Drilling Automation and WITSML

Clinton D. Chapman

Drilling Automation Program Architect

Schlumberger

Overview

Drilling Automation

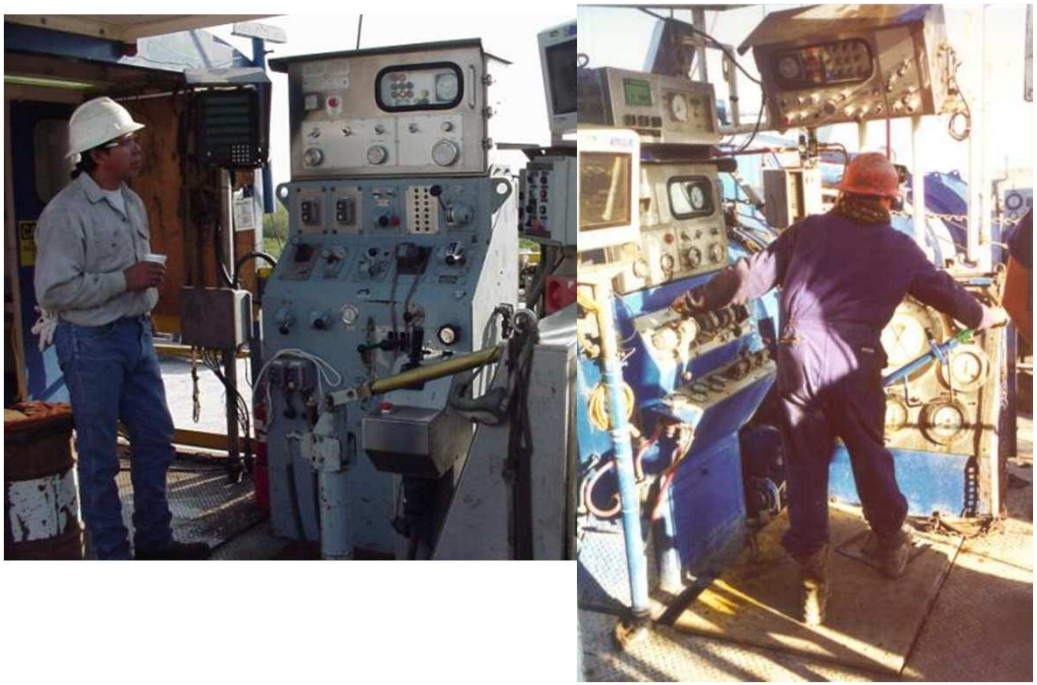
- Why automate with examples
- Industry Groups

DSA-TS Architecture

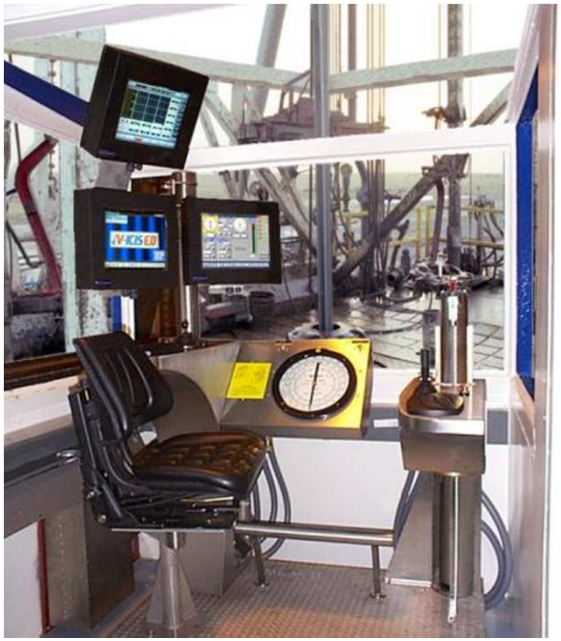
Opportunities for WITSML

What is an Automated Rig?

