RAC: Real-time Audio Coordination Framework for Immersive Sound Platform

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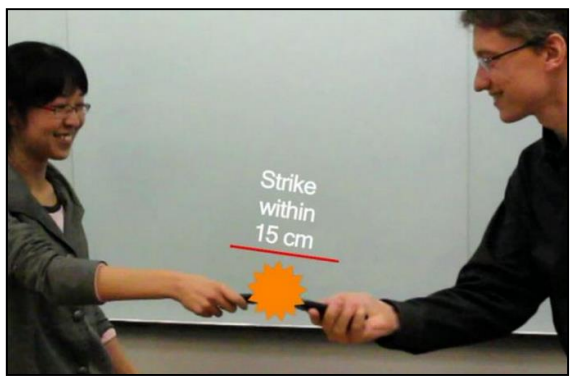
Motivation: Real-time Audio Apps.

Many real-time audio applications are emerging.

Specifically, many of them use an audio device for measuring something based on acoustic sensing.

1. Localization
- *GuoGuo (MobiSys '13)*
- *SwordFight (MobiSys '12)*

2. Gesture recognition
- *SoundWave (SIGCHI '12)*
- *AirLink (UbiComp '14)*
- *Spartacus (MobiSys '13)*

3. Mobile acoustics
- *Mobile Maestro (UbiComp '14)*

Mobile Multi-speaker Audio (MMA) Apps

As one of them, MMA apps use loudspeakers of mobile devices collaboratively for immersive sound (e.g., 5.1ch surround sound)
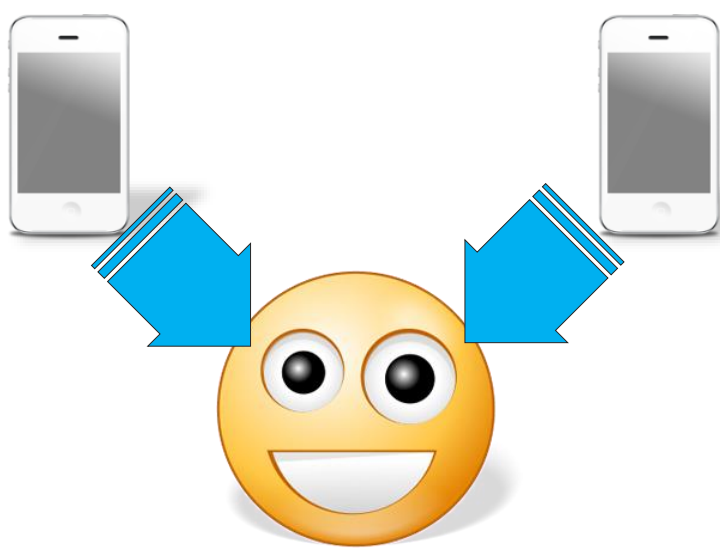
Example: on a camping site, users easily can construct a spectacular surround sound for an action movie through MMA applications.
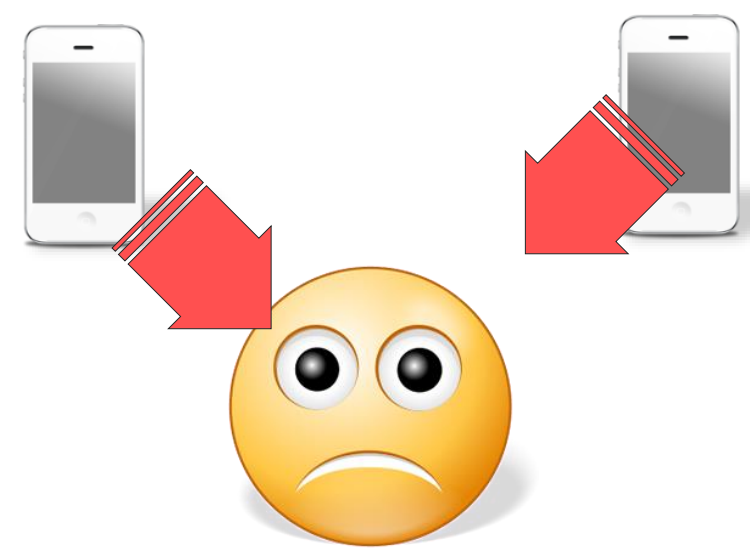
Timing Requirements of MMA Apps

