



iICT

INSTITUTE FOR INFORMATION AND
COMMUNICATION TECHNOLOGIES

SKA days, Uni Bern 2019-06-19

HEIG-VD capabilities for SKA

Hes·SO

Haute Ecole Spécialisée
de Suisse occidentale
University of Applied Sciences
Western Switzerland

heig-**vd**

Haute Ecole d'Ingénierie et de Gestion
du Canton de Vaud

Dominique Bovey



Presentation of HEIG-VD

- Applied Research, and Development
 - From TRL2 to TRL5-6
 - Prototype delivery, with local assembly companies
 - Industry-oriented, results-oriented
 - Long-term partnerships with industry
- Labs active in radio
 - IICT: RF and embedded
 - REDS: high-speed signal processing
- Projects in:
 - Communication, sensing, energization
 - Space communications
 - Industry
 - Medical



Presentation of HEIG-VD

- University of applied sciences of Western Switzerland (HES-SO)
 - School of engineering and Business HEIG-VD
 - Campus Yverdon, Switzerland (20km from EPFL)
- Main scope: teaching (bachelor and master), **applied R&D**
- IICT Institute of Information and Communication technologies
 - <http://iict.heig-vd.ch>
 - 60+ persons
 - Network, security, **big-data**, AI, RF
 - 9 active in RF/IoT (Yverdon/Y-Parc)
 - IOT, sensors, analog, low-power embedded, microwave systems, fast low-noise electronics, medical devices, wireless power
 - REDS Reconfigurable Embedded systems
 - <http://reds.heig-vd.ch/en/rad>
 - 27 persons
 - High performance embedded systems (>10GBps)
 - SDR, signal processing (FPGA)

