CloudREST

An open architecture for connecting consumer IoT devices using RESTful APIs

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Outline

- Internet of Things
- Motivation
- IoT cloud platforms
- IoT communication protocols
- CloudREST architecture overview
- Learning from mistakes
- A better architecture
- Improving the architecture
- Conclusions

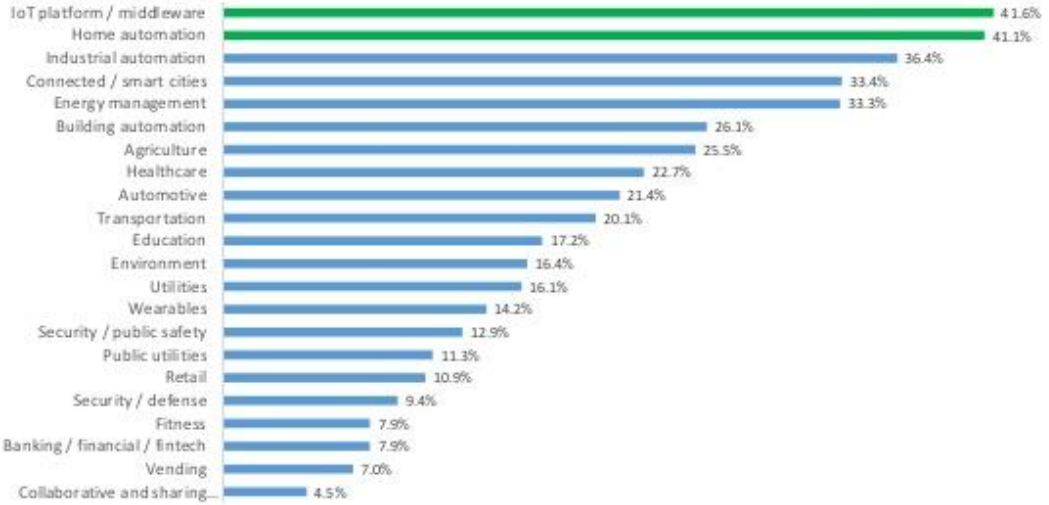
Internet of Things

- A system of interconnected computing devices and smart devices on a global scale
- Sensors, intelligent Heat Ventilation and Air Conditioning (HVAC), irrigation controllers, home appliances, identification tags and many more
- Industrial Automation: harness sensor data, mostly M2M communication
- Home Automation: interconnectivity, M2M, M2H, D2H, D2D
- Consumer IoT: home automation, surveillance, smart metering, connected car: **human interaction**

IoT Industry trends 2017

KEY INDUSTRIES

What industry or industries best describe(s) the type of IoT solutions you have built or will build?



Consumer IoT

Powerful devices that are designed for human interaction

can do much **more** than send or receive data

1GHz CPU and 512MB RAM
~1W power consumption

IoT challenges

- Interoperability
- Accessibility
- Connectivity
- Multiple platform vendors with solutions not compatible with each other.
- AWS, Google IoT, Azure IoT focused on ingesting data.

Motivation

- **Not “Internet only”**: devices should also be accessible locally
- **Promote interoperability** and Web 3.0, promote the use of RESTful APIs on devices
- **No vendor lock-in**: an open solution that should work on any cloud platform provider
- **No vendor SDK needed**
- **Promote client compatibility**

IoT Cloud Platforms

AWS IoT

Ingest via MQTT

Device Registry

Rules Engine

Device shadows good idea but awkward for complex messages

Google IoT

Ingest via gRPC (HTTP/2)

Device Traits, Device Schema good ideas but limited in options

Firmware must be "certified"

Cannot be compiled on OpenWRT MIPS

Microsoft IoT Hub

Ingest via MQTT, AMQP, HTTP

Device Twins even more complex than AWS Device Shadows

No direct topic subscriptions

Complex REST API

None consider local network access as needed.

