

# Drilling Automation and WITSML

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# Overview

## Drilling Automation

- Why automate with examples
- Industry Groups

## DSA-TS Architecture

## Opportunities for WITSML

# What is an Automated Rig?

**Conventional**



**Automated**



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# RSS PowerDrive Activity US Land 2004

Number of Runs on Automated rigs versus conventional rigs



Footage Drilled on Automated rigs versus conventional rigs

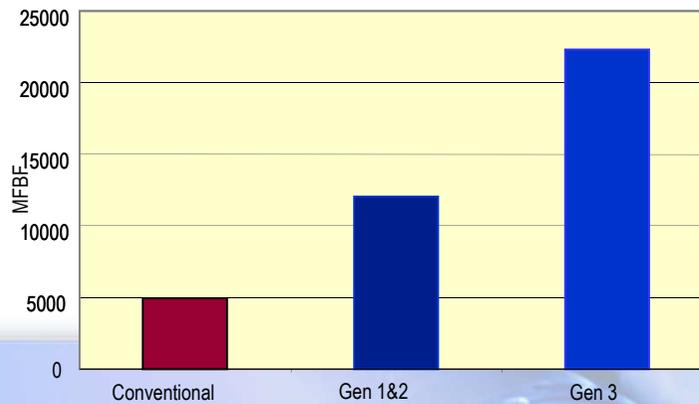
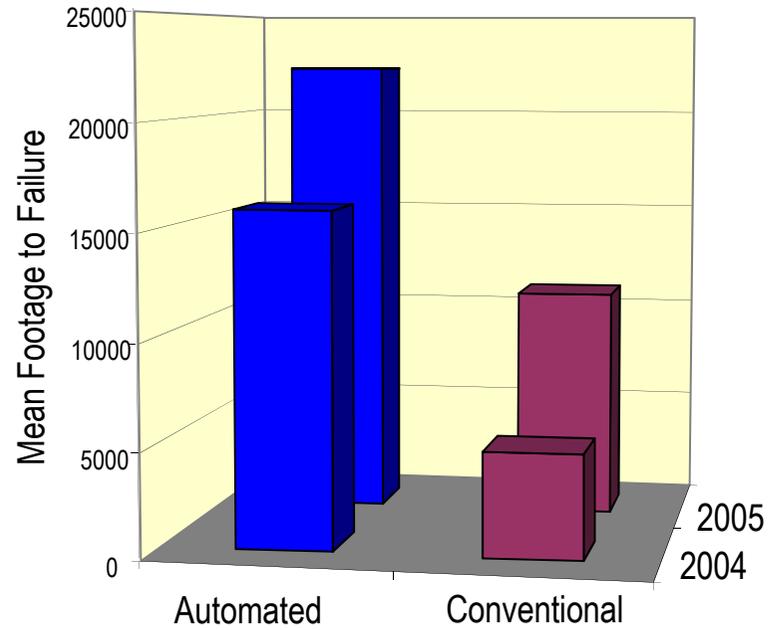
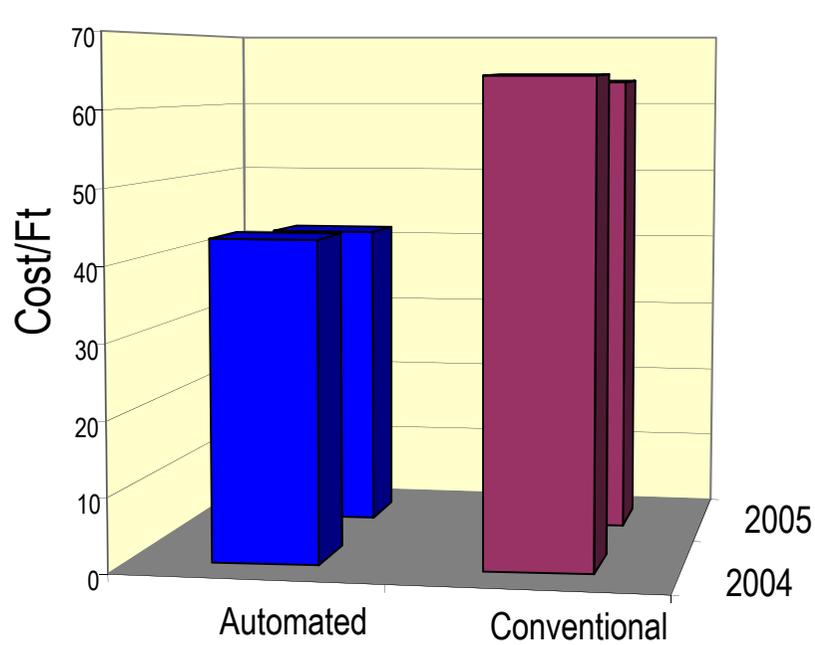


