

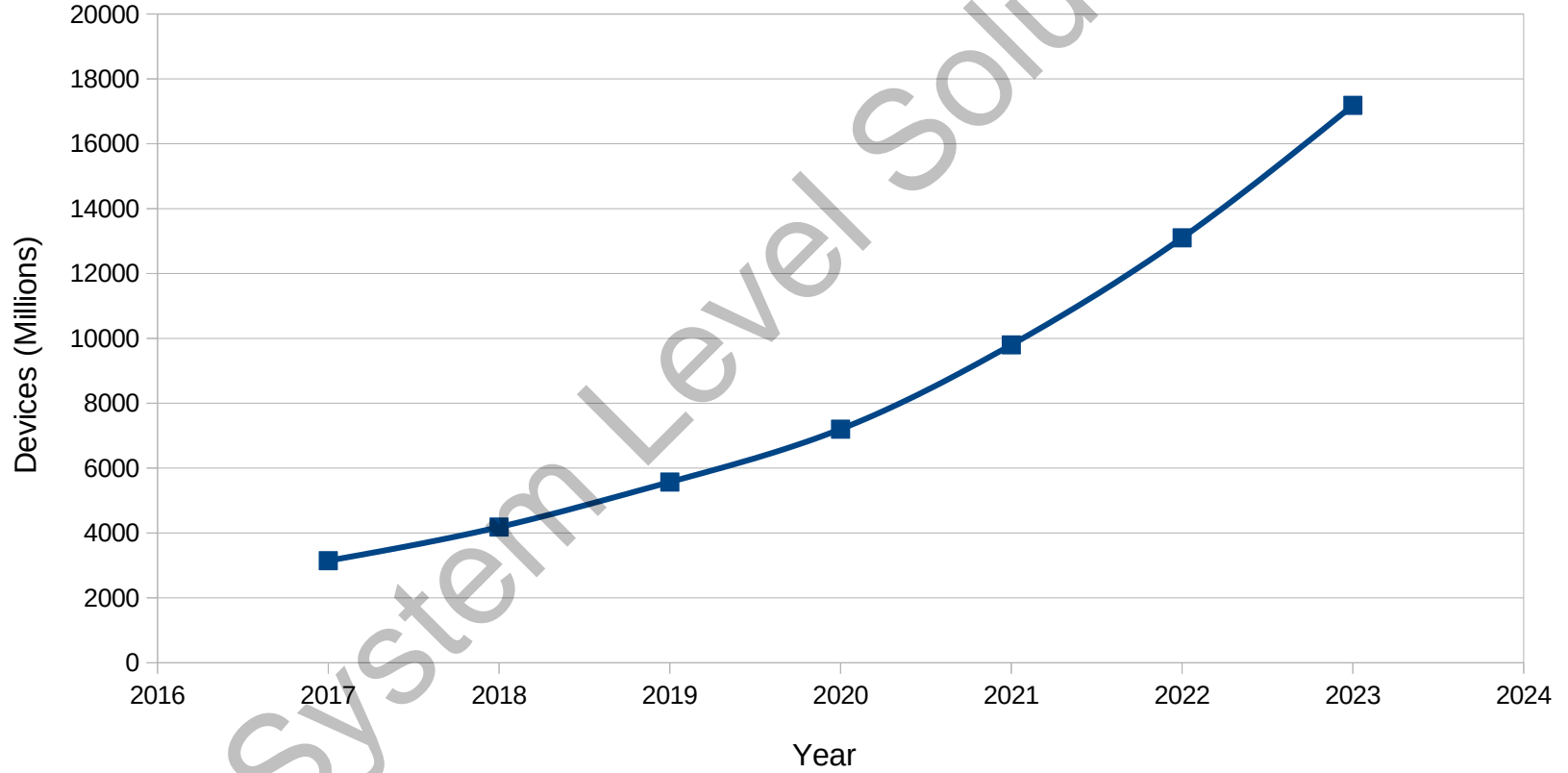
# Designing Energy Efficient Products: Challenges and Solutions

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President and CEO  
System Level Solutions, Inc.



