

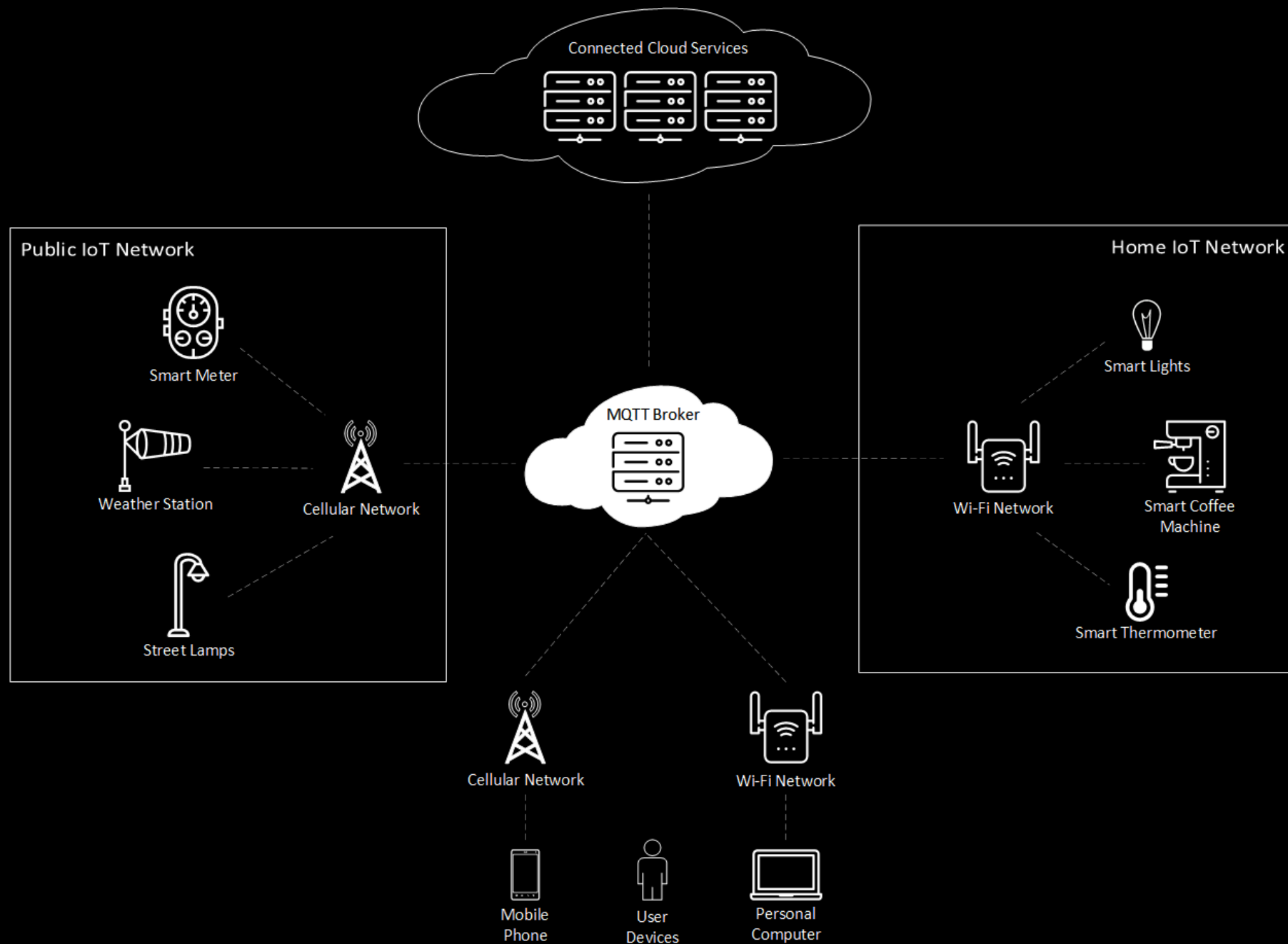
Quick MQTT Introduction

Chia Lih Wei (clw@nus.edu.sg)

