BENEFITS OF A STANDARDS BASED APPROACH TO DAS DATA MANAGEMENT

DAS Webinar 2019-03-28

Presenters

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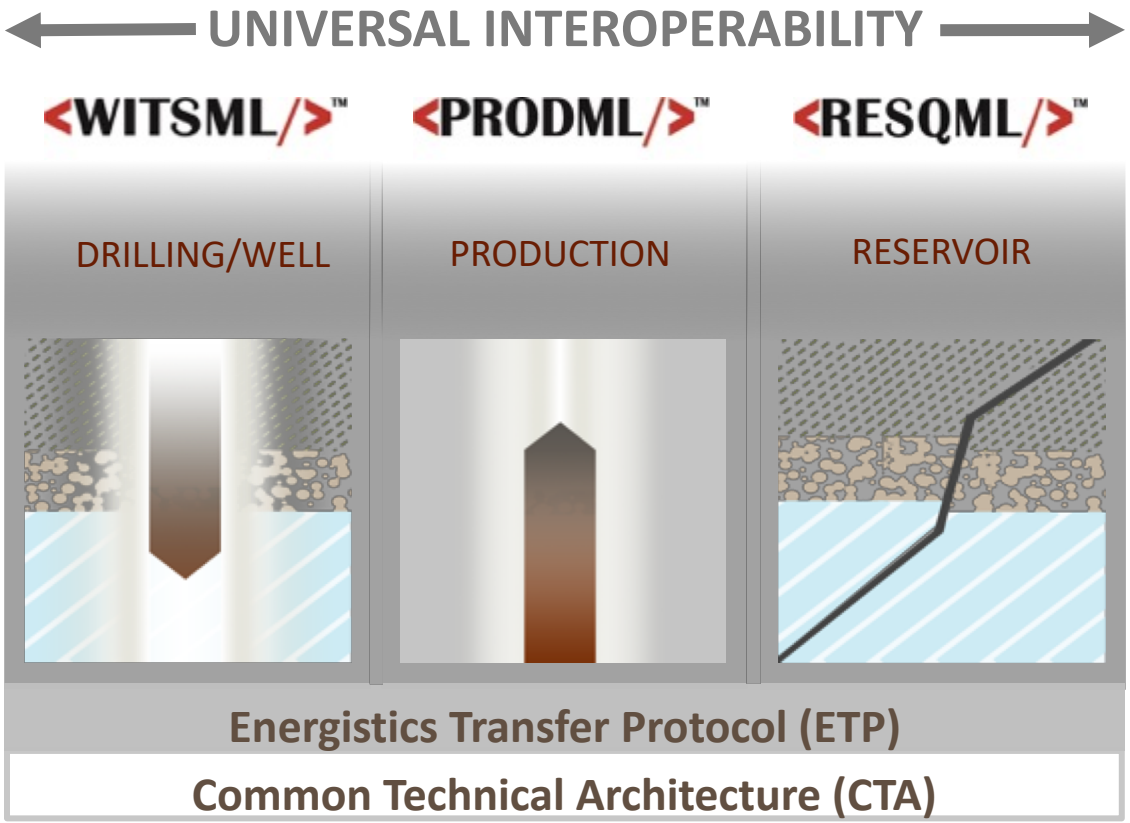
Energistics' Spectrum of Standards



Production Standards: PRODML™

- Consistent, high-quality transfer of production-related data
  - Volumes reporting (intra company, partner to partner, company to regulator)
  - PVT fluid properties (acquisition, samples, lab analysis, fluid characterization)
  - Flow tests (production, pressure transient, formation testing)
  - Flow networks

➢ DTS and DAS exchange standards

DAS Data Exchange Use Cases

ENERGISTICS

Type of surveillance

In-well monitoring applications

- Hydraulic Frac
- Zonal Injection and Production
- Artificial Lift
- Well Stimulation

Seismic Surveillance

- Vertical Seismic Profiling
- Microseismic and strain front

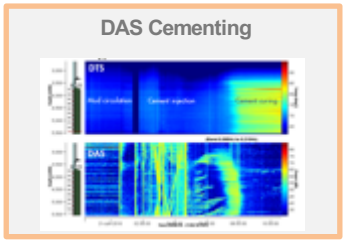
Type of DAS Data exchanged

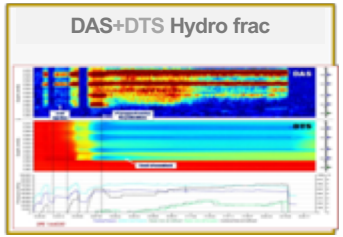
DAS data types

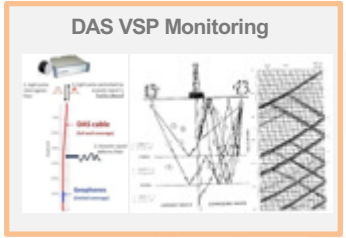
- Raw >1 TB/fiber/day
- Processed MB -GB/fiber/day
  - Frequency filtered (frequency bands)
  - Fourier transformed (spectrum)

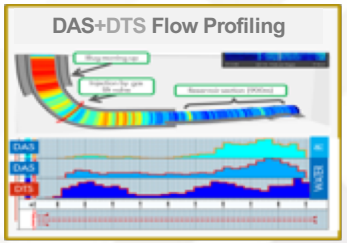
DAS and SEG data types

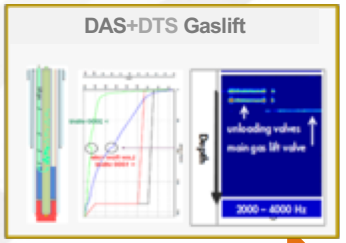
- Raw for R&D, ~1 TB/fiber/day)
- SEGY/SEGD for end-users GB/fiber/day











Drilling Cementing Completion Production Intervention Production Artificial Lift / EOR Abandonment

Business Case for a Distributed Acoustic Sensing Data Exchange Standard

ENERGISTICS

A shared data exchange format will accelerate development, reduce cost and improve uptake of Distributed Acoustic Sensing (DAS) applications in the oil and gas industry.

