Caribou Labs

CaribouLite

Edge-SDR

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www.github.com/cariboulabs/cariboulite

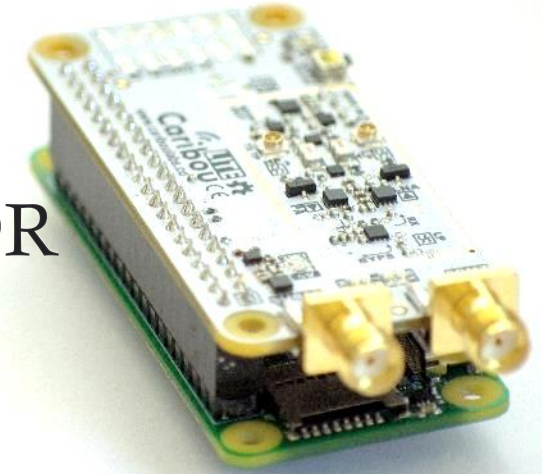
Who am I

Caribou Labs

- EE and Entrepreneur
- Technion IIT, Haifa, Israel
- In my past: [RF, IoT, System]-Engineer, SW & HW
- Motivated by
  - Curiosity
  - Joy of learning and sharing
  - The need to create

Today's talk

- SDR Evolution
- Problems of SDRs
- CaribouLite – Edge-SDR
  - Motivation
  - Design
  - Use Cases
- The Potential of Edge-SDR
- Current Stage



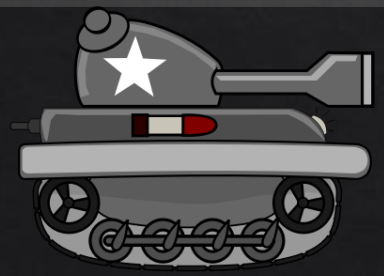
SDR Evolution

1980-2000

Driven by:
- Academic research
- Military & Defense (DARPA, Raytheon, US-DoD)

Used for:
- MILCOM – Military Communication
- SIGINT – Signal Intelligence
- EW – Electronic Warfare
- Spectrum Monitoring

Enabler: FPGA



2000-2015

Driven by:
- Commercial – Cost, Scalability

Used for:
- Cellular (4G/LTE) **Infrastructure**

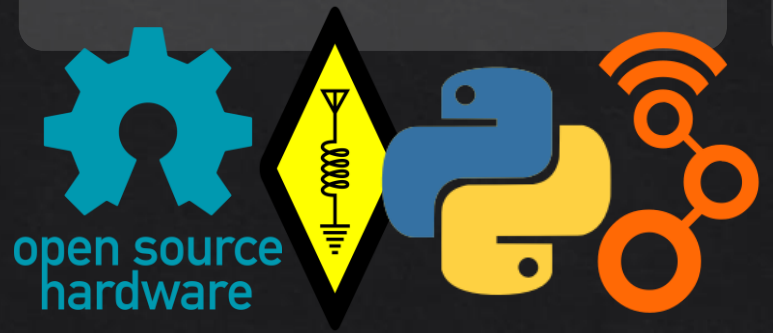
Enablers:
- RFIC (Analog Devices, Lime Systems)
- Design tools – MathWorks Simulink, Gnu-Radio, etc.
- FPGA SoC / Integration

2015-2020

Driven by:
- IoT
- Open-Source

Used for:
- Everything RF (?)

Enablers:
- RTL-SDR, HackRF-One, BladeRF, and many others!
- Open-Source FPGA tools
- The community



2020+

Edge-SDR
IoT
Cloud

Problems of SDRs

- **Knowledge barrier** – RF, digital-communication, DSP, programming
  - We need tutorials
  - We need documentation
  - **We need examples**
- **Cost barrier** – SDR front-ends are still very expensive
- **Portability barrier** – $SDR \equiv RFFE + BB$
  - Currently $\boldsymbol{BB = PC}$
  - You cannot slide it in your pocket
  - Power considerations

- **Regulation Barrier**

CaribouLite Edge-SDR

Motivation
Design
Use Cases

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- An SDR **Small enough** to slide in you pocket (Tx + Rx)
- **Good enough** to fit many IoT use cases (LORA, Narrow Band, etc.) at **low-cost**
- Based on a **platform that everyone loves** to use
- **Educational and simple**