- 34% of all PD runs in USL to date are on Automated rigs
- 46% of PD footage has been drilled on Automated rigs
- Average run length of 2,213ft on Automated compared to 1,344 ft on any other rig
- Automated rigs used on difficult well
- RSS predominantly used on 'good' land rigs

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# RSS Performance US Land



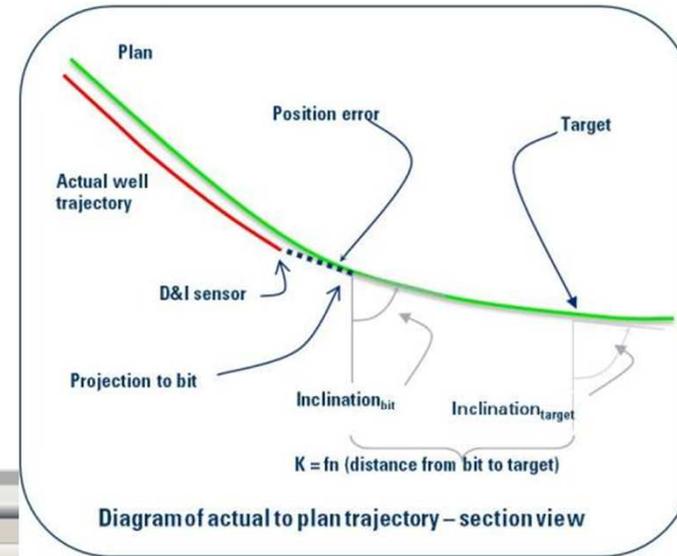
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# Automated Steering

Predict RSS Tool settings and then advise and/or control the RSS via downlinks to tool.



**TOOLFACE**

Bit Depth: 3108.91 m  
Hole Depth: 3108.91 m

Steering Control: Synchronized, On Bottom, Out of Slip, Drilling

Current: 0.00 deg, Power Setting: 45.00, Depth: 1063.14 m  
Recommended: 20.00 deg, Power Setting: 60.00, Depth: 1090.64 m

Rec. freq. SRV TF Offset is too large. Recommended DL can be wrong!

Survey Data (last 5 stations)

MD	Incl	Actm	TVD	DLS
3063.44	92.68	321.30	3228.34	0.98
3086.20	92.68	321.30	3227.56	0.00
4000.00	92.68	321.30	3222.24	0.00
4100.00	92.68	321.30	3217.56	0.00
4200.00	92.00	321.00	3213.48	0.22

RT Drilling Parameters

Channel	Unit	Current	Average
ROPS		--	--
RFM		--	--
SWOB		--	--
FLW		--	--
STICK_RT		--	--

RT Drilling Parameters (continued):

HD	1076.00 m
Inclination	22.00 deg
Azimuth	302.22 deg
DLS Gain	-3.83 deg/30m
Build Bias	0.40 deg/30m
Walk Bias	0.37 deg/30m
TF Offset	-24.70 deg
Cal. Inter.	m

10:53:42 AM

TOOLFACE RSS Details RSS Downlink Page

RSS InputData

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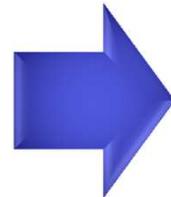
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# Automatic Downlinking

