Guzik Products Embrace New ODI Optical Standard

By Lauri Viitas, Guzik Technical Enterprises

The Optical Data Interface standard, abbreviated as ODI, is a new high-speed interface for instrumentation systems. ODI shatters speed and distance barriers by relying on optical communication between devices, over a simple pluggable optical cable. Guzik Technical Enterprises is a pioneer in using this technology, and was a key contributor in the development of the specification. The ODI standard is designed to address challenging applications in 5G communications, mil/aero, and advanced communication research. This article will highlight how Guzik is using the ODI standard to offer breakthrough measurement and analysis capability to the industry.

The ODI standard defines a standard optical port that can be placed on any instrument or device. Each port is capable of sending or receiving up to 160Gb/s of real-time data, continuously. The ODI optical cable can be up to 100 meters in length, easily eliminating distance constraints in racked systems. Multiple ports may be aggregated, expanding the data bandwidth by the number of ports. For more information about the ODI standard, the ODI Specifications page offers a technical summary and slide format overview, along with the specifications.

Guzik exploits the high speeds available from ODI in three key products: the new ADP7000 AXIe digitizer, the DP7000 AXIe digital processor, and the Fiber Optic Bridge Card V2 (FOBC). To see why ODI is so critical, a review of the ADP7000 digitizer series is in order.

Figure 1 shows the first ODI products to be announced. The Guzik ADP7104 AXIe digitizer, on top, has four ODI ports shown in the lower right corner of the module. The product can stream two channels, each at 10-bits and 32Gsamples/s, continuously to the DP7000 digital processing modules shown

underneath. The entire system is integrated into a Keysight AXIe chassis. Total bandwidth: 640 Gb/s between modules.

The Guzik ADP7000 AXIe digitizer series combines cutting edge measurement performance with powerful signal processing. The digitizers use Keysight's proprietary 10-bit ADC (analog-to-digital converter) technology previously only available in the Keysight Infiniium S-Series Oscilloscopes. With each digitizer capable of sourcing two channels, each at 32 Gsamples/s and 10-bits of resolution, total real-time streaming data bandwidth can reach 80 GBytes/s, well beyond the range of electrical cables. The ADP7000 digitizer series solves this by deploying four ODI optical ports, each capable of 20 GBytes/s. The data may be streamed to the Guzik DP7000 Digital Processor module, or to storage systems using the Guzik Fiber Optic Bridge Card.

Figure 1 shows the Guzik ADP7104 in the top slot of an AXIe chassis. Immediately below it are two Guzik DP7000 digital processors, also supporting ODI. The ODI ports can be seen in the lower right corner of the ADP7104, and at the rightmost edge of the DP7000s. By connecting an ODI fiber optic cable between the digitizer ports and the processor ports, data may be streamed at full speed continuously.

This combination is a fundamental change to the block diagram of most RF measurement systems. RF signals up to 10 GHz in bandwidth may be sampled directly by the ADP7104, without downconversion. Digital Downconversion (DDC) is executed in real-time by the onboard signal processing engine, itself an equivalent of a DP7000. The ADP7000 series and the DP7000 each deploy four Intel FPGAs, including 13,504 multipliers, and deliver a combined processing power of 6 TeraFLOPS (Trillion Floating Point Operations Per Second). Besides DDC, the processors are capable of executing a long list of functions, including frequency and phase equalization, baseband digital filtering and decimation, and periodic averaging functions for high dynamic range and low noise. Combined with IF Magnitude Triggering, the combination allows users to store and analyze variable sub-bands of interest up to 2.5 GHz wide, with the IF Magnitude Triggering defining the start and stop points of the variable-length segmented acquisition.

Applications

ODI extends the capability of the ADP7000 series in two ways. First, for applications where 6 TeraFLOPS of processing isn't enough, DP7000s may be added to increase the processing power in 6 TeraFLOPS increments. Second, the ADP7000 series may be deployed with several Fiber Optic Bridge Cards V2 (FOBCs) to create a real-time recording system at full bandwidth.

