# Update and Overview of IEEE 1451.4 Interfaces and Applications

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# Agenda

- Brief review of IEEE 1451.4
- 1451.4 “Plug and Play” Sensors Available
- Trends and Uses of IEEE 1451.4
- Real applications and use cases



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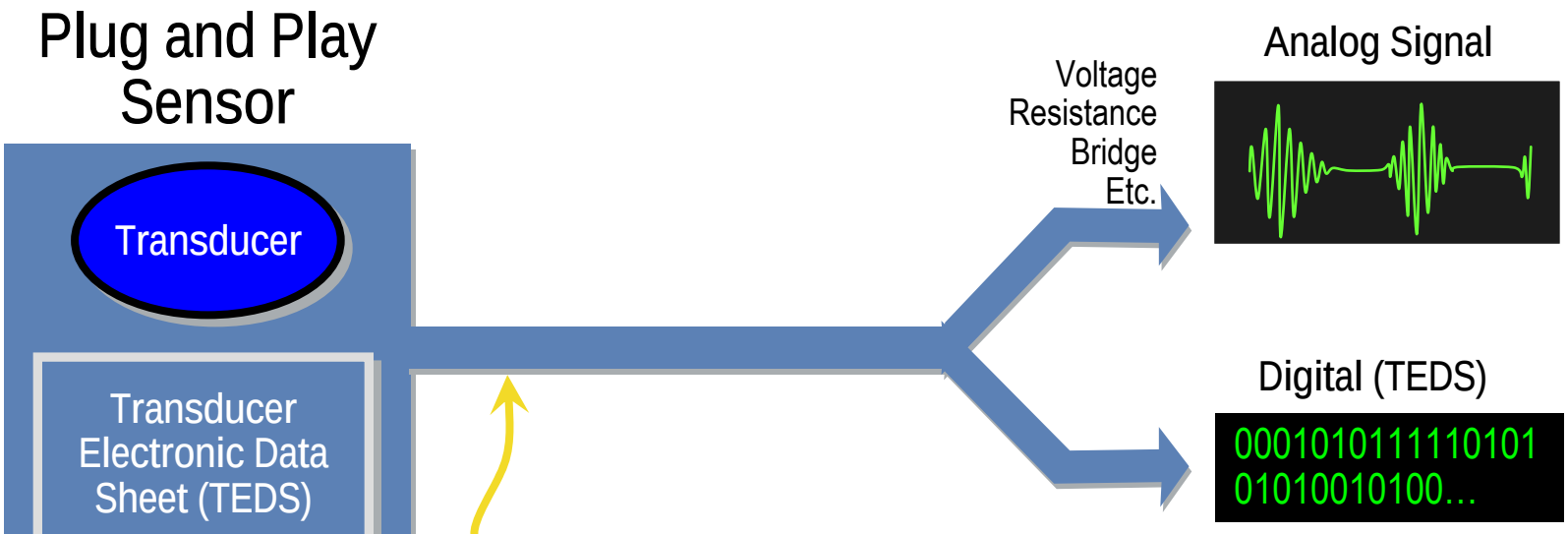
# IEEE 1451.4 Standard for Plug and Play Sensors




**Mixed-Mode Interface**
- Method of combining analog + digital
  - Shared (Class 1) or separate wires (Class 2)
- Digital protocol/commands

**TEDS**
- Set of standard templates
- Description language for TEDS templates

Standard Templates
- *Accelerometer*
- *Bridge transducer*
- *Strain gage*
- *Thermocouple*
- *RTDs*
- *Thermistors*
- *Voltage Output*
- *Current loop*
- *Resistance sensors*
- *Microphones*
- *AC LVDT/RVDT*
- *Cal. Curves/tables*

# What 1451.4 Does and Does Not Do

| Does… | Does Not… |
|---|---|
| Add Self-Identification to Analog Sensors | Address or Provide Self-Identification for Digital/Networked Sensors |
| Apply to Any Analog Sensor-to-Instrument Connection | Require Network Connectivity (NCAP is optional) |
| Provide paper-less method of managing sensor and calibration information | |
| Provide benefit in networked sensors if TIM is connected to separate analog sensor | |
| Have sensors, instrumentation, and users today. | |

