

The background image shows an industrial oil field. In the foreground, there are numerous red pipes and machinery, likely part of a hydraulic fracturing (fracking) operation. The pipes are arranged in rows, extending into the distance. In the background, there are drilling rigs and other industrial structures under a cloudy sky. A red semi-transparent box is overlaid on the right side of the image, containing white text.

Technologies Impacting US Unconventional

Stephen R Ingram

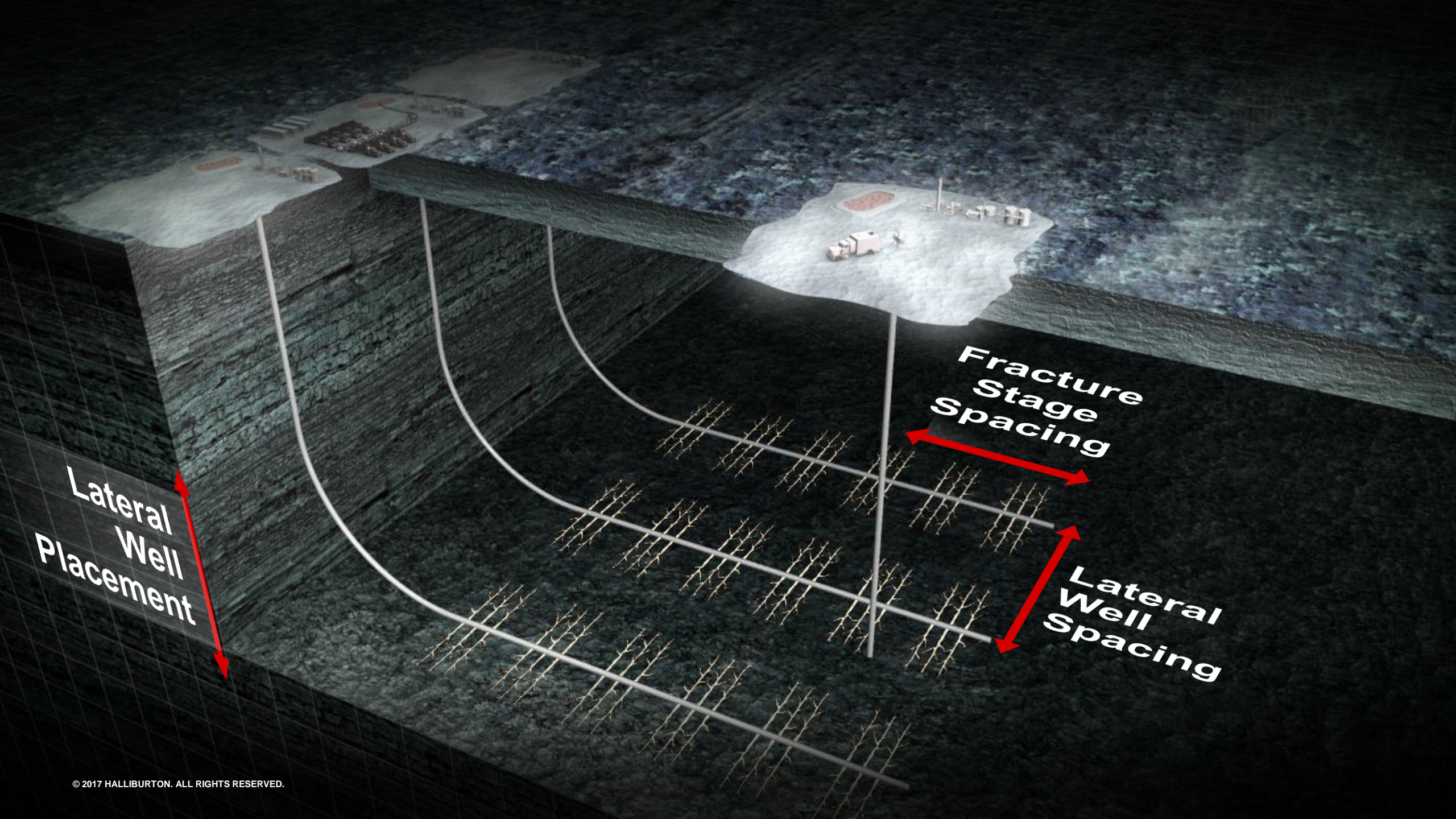
Halliburton

The Frac Site

Time Based

Time & Outcome Based

Outcome Based



Lateral Well Placement

Fracture Stage Spacing

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% ↑

