
Intel
FPGA
Technology
Day 2021
accelerating
a smart and connected world
The Newest Intel® Agilex™ FPGAs
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intel

Agenda

- Inspiration
- Intel® Agilex™ M-Series FPGA
- Intel® Agilex™ I-Series FPGA
- To Learn More

Intel® Agilex™ FPGA – Strong Out of the Gate

Shipping in Production Today

~2X better fabric performance per watt*
compared to competing 7nm FPGAs enabling flexible, energy-efficient designs for the data center and beyond

Intel® Agilex™ FPGAs
Industry-leading FPGAs offering customers the adaptability and agility to innovate for diverse workload transitions in 5G, Network, Cloud, and Edge

*See Intel.com/performanceindex for configuration details

Intel® Agilex™ FPGA Series

F-SERIES

For a wide range of applications

- Up to 58G transceivers
- PCIe Gen4
- DDR4
- Quad-Core Arm Cortex-A53 SoC Option

In Production Now

I-SERIES

For high-performance processor interface and bandwidth-intensive applications

- Up to 116G transceivers
- PCIe Gen5
- DDR4
- Quad-Core Arm Cortex-A53 SoC Option
- Coherent attach to Intel® Xeon® Scalable Processor option

Sampling Now, New Family Members Early Access in 2H 2022

M-SERIES

For compute-intensive applications

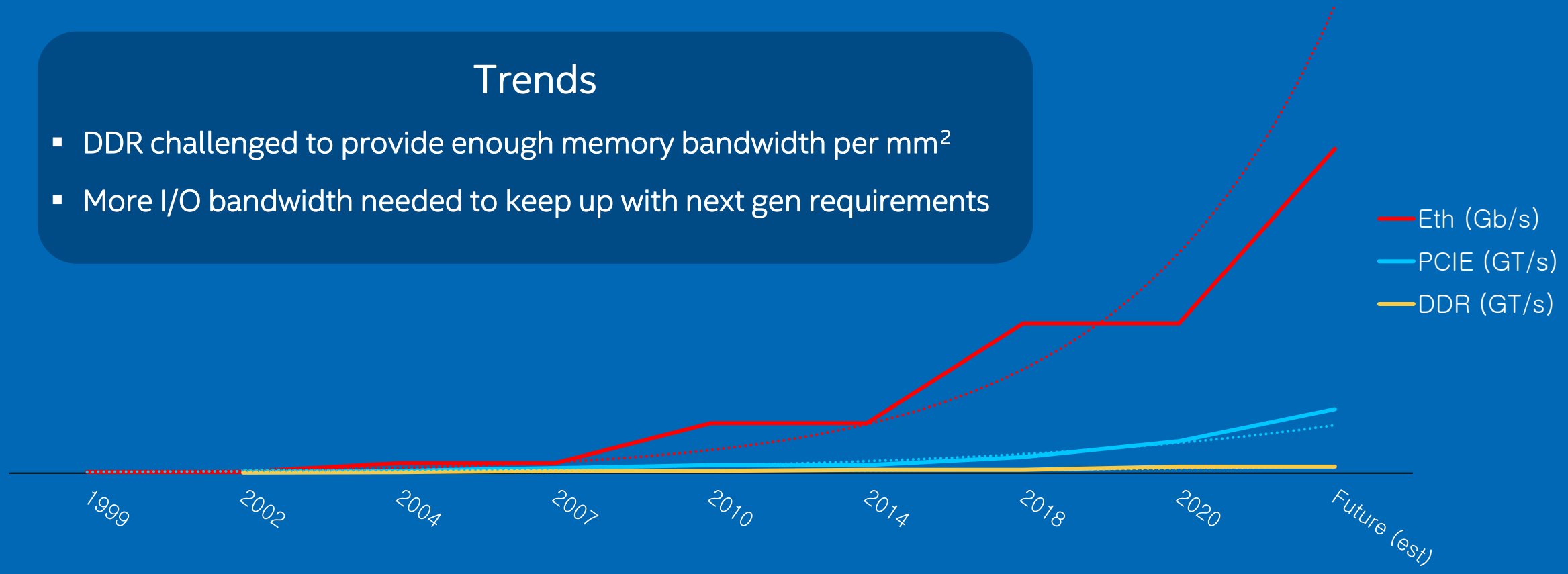
- Up to 116G transceivers
- PCIe Gen5
- DDR4, DDR5, LPDDR5, and Intel® Optane™ persistent memory support
- Quad-Core Arm Cortex-A53 SoC Option
- Coherent attach to Intel® Xeon® Scalable Processor option
- HBM Option

Early Access Summer 2022

System Bandwidth Significantly Outpaces Traditional Device Memory Bandwidth

Trends

- DDR challenged to provide enough memory bandwidth per mm^2
- More I/O bandwidth needed to keep up with next gen requirements



Addressing the Greatest Memory and Compute Challenges with Intel® Agilex™ M-Series FPGAs

	Edge	Networking	Cloud
Trends	4K-> 8K video production and transport requires higher performance processing, more channels → Need more memory bandwidth for codecs and higher transcoding speeds combined with many serial digital interface (SDI) and Ethernet interfaces	New high-bandwidth and low-latency use cases in Internet of Things (IoT), mobile edge computing, and security → Need high-performance data path, deep memory buffers, and high bandwidth connectivity	Memory-intensive acceleration workloads in high performance computing (HPC) and cryptocurrency require more memory bandwidth → Need higher memory bandwidth within server card size limitations while minimizing power
Intel® Agilex™ M-Series FPGAs Provide	▪ Highest memory bandwidth, high-performance logic, and DSP to implement advanced codecs and other video processing ▪ Up to 72 transceiver channels per device and Ethernet blocks for SDI and Ethernet I/Fs	▪ Highest memory bandwidth, high-performance logic, high-speed memory access to logic to implement routing and security functions ▪ Transceiver rates up to 116Gbps; multi-protocol support (100/200/400GbE, PCIe Gen5)	▪ Higher memory bandwidth for FFTs and other memory-bound HPC functions with more power efficiency ▪ Reconfigurability to switch algorithms on-the-fly to optimize efficiency
Benefit	More compact, low-latency 4k/8k video production equipment	New revenue-generating services at the Edge	Higher performance for memory-intensive HPC and cryptocurrency applications with lower power consumption

