Technologies Impacting US Unconventional

Stephen R Ingram

Halliburton

The Frac Site

Time Based

Time & Outcome Based

Outcome Based

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Fracture
Stage
Spacing

Lateral
Well
Placement

Lateral
Well
Spacing

Basin	Plays	Avg Lat.	Avg Stgs	Sand	HHP	Pad Drilling
Midland	Lower Sprayberry, Wolfcamp A, B, C & D, Cline	10,100 ↑	54 ↑	19M ↑	30k ↑	45% ↑
Delaware	Avalon, Bone Spring 1, 2 & 4, Wolfcamp	8,500 ↑	44 ↑	20.4M ↑	38k ↑	60% ↑
Eagle Ford	Eagle Ford, Austin Chalk, Eagle Bine	7,500 ↑	25-40 ↑	8-11M ↑	40k	93%
DJ	Niobrara, Codell	7,500 ↑	40 ↑	12M ↑	28k	99%
Williston	Bakken, Three Forks	10,000 ↑	35-50 ↑	10M ↑	28k ↑	95%
Marcellus	Lower & Upper Marcellus, Geneseo / Burkett	7,250 ↑	45 ↑	20.5M ↑	28k	94%
Utica (OH)	Point Pleasant	10,000 ↑	50 ↑	23M ↑	32k ↑	90%
Anadarko	SCOOP/STACK, Cana, Woodford, Osage, Merge, Mississippi Lime, Barnett, Granite Wash	7,800 ↑	26 ↑	10M ↑	34k ↑	25% ↑

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1) Frac Site Advances
Time Based Efficiencies

6

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The Frac Site

Time Based

Time & Outcome Based

Outcome Based
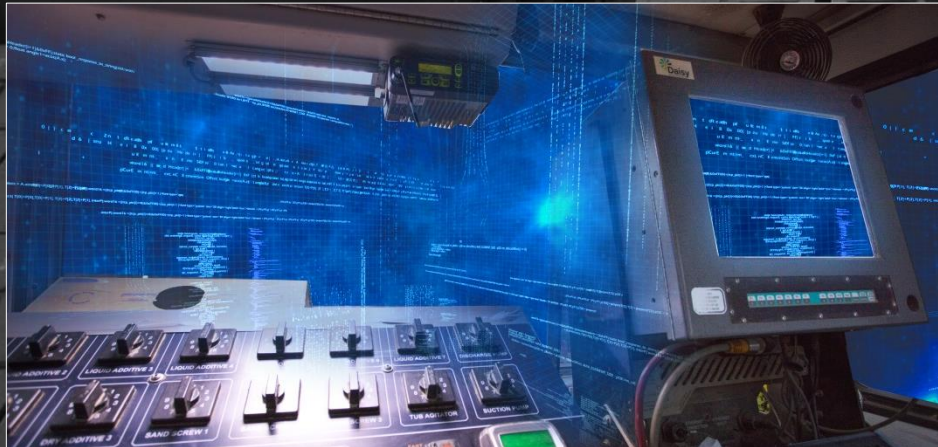
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2) Frac Site Advances
Time & Outcome Based

Algorithm-based decision making ⟶ **Process consistency**

- Dynamically control flow rate
- Use real-time measurements
- Adjust to stage design and formation variability

- Manufactured Delivery
- Design replication stage-by-stage
- Reduce risk of screen-out
- Backbone for faster learnings

