Slide 1

Advantages of Analog Signal Processing over FPGA and DSP in Fuzing

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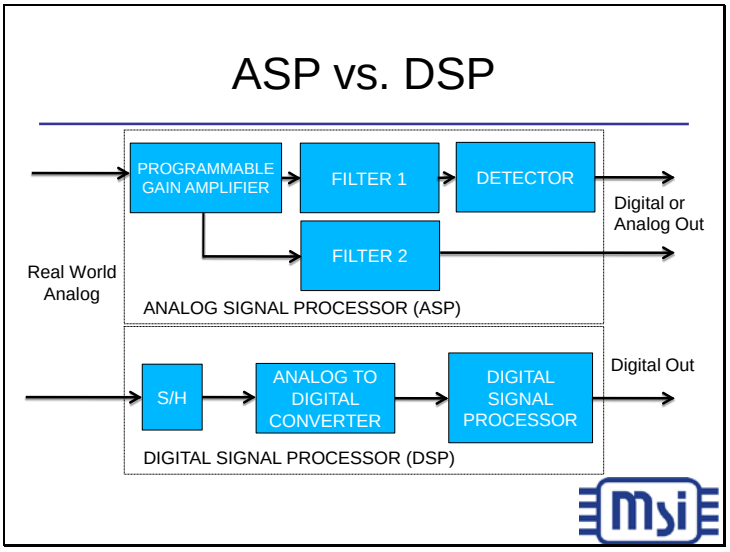
by Douglas Cox

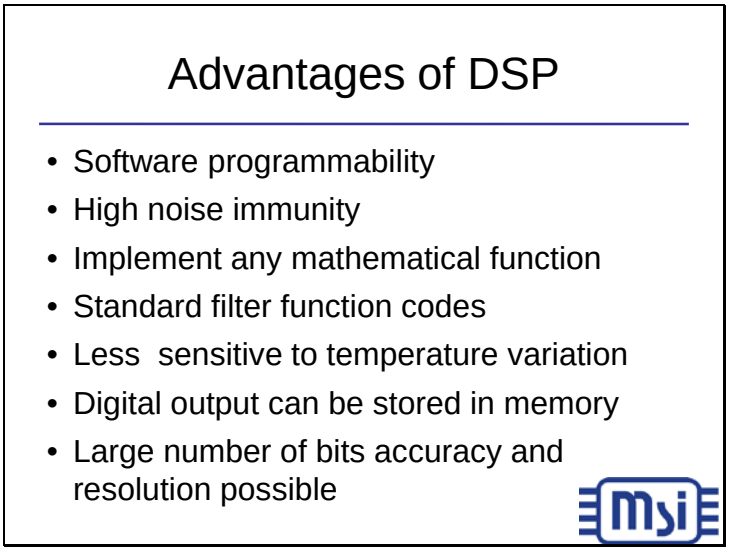
Mixed Signal Integration

Slide 2



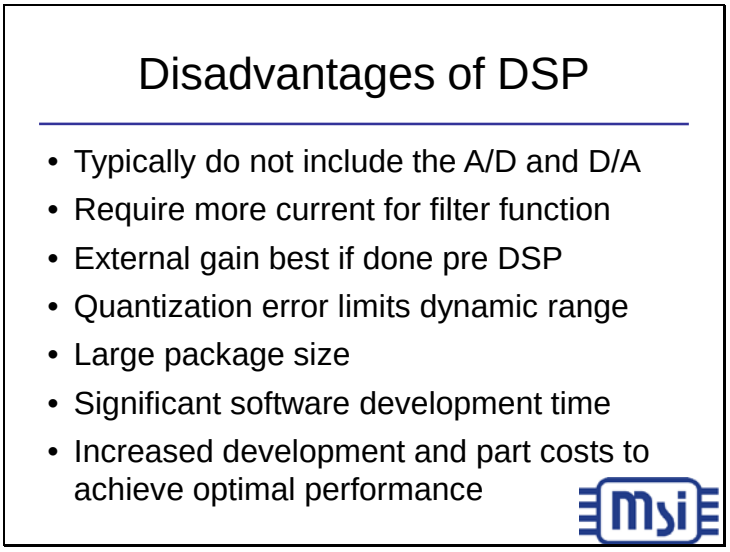
Over the last couple of decades there have been significant improvements in integrated signal processing capabilities. Much of that improvement has been in the area of Digital Signal Processing and there has been much emphasis on using those developments to enhance advanced signal processing applications. Less noticed have been the improvements in integrated Analog Signal Processing. This presentation will concentrate on those improvements and areas where there might be an advantage to using Analog Signal Processing. Here are simplified block diagrams of a Simple Analog Signal Processing Design and an equivalent Digital Signal Processing solution. Both solutions start in the analog world. In the DSP solution the analog input is converted to Digital and the processing is done via DSP.