The Frac Site

Time Based

Time & Outcome Based

Outcome Based

1) Frac Site Advances

Time Based Efficiencies



The Frac Site

Time Based

Time & Outcome Based

Outcome Based

2) Frac Site Advances

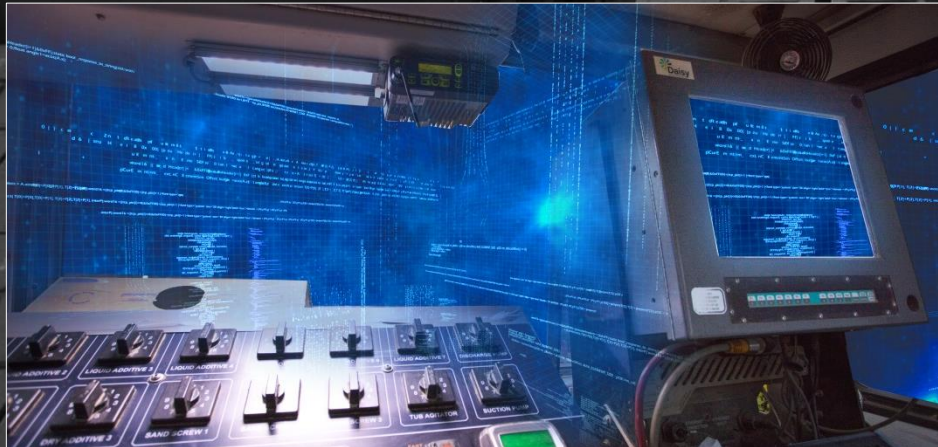
Time & Outcome Based



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

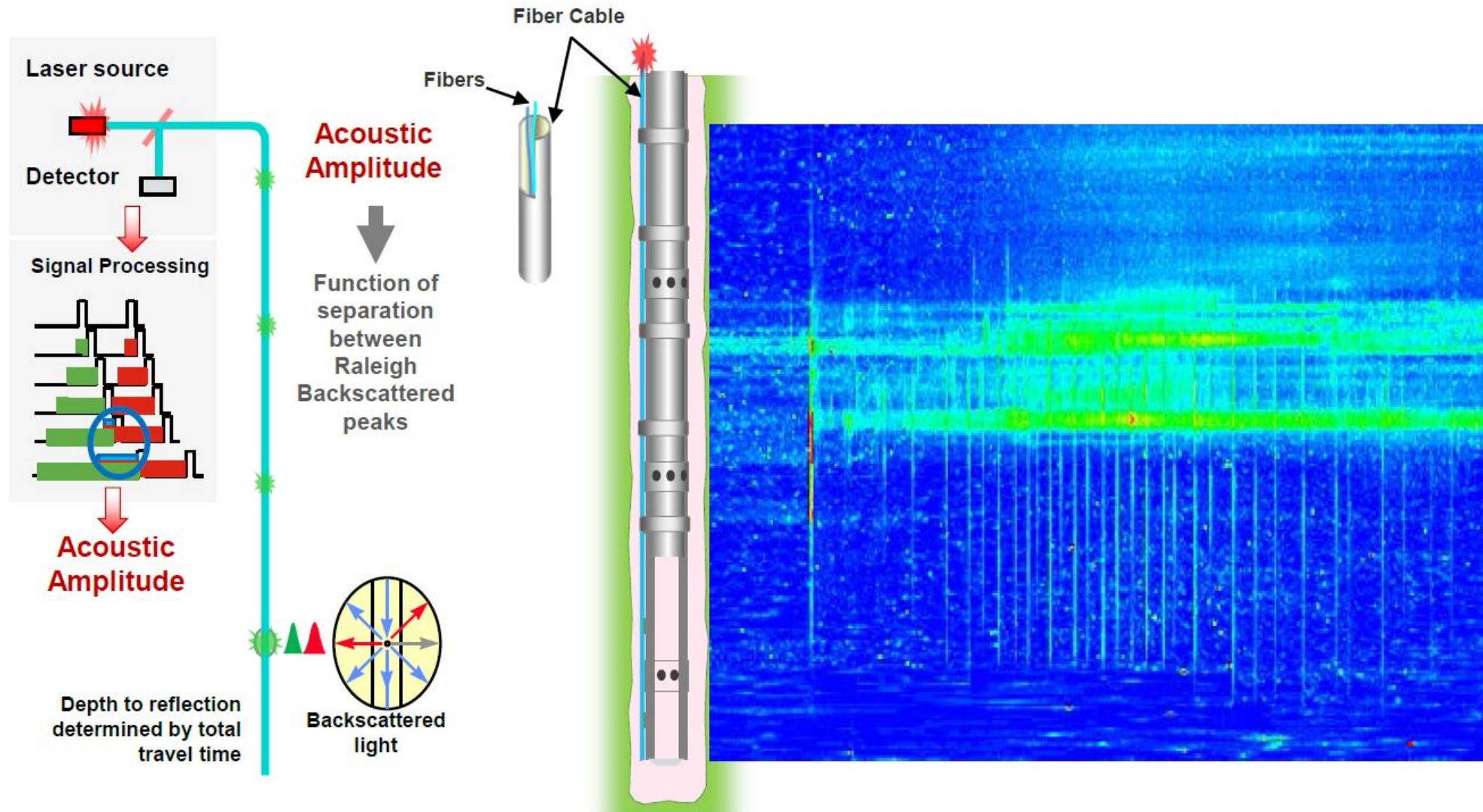
