A FIDUS SYSTEMS **SUCCESS STORY**

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Solving Low-Latency, High-Bandwidth Data Acquisition and Storage for a High-Resolution Drone Camera System

THE CHALLENGE

For observation applications, including geological and hydrological surveying, drones and aircrafts need high-resolution camera systems that can manage high-bandwidth, low-latency image-sensor data acquisition and storage.

THE SOLUTION

Fidus partnered with an aerospace client to help collect and store data from their drones. Each drone included 15 different image sensors that acquired image data independently. To meet the system's resolution requirements, image sensors needed to trigger all at the same instant, so the team leveraged FPGA technology to ensure that data acquisition happened in parallel.

Once the sensors started collecting image data, it was processed and stored in NVMe drives – low-latency storage mediums on the drone. When the drone landed, those drives were moved to a workstation where the information was transferred for post-processing.

Each image frame was annotated in the FPGA, so it was clear which images came from each sensor, and a proprietary algorithm used that information to assemble a 3D visualization of the captured environment. Fidus assisted with image data acquisition, pre-processing, movement, and storage throughout the system – including the server-side application development.

The client originally came to Fidus for Sidewinder, Fidus' customizable board designed for low-latency, high-bandwidth networking and storage applications like this one. Sidewinder was particularly preferable because it can accommodate parallel storage into multiple NVMe drives. After validating the technological approach using a Sidewinder-based proof of concept, the team moved into productization.

Anticipating the Unexpected

Fidus helped the client articulate and frame each element of their program in terms of potential risks to be addressed during the development process. These considerations included:

Small Form Factor

With such a small form factor, Sidewinder boards and other electronic equipment had to be placed extremely close together in the housing, introducing interference concerns. Mechanical engineers and EMI experts at Fidus shielded the board and other systems in the drone environment.

Mechanical Vibration

In addition to size constraints, mechanical vibration was cause for concern. Knowing that vibration couldn't be completely eliminated, Fidus customized the board and its mounting features with higher mechanical tolerances to accommodate potential vibrations from high-velocity rotor blades.

Storage Capacity Constraints

Fidus defined storage capacity requirements based on flight time, duration of image capture, and the power capacity of the drone itself. Image resolution and frame rate were constants; those values were not modulated in flight. However, the acquisition, processing, and storing of consistent, high-resolution image data from multiple image sensors demanded tens of watts of the drone's power supply, which placed additional demands on the electrical and mechanical solutions.

Storage capacity and bandwidth were both limiting factors in the beginning because the team was working with cutting-edge NVMe solid-state drives (SSDs). SSDs originally quoted at 500 GB capacity, with access speeds of about 500 MB/s, expanded to 2 TB drives with access speeds of about 3000 MB/s because of advances in the data storage market. This development expanded the storage capacity, and adjacently, the drone's image acquisition time with no additional design changes required.

Size, Weight, Area, and Power

The existing Sidewinder takes the form of a PCIe card, but Fidus can customize it for compatibility with any application's mechanical form factor. For the drone camera system, most customizations occurred to accommodate a form factor similar in size to a standard 3U OpenVPX PCB.

Encryption

While Fidus wasn't involved with designing the encryption technology for this application, Sidewinder is equipped to support AES 256, Secure Boot, and Bitstream encryption. These features, among others, reduce the system's vulnerability to malicious attack vectors and improve the system's overall security performance. For ingress and egress networking data, Sidewinder features two 100 Gbps (gigabits per second) QSFP ports connected directly to the FPGA fabric via gigabit transceivers. This feature enables line-rate encryption and decryption as well as compression and decompression.

Future Outlook

This client integrated their image post-processing prowess with a Fidus-developed acquisition system to deliver cutting edge capabilities to their customers. With strategic futureproofing from Fidus, the client continues to implement system innovations without incurring substantial development costs. With these benefits, the client can serve a wide variety of customers through incremental software-based feature releases. Today, Fidus plays a technical advisory role to support the client as they continue to push the envelope in the aerospace industry.

For more information on defining and achieving requirements for low-latency, high-bandwidth data movement, check out our recent white paper.

DESIGN SOLUTIONS WITH FIDUS

Need prototype and product design help?

We'll work with you to understand what you're looking for, and we'll dedicate the necessary resources to make sure it's a success the first time. Come to us with just an idea or specific challenges that are keeping you up at night, and we'll help you solve them.

Fueled by 20+ years' experience, our expertise, and creativity, along with our collaborative and process driven approach, turns complex challenges into well-designed solutions, and we keep customers like you coming back, again and again:

1. We are committed to "first time right".
2. Experience has taught us how to solve problems on any scale.
3. Faster time to market means faster time to benefit.
4. You choose how we work together.
5. Unique projects are our obsession.
6. We believe transparency builds trust.
7. Customer focus is our calling card.

20+
years experience
Collaborating with smart teams is what fuels us every day.

3,000+
successful projects
Your unique challenges are our obsession.

400+
customers
Extending your team with our expertise brings designs to market faster.

82%
repeat customers
Customers love to work with us, again and again.

ABOUT FIDUS

Fidus Systems, founded in 2001, specializes in leading-edge electronic product development with offices in Ottawa and Waterloo, Ontario, and San Jose, California. Our hardware, software, FPGA, verification, wireless, mechanical and signal integrity teams work to innovate, design and deliver next-generation products for customers in emerging technology markets. Fueled by 20+ years' experience and creativity, along with our collaborative and process driven approach, we turn complex challenges into well-designed solutions. And with over 400 customers and 3000+ completed projects, we have the expertise to be a seamless extension of your team, providing a clear focus and commitment to getting designs and prototypes to market faster. Once you start working with us, you'll trust us like one of your own. Our hallmark is transparency. Our guiding principle is first time right.

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