Mini Project Report

Smart Cart Simulation in Cooja

Submitted by:

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January - May 2024

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1. Introduction

Smart technologies are revolutionizing retail by enhancing customer experiences and streamlining operations. This project simulates a smart shopping environment using COOJA, a network simulator for Contiki OS, modeling a retail space with three product clusters: grocery, fashion, and electronics.

Nodes representing products are arranged in a Manhattan grid pattern to reflect a typical store layout. The simulation includes fixed item nodes (senders) and mobile sync nodes simulating smart shopping carts, mimicking customer movement through the store.

Key performance metrics such as communication range, data transfer rates, network congestion, and the system's ability to handle multiple smart carts are evaluated. The results provide insights into the feasibility, scalability, and potential challenges of implementing a smart shopping system, particularly in maintaining connectivity as carts move between product clusters. This project highlights the practical implications of smart retail technologies and identifies areas for improvement, paving the way for more efficient solutions.

2. Background

Contiki OS

Contiki OS is an open-source operating system designed for IoT and wireless sensor networks. It is ideal for resource-constrained devices, making it suitable for simulating the fixed item nodes and mobile sync nodes in a smart shopping environment. Key features include:

- **Lightweight Design**: Efficient for low-power devices.
- **Event-Driven Architecture**: Manages multiple processes efficiently.
- **Integrated Networking**: Supports reliable data transfer.
- **Modularity**: Allows easy integration of additional protocols and applications.

Cooja Simulator

The Cooja simulator is a vital tool for developing and testing applications in Contiki OS. It provides a detailed and customizable simulation environment, essential for this project:

- **Network Simulation**: Models large-scale networks representing grocery, fashion, and electronics clusters.
- **Node Emulation**: Simulates both fixed item nodes and mobile sync nodes (smart shopping carts).
- **Custom Scenarios**: Allows for realistic modeling of store layouts and customer movements.
- **Performance Metrics**: Evaluates communication range, data transfer rates, network congestion, and system scalability.

- **Visual Analysis**: Offers visual tools for debugging and analyzing the network.
- Using Contiki OS and Cooja, this project aims to simulate a smart shopping environment, providing insights into the feasibility and challenges of smart retail technologies.

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3. Project Description

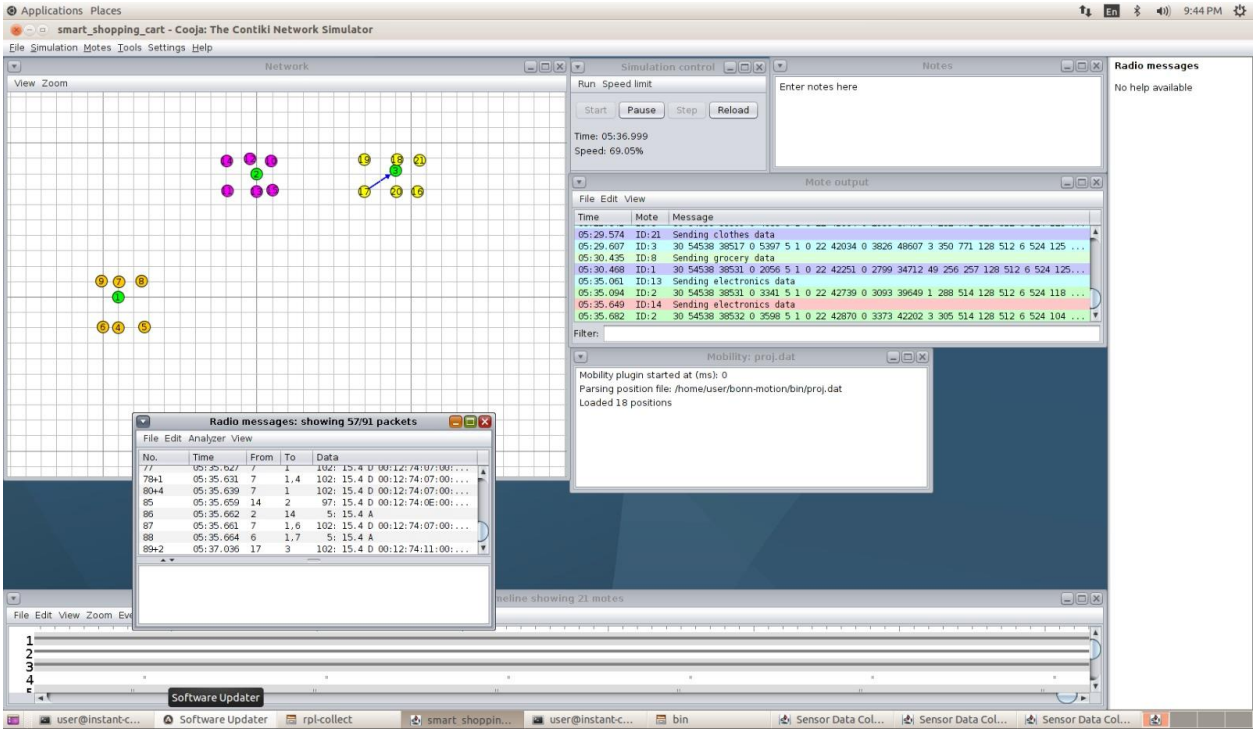
• Problem Statement:

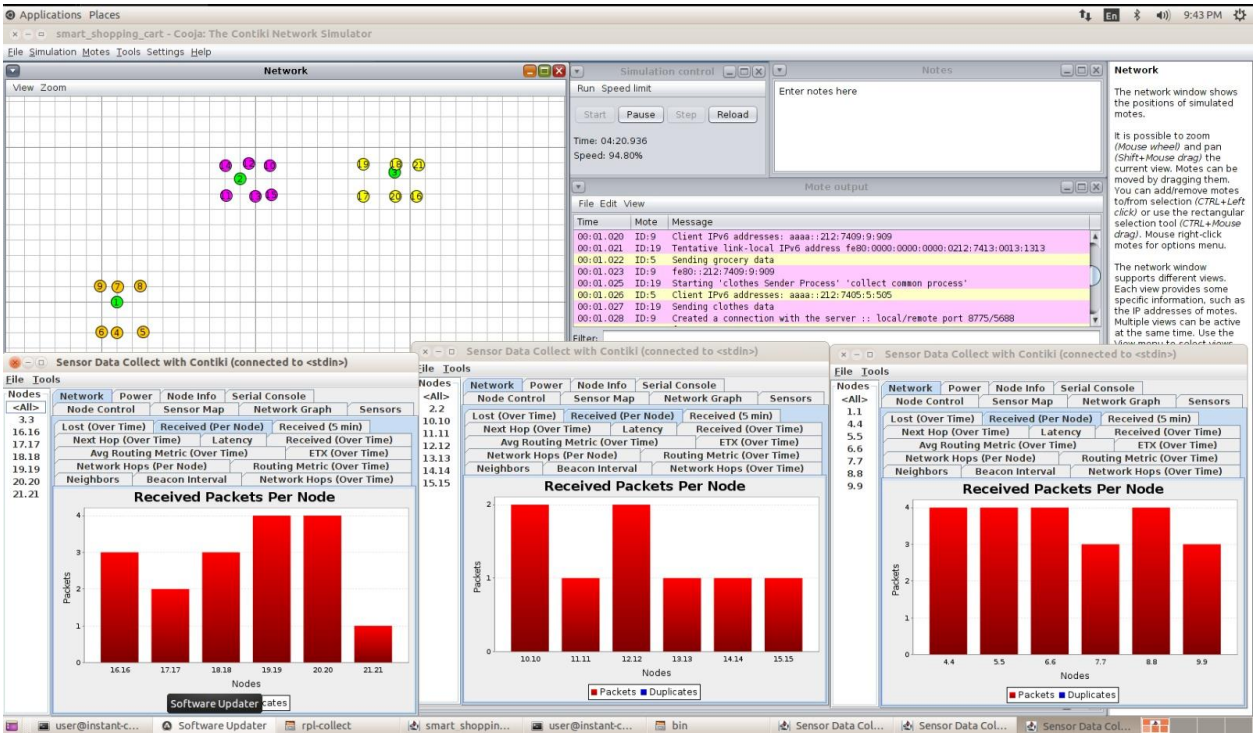
Traditional retail environments lack real-time product tracking and customer interaction capabilities, leading to inefficiencies in inventory management, customer service, and overall shopping experience. This project aims to address these limitations by simulating a smart shopping environment using COOJA, the network simulator for Contiki OS, to evaluate the feasibility and performance of an Internet of Things (IoT) based solution in a realistic retail setting.