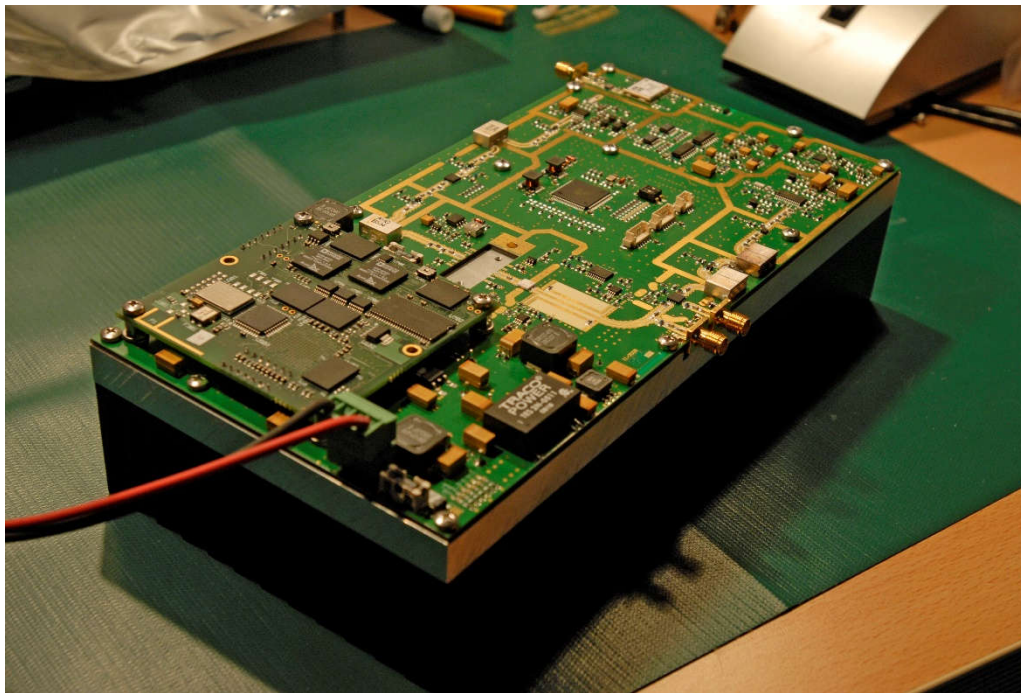


HEIG-VD projects related to SKA

- Directly relevant:
 - Satellite communications PocketSat (ESA)
 - Automotive terminal
 - GEO
 - CubeSat comms (CTI/Innosuisse)
 - Embedded in LEO satellite
 - Antaara humanitarian communications
 - Broadcast data, agriculture, nutrition etc
 - SDR makerspace (ESA)
 - Direct sampling at antenna (X-band)
 - Laser modulator 11-15GHz for telemetry (HES-SO)
 - Digital video broadcasting (Mandate)
 - RF to 4GHz: IICT
 - OFDM Baseband by REDS
- Other:
 - telecom links (>10Gbps) on FR4 PCB
 - >10Mbps wireless digital link for medical implant

HEIG-VD projects related to SKA

- Satellite communications PocketSat (ESA)
 - Automotive terminal (intercontinental trucks)
 - L-band, 1.6GHz, 10W
 - Skyterra GEO
 - 20/40kbps with 35cm radome antenna





HEIG-VD projects related to SKA

- Cube Sat data high data rate link (CTI/Innosuisse)
 - LEO
 - S-band radio
 - Downlink for data gathered from M2M by satellite
 - SDR-based
 - 1Mbps, flexible
 - 10x10cm, 1 board RF, 1 board Baseband
 - S-band, 2W
- M2M uplink (MdP/Swiss space office)
 - TRX module for miniature ground terminals
 - L-band (1.6GHz)
- Radar for space debris detection
 - Navigation radar for Cubesat projet
 - 10x10x2cm device (incl. antenna) detects 10cm object at 5km
 - X-band



HEIG-VD projects related to SKA

- SDR makerspace (ESA)
 - GR, CH
 - Subproject “direct sampling”
 - Direct sampling at antenna (X-band)
 - Wideband processing

- Application to radio-astronomy
 - Centimeter waves
 - Direct sampling up to 32GHz
 - possible bandwidth: 3-4GHz (8-9GS/s)
 - Digital system can directly extract a number of interesting sub-bands, putting less burden on data storage



HEIG-VD projects related to SKA

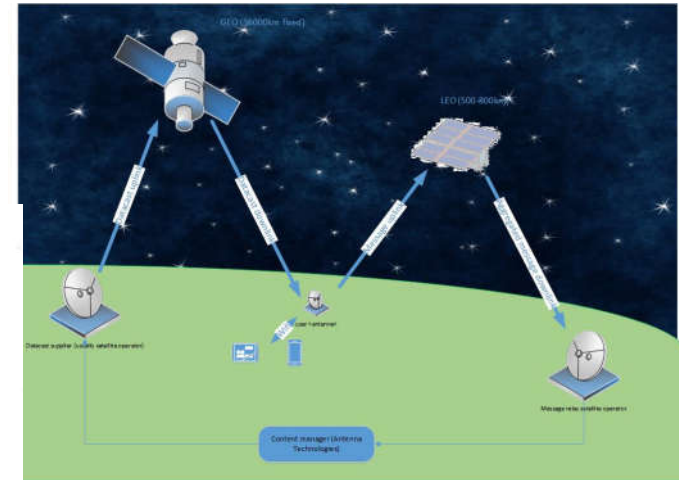
- LA2SPI
 - Laser modulator for telemetry (HES-SO)
 - Agile frequency generator 11-15GHz

- Digital video broadcasting (Mandate)
 - RF to 4GHz: IICT
 - TX Miniature module
 - 6x1cmx0.5cm, several watts
 - Baseband by REDS
 - FPGA integration
 - OFDM (2k subcarriers)



HEIG-VD projects (less related to SKA)