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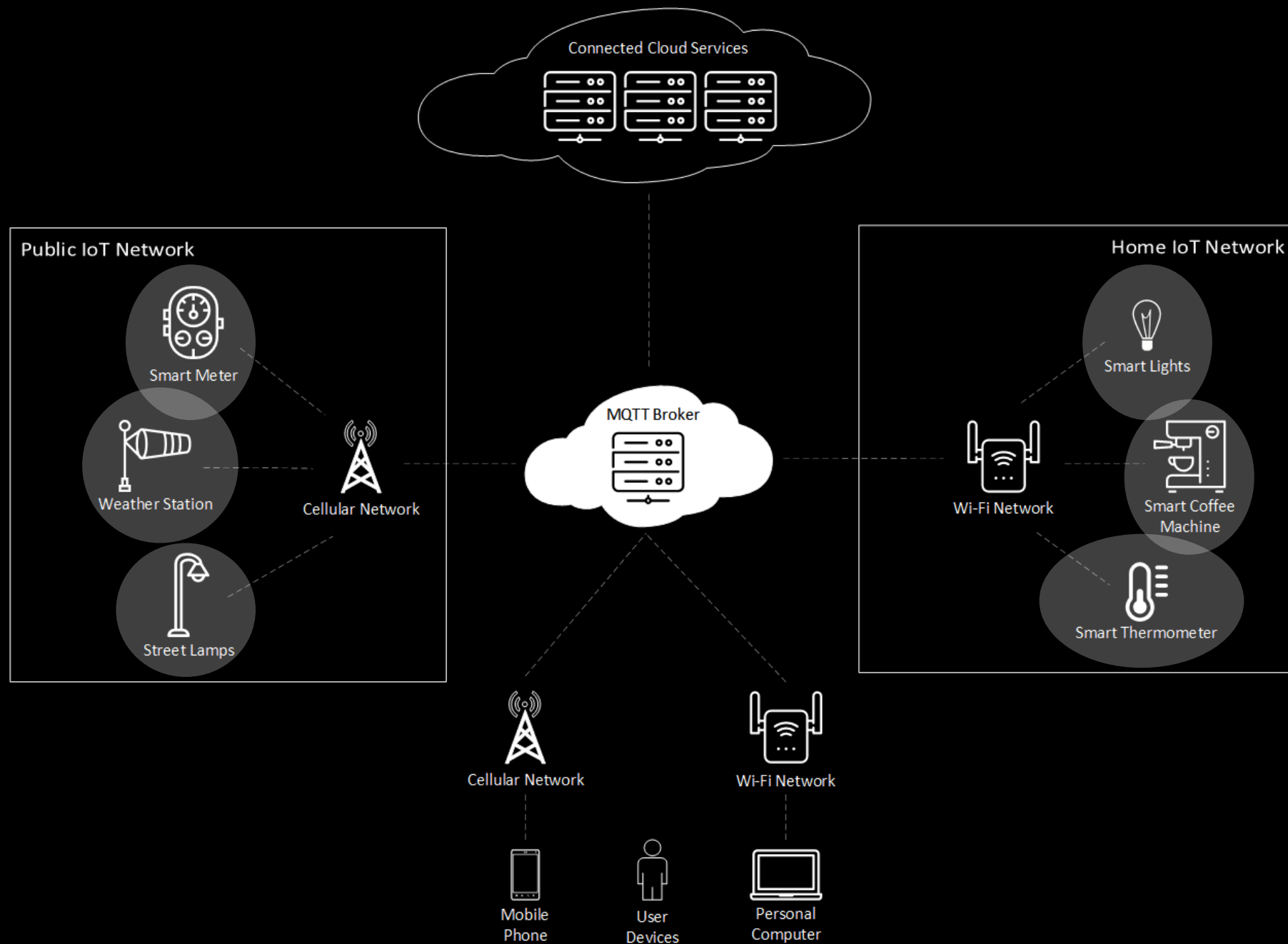
Lee Si En (leese@nus.edu.sg)

