A Nonvolatile Flip-Flop-Enabled Cryptographic Wireless Authentication Tag with Per-Query Key Update and Power-Glitch Attack Countermeasures

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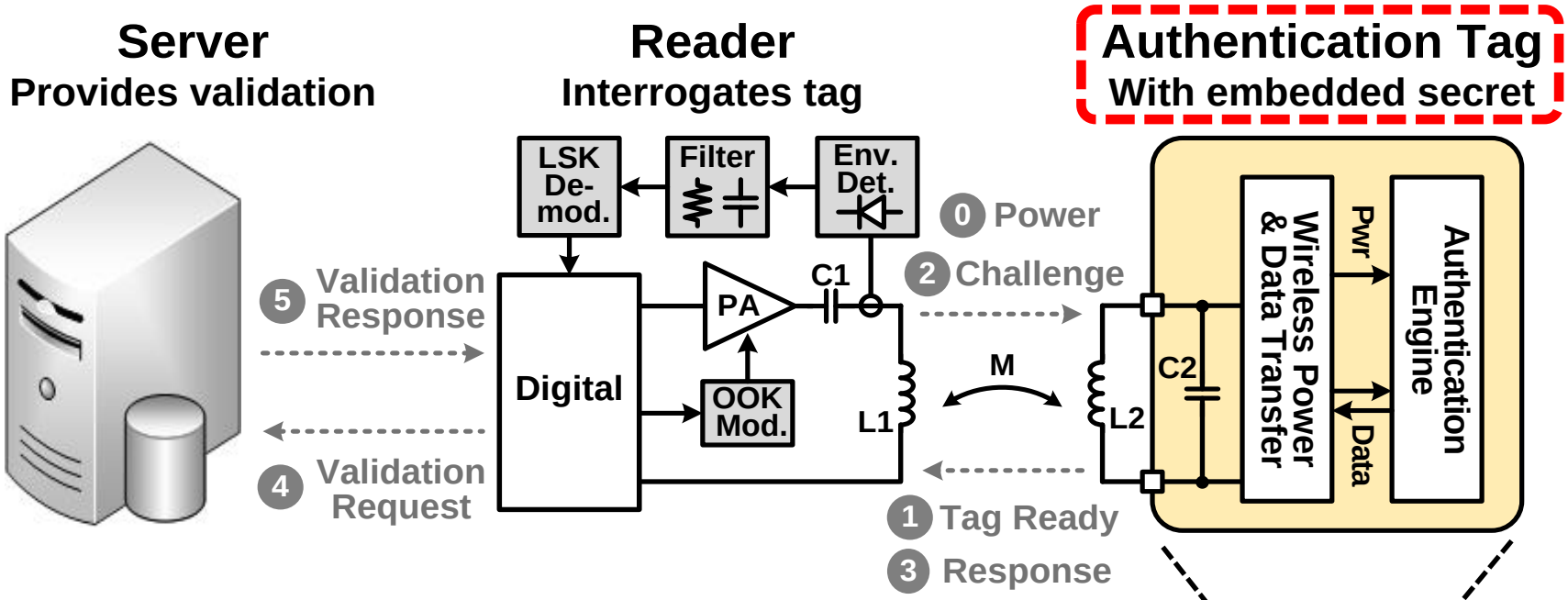
$30 million worth fake wines were seized in 2012

In 2014, Aston Martin recalled 18,000 cars due to counterfeit brake pedals

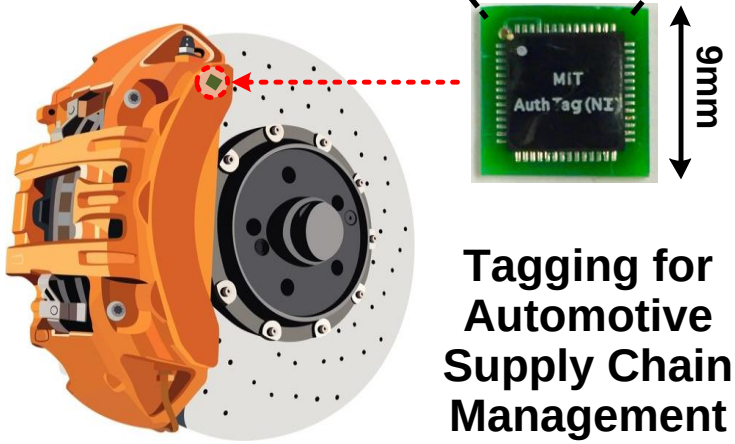
Fake malaria drugs caused 100,000 deaths in Africa