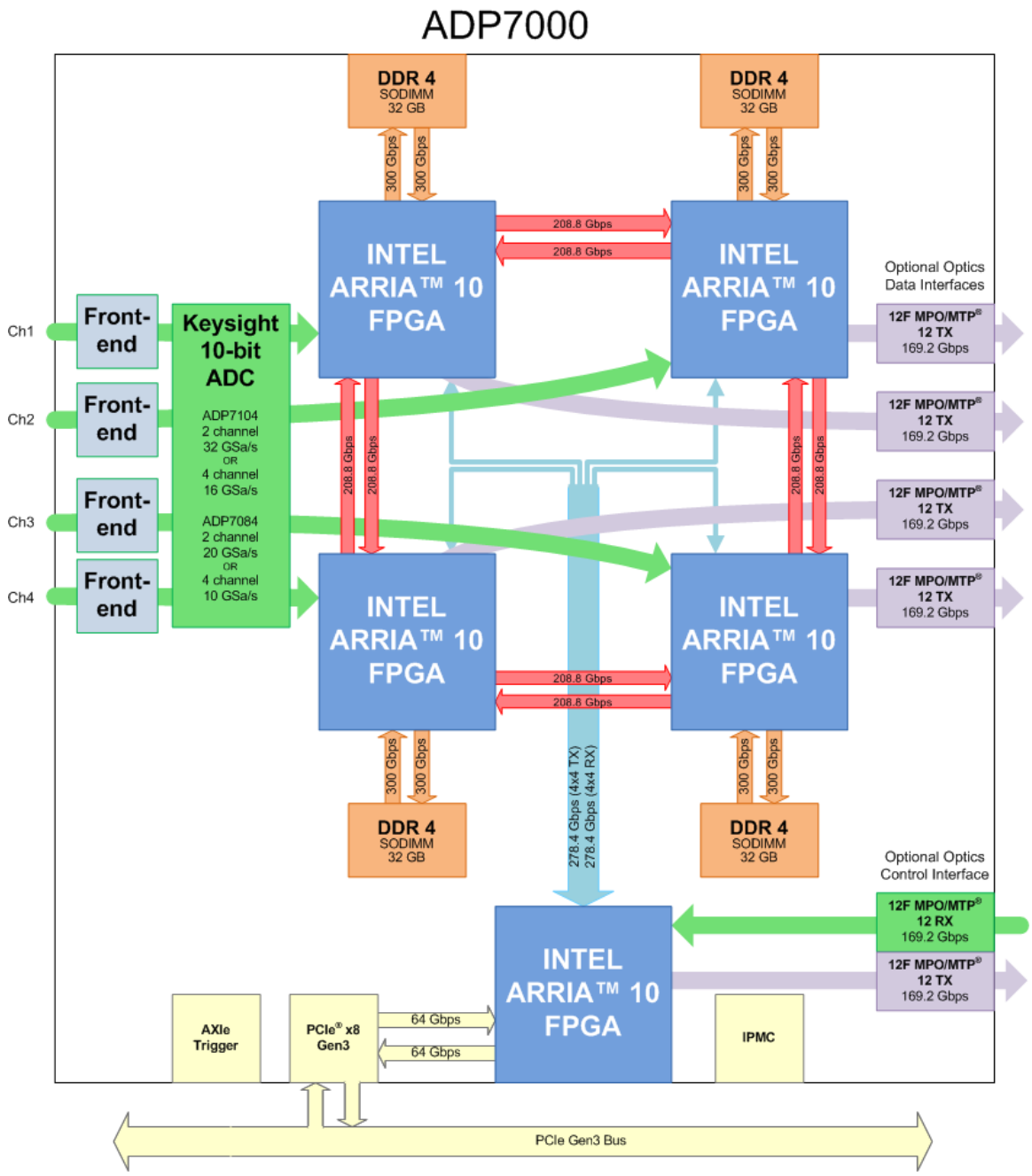

Figure 2 shows the processing architecture and data flow of the ADP7000. The four ODI ports are shown on the right, and can source data at the full converter speed.

Figure 2 shows the block diagram and processing architecture of the ADP7000. Four ODI ports are shown at the right, which can stream to any number of DP7000 digital processors for additional processing power. This is shown in Figure 3, below.