The Internet of Things

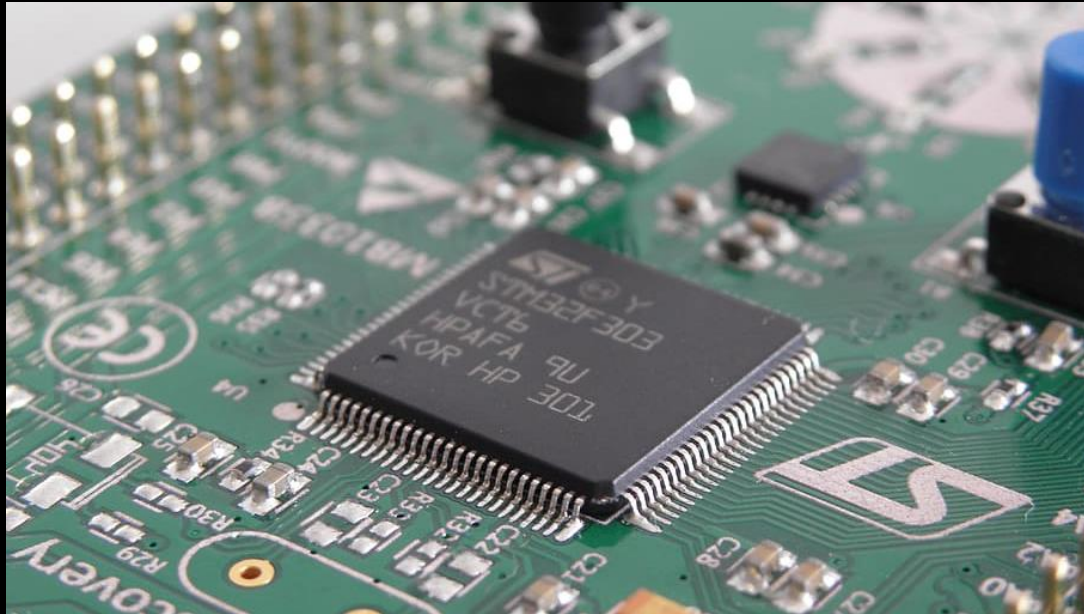


List some commonalities

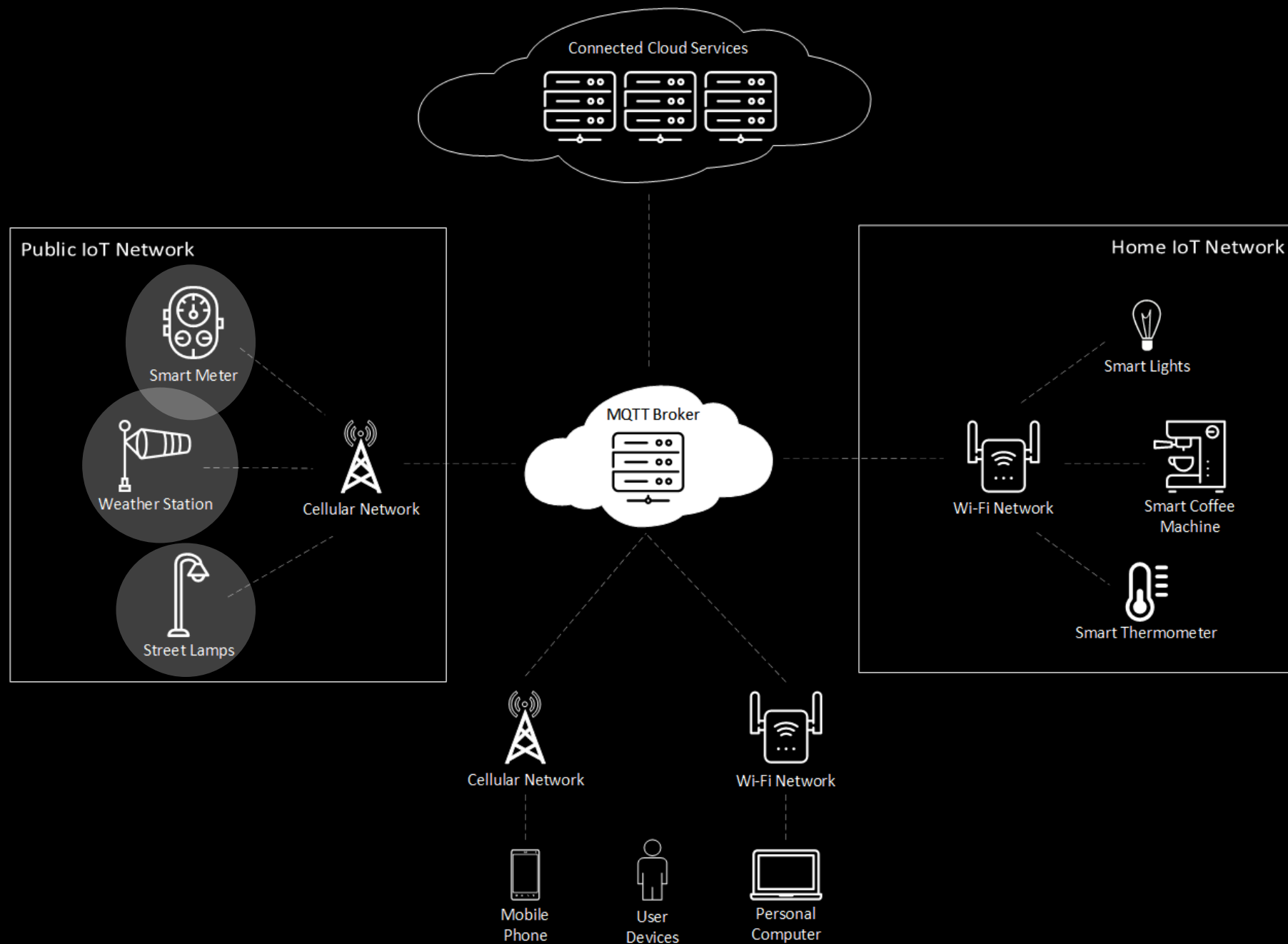
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Lack of Processing Capability



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Limited Data Rate + Limited Data Cap

From (PDF):
<https://www.singtel.com/content/dam/singtel/business/globalservices/Featured%20Articles/brochure-iotconnect.pdf>

IoTConnect Offerings

Singtel IoTConnect cellular technologies, comprising of 3G, 4G, CAT-M1 and NB-IoT networks, come with both standard SIM and durable ruggedised SIM options, provided with management capabilities from our IoT Control Centre.

| Singtel IoTConnect | Standard | Frequency | Max. Throughput |
|--------------------|---------------------------|------------------|--|
| 4G | LTE-A, LTE-A Pro | 1800MHz, 2600MHz | DL: 300Mbps UL: 150Mbps |
| 3G | UMTS, HSPA (HSPDA), HSPA+ | 900MHz, 1800MHz | DL: 42Mbps UL: 8Mbps |
| CAT-M1 | 3GPP Rel-13 | 1.4 MHz | DL: 1Mbps/375Kbps UL: 1Mbps/300Kbps |
| NB-IoT | 3GPP Rel-13 | 200KHz | DL: ~20Kbps UL: ~20Kbps |

Low-Power Wide Area Networks

Low-Power Wide Area Networks (LPWANs) include CAT-M1 and NB-IoT which are 3GPP-standardised cellular solutions supported by an established ecosystem, ensuring interoperability across different network providers and prevents vendor lock-in. This means you will be able to scale up fast and enjoy rapid deployment.

Comparing Singtel CAT-M1 and NB-IoT

| Network | Bandwidth | Coverage | Capacity | Mobility | Voice | Possible Usage |
|---------|-----------|---------------|-------------------|------------------|---------------|--|
| CAT-M1 | 1.4Mhz | 160dB (+15dB) | To be verified | Connected & idle | Supported | Mobile applications with higher service requirements |
| NB-IoT | 200kHz | 164dB (+20dB) | 200K devices/cell | Limited | Not supported | Ultra-low end applications such as sensors, meters, smoke alarms, and more |

