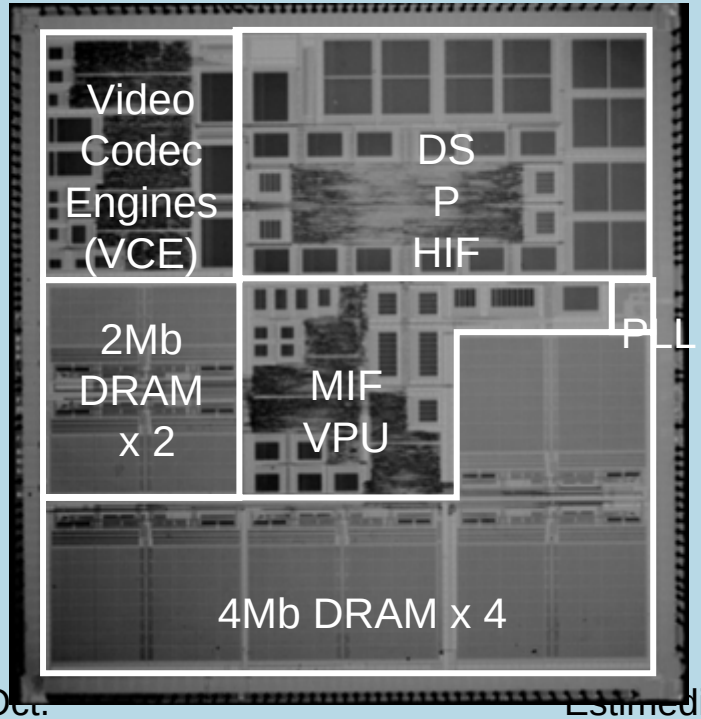


MPEG4 Codec and decoder

MPEG4 Codec

0.18um e-DRAM
31M Tr
90 mW@54MHz

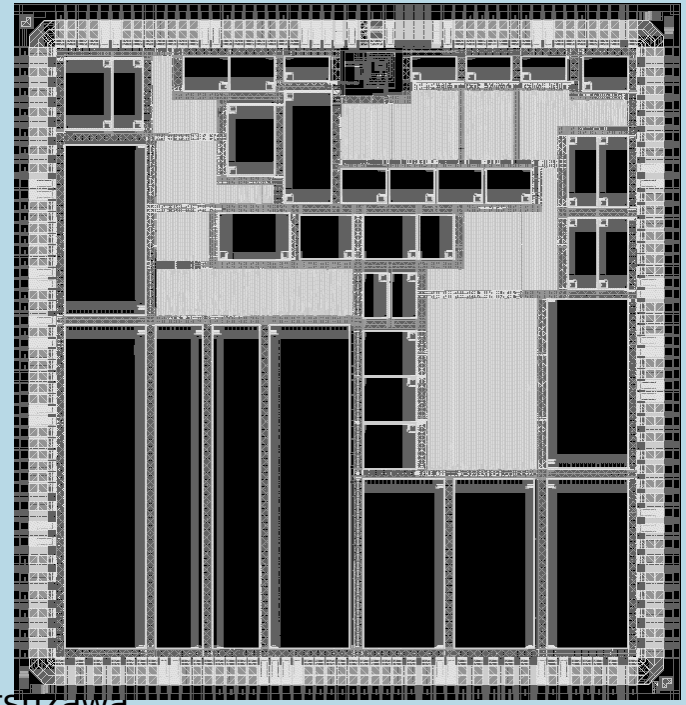
15fps (Core@L1 decode)
30 fps (Simple@L3 decode)



MPEG4 Decoder

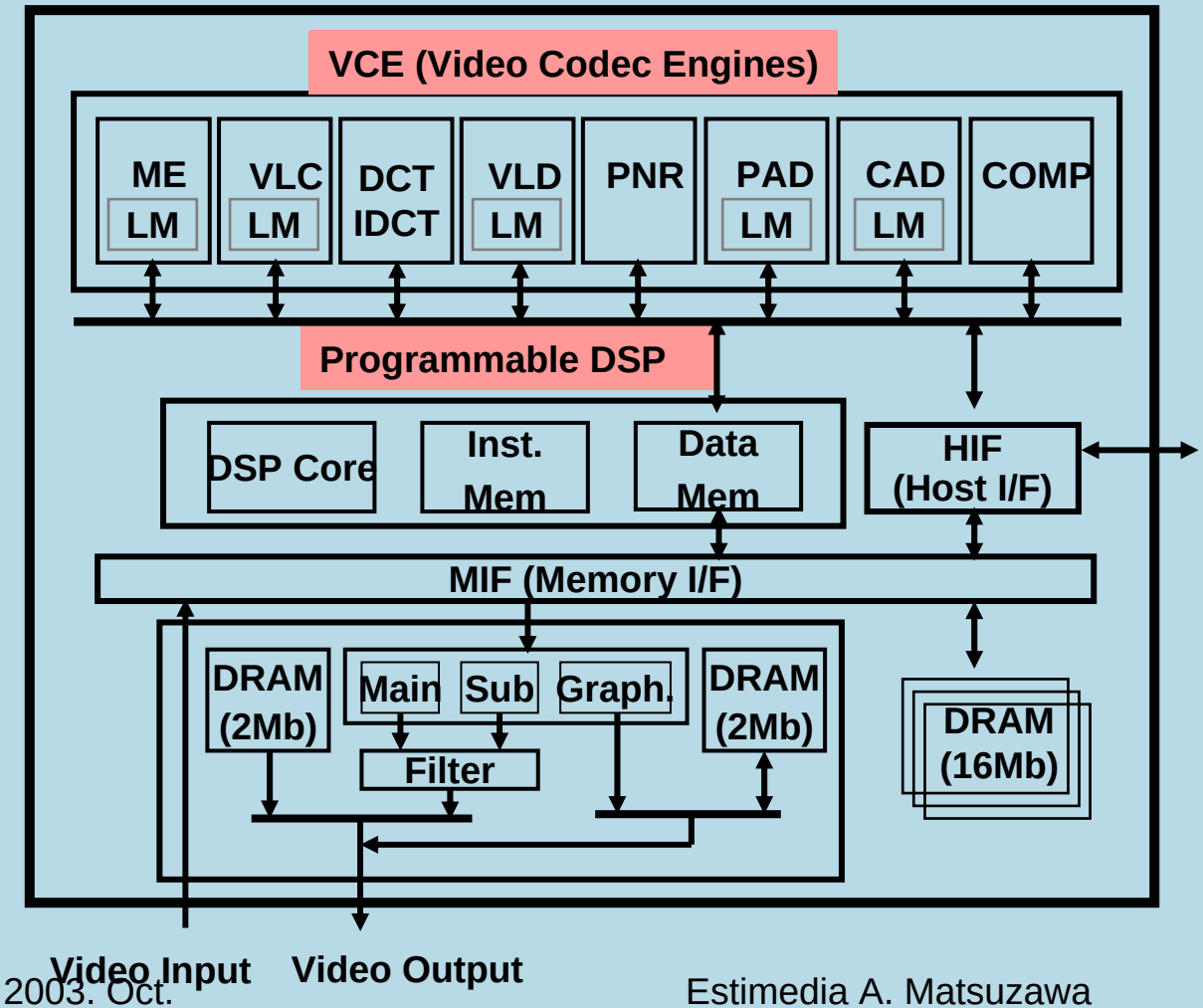
0.18um CMOS
11M Tr
11 mW@27/54MHz

15fps (Core@L1 decode)



