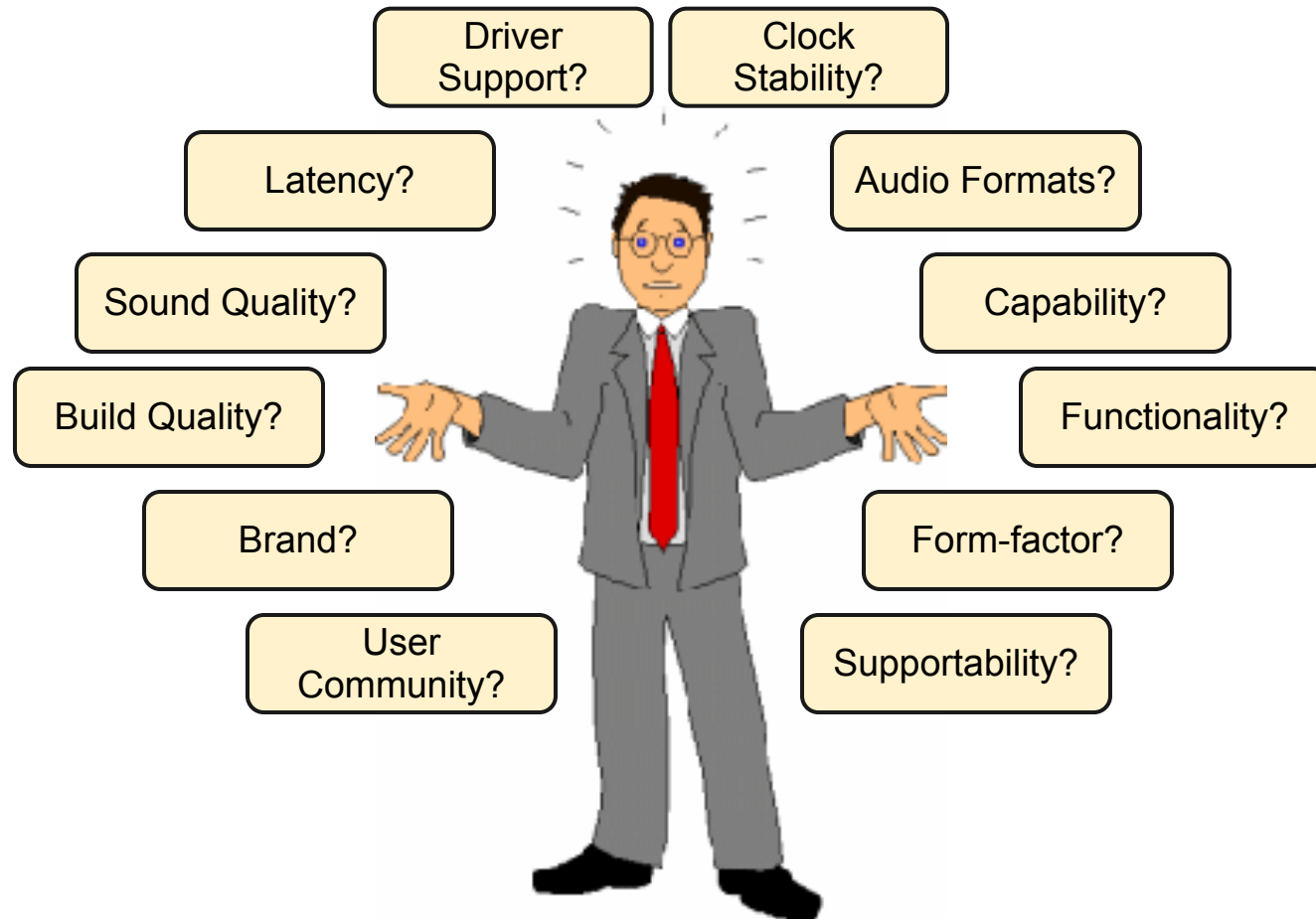


Computer Interfaces for Audio

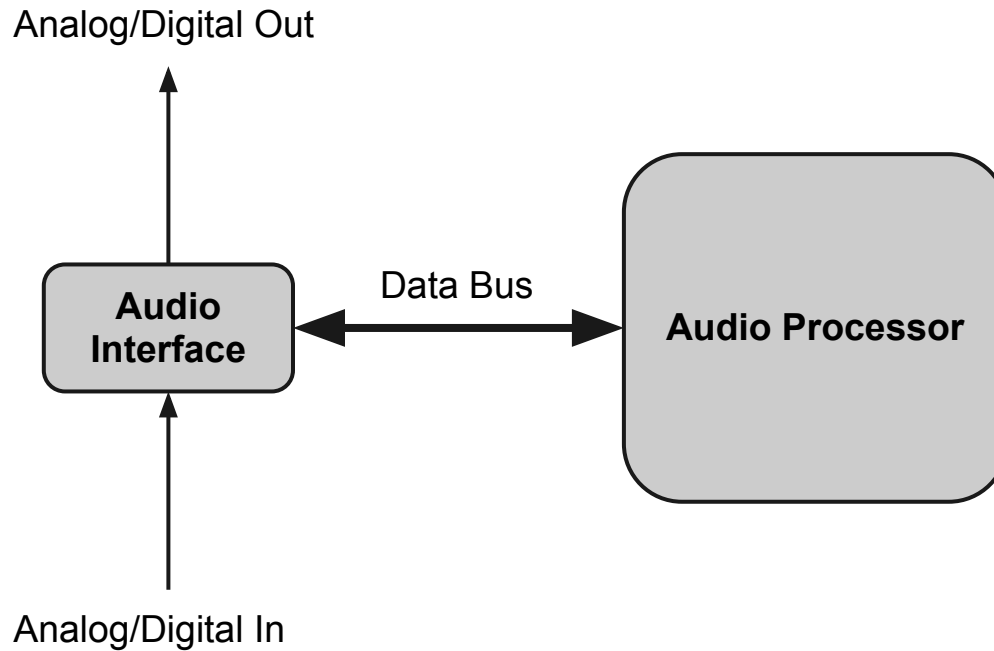
AES Melbourne Section Presentation



Interface Considerations



Audio Processing Device



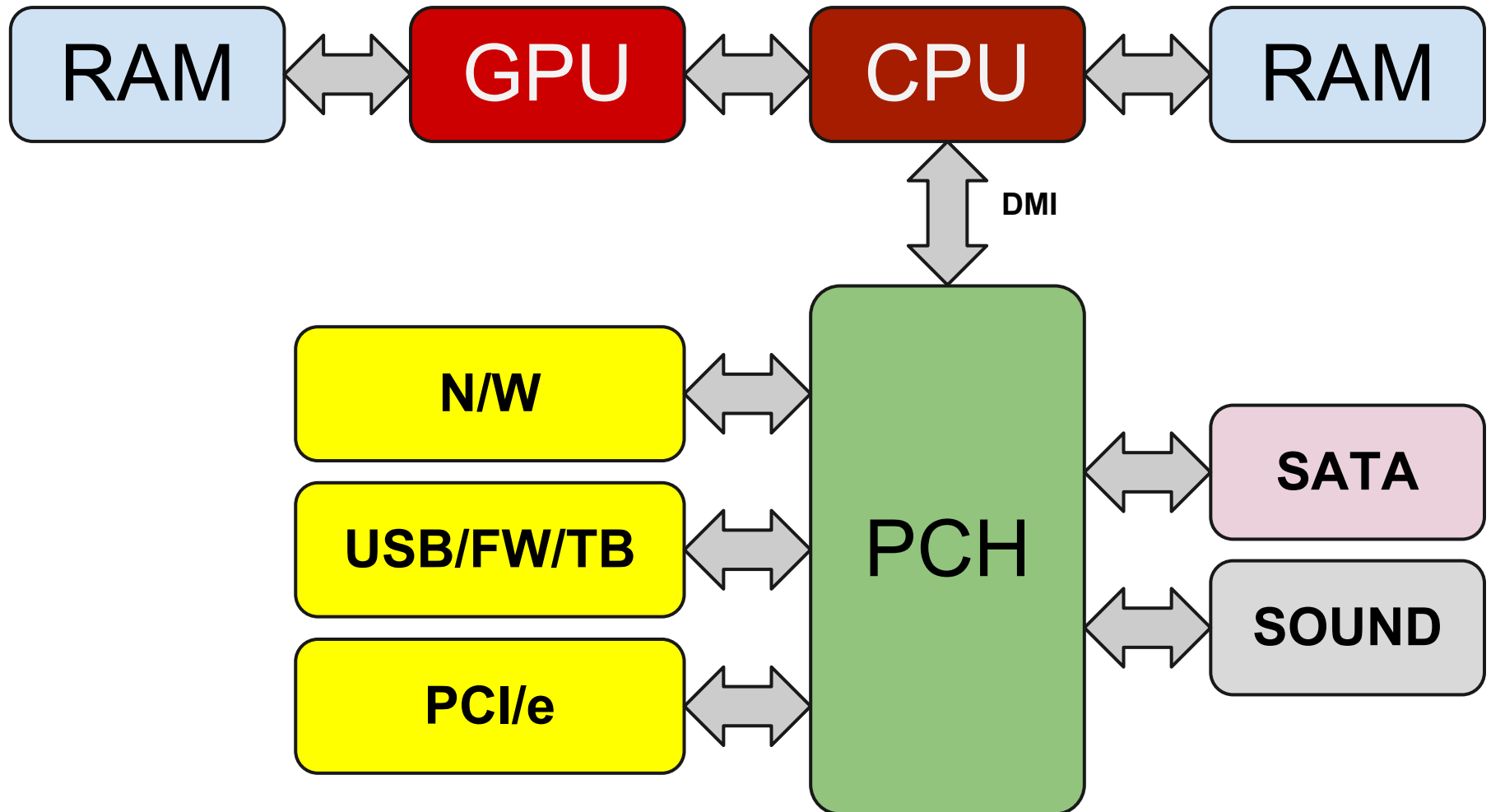
Types of A/P Devices

- Proprietary
- Generic - software based, PC hosted
- Hybrid - PC hosted turnkey solutions