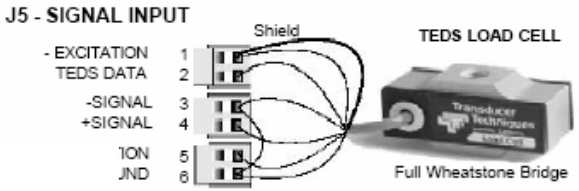
# 1451.4 Sensors Becoming More Widely Available

- Accelerometer/Vibration/Acoustics (Class 1)

- Load/Force/Torque and Pressure

(Honeywell Sensotec)

- Other Applications
  - RTDs, Thermocouples
  - Displacement/Position
  - Electrical




(Transducer Techniques)

- Easy conversion and retrofit of sensors
  - "Single-chip" addition for Class 2 TEDS sensors
  - Retrofit options
    - In-line modules, "smart connectors"
  - Virtual TEDS

PCB In-Line Module

Transducer Techniques
CAL-TEDS connector

TEDS EEPROM in connector of
Watlow Thermocouple cable

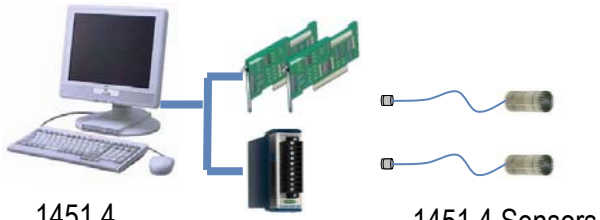
# IEEE 1451.4 – General Use Cases

Networked

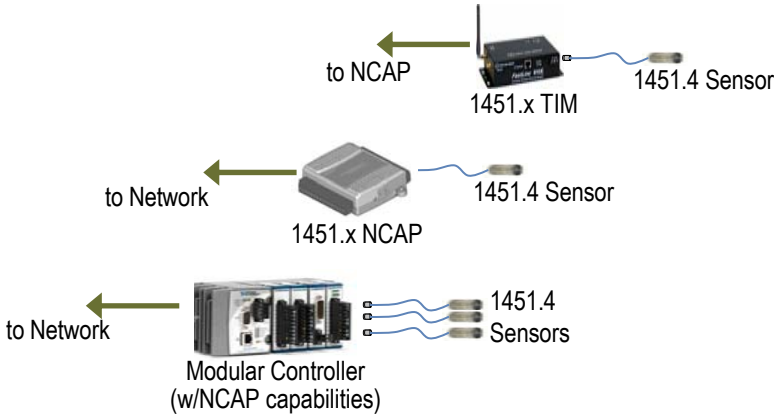
(PC DAQ/Measurement System
with Network Connection)