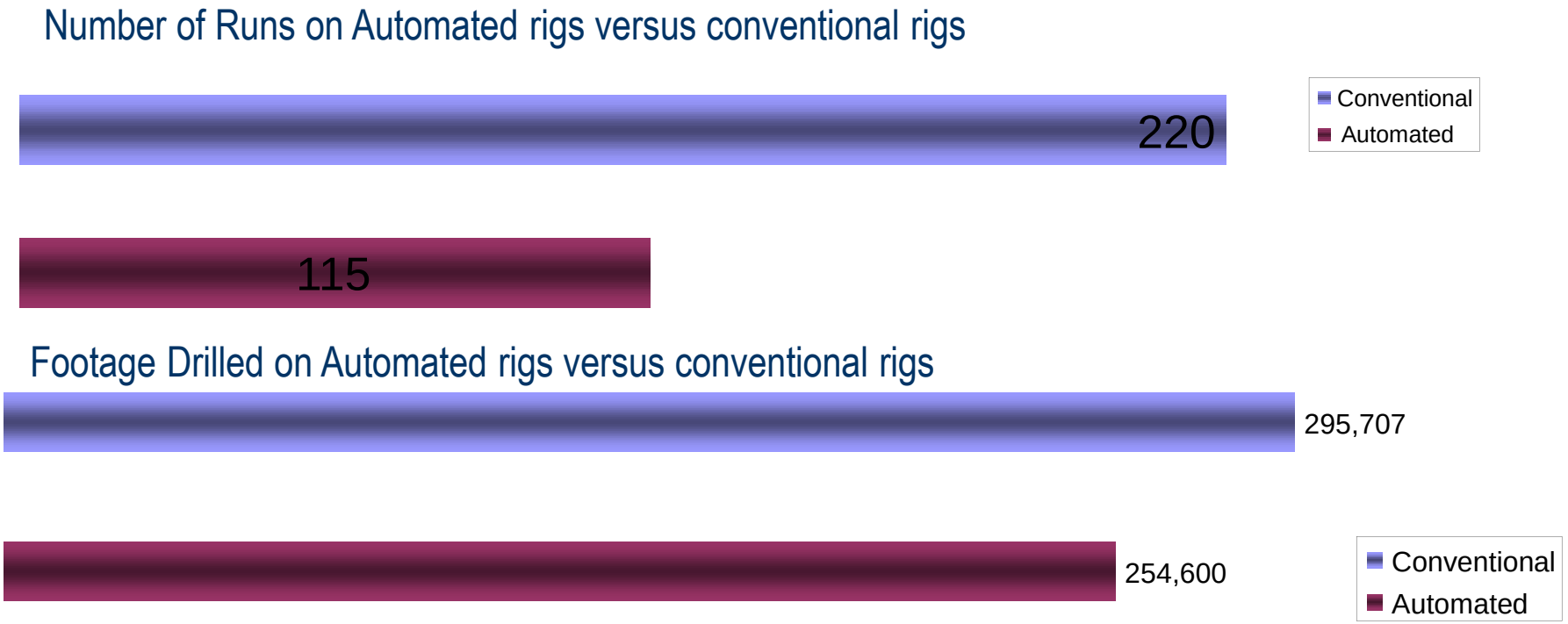
Conventional



Automated

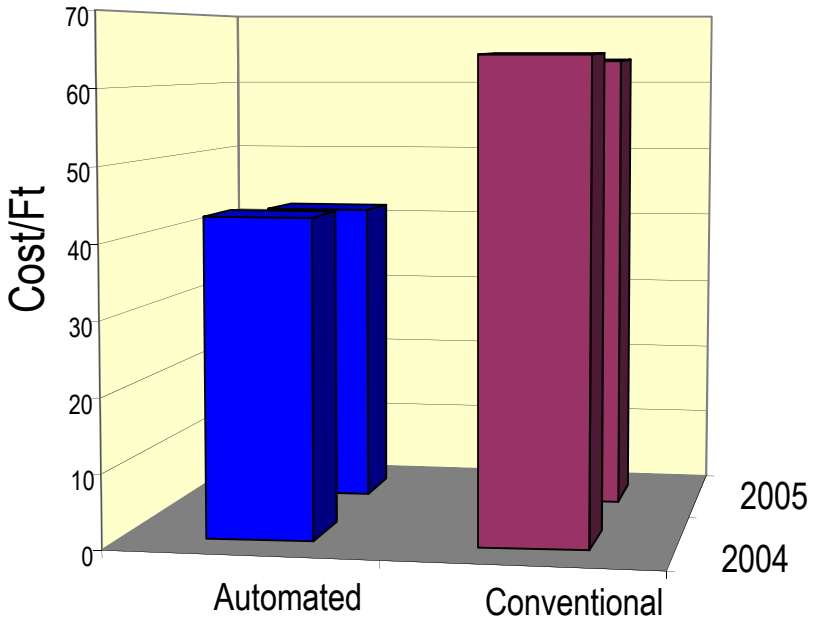


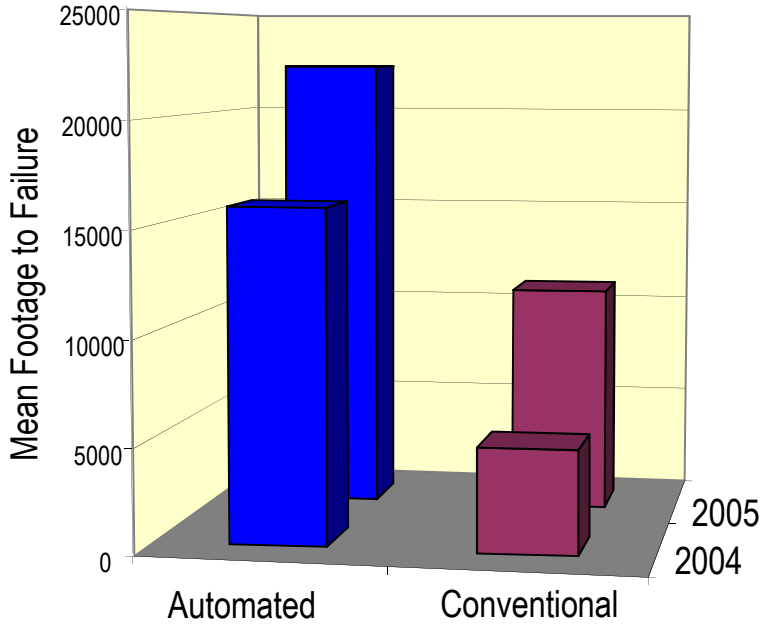
RSS PowerDrive Activity US Land 2004

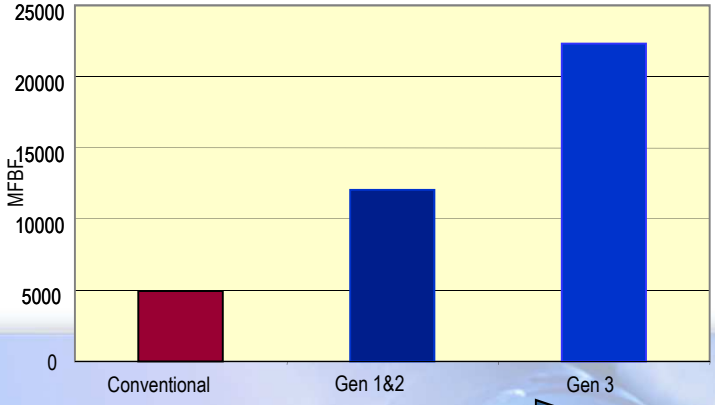


- 34% of all PD runs in USL to date are on Automated rigs
- 46% of PD footage has been drilled on Automated rigs
- Average run length of 2,213ft on Automated compared to 1,344 ft on any other rig
- Automated rigs used on difficult well
- RSS predominantly used on 'good' land rigs