MPEG4 Codec

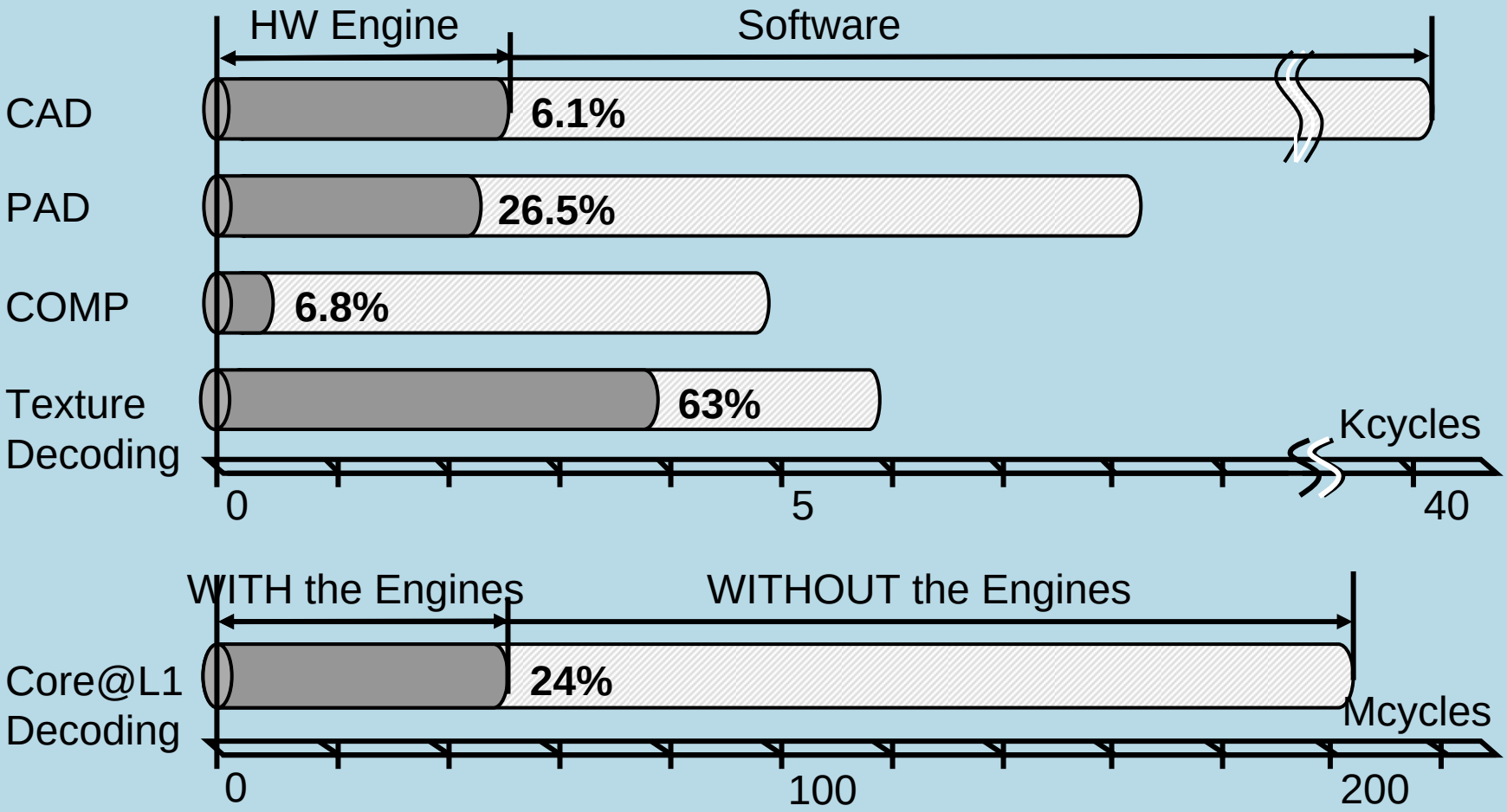
DSP with Vector Pipeline and dedicated HW engines enables high throughput and low power video processing



1.5 GOPS: Simple@L1
12 GOPS: Simple@L3
6 GOPS: Core@L1

Performance of core decoding

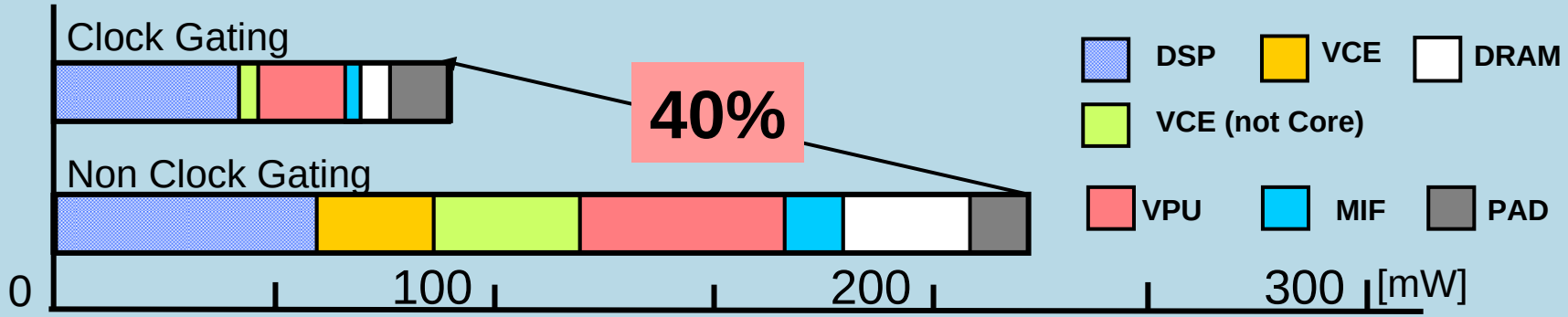
Hardware engines increase the performance 4 times higher



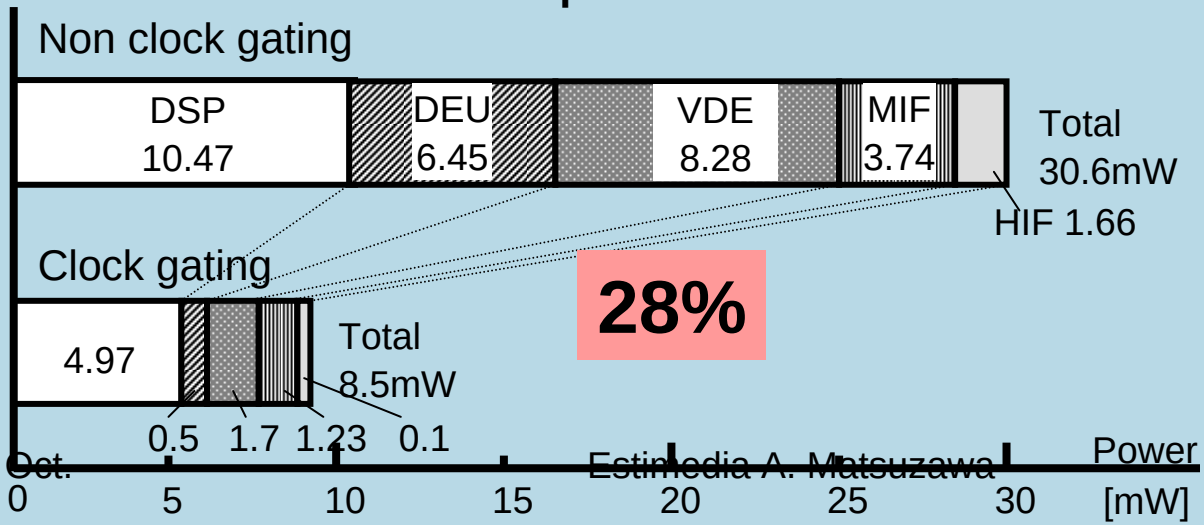
Clock gating

The sophisticated clock gating is very effective to reduce the power consumption.