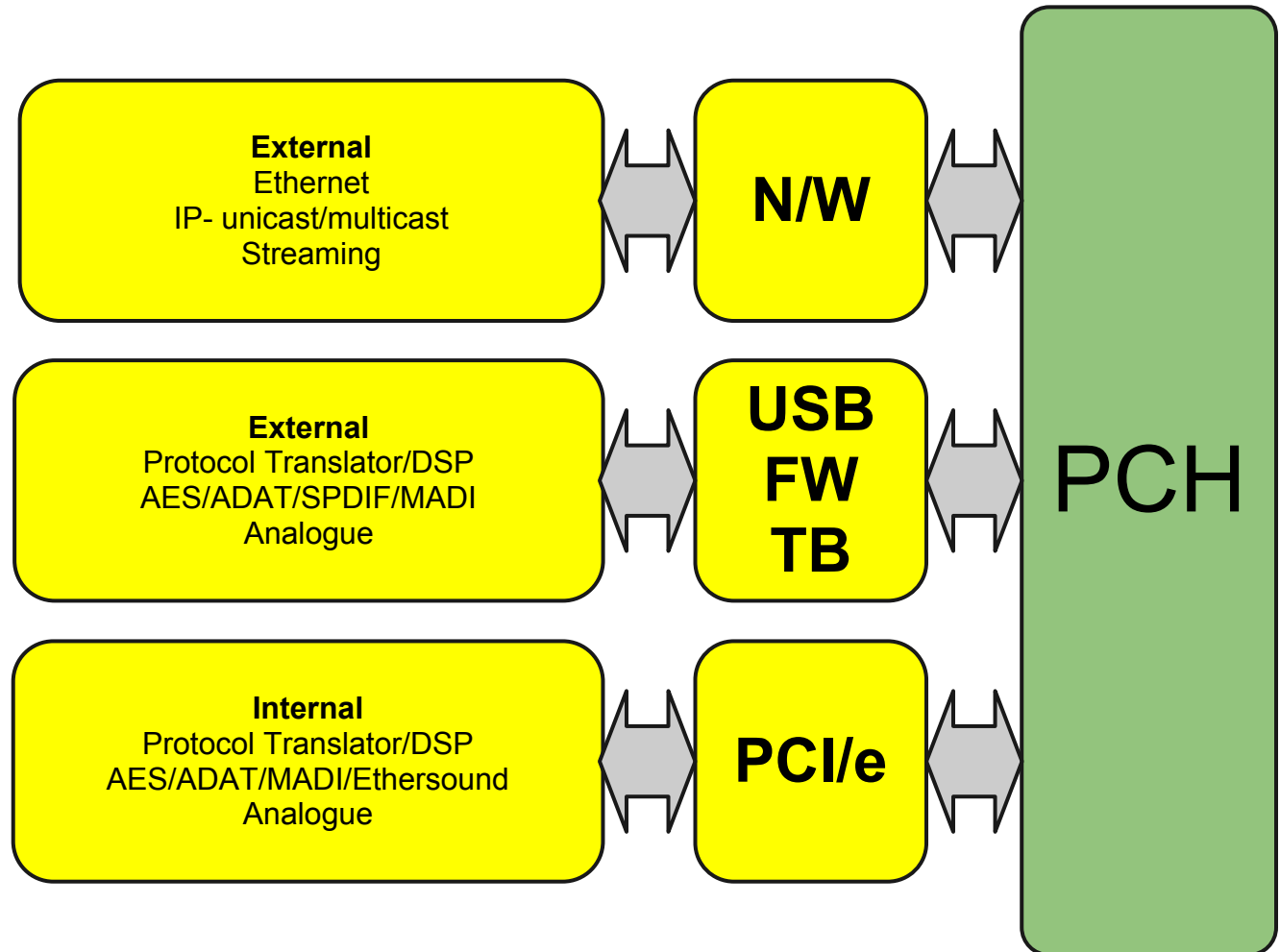
Focus will be on Generic/Hybrid devices.

These both use Generic PC Architectures for information processing.

