



MIPI ALLIANCE DEVELOPERS CONFERENCE

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Mixel, Inc.

**MIPI D-PHYSM and MIPI CSI-2SM for
IoT: AI Edge Devices**

28-29
SEPTEMBER
2021



Agenda

- Benefits of Edge Processing
- Perceive Ergo[®] Edge Inference Processor Overview
 - Block diagram
 - target solutions
 - Target Applications
- Why MIPI?
- Why FDSOI?
- Mixel MIPI IP and Silicon Results



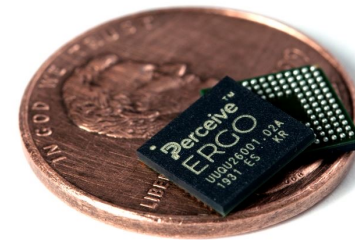
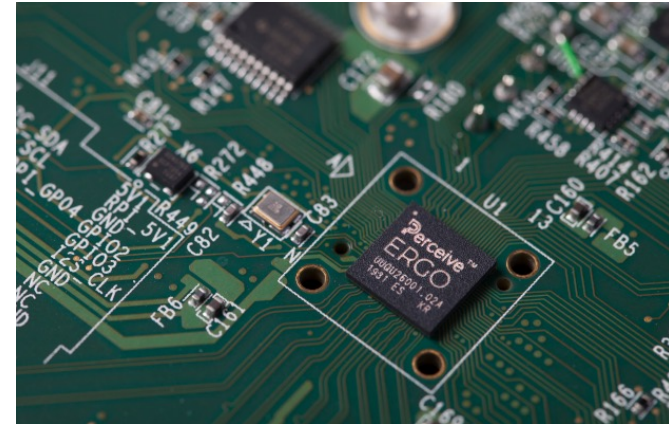
Benefits of Processing at the Edge

- Latency: able to make decisions in real-time or near real-time vs. increased latency when processing at a data center or in the cloud
- Power savings: smarter devices require less bandwidth, provide less false notifications which can improve battery life
- Security and privacy: reduced chance for breach by reducing transmission of raw data to be processed somewhere else
- Connectivity: in some cases, connecting to broadband or even mobile may not be feasible so local computing is required
- Connection costs: even if connection is available, it may be worthwhile to save bandwidth due to connectivity costs

