

Home Automation using Augmented Reality (HAAR)

Ali Ali El-Moursy

University of Sharjah

Fadi N. Sibai

Prince Mohammad Bin Fahd University

Jahanzeb Rehman

University of Sharjah

Omar M. Gouda

University of Sharjah

Abdelrahman T. Gaber

University of Sharjah

Ahmed M. Khedr (✉ akhedr@sharjah.ac.ae)

University of Sharjah <https://orcid.org/0000-0001-7957-7862>

Research Article

Keywords: Augmented Reality, IoT, Infrared, MQTT, Smart Home Controller

Posted Date: March 23rd, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-173364/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Version of Record: A version of this preprint was published at Wireless Personal Communications on January 20th, 2022. See the published version at <https://doi.org/10.1007/s11277-021-09419-7>.

Abstract

The development of Smart Home Controllers has seen rapid growth in recent years, especially for smart devices, that can utilize the Internet of Things (IoT). However, a large portion of the household devices and appliances already in use, are not IoT enabled, and therefore, requires their default control mechanisms for the devices to operate. This paper proposes a smart appliance controller that uses Augmented Reality, MQTT, and other up-to-date platforms to control aftermarket home appliances in the most efficient manner. The proposed work integrates mobile AR with IoT, to control household appliances, with the help of infrared (IR) signals. The characteristics of the system are evaluated through a series of tests and performance measures. The results of the test highlight th quick response time of MQTT for the implementation of a Home Automation System, when compared to the request-reply protocol: CoAP (4 times as fast).

Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the latest manuscript can be downloaded and [accessed as a PDF](#).

Figures

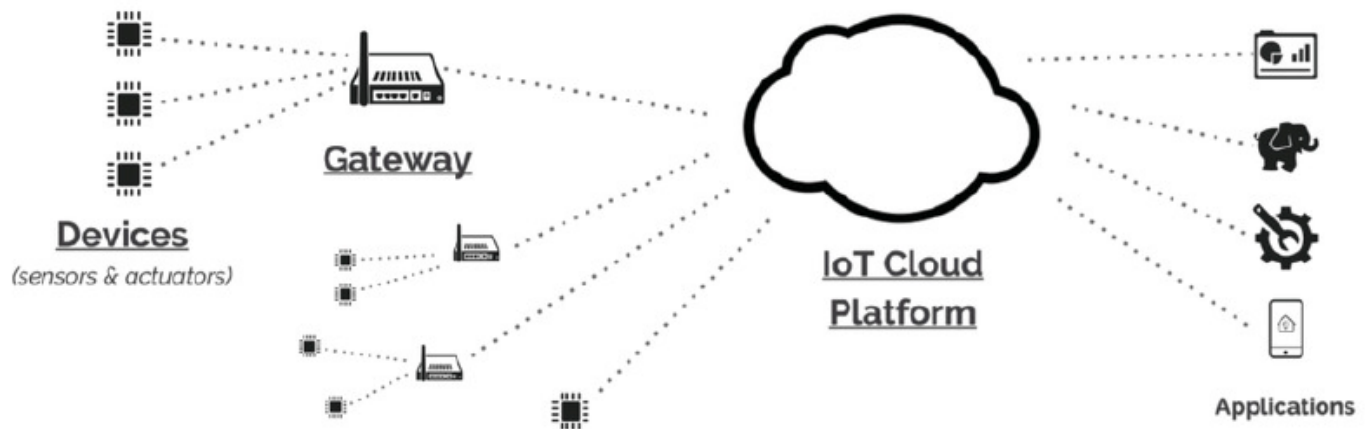


Figure 1

A standard IoT architecture. [1]

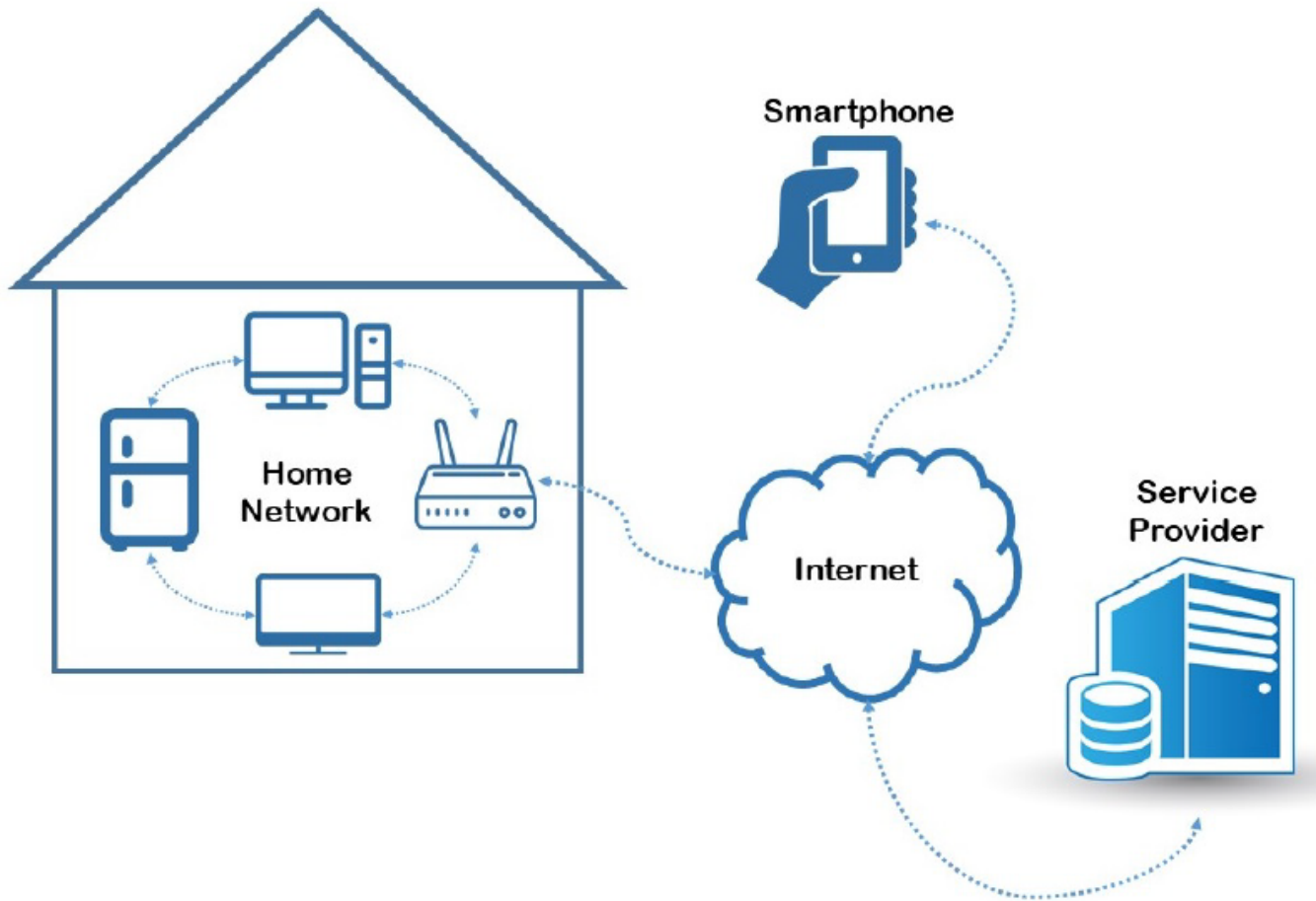


Figure 2

A standard smart home architecture.

