APPLYING FUEGO WITH AUDIO TEST AUTOMATION TO AUTOMATE MULTIMEDIA VERIFICATION FOR AGL DISTROS

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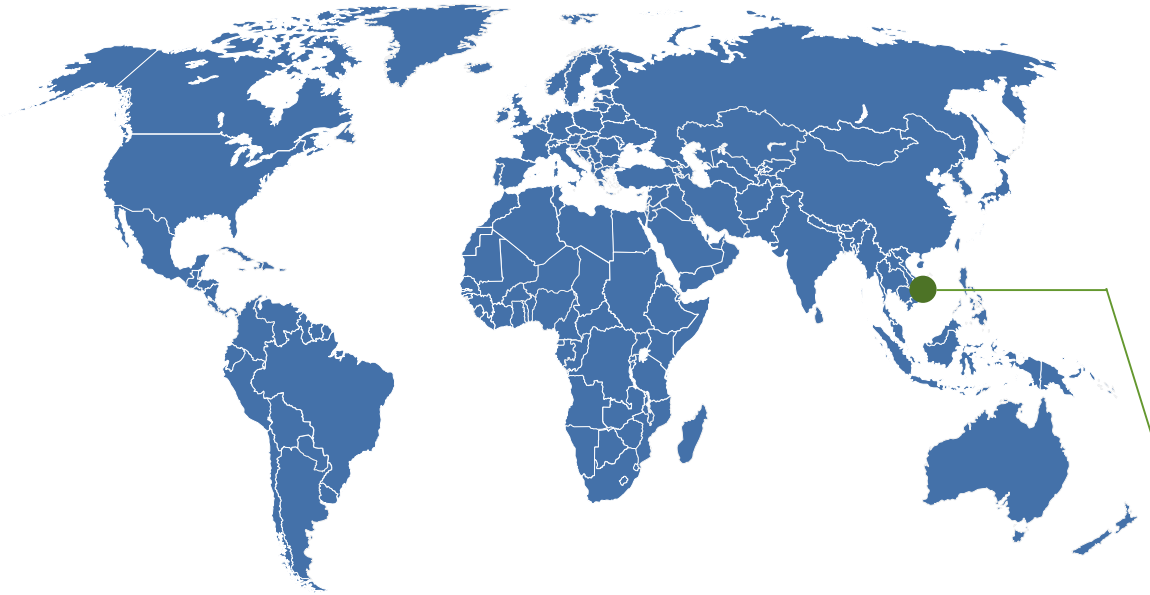
BIG IDEAS
FOR EVERY SPACE

RENESAS

INTRODUCTION



Sales Companies

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Design and Application Technologies Companies

Renesas System Design
Renesas Engineering Services
Renesas Design Vietnam
Renesas Semiconductor Design (Beijing)
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Business Corporation

Intersil Corporation

- Renesas Design Vietnam Co., Ltd. (RVC) was founded in October 2004, as one of the main design centers in Renesas group.
- Business line: Design of semiconductor for both hardware and software.

INTRODUCTION

WHO AM I ?

- Name: Triet Luu. Huynh (TRIET Huynh – チエト　ヒュイン)
- Company: Renesas Design Vietnam
- Career: 06 years experiences in embedded software development (software verification)
  - ✓ Quality Verification for Mobile software platform
  - ✓ Development and verification for In-vehicle software platform
  - ✓ Development for test automation solutions of In-vehicle software platform
- Email: *triet.huynh.jy@rvc.renesas.com*

AGENDA

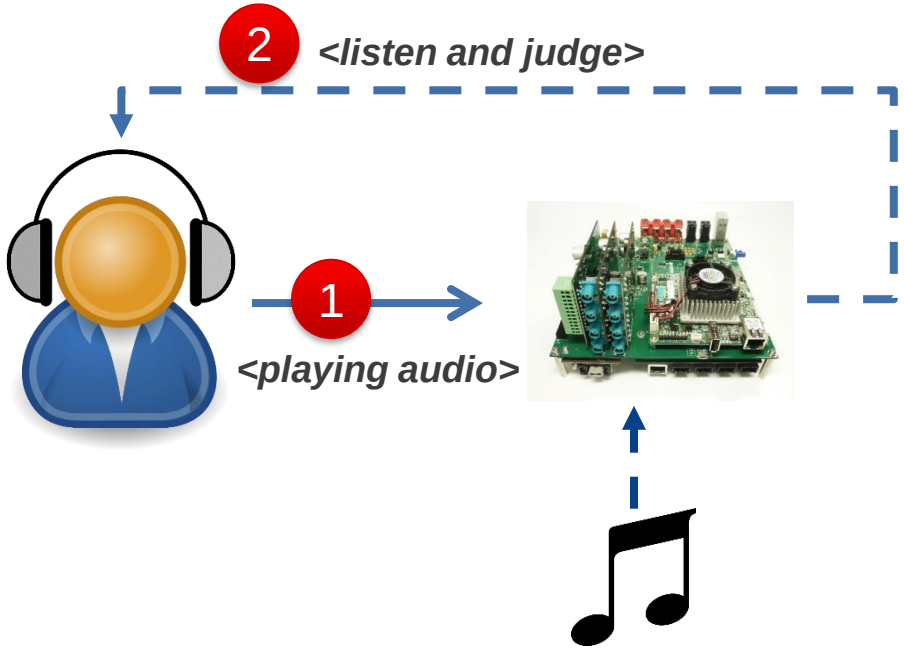
- Introduction about Audio Automation Test
- An approach for Audio Automation Test
- How to apply the audio automation test
- Limitation and Future plan
- Conclusion