System Overview and Threat Model



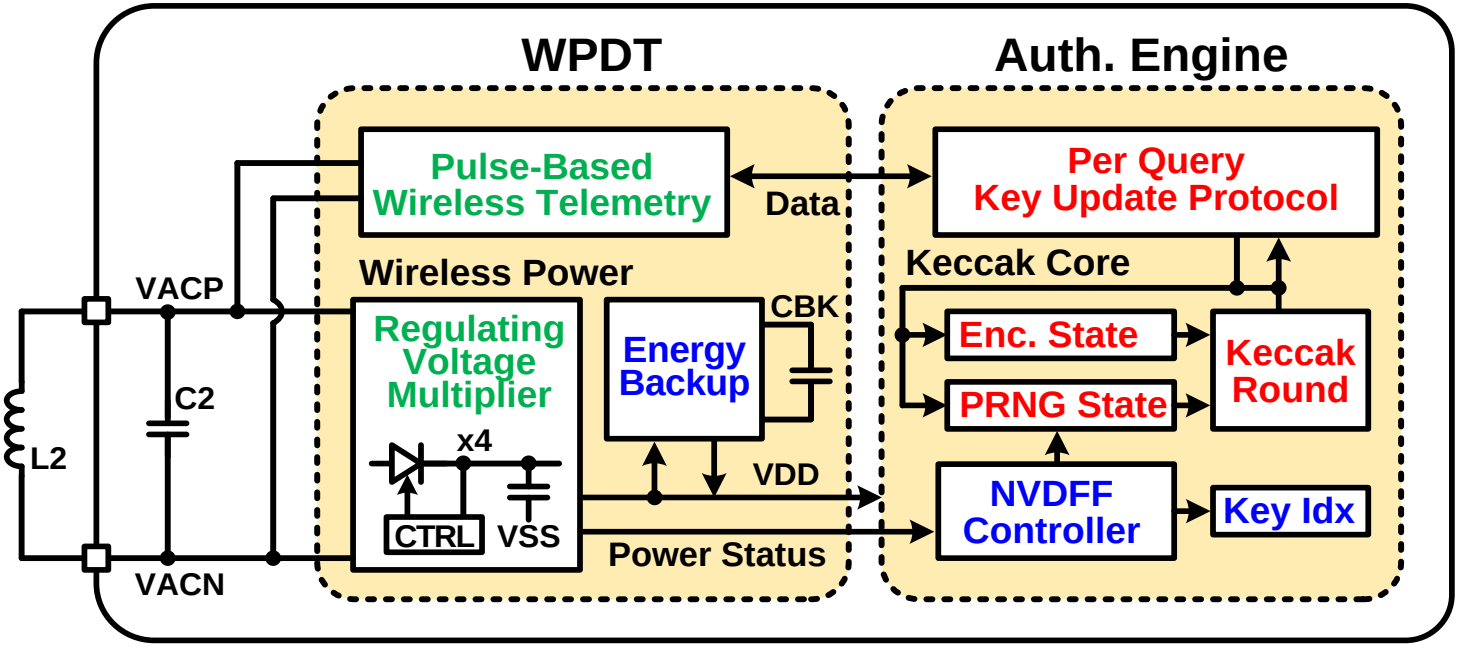
Threat Model:

- **Passive attacks** against the tag such as DPA/DEMA
- **Non-invasive active attacks** like power glitch attacks



