

Today's Agenda:

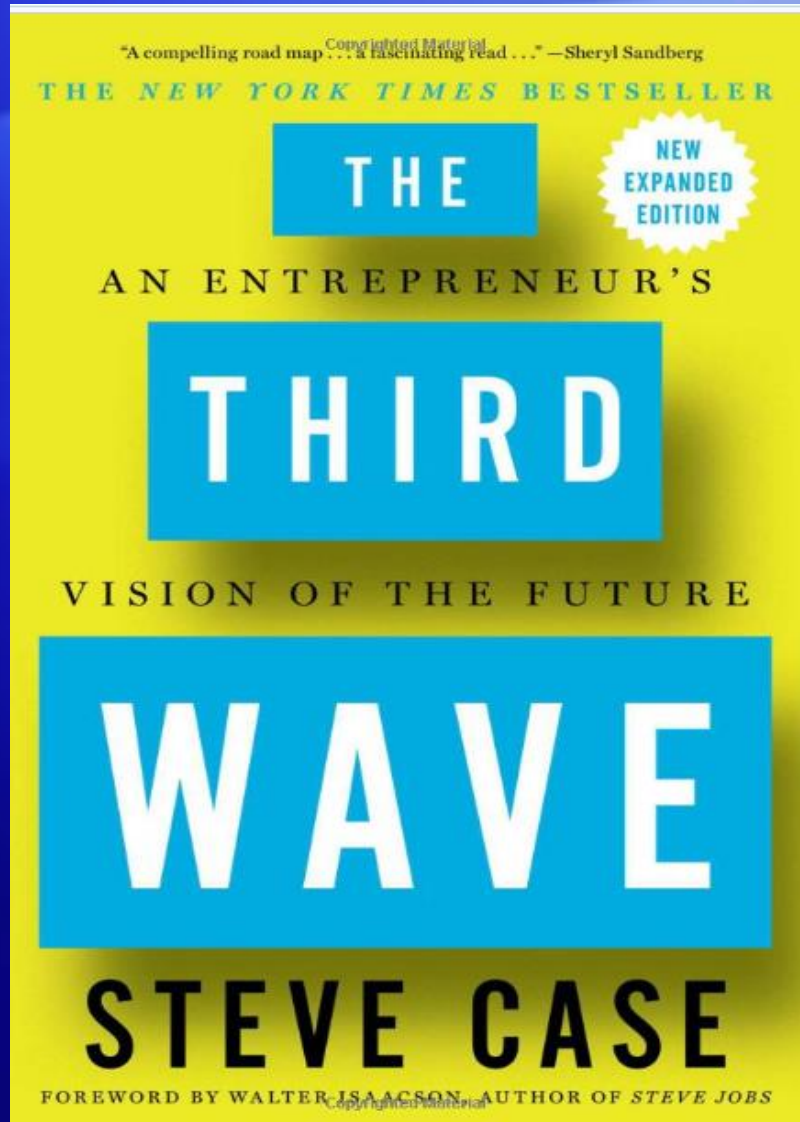
1. What is the IoT ?
2. Examples of real-world apps
3. Inspection / NDT apps
4. Conclusions

But first a “Thank you” to:

- Hugh Doran (MQS)
- George Moran & Tony Sansavera

- Contributors:
 - LinkLabs
 - Libelium
 - Olympus Corp.
 - Mistras Group

- Mr. Jim Treat for



Internet: Created, as ARPANET in 1971 by US DoD.

Internet's First Wave:

- 1985 - 1999
- Email (AOL), basic websites.

Second Wave:

- 2000 – 2015
- Google Search
- Ecommerce, apps & mobility

Third Wave:

- > 2016
- Internet of Things – IoT
- A tsunami by comparison due to distribution of “things” with many smaller players

