OILFIELD IoT DATA ACQUISITION AND COMMUNICATION ARCHITECTURE GUIDE

01 OILFIELD IOT SYSTEM ARCHITECTURE

The Oilfield IoT system links wellsite equipment, field measurement instruments, intelligent control terminals, communication networks and software applications. It provides a structured path for acquiring operating information from different artificial-lift systems and making the data available to centralized monitoring and management functions. Rod-pumped and PCP wells require application-specific data acquisition because their operating mechanisms and measurable parameters differ.

FIVE-LAYER FUNCTIONAL ARCHITECTURE

01 WELLSITE EQUIPMENT
- Rod-pumped wells
- PCP wells
- Wellhead equipment

02 MEASUREMENT & ACQUISITION
- Dynamometer card host
- Acoustic liquid-level tester
- Field sensors

03 LOCAL CONTROL & PROCESSING
- IoT chip module
- Intelligent control terminal
- Configured signal inputs

04 COMMUNICATION NETWORK
- Radio frequency
- Wired / wireless links
- Communication gateway

05 SOFTWARE PLATFORM
- Rod string design
- Rod-pumped production
- PCP function module

FIELD DATA TRANSMISSION →

AUTHORIZED CONTROL FEEDBACK

FUNCTIONAL LAYERS AND RESPONSIBILITIES

FUNCTIONAL LAYER	RESPONSIBILITY
Wellsite Equipment	Defines the production equipment and well context, including rod-pumped wells, PCP wells and wellhead equipment.
Measurement & Acquisition	Captures operating information through dynamometer-card acquisition, acoustic liquid-level testing and configured field sensors.
Local Control & Processing	Connects configured inputs with local processing and intelligent terminal functions; the chip module role follows its product documentation.
Communication Network	Transfers field information through the communication media and interfaces configured for the installation.
Software Platform	Organizes application functions for rod-string design, rod-pumped production and progressive cavity pump operations.

TECHNICAL NOTE This is a functional overview, not a fixed wiring or protocol specification. Actual device connections, communication media, supported interfaces and control functions must be verified against the confirmed equipment configuration. Do not assume that every listed communication option is supported by the supplied system.

02 FIELD DATA ACQUISITION AND MEASUREMENT

This page summarizes the main field data acquisition paths used in oilfield IoT systems, with separate monitoring arrangements for rod-pumped wells, PCP systems, and acoustic liquid-level measurement.

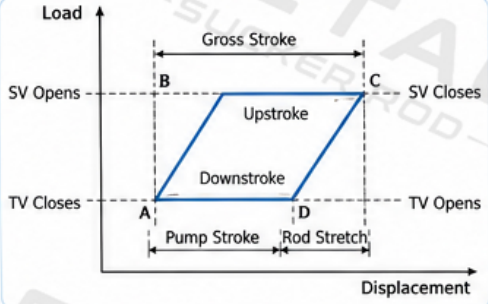
1. ROD-PUMPED WELL DATA ACQUISITION



Key device: Dynamometer Card Acquisition Host

Measurement Principle

Polished rod load, polished rod displacement, stroke information, and upper/lower dead-point switching signals are acquired and processed to generate a surface dynamometer card.



Measured Data and Purpose

Measured Data	Purpose
Polished Rod Load	Records rod loading during the pumping cycle.
Polished Rod Position / Displacement	Records rod movement and stroke behavior.
Stroke / Switching Signals	Supports pumping-cycle interpretation.
Surface Dynamometer Card	Supports load-displacement review.

Engineering Value

These measurements support pumping-condition review and help identify changes in operating behavior, but they are surface measurements and should be interpreted together with well and rod-string context.

2. PROGRESSIVE CAVITY PUMP (PCP) MONITORING



Key module: Progressive Cavity Pump Function Module

PCP monitoring manages operating data made available by the installed control terminal and configured measurement devices. The actual fields depend on the installed controller, sensors, and interfaces.