Example 1: MPEG4 Codec



Example 2: MPEG4 Decoder



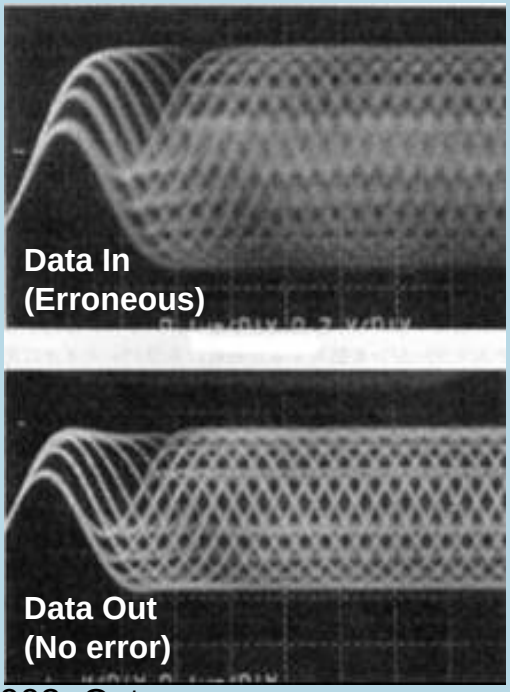
Mixed signal technology

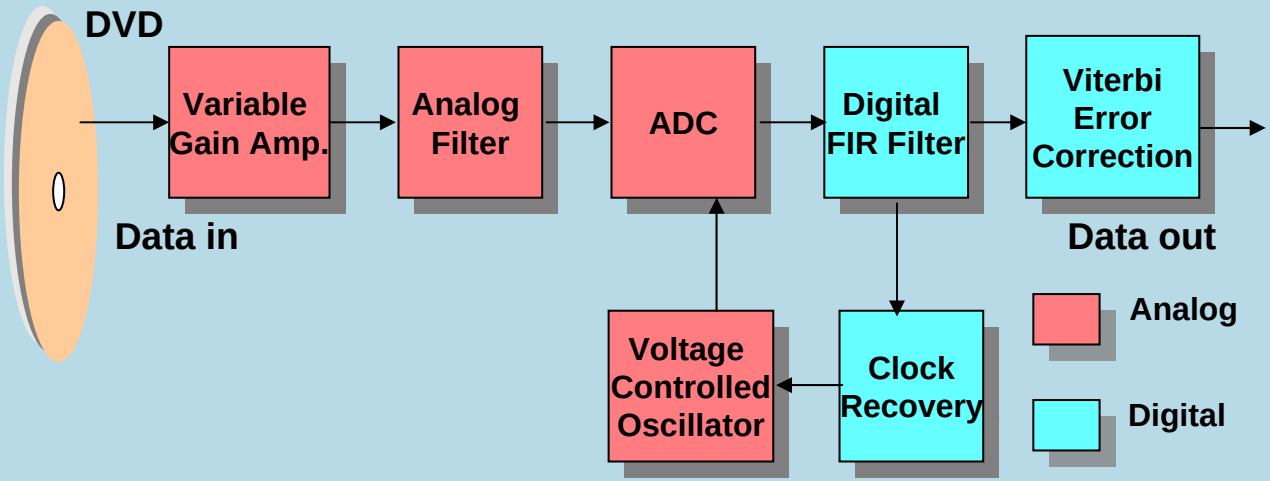
Mixed signal technology

The mixed signal is vital to current SoC for the consumer and networking.

However, conventional analog needs 2 or 3 redesigns!

How to develop it without re-design!



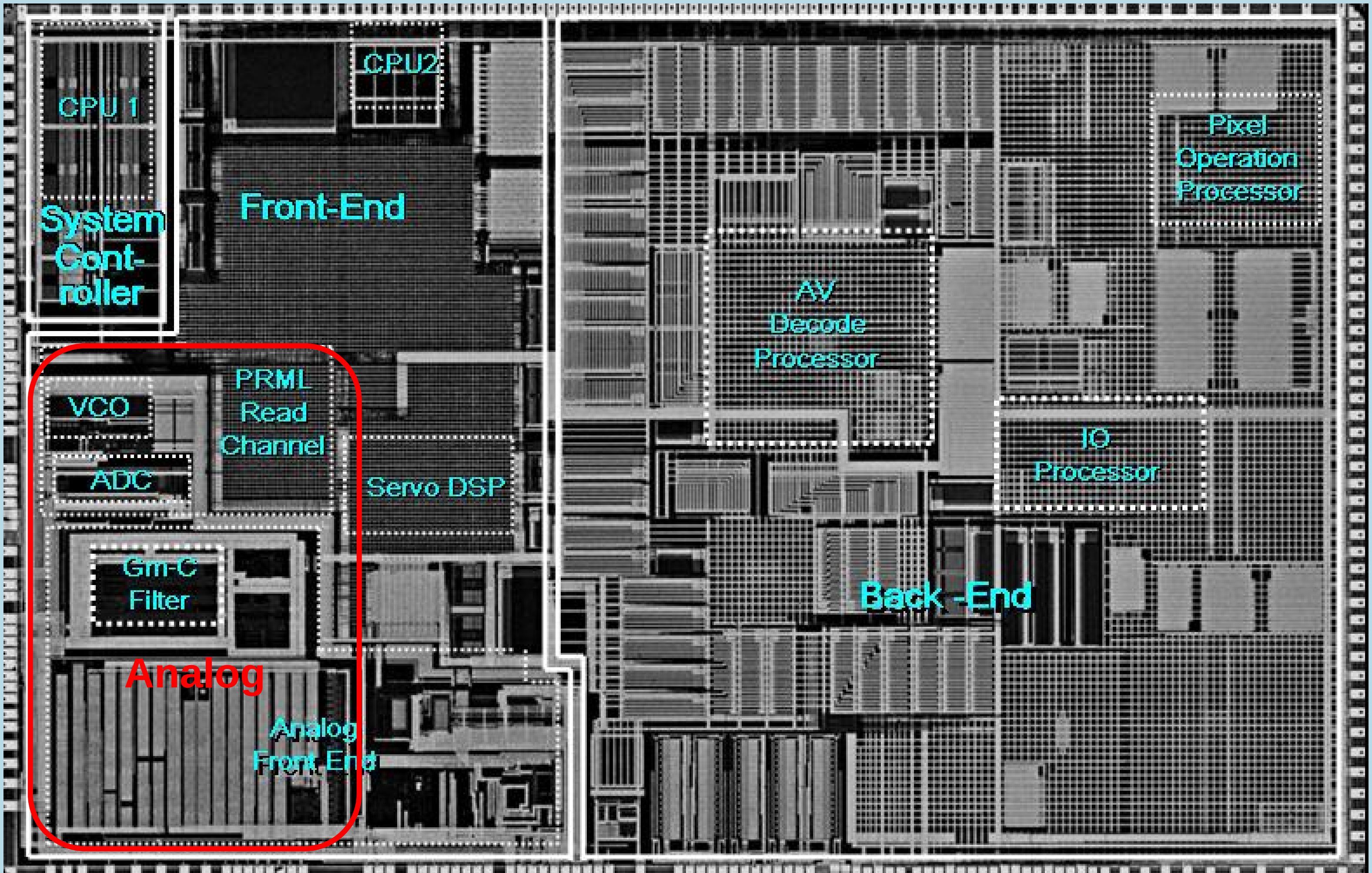


Mixed signal can decrease bit-error rate and can increase stability in DVD recorder systems.

Mixed signal SoC for DVD systems

The SoC integrates analog FE, font-end, and back-end in 0.13um tech.