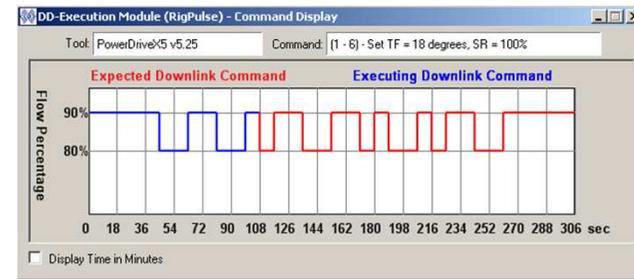
## Manual method



Command	Sequence	Channel	Steps	Current Value	Progress %	Type	Duration
1	1	PowerDrive	Set TF = 18 degrees, SR = 100%				
2	2	PowerDrive	Set TF = 18 degrees, SR = 100%				
3	3	PowerDrive	Set TF = 18 degrees, SR = 100%				
4	4	PowerDrive	Set TF = 18 degrees, SR = 100%				
5	5	PowerDrive	Set TF = 18 degrees, SR = 100%				
6	6	PowerDrive	Set TF = 18 degrees, SR = 100%				
7	7	PowerDrive	Set TF = 18 degrees, SR = 100%				
8	8	PowerDrive	Set TF = 18 degrees, SR = 100%				
9	9	PowerDrive	Set TF = 18 degrees, SR = 100%				
10	10	PowerDrive	Set TF = 18 degrees, SR = 100%				
11	11	PowerDrive	Set TF = 18 degrees, SR = 100%				
12	12	PowerDrive	Set TF = 18 degrees, SR = 100%				
13	13	PowerDrive	Set TF = 18 degrees, SR = 100%				
14	14	PowerDrive	Set TF = 18 degrees, SR = 100%				
15	15	PowerDrive	Set TF = 18 degrees, SR = 100%				
16	16	PowerDrive	Set TF = 18 degrees, SR = 100%				
17	17	PowerDrive	Set TF = 18 degrees, SR = 100%				
18	18	PowerDrive	Set TF = 18 degrees, SR = 100%				
19	19	PowerDrive	Set TF = 18 degrees, SR = 100%				
20	20	PowerDrive	Set TF = 18 degrees, SR = 100%				
21	21	PowerDrive	Set TF = 18 degrees, SR = 100%				
22	22	PowerDrive	Set TF = 18 degrees, SR = 100%				
23	23	PowerDrive	Set TF = 18 degrees, SR = 100%				
24	24	PowerDrive	Set TF = 18 degrees, SR = 100%				
25	25	PowerDrive	Set TF = 18 degrees, SR = 100%				
26	26	PowerDrive	Set TF = 18 degrees, SR = 100%				
27	27	PowerDrive	Set TF = 18 degrees, SR = 100%				
28	28	PowerDrive	Set TF = 18 degrees, SR = 100%				
29	29	PowerDrive	Set TF = 18 degrees, SR = 100%				
30	30	PowerDrive	Set TF = 18 degrees, SR = 100%				
31	31	PowerDrive	Set TF = 18 degrees, SR = 100%				
32	32	PowerDrive	Set TF = 18 degrees, SR = 100%				
33	33	PowerDrive	Set TF = 18 degrees, SR = 100%				
34	34	PowerDrive	Set TF = 18 degrees, SR = 100%				
35	35	PowerDrive	Set TF = 18 degrees, SR = 100%				
36	36	PowerDrive	Set TF = 18 degrees, SR = 100%				
37	37	PowerDrive	Set TF = 18 degrees, SR = 100%				
38	38	PowerDrive	Set TF = 18 degrees, SR = 100%				
39	39	PowerDrive	Set TF = 18 degrees, SR = 100%				
40	40	PowerDrive	Set TF = 18 degrees, SR = 100%				
41	41	PowerDrive	Set TF = 18 degrees, SR = 100%				
42	42	PowerDrive	Set TF = 18 degrees, SR = 100%				
43	43	PowerDrive	Set TF = 18 degrees, SR = 100%				
44	44	PowerDrive	Set TF = 18 degrees, SR = 100%				
45	45	PowerDrive	Set TF = 18 degrees, SR = 100%				
46	46	PowerDrive	Set TF = 18 degrees, SR = 100%				
47	47	PowerDrive	Set TF = 18 degrees, SR = 100%				
48	48	PowerDrive	Set TF = 18 degrees, SR = 100%				
49	49	PowerDrive	Set TF = 18 degrees, SR = 100%				
50	50	PowerDrive	Set TF = 18 degrees, SR = 100%				



## Automatic method




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## Shell Cliffdale Asset, Peace River

