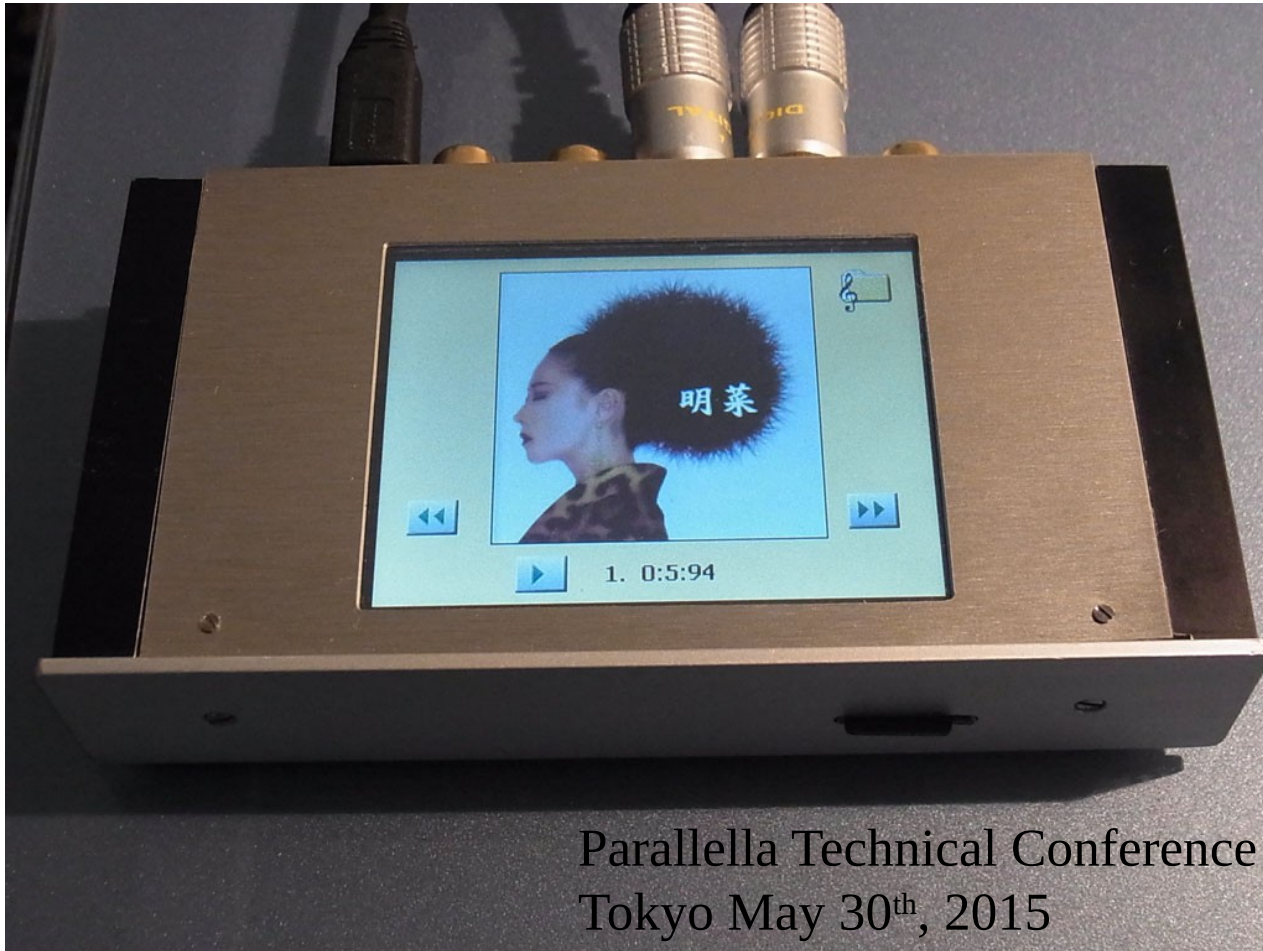


# High-end Audio Playback with the Parallella



Parallella Technical Conference  
Tokyo May 30<sup>th</sup>, 2015

# It all started with...

- Benefits of Bi-Amping from Rod Elliott  
<http://sound.westhost.com/bi-amp.htm>
- Digital Room Correction from Denis Sbragion  
<http://drc-fir.sourceforge.net/>