Standalone

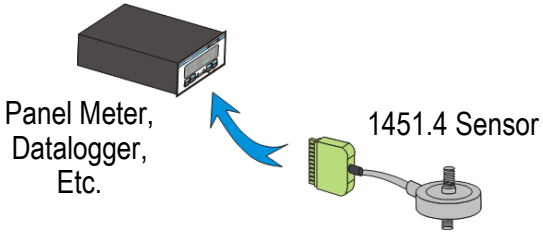
## PC DAQ/Measurement System




## Networked Measurement/Control Device




## Standalone Instrument




PC-Based

Embedded



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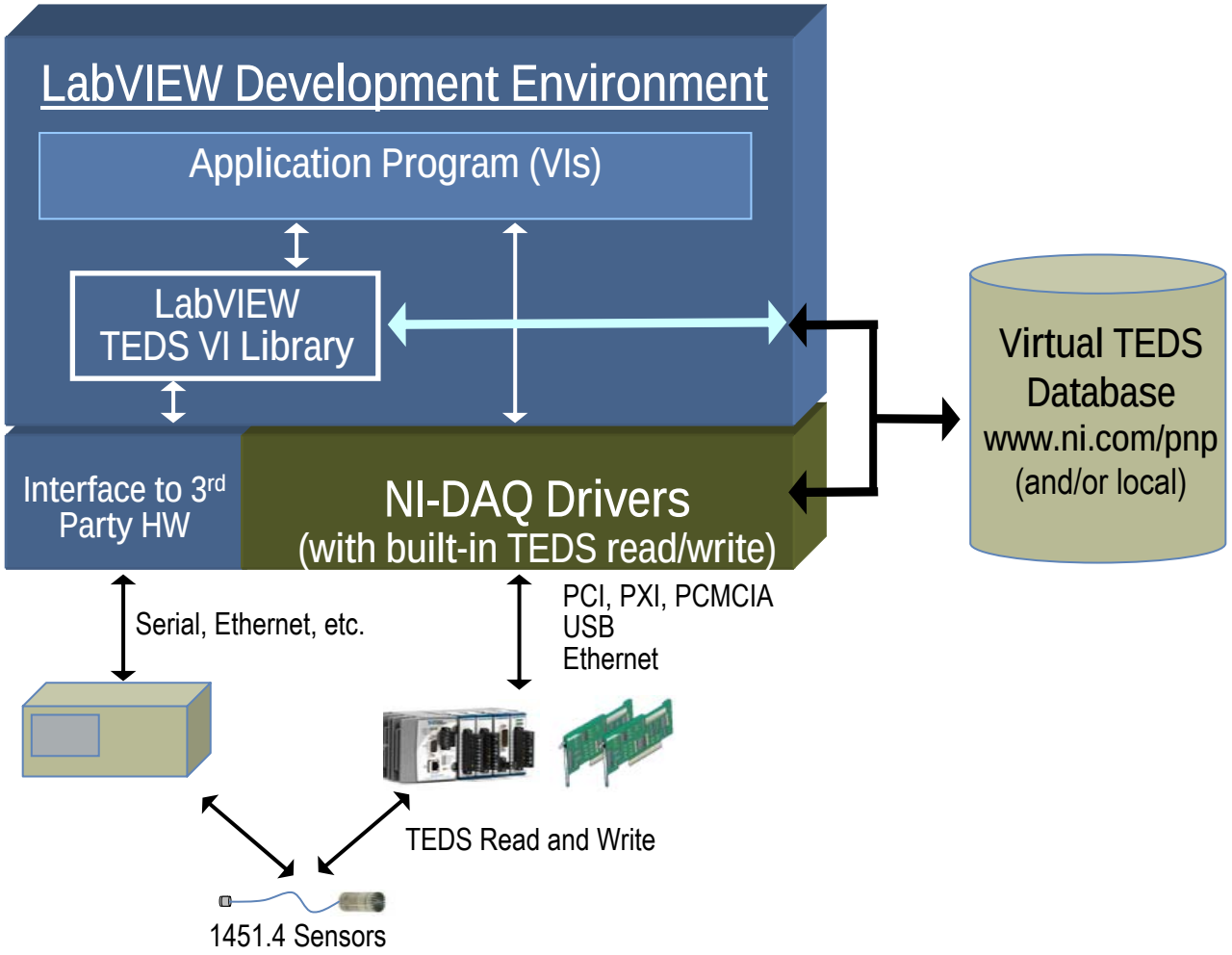
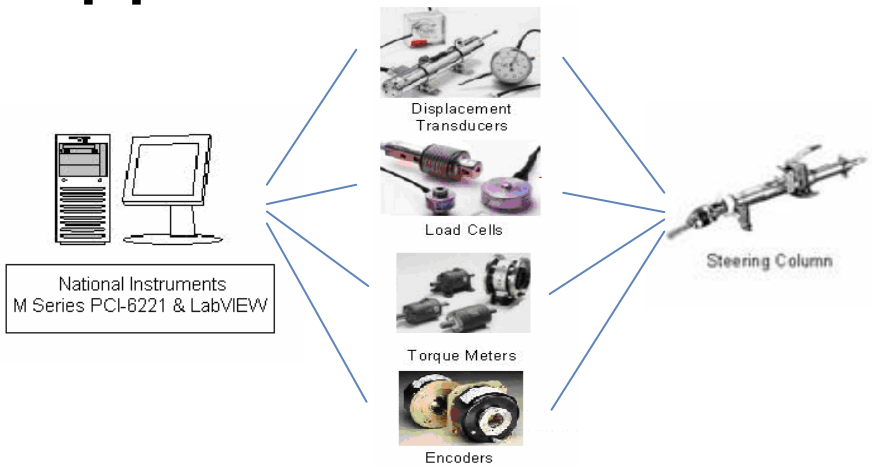
# Example Software for IEEE 1451.4 Systems