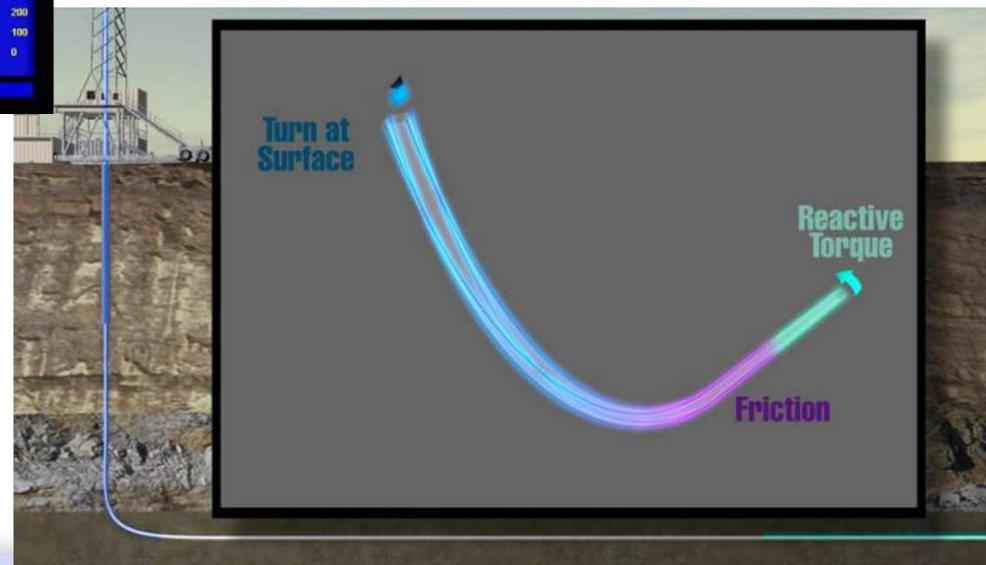
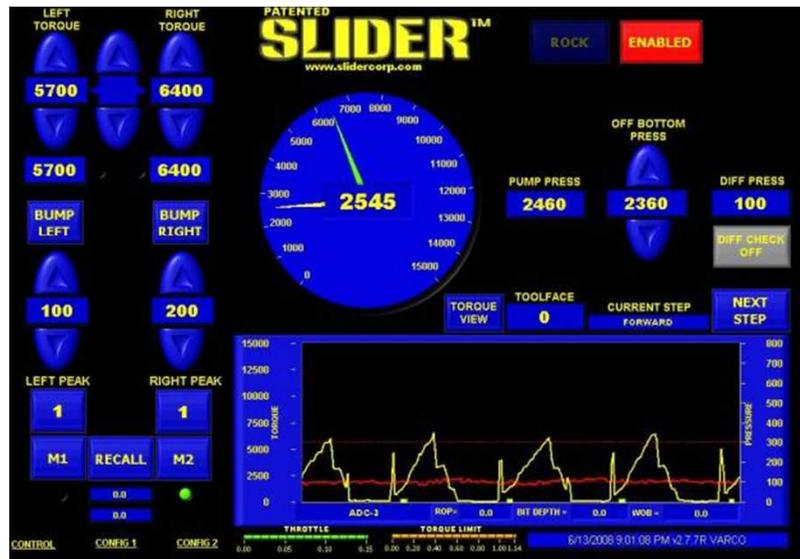
In 2009, a Shell-engineered **SCADA** system was installed on a hydraulic rack-and-pinion rig. It integrated the control and data acquisition systems of:

- **Top Drive**
- **Mud Pumps**
- **Electronic Data Recorder**
- **MWD (un-manned)**
- **Flow Meters**



“Two multi-lateral oil production wells were drilled in closed-loop autonomous fashion, with the SCADA system controlling the entire rotary and slide-drilling process from slips-out to slips-in, without driller intervention. This included automatically generated trajectory steering commands.”