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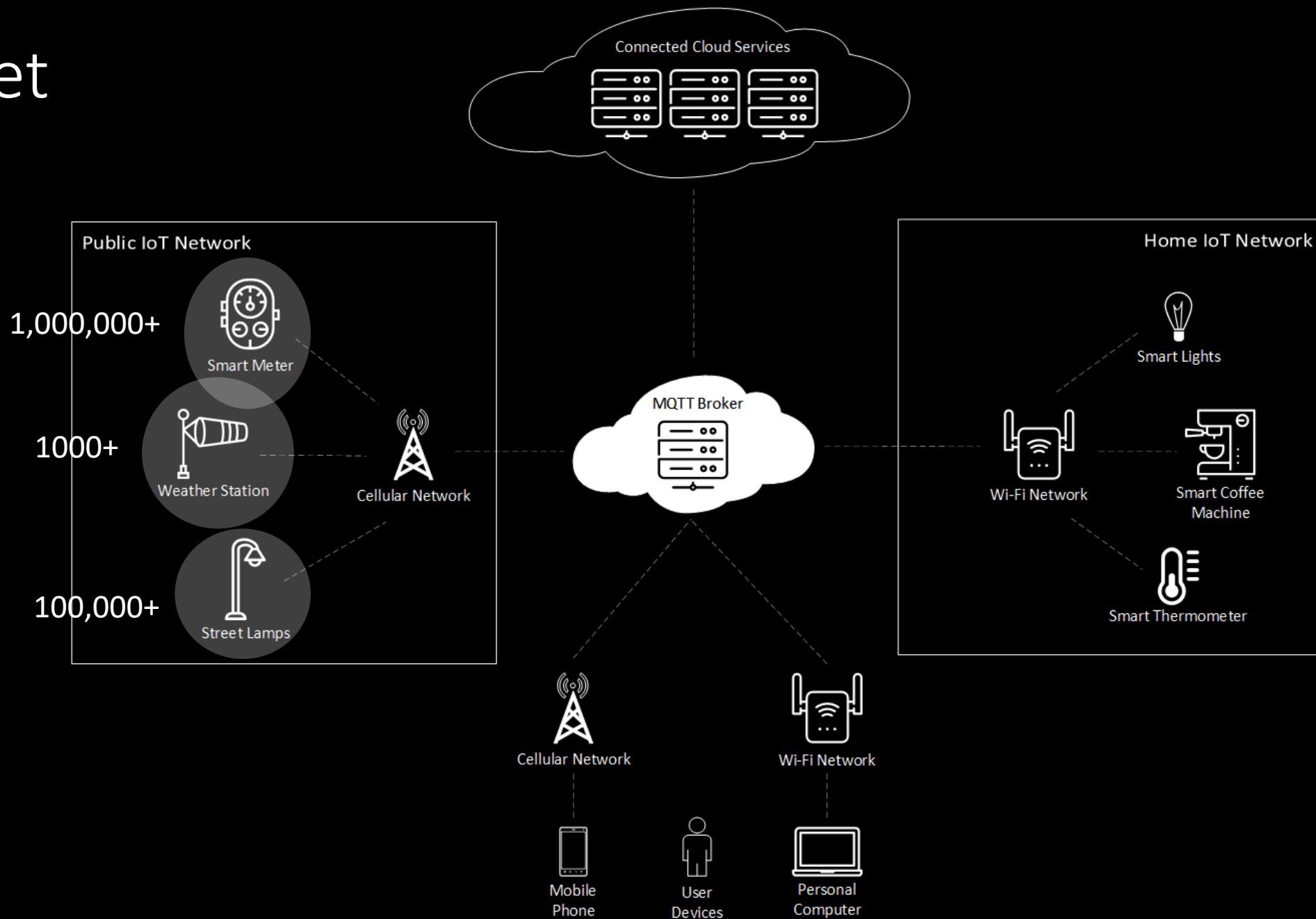
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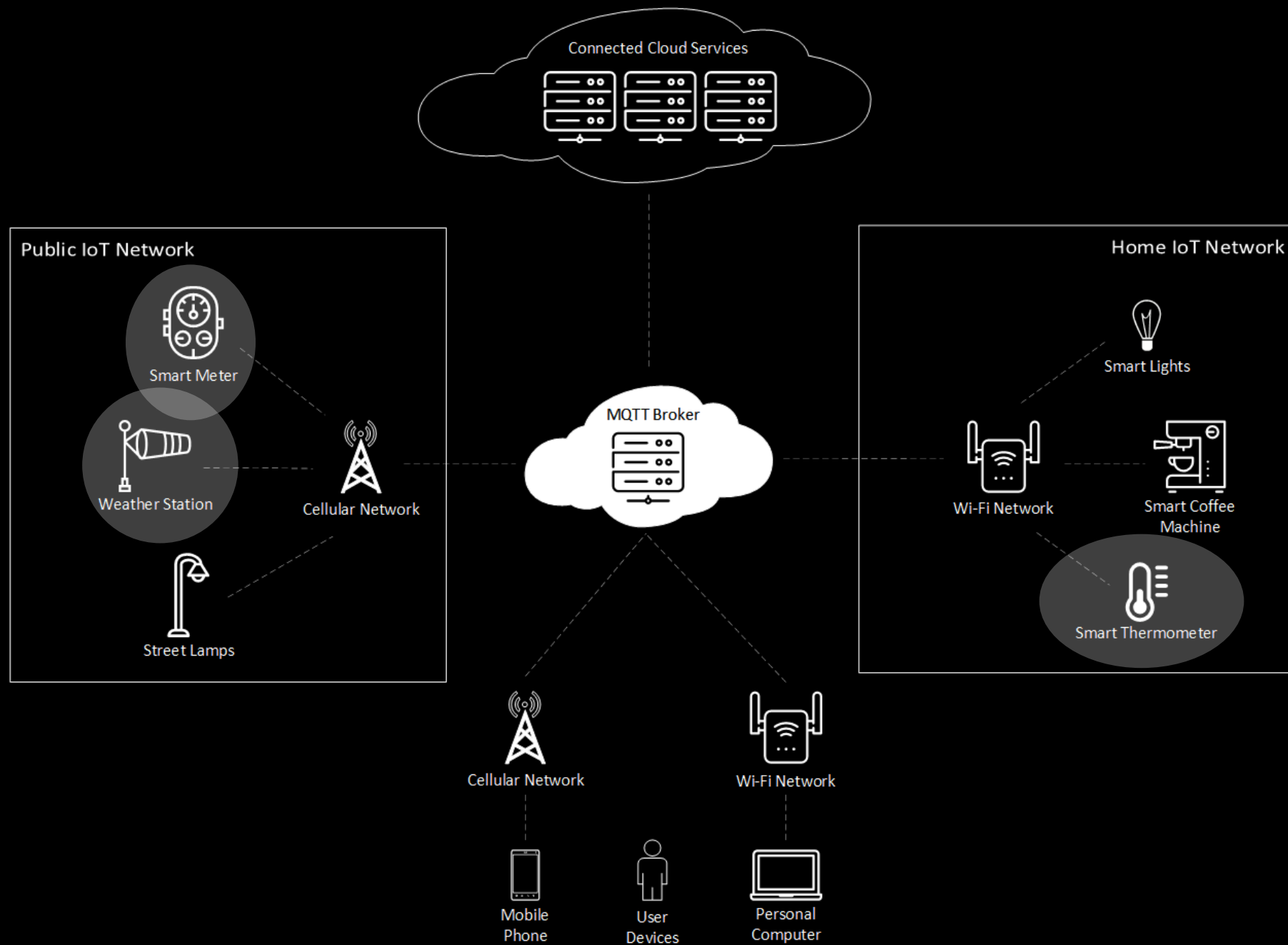
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The Internet of Things