# Objectives

- High-Quality Audio Reproduction
- User friendly
- Low Budget

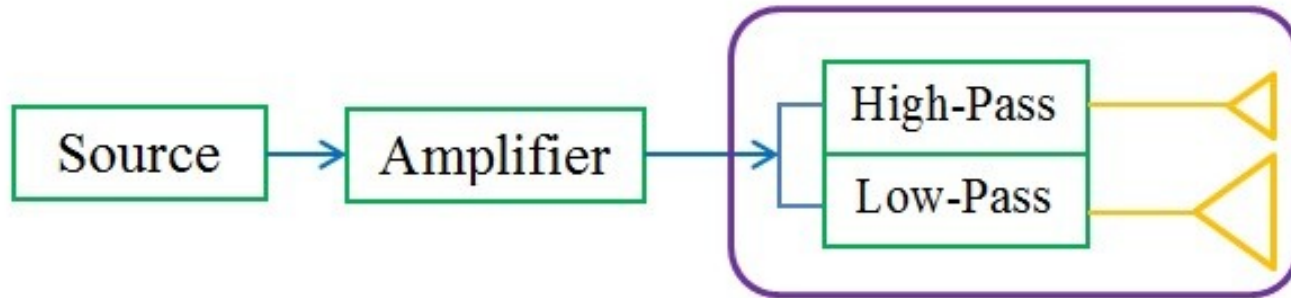
# Functionalities

- “Jukebox”-like
- Digital Crossovers for a Multi-Amps setup
- Digital Room Correction

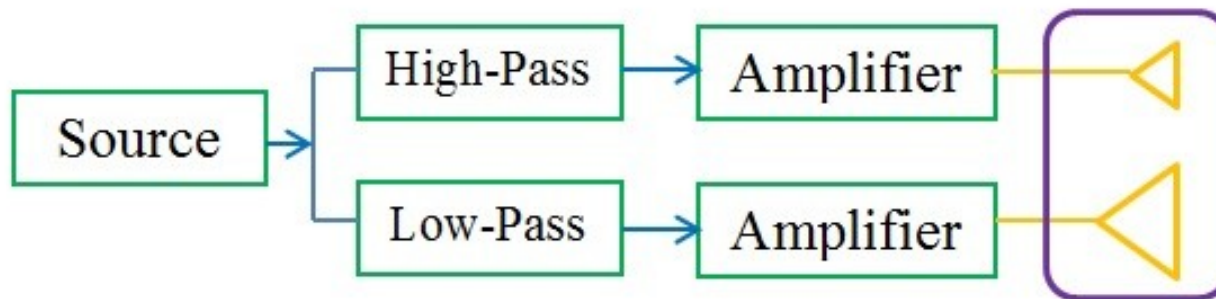
# “Jukebox”-like

- Uncompressed standard CD files stored in a micro-SD card (~200 CDs in 128GB)
- Graphical User Interface to select and play the CD files

# Multi-Amps setup



**HiFi typical configuration**



**Bi-Amping configuration**

# Crossover Types

- Passive
- Active
  - Electronic filter
  - Digital filter (MCU or FPGA)

