

Università degli Studi di Padova – Dipartimento di Ingegneria Industriale
Corso di Laurea in Ingegneria dell'Energia

Relazione per la prova finale
***«Analisi delle prestazioni energetiche e ottimizzazione dei sistemi
di Power Management in dispositivi IoT per l'Agricoltura 4.0»***

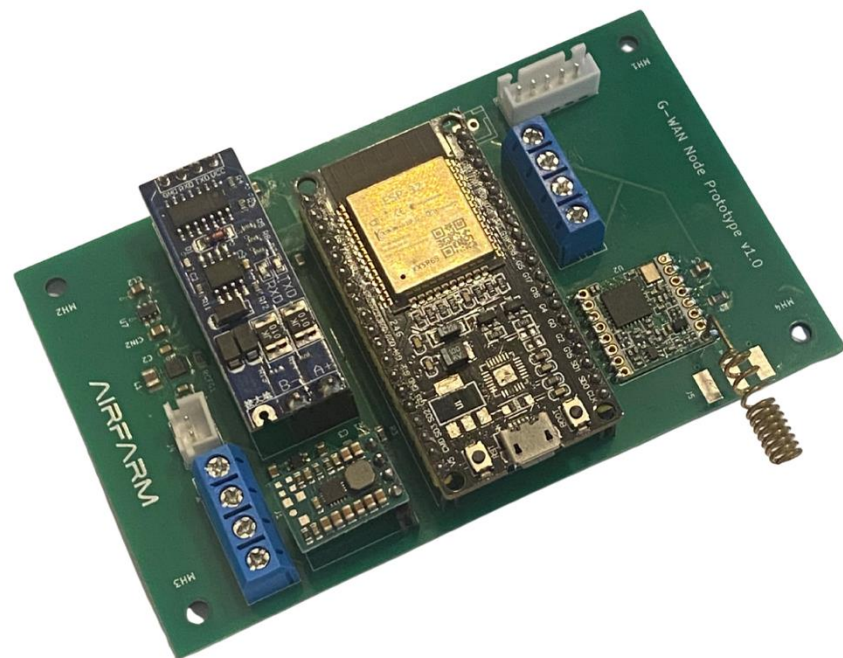
Tutor universitario:

Prof. Varagnolo Damiano

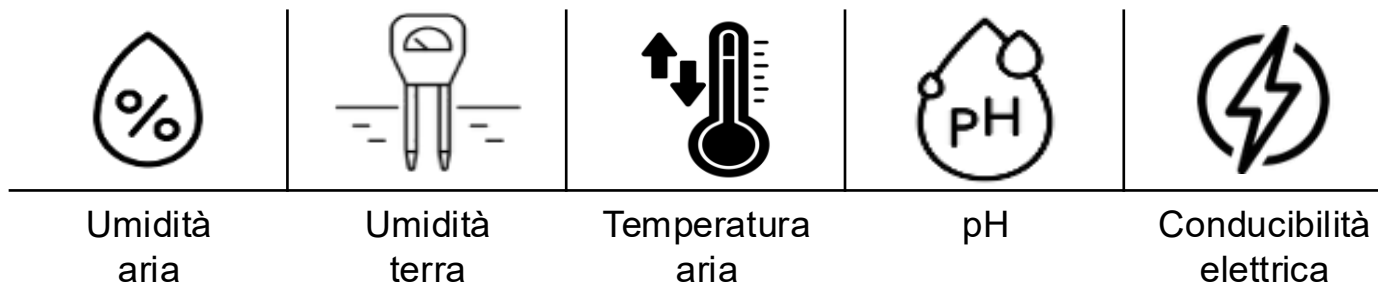
Laureando:

Cappelletto Francesco

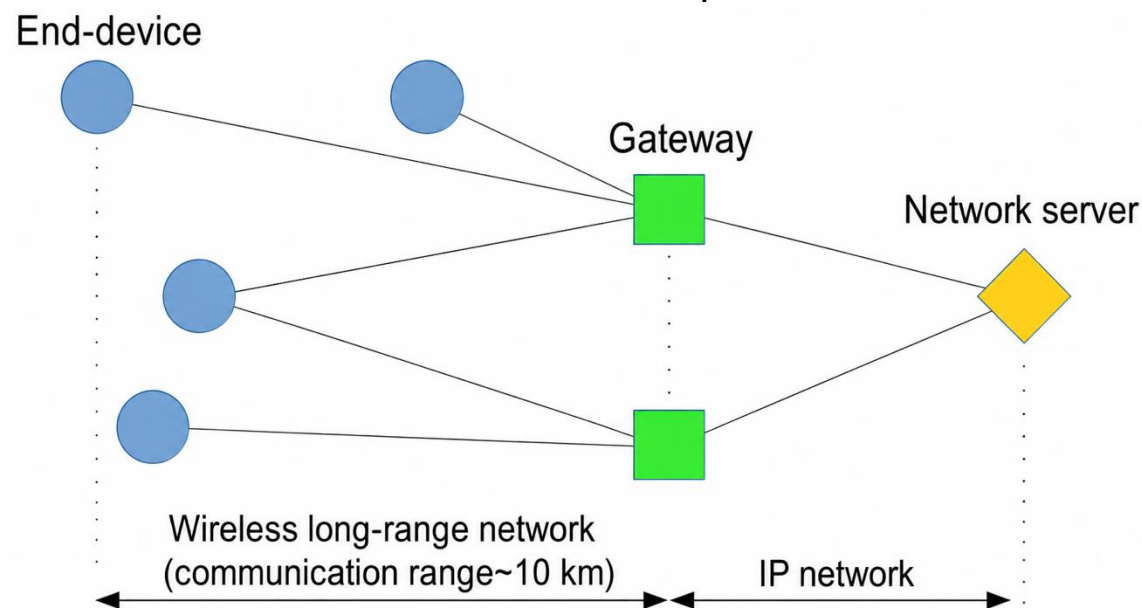
Padova, 17/09/2026



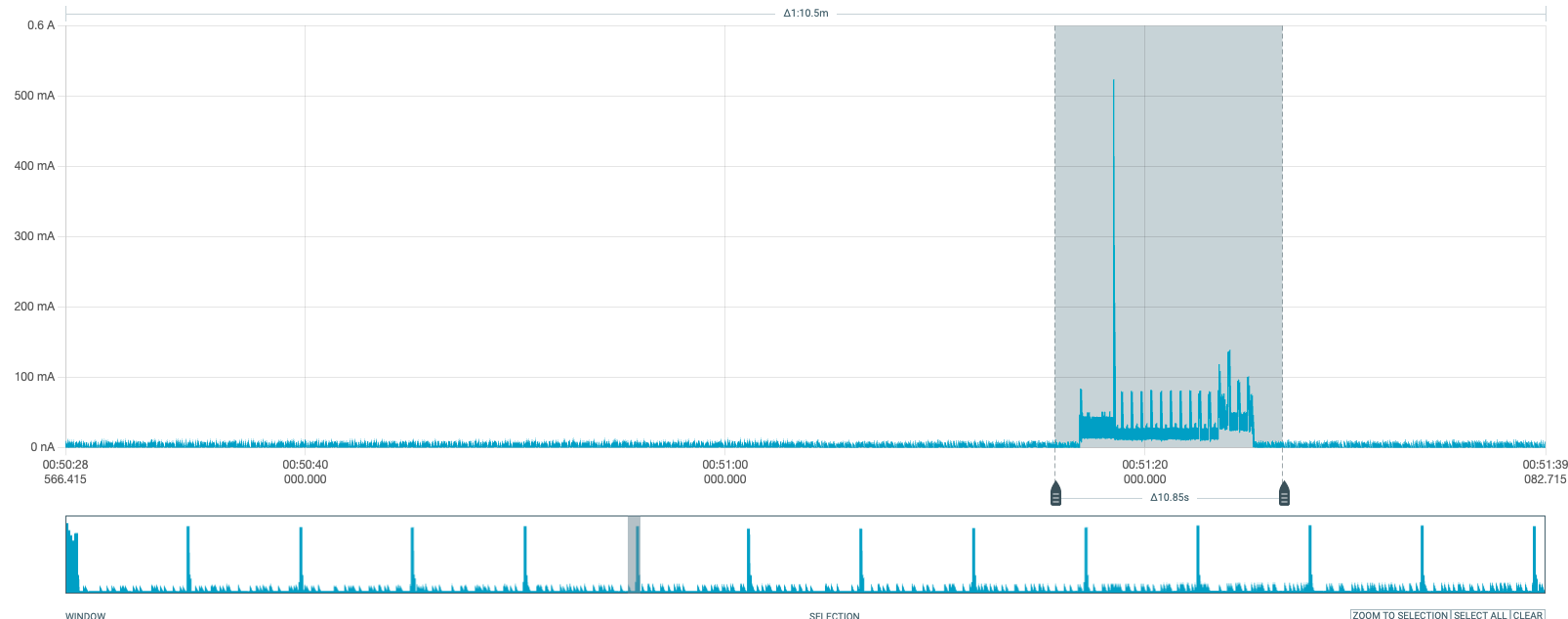
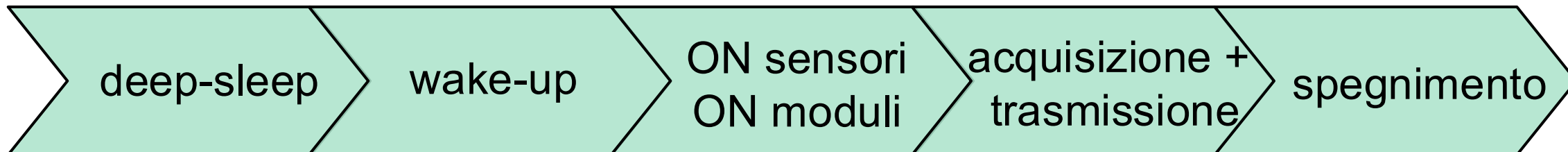
Dispositivo a bassa potenza, **parametri misurati:**