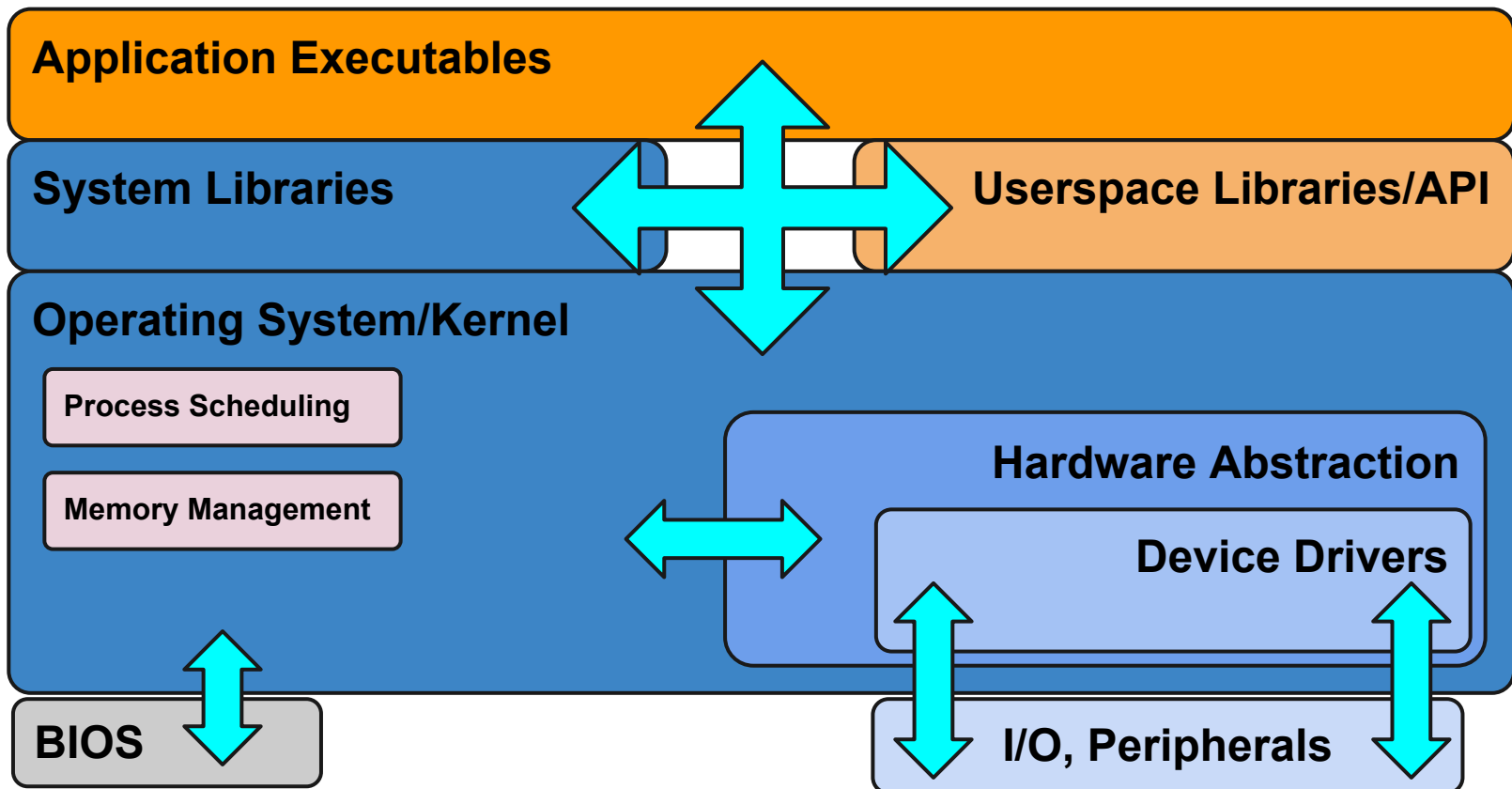
PC Hardware Architecture



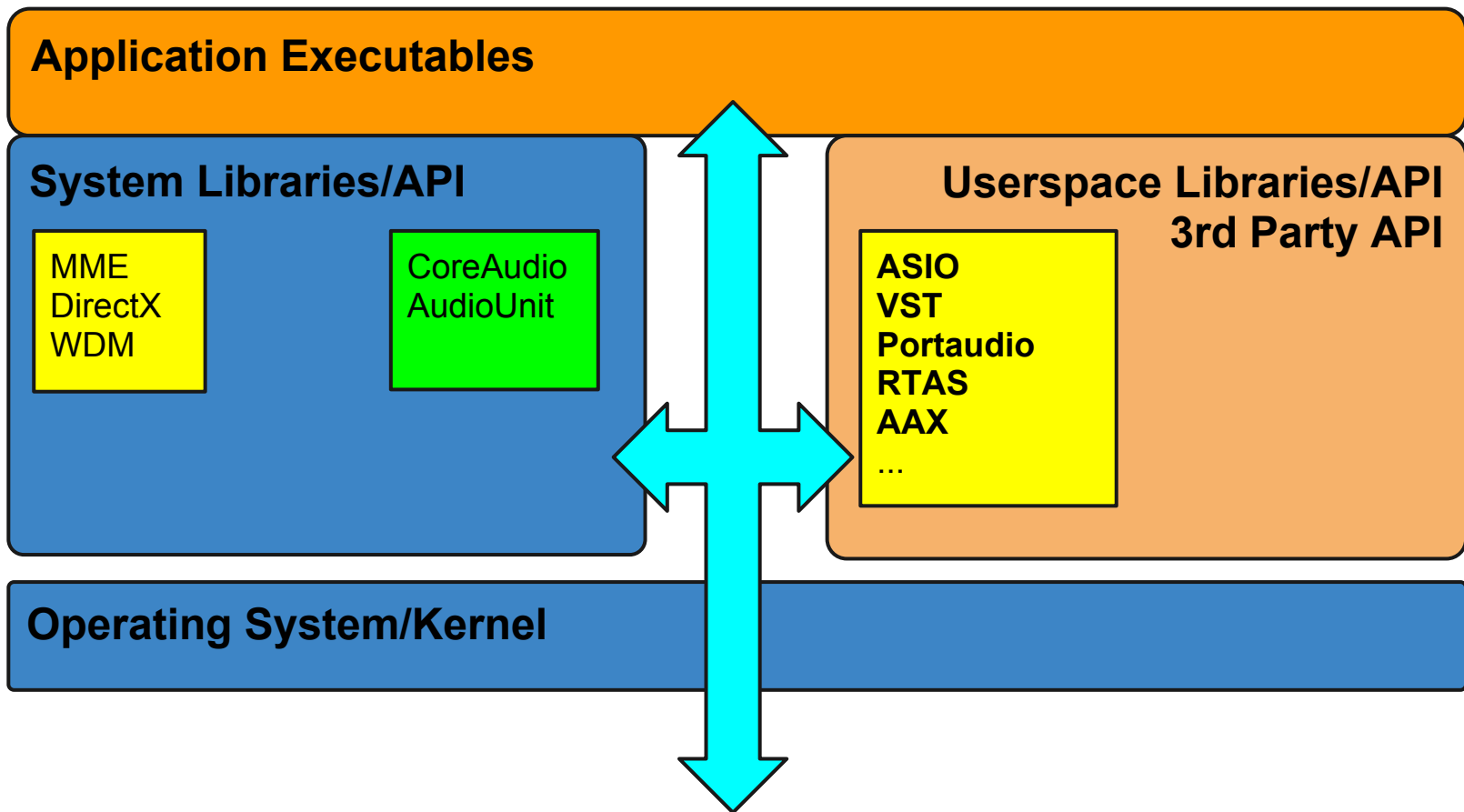
PC Hardware Architecture



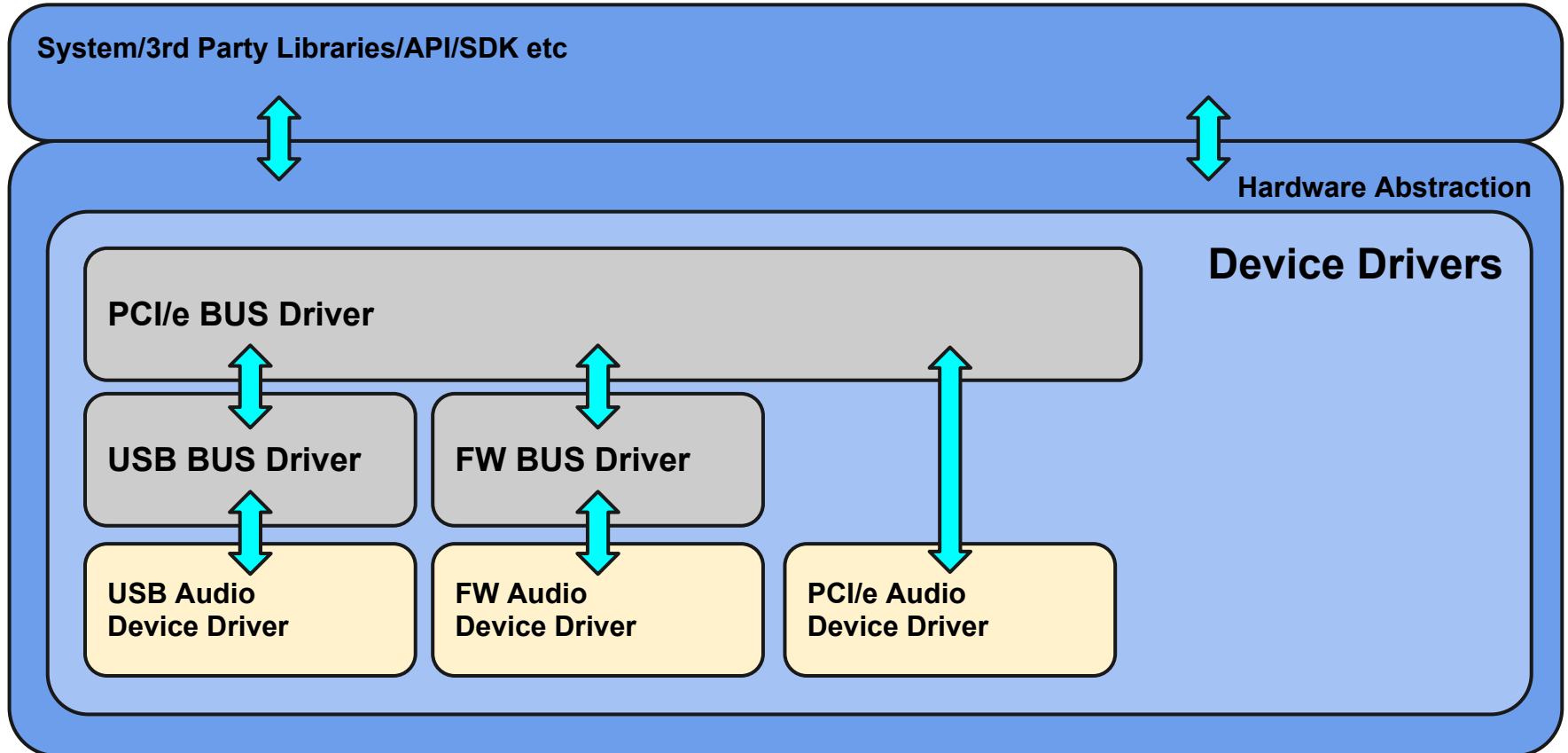
O/S Architecture



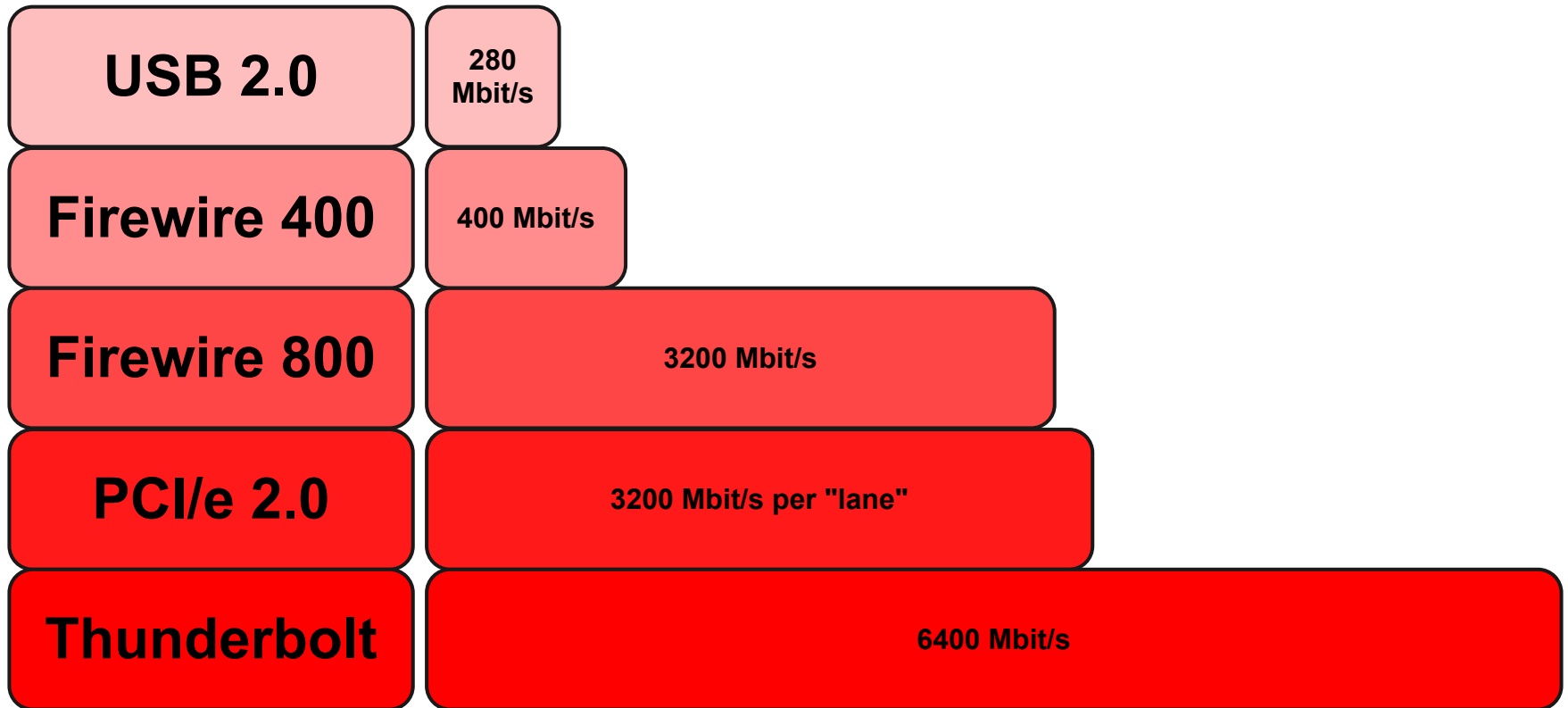
O/S Architecture



Device Drivers



Data Interface Capacities



Interface Examples -

RME Fireface 800

FW800

ADAT

MIDI

FW400

SPDIF

AD/DA



RME Fireface UFX

USB 2.0

ADAT

MIDI

FW400

AES

AD/DA



Lynx AES16e

PCI/e

AES



RME MADIFace

PCI/e

MADI



Interface Characteristics

USB 2/3

- Star/Hub Network Topology
- Published transfer rates are PER CONTROLLER (shared across all devices)
- Host Based (and required)

FIREWIRE 400/800

- Daisy Chain network Topology
- Peer-To-Peer (no host required).

PCI/e

- Host Based - Single device.

Protocol Characteristics

- **MIDI**
 - Serial Data Exchange - Note on/off, Controller
 - Daisy-chained
- **ADAT (Lightpipe)**
 - Digital Audio - point-to-point
 - Up to 8 channels (@ 48kHz)
- **AES3, SPDIF**
 - Digital Audio - point-to-point
 - Up to 2 Channels
- **MADI (AES10)**
 - Digital Audio - Ring Network
 - 64 Channels @ 48kHz

Assumptions for pro work

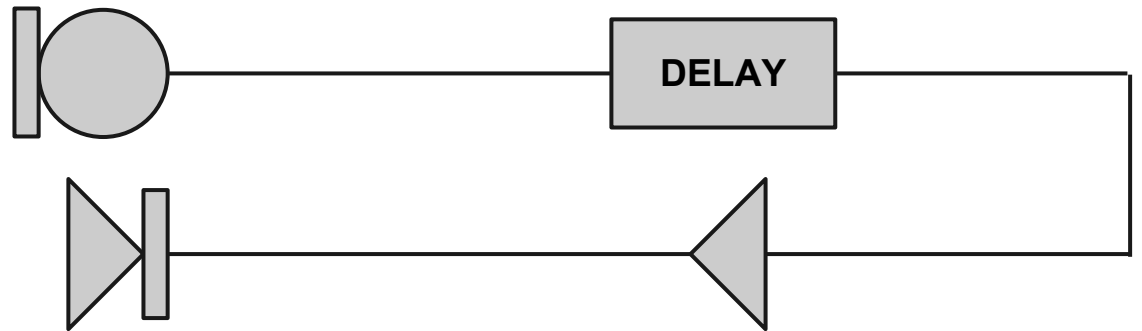
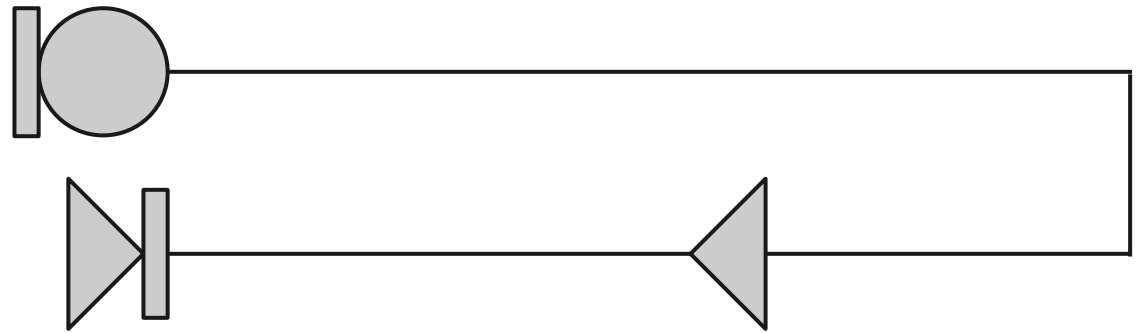
Windows:

- ASIO drivers required

MAC:

- CoreAudio drivers required (default)

What is Audio Latency?