# Digital Room Correction

Wikipedia definition

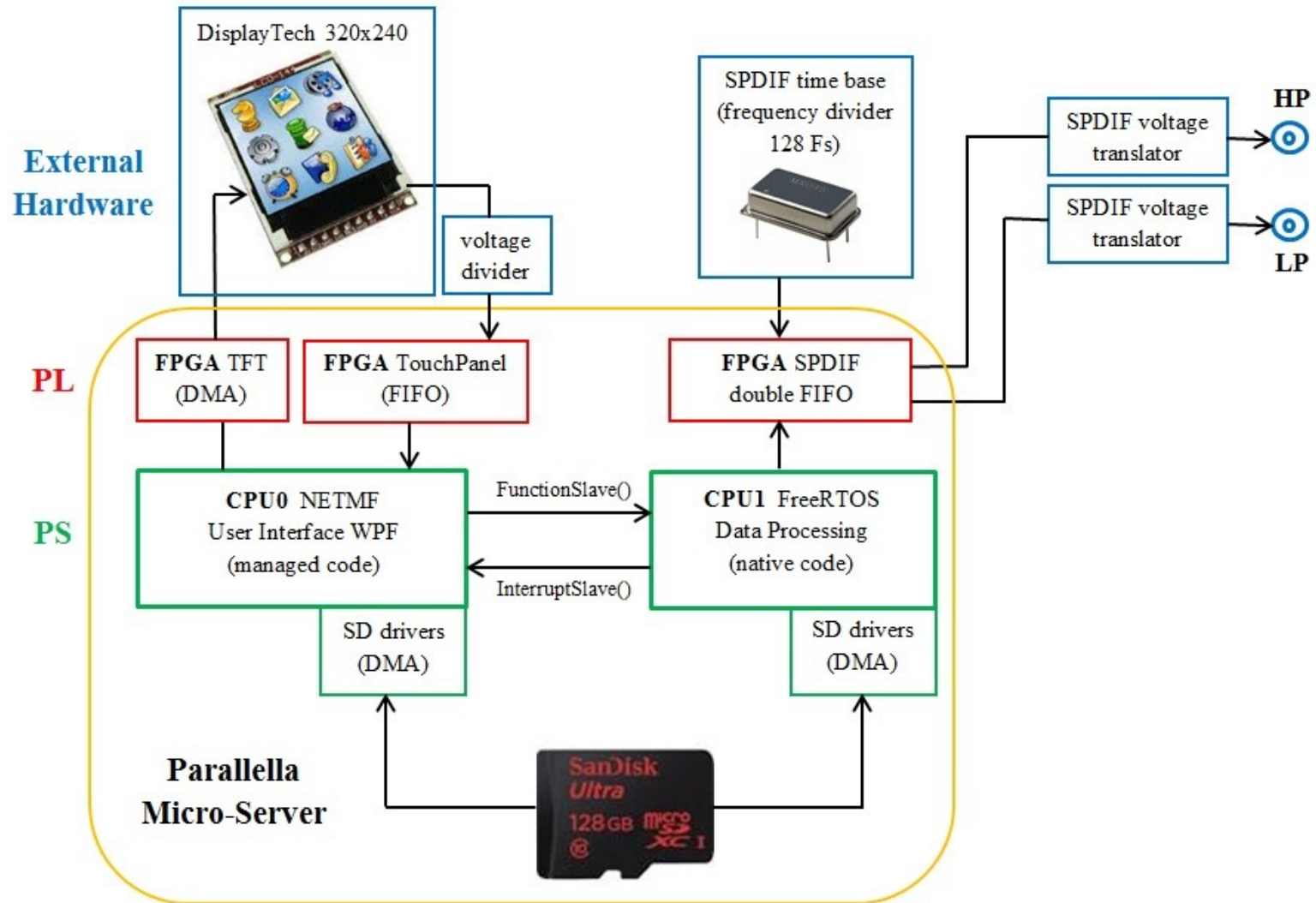
*“Digital filters are applied to the input of a sound reproduction system to improve unfavorable effects of a room's acoustic”*