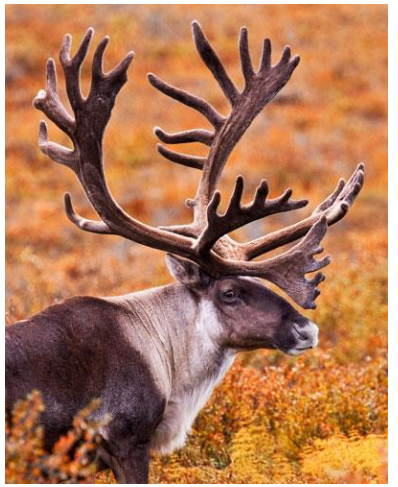
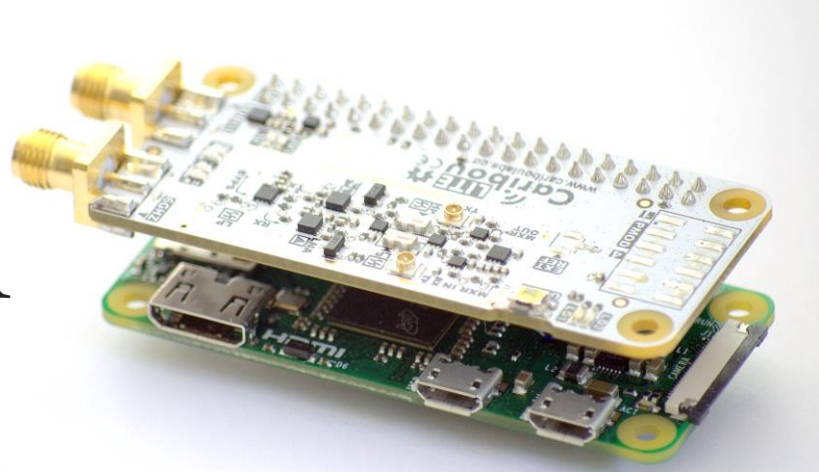


photo by: Sandy Brown Jensen, CC BY-SA 2.0

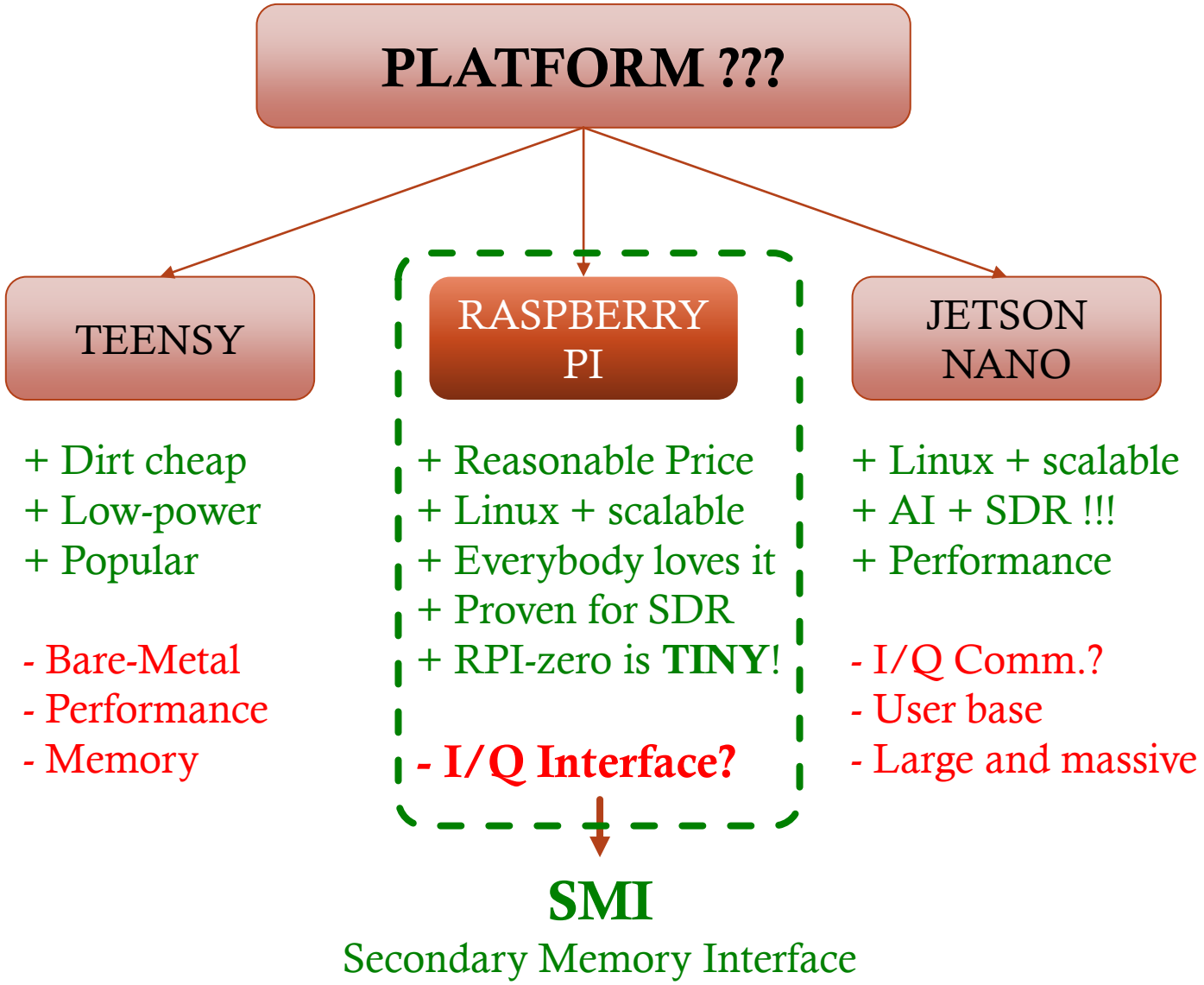
- **Demoing edge-SDR paradigm is doable**



