

# An IoT Interface for Industrial Analog Sensor with IEEE 21451 Protocol Draft

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\*Chair of IEEE 21451.2 Working Group



# Topics

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- IoT and Sensors
- Industrial Sensor Specifications
- IoT Interface Description
- IEEE 21451 Smart Transducer Format



# Sensors for the Internet of Things

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- ❑ Sensors a large part of IoT
- ❑ Ubiquitous, small low-cost sensors envisioned
- ❑ Number of sensors potentially large (100B)
- ❑ Need to auto-configure (plug and play)
- ❑ Currently standards and security are limiting factors
- ❑ Industrial sensors are a good area to start



# Popular Industrial Sensors

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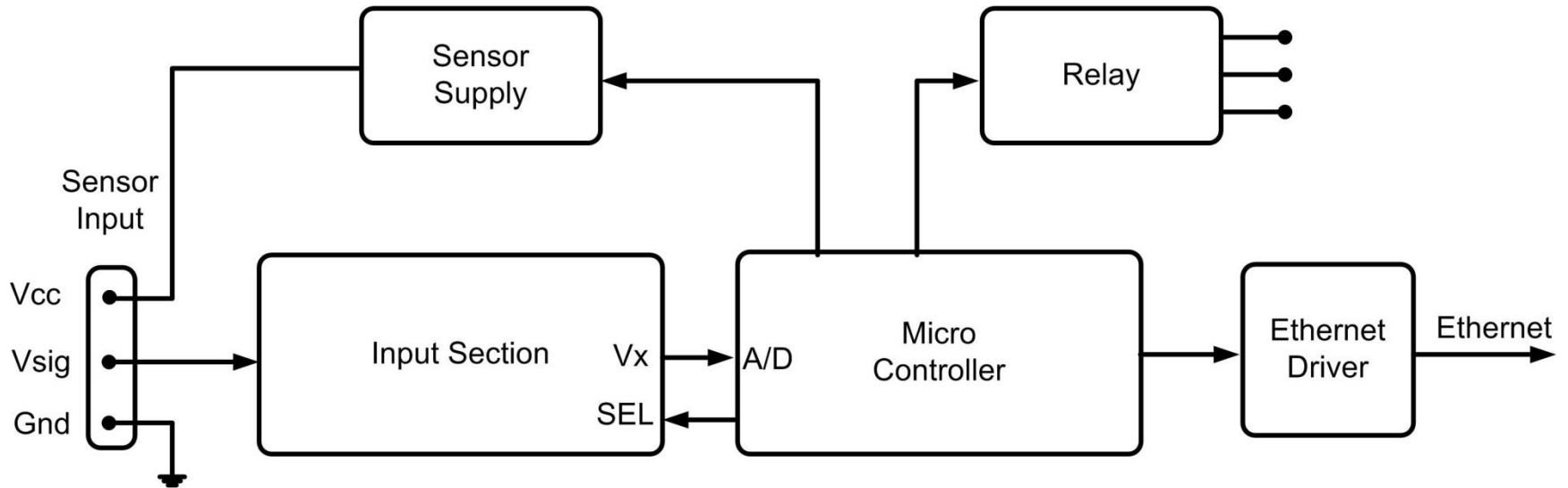
- ❑ Temperature
- ❑ Pressure
- ❑ Flow
- ❑ Liquid Level
- ❑ Proximity
- ❑ Dry contact (sensor and actuator)

