Prácticas de laboratorio usando el dispositivo SDR HackRF One para la asignatura Fundamentos de Antenas y Sistemas de Radiotransceptores

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Introducción a la tecnología SDR (Software Defined Radio)

Antecedentes:

- Término SR (Software Radio): Joseph Mitola, 1991 [1]

Definiciones:

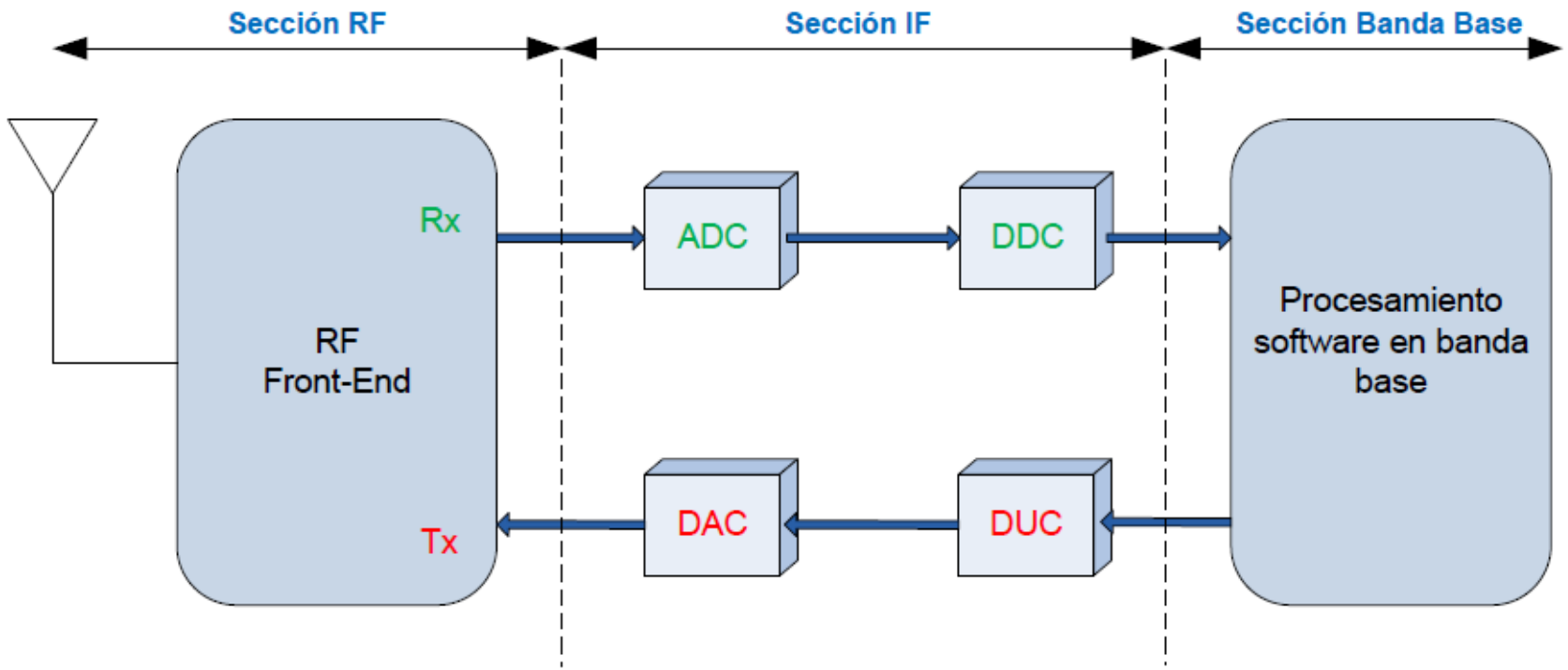
- *SDR (Software Defined Radio)* [2]: “A radio transmitter and/or receiver employing a technology that allows the RF operating parameters including, but not limited to, frequency range, modulation type, or output power to be set or altered by software, excluding changes to operating parameters which occur during the normal pre-installed and predetermined operation of a radio according to a system specification or standard.”

- *CRS (Cognitive Radio System)* [2]: “A radio system employing technology that allows the system to obtain knowledge of its operational and geographical environment, established policies and its internal state; to dynamically and autonomously adjust its operational parameters and protocols according to its obtained knowledge in order to achieve predefined objectives; and to learn from the results obtained.”

[1] J. Mitola, “Software radios: Survey, critical evaluation and future directions,” *IEEE Aeroespacial and Electronic Systems Magazine*, Vol. 4, No. 8, apr. 1993.
[2] Radiocommunication Sector of ITU (ITU-R), “Definitions of Software Defined Radio (SDR) and Cognitive Radio System (CRS)”, Report ITU-R SM.2152, sep. 2009.

