

# Animal Movement Research Using Phase-based Trilateration (AMRUPT)

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## Objective: Cost-Effective Outdoor Localization of Small Animals

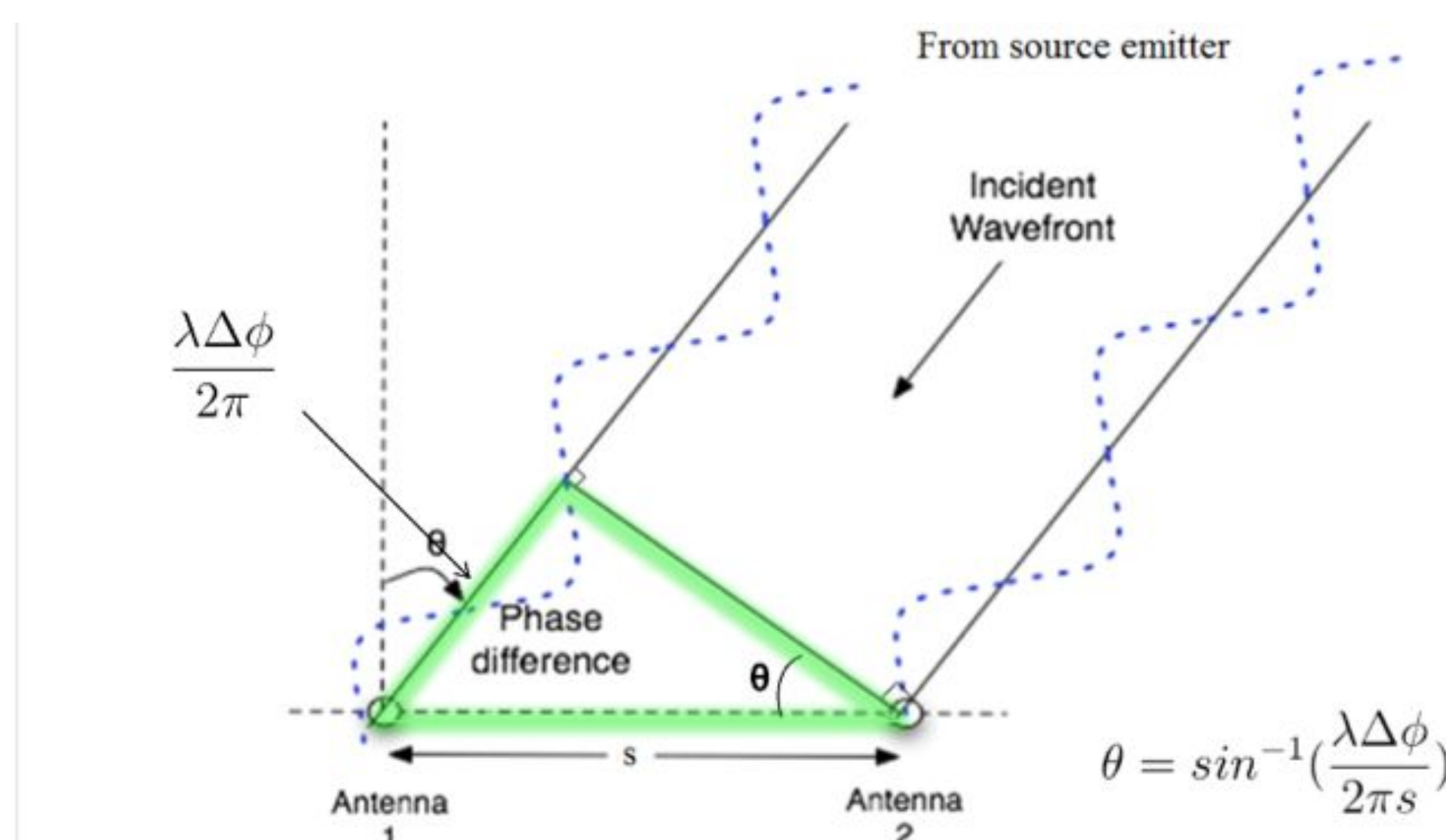
- Design a more accurate outdoor location tracking technology for the localization of small animals in the field of ecology
- Used for the study of flight patterns, social interactions, or other biological attributes to most species.
- Designed system architecture must be resilient in cluttered environment, i.e. unsusceptible to multipath interference, electromagnetic interference, and other environmental conditions.

