A New Approach to Fiber Optic Deployment

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TECHNOLOGY LIMITED

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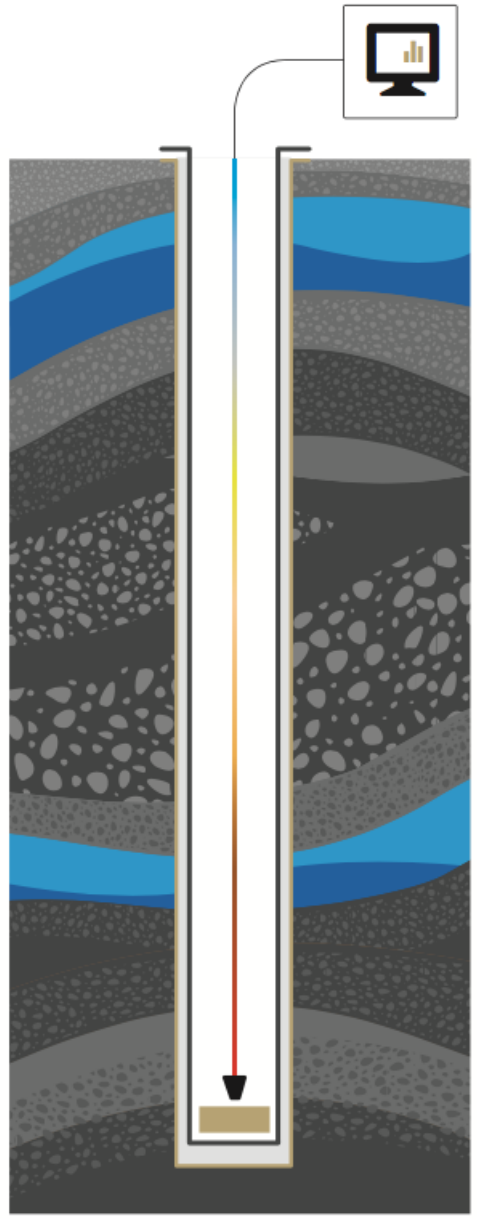
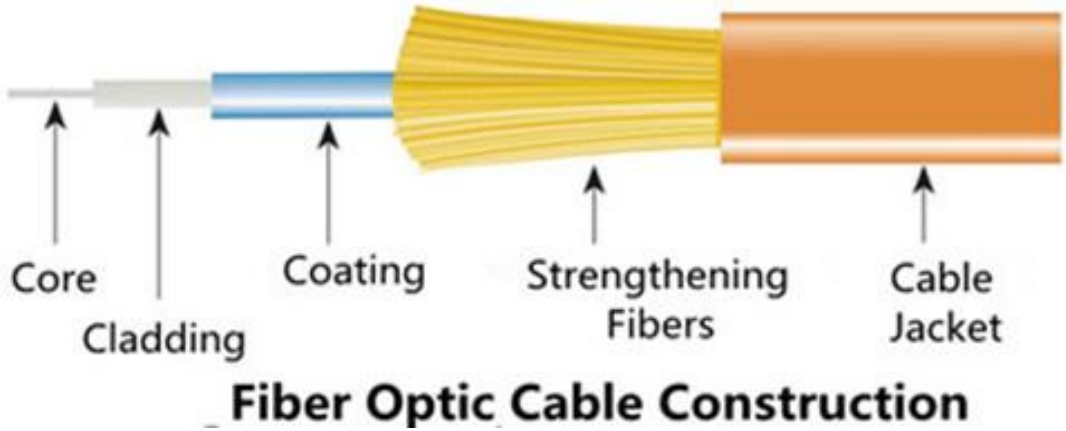


The Deployment Challenge

- Existing Methods
  - Permanent Install
  - Fiber in Coil Tubing
  - Carbon Rod
  - Fiber Optic Slickline
  - Dart
- Cost, risk & logistics challenges
- Significant hardware and personnel requirements



Fiber Optic Cable Construction

Result - low levels of implementation & understanding of DFO

Simplified Approach

Problem - ‘Cost effective deployment of FO into oil & gas wells’

Solution - ‘A system that simply gets a fiber into the well’