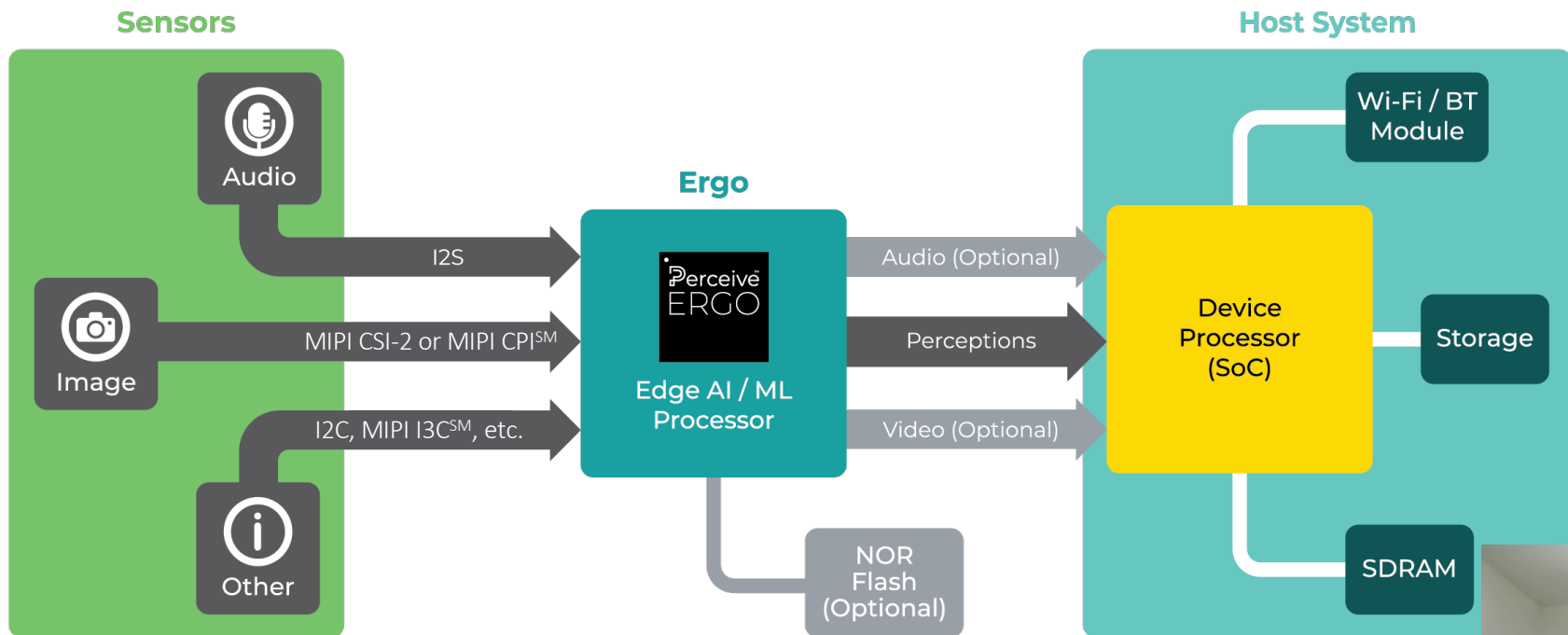


Perceive ERGO™

- Edge inference processor for use in devices such as security cameras or smart appliances
 - 20-100x more power-efficient, delivering 4 sustained GPU-equivalent floating-point TOPS at 55 TOPS/W
 - Able to process large neural networks in 20mW and supports a variety of advanced neural networks