ISSCC 2003, K Okamoto et., al. **24M Tr**

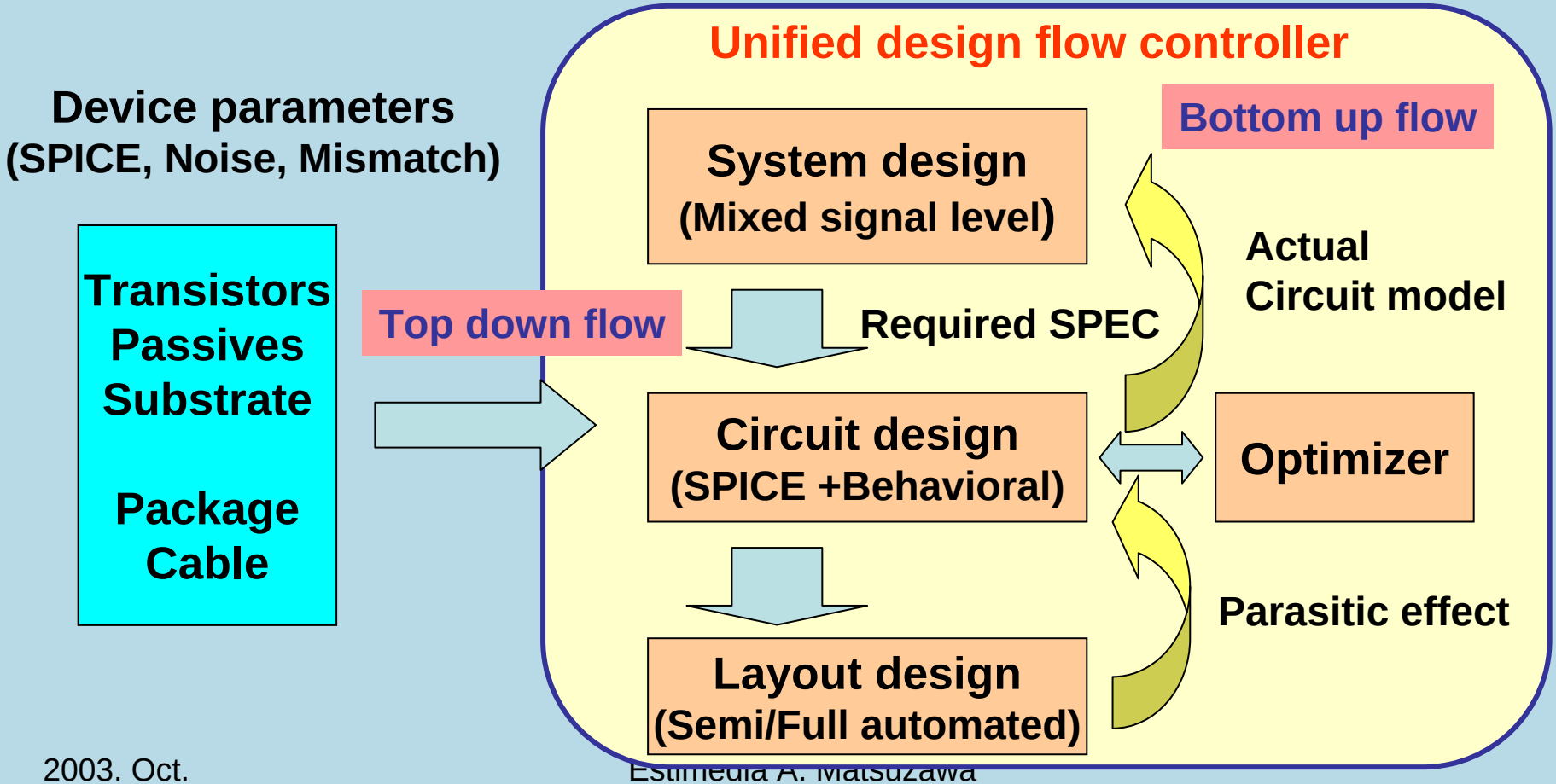


Strategy for the mixed signal SoC

- **System design**
  - **Digital calibration** for analog adjustment and unknown parameters.
  - **System optimization** to reduce analog area and increase robustness.
- **System verification**
  - Fast and accurate **mixed signal system simulator** with behavioral model to verify and optimize the mixed signal system.
  - Create the **target performance** for circuit blocks.
- **Circuit design**
  - Ultra fast and accurate circuit simulation for **P.V.T and fluctuation analysis** to verify the performance and robustness.
  - **Circuit optimizer** to find the sweet spot of the circuit.
  - Automated **creation of analog behavioral model** for system simulation.
- **Process and device development**
  - Develop suitable **analog option device**
  - Early **analog parameter extraction** (mismatch, temp. and voltage chara.)
  - **Monitor and control the analog parameters** in Fab.

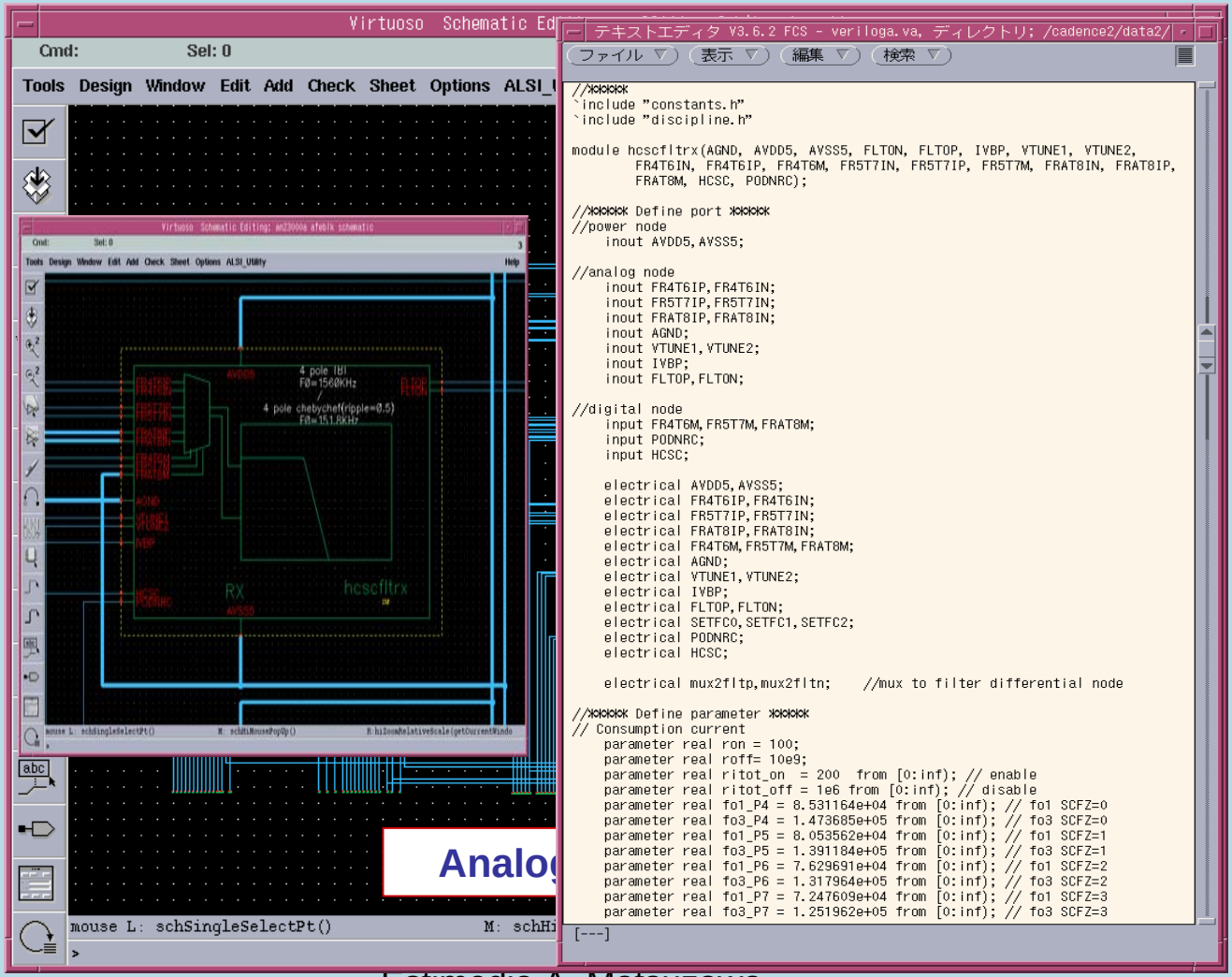
Design flow for mixed signal SoC

The design flow from a system to a layout with top down and bottom up process should be used for designing the mixed signal SoC.
The accurate and a variety of device parameters is an another key.



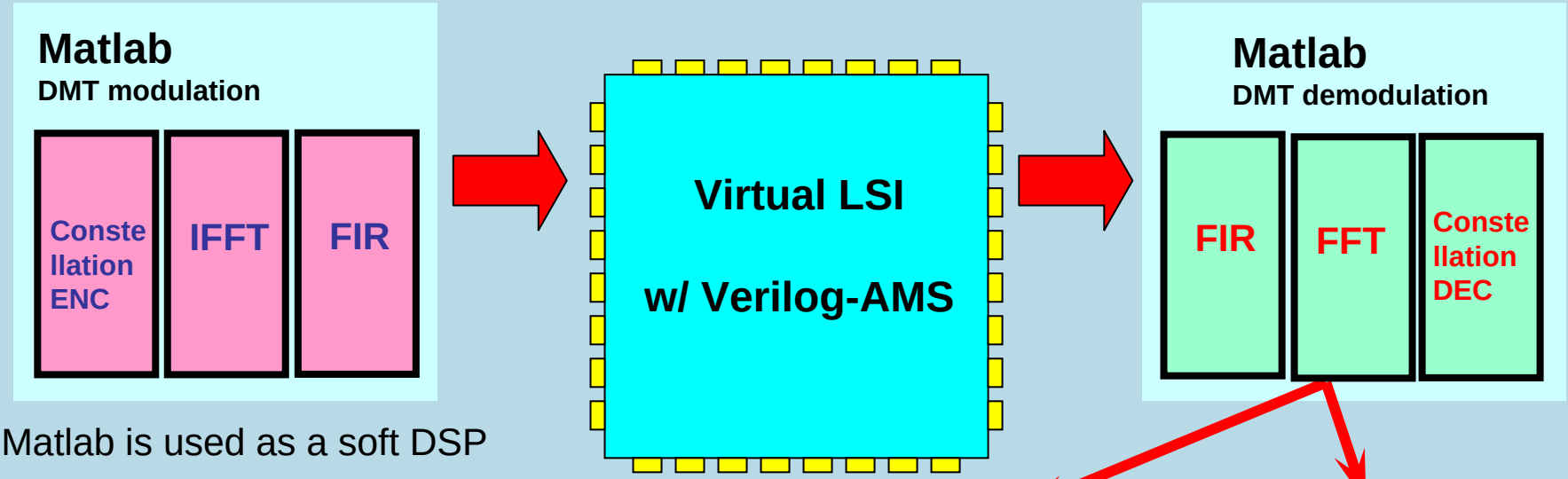
Hierarchical and behavioral system design

This system should be described in behavioral language, hierarchically.

