

Digitizers for Big Physics

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TELEDYNE SP DEVICES
Everywhere **you** look™



AGENDA

- ❖ About Us
- ❖ Technology
- ❖ Products in MTCA.4
- ❖ Developments



TELEDYNE SP DEVICES
Everywhere**you**look™

About Teledyne Signal Processing Devices

- **Innovative supplier**
 - Spin-off from Linköping University, Sweden (2004)
 - Research since 1998 with 65 active patents
- **Skilled team**
 - More than 80% are holding a PhD or MSc engineering degree
 - 60% of our employees work in R&D
- **Production capacity with the highest standards**
 - ISO 9001:2015, ISO 14001:2004, IPC-A-610
 - High-volume capacity



Technology

- **High-Speed Digitizers**

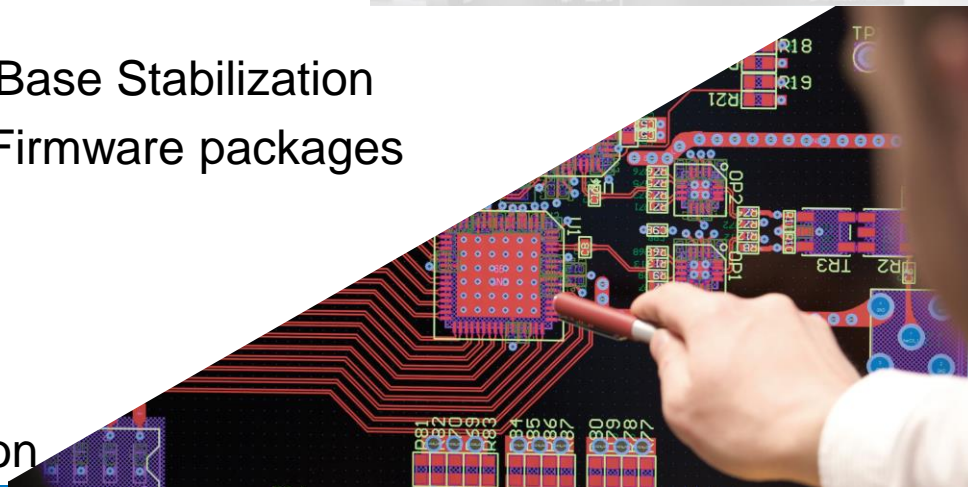
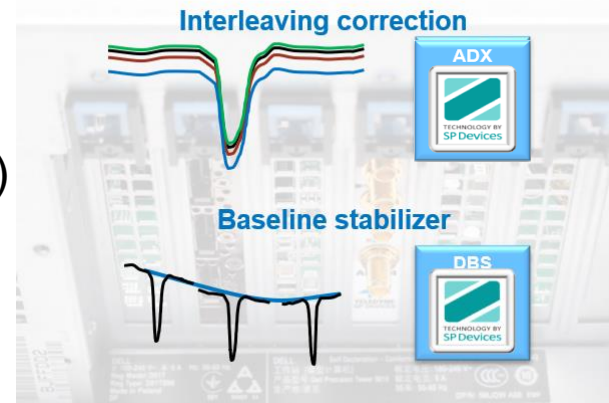
- Portfolio reaching 10GSPS at 14bit
- High-precision trigger (resolution:50ps; jitter:25ps)
- Multi-channel synchronization support
- 52ns re-arm time

- **Signal Processing**

- Core IP: Interleaving and Digital Base Stabilization
- Selection of application-specific Firmware packages
- Open FPGA

- **Software Development Kit**

- Digitizer Studio
- Rich example code documentation



Product Portfolio in MTCA.4

- **ADQ412**
 - 2 / 4 channels
 - 4 / 2 GSPS
 - 12-bit resolution



- **ADQ14**
 - 2 / 4 channels
 - 2 / 1 GSPS
 - 14-bit resolution



- **ADQ7**
 - 2 / 1 channels
 - 5 / 10 GSPS
 - 14-bit resolution



- **ADQ8**
 - 8 channels
 - 1 GSPS
 - 10-bit resolution



Product Portfolio in MTCA.4

■ ADQ412

- 2 / 4 channels
- 4 / 2 GSPS
- **1 GByte DRAM**
- **Xilinx Virtex-6**



■ ADQ14

- 2 / 4 channels
- 2 / 1 GSPS
- **2 GByte DRAM**
- **Xilinx Kintex7 325T**



■ ADQ7

- 2 / 1 channels
- 5 / 10 GSPS
- **4 GByte DRAM**
- **Kintex Ultrascale XCKU085**



■ ADQ8

- 8 channels
- 1 GSPS
- **1 GByte DRAM**
- **Xilinx Kintex7 325T**



Product Portfolio in MTCA.4

- **ADQ412**
 - 2 / 4 channels
 - 4 / 2 GSPS
 - **AC-coupled**
 - **BW 1.3 GHz**



- **ADQ7**
 - 2 / 1 channels
 - 5 / 10 GSPS
 - **DC-coupled**
 - **BW 3 GHz**



- **ADQ14**
 - 2 / 4 channels
 - 2 / 1 GSPS
 - **DC-coupled**
 - **BW 1.2 GHz**



- **ADQ8**
 - 8 channels
 - 1 GSPS
 - **DC-coupled**
 - **BW 500 MHz**



Product Portfolio in MTCA.4

■ ADQ412

- 2 / 4 channels
- 4 / 2 GSPS
- AC-coupled
- **Flexible configuration**



■ ADQ7

- 5 / 10 GSPS
- 4 GByte DRAM
- Kintex Ultrascale XCKU085
- **Maximum performance on few channels**



