# Carina® XwellXpress enables hydraulic fracture operation optimization on the fly by delivering real-time distributed acoustic sensing data obtained on wireline

Client: Apache, USA

## Challenge

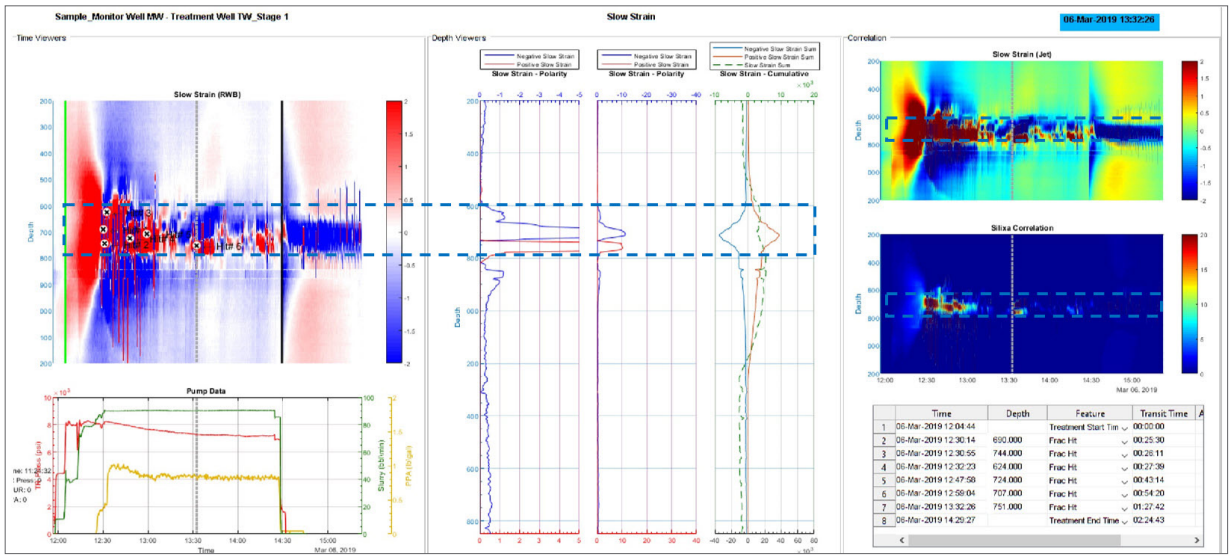
Enable operators to better understand near-field and far-field completions effectiveness during hydraulic fracturing operations to maximize productivity and optimize perforation and treatment designs.

## Solution

Deploy Silixa's retrievable fiber optic sensing-based system, Carina XwellXpress, in offset wells to monitor and characterize fracture driven geometrics in combination with ArrayFrac in-well frac allocation cluster uniformity analysis. Fracture-driven interactions, or frac-hits, recorded in the far-field coupled with fracture creation at the treatment well help optimize drilling and completion programs.

## Results

Silixa's fiber optic in-well allocations, crosswell low frequency strain and microseismic monitoring service was able to identify the optimal stimulation design on the pad for a given well spacing. Key insights into the offset well communication enabled the operators to better gauge the stimulated reservoir volumes and assess the optimum completions on future pads, leading to maximized efficiency and significant cost-savings.




Dashboard of interactive software for Far-Field Strain (FFS) data processing, frac hitsand frac hit corridor (FHC) picking. Left top: strain data colored by red-blue scale presents tension-compression; Left bottom: pumping data; Center: strain curves red=tension, blue=compression for bothinstanteous and cumulative strain; Right top/middle: strain heat map; Right bottom: frac hits picking data.

## Background Information

Characterizing hydraulic stimulation uniformity and geometry to better optimize and improve efficiency of the stimulation has been the focus of the industry for many years. By optimizing the hydraulic geometry, well production can be increased while completion costs lowered.

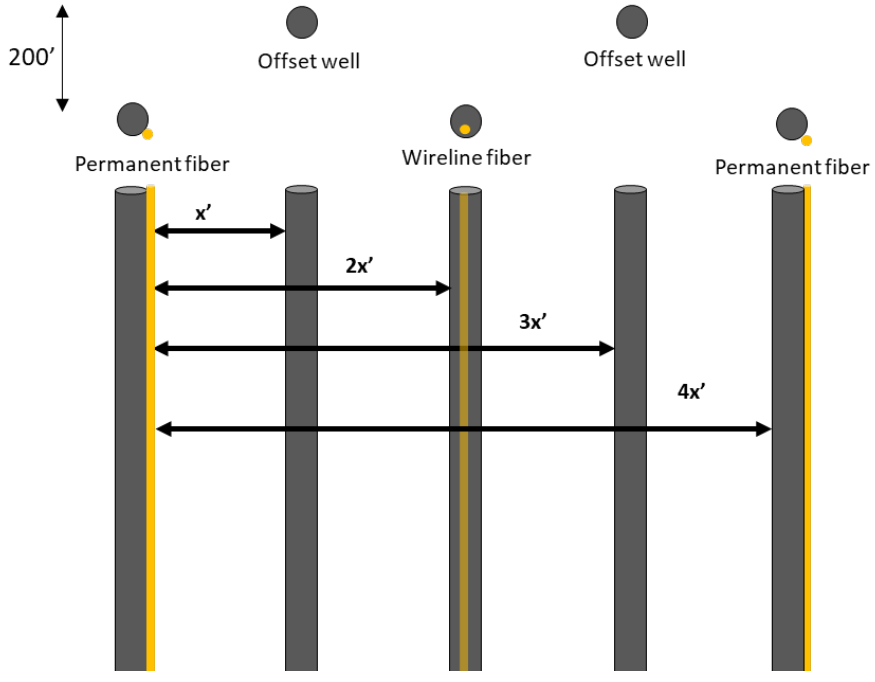
Downhole fiber cables can be permanently installed external to the casing to monitor the near-field wellbore environment. A second fiber or multiple fibers can be deployed in offset wells to monitor and characterize fracture geometries recorded by fracture-driven interactions or frac-hits in the far-field. Fracture opening and closing, stress shadow creation and relaxation, along with stage isolation can be clearly identified and fracture propagation from the near to far-field can be better understood and correlated.