# Industrial Analog Sensor Input Options

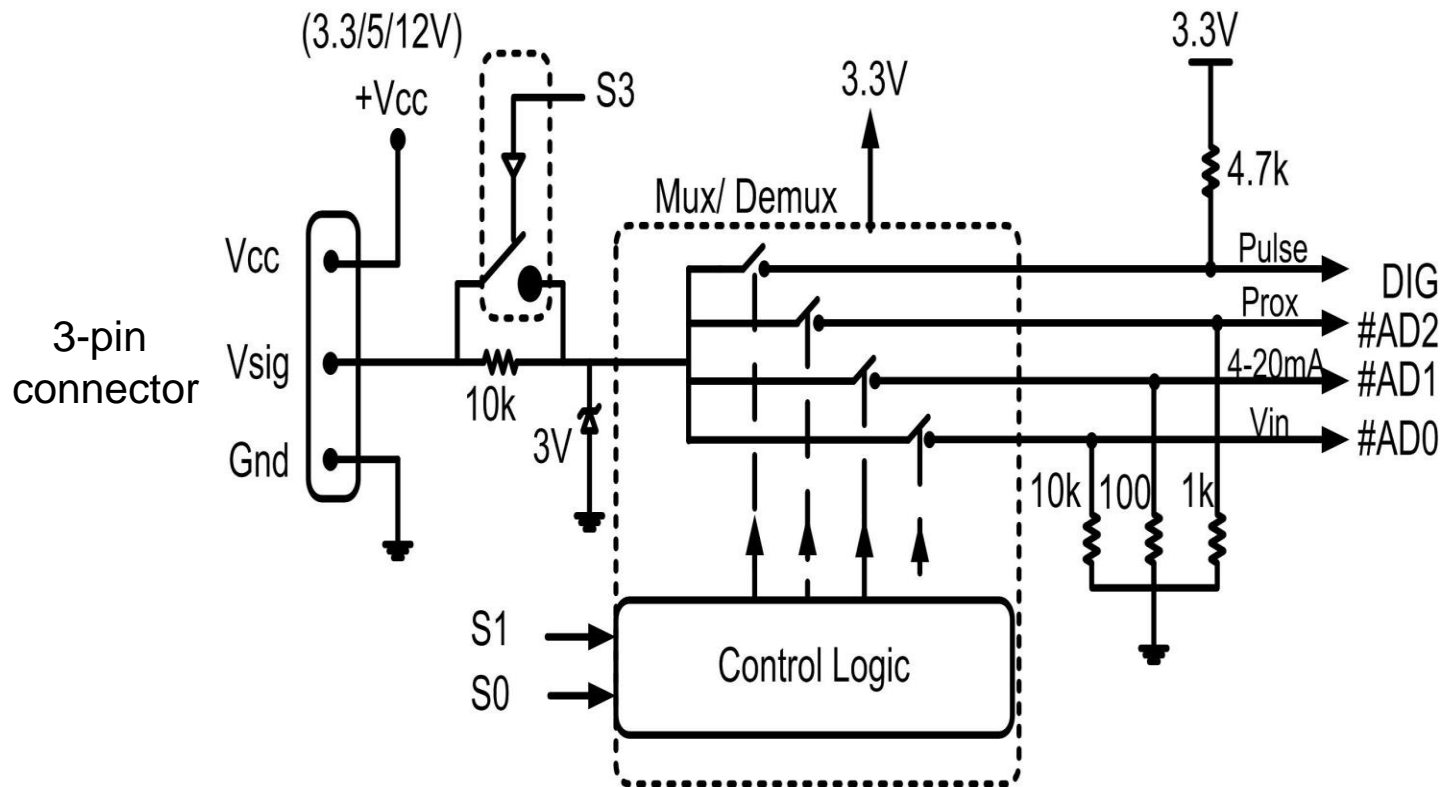
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- Voltage:
  - Output from signal conditioner is proportional to voltage, most often 0 to 5v (i.e. temperature and pressure sensor).
- Current:
  - Sensor transmitter output is 4 to 20 mA current (i.e. temperature and pressure sensors)
- Pulse:
  - Signal is proportional to the frequency of pulse or square wave output (i.e. flow sensors)
- Switch: NPN/PNP or dry contact
  - Proximity sensors (inductive, capacitive, ultrasonic)
  - Dry contact (microswitch or magnetic reed)