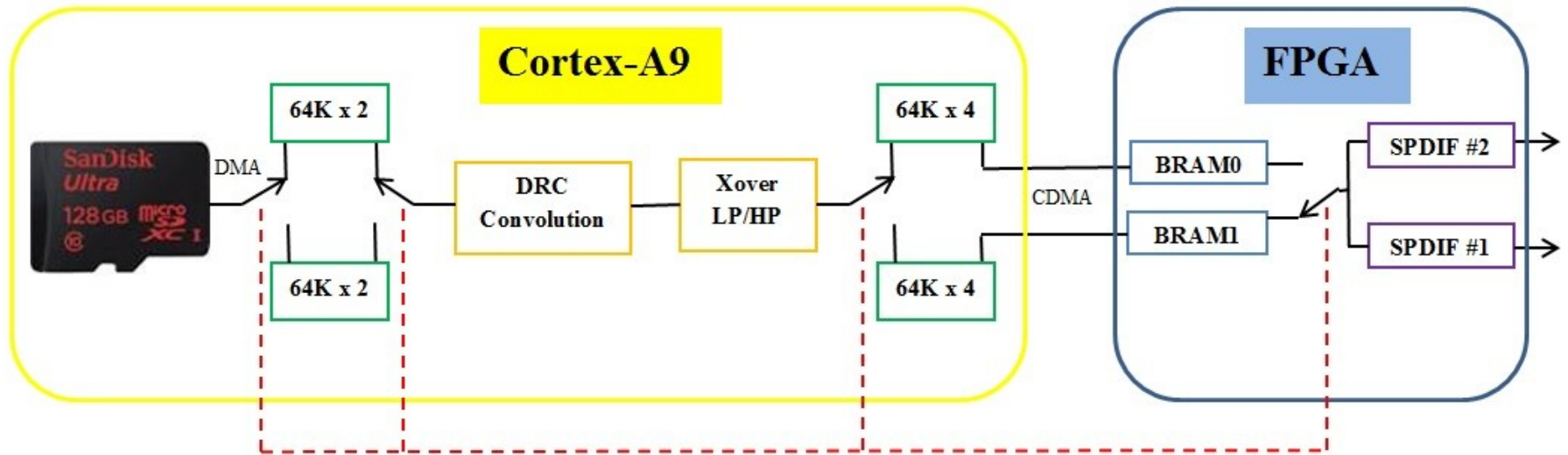
# DRC Setup

- Measure and adjust both speakers level and speakers time-alignment
- Measure the room response
- Generate the room compensation filters with Denis Sbragion's DRC module
- Apply the correction during playback

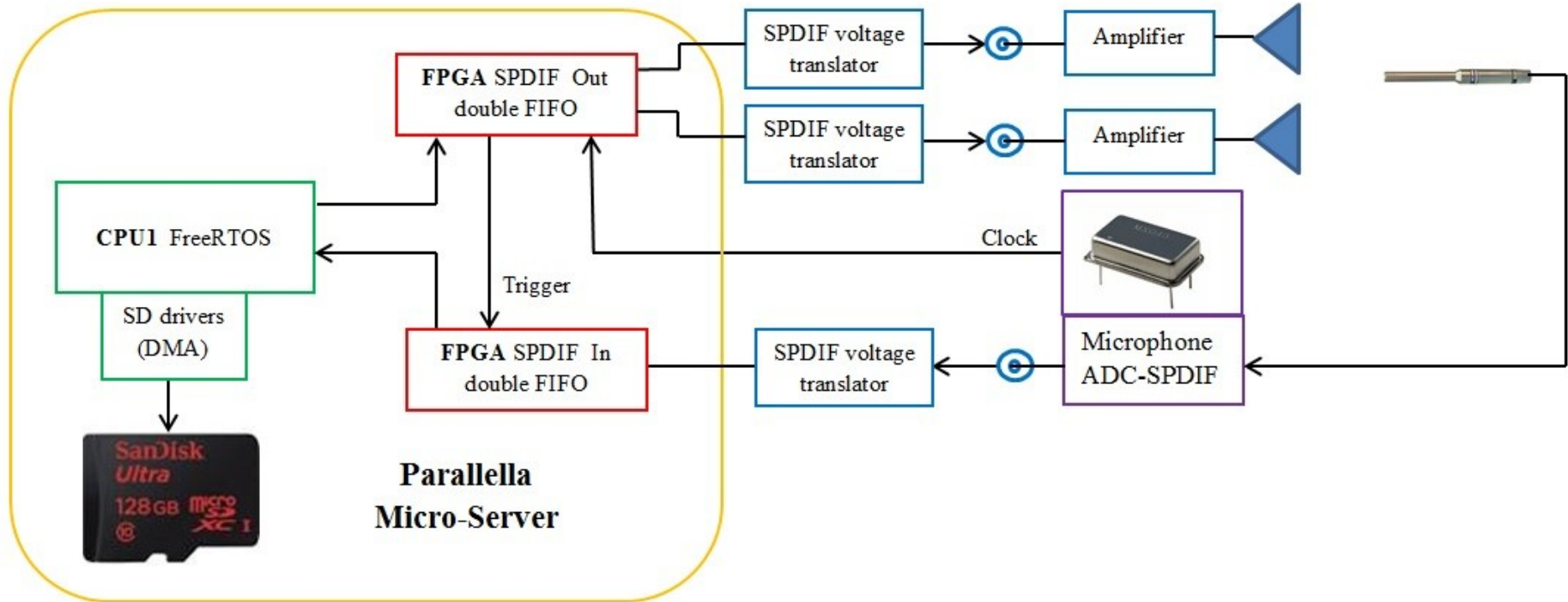
# Playback Configuration



# Playback Workflow



# Measurements Configuration



# FPGA Programmable Logic

- LCD Interface: 8-bit parallel
- Touch Panel interface: resistive
- SPDIF in/out: simple voltage translator
- External SPDIF clock 128 Fs: high stability
- BRAM blocks: SPDIF data transfer
- Trigger to have a time-reference output to input (measurements)