Intel® Agilex™ M-Series FPGAs

Integrated HBM2e Memory

Up to 32GB HBM2e memory integrated in package

Processor Interface Options

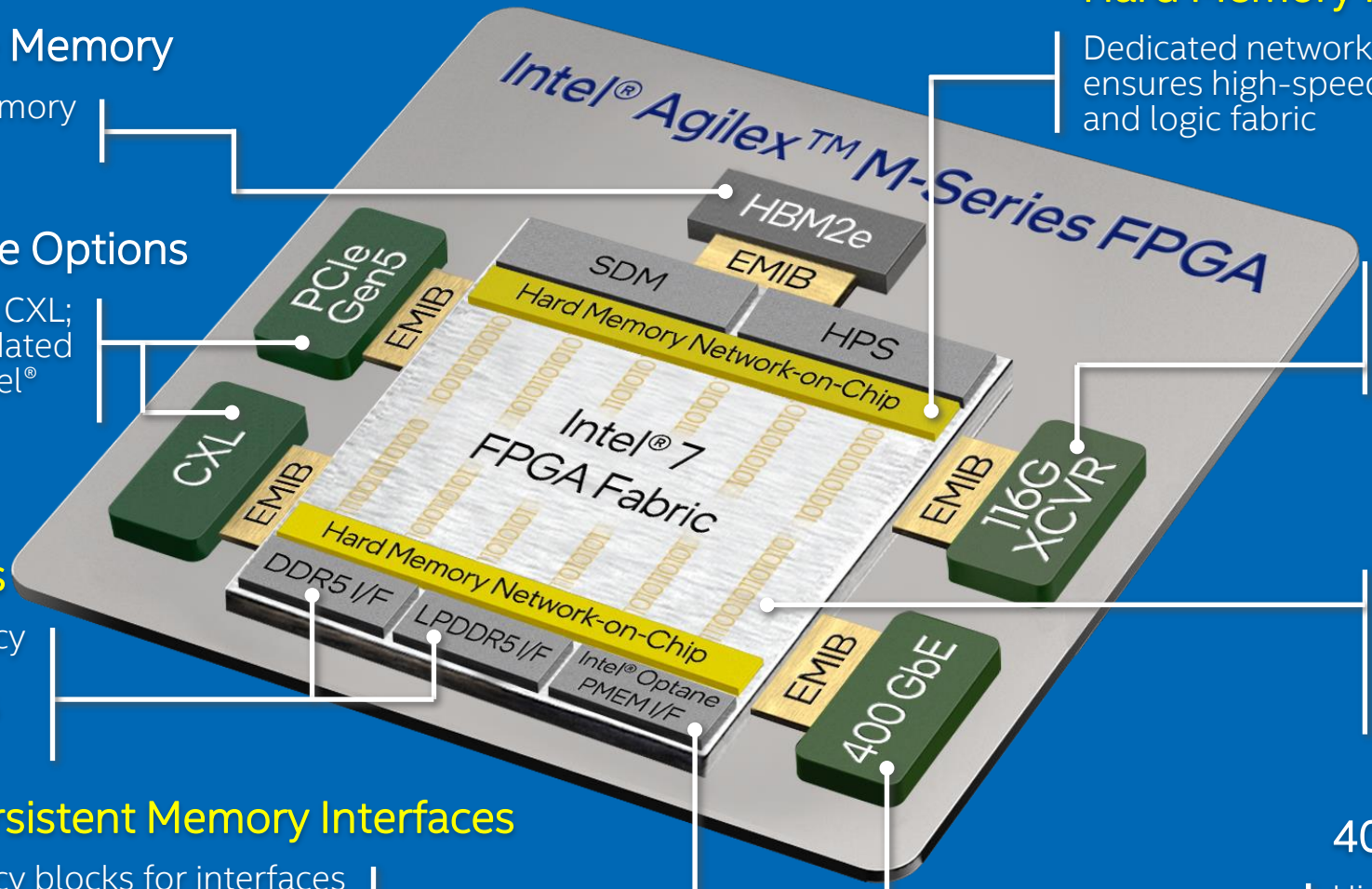
PCIe Gen5 up to x16 or CXL; high-performance, validated interoperability with Intel® Xeon® processors

DDR5 / LPDDR5 Memory Interfaces

Dedicated high-efficiency blocks for interfaces to DDR5 / DDR4 / LPDDR5 memory devices

Intel® Optane™ Persistent Memory Interfaces

Dedicated high-efficiency blocks for interfaces to Intel Optane persistent memory devices



Hard Memory Network-on-Chip (NoC)

Dedicated network of communications channels ensures high-speed data flow between memories and logic fabric

116 Gbps Transceivers

Industry's highest data rate transceivers provide flexibility for multiple communication protocols and line rates

Intel® 7 Process-Based FPGA Fabric

Up to 3.8M logic elements

Over 2X better fabric performance per watt vs. competing 7 nm FPGAs*

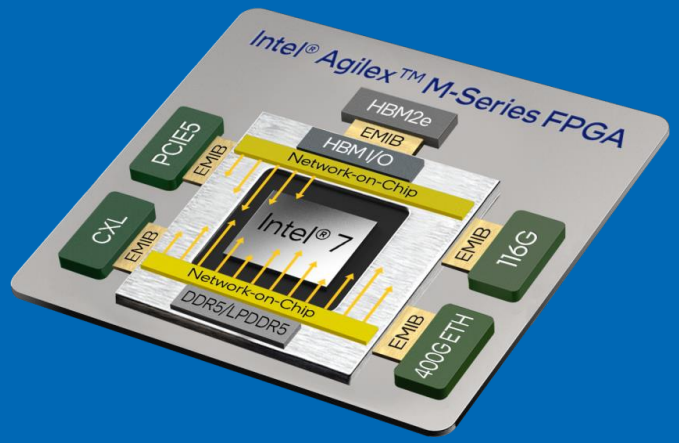
400 Gb Ethernet Blocks

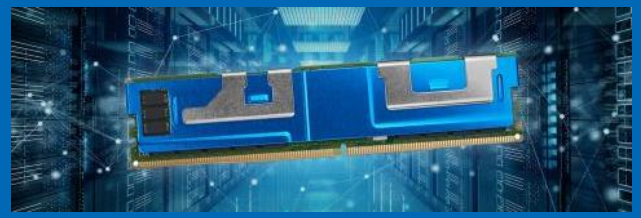
High-performance, high-efficiency support for Ethernet protocols