IoT



THING



IoT Steps

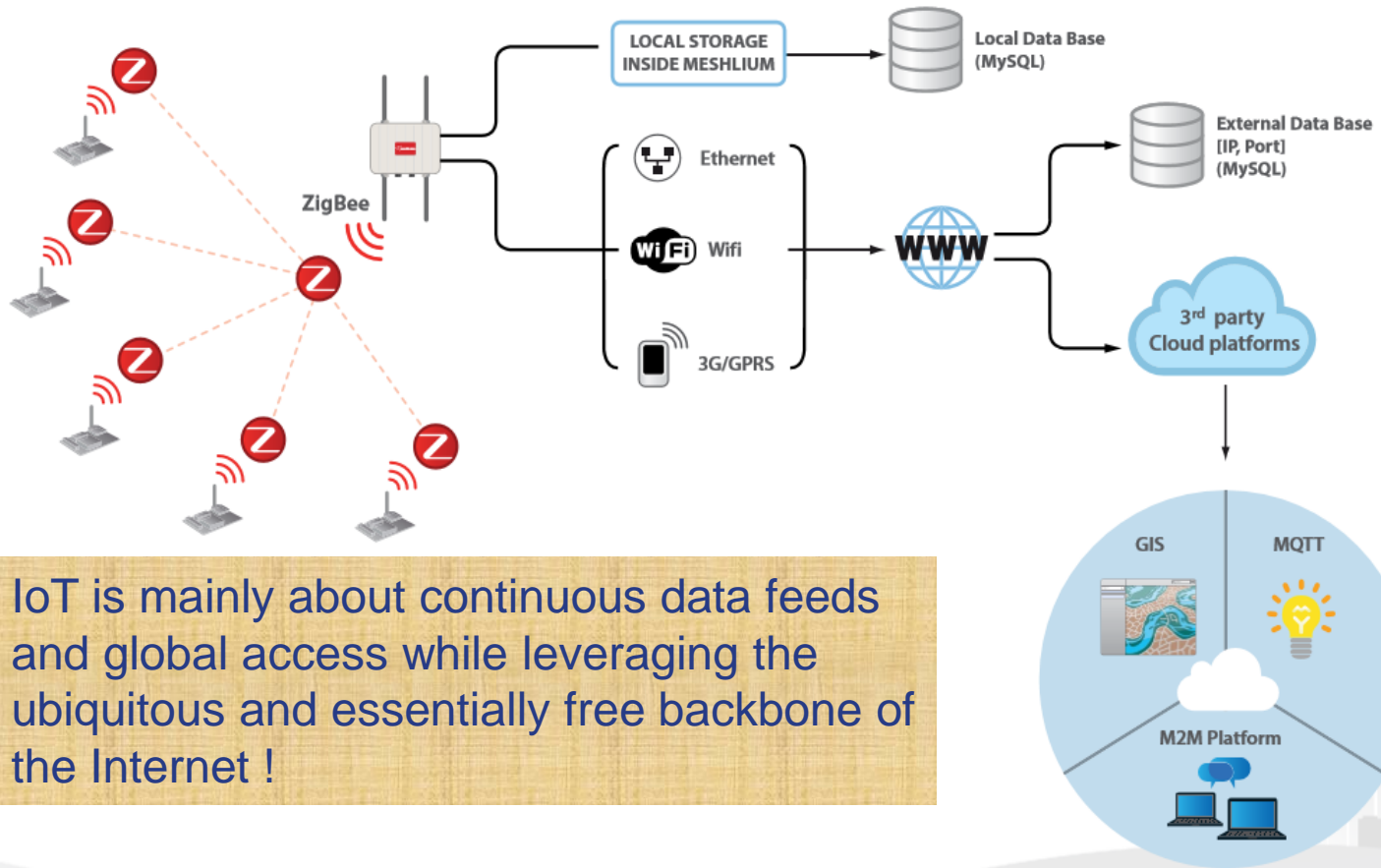
1. Sense
2. Communicate
 - a) Local
 - b) Backhaul
3. Display
4. Analyze-Decide