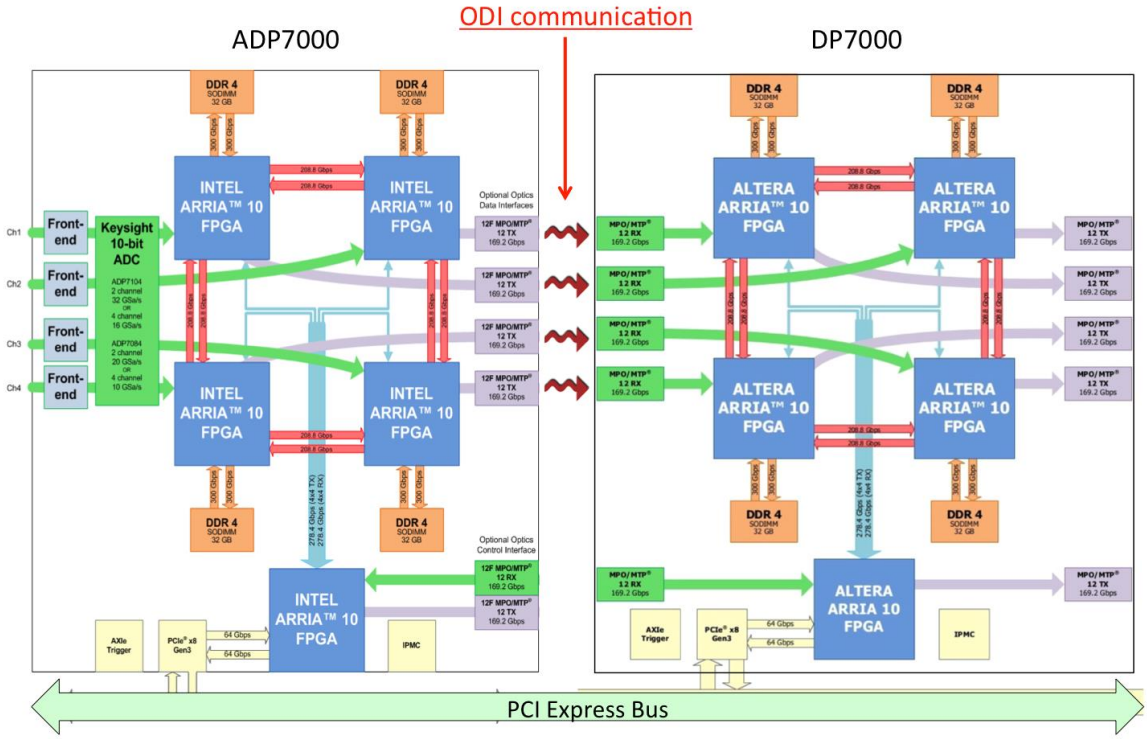

Figure 3 shows an ADP7000 streaming data to a DP7000 signal processor over the four ODI links.

Figure 3 shows an ADP7000 connected to a DP7000 acting as a coprocessor. Each DP7000 adds 6 TeraFLOPS of processing power. Any number of DP7000s may be chained together to achieve the aggregate processing power needed.

For recording applications, the ADP7000 can be connected to eight FOBCs, shown below in Figure 4. Each FOBC is a pluggable PCI Express Gen 3 x16 card. Since PCI Express Gen 3 is limited to under 16 GBytes/s, two FOBCs are needed to support one 20 GBytes/s ODI port. Each FOBC sits on a RAID server backplane, storing the data it sees to a high-speed RAID array. Guzik splits each port by dividing the 12-lane optical connection to two 6-lane connections. This is an extension to the ODI specification. It is expected that future storage units will record ODI's full 20 GBytes/s bandwidth onto their storage arrays through a single connection.