■ ADQ14

- 2 / 1 GSPS
- 2 GByte DRAM
- Xilinx Kintex7 325T
- **Large arrays of high-performance measurement**



■ ADQ8

- 8 channels
- 1 GSPS
- **Multi-board synchronization targeting single shot installations**



Product Portfolio in MTCA.4 – upcoming release

■ ADQ412

- 12-bit resolution
- 2 / 4 channels
- 4 / 2 GSPS
- 1 GByte DRAM

■ ADQ7

- 14-bit resolution
- 2 / 1 channels
- 5 / 10 GSPS
- 4 GByte DRAM

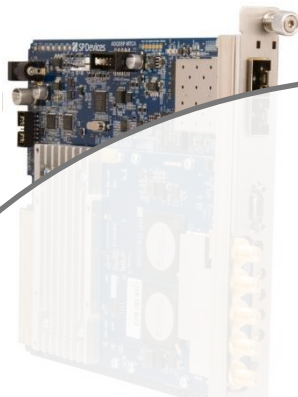
■ ADQ14

- 14 bit resolution
- 2 / 4 channels
- 2 / 1 GSPS
- 2 GByte DRAM

■ ADQ8

- 10-bit resolution
- 8 channels
- 1 GSPS
- 1 GByte DRAM

NEW DEVELOPMENT



Product Portfolio in MTCA.4 – upcoming release

■ ADQ412

- 12-bit resolution
- 2 / 4 channels
- 4 / 2 GSPS
- 1 GByte DRAM

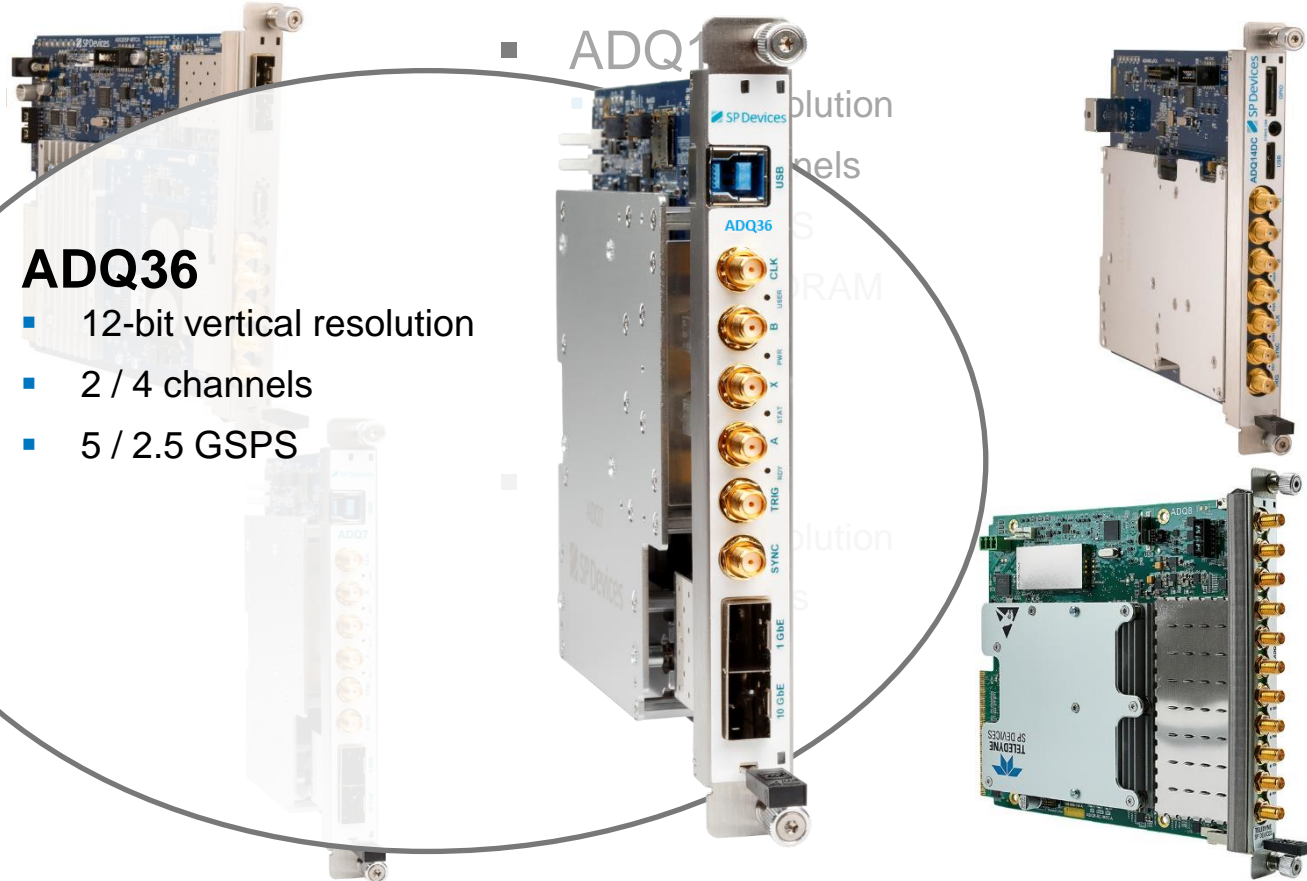
■ ADQ7

- 14-bit resolution
- 2 / 1 channels
- 5 / 10 GSPS
- 4 GByte DRAM

ADQ36

- 12-bit vertical resolution
- 2 / 4 channels
- 5 / 2.5 GSPS

■ ADQ1



Product Portfolio in MTCA.4 – upcoming release

■ ADQ412

- 12-bit resolution
- 2 / 4 channels
- 4 / 2 GSPS
- 1 GByte DRAM