Industry-First Features and Capabilities

*See Intel.com/performanceindex for configuration details

Intel® Agilex™ M-Series FPGA Memory Hierarchy



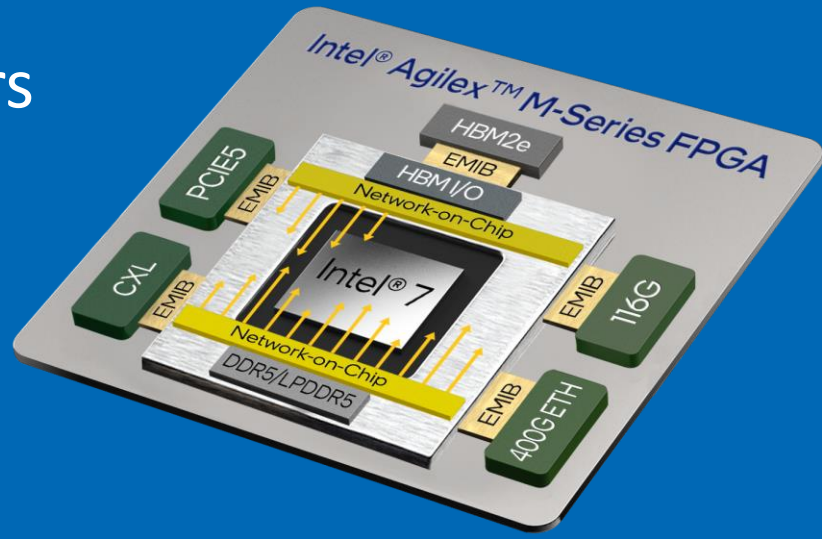


MLAB (40 Mb)	On-Chip Memory (up to 410 Mb)
M20K (370 Mb)	
DRAM SiP – HBM2e	In-Package Memory (up to 32 GB)
DDR4 (16Gb), DDR5 (64Gb) LPDDR5	On-Board Memory (over 1 TB)
QDR IV	
Intel® Optane™ persistent memory (1Tb)	

Wide range of memory options to address your design's low latency, high throughput, and low power needs

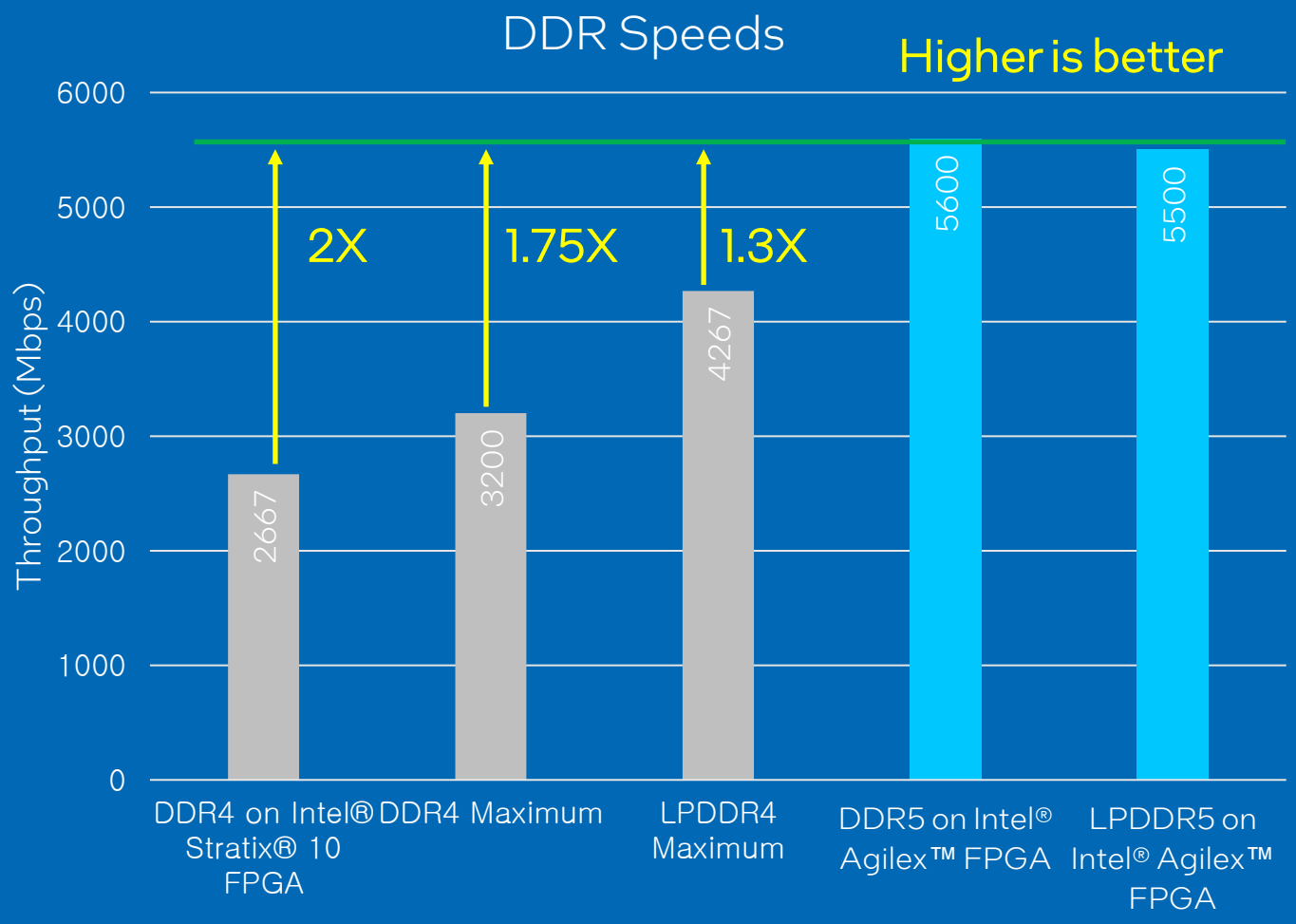
Intel® Agilex™ M-Series FPGA DRAM System in Package Maximizes Bandwidth per mm^2