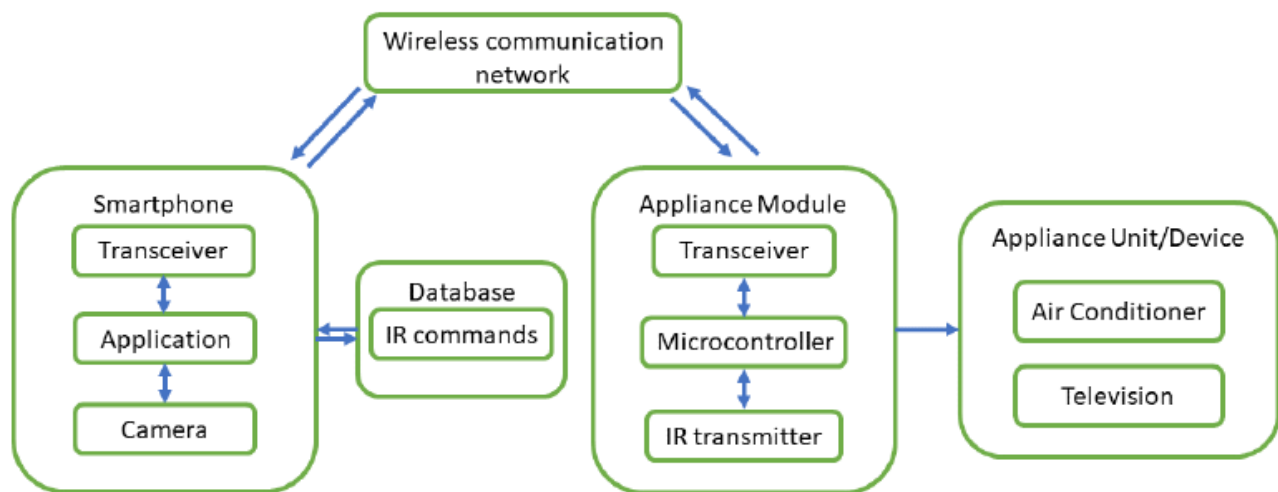


Figure 3

High Level Design of the ARRC system

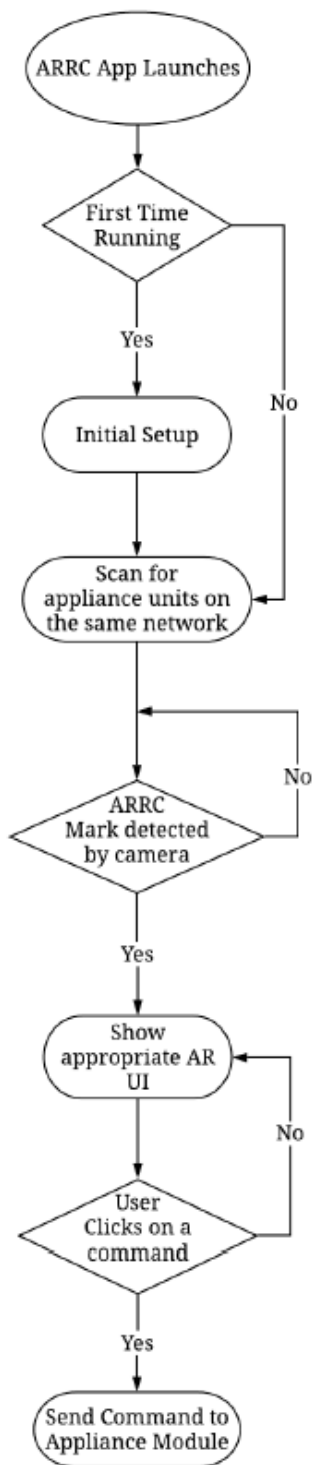


Figure 4

Operational flow of ARRC system

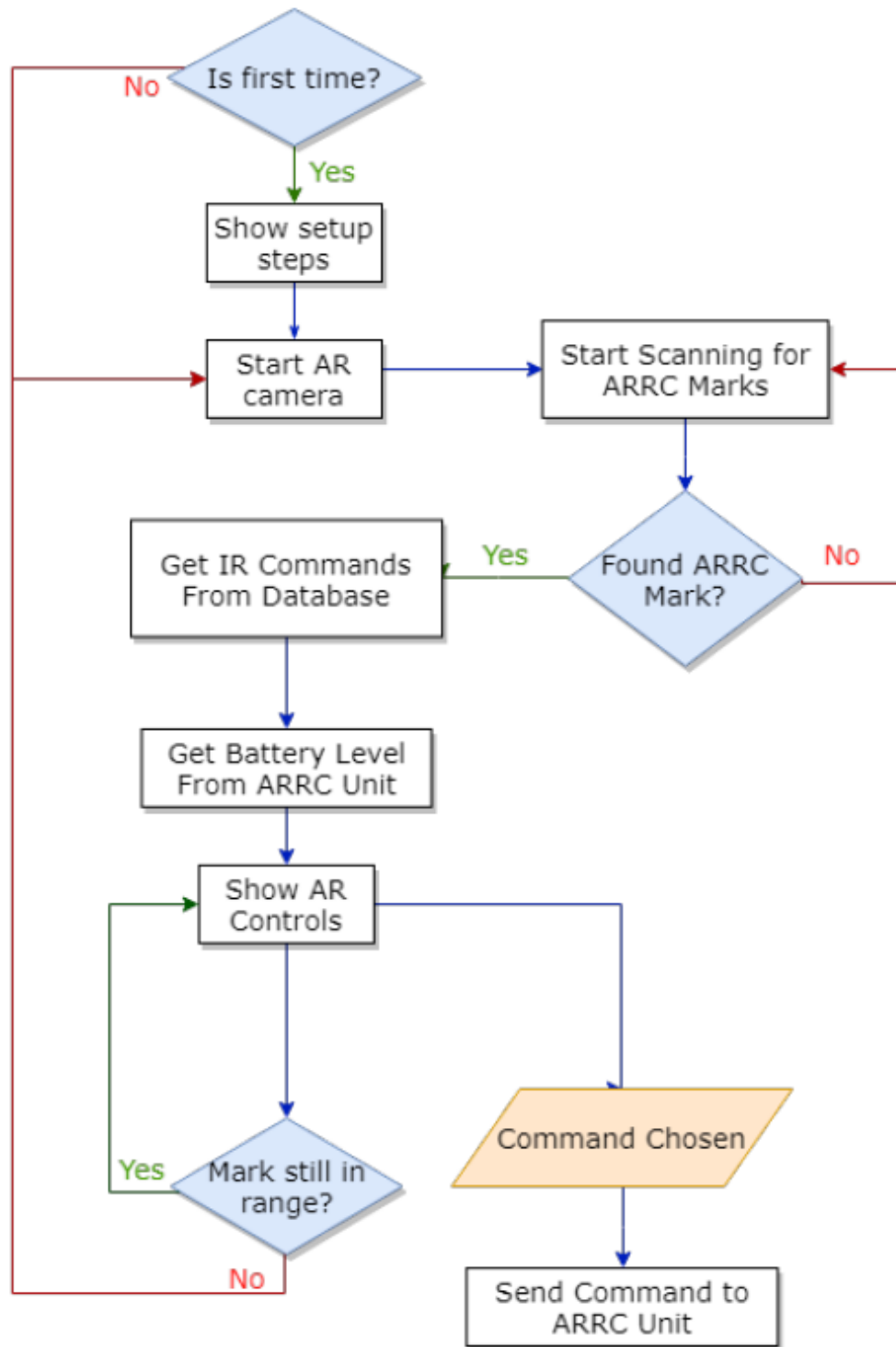


Figure 5

Operational flow of Smartphone Application

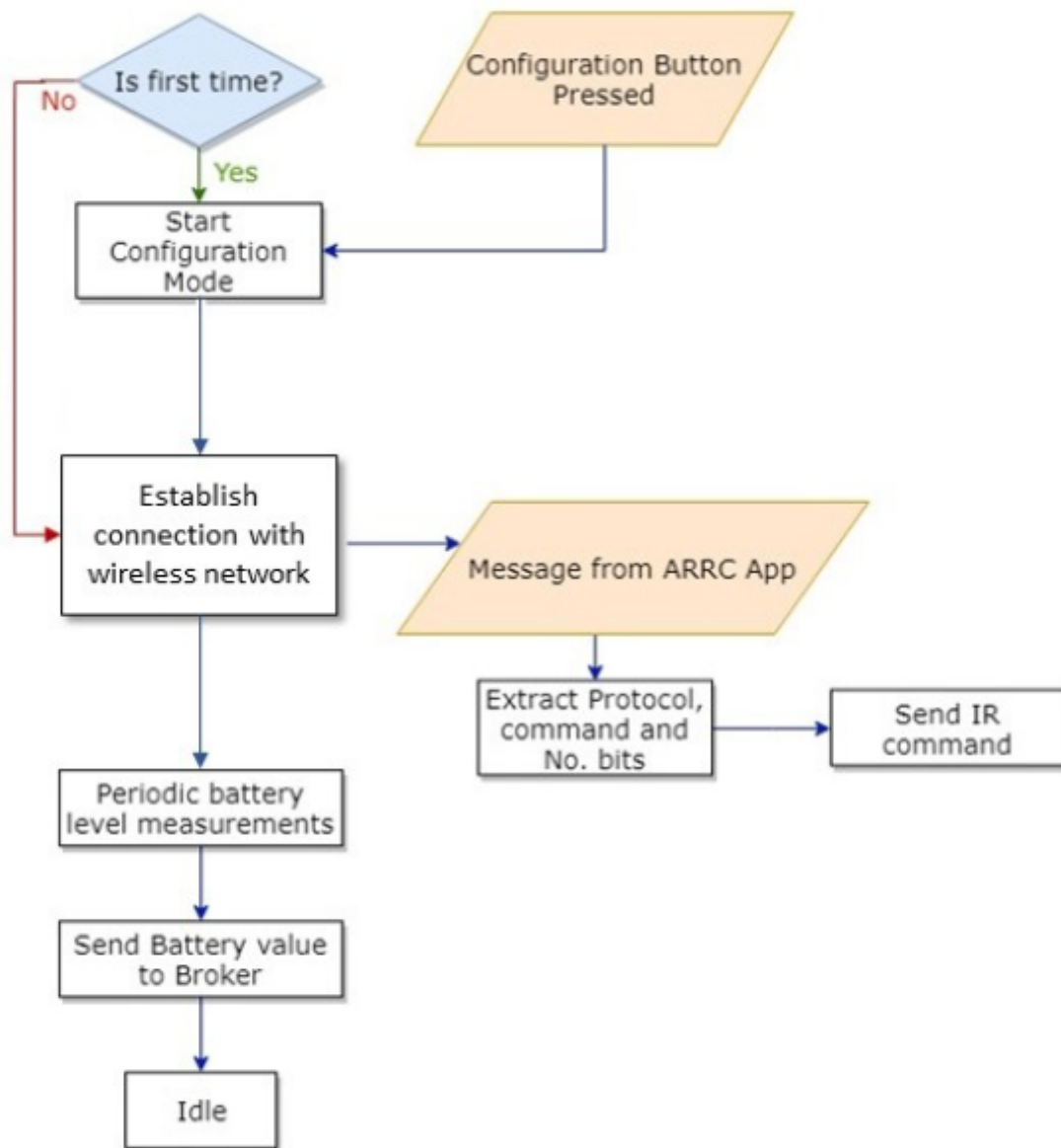


Figure 6

Operational flow of Appliance Module

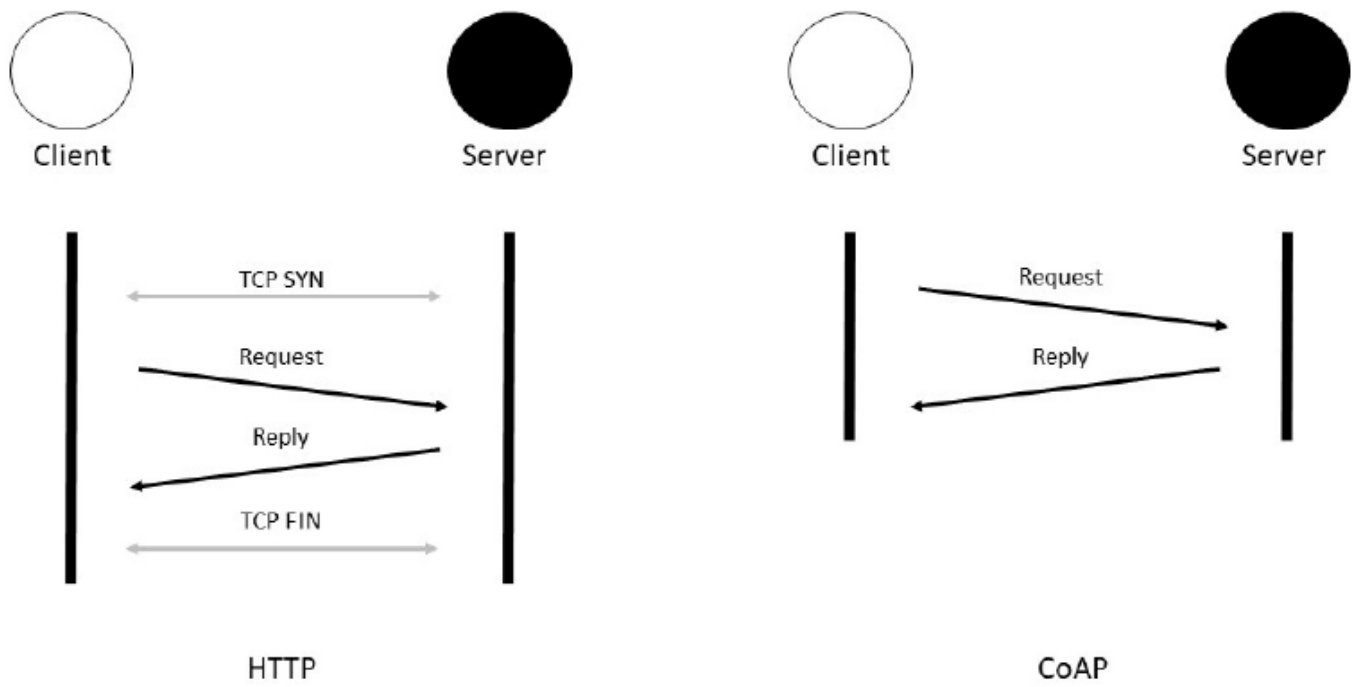


Figure 7