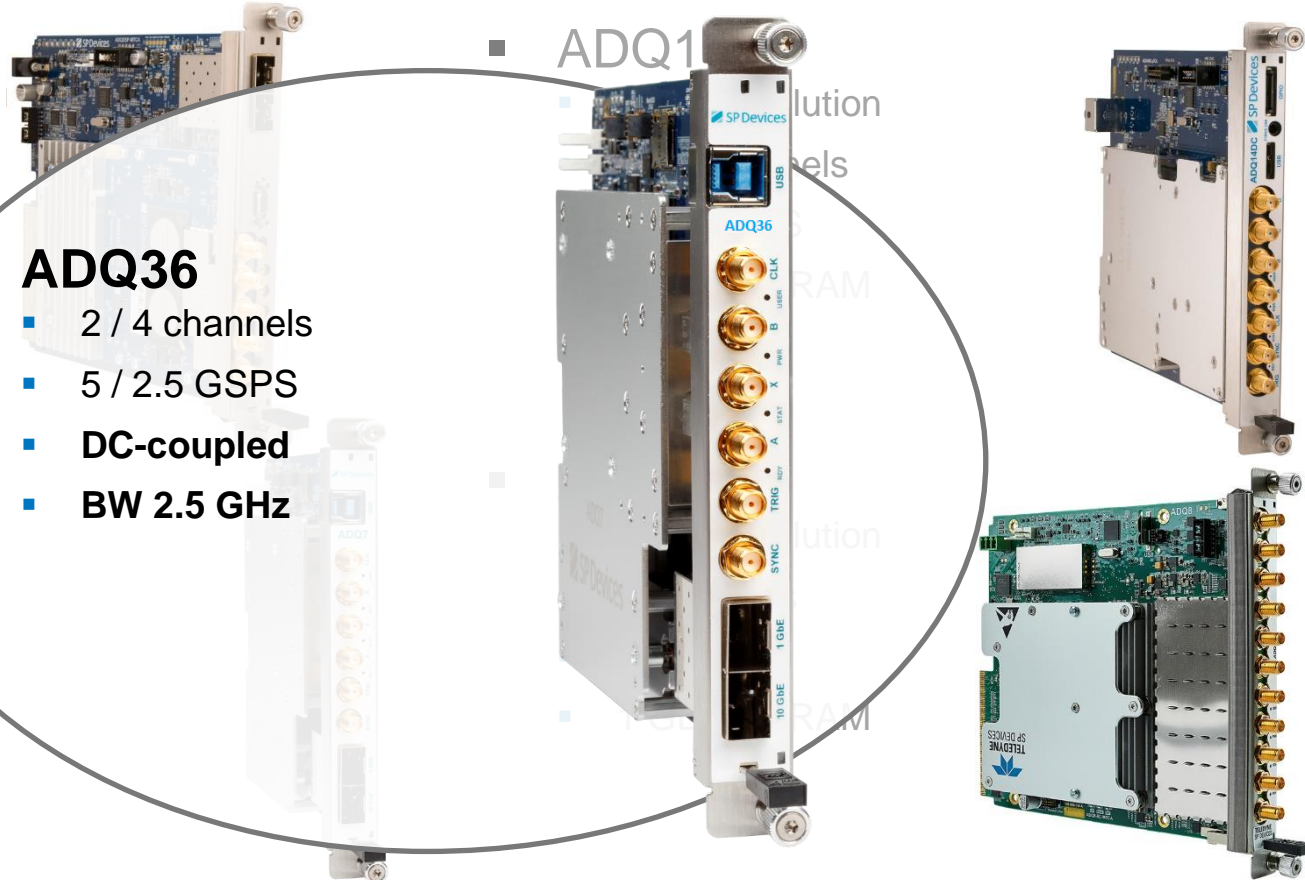
■ ADQ7

- 14-bit resolution
- 2 / 1 channels
- 5 / 10 GSPS
- 4 GByte DRAM

■ **ADQ36**

- 2 / 4 channels
- 5 / 2.5 GSPS
- **DC-coupled**
- **BW 2.5 GHz**

■ ADQ1



Product Portfolio in MTCA.4 – upcoming release

■ ADQ412

- 12-bit resolution
- 2 / 4 channels
- 4 / 2 GSPS
- 1 GByte DRAM

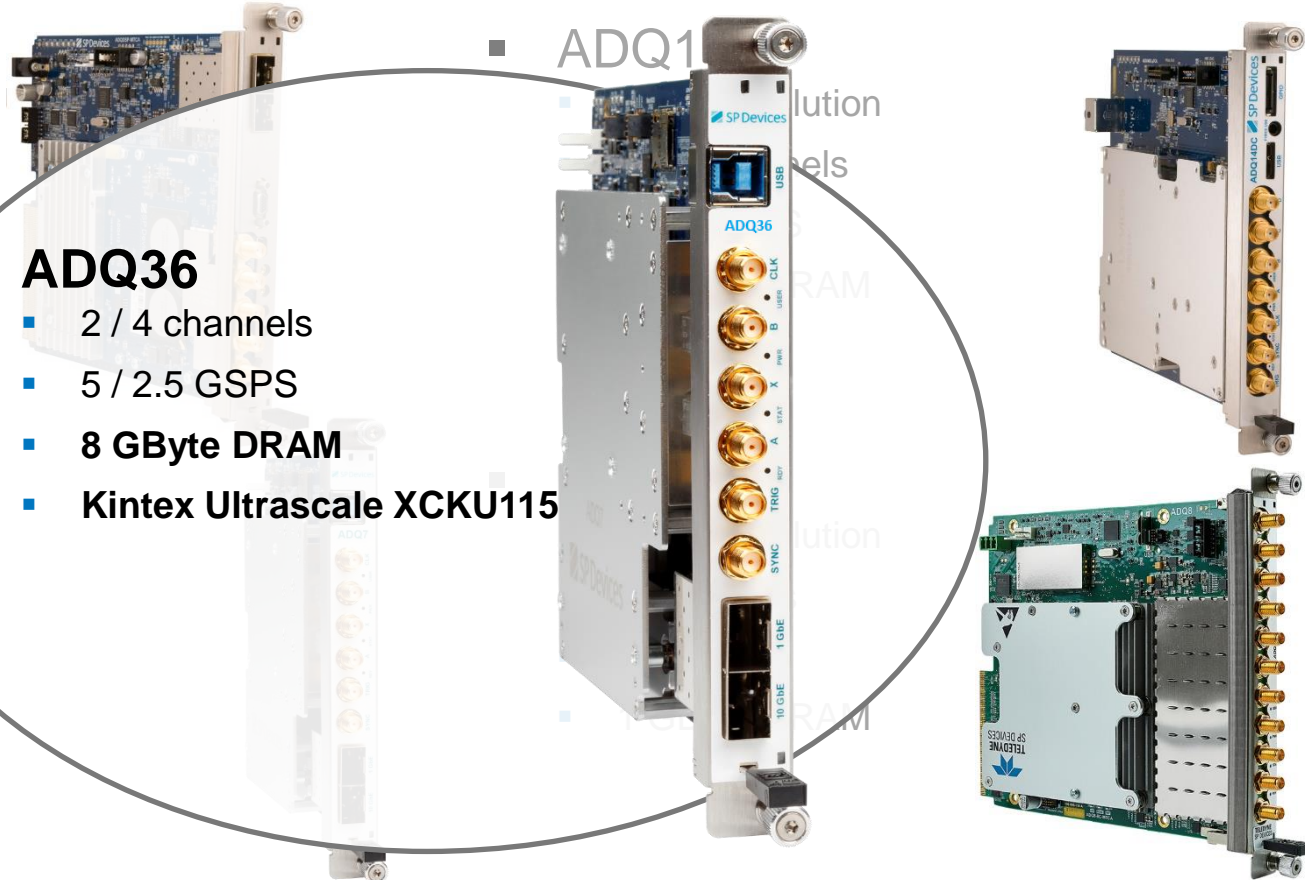
■ ADQ7

- 14-bit resolution
- 2 / 1 channels
- 5 / 10 GSPS
- 4 GByte DRAM

ADQ36

- 2 / 4 channels
- 5 / 2.5 GSPS
- **8 GByte DRAM**
- **Kintex Ultrascale XCKU115**