- Integrates HBM2e DRAM with Intel® Agilex™ FPGA
  - Support for up to 32 GB in a single device
- Two dedicated hard HBM2e memory controllers in every device
  - Maximizes performance across all transactions
- Up to 820 GBps peak memory bandwidth[1]
  - 10X more bandwidth vs. DDR5, 7X more vs. GDDR6[1]
  - Up to 410 GBps memory bandwidth per HBM stack; 1.6X higher vs. prior generation(1)



[1]See backup for configuration details. For more complete information about performance and benchmark results, visit www.intel.com/benchmarks

Intel® Agilex™ M-Series FPGA with DDR5 Support Enables Power Efficient DRAM Interfaces



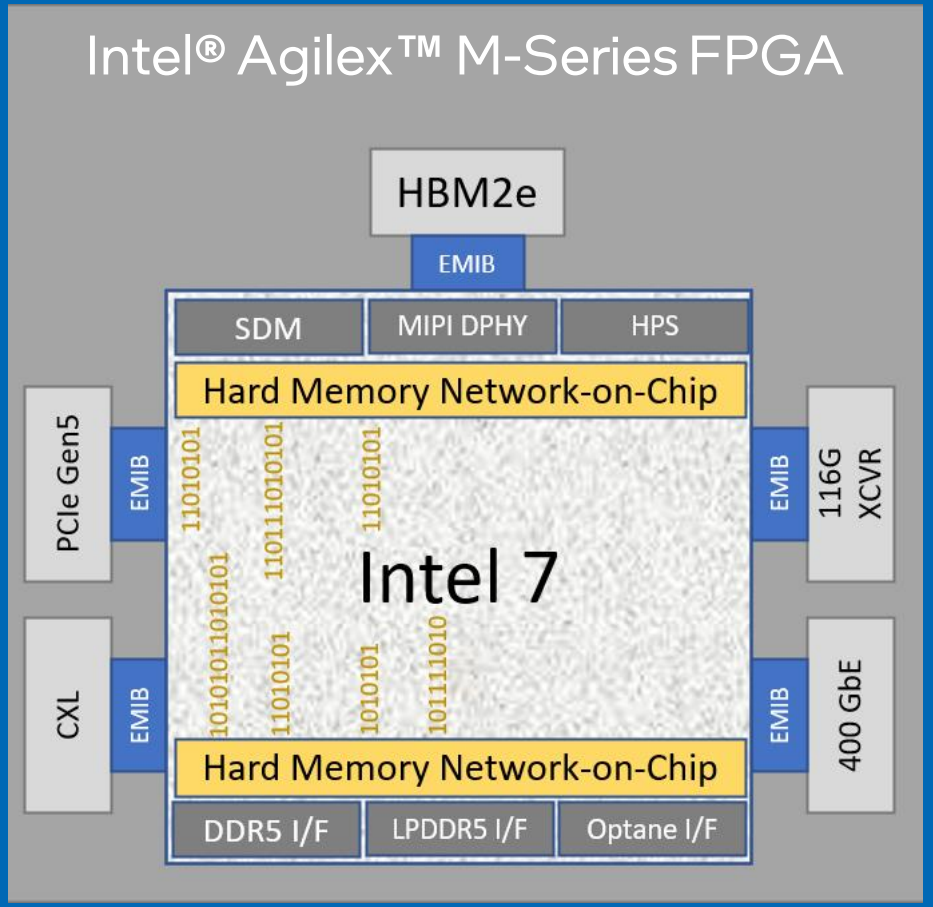
DDR5 Performance Advantages

- ✓1.75X higher throughput and bandwidth than DDR4
- ✓Greater memory efficiency
- ✓Greater power efficiency
- ✓Lower latency

Source: JEDEC DDR5 announcement
https://www.jedec.org/news/pressreleases/jedec-publishes-new-ddr5-standard-advancing-next-generation-high-performance

Hard Memory Network-on-Chip (NoC)

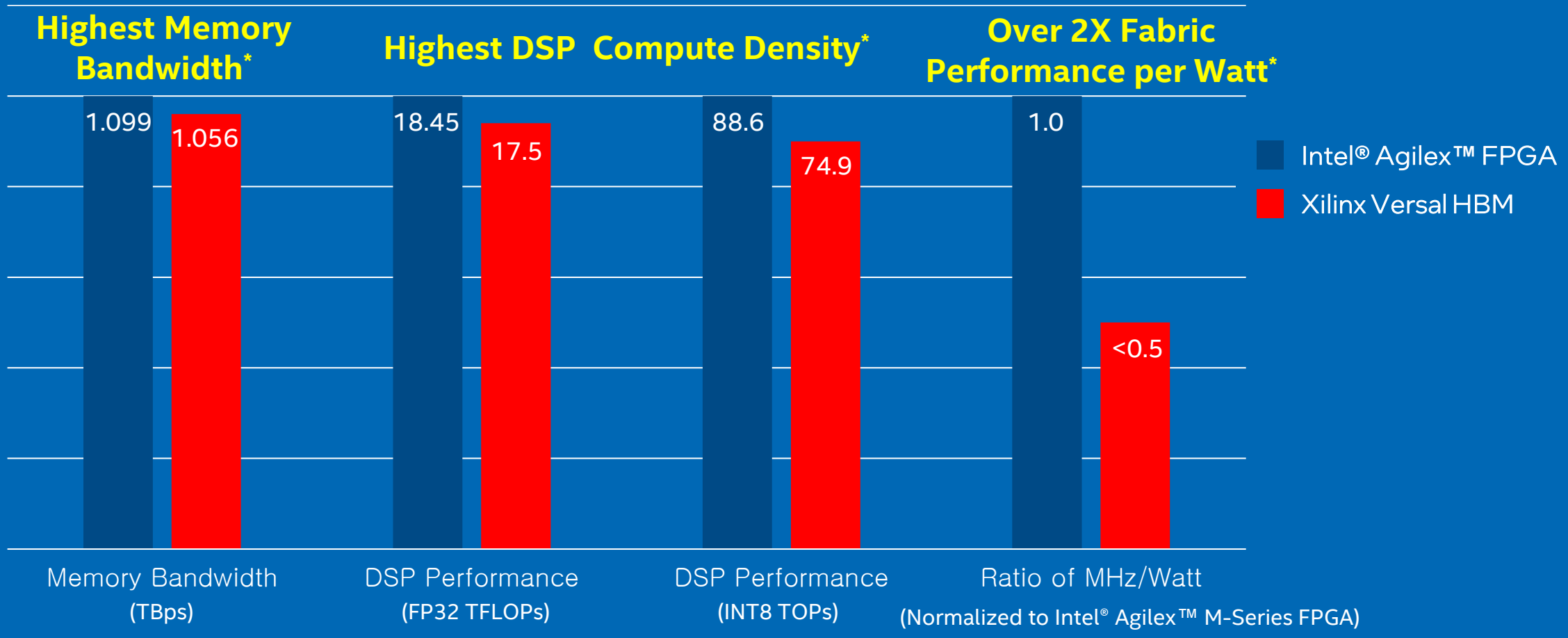
- High-performance network on-chip, communication channels dedicated to memory data transport
- Facilitates high-speed data flow between HBM2e/DDR5/ DDR4/LPDDR5 and FPGA fabric, without using FPGA routing resources
- Supports over 1 TBps of aggregate memory bandwidth