Introduction about Audio Automation Test

INTRODUCTION ABOUT AUDIO AUTOMATION TEST

❖ **The Audio Manual test:**

- Testers will **hear and judge** the audio's quality by human ears



❖ **Big problem:**

- The audio testing results are based on the tester's **feeling / experiment**

➔ **The test result is un-reliable**

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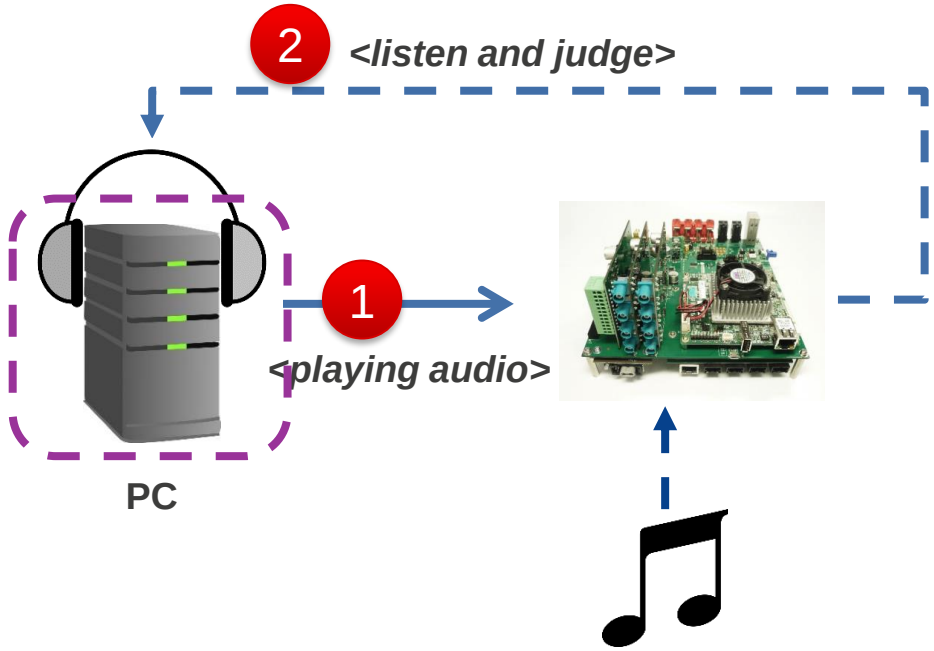


➔We need to automate this, to make the reliable test results, NOT depends on Human Feeling

➔Replace "human role" by "MACHINE ROLE"

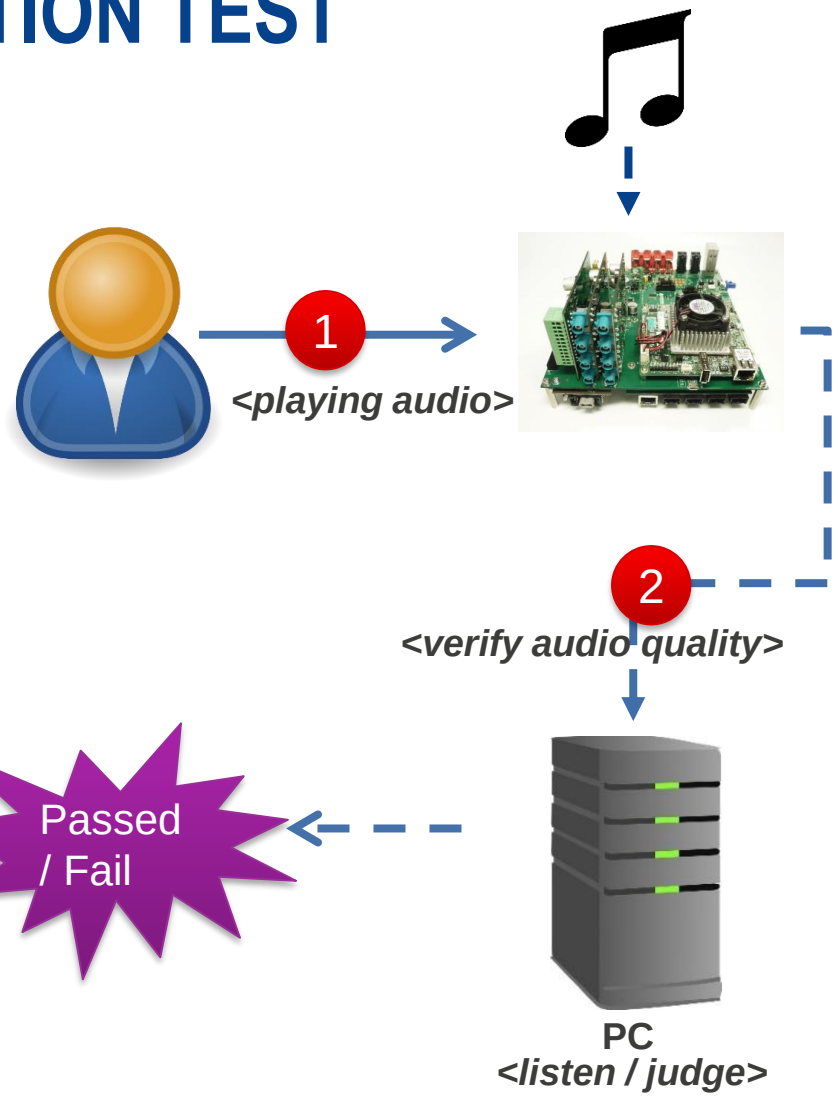
INTRODUCTION ABOUT AUDIO AUTOMATION TEST

❖ **The Audio Automation test:**

- Testers will check the report from automation judgment
- The test result is **NOT depend on tester's feeling**

❖ **Big problem:**

- **Difficult to implement** the audio automation test / the reliable audio automation judgment



Propose an approach for Audio Automation Testing

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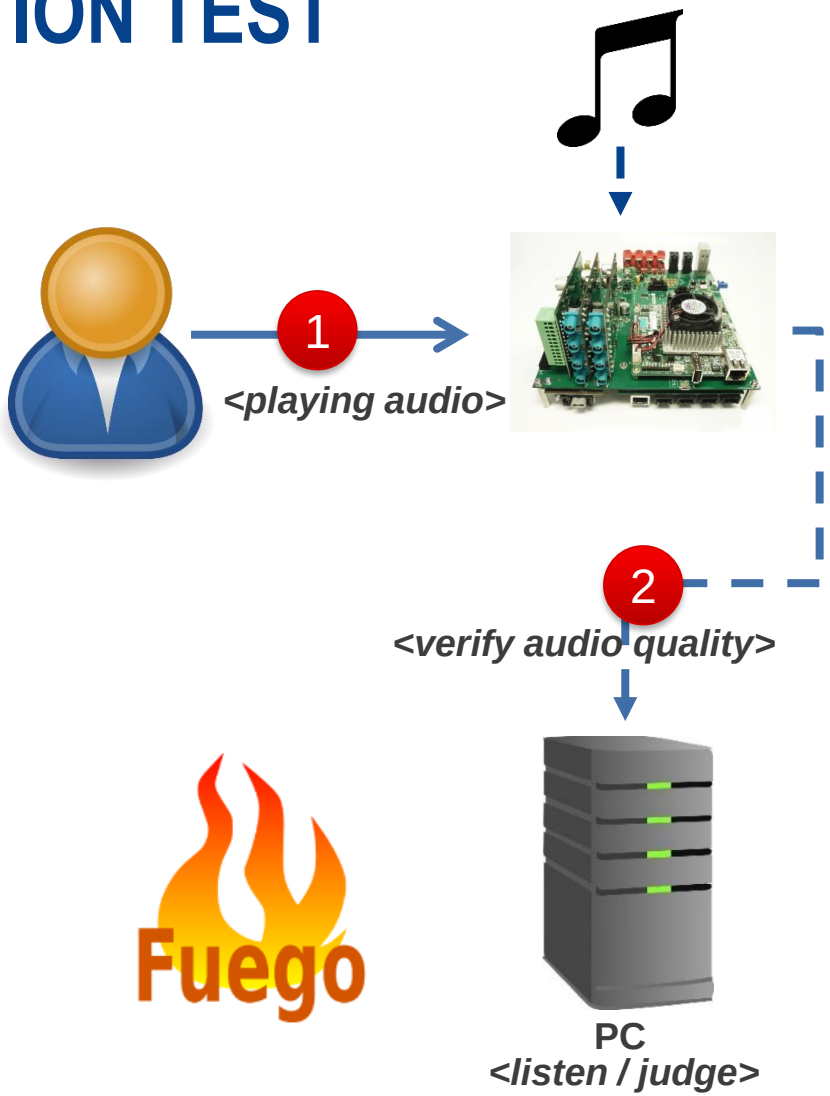