Time Based

Time & Outcome Based

Outcome Based

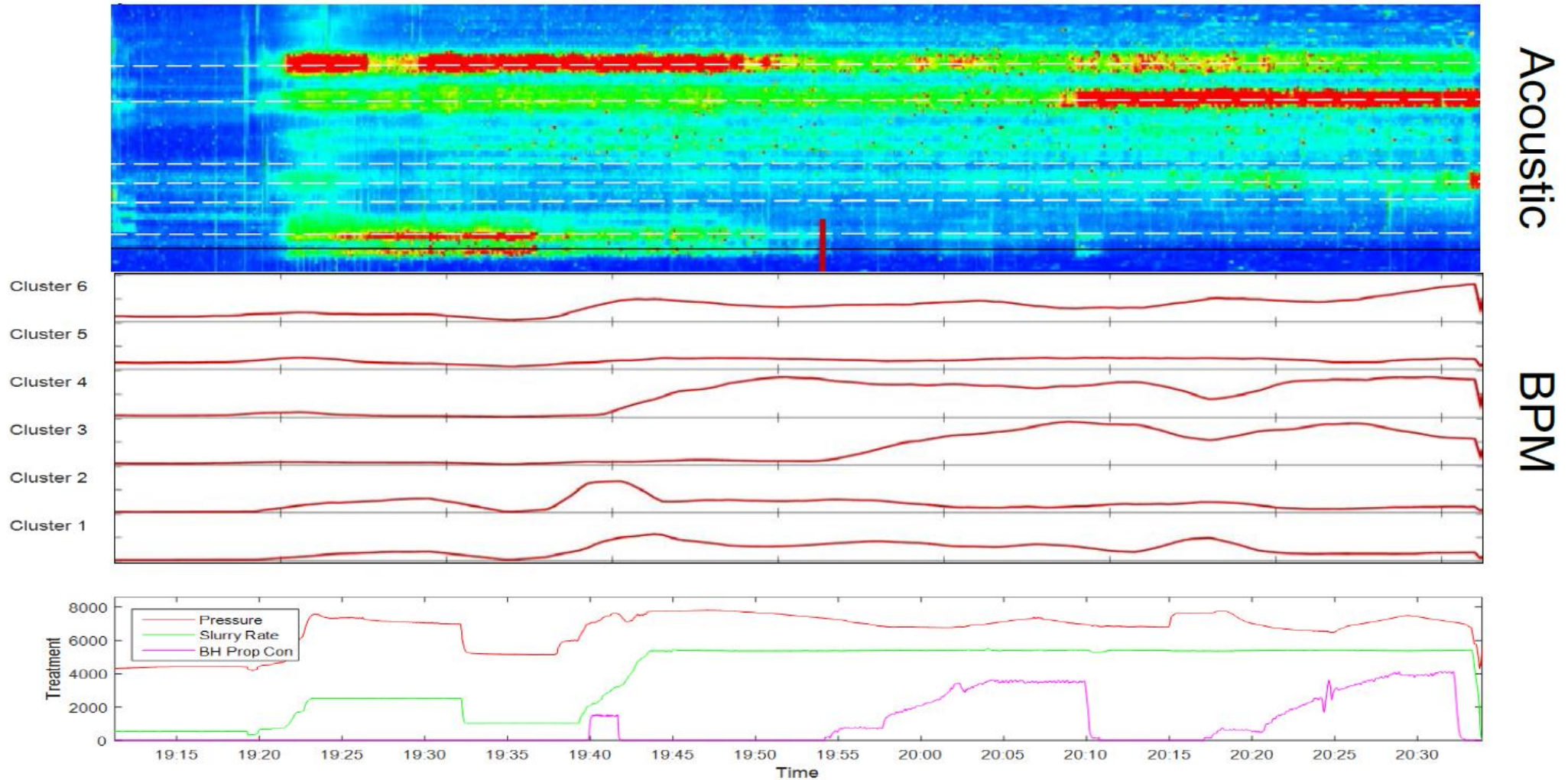
3) Frac Site Advances

Outcome Based (Fiber Optic Technology)



3) Frac Site Advances

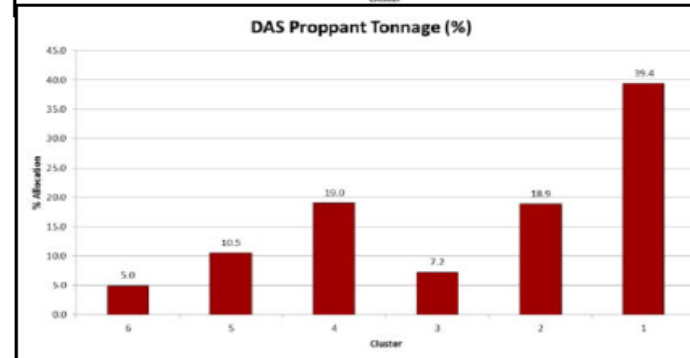
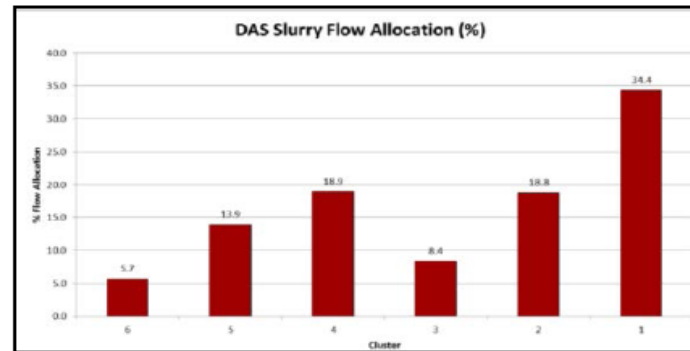
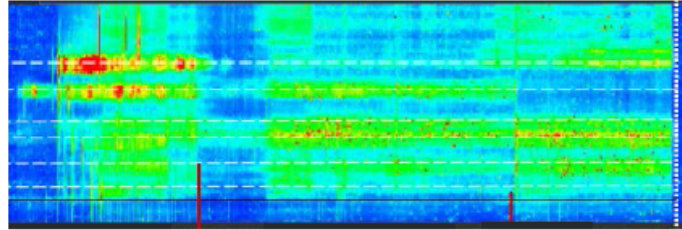
Outcome Based (Fiber Optic Technology)