CaribouLite Edge-SDR

Motivation
Design
Use Cases

Labs Caribou



CaribouLite Edge-SDR

Motivation
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Use Cases

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Raspberry Pi (40-Pin header)

- **Can you slide in a pocket?** Yes
- **Performance?** Yes, RTL-SDR-proven
- **Self contained?** Needs power, but yes.
- **HW Scalable?** Yes – many types of RPIs exist, almost a desktop (HDMI, Eth, etc.).
- **SW Scalable?** Yes – Linux!
- **User base?** Huge
- **Educational?** Yes, and very friendly

CaribouLite Edge-SDR

Motivation
Design
Use Cases

Radio Principles

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- **Radio platform**: Microchip **AT86RF215**
  - Dual mode X Dual channel
  - Like RTL-SDR, with **TX**
  - I/Q input + output
  - Synchronization, clock buffering and more!
- **RF Front-End**: inspired by **HackRF-One**

CaribouLite Edge-SDR - Design

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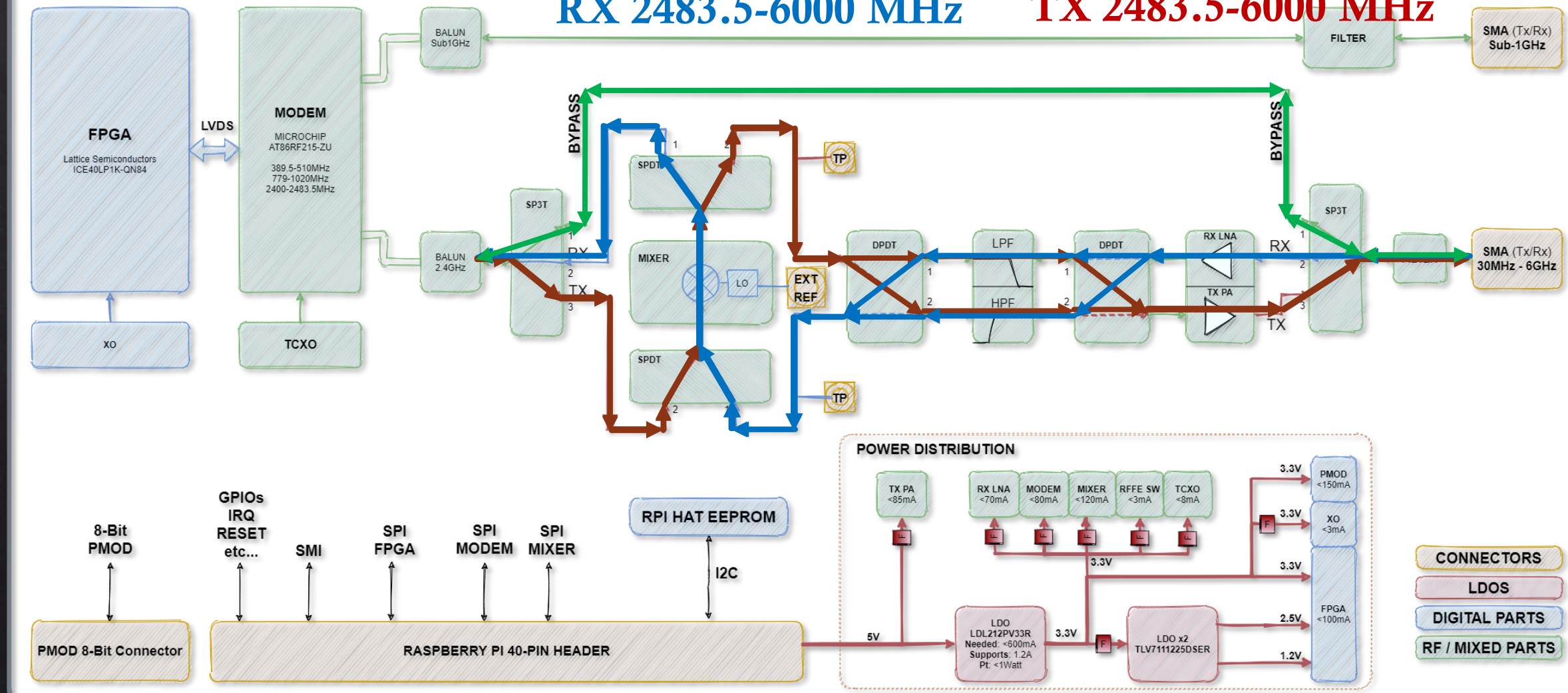
TX/RX 2400-2483.5 MHz RX 30-2400 MHz TX 30-2400 MHz RX 2483.5-6000 MHz TX 2483.5-6000 MHz



