What is New in Wireless System Design

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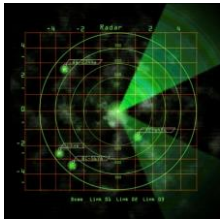
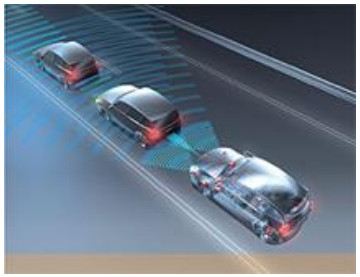
Agenda

- Landscape of Wireless Design
- Our Wireless Initiatives
  - Antenna-to-Bit simulation
  - Smart RF Design
  - Over-the-air testing
  - LTE and LTE-Advanced
  - RADAR systems
- Summary



Landscape of Wireless Design
Mobile Communications: LTE, 5G and beyond

- 5G standardization
  - 100-1000 times Faster speeds
  - Reliable service everywhere

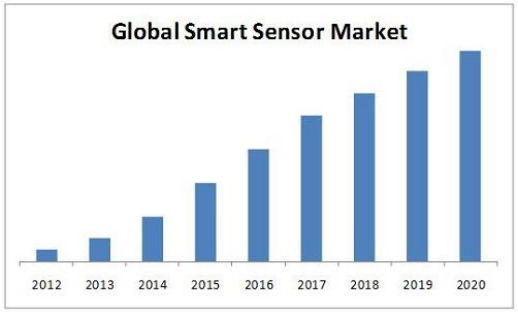


- Greater complexity
  - New architectures
  - New frequency bands (mmWave)
  - More antennas (massive MIMO)
  - Advanced RF and DSP co-design

Landscape of Wireless Design
Connected Smart Devices, Internet of Things

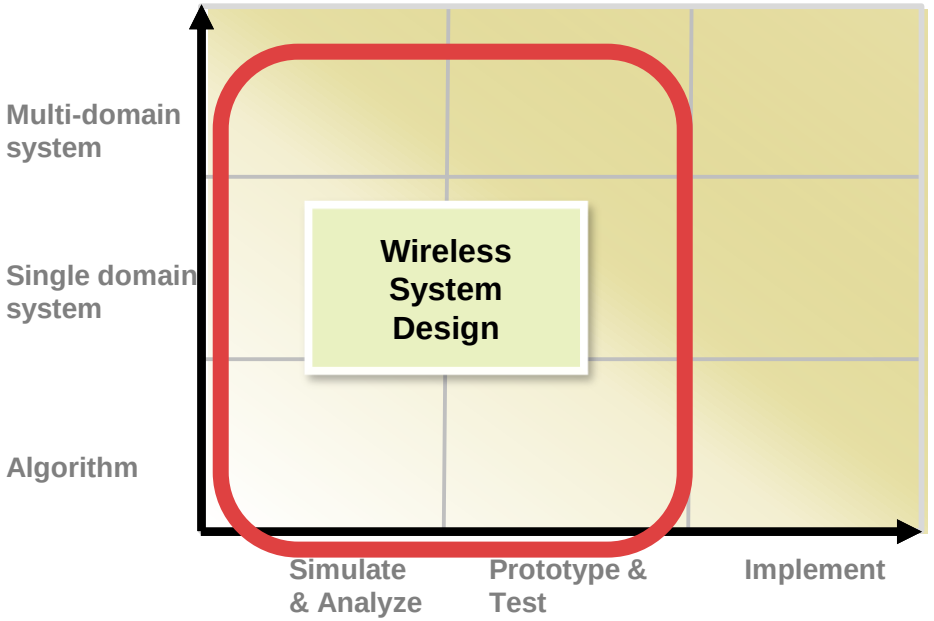
- Internet of Things
  - Embedded sensors
  - Digital health
  - Industrial instruments

- Characteristics
  - Connected wirelessly to internet
  - Low power
  - Generate lots of data



Wireless System Design: MATLAB and Simulink

- Who are our users?
  - R&D Algorithm designer
  - Digital Baseband engineer
  - RF System engineer
  - Test or validation engineer
- What do they need?
  - End-to-end simulation
  - Design verification
  - Real-world over-the-air testing



Wireless System Design: What's new in 2015?