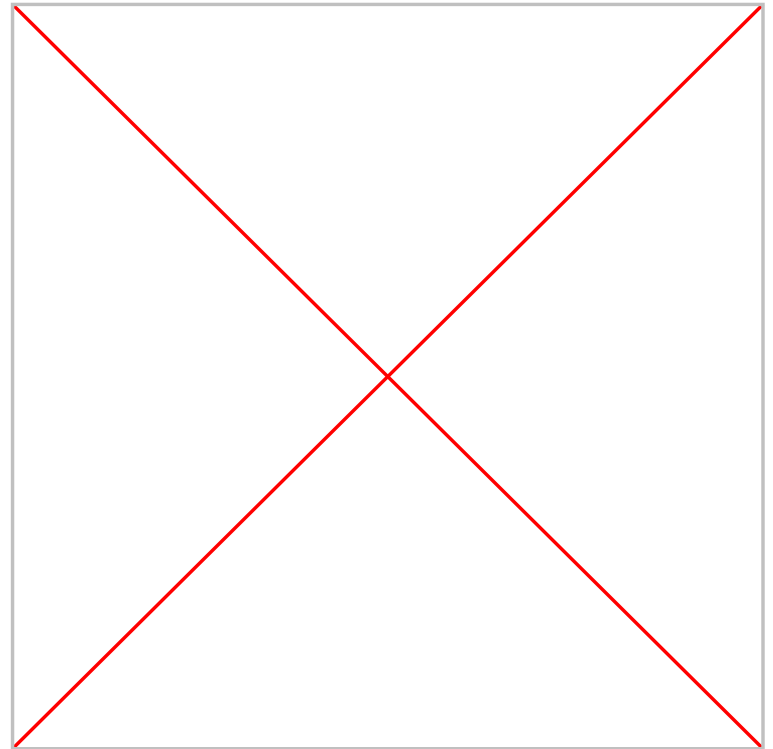


Is this bad?

Brain is wired to experience
Cause and Effect!

With Digital Audio, the "Effect"
is always delayed to some
extent behind the "Cause".

When Recording/monitoring,
Cause/Effect need to be
aligned as closely as possible
and latency minimised.



What Causes Latency?

- Air ($\sim 1\text{ms/ft}$)
- Peripheral Control Bus Drivers/Hardware
- Audio Device Drivers
- Sound/Audio API/SDK libraries
- Audio Buffers (Tunable)
- Processing Filters

Typical Driver Processing Latencies

Windows MME - BAD (>150ms)

Windows WDM - BETTER (30ms-150ms)

Windows ASIO - BEST (1ms-30ms)

AIR 1ms/foot (approx)

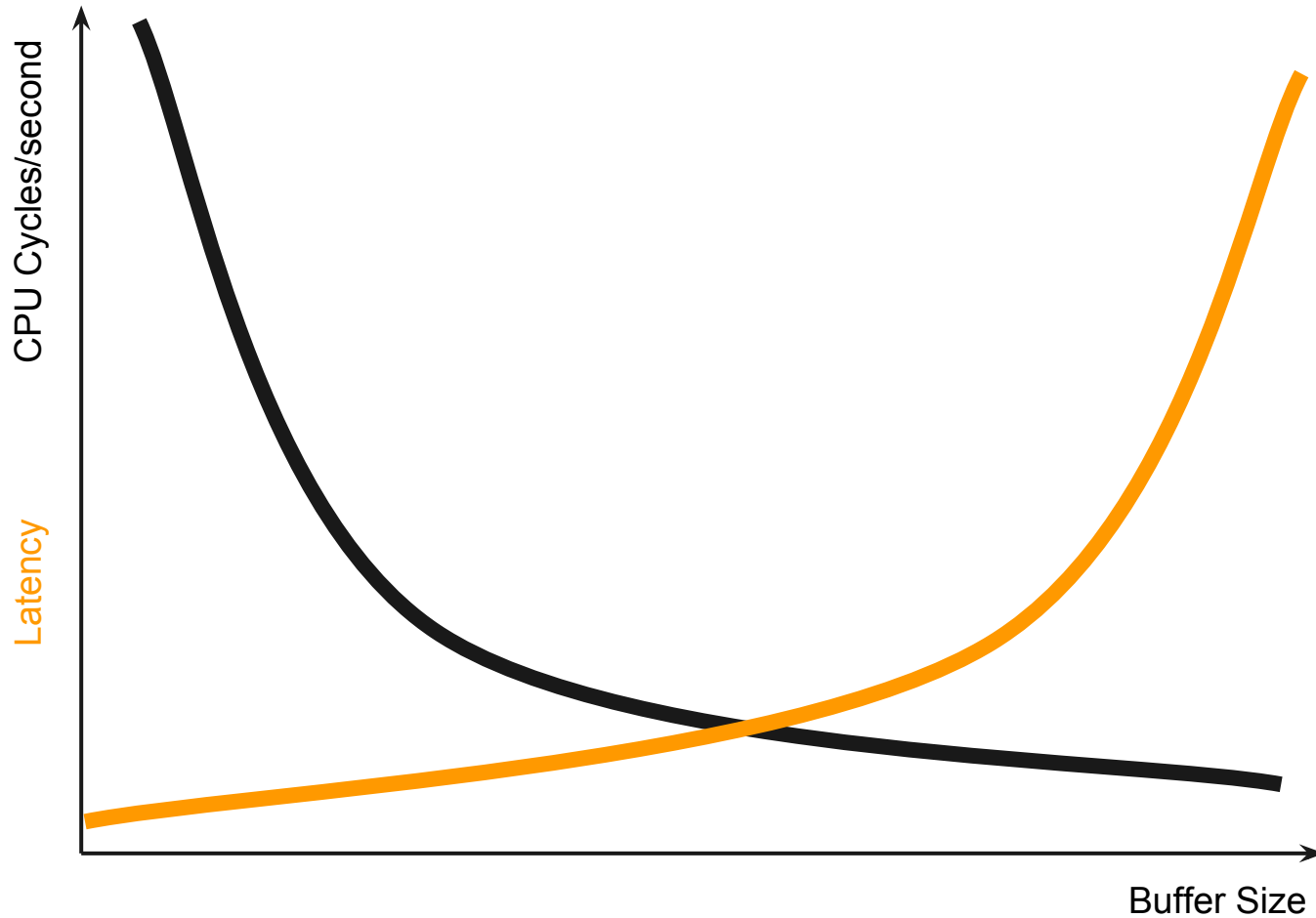
CPU/Latency relationship

Latency in ASIO drivers can be tuned through use of "buffer sizes".

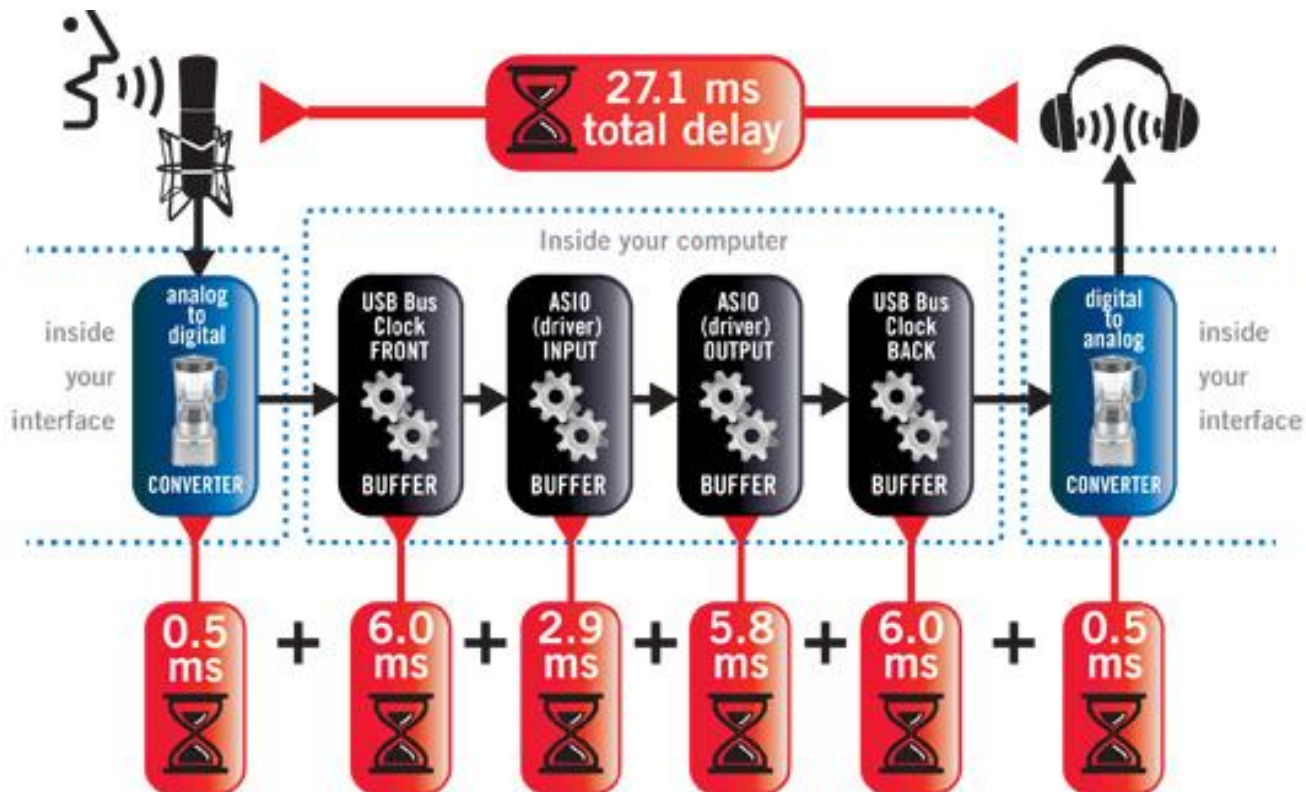
Buffer size determines how many samples are collected before audio processing is performed upon each buffer.

The smaller the buffer, the faster the CPU has to work to pump audio data around the system.