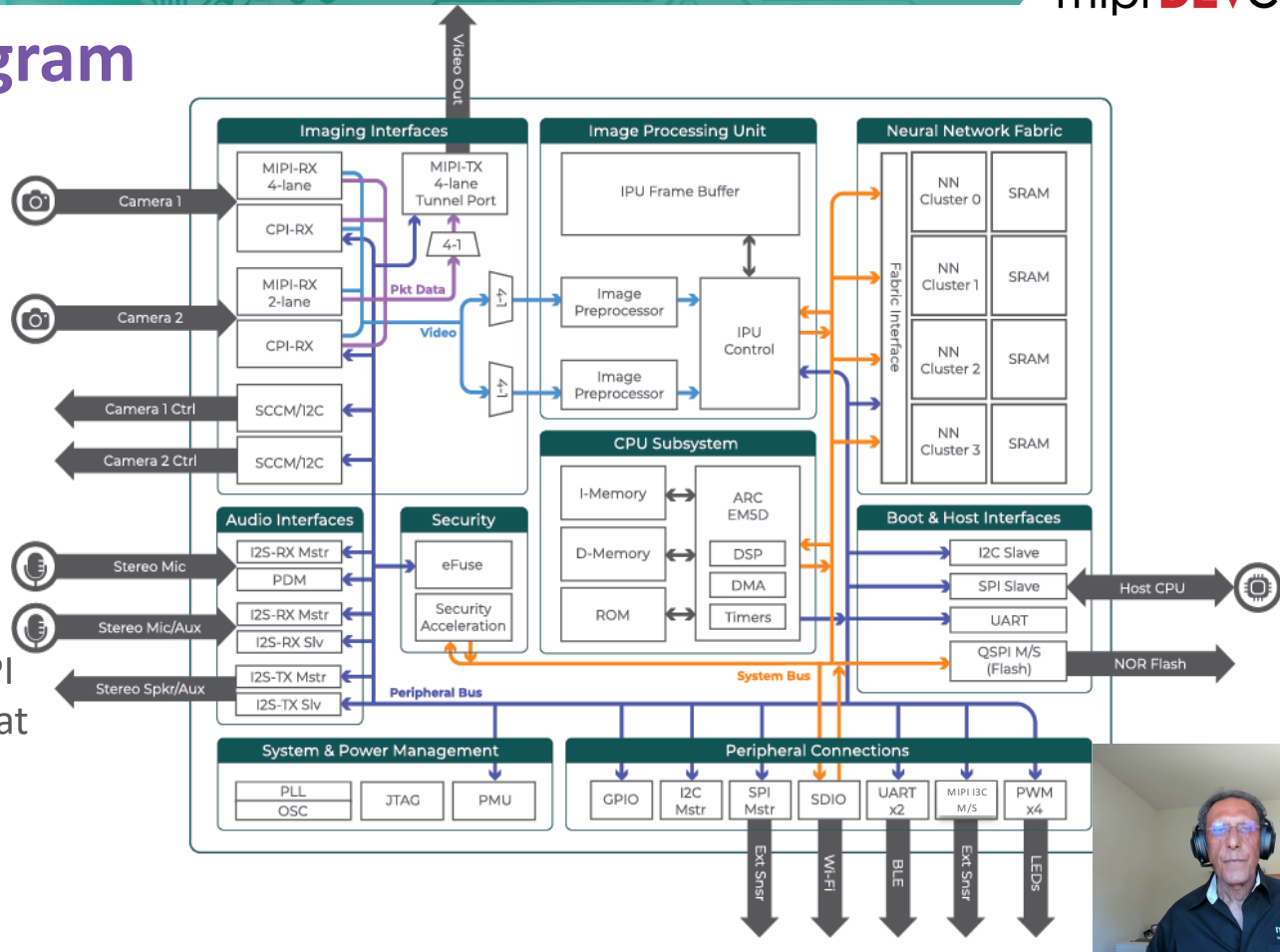
Overview of System Design



Ergo Block Diagram

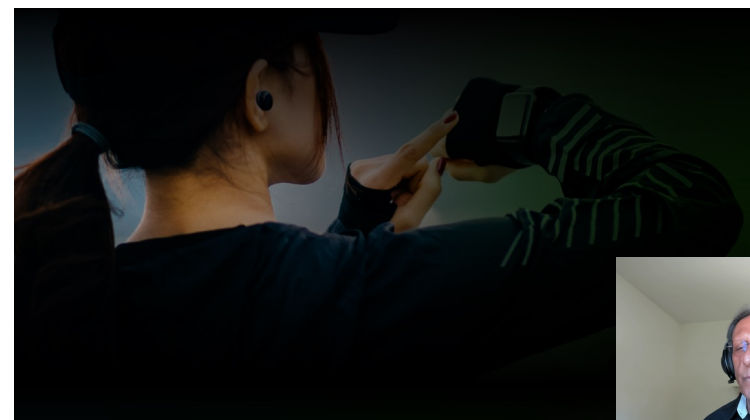


- Built on GLOBALFOUNDRIES® 22FDX® Platform
- Integrates Mixel's MIPI D-PHY CSI-2 TX/RX IP at 1.5Gbps/lane



Perceive Target Solutions

- Video Object Detection
 - Enables home or enterprise security to detect interesting motion and ignore false alerts
- Audio Event Detection
 - Able to detect critical sounds around the device to improve safety and contextual awareness
- Face Recognition
 - Can be used as standalone biometric or part of multi-factor authentication to unlock devices or objects
- Speech Recognition
 - Used for wakeup words, device-specific commands, and natural language interfaces for smartphone, smart toy, or home appliance



Perceive Target Applications

- Smart Home – Security Cameras and Doorbells
 - Detect interesting motion and ignore false alerts
 - Recognize faces, voices, and people
 - Detect relevant objects – animals, packages, vehicles, etc.
 - Use voice for local commands
 - Detect important sounds – alarms, people, glass breaking, etc.
 - Describe people, vehicles, or even the actions in a scene



Perceive Target Applications

- Wearables
 - Detect important sounds around the user
 - Use local voice commands and advanced wake words to simplify device UI
 - Recognize faces, people, voice, and emotions
 - Detect relevant objects around the user
 - Integrate data across multiple sensors