(Extremely) Limited Power Source



Image source: Getty Images/iStockphoto



Image source: Flonidan A/S



Image source: Saft Groupe SAS



Image source: UniBot

Issues Facing IoT Devices

- Limited processing capability
- Limited data rate
- Limited data cap
- (Extremely) Limited power source

Issues Facing IoT Devices

- Limited processing capability¹
- Limited data rate²
- Limited data cap³
- (Extremely) Limited power source⁴

Thus, data transfers must be

- Simple^{1, 4}
- Lightweight^{2, 3, 4}

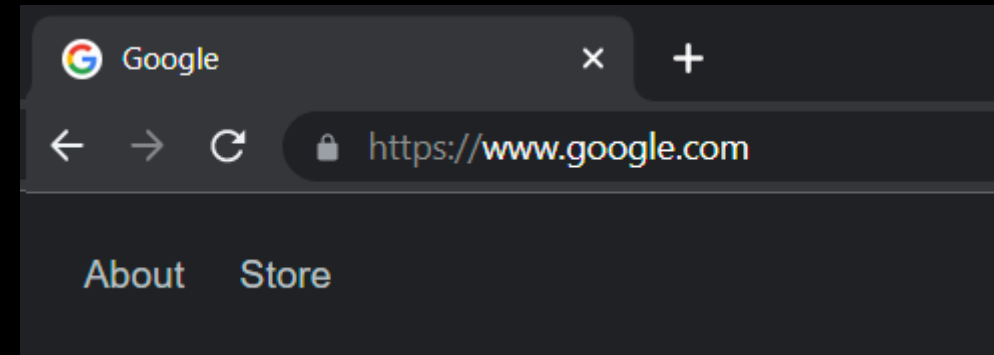
Message Queue Telemetry Transport

MQTT

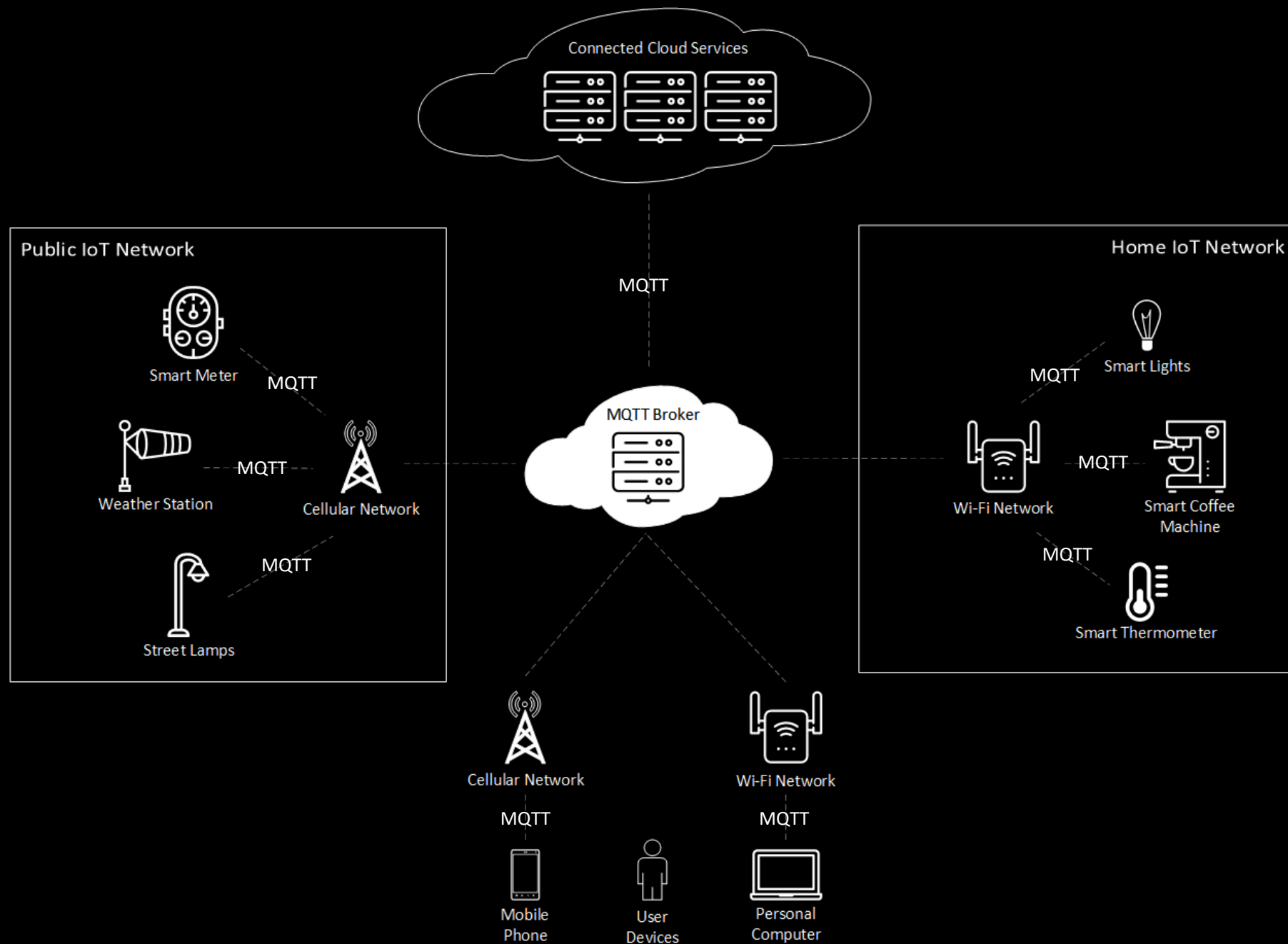
MQTT is the
Communication Protocol

Communication Protocol?