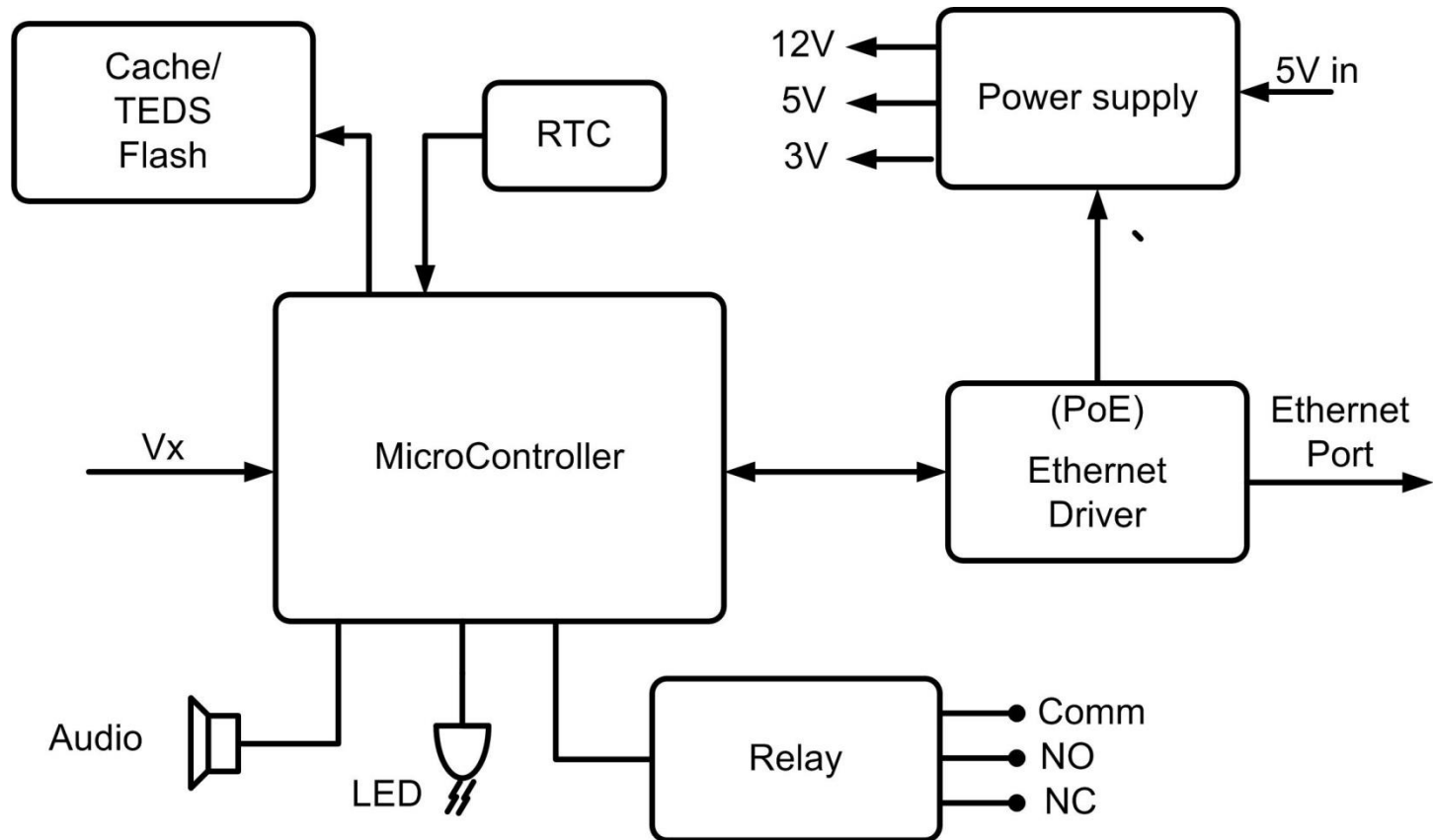
# Block Diagram of Interface



# Analog Signal Input Section



# Block Diagram of Microcontroller and Ethernet Driver





# Output (actuator) Options

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- ❑ LED indicator
- ❑ LCD display (2x16 character)
- ❑ Relay contacts (SPDT)