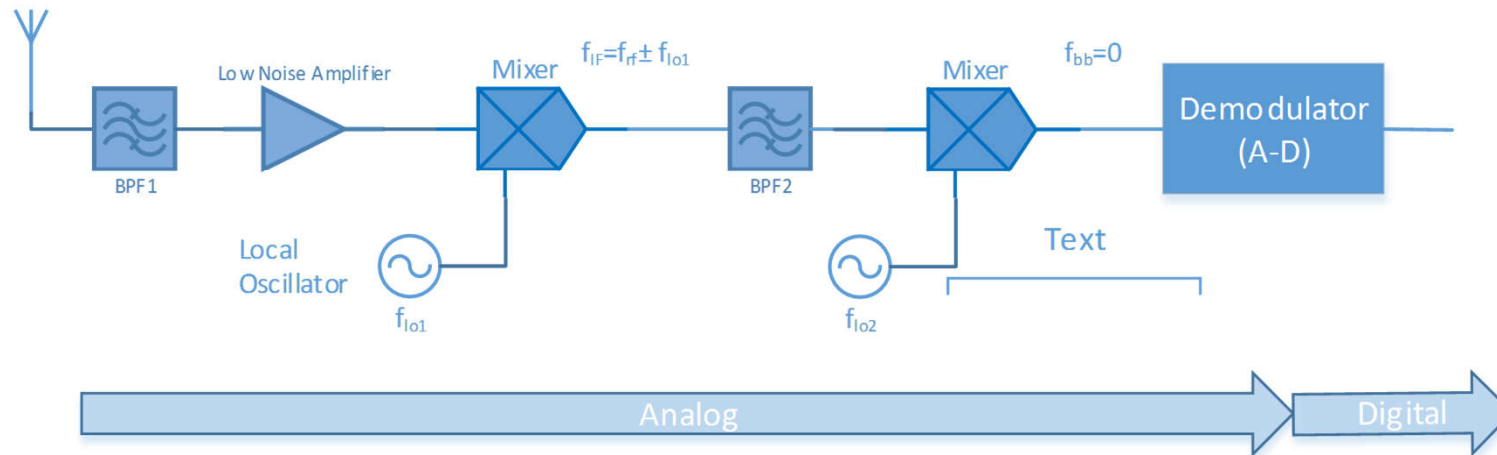
- Antaara project (mandate for NGO)
 - Broadcast information for primary needs
 - Agriculture, nutrition, health...
 - Info requests are possible (e.g. Wikipedia)
 - Ku-band Datacast from GEO in (12GHz)
 - L-band Uplink to LEO
 - Inexpensive ground terminal
 - Easy to point antenna



What is SDR?

- Software-defined radio vs analog radio
 - Depends on where the A-to-D conversion is

