

## Recording system enablers of large-scale onshore seismic with nodes

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### ABSTRACT

Seismic production on typical vibroseis crews is limited by receiver roll-rates, especially as high-productivity single-source and simultaneous sweeping techniques are increasingly employed. While the operational benefits of nodal acquisition have led to rapid adoption in most markets, nodes are not yet routinely used for large-scale surveys in desert environments, typically requiring 50,000 or more channels. To understand what factors may be limiting the uptake of nodes for large-scale seismic surveys, we examine how different nodal system architectures affect receiver throughput and crew resourcing requirements. We use a realistic scenario of a crew rolling 10,000 nodes per day to assess the feasibility of various nodal system designs for land seismic production at scale.

### INTRODUCTION

At a high level, all nodal systems follow a similar operational procedure. Nodes are prepared in camp and laid out in the field to listen during source acquisition. Once acquisition is complete, nodes are retrieved and returned to camp so that the recorded seismic data and metadata can be offloaded, quality checked and transcribed for delivery to processing. The cycle then restarts, with nodes prepared again for deployment as the spread rolls across the survey area. Nodal system operation can thus be separated into camp procedures, such as battery charging and data download, and field procedures, such as node planting, activation and retrieval. The efficiency of each can be analysed separately to assess overall constraints on system throughput and opportunities for improvement.

### FIELD OPERATIONAL EFFICIENCY

The main factors controlling field operational efficiency of nodal systems are the weight of equipment to be transported to the field, and the time taken to deploy and retrieve each receiver station per member of line crew. Small and lightweight nodes are preferred as they are easier to transport and faster to plant. All other things being equal, the choice of sensor technology determines the weight of a node. MEMS sensors are extremely small and light but have higher power requirements, paradoxically making MEMS nodes similar in size and weight to nodes containing larger and heavier, but less power-hungry, geophone sensors (Figure 1). Innovative sensor designs, such as using the battery cell both to

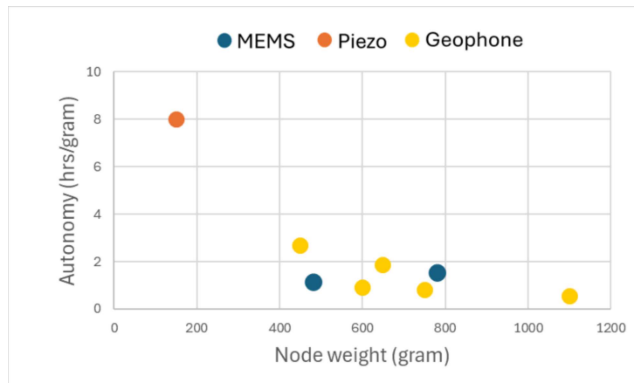


Figure 1: Comparison of node weight and autonomy for various sensor types. Trade-offs between sensor weight and power consumption control the overall weight of MEMS and geophone nodes.

power the node and act as a large reaction mass for a piezoelectric ceramic, are required to minimize overall node size and weight.

### CAMP EFFICIENCY

Node battery charging is the rate-limiting step when preparing nodes in camp. Today's nodal systems can be separated into three types based on their approach to battery charging: i) batch handling of units of 90 nodes using a motorized lifting aid (Figure 2) with combined charging and data download hardware; ii) individual handling of nodes with combined charging and data download hardware; iii) individual handling of nodes with separate charging and download hardware. Battery charging time is similar for most nodal systems, so charging rack capacity and loading/unloading efficiency controls overall camp operational efficiency. Table 1 summarises charging and download hardware and manual handling requirements when rolling 10,000 nodes per day using the three types of nodal recording system described above, and shows that high capacity charging/download racks that can be loaded in bulk are fundamental for enabling large-scale nodal seismic acquisition with nodes.



Figure 2: Nodal system camp operations using a motorized lifter to batch-handle 90 nodes into a high capacity charging/download rack.

### CONCLUSIONS

A holistic approach to nodal recording system design, optimizing both camp and field operations, is required for nodal seismic to be cost effective and logistically feasible at channel counts (50,000+) and roll rates (10,000+ per day) demanded by modern, high-density, single-sensor, survey designs. Receiver system architectures that require manual handling of individual nodes in camp inherently require recording department headcount to increase in proportion to channel count and roll-rate, making them impractical and uneconomic for large-scale seismic operations. In contrast, system designs that enable batch handling of nodes in camp can scale in a cost-effective way.

| Handling Method    | Charging & Download | Rack Capacity & Throughput        | Racks                          | Handling Operations |
|--------------------|---------------------|-----------------------------------|--------------------------------|---------------------|
| Batch, motorized   | Combined            | 540 nodes<br>3,240 nodes/day      | 4 racks<br>3 linear m          | 223                 |
| Individual, manual | Combined            | 36–108 nodes<br>144–432 nodes/day | 35–70 racks<br>14–42 linear m  | 20,000              |
| Individual, manual | Separate            | 32–48 nodes<br>220–355 nodes/day  | 56–90 racks<br>70–120 linear m | 40,000              |

Table 1: Charging/download rack and manual handling requirements for three types of nodal recording system rolling 10,000 nodes per day.