Costs of not having a DAS standard

Expensive in-house Software development to deal with non-standard formats

Non productive staff time to deal with non-standard formats

Delayed decisions, missed opportunities and diminished confidence in DAS technology

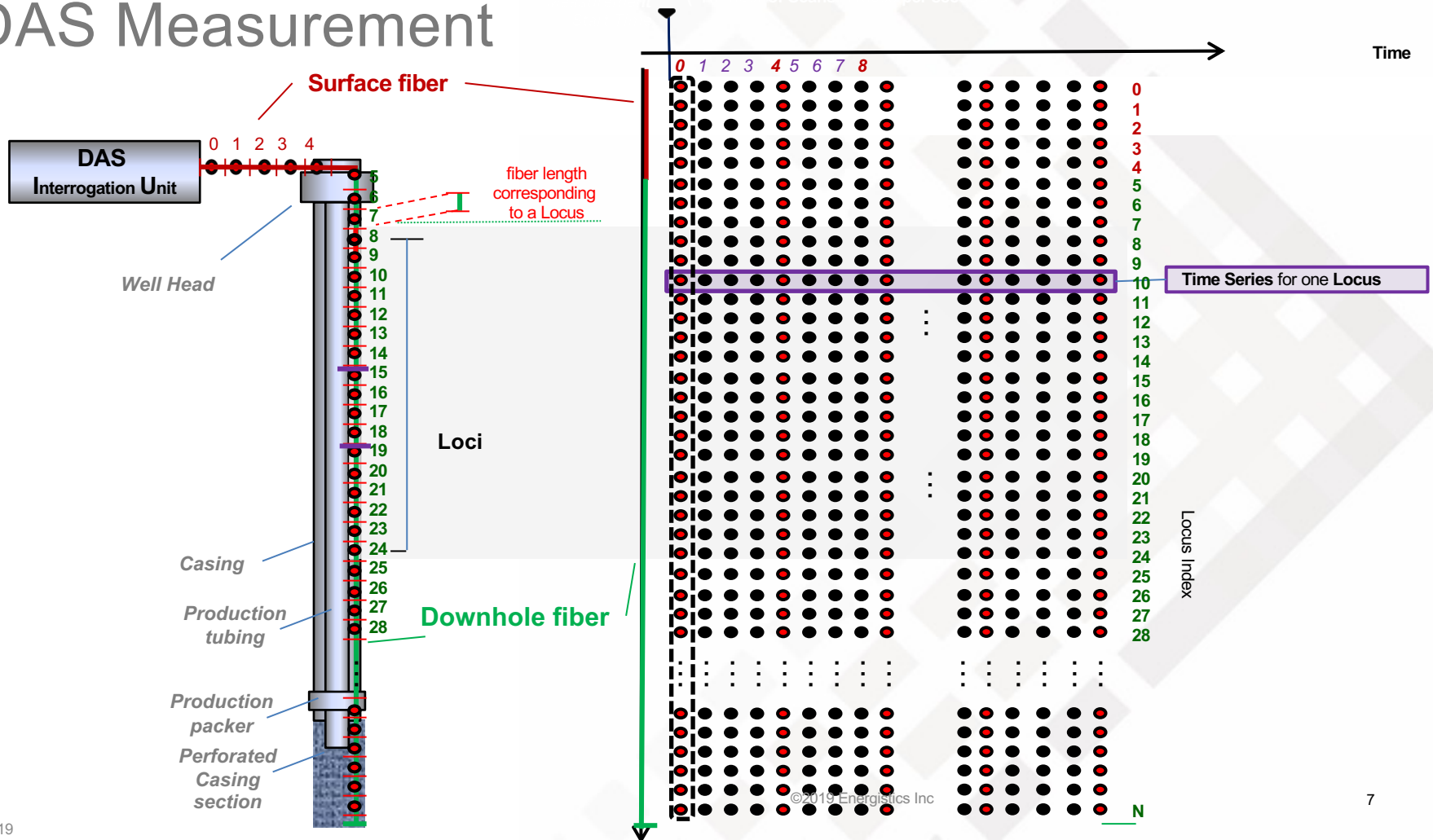
Slow uptake in the assets (complex, too much work, too difficult to visualize, problematic data nightmare …)

