Zynq RFSoC DFE (Digital Front-End)
Product Announcement
Xilinx Unveils Zynq RFSoC DFE for 5G NR Mass Deployment

Breakthrough Integration of Hardened IP

Meets 2nd wave 5G NR requirements with 2X performance/watt*

A 5G NR radio solution that balances flexibility and cost

Hardware adaptable to keep pace with the evolution of 5G

New Class of Devices Integrates More Hardened IP than Soft Logic

*Power and Performance vs. Zynq RFSoC Gen3
Portfolio for Current and Future Market Needs

Meeting 5G NR Requirements Now and in the Future

✓ More processing per channel
✓ Greater instantaneous bandwidth
✓ More integration
✓ ½ the DC power for a given use case
✓ Cost-effective for high volume

Majority of 5G NR early production deployed with Zynq MPSoC / RFSoC

Performance

ZYNQ®
RFSoC

4GHz of Analog Bandwidth

5GHz of Analog Bandwidth

6GHz of Analog Bandwidth

7.125GHz of Analog Bandwidth w/Hardened DFE Subsystem

2018 2019 2020 2021

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Challenges for 5G NR Rollout in 2nd Wave of Deployment

- Increasing Bandwidth & Compute Requirements at Lower Power and Cost
- Diverse 5G NR Use Cases and Evolving Standards
- Market Disruption (e.g., ORAN) Creates Opportunities & Solutions

Enhanced Mobile Broadband

Massive Machine Type Communication

Ultra-Reliable & Low Latency Communication
5G Will Be More Complex than 4G with Multiple Use Cases and Emerging Requirements

5G

Enhanced Mobile Broadband
- Spectral Efficiency
- New Spectral Bands

Massive Machine Type Communication
- Low transmit power
- 100x-connected devices

Ultra-Reliable & Low Latency Communication
- Deterministic latency
- Low error rates

An Adaptable Platform Needed to Support Diverse Use Cases As They Evolve

Evolving Standards

- eMBB Focused
- mMTC/URLLC Focused
- Future Release

2018 2019 2020 2021 2022 2023 2024 2025

Release 15
Release 16
Release 17
Release 18
Future Release

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5G’s Diverse Requirements and Increasing Complexity

**INCREASING BANDWIDTH & PERFORMANCE/WATT REQUIREMENTS**

Zynq RFSoC DFE Hardens Radio Cores for Performance and Power that Rivals ASICs

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**NEED FOR 4G & 5G IN PARALLEL**

Zynq RFSoC DFE enables multi-mode (LTE and 5G) and RAN sharing support on a single radio

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**DISAGGREGATED RAN with O-RAN**

Zynq RFSoC DFE allows for flexibility to split baseband processing between radio unit & distributed unit

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**SPECTRUMS ARE IN FLUX**

Zynq RFSoC DFE delivers Direct RF multi-band (tri-band) in FR1 and optimized mmWave interface

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1: Mobile Experts, August 2020
5G Market Disruption Enables New Operators and Providers

4G
Market was Rigid

- 4G Market was one use case: Mobile Data
- Operators selling data to consumers
- Operators building network with traditional hardware OEMs

5G
Will Enable
New Business Models & Competition

- O-RAN and TIP are disrupting established business models enabling smaller more diverse supplier base
- Disruptive operators, MVNO, Cable and Satellite are acquiring spectrum and becoming mobile operators
- Private networks will harness advantages of 5G for enterprise customers creating unique solutions

Zynq RFSoC DFE Offers an ASIC Alternative to Both Traditional OEMs and New Providers
Zynq RFSoC DFE: Adaptive SoC with a Hardened Radio Subsystem

Hardened Radio Subsystem
Single-Chip 8T8R FDD/TDD

- Direct-RF DACs/ADCs
  7.125GHz Direct-RF Bandwidth
- Digital Pre-Distortion (DPD)
  Supports traditional & ultrawide band (400MHz) GaN PAs
- Crest Factor Reduction (CFR)
  Up to 400MHz of Instantaneous Bandwidth
- DUC / DDC
  Multi-carrier, multiband support
- Signal Processing IP
  Re-Sampling, Equalizer

1: Digital Up-Conversion, Digital Down Conversion

Adaptive SoC
Arm Processing System • UltraScale+ Programmable Logic • 32G SerDes
Hard IP: Power and Area Reduction for the Same Compute

- Hard IP (@500MHz) enables ~80% lower power vs. equivalent soft IP implementation
- 50% lower total power for an equivalent use case chip-to-chip
- Balanced logic density for adaptability with improved cost effectiveness
Delivering 2X the Compute

More Processing per Channel to Meet 2nd Wave 5G New Radio Requirements
Efficiency of Hard IP with Adaptive Programmable Logic

- Common compute intensive and power-hungry blocks are hardened (>500MHz F_MAX)
- Each hard block can be bypassed and/or appended for maximum flexibility and customization
- Programmable logic for differentiation and adaptability to future 5G market requirements
System Capabilities for Diverse Carrier Needs

Industry’s Only 400MHz Instantaneous Bandwidth (iBW) Radio Platform (2X the Industry)

- Supports 400MHz (8T8R) up to 7.125GHz Direct-RF (FR1)
- Up to 1600 MHz iBW mmWave IF transceiver (FR2)
- Delivers greater compute per antenna or more antennas per radio
- More bandwidth per radio → fewer units → fewer power amplifiers → lower system cost

Multi-Band with Carrier Aggregation of Up to 8 Carriers-per-Antenna

- 4G LTE & 5G on the Same Radio (Multi-Band, Multi-Mode)
- More data pipes through same radio lowers system cost
- Enables RAN sharing (multiple operators sharing the same radio unit)
RFSoC DFE Hard IP Integration Requires higher ASIC Volume for ASIC TCO break-even

- **ASIC Spin**
- **Break-even With Hard DFE IP**
- **Break-even Adaptable Logic**

**Graph:**
- **Total Cost of Ownership**
- **Volume**
- **ASIC**
- **FPGA**
- **Zynq**
- **RFSoC**
- **DFE**

**Optimized Adaptable Logic**

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5G Evolution and Diverse Use Cases Blur ASIC Strategy

ASIC Economics Not Always Viable

- ASIC NRE cost in 5G era is 3x higher vs. 4G era
- Niche markets and use cases will not justify an ASIC
- 2+ year ASIC cycle time is too long

Expect a Decade of 5G Upgrades

- Not clear how 5G NR requirements will change
- ASICs will launch in parallel for multiple radio variants
- Zynq RFSoC DFE is an alternative for mass deployment

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Scalable From Massive-MIMO Macrocell to Small Cell

- **MASSIVE MIMO MACROCELL**: Full Sub-7GHz Direct RF
- **MULTI-MODE MACROCELL**: Support for 5G and 4G LTE
- **FIXED WIRELESS ACCESS**: IF Digital Transceiver mmWave Spectrums
- **SMALL CELL NODES**: Power & Cost-Efficient Single-Chip Radio
Zynq RFSoC DFE : The Best Balance of Both Worlds

- **FPGA**
- **Zynq RFSoC DFE**
- **ASIC**

- HW Adaptable
- Time to Market
- RF Integration
- Cost, Performance, Power

Optimized to Capture Important Application Attributes
Zynq RFSoC DFE: for 5G NR Mass Deployment

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Silicon Shipping
1st Half 2021
Thank You