■ ADQ1



Product Portfolio in MTCA.4 – upcoming release

■ ADQ412

- 12-bit resolution
- 2 / 4 channels
- 4 / 2 GSPS
- 1 GByte DRAM

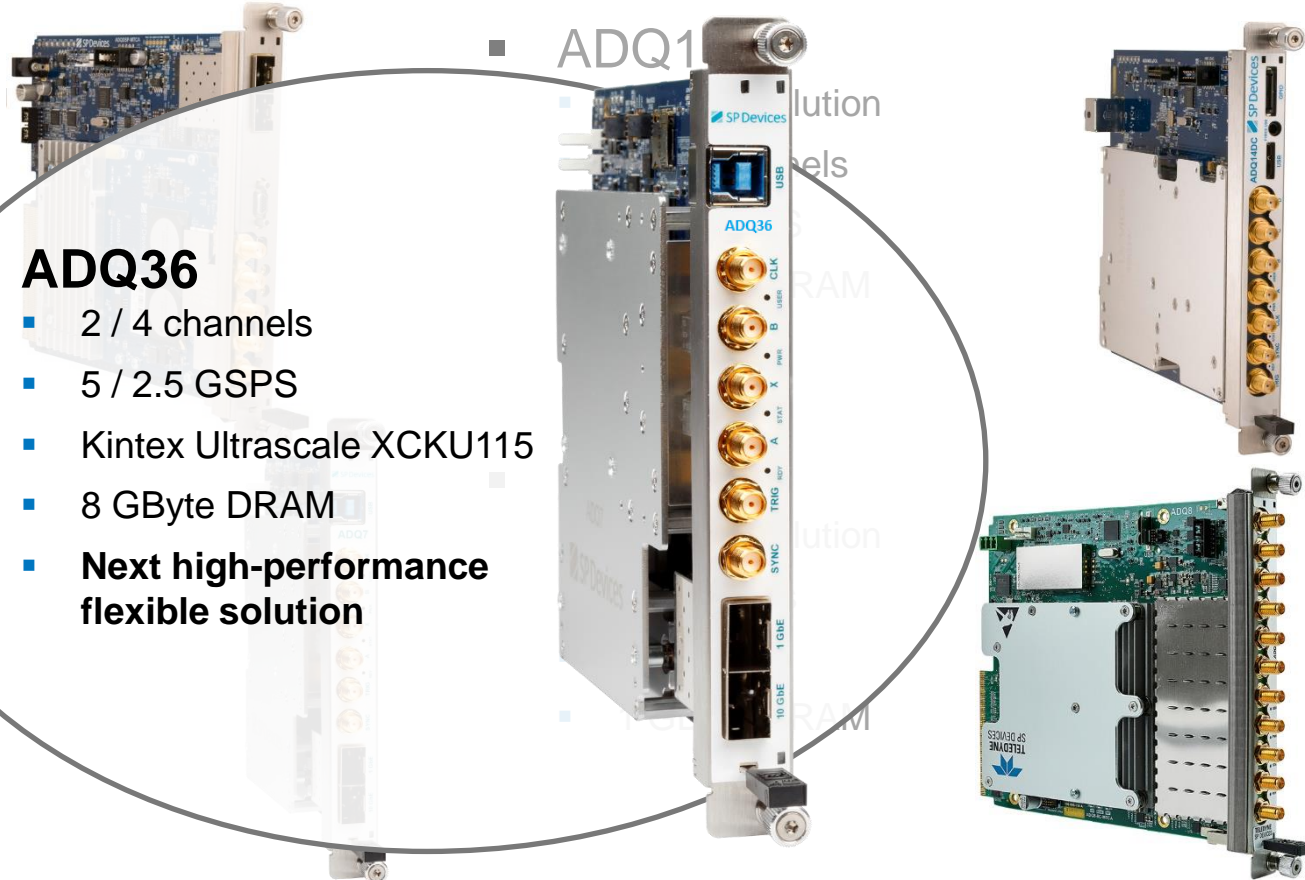
■ ADQ7

- 14-bit resolution
- 2 / 1 channels
- 5 / 10 GSPS
- 4 GByte DRAM

ADQ36

- 2 / 4 channels
- 5 / 2.5 GSPS
- Kintex Ultrascale XCKU115
- 8 GByte DRAM
- **Next high-performance flexible solution**

■ ADQ1

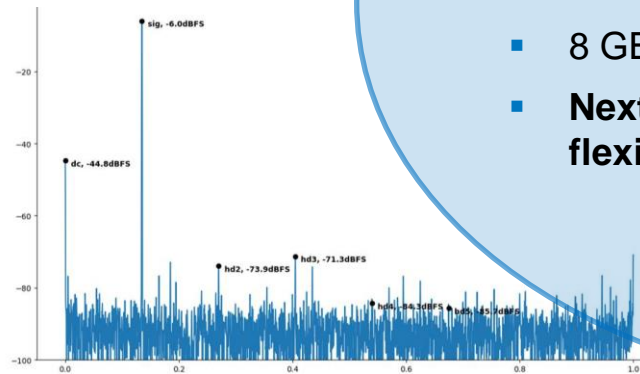


Product Portfolio in MTCA.4 – upcoming release

- High Performance
- High Processing Power
- High Speed
- High Signal Quality
- Flexibility