Complexity of sharing data with partners

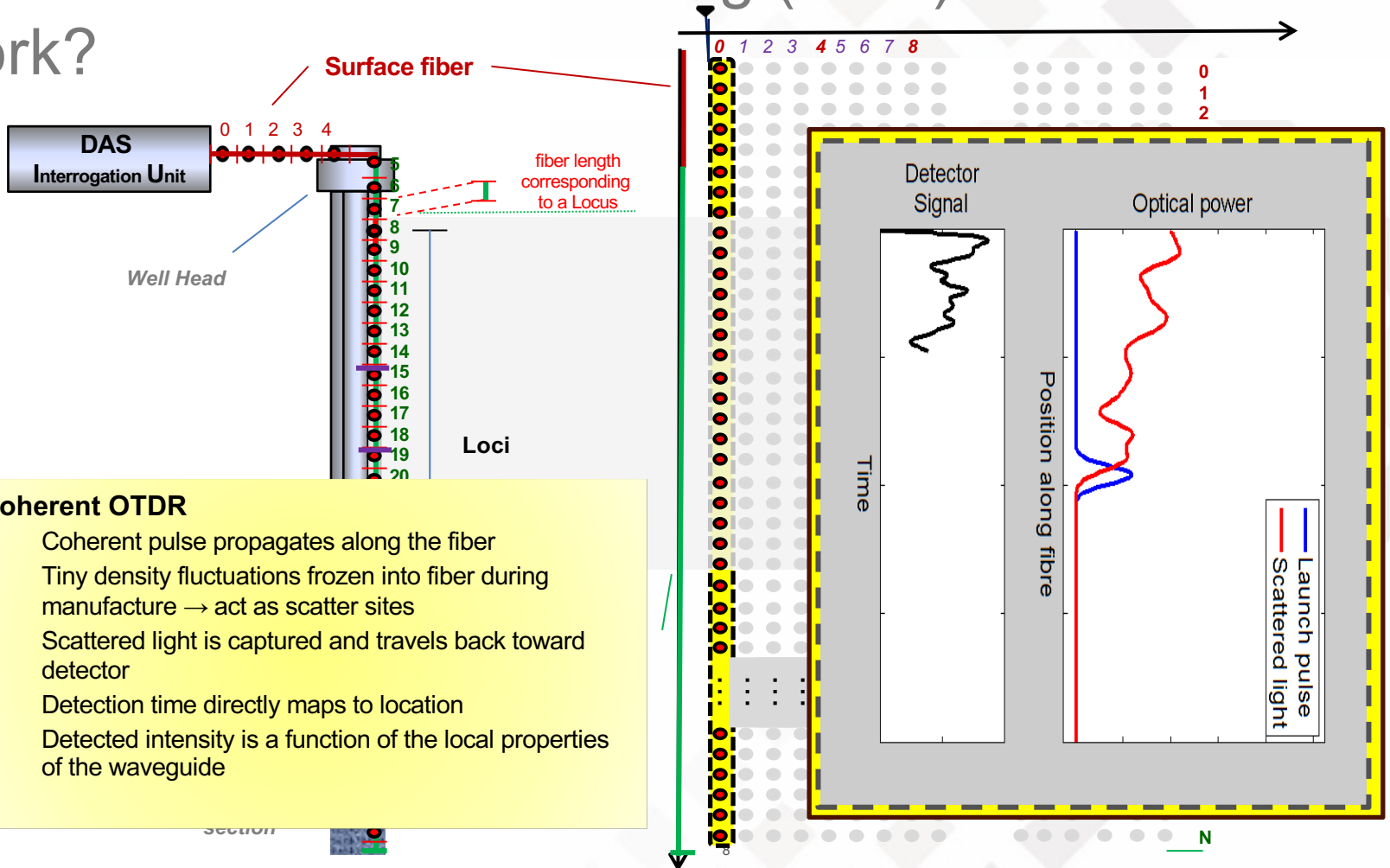
Difficult to leverage third party solutions and best practices

Impossible to develop common toolsets and data management processes

DAS Measurement



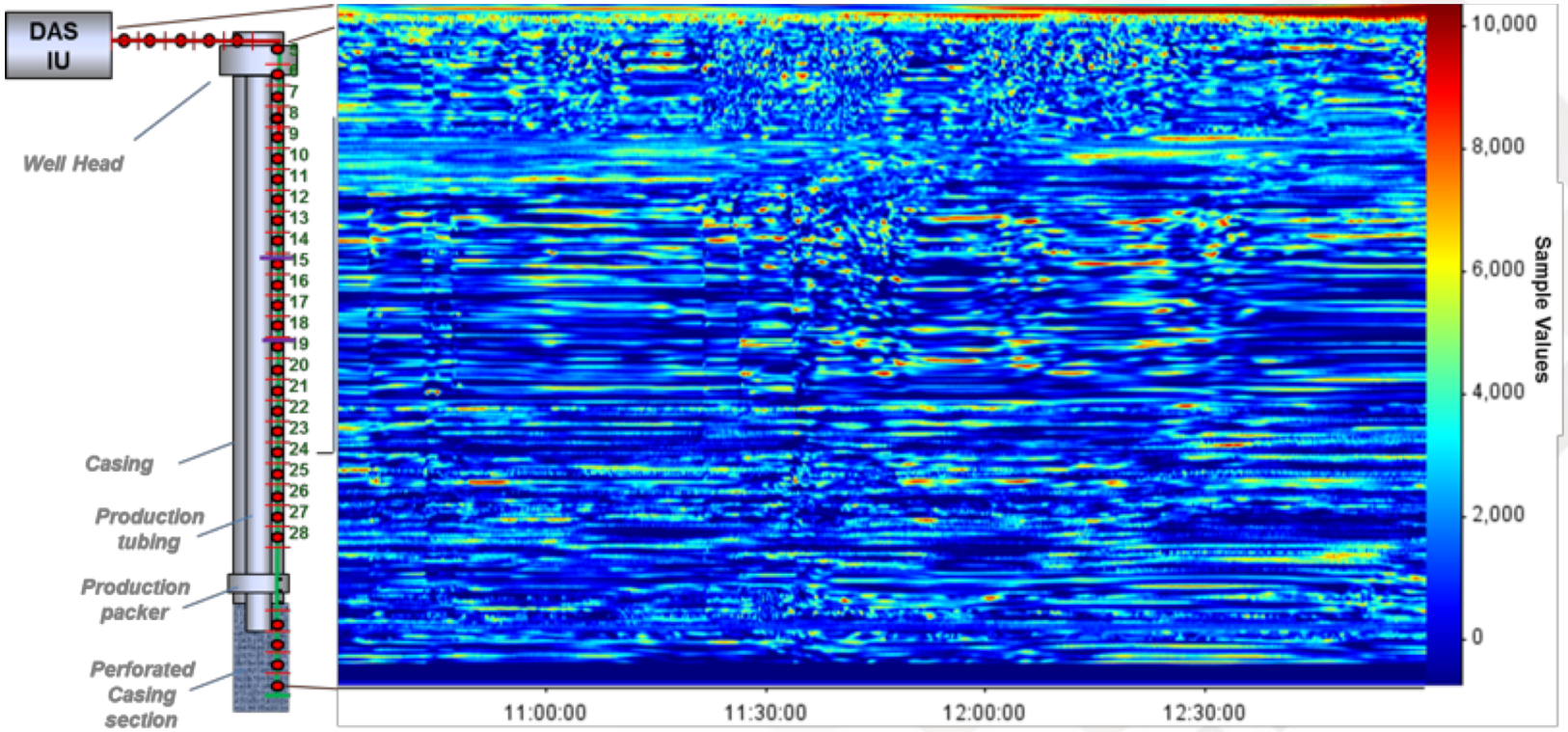
Distributed Acoustic Sensing (DAS): how does it work?