Slide 3



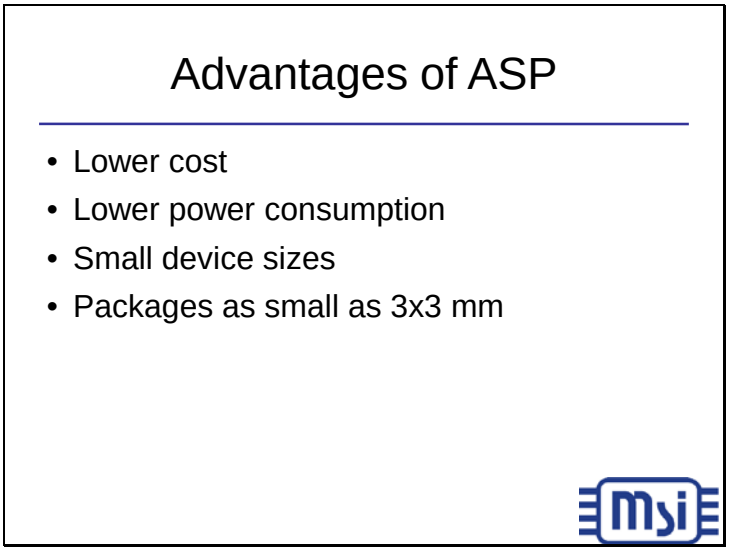
The primary advantage of a Digital Signal Processing solution is that the analog signal is digitized and all signal processing is done in the digital domain. This means all of the processing functions can be programmed in software making it very powerful and flexible. Newer FPGA's are powerful enough to do many signal processing applications, improving the programmability over traditional Digital Signal Processing solutions. For many analog functions, especially filters, the code to generate the function is straight from a text book. Other advantages of digital over analog are listed in the slide.

Slide 4



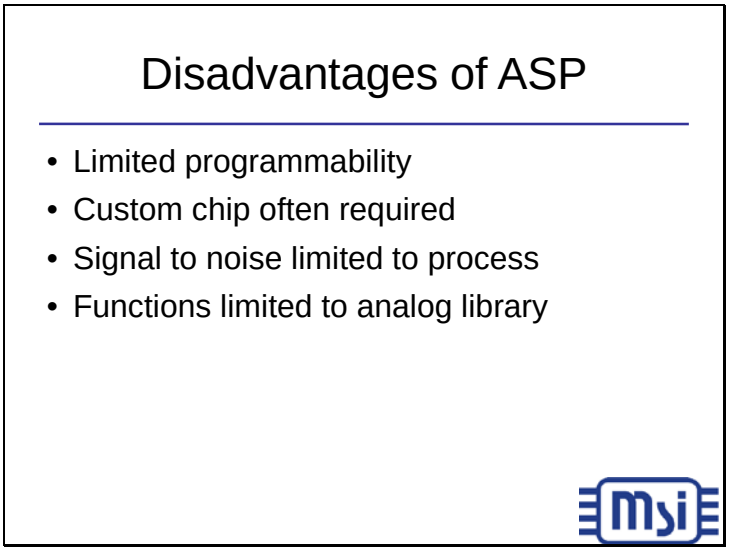
One of the biggest disadvantages of DSP is that significant analog is still required. Circuits like a preamp and A/D are usually required. One of the major advantages, high bit accuracy and resolution can becomes a disadvantage where large processing and memory circuits are required. Most applications require large high pin count FPGA's or dedicated DSP's, draw significant power and have a high per unit cost.

Slide 5



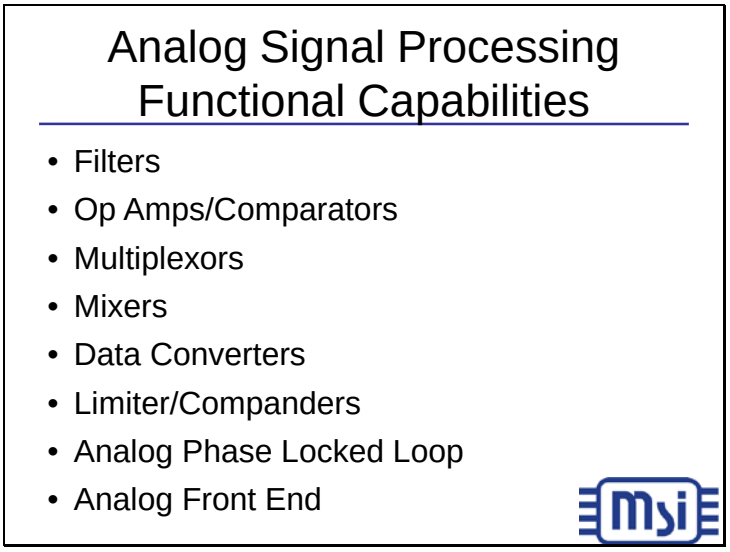
Analog Signal Processing is often the best or only solution when device size or power consumption are critical. High volumes applications often have a significant cost saving when Analog Signal Processing solutions are used.