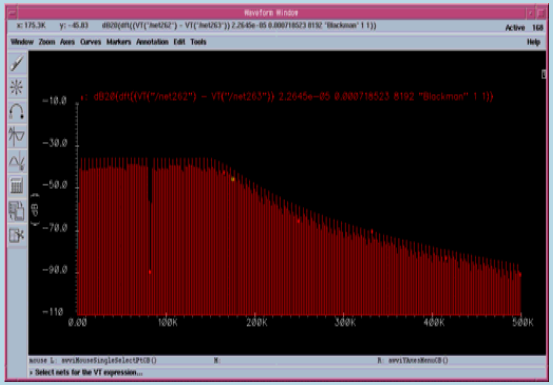


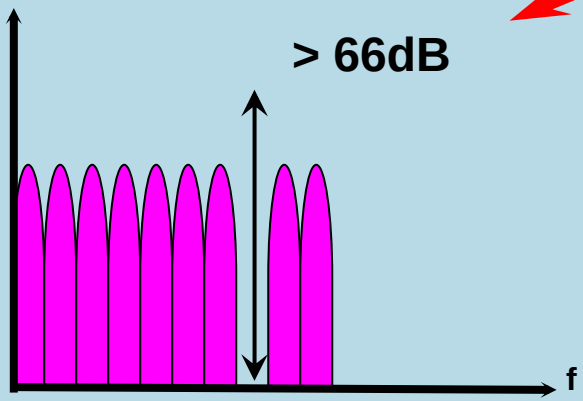
Virtual System test using verilog AMS and Matlab

We can simulate the performance of mixed signal system, using Verilog AMS and Matlab.

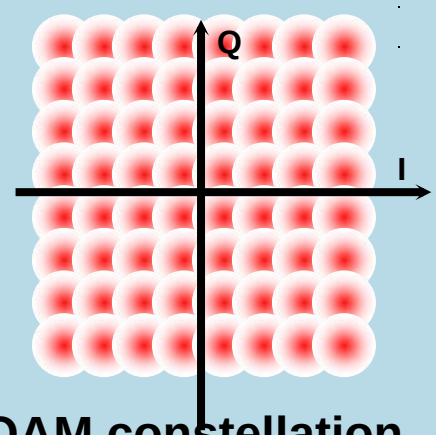


Matlab is used as a soft DSP





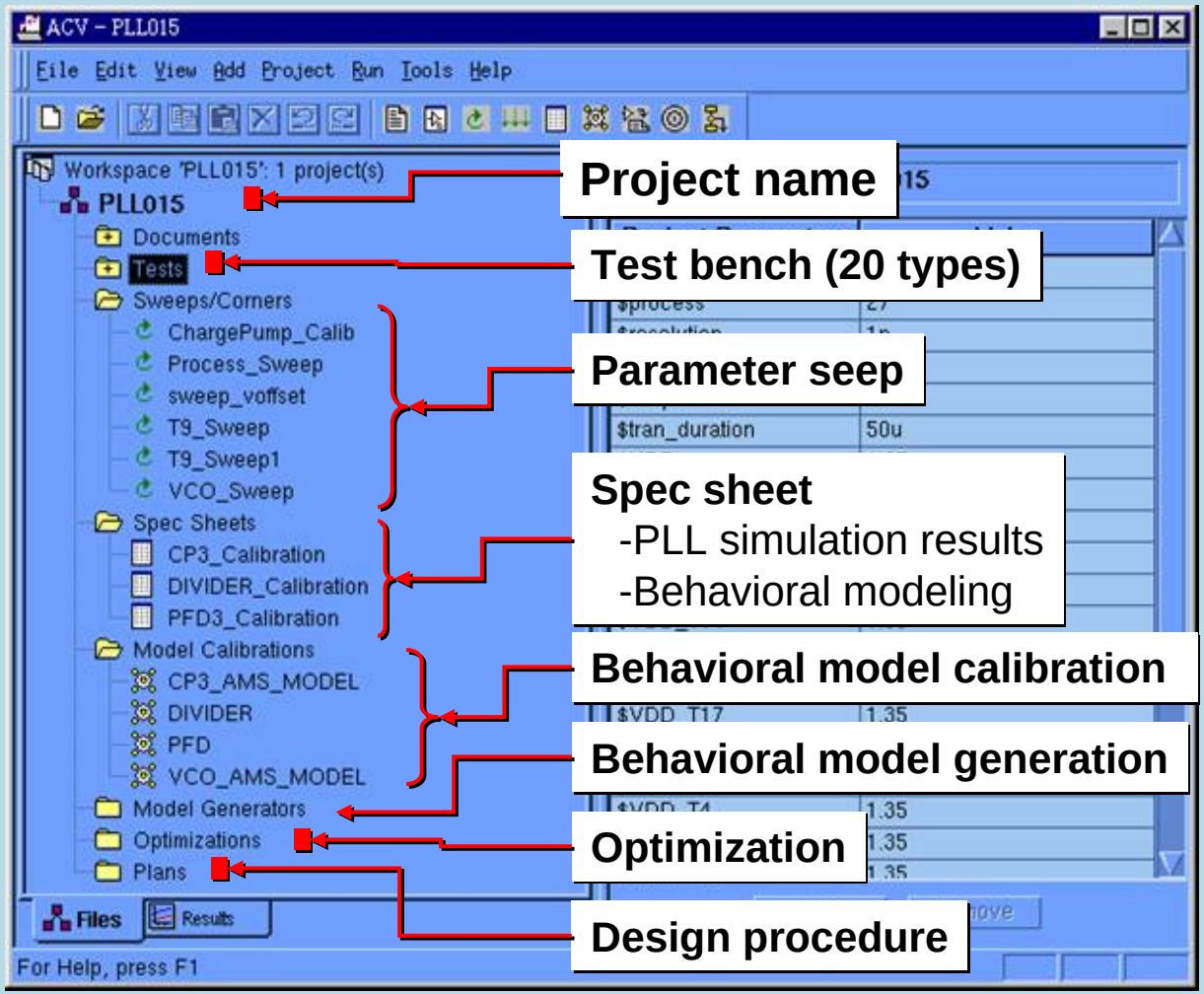
MTPR TEST (DMT Carrier hole)



QAM constellation

Controller for automated simulation

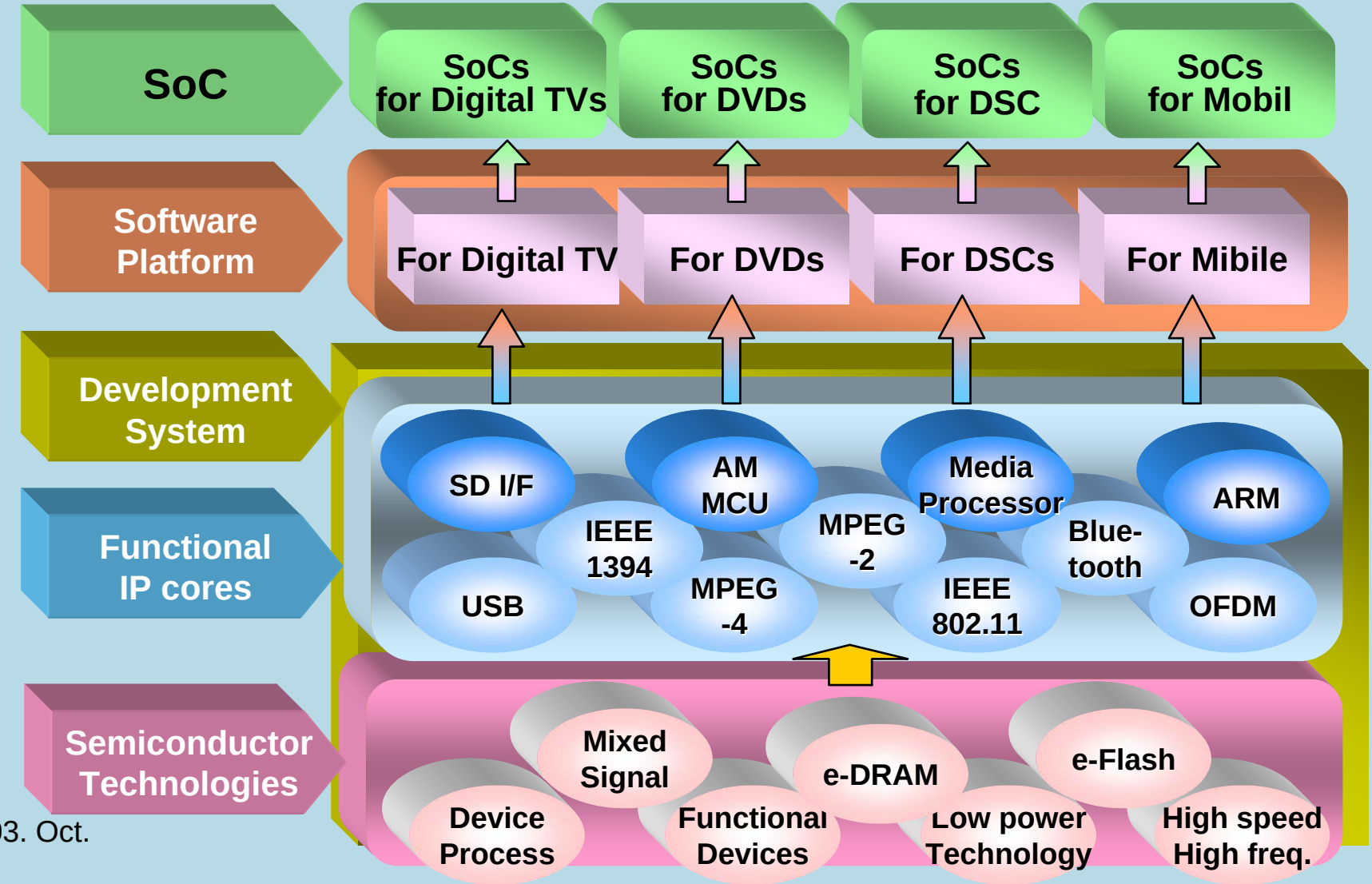
Simulation controller enables fast and automated simulation steps



