IoT on Fedora

Using Fedora as a base for the IoT Revolution

Presented by

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Overview

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

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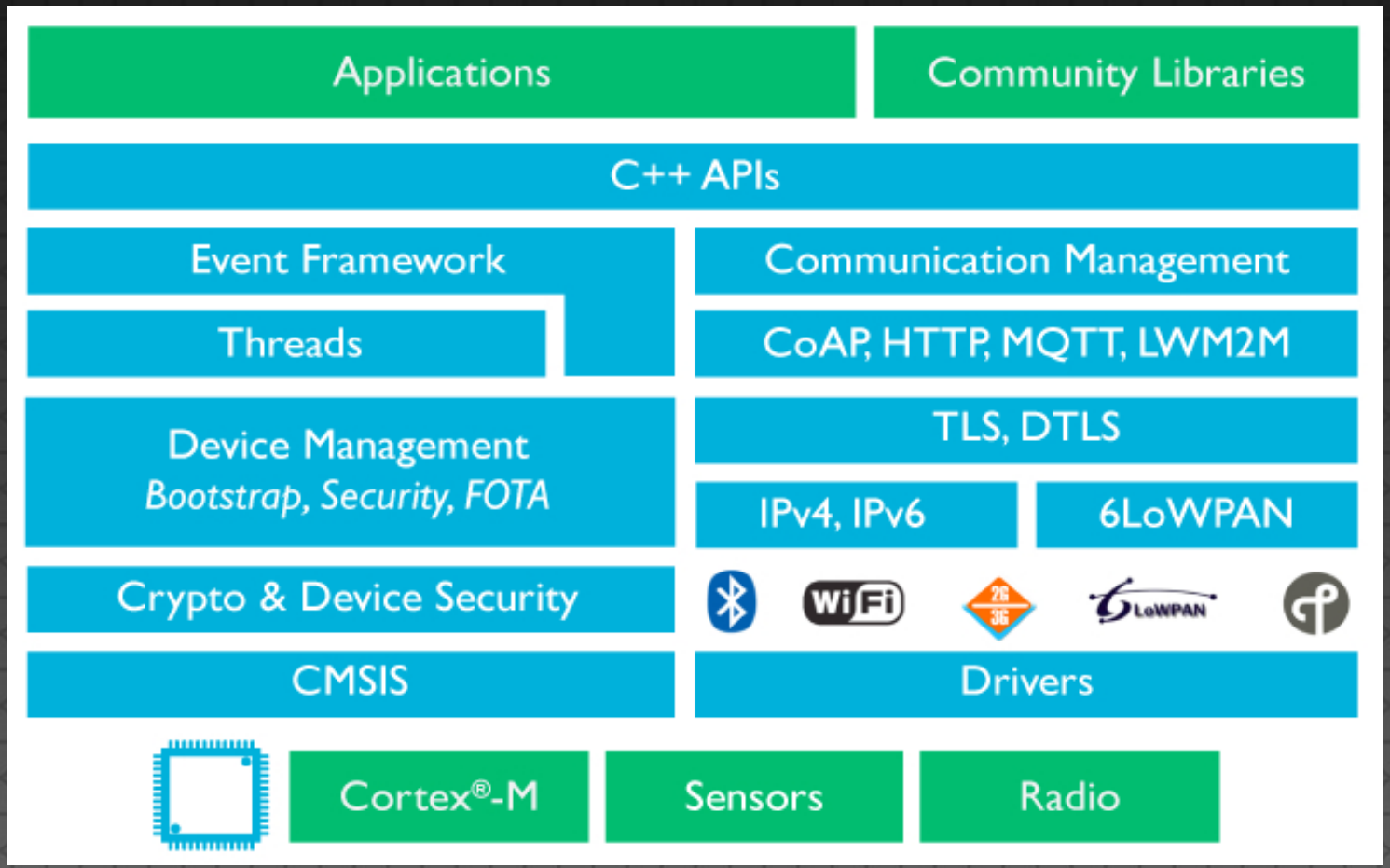
An IoT Stack



