# DSU1: a single sensor that makes sense

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On land, the conventional way of sensing reflected waves is by planting thousands of geophones at the surface of the ground to isolate the usable signal from the strong background noise. These geophones deliver a voltage proportional to the ground velocity. More often than not, they are connected into receiver groups laid out as arrays to attenuate the source noise by summation of the individual voltages. However, from an operational point of view, these arrays are heavy and they require significant manpower. From a geophysical point of view, signal and noise may not be well sampled by these arrays. In addition, high frequencies are attenuated due to differential time shifts inside the groups of geophones. Obviously a step change was needed to improve operational efficiency as well as seismic imaging.
With the capability of recording systems to handle an increasing number of channels, the industry is now able to record single sensors with smaller receiver intervals. Most of these single sensors are digital accelerometers including the sensor and the digitizer in the same housing.

**The Digital Sensor Unit (DSU1): a MEMS based accelerometer**
The main advantage of accelerometers based on Micro-Electro-Mechanical-Systems (MEMS acting as a capacitor) is that their low tolerance specifications are stable with temperature and aging. Their amplitude and phase responses are flat over a wide frequency range (from 0 to 800 Hz). Thus, low as well as high frequencies are recorded without any attenuation or phase variation. Being able to sense Direct Current at 0Hz, a MEMS-based accelerometer can detect the gravity vector used as a reference for sensor calibration and automated tilt corrections. Like geophones, MEMS-based accelerometers are available in 1C (DSU1) or 3C versions (DSU3) as well as with different housings for use in various environments (e.g. transition zone or seabed).

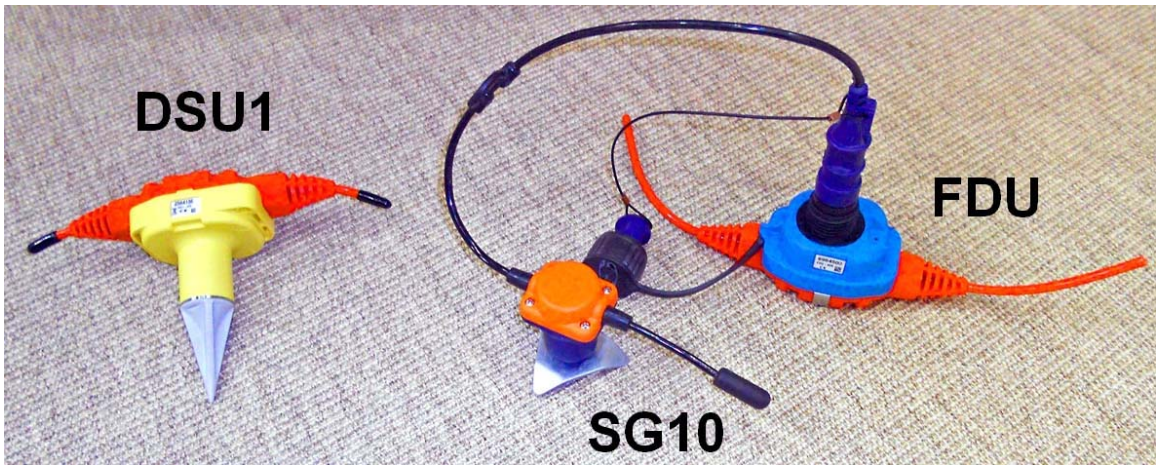


**Figure 1:** Comparison of the Digital Sensor Unit (DSU) with the equivalent vertical geophone (SG10) connected to a digitizer (FDU). DSU1 is more compact and half the weigth of the geophone based solution.

**Comparison with the geophone**
The most basic single sensor is a geophone (SG10) connected to digitizers (FDU, Figure 1). By grouping the sensor and the A/D converter together in a single package (e.g. DSU1) we dispense with the cable and connectors. This improves weight (0.375 kg, about half that of a digitizer connected to an external geophone), compactness and reliability (less leakage). For a high-channel count crew, this can make a significant difference to operational efficiency.
While the DSU1 specifications are fixed, the geophone specifications (resonant frequency, coil resistance, sensitivity and damping) still vary within a range depending on temperature and aging. Even if the resulting impact is not obvious on raw records, it may have a detrimental effect on amplitude preservation. At the same time all perturbations (pick-up noise, cross-talk) related to the analog transmission are minimized.

**Conclusion**
From a geophysical point of view, acquisition with DSU1 offers the capability to get broadband data. Low frequencies are preserved by the flat amplitude response of the MEMS based accelerometer, and high frequencies are not attenuated by any array effect. From an operational point of view, the lightweight DSU1 answers productivity requirements to be as efficient on the receiver side as we can be on the source side.
Today, digital accelerometers are setting the standard for single-sensor acquisition. Compatible with the cable and the cableless Sercel 428XL system, different versions of DSU have been developed, 1C or 3C, to optimally meet all survey conditions from areas that are difficult to access to land, transition zone and seabed.