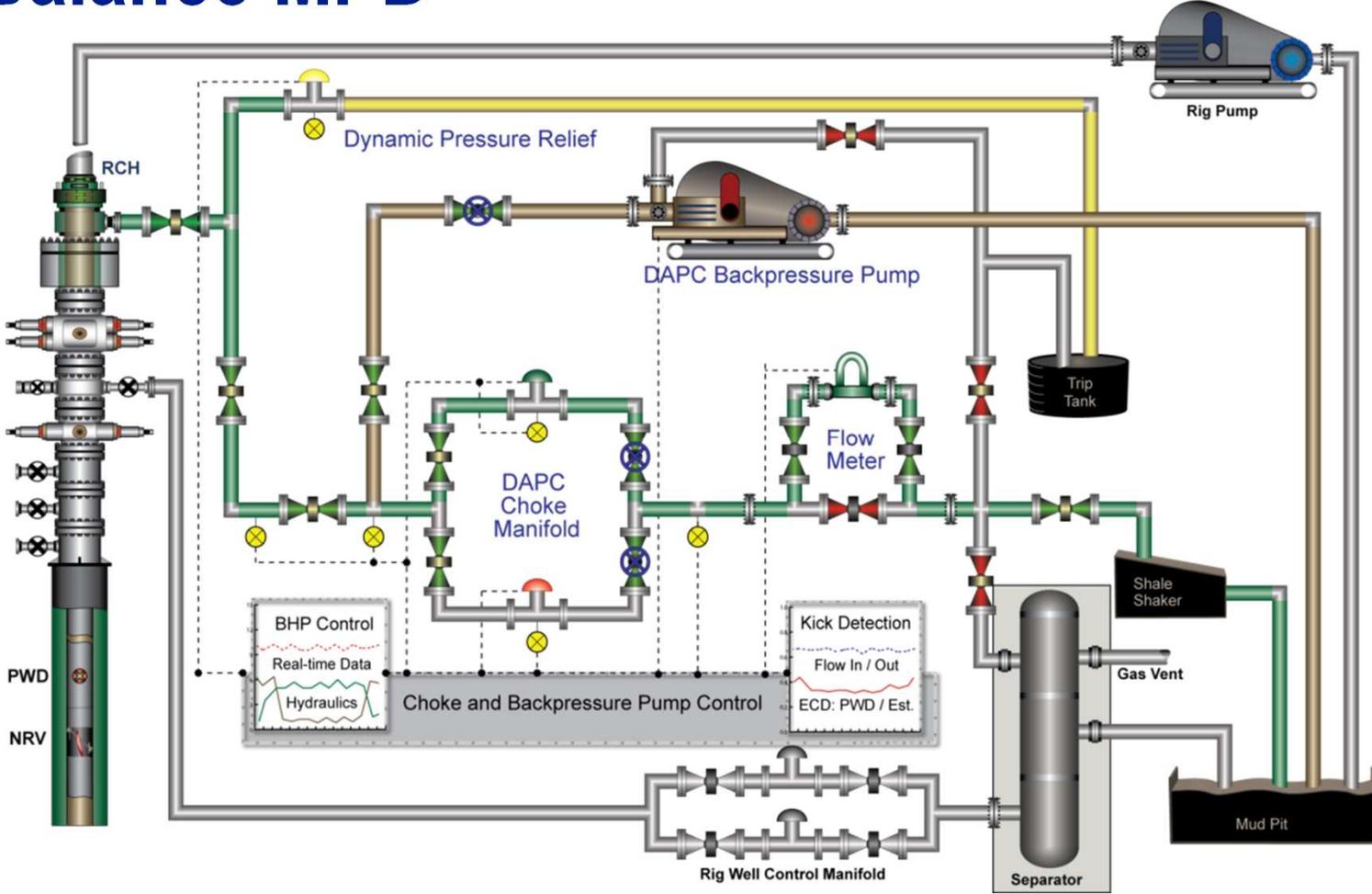
# SLIDER™



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# @Balance MPD



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# Industry Committees

## IADC ART - Advanced Rig Technology

- Reliability
- Future Technology
- Drilling CS
- Technology Value Guide



## SPE DSA-TS – Drilling System Automation Technical Section

- Communication Sub-Team



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# DSA-TS Comms Team

## Phase I

- Identify and define key interface points to equipment on rig
- Agree upon a list of tag names for the key interface points for use in communication protocols
- Agree upon at least one open communication protocol between components

## Phase II

- Define components of architecture
- Define high levels roles and responsibilities of each component
  - Security
  - Heartbeat – Protocol and methodology
  - Etc.

## Phase III

- Identify and define industry terminology necessary to enable process automation for drilling of oil and gas wells
- Define interface for components (e.g. limits management, authorization, alarm & events, etc.)

## Phase IV

- Define commissioning tests (starting conditions, procedure, and expected results) for DSATs Comms Box control system.

