

# Ultra Low Dynamic Energy Measurement

New Agilent Solution  
To Address  
Old Measurement  
Challenges

Carlo Canziani  
EMEA Business Development

London March 28<sup>th</sup>, 2012

*Anticipate —Accelerate —Achieve*



**Agilent Technologies**

**Energy Harvesting**  
An EPSRC Funded Network

**EPSRC**  
Engineering and Physical Sciences  
Research Council

# Demand for Energy Harvesting from Wireless Sensor Network

Wireless Sensor Network devices  
today relies on batteries

When battery is dead ?

It's a piece of junk

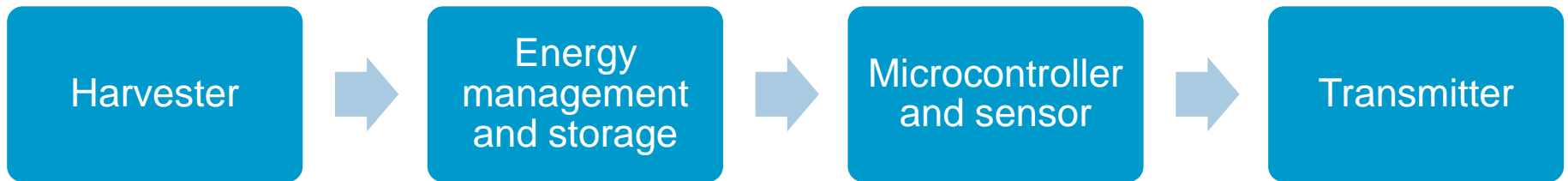
Smart Building, Structural Monitoring, Wearable Devices  
demand for long life, maintenance free.

# Energy Harvesting

Energy Harvesters,  
Ultra Low Power Microcontroller  
Transmitter  
Receiver

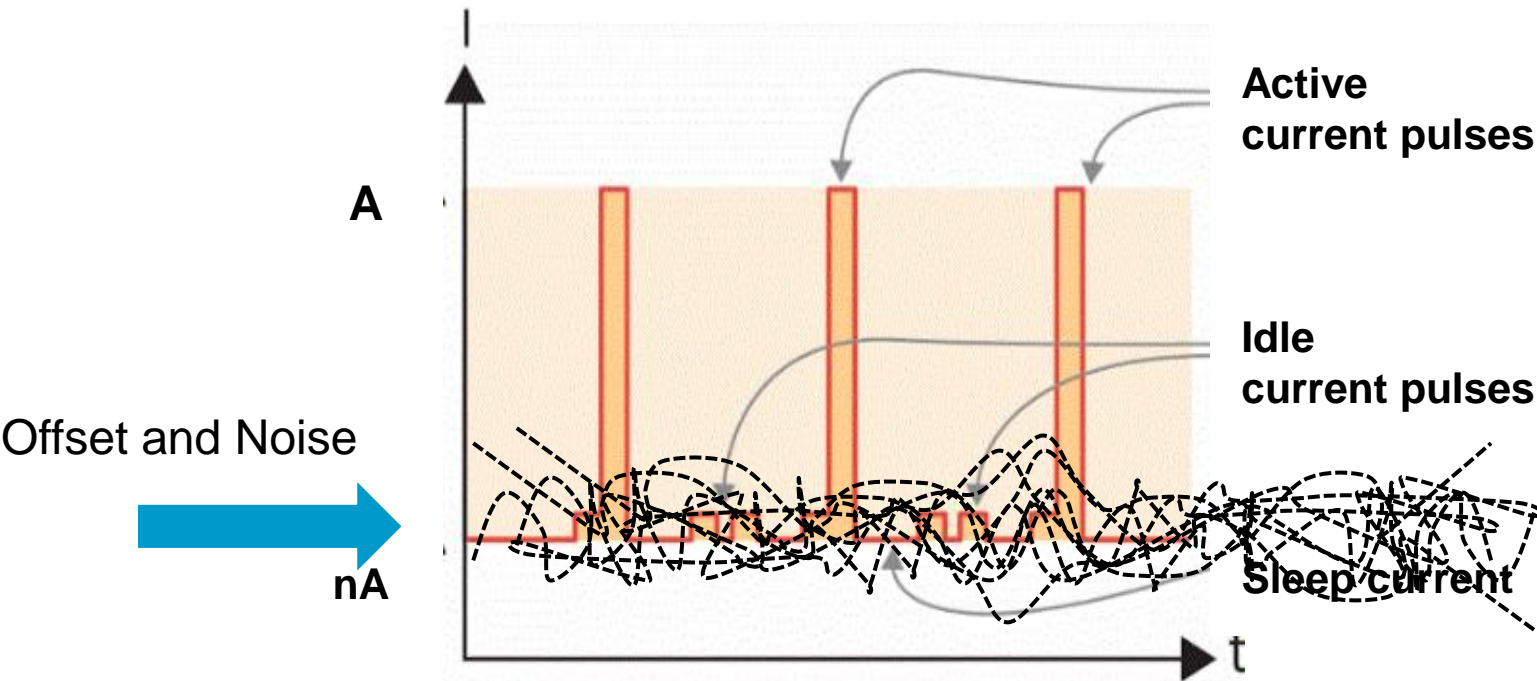
need to be combined with a great:

## Power Management



Simplified block diagram of a Wireless Sensor

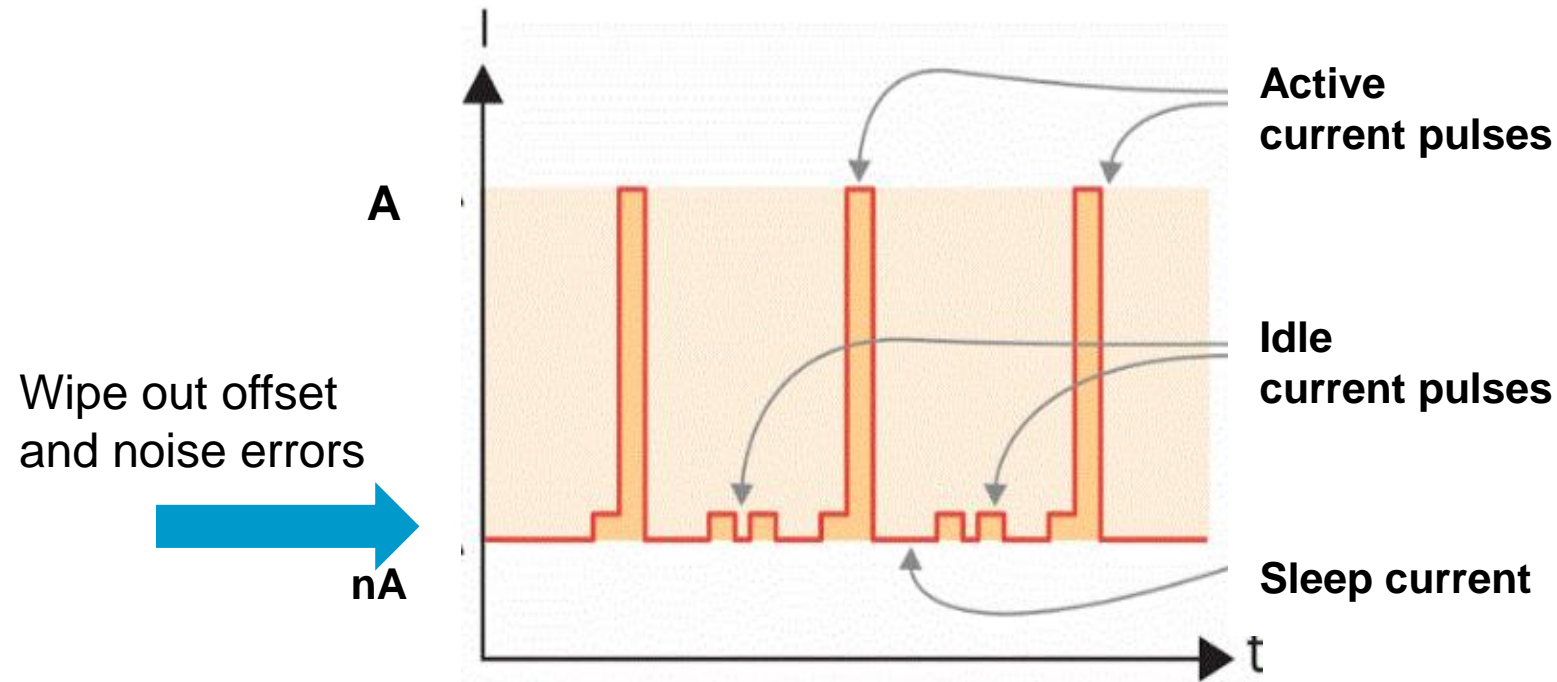
# Power Management - Measurement Challenges with Traditional T&M Equipments