# Configuration Screen

SELECT SENSOR TYPE

Pressure (SI Unit:Pascal)

UNITS

Pounds/ sq. inch (PSI)

MINIMUM READING (Usually Zero)

0

FULLSCALE (CALIBRATION UNITS)

15

SELECT SENSOR SIGNAL TYPE

4-20mA

UNITS CONVERSION FACTOR (SISlope)

6894.7

# Modes of Operation

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- Stand-alone
  - Send data upon request
- Master-push
  - Client
- Save on event
  - Server
- **Verify this slide**

# Digital (network) Formats

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- HTTP
- JSOM
- XML
- SNMP (V2, v3)
- XMPP
- **Expand on this slide**

# TEDS LISTING

#	ACCESS CODE	TEDS NAME	CHAN	S/A <sup>1</sup>	TEDS FIELDS <sup>2</sup>	DATA TYPE	# BYTES <sup>3</sup>
1	1	<u>METATEDS</u>	-		UUID [], TIMEOUT[], # CHANNELS	--	13
2	3	<u>CHANTEDS</u>	1-TIME	S		TAI 64-BIT INTEGER	
3	5	<u>CALTEDS</u>	1-TIME	S	INTERCEPT(31)=17, SISLOPE <sup>4</sup> =1, DATA(128), <u>CALUNITS(129)="SEC"</u>	32-BIT INT TEXT	
4	3	<u>CHANTEDS</u>	2-PRESSURE	S	<u>CALKEY[10], CHANTYPE[11], PHYUNITS[12], UNTYPE[50]</u>	FLOAT 32-BIT	
5	5	<u>CALTEDS</u>	2-PRESSURE	S	SISLOPE[30], DATA(128) <u>CALUNITS[129]</u>	FLOAT, TEXT	12+
6	3	<u>CHANTEDS</u>	3-AUDIO	A	<u>CALKEY[10], CHANTYPE[11], PHYUNITS[12], UNTYPE[50]</u>	8-BIT INTEGER	
7	3	<u>CHANTEDS</u>	4-LED	A	<u>CALKEY[10], CHANTYPE[11], PHYUNITS[12], UNTYPE[50]</u>	8-BIT INTEGER	
8	3	<u>CHANTEDS</u>	5-LCD	A	<u>CALKEY[10], CHANTYPE[11], PHYUNITS[12], UNTYPE[50]</u>	8-BIT INTEGER	
9	12	<u>XDRNAME TEDS</u>	-		"IOT INTERFACE"	TEXT	
10	13	<u>PHYTEDS</u>	SERIAL, DOT 2		TYPE (10)=01 (INTERNAL)	--	2

# Meta-Teds Example

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MSB LSB	FIELD DEF
00 00	TOTAL LENGTH
00 24	
03 04	HEADER
00 01	03 04 00 01 01 01
01 02	
04 0A	UUID
81 C0	04 0A 81 C0 F9 74 48 81 F5 62 2E 78
F9 74	
48 81	
F5 62	
2E 78	
0A 04	OPERATIONAL TIMEOUT
BF A0	0A 04 3F 00 00 00
00 00	
0D 02	NUMBER OF CHANNELS
00 01	0D 02 00 01
F8 D1	CHECKSUM