Introducción a la tecnología SDR (Software Defined Radio)

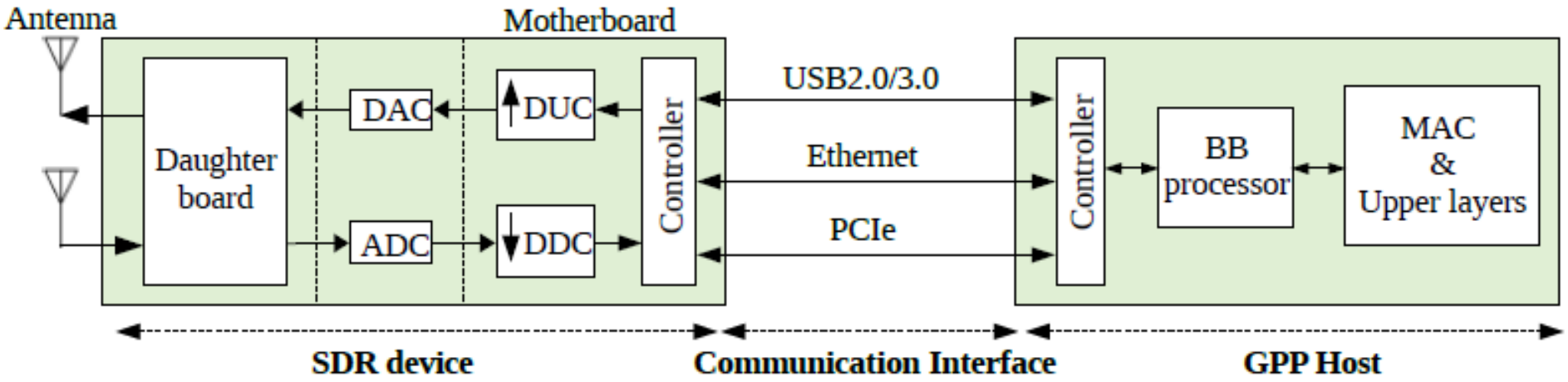
- Arquitectura de un sistema SDR [3]:



[3] I. Pinar, Domínguez, y J.J. Murillo, Fuentes, ”Laboratorio de Comunicaciones Digitales: Radio Definida por Software,” Dep. Teoría de la Señal y Comunicaciones, Universidad de Sevilla, TSC, 2011.

Introducción a la tecnología SDR (Software Defined Radio)

- Arquitectura general de un sistema SDR basada en GPP [4]:



[4] Dereje M. Molla, Hakim Badis, Laurent George, and Marion Berbineau, “Software Defined Radio Platforms for Wireless Technologies,” *IEEE Access*, Vol. 10, 26203-26229 pp., feb. 2022.

Introducción a la tecnología SDR (Software Defined Radio)

- Características de la tarjeta madre de diversos dispositivos SDR [4]:

SDR family	DSP processor	Sample rate (MS/s)		Resolution (bits)		Comm. Interface	Type
		ADC	DAC	ADC	DAC		
HackRF One [45]	NXP LPC43XX ARM Cortex-M4 MCU	20	20	8	8	USB 2.0	Integrated
USRP B210 series [43]	Xilinx Spartan-6 FPGA	61.44	61.44	12	12	USB 3.0	Integrated
USRP X310 series [43]	Xilinx Kintex-7-410T FPGA	200	800	14	16	Ethernet	Separate
Microsoft Sora [48]	Virtex-5 FPGA	44	40	12	12	PCIe	Separate
LimeSDR [47]	Altera Cyclone IV EP4CE40F23 FPGA	160	640	12	12	USB 3.0, PCIe	Integrated

[4] Dereje M. Molla, Hakim Badis, Laurent George, and Marion Berbineau, “Software Defined Radio Platforms for Wireless Technologies,” *IEEE Access*, Vol. 10, 26203-26229 pp., feb. 2022.

Introducción a la tecnología SDR (Software Defined Radio)