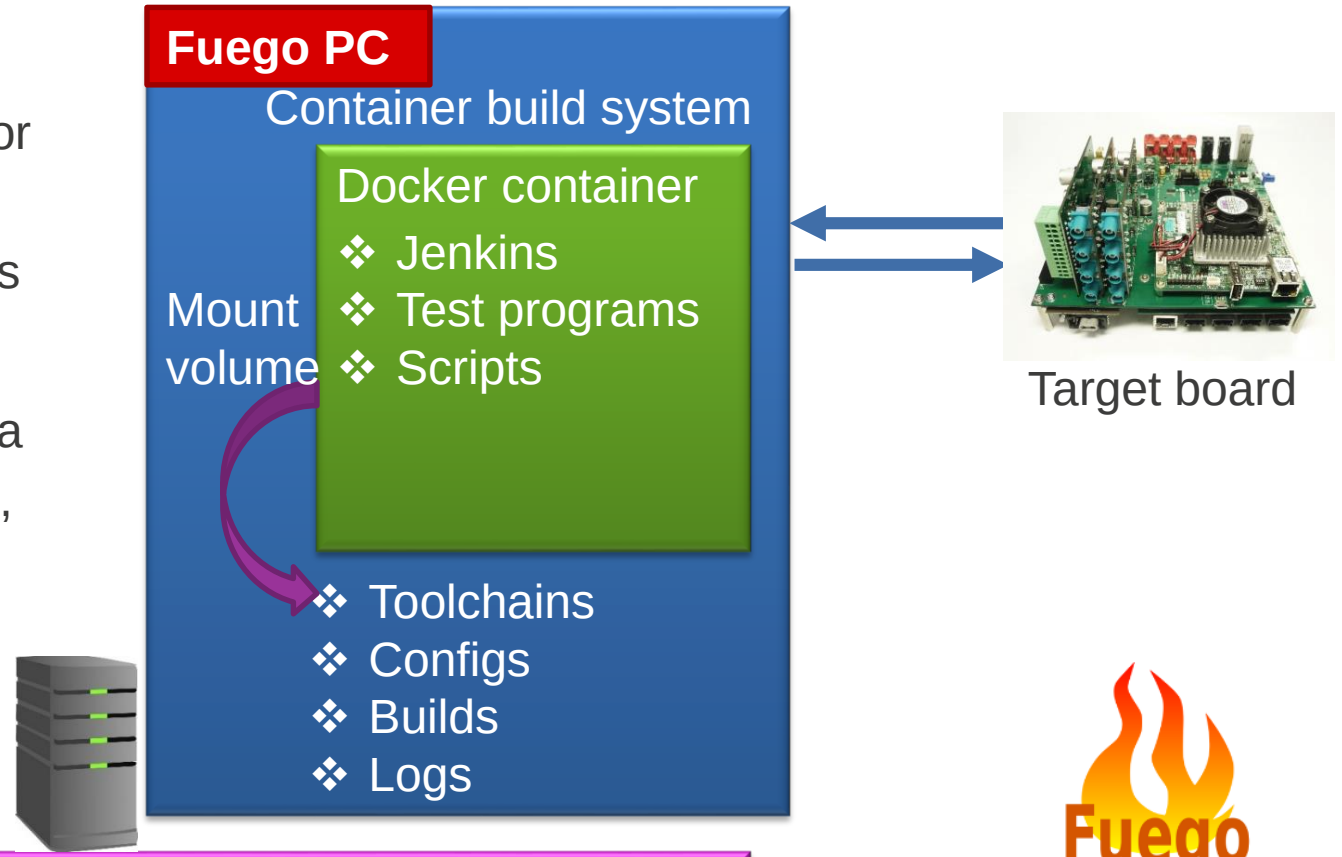
❖ **Solution:**

- **The automation test framework: Fuego**
- **The hardware connection**
- **Audio issue detection method: the OSS Application / Tools**

INTRODUCTION ABOUT AUDIO AUTOMATION TEST

❖ **What is Fuego?**

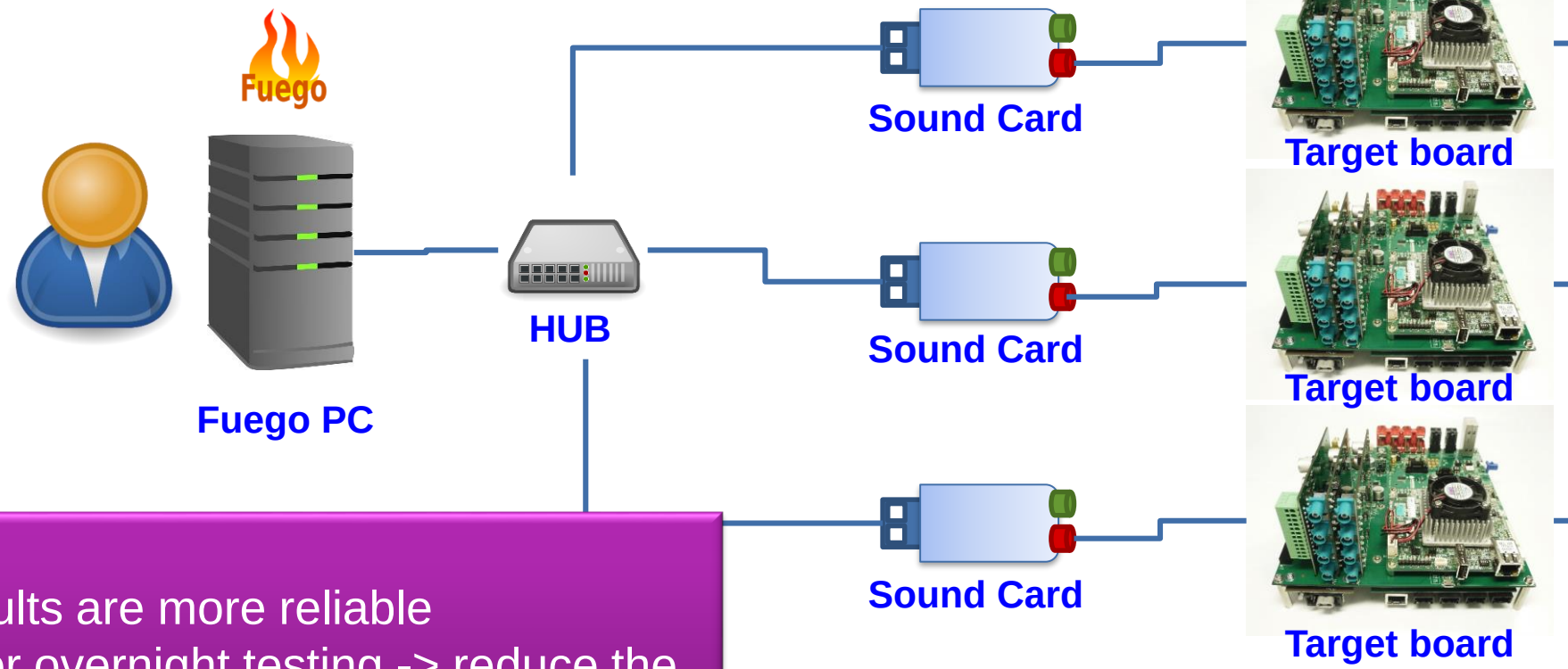
- Fuego is **a test framework** specifically designed for **embedded Linux testing**. It supports automated testing of embedded targets from a host system, as it's primary method of test execution.
- Fuego consists of a host/target script engine, with a Jenkins front-end, and over 50 pre-packaged tests, installed in a docker container.
- Tim Bird gave a talk introducing Fuego, at *Embedded Linux Conference in April 2016, and LinuxCon Japan 2016*