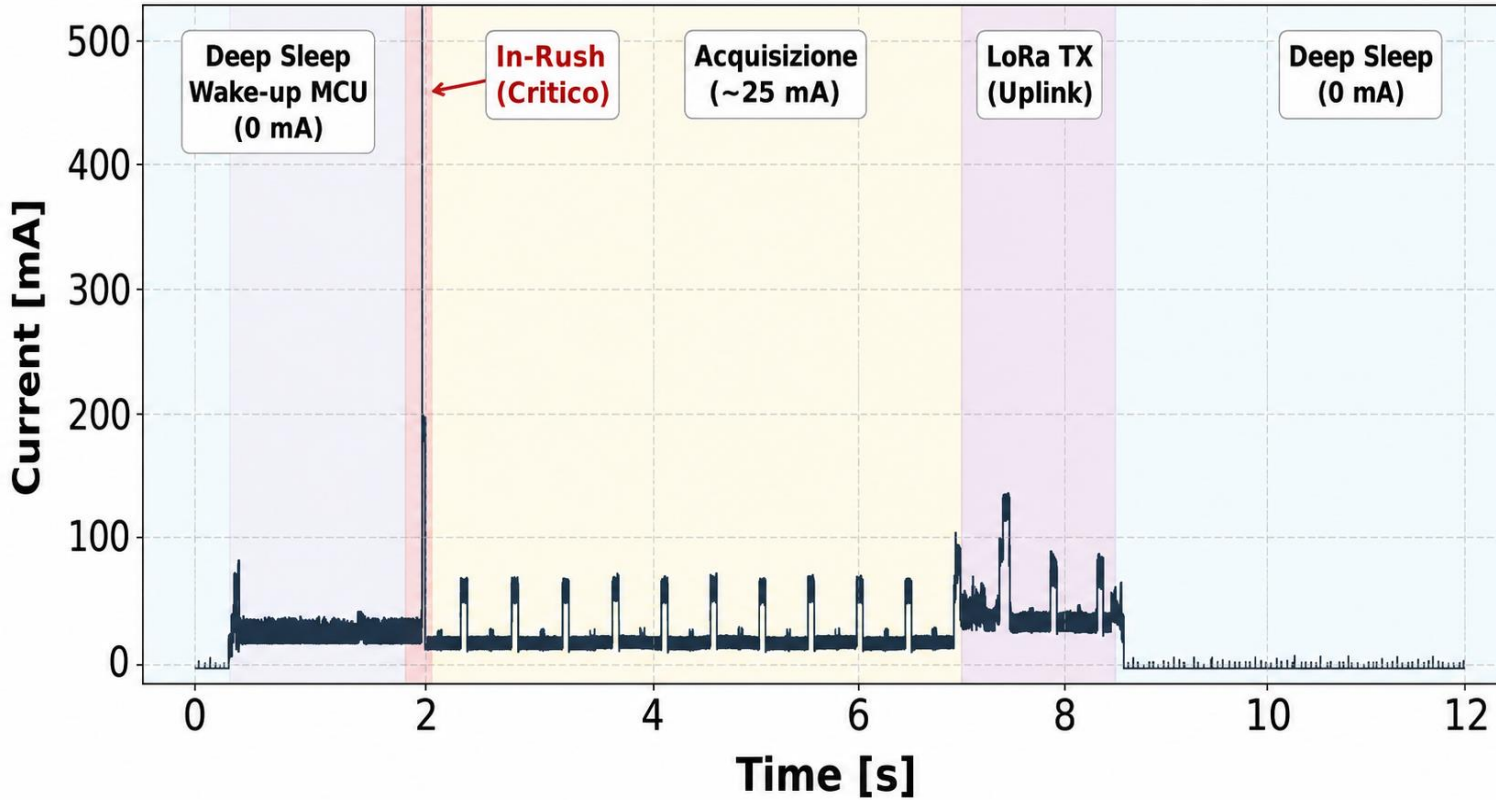
WSN: Wireless Sensor Network sul campo la trasmissione avviene tramite protocollo **LoRaWAN**



