Master thesis: Embedded Linux for Software Defined Radio.

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🔬 Internship Context

Software Defined Radio (SDR) is a wireless communication technology that distinguishes itself by its ability to define and manipulate radio parameters through software, rather than traditional electronic components. The concept was introduced in the early 1990s [Mit]. Its advantages primarily lie in its flexibility, enabling quick adaptation to changing communication requirements (bandwidth, carrier frequency, signal processing tasks). SDR also offers the ability to enhance its performance over time through software updates, making it an extremely scalable solution [MBGB].

In the context of future communication standards, ensuring adaptability and the long-term viability of deployed systems is essential. An existing challenge is the ability to remotely update these networks. Software solutions that combine Software Defined Networks and Software Defined Radio open the possibility of reconfigurable end-to-end networks, allowing for modifications to services and even significant changes to the standard [KVVK]. This is the objective of the collaborative PERENNE project, which encompasses this internship.

This internship focuses on software-defined radio, which consists of a radio head and a processing unit. This platform will be embedded with a lightweight Linux kernel [SA] to perform processing tasks and execute certain higher-level tasks [LGGB], enabling the management of various SDR actions and regular measurements for selecting configuration changes.

This internship takes place within the GRANIT team at IRISA. Its goal is to implement a low-latency Linux kernel on the embedded software-defined radio platform to execute telecommunications chains and a high-level scheduler capable of analyzing the radio frequency environment.

🚀 Objectives

The objectives of the internship are as follows:

- Take control of the software-defined radio platform based on Zynq and compile an embedded Linux dedicated to the platform. This Linux will be able to interface with the radio card and the Ethernet interface.

- Compile and run telecommunications chains such as Open WiFi or 802.15.4 and verify the proper behavior of the chain.

- Propose data processing and radio frequency data monitoring tasks (power analysis, monitoring the packet error rate of the previous chains) that will run in the background on embedded Linux and allow for parameter updates (e.g., changing the WiFi channel).

💪 Skills

You are in your final year of engineering school or pursuing a master's degree. You have strong skills in embedded systems and wireless communication. Experience in the field of embedded Linux is also desirable.

> This internship can validate a research master's degree. Note that, as part of the PERENNE project, a doctoral scholarship related to this internship topic will be funded, beginning in September 2024.

ℹ️ Information and Contacts

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💰: Monthly gratification 567€
⏱️: 6-month internship starting in February 2024
🌍: IRISA, Lannion, Brittany, France

📚 References

[KVVK] Dimitrios Kafetzis, Spyridon Vassilaras, Georgios Vardoulias, and Iordanis Koutsopoulos. Software-Defined Networking Meets Software-Defined Radio in Mobile ad hoc Networks: State of the Art and Future Directions. 10:9989–10014.

[LGGB] Corentin Lavaud, Robin Gerzaguet, Matthieu Gautier, and Olivier Berder. AbstractSDRs: Bring Down the Two-Language Barrier With Julia Language for Efficient SDR Prototyping. 13(4):166–169.

[MBGB] Dereje M. Molla, Hakim Badis, Laurent George, and Marion Berbineau. Software Defined Radio Platforms for Wireless Technologies. 10:26203–26229.

[Mit] J. Mitola. Software radios: Survey, critical evaluation and future directions. 8(4):25–36.

[SA] Otavio Salvador and Daiane Angolini. *Embedded Linux Development with Yocto Project*. Packt Publishing Ltd.