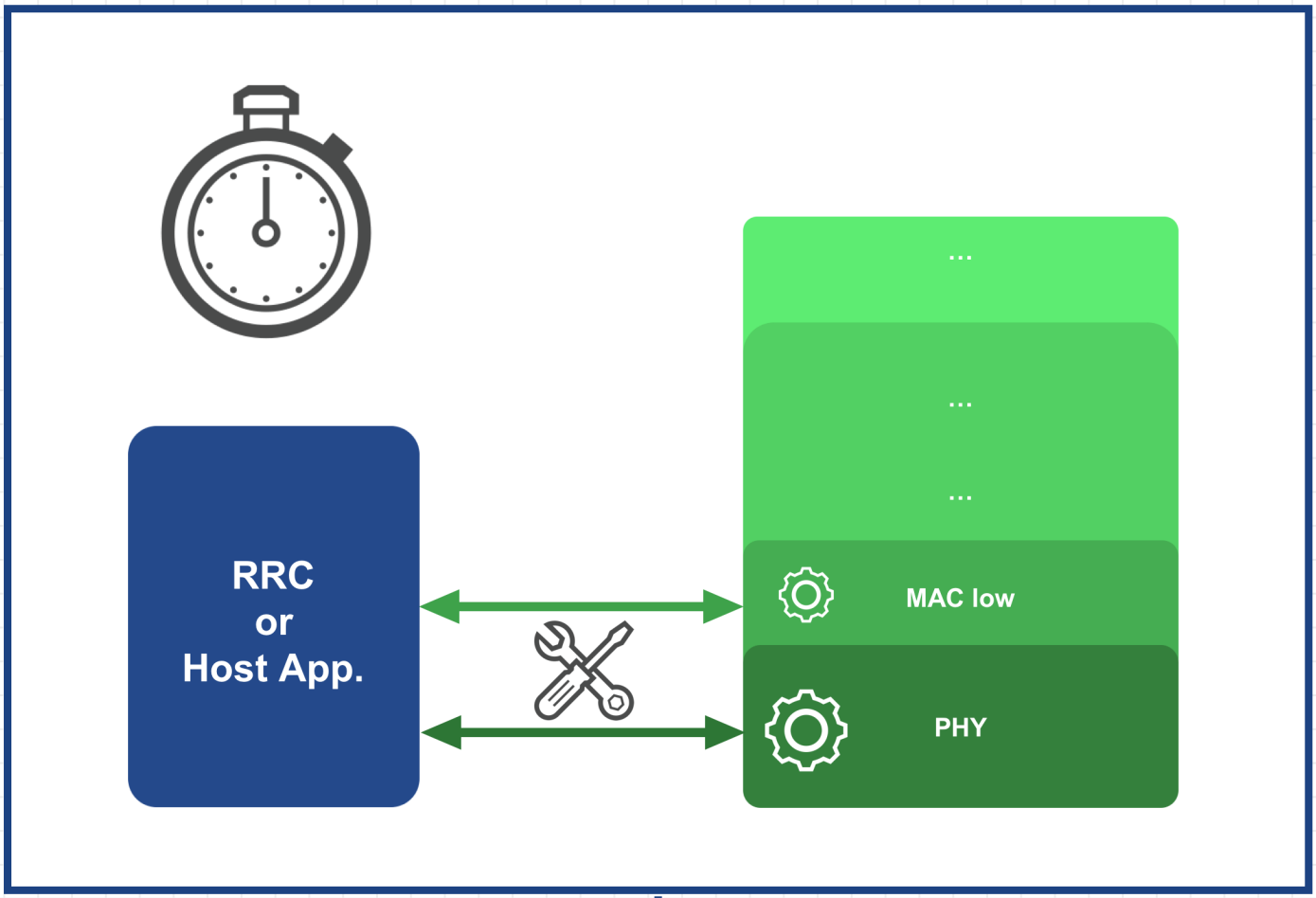
Orca

Orchestration and Reconfiguration Control Architecture

BASIC SDR CONTROL PLANE FUNCTIONALITY

Build SDR control plane:
Runtime parametric control of PHY and lower MAC



Interface to provide run-time access to lower layers of communication protocol stacks in order to realize