# DSA-TS

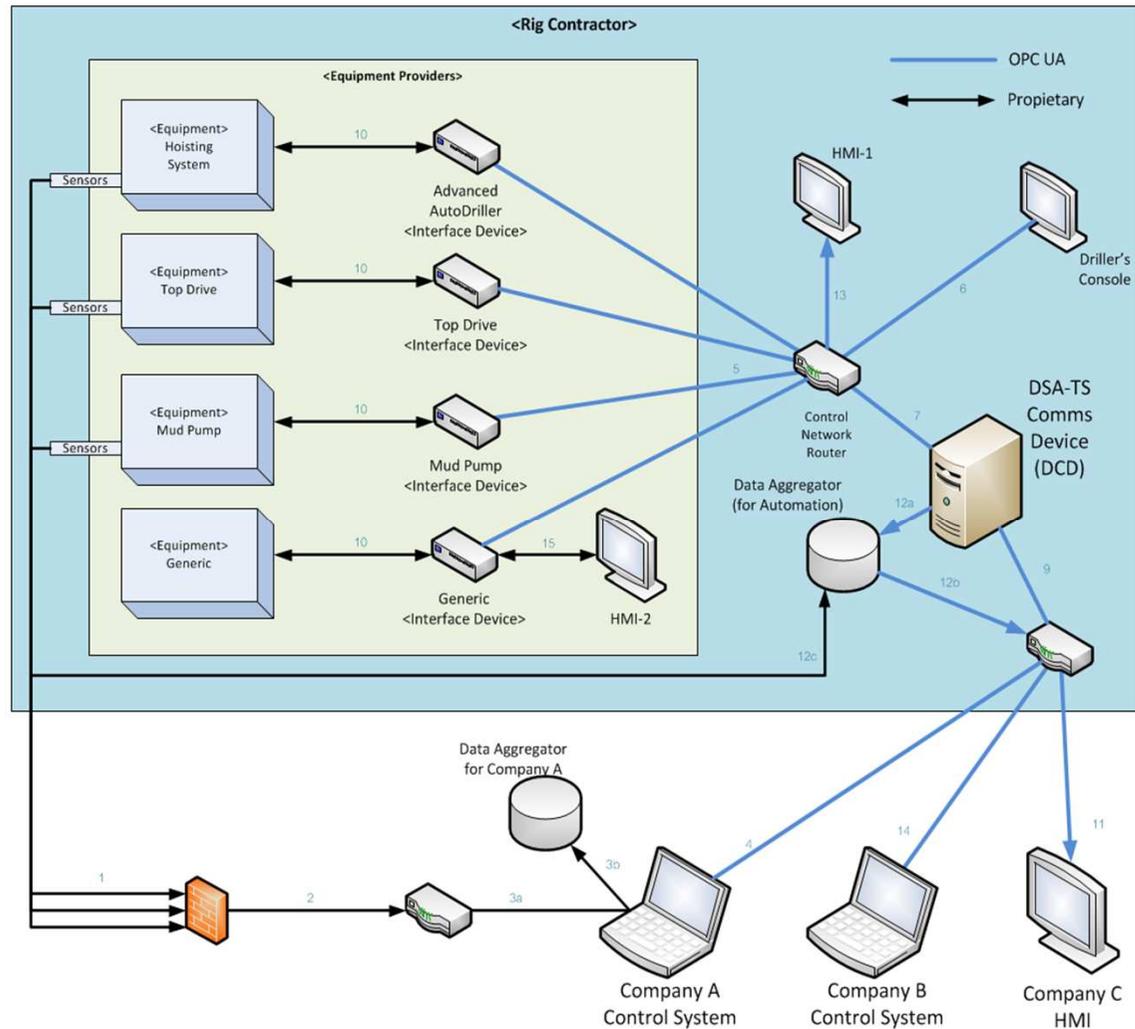
## Automation Architecture

### Communication Protocols

- OPC UA
- Proprietary

### DCD

- Isolates Rig Equipment
  - Security / Authorization
  - Standard Interface
    - Equipment Interfaces
    - External Interfaces



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# OPC UA (Unified Architecture)

- Moves from COM to Web Services
- Easier to implement on non-Microsoft OS.
- Single set of services to expose all OPC Services (DA, HDA, A&E, ...)
- Organizations need efficient method to expose and move high level structured data

## Protocols that support:

- Security & Authentication
- Binary data transfer
- Publish / Subscribe
- RT Data Access
- Historical Data Access
- Alarms & Events
- Discovery