Full Cross Bar Configuration Support with Hard Memory NoC

In a Class of its Own

Higher is better



Highest Memory Bandwidth, Highest Compute Density, Highest Fabric Performance/Watt

*Compared to competitive 7 nm FPGAs (Xilinx Versal), see disclosures in backup

Intel® Agilex™ M-Series FPGA Device Family Plan

Features	AGM032	AGM039
Logic Elements (M)	3.2	3.9
Embedded Memory from M20Ks (Mb)	311	370
Variable-Precision DSP Blocks	9,375	12,300
DSP (18x19 Multipliers)	18,750	24,600
Single-Precision TFLOPS / Half-Precision TFLOPS / INT8 TOPS	14 / 28 / 67.5	18.5 / 37 / 88.6
HBM Capacity (GB)	16 - 32	
Maximum GPIO	768	
Maximum transceivers (XCVRs) (including PCI Express XCVRs)	72	
Maximum 116G XCVRs	8	
Maximum PCIe Gen4 Interfaces, 1x16 or 2x8 (EP) or 4x4 (RP)	4	
Maximum PCIe Gen5 Interfaces, 1x16 or 2x8 (EP) or 4x4 (RP)	1	
Maximum Compute Express Link (CXL) Interfaces (x16)	1	
Quad Core A53 Integration (HPS)	Yes	
Maximum EMIF x72 (x80 for DDR5) supported	4	
Memory Interfaces Supported	DDR5, LPDDR5, DDR4, QDR IV, HBM2e, Intel® Optane™ persistent memory support	

Transceiver Tile Overview

Networking & Communication Tiles

Processor Attach Tiles

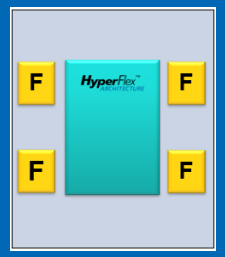
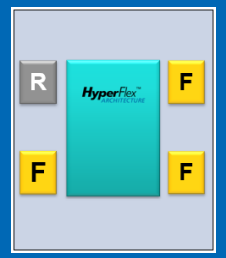
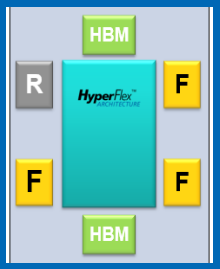
XCVR Tile Options	E-Tile	F-Tile	P-Tile	R-Tile
Maximum Data Rate and Channel Count	12 x 57.8G PAM4 or 24 x 28.9G NRZ	(HS) 4 x 116G(1) PAM4 plus (GP) 12 x 58G PAM4 or 16 x 32G NRZ	16 x 16G NRZ	16 x 32G NRZ
Hard IP	10/25/100GbE MAC, PCS and KR/KP RSFEC	PCIe Gen4 x16 EP/RP 8 PF/2K VF SR-IOV 10/25/50/100/200/400GbE MAC, PCS & KR/KP RSFEC	PCIe Gen4 x16 EP/RP 8 PF/2K VF SR-IOV, VirtIO	PCIe Gen5 x16 EP/RP 8 PF/2K VF SR-IOV, SIOV, SVM, VirtIO CXL v1.1(2) interface PIPE v5.1.1

