**Research Group:**
„INTELLIGENT NETWORKS AND RADIOCOMMUNICATIONS”

<table>
<thead>
<tr>
<th>Domain of activity. Research objectives</th>
<th>Keywords</th>
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<tr>
<td>• Software radio and cognitive radio, wireless communication &quot;cognitive radio&quot; and &quot;software radio&quot; systems applications</td>
<td>NFC, RFID, SDR, USRP, WSAN, IoT, VNA, Fractal antennas, MIMO Antennas, ATCA, BPEL-XPDL, JAIN-SLEE, IP, IT Integration, Smart Grids, PXI-VISA, M2M, IoT, streaming, PP-DPI, DSP, transcoding</td>
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<td>• Radio spectrum monitoring using &quot;spectrum sensing&quot;</td>
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<td>• Proximity radio communications</td>
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<td>• Antennas, measuring the repartition parameters for determining the operational quality in the spectrum bands</td>
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<td>• Study of the microwave effects</td>
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<td>• Development of remote applications and laboratories</td>
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<td>• Modeling and simulating of radio channels</td>
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<td>• Development of wireless sensor networks</td>
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<td>• Intelligent communication networks – IT integrated</td>
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<td>• Multimedia streaming</td>
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<td>• Optimization of IT integrated networks – design, implementing and protocol analysis</td>
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<td>• Industrial communications for Smart Grids and for the Internet of Things</td>
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**Research group profile**
The research activities of the IN and RadioComm laboratory are multidisciplinary oriented and integrative: radio access networks and switching networks are interconnecting – from a microelectronic scale (NoC – Network on Chips) up to a global scale – systems of great diversity, with partial availability and limited connectivity, with special security needs. The team answers the challenges of complexity, distributivity, mobility and interoperability by a service-oriented approach: in the Intelligent Networks, technical conditions are created so that users themselves are enabled to create and configure portable services. The “IT integration” of telecom networks with the computer networks is promoted by the implementation of IP in broadband communications / multimedia streaming, in solutions as content-to-terminal adaptation, packet processing and digital processing of multi-rate acquired signals. The group aims to assimilate new timing-over-packet LXI-AXI technologies in order to include advanced instrumentation in the IT integration. A special part of the IN team expertise consists in the telematic approach of distributed systems, online publishing of laboratory resources and multiplexing the access to own high-tech infrastructure for a broad range of beneficiaries. Industrial communications GPIB-SCPI-VISA-IVI are implemented in modern solutions that replaced the slogan „the software is the instrument" with the new one: „the service is the instrument". Through software defined radio communication solutions, as well as through Smart Grids instrumentation solutions, we open the way to possible partnership in IoT and M2M (in the near future, machine-to-machine communications will exceed in volume the man-machine or man-to-man communications).
1. **Systems for testing large bandwidth fractal antennas and measuring of radio signals from the surrounding environment.** These systems allow the measuring of the characteristics of the antennas and they also permit studying large bandwidth radio signals.

![System for the study and design of fractal antennas using the Anritsu MG3700A signal generator and the Tektronix SA 2600 signal analyzer](image1)

![The Anritsu 37347A VNA](image2)

2. **The ATCA platform** (“Advanced Telecom & Computing Architecture”), remotely accessible, dedicated to development, testing and hosting of prototype services in the field of advanced communications. Resources and capabilities – organized as IaaS (Infrastructure-as-a-Service) – are available to be used and aggregated in distributed configurations, according to the PnP (Plug-and-Play) principles of inclusion in the Clouds, based on XMPP (Extensible Messaging and Presence Protocol) for Social Networks, extended to the IoT (Internet of Things).

![Converged telecom platform: ISDN Philips "Sapho" & ATCA Schroff-Siemens / ATCA Radisys-Continuous Computing](image3)

From the PaaS (Platform as a Service) perspective, there were integrated the software components open BSC, open GGSN and open IMS in an APS (Application Programs System) that is more than an open OS (Operating System) – it combines the basic Call-Control functionality of a fixed-mobile convergent Core Network with the IN-SCP (Intelligent Network-Service Control Point) functionality.

3. **Telematic / Telemeasurement solutions** were consolidated in more than a decade of pilot projects and coordination of EU-financed transnational networks, in the domain of „remote laboratories” able to publish online their experimental capabilities, offering complete telematic services over any access networks. Real equipment was integrated with the emulated/simulated one by unified access techniques, in a „transparent” mode, quasi-independent of user location (in the frame of „Virtual Electro-Lab”, [http://vlab.unitbv.ro/velab](http://vlab.unitbv.ro/velab)). Operating is seamless, real/emulated – in parallel – by stimuli „parsing” into behavioural simulation. Implementation of the MSA (Measurement Subsystems Architecture) is based on the co-design: hardware – experimental workbenches (WB) – and T&M software, in the context of industrial communications compliant with SCPI (Standard Commands for Programmable Instruments) / IVI (Interchangeable Virtual Instruments). The multi-tier implemented architecture is controlled by an Internet Server
(with one or more NIC – Network Interface Cards) having in its Intranet various WB servers running dedicated instrumentation software that is driving the advanced laboratory infrastructure.