# Motivation

IoT Devices Forecast



Modified from Source: <https://www.marketsandmarkets.com/Market-Reports/iot-gateway-market-248007097.html>



Approximately **10 Billion** Devices forecasted from 2020 to 2023

**What if you could save 0.1 Watt  
of  
Power per device?**

The image is a composite. The top half shows a pair of hands holding a large amount of dark, lustrous coal. The bottom half shows a dark industrial chimney on the right, emitting a thick, white plume of smoke that drifts across the sky. The sky is a deep blue with scattered white clouds. A large, semi-transparent watermark reading "System Level Solutions" is oriented diagonally across the entire image.

Save about 450,000kg of coal



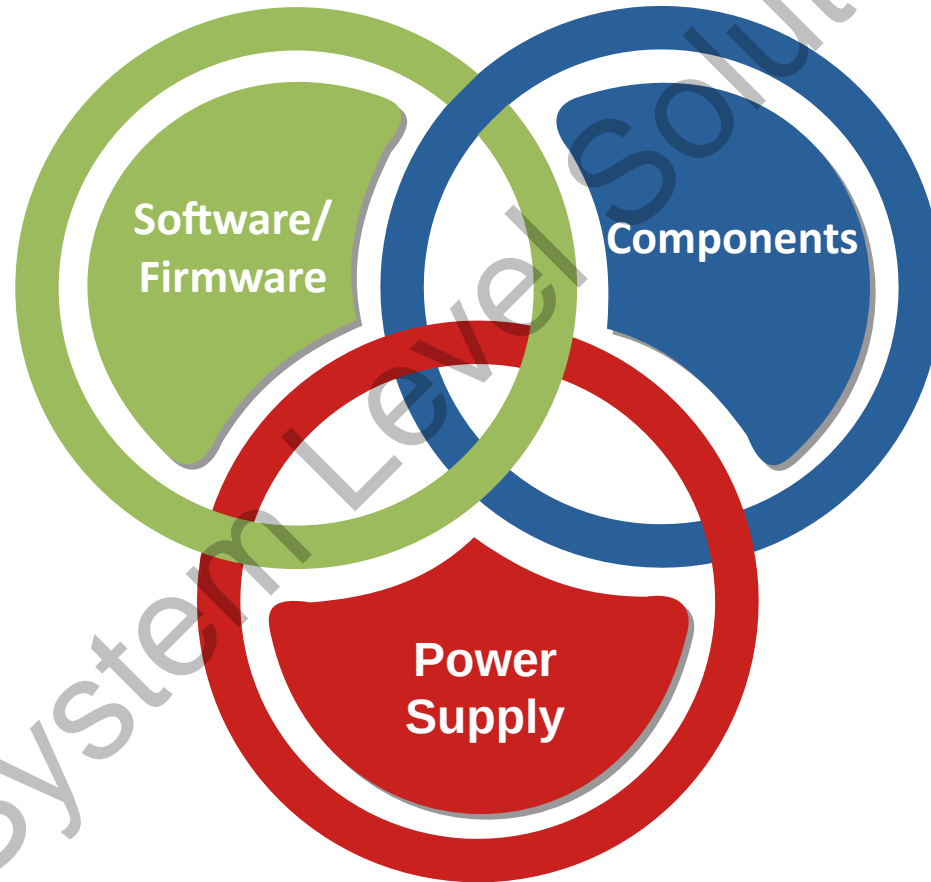
Equivalent to about 3.125 Million Solar Panels