Request-Reply model for HTTP and CoAP

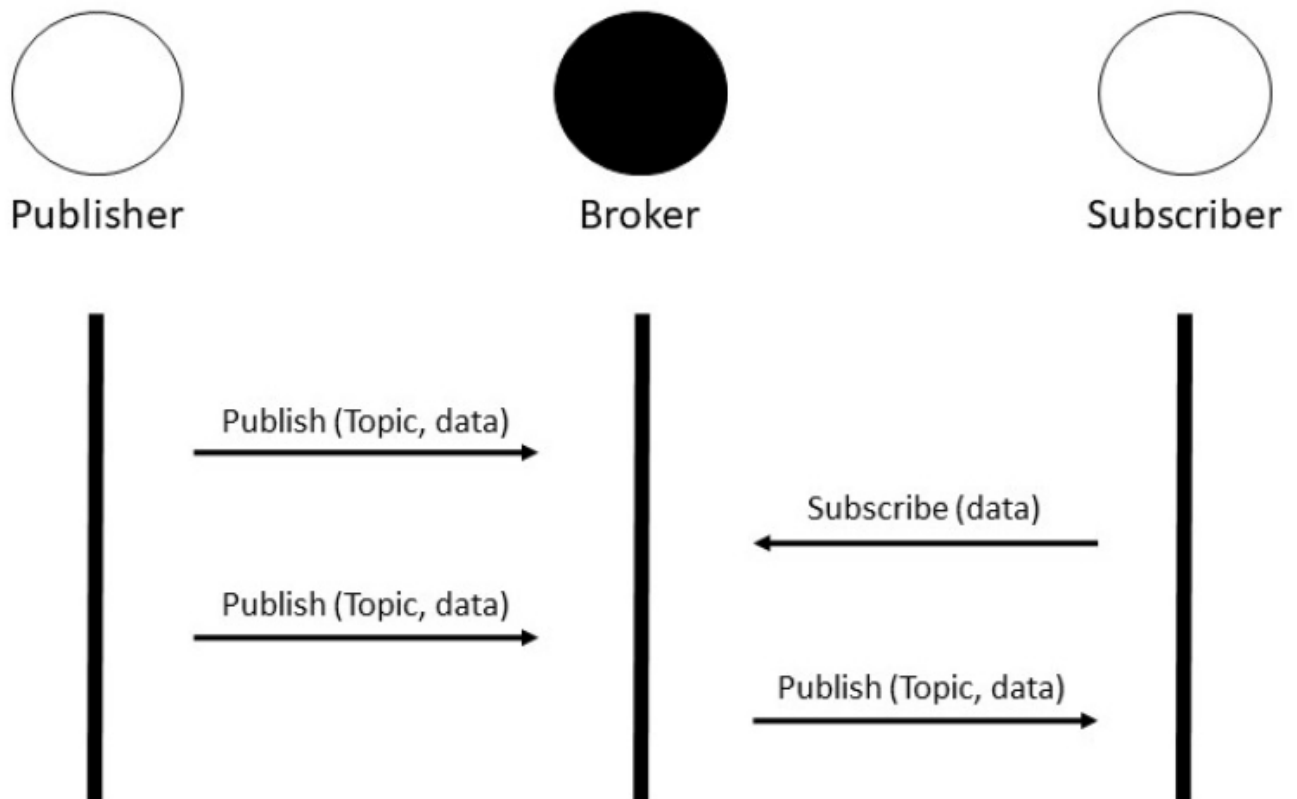


Figure 8

Publish-Subscribe model for MQTT, DDS and AMQP

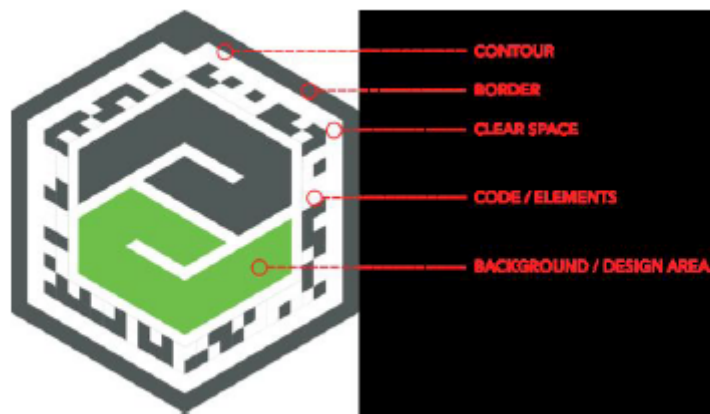


Figure 9

VuMark design feature



Figure 10

ARRC Mark



Figure 11

ARRC Mark Features



Figure 12

ARRC TV control UI

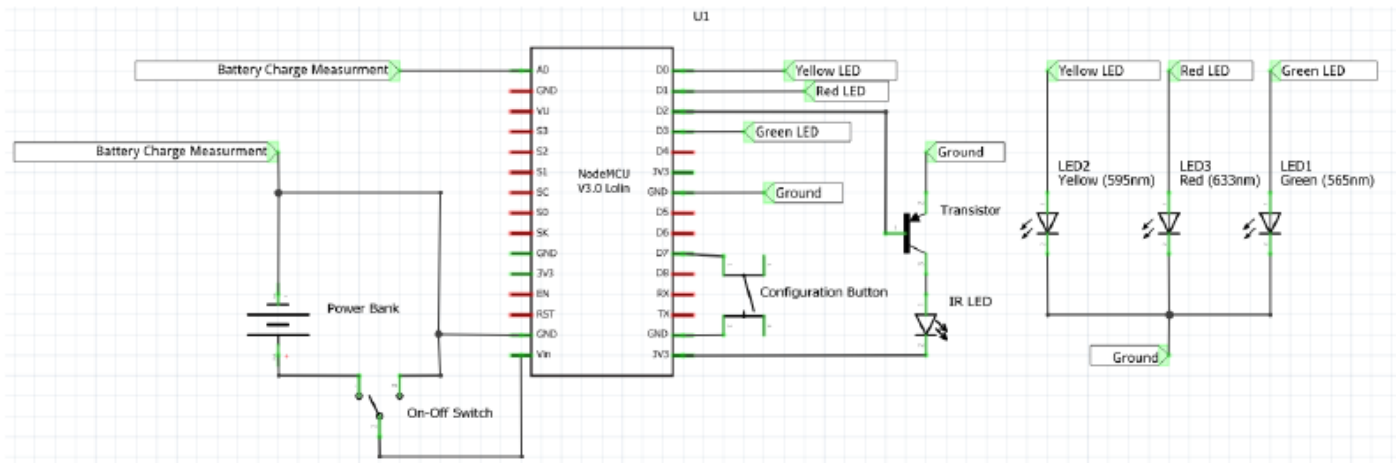


Figure 13

Appliance Module Schematic



11:43:32

24%

Sign in to ARRC_335

wifi.urremote.com

Configuration