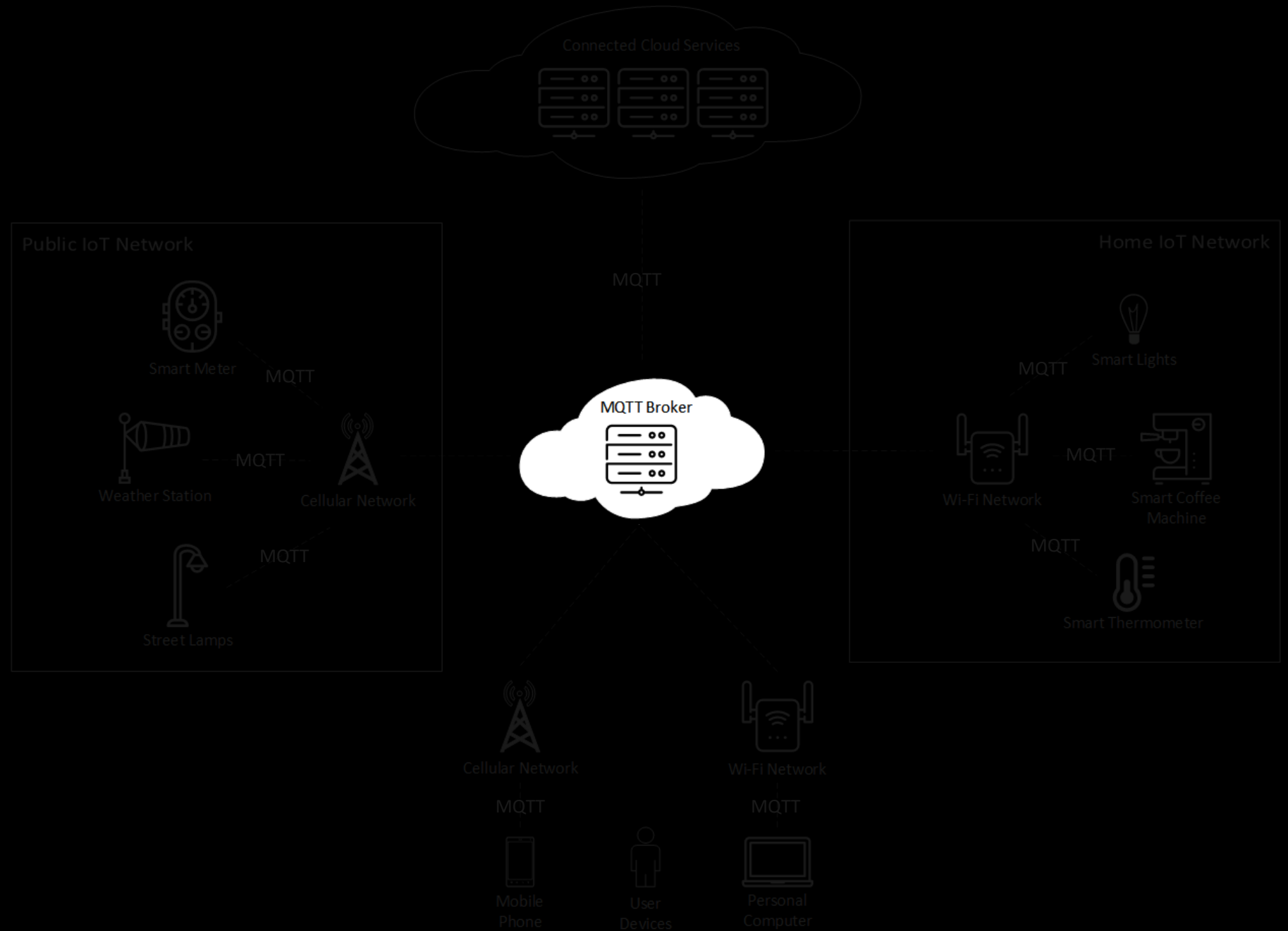
- Communication protocols you use daily:
 - HTTP/HTTPS – Web browsing
 - RTSP/RTP – Video streaming
 - SMTP/POP/IMAP - Emails
 - FTP – File downloads (legacy)
- Standards for machines to talk to each other to exchange information efficiently