Fuego = (Jenkins + abstraction scripts + pre-packed tests) inside a container

INTRODUCTION ABOUT AUDIO AUTOMATION TEST

❖ **Hardware connection:**



Advantages:

- ✓ The test results are more reliable
- ✓ Can apply for overnight testing -> reduce the workload

An approach for Audio Automation Test

AN APPROACH FOR AUDIO AUTOMATION TEST

❖ **Audio issues:**

- We list the common audio issues which usually occurs in our testing (based on the experimental)
  - ➢ Burst noise
  - ➢ Background noise
  - ➢ Gap (silence) issue
  - ➢ Left/Right Channel Reverse

AN APPROACH FOR AUDIO AUTOMATION TEST

❖ **Definition:**

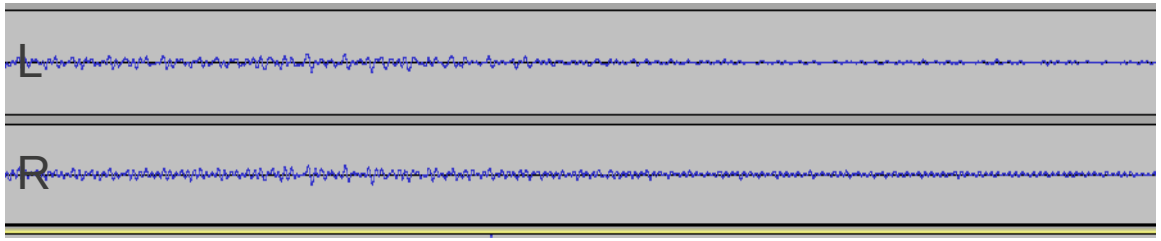
- **Burst Noise** is the sound we hear **like popcorn (white noise)**
- When transform the waveform in time domain to Frequency domain and power domain, in which there are high energy and almost random distribution of sample values across the full bandwidth

❖ **Solution:**

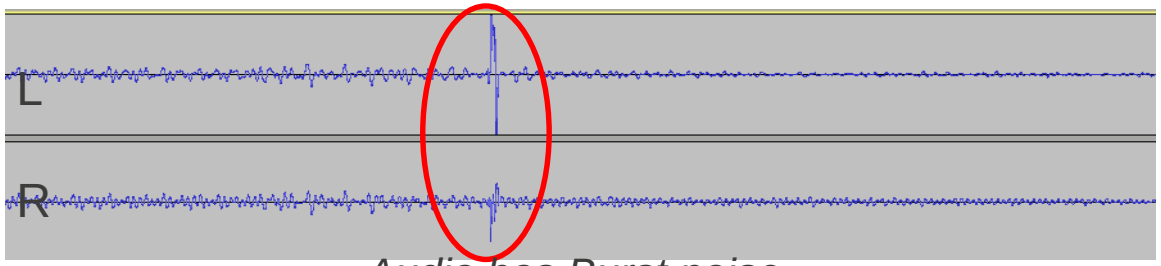
- Utilize the **Open Source Software tools** (E.g. Audacity, ffmpeg) to detect the noise

❖ **Limitation:**

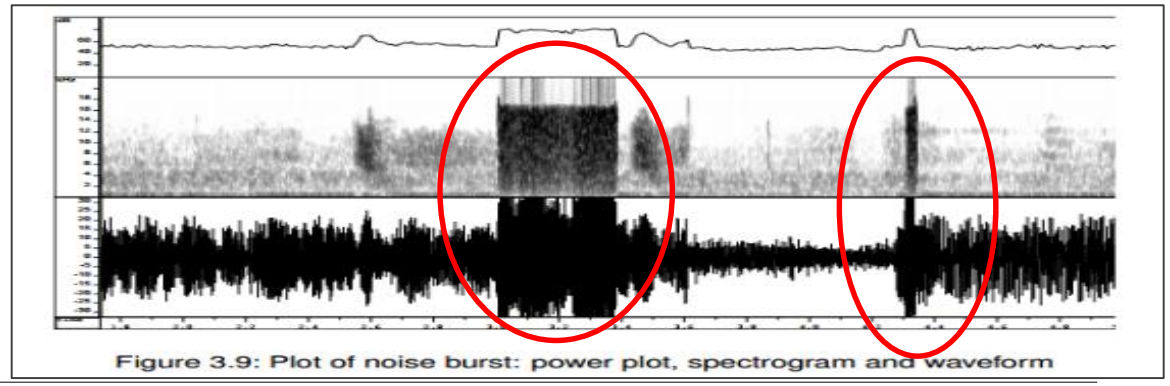
- Wrong issue judgment if audio hardware's quality is not good