Perceive Target Applications

- Portable computing
 - Detect and recognize people and faces
 - Detect other relevant objects and sounds
 - Recognize voices and local voice commands
 - Track emotions, attention, and eye location
 - Blur or replace video conference backgrounds
 - Improve audio or video signal



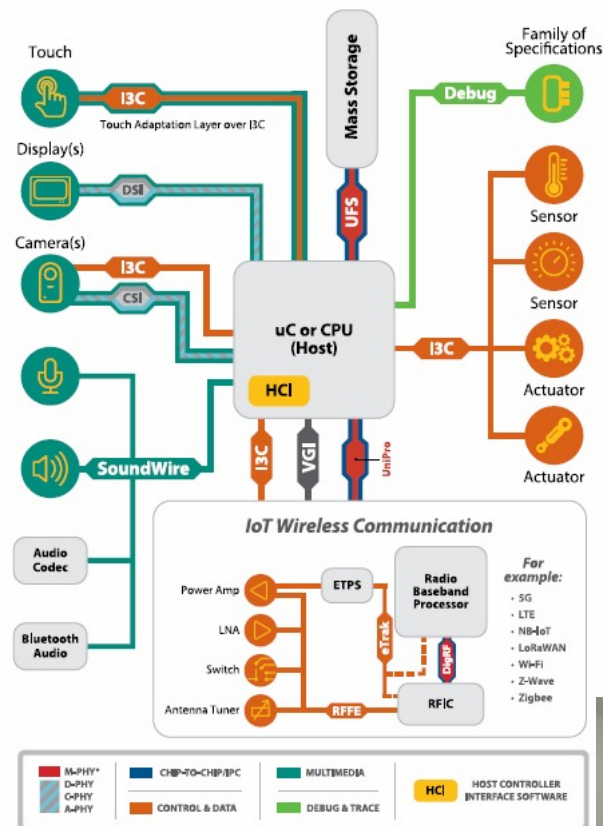
Perceive Target Applications

- Video conferencing
 - Detect and track people, faces, and voices
 - Recognize individual faces and voices
 - Audio noise reduction and intelligent muting
 - Use gesture or voice for touchless control
 - Blur or replace video conference backgrounds
 - Gaze correction and audience analytics
 - Detect other relevant objects and sounds



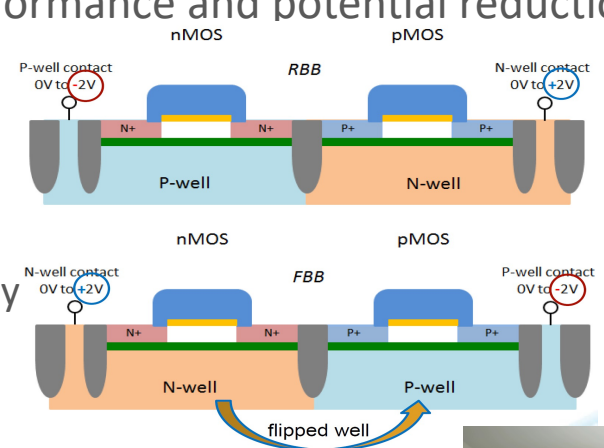
Why MIPI

- MIPI was designed from the ground up to minimize power requirements while supporting high bandwidth and strict EMI requirements
- Many edge applications are battery operated
- MIPI CSI-2 is widely adopted for sensor applications
- MIPI D-PHY is the first and most widely adopted MIPI PHY today



Why FDSOI

- FDSOI provides the right mix to achieve better performance, with lower power, at lower cost—without the need to move to more costly FinFET processes
- Compared with bulk silicon, FDSOI provides additional flexibility, due to the programmability of body bias, resulting in higher performance and potential reduction in power and area
 - Body biasing allows trade-off between dynamic and leakage power resulting in lowest possible power consumption for workload and operating conditions
 - Reverse Body Bias (RBB) can be applied during stand-by mode to drastically reduce leakage current
 - FDSOI enables performance/frequency boost through Forward Body Bias (FBB)
- No wonder FDSOI is widely adopted for IoT devices!