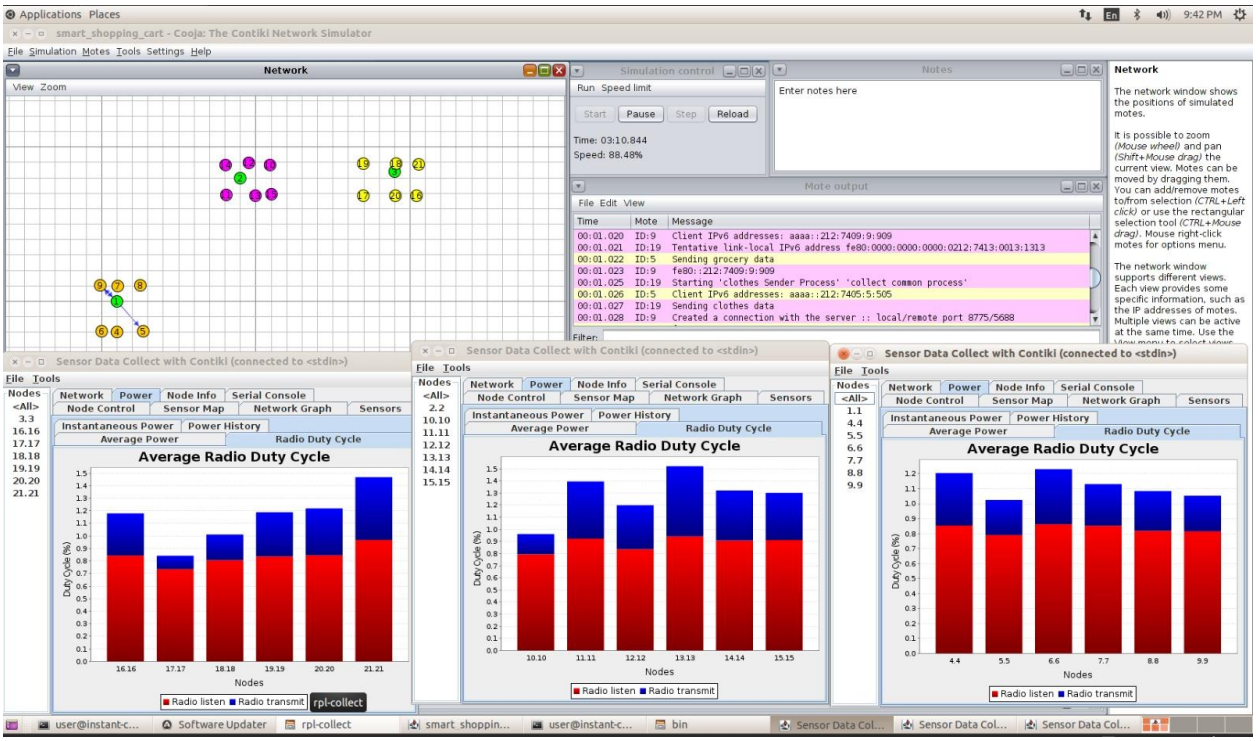
• Objectives:

- Design and implement a COOJA simulation of a smart shopping environment with three distinct product clusters (grocery, fashion, and electronics) arranged in a Manhattan grid pattern.
- Develop and integrate two types of nodes within the simulation: a. Fixed item nodes (senders) representing stationary products b. Mobile sync nodes simulating smart shopping carts
- Evaluate key performance metrics of the simulated smart shopping system, including:
    - Communication range between nodes
    - Data transfer rates
    - Network congestion levels
    - System capacity for handling multiple smart carts simultaneously
- Analyze the system's ability to maintain connectivity as smart carts move between different product clusters.
- Assess the scalability of the proposed smart shopping system based on simulation results.
- Identify potential challenges and limitations in implementing such a system in a real-world retail environment.

- Provide recommendations for optimizing the smart shopping system based on the simulation findings.




Applications Places
smart_shopping_cart - Cooja: The Contiki Network Simulator
File Simulation Motes Tools Settings Help
Network
View Zoom
Simulation control
Run Speed limit
Start Pause Step Reload
Time: 04:20.936
Speed: 94.80%
Notes
Enter notes here
Mote output
File Edit View
Time Mote Message
00:01.020 ID:9 Client IPv6 addresses: aaaa::212:7409:9:909
00:01.021 ID:19 Tentative link-local IPv6 address fe80:0000:0000:0000:0212:7413:0013:1313
00:01.022 ID:5 Sending grocery data
00:01.023 ID:9 fe80::212:7409:9:909
00:01.025 ID:19 Starting 'clothes Sender Process' 'collect common process'
00:01.026 ID:5 Client IPv6 addresses: aaaa::212:7405:5:505
00:01.027 ID:19 Sending clothes data
00:01.028 ID:9 Created a connection with the server :: local/remote port 8775/5688
Filter:
Network
The network window shows the positions of simulated motes.
It is possible to zoom (Mouse wheel) and pan (Shift+Mouse drag) the current view. Motes can be moved by dragging them. You can add/remove motes to/from selection (CTRL+Left click) or use the rectangular selection tool (CTRL+Mouse drag). Mouse right-click motes for options menu.
The network window supports different views. Each view provides some specific information, such as the IP addresses of motes. Multiple views can be active at the same time. Use the
Sensor Data Collect with Contiki (connected to <stdin>)
File Tools
Nodes
Network Power Node Info Serial Console
Node Control Sensor Map Network Graph Sensors
Lost (Over Time) Received (Per Node) Received (5 min)
Next Hop (Over Time) Latency Received (Over Time)
Avg Routing Metric (Over Time) ETX (Over Time)
Network Hops (Per Node) Routing Metric (Over Time)
Neighbors Beacon Interval Network Hops (Over Time)
Received Packets Per Node
Packets
Nodes
Packets Duplicates
Software Updater
user@instant-c...
rpl-collect
smart_shoppin...
bin
Sensor Data Col...