Original Audio



Audio has Burst noise



Audio has Burst noise

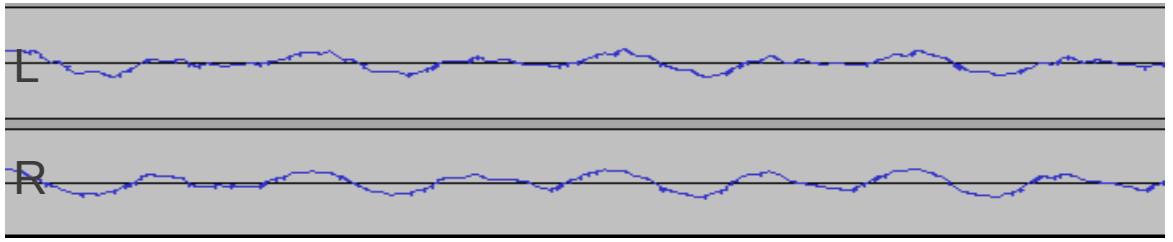
AN APPROACH FOR AUDIO AUTOMATION TEST

❖ **Definition:**

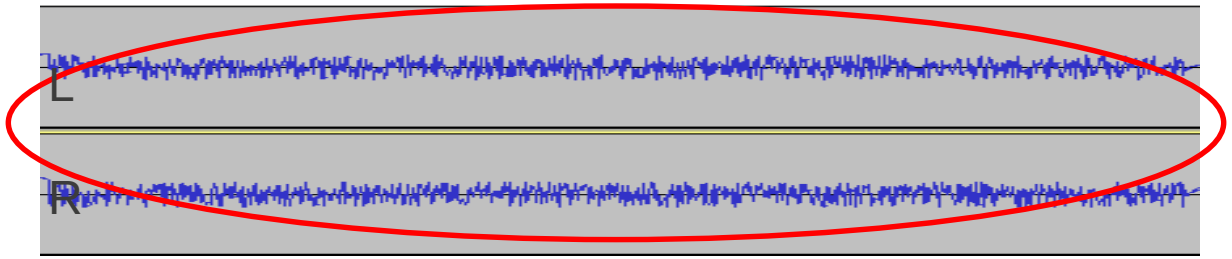
- **Background noise** is the **pink noise** which causes the different waveform between original audio and recorded audio

❖ **Solution:**

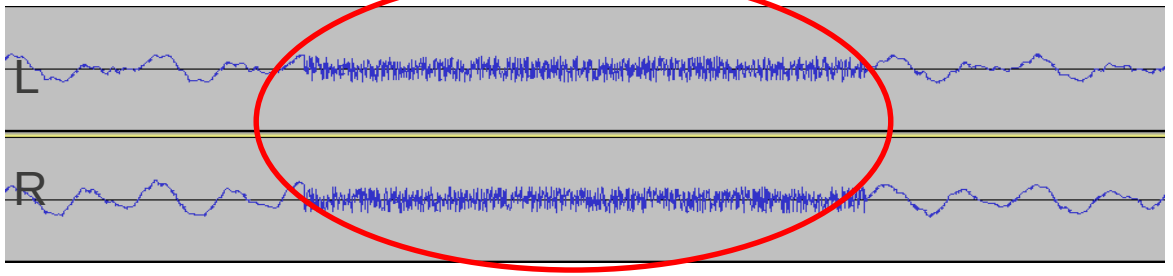
- Use **Open Source Applications** to compare the similarity between recorded audio and original audio (E.g. ffmpeg, Musly)



Original Audio



Audio has Background noise



Audio has Background noise

AN APPROACH FOR AUDIO AUTOMATION TEST

❖ **Definition:**

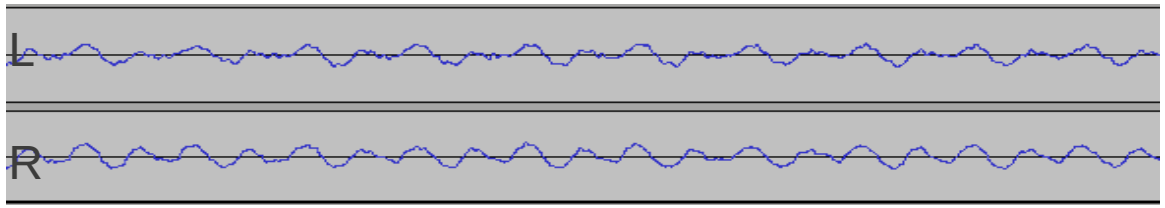
- **Gap or silence** is the issue that there is **silent part** while playing audio.

❖ **Solution:**

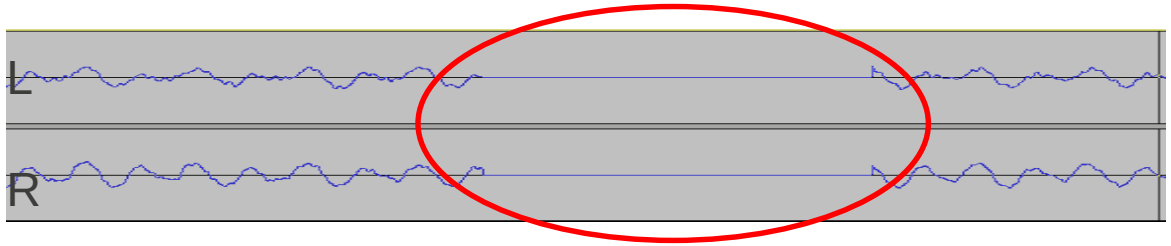
- Use silent detection feature in some **Open Source Applications** to detect (E.g. ffmpeg, Audacity,…)

❖ **Limitation:**

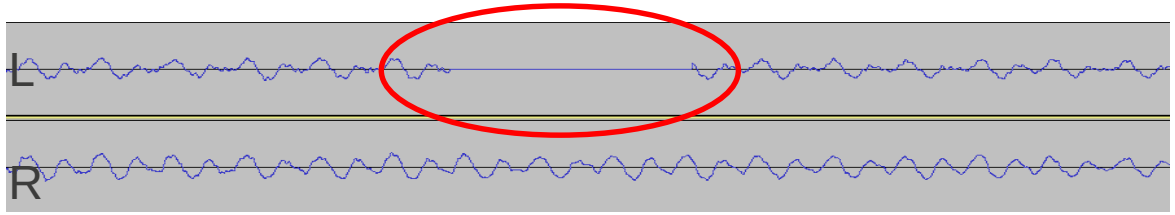
- Now, the Open Source Applications cannot detect silent in one audio channel