1. Sense	2. Communicate		3. Display	4. Analyse / Decide
50% HW/SW	2a. Local	2b. Backhaul	100% SW	100% SW
UT Thickness	25% HW/ 75% SW	25% HW/ 75% SW	Raw Data	Predict
UT - Cracking	ISM	Satellite	Processed data	Trend
Other UT	Zigbee	DCS	Hierarchy	Alarm
Guided Wave	Cell	Ethernet	2 D / 3 D Maps	Boolean
Acoustic / AE	Wifi	Cell	Image	Control
Other NDT	Custom	Cloud	Process Variable	Knowledge
Vibration	WiHART	Security	KPIs	Closed-loop
Location GPS	RS-485			Big Data
Micro-GPS	RPMA			Set points, limits
Radiation	ISA-100			
Temp	LoRa			
Pressure	Bluetooth			
Flow	Modbus			
Load	Foundation Fieldbus			
A/V				
InfrRed	Attributes			
Position	Low power			
Proximity	Long range			
Current / CP	Bandwidth			
Acoustic / Tank	Low cost			
Air / Hazard	Small size			
On / Off	Integrated with sensor			
Hydrocarbons				
Moisture				
ER				
PH				
LPR				
Multi-modal				



IoT Connectivity : Asset to Desktop

Connections Options Chart:



IoT is mainly about continuous data feeds and global access while leveraging the ubiquitous and essentially free backbone of the Internet !

Many IoT apps serving all segments

<p>04 A UNIVERSE OF APPLICATIONS FOR GETTING INSPIRED...</p> 	<p>05 SMART CITIES</p> 	<p>07 SMART ENVIRONMENT</p> 	<p>08 SMART WATER</p> 	<p>09 SMART METERING</p> 	<p>10 SECURITY & EMERGENCIES</p> 
<p>11 RETAIL</p> 	<p>12 LOGISTICS</p> 	<p>13 INDUSTRIAL CONTROL</p> 	<p>14 SMART AGRICULTURE</p> 	<p>15 SMART ANIMAL FARMING</p> 	<p>16 DOMOTIC & HOME AUTOMATION</p> 
<p>17 eHEALTH</p> 	<p>18 APPLICATIONS / SENSOR BOARD / SENSORS INTEGRATED</p> 	<p>25 THE LIBELIUM EXPERIENCE: THINK, DEVELOP, GO!</p> 	<p>29 TECHNOLOGY: WASPMOTE, PLUG & SENSE!, MESHLIUM</p> 	<p>35 LIBELIUM'S VALUE CHAIN</p> 	<p>36 LIBELIUM'S CASE STUDIES</p> 

What is the Olympus Scientific Cloud ?