## Using Phase Interferometry for Localization

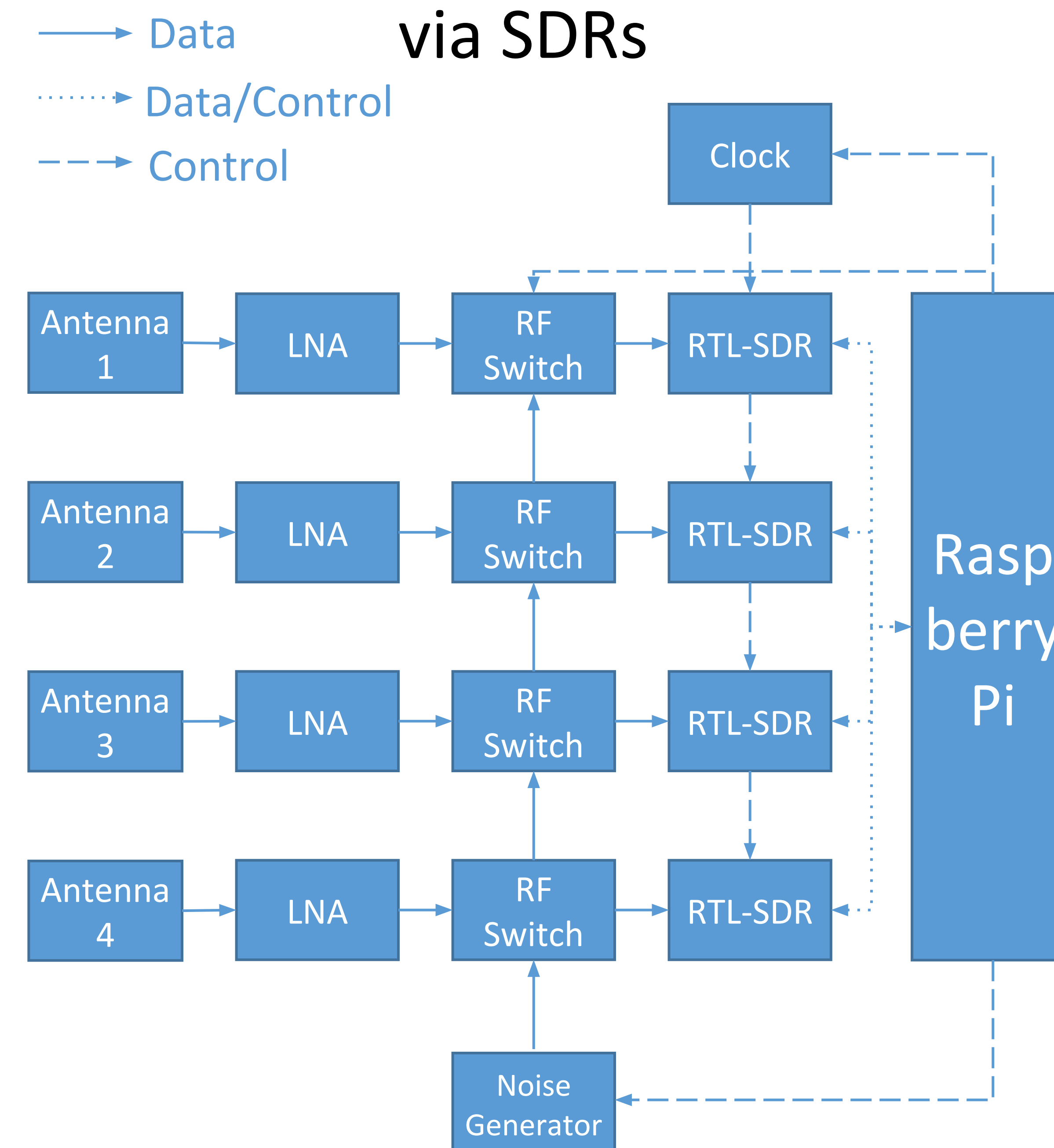
- Utilize Phase Interferometry for use in estimating the Angle of Arrival (AOA) of radio signals
- RF signals' phase information is calculated on the RTL SDR (Software-defined Radio)
- I & Q values are sent to a Raspberry Pi for AOA calculation

## AOA Calculations

- Angle of arrival equation formed using the phase difference of a signal received at two antennas, the distance between antennas, and the wavelength of the signal