4. **Cognitive Radio signal power measurement of spectrum occupancy.** Case study in partnership with the University of Cagliari, Italy and the University of Bilbao, Spain, in conformity with the Hidden Node Margin model (between the generated signals from the cognitive radio devices and the power levels which could affect the “hidden receiving nodes”, especially the DVB receptors). Estimations have been made for the received power on the UHF channels, occupied and unoccupied, with different bandwidths, in multi-storied living buildings from different urban areas from Cagliari, Bilbao and surroundings and in a rural location. The RMS power has been recorded, using log-periodic and omnidirectional antennas and channel filters with 8MHz bandwidths (specific for terrestrial digital broadcasting stations), along with 1MHz and 100kHz, using a vector signal analyzer. The study has concluded that the occupation level of the frequency spectrum could reach 84%, with roof antennas, in rural areas, but can drop to 32%, for preventing the interferences in urban areas. The need for joint using geo-location databases and spectrum detection techniques has been demonstrated.

5. **Advanced virtualization solutions developed on the ATCA platform:** integrated top-down approach – the SDN (Software Defined Networking) separates control from the switching (on an ultra-fast 40G – Infiniband fabric), via a protocol synthesis zone (on the Open-Flow principles) powered by RMI / NetLogic / Broadcom XLR Packet Processors. Capabilities for DSP (Digital Signal Processing), based on 10 x TNETV302 hexa-core Texas Instruments for trans-coding and/or adapting of multimedia content to the channel or the terminal (in mobile browsing, IP-TV etc); capabilities for DPI (Deep Packet Inspection), enabling flow discrimination, peer-to-peer traffic filtering (with real-time Spam reject ) for high- bandwidth streaming; capabilities of multi-modal signal synthesis & modulation based on the IQ-producer functionality of a multi-standard Anritsu MG3700A generator (up to 6GHz); „load & stress” capabilities for intensive-traffic testing.

6. **Solutions for the Management of IaaS (Infrastructure-as-a-Service) in Telecom:** Controllability is provided by SNMP agents (RFC 1157), version 4J, embedded in the IOS (Internetwork Operating System)– Cisco or similar. Telecom equipment is enrolled in the IaaS „colony” – by an OpenStack cloud controller – based on Social Networking models (discovery of presence and availability – compliant with XMPP). This enables automated configuration of resources from heterogeneous networks with real and/or emulated equipment (Cisco Dynamips-GNS3 / Juniper JunOS Olive pilot implementation). It was implemented – by Groovy – the concept of generic driver (on the originating I VI principle) grouping basic functionality, according to Telecom standards. Specific parameterisation data were defined as Java objects (ConfigInfo), associated with generic signalling (via an Expect module) between emulated nodes (using jsch library) – under control of a Jboss Application Server 7.

7. **Pilot implementation of a RFID-WSN hybrid system**: it suggested the integration of the internet of the future, at application level, in the three domains – The internet of objects, The Internet of services and The Internet of 3D environments; implementing the network core, using the MICAz platform, with a real time operating system TinyOS; integrating of the wireless sensors and distributed actuators (as self-configurable radio nodes, which can be accessed directly, without the need of special gateways), in a virtual 3D environment based on an original paradigm for the interaction between users and intelligent objects.

**Completed and ongoing research projects at national and international level**

**Platform for the development of innovative technologies (”PLADETINO”)** – Acquisition and processing of data transmitted via industrial communications – a research and development project for multi-disciplinary integration of CAD, CAPP, CAM, and CIM technologies, for rapid manufacturing/prototyping, reverse engineering, concurrent engineering, virtual and remote engineering.
COST Programme (European Cooperation in Science and Technology) – IC1004 action – “Cooperative Radio Communications for Green Smart Environments”. Members of the team take advantage of modern equipment: spectral analyzers, network vector analyzer, vector signal generator with IQ producer software (HSPA, LTE, ISDB-T/GPS, DVB-T/H, etc.) for the research of wave propagation outside and inside of the buildings, remarkable results being obtained in the antenna field, especially.

Selection of publications representative for the research group


Contact data

Name: Prof. dr. ing. Florin Sandu
Role: Coordinator of the Telecom Group
sandu@unitbv.ro

Web: http://www.unitbv.ro/dec
- ICDT, L3, Str. Institutului nr. 10, Brasov, Romania
- Building N, str. Politehnicii nr. 1, Brasov, Romania
- Tel: +40 268 478705