**Charge 33,000 Nexon EVs**

# Universal Challenges

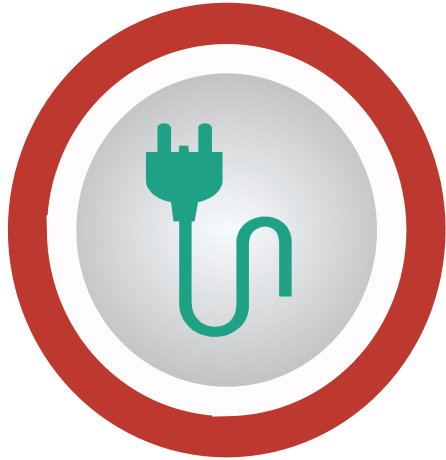


# Areas of Opportunity





# Power Sources for Electronic Products



Mains



Battery

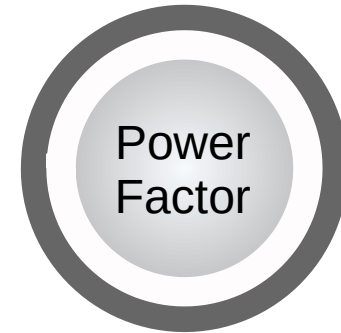


Harvested

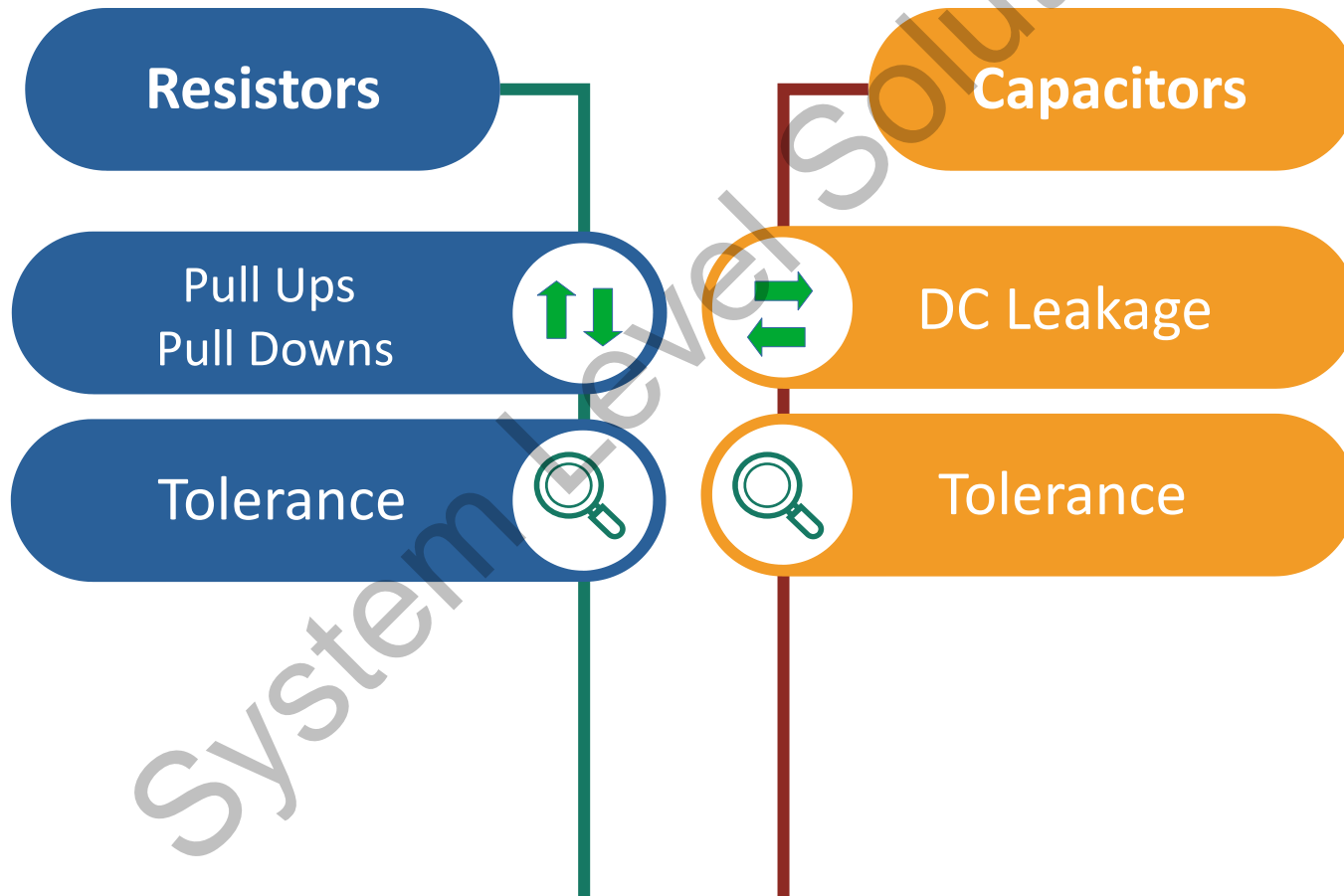
Doesn't Hurt to Try and Optimize

# Voltage Regulator

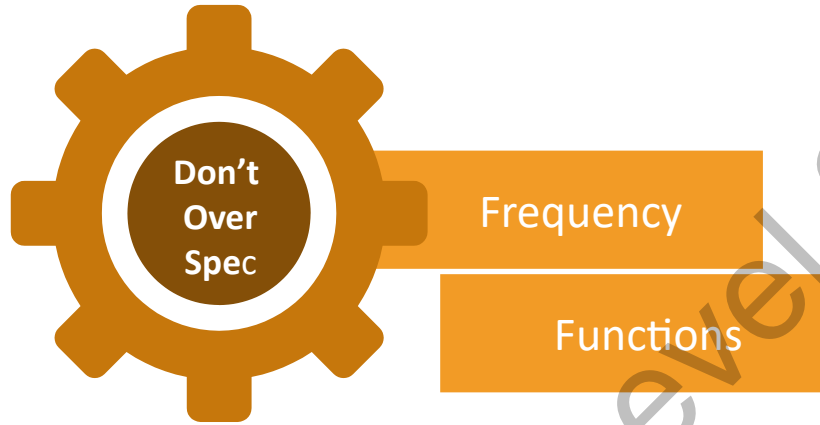
	LDO	Switcher
High Efficiency		✓
Low EMI	✓	
Less Components	✓	