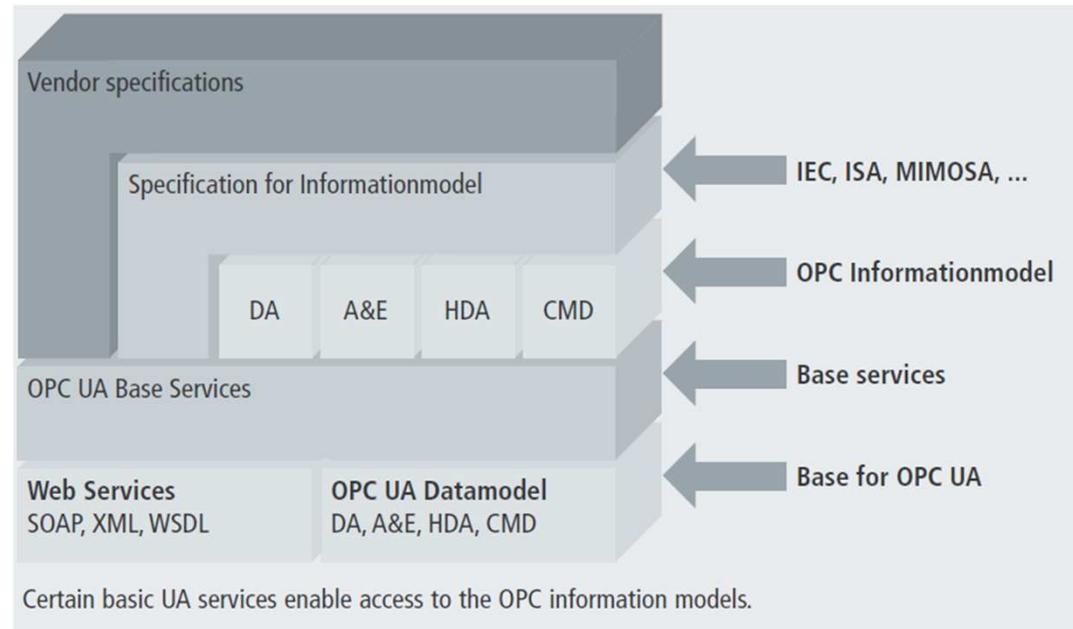
# WITSML Opportunities / Directions

## OPC UA

MIMOSA - An Operations and Maintenance Information Open System Alliance  
ISA – International Society of Automation  
IEC – International Electrotechnical Commission

Lay schema on top of services to get access to data.

- Integrate with off-the-shelf OPC UA data servers / client



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# WITSML Opportunities / Directions

## Automation Metadata

### Surface Equipment

- Description
- Tags
  - RT Values
  - Set Points
- Limits / Capacities

### Top Drive



FDS 150 portable direct drive patented Top Drives for Service Rigs and shallow to medium depth drilling rigs.

#### Features:

- Integrated Swivel and Traveling Block
- Back Torque Track and Bushing
- Integrated Backup Leg
- Integrated Thread Saver
- Top Drive Extend, c/w Back Torque Track
- Front Torque Track Available, no extend

#### Specifications:

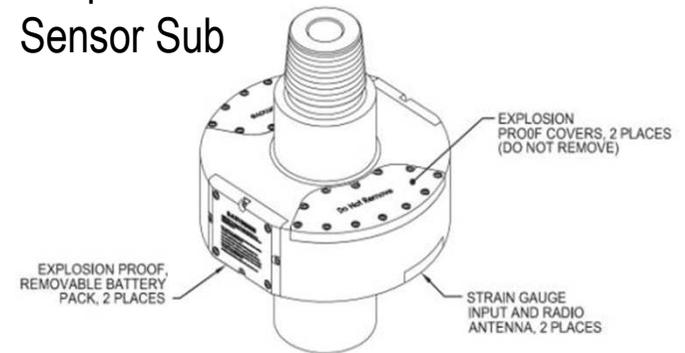
- Rated Capacity = 150 Ton
- API Dynamic Capacity = 100 Ton
- Pull Down Capacity = 15 Ton
- Breakout Torque = 15,000 ft-lb
- Makeup Torque = 13,000 ft-lb

#### Top Drive Running range:

- @ 40 RPM max 23,500 ft-lb (intermittent)
- @ 100 RPM max 19,000 ft-lb
- @ 180 RPM max 13,000 ft-lb

Maximum Speed = 200 RPM

### Torque / Hookload Sensor Sub



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### Manufacturer

- FDS

### Firmware Version

- V5.6.3

### Owner

- Saxon

### Type

- Top Drive Controller

### Etc.



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### Real-Time Values

- RPM (TD\_SPEED\_REF)
- Angular Position (TD\_POS\_DEGR)
- Torque (TD\_TORQUE\_REF)
- Bail Position (TD\_BAILS\_POS\_REF)
- Brake On (TD\_BRAKE\_ON\_OFF)
- Etc.

### Set Points

- Enable (REM\_DRILL\_ON\_CMD)
- RPM (TD\_RPM\_SP)
- Max Torque (TD\_MAX\_DRILL\_TORQUE\_SP)
- Angular Position (TD\_POS\_DEGR\_SP)
- Gear (TD\_GEAR\_SP)
- Etc.