- End-to-end simulation
  - Antenna-to-Bits Simulation
  - Smart RF Design
- Design verification
  - Standard-compliant (LTE, LTE-A)
  - RADAR systems
- Over-the-air testing
  - Connectivity to SDR and RF instruments

- **New product:**
  - Antenna Toolbox
- **Major releases**:
  - Communications System Toolbox
  - LTE System Toolbox
  - Phased Array System Toolbox
- **New Hardware Support Package**
  - Zynq ® Software-Defined Radio

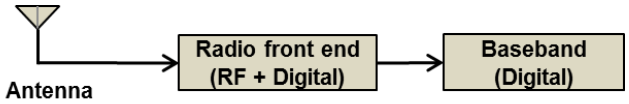
1. **Antenna to Bits Simulation**
2. Smart RF Design
3. Over-the-air testing
4. LTE & LTE-Advanced
5. Airborne & Automotive RADAR

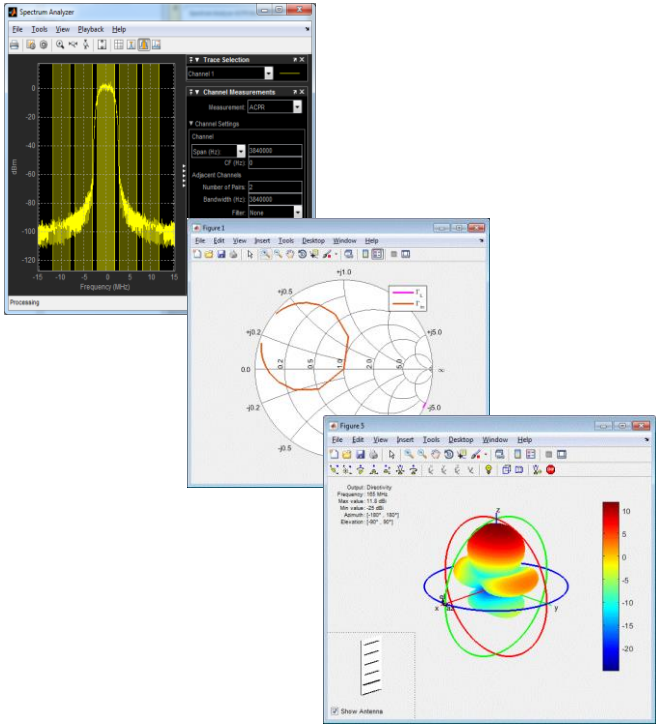
Antenna-to-Bits Simulation

MATLAB & Simulink

Simulate a complete wireless link

- Design modern wireless systems with components such as MIMO, OFDM, and adaptive beam-forming
- Analyze signals and make measurements such as EVM, ACLR, BLER, Throughput
- Generate waveforms and create verification references for downstream implementation
- New Antenna Toolbox 1.0 released in R2015a



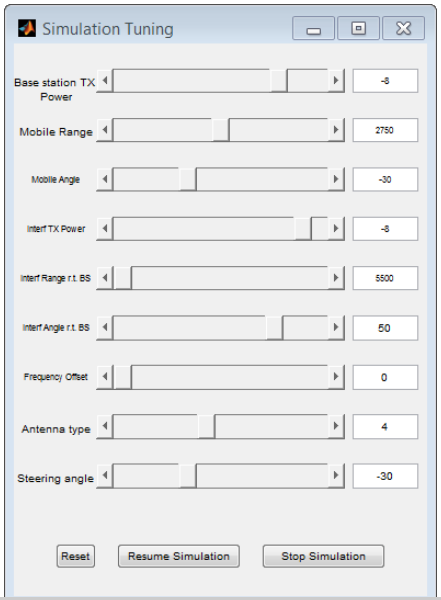


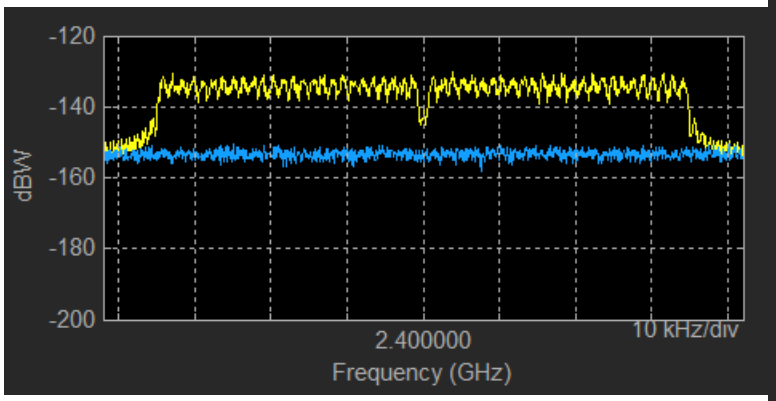
Is this for me?