ACTIVE PHASE: durata ~10 s



Active Phase Analysis



63
 μAh

Carica assorbita per ogni ciclo

0,4
 μAh

Assorbimento deep-sleep

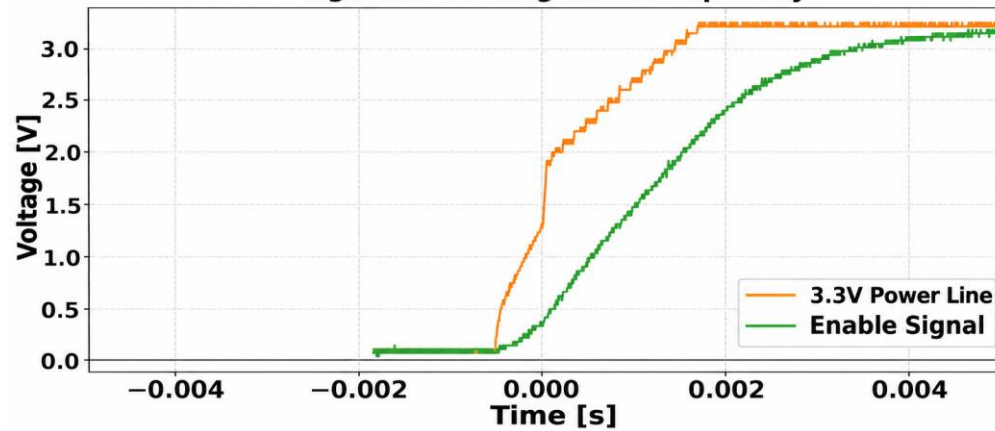
2
cicli/h

1 ciclo ogni 30 minuti

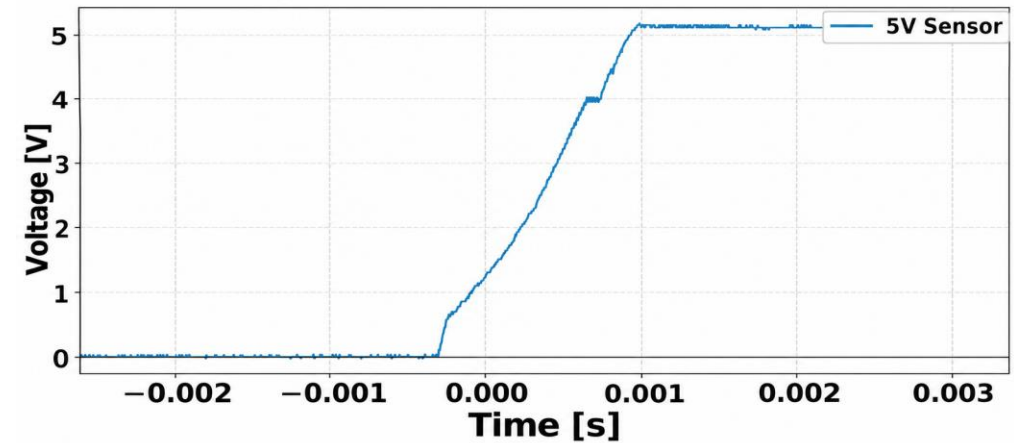
~1,6
anni

Durata vita batteria 2200mAh

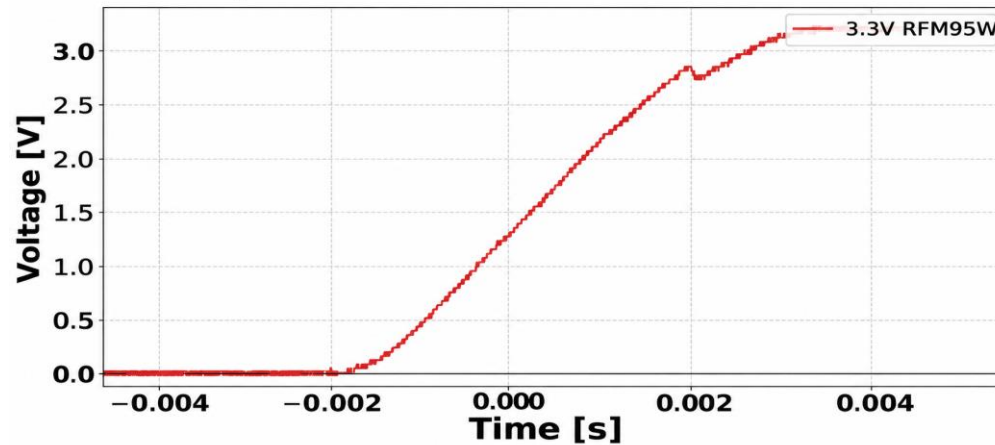
3.3V+ENABLE:
Correlation between the 3.3V power line and the Enable signal illustrating the startup delay



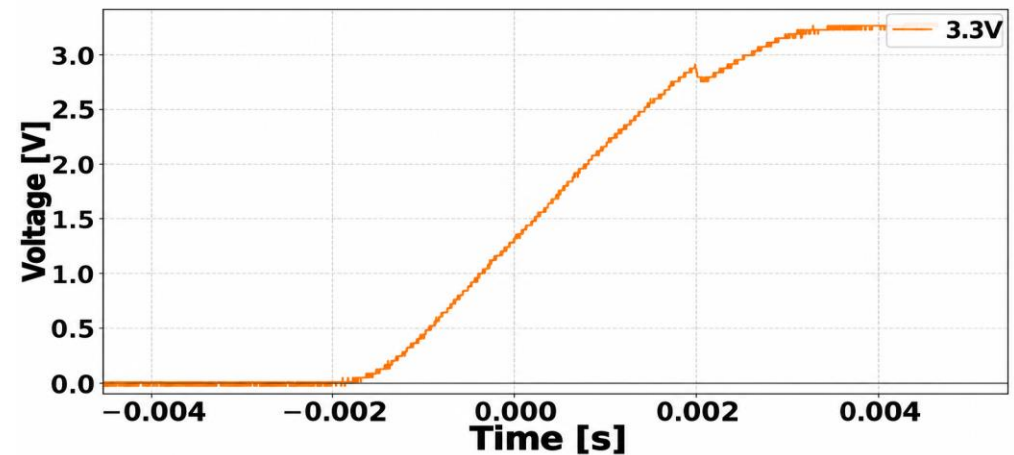
SEN0604 5V:
Power-up transient of the underground soil sensor