CaribouLite Edge-SDR

Motivation
Design
Use Cases

Software

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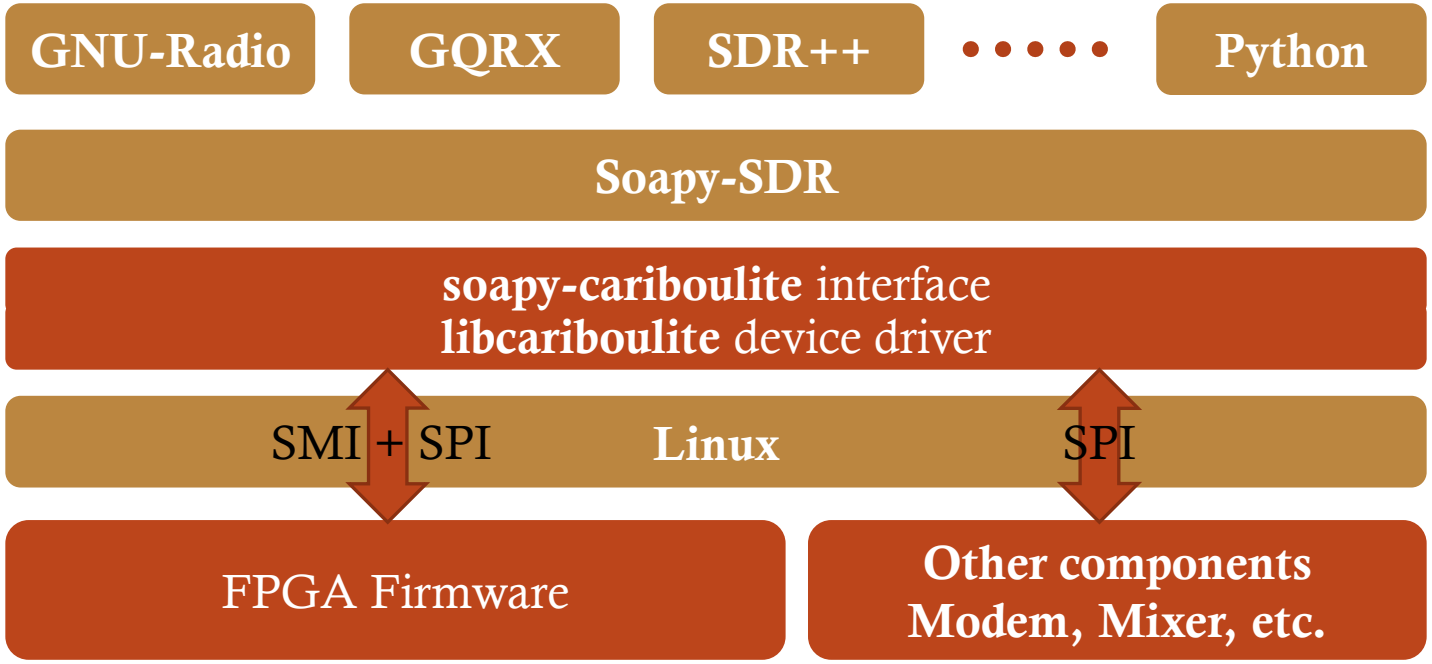
- **One-stop solution on RPI**
  - **RPI HAT** – auto-loading / recognition
  - **Soapy-SDR** – interfacing (almost) everything
  - **IceStorm** – open-source FPGA toolchain