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Issues Facing IoT Devices

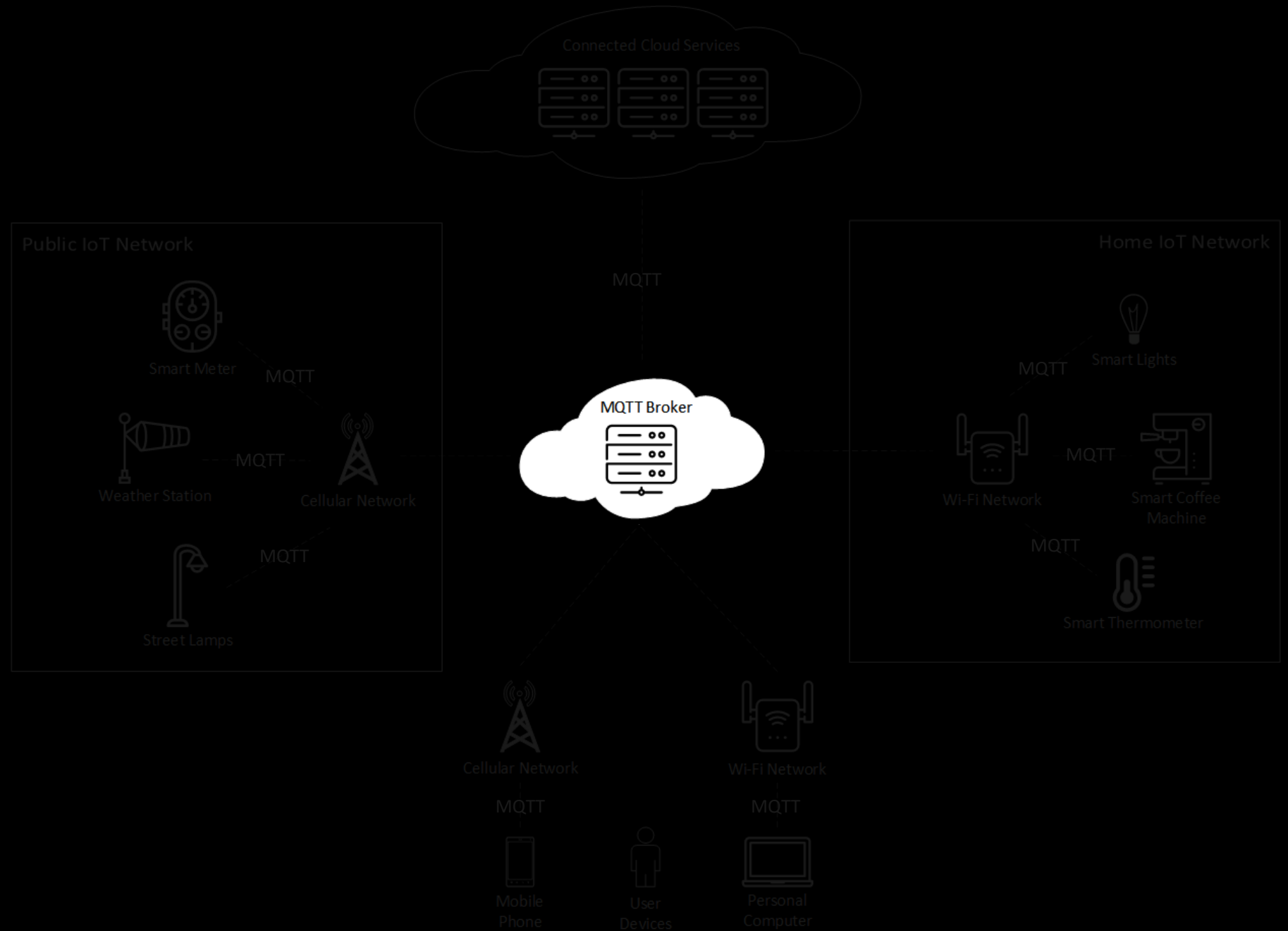
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Issues Facing IoT Devices

- ~~Limited processing capability~~
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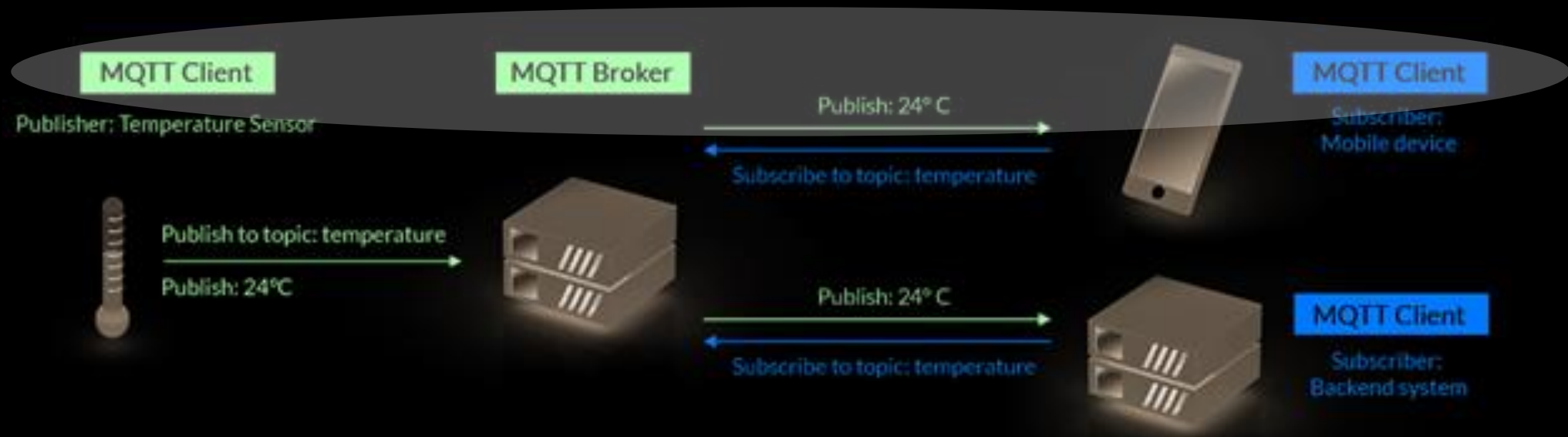
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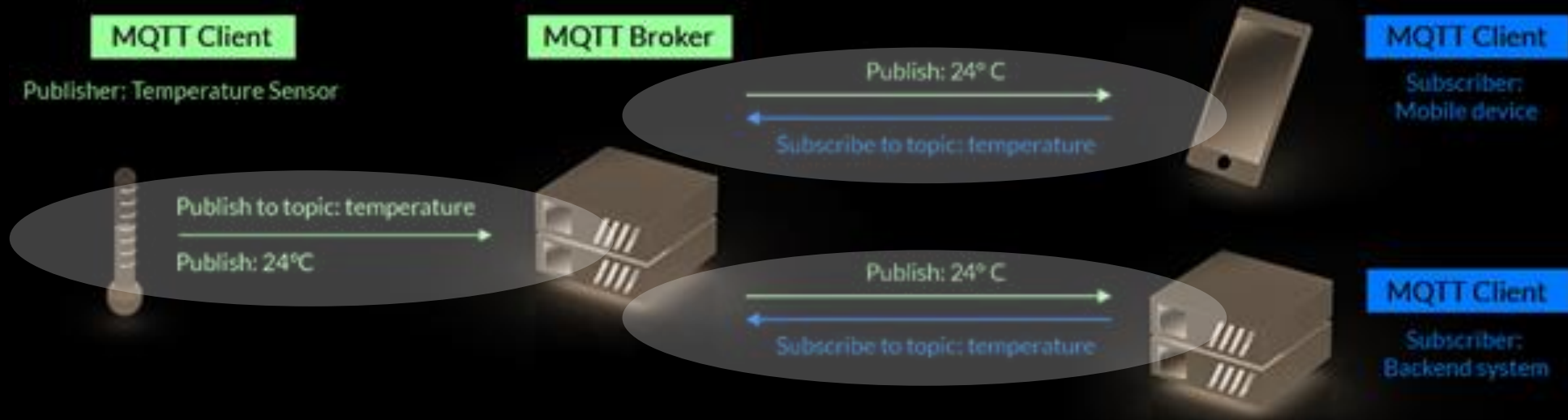
Achieving Simplicity: Publish-Subscribe Architecture