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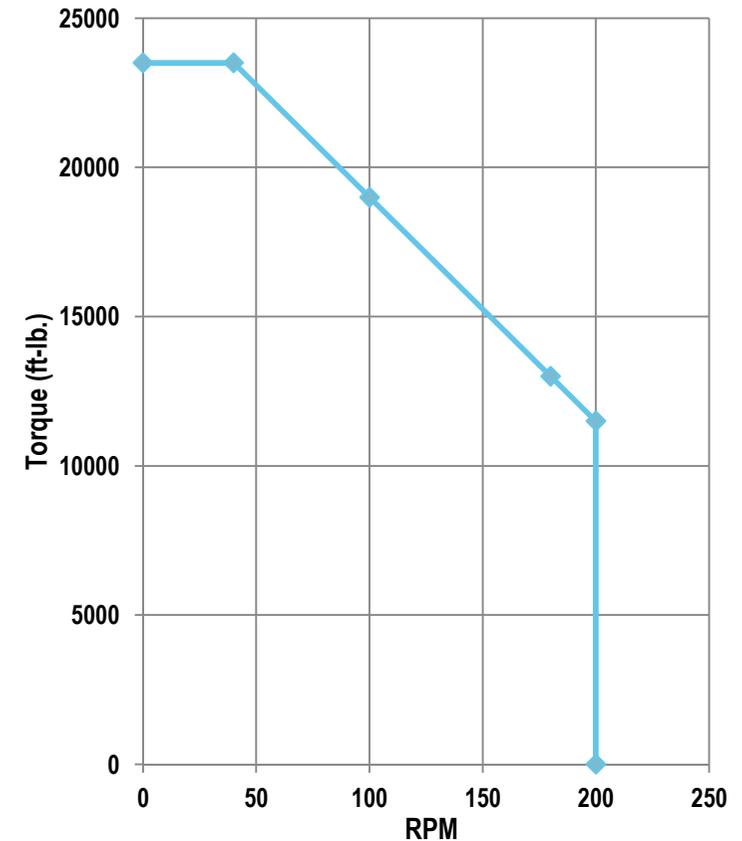
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### Top Drive Performance Curve FDS 150



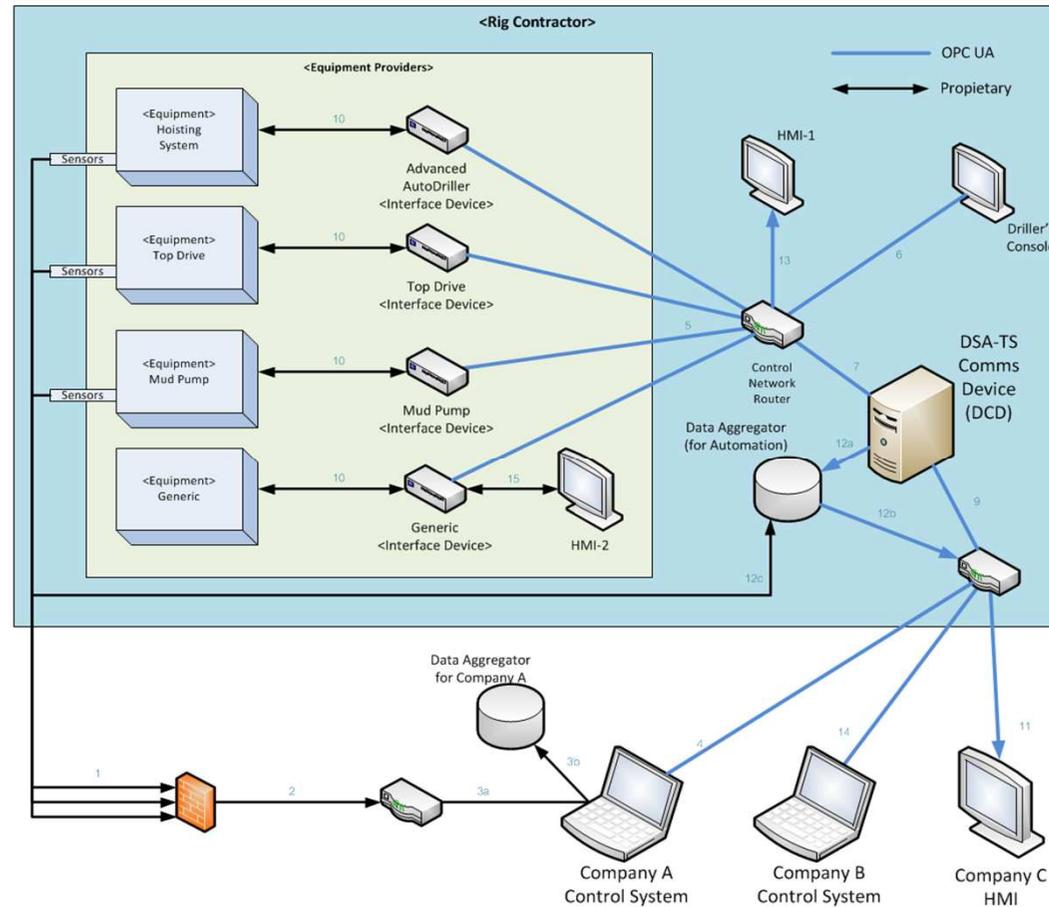
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# WITSML Opportunities / Directions

## Automation Metadata

### Network Topology

- Agent Description
- Company
- Users
- Status
- Versions
- Services
- Etc.



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# Overview

## Drilling Automation

- Why automate with examples
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## DSA-TS Architecture

## Opportunities for WITSML

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# Questions?

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