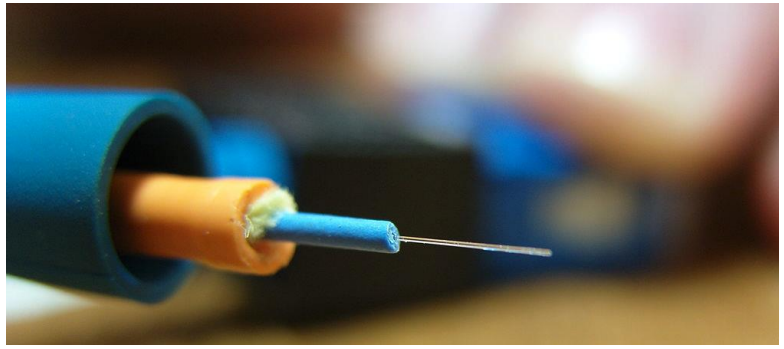
Characteristics - Small, light & portable ➔ Disposable

Ease the process by:

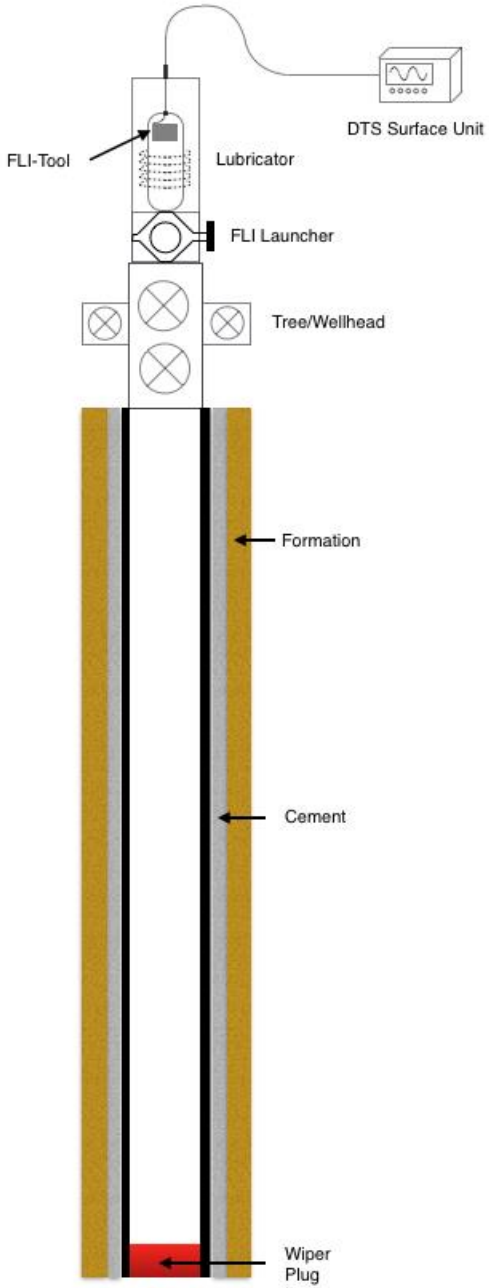
- Leverage existing technologies and services
- Look inside and outside of our industry

