PROKJETY W RAMACH KONKURSÓW CAS/III/POKL ORAZ CAS/IV/POKL

1. Uniwersytet w Luksemburgu:

1.1 Static analysis for android security: building the map of Android Inter-Application Communication

Android is the most widespread smartphone operating system in the world accounting 70% market share. More than 600 000 Android applications available on dozens of application markets can be installed by end users. On the official market of Google (AndroidMarket), more than 10 000 new applications are available every month. For the end user, downloading an application on his smartphone is similar to choosing an apple on an apple tree: he only sees the surface and has no evidence that there is no worm in it. Unfortunately, there are many worms of different kinds waiting to invade smartphones: malware leaking data, applications eating all the battery, adware calling premium-rate numbers, etc. In an open world as the Android world is, the end user receives and install an application file and can then only pray that the application is not harmful in any sense. Hopefully, it's not inevitable! Recent research works try to propose different kind of security analyses on Android applications.

Nevertheless, analyzing one Android application in isolation is not sufficient. Indeed, even if a permission-based architecture (as the one of Android) ensures that an application A can only access the resources for which A has the permission, the specificities of Android make communication between applications (and the components constituting an application) possible through elements called Intents. Consequently, on Android, several applications can collude to leak sensitive information. For instance, an application can get the user's location and send it to another application which then leaks the sensitive information to an untrusted third party.

The first expected outcome of AndroMap is a detailed map of Android application components and the links that exist between them. The map can be used to detect problems such as privacy leaks and click fraud, or to determine interesting properties such as long or otherwise interesting communication paths, or paths with loops, hinting at potential for a Morris-worm or denial-of- service attacks. A direct application is to use the map to warn the user when she is about to install an app that would yield suspicious links in the user's "device map".

The second expected outcome of AndroMap is to go beyond simply warning the user by providing a tool which allows the correction of the identified security flaws. The main research difficulty is to modify the code of an android application without altering the nominal functionalities of the application.

1.2 Energy efficient cloud computing

The ECO-CLOUD project aims to provide an integrated solution to the autonomous energy-efficient management of communication networks and processes in a cloud computing environment. Current research on cloud computing has evolved from, and is dominated by, cluster and grid computing domains where communication aspects are secondary. However, cloud computing systems and cloud applications are fundamentally different from cluster and grid computing, and communications must be considered to unveil their full potential.

To address this gap, the ECO-CLOUD project will develop a framework of novel techniques and to deliver efficient solutions, in the form of prototype software, for optimisation of performance and energy-efficiency in (a) network hardware (switches, routers and links), (b) data center communication systems, and (c) communication protocols. Furthermore, ECO-CLOUD aims to develop new metrics for assessing the energy efficiency and performance of cloud computing communication systems. It will be proposed that these metrics be included in future standards and it is projected that it will impact the whole cloud computing industry, and guide the design of future data centers.

Another important outcome of the ECO-CLOUD project will be the release of a cloud computing simulation platform to offer fine-grained modelling of communication processes. This will be used for performance evaluation and for comparison of the techniques developed which will be further benchmarked in an operational cloud computing facility.

By aiming at energy efficiency and the performance of cloud computing communication systems, the ECO-CLOUD project will become a significant step towards bridging two major ICT research domains, namely a) communication systems and b) distributed and cloud computing.

1.3 Optimization of performance and energy - efficiency in cloud computing

Greencloud (http://greencloud.gforge.uni.lu/) is a sophisticated packet-level simulator for energy-aware cloud computing data centers with a focus on cloud communications. It offers a detailed fine-grained modeling of the energy consumed by the data center IT equipment, such as computing servers, network switches, and communication links.

Tasks:

- contribute to the scientific research efforts in developing novel energy-efficient techniques for cloud computing environments
- develop models and simulation tools
- participate in writing of scientific articles that will be presented in international conferences and published in major scientific journals.

1.4 Automatic detection and diagnosis of program faults (ADDOPF)

Software has an increasing use in systems and devices that pervade all the aspects of our life. Businesses, financial, health, communication, transportation and every other service of a modern society rely on software. Thus, a rising demand for its amplified reliability has long been established. In ADDOPF project we aim at proposing automatic techniques for the effective detection and diagnosis of software defects targeting on program faults.

Software testing and debugging techniques form the current practice for identifying and fixing software defects. However, these techniques are very expensive as they can consume 50% or even 60% of the total cost of the software development. Therefore, the need for automatic solutions is imperative, especially when high reliability is a mandatory requirement. In the absence of such solutions, i.e. current practice in industry, these activities must be manually performed making its cost exceedingly expensive.

The ADDOPF project addresses two crucial dimensions: establishing an empirical model of the faults' behaviour and the development of automatic testing and debugging strategies based on the established model. The challenging points of the project are:
1. the analysis of how faults are propagated, i.e., how a fault affects program behaviour, and fault correlation, i.e., the relationship between multiple faults within one program
2. the development of automated testing and debugging techniques taking into account the propagation and correlation properties of program faults.