The Frac Site
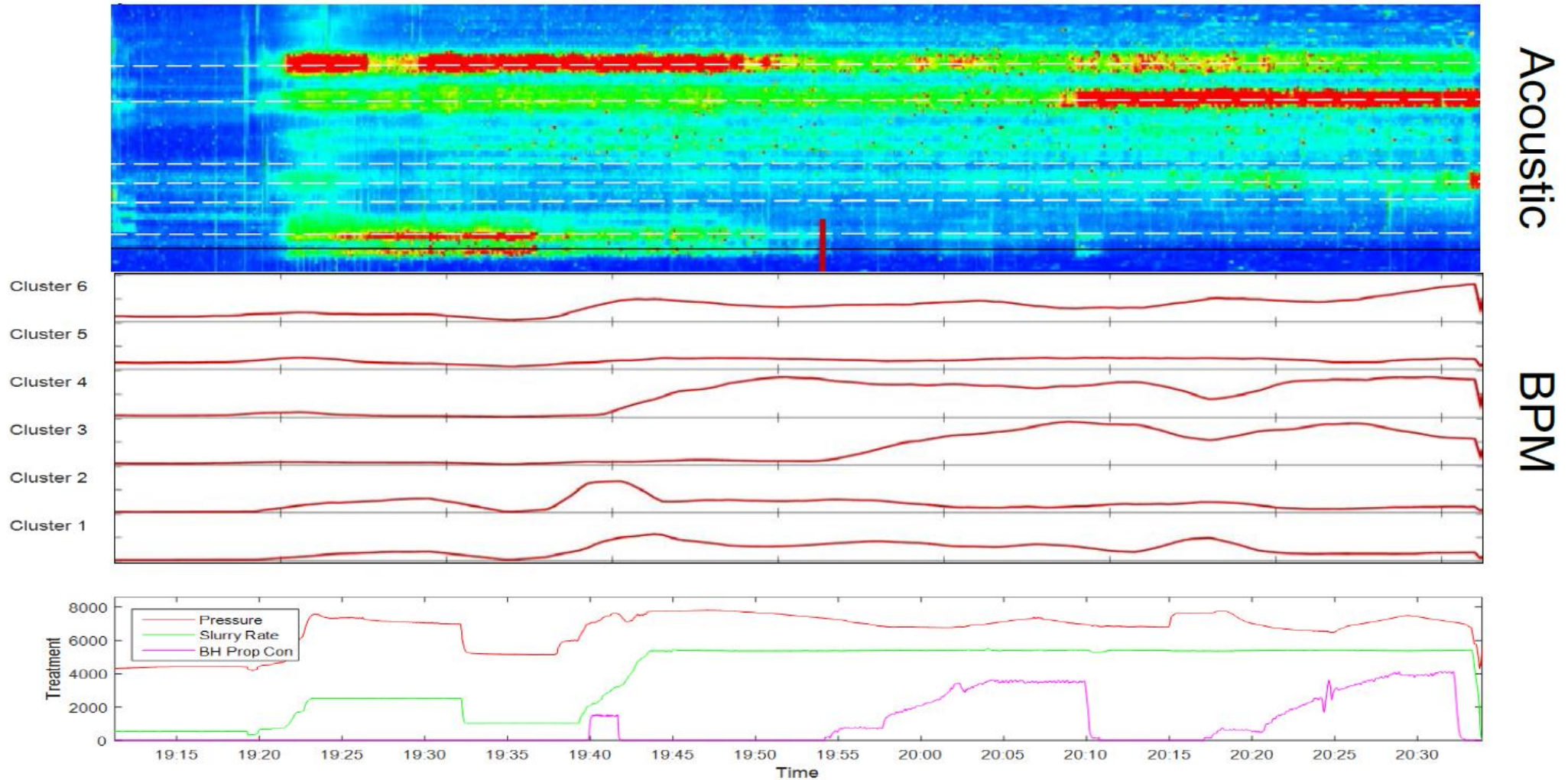
Time Based

Time & Outcome Based

Outcome Based

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3) Frac Site Advances
Outcome Based (Fiber Optic Technology)