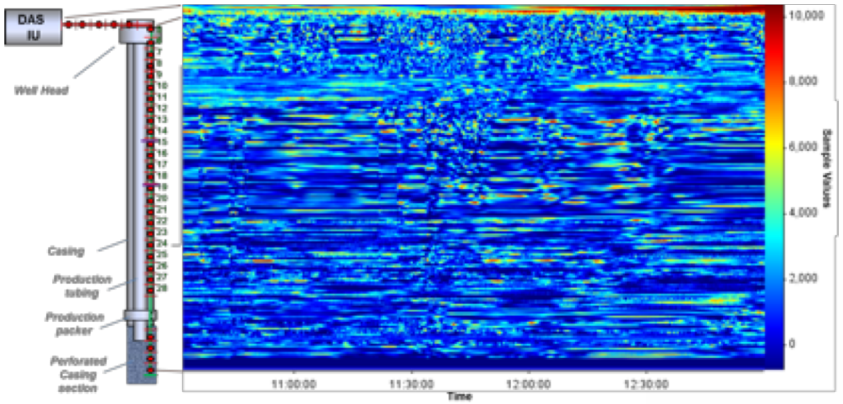
Coherent OTDR

- Coherent pulse propagates along the fiber
- Tiny density fluctuations frozen into fiber during manufacture → act as scatter sites
- Scattered light is captured and travels back toward detector
- Detection time directly maps to location
- Detected intensity is a function of the local properties of the waveguide

DAS measurement – Raw data (1 Tb/day)



DAS measurement – Raw data array Mapping



Data Array

M(L0,T0)	M(L0,T1)	M(L0,T2)	M(L0,T4)	…	M(L0,TN)
M(L1,T0)	M(L1,T1)	M(L1,T2)	M(L1,T4)	…	M(L1,TN)
M(L2,T0)	M(L2,T1)	M(L2,T2)	M(L2,T4)	…	M(L1,TN)
…	…	…	…	…	…
M(LM,T0)	M(LM,T1)	M(LM,T2)	M(LM,T4)	…	M(LM,TN)

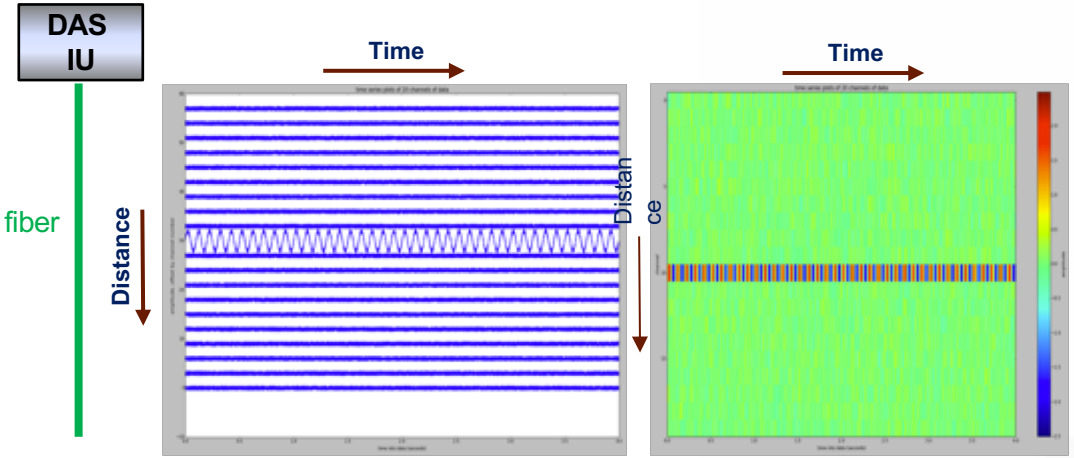
Missing scan

Time array

T0	T1	T2	T4	…	TN

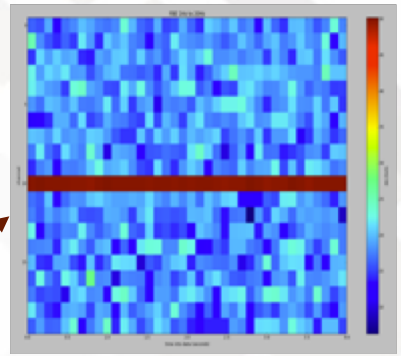
To record a DAS measurement we need to store both the data samples and the times

