

# PHILIPS

Misleading trade-offs in a combi-product:  
the Hard Disk / DVD+RW case.

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# Overview

- Why a HD / DVD+RW combi? Requirements.
- Ideal system architecture versus available
- Proposal of DXC architecture
- Exposure of unsound trade-off thinking
- Outcome & results
- Conclusion

# Why a HD / DVD+RW combi?

## DVD-recorder

- playback, record, HQ, **permanent** storage
- **removable** disk

## HD-recorder

- playback, record, HQ, semi-permanent storage
- **time-shift by *simultaneous* playback & record**
- non-removable **large** disk

## Combi has it all,

- giving **more freedom** when to watch what and
- **ease of use**: less fiddling with disks.

# DXC project

Project Leader: Roel de Bruijne



Chief SW architect: Pavlo Barvinko



Major project issues: (dd Q1 2003)

1. Time-to-market (Q1 2004)
2. Product reliability

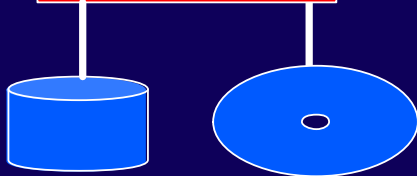
# Ideal: HD/DVD

Integral application

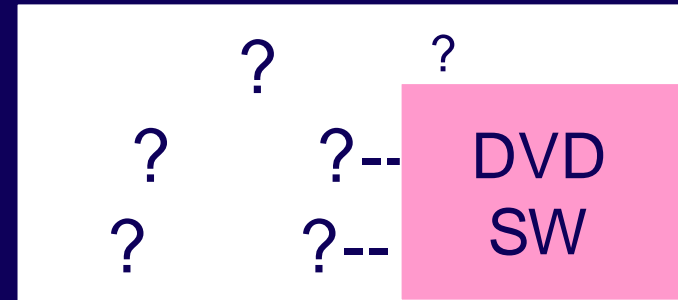
HD and DVD+RW

Board

Chrysalis

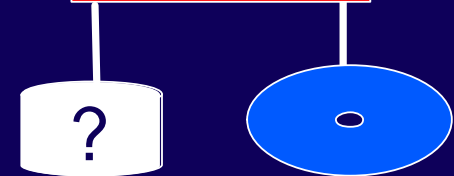


# Available: DVD

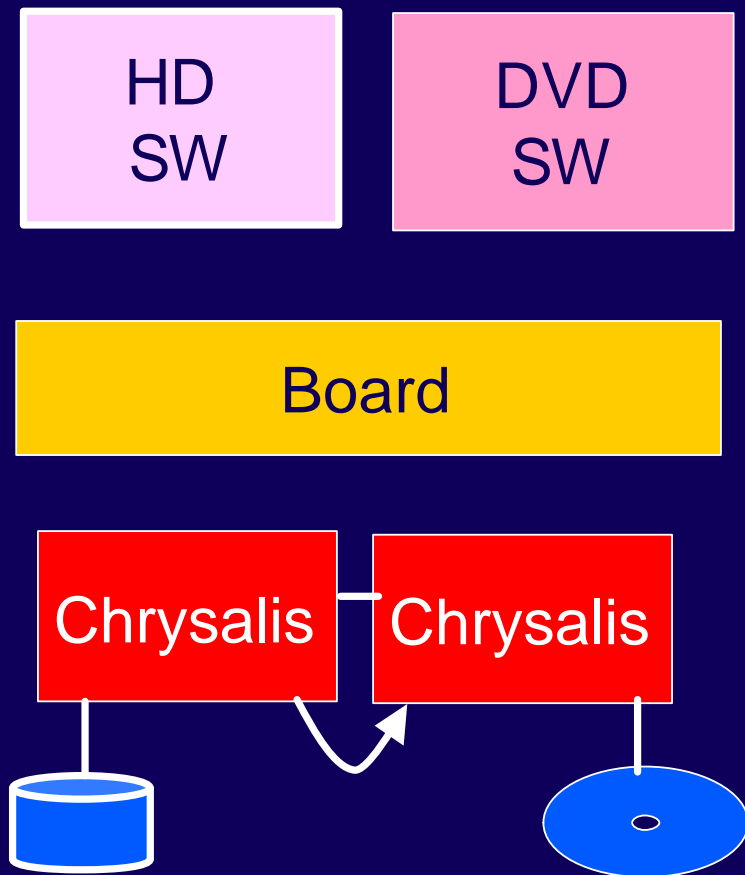


Board

Chrysalis



# Dual Xalis Combi proposal



- ++ Reuse DVD SW as is
- ++ No interference
- ++ No performance issues
- Distributed Control, booting, testing, etc.
- Merging of A/V output
- Synchronization of streaming
- BOM