Global development management

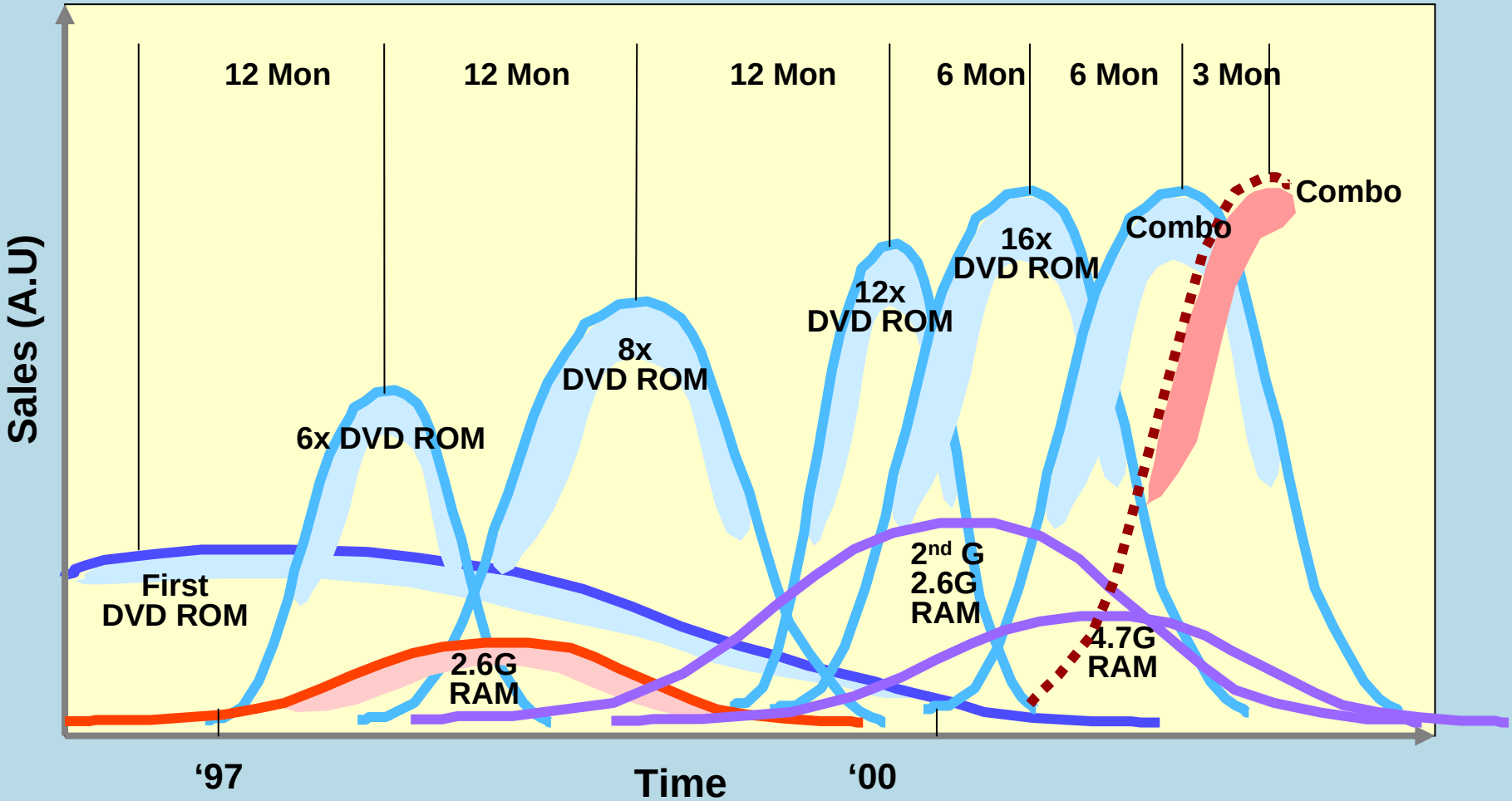
Development Platforms for SoC

SoC needs several technology layers from system and software to device



Narrow development time slot

The development time slot is very narrow.
So “Just in time” develop is required.

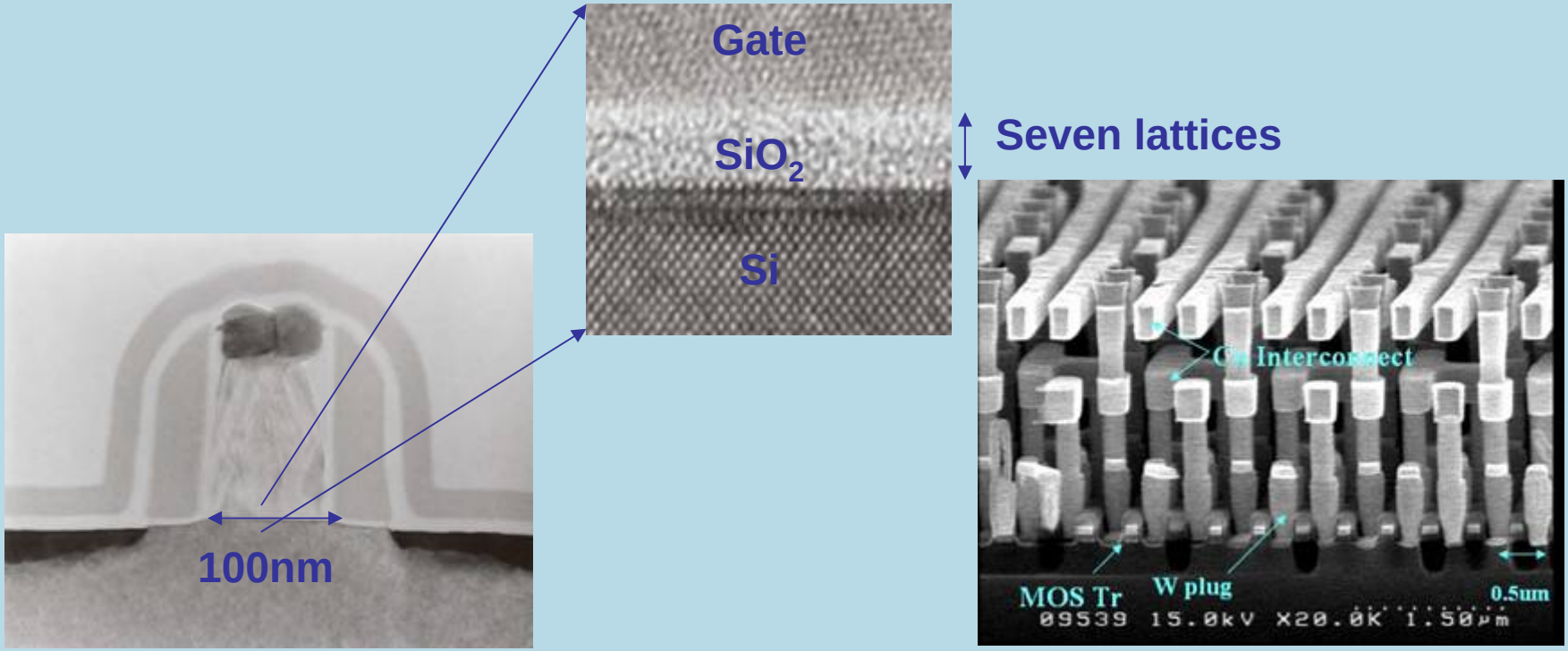


Scaled CMOS

Current Scaled Si technology is very artistic.

