IoT on Fedora

Using Fedora as a base for the IoT Revolution

Presented by
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Am I just going to talk ARM? HELL NO!! IoT is a LOT bigger than little devices and Fedora has the basis of it all:

- End point devices
- Gateways
- Messaging systems (M2M, M2Data)
- Data gathering, storage and analytics
- Device and Data Security
- Device Management
An IoT Stack

An example of a typical IoT stack

(image courtesy ARM mBed OS)
End point devices
Low power devices

- The IoT endpoints need to be low cost low power devices. In a lot of cases “disposable”
- ARM devices are driving this revolution
- Arduino or more capable ARM devices like the BeagleBone
- A number of open and closed OS IoT Stacks:
  - Contiki-OS
  - TinyOS
  - Poky/OpenEmbedded/Yocto
  - Ubuntu Snappy Core
  - ARM mBed OS
Fedora IoT endpoints

- Fedora (x86, ARMv7 and aarch64)
- Atomic images are an excellent fit!
- 802.15.4, Bluetooth LE: Radio, Topology, Frame formats, Media Access Control, Security
- 6LoWPAN: IPv6 over 802.15.4/BT-LE
- RPL: IPv6 routing protocol for LLN
- Higher stacks like MQTT/CoAP
- Management of Device firmware and security fixes
IEEE 802.15.4

- The IEEE 802.15.4 standard offers phys & MAC layers for low cost/speed/power WPANs
- Used for zigbee and other prop protocols
- Number of device types:
  - Full Function Device / Reduced Function Device
  - Coordinator (must be FFD)
  - Network Devices (either RFD or FFD)
- Star, Peer to Peer, Cluster tree topologies
- Security is provided by AES encryption with key management imp in upper layers
6LoWPAN

- Open Layer 3 standard is 6LoWPAN a cut down IPv6 protocol
- 802.15.4/6LoWPAN stack supported by groups ThreadGroup (Google/Nest) to keep IoT open
- RPL (IPv6 Routing Protocol for LLNs)
- 802.15.4/6LoWPAN Upstream in kernel/Fedora but support in NM/systemd-network support still coming
- RPL not yet supported in an open routing project
Gateways
Gateways

- 802.15.4 PAN Controller and ethernet bridge
- BT-LE bridge (IP support coming with BT 4.2)
- 6LoWPAN to IPv4/IPv6 GW router & tunnels
- Possibly Zigbee and other legacy protocols
- RPL router
- Caching / routing for MQTT/CoAP from End Point to “cloud”
- Useful as a key means to secure IoT device networks and access
Sample IoT Network

A typical IoT network topology

(image courtesy waspnote)
Messaging systems
MQ for Telemetry

A lightweight publisher-subscriber messaging protocol being standardized at OASIS

A number of open endpoints and server implementations

Open projects include:
- Broker/server: ActiveMQ 5.10+ and Mosquitto
- Client: Apache Paho, python implementations
- Hosted platforms: robomq.io & opensensors.io

Some updates needed in Fedora
CoAP

- Constrained Application Protocol (IETF RFC 7252 standard)
- Constrained machine-to-machine web protocol
- Representational State Transfer (REST) arch
- Low header overhead and parsing complexity
- UDP binding (may use IPsec or DTLS)
- Reliable unicast and best-effort multicast support
- Built-in resource discovery
- libcoap still being packaged (RSN!!)
OMA LightweightM2M (LWM2M) is an industry standard for device mgmt of M2M/IoT devices. Relies heavily on CoAP and hence is optimized for comms over sensor networks like 802.15.4. An extensible object model that allows to enable application data exchanges in addition to the core device management features (firmware upgrades and device monitoring). IPSO Smart Objects is based on LWM2M. Open implementations include Eclipse wakaama, ETSI M2M.
IPSO Smart Objects

- Uses CoRE RD Resource Links (RFC 6690)
- REST API with URI templates
- Object IDs registered through OMNA
- Naming of Sensors and Controllers
- Used for both input/output:
  - Input (turn lights on/off)
  - Output (temperature, humidity)
- Device Profiles (eg Smart Thermostat)
- Composite Smart Objects (Thermostat connecting with Energy Metre)
Data Analytics and Storage
Data Analytics

- Lots of big data style platforms for analytics
  - Elastic Search is a feature for Fedora 22
  - Dashboards with Kibana
  - Hadoop and other similar tools and platforms
- Use of data for trending, monitoring and alerting
- Mobile client alerting, reporting and notifications
Data Storage

- A number of means of storing big data
  - Elastic Search
  - MongoDB, PostgreSQL NoSQL support
  - A number of other big data storage applications
- VMs, Clouds, Containers for scaling
- Orchestration like OpenShift for automated control and scaling
- Not a lot of data is open
- Is it possible to own your own data?
Security
Securing IoT

“Internet of other people's things”

SELinux EVERY where!!

Network Security (802.15.4 Security, 6LoWPAN)

SSL/TLS for all application communications

Application Security (MQTT, CoAP etc)

Atomic images for Device updates/rollbacks

Regular, constant and consistent updates

How do we deal with planned obsolescence, long term updates for security???
Is it a problem?

- How many IoT devices by 2020?
  - Gartner: 26 Billion
  - Cisco: 50 Billion
  - Intel: 200 Billion
  - IDC: 220 Billion

- So YES which ever way you look at it there is going to be a problem!

- Important that there's diversity in IoT platforms
Fedora is already a great base building block for an end to end IoT ecosystem and platform.

Still a lot of work to do:
- Use of Atomic for endpoint/gateway deployments
- Enhancements to network stack for standards based comms
- New/updated packages higher up the stack needed
- End to End testing and fixing of bugs
- Example dev platforms and images for EP/GW
Questions?

Thank you


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