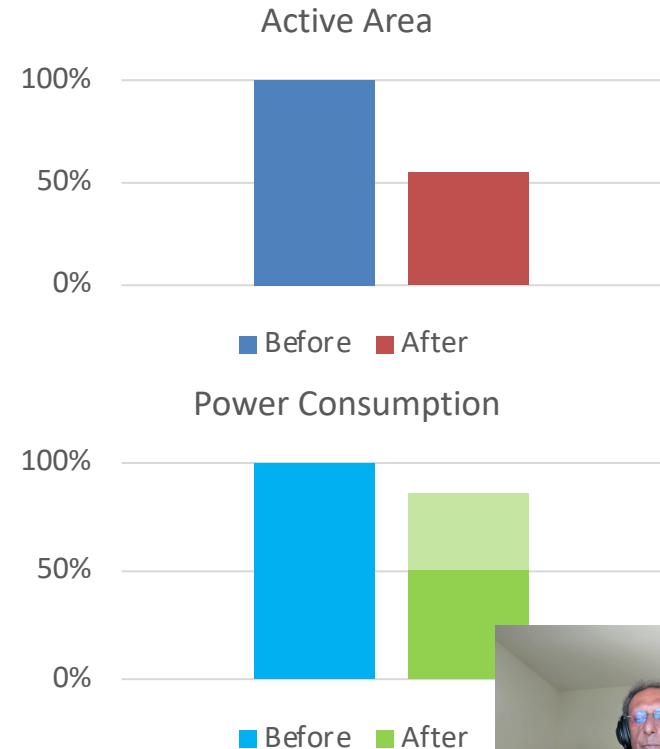
FDSOI:

- Fully-Depleted Silicon-On-Insulator
- Planar process similar to bulk



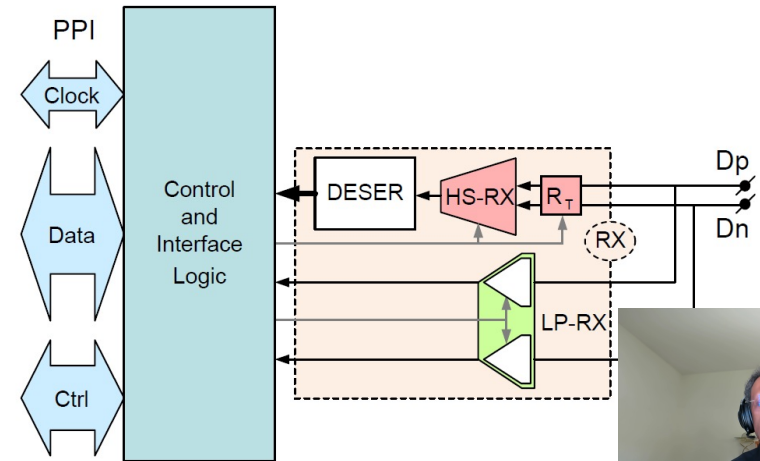
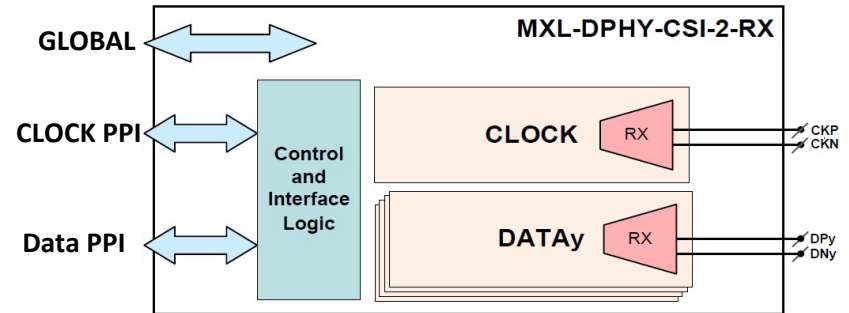
Power and Area Saving Evaluation

- By applying Forward Body Bias (FBB), device size was minimized while maintaining the same performance
- By adjusting the FBB and RBB based on PVT you can either reduce the area or the power or both
- Achievable power and area savings for FDSOI process:
 - Active area reduction of ~55%
 - Power reduction of 14-50% across PVT