Typical Managed Operating Information

Operating Information	Purpose
Motor Current	Indicates electrical loading of the drive.
Motor Voltage	Supports electrical operation review.
Motor Power	Helps evaluate energy consumption.
Rotation Speed	Describes drive operating speed.
Torque	Indicates mechanical loading of the drive system.
Inlet Pressure	References suction-side operating condition when configured.
Discharge Pressure	References discharge-side condition when configured.
Flow Information	Only when supported by the installed system.

Engineering Note

Compatibility between the PCP control equipment, data acquisition terminal, and monitoring platform must be verified during system integration.

3. ACOUSTIC LIQUID LEVEL MEASUREMENT



Key device: Acoustic Liquid Level Tester

The instrument introduces an acoustic pulse into the well, receives and analyzes reflected signals, and interprets the response associated with the liquid interface to determine liquid-level depth.

Measurement Process

Acoustic Pulse Generation → Pulse Transmission into the Well → Reflection from Internal Well Features and Liquid Interface → Echo Reception and Signal Analysis → Liquid-Level Depth Determination → Measurement Data Available for Well-Condition Review

Calculation Concept

$$D = \frac{c \times t}{2}$$

The actual interpretation also depends on well geometry, acoustic conditions, gas-column characteristics, and reflected-signal quality.

Note

Acoustic liquid-level testing determines liquid-level information and does not directly measure oil or gas production flow rate.

TECHNICAL NOTE This page summarizes functional measurement paths and typical data categories only; actual device configuration, supported inputs, and communication arrangements must be confirmed against the selected system documentation.

03 INTELLIGENT CONTROL AND DATA PROCESSING

This page explains the role of intelligent control and local data processing in an oilfield IoT system. After field signals are collected, the terminal performs input handling, data acquisition, local processing, and communication preparation. It also clarifies the engineering distinction between data monitoring and equipment control.

1. DATA ACQUISITION WORKFLOW



Key module: Intelligent Control Terminal Module

The intelligent control terminal connects configured field inputs with local processing functions. Its role includes signal adaptation, data acquisition, local validation, and preparation of field data for transmission to the monitoring platform.

Field Data Acquisition Workflow

01 Signal Input
Sensors and measurement instruments

→

02 Signal Conditioning
Input matching and signal conversion

→

03 Data Acquisition
Sampling, scaling, and time identification

→

04 Local Processing
Data validation and operating-state handling

→

05 Data Transmission
Transfer to the monitoring platform

Workflow Function Summary

Workflow Stage	Engineering Role
Signal Input	Receives raw field signals from sensors and measurement devices.
Signal Conditioning	Matches input characteristics and converts signals for reliable terminal recognition.
Data Acquisition	Collects measurements, applies scaling or unit treatment, and associates time and equipment identification.
Local Processing	Performs basic validation and handles operating-state or alarm-related logic.
Data Transmission	Transfers processed data to the upper monitoring platform through the configured communication path.

2. MONITORING VS. CONTROL

Data Monitoring

Information Flow

- Operating parameters
- Equipment status
- Measurement records
- Alarm conditions
- Historical trends

Focuses on information visibility and operating review.

Equipment Control

Control Flow

- Authorized commands
- Configured setpoints
- Local control logic
- Interlock conditions
- Execution feedback

Focuses on controlled action under defined logic and permissions.

3. SUPERVISORY CONTROL FEEDBACK LOOP

Monitoring Platform
Authorized Operating Command

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Intelligent Control Terminal
Command Validation · Local Logic · Interlocks

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Field Equipment
Configured Control Execution

Equipment feedback returns through the acquisition and communication path.