RSS Performance US Land







Welcome to productive drilling

Increasing Technology

Schlumberger

Automated Steering

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

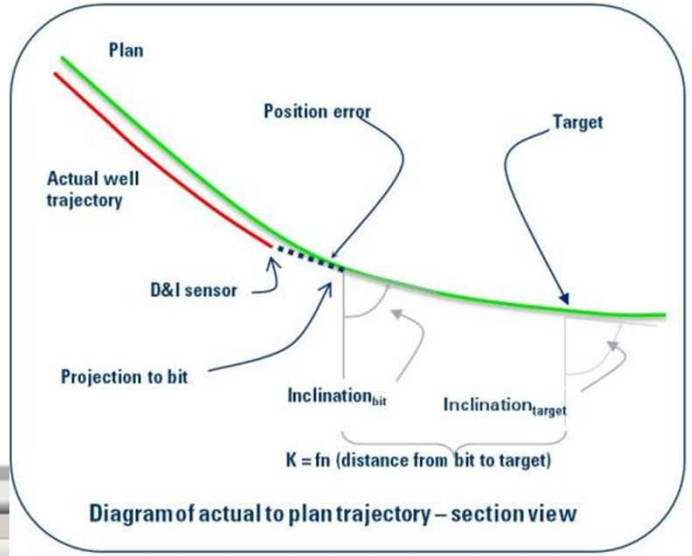
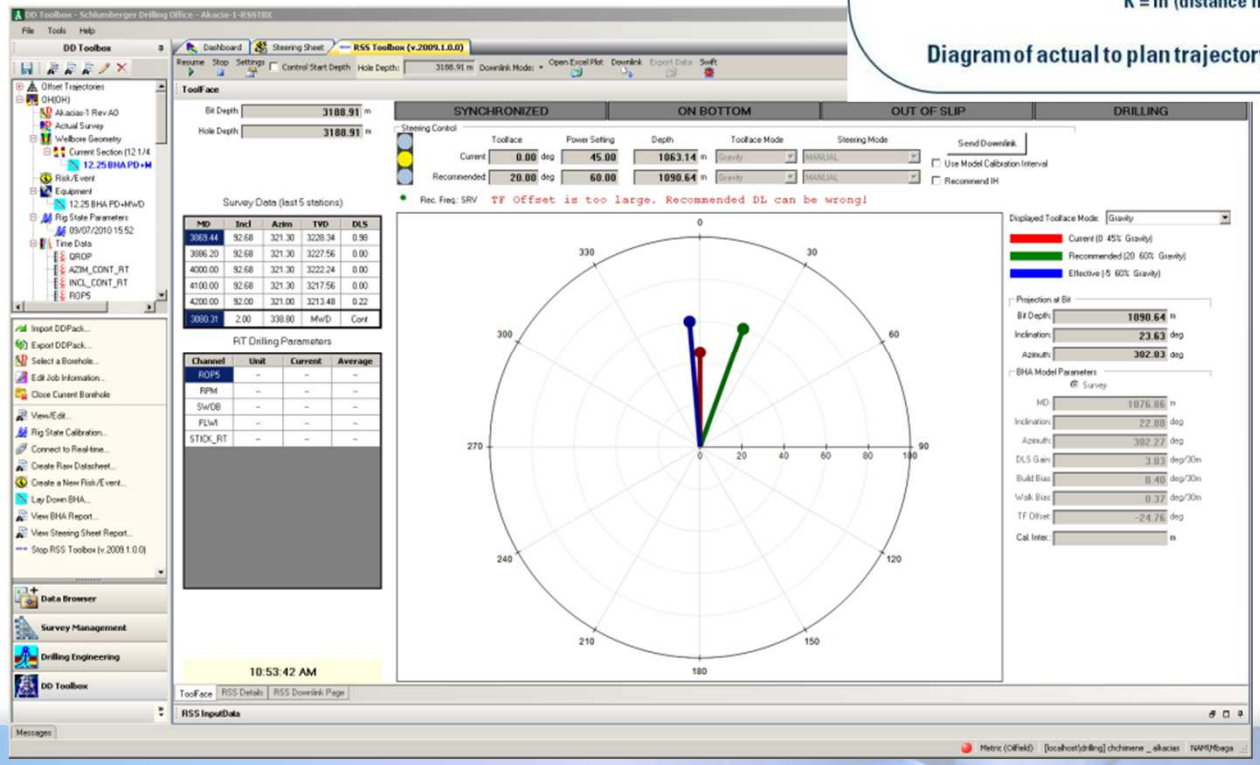
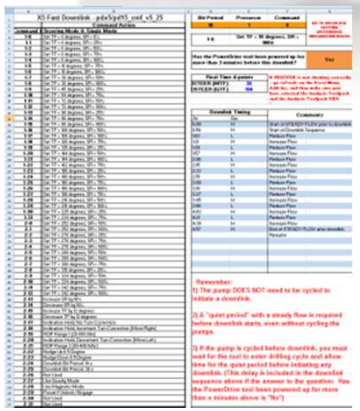