CaribouLite Edge-SDR

Motivation
Design
Use Cases

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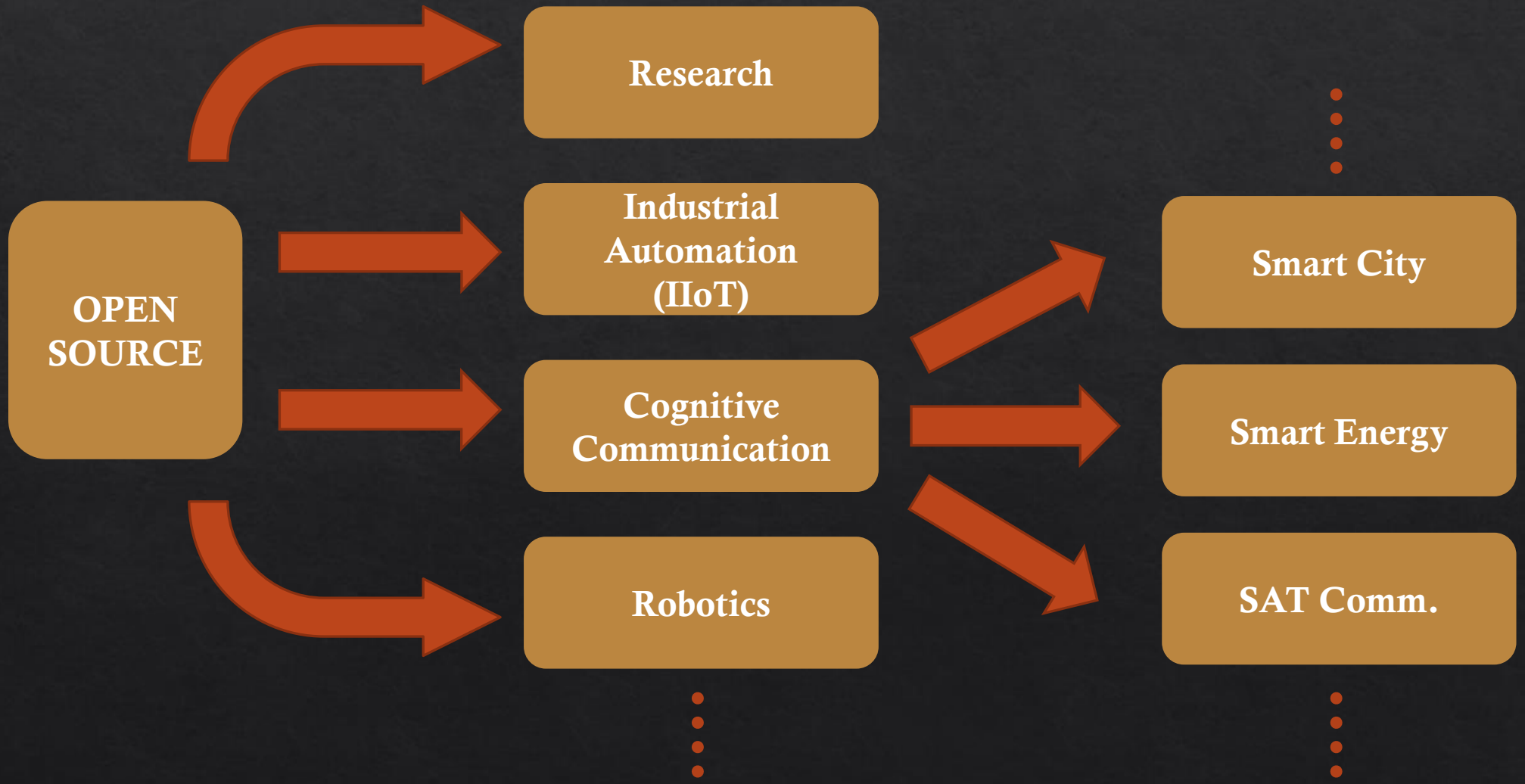
- **Radio-communication education kit**
- Radio-hacker Swiss-army-knife
- Reconfigurable (LORA)WAN concentrator
- Signal-Generator / Spectrum-Analyzer
- Direction-finding and TDOA measurement
- ADS-B connected tiny-server
- Web-SDR tiny-server
- Radio repeater / relay / frequency transformer
- Drone (ROS?) communication & controller
- And much more!!!

The Potential of Edge-SDR



CaribouLite – Current Stage

- Campaign starts **in a few weeks**
- Finalizing / debugging software
- Finalizing production, testing
- Writing **examples, demos** (C/C++, python)
- Writing **documentation**