2. Duński Uniwersytet Techniczny w Kopenhadze:

2.1 Assessment of antenna configurations for microwave tomography

Purpose:
select the best configuration of 32 monopoles among these options:

- horisontal antennas in 4 layers (current DTU layout)
- horisontal antennas in 8 layers (modified DTU layout)
- vertical antennas in a cylindrical geometry at 4 different heights
- a few variations of the vertical layout

Tasks:

- build an EM forward model e.g. using Comsol
- make an SVD analysis of sensitivity (Shea 2012, P.C.Hansen book, …)
- conference paper
- fabrication of new antenna system (electical and mechanical workshop at DTU)
- measurements with original antenna system

- transfer of electronic hardware to new antenna hardware
- measurements with new system
- journal paper

Required other work:
- electrical isolation of antenna (needed for patient approval)
    - leak current measurements on old antenna
    - test of paint, gelcoat, etc.
    - leak current measurement on new antenna
    - EM modelling.

http://www.ems.elektro.dtu.dk/research/research_areas/Antennas

2.2 Design of systems for microwave breast cancer detection

Worldwide, more than a million women are diagnosed with breast cancer every year. It is the most common cancer and the second leading cause of cancer death in women today. Research over the last years indicates that microwave imaging might be an accurate method for breast cancer detection. The method is based on measurement of the complex transmission coefficient in several directions through the object to be imaged (the breast). This data is then used to reconstruct an image. This image should be used to detect cancer tissue. However, presently no commercial 3-D imaging system exist, so experiences with this type of images are limited. The long-term goal of the breast cancer project at DTU Elektro is to develop a system suitable for clinical test.

The microwave imaging system to be developed in this project employs a multi-element antenna array connected to a Vector Network Analyser (VNA) through a multichannel switching network, enabling multiport coherent measurements.

The project focuses on developing the hardware for gathering the needed data. The main components of the system are:
• 2-port network analyzer;
• Switching network;
• Antenna system;
• Control electronics.
The heart of the system will be the VNA, which is used to do the actual measurement. Since most VNAs only provide two ports, a switching network should be created to extend the two ports. This will make it possible to select one of the multiple antennas for transmission and another for receive as illustrated in Fig. 1.

The antenna system is already developed and is suitable to generate data for a 3D image.

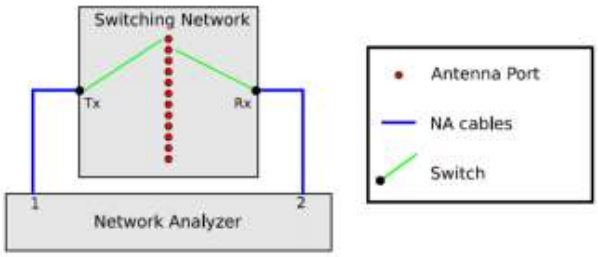


Fig.1. The switching network makes it possible to select one antenna for transmit and another for receive.

The goal of the project is to design fabricate and characterize the multiport switching network, which would provide a wide operating frequency range (from 0.5 GHz to 3+ GHz), maintain a high level of channel-to-channel isolation (over 100 dB) and high switching speed (in order of seconds). To achieve a high sensitivity it would probably be necessary to include a broad-band (of the-shelf) low-noise amplifier in each receive channel.
The project also includes an implementation of the computer control and data acquisition.

2.3 Design of millimeter-wave integrated power amplifiers (possibility for tape-out)

With the advent of smartphones, tablets and connected cameras, the number of users of wireless networks is dramatically increasing. Cisco forecasts an 18-fold increase in wireless data traffic between 2011 and 2016. As a consequence, the capacity of wireless network must be increased to face this data explosion. In that respect there is at present an increased interest to exploit the millimeter-wave (mm-wave) frequency range (30-300 GHz) for wireless backhauling. The primary motivation for moving to

mm-wave frequencies are the availability of large absolute bandwidth, small system size, and highly directive antennas. The recent world-wide allocation of the E-band spectrum (71-76 and 81-86 GHz) provides the opportunity for line-of-sight radio links with "fiber-like" multi-gigabit data transfer rates. The E-band spectrum falls within an atmospheric window with low attenuation, making transmission over fairly long distances (up to 10km) possible. This makes E-band wireless links attractive not only for mobile backhaul applications but also for bridging the gaps in optical fibre networks. In the pursuit for ever higher data rates, the underexploited deep mm-wave bands above 100 GHz are attracting significant interest. In particular, the frequency bands around the atmospheric windows located at 140-GHz and 220-GHz are promising for this purpose.

The progress in semiconductor device technology, in particular compound semiconductor transistors such as High Electron Mobility Transistor (HEMT) and Heterojunction Bipolar Transistor (HBT) devices, enables the development of wireless communication circuits operating at frequencies well above 100 GHz. At such high frequencies, monolithic microwave integrated circuit (MMIC) technology is mandatory. The main bottleneck in mm-wave systems today is the power amplifier (PA). The high operation frequency of semiconductor devices, in particular Silicon based, has been obtained by aggressive geometrical downscaling. As a consequence, the available output power per semiconductor device is limited. InP technology is particular well suited for applications in the high end of the millimeter-wave frequency band and even in the sub-millimeter-wave frequency band.