DAS data types Raw to Processed

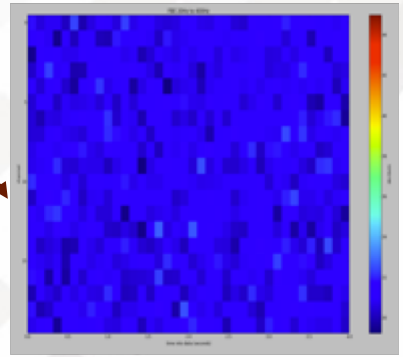


Sine wave exciting a channel displayed as a wiggle plot

Sine wave exciting a channel displayed using false color for amplitude



Frequency band including sine wave frequency

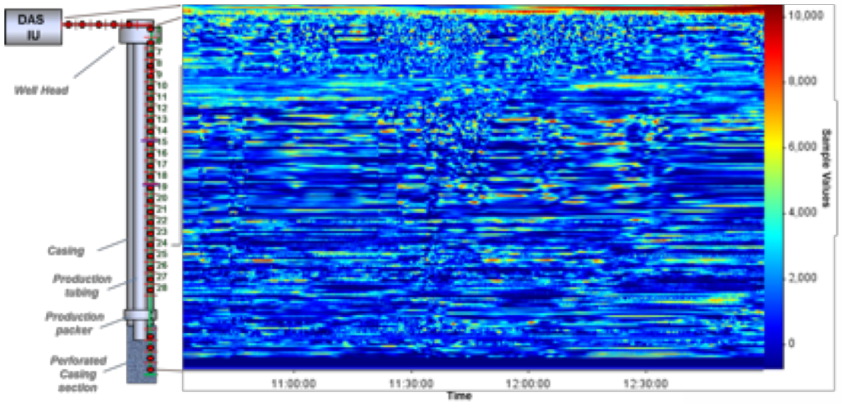


Frequency band excluding sine wave frequency

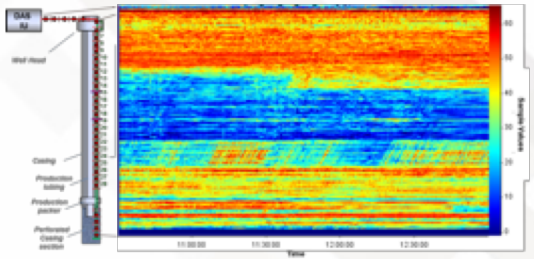
DAS data types Raw to Processed

Frequency Band filtered

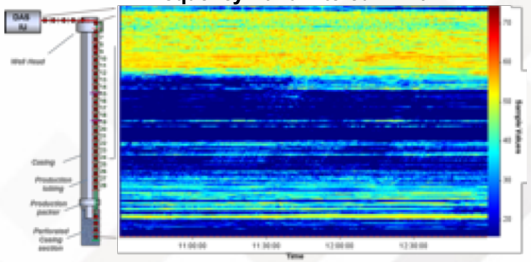
For many applications DAS data is filtered and downsampled



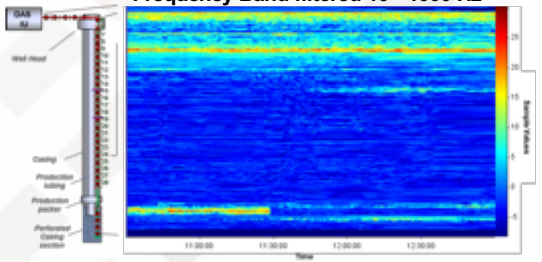
Frequency Band filtered 0 - 1 Hz



Frequency Band filtered 1 - 10 Hz



Frequency Band filtered 10 - 1000 Hz

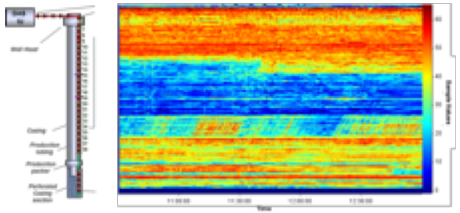


DAS measurement

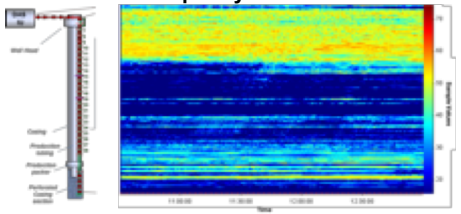
Frequency Band Filtered & Down sampled (Gb/day)

ENERGISTICS

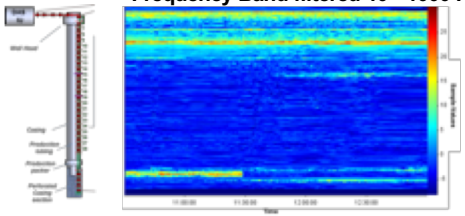
Frequency Band filtered 0 - 1 Hz



Frequency Band filtered 1 - 10 Hz



Frequency Band filtered 10 - 1000 Hz



Data Arrays

F1(L0,Tf0)	F1(L0,Tf1)	F1(L0,Tf2)	…	F1(L0,TN)
F1(L1,Tf0)	F1(L1,Tf1)	F1(L1,Tf2)	…	F1(L1,TN)
…	…	…	…	…
F1(LM,Tf0)	F1(LM,Tf1)	F1(LM,Tf2)	…	F1(LM,TN)

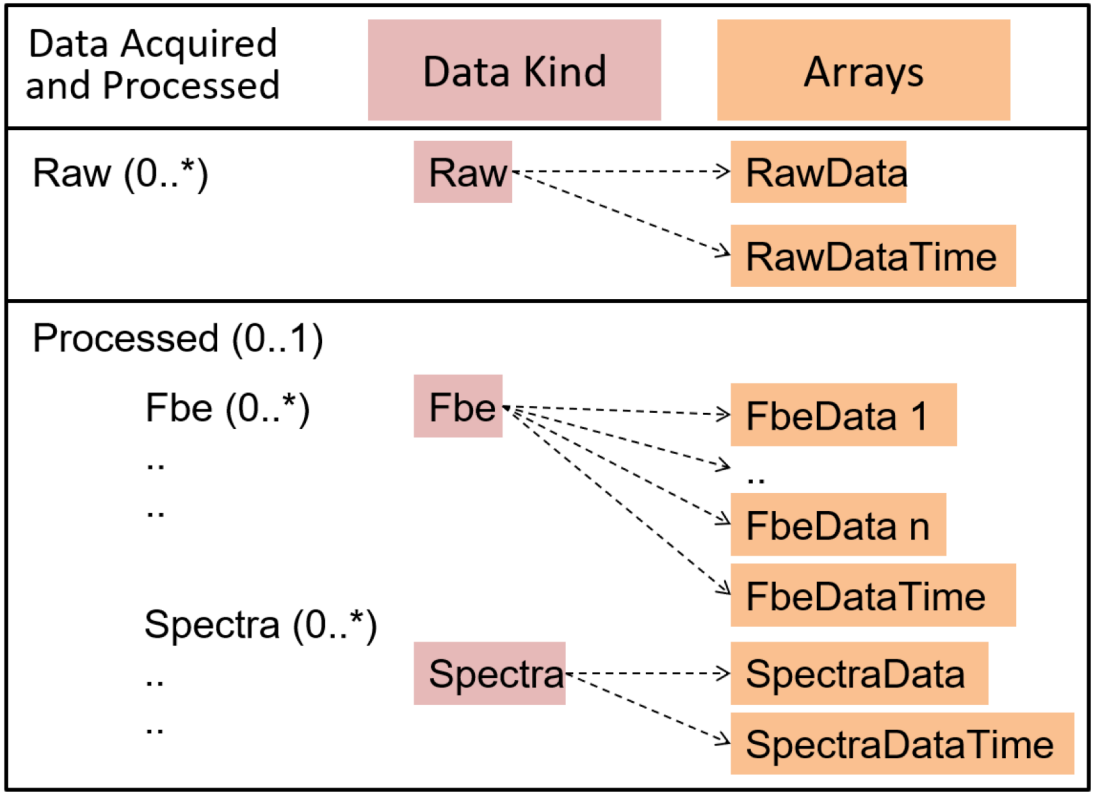
F2(L0,Tf0)	F2(L0,TF2)	F2(L0,Tf2)	…	F2(L0,TN)
F2(L1,Tf0)	F2(L1,TF2)	F2(L1,Tf2)	…	F2(L1,TN)
…	…	…	…	…
F2(LM,Tf0)	F2(LM,TF2)	F2(LM,Tf2)	…	F2(LM,TN)

