

Particle Accelerator Simulator

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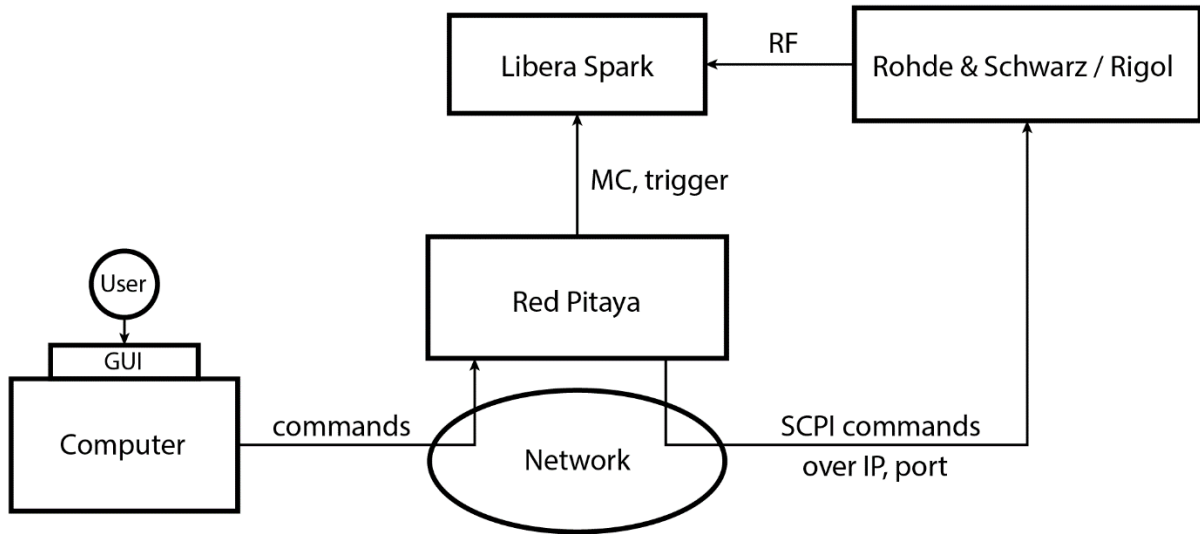
Mentor: Uroš Dragonja

1. Introduction

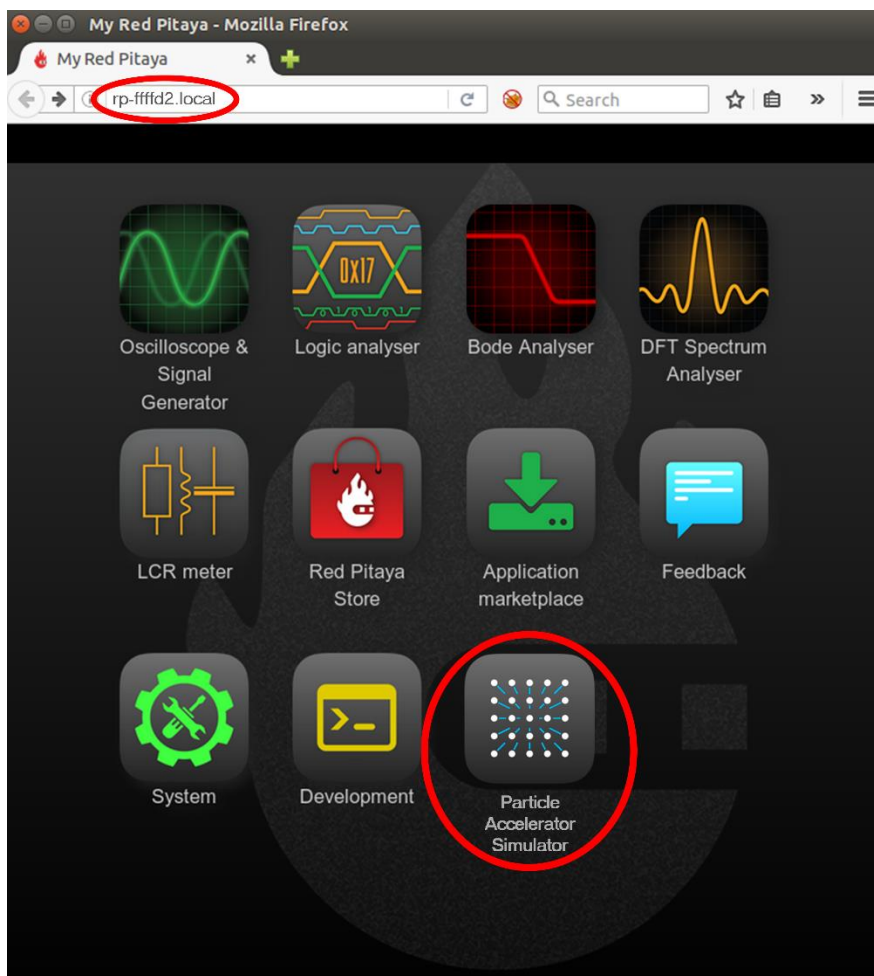
Particle Accelerator Simulator is an application that uses Red Pitaya 250-12 to set parameters on Libera Spark. Libera Spark is Instrumentation Technologies' beam position monitor for particle accelerators. Red Pitaya sets Spark's machine clock on output 1 and trigger on output 2. It also sends SCPI commands to Rigol or Rohde & Schwarz's signal generator to generate RF signals.