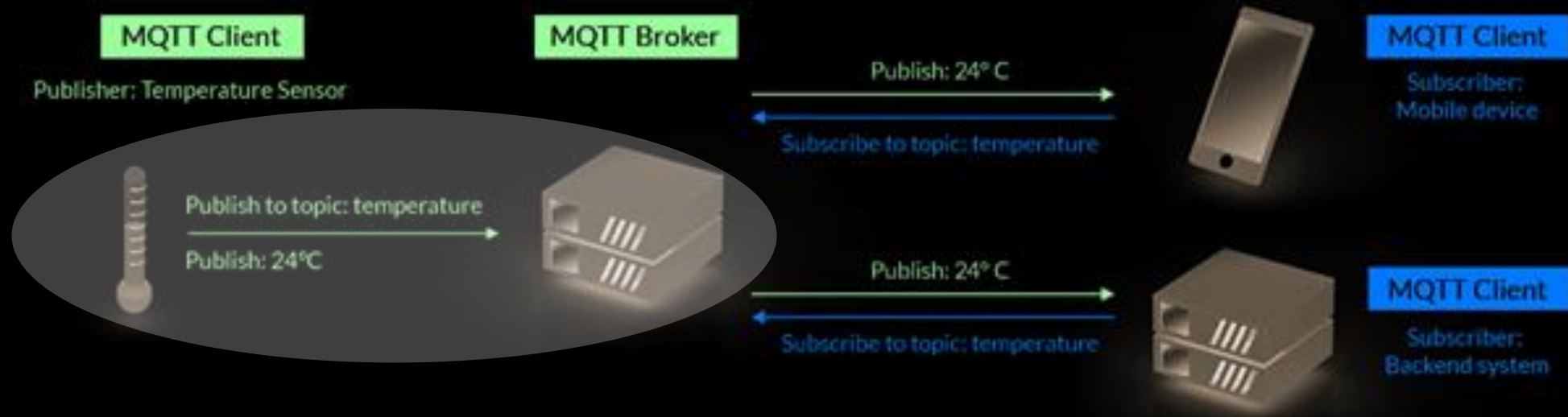
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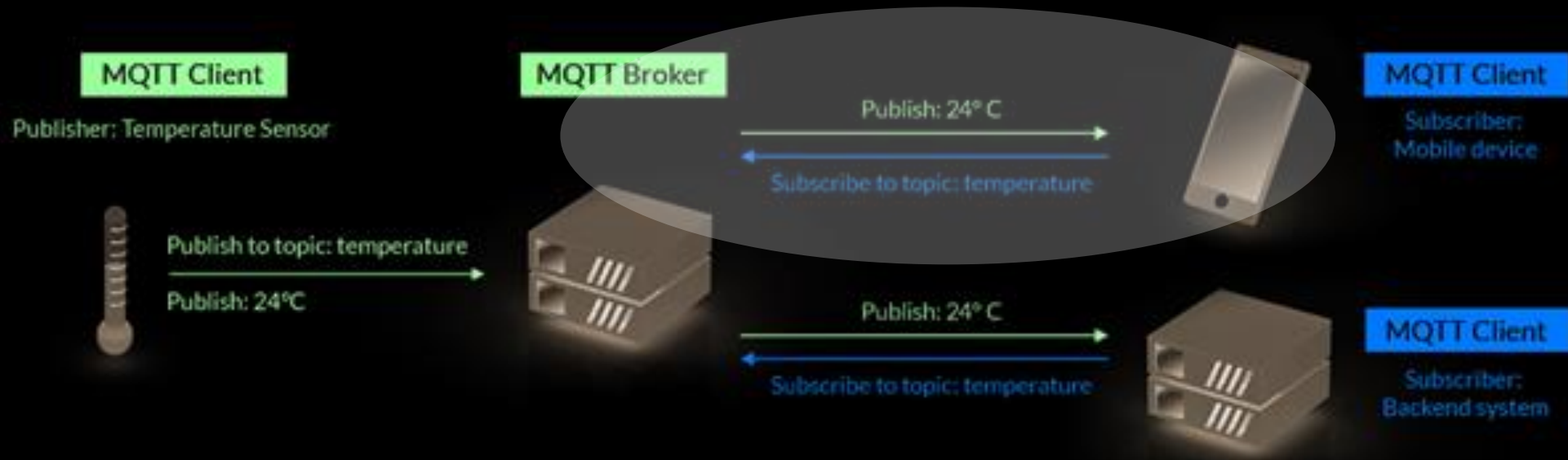
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Demonstration