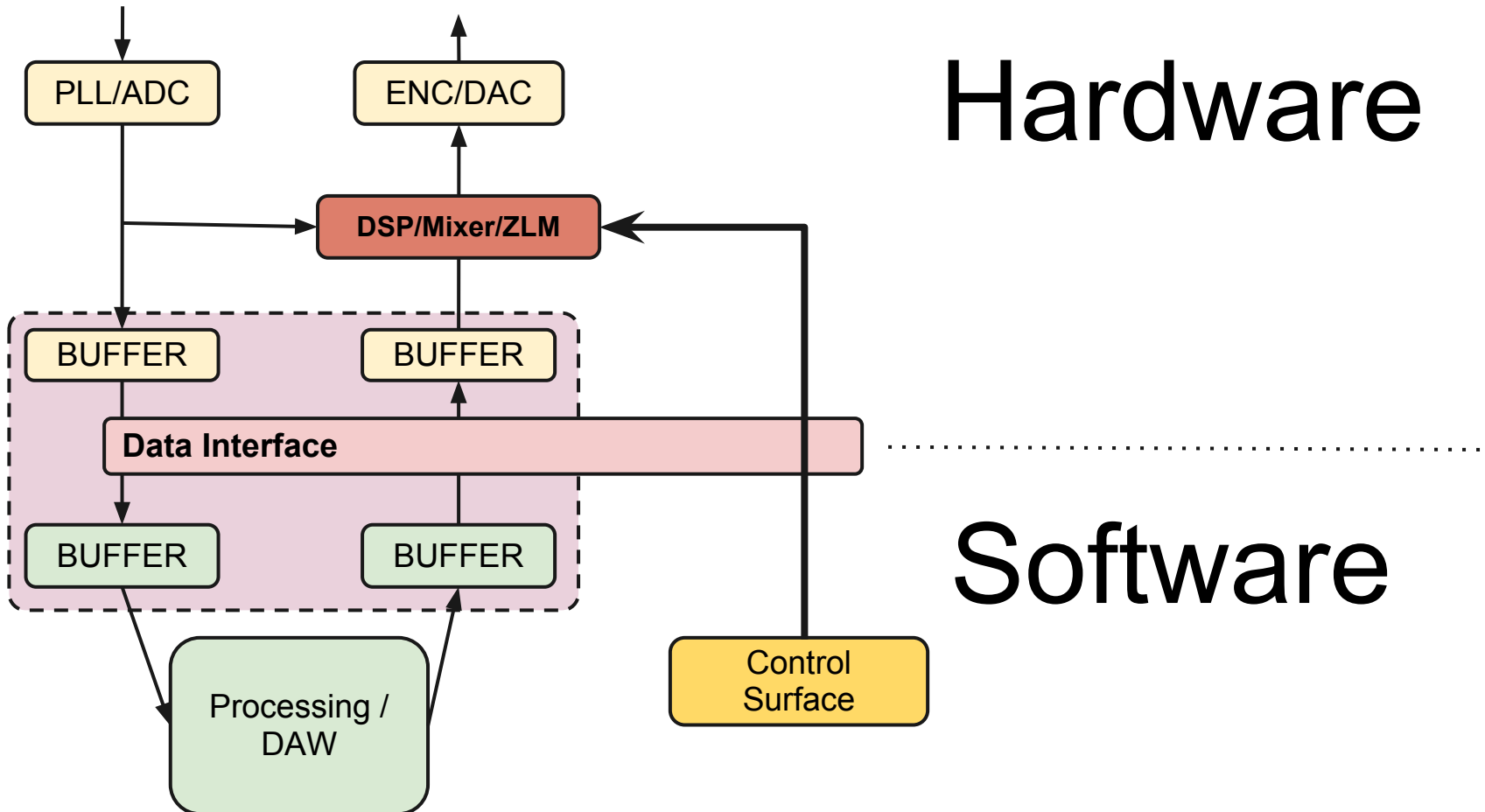
CPU/Latency relationship



Round-Trip Latency



Zero Latency Monitoring



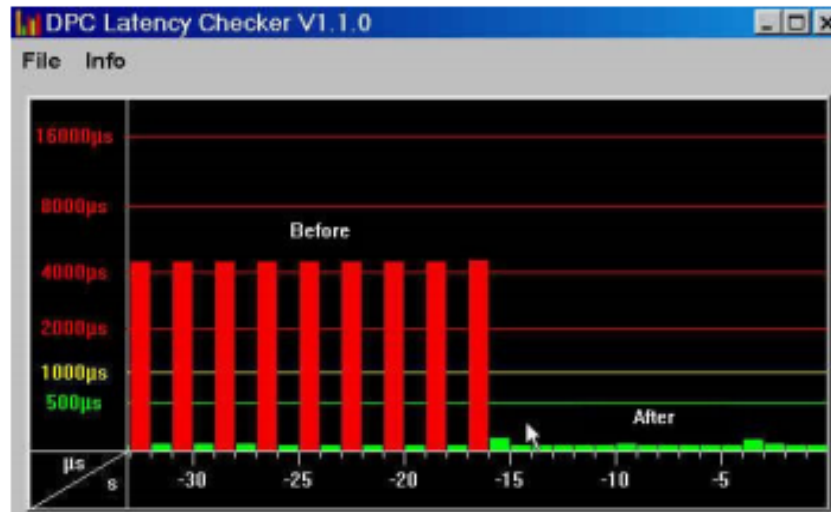
Deferred Procedure Call (DPC) Latency

Windows O/S feature allows high-priority tasks to defer lower priority tasks until they are finished.

Allows a system driver to get top I/O priority for critical tasks.

In badly written drivers, this can cause large amounts of CPU time to be grabbed, and audio to dropout.

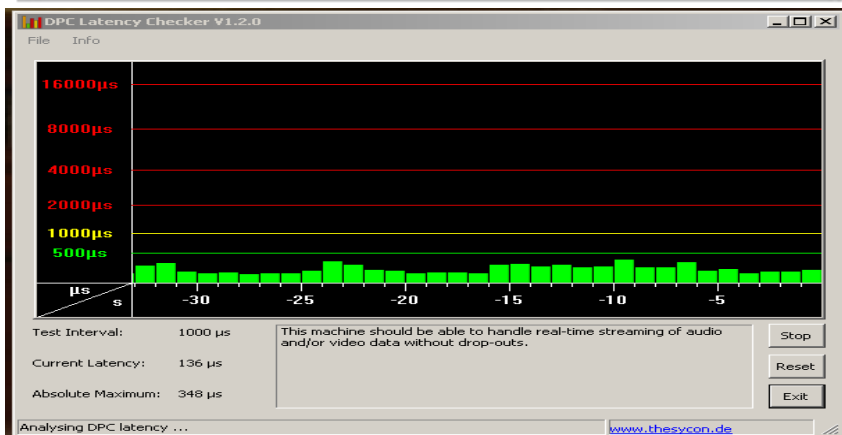
DPC Latency Checker



Use DPCLAT.exe to check and correct processor latency issues.

Common troublemakers:
Network drivers, Wireless drivers, Virus Scanners.

Disable drivers and processes until the red goes away.



Main Functionality Blocks

DSP

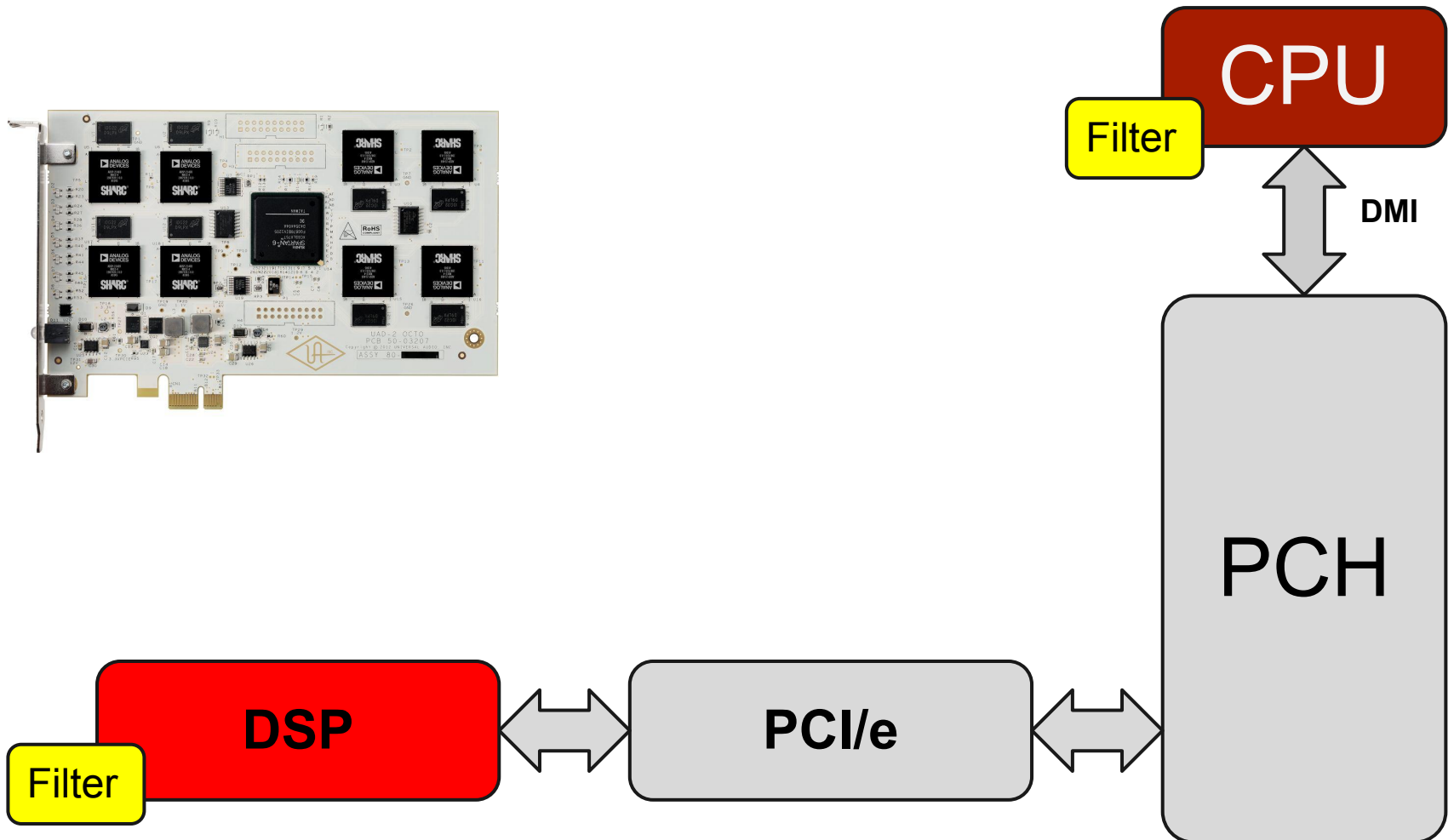
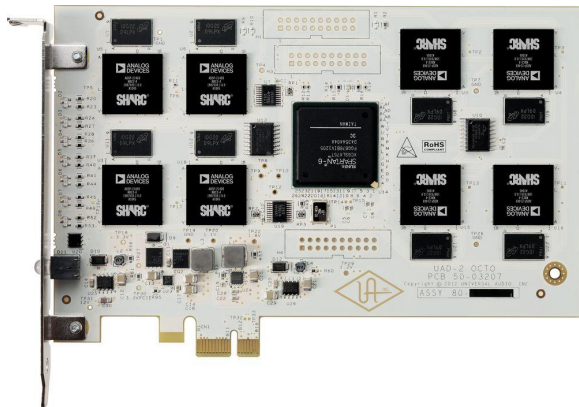
AD/DA

