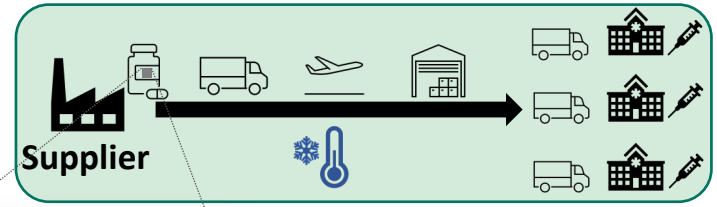
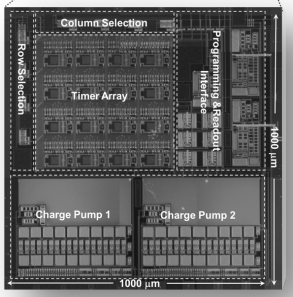
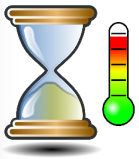
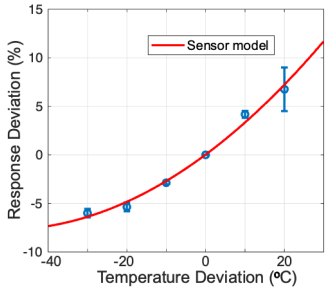
Battery-free dynamical sensors for cold-chain monitoring and asset tracking









Enables battery-free, continuous data logging of historical conditions such as temperature, vibration, or light

Covid-19 Use Cases:

- **Temperature Compliance:** Ensures that vaccines did not exceed their rated storage temperature
- **Per-vial Monitoring:** tiny (< 1mm2) size and low-cost allows each vial to have its own sensor
- **End-user Verifiable:** sensor data provides decision support prior to administration of medication

Use Cases:

- **Radio-frequency Sniffing:** high input sensitivity allows logging of ambient RF signal signatures for asset security
- **Asset Tracking:** always-on sensing/data logging of high-value assets' environmental condition
- **MRE Safety Verification:** track individual MREs through the supply chain and detect spoilage before use

Technology Summary:

Our silicon-based quantum sensor can continuously sense and record information without the need for batteries. By interrogating the stored information at a later time instant, the recipient can retroactively monitor the environmental conditions the sensor experienced.

Advantages:

- Continuously logs data from environmental stimuli without external power or batteries
- Provides cumulative, time-integrated information for later retrieval
- Leverages mature silicon manufacturing to reduce cost
- Reduces gap in coverage by augmenting existing periodic, battery-based solutions

Cost Estimate for Phase II: $1.2M (15 months)

➢ Wafer run for fabricating >100,000 chipsets	6 months
➢ Packaging	3 months
➢ Software + API development	6 months
➢ Validation and Destructive Testing	2 months
➢ Field Demonstration	3 months

Traction:

➢ National Science Foundation ($600k)	2015-2020
➢ Semiconductor Research Corporation ($75k)	2015-2019
➢ National Institute of Health ($450k)	2017-2020
➢ Leadership and Entrepreneurship Acceleration Program Award ($50k)	2019
➢ NSIN National Security Academic Accelerator Pilot Cohort Award ($54k)	2020-2021

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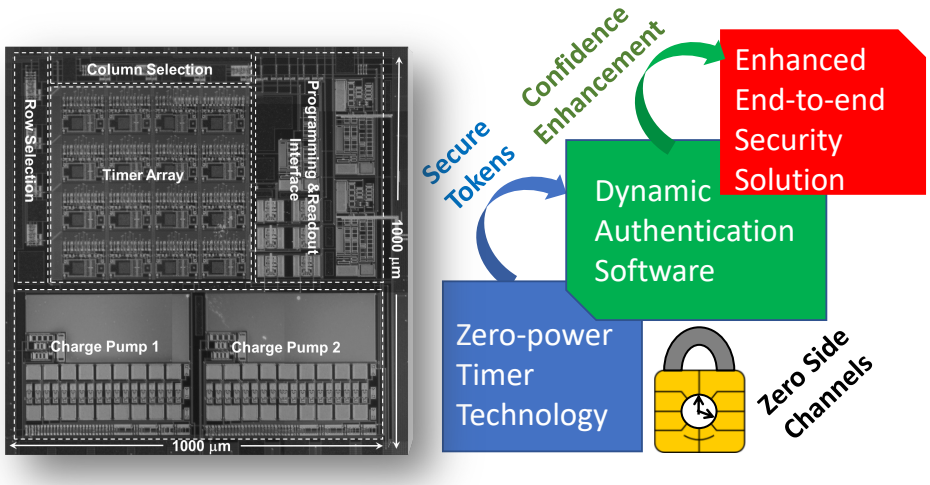
IoT Security Solutions using Zero-power Timers



Ultra-secure root-of-trust for resource constrained internet-of-things (IoTs) like sensors and wearables

Use Cases:

- **Sensors and healthcare IoTs:** A low-cost solution that can be used to securely sign the signal source and verify the received signals.
- **Passive IoTs:** Battery-free operation allows more secure authentication with passive tags and access cards.
- **Hardware root-of-trust:** Dynamic tokens are generated for trust verification and for securing vulnerable transactions like software upgrades.
- **Intellectual property protection:** Time-sensitive tokens can be used to disable specific IPs or information on a hardware asset (e.g. obsolete address or passwords).
- **Dynamic bar-codes: I**dentifiers can change with time to become immune to theft and tampering.

Technology Summary:

Our zero-power timekeeping technology uses quantum tunneling to implement chip-scale synchronized clocks that can operate without any external powering. This can be used for security and for single and two-way authentication. The device has zero side-channels and is immune to snooping and tampering.

Advantages:

- Provides ultra-secure root-of-trust for fast authentication of IoT transactions.
- Reduces computational footprint compared to other authentication technologies.
- Allows mutual authentication where IoTs and their readers can verify each other.

Cost Estimate for Phase II: $1.2M (15 months)

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