The Carina XwellXpress solution can cost-effectively record the far-field data on retrievable fiber, enabling operators to evaluate and understand the correspondence between far-field and near-field Distributed Acoustic Sensing (DAS) data.

## Surveillance program

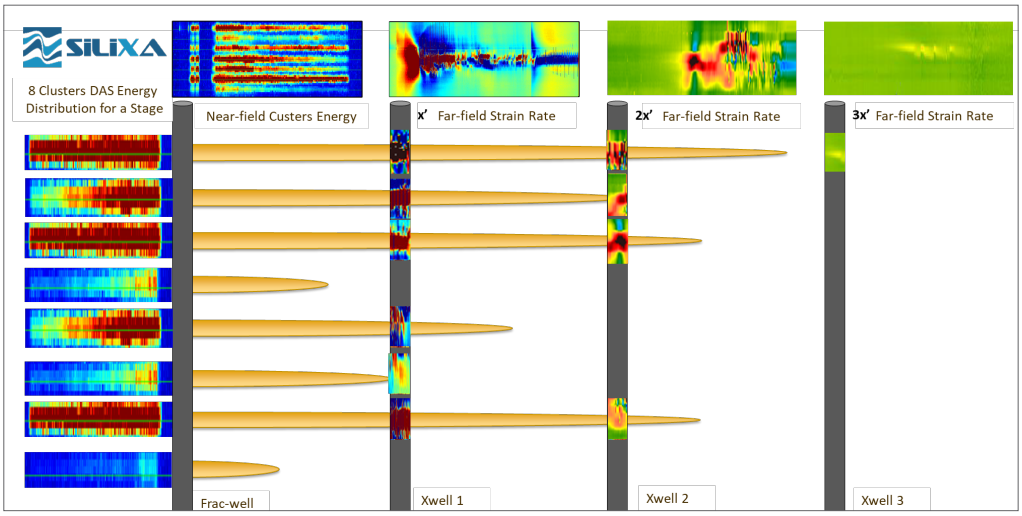
The operator's project was located in the Permian Basin and contained 13 wells with 4 different landing zones on 3 pads within the lease. Specifically, the operator was trying to understand the appropriate fracture stimulation design for two landing zones within the upper and lower benches.

To diagnose the near-field fracture stimulation, two permanent fiber optic cables were installed in the to-be fracture stimulated wells. The permanent fiber cables quantified the amount of slurry flowing into individual clusters of the current stage, and potentially prior stages, during hydraulic fracturing using DAS and DTS fiber data. To diagnose the far-field stimulation, a permanent fiber optic cable and a wireline fiber cable were used to obtain strain measurements to observe direct and indirect frac-hits on adjacent wells. All cables were used to co-locate microseismic events to provide additional evidence of far-field fracture geometry.



## Value created to client

By combining the multiple fiber data sets including strain, co-located microseismic, first-hit volumes, velocity, azimuth and overlapping geometries including both near-field cluster slurry allocation and far-field frac-hits, the operator obtained a better understanding of the fracture geometries of the two landing zones within the upper and lower formation benches. Optimized fracture geometries increase the well and lease's production and lower completion costs.




## Benefits of using the Carina XwellXpress solution demonstrated

Indirect frac-hits observed on the engineered Constellation™ fiber optic cable, invisible to standard non-engineered fibers, were observed giving a more accurate measurement of fracture length and height. Slurry was allocated to individual clusters, including the prior stages, giving a more accurate measurement of cluster stimulation efficiency.

## Why Use Carina XwellXpress

- Allocate slurry to individual clusters, including the prior stages, giving a more accurate measurement of cluster stimulation efficiency.
- Better model fracture half-lengths and heights with fiber data by matching frac-hits to individual clusters.
- Using Silixa's engineered fiber (100x SNR improvement), fractures normally invisible to other fibers that pass above and below the monitor wellbore can be seen, analyzed, and modeled.

Reference: ( SPE-204205-MS, May 2021), Hydraulic Fracturing Diagnostics Utilizing Near and Far-Field DistributedAcoustic Sensing DAS Data Correspondences

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