TRANSLATE

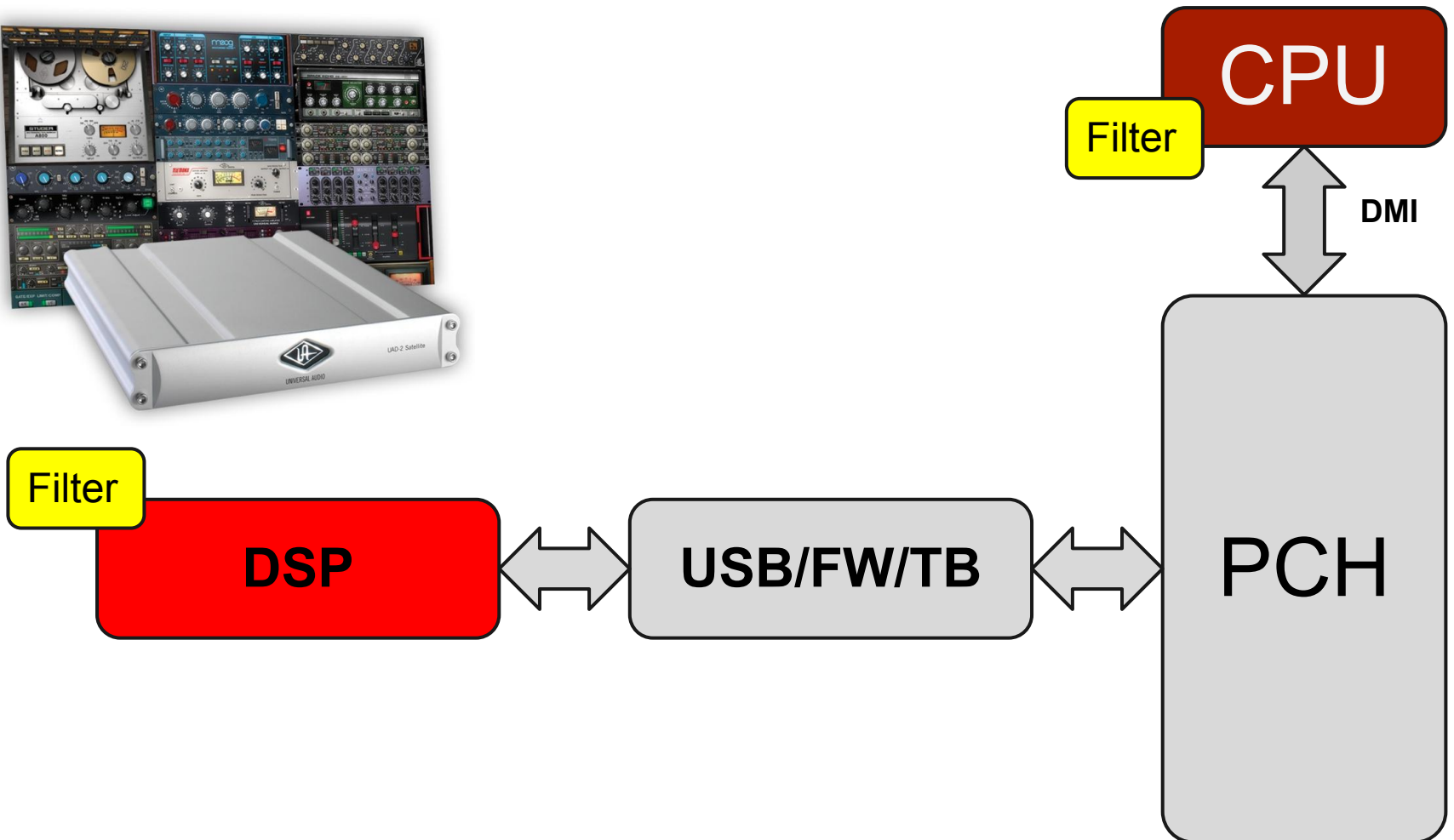
SRC

INTERFACE

DSP/PCIe



DSP/USB



Clocks

No, Not a Coldplay Track...

A Little bit of Digital Audio Theory....(wikipedia)

Analogue audio signal (electrical)

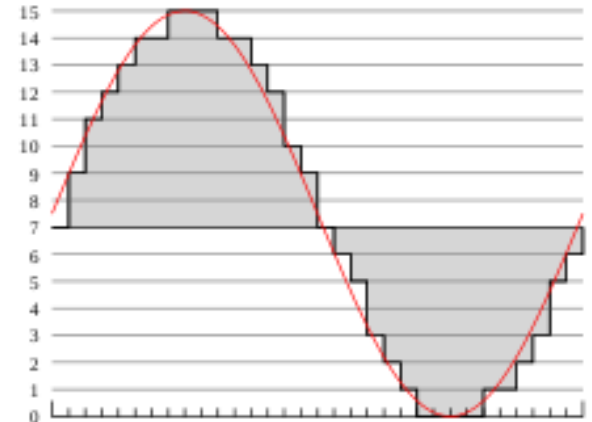
In an analog audio signal, the **instantaneous voltage** of the signal varies **continuously** with the pressure of the sound waves.

Digital Audio Signal

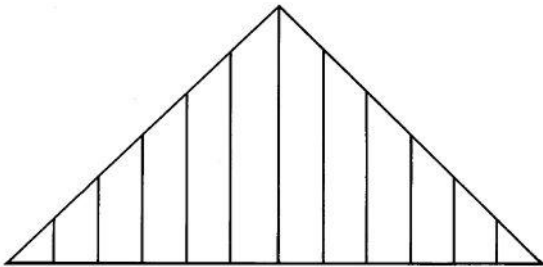
A digital signal, in which a **continuous quantity** is represented by a **discrete function** which can only take on one of a finite number of values (samples).

Digital Audio Sample

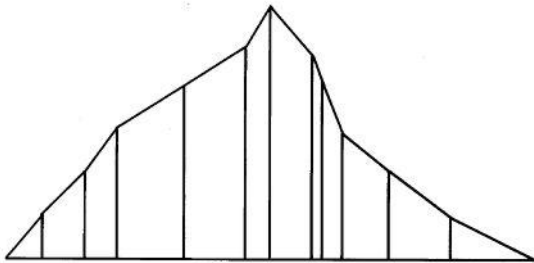
Digital (numeric) representation of the amplitude of an analogue waveform at a specific point in time.



Digital audio and time



A) Analog signal reconstructed correctly with jitter-free clock.



B) Analog signal reconstructed with jittered clock. (Exaggerated for clarity).

Analogue audio is the end goal. Our ears are analogue devices.

An Accurate Clock is required to reconstruct the analogue waveform from the digital audio data stream.

Clocks

Required to synchronise independent digital sources.