# Software Systems

- Graphical User Interface written in C# and running under Microsoft .NET Micro-Framework on Core #0
- Data Processing (room correction convolution and digital crossovers) written in C/C++ and running under FreeRTOS on Core #1

# Microsoft .NET Micro-Framework

## Advantages:

- Developing with the C# and Visual Basic .NET programming language
- A full managed execution environment with automatic memory management, multi-threading and persistent storage
- A substantial subset of the .NET Base Class Libraries including GUI classes based on the Windows Presentation Foundation

# Microsoft .NET Micro-Framework

## Weaknesses:

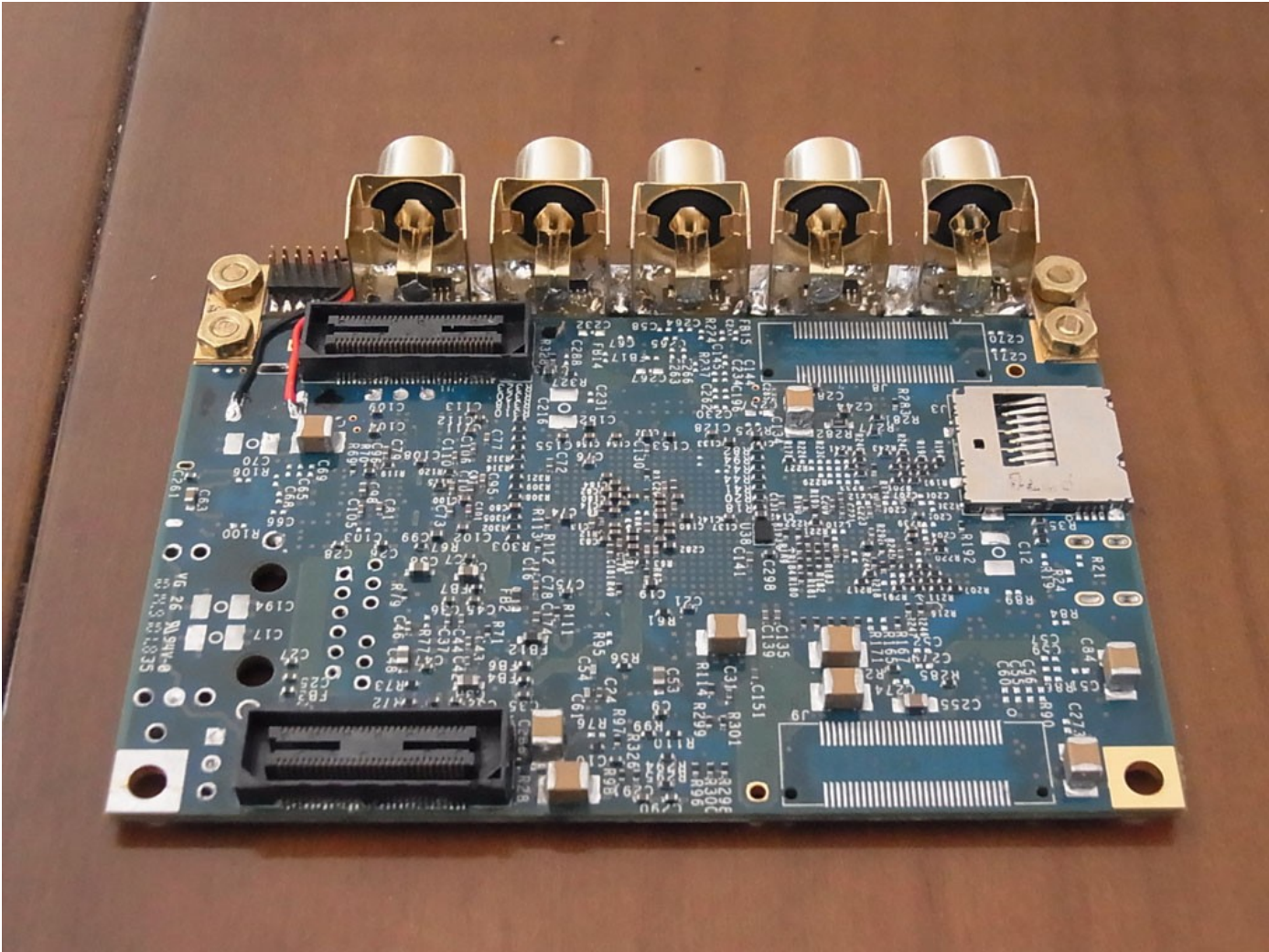
- No JIT or AOT: *interpreted code is slow*
- Garbage collector can kick-in at any times: *system not deterministic*