Lower Thermal Loss		✓
Simple Design	✓	
Lower Cost	✓	



# Passives Best Practices



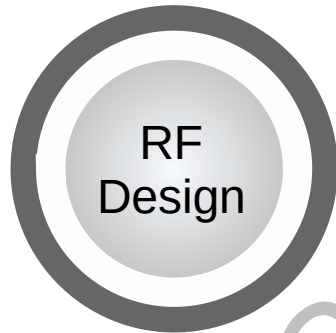
# Microprocessor/Microcontroller



# Software/Firmware



Software  
Matters



RF  
Design



Clock Scaling

01



Peripheral Power

02



Sleep Modes

03



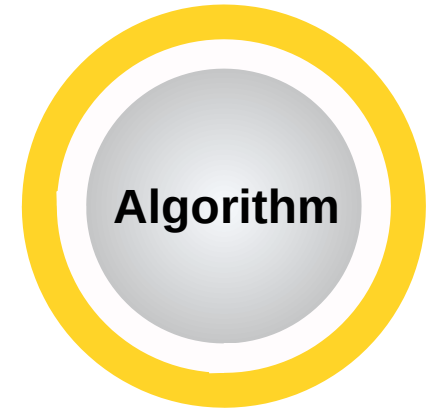
Interrupt I/O

04



PWM I/O

05



Algorithm

# RF Output Power

Test Freq (MHZ)

2450

CW Test Power (dBm)