dlink-C0F8	 72%
Khan	 56%
Rabufatu	 54%
dlink-CA20	 28%
DADOSH	 28%
Mchowdhury	 24%
Itsmejy	 20%

SSID

dlink-C0F8

Password

Nahnotgonnasharemypassword

(IP unset)

(IP unset)

(IP unset)

save

Figure 14

Module Set up

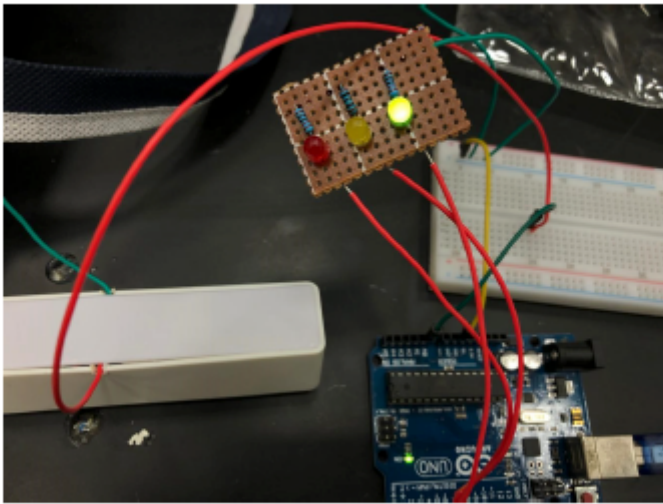


Figure 15

Battery level indicated by LEDs

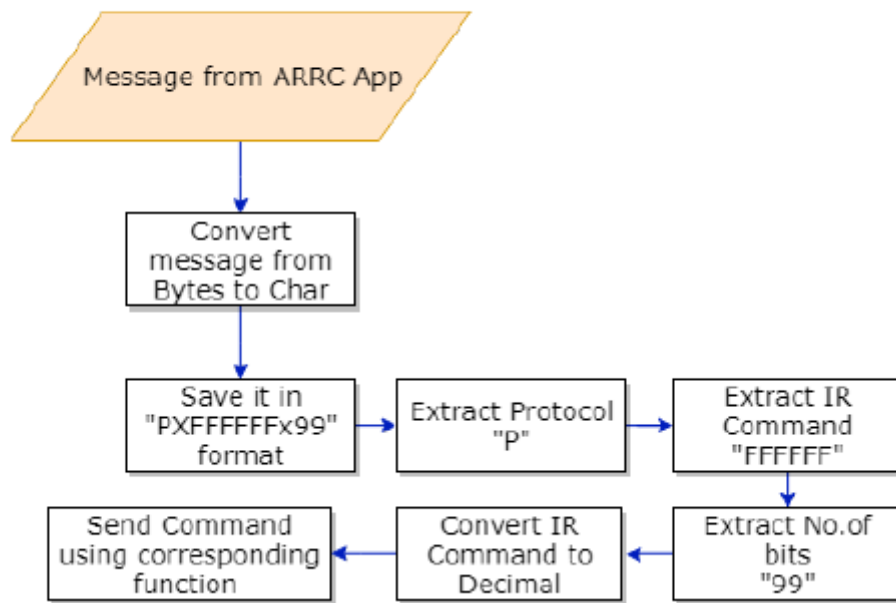


Figure 16

Decoding Process

```

arccsenior
├── AC
│   ├── Hitachi
│   └── LG
│       ├── MOD: "NXAA2251x32"
│       ├── ON-OFF: "NXAA996x32"
│       ├── TEMPD: "NXAA778x32"
│       └── TEMPU: "NXAA887x32"
│   ├── Samsung
│   ├── Super_General
│   └── Whirlpool
└── TV
    ├── Hisense
    ├── LG
    │   ├── CH+: "NXFF254x32"
    │   ├── CH-: "NXFF256x32"
    │   ├── ON-OFF: "NXFFD56x32"
    │   ├── VOL+: "NXFFCD1x32"
    │   └── VOL-: "NXFFAA1x32"
    ├── Philips
    ├── Samsung
    ├── Sony
    └── Toshiba