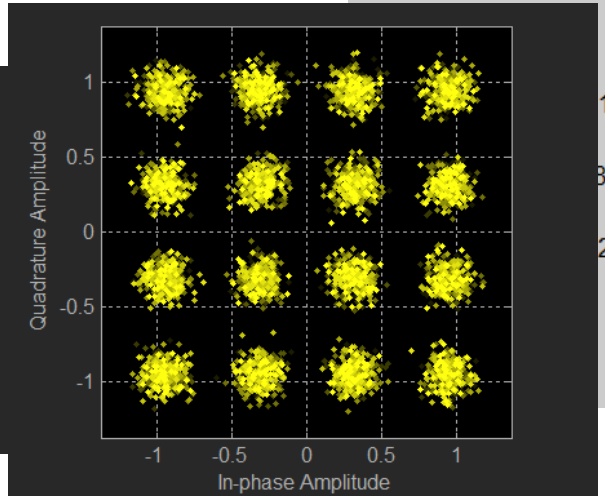
- Do you work on wireless physical layer?
- Do you simulate and measure system performance?

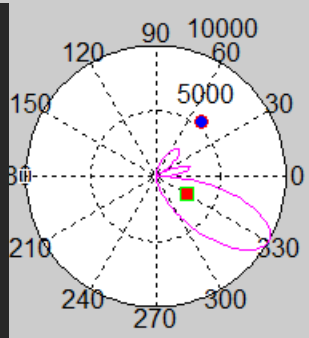
Example:
802.11a/g/n/ac MIMO-OFDM system

- Step-by-step MATLAB demo
  - OFDM as the air interface technology
  - Adaptive Beam-forming (up to 8 antenna)
- Easy-to-follow end-to-end simulation
- Graphical test bench
- Tune system parameters on-the-fly









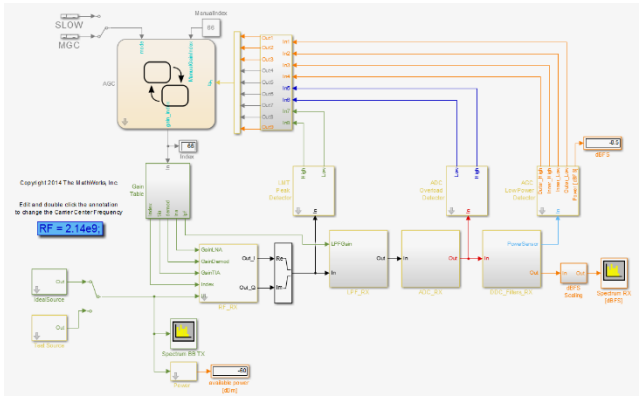
1. Antenna to Bits Simulation
2. **Smart RF Design**
3. Over-the-air testing
4. LTE & LTE-Advanced
5. Airborne & Automotive RADAR

Smart RF design

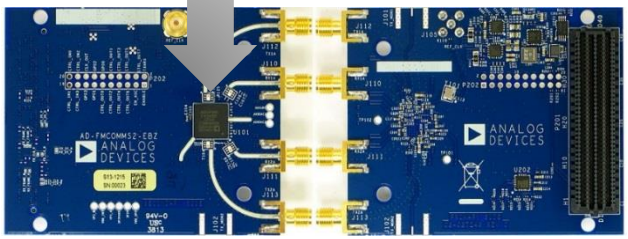
Fast behavioral RF modeling & simulation

MATLAB & Simulink

- Model and simulate RF transceiver together with baseband algorithms
- Develop calibration and control algorithms such as DPD or AGC to mitigate impairments and interferers
- Add measured RF component characteristics
- Use circuit envelope techniques to accelerate simulation of RF transceivers



[Analog Devices AD9361](#)
RF Agile Transceiver™



Is this for me?
- Are you an RF system designer?
- Do you jointly model RF and digital components?