- Parameterization
- Configuration
- Monitoring

BASIC SDR CONTROL PLANE FUNCTIONALITY

Build SDR control plane: Runtime parametric control of PHY and lower MAC

CONTEXT

Most MAC-PHY implementations today offer minimum or no support at all for real-time parametric control. Parameters that control the performance of a MAC-PHY pair are either predefined to a default value or are controlled by a locally executed algorithm with no support of outside reconfiguration or update of the controlling algorithm. Here the focus is on the lower layers such as PHY, PHY control or lower MAC. Since these layers are very close to the analog RF front-end and must meet tough timing requirements a real-time control for parameterization during runtime is needed. This allows fast response times, flexibility and customization. The runtime parameterization can be triggered via the testbed or adaptive through a Radio Resource Control layer (RRC) as applied for LTE. Alternatively, dedicated MAC processor could be running on microcontroller or SDR onboard processor, ensuring time agnostic and real time control of lower level parameters.

UNIQUE SELLING POINT

- Required element for building a complete control plane.
- Real-time access to lower layer functionality.
- The support for multiple runtime configurations can be scheduled at accurate time instances in the future.
- The support for dynamic reconfiguration of exposed parameters and update controlling algorithm.
- Accurate time-scheduled execution of PHY action by a MAC command, such as transmitting a packet at a well-defined time.

OPPORTUNITIES

Depending on the underlying PHY technology, different lower layer parameters can be changed such as:

- RF-Parameter (Frequency / Bandwidth / Transmit Power).
- Waveform related parameter: (Type: OFDM, GFDM, SC-FDE / Number of subcarriers / Cyclic Prefix lengths / Windowing).
- Resource allocation.
- MCS.
- Enabling easy implementation for TDMA like MAC protocol.
- MAC related parameters, such as super frame size of TDMA, or contention window size of CSMA.

PHY and lower MAC support of real-time parametric control will open opportunities to support:

- Highly dynamic application level environments and scenarios.
- Cooperation / Coexistence of multiple wireless technologies on the same spectrum.
- Ability to adapt to mobile environments.

REFERENCES

Parametric runtime control will be implemented and applied in NI's LTE and 802.11 Application Frameworks [1, 2] used in showcase 4 which was defined in D2.1 [3] as well as in the GFDM flexible physical layer. [4] KU Leuven will add parametric control for their full duplex PHY and MAC.
Alternatively, this offer is also supported on the Xilinx Zynq ZC706 evaluation board with the Analog Device frontend FMCOMMS2 board, the following steps should be followed to get started:

- a quick scheme through the AD reference design is recommend through this link: http://polr.me/1mpt
- multiple SDR platforms are available in w-ilab.t testbed, where the Zynq and AD FMCOMMS2 based SDR will also be deployed, http://polr.me/1mpu

1 National Instruments, "LabVIEW Communications 802.11 Application Framework 2.0 and 2.0.1", White Paper, http://polr.me/26za , December 2016.

2 National Instruments, "LabVIEW Communications LTE Application Framework 2.0 and 2.0.1", White Paper, http://polr.me/26f6 , December 2016.

3 Vincent Kotzsch, Clemens Felber, Sofie Pollin, Tom Vermeulen, Martin Danneberg, Roberto Bomfin, Wei Liu, Ingrid Moerman (IMEC), Ivan Seskar (RUTGERS), Achim Nahler (NI), Francisco Paisana (TCD), Luiz DaSilva (TCD), „D2.1: Definition of showcases", ORCA Deliverable, March 2017.

4 M. Danneberg, N. Michailow, I. Gaspar, D. Zhang and G. Fettweis "Short Paper: Flexible GFDM implementation in FPGA with support to run-time reconfiguration" in Proceedings of the IEEE 82nd IEEE Vehicular Technology Conference (VTC Fall'15), Boston, USA, 6.9. - 9.9.2015