An example of a typical IoT stack

(image courtesy ARM mBed OS)

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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

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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

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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

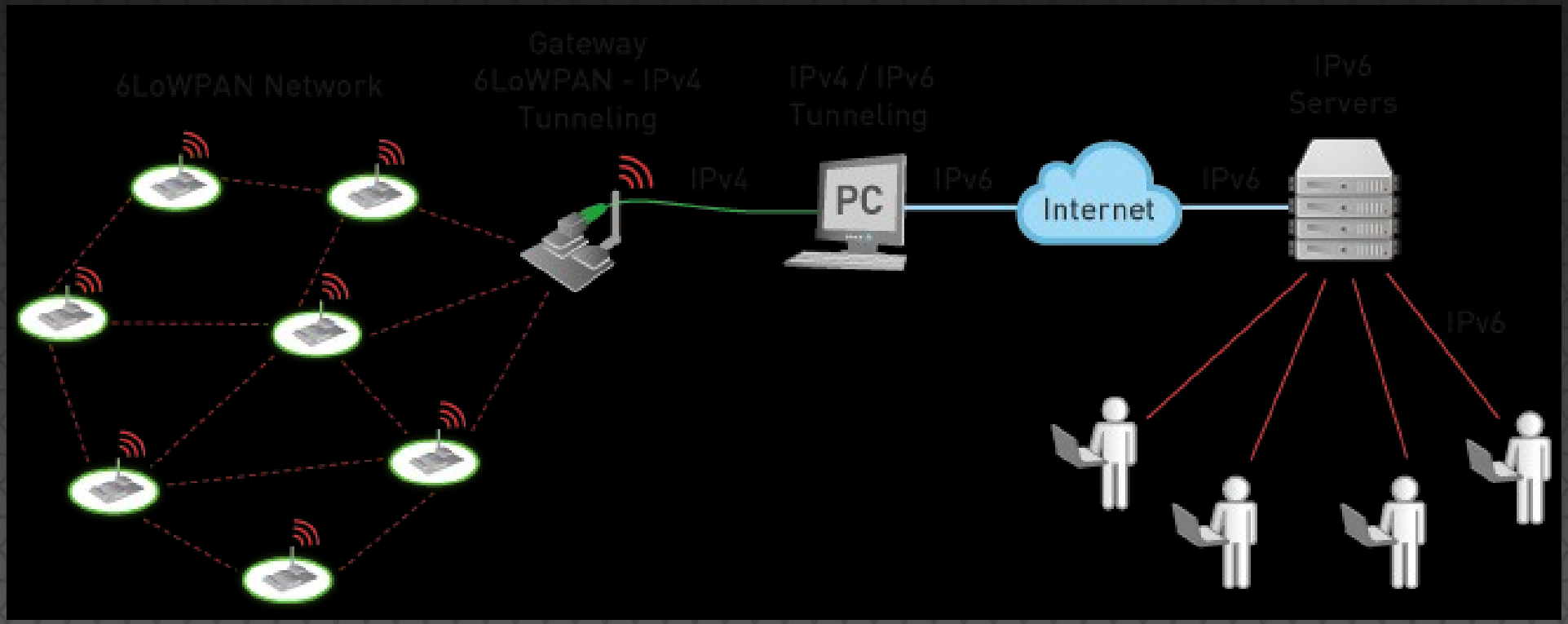
- Open Layer 3 standard is 6LoWPAN a cut down IPv6 protocol
- 802.15.4/6LoWPAN stack supported by groups ThreadGroup (Google/Nest) to keep IoT open
- RPL (IPv6 Routing Protocol for LLNs)
- 802.15.4/6LoWPAN Upstream in kernel/Fedora but support in NM/systemd-network support still coming
- RPL not yet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

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Messaging systems

MQTT

- 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

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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

- 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

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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 obsolenance, long term updates for security???

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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

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Summary

- 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

Feedback: http://devconf.cz/f/106

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