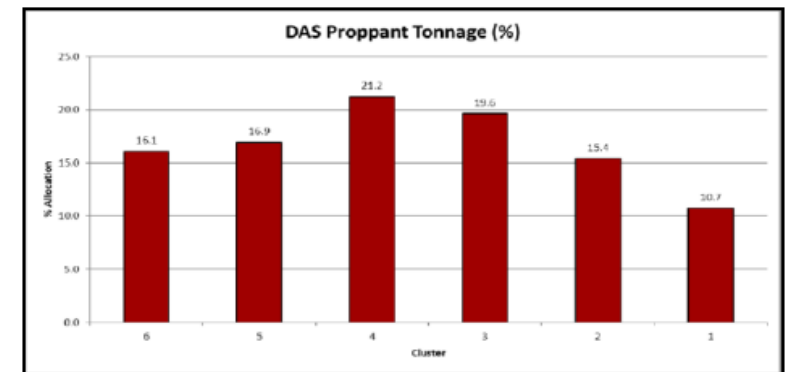
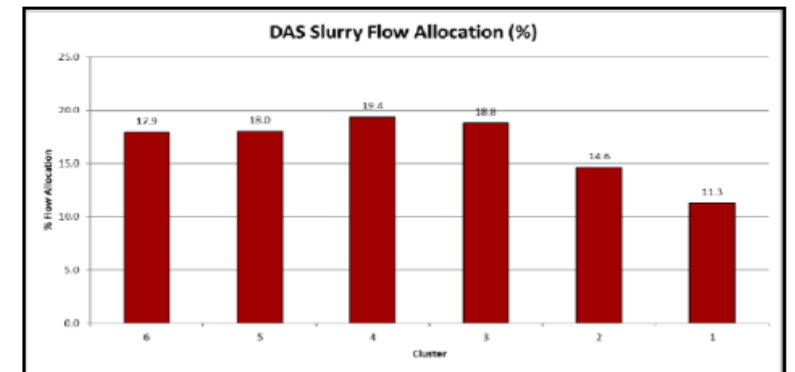
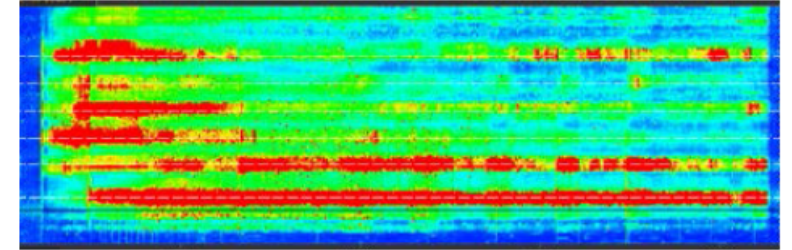
3) Frac Site Advances Outcome Based (Fiber Optic Technology)