Slide 6



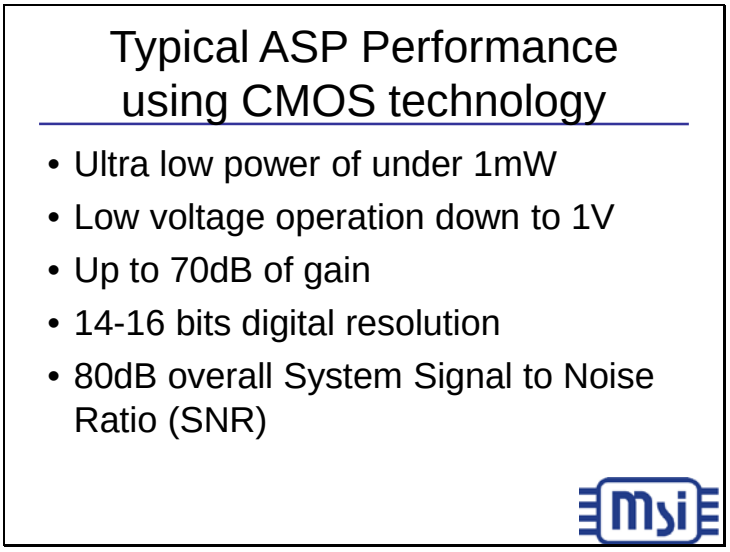
The biggest disadvantage of Analog Signal Processing compared to DSP is there is limited device programming. In order to achieve the desired cost savings and circuit size improvements a custom chip is often required. Though there are large circuit libraries available, not every function can be achieved.

Slide 7



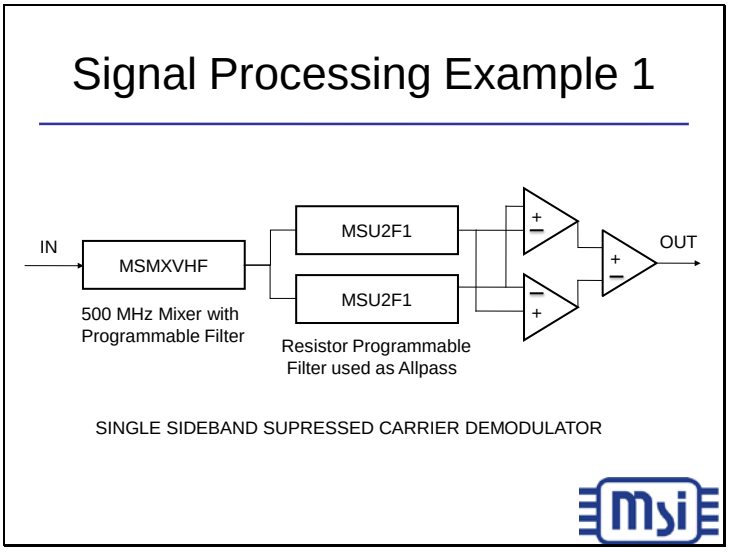
Available analog libraries have a wide range of circuit functions available. They can be optimized for the application requirements. Parameters like speed, power consumption and signal to noise can be optimized for specific applications. Using a custom analog CMOS integrated circuit, a high level of integration can be achieved for complicated and sophisticated applications.

Slide 8



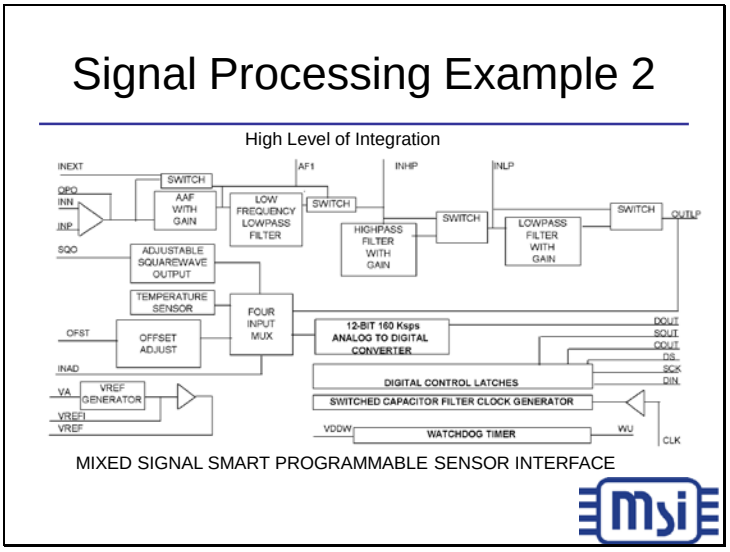
Most Fuzing applications can be achieved with the performance limits of Analog CMOS Integrated Circuits.