Key Control Requirements

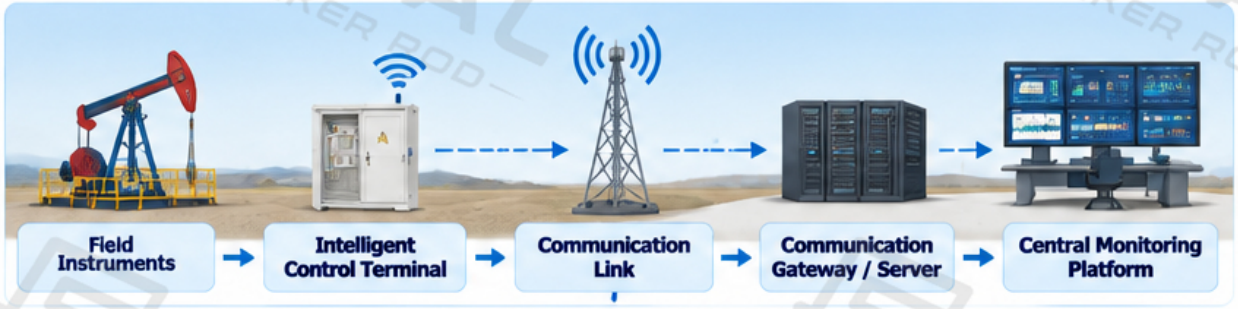
Requirement	Engineering Meaning
Local Control Priority	Remote commands must not bypass required local protection or interlock logic.
Command Authorization	Remote control commands must meet defined permission and operating conditions.
Execution Feedback	A control command should be confirmed by returned status and actual equipment response.

TECHNICAL NOTE This page summarizes functional control and local data-processing roles only. Actual buffering, communication interruption handling, control permissions, interlocks, and supported control functions must be verified against the confirmed equipment configuration and field operating requirements.

04 COMMUNICATION AND SOFTWARE INTEGRATION

This page describes the field communication archtiecture, **software functional integration, and key considerations for data integrity and system configuration, forming a complete** data path from field acquisition to production applications.

1. COMMUNICATION ARCHITECTURE

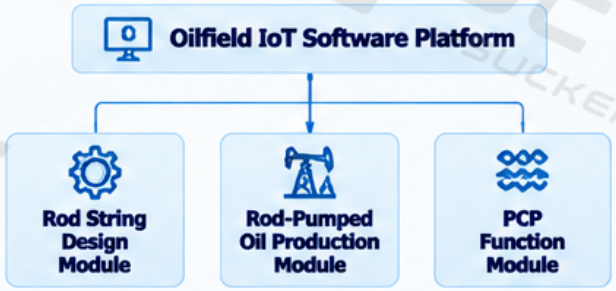


Communication Method and Engineering Considerations

Communication Method	Typical Engineering Coniderations
Radio Frequency	Coverage distance, line of sight and interference.
Cellular Network	Network coverage and service availablity in the oilfield area.
Fiber Optic	Infrastructure conditions and physical routing.
Satellite Communication	Geographic coverage, transmission delay and operating cost.
Wired Communication	Cable routing, installation environment and reliability.

2. SOFTWARE FUNCTIONAL INTEGRATION





Software Modules and Application Focus

Software Module	Application Focus
Rod String Design Module	• Rod-string configuration and design functions. • Provides engineering support for rod-pumped wells.
Rod-Pumped Oil Production Module	• Rod-pumped well monitoring and production management. • Uses field data such as the dynanometer card and operating parameters.
PCP Function Module	• PCP operating data management and production review. • Integrates key operating parameters for PCP wells.

3. DATA INTEGRITY AND CONFIGURATION



Key Configuration Checklist

Verification Item	Required Information
Device Identification	Well ID and equipment ID.
Signal Configuration	Input type and parameter mapping.
Measurement	Range, unit and calibration status.
Communication	Interface and configured communication method.
Data Management	Timestamp and missing-data handling.
Control	Authorized commands and execution feedback.

TECHNICAL NOTE Reliable oilfield data management requires more than successful data transmission. Each measurement must remain associated with the correct well, equipment, parameter, unit and acquisition time. Actual communication methods, data interfaces and software functions must be confirmed against the selected system configuration.