9.764

Phase Noise





Excellent

Spectrum purity

Clean, as per ETSI standards

Equipment Used: Signal Hound USB-SA44B  
measurement uncertainty  $\pm 1.5$  dB

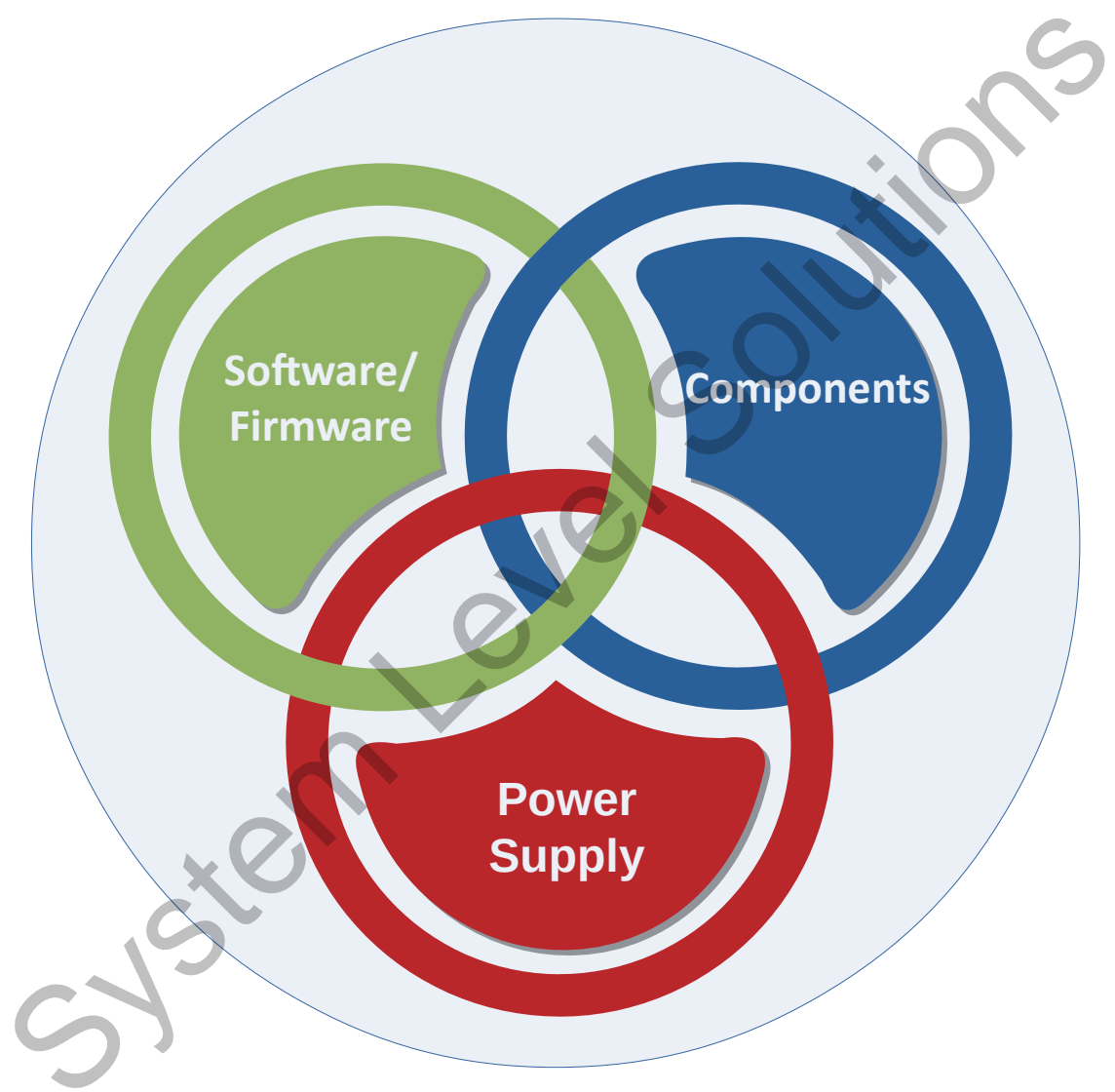


-  Rx Current 19.6 mA
-  Tx Current 26.8 mA
-  Deep Sleep Current 0.66  $\mu$ A
-  Sleep Current 2.23  $\mu$ A