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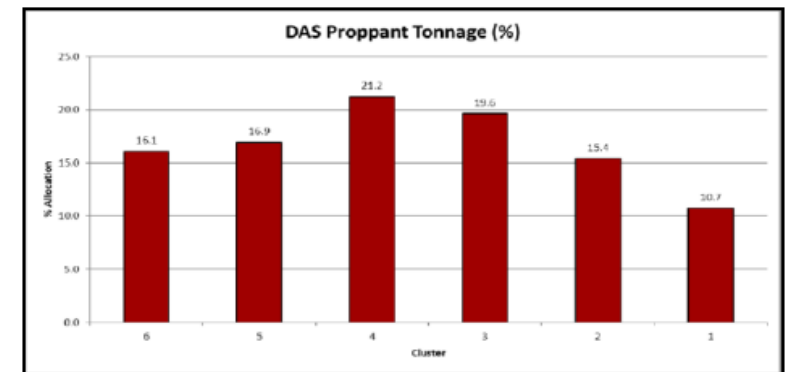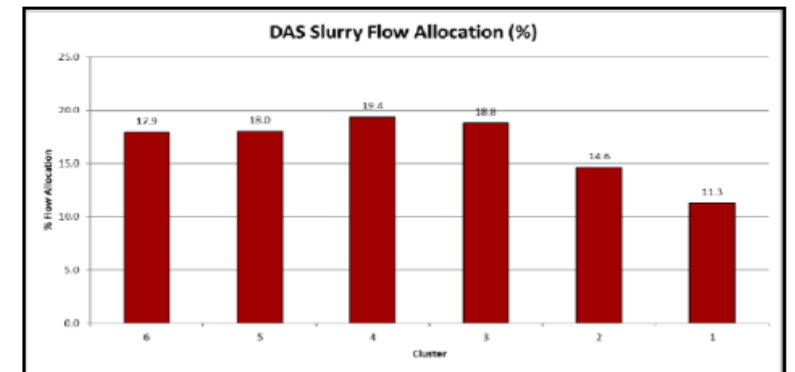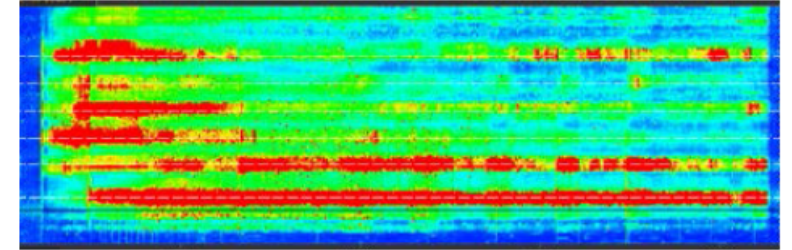