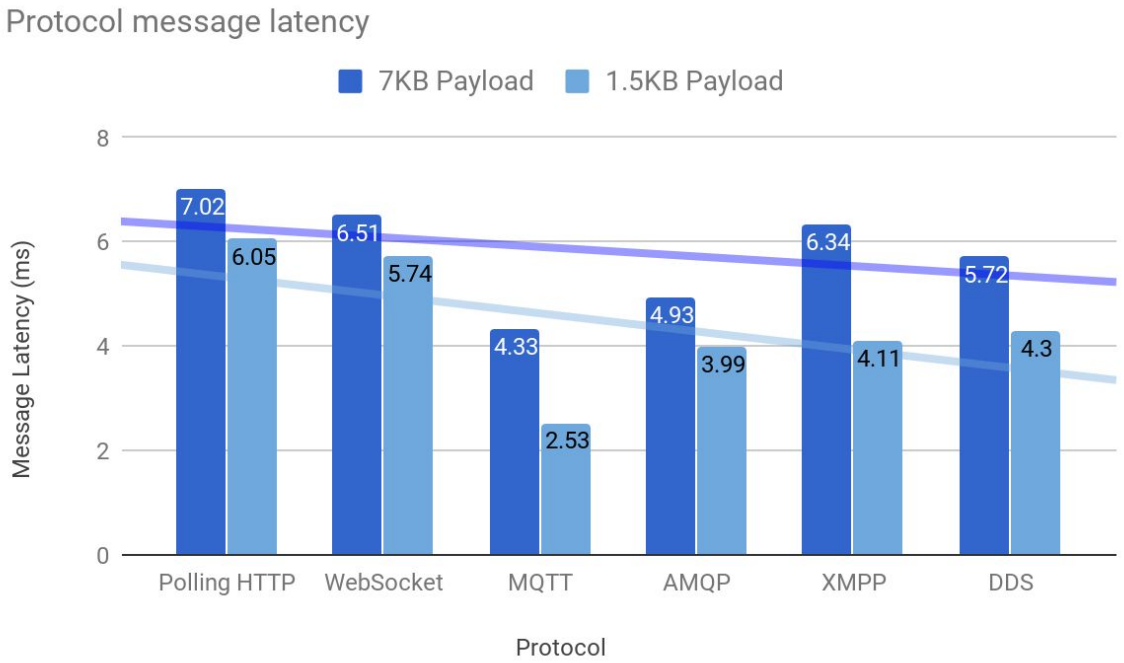
IoT communication protocols

Protocol	RESTful HTTP(S)	RESTful HTTP/2	WebSocket	CoAP
Transport	TCP	TCP	TCP	UDP
Payload	Text	Binary	Binary/Text	Binary
Architecture	Request/Response	FullDuplex Streams Multiplexing	FullDuplex Stream Channels	Request/Response Publish/Subscribe (OBSERVE)
QoS	N	Y	N	Y
Security	TLS/SSL	TLS/SSL	TLS/SSL	DTLS
Discovery	Y	Y	N	Y
Device - Device	Y	Y	Y	Y
Application Fields				real-time data sharing or real-time device control

IoT communication protocols

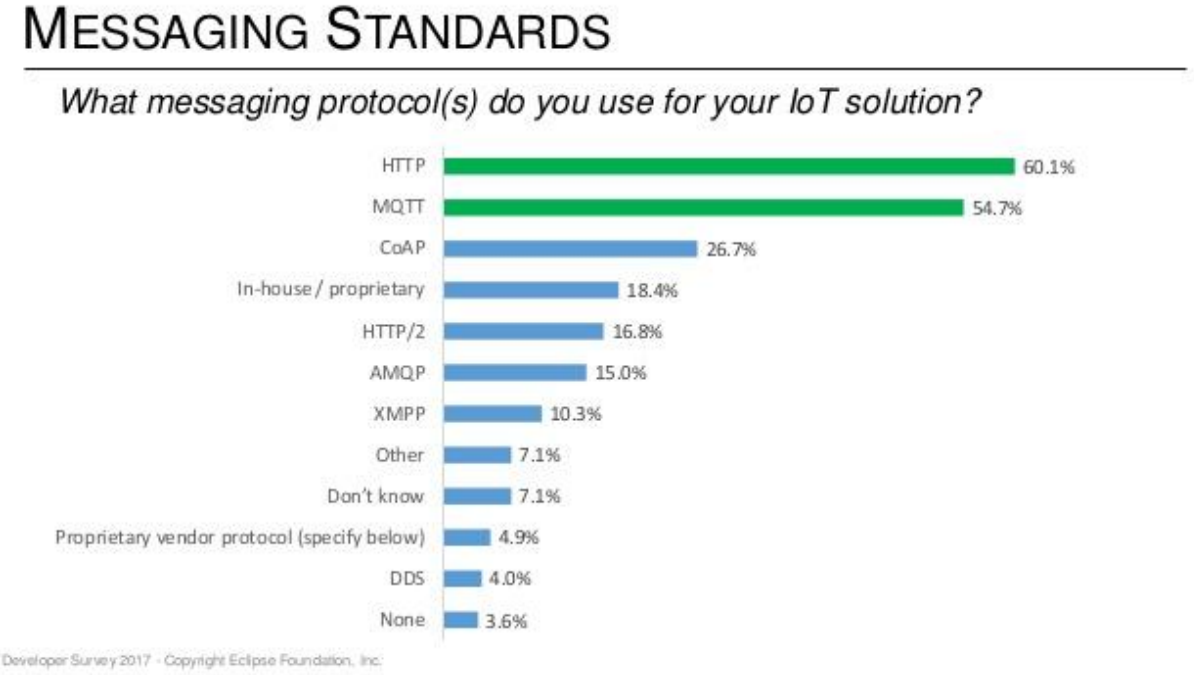
Protocol	MQTT	XMPP	AMQP	DDS	STOMP
Transport	TCP	TCP	TCP	UDP/TCP	TCP
Payload	Binary	Text (XML)	Binary	Binary	Text
Architecture	Publish/Subscribe	Publish/Subscribe Request/Response (IQ stanzas)	Publish/Subscribe	Publish/Subscribe Request/Response	Publish/Subscribe
QoS	Y	Y	N	Y	N
Security	TLS/SSL	TLS/SSL	TLS/SSL	TLS/SSL	TLS/SSL
Discovery	N	N	N	Y	N
Device - Device	N	N	N	Y	N
Application Fields	telemetry or remote monitoring	Decentralized messaging	Messaging queues	distribute data to other devices	