(1) 116G Supported in I and M-Series only
(2) I-Series Only

Available in M-Series

Available in M-Series

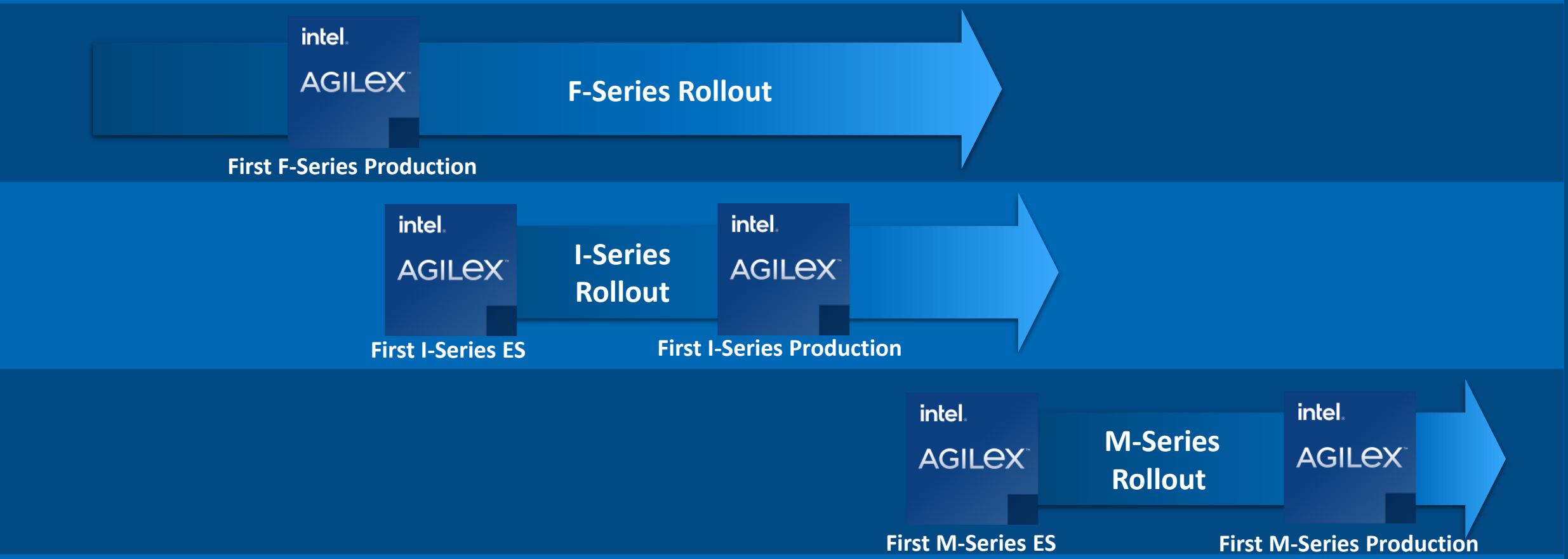
Intel® Agilex™ M-Series Device Package Plan

Device	R31B (3184B)				R36A (3687A)				R46A (4680A)			
	4x F-Tile  56x45 mm²				3x F-Tile, 1x R-Tile  56x52.5 mm²				3x F-Tile, 1x R-Tile, 16-32GB HBM  56x66 mm²			
	GPIO	32G/ 58G XCVR	116G XCVR	PCIe G5 XCVR	GPIO	32G/ 58G XCVR	116G XCVR	PCIe G5/CXL XCVR	GPIO	32G/ 58G XCVR	116G XCVR	PCIe G5 XCVR
AGM 032	720	64/48	8	0	768	48/36	8	16	768	48/36	8	16
AGM 039	720	64/48	8	0	768	48/36	8	16	768	48/36	8	16

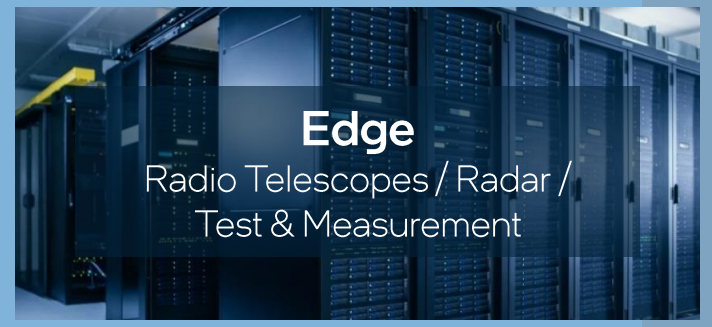
Indicates Pin Migration across devices in the same package

Intel® Agilex™ FPGA Rollout Schedule

2020	2021	2022	2023



Addressing the Greatest I/O Bandwidth Challenges with Intel® Agilex™ I-Series FPGAs

			
Trends	Increased video transport requires higher performance processing and more channels ➡ Need higher transcoding speeds combined with many SDI and Ethernet interfaces	5G, streaming, WFH, and cloudification drive need for more network capacity, more secure transport ➡ Need higher interface rates, higher total throughput, more data encryption	Large distributed antennas demand high connectivity and compute density ➡ Need highest data throughput and compute to support larger antenna array and testers
Intel® Agilex™ I-Series FPGAs Provide	▪ High-performance logic to implement advanced video processing ▪ Up to 120 transceiver channels per device and Ethernet blocks for SDI and Ethernet I/Fs	▪ 120 transceivers, rates up to 116Gbps. Multi-protocol support for OTN, Ethernet, FlexO, FlexE, FibreChannel ▪ Leading performance and dedicated hardware functions for data error correction and encryption	▪ 120 transceivers, rates up to 116Gbps. Multi-protocol support for Ethernet and lightweight high speed serial IO protocols ▪ 25,600 18x19 mults/adds for beamforming
Benefit	More compact switchers and routers for video transport	2-4X higher network capacity at lower power and cost in smaller form factor systems	High connectivity and DSP reduces part count and enables larger arrays

New Intel® Agilex™ I-Series FPGAs

Process Data

2nd Generation Intel® Hyperflex™ FPGA Architecture

~2X Better Fabric Performance per Watt
compared to competing 7nm FPGAs[1]