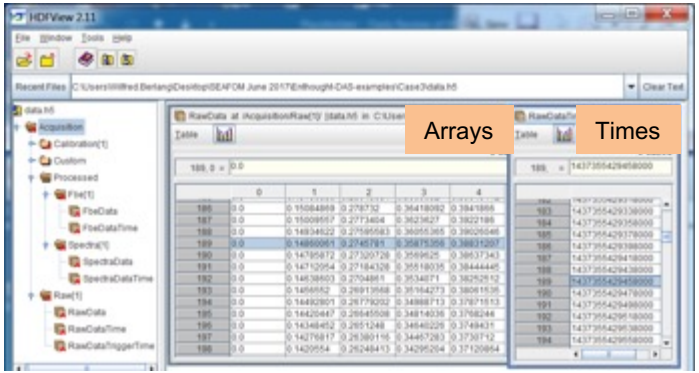
F3(L0,Tf0)	F3(L0,TF3)	F3(L0,TF3)	…	F3(L0,TN)
F3(L1,Tf0)	F3(L1,TF3)	F3(L1,TF3)	…	F3(L1,TN)
…	…	…	…	…
F3(LM,Tf0)	F3(LM,TF3)	F3(LM,TF3)	…	F3(LM,TN)

Time array (shared between Frequency Bands)

Tf0	Tf1	Tf2	…	TfN

DAS Conceptual Model for Raw & Processed Arrays





The data and times arrays are very large and are stored in HDF files

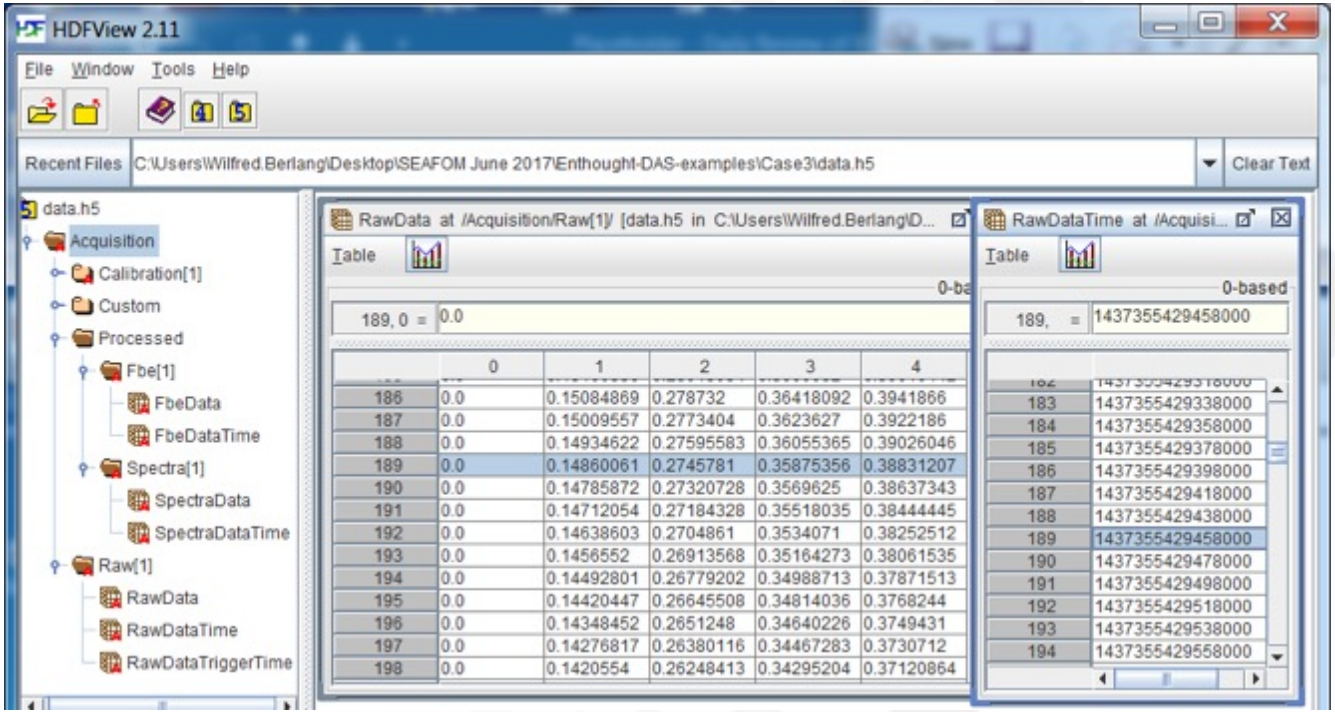
What metadata do we need for the acquisition?