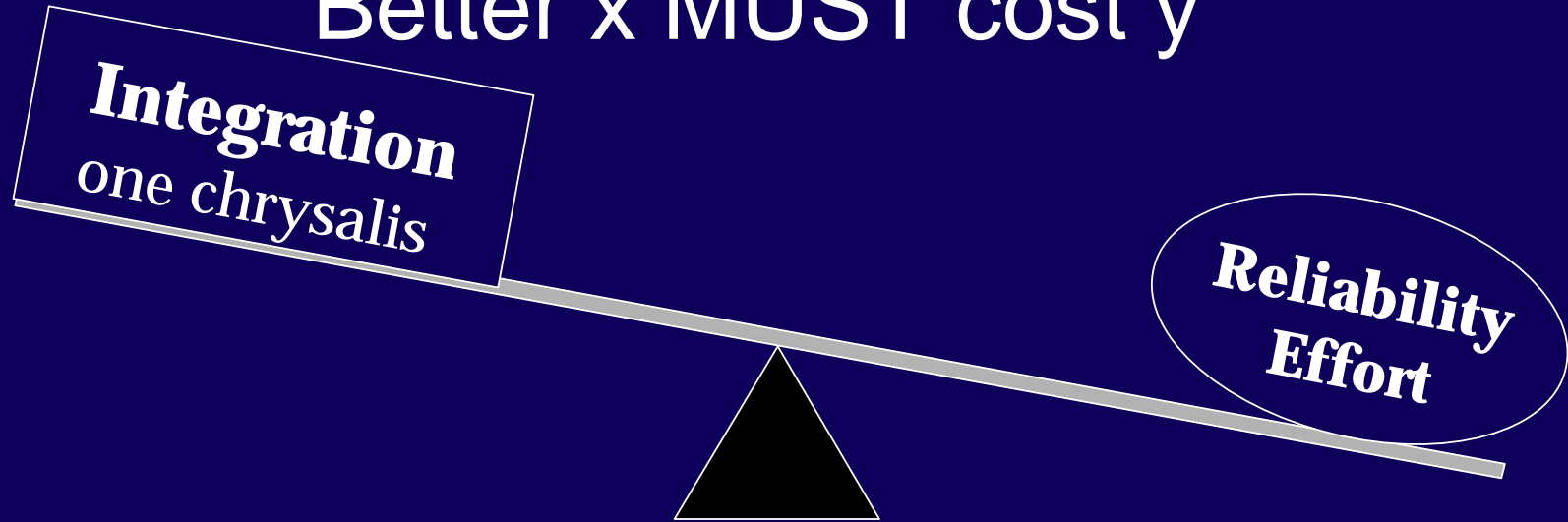
Main opinion against the ideal:

*Don't put two stacks on one processor*

- DVD SW is used to 'own' the processor.
- DVD SW is too fragile and monolithic.
- True independence is better, no interference.
- Prevent performance problems.
- Time-to-market is key.
- Reliability is key.
- BOM can be optimized later.