Store Data

DDR4 Memory Interface Support

Intel® Optane ™ Persistent Memory Interface Support

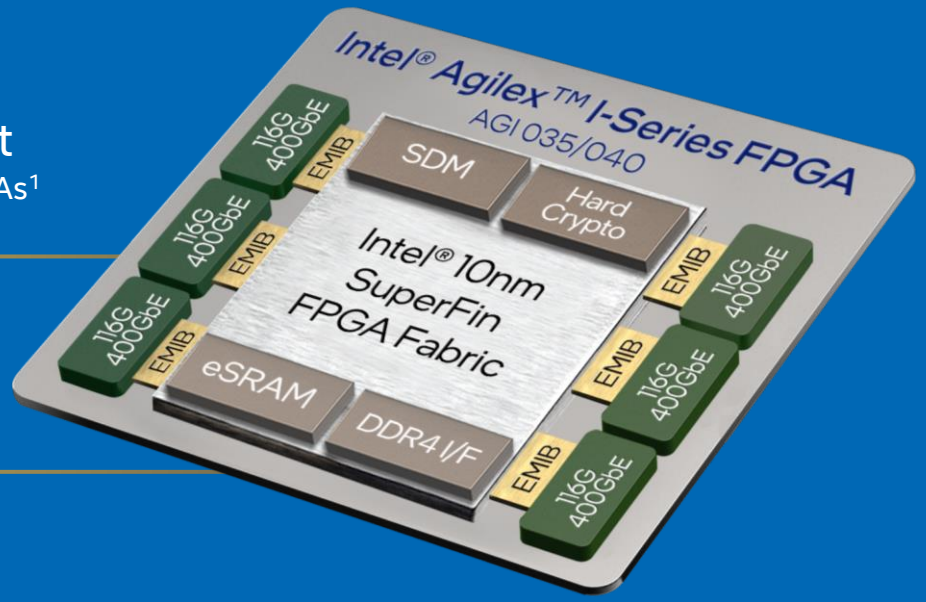
Move Data

Connectivity to Intel® Xeon® Processors

Up to 6 Instances of PCIe Gen4x16

116G Transceiver Data Rates

Up to 120 Transceiver Channels per Device



Two new density options , 3.5M/4.0M logic elements

Intel's Highest Transceiver Bandwidth FPGA, >4.0 Tbps in a Single Device

[1] See Intel.com/performanceindex for configuration details

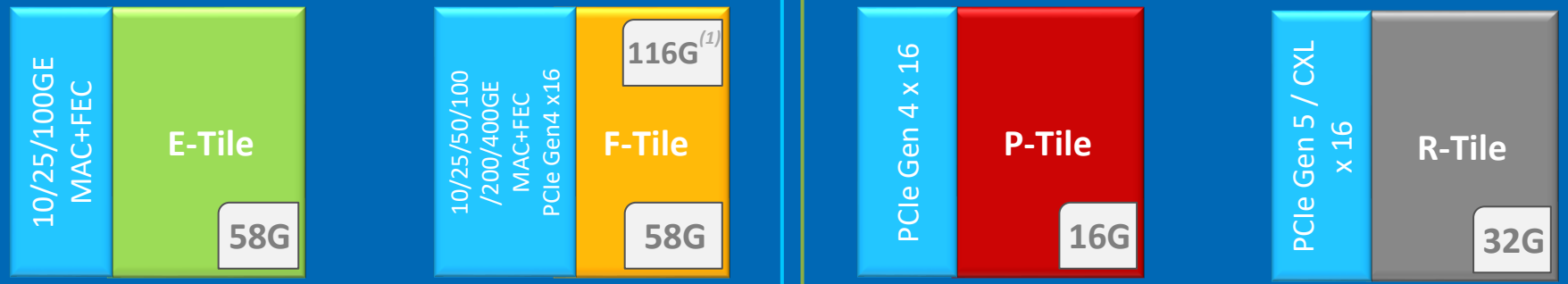
Intel® Agilex™ I-Series FPGA High Transceiver Device

Features	AGI 035	AGI 040
Logic Elements (M)	3.5	4.0
Embedded Memory from M20Ks (Mb)	292	389
Variable-Precision DSP Blocks	9,594	12,792
DSP (18x19 Multipliers)	19,188	25,584
Single-Precision TFLOPS / Half-Precision TFLOPS / INT8 TOPS	14.3 / 28.7 / 69.0	19.1 / 38.3 / 92.1
Maximum GPIO	1152	
Maximum transceivers (XCVRs) (including PCI Express XCVRs)	120	
Maximum 116G XCVRs	24	
Maximum PCIe Gen4 Interfaces, 1x16 or 2x8 (EP) or 4x4 (RP)	6	
Maximum EMIF x72 Interfaces	4	
Quad Core A53 Integration (HPS)	No	
Memory interfaces supported	DDR4, QDR IV, Intel® Optane™ persistent memory	

Transceiver Tile Overview

Networking & Communication Tiles

Processor Attach Tiles



XCVR Tile Options	E-Tile	F-Tile	P-Tile	R-Tile
Maximum Data Rate and Channel Count	12 x 57.8G PAM4 or 24 x 28.9G NRZ	(HS) 4 x 116G(1) PAM4 plus (GP) 12 x 58G PAM4 or 16 x 32G NRZ	16 x 16G NRZ	16 x 32G NRZ
Hard IP	10/25/100GbE MAC, PCS and KR/KP RSFEC	PCIe Gen4 x16 EP/RP 8 PF/2K VF SR-IOV 10/25/50/100/200/400GbE MAC, PCS & KR/KP RSFEC	PCIe Gen4 x16 EP/RP 8 PF/2K VF SR-IOV, VirtIO	PCIe Gen5 x16 EP/RP 8 PF/2K VF SR-IOV, SIOV, SVM, VirtIO CXL v1.1(2) interface PIPE v5.1.1

Available in I-Series High-Transceiver

(1) 116G Supported in I and M-Series only
(2) I-Series Only

Industry-Leading Intel® Agilex™ M-Series FPGAs and New Intel® Agilex™ I-Series FPGAs

Intel® Agilex™ M-Series FPGAs

- Highest Memory Bandwidth FPGAs*
- Highest DSP Compute Density*
- Over 2X Better Fabric Performance per Watt
  Compared to Competing 7 nm FPGAs*