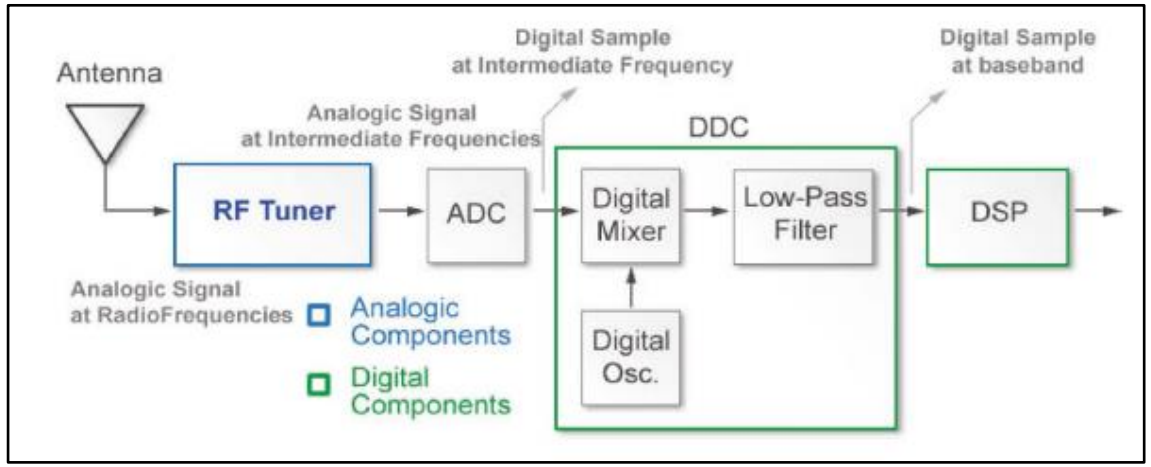
- Características de la tarjeta hija de diversos dispositivos SDR [4]:

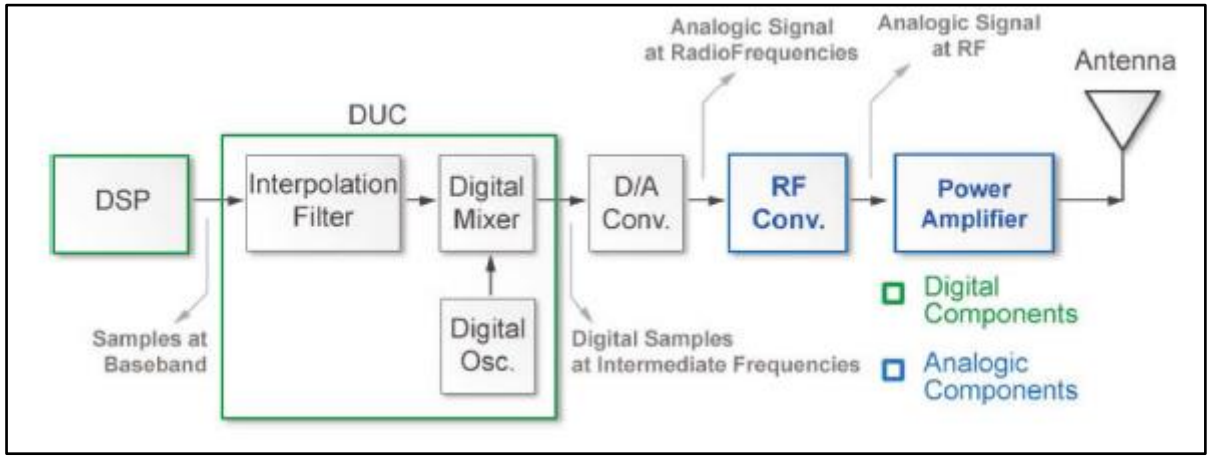
Daughterboard	Frequency Band (MHz)	Bandwidth (MHz)	TX/Rx/Mode	Type	SDR family
UBX	10 – 6000	40/160	Tx/Rx/FD	Stand-alone	USRP [43]
CBX	1200 – 6000	40/120	Tx/Rx/FD		
SBX	400 – 4400	40/120	Tx/Rx/FD		
WBX	50 – 2200	40/120	Tx/Rx/FD		
B210	70 – 6000	56	Tx/Rx/FD	Integrated	
HackRF FE [45]	1 – 6000	20	TX/RX/HD	Integrated	HackRF
WARP Radio RF [46]	2400-2500, 4900-5875	40	TX/RX/FD	Stand-alone	Used by Sora
LMS7002M FPRF [47]	0.1 – 3800	60	Tx/Rx/FD	Integrated	LimeSDR
AD-FMCOMMS2-EBZ [44]	70 – 6000	56	Tx/Rx/FD	Integrated	Analog Devices

[4] Dereje M. Molla, Hakim Badis, Laurent George, and Marion Berbineau, “Software Defined Radio Platforms for Wireless Technologies,” *IEEE Access*, Vol. 10, 26203-26229 pp., feb. 2022.

Introducción a la tecnología SDR (Software Defined Radio)

- Diagramas funcionales de un receptor (izq.) y un transmisor (der.) basados en SDR [5]:





[5] Machado-Fernández, and José Raúl, “Software Defined Radio: Basic Principles and Applications,” Facultad de Ingeniería, Universidad Pedagógica y Tecnológica de Colombia, Vol. 24, No. 38, 79-96 pp., ene. – jun. 2015.

DISCUSIÓN:

¿Ventajas y desventajas de los sistemas SDR?

¿ Aplicaciones de los sistemas SDR?