2. Setup architecture and use

This is what the setup looks like:



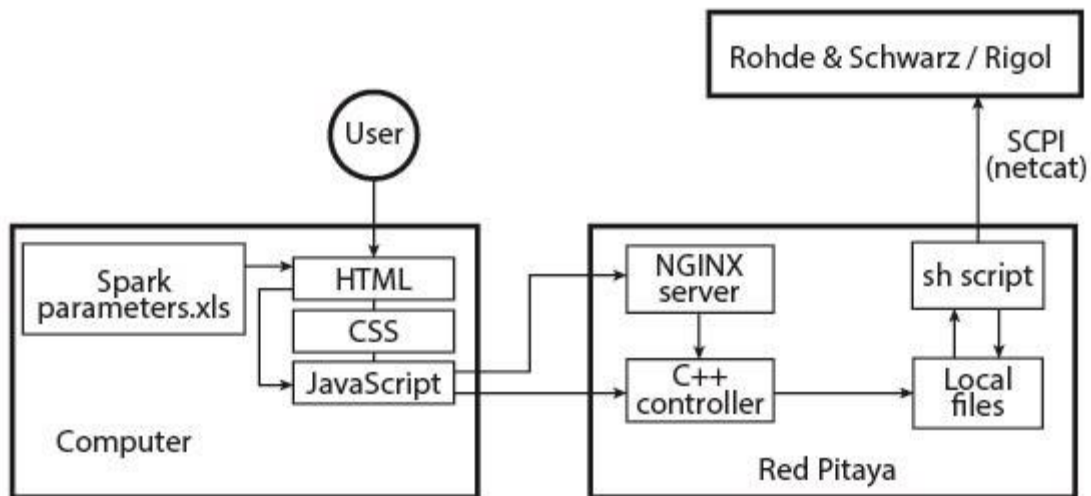
The user has to connect to Red Pitaya's web application over a computer that is in the same network. The GUI is accessible in a browser: `rp-<last 6 digits of MAC address>.local`



First of all the signal generator's settings have to be chosen. After that, the application is ready to use. Next the Excel file with Libera Spark parameters has to be uploaded (from the input element in the GUI). The Red Pitaya then reads the Spark parameters from this file.

At this point it is time to choose the machine and set up the amplitudes and offsets of the signals. After clicking "Set!", Red Pitaya sets its outputs and sends SCPI commands to the signal generator, which also outputs a 10 MHz clock to Red Pitaya's REF IN (reference clock) to sync the output signals.

3. Software



The application's GUI is written in HTML, CSS and JavaScript. This frontend communicates with the backend on Red Pitaya using the parameters. JavaScript then sends the parameters to C++ controller, which reads them, sets all the necessary signals and writes the frequencies and levels of the RF signals (with some other parameters) to local files in Red Pitaya's file system. Finally there is a script on Red Pitaya that runs in the background, reads those local files and sets up a raw socket connection to the signal generator and sends it the SCPI commands.

4. Application

The first page of the application looks like this:

CHANGE NETWORK SETTINGS

RF DEVICE

First you have to choose the device that will output the RF signal:

Rohde & Schwarz SMB 100A
 Rigol DSG836 Confirm

IP INFO

Please write down signal generator's IP:
 (Rohde & Schwarz => navigate to: SETUP > Network Settings... > IP Address)
 (Rigol => navigate to: Syst > I/O Config > View (🔍))

0 . 0 . 0 . 0 Set!

DESCRIPTION

The application will set the next output signals:
 MC on Red Pitaya Out1
 Trigger on Red Pitaya Out2
 RF on Rohde & Schwarz SMB 100A or RiGOL DSG836

SETTINGS

Upload excel file with Libera Spark parameters

Machine:

MC amplitude: Vpp

MC offset: V

Trigger:

Frequency: Hz

Amplitude: Vpp

Offset: V

RF level: dBm Set!

The “Change network settings” button brings you to the network settings page:

CHANGE NETWORK SETTINGS

DHCP Confirm

Wait for about one minute for the DHCP to assign an IP to the signal generator. Then check the IP and insert it below.
 (Rohde & Schwarz => navigate to: SETUP > Network Settings... > IP Address)
 (Rigol => navigate to: Syst > I/O Config > View (🔍))

IPv4 address: Set!

Static

Choose the desired IP and mask.

IPv4 address:

Subnet Mask: Set!

5. Conclusion

Red Pitaya SIGNALlab 250-12 is perfect for generating up to 60 MHz signals. It's voltage range is +/- 10V on Hi-Z load. The outputs are precise, and Libera Spark works perfectly with the Red Pitaya. The reference clock also works smoothly, and the two outputs are synced with the signal generator.