Applications Places
9:42 PM
smart_shopping_cart - Cooja: The Contiki Network Simulator
File Simulation Motes Tools Settings Help
Network
View Zoom
Simulation control
Run Speed limit
Start Pause Step Reload
Time: 03:10.844
Speed: 88.48%
Notes
Enter notes here
Mote output
File Edit View
Time Mote Message
00:01.020 ID:9 Client IPv6 addresses: aaaa::212:7409:9:909
00:01.021 ID:19 Tentative link-local IPv6 address fe80:0000:0000:0000:0212:7413:0013:1313
00:01.022 ID:5 Sending grocery data
00:01.023 ID:9 fe80::212:7409:9:909
00:01.025 ID:19 Starting 'clothes Sender Process' 'collect common process'
00:01.026 ID:5 Client IPv6 addresses: aaaa::212:7405:5:505
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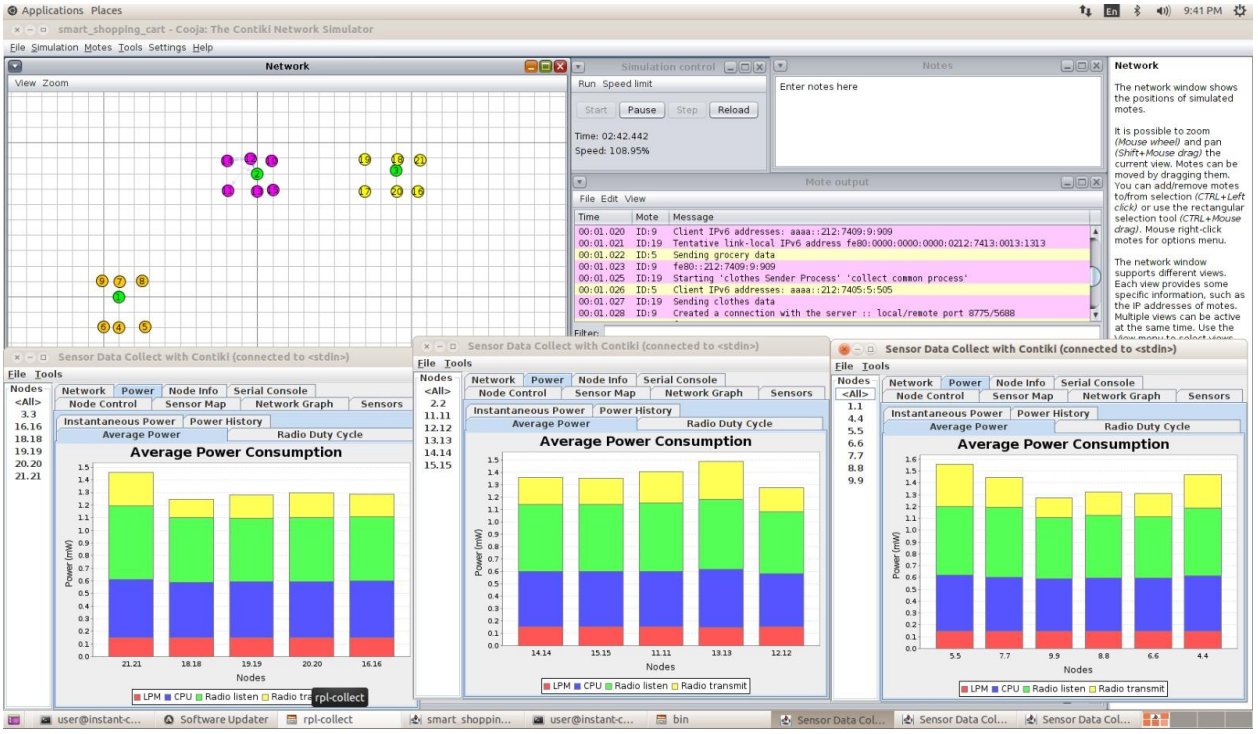
Sensor Data Collect with Contiki (connected to <stdin>)
File Tools
Nodes
Network Power Node Info Serial Console
Node Control Sensor Map Network Graph Sensors
Instantaneous Power Power History
Average Power Radio Duty Cycle
Average Radio Duty Cycle
Duty Cycle (%)
Nodes
Radio listen Radio transmit
rpl-collect
user@instant-c...
Software Updater
smart_shoppin...
bin
Sensor Data Col...


Applications Places
smart_shopping_cart - Cooja: The Contiki Network Simulator
File Simulation Motes Tools Settings Help
Network
View Zoom
Simulation control
Run Speed limit
Start Pause Step Reload
Time: 02:42.442
Speed: 108.95%
Notes
Enter notes here
Mote output
File Edit View
Time Mote Message
00:01.020 ID:9 Client IPv6 addresses: aaaa::212:7409:9:909
00:01.021 ID:19 Tentative link-local IPv6 address fe80:0000:0000:0000:0212:7413:0013:1313
00:01.022 ID:5 Sending grocery data
00:01.023 ID:9 fe80::212:7409:9:909
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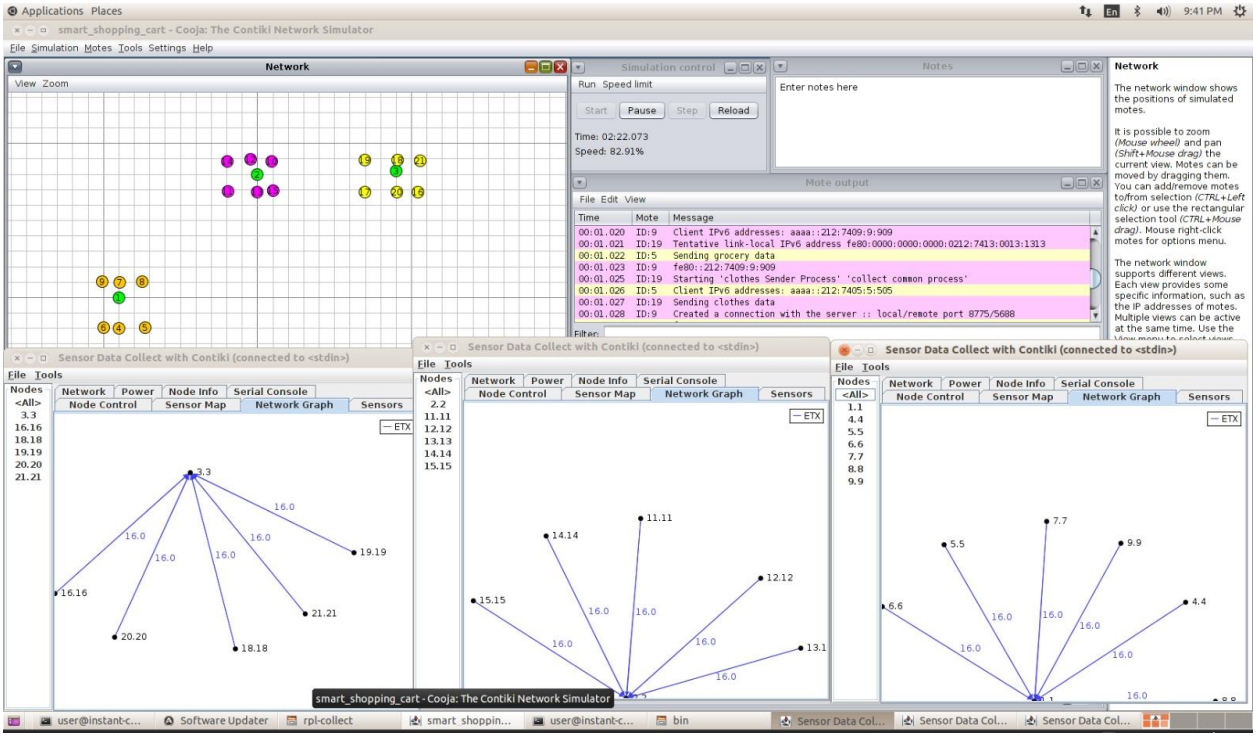
Sensor Data Collect with Contiki (connected to <stdin>)
File Tools
Nodes
Network Power Node Info Serial Console
Node Control Sensor Map Network Graph Sensors
Instantaneous Power Power History
Average Power Radio Duty Cycle
Average Power Consumption
Power (mW)
Nodes
LPM CPU Radio listen Radio transmit
rpl-collect
user@instant-c...
Software Updater
smart_shoppin...
bin
Sensor Data Col...