48.0001kHz

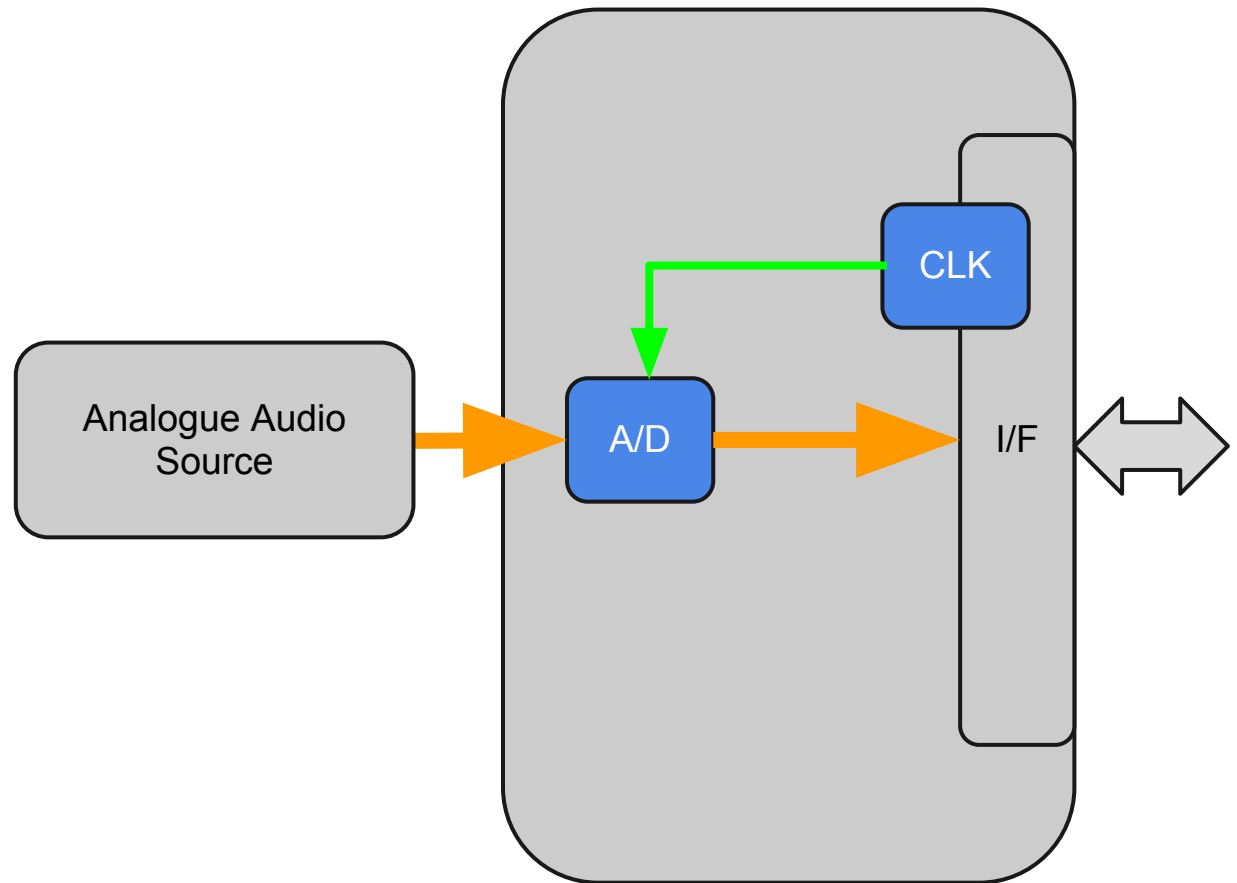
47.9999kHz

48.0000kHz

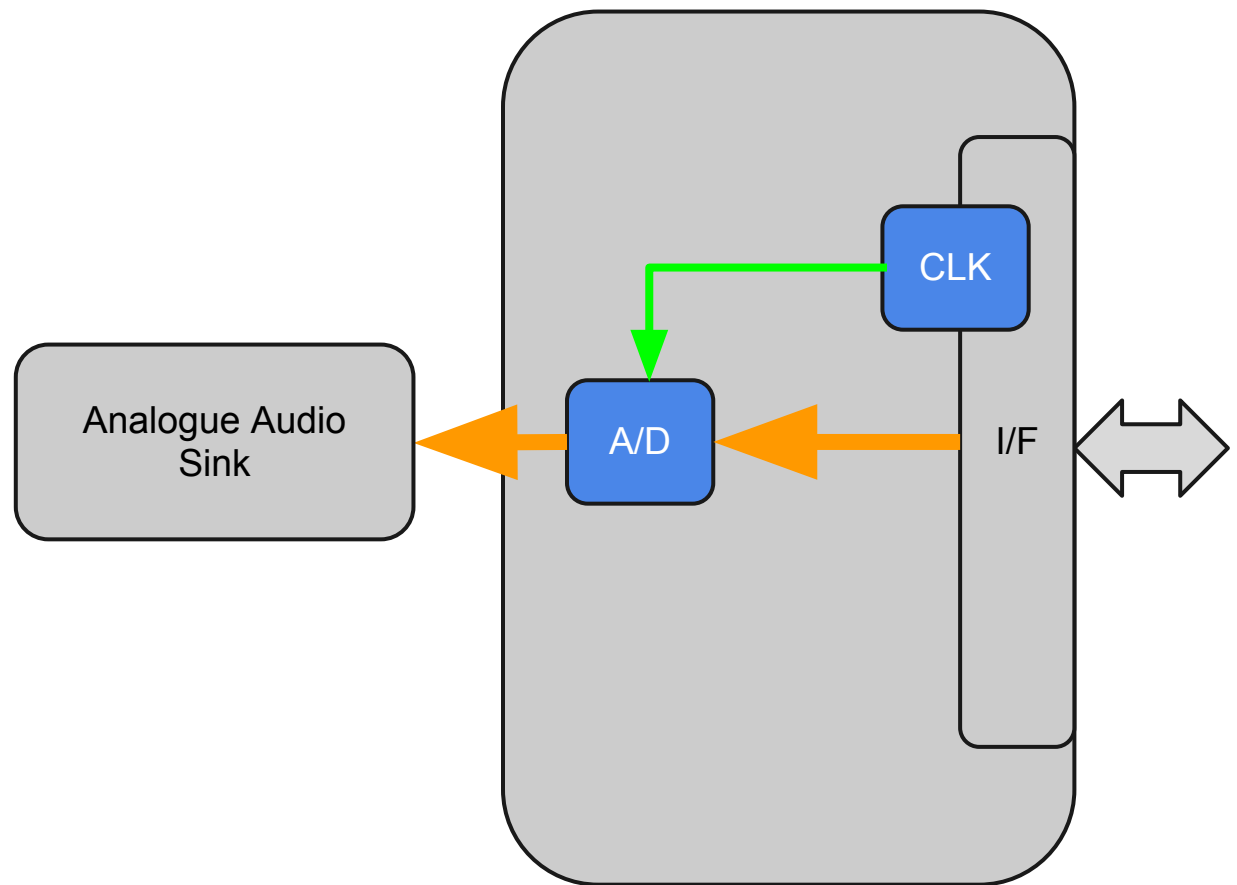
Clock Error / Jitter =

Increased noise & Total Harmonic Distortion.