Device
Location

Enhancements to
the performance
of Olympus
Scientific
Products

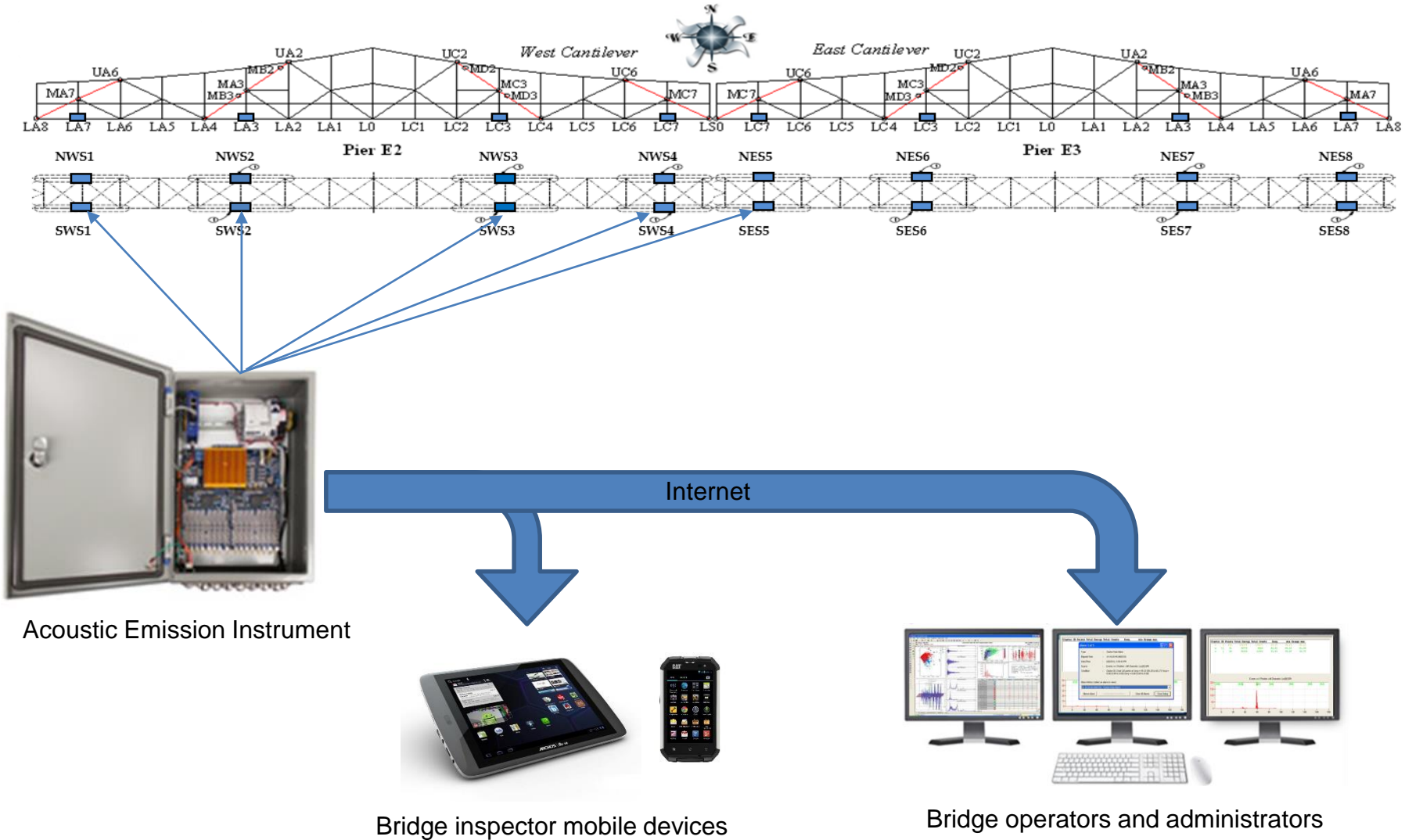
Device
Information /
Fleet
Management

Software
Updates
And Better
Support

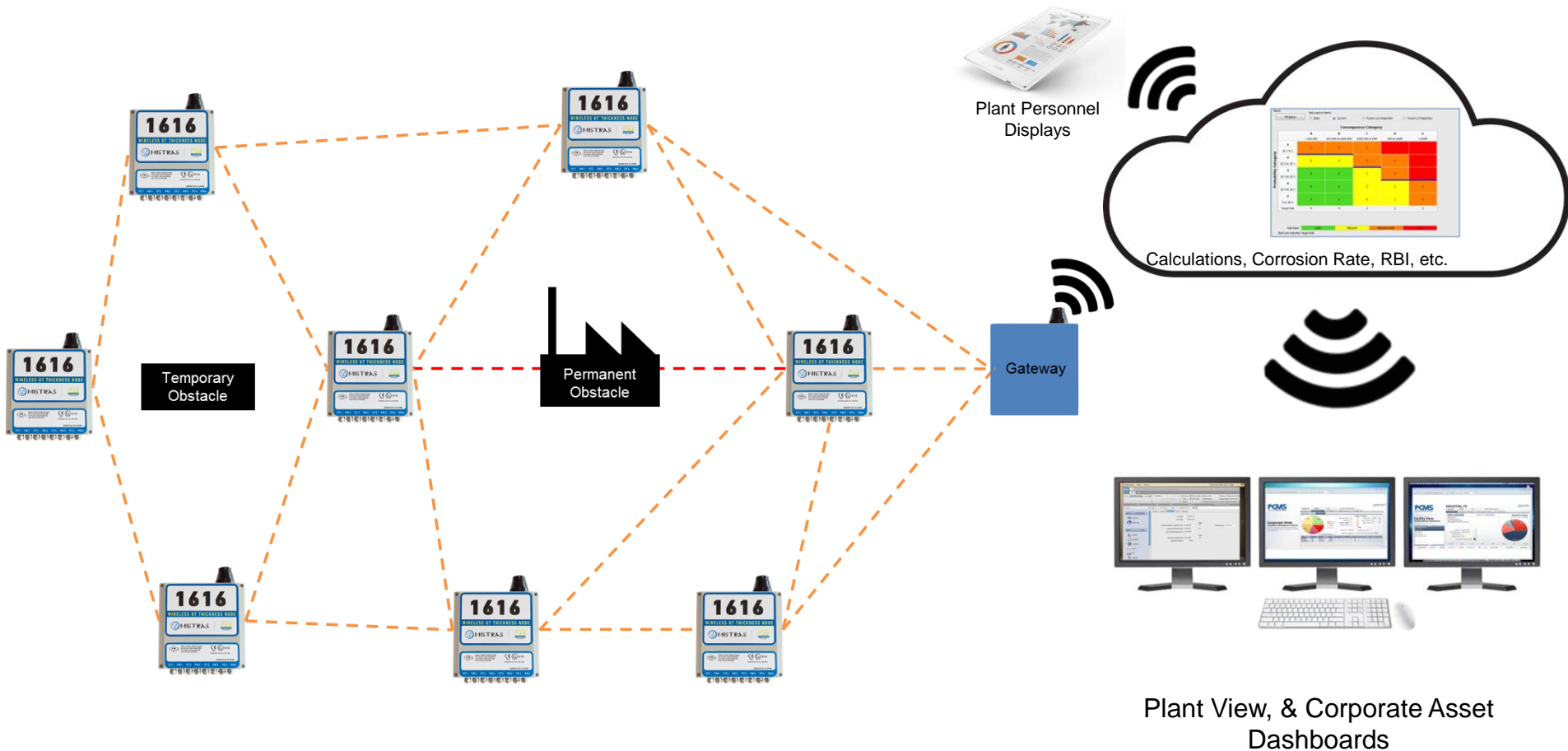
Collaboration
Tools

Inspection
Data
Management

Remote Acoustic Emission Monitoring of a Bridge through the internet



Remote Ultrasonic Thickness Monitoring with IIOT



One Source for
Asset Protection Solutions



Cellular

Remote Asset-Integrity Monitoring
Measure It, Manage It



smart
PIMS
Cellular

- 1 cellular transmitter
- 2 dual-element transducer* (up to 8/transmitter)
- 3 temperature compensation sensor

- 16 channels in single-element mode
- measurement range: 0.040-4.0"