```

Figure 17

Online Database of commands

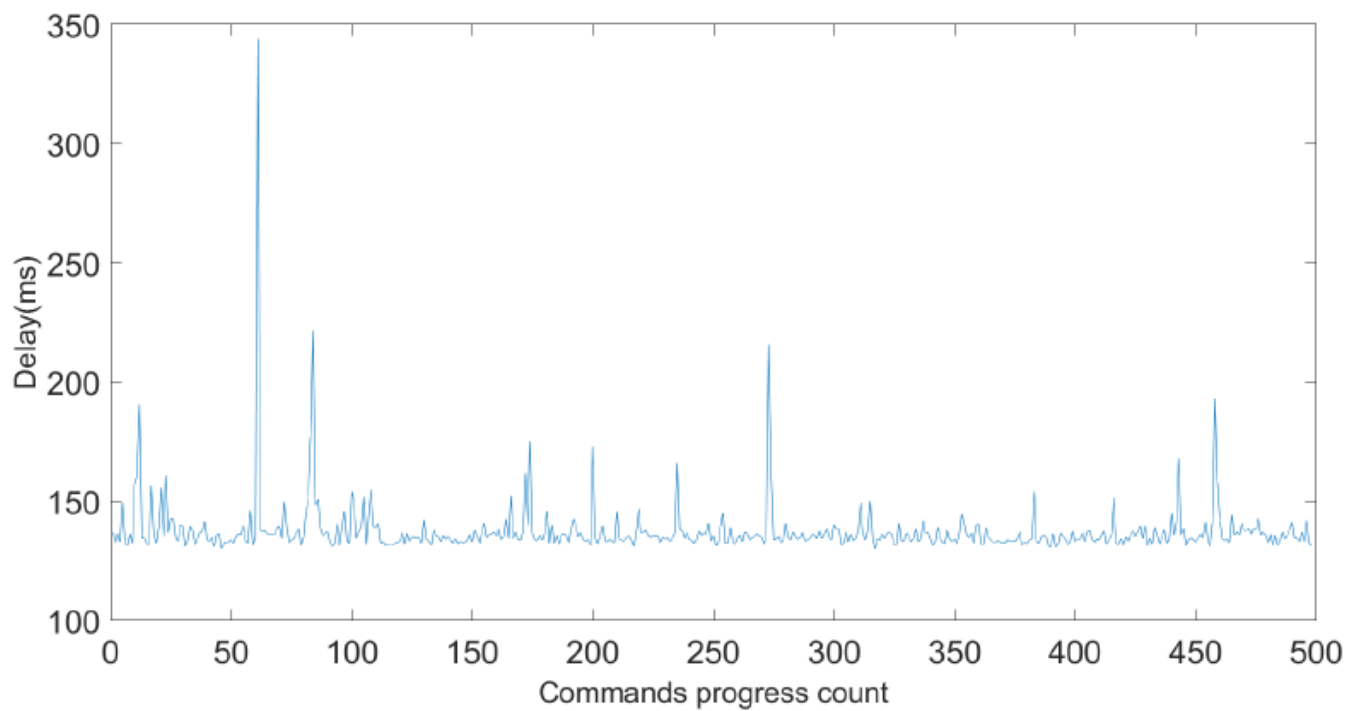


Figure 18

Average time delay for every 10th command for 5000 commands from a smartphone

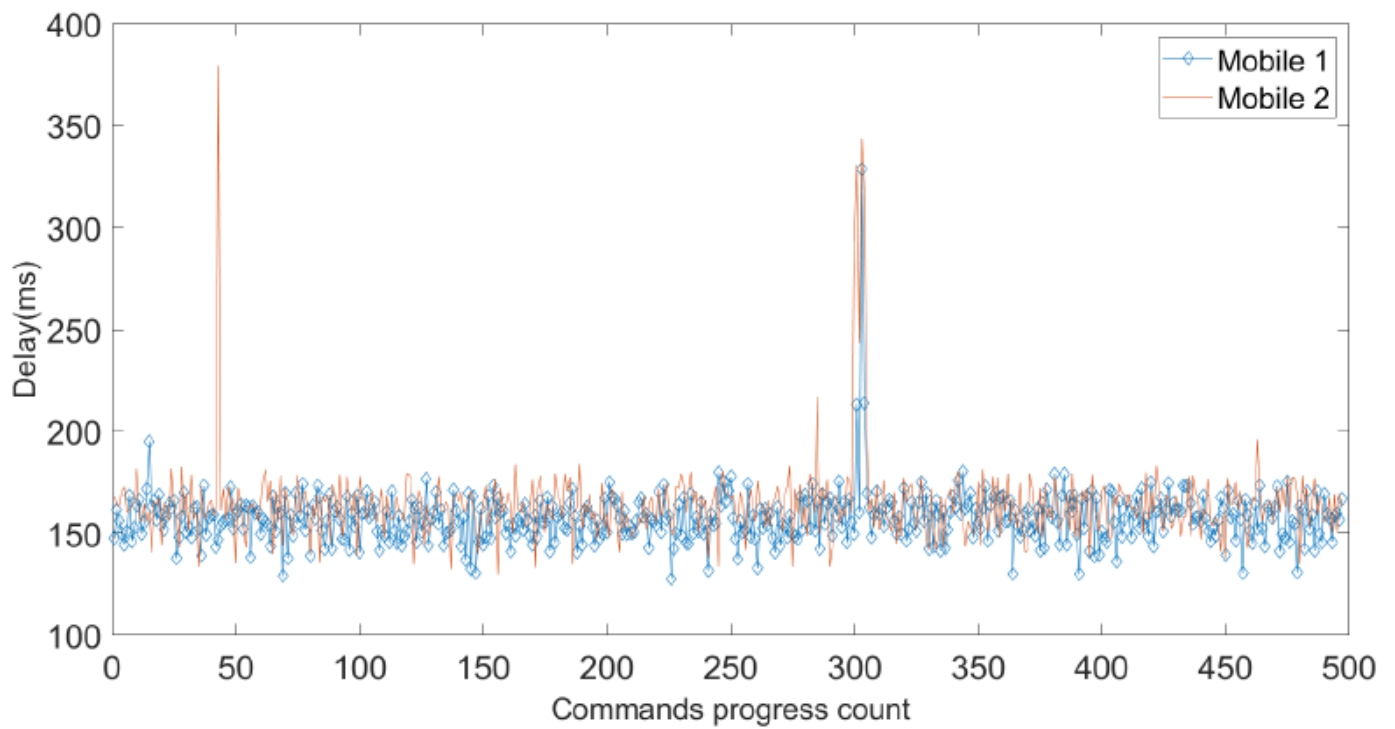


Figure 19

Average time delay for every 2nd command for 1000 commands from 2 mobiles

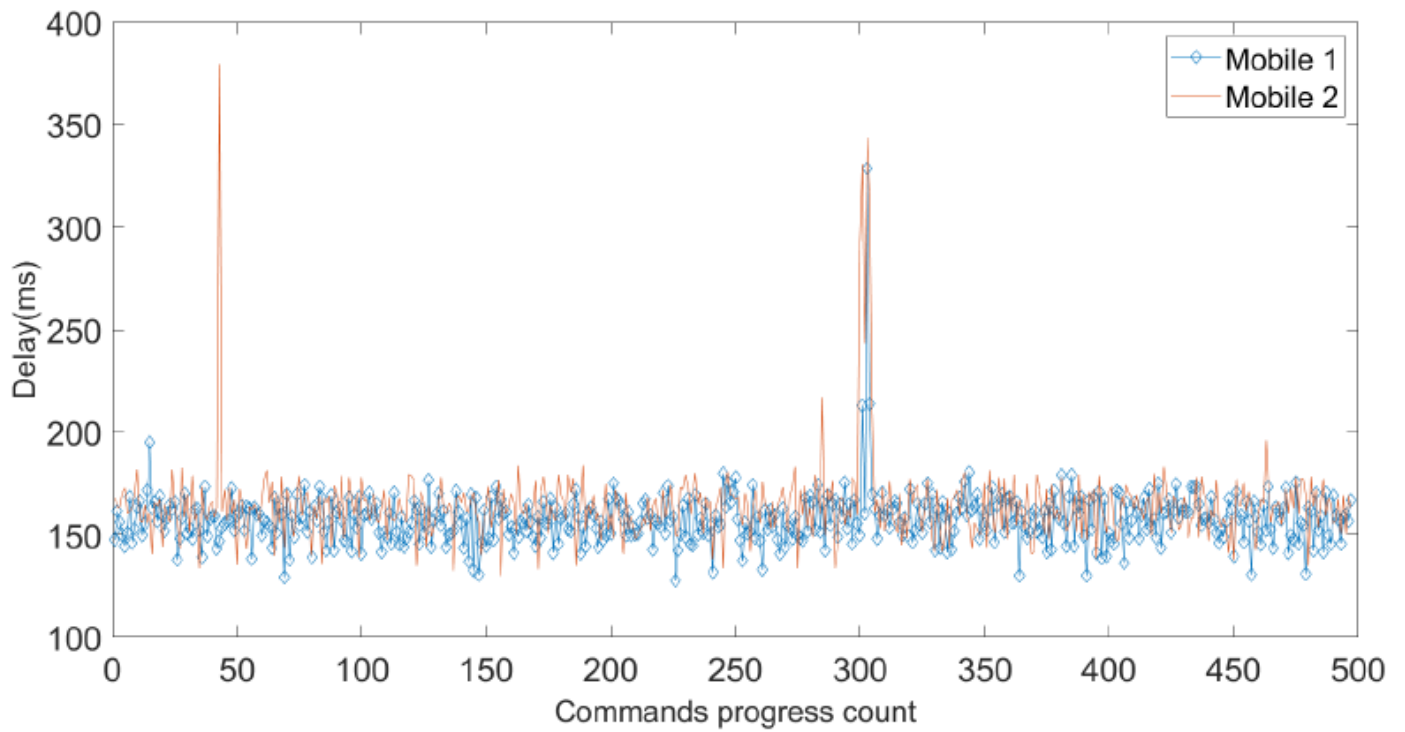


Figure 20