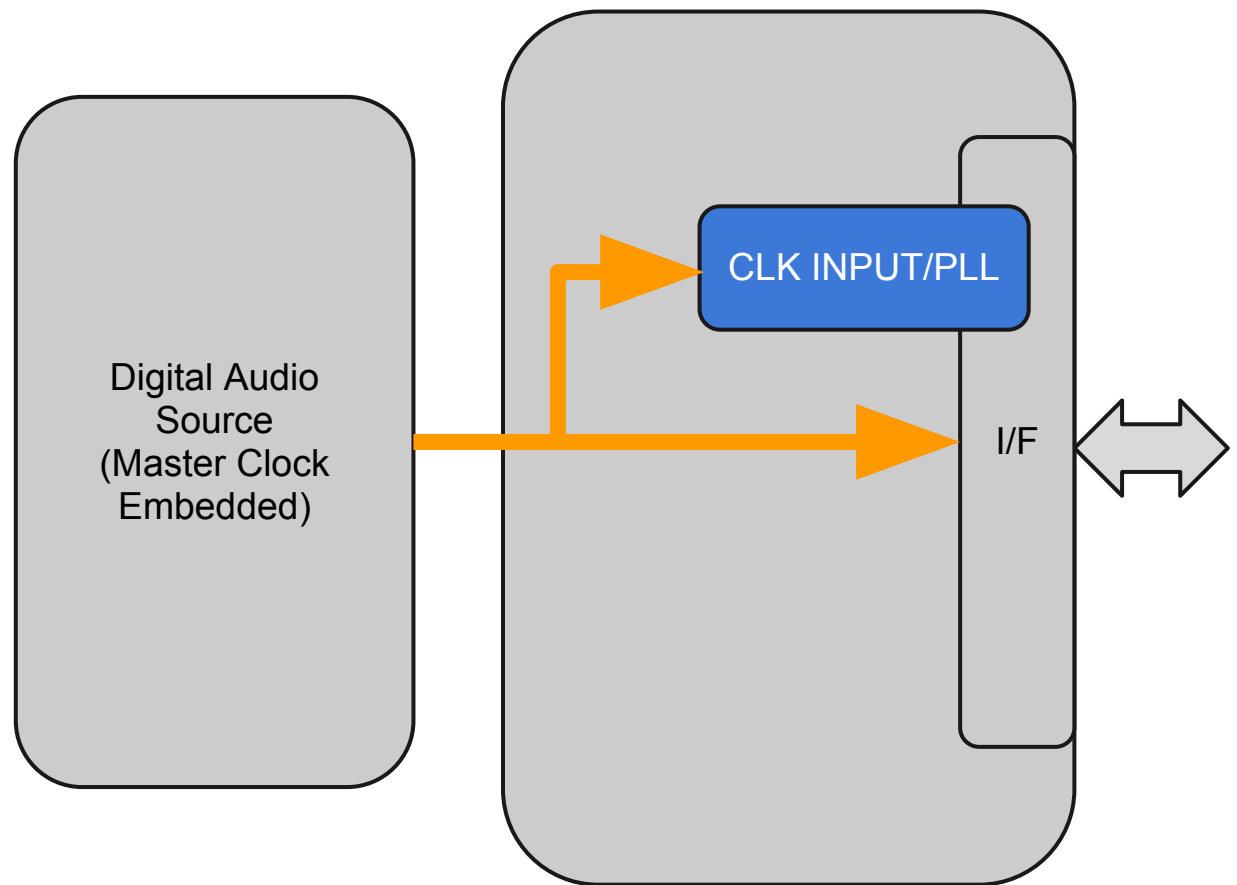
Analogue Audio Input



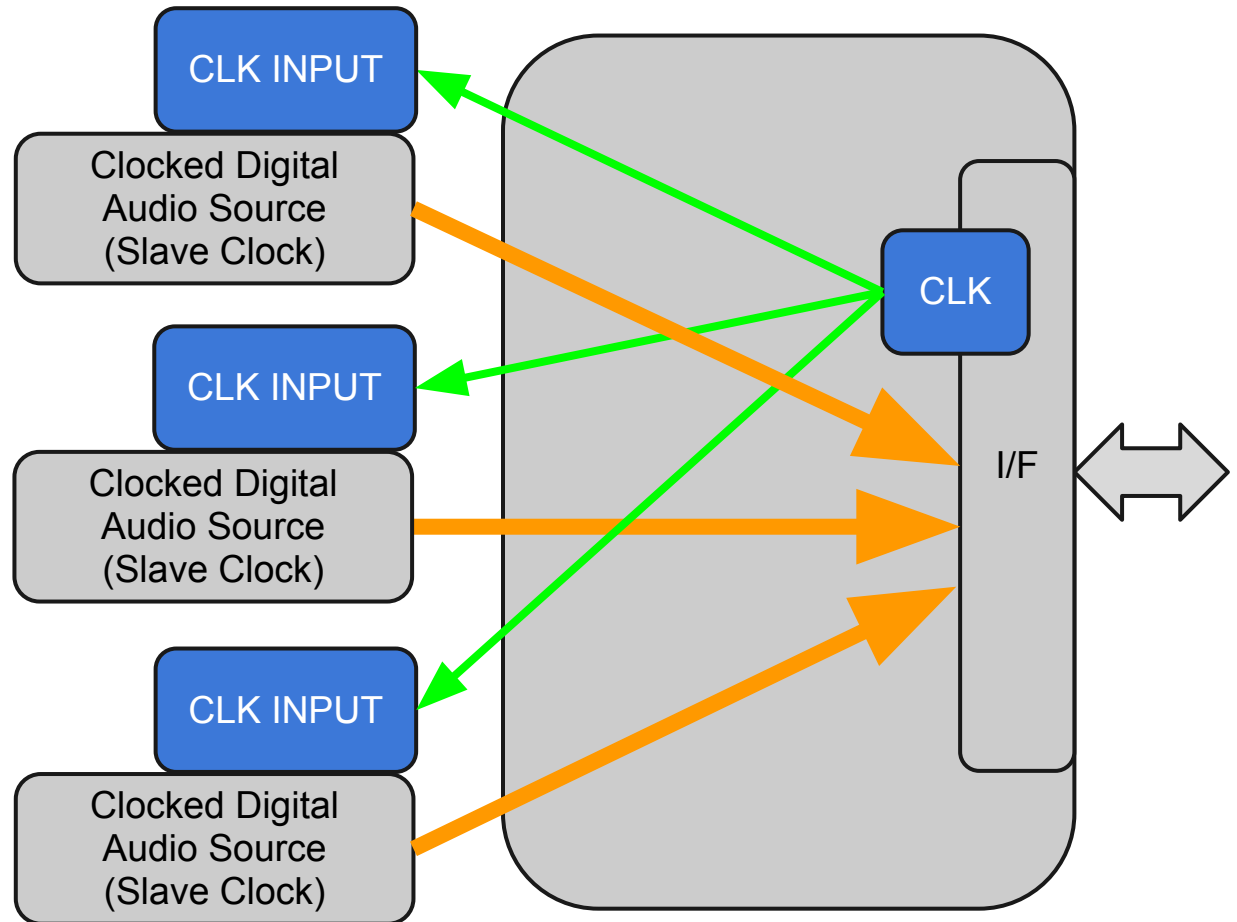
Analogue Audio Output



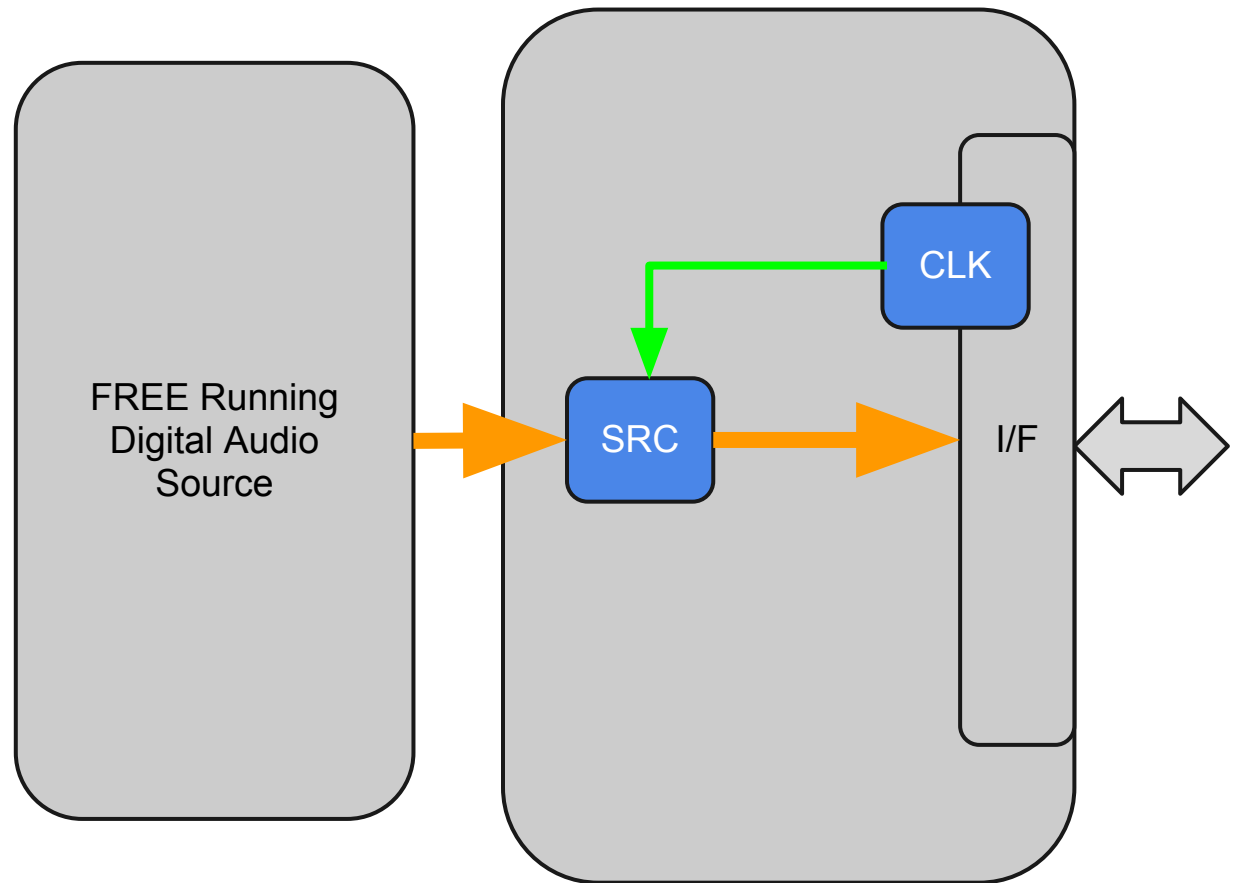
Digital Audio Input



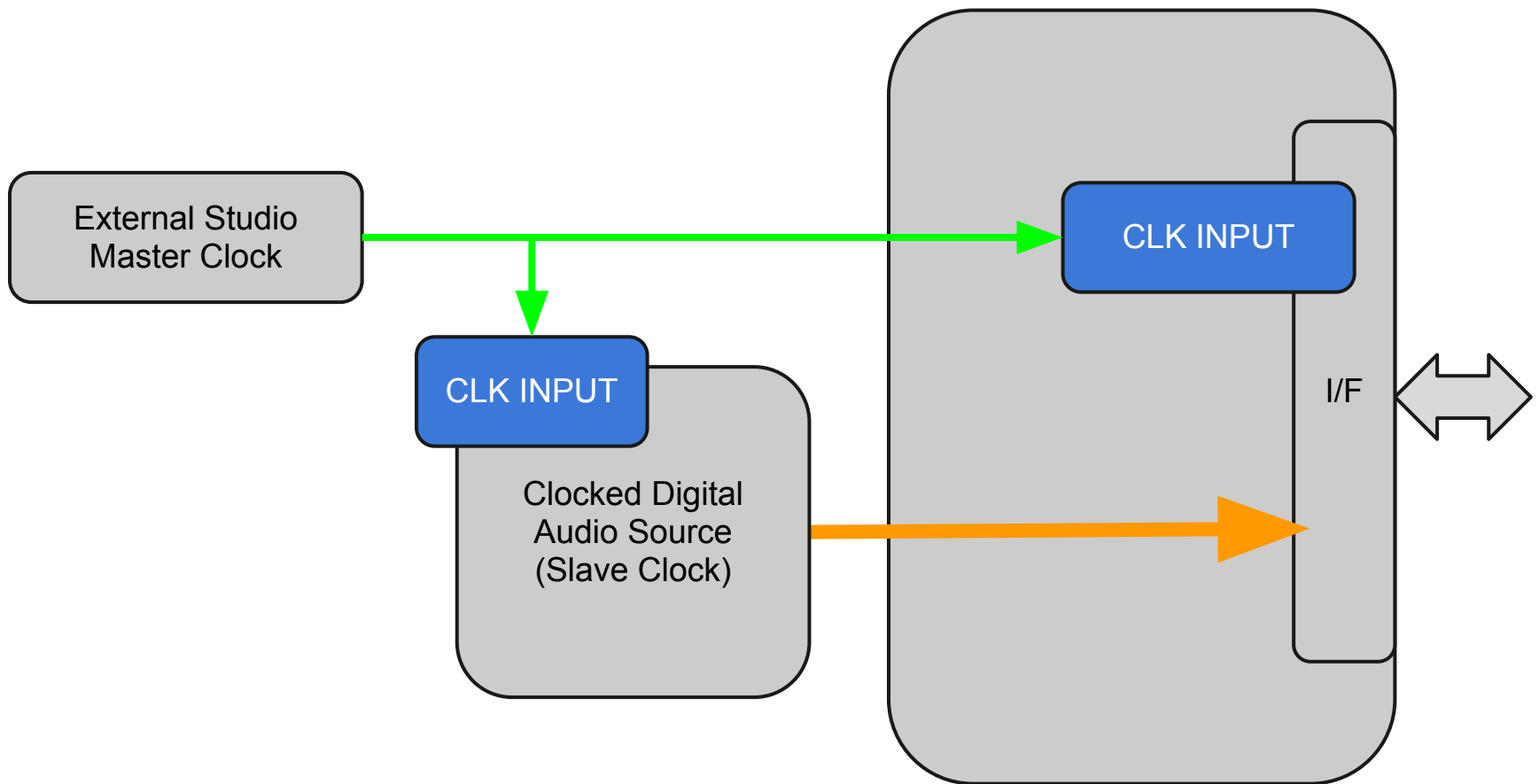
Digital Audio Clocks



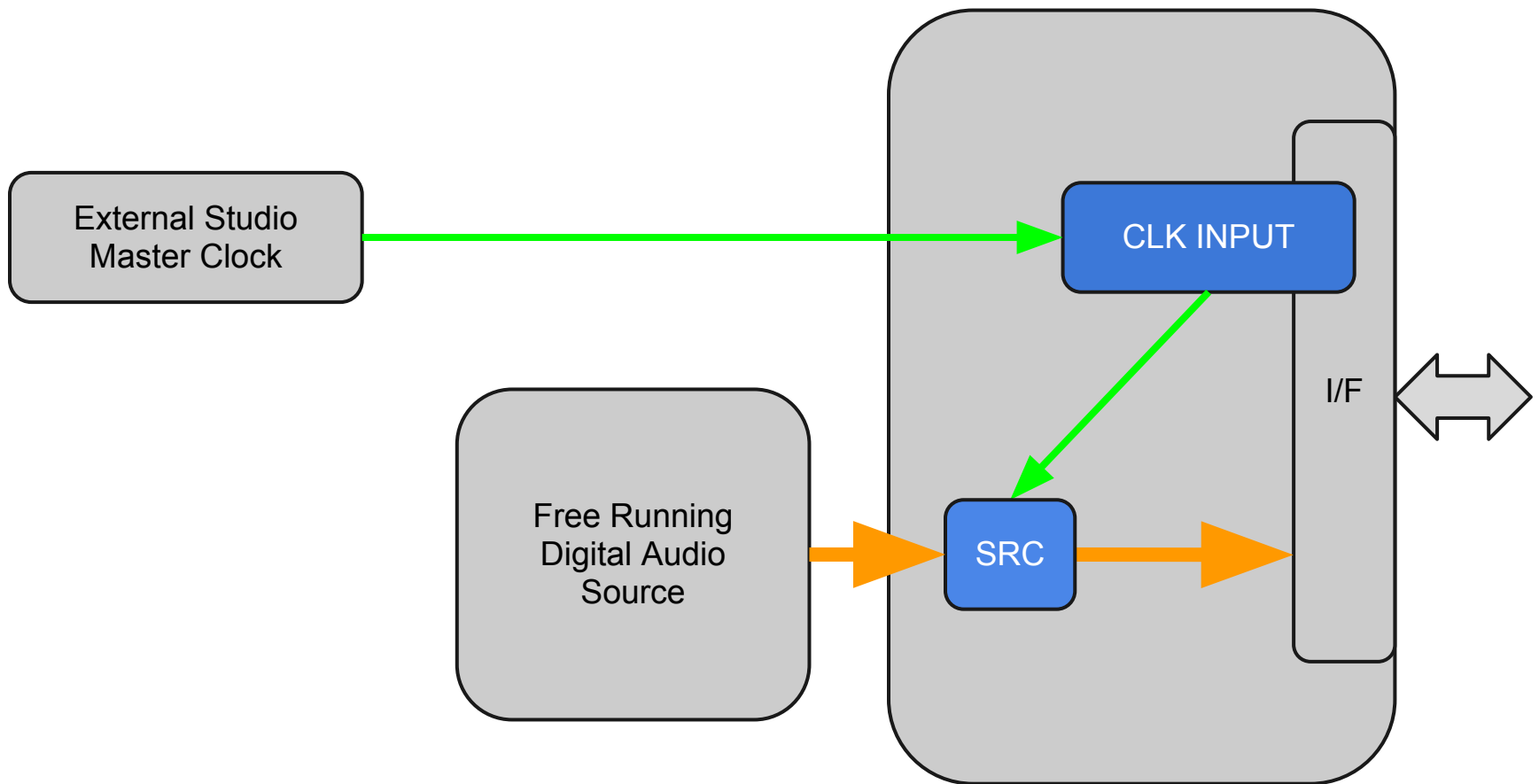
Digital Audio Input - SRC



Digital Audio Input



Digital Audio Input - SRC



Analogue Audio Input