Typical Wireless Device Energy Drain

# Seamless Ranging

## Benefit in Ultra Low Energy Measurements

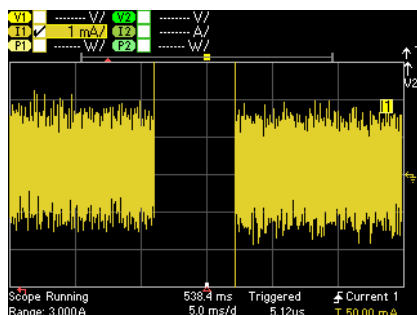


**Get the full picture**

# Seamless Ranging Measurement

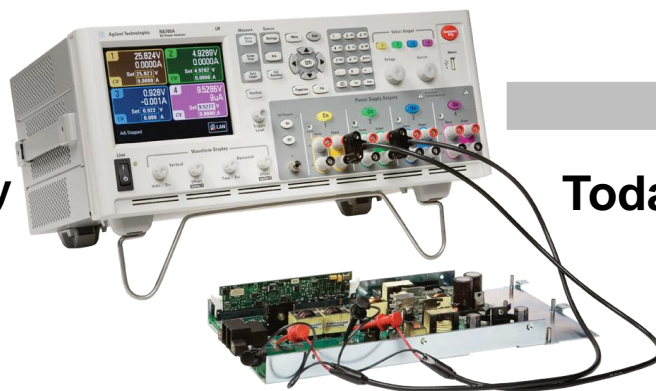
All new, Agilent-exclusive feature – never been done before

- Can change range, without glitch, mid-sweep and not lose any readings
- 200 kHz, 18-bit digitizer acts like single range of ~28-bits

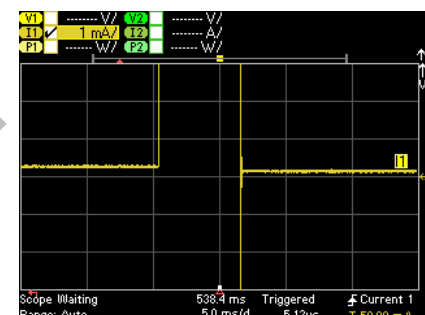


**Seamless Off**

Yesterday



Today



**Seamless On**

*See the complete current waveform you've never seen before  
– from nA to A –  
in one pass and one picture*

# Agilent N6781A Seamless Ranging Innovation Performance

Voltage			
Range	20V	1 V	100 mV
Measurement Accuracy	$\pm(0.025\% + 1.2\text{mV})$	$\pm(0.025\% + 75\mu\text{V})$	$\pm(0.025\% + 50\ \mu\text{V})$

Seamless measurement between these 3 ranges

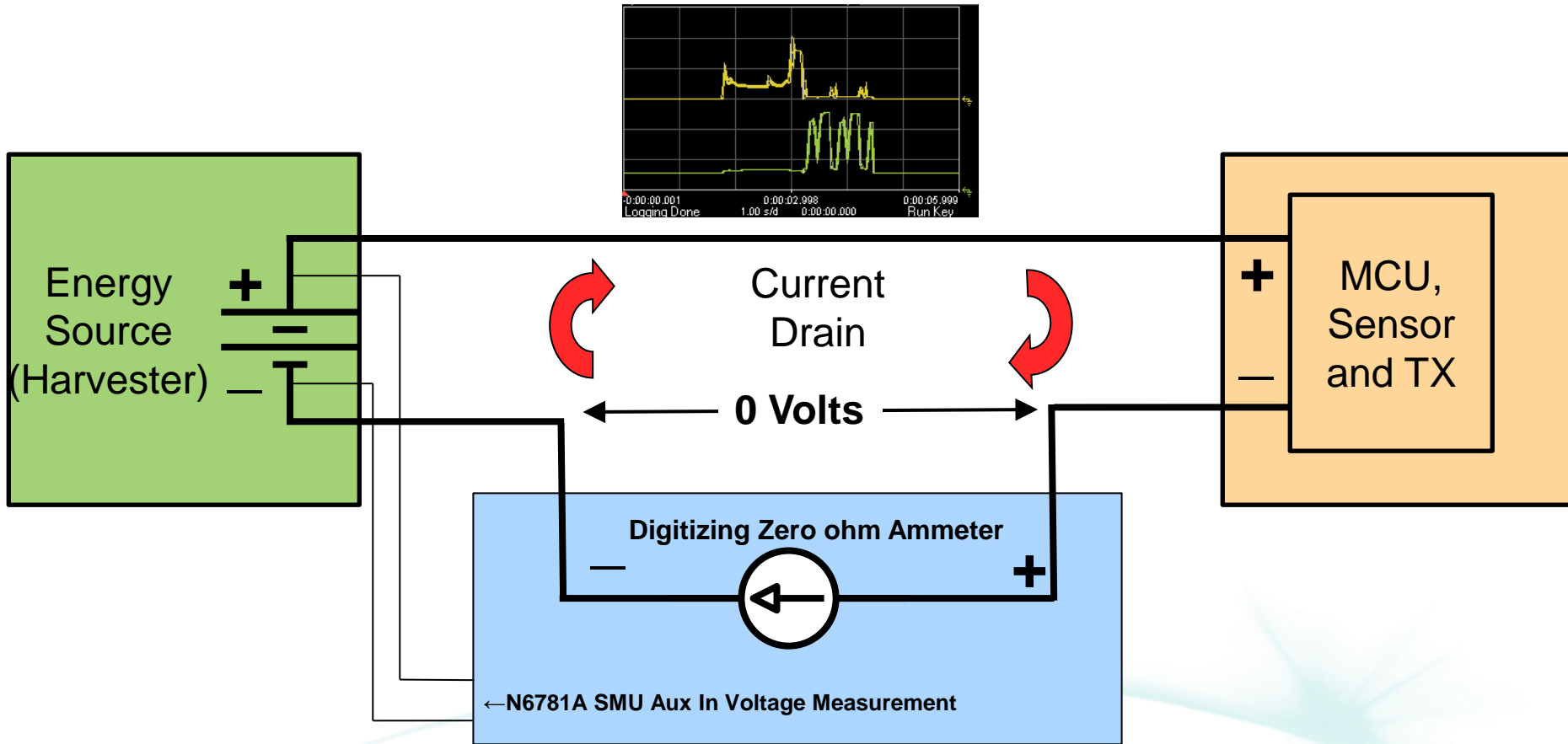
Current				
Range	3 A	100 mA	1 mA	10 $\mu\text{A}$
Measurement Accuracy	$\pm(0.03\% + 250\ \mu\text{A})$	$\pm(0.025\% + 10\mu\text{A})$	$\pm(0.025\% + 100\ \text{nA})$	$\pm(0.025\% + 8\ \text{nA})$