The Dart Concept

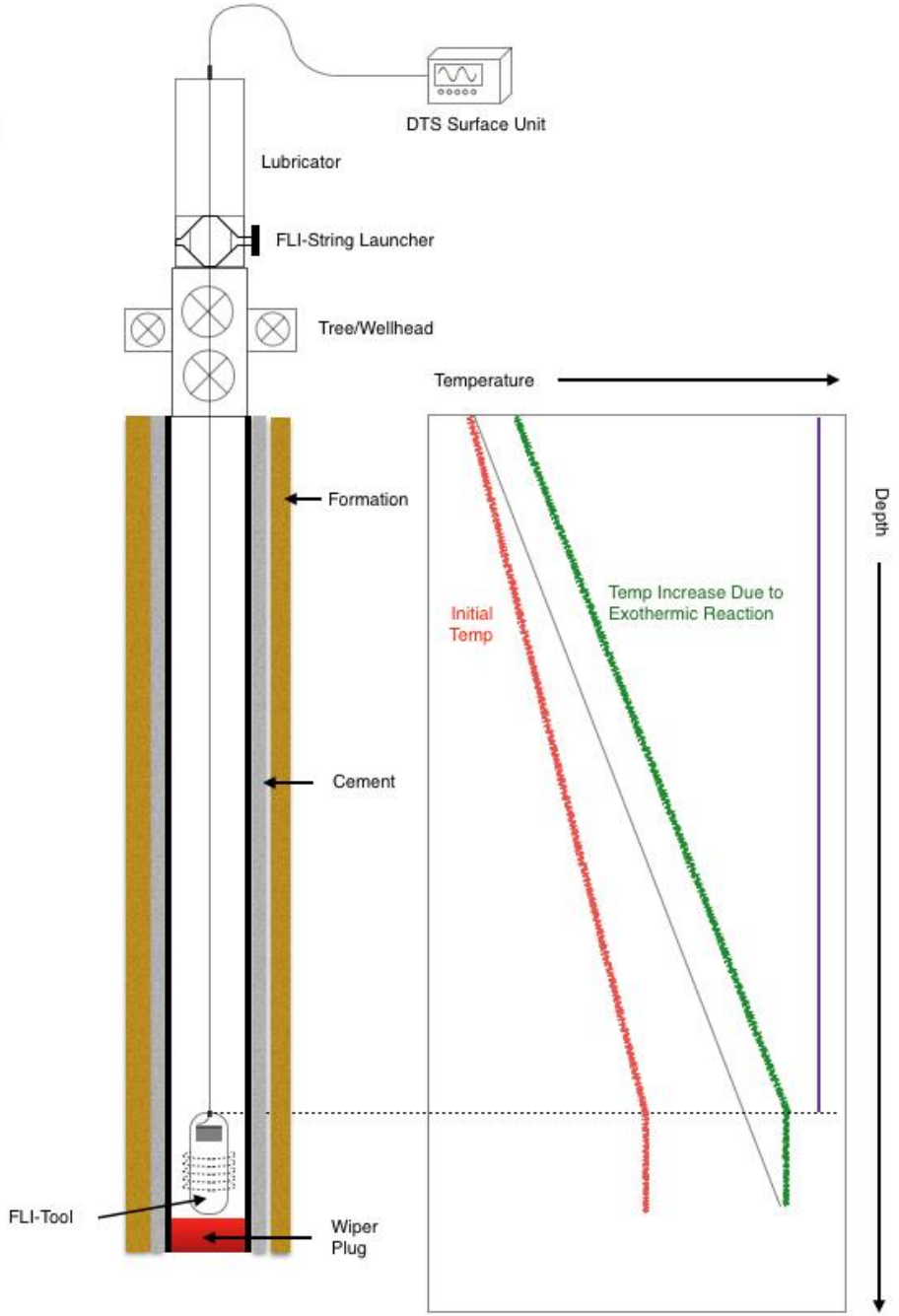
- What is bare fiber optic line?
  - 0.250mm diameter
  - Glass core (0.10-0.065mm dia)
  - Protective Coating
  - Human Hair is 0.100mm dia
- Will bare Fiber work?
  - Yes but duration unknown
- How do we get it into a well?
  - Wind it up and drop it in?



Rig-Up



Monitor

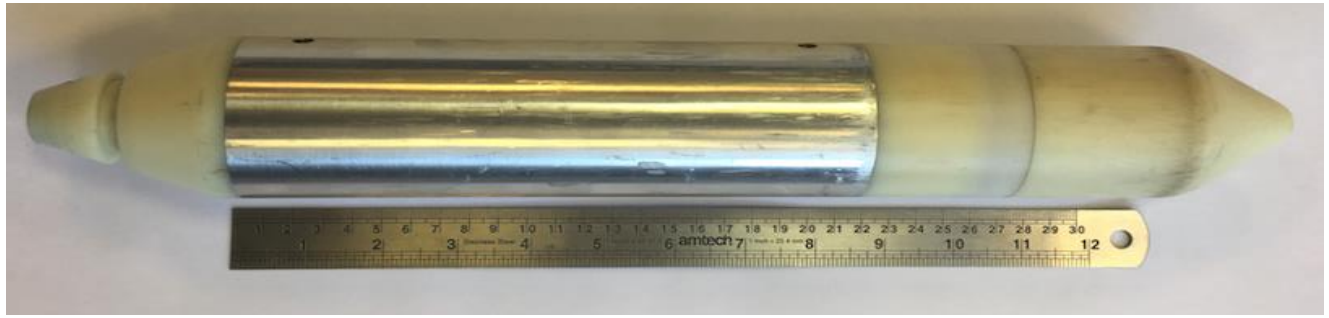


Rig Down

Initial Prototype

- Purchased lowest grade fiber
- 3D Printed equipment to wind fiber
- Plastics and aluminum to manufacture tools
- Successful drop testing – low height
- Unsuccessful drop testing – test well (1,600ft)
- Some data capture from DAS