Applications Places
9:41 PM
smart_shopping_cart - Cooja: The Contiki Network Simulator
File Simulation Motes Tools Settings Help
Network
View Zoom
Simulation control
Run Speed limit
Start Pause Step Reload
Time: 02:22.073
Speed: 82.91%
Notes
Enter notes here
Mote output
File Edit View
Time Mote Message
00:01.020 ID:9 Client IPv6 addresses: aaaa::212:7409:9:909
00:01.021 ID:19 Tentative link-local IPv6 address fe80:0000:0000:0000:0212:7413:0013:1313
00:01.022 ID:5 Sending grocery data
00:01.023 ID:9 fe80::212:7409:9:909
00:01.025 ID:19 Starting 'clothes Sender Process' 'collect common process'
00:01.026 ID:5 Client IPv6 addresses: aaaa::212:7405:5:505
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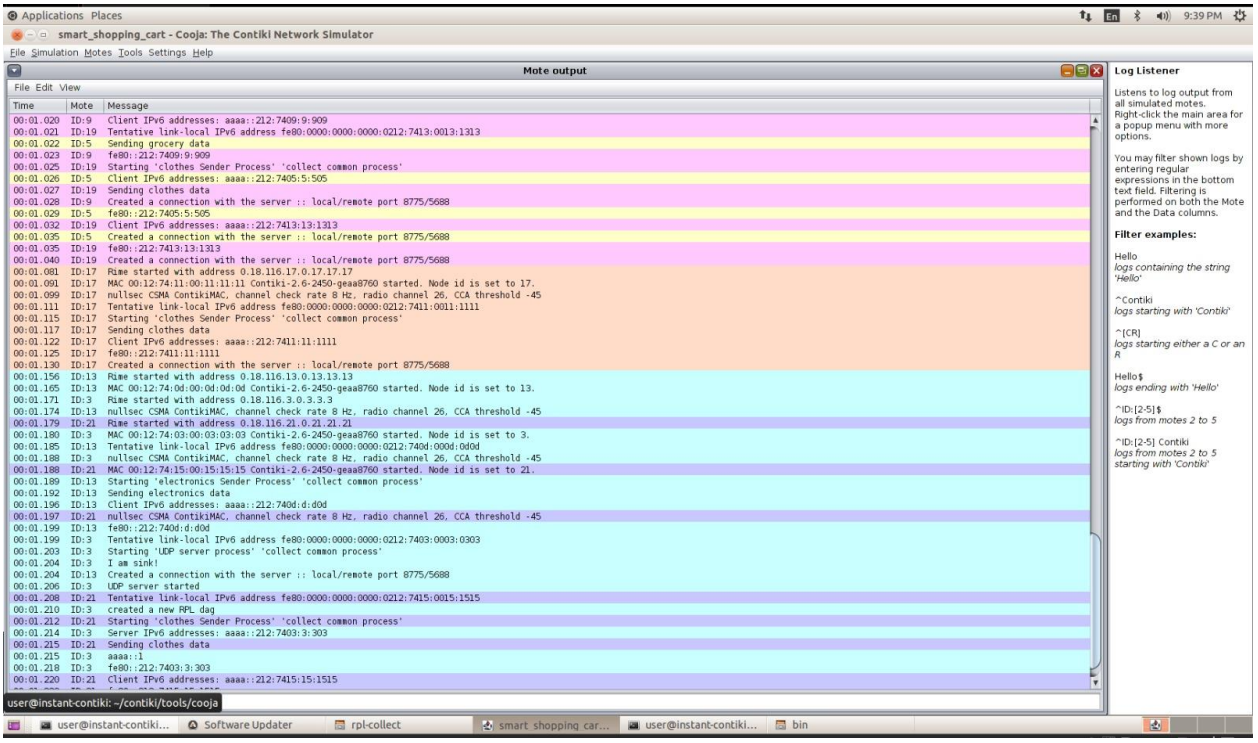
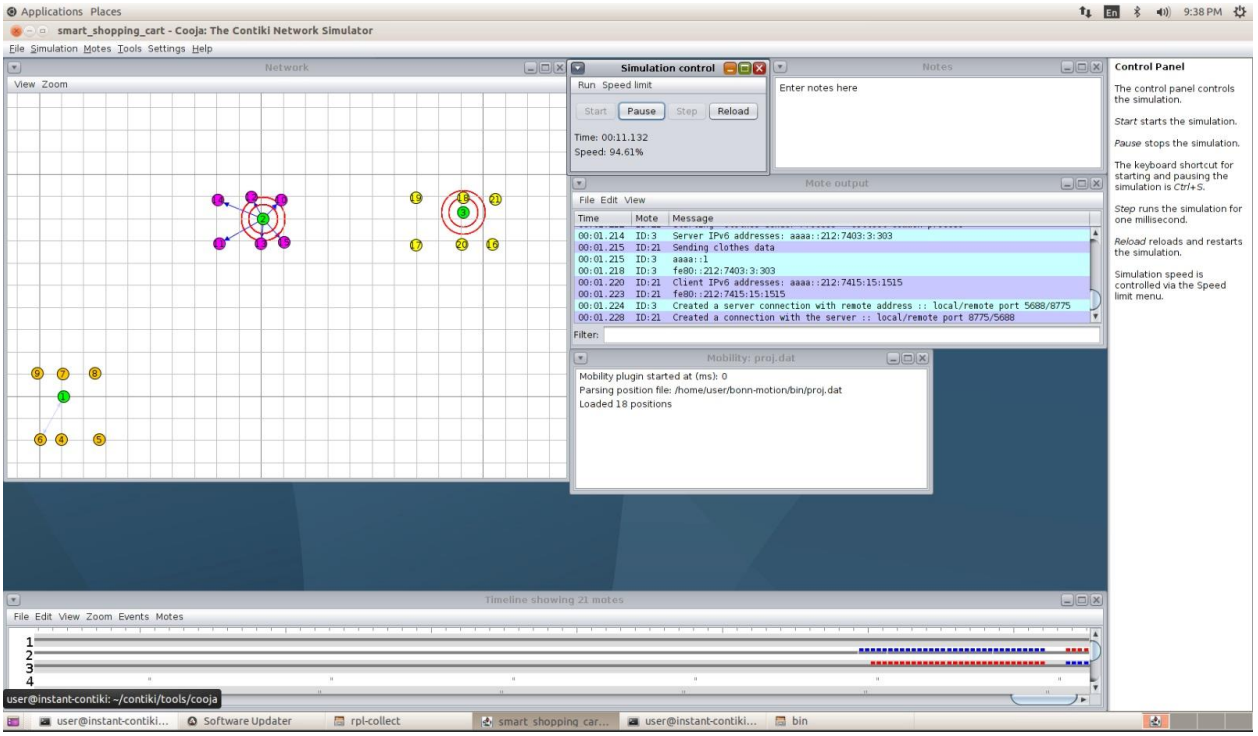
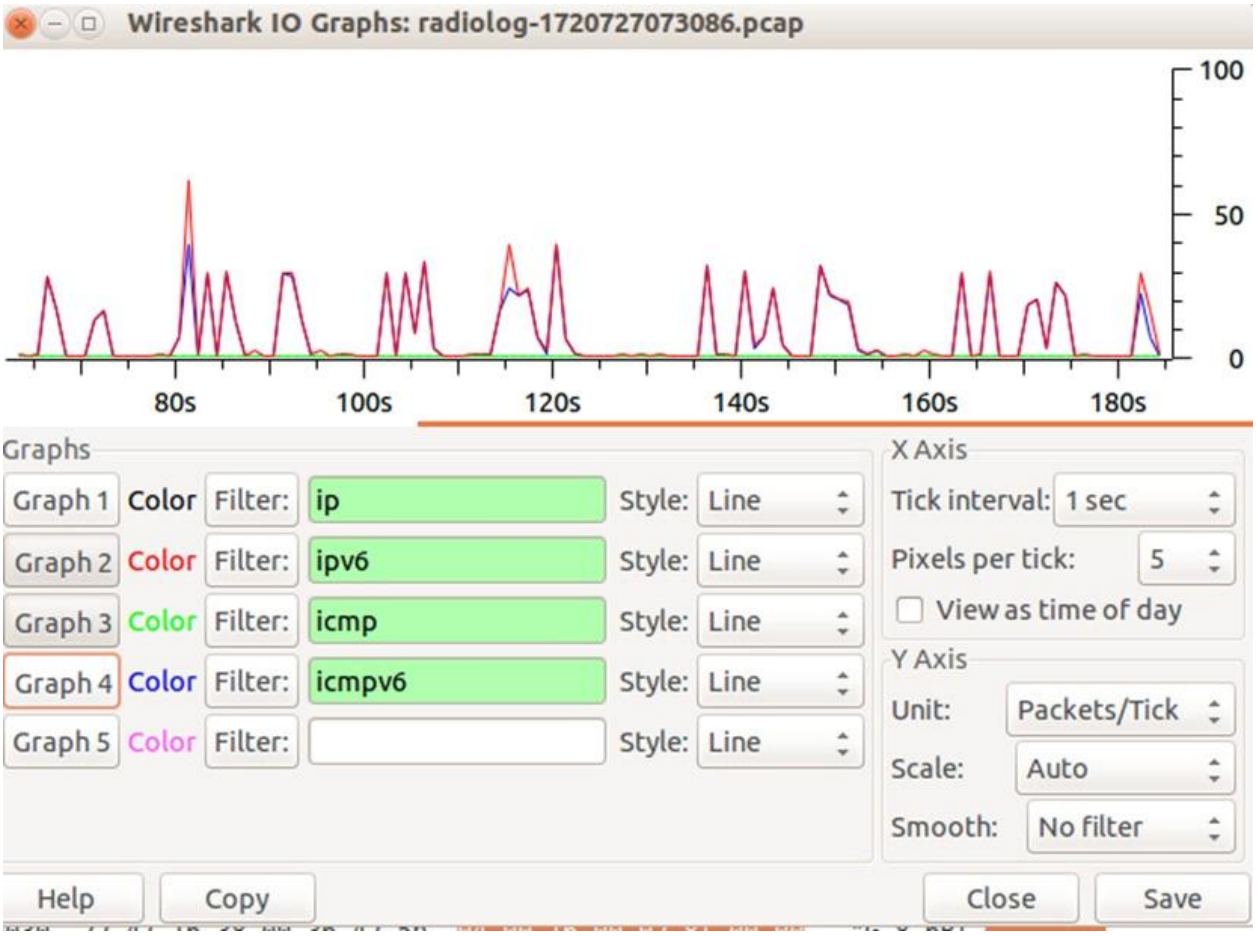