Seamless measurement between these 3 ranges

- Seamless ranging continually changes ranges without glitch nor lose readings
- 200 kHz, 18-bit digitizer, with seamless ranging, acts like a single range of ~28-bits
- 3 A range with an effective offset error as low as 100 nA (0.03 PPM)
- Accurate measurements from Amps to  $\mu\text{A}$  during a single scope sweep or data-log

# Operation as a Virtual shunt

Realistic assessment of DUT with actual harvester



Single reading, Scope or Datalogger with Seamless Ranging



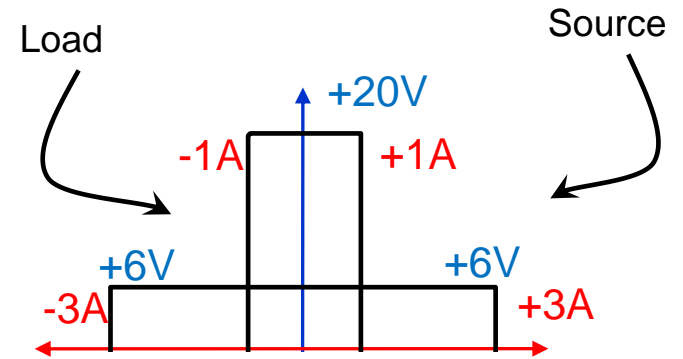
# Device Energy Drain

## Single Shot Acquisition - $\mu\text{J}$



# Source Measure Unit N6781A

## for Modular DC Power Analyzer N6705B



- Voltage Source
- Current Source
- Electronic Load
- Arbitrary waveform for Source and Sink
- Capture Single Shot Event
- Multiple Channels
- Time Correlated Measurements
- Trigger IN/OUT



# Summary

Adoption of Energy harvesting for Wireless Sensor is a top priority

Wireless devices operate in short bursts of activity to conserve power

- Applicable to a very wide variety of devices
- Resulting current drain is pulsed

The high peak and low average values of current drain signals are challenging for traditional test equipment to measure accurately:

- Dictates needing DC measurement offset errors  $< \mu\text{A}$
- Traditional test equipment offset error mA is too high!

Innovation in the form of seamless ranging resolves the inherent problem of DC measurement offset error for accurately measuring dynamic current drain

[www.agilent.com/find/N6781A-EU](http://www.agilent.com/find/N6781A-EU)

Questions



*“Save the Planet  
One Battery at Time”*



Carlo Canziani  
Business Development Manager  
+390 292 608 689  
carlo\_canziani@agilent.com

Thank you