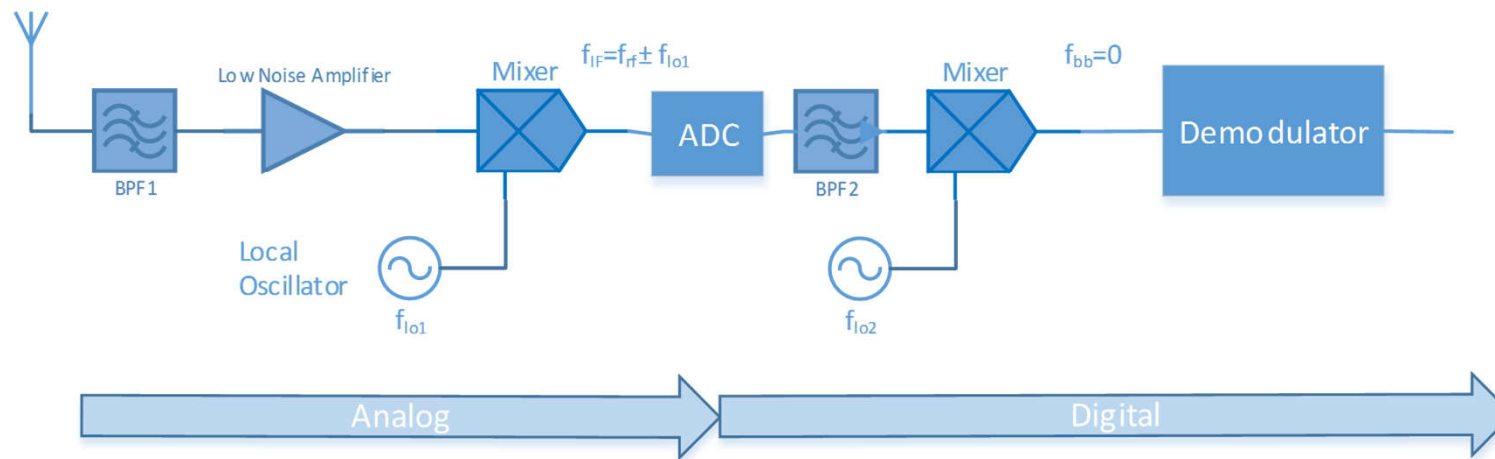
Analog radio



What is SDR?

- Software-defined radio vs analog radio

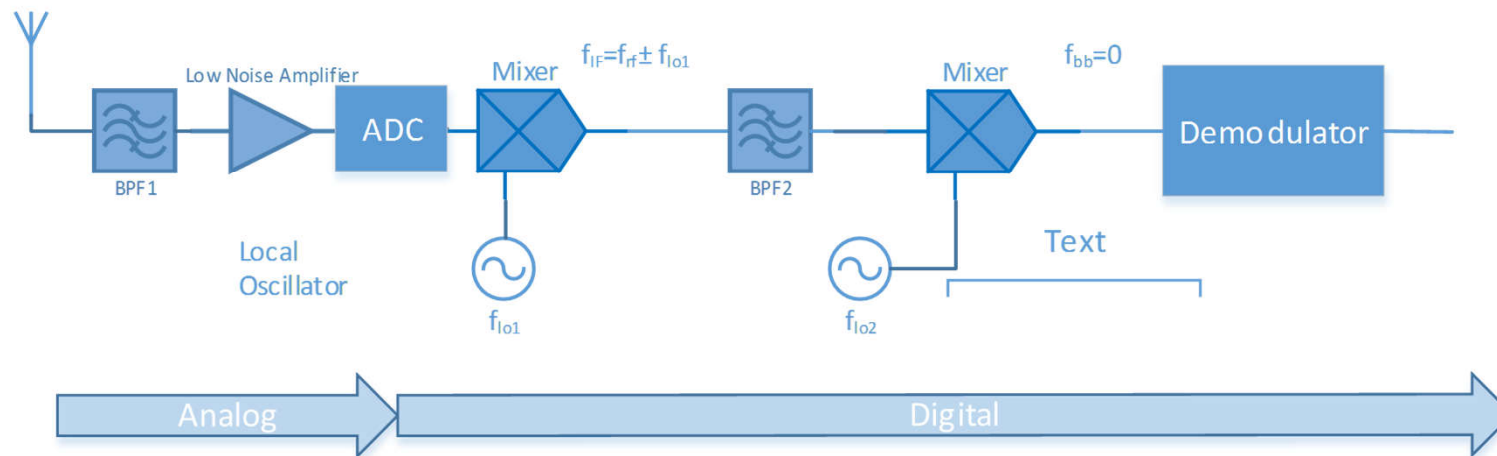
Software-defined radio, architecture 1



What is SDR?

- Software-defined radio vs analog radio

Software-defined radio, architecture 2



- Advantage: the whole architecture of the digital part can be changed upon requirement, during operation, offering extreme flexibility.



HEIG-VD infrastructure

- Microwave/high-speed instrumentation
 - Spectrum analyzers to 30GHz
 - Vector network analyzers to 20GHz
 - High-bandwidth oscilloscopes
 - Rental if needed
- Software
 - ANSYS Electromagnetic suite
 - Microwave simulation
 - Optenni
 - Circuit synthesis
 - SDR frameworks
 - Gnuradio, etc.
 - FPGA design and simulation
- Anechoic room
 - At HEIG-VD
 - Access to EPFL/MAG room



Contact

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What is SDR?

- Software-defined radio vs analog radio

	Analog	SDR
Function	fixed	flexible
RF performance	High	High
Power	Low to high	Medium to high