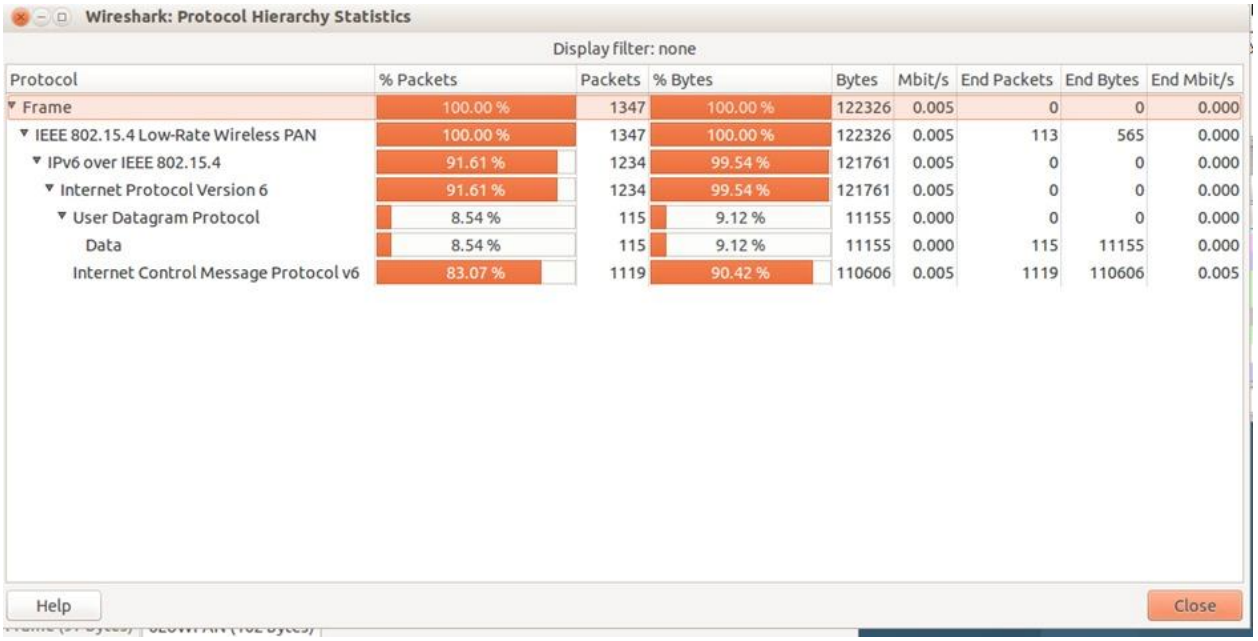
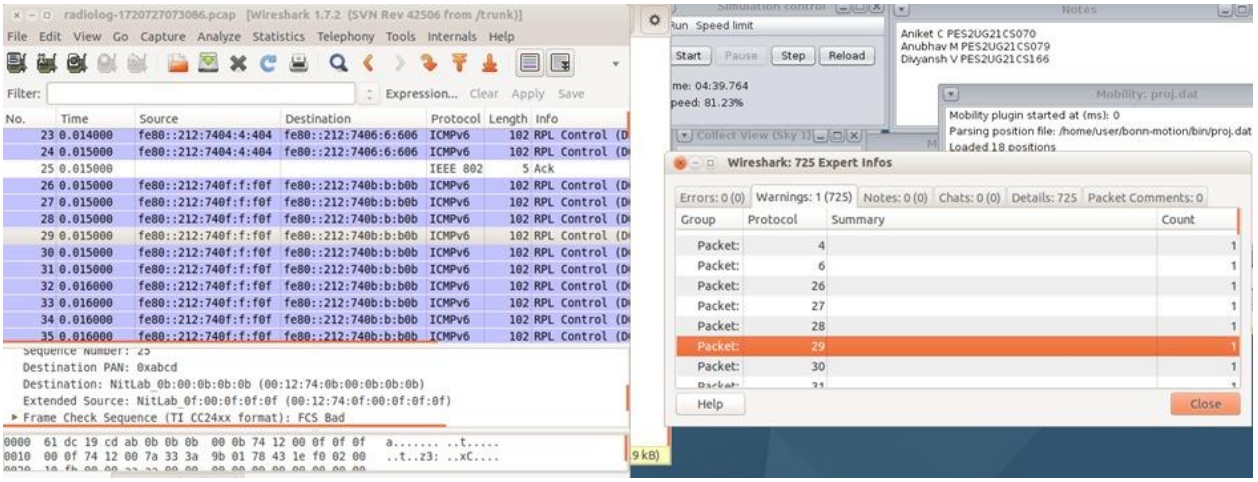
Sensor Data Collect with Contiki (connected to <stdin>)
File Tools
Nodes
Network Power Node Info Serial Console
Node Control Sensor Map Network Graph Sensors
ETX
3.3
16.16
19.19
20.20
18.18
21.21
16.0
smart_shopping_cart - Cooja: The Contiki Network Simulator
Sensor Data Collect with Contiki (connected to <stdin>)
File Tools
Nodes
Network Power Node Info Serial Console
Node Control Sensor Map Network Graph Sensors
ETX
11.11
14.14
12.12
15.15
13.13
16.0
Sensor Data Collect with Contiki (connected to <stdin>)
File Tools
Nodes
Network Power Node Info Serial Console
Node Control Sensor Map Network Graph Sensors
ETX
7.7
5.5
9.9
6.6
4.4
16.0
user@instant-c...
Software Updater
rpl-collect
smart_shoppin...
user@instant-c...
bin
Sensor Data Col...
Sensor Data Col...
Sensor Data Col...