Multiple mobile devices should be harmonized in terms of sound arrival time.
"A high degree of accuracy in sound arrival time (up to 1 millisecond)"
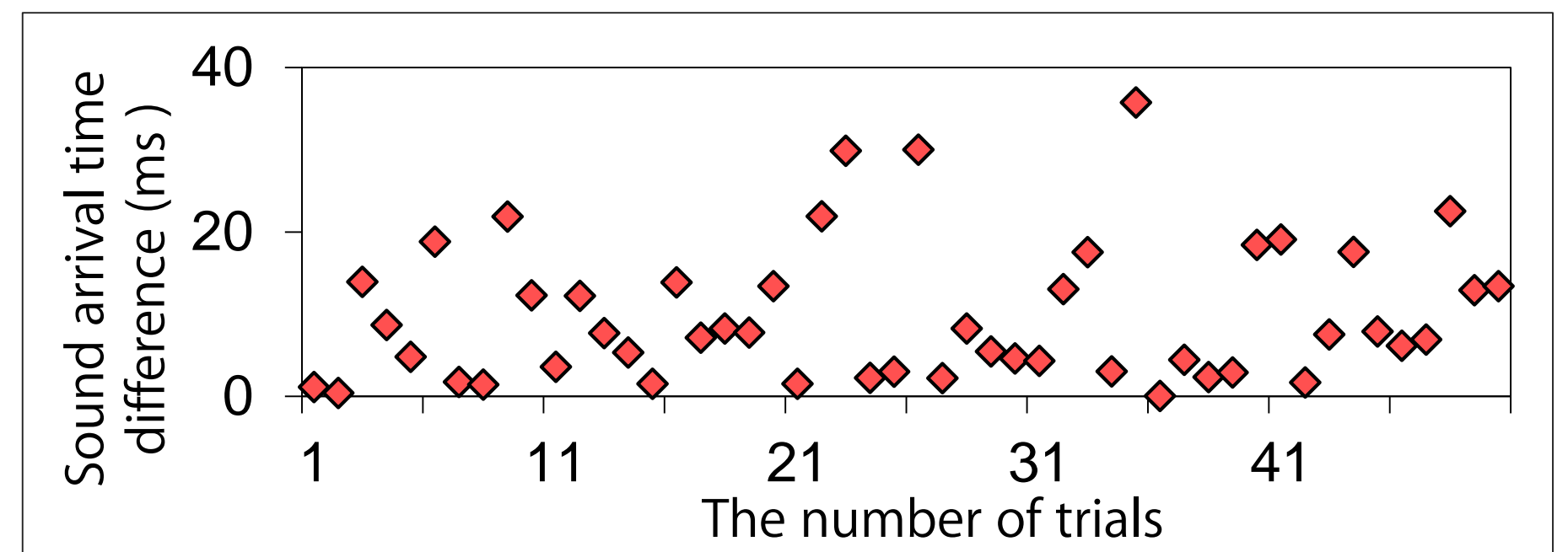
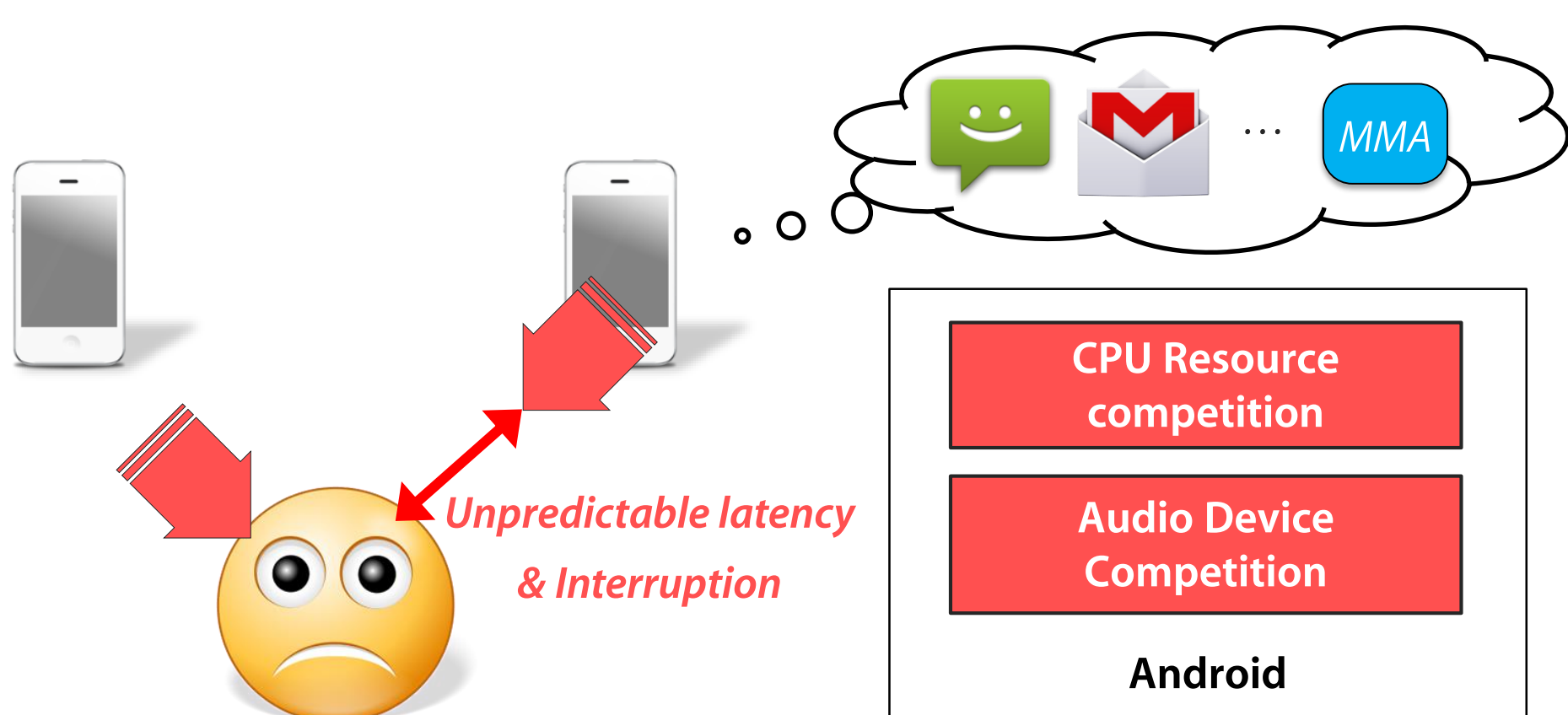*Harmonized*
(Within 1 millisecond)