IoT communication protocols



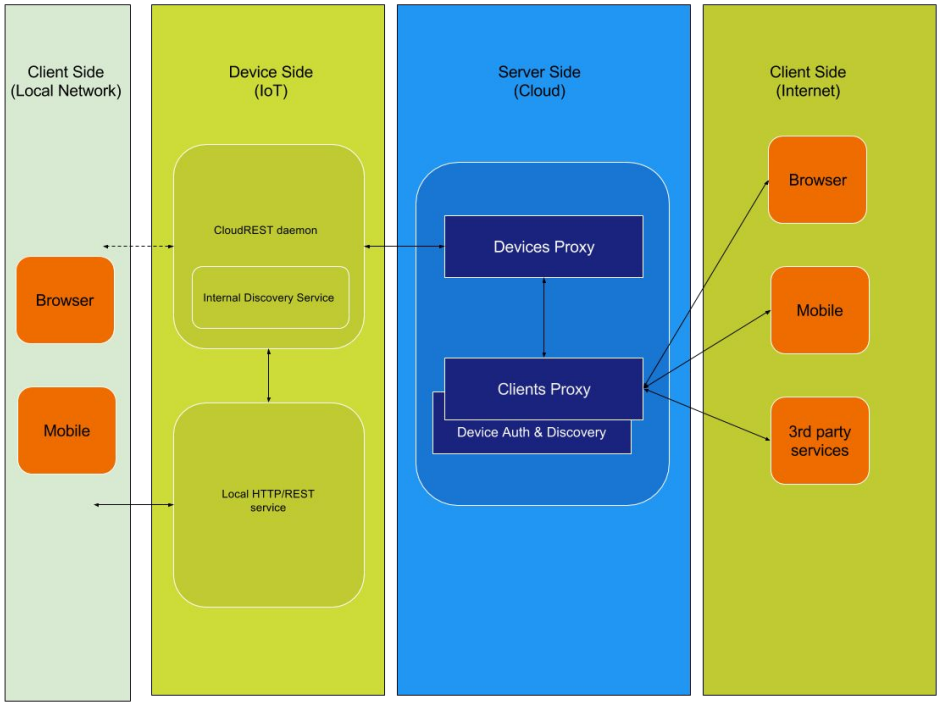
Based on: ZB Babovic, J Protic, V Milutinovic: *Web Performance Evaluation for Internet of Things Applications,* IEEE Access 4, 6974-6992 2016