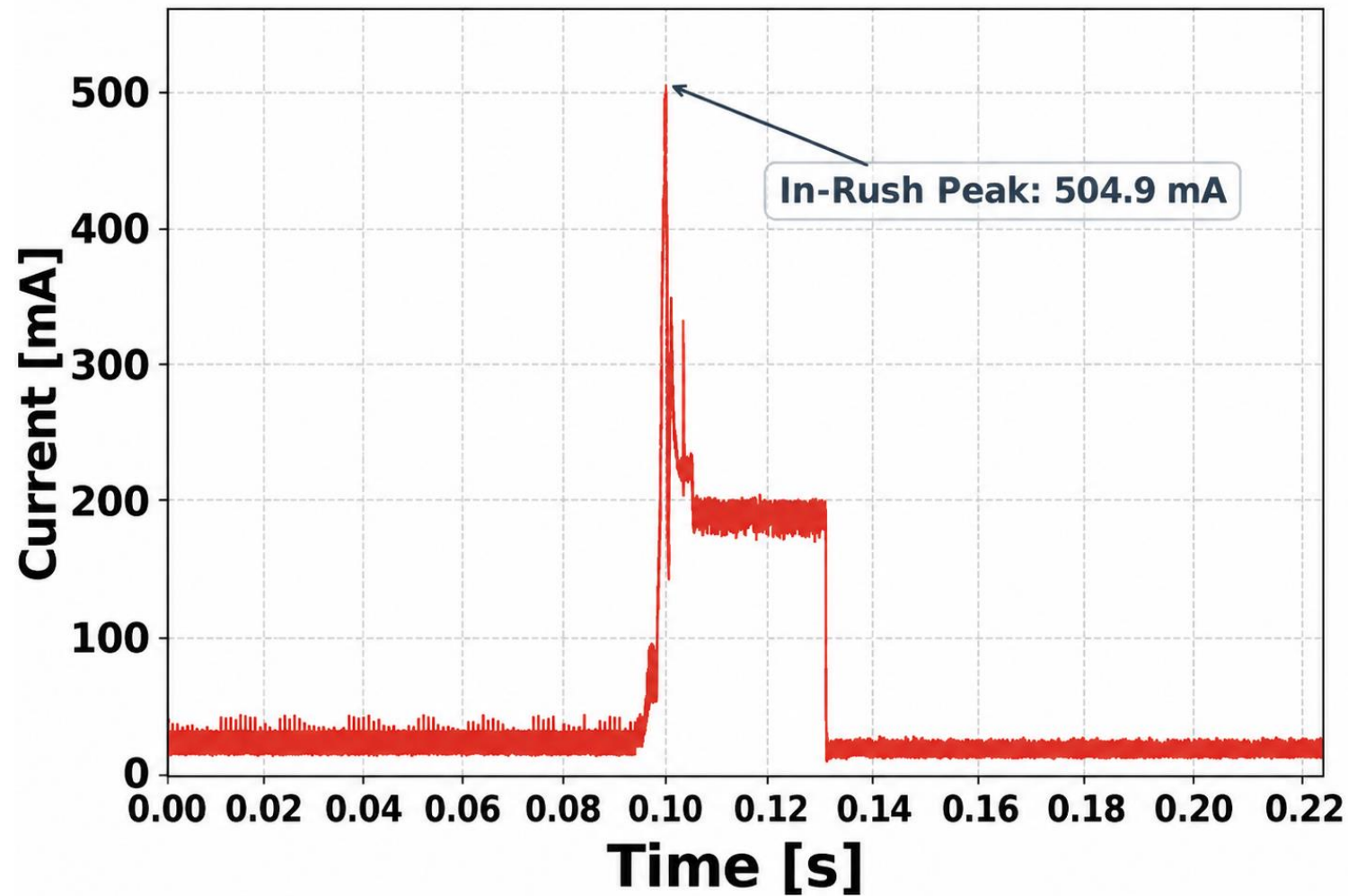
RFM95W:
Power-up transient of the wireless communication module