Original Audio



Audio has Gap issue

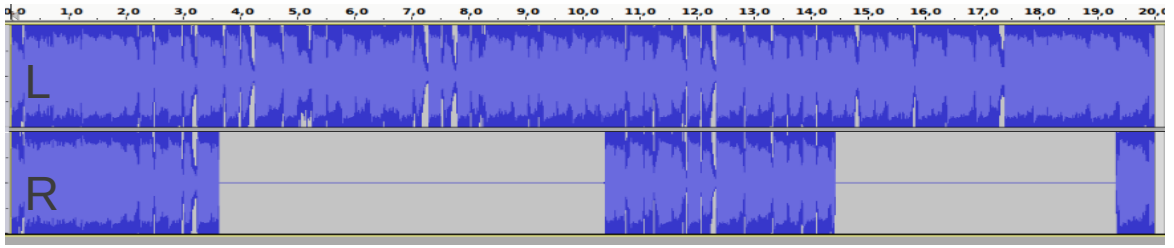


Audio has Gap issue in one channel

AN APPROACH FOR AUDIO AUTOMATION TEST

❖ **Definition:**

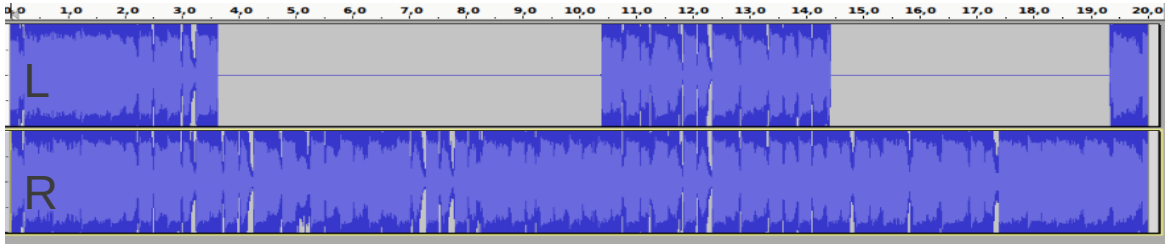
- **Left/Right Reverse** is the issue that the Left and Right channels of the recorded audio file are **reversed**.



Original Audio

❖ **Solution:**

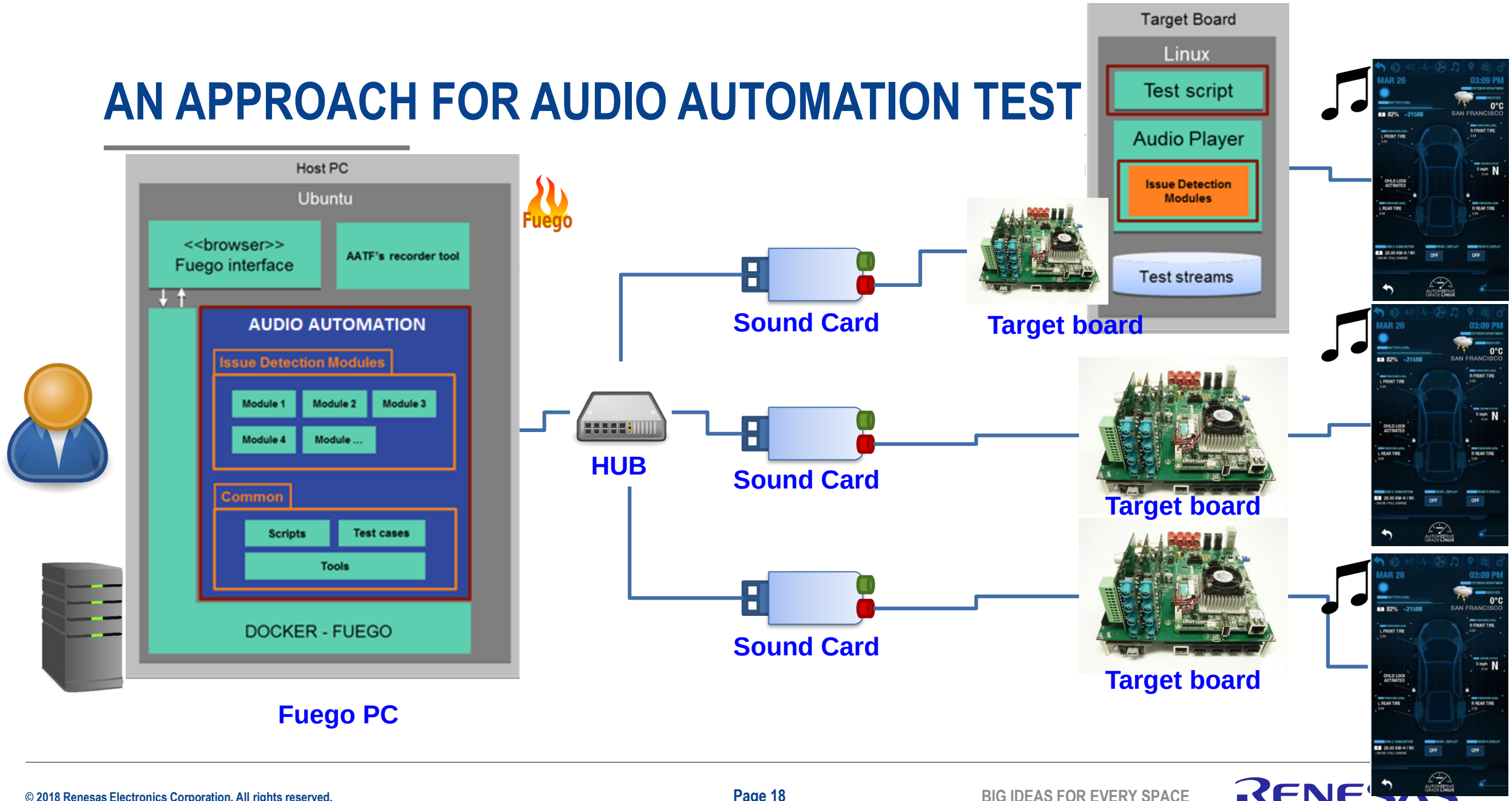
- Use the **Fast Dynamic Time Warping algorithm** (*) to compare the recorded file with the original file.



Audio has reversed channel

(*) https://pdfs.semanticscholar.org/05a2/0cde15e172fc82f32774dd0cf4fe5827cad2.pdf