The overall objective of the project is to demonstrate high power amplifier MMICs for emerging D-band (110-170 GHz) wireless communication network using European based InP DHBT technology. In particular, the potential and limitation of the InP DHBT technology currently under development at the III-V Lab in France should be investigated. For the proposed application an output power at around 20 dBm (100 mW) must be targeted. To complicate matters, it is foreseen that higher order modulation formats will be employed to enhance the spectral efficiency in future mm-wave wireless communication links and this dictates strict linearity requirements to the power amplifiers. Therefore the power amplifier performance should be optimized at the 1 dB compression point.

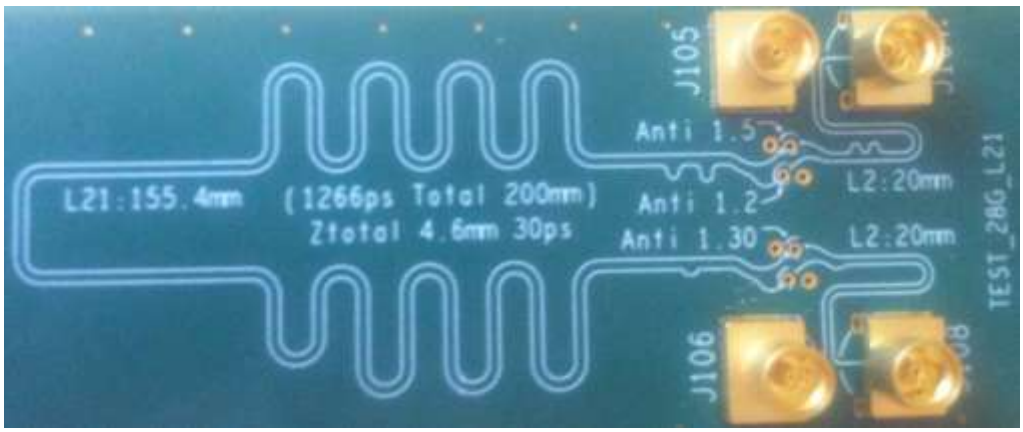
Several open issues should be addressed during the project. These are among others:

1) Transmission line implementation (inverted μ-Strip, CPW, ECPW, ACPS) and requirements for single-mode propagation (substrate thickness, finite ground plane, overall CPW size)
2) InP DHBT device performance at D-band (optimum biasing, numbers of device fingers, emitter ballasting)
3) Design a passive low-loss power combining structures at D-band frequencies.
4) Design a multi-stage balanced power amplifier at D-band frequencies using optimized power cells.
5) Investigation stability and thermal issues.

The power amplifier design should be performed in Agilent ADS and performance of critical passive structures verified in HFSS. The complete layout should be transferred to Cadence for final design rule check (DRC) and layout versus schematic (LVS) verification. Tape-out is expected regularly over the following three years period. Next tape-out is planned in early 2015.

2.4 EM modelling of high-speed via transitions (28G FR4 test-board available)

In this project the influence of high-speed vias on high-speed signal transmission up to 28 Gbit/s should be investigated. The vias connect traces on a 22-layers FR4 printed circuit board. The effect of nearby ground vias on the quality of the signal transmission must be accessed. The project will involve signal processing in Agilent ADS and electromagnetic modelling of the vias using the simulation tool HFSS. Experimental S-parameters measured to 65 GHz are available for several test-structures with and without nearby ground vias.



Figur 1: Test board with via transitions of varying geometry and nearby ground vias.

The following tasks can be proposed for this project:

1) Transform experimental data from frequency to time-domain and extract information about of transmission line parameters and analyze via transitions on the test boards.
2) Investigate plane radiation effects at via transitions using HFSS. What is the effect of nearby ground vias? What is the effect of simulation domain truncation on the parasitic modes? There is the return current path when no nearby ground vias are present?
3) Investigate the influence of ground vias on the Eye diagram quality of a real-world high-speed bit pattern.
4) Propose optimized via transitions for 28Gbit/s transitions.

The project is motivated by the fact that it seems to be a contradiction between EM simulation results showing that it is necessary to include several ground vias near via transitions and real life boards that still function well without these! The physical reason behind this difference must be better understood.

3. Politechnika Nantes:

3.1 Development of a tool-chain for the generation (compilation) of Linux kernel and related drivers depending on the target ARM-based SoC

This project aims at a rapid development of Linux distributions for a number of SBC (Odroid, Radxa, E9, ..) with multicore SoCs.

3.2 Development of a wearable server based on Odroid-W (IoT)

This project includes a number of multimedia services that can be provided via Odroid-W GPU including audio and video streaming. Before the activation of streaming services the server needs to be activated as an intelligent access point.

3.3 Development of a multimedia library for audio and video services based on hardware accelerator provided by Tegra K1

This projects is based on GStreamer and the packages provided by nVIDIA. It targets mainly (but not only) H.264 and H.265.