Example: Simulation of Analog Devices® RF Transceivers with MATLAB and SimRF

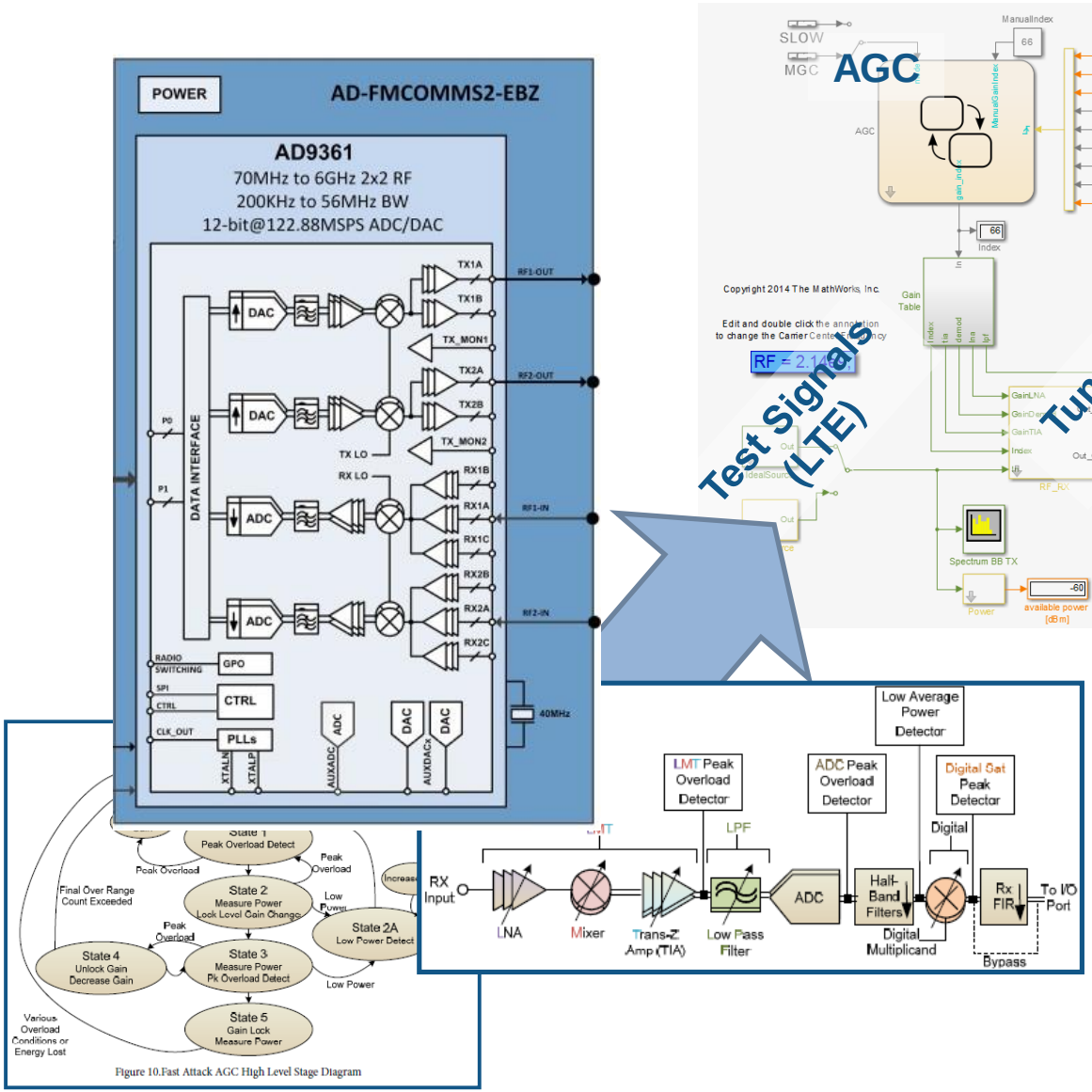


Figure 10.Fast Attack AGC High Level Stage Diagram

1. Antenna to Bits Simulation
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3. **Over-the-air testing**
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Over-the-air Testing with Radio Hardware