**Integration costs reliability and effort**

Trade-off thinking:  
Better x MUST cost y



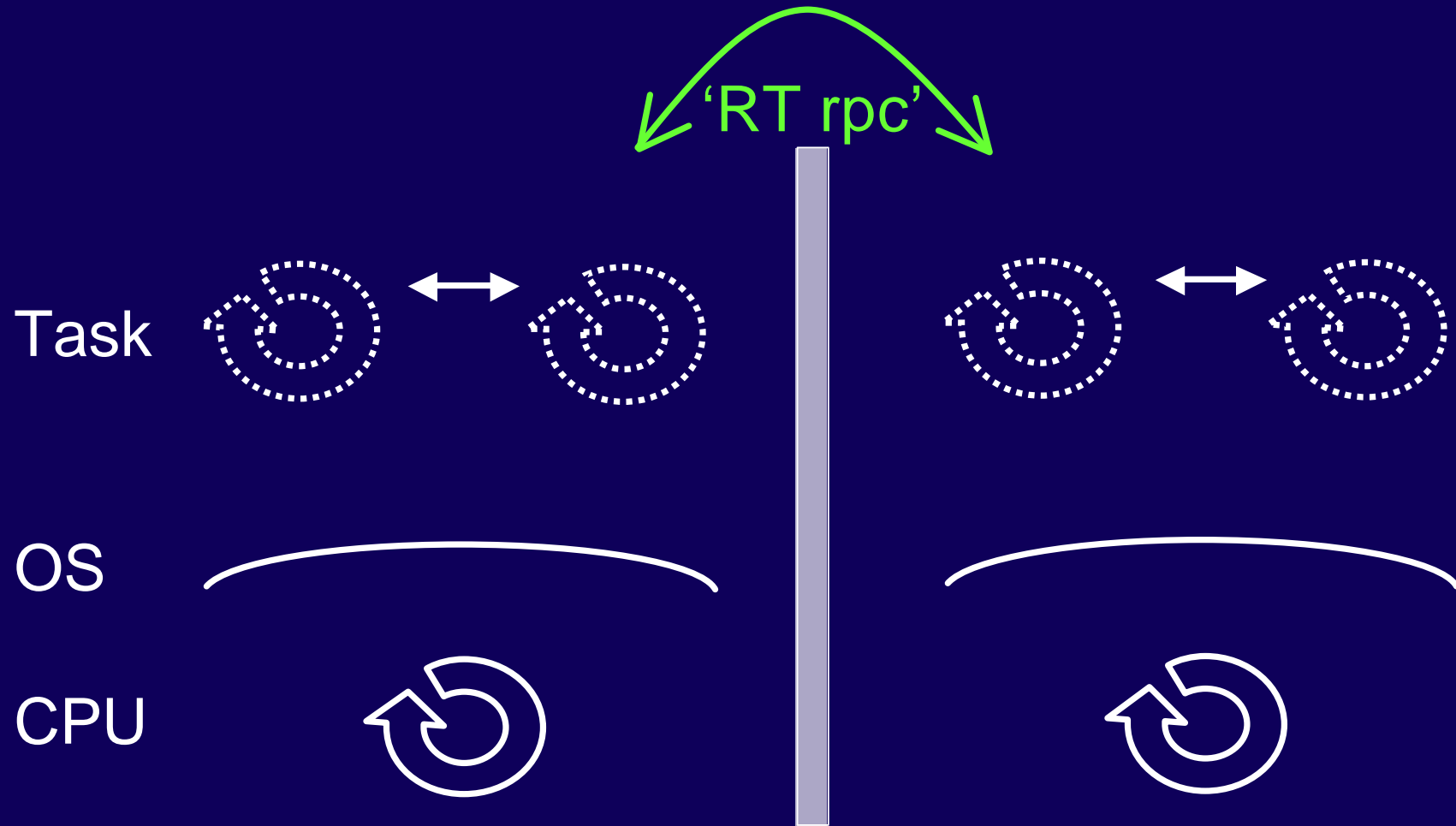
Oversimplification

Qualitative

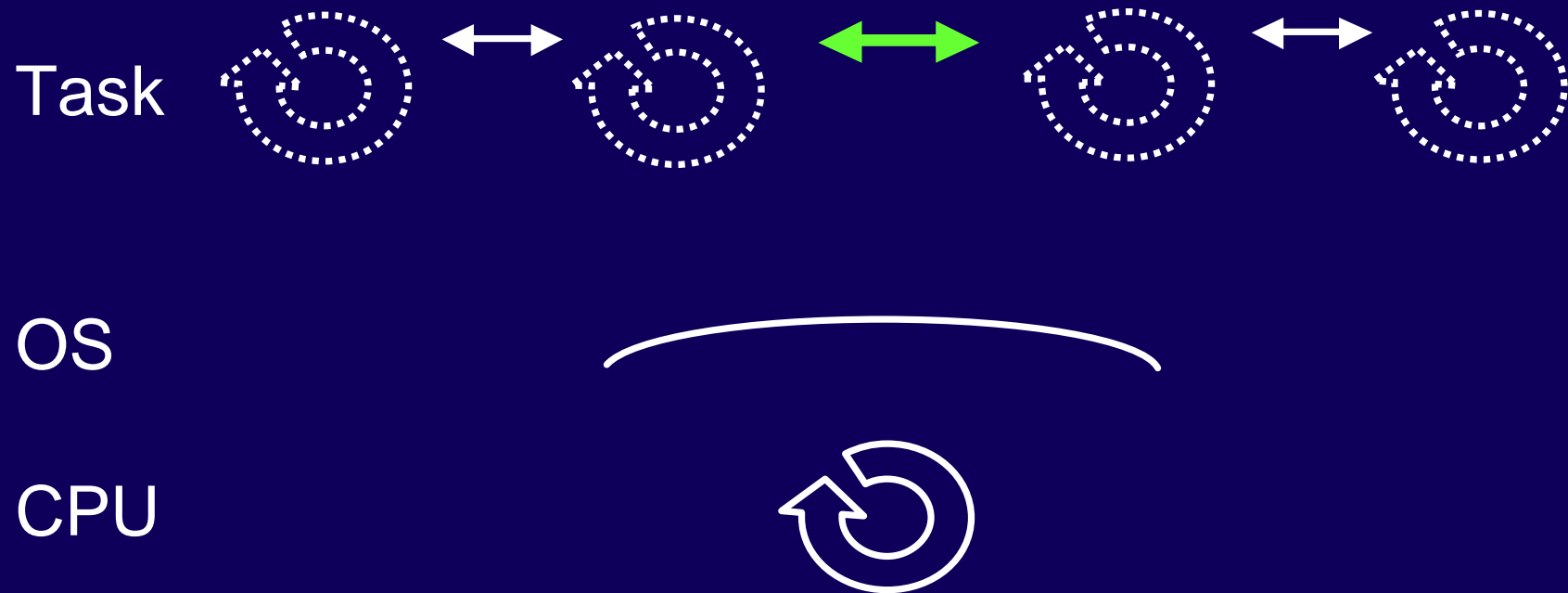
Artificial balance  
paradigm versus  
multi-dimensions in  
design space