Average time delay for every 2nd command for 1000 commands from 2 smartphones for 2 different appliances

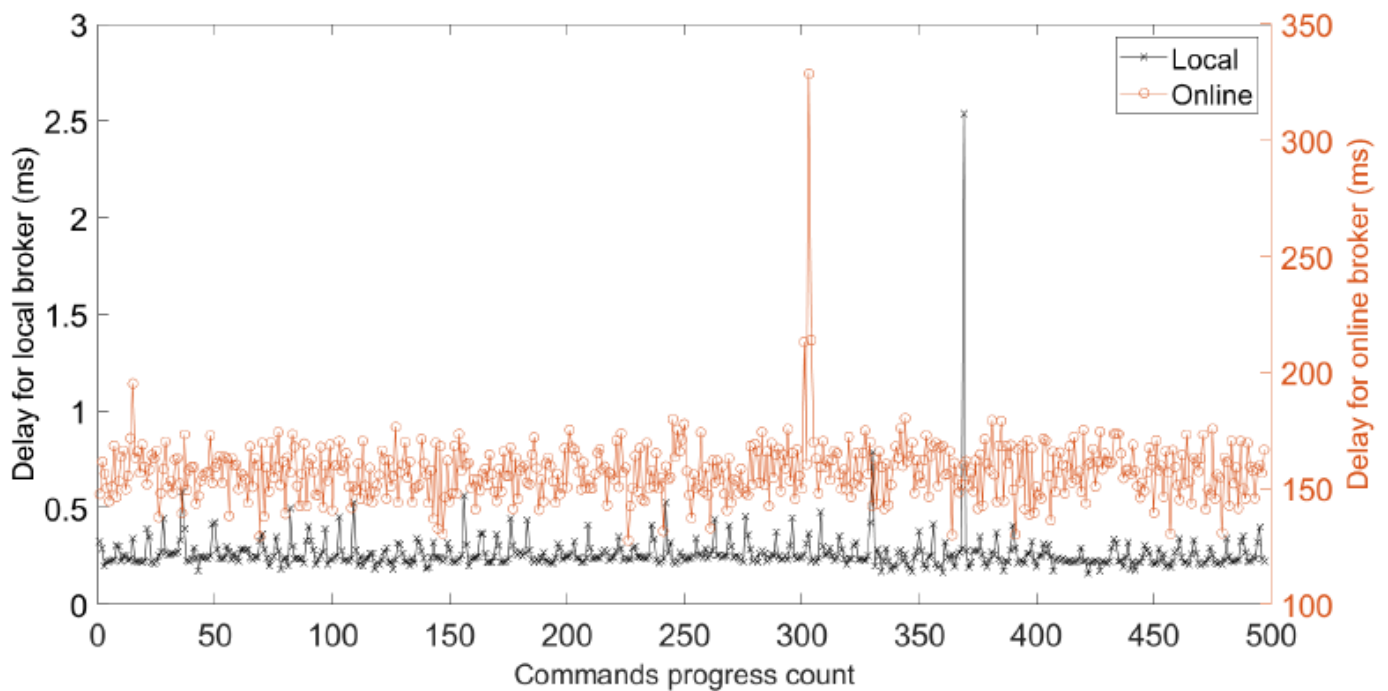


Figure 21

Average time delay for every 2nd command for 1000 commands on a local network using MQTT

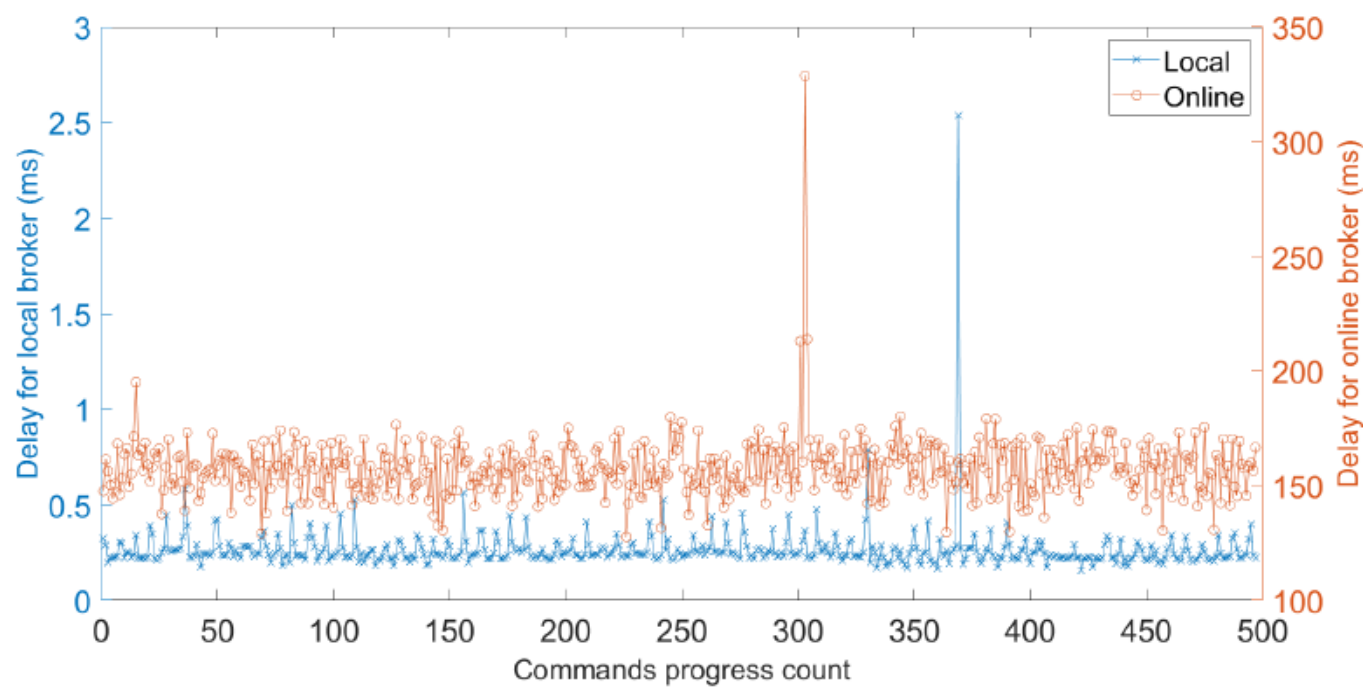


Figure 22

Average time delay for every 2nd command for 1000 commands on a local network (left vertical axis) and an online broker (right vertical axis)