Transmit and receive live radio signals

MATLAB & Simulink

- Transmit and receive generated waveforms
- Configure hardware parameters from MATLAB for a range of center frequencies and sampling rates
- Analyze acquired I/Q baseband signal with configurable measurement tools
- Verify and validate your designs based on live radio signals

Zynq SDR

RF Signal Generator

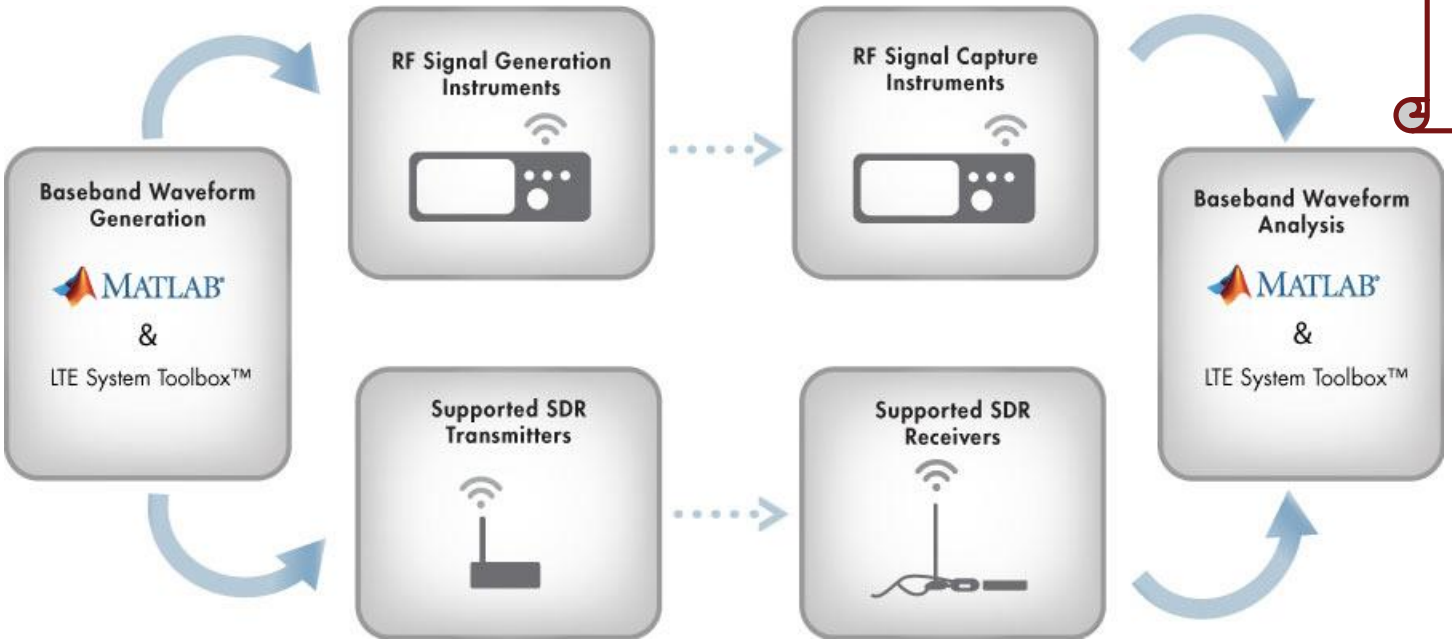
Spectrum Analyzer

Is this for me?

- Do you have a wireless lab?
- Do you need to validate your design with live signals?

Example:
Over-the-air testing with SDRs & RF instruments

Demo



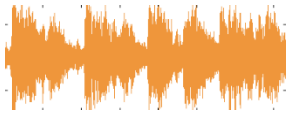
Process original data bits and generate custom digital baseband waveforms in transmitter