AN APPROACH FOR AUDIO AUTOMATION TEST



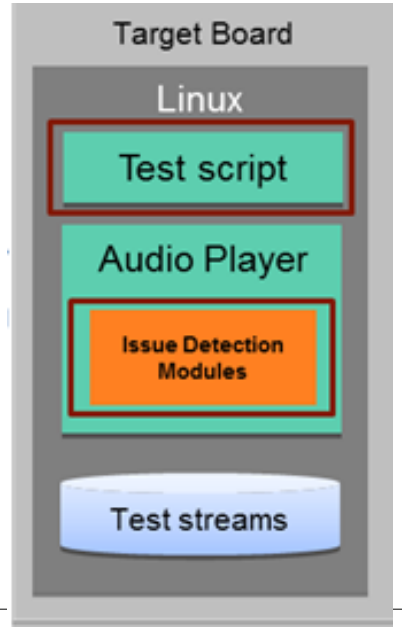
How to apply the audio automation test

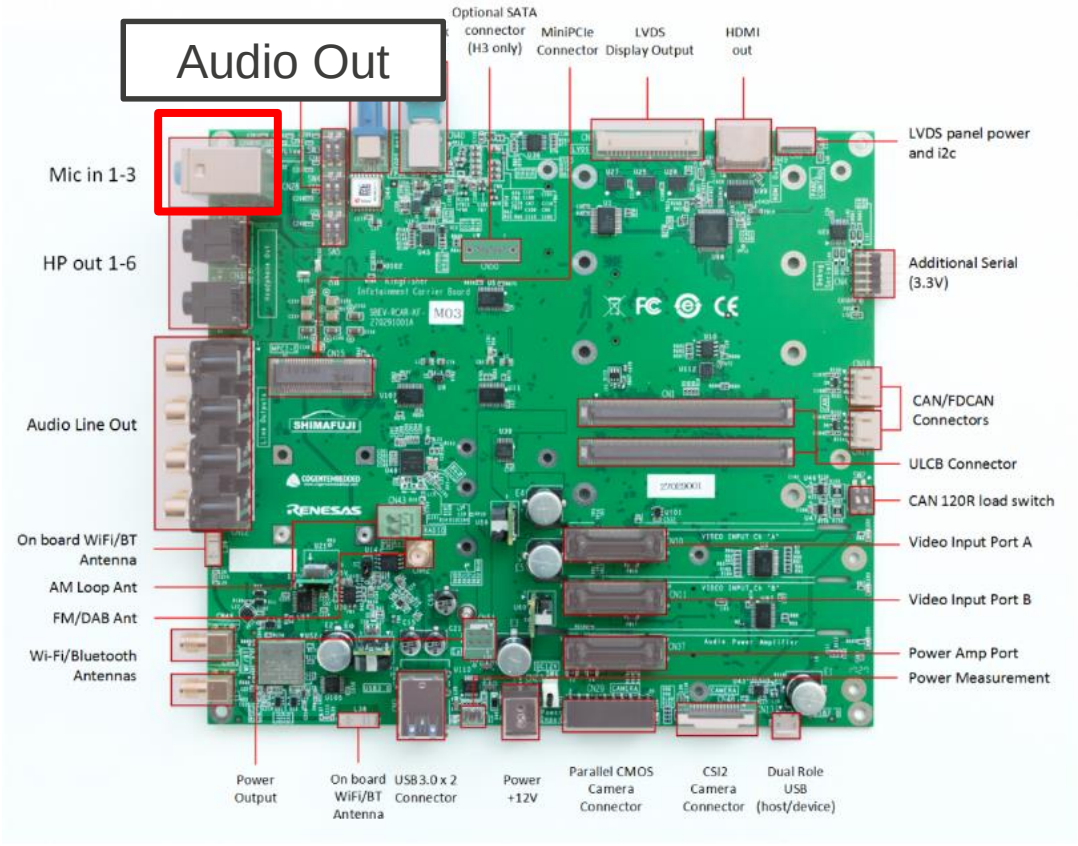
HOW TO APPLY THE AUDIO AUTOMATION TEST

Procedure to apply the Audio Automation Test:

❖ **Target Board:**

- Modify the Software on Target boards (E.g. Audio Player) to synchronize Host PC and Target Board





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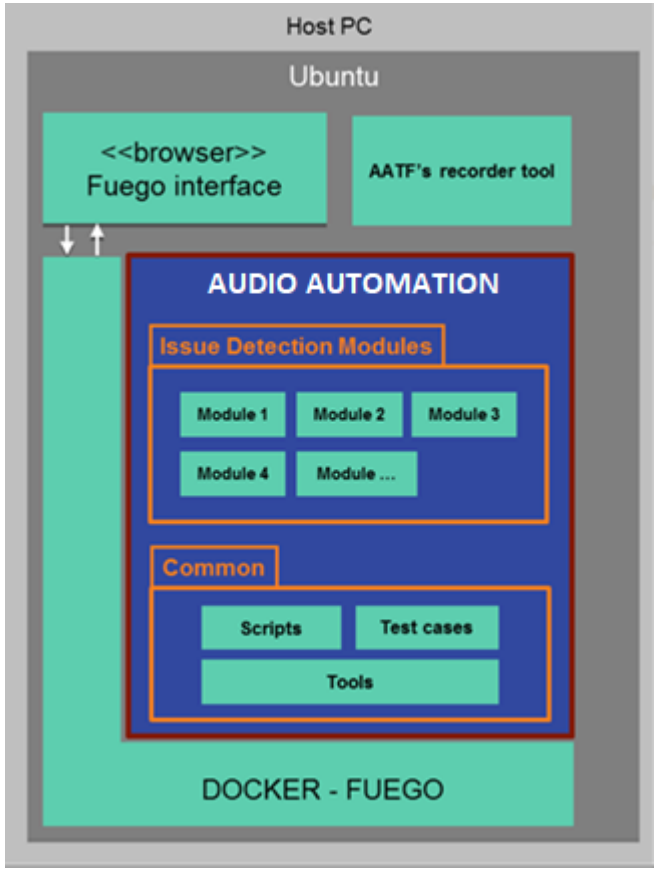
- Install Fuego on Host PC
- Install the Audio Automation Test on Fuego



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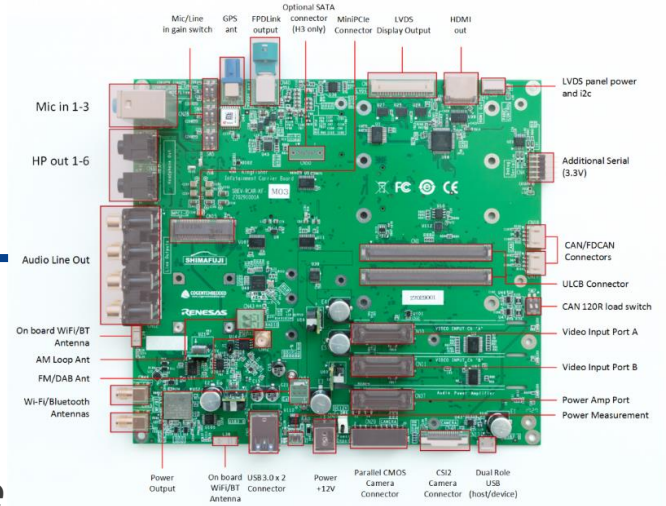
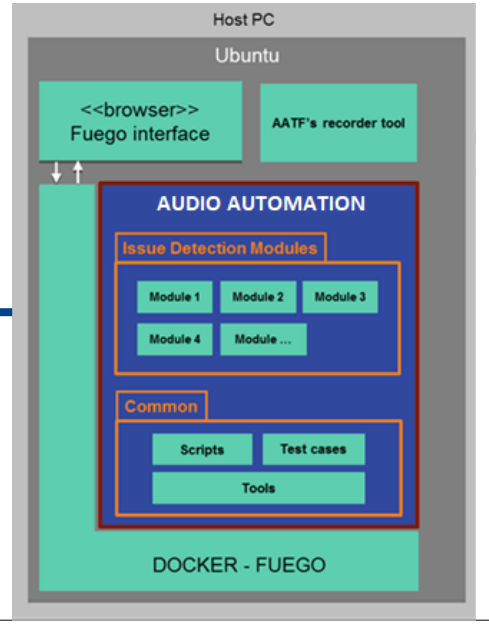
❖ **Hardware Connection:**