ADQ36

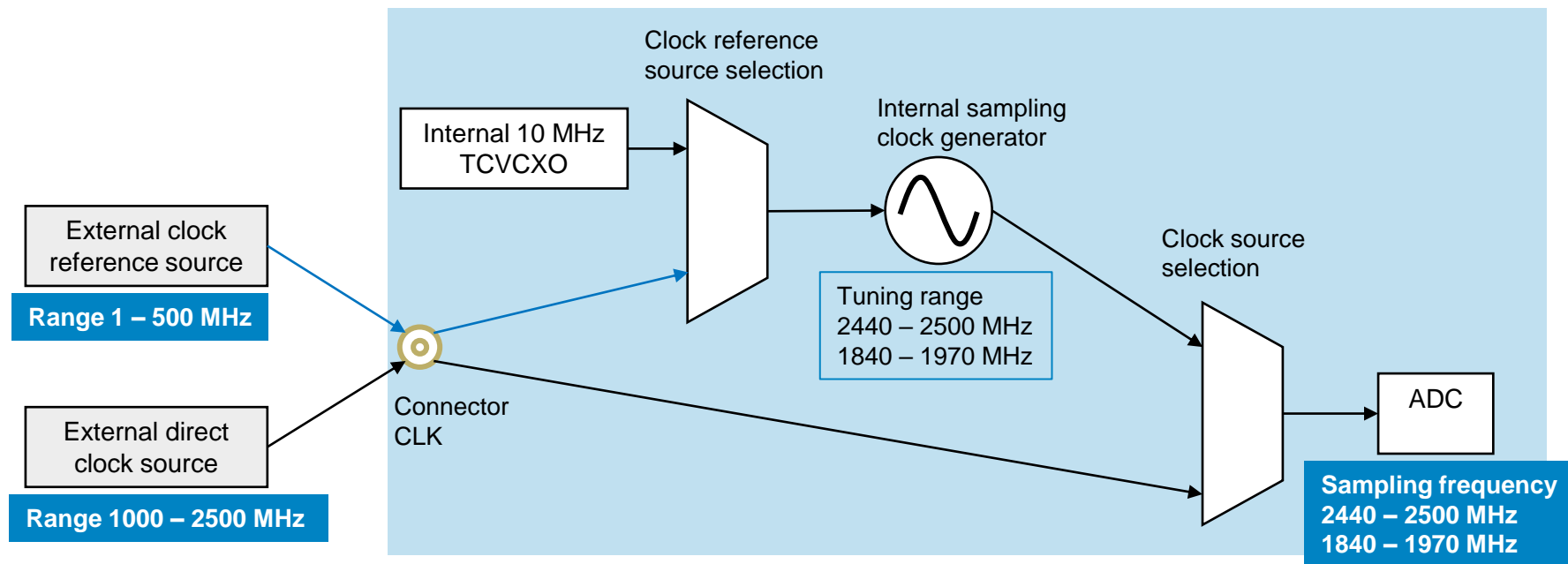
- 2 / 4 channels
- 5 / 2.5 GSPS
- Kintex Ultrascale XCKU115
- 8 GByte DRAM
- **Next high-performance flexible solution**



- $F = 135 \text{ MHz}$
- $\text{Ampl} = -6 \text{ dBFS}$
- $\text{ENOB} = 9.1$
- $\text{SNR} = 56.7 \text{ dB}$
- $\text{SINAD} = 56.5 \text{ dB}$
- $\text{SFDR} = 67.9 \text{ dB}$
- $\text{HD2} = -67.9 \text{ dBc}$
- $\text{HD3} = -65.3 \text{ dBc}$

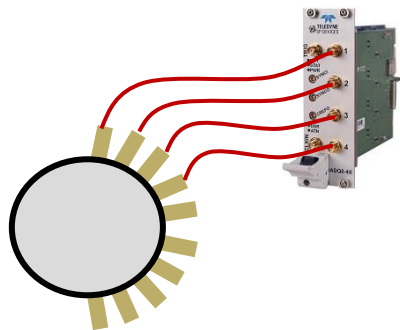
Developments – Flexible Clock Solution

- Multiple frequency control options
- Designed for synchronization with facility reference frequency

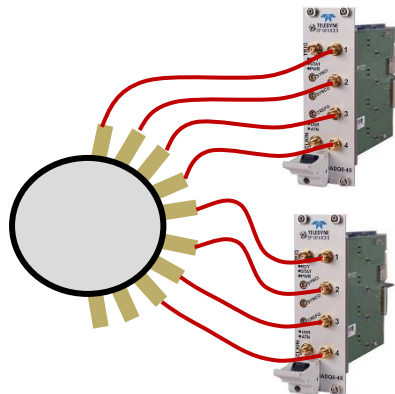


Developments – Sampling Rate Switching

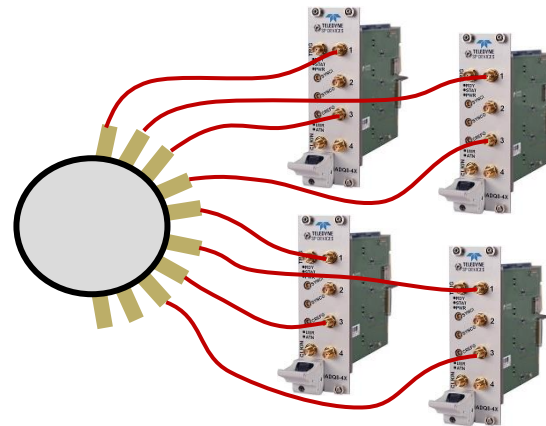
- The benefit of switchable sampling rate – **re-use of existing equipment**
- Adapted to phases of the project/experiment
 - proof of concept, prototype, final experiment)
- Available for ADQ7DC, ADQ8-4X and ADQ36



