



## NDT Meets the Internet of Things (IoT)

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## Agenda

- IoT explained
- Everyday IoT examples
- IoT meets NDT
- The future for IoT & NDT
- Conclusion

## The Internet of Things

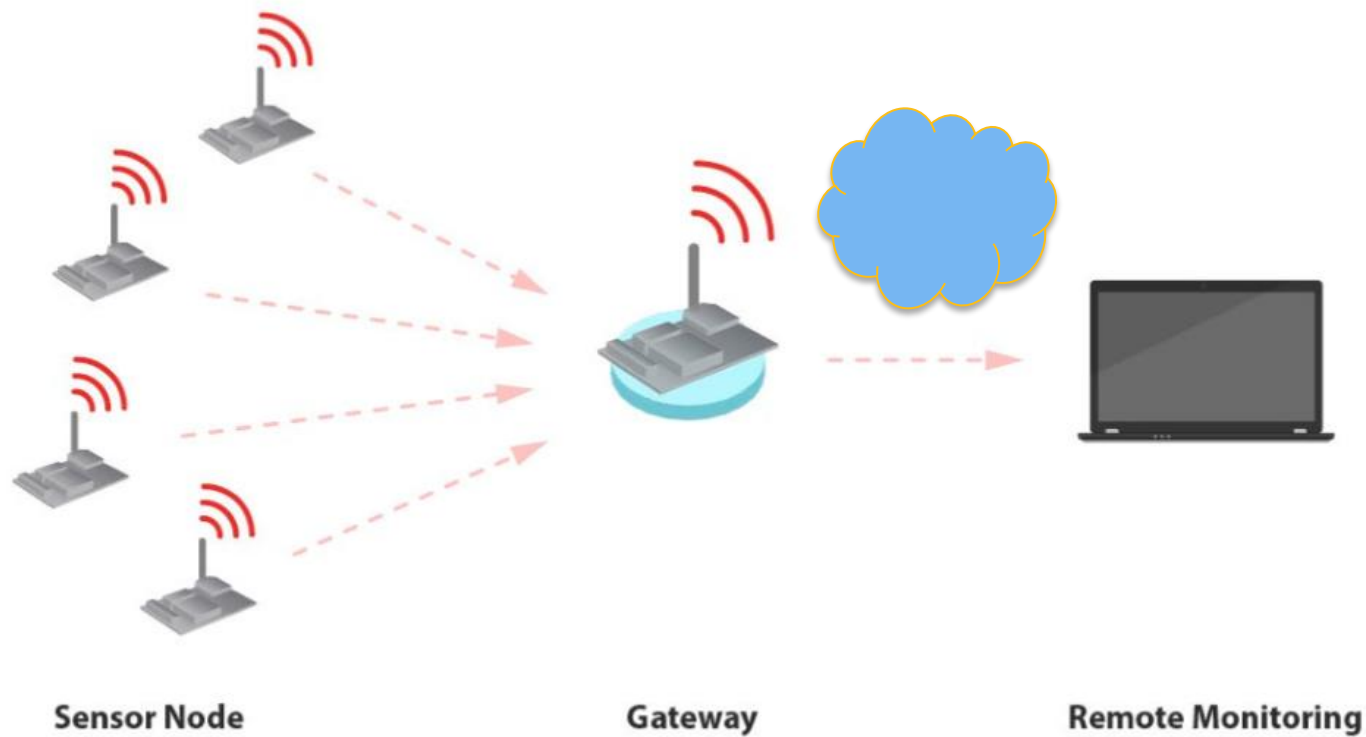
- Industrial Internet of Things : *GE*
- Internet of Everything : *Cisco*
- Internet of Things That Matter : *Hitachi*
- Internet of Things for Business: *Business Insider*
- Not your father's Internet : *Bruce*

IoT: “Where Physical and Digital Worlds Meet”

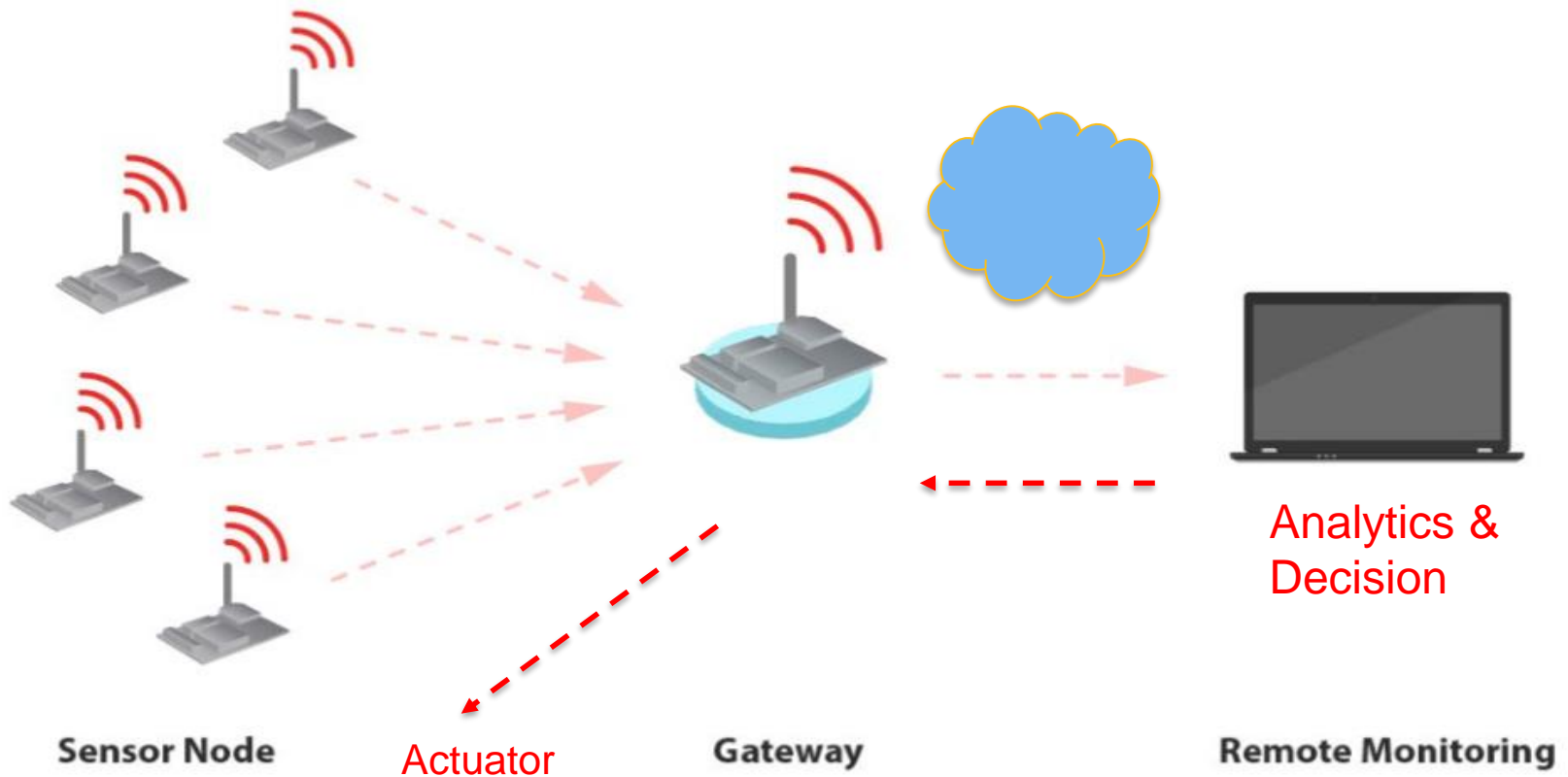
# Quotable Quotes

- Think tank Machina Research says the IoT market will swell to **\$4.3 trillion USD by 2020**. Gartner predicts that the number of IoT devices will grow to **26 billion units by 2020** in the US. McKinsey & Co **predict 30 billion devices!**
- In Cisco's "Internet of Everything" 2013 report, the highest percentage **(27%) of value in future IoT revenue will be in manufacturing**. And, an oil company with \$50 billion in annual revenue could **add about \$1 billion in profit** if it was able to fully optimize the IoT solutions available to it.
- "Smart" IoT/M2M-enabled factories alone could **reap \$1.95 trillion in profits** between now and 2022, thanks to sensors incorporated into machines and processes.
- Accenture's 2014 report, "Driving Unconventional Growth Through the Industrial Internet of Things," finds that manufacturers could **boost their efficiency by 30% using IoT**.

# Uni-directional Wireless Data Paths



# Bi-directional Wireless Data Paths



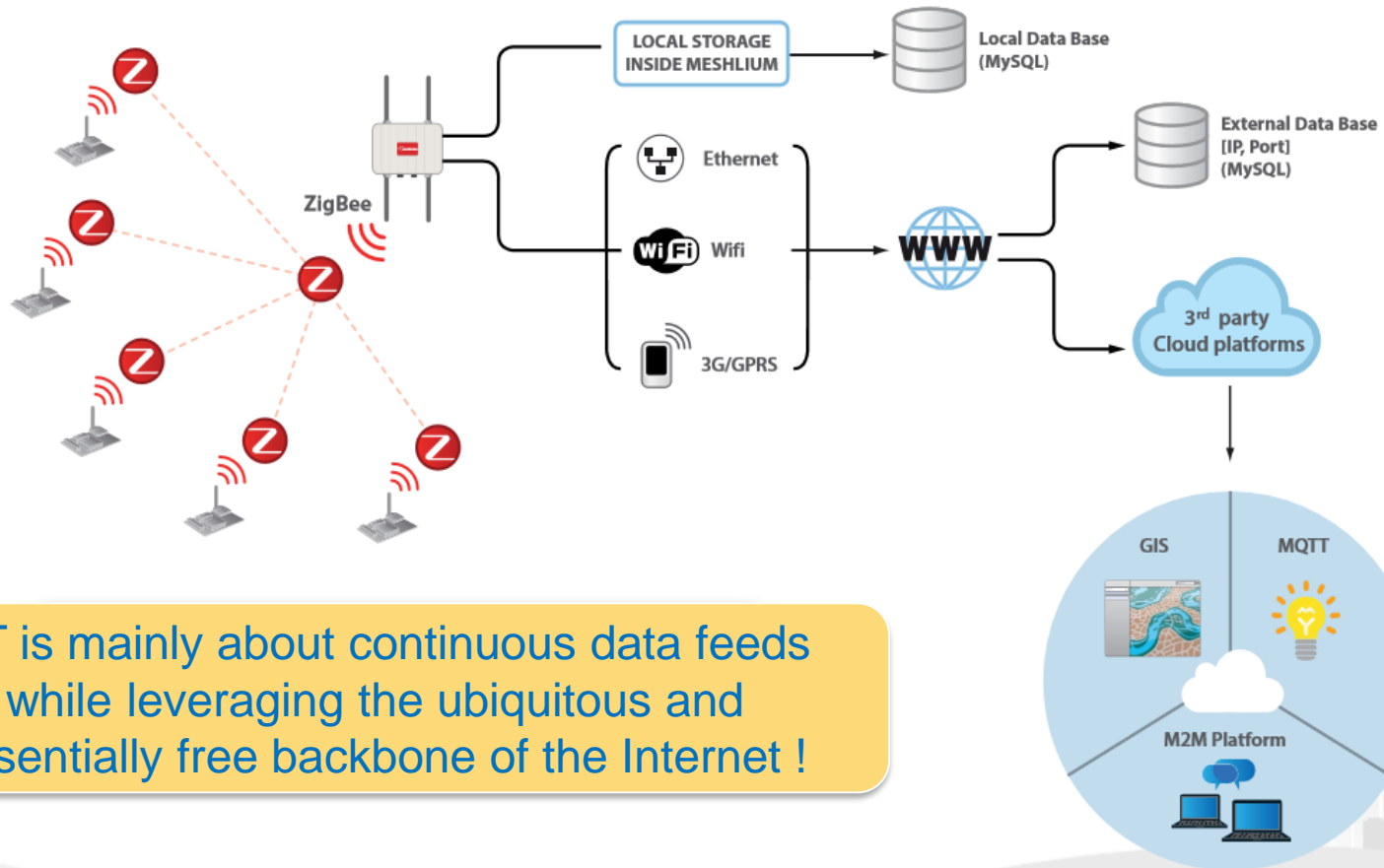
# IoT Steps

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	<b>Attributes</b>			
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				

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

# IoT Connectivity : Asset to Desktop

Connections Options Chart:



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



## IoT is all around us ...

- **Supply Chain** – RFID (Radio Frequency Identification) technology ‘chips’ were developed in 90s’ as inventory mgmt. system
- **Logistics** – GPS for traffic conditions, package/parcel tracking, fleet management, etc.
- **Consumer & Industrial Control** – smartHome: security systems, temperature, lighting, appliances, electronics, swimming pools, etc.
- **M2M** – smartGrid, vehicle diagnostics, vibration, flow, pressure, current sensing devices w/ programmed instruction
- **People and other mammals** – health monitoring, movement studies, NFL player tracking, Race Horses

# Many IoT apps serving all segments

04 A UNIVERSE OF APPLICATIONS FOR GETTING INSPIRED...



05 SMART CITIES



07 SMART ENVIRONMENT



08 SMART WATER



09 SMART METERING



10 SECURITY & EMERGENCIES



11 RETAIL



12 LOGISTICS



13 INDUSTRIAL CONTROL



14 SMART AGRICULTURE




15 SMART ANIMAL FARMING




16 DOMOTIC & HOME AUTOMATION



17 eHEALTH



18 APPLICATIONS / SENSOR BOARD / SENSORS INTEGRATED



25 THE LIBELIUM EXPERIENCE: THINK, DEVELOP, GO!



29 TECHNOLOGY: WASPMOTE, PLUG & SENSE!, MESHLIUM



35 LIBELIUM'S VALUE CHAIN



36 LIBELIUM'S CASE STUDIES



## NDT meets IoT ...Why ?

### NDT issues today:

- Productivity
- Aging workforce
- Not enough experts (Level IIIs)
- Do more with less
- Need information/data/reports:
  - Better!
  - Faster! (Real time)
  - Cheaper!

## NDT Examples:

### Good

- Training: Remote Class Room
- RVI, UT, ET : Remote Collaboration
- UT Thickness: Remote wall-thickness monitoring for corrosion
- Vibration Monitoring of pumps & motors

### Possible

- RT : Film reading for redundancy or at a lower cost

### Bad:

- ECT : Independent 3<sup>rd</sup>-party assessment of real-time signal & data for Nuclear Steam Gen

## IoT for Remote Collaboration

Connectivity enabled Remote Visual Borescopes  
Expert can interact with technician – REALTIME!

- Talk, text, chat, view, etc....

Accept/reject decisions made immediately

Result:

- Assets back to work sooner ( ↑ \$ )
- No re-work ( ↓ time )
- Satisfied customer ( ↑ work )



## IoT for Remote Asset Condition Monitoring

Installed sensors (permanently or temporarily) to the asset

Data availability IMMEDIATELY ... 24x7

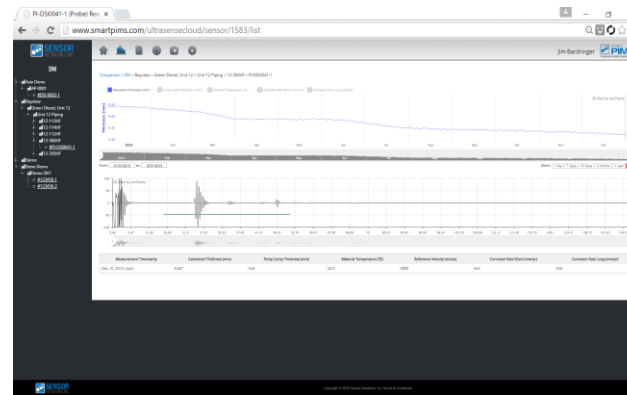
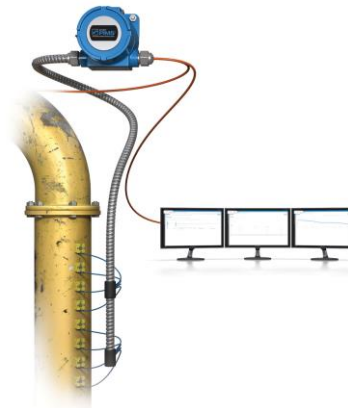
Pass-through cost savings to clients: scaffolding, excavation, etc.

Inspection vs. monitoring

- Inspection – is my pipe thick enough today?
- Monitoring – based on process conditions, turnarounds/outages & maintenance intervals can be optimized

Potential for new revenue streams for service companies

- Installations & device mgmt.
- Pay per point
- Data management



## IoT for Remote Inspection Services

Procedure mgmt. over internal network: share, update, review

Local data collection w/ remote expert oversight and fleet management:

- Technicians
- Equipment
- Process
- Data

## Conclusions

- IoT is all around us – look for ways to use it to become more productive
- Leverage the infrastructure and tools around you
- Let IoT help create competitive advantages
- Become familiar with data transmission protocols
- IoT is not going away and will get bigger ...  
delegate a person to oversee your IoT efforts



Thank you for your participation in the  
NDTMA  
2016 Annual Conference



Back-up slides

## The IoT IS ...

- An information technology conduit which leverages a pre-existing, no/low cost, infrastructure which can be public or private to allow the free flow of real-time (or near) data to provide a platform by which assets/processes can be monitored for safety, efficiency or economic optimization



## The IoT IS ...

- A means by which assets can be sensed and controlled remotely via installed sensors across an existing network infrastructure creating opportunities for more direct integration between the physical world and computer-based systems