Transmit waveform using SDR devices or RF instruments

Capture received samples with SDR devices or RF instruments

Process received samples in receiver. Decode/recover original data

Over-the-air testing with SDRs & RF instruments
Solution



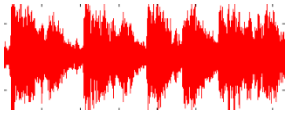
Voice in



Video in


Transmitter


Receiver


Voice out


Video out

Supported SDRs & RF instruments

RF Signal Generator

RF Spectrum Analyzer

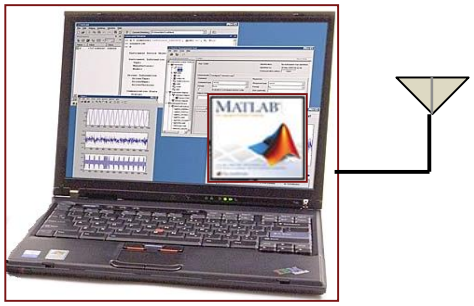
Zynq Radio SDR

Zynq Radio SDR

USRP SDR

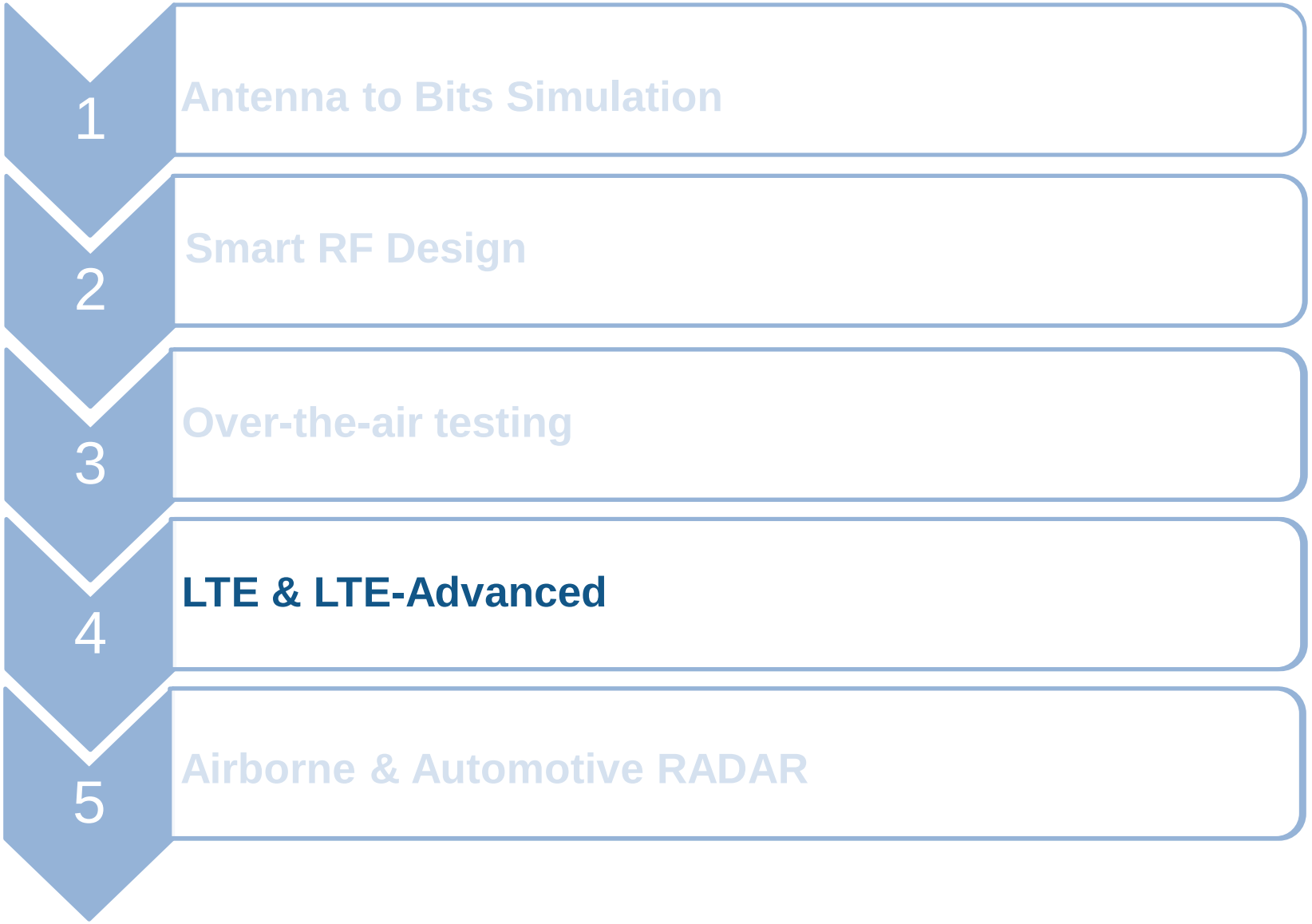
USRP SDR

RTL SDR



Transmitter

Receiver


1
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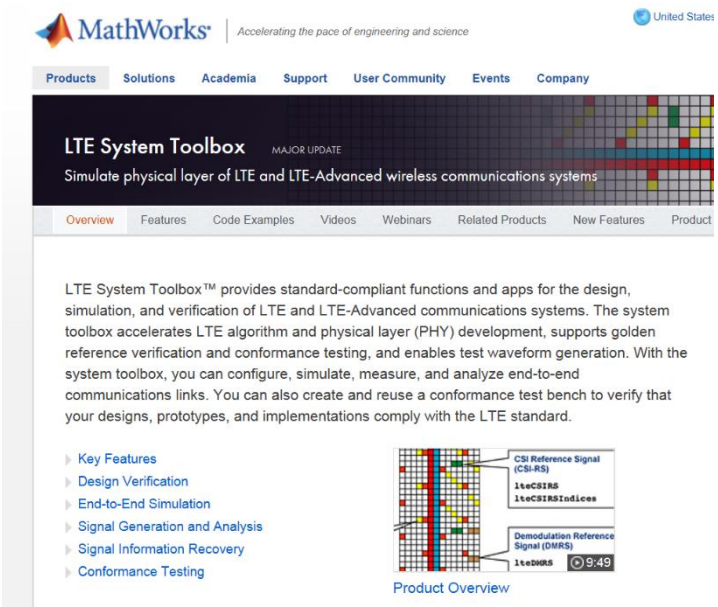
LTE & LTE-Advanced

Design, simulate, and test

LTE and LTE-Advanced systems

- Specify your LTE and LTE-A PHY systems covering all transmission modes, channels, and signals
- Combine your LTE baseband models with RF modeling for a combined digital-RF design
- New features in R2015a
  - LTE Rel. 11 support
  - UMTS/HSPA+ Waveform Generation
  - Coordinated Multipoint (CoMP)



Qualifying question

- Are you working on LTE Physical layer?