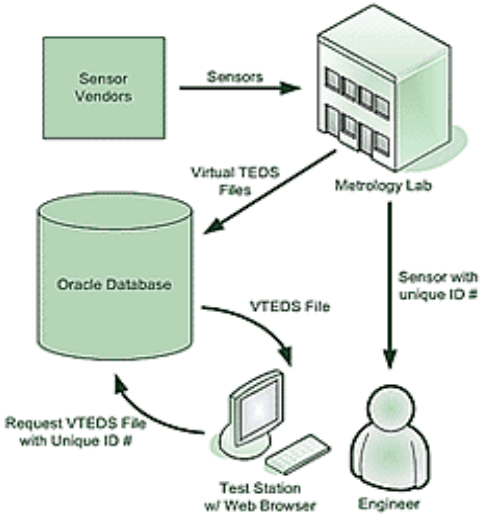


# Automotive R&D Testing Applications

- NSK Steering Systems and Bloomy Controls
  - Mechanical tests of steering columns
  - Frequent test reconfiguration
  - New system based on Virtual TEDS
    - Much easier setup, configuration
    - Manages calibration data




- John Deere
  - Product Engineering Center; Waterloo, Iowa
  - Improved efficiency
  - Reduced setup times
  - Improved accuracy
    - Use 1451.4 calibration TEDS

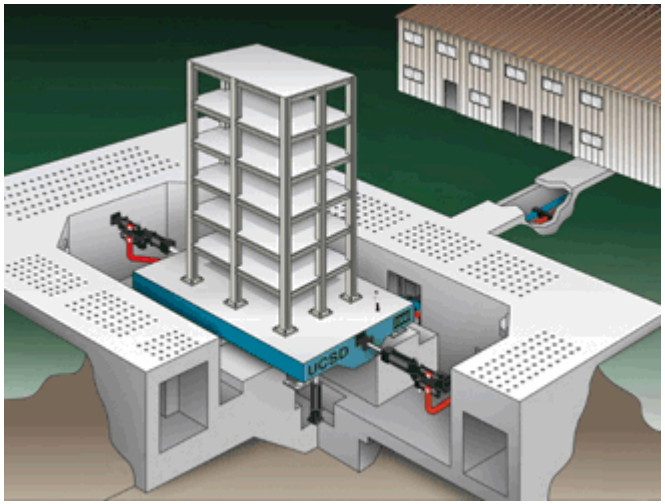


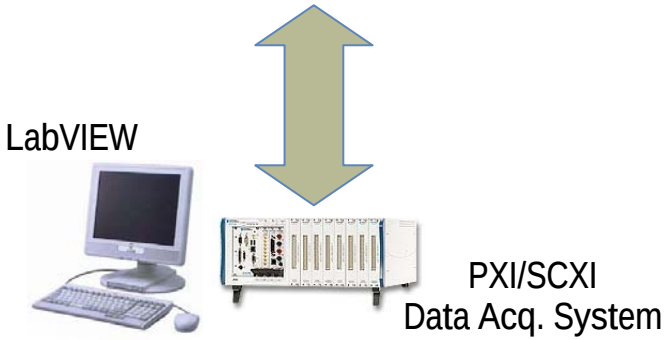

JOHN DEERE

# University of San Diego

## Large High Performance (LHP) Outdoor Shake Table

- National Earthquake Engineering Consortium
- Largest shaker table in U.S.
  - 25 x 40 ft.
  - Handles 2,200 tons; buildings up to 60 ft. tall
  - Speeds up to 6ft/sec
- Instrumented with 560 strain-gage based load cells
- LabVIEW and SCXI system
  - uses SCXI TEDS-enabled strain measurement module



# Summary

- IEEE 1451.4 provides “plug and play” for analog sensors via simple self-identification
  - does not solve digital (network) sensor connectivity
- Today, applies primarily to wide range of “traditional” measurement systems that rely on analog sensor interfaces
  - Provides easier setup and configuration
  - Management of sensor data, calibration info, etc.
- Will provide useful component of 1451 systems wherever analog interfaces are required (TIM-to-sensor)