Alternate Path Technology

Higher production from gravel-packed wells
Applications
- Bypass premature bridging in vertical intervals longer than 40 ft
- Frac pack in unconsolidated sands or high-permeability zones
- Gravel pack of horizontal intervals as long as 8000 ft
- Gravel pack in deviated wells
- Separate completions of two intervals in one trip
- Control of gas or water influx during production

Benefits
- Improved gravel packs over long intervals
- Improved production from tightly packed annulus and perforations
- Efficient gravel packing of long horizontal, deviated and vertical intervals
- Higher conductivity in fractured intervals
- Reliable screen protection for high-rate wells
- Longer completion life
- Single-step multizone completions
- Higher cash flow and increased reserves from higher production

Features
- Excellent diversion over the entire perforated interval
- No need for premium screens in openhole horizontal completions
- Multiple Alternate Path† screen designs
- Annular bridges bypassed by gravel slurry
- Various sizes of shunts and exit ports
- Shorter pumping times

Introduction
Services based on Alternate Path technology provide shunts with nozzles on the outside of the gravel-pack screen. These shunts create an alternative flow path, allowing slurry to bypass premature bridging and fill the voids below. In an Alternate Path operation, gravel placement proceeds initially in the standard packing mode until screenout. A pressure buildup occurs after screenout and forces the slurry to flow through the shunts and exit through the nozzles to the first available void. Packing continues until all voids are filled and a final screenout occurs. With voids eliminated, the gravel pack is tight and complete.

Alternate Path technology is used in the AllPAC† standard gravel-pack service, the combination of AllFRAC† and Schlumberger frac and pack services, MZ packer zone-isolation service, and Horizontal AllPAC and AllFRAC services for horizontal wells.

AllPAC service
AllPAC service applies Alternate Path technology to standard gravel-pack operations. Nozzles every 6 ft on the shunt allow slurry to exit below a premature bridge, filling remaining voids. In one study, AllPAC completions averaged 42 lbm/ft of gravel placed behind the casing, compared to 15 lbm/ft placed by conventional completions. AllPAC service operates in vertical, deviated or horizontal wells, either cased or openhole. More gravel placed means more complete perforation packing and fewer annular voids. The result is a more reliable completion with higher production.

AllFRAC service
By using larger shunts that allow for increased pump rates, Alternate Path technology is applied to frac and pack operations. Fractures propagate throughout the interval, not just above a premature bridge, and propellant is placed along the entire interval. Fractures are tightly packed for maximum conductivity. Multiple zones can be fractured and packed during a single run, saving the cost of multiple completions. AllFRAC technology has played an integral part in the record-setting production from one operator’s wells in the Gulf of Mexico.
MZ packer zone-isolation service

AllPAC and AllFRAC services are also used in multizone single-trip completions to control water or gas influx during production. To extend Alternate Path technology to this application, one or more opposable-cup isolation packers are added. Shunt tubes pass through the packer cups to enable gravel packing over multiple intervals. The MZ packer creates a barrier between the screen and casing. At the end of gravel-packing operations, the shunt tubes and nozzles are packed off. The packed shunt tubes act as linear flow cells, preventing fluid flow through the shunts and effectively isolating the intervals from each other during production. Completions can include fracturing one interval (usually the upper zone) and gravel packing the second interval (usually the lower zone).

Multizone completions have resulted in substantial cost savings and higher production compared to conventional completions. This higher production results from minimizing the use of fluid loss pills in a single-trip completion.

Horizontal AllPAC and AllFRAC services

When gravel packing horizontal wellbores using conventional technology, significant problems are often encountered: silt and shale sloughing, premature bridging from high leak-off, filter-cake cleanup problems, and difficulty regaining permeability. Gravel packs in these wells are often poor or incomplete, exposing long intervals of screen to erosion or plugging.

Completions with Alternate Path technology avoid the conventional problems because the pack quality is excellent, even over long horizontal intervals. Horizontal AllPAC and AllFRAC services use nondamaging carrier fluids, remove filter cake during gravel placement and maximize productivity. Wells completed using this technology have a high productivity index because sloughing and premature bridging are bypassed and the entire interval is packed. With a complete gravel pack, ordinary wire-wrapped screens, which are more resistant to plugging than premium screens, can be used even in intervals as long as 8000 ft.
**AllPAC applications**
- Vertical intervals greater than 40 ft long
- Openhole intervals with silt and/or shale streaks
- High-permeability unconsolidated intervals
- Intervals with high rates of production
- Deviated wells

**AllFRAC applications**
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- High-permeability unconsolidated intervals
- Intervals with high rates of production
- Deviated wells

**MZ packer applications**
- Single-run completions of multiple zones with zonal isolation
- Control of gas or water during production
- Multizone completions