How to control it and how to increase the production yield quickly!

Matsushita's 0.13um CMOS

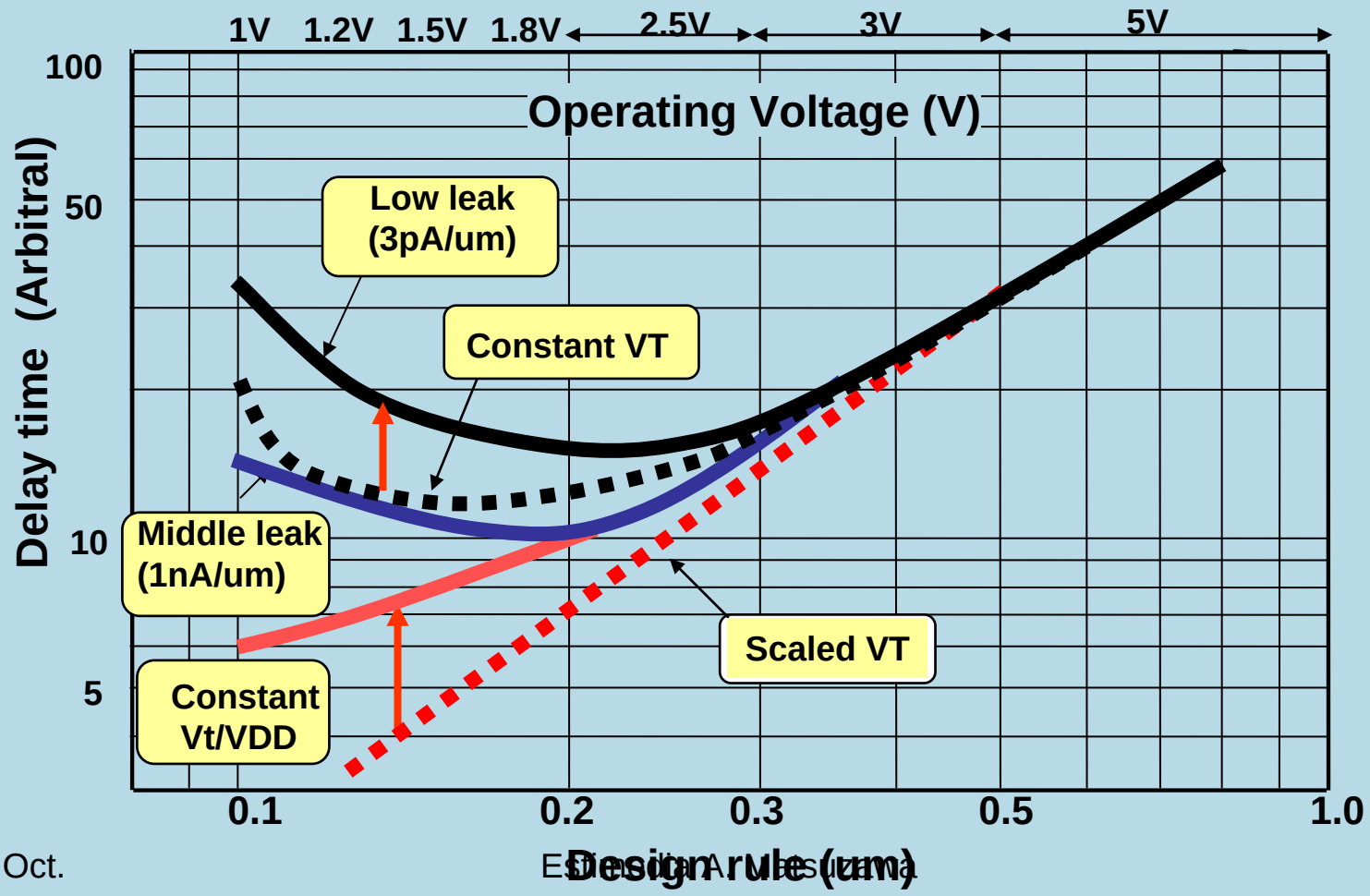


Transistor **Interconnection**

Choice of transistor

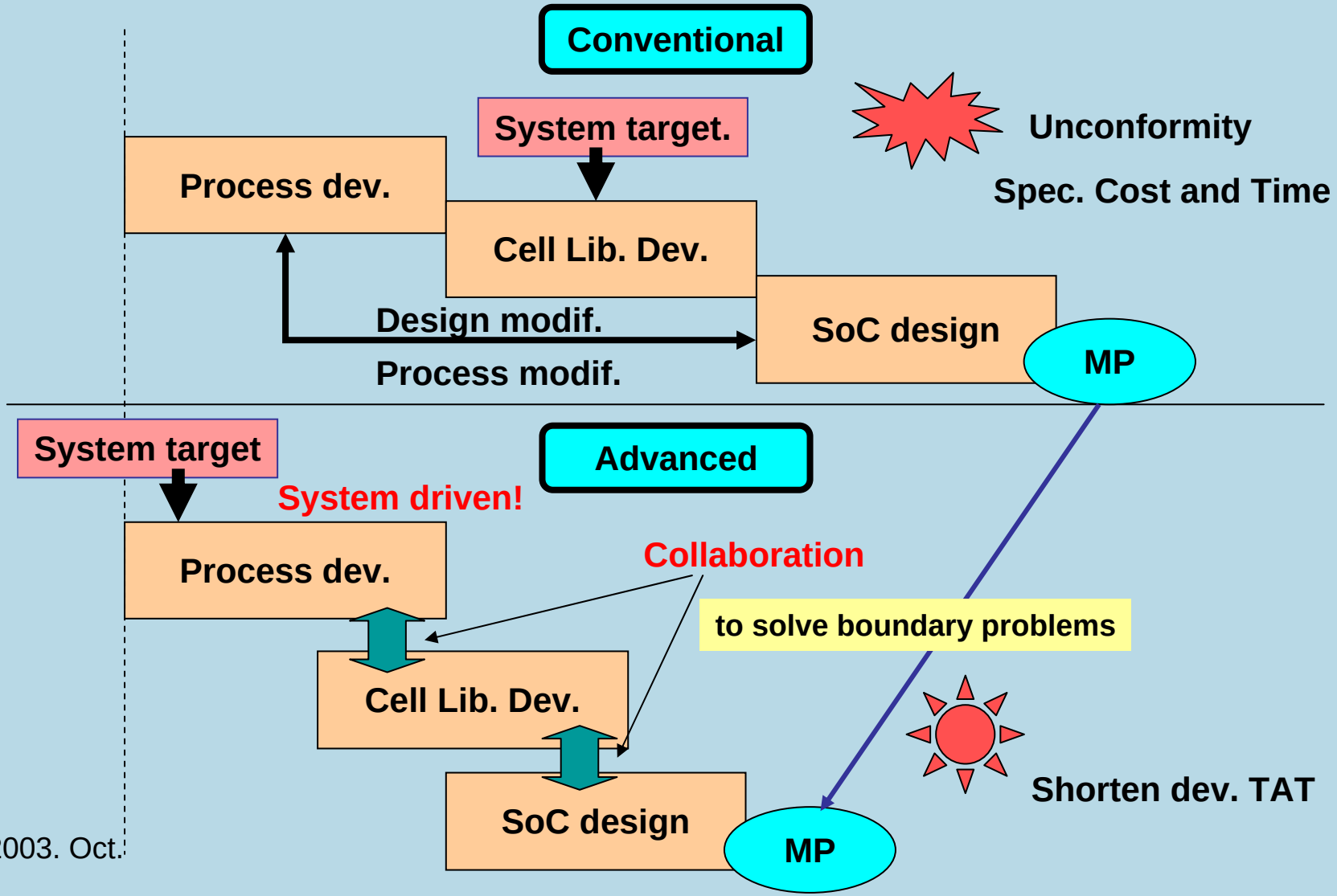
A variety of transistors has increased.