IoT communication protocols

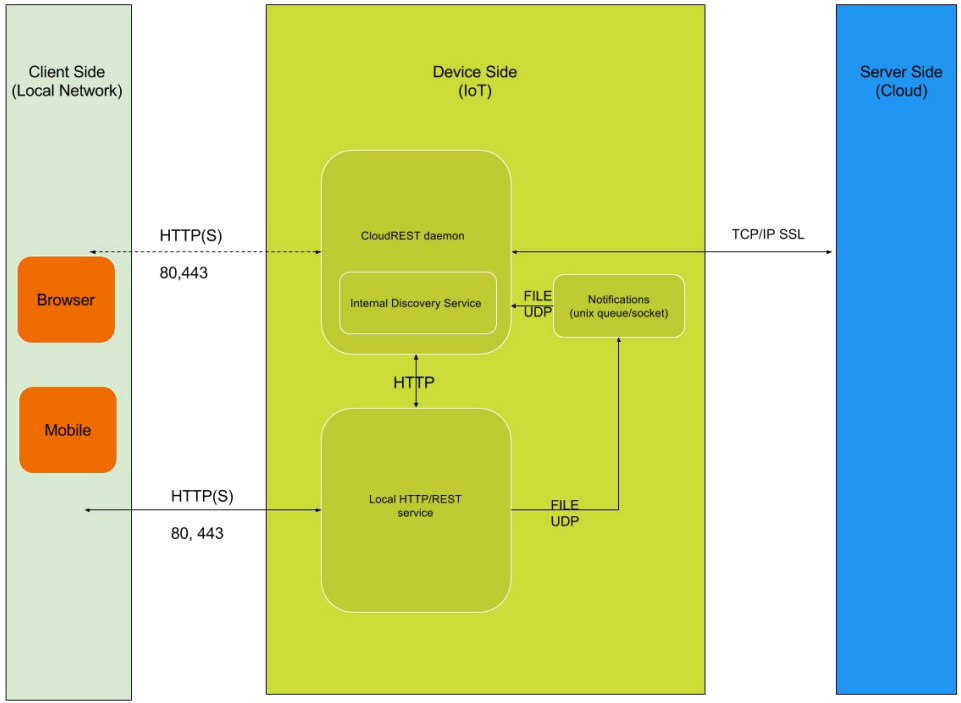


RESTful HTTP: a Web of Things

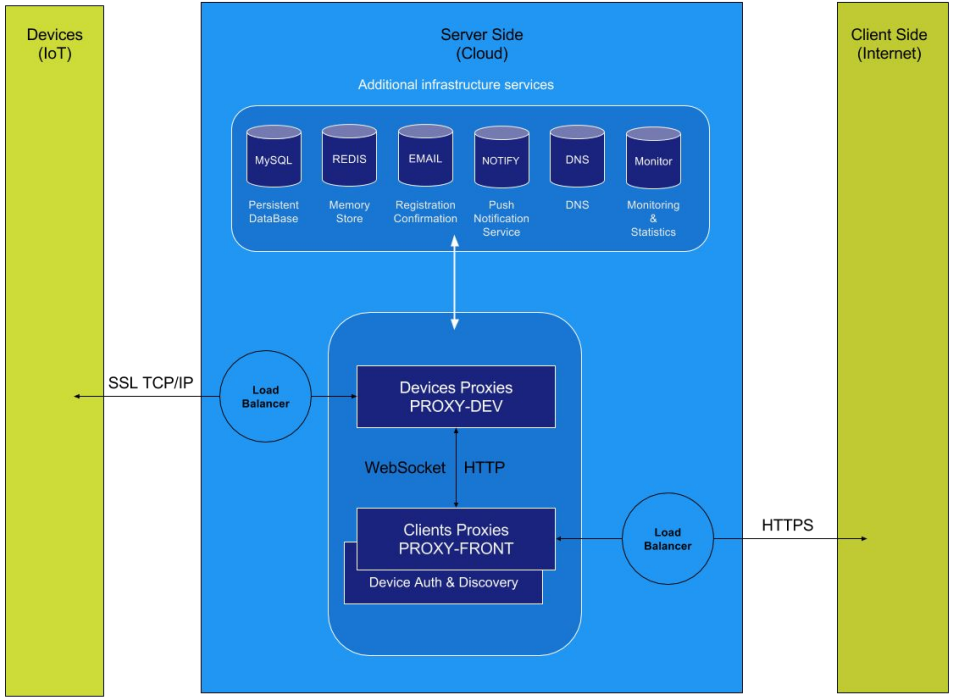
CloudREST architecture overview



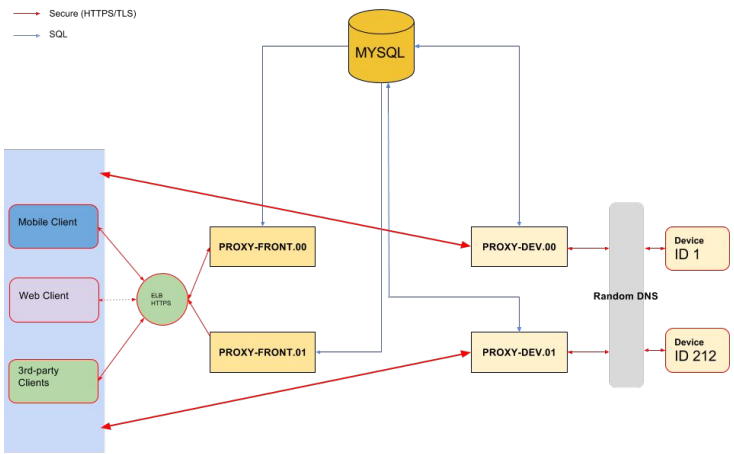