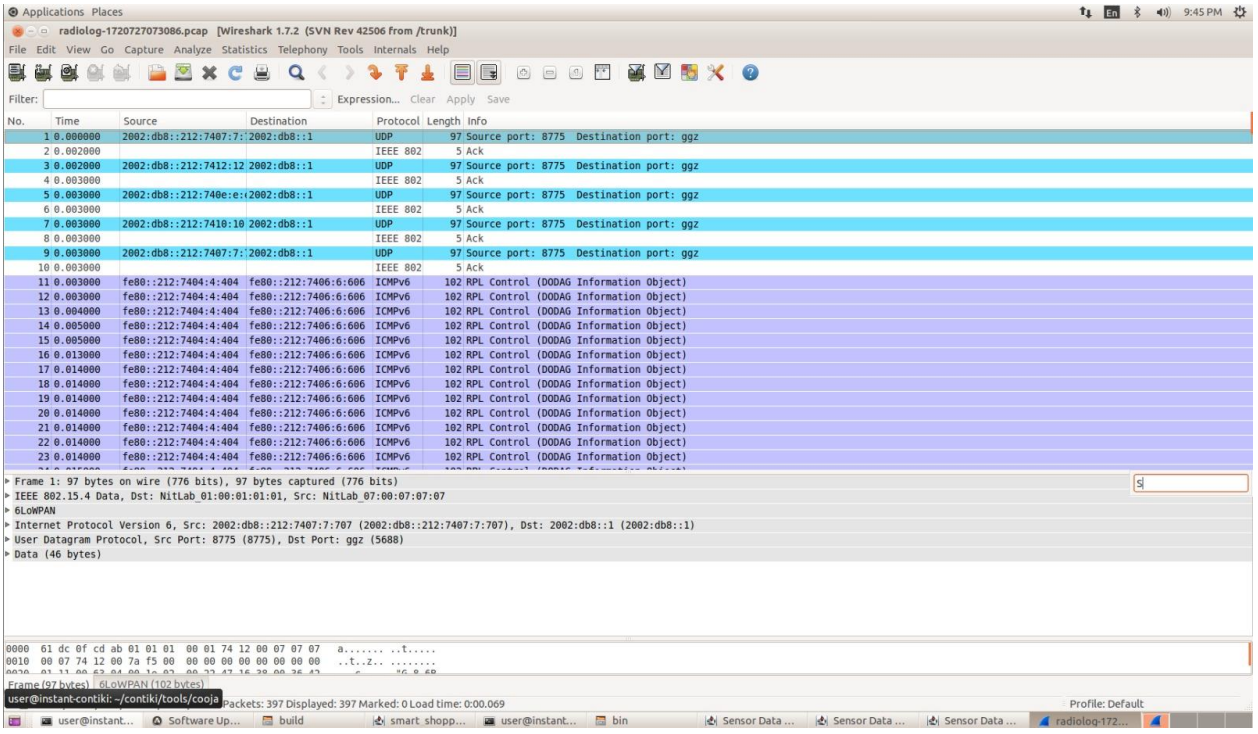

Applications Places
9:39 PM
smart_shopping_cart - Cooja: The Contiki Network Simulator
File Simulation Motes Tools Settings Help
Mote output
File Edit View
Time Mote Message
00:01.020 ID:9 Client IPv6 addresses: aaaa::212:7409:9:909
00:01.021 ID:19 Tentative link-local IPv6 address fe80:0000:0000:0000:0212:7413:0013:1313
00:01.022 ID:5 Sending grocery data
00:01.023 ID:9 fe80::212:7409:9:909
00:01.025 ID:19 Starting 'clothes Sender Process' 'collect common process'
00:01.026 ID:5 Client IPv6 addresses: aaaa::212:7405:5:505
00:01.027 ID:19 Sending clothes data
00:01.028 ID:9 Created a connection with the server :: local/remote port 8775/5688
00:01.029 ID:5 fe80::212:7405:5:505
00:01.032 ID:19 Client IPv6 addresses: aaaa::212:7413:13:1313
00:01.035 ID:5 Created a connection with the server :: local/remote port 8775/5688
00:01.035 ID:19 fe80::212:7413:13:1313
00:01.040 ID:19 Created a connection with the server :: local/remote port 8775/5688
00:01.081 ID:17 Rime started with address 0.18.116.17.0.17.17.17
00:01.091 ID:17 MAC 00:12:74:11:00:11:11:11 Contiki-2.6-2450-geaa8760 started. Node id is set to 17.
00:01.099 ID:17 nullsec CSMA ContikiMAC, channel check rate 8 Hz, radio channel 26, CCA threshold -45
00:01.111 ID:17 Tentative link-local IPv6 address fe80:0000:0000:0000:0212:7411:0011:1111
00:01.115 ID:17 Starting 'clothes Sender Process' 'collect common process'
00:01.117 ID:17 Sending clothes data
00:01.122 ID:17 Client IPv6 addresses: aaaa::212:7411:11:1111
00:01.125 ID:17 fe80::212:7411:11:1111
00:01.130 ID:17 Created a connection with the server :: local/remote port 8775/5688
00:01.156 ID:13 Rime started with address 0.18.116.13.0.13.13.13
00:01.165 ID:13 MAC 00:12:74:0d:00:0d:0d:0d Contiki-2.6-2450-geaa8760 started. Node id is set to 13.
00:01.171 ID:3 Rime started with address 0.18.116.3.0.3.3.3
00:01.174 ID:13 nullsec CSMA ContikiMAC, channel check rate 8 Hz, radio channel 26, CCA threshold -45
00:01.179 ID:21 Rime started with address 0.18.116.21.0.21.21.21
00:01.180 ID:3 MAC 00:12:74:03:00:03:03:03 Contiki-2.6-2450-geaa8760 started. Node id is set to 3.
00:01.185 ID:13 Tentative link-local IPv6 address fe80:0000:0000:0000:0212:740d:000d:0d0d
00:01.188 ID:3 nullsec CSMA ContikiMAC, channel check rate 8 Hz, radio channel 26, CCA threshold -45
00:01.188 ID:21 MAC 00:12:74:15:00:15:15:15 Contiki-2.6-2450-geaa8760 started. Node id is set to 21.
00:01.189 ID:13 Starting 'electronics Sender Process' 'collect common process'
00:01.192 ID:13 Sending electronics data
00:01.196 ID:13 Client IPv6 addresses: aaaa::212:740d:d:d0d
00:01.197 ID:21 nullsec CSMA ContikiMAC, channel check rate 8 Hz, radio channel 26, CCA threshold -45
00:01.199 ID:13 fe80::212:740d:d:d0d
00:01.199 ID:3 Tentative link-local IPv6 address fe80:0000:0000:0000:0212:7403:0003:0303
00:01.203 ID:3 Starting 'UDP server process' 'collect common process'
00:01.204 ID:3 I am sink!
00:01.204 ID:13 Created a connection with the server :: local/remote port 8775/5688
00:01.206 ID:3 UDP server started
00:01.208 ID:21 Tentative link-local IPv6 address fe80:0000:0000:0000:0212:7415:0015:1515
00:01.210 ID:3 created a new RPL dag
00:01.212 ID:21 Starting 'clothes Sender Process' 'collect common process'
00:01.214 ID:3 Server IPv6 addresses: aaaa::212:7403:3:303
00:01.215 ID:21 Sending clothes data
00:01.215 ID:3 aaaa::1
00:01.218 ID:3 fe80::212:7403:3:303
00:01.220 ID:21 Client IPv6 addresses: aaaa::212:7415:15:1515
user@instant-contiki: ~/contiki/tools/cooja
Log Listener
Listens to log output from all simulated motes. Right-click the main area for a popup menu with more options.
You may filter shown logs by entering regular expressions in the bottom text field. Filtering is performed on both the Mote and the Data columns.
Filter examples:
Hello
logs containing the string 'Hello'
^Contiki
logs starting with 'Contiki'
^[CR]
logs starting either a C or an R
Hello$
logs ending with 'Hello'
^ID:[2-5]$
logs from motes 2 to 5
^ID:[2-5] Contiki
logs from motes 2 to 5 starting with 'Contiki'
user@instant-contiki:... Software Updater rpl-collect smart_shopping_car... user@instant-contiki... bin