ENERGISTICS

DasAcquisition
AcquisitionID: UuidString
GaugeLength: LengthMeasure
PulseRate: FrequencyMeasure
PulseWidth: TimeMeasure
SpatialSamplingInterval: LengthMeasure
TimeZone: String64
MeasurementStartTime: TimeStamp
Triggered Measurement: Boolean
TriggeredTime: TimeStamp
…

DasRaw
RawID: String64
NumberOfLoci: long
StartLocus: Long
StartTime: TimeStamp
…

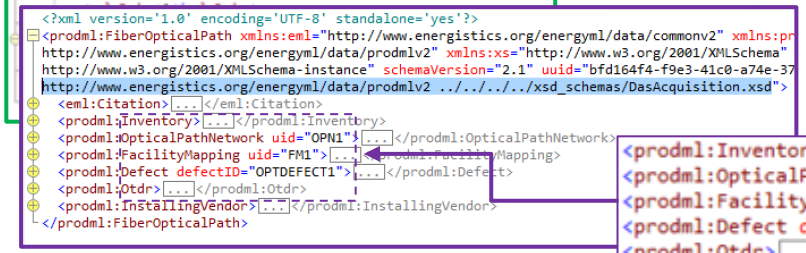
DasFbe
OutputDataRate: FrequencyMeasure
NumberOfLoci: long
StartLocus: Long
StartTime: TimeStamp
…

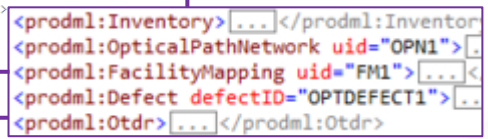


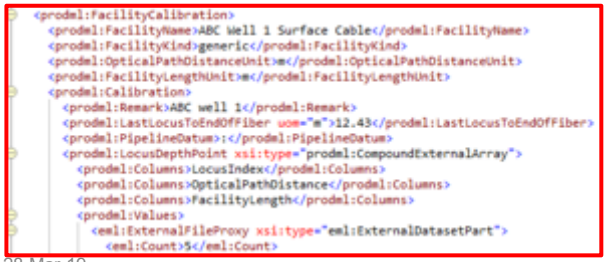
Essential data is stored in the HDF files