Not harmonized
*(More than 1 millisecond)*

## Challenge: Unpredictability on Android

Commodity mobile devices do not offer tight timing guarantees for playing back audio streams.

Unpredictable latency & Interruption

CPU Resource competition

Audio Device Competition

Android

Sound arrival time difference of two devices on Android platform:
Due to the unpredictability of Android, the difference is randomly distributed [0, 35.7ms]

Real-time Audio Coordination (RAC)

We propose Real-time Audio Coordination (RAC) framework to support predictable audio playback of MMA apps.

MMA

Real-time CPU Scheduling

Priority-based Audio Device Scheduling
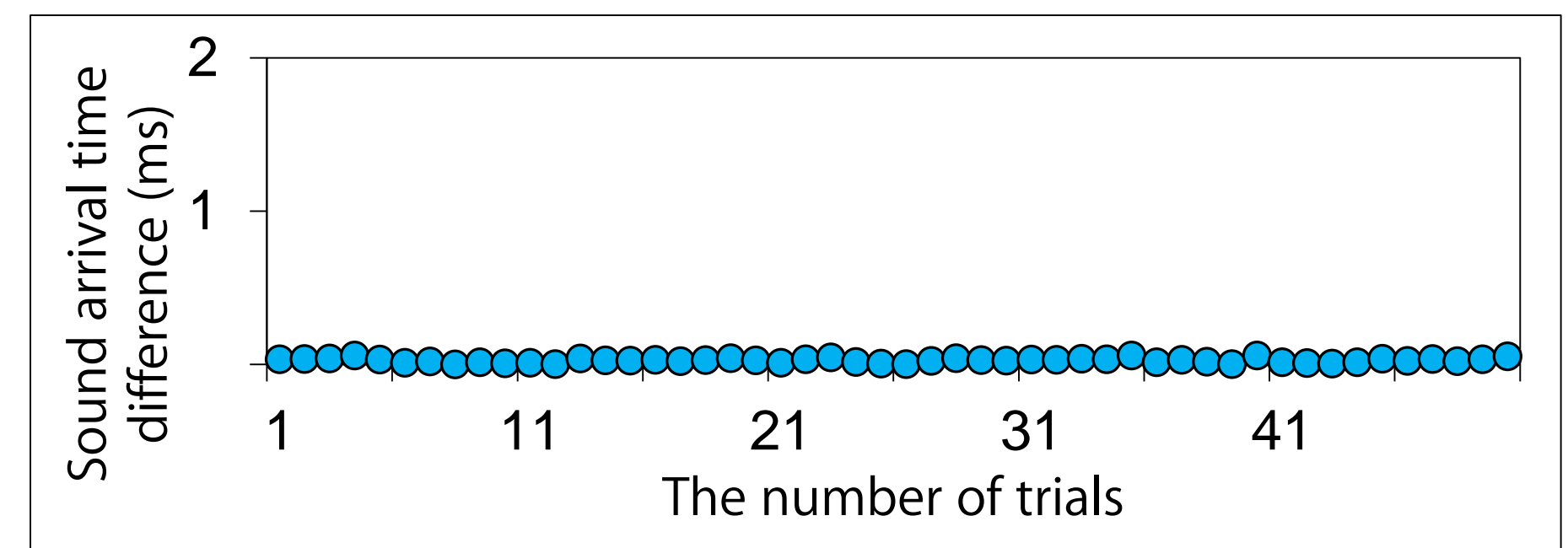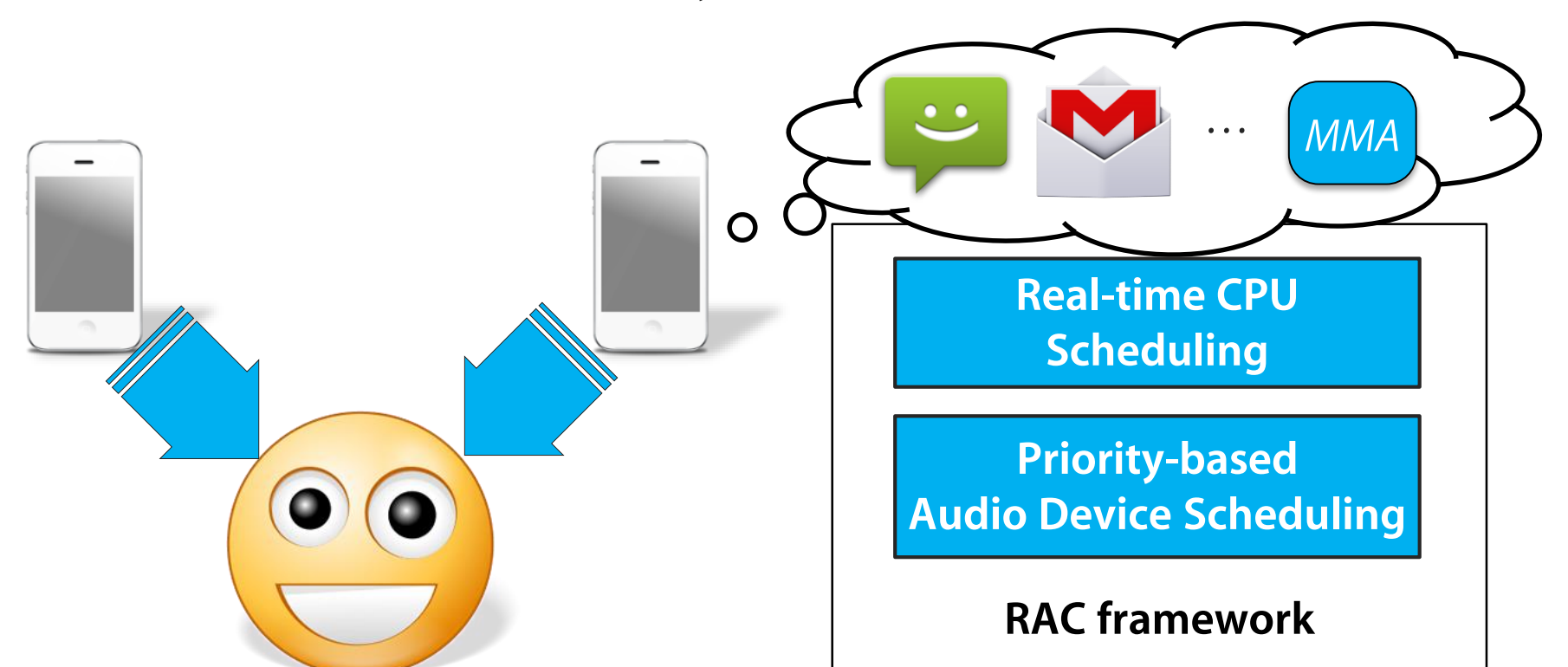
RAC framework

Sound arrival time difference of two devices on the RAC framework:
In all cases, the RAC framework supports the timing requirement (1ms).

In This Demo: Mobile Theater

You will experience Mobile Theater, a mobile 5.1ch surround sound system, based on [1] Android and [2] RAC

Scenarios

1. Other applications are already running while competing for CPU

2. Users construct a 5.1ch surround sound system using Mobile Theater, and watch a movie.

3. During the playback of Mobile Theater, one of players gets a message and a notification alarm is requested.

I've got new message!!

MMA