Tagging for Automotive Supply Chain Management

Key Features



- Regulating Voltage Multiplier
- Pulse-based Telemetry

Wireless power/data for compact-size tag

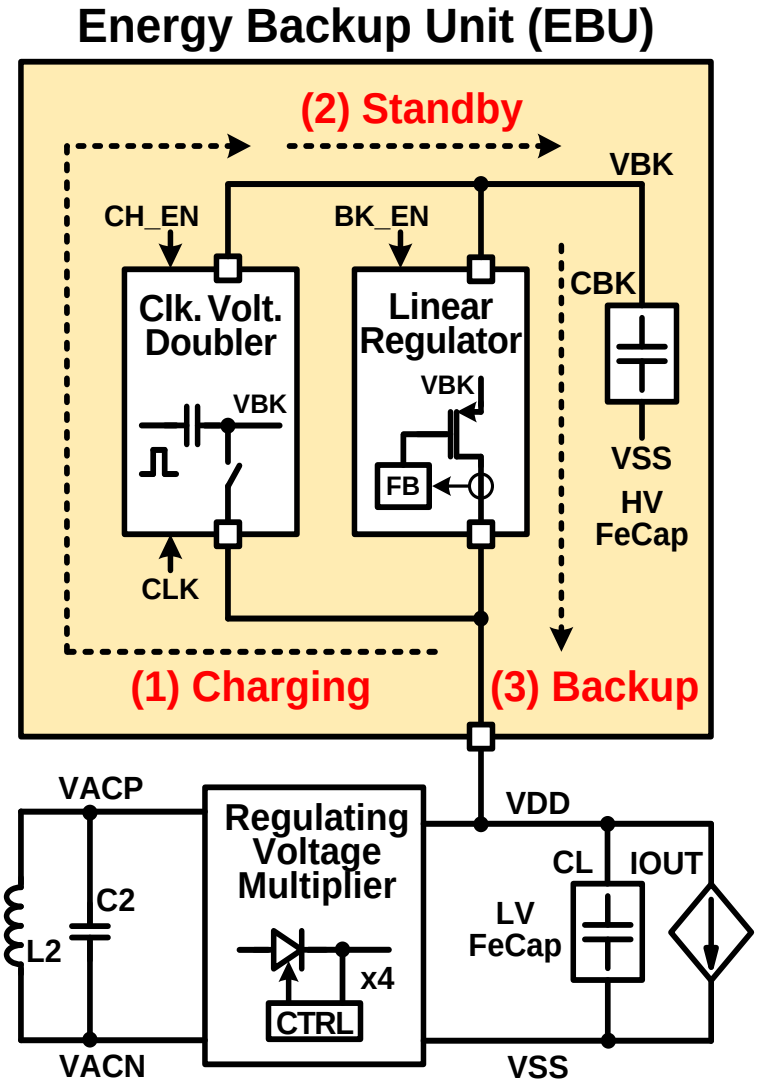
- Key Update Protocol
- Keccak Cryptographic Core