# Two stacks on two processors



# Two stacks on one processor



## A closer look at the arguments

- DVD SW is used to 'own' the processor.
  - DVD SW is too fragile and monolithic.
  - True independence is better, no interference.
- SW runs CPU at max 50 % load for playback or record.
  - SW is 50 % ☺, other half:
    - Only PBS is used
    - Already ported ST to X
  - Parts of a combi cannot be totally independent.
  - Synchronization and merging **REQUIRES** interference, mainly at streaming (Gen. 2)

# Elaborate concrete pros and cons and quantify for Dual or Single Chrysalis

## **Pros of single X:**

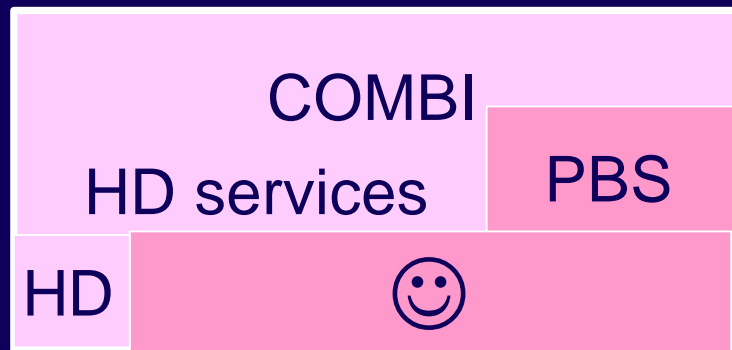
- Synchronization / merging / control.
- No new board required.
- Much more reuse of DVD SW: boot, factory test, tooling.
- Huge reduction in BOM.

## **Concerns**

- Feasibility of combi SX execution architecture.
- Effort estimates
- Risks

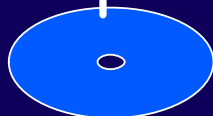
## **Decision Window**

# Dual stack single Xalis Combi



Board

Chrysalis



## Features

Continuous HD recording

Simult. HD Play / record

Timeshift

Play DVD[+RW]

Archive to DVD

CAM support

...

# Outcome

- Performance / execution arch. feasible,
  - requires mostly non-intrusive changes, e.g., compiler and priority settings, memory arbiter settings, ...
  - Changes would also be required for Dual case!
- Total project effort was slightly less, due to
  - synchr./ merging / control greatly simplified.
  - booting, debugging, factory test same as DVD SW
  - no new board design required.
- BOM reduction received a warm welcome, resulting in an increasing amount of orders.

## Current status

- Performance improvement:
  - From >100 % to 60 % continuous cpu load for worst case scenario.
  - Total change effort: 1.5 man-year = 2 % of all !
- Changes were integrated in two days.
- Some unexpected problems were encountered, but none were lethal.
- All project deliveries are on time.

# Conclusion

- Reusing DVD SW is possible and beneficial.
- In-depth design exploration really pays off, guided by time-boxing to serve planning.
- Execution architecture effort gives large benefits at low cost, and need not be intrusive.
- **Trade-off thinking**
  - Takes a one-dimensional look at a multi-dimensional solution space.
  - Based on oversimplification and qualitative reasoning, one overlooks much better solutions.



# Thanks

- Roel de Bruijne & Pavlo Barvinko
- Vlatko Milosevski
- Bart Franco
  
- CAEN Chrysalis Driver System team
- DVD+RW 2.1 team
- ...