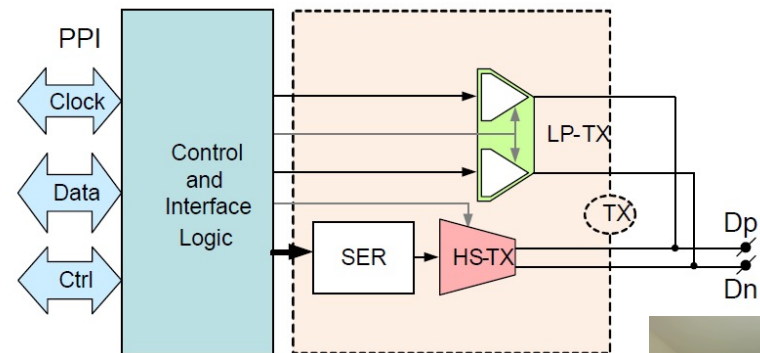
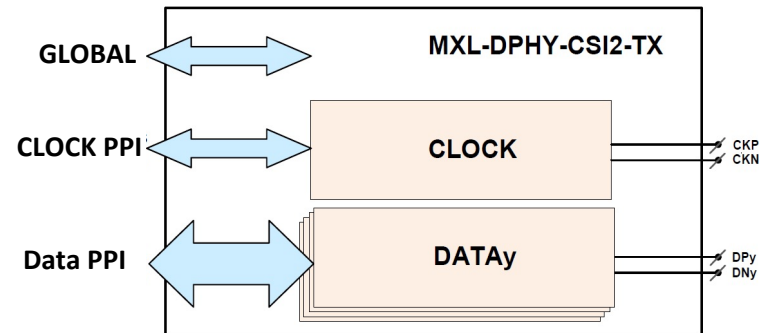
Mixel MIPI Receiver IP

- MIPI D-PHY CSI-2 RX IP
- Supports MIPI D-PHY v2.1 with backwards compatibility for v1.2 and v1.1
- High-speed transmitter running at 2.5Gbps/lane
- Low-power transmitter running at up to 80Mbps/lane
- 2 and 4 data lanes and 1 clock lane configurations
- Area optimized
- Achieved first time silicon success



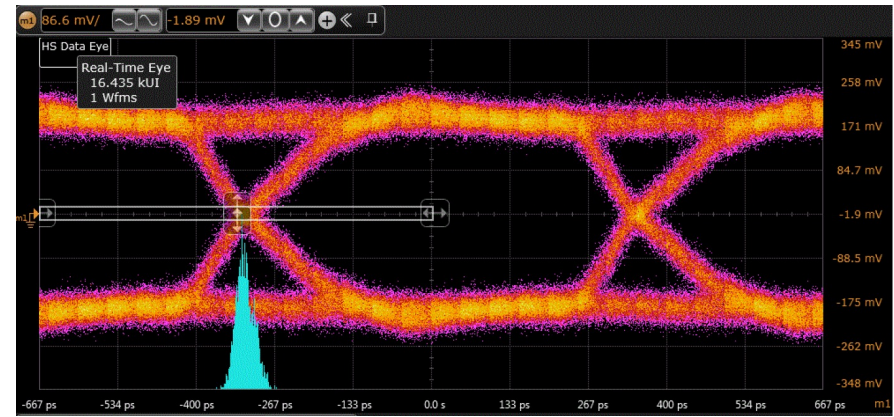
Mixel MIPI Transmitter IP

- MIPI D-PHY CSI-2 TX IP
- Supports MIPI D-PHY v2.1 with backwards compatibility for v1.2 and v1.1
- High-speed transmitter running at 2.5Gbps/lane
- Low-power transmitter running at up to 80Mbps/lane
- 4 data lanes and 1 clock lane
- Area optimized
- Achieved first time silicon success