Initial tests
4 channels @ 2.5GSPS

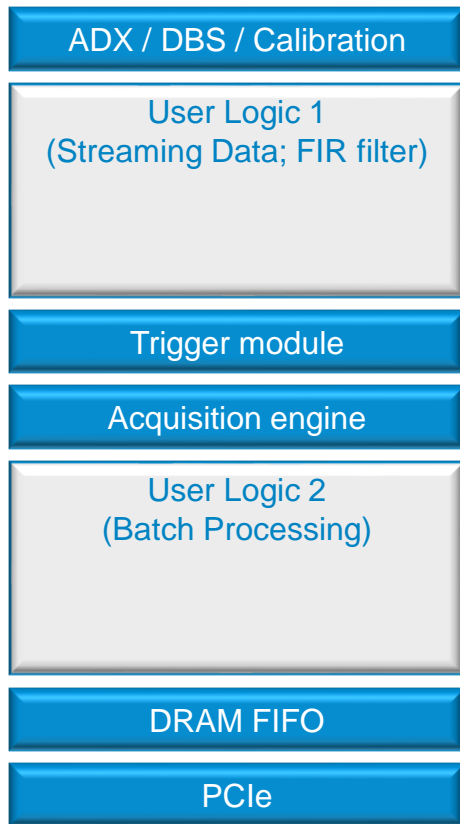


More channels
8 channels @ 2.5GSPS



Upgrade of performance
8 channels @ 5 GSPS

Developments – Open FPGA



Standard Functionality

FWDAQ

Firmware Packages

FWPD

FWATD

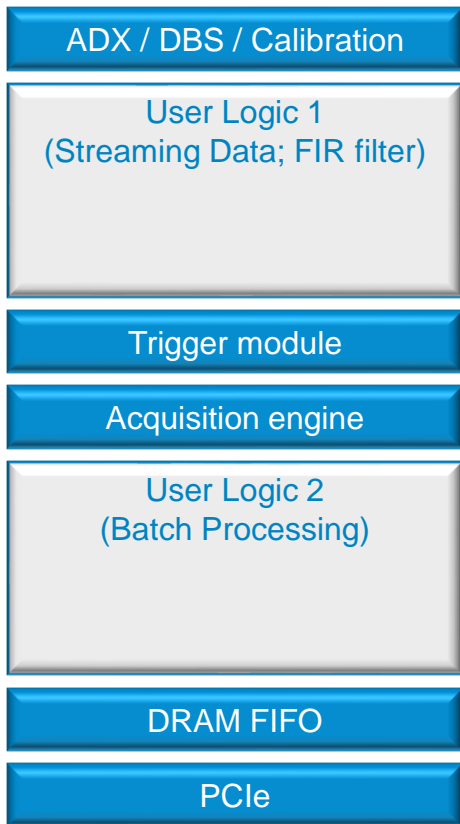
FWSDR

Design Services

Many projects
completed successfully



Developments – Open FPGA



Standard Functionality

FWDAQ

Firmware Packages

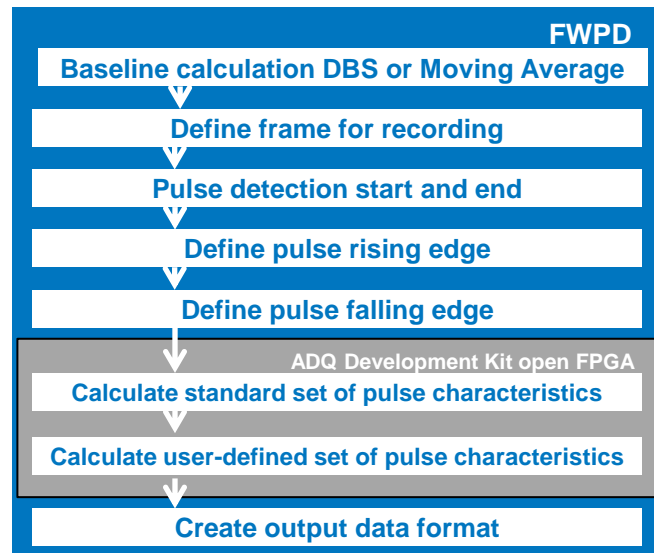
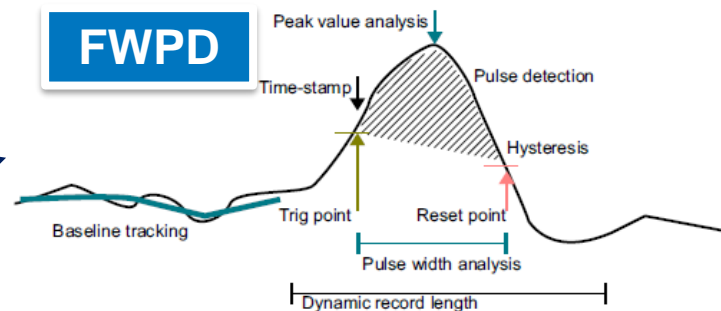
FWPD

FWATD

FWSDR

Design Services

Many projects
completed successfully



Developments – Support for industry standards

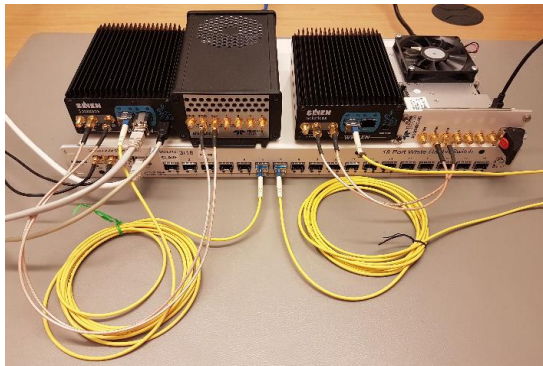
White Rabbit



- Ethernet-based time distribution network with picosecond precision

Supported features (on example of ADQ7)

