Wireless Software and Hardware platforms for Flexible and Unified radio and network controL

OC5 Experiment

Flexible PHY experiments using Remote Radio and cloud processing

Overview

The aim of Experiment was to:

- create and propose a cloud-based solution for remote LTE/LTE-A link-level modelling and hardware-in-the-loop experimentation,
- validate IS-Wireless' link-level simulation tool available remotely on a "software-as-a-service" basis (LTE PHY Lab SaaS) in the environment composed of multiple users requesting advanced single processing.

Description of setup of Experiment

The Experiment was performed at NITOS indoor testbed with the usage of USRP nodes (models B210 and N210). Three logical components has been designed for the experiment (Figure 1), based on the Local and Global Control Programs implemented.

Local Control Program – Implements two possible roles for the node: **eNB Transmitter** and **UE Receiver**.

Global Control Program - allows the hierarchical management of multiple nodes. It uses UPI_{HC} and UPI_{R} to control flexPHY Agent's components.

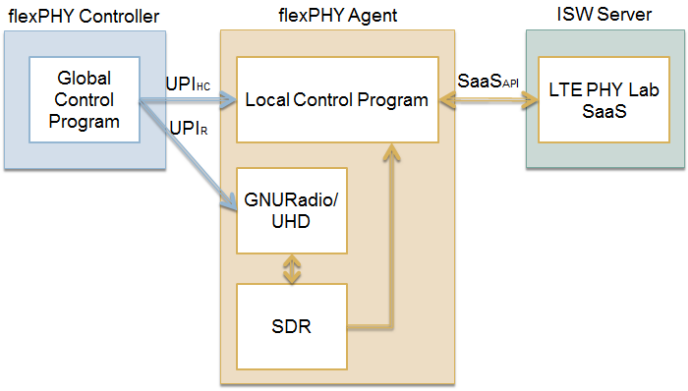

Figure 1 Experiment design

flexPHY Agent represents a specific node in the experiment. It consists of all the components enabling its execution.

flexPHY Controller is responsible for the complete management of the experiment, including support for various use-cases scenarios and flexPHY Agents' configuration for LTE PHY Lab SaaS, GNURadio/UHD and radio parameters.

ISW Server - a host server for LTE PHY Lab SaaS. It provides algorithms for LTE/LTE-A link-level baseband processing.

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MAIN RESULTS

Scenarios implemented and deployed:

- Single eNB Transmitter
- Single UE Receiver
- Hardware-in-the-loop scenario for LTE downlink transmission
- Single-cell environment (single eNB, multiple UE)
- Multi-cell environment (multiple eNB, multiple UE) – Figures 2-3 presents the setup and the nodes used in the example scenario with 2 eNB transmitters and 4 UE receivers

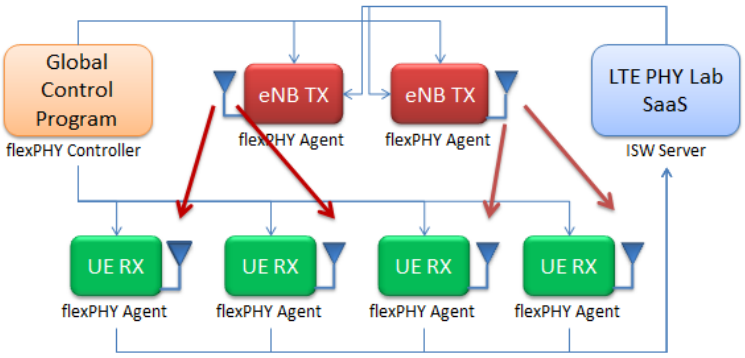

Figure 2 Multi-cell environment scenario setup

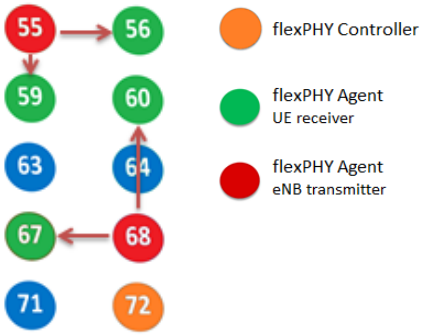

Figure 3 NITOS indoor testbed topology used for multi-cell environment with 2 eNB transmitters and 4 UE receivers

flexPHY Agent: eNB Transmitter - generates IQ samples for LTE downlink signal with predefined settings (such as bandwidth, modulation, number of frames to be generated, physical cell ID, center frequency and RF gain) and transmits the waveform with the use of USRP device

flexPHY Agent: UE receiver

- Records the signal with the use of USRP device,
- Decodes and analyses the captured LTE signal, including:
  - return of basic signal measures: SNR, RSRP, BLER
  - time/frequency synchronization, channel estimation & correction, physical channels decoding (PBCH, PCFICH, PHICH, PDCCH, PDSCH)
  - recovery of key information parameters, such as physical cell ID, Master Information Block (MIB), Control Format Indicator (CFI), Hybrid-ARQ Indicator (HI), Downlink Control Information(DCI), System Information Block type 1 (SIB1).

Conclusions

- The solution for remote LTE/LTE-A PHY modeling and hardware-in-the-loop experimentation was proposed based on ISW's LTE PHY Lab SaaS, WiSHFUL UPIs and WiSHFUL facility.
- Several test scenarios has been implemented, deployed and analyzed, including single-cell and multi-cell environment cases.

CONSORTIUM