Slide 9



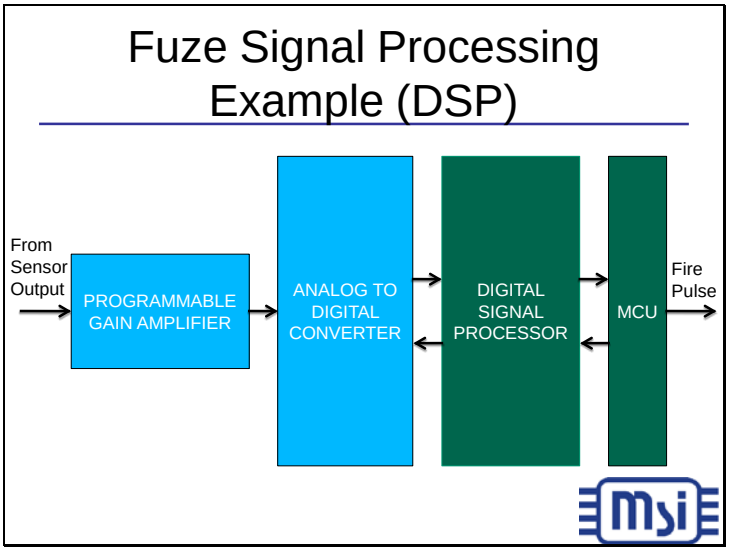
Using our standard products a single sideband demodulator can be created. These building blocks could be integrated into a single integrated circuit. The MSMXVHF contains a 500 MHz mixer with a programmable lowpass/bandpass filter. The MSU2F1 resistor programmable filter is used for an allpass filter function. The op amps provide the addition and subtraction of the I and Q signals.

Slide 10



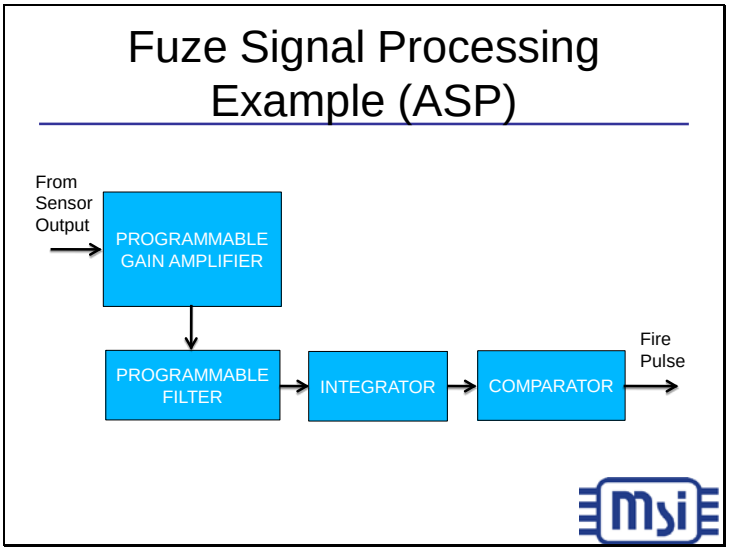
This is the block diagram for Mixed Signal Integration's standard product, the MSSPSI. This shows the large number of functions that can integrated onto a single chip and put into a 32 pin LQFP7x7 mm package.

