Zero-Power Authentication

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Problem:

Devices are not always accessible.
Devices often have finite battery.
Radio communication uses battery power.

Risk: sleep deprivation; power DoS.

(Standard Yacht Fabergé egg. Image: Wikipedia.)

Example scenario:

Weather measurement node in unfriendly conditions; finite battery. Warns a community of impending danger. Able to transmit its vital signs (voltage, etc.) to a nearby maintenance person.

Problem: misanthropic teenager figures out how to query the device over, and over, and over...

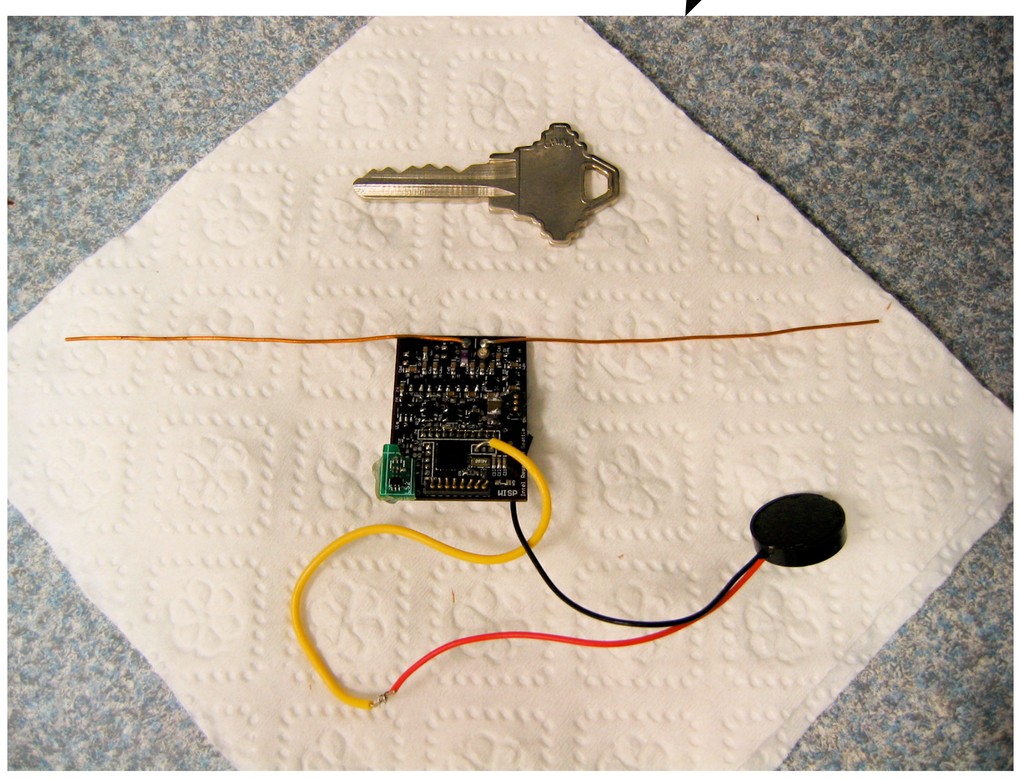
Our approach:

Passively-powered "gatekeeper" device **authenticates** external parties **before any battery power is used**.

Physical analogue: hire a bouncer.

Implementation:

WISP tag (MSP430, 256B RAM, EPC Class 1 Gen 1)
Added ~30 lines of C++ code
Simple challenge-response protocol (below)



Why this is interesting:

More battery power available for device functioning.
Longer battery lifetime.
Simple modification of existing devices.
Authentication for "free."
Also interesting because it's not perfect.

Open questions:

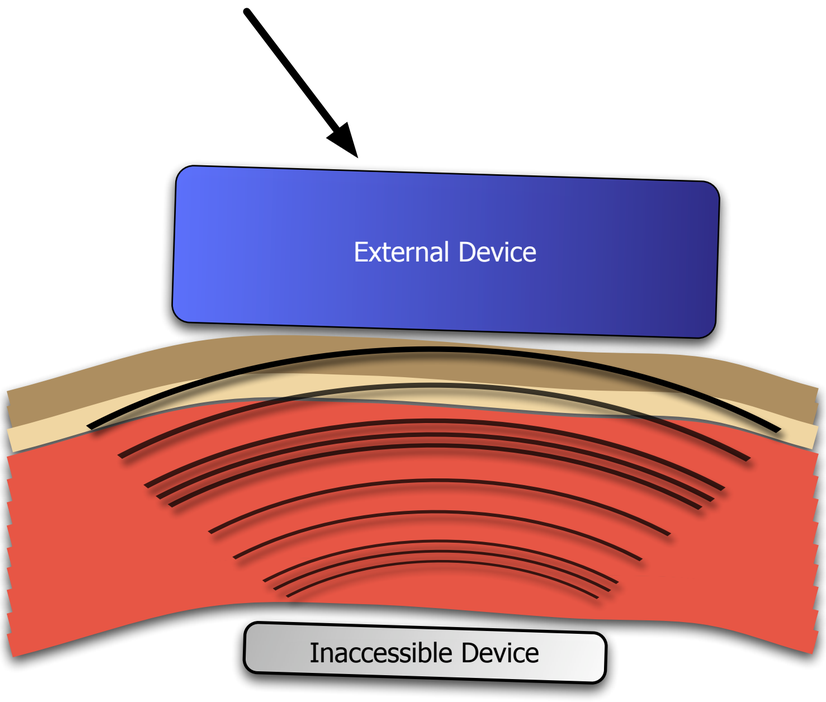
Key management?
How much computation can we squeeze out of the WISP?
Applications: best way to harvest power through various media?

Prototype ("WISPer")

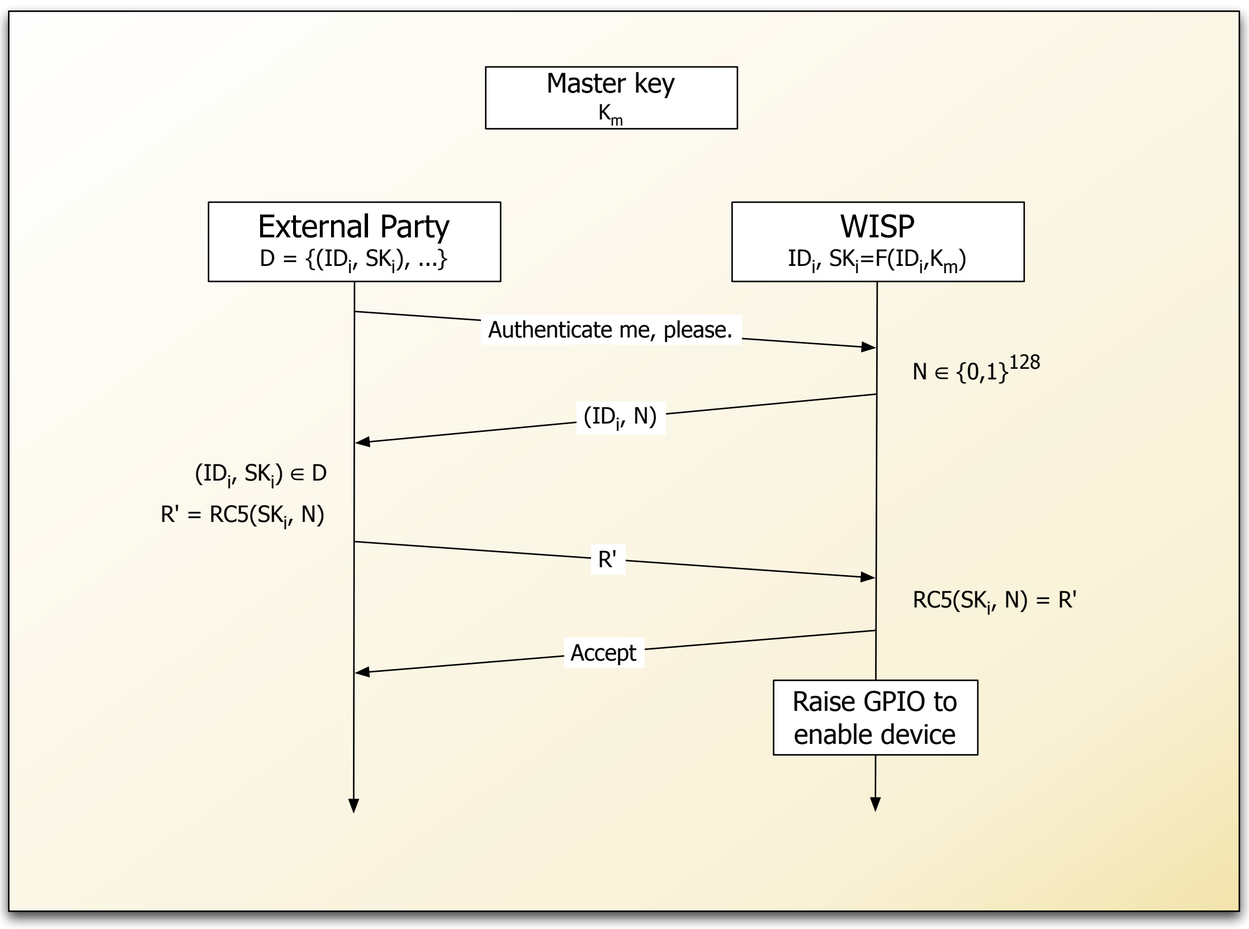
WISP beeps (piezobuzzer on GPIO) on successful authentication.
We have installed this device in *various inconvenient locations*.
Photo depicts WISP v1; newer WISP is smaller.

Future work:

Gather randomness from WISP SRAM (FERNS)?
Distance bounding (Drimer & Murdoch)?
Acoustic key exchange (certain circumstances).



A device that is inaccessible may have a private channel to external devices in the form of physical contact. A piezobuzzer produces acoustic waves (sound and vibration) that represent a modulated binary version of key material. This makes key distribution easier under those circumstances.



References:

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"Security and privacy for implantable medical devices." IEEE Pervasive Computing, Special Issue on Implantable Electronics, January 2008.
"Initial SRAM state as a fingerprint and source of true random numbers for RFID tags." Conference on RFID Security, July 2007.
"A wirelessly-powered platform for sensing and computation." 8th International Conference on Ubiquitous Computing (Ubicomp), September 2006.

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