## Solution:

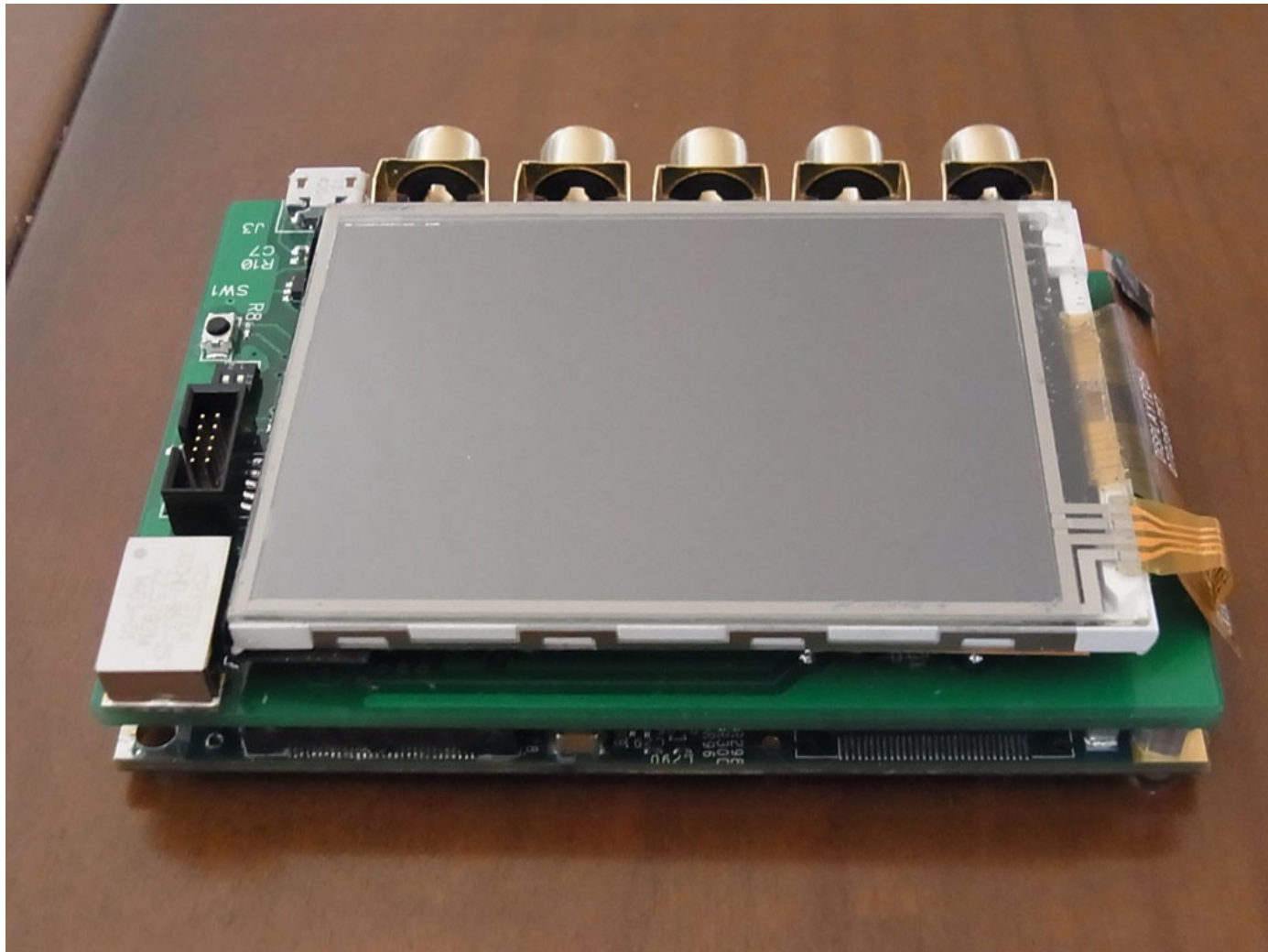
FreeRTOS running on Core #1 overcomes those two limitations



# Parallella with SPDIF in/out



# Parallella with Daughter Card



# Conclusions

## All Programmable SoC

### Pros

- Performances
- Flexibility
- Lower Development Cost

### Cons

- Complexity
- Higher Initial Cost