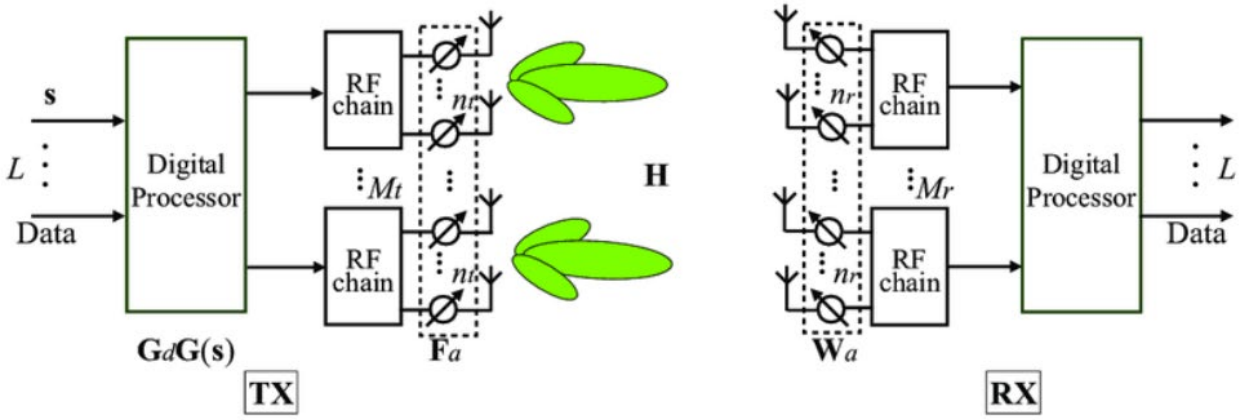
Linearization of a Hybrid beamforming phased array antenna module

Introduction Hybrid beamforming

Hybrid beamforming is a technique within 5G and millimeterwave communications. The idea is to combine the advantage of a fully digital beamforming system with the lower cost of an analog beamforming system. At the transmitter there is a set of digital signals, each connected to an analog RF chain with many phase-shifters and antennas, enabling the possibility to create multiple beams that can be combined to communicate with the receivers. Likewise, the receiver combines (adds) many received antennas in a set of analog phase-shifters, followed by digital sampling, and the set of digital signals can then be further combined to optimize the performance.



Scope

The scope of the thesis is to use Gapwaves 28 GHz phased array antennas module based on hybrid beamforming technology for implementing/analyzing and verify various signal processing algorithms for maximizing the performance of the phased array antenna. The main focus lies on optimization of the Power Added Efficiency (PAE) by linearization algorithms. This is mainly done through linearization of the amplifiers in the phased array antenna to enable the amplifiers to operate in their most efficient way which is close to saturation without degrading the transmission characteristics.

The test setup shall include two phased array antenna modules with appropriate interface equipment and an RF system-on-chip (RFSoC) development platform for algorithm and feature implementation. The software implementation on the RFSoC shall not only include the linearization and beamforming functionality but also the Serial Peripheral Interface (SPI) to control the phased array antenna module.

Some illustrations and technical data of the current setup is given below.

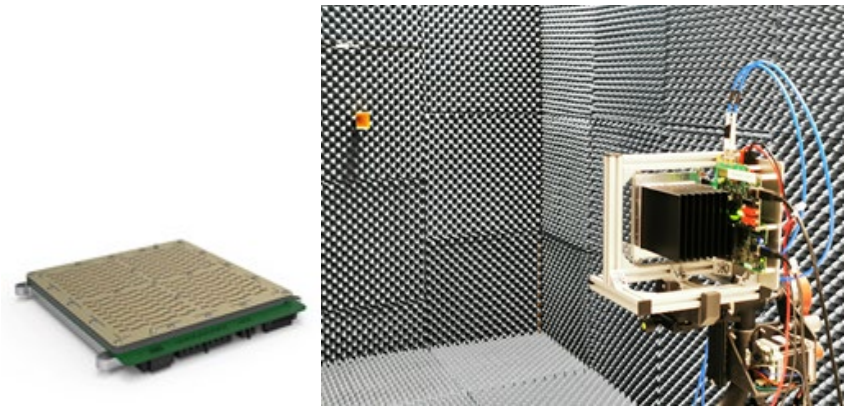


Fig 1. Testfixtures including Phased array antenna modules, Control interface modules, IF interface board, Mechanical stand, Cables and heatsink

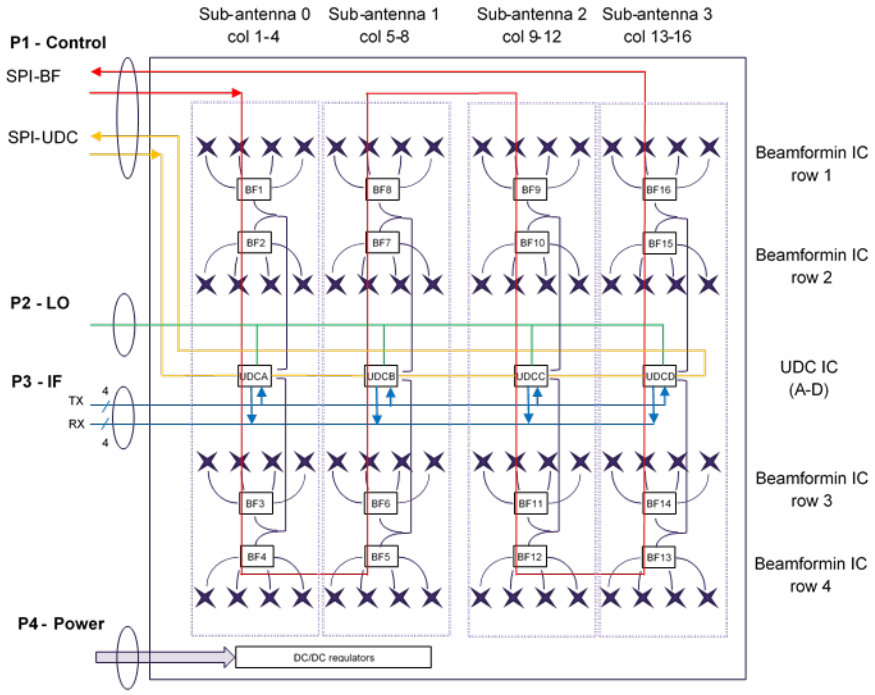


Fig 2. Functional diagram of the phased-array antenna module from Gapwaves

Expected outcomes

The project will require signal processing skills, combined with understanding of analog hardware. The expected outcomes are:

- Development environment for the usage of RFSoC (Zynq eval platform)
- Algorithms and code for linearization techniques for a sub-antenna structure.
- Measurements results showing accuracy of beamforming when linearization is active

About the company: Gapwaves

The company Gapwaves was founded in 2011 by Prof. Per-Simon Kildal at Chalmers University of Technology. Gapwaves was listed on Nasdaq First North in Nov 2016 and has currently more than 5 000 shareholders. The total number of employees is currently 25 developing antenna and antenna modules up to 140 GHz. The company is located at Klippan in Göteborg.

Gapwaves patented technology is unique as the first to combine manufacturability, cost and performance for waveguide solutions by using an artificial magnetic conductor enabling multilayer waveguide structures to be built.

A large patent portfolio protects the Gapwaves waveguide technology and other areas including not only waveguide structures but also bowtie antenna structures for optimizing low losses and high bandwidth with flexible design and assembly principles in any antenna from low GHz to THz frequencies.

Gapwaves specializes in active antenna solutions for telecommunication, automotive radar and connected vehicles.