Diagram of actual to plan trajectory – section view

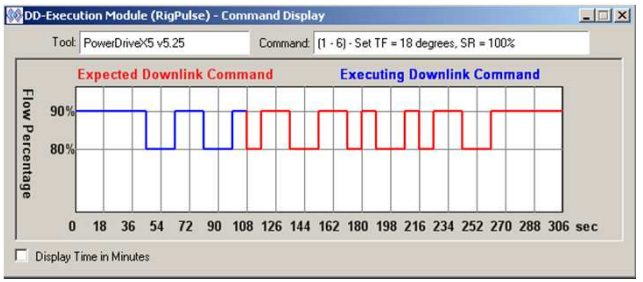


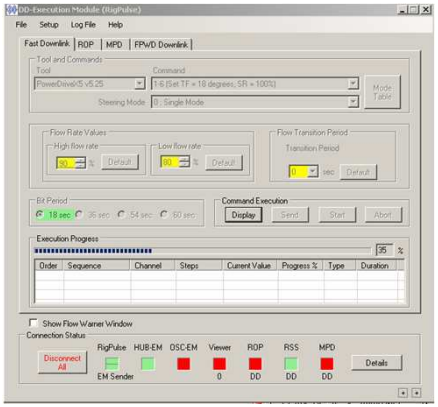
Automatic Downlinking

Manual method



Automatic method





Slide courtesy Jim B. Rogers of Shell

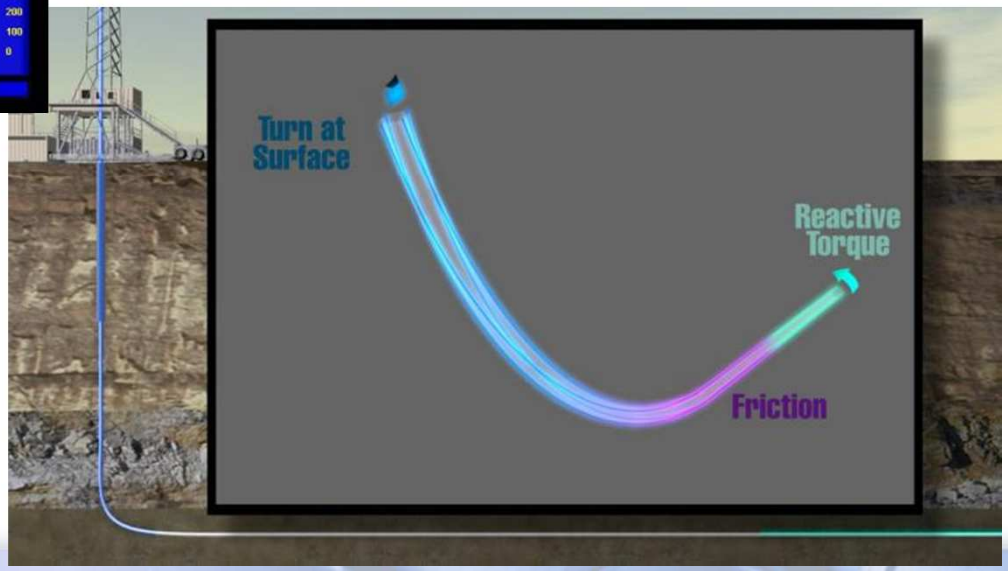
Shell Cliffdale Asset, Peace River

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."