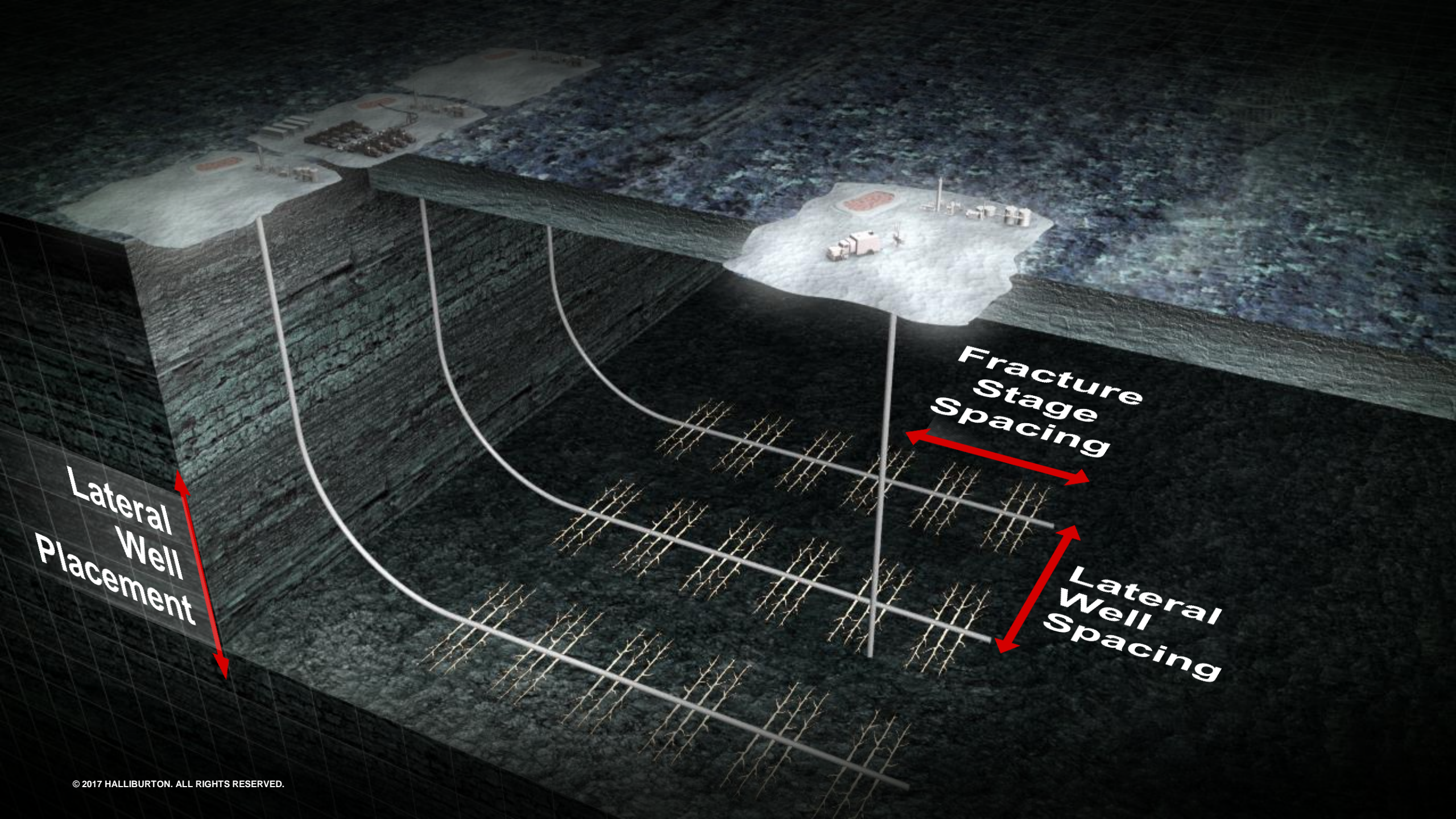
- Data Provided Real-time
- Key Design Parameters Adjusted
 - Stage length
 - Number of clusters per stage
 - Rates
 - Volumes
 - Proppant Staging
 - Cluster Spacing
 - Diversion

Initial Stages



Later Stages





Lateral Well Placement

Fracture Stage Spacing

Lateral Well Spacing



Thank you