3 Months

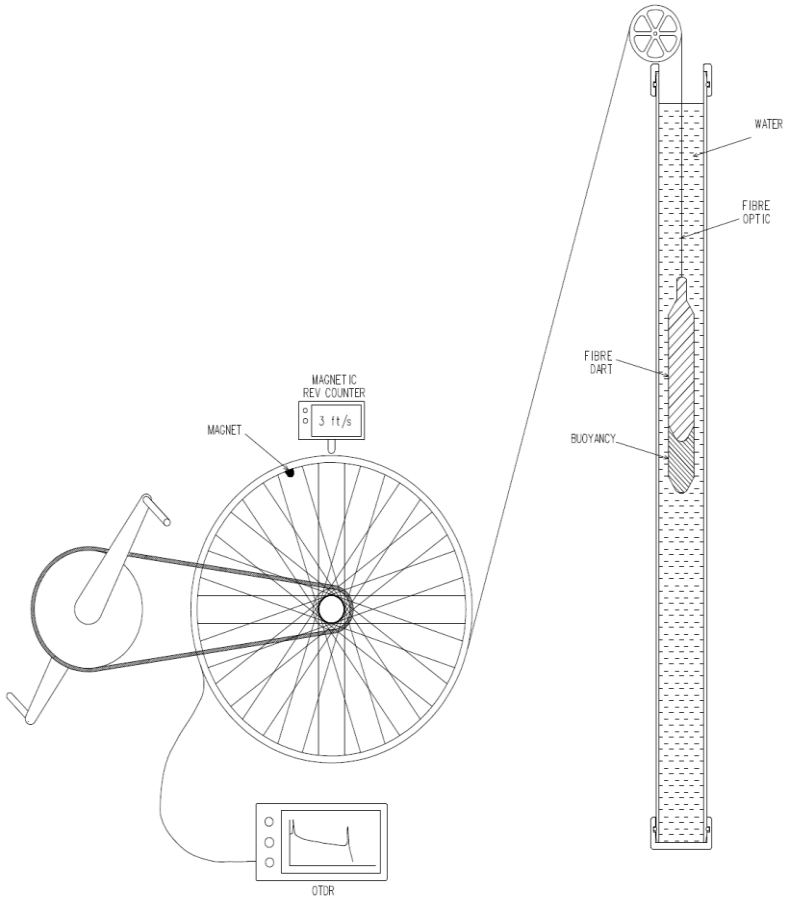


Modified Prototype

- Re-think winding designs
- Simulator for de-spooling longer lengths
- Re-design winding equipment
- Successful drop testing – low height
- Successful de-spooling testing – 3,000ft+
- Successful drop testing – test well (1,600ft)
- Multiple drops showed repeatability
- Good response & data capture from DAS
- Good depth correlation