**Horizontal AllPAC applications**
- Intervals as long as 8000 ft
- Heterogeneous intervals with silt and/or shale streaks
- Intervals with areas of high leakoff
- Wellbores having difficulty regaining permeability or filter-cake cleanup problems
- Openhole wellbores drilled with oil-base fluids

**AllPAC case history**
In a circulating gravel-pack treatment, AllPAC technology was used to ensure complete packing of all voids. After 36 min of treatment, the pumping rate was reduced. At the end of the treatment, all remaining voids were packed for 2 min at a rate of 2 bbl/min. In this short period 675 lbm of proppant were delivered to the annulus, ensuring the tight and complete annular packing that was critical to the success of this high-rate well. The resulting skin of 1.1 is a significant improvement to the industry average of 8 for openhole gravel packs in shaly reservoirs. Specifications for this well and treatment were:
- Measured depth (MD): 12,275 ft
- True vertical depth (TVD): 5800 ft
- Deviation: 75°
- Interval length: 300 ft
- Proppant design: 8000 lbm
- Proppant pumped: 8000 lbm
- Carrier: 4% ClearFRAC fluid.

**AllFRAC case history**
A STIMPAC frac and pack treatment to bypass damage was performed using the AllFRAC service over a long interval containing laminated pay zones. Without Alternate Path technology, a premature screenout would have occurred after 42 min of treatment in these zones, at the 3-ppa stage, resulting in a less than optimal treatment. The AllFRAC service allowed the slurry to bypass the premature bridge, diverting it through the shunts to frac and pack the lower zone. Changes in temperature recorded by gauges in the wash pipe during the operation confirmed treatment success. Specifications for this well and treatment were:
- MD: 8806 ft
- Deviation: 15°
- Interval length: 133 ft
- Proppant design: 42,000 lbm
- Proppant pumped: 37,500 lbm
- Carrier: YF100LG fracture treatment gel.

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**Eccentric and concentric AllPAC and AllFRAC shunt tube geometries are shown for cased hole applications.**
**AllPAC technology provided a low-skin completion in this high-rate well.**

**AllFRAC technology diverted the slurry past the annular bridge to the lower zone, resulting in a complete frac and pack of the interval.**
**Complementary fluids and services**

The following fluids and treatment solutions are available for wells completed using Alternate Path technology.

- **ClearFRAC fluid**—This polymer-free viscoelastic (VES) surfactant-based carrier fluid is used for gravel packing, fracturing applications and horizontal completions.

- **ClearPAC* fluid**—A polymer-free VES fluid, it is especially designed for gravel-pack operations in weighted brines and elevated temperatures.

- **OILPAC* fluid**—An oil-external emulsion, this fluid is used for well-control operations in circulating packs using oil-base drilling fluids.

- **HEC fluids**—Hydroxyethylcellulose polymer-based fluids are used as gravel-pack carriers.

- **Xanvis® fluid**—This fluid is a biopolymer gravel-pack carrier fluid.

- **MudSOLV* filter-cake removal service**—This engineered cleanup technique enables filter-cake removal concurrent with the sand-control treatment. MudSOLV service maximizes the filter-cake removal treatment. Filter-cake removal is a key factor in optimizing the production from or injection into openhole gravel packs.

**Multizone completion case history**

In a multizone completion, an AllFRAC frac and pack treatment on the upper interval and AllPAC gravel-pack treatment on the lower zone were conducted sequentially. After the fracture treatment, returns were taken to force all the slurry to the lower zone for the gravel pack. The AllPAC shunts limited the rates below the MZ packer, preventing fracture propagation in the lower zone. A shale interval prevented growth of the fracture downward.

This multizone completion technique produced oil from the lower zone that would have otherwise remained in place. Specifications for this well and treatments were:

- **MD**: 8608 ft
- **deviation**: 25°
- **length of interval**: 155 ft
- **proppant design**: 85,000 lbm
- **proppant pumped**: 95,000 lbm
- **carrier**: low-guar borate crosslinked water-base polymer fluid.

**The flexibility of the shunt configurations enabled successful treating and fracturing of the upper zone and gravel packing of the lower zone, which was close to a water contact.**
Horizontal completion case history
An openhole circulating gravel pack was pumped after the slurry was mixed. Before the slurry reached the openhole section, the return rates began to decrease. A premature bridge formed in the annulus, making it necessary to divert the flow through the shunted screen. After the flow bypassed the area of high leakoff, the returns increased until the well was completely packed. Specifications for this well and treatment were
- MD: 5000 ft
- deviation: 90°
- length of interval: 1200 ft
- proppant design: 45,000 lbm
- proppant pumped: 40,000 lbm
- carrier: MudSOLV filter-cake removal treatment fluid.

Changes in downhole conditions do not jeopardize the success of a completion using Alternate Path technology.

Horizontal AllPAC and AllFRAC services provide technology for complete gravel packing of horizontal intervals as long as 8000 ft.