- Connect the Audio Output from Target Board to the Sound Card of Host PC



Audio cable



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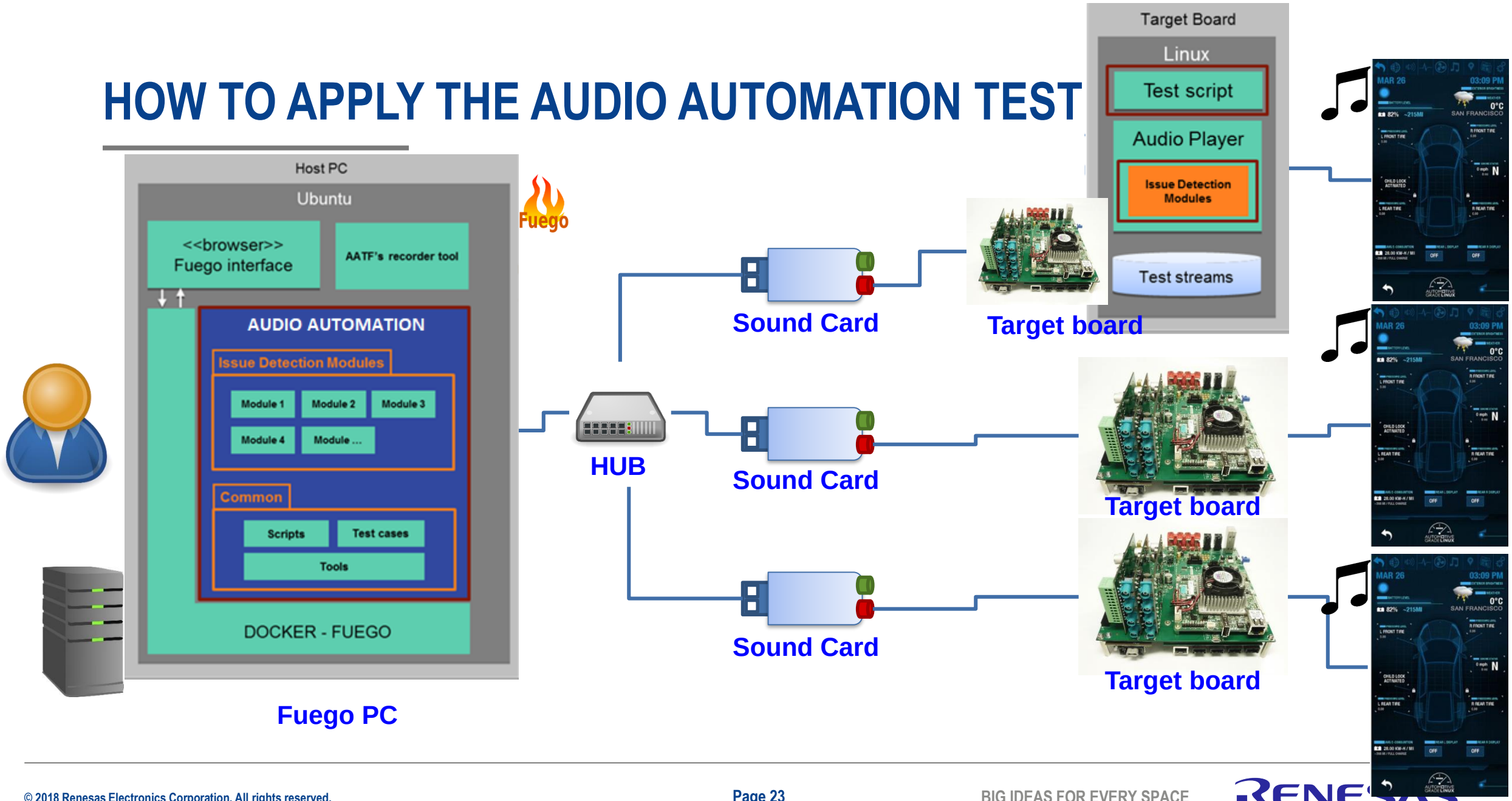

HOW TO APPLY THE AUDIO AUTOMATION TEST

Impact of Audio Automation Test:

Compare the testing time:

- Audio – Manual Test:
  - Audio length (E.g: **4 mins**)
- Audio – Automation Test:
  - Audio length (4 mins)
  - Recording time (~15 secs)
  - Issue detection (~1min 30secs)

  Total: **~6 mins** (**1.5 times** comparing with manual test)

Compare the productivity:

- Audio – Manual Test:
  - 1 person / 1 board / 1 day: **30 TCs**
- Audio – Automation Test:
  - 1 person / 1 boards / **1 day (24-hours)**: **~100 TCs**

(could use for **overnight testing**)

Limitation and Future plan

LIMITATION OF AUDIO AUTOMATION TEST

Current limitations:

- "**False-positive**":
  - Using the "bad-quality test stream" ➔ Result is always FAIL
- MUST **modify** the software on Target Board
  - In order to synchronize the Target Board and Host PC while testing
- Limitation of **Open Source** applications / tools:
  - Because of the current limitation of some Open Source applications (E.g. ffmpeg, Audacity, …)

FUTURE PLAN

- Fix the **current limitations**:
  - "False-positive":
    - Re-order the detection modules: Compare waveform ➔ Check issues
  - MUST modify the software on Target Board
    - Re-searching the solutions: E.g. Detect the first audio signal from target board, …
  - Limitation of Open Source applications / tools:
    - Try to feedback the limitations to the Community
- Expand the Audio Automation Test for **various systems**
- Make the Audio Automation Test become **more friendly** for every user

CONCLUSION

- By combination between the Fuego and the Open Source Applications, Renesas could make an simple Audio Automation Test for Linux platform.
- With the Audio automation test => **reduce the testing workload** and get the **reliable results**
- But, still **some current limitations** (in the development and Open Source side)
- Continue to **fix these** and **promote** the Audio automation test for various platforms

REFERENCE

http://waubrafoundation.org.au/wp-content/uploads/2013/04/Leventhall-LFN-Whatweknow.pdf

https://gi.cebitec.uni-bielefeld.de/teaching/2007summer/jclub/papers/Salvador2004.pdf

THE END

THANK YOU VERY MUCH!

Q & A