CloudREST on device

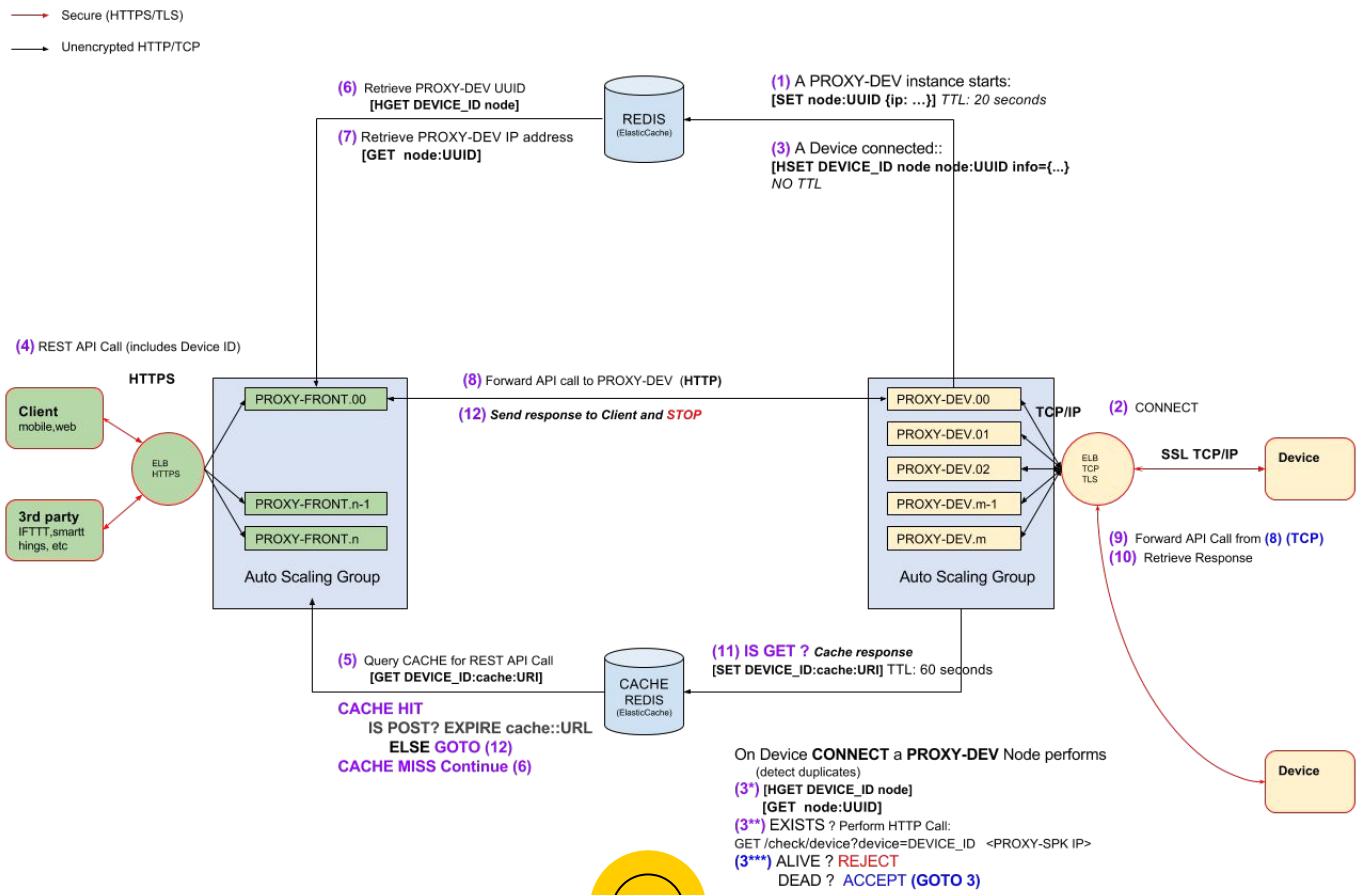


CloudREST on cloud

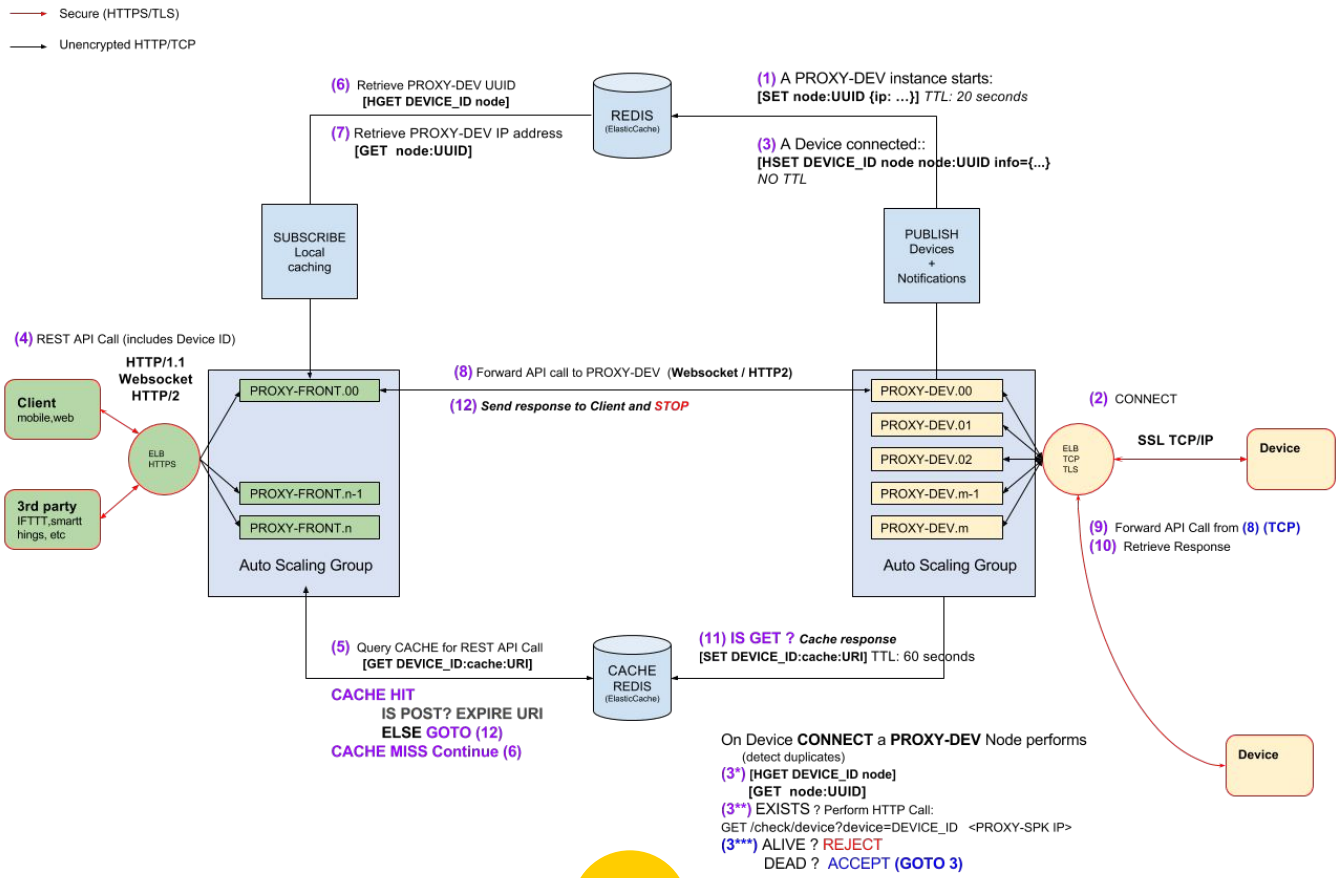


Learning from mistakes





A better architecture



Improving the architecture

Conclusions

- IDLE CPU
- USED CPU

- Separation of duties
- Automatic scaling
- Faster delivery
- Common endpoint for clients

- Vendor independent
- Local Access
- Promote the use of RESTful APIs
- Open standards
- HTTP/2 ready

Thanks!

Questions ?