CoAP IoT Update System Deployment Guide

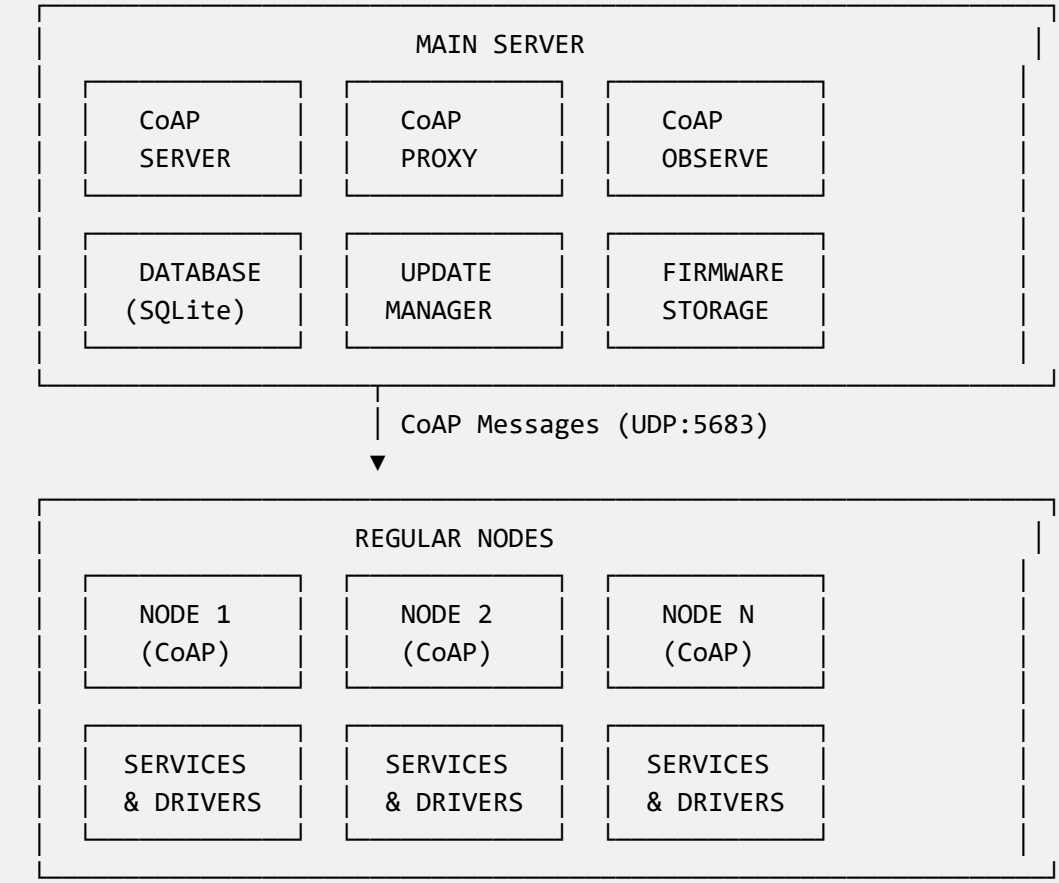
🎯 Deployment Overview

This guide explains how to deploy the CoAP-based IoT update system across your ARM Cortex A55 infrastructure.

📋 Prerequisites

- ARM Cortex A55 devices (or compatible ARM64)
- Ubuntu 20.04+ or Debian 11+
- Root access on all devices
- Network connectivity between devices
- Python 3.9+

📐 Architecture



🚀 Step-by-Step Deployment

Step 1: Deploy Main Server

1. **Copy files to main server:**

```
# On main server
scp -r main_server_coap/ user@<MAIN_SERVER_IP>:/tmp/
scp deployment/coap/install_main_server.sh user@<MAIN_SERVER_IP>:/tmp/
```

2. **Run main server installation:**

```
# On main server
sudo chmod +x /tmp/install_main_server.sh
sudo /tmp/install_main_server.sh
```

3. **Verify main server:**

```
# Check service status
sudo systemctl status main-server-coap

# Check CoAP endpoint
coap-client -m get coap://<MAIN_SERVER_IP>:5683/health
```

Step 2: Deploy Regular Nodes

1. **Copy files to each regular node:**

```
# On each regular node
scp -r regular_node_coap/ user@<NODE_IP>:/tmp/
scp deployment/coap/install_regular_node.sh user@<NODE_IP>:/tmp/
```

2. **Run regular node installation:**

```
# On each regular node
sudo chmod +x /tmp/install_regular_node.sh
MAIN_SERVER_IP=<MAIN_SERVER_IP> sudo /tmp/install_regular_node.sh
```

Replace `<MAIN_SERVER_IP>` with your actual main server IP address.

