ORCA

Orchestration and Reconfiguration Control Architecture

BASIC SDR CONTROL PLANE FUNCTIONALITY

Slice coordination: Sense and abort MAC

Control flow →
Data flow →

MAC software
Collision detection
PHY
RF frontend
Processor
FPGA
SDR
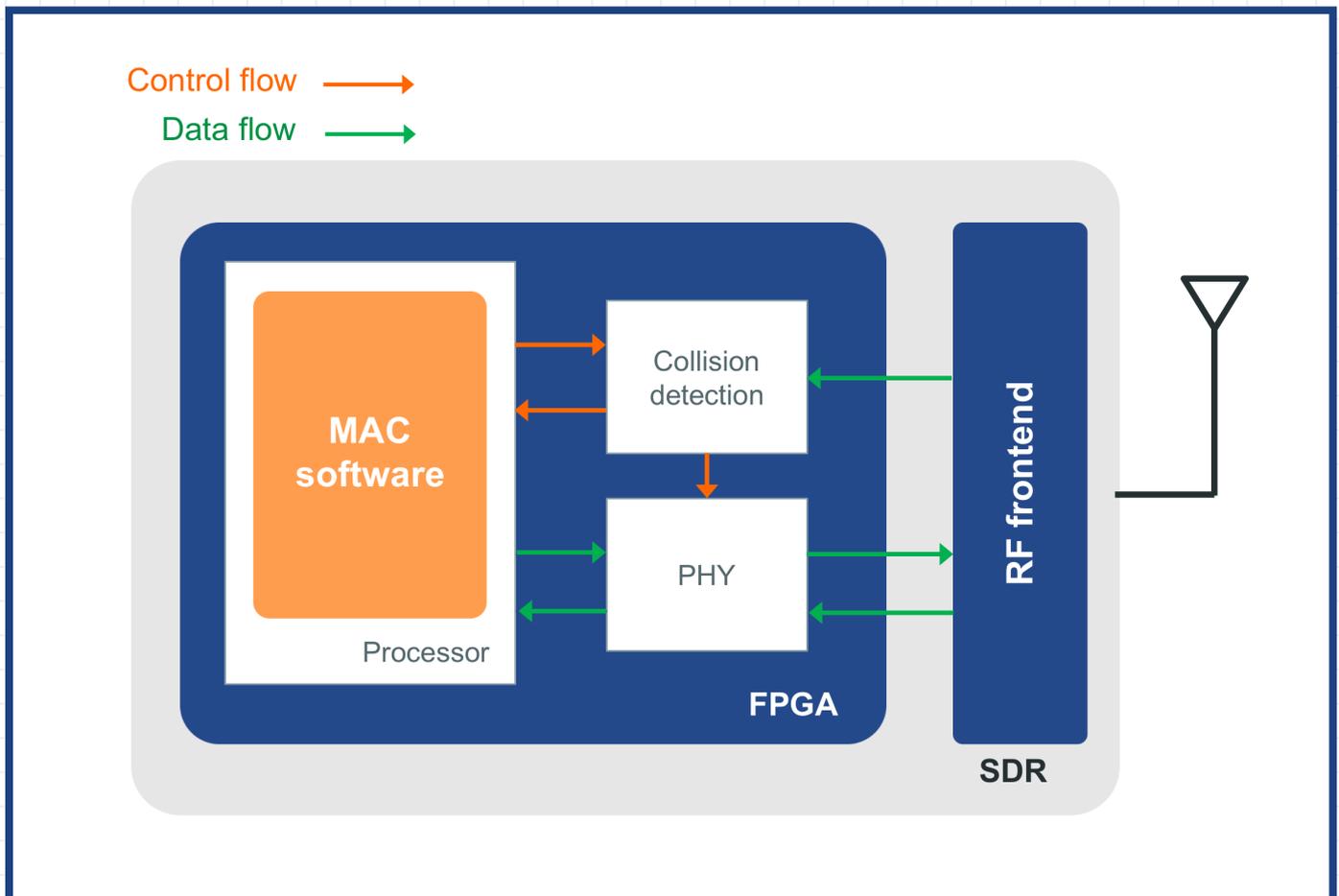
- Tight integration between PHY and MAC.

- Collision detection algorithm can instantly abort an ongoing transmission.

- The collision detection algorithm uses a statistical hypothesis test to sense for collisions during a transmission.

- Collisions can be detected with a high probability up to 20m away.

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CONTEXT

In dense networks, collisions often occur, having a negative effect on the overall performance [1]. Being able to sense ongoing transmissions during your own transmission solves this problem [2]. This is made possible by tightly integrating the PHY and MAC. The delay in detecting the collision is crucial for high performance gains. By implementing the collision detection algorithm in FPGA fabric, instant detection can be achieved. The sense and abort MAC algorithm enables a statistical hypothesis test which distinguishes between the own transmitter signal and an interferer. The output is fed back to the MAC processor which will abort the ongoing transmission if a collision is detected. By using in-band full duplex to cancel part of the self-transmitted signal, a collision detection range of up to 20m using 0 dBm transmit power at 2.4 GHz can be achieved.

UNIQUE SELLING POINT

- Highly reliable collision detection during a transmission.

- Instantaneous abort of an ongoing transmission upon collision detection.

- Increased network performance in terms of energy-efficiency, throughput and delay.

OPPORTUNITIES

- Interference detection and mitigation experiments.

- Development of new collision detection algorithms.

- Development of new MAC algorithms using continuous sensing of the spectrum.

REFERENCES

The MAC algorithm runs inside a Xilinx MicroBlaze on an NI USRP RIO. The PHY and collision detection algorithm is programmed using LabVIEW communications system design suite while the MAC algorithm is programmed in C. The Sense and Abort MAC algorithm and the collision detection algorithm is analysed in [3]

1 T. Vermeulen, S. Pollin . 2014. Energy-Delay Analysis of Full Duplex Wireless Communication for Sensor Networks. In Global Communications Conference (GLOBECOM), 2014 IEEE. Global Communications Conference (GLOBECOM), Austin, Texas, 08-12 December 2014. , pp. 455-46

2 T. Vermeulen, M. Laghate, G. Hattab, B. van Liempd, D. Cabric and S. Pollin, "Nearly instantaneous collision and interference detection using in-band full duplex," 2017 IEEE International Symposium on Dynamic Spectrum Access Networks (DySPAN), Piscataway, NJ, 2017, pp. 1-2.

3 T. Vermeulen, M. Laghate, G. Hattab, D. Cabric, and S. Pollin, "Towards instantaneous collision and interference detection using in-band full duplex," in IEEE Infocom, 2017.