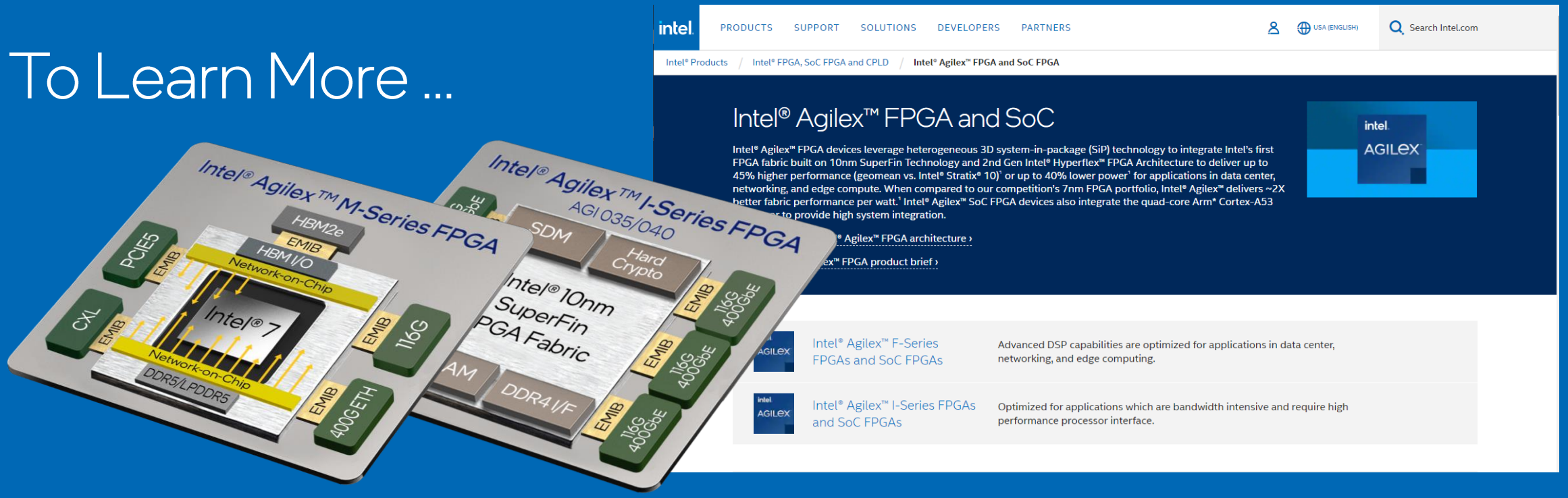
New Intel® Agilex™ I-Series FPGAs

- Intel's Highest Transceiver Bandwidth FPGAs

Addressing the Greatest Memory, Compute, and Bandwidth-Intensive Challenges Across the Edge, in Networks, and in the Cloud

*See Intel.com/performanceindex for configuration details

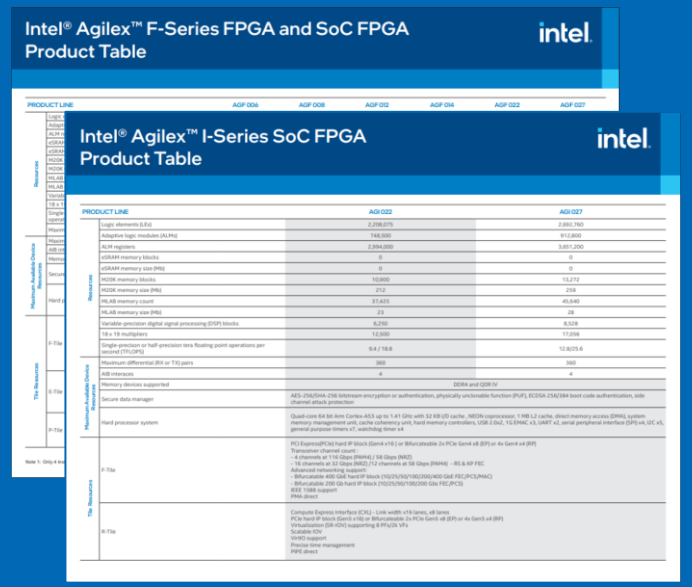
To Learn More …



- Visit the Intel® Agilex™ FPGA product page: https://www.intel.com/content/www/us/en/products/details/fpga/agilex.html
- Watch the new M-series video!
- Read the M-series Whitepaper
- Download the M-series Solution Brief
- Contact your Intel® sales representative today!

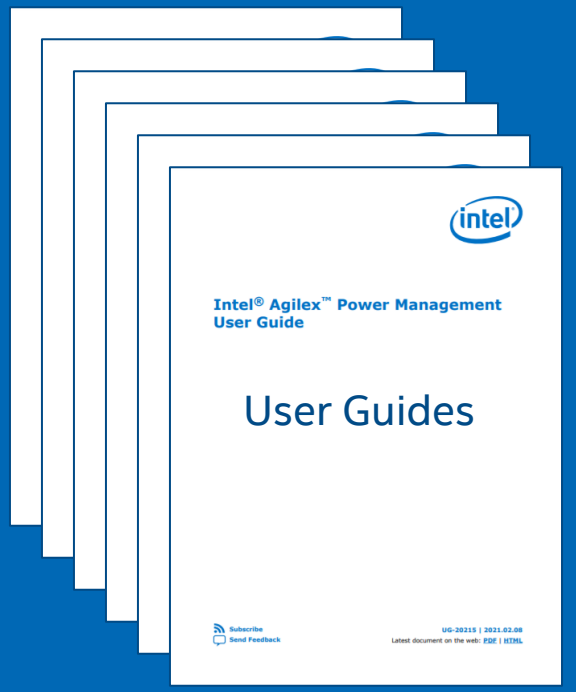
Design Collateral

Silicon Product Tables

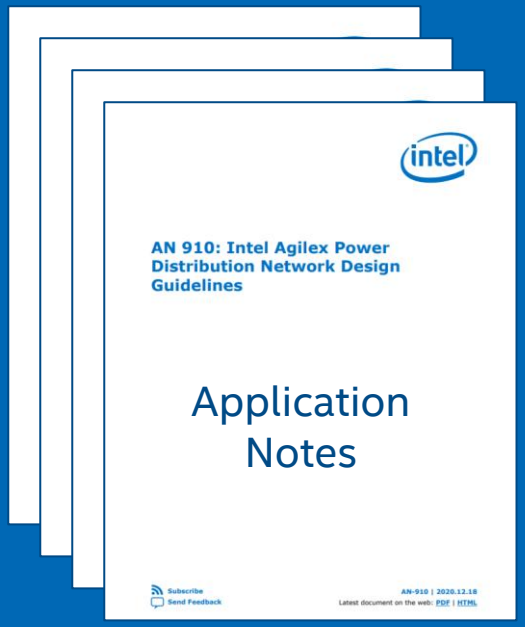


Datasheets

User Guides



Application Notes



Product tables/selector guides: https://www.intel.com/content/www/us/en/products/details/fpga/agilex.html

User guides: https://www.intel.com/content/www/us/en/programmable/products/agilex-series/ag/support/documentation.html

Intel® Quartus® Prime software: https://www.intel.com/content/www/us/en/software/programmable/quartus-prime/download.html

Development kits: https://www.intel.com/content/www/us/en/products/details/fpga/find-fpga-boards.html

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