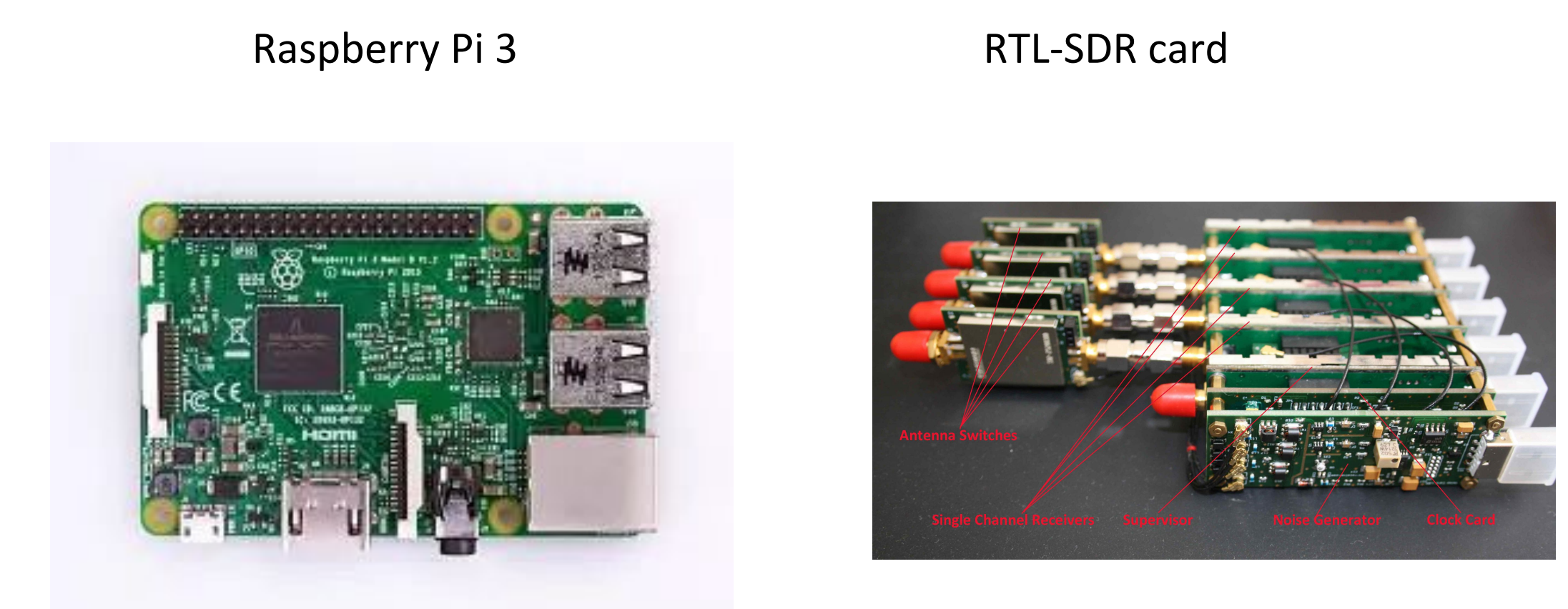


## Architecture: Coherent Detection via SDRs



## Raspberry Pi for Signaling Processing

- The base station setup needs Raspberry Pi 3 and RTL SDR cards with antenna to be able to receive signals from bird tags.
- RTL-SDR card is an inexpensive, open-source signal receiving device that can support direction finding
- Raspberry Pi 3 is an inexpensive, powerful and highly consumable device that can support system operation and allow us to run GRC software

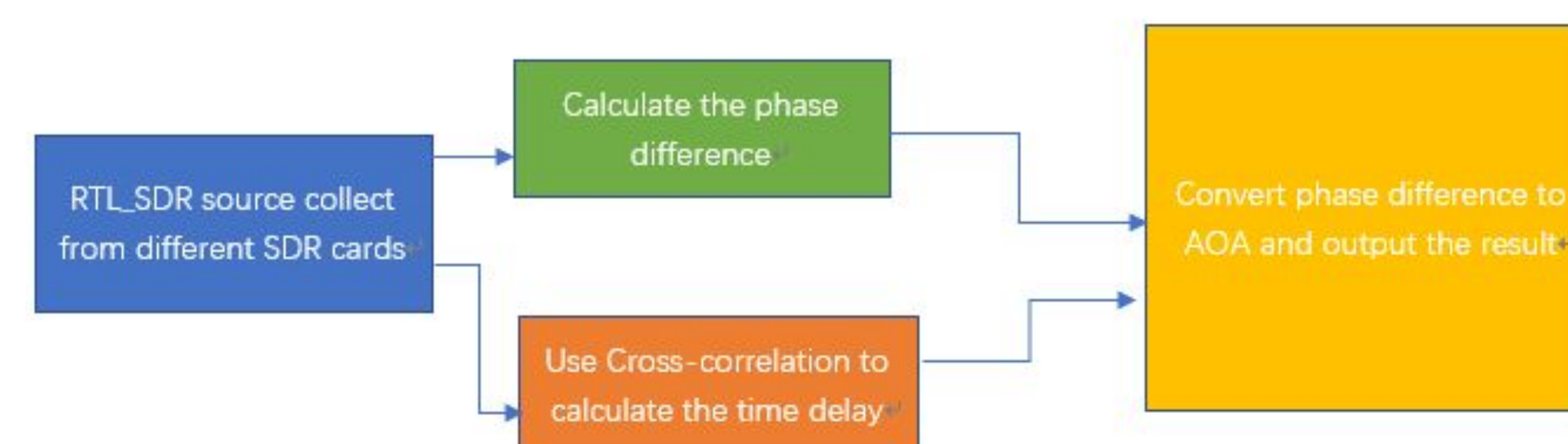


## Literature

- [1] D. Guerin, S. Jackson, and J. Kelly, "Passive Direction Finding: A Phase Interferometry Direction Finding System for an Airborne Platform," Oct. 10, 2012. <https://web.wpi.edu/Pubs/E-project/Available/E-project-101012-211424/unrestricted/DirectionFindingPaper.pdf>.
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- [3] Whiting, Sam, et al. "Time and Frequency Corrections in a Distributed Network Using GNURadio." 2017.
- [4] [https://github.com/samwhiting/gnuradio-doa/blob/master/gr-doa/lib/phase2doa\\_ff\\_impl.c](https://github.com/samwhiting/gnuradio-doa/blob/master/gr-doa/lib/phase2doa_ff_impl.c)

## GNU Radio for AOA Calculations

- Execute GRC on Raspberry Pi to run RTL-SDR card
- Use GRC to process the received signal, then we can get the AOA based on the phase difference



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