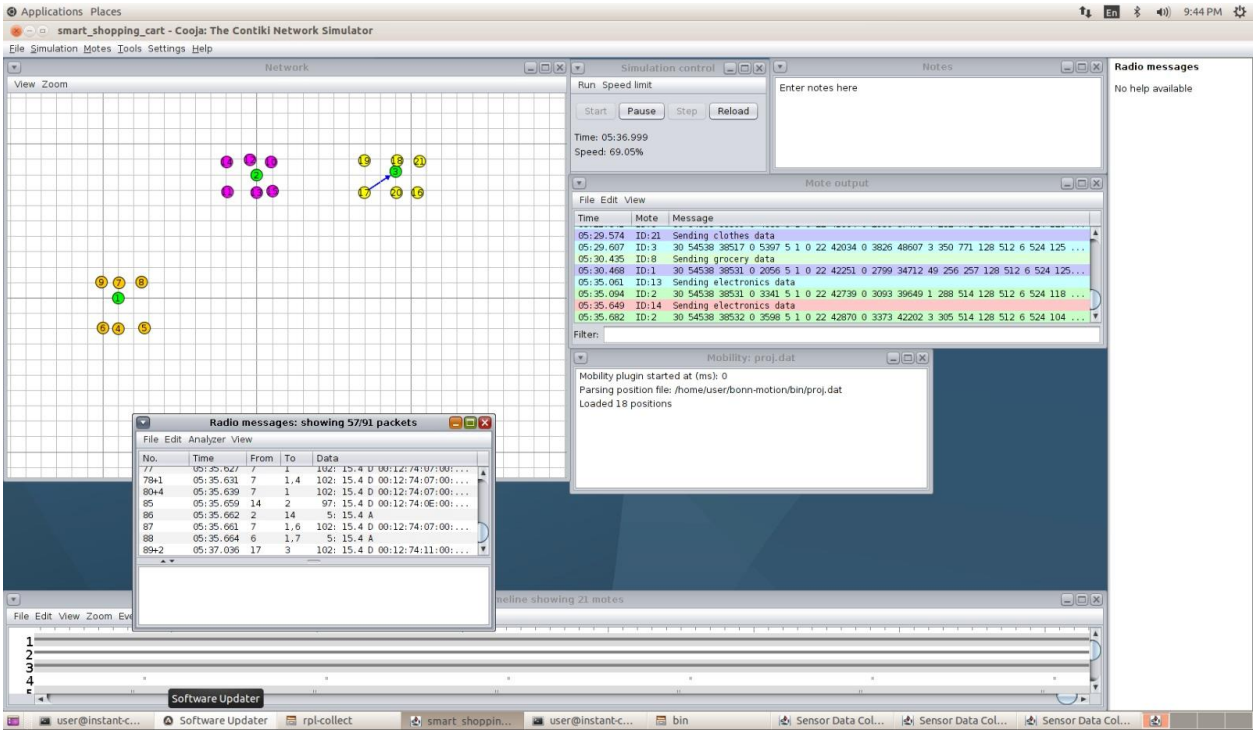

Applications Places
9:38 PM
smart_shopping_cart - Cooja: The Contiki Network Simulator
File Simulation Motes Tools Settings Help
Network
View Zoom
Simulation control
Run Speed limit
Start Pause Step Reload
Time: 00:11.132
Speed: 94.61%
Notes
Enter notes here
Control Panel
The control panel controls the simulation.
Start starts the simulation.
Pause stops the simulation.
The keyboard shortcut for starting and pausing the simulation is Ctrl+S.
Step runs the simulation for one millisecond.
Reload reloads and restarts the simulation.
Simulation speed is controlled via the Speed limit menu.
Mote output
File Edit View
Time Mote Message
00:01.214 ID:3 Server IPv6 addresses: aaaa::212:7403:3:303
00:01.215 ID:21 Sending clothes data
00:01.215 ID:3 aaaa::1
00:01.218 ID:3 fe80::212:7403:3:303
00:01.220 ID:21 Client IPv6 addresses: aaaa::212:7415:15:1515
00:01.223 ID:21 fe80::212:7415:15:1515
00:01.224 ID:3 Created a server connection with remote address :: local/remote port 5688/8775
00:01.228 ID:21 Created a connection with the server :: local/remote port 8775/5688
Filter:
Mobility: proj.dat
Mobility plugin started at (ms): 0
Parsing position file: /home/user/bonn-motion/bin/proj.dat
Loaded 18 positions
Timeline showing 21 motes
File Edit View Zoom Events Motes
user@instant-contiki: ~/contiki/tools/cooja
user@instant-contiki...
Software Updater
rpl-collect
smart_shopping_car...
user@instant-contiki...
bin


Wireshark IO Graphs: radiolog-1720727073086.pcap
100
50
0
80s
100s
120s
140s
160s
180s
Graphs
Graph 1 Color Filter: ip Style: Line
Graph 2 Color Filter: ipv6 Style: Line
Graph 3 Color Filter: icmp Style: Line
Graph 4 Color Filter: icmpv6 Style: Line
Graph 5 Color Filter: Style: Line
X Axis
Tick interval: 1 sec
Pixels per tick: 5
View as time of day
Y Axis
Unit: Packets/Tick
Scale: Auto
Smooth: No filter
Help
Copy
Close
Save