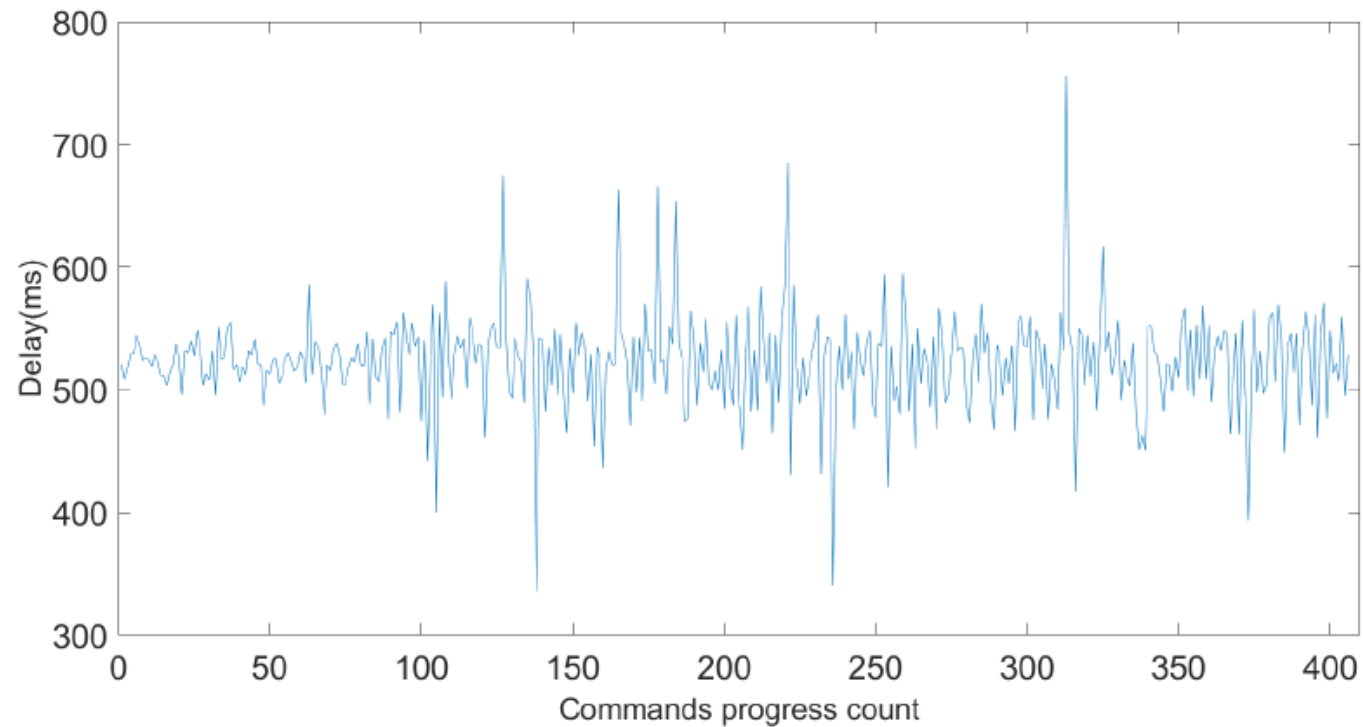


Figure 23

Average time delay for every 2nd command for 1000 commands on a local network

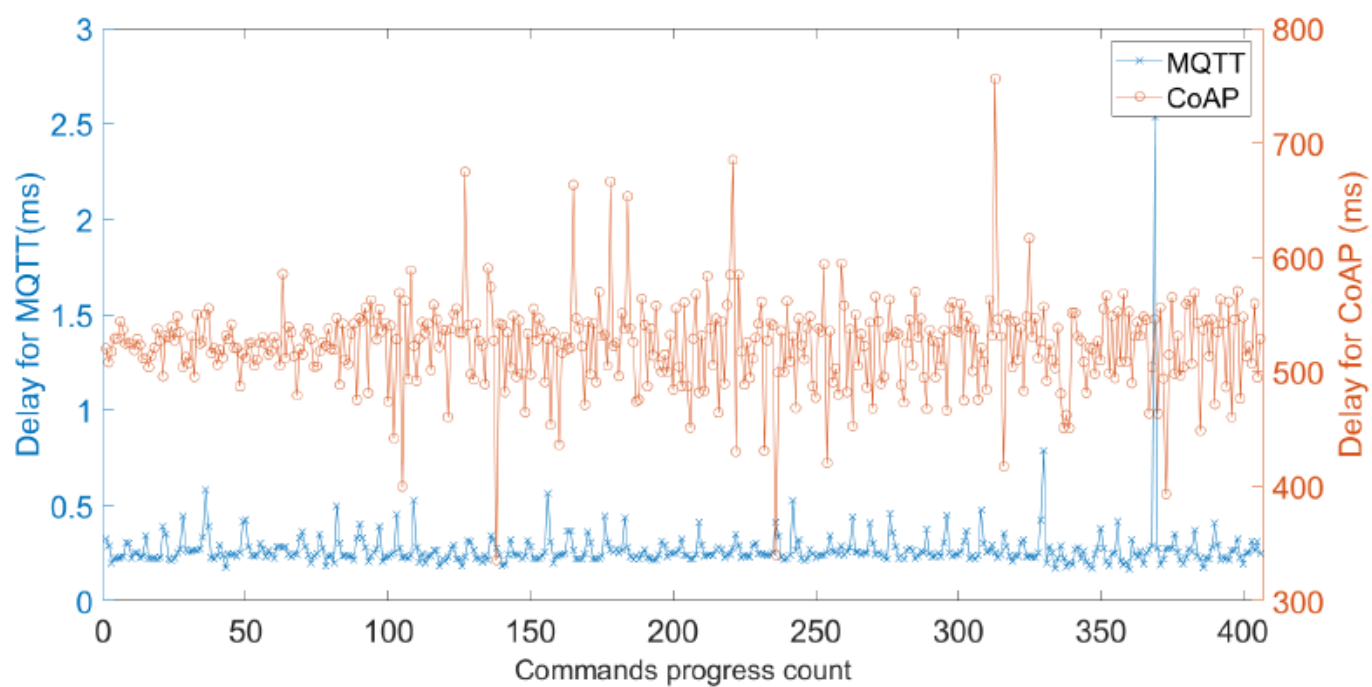


Figure 24

Average time delay for every 2nd command for 1000 commands on a local network for MQTT (left vertical axis) and CoAP (right vertical axis)