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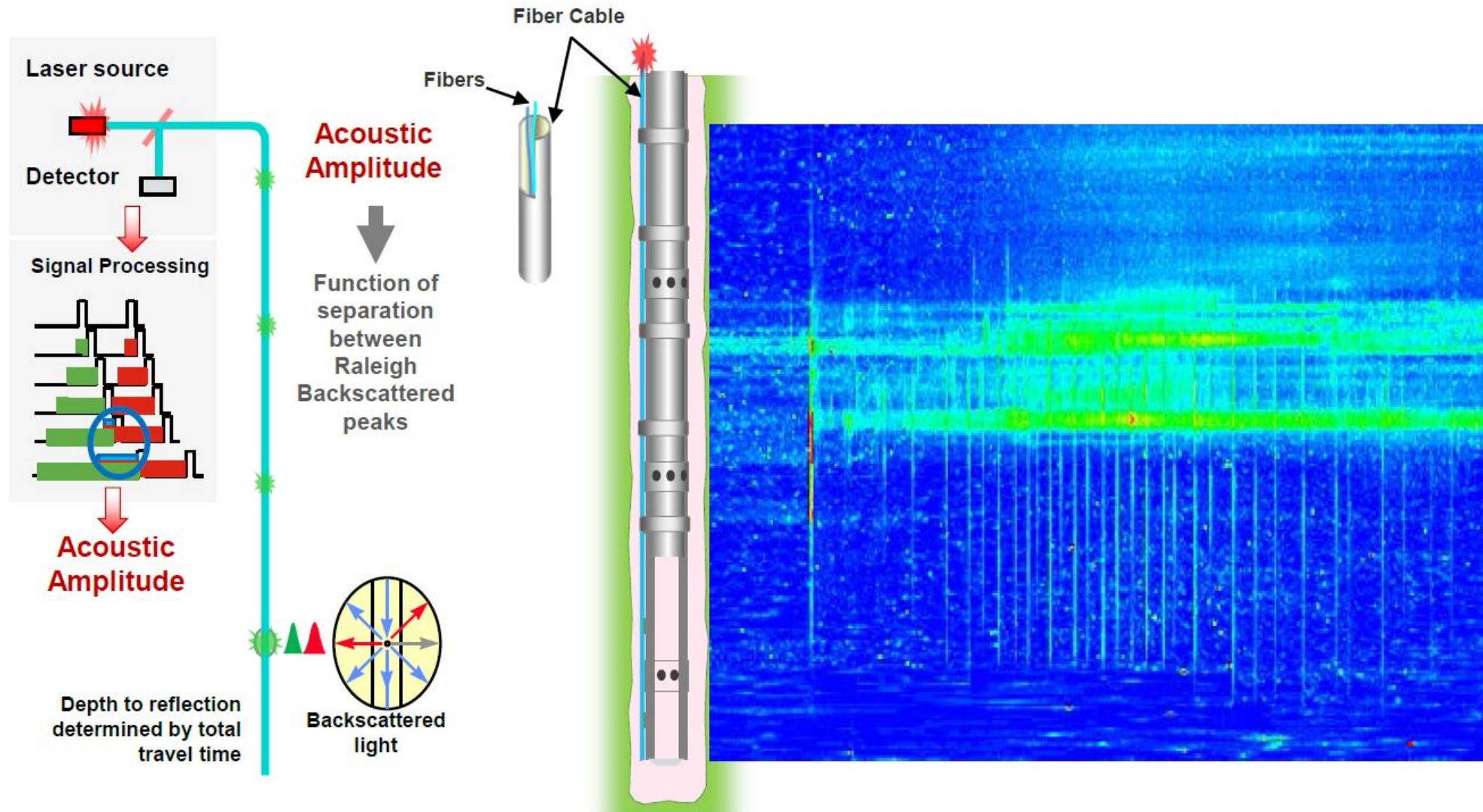
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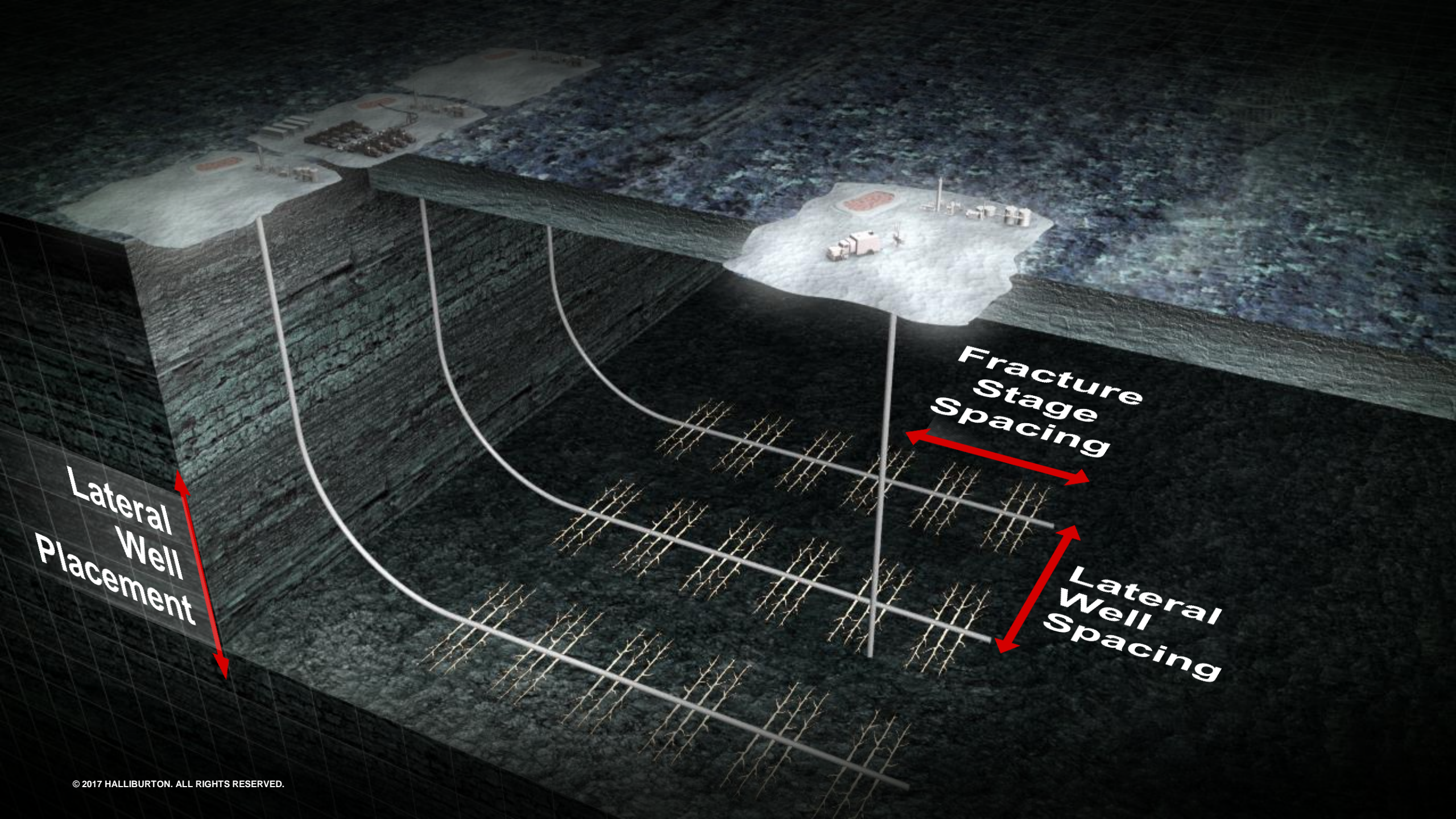
- Data Provided Real-time