SEN0385:
Power-up transient of the external environmental parameter sensor



Transient Analysis: In-Rush Current at Load Activation



picchi di assorbimento

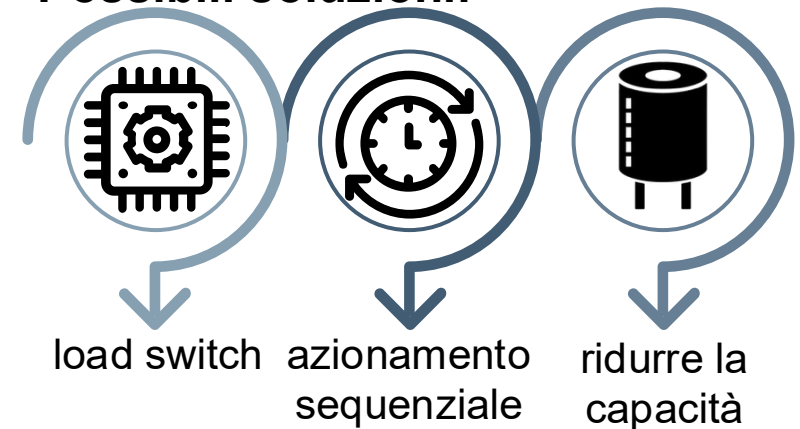


voltage drop



picchi di corrente

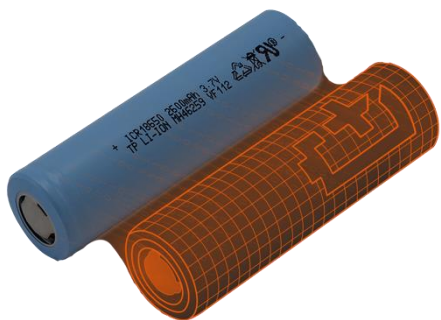
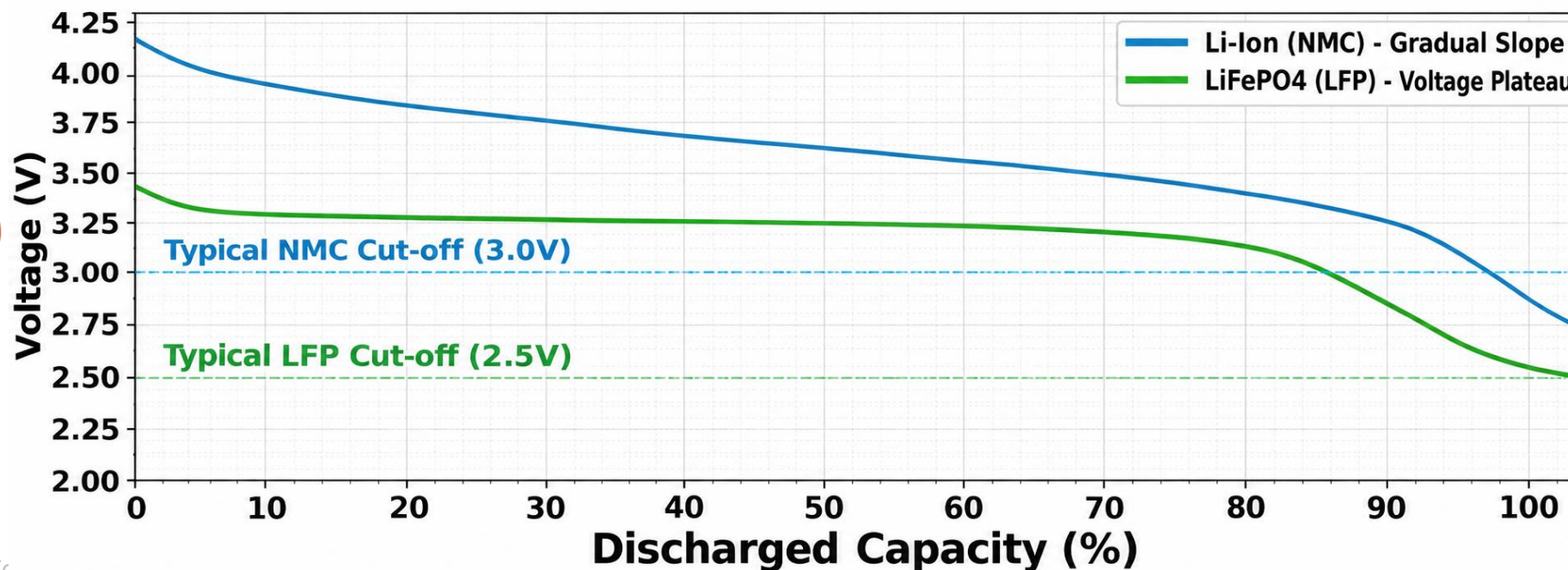
Possibili soluzioni:

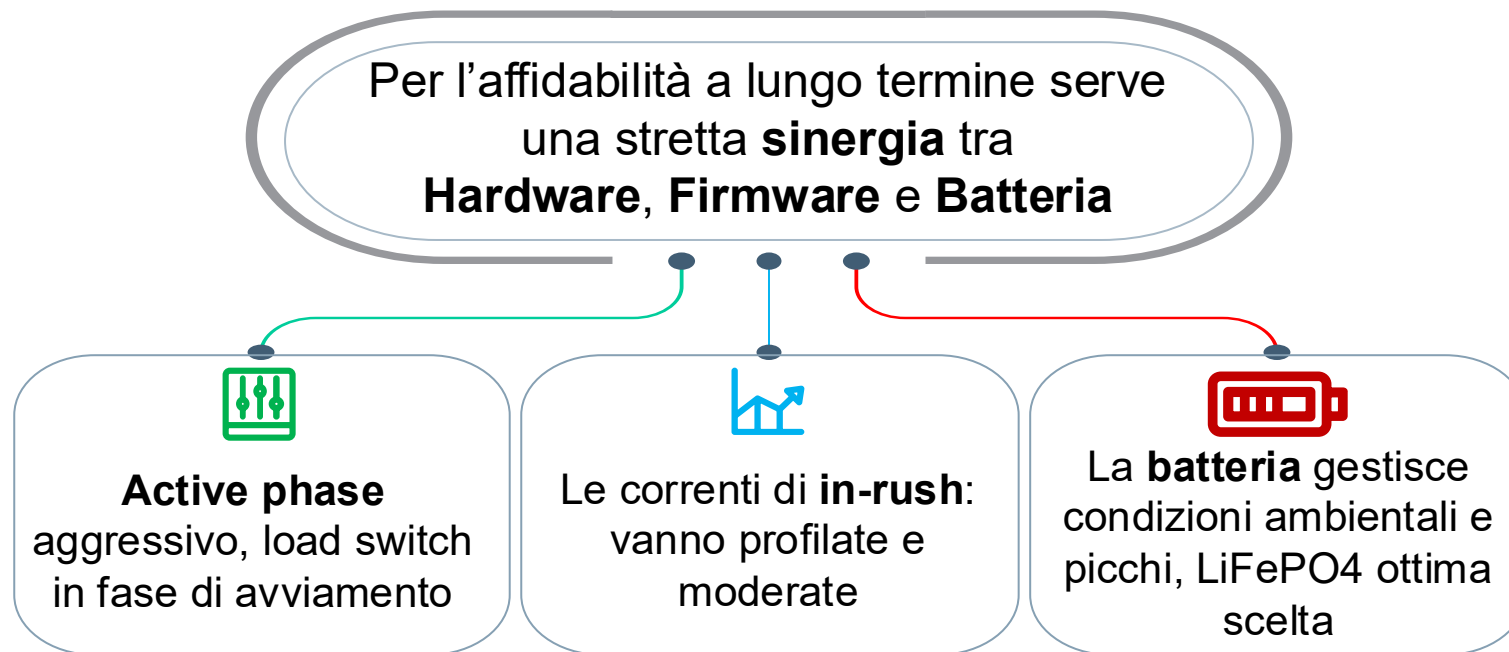


BATTERIE 18650 LI-ION VS LIFePO4: UPGRADE?

	Densità energetica	Resistenza interna	Stabilità ambientale	Stima della SoC
Li-Ion: in uso	alta	alta	vulnerabile	semplice
LiFePO4: upgrade	media	bassa	robusta	complessa

Discharge Profile Comparison: Li-ion vs LiFePO4 (0.5C Rate)





La presente analisi è anche su:



```
> .github
✓ docs
  > assets
  > firmware
  > hardware
  ✓ power_analysis
    > oscilloscope_readings
    > PPK2_reading
```