- accuracy: ± 0.001"
- temperature compensation algorithm

Cellular systems leverage existing and ubiquitous digital networks: 2G, 3G, 4G, LTE and newer M1

Programed to turn on/off at any user interval

Long-life, lithium batteries can last for >5 yrs.

LORA WLAN

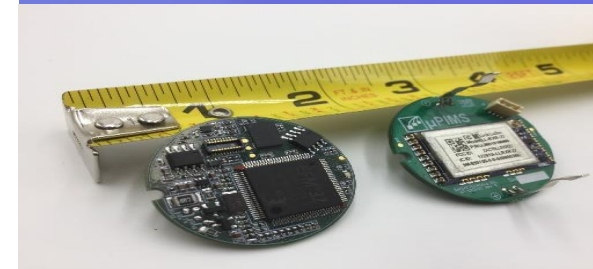
Remote Asset-Integrity Monitoring
Measure It, Manage It



micro
PIMS™
WLAN

- 1 LORA WLAN gateway
- 2 mid-temp transducer
- 3 high-temp transducer
- 4 temperature compensation sensor

- scalable to >1,000 nodes/gateway
- measurement range/accuracy: 0.040-4.0" / ± 0.001"
- communication: wireless 900 MHz
- wireless range: >1 mile
- permanent or temporary installation
- temp range: -30 to 900°F continuous (dual MT or single HT)

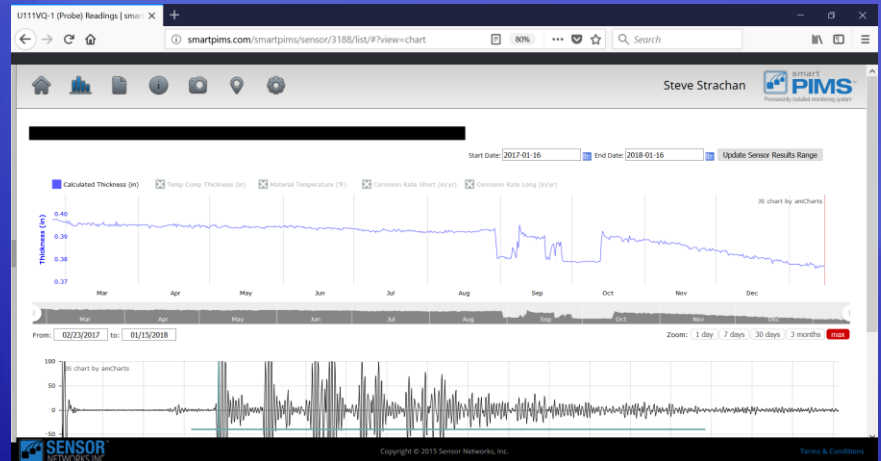
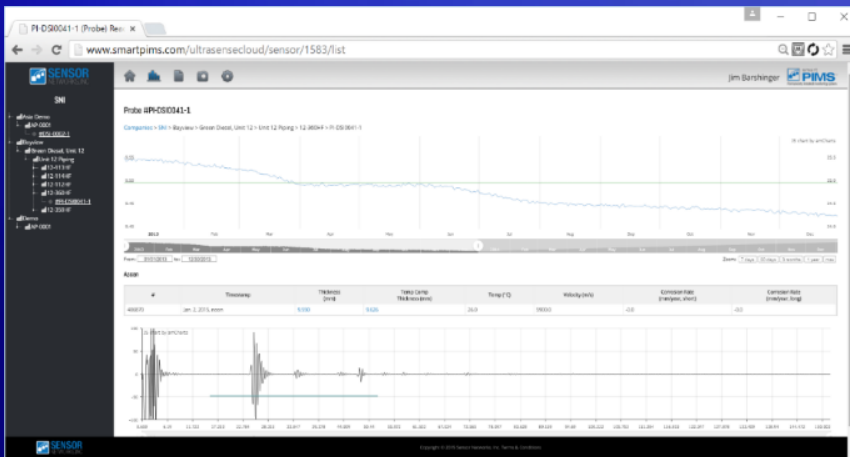
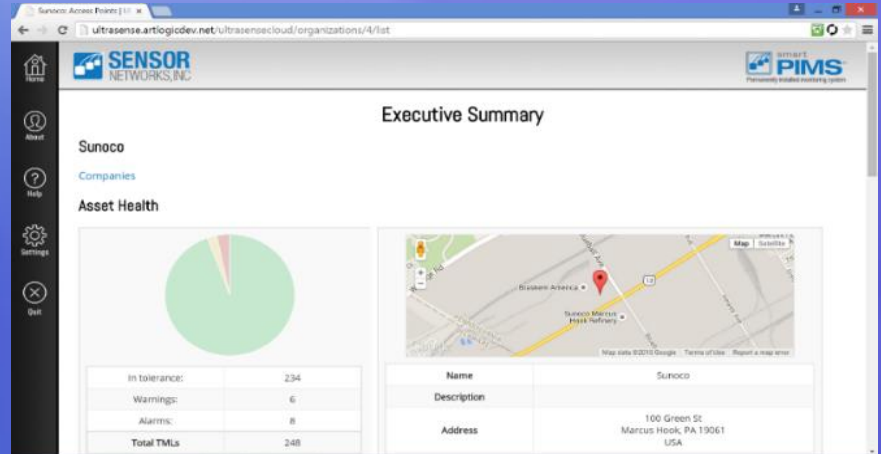


LoRa is a **Long-Range**, Industrial IoT wireless protocol (900 MHz).
Low-power, low-cost w' small footprint and a range of > 1 mile.

Web Portal as common back end

A cloud-based web portal can be used to:

- Compile, archive, analyze & trend
- Allow easy access across an organization
- Push software updates to multiple devices



Network-distributed Ultrasound: 3 into 1

Remote Asset-Integrity Monitoring: Measure It, Manage It.

Cloud-based management of thickness data from installed UT sensors.

webPIMS™ can automatically or manually receive data from ultrasonic sensors for web-based display, storage, trending and analysis. Users can access this data from anywhere with an internet-enabled device such as a PC, tablet or smart phone.



(814) 466-7207
www.sensornetworksinc.com



- 1 cellular transmitter
 - 2 dual element transducer* (up to 16/transmitter)
 - 3 temperature compensation sensor
- 16 channels in single-element mode
 - measurement range: 0.040-4.0"
 - accuracy: ± 0.001"
 - temperature compensation algorithm

Single element, dual element, high-temp, and shear-wave transducers are available. Only one type of transducer per transmitter.



- 1 modbus transmitter
 - 2 high-temp transducer* (up to 16/transmitter)
 - 3 temperature compensation sensor
 - 4 multiPIMS linear sensor array
 - 5 multiPIMS area sensor array
- can operate 1-16 sensors
 - measurement range: 0.100-2.0"
 - accuracy: ± 0.001"
 - temp range: -30 to 900°F
 - communication: Modbus
 - ideal for buried and hard-to-access applications
 - integrates with DCS and SCADA systems



- 1 LORA/WLAN gateway
- 2 mid-temp transducer
- 3 high-temp transducer
- 4 temperature compensation sensor

- scalable to >1,000 nodes/gateway
- measurement range: 0.040-4.0"
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Multiple network connectivity schemes, including manually-collected data can all be stored and accessed in one common secure portal.

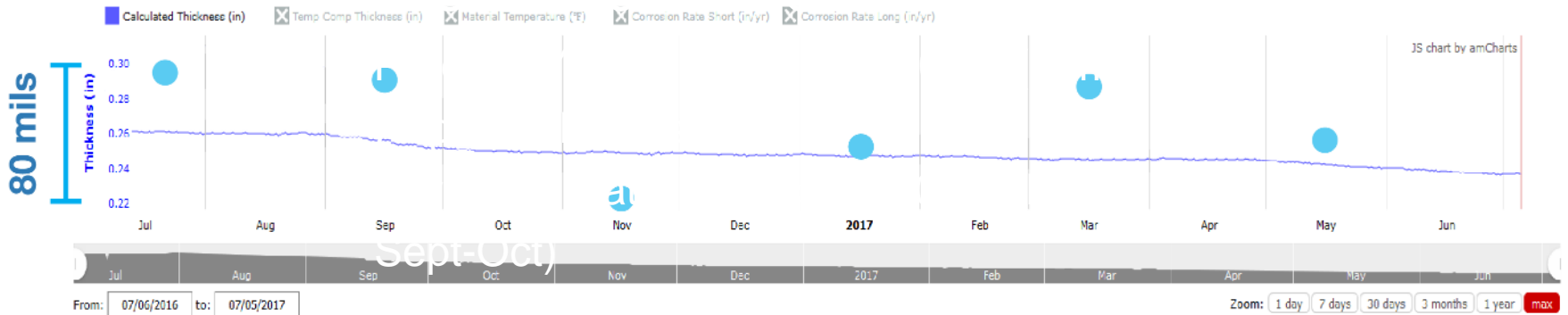
CASE STUDY

Manual vs. Installed Sensor Data

| Represent manual UT readings

Companies > [Redacted]

Start Date: 2016-07-06 | End Date: 2017-07-06 | Update Sensor Results Range



Manual UT Results

Precise: No | Accurate: Maybe | Repeatable: No
 Corrosion Rate: Undiscernible
 6 readings x \$75/CML = \$450 for 1 yr

Installed Sensor Results

Precise: Yes | Accurate: 0.001" (1 mil) | Repeatable: Yes
 Corrosion Rate: ~20mpy (~10mils loss in Sept-Oct)
 6 readings x \$75/CML = \$450 for 1 yr

INSTALLATIONS



LT Singles

- Temporary: Stopaq (up to 150F/65C)
- Permanent: Epoxy (up to 150F/65C)
- Each probe can be mounted using magnetic housing, strap, or band
- Insulate over top or buried

Mid Range Duals

- Temporary: Stopaq (up to 200F/93C)
- Permanent: Epoxy (up to 300F/150C)
- Each probe can be mounted using magnetic housing, strap, or band
- Insulate over top or buried

HT Singles

- Temporary OR permanent: Dry couple using foil, probe housing & band clamp
- Temperature ranges: -40°F-900F/480C

CASE STUDY

Pipeline Integrity | Liquid Line

Operator performed ILI using a smart pig to inspect a segment of their crude oil pipeline.