Slide 11



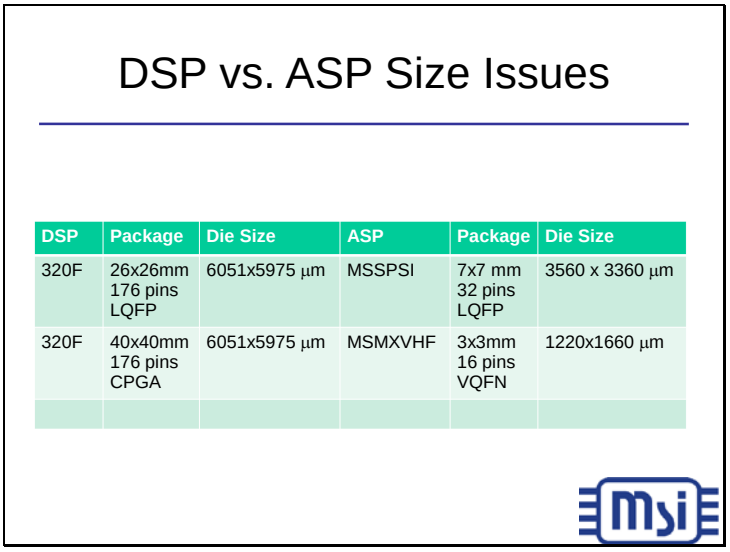
Here is a typical DSP example for a fuzing. A wide range of sensors could be used such as barometric, heat, capacitance, etc. to detect the signal that would trigger the Fuze. Note that significant analog circuitry is still required. The sensor output would be amplified and digitized, then processed by the DSP. The microcontroller would determine if the reading was correct for triggering the primer.

Slide 12



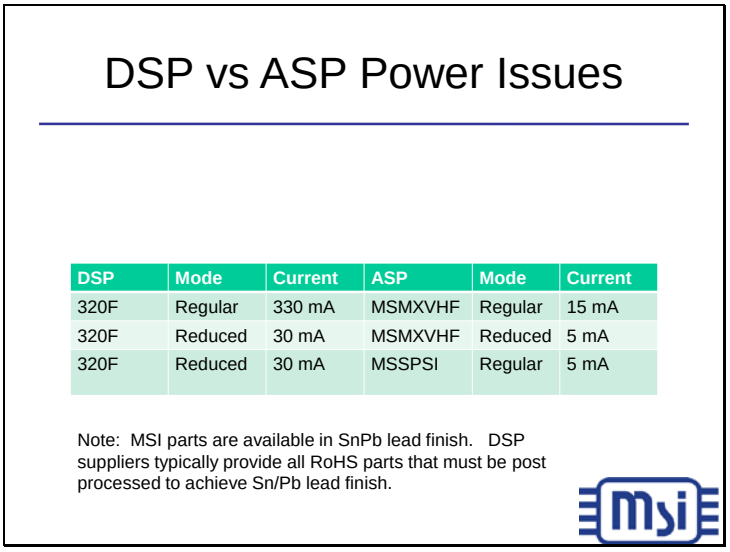
Here is the full analog signal processor example. There is no need for an Analog to Digital Converter. The programmable amplifier and filter remove undesired noise from the sensor and the desired signal is integrated and compared to provides a digital output to trigger the primer.

Slide 13



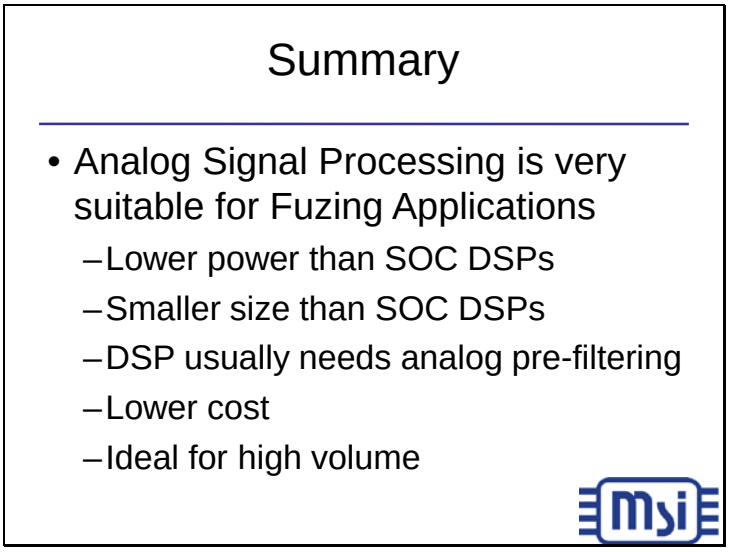
This is a table of the die size of a typical flash DSP, TMS 320F28335. This would be powerful enough for fuzing applications. The smallest offering package is a plastic LQFP. The analog solution can be up to 8 times smaller.

Slide 14



This is a comparison of the 320F28335 current consumption vs. the MSI standard product, the MSMXVHF Mixer Very high frequency filter and the MSSPSI Smart Programmable Sensor Interface. The power consumption for the analog solution can be much less than the DSP solution.

Slide 15



In conclusion Analog Signal Processing is ideal for many fuzing applications, due to smaller size and lower current than the DSP solutions. A high level of integration can be achieved.

Slide 16

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