W3C Workshop on the Web of Things
June 25, 2014

Programming Device Ensembles in the Web of Things

Ricardo Morin
Software and Services Group
Intel Corporation
Today’s IoT programming model comes from embedded computing

• Device centric
• Statically partitioned
• Constrained by device capabilities
• Single-purpose applications
• Siloed security

*Under this model, the WoT would be scale-limited*
WoT model should evolve towards “ensemble” programming

• Everything is a resource (URL)
  – Sensors & actuators
  – Devices & device capabilities
  – Application runtimes & application services

• Applications dynamically...
  – Establish ensembles via **Resource Discovery**
  – Obtain access via **Multiparty Authorization**
  – Off-load computation via **Remote Workers**
Discover “nearby” sensors
Get permission to access sensor

Device A: Application
Device B: Temperature Sensor
Device C: Mobile GPS Sensor

Protection API
Authorization API
Policy Engine API

Protection

Protect(SensorBox.local/sensors/temperature)

Ok

Protect resource (example.com/sensors/location)

Ok

CreatePolicy(...) Ok

First Access (after discovery)

GET example.com/dev1234/sensors/location

Need authorization

Authorize(example.com/dev1234/sensors/location)

Granted

CheckPolicy(...) Ok

Application Logic (after authorization granted)

GET example.com/dev1234/sensors/location

{lat=45.447772, lng=-122.701529}

do something

repeat flow with other sensors
Off-load intensive computation

Device A
Application
createWorker(Worker, manifest)

Worker Library
find(worker target)
target=EdgeDevice.local
createWorker(Worker)

Embedded Video Sensor
Ok

Discovery API
Ok

Edge Device

Worker Framework
create
Ok

Video Analytics Worker

Cloud
Video Surveillance Service

Application
Worker Library
Embedded Video Sensor
Discovery API
Worker Framework
Video Analytics Worker
Video Surveillance Service

something interesting is happening

Time goes by

video stream
sendFrame
sendFrame

intrusion event

Time goes by
Putting it together: Intelligent Container
Our team is ready to participate and contribute in these areas

- **Discovery**
  - Holistic view that encompasses service & resource, local & global, semantics
  - Leverage: mDNS, NDS, Web Linking, Well-Known URIs, CoAP CORE, RDF

- **Authorization**
  - Privacy by design, multi-party from the ground-up
  - Leverage OAuth and User Managed Access (UMA)

- **Code off-loading**
  - Focus on simple programming model
  - Leverage JavaScript, Web Workers and extend to support remote Workers
BACKUP
DEMO DIAGRAM
DVR Demo

- Dumb Cameras
- Anchor Device
- Smart Cameras

[Site]

AuthN  AuthZ

App Ecosystem

Video Analytics In the Cloud

Provisioning & Discovery