Equipment Meta Data

Metadata Equipment



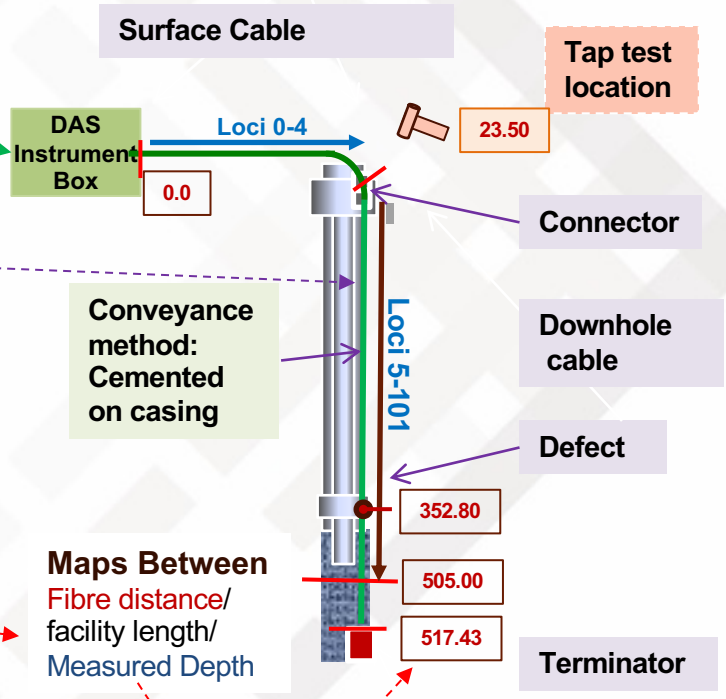




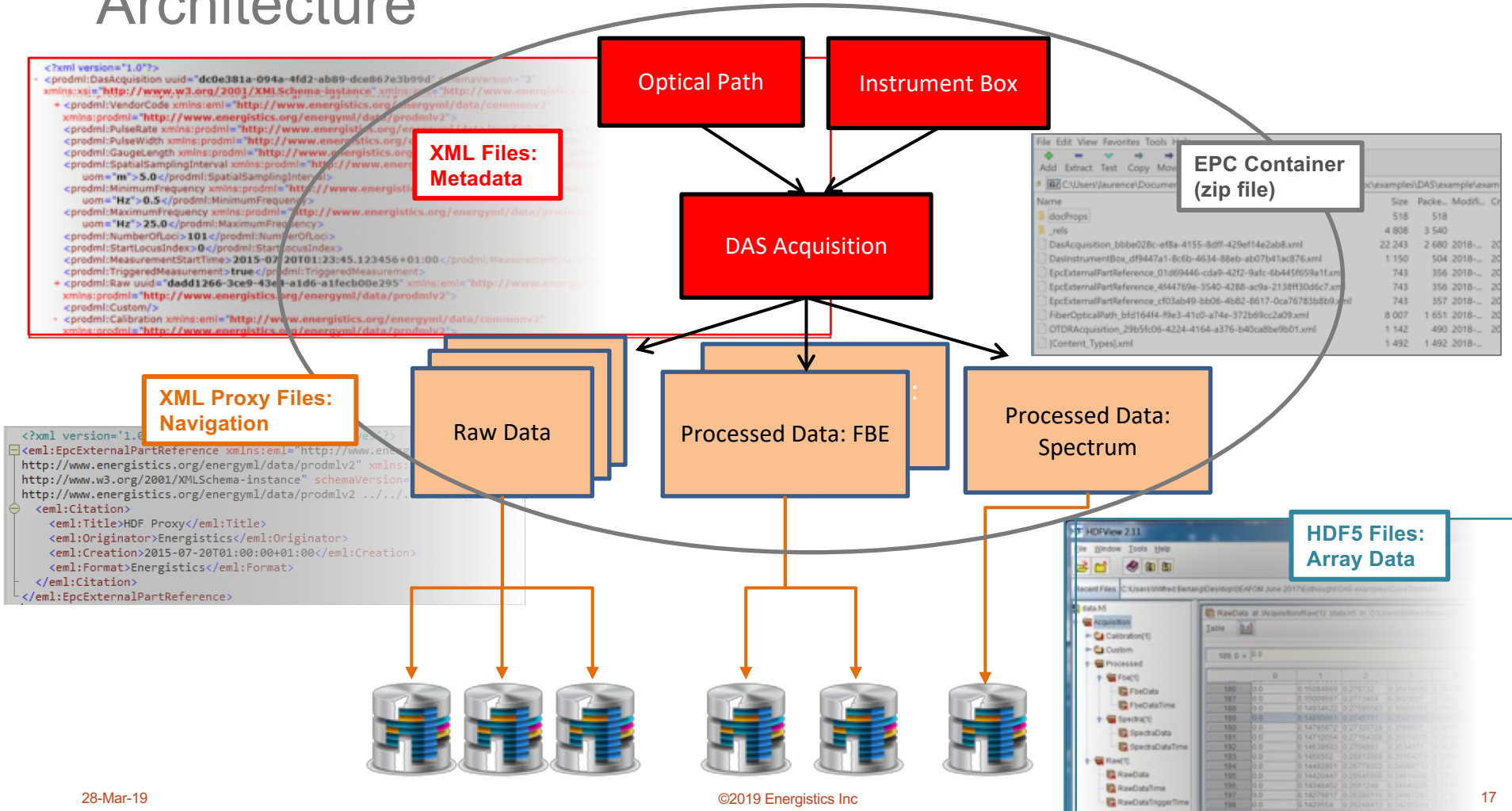
DAS Instrument Box

Fiber Optical Path & OTDR

DAS Acquisition Tables of locus locations



Architecture



PRODML DAS from Inception to Adoption

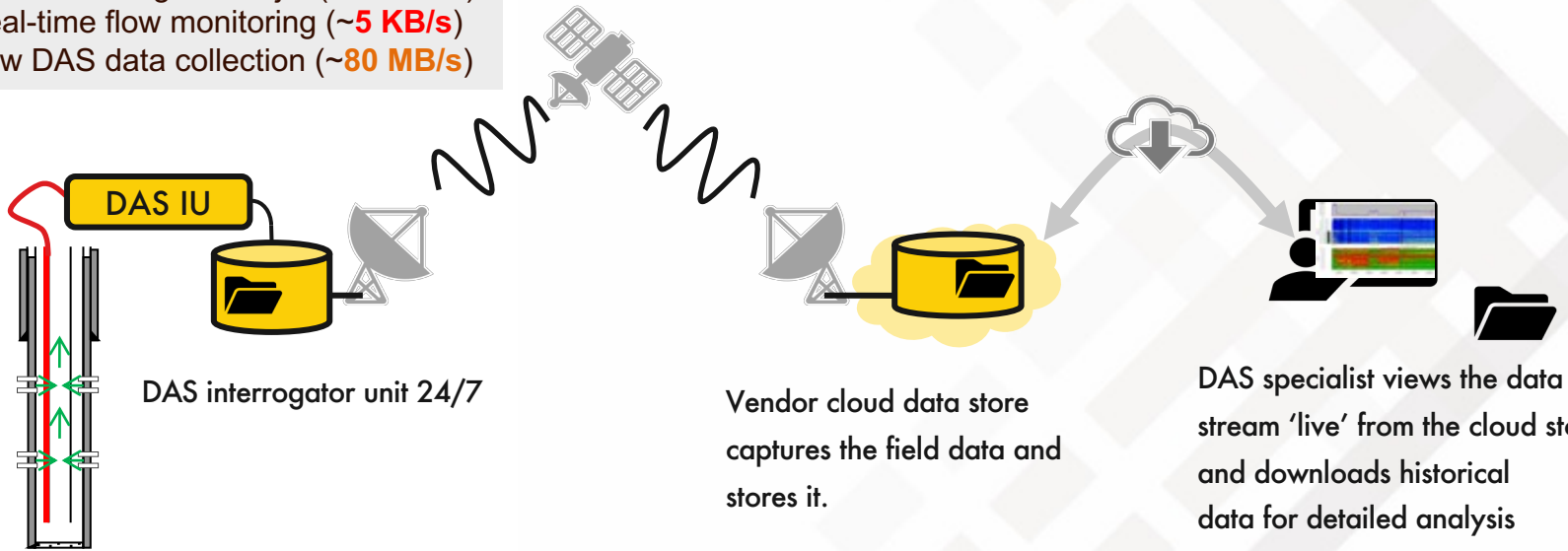
ENERGISTICS

- DAS Scope (build on DTS PRODML)
  - Raw data & processed data: frequency and spectrum

- Status
  - June 2014 - First proposal to develop DAS exchange standard to Energistics
  - December 2016 - PRODML v2.0 exchange standard – first schema published
  - January 2017 to date - PRODML DAS adoption project – real world deployments
  - August 2018 PRODML v2.1 draft – update based on adoption experiences
  - April 2018 to date - ETP for DAS streaming – new activity, charter drafted, preliminaries
  - Team (**Development**/Review):
    Shell, Chevron, Total, BP
    OptaSense, Silixa, Baker Hughes, **Enthought, FoTech, Ziebel,** Schlumberger, Halliburton, Weatherford, Petrabytes, ISP & others

DAS Streaming: lower cost using remote instead of field support; safer operations - reduced exposure; low cost on-line monitoring as needed

Use Cases
DAS **frac** - live monitoring of frac job(~**100kB/s**)
DAS **flow** - real-time flow monitoring (~**5 KB/s**)
DAS **raw** – raw DAS data collection (~**80 MB/s**)



- PRODML is a **data exchange standard**, but XML overhead makes less suitable for real-time data streaming
- **Energistics Transfer Protocol** - **ETP** – provides layer that enables 'Netflix'-like data streaming

Key Take-Aways

- **DAS PRODML v2.0 released December 2016**
- **DAS Adoption project 2017 - 18**
  - Test data sets provided by Shell (synthetic samples) and Silixa (real lab data)
  - Adopted by several operators and service providers, growing user base
- **DAS PRODML v2.1** review release Q3 2018 **(publication Q2 2019)**
  - Optimizations and bug-fixes based on feedback from adoption project
  - Schemas, worked examples and datasets, fully documented, limited open source
  - Adoption team continues for support, issue resolution etc.
- **Clear business benefits using a standardized approach**

- DAS ETP streaming activity has been kicked off … open for participation

Q&A

- PRODML DAS Technical Webinar 24 April 2019
- More information: https://www.energistics.org/

ENERGISTICS

ADOPT > ADVANCE > ACCELERATE

Thank you

Next Webinar on DAS - PRODML Technical Information April 24th 2019

www.energistics.org