- Key Design Parameters Adjusted

  - Stage length

  - Number of clusters per stage

  - Rates

  - Volumes

  - Proppant Staging

  - Cluster Spacing

  - Diversion

Initial Stages

Later Stages

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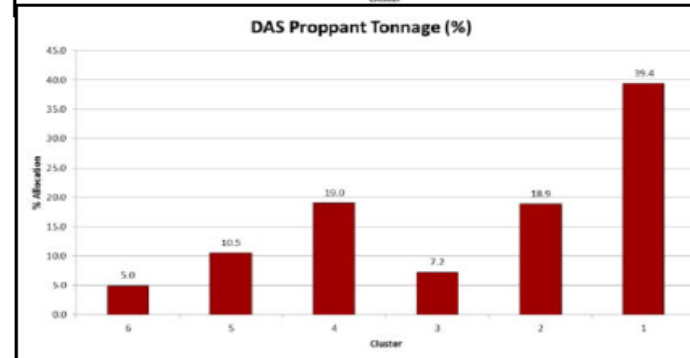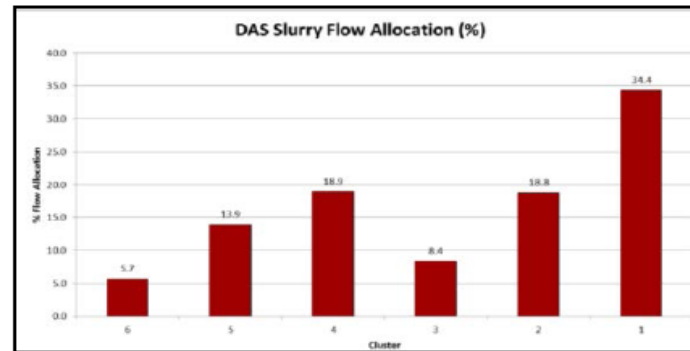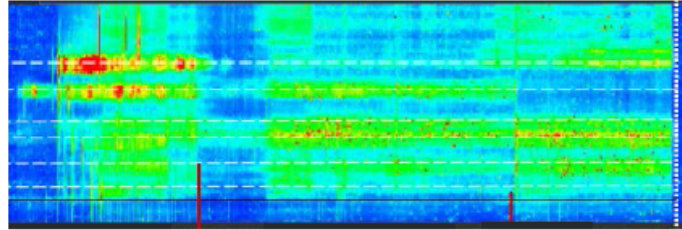
Lateral Well Placement

Fracture Stage Spacing

Lateral Well Spacing

Thank you