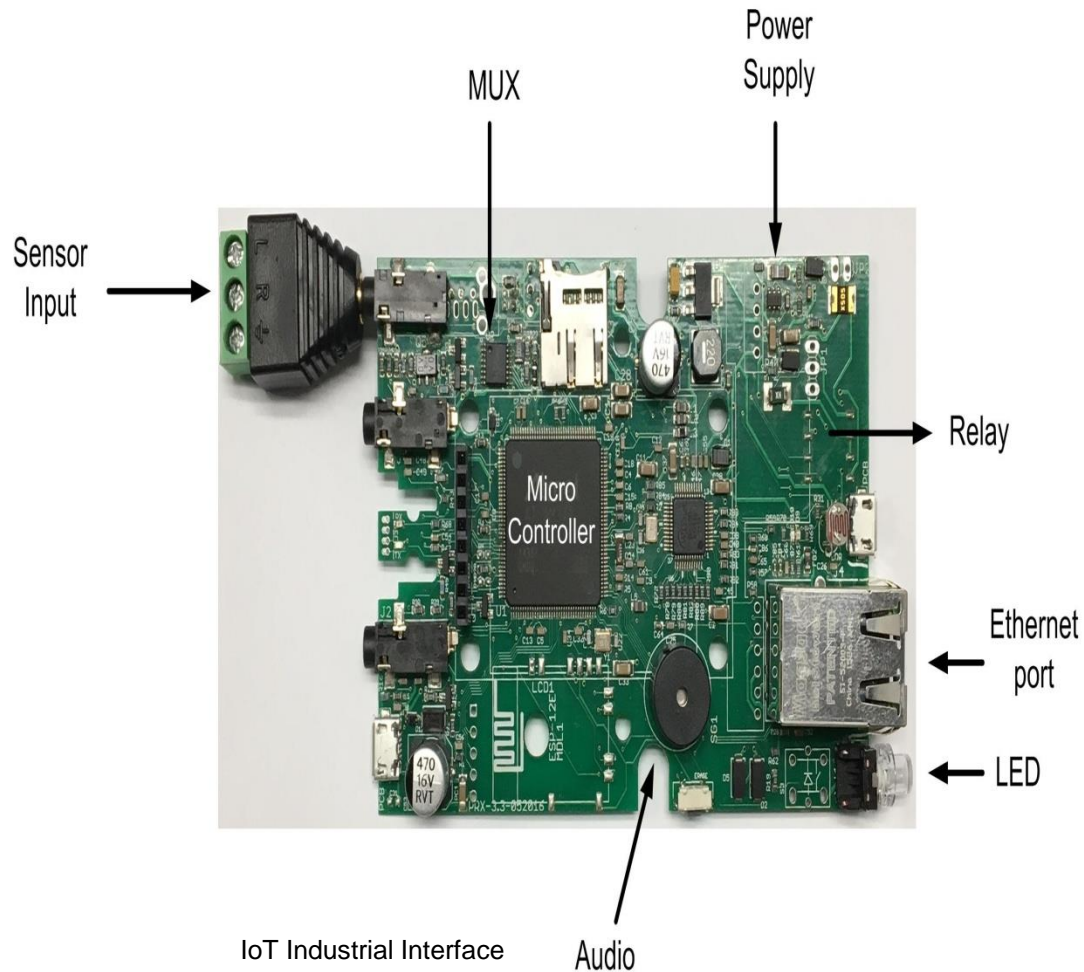
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# Security

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- Use SSL for email
- Tested by NASA for network vulnerability
- VALLOP???
- **Check this**

# Photo of Interface



IoT Industrial Interface





# Example Results

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# Summary

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- Review role of Sensors in IoT
- Summarize Industrial Sensor Characteristics
- Described our IoT Interface for analog sensor
- IEEE 21451 Smart Transducer Format

# End

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- Backup Slides Follow



Contact: [designer@eesensors.com](mailto:designer@eesensors.com)