Wireshark: Protocol Hierarchy Statistics
Display filter: none
Protocol % Packets Packets % Bytes Bytes Mbit/s End Packets End Bytes End Mbit/s
Frame 100.00 % 1347 100.00 % 122326 0.005 0 0 0.000
IEEE 802.15.4 Low-Rate Wireless PAN 100.00 % 1347 100.00 % 122326 0.005 113 565 0.000
IPv6 over IEEE 802.15.4 91.61 % 1234 99.54 % 121761 0.005 0 0 0.000
Internet Protocol Version 6 91.61 % 1234 99.54 % 121761 0.005 0 0 0.000
User Datagram Protocol 8.54 % 115 9.12 % 11155 0.000 0 0 0.000
Data 8.54 % 115 9.12 % 11155 0.000 115 11155 0.000
Internet Control Message Protocol v6 83.07 % 1119 90.42 % 110606 0.005 1119 110606 0.005
Help
Close


radiolog-1720727073086.pcap [Wireshark 1.7.2 (SVN Rev 42506 from /trunk)]
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
23 0.014000 fe80::212:7404:4:404 fe80::212:7406:6:606 ICMPv6 102 RPL Control (D
24 0.015000 fe80::212:7404:4:404 fe80::212:7406:6:606 ICMPv6 102 RPL Control (D
25 0.015000 IEEE 802 5 Ack
26 0.015000 fe80::212:740f:f:f0f fe80::212:740b:b:b0b ICMPv6 102 RPL Control (D
27 0.015000 fe80::212:740f:f:f0f fe80::212:740b:b:b0b ICMPv6 102 RPL Control (D
28 0.015000 fe80::212:740f:f:f0f fe80::212:740b:b:b0b ICMPv6 102 RPL Control (D
29 0.015000 fe80::212:740f:f:f0f fe80::212:740b:b:b0b ICMPv6 102 RPL Control (D
30 0.015000 fe80::212:740f:f:f0f fe80::212:740b:b:b0b ICMPv6 102 RPL Control (D
31 0.015000 fe80::212:740f:f:f0f fe80::212:740b:b:b0b ICMPv6 102 RPL Control (D
32 0.016000 fe80::212:740f:f:f0f fe80::212:740b:b:b0b ICMPv6 102 RPL Control (D
33 0.016000 fe80::212:740f:f:f0f fe80::212:740b:b:b0b ICMPv6 102 RPL Control (D
34 0.016000 fe80::212:740f:f:f0f fe80::212:740b:b:b0b ICMPv6 102 RPL Control (D
35 0.016000 fe80::212:740f:f:f0f fe80::212:740b:b:b0b ICMPv6 102 RPL Control (D
Destination PAN: 0xabcd
Destination: NitLab_0b:00:0b:0b:0b (00:12:74:0b:00:0b:0b:0b)
Extended Source: NitLab_0f:00:0f:0f:0f (00:12:74:0f:00:0f:0f:0f)
Frame Check Sequence (TI CC24xx format): FCS Bad
0000 61 dc 19 cd ab 0b 0b 0b 00 0b 74 12 00 0f 0f 0f a..... ..t.....
0010 00 0f 74 12 00 7a 33 3a 9b 01 78 43 1e f0 02 00 ..t..z3: ..xC....
Run Speed limit
Start Pause Step Reload
me: 04:39.764
peed: 81.23%
Aniket C PES2UG21CS070
Anubhav M PES2UG21CS079
Divyansh V PES2UG21CS166
Mobility: proj.dat
Mobility plugin started at (ms): 0
Parsing position file: /home/user/bonn-motion/bin/proj.dat
Loaded 18 positions
Wireshark: 725 Expert Infos
Errors: 0 (0) Warnings: 1 (725) Notes: 0 (0) Chats: 0 (0) Details: 725 Packet Comments: 0
Group Protocol Summary Count
Packet: 4 1
Packet: 6 1
Packet: 26 1
Packet: 27 1
Packet: 28 1
Packet: 29 1
Packet: 30 1
Help
Close
9 kB)


Applications Places
9:45 PM
radiolog-1720727073086.pcap [Wireshark 1.7.2 (SVN Rev 42506 from /trunk)]
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
1 0.000000 2002:db8::212:7407:7: 2002:db8::1 UDP 97 Source port: 8775 Destination port: ggz
2 0.002000 IEEE 802 5 Ack
3 0.002000 2002:db8::212:7412:12 2002:db8::1 UDP 97 Source port: 8775 Destination port: ggz
4 0.003000 IEEE 802 5 Ack
5 0.003000 2002:db8::212:740e:e: 2002:db8::1 UDP 97 Source port: 8775 Destination port: ggz
6 0.003000 IEEE 802 5 Ack
7 0.003000 2002:db8::212:7410:10 2002:db8::1 UDP 97 Source port: 8775 Destination port: ggz
8 0.003000 IEEE 802 5 Ack
9 0.003000 2002:db8::212:7407:7: 2002:db8::1 UDP 97 Source port: 8775 Destination port: ggz
10 0.003000 IEEE 802 5 Ack
11 0.003000 fe80::212:7404:4:404 fe80::212:7406:6:606 ICMPv6 102 RPL Control (DODAG Information Object)
12 0.003000 fe80::212:7404:4:404 fe80::212:7406:6:606 ICMPv6 102 RPL Control (DODAG Information Object)
13 0.004000 fe80::212:7404:4:404 fe80::212:7406:6:606 ICMPv6 102 RPL Control (DODAG Information Object)
14 0.005000 fe80::212:7404:4:404 fe80::212:7406:6:606 ICMPv6 102 RPL Control (DODAG Information Object)
15 0.005000 fe80::212:7404:4:404 fe80::212:7406:6:606 ICMPv6 102 RPL Control (DODAG Information Object)
16 0.013000 fe80::212:7404:4:404 fe80::212:7406:6:606 ICMPv6 102 RPL Control (DODAG Information Object)
17 0.014000 fe80::212:7404:4:404 fe80::212:7406:6:606 ICMPv6 102 RPL Control (DODAG Information Object)
18 0.014000 fe80::212:7404:4:404 fe80::212:7406:6:606 ICMPv6 102 RPL Control (DODAG Information Object)
19 0.014000 fe80::212:7404:4:404 fe80::212:7406:6:606 ICMPv6 102 RPL Control (DODAG Information Object)
20 0.014000 fe80::212:7404:4:404 fe80::212:7406:6:606 ICMPv6 102 RPL Control (DODAG Information Object)
21 0.014000 fe80::212:7404:4:404 fe80::212:7406:6:606 ICMPv6 102 RPL Control (DODAG Information Object)
22 0.014000 fe80::212:7404:4:404 fe80::212:7406:6:606 ICMPv6 102 RPL Control (DODAG Information Object)
23 0.014000 fe80::212:7404:4:404 fe80::212:7406:6:606 ICMPv6 102 RPL Control (DODAG Information Object)
Frame 1: 97 bytes on wire (776 bits), 97 bytes captured (776 bits)
IEEE 802.15.4 Data, Dst: NitLab_01:00:01:01:01, Src: NitLab_07:00:07:07:07
6LoWPAN
Internet Protocol Version 6, Src: 2002:db8::212:7407:7:707 (2002:db8::212:7407:7:707), Dst: 2002:db8::1 (2002:db8::1)
User Datagram Protocol, Src Port: 8775 (8775), Dst Port: ggz (5688)
Data (46 bytes)
0000 61 dc 0f cd ab 01 01 01 00 01 74 12 00 07 07 07 a..... ..t.....
0010 00 07 74 12 00 7a f5 00 00 00 00 00 00 00 00 00 ..t..z.. ....
Frame (97 bytes) 6LoWPAN (102 bytes)
user@instant-contiki: ~/contiki/tools/cooja
Packets: 397 Displayed: 397 Marked: 0 Load time: 0:00.069
Profile: Default
user@instