Swarm
Minimum Broker: an approach to deal with the Internet of Things heterogeneity

Global IoT Summit 2018

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OUR TEAM

Scientific counselors

Researchers

Interns and trainees
Current IoT is cloud-centric
The Swarm

- The Swarm is edge-centric
- Cloud is not the main participant
- Constitute a P2P network of small resource devices.
The Swarm network is composed of intelligent individuals that behave similarly to a society, showing an organized behavior that results in an emergent collective intelligence.
SWARM Networks

- Autonomous
- Heterogeneous
- Collective Intelligence
- Spontaneous relationships
- Open networks
- Energy Efficient
The Problem: Heterogeneity

One of the main problems for IoT implementations is resource heterogeneity. In this paper, we address resource heterogeneity, with a focus on low constraint devices.

The Edge of the Edge
In Swarm:
Device functionalities are wrapped by Services
The Swarm Broker

Device + Broker = Swarm Insect
Broker: a communication mediator on P2P Networks
Broker architecture

Application Services

Platform Services (Broker)

- Discovery Service
- Registry Service
- Access Control Service
- Binding Service
- Policy Management Service
- Contracting Service
- Optimization Service
- Accounting Service
- Mediation Service

2 implementations
Still needs simplification for devices with very small resources.
The Minimum Broker

The minimum software modules for a device to participate in the Swarm network

Special for resource constrained devices
Minimum necessary services: registration and discovery

Stage 1:
Service **registers** itself into Service Directory

Stage 2:
Service **searches** the Service Directory for other service
The full locate process in 5 steps:

1. A service asks Broker (originator) to find a service in the network.
2. The originator Broker sends a multicast request to the local network.
3. A Minimum Broker receives the multicast SSDP request and searches for the requested service.
4. If Minimum Broker finds the service it sends a response to the requester broker (unicast SSDP).
5. The originator Broker sends a response to the requester with the services best descriptions found.
6. A direct communication is established from service to service after the matching.
Proof of Concept: **Smart-Office**

- Ambient controller
- Common Broker
- Light Switch
- Infrared Receptor
- Minimum Broker

**Android Tablet**

**NodeMCU**

Proof of Concept: **Smart-Office**

**Tablet**

**USER TERMINAL**

- User initiates: **Refresh**
- POST /locate-requests
  - payload = {type: *, ttl: 1, max_distance: 3}
  - Local Locate
- SSDP M-SEARCH
  - payload* = {payload | ttl: 0}
- HTTP 200 OK
  - {SD1, SD2}

**NodeMCU**

**LIGHT SWITCH**

- POST /registry
  - Service Description (SD1)
  - 200 OK

**INFRARED TV RC**

- POST /registry
  - Service Desc. (SD2)
  - 200 OK

**MINIMUM BROKER**

- SSDP M-SEARCH
  - payload*
  - Locate Local
- HTTP 200 OK

**PUT SD.host/SD.id/toggle**
Ultra low resource consumption
Common Broker vs Minimum Broker

The Minimum Broker is 1.76% in firmware size, and 0.27% in RAM compared with the Common Broker.
Conclusions

High scalability of Peer To Peer networking of low constraint devices is fundamental for the Swarm heterogeneity.

The had proposed and successfully implemented a Minimum Broker in low constraint devices.

We illustrated a scenario with a P2P network heterogeneous low constraint Brokers.

The minimum broker can bring coelive intelligence to the Edge of the Edge in the Cloud.
Acknowledgements

Prof. Jan Rabaye UC Berkeley
USP Research Office
Insects that inspire us everyday
Questions?
Thank you

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