# List of TEDS types

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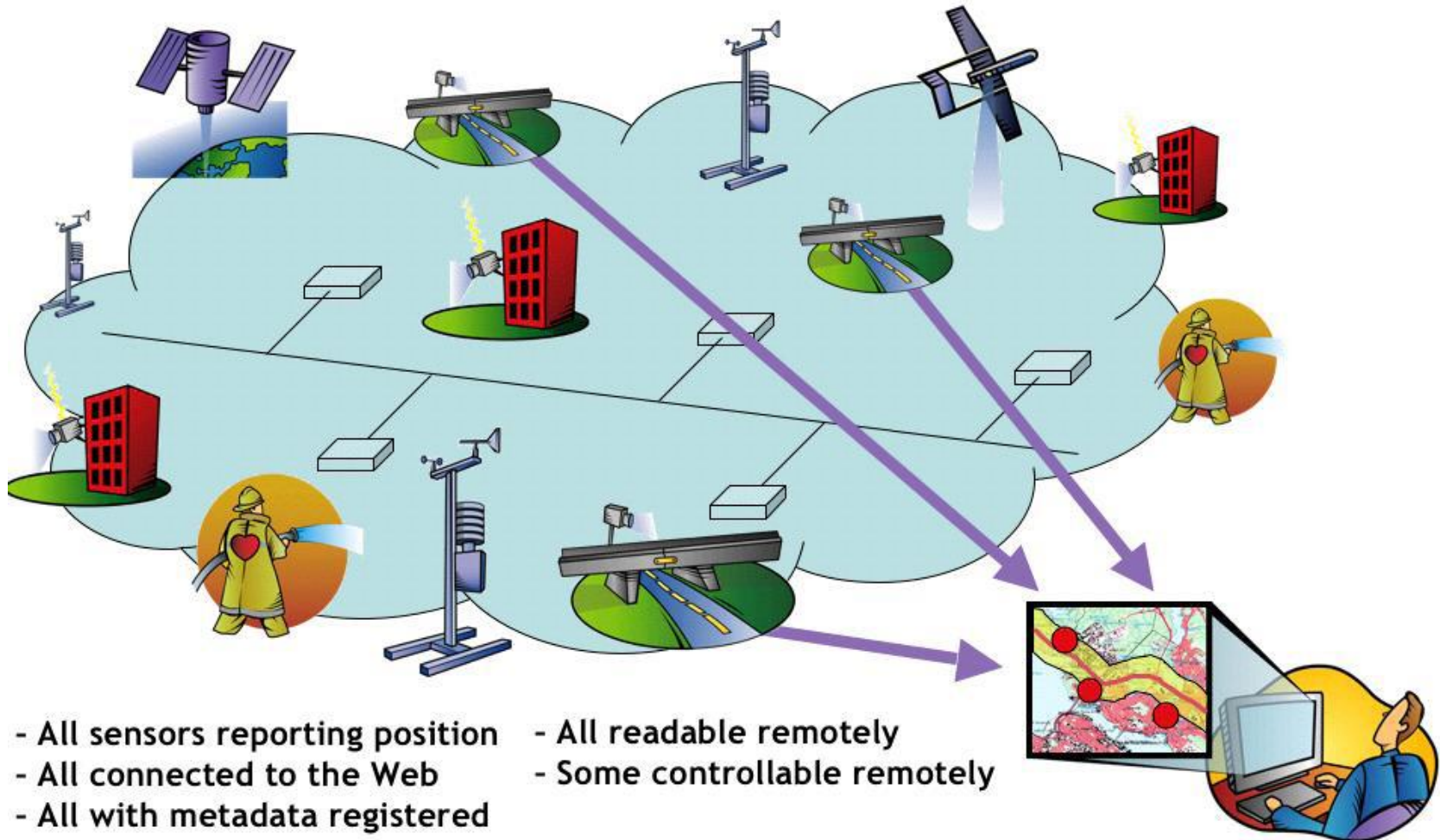


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TEDS	Necessity
Meta-TEDS	Required
<u>TransducerChannel TEDS</u>	Required
Calibration TEDS	Optional
Frequency Response TEDS	Optional
Transfer Function TEDS	Optional
Text-based TEDS	Optional
End User Application Specific TEDS	Optional
User's TransducerName TEDS	Required
Manufacturer-defined TEDS	Optional
PHY TEDS	Required

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# Sensors on Internet of Things



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