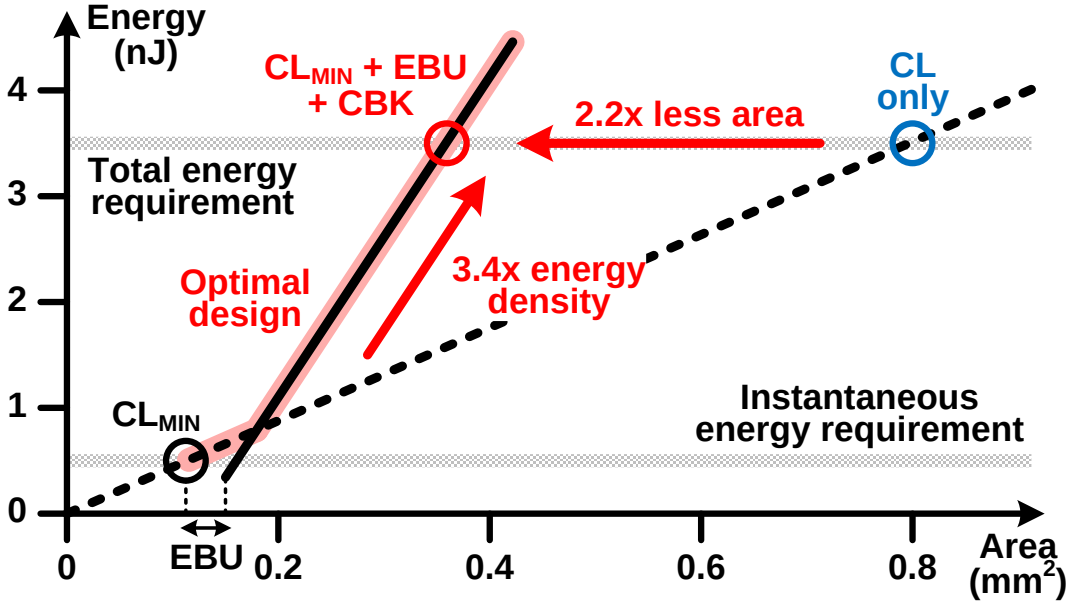
To prevent side-channel attack

- NV-DFF Key-storage
- FeCap-based Energy Backup

To limit power-glitch attack

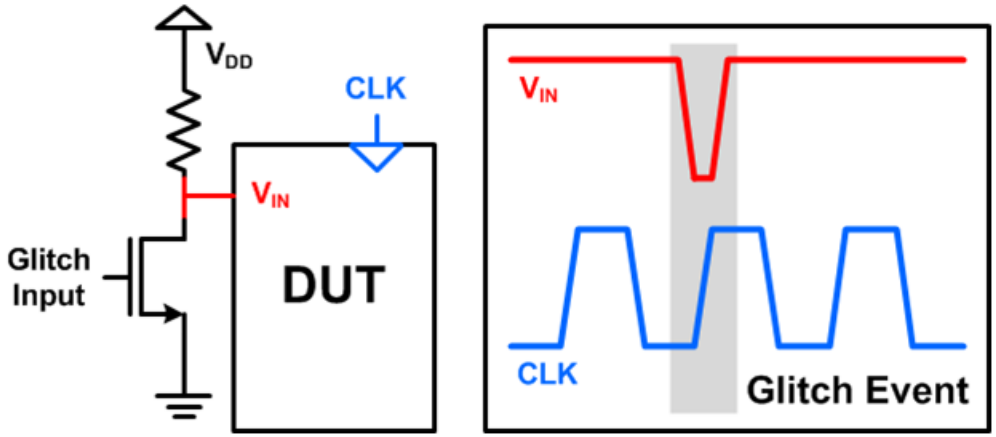
Area-Optimal Energy Backup Unit





- **3.5nJ** backup energy requirement
- C_{BK} (HV FeCap) has **3.4x higher energy density** including regulator efficiency than C_L (LV FeCap)
- Energy Backup Unit **needs 2.2x less area** compared to single output cap

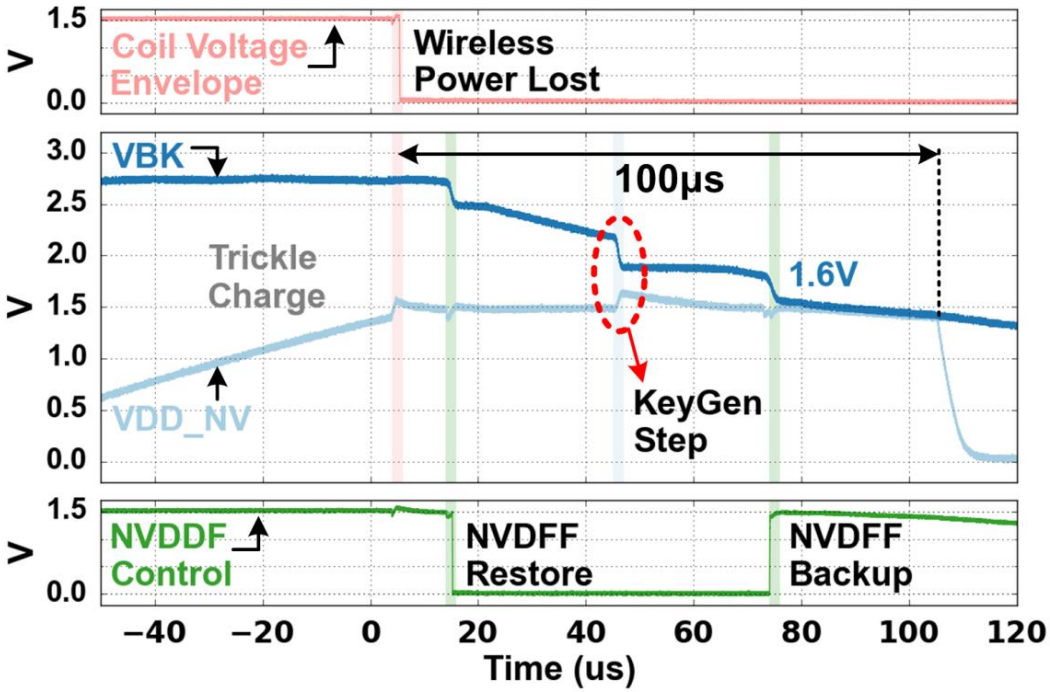
Power-Glitch Countermeasures



Power Glitch Causes:

- Reader is pulled away
- Malicious Reader

Guaranteed safe backup and key update



Backup w/ Worst-Case Glitch Event

The tag safely performs:

- NVDFF restore
- Key update
- NVDFF backup