3. **Verify regular node:**

```
# Check service status
sudo systemctl status regular-node-coap

# Check CoAP endpoint
coap-client -m get coap://<NODE_IP>:5683/health
```

Step 3: Test the System

2. **Verify node registration:**

```
# Check registered nodes
coap-client -m get coap://<MAIN_SERVER_IP>:5683/nodes
```

🔧 Configuration

Main Server Configuration

The main server runs on:

- **CoAP Port**: 5683 (UDP)
- **DTLS Port**: 5684 (UDP, if enabled)
- **Resource Paths**:
  - `/updates` - Update management
  - `/nodes` - Node management
  - `/health` - Health monitoring
  - `/system` - System operations

Regular Node Configuration

Each regular node:

- **Connects to**: Main server CoAP endpoint
- **Runs on**: Port 5683 (UDP)
- **Registers with**: Main server on startup
- **Reports health**: Every 60 seconds

📊 Resource Usage

Main Server

- **RAM**: ~200MB
- **CPU**: ~0.2 cores
- **Storage**: ~100MB + firmware files

Regular Node

- **RAM**: ~100MB
- **CPU**: ~0.1 cores
- **Storage**: ~50MB + update files

🔒 Security Configuration

Enable DTLS (Optional)

1. **Generate certificates:**

```
# On main server
openssl req -x509 -newkey rsa:2048 -keyout server.key -out server.crt
-days 365 -nodes
```

2. **Configure DTLS in CoAP server:**

```
# In main_server_coap/app/main.py
context = await Context.create_server_context(
    bind=("0.0.0.0", 5684),
    server_credentials=load_certificate_chain("server.crt"),
    private_key=load_private_key("server.key")
)
```

🛠️ Management Commands

Main Server Commands

```
# Check status
sudo systemctl status main-server-coap

# View logs
sudo journalctl -u main-server-coap -f

# Restart service
sudo systemctl restart main-server-coap

# Health check
sudo /opt/management-system/health-check-main-server.sh
```

Regular Node Commands

```
# Check status
sudo systemctl status regular-node-coap

# View logs
sudo journalctl -u regular-node-coap -f

# Restart service
sudo systemctl restart regular-node-coap

# Health check
sudo /opt/management-system/health-check-regular-node.sh
```

🔍 Troubleshooting

Common Issues

1. **CoAP connection failed**

```
# Check if UDP port 5683 is open
sudo netstat -ulpn | grep 5683

# Check firewall
sudo ufw status
sudo ufw allow 5683/udp
```

2. **Service won't start**

```
# Check logs
sudo journalctl -u main-server-coap -n 50

# Check Python dependencies
/opt/management-system/main-server/venv/bin/pip list
```

3. **Node registration failed**

```
# Check network connectivity
ping <MAIN_SERVER_IP>

# Check CoAP endpoint
coap-client -m get coap://<MAIN_SERVER_IP>:5683/health
```

Debug Commands

```
# Test CoAP connectivity
coap-client -m get coap://<MAIN_SERVER_IP>:5683/health

# Check system resources
htop
free -h
df -h

# Check network connections
netstat -ulpn | grep 5683
```

📈 Monitoring

Health Check Endpoints

- **Main Server**: `coap://<MAIN_SERVER_IP>:5683/health`
- **Regular Node**: `coap://<NODE_IP>:5683/health`

Resource Monitoring

```
# Check memory usage
systemctl show main-server-coap --property=MemoryCurrent

# Check CPU usage
systemctl show main-server-coap --property=CPUUsageNSec
```

🔄 Updates and Maintenance

Update the System

1. Stop services
2. Update code
3. Restart services
4. Verify functionality

Backup Configuration

```
# Backup configuration
sudo tar -czf coap-backup-$(date +%Y%m%d).tar.gz /opt/management-system
/etc/systemd/system/*coap*
```

📚 Additional Resources

- CoAP Protocol Specification
- aiocoap Library Documentation