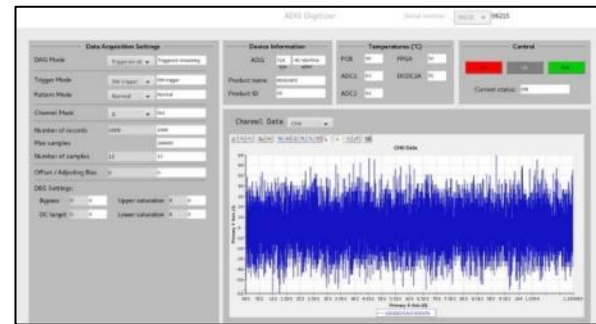
- Clock reference distribution
- Time stamp distribution
- Software Support for 3rd Party WR devices



EPICS

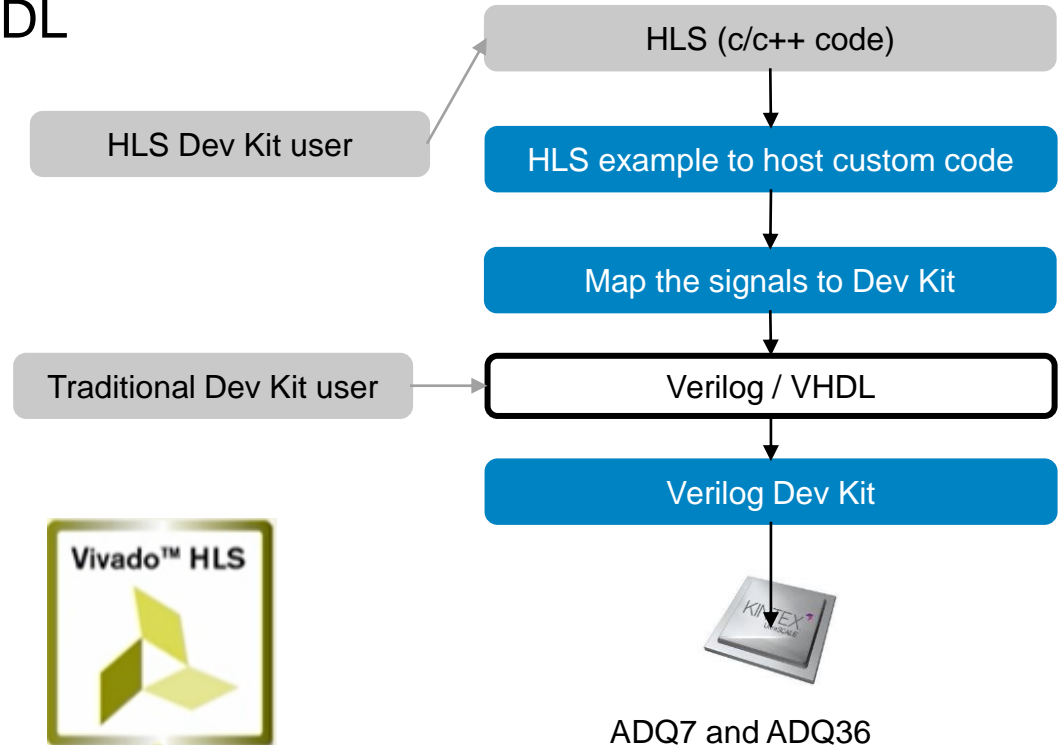
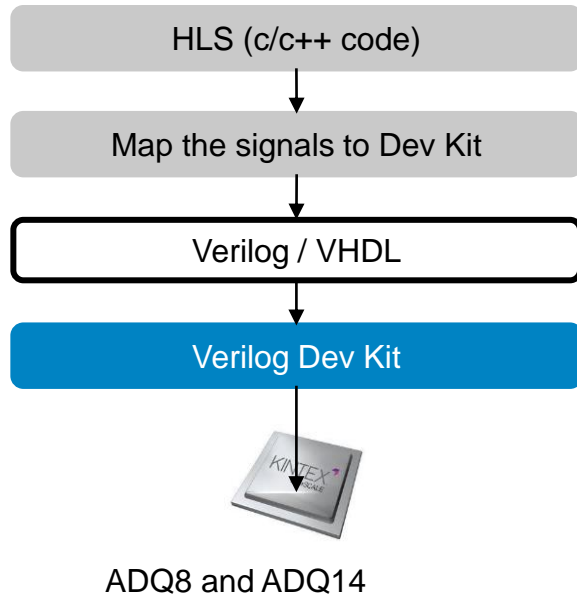


- Experimental Physics and Industrial Control System – standardized control interface
- Abstracts away device specific protocols
- Supports initially EPICS CODAC Installation
- In collaboration with Cosylab



Developments – Support for Vivado HLS

- Developing algorithm in high level programming language
- Synthesis to Verilog & VHDL



THANK YOU

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Digitizers for Big Physics and Research

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