CONIX RESEARCH CENTER

Computing On Network Infrastructure for Pervasive Perception, Cognition and Action

VirtSense: Virtualizing sensing through ARM TrustZone on Internet-of-Things

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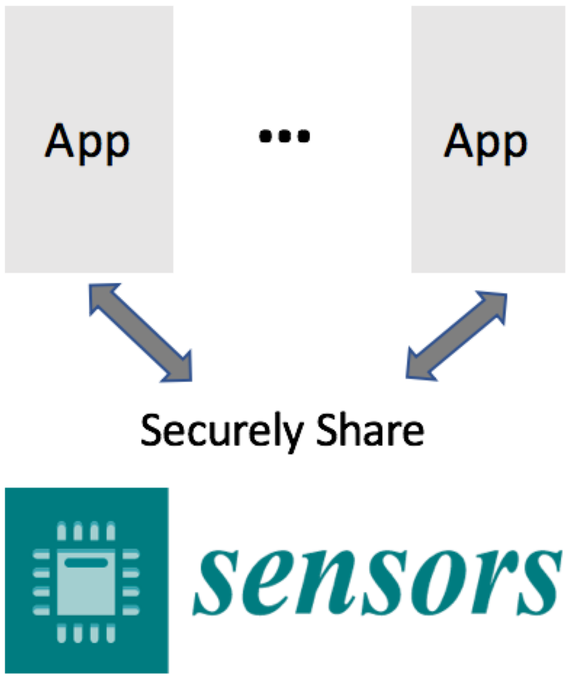
Motivation



How to securely share sensor resources in multi-tenancy IoT system?

- **Embedded system:** when an application needs to use sensor resources, it sets up a mutex lock so that other applications cannot modify it if a different sampling rate is sought.
- **Android:** The sensing service is performed through a max-for-all mechanism. (Max(App 1, App2, etc.))
- **iOS:** the sensor management simply discards the excessive data when doing a downsampling for different apps.

Architecture

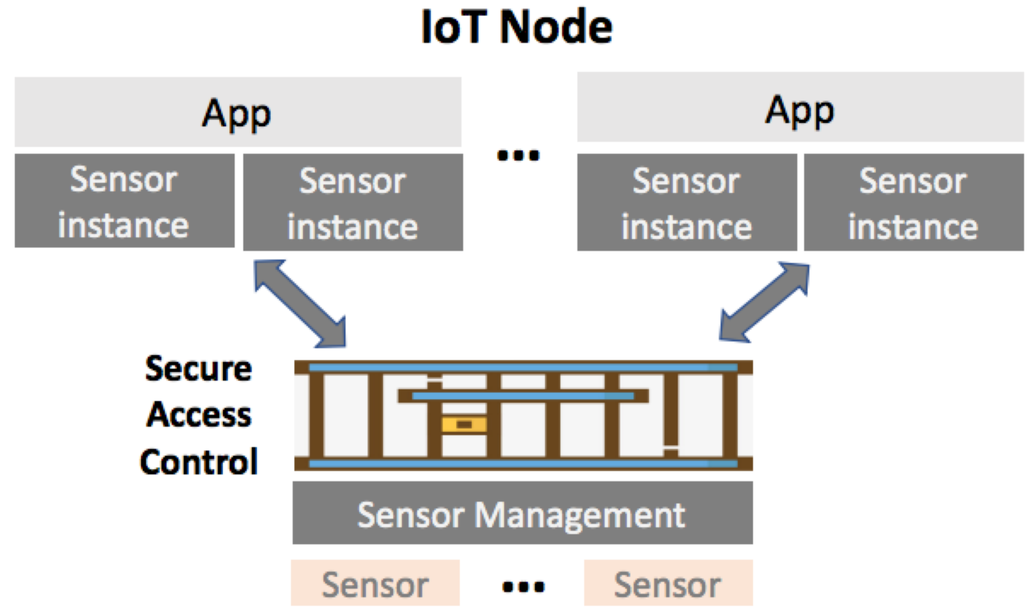


Figure 1: VirtSense Architecture

Implementation

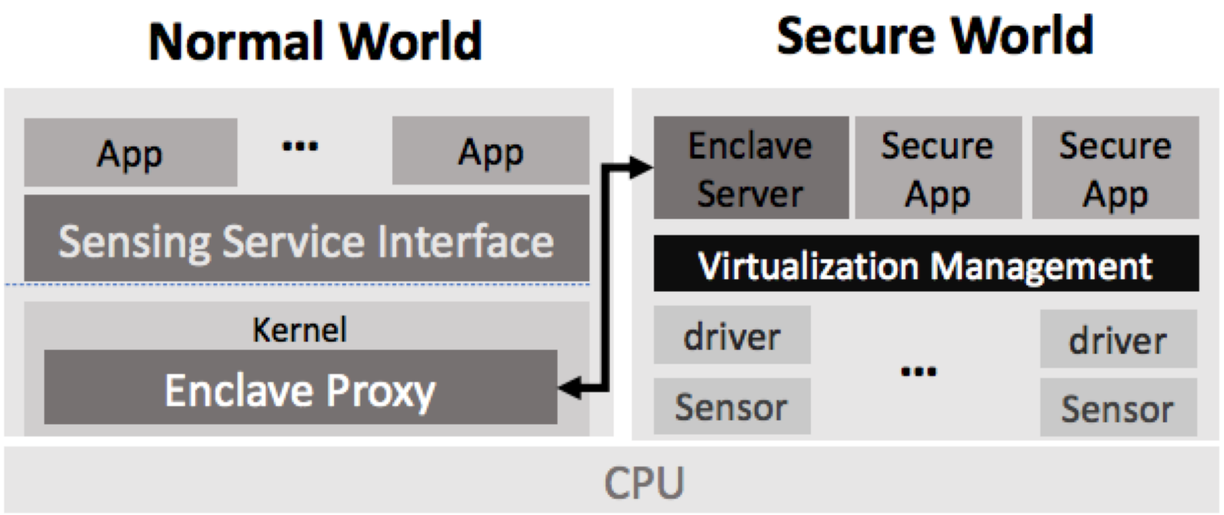


Figure 2: VirtSense Overview

- **Sensing Service Interface**: Sensing service interface provides the interface APIs to applications for sensing instances creation and the sensing rate and accuracy manipulation
- **Enclave Proxy**: Enclave Proxy communicates with the secure world inside the enclave.
- **Enclave Server:** Enclave server is the communication midpoint between the normal world and the secure world, residing in the secure world.
- **Secure Apps:** Secure apps, which are the key components of access control mechanism, are pre-installed by the users.
- **Virtualization Management:** Virtualization management enforces the access policies from secure apps and dynamically chooses the sensing sampling rate set for the real physical sensors to satisfy the sensing requests from the normal world applications.

Sensing Virtualization Algorithm

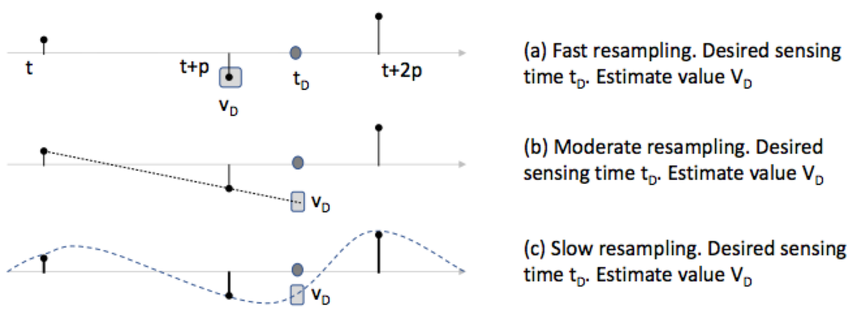


Figure 3: Example of resampling methods. Physical sensor value updated at t, t+p and t+2p, where p is the physical sensor sampling rate. t_D is the desired sensing time for a virtual sampling request, and V_D is the returned value marked in a grey box from *VirtSense* .

Results

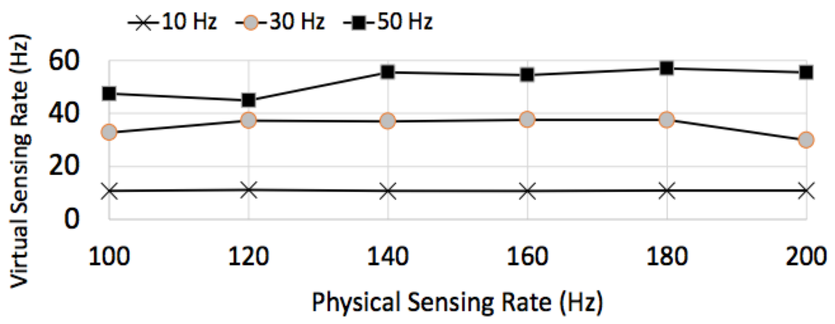


Figure 4: Running application with desired sampling rate 10Hz, 30Hz and 50Hz simultaneously (fast resampling) with physical sensor value from 100Hz to 200Hz with 20Hz increment in *VirtSense* .

Future Work

- Virtualize sensor and actuator coupling so that the applications need not worry about the current state of the IoT device
- Using secure apps to detect malicious behaviors from the applications in the normal world

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