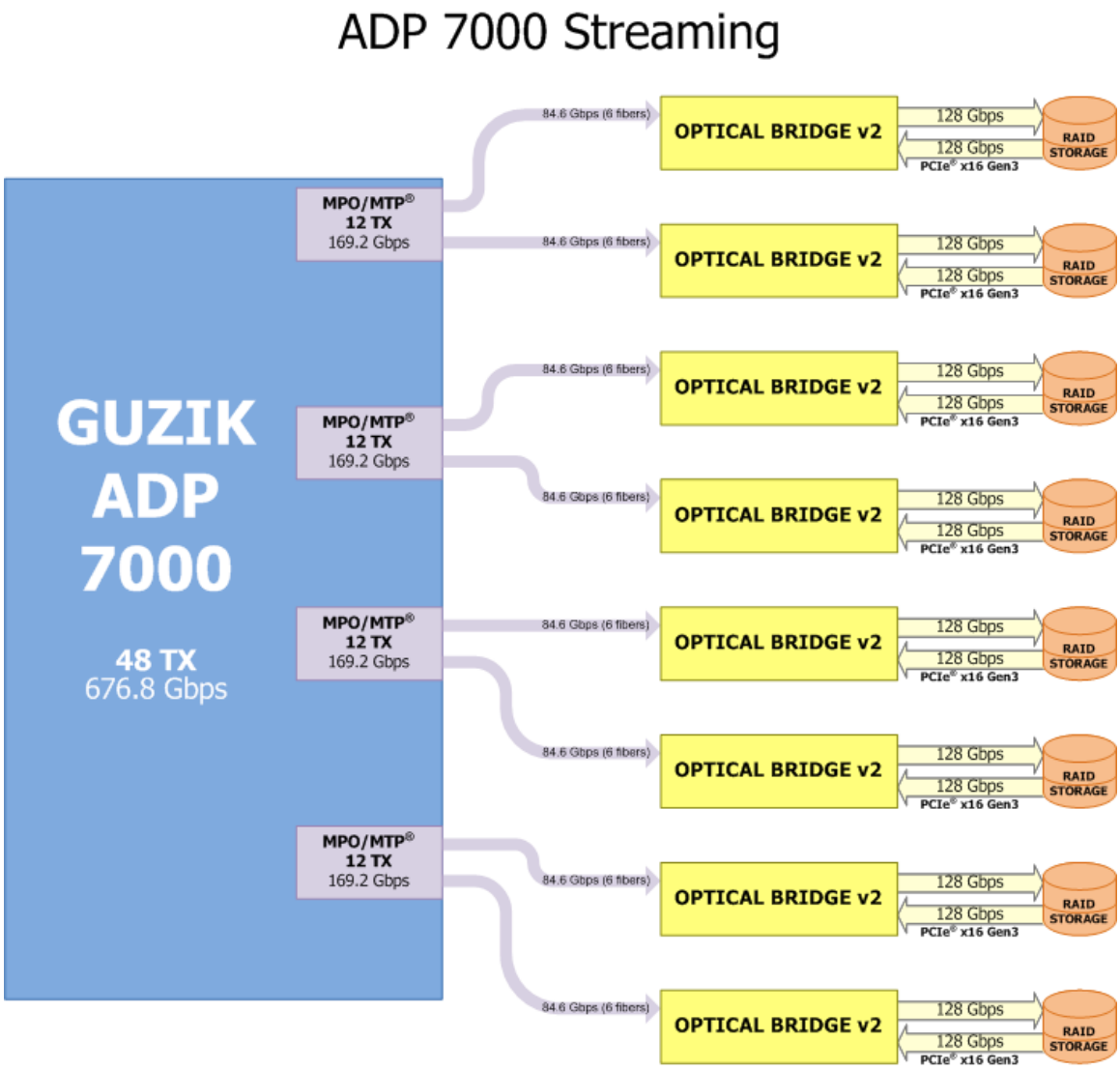

Figure 4 shows how the ADP7000 can be configured with eight FOBC V2s to create a continuous real-time recording system at the full rate of 640 Gb/s.

Summary

The historical architecture of RF measuring devices is being challenged. Phased-array radar and advanced wireless communication technologies such as 5G present fundamental challenges to traditional measurement architectures. New architectures, relying on direct sampling and powerful signal processing are needed. However, electrical interfaces between measurement devices and processors simply cannot cope with the data bandwidth required. With ODI, this problem is solved. Guzik's offering of ODI-equipped digitizers, processors, and PCIe interface boards enable users to address these challenging applications.