3 Months

Unconventional Testing Methods



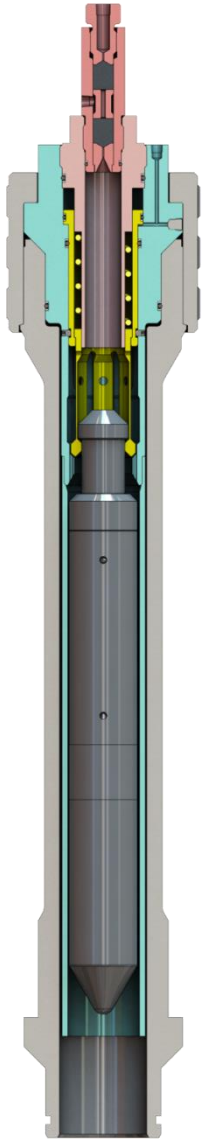
Initial Commercial Product

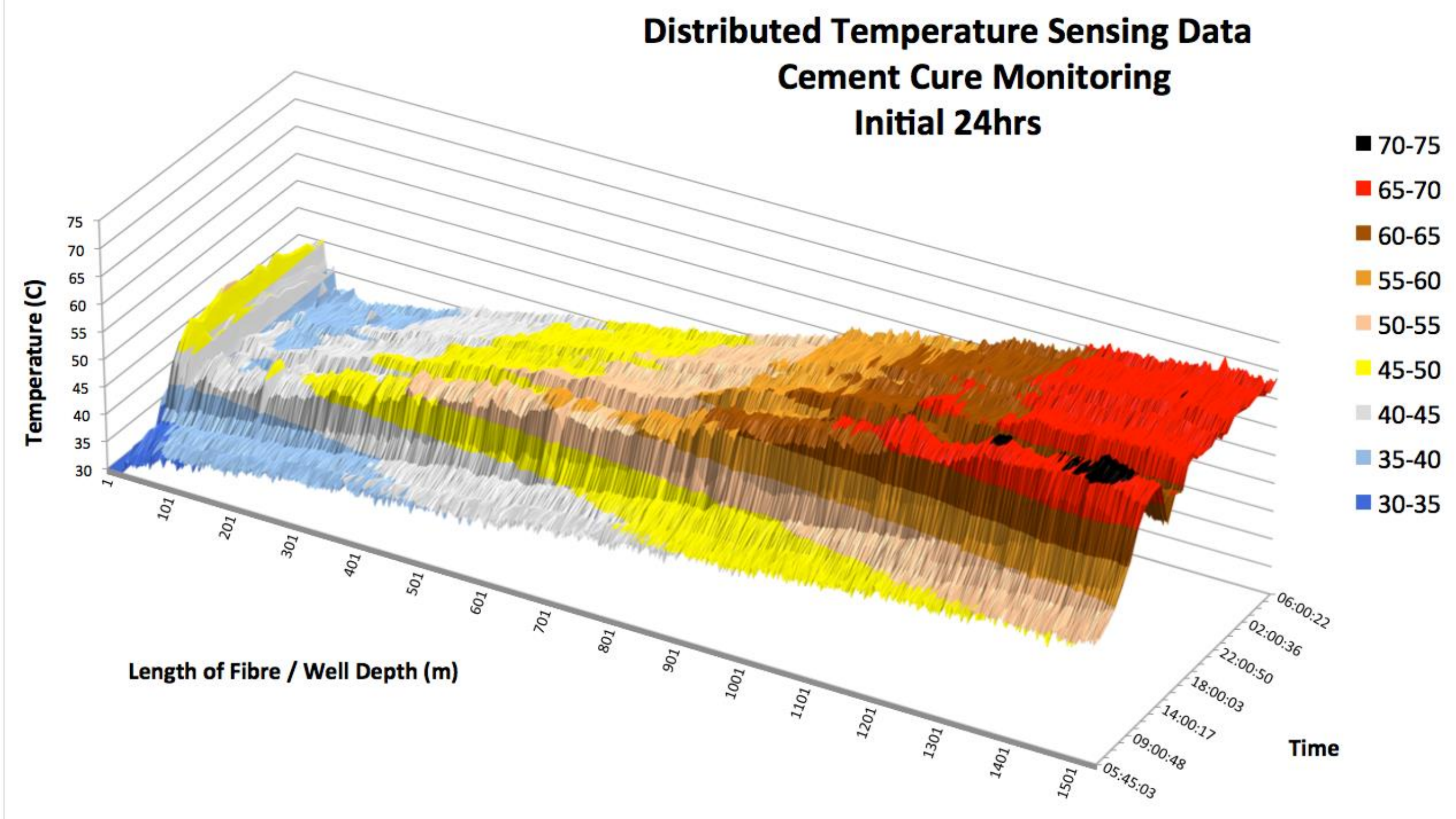
- Engage L48 Operators for trial wells
- Identify low risk candidate & clear objectives
- Design, manufacture and test system
- Mobilise equipment to USA (Eagleford)
- Stack-up Integration Testing
- Successful deployment (main objective)
- Monitored DTS over 53hrs
- Monitored fiber over total of 6 days

6 Months

Dimensions

- Complete Launch Package
  - 5ft long
  - 20 kgs (not including Lubricator)
- Dart
  - 2.750” OD
  - 3ft Long
  - 4kgs (including 2kg of Concrete)




Distributed Temperature Sensing Data
Cement Cure Monitoring
Initial 24hrs
Temperature (C)
75
70
65
60
55
50
45
40
35
30
1
101
201
301
401
501
601
701
801
901
1001
1101
1201
1301
1401
1501
Length of Fibre / Well Depth (m)
05:45:03
09:00:48
14:00:17
18:00:03
22:00:50
02:00:36
06:00:22
Time
70-75
65-70
60-65
55-60
50-55
45-50
40-45
35-40
30-35

Conclusions

- Bare fiber optic can be reliably deployed into a well
- DTS and DAS Measurements can be taken
- Results are accurate and are well correlated to depth
- Can be packaged into a compact plug and play system
- The limits of the technology have yet to be reached
- Disposable system simplifies the overall system design
- Cost effective solutions can be implemented more widely
- Increased DFO can provide a better understanding of wells
- Enabling more frequent and efficient well intervention

What's Next?

- Build on the technology as a platform for well intervention
  - Passive (Distributed Sensing)
  - Active (Passive plus sensors)
  - Mechanical
- Installation into a horizontal well
  - For the purposes of offset micro-seismic
- Integration of passive and active optical sensors
  - Pressure / Temperature Gauge
  - Camera
  - INS

Thank You

Questions