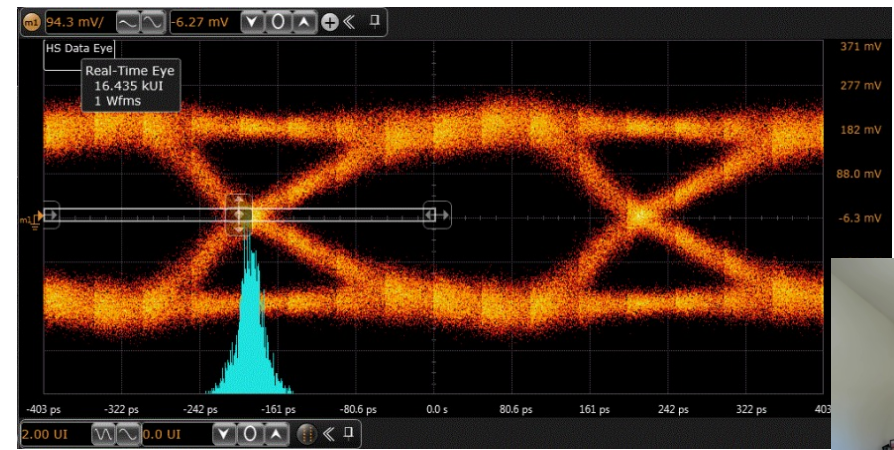


Silicon Results

MIPI D-PHY TX @ 1.5Gbps



MIPI D-PHY TX @ 2.5Gbps



Mixel IP in FDSOI Processes

IP Name	Features	Node
D-PHY Universal	V1.2; 2.5Gbps; De-skew; loopback testability.	Silicon-Proven in 28FDSOI
D-PHY Universal	800Mbps; Ultra low power; Wearables, IoT.	
D-PHY DSI TX	1.5Gbps; low Skew; Test modes.	
D-PHY CSI-2 RX	1.5Gbps; Test modes.	
LVDS TX	1.25Gbps; 4 Channel; 7 or 10 bits/channel	
LVDS TX	1.25Gbps; 8 Channel; 7 or 10 bits/channel	
LVDS/D-PHY TX Combo	1.05Gbps; 4 Channel; Test modes.	
LVDS/D-PHY TX Combo	1.05Gbps; 8 Channel; Test modes.	
D-PHY CSI-2 TX	2.5 Gbps/lane; 4 lanes	Silicon-Proven in 22FDX
D-PHY CSI-2 RX	2.5Gbps/lane; 2 or 4 lanes	
D-PHY CSI-2 RX	2.5Gbps/lane; 2 or 4 lanes	



Mixel MIPI PHY Portfolio

- Industry leader in MIPI® interfaces and contributing member of the MIPI Alliance since 2006
 - MIPI D-PHY first silicon-proven in 2008
 - MIPI M-PHY® first silicon-proven in 2011
 - MIPI C-PHY first silicon-proven in 2016
- Complete integrated solution includes PHY, controller, and platform
- Widest coverage of process nodes and foundries: silicon-proven in 11 different nodes and 8 different foundries



Conclusion

- Edge computing provides many benefits including the ability to make decisions in real time, with very low latency
- MIPI specifications are uniquely designed to enable low power, high bandwidth requirements of IOT & edge devices
- FDSOI provides high performance with lower power at lower cost
- Processors like Perceive Ergo enable AI processing at the edge to make connected devices smarter, resulting in lower latency, improved battery life, and better security
- Mixel MIPI PHY IP enables SoC designers to leverage the benefits of MIPI with silicon-proven designs in FDSOI, lowering project risk





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THANK
YOU!

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- [From Cloud to Edge](#)
- [A look at examples of IoT devices and their business applications in 2021](#)
- [What is edge computing? Everything you need to know](#)
- [Edge Intelligence Makes Smart Homes Truly Intelligent](#)
- [Autonomous Vehicles Drive AI Advances for Edge Computing](#)
- [Smart manufacturing and the IoT are driving the Industry 4.0 revolution](#)
- [Smart Manufacturing: Cloud vs. Edge Computing](#)
- [MIPI White Paper: Enabling the IoT Opportunity](#)
- [It's Time to Look at FDSOI Again](#)