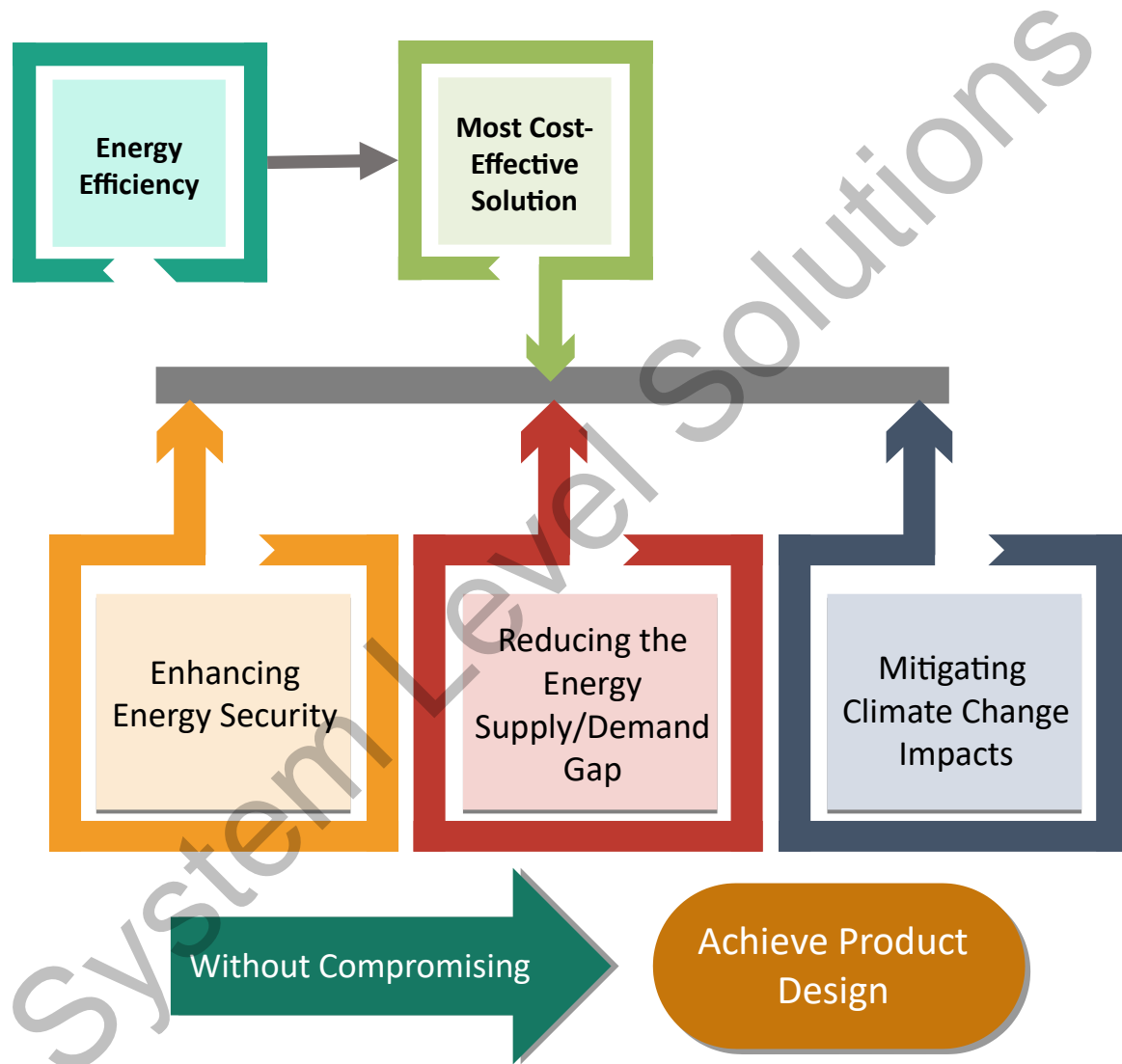


Test done by: Tektronix MSO 2024B

Software Matters







Thank You

[www.slscorp.com](http://www.slscorp.com)