Choose the proper transistor depending on the systems



System target driven development

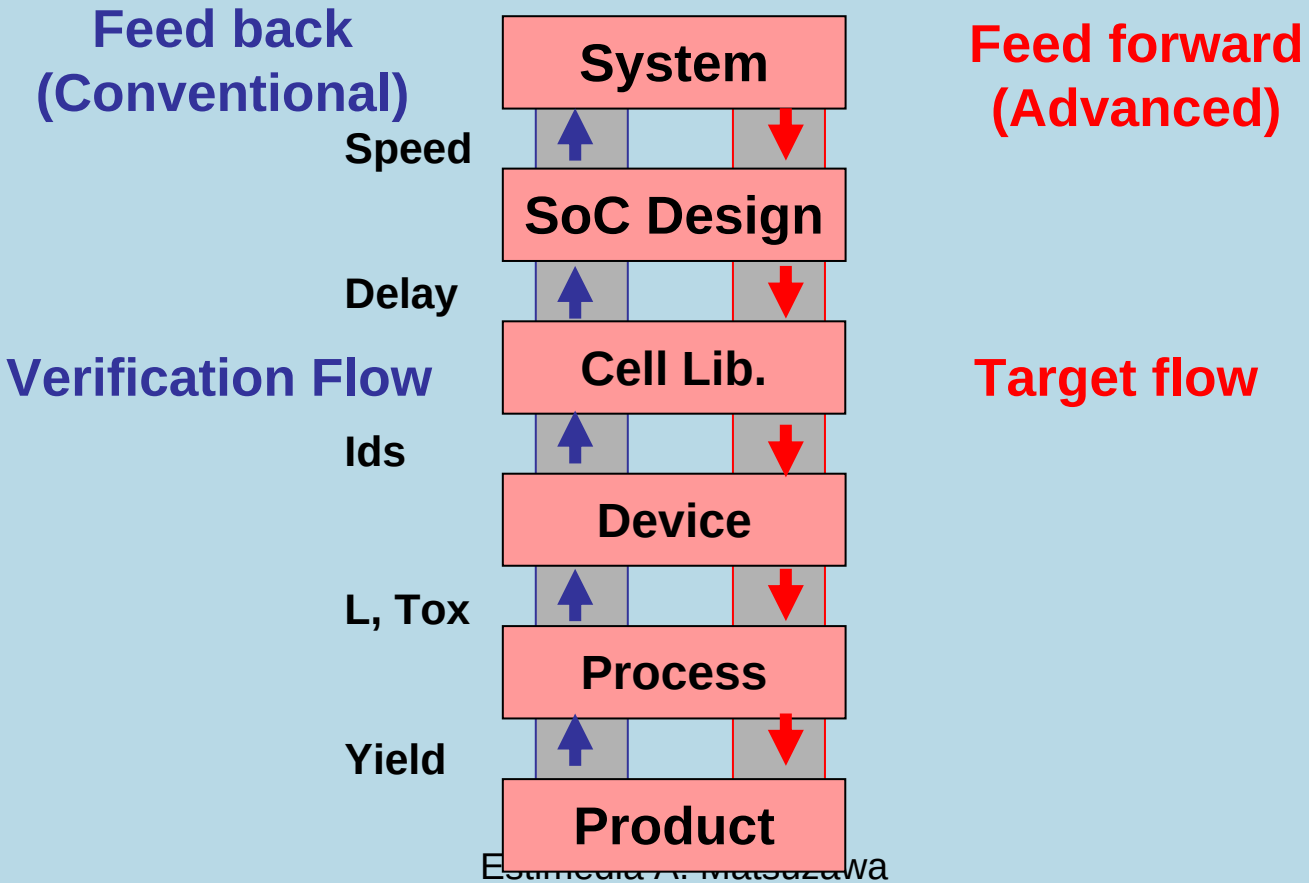
System target driven can reduce unconformities and shorten the TAT.



Bidirectional design flow

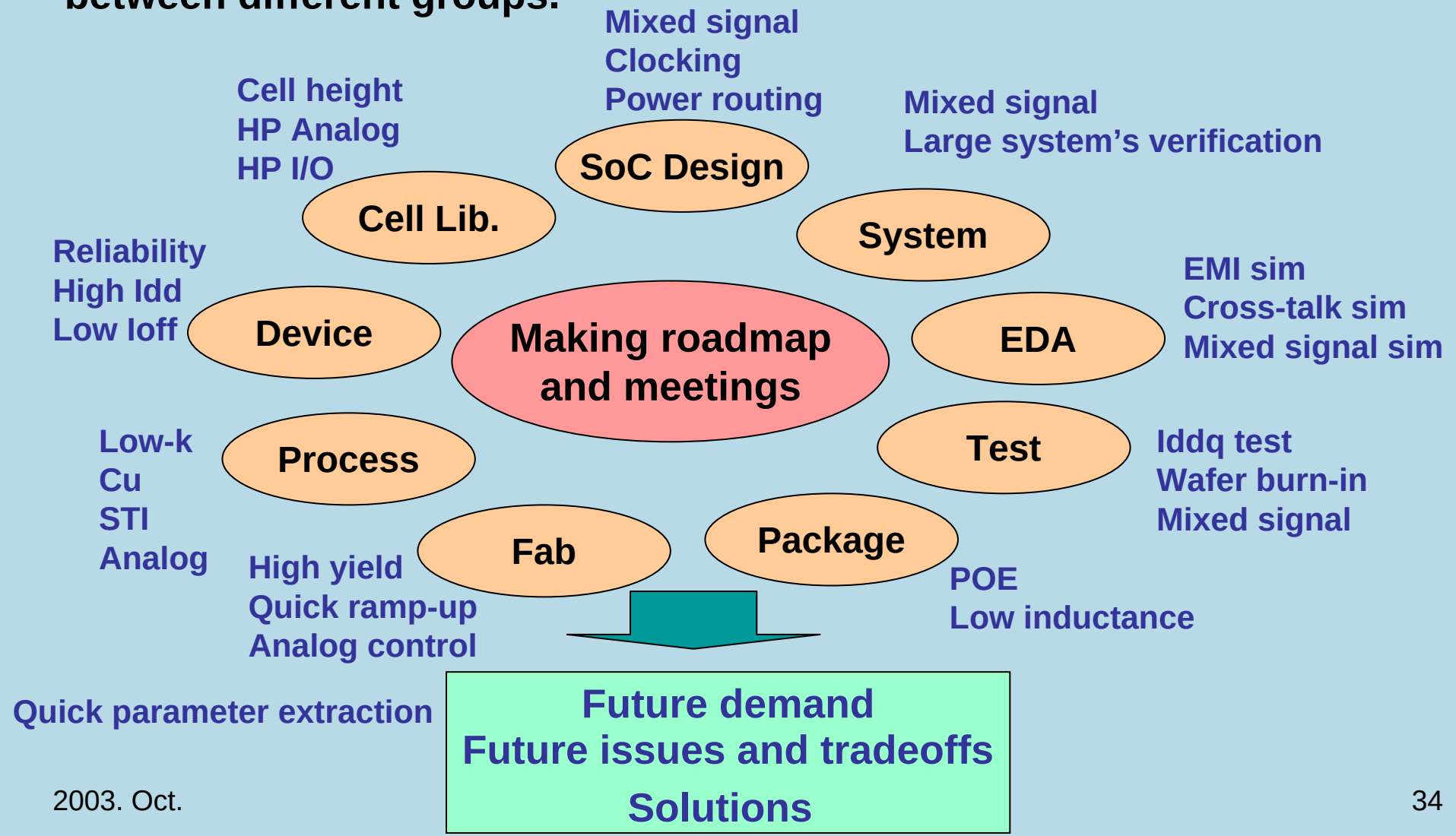
Bidirectional design flow; **feed forward flow, as well as feedback flow can pass early targets to different groups.**

This shorten the TAT and reduce the conflicts.



Making roadmap

Making roadmap makes a good communication and a corroboration between different groups.



Summary

- Digital consumer electronics based on multimedia technology has emerged and become big market.
- SoC also has become a dominant along with this technology.
- Architecture of SoC should be optimized for the application system.
- The mixed signal technology is vital for SoC.
  Increase the design quality and development speed.
- SoC development needs a variety of technology layers from a system to a device and needs several optimization for the applications.
- A global development managing system is an another key to success.
  Make collaboration and unification over different technology groups to shorten the development time and increase customer satisfaction .