The ILI report showed a number of pits which were not present the last time the ILI was completed.

The operator wanted to know if the pits were episodic in nature or were growing (if so, at what rate



Application
Asset integrity post inspection

ILI run was performed, DA is executed, inspection company evaluated and marked pits

SNI installed probes on exact pits called out by inspection

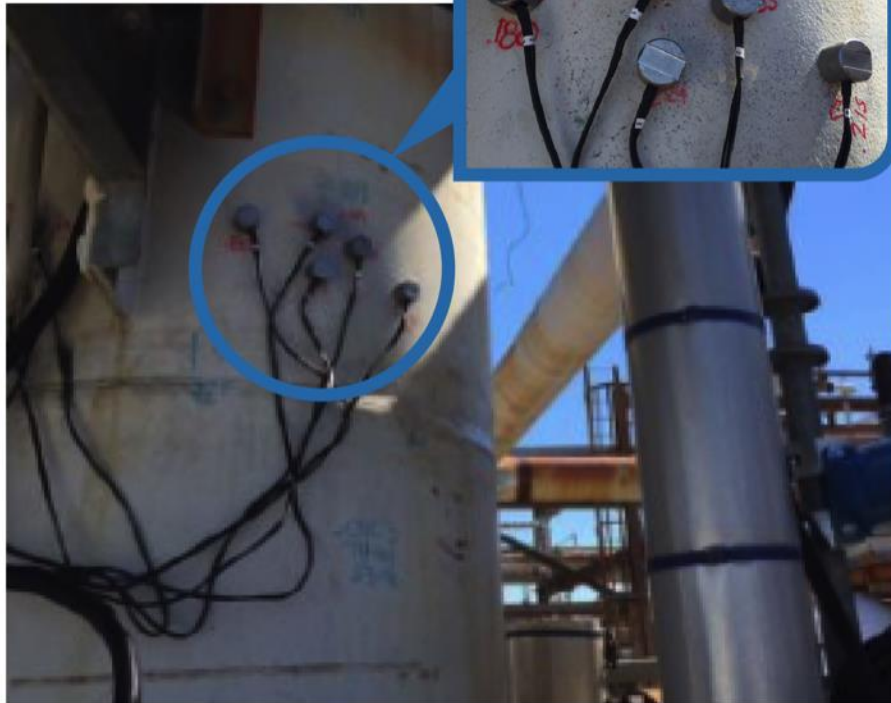
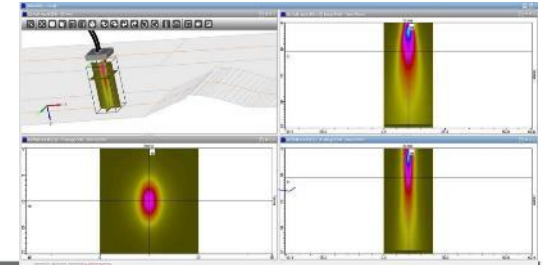
Product Used
smartPIMS Modbus configuration w/ 8 dual element probes permanently attached to monitor pits

smartPIMS systems are completely buried after DA is complete

Operator will send personnel to defined locations quarterly to collect data w/ tablet

Outcome | Operator did NOT have to fix / repair, kept line running and continue normal ILI inspection intervals | Saved \$750K material/labor & ZERO downtime

Low-spot *Pit Tracking*[™] With 3 mm-beam spot size



Vessel Monitoring
Sulfuric Acid Alkylation unit routine inspection
discovered significant pitting which was near T-min

Operator was sending UT technicians daily to map
low spots to determine rate they were thinning

Was costly, putting inspection group behind
schedule, and readings were not consistent/reliable
operator to operator

smartPIMS Cellular
8 temporarily installed dual element probes

Readings once every four hours

Installation took two hours

Outcome |

Saved >\$100K in inspection | Kept unit safely operating until scheduled shut
down | Was able to redeploy smartPIM equipment on different asset

IoT is evolving quickly.

Embrace it for your business.

Thank you for attending this session of
NDTMA's 2018 Annual Conference