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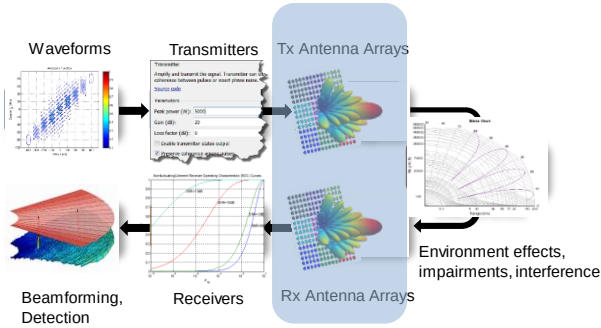
Airborne & Automotive RADAR

Simulate and test multi-domain RADAR systems

MATLAB & Simulink



- Simulate ground-based, airborne, ship-borne, or automotive radar systems with moving targets and platforms
- Explore the characteristics of sensor arrays, and perform link budget analysis
- Accelerate development with a library of array processing algorithms such as beam-forming, DOA, range, and Doppler estimation and detection

Qualifying questions

- AERO: Do you design or validate RADAR systems?
- AUTO: Do you work on driver assistance or active safety?

Summary

- Simulate physical layer of wireless communication systems from antenna to bits
- Design smart RF systems such as Analog Devices AD9361 Agile RF Transceiver
- Test wireless designs with RF instruments & SDR hardware such as RTL-SDR, USRP, and Xilinx Zynq-based radio
- Analyze, simulate, and test LTE/LTE-A standard-compliant systems
- Simulate defense and automotive radar systems

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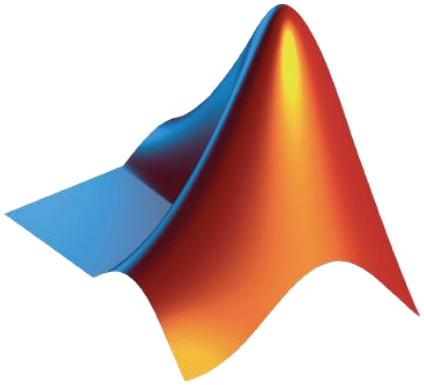
Thank You



Q & A