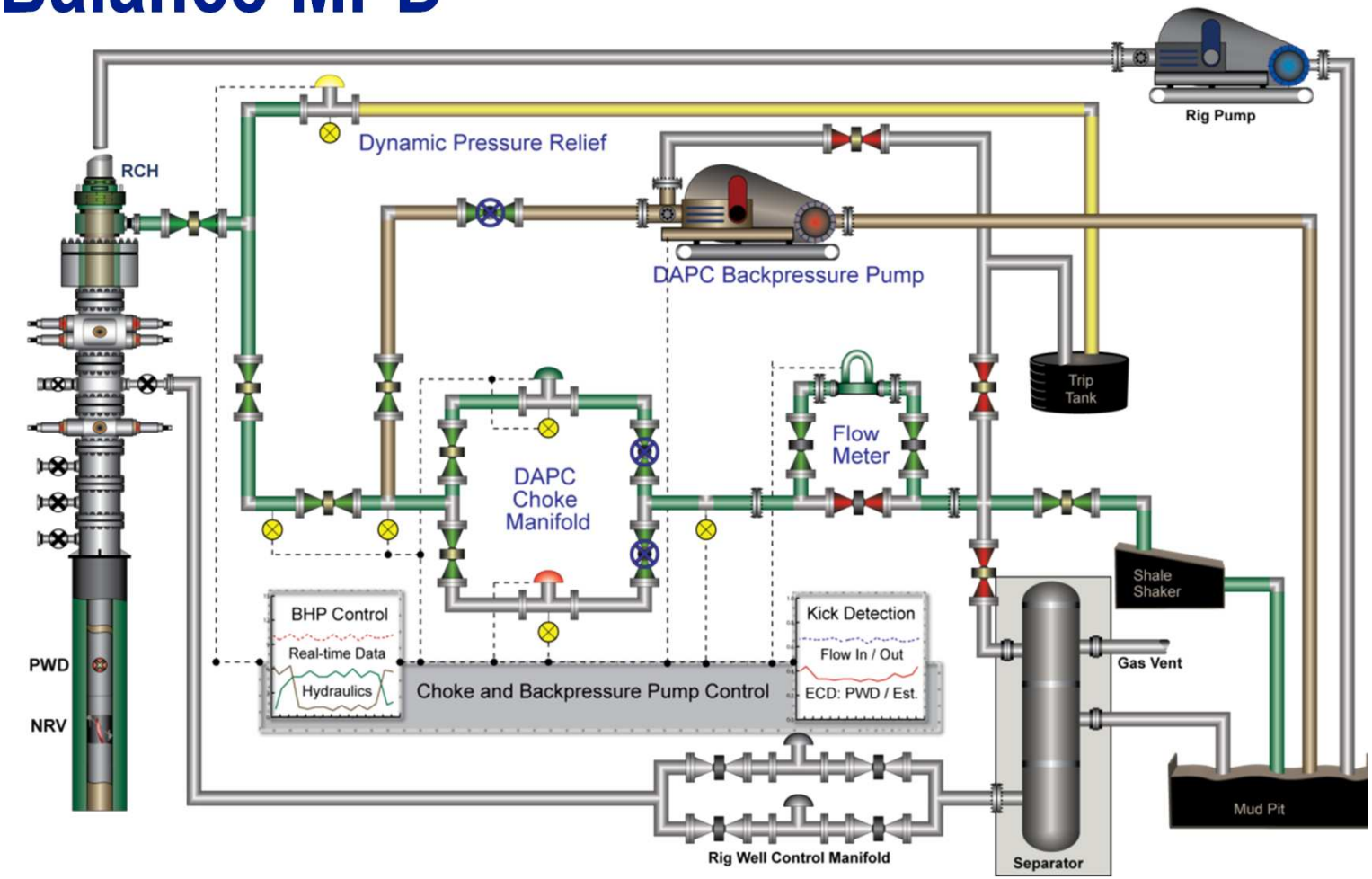
SLIDER™



Welcome to productive drilling

Schlumberger

@Balance MPD



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

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

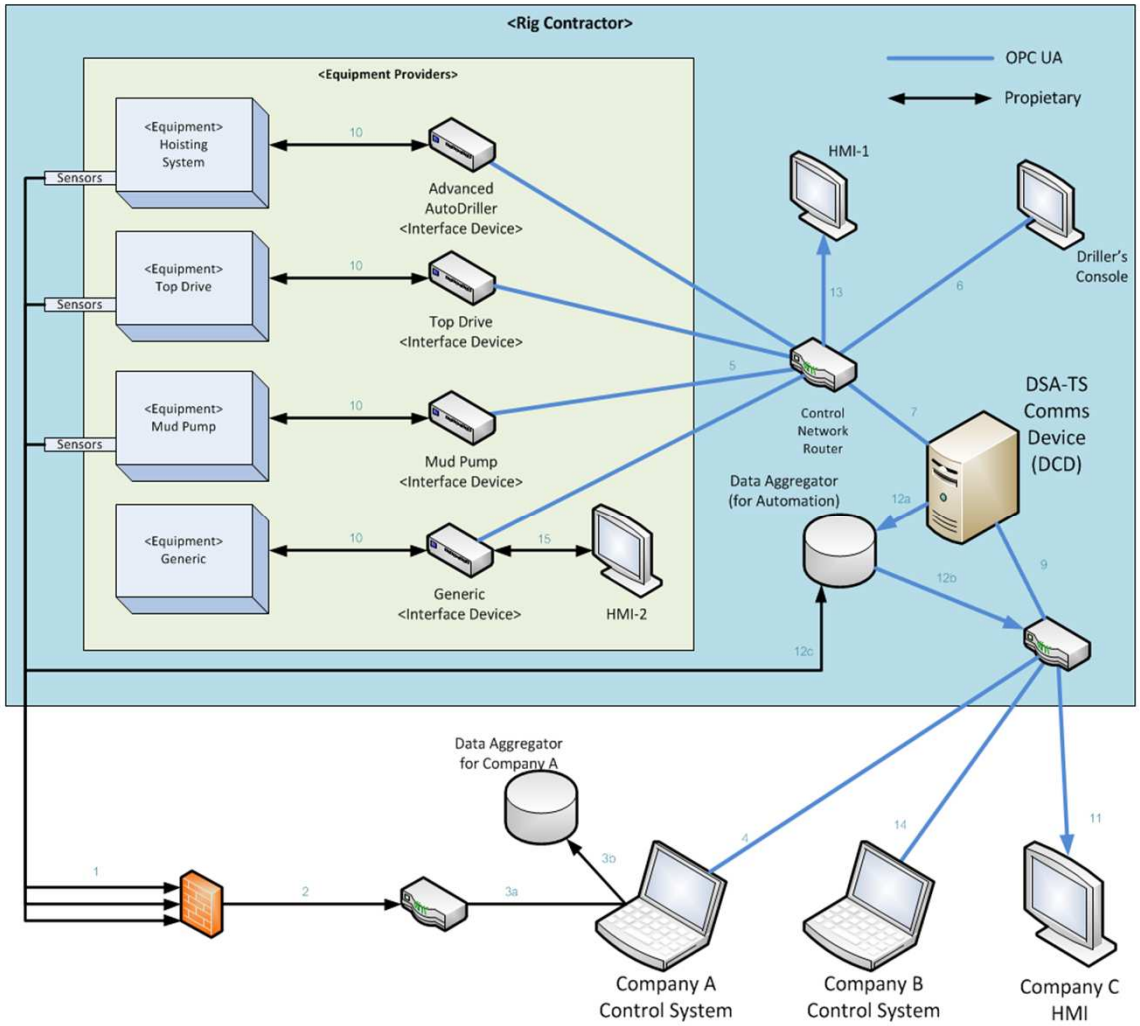
Automation Architecture

Communication Protocols

- OPC UA
- Proprietary

DCD

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



OPC UA (Unified Architecture)

WWW.OPCFOUNDATION.ORG

- 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

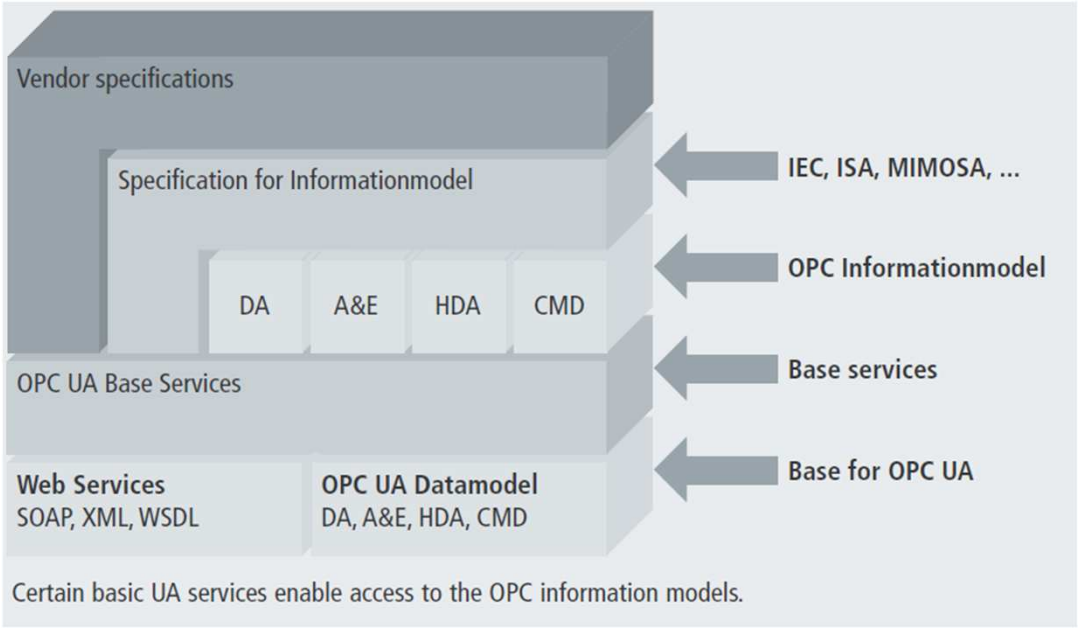
MIMOSA - An Operations and Maintenance Information Open System Alliance

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



Certain basic UA services enable access to the OPC information models.

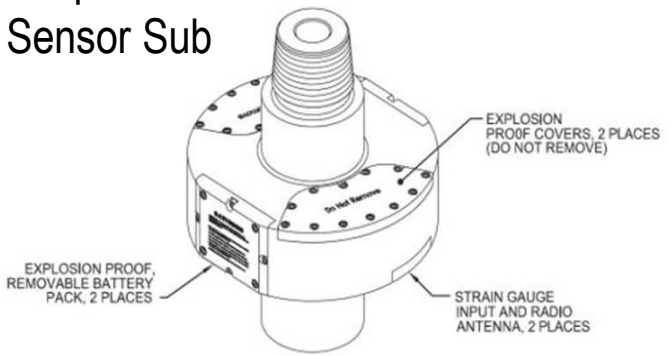
WITSML Opportunities / Directions

Automation Metadata

Surface Equipment

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

Torque / Hookload Sensor Sub



Mud Pump

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

WITSML Opportunities / Directions

Automation Metadata

Surface Equipment

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

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

Manufacturer

- FDS

Firmware Version

- V5.6.3

Owner

- Saxon

Type

- Top Drive Controller

Etc.

WITSML Opportunities / Directions

Automation Metadata

Surface Equipment

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

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.

WITSML Opportunities / Directions

Automation Metadata

Surface Equipment

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

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

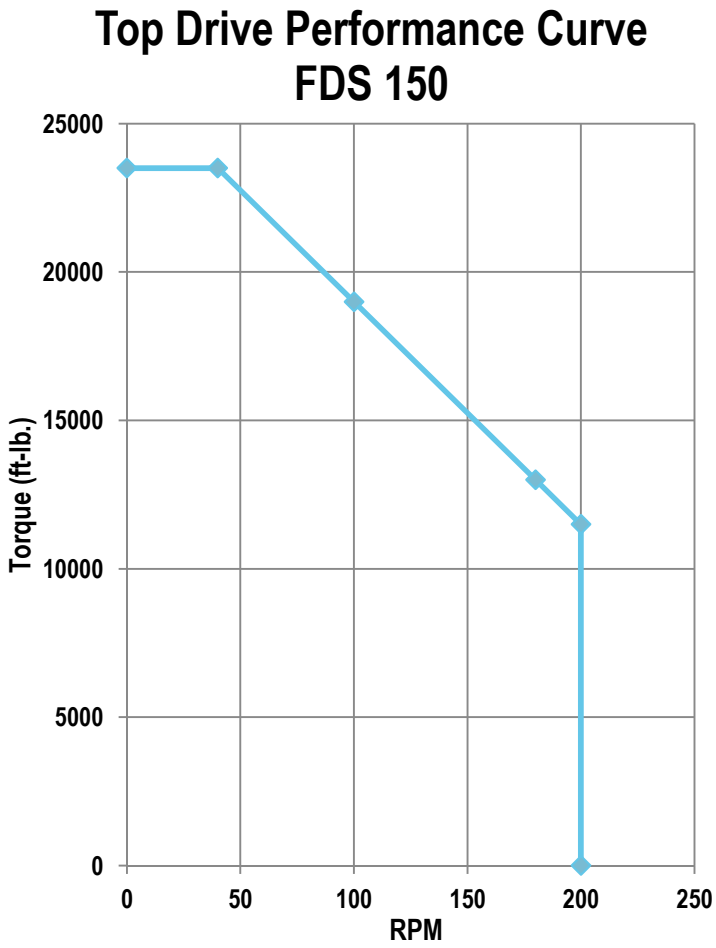
Specifications:

- 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



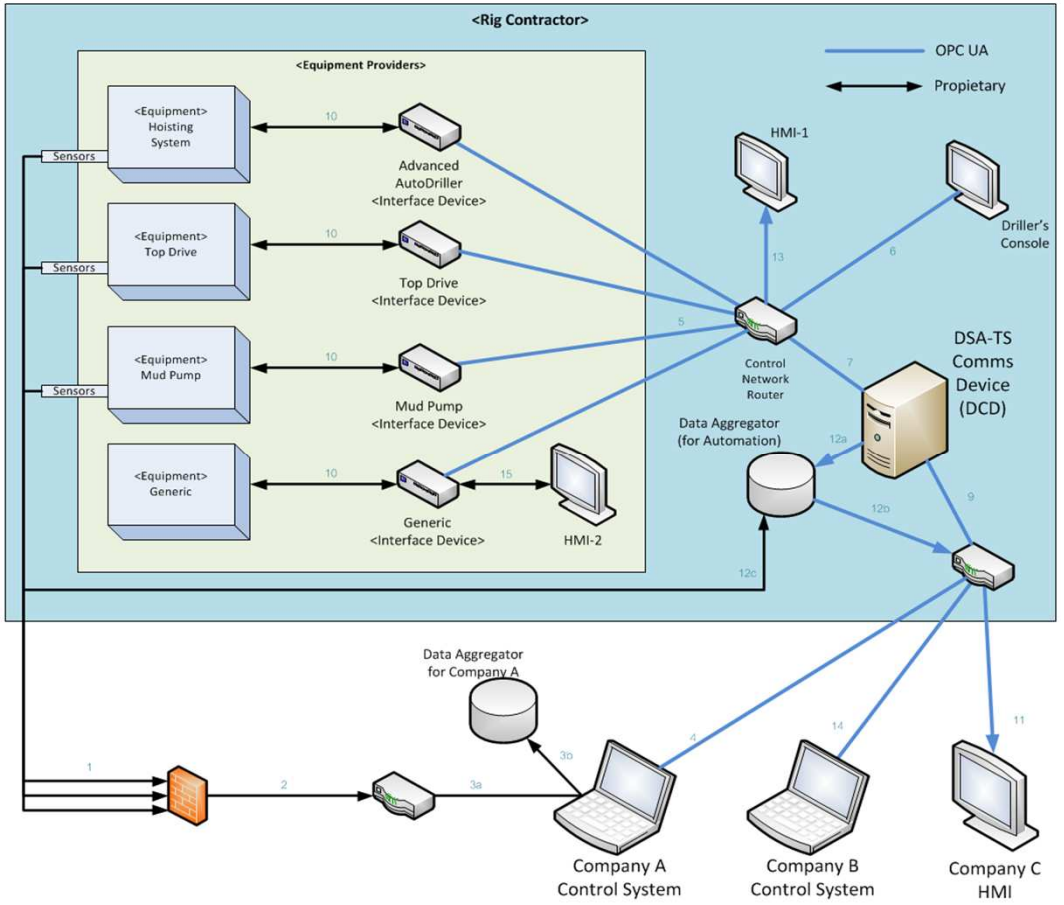
Schlumberger

WITSML Opportunities / Directions

Automation Metadata

Network Topology

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



Overview

Drilling Automation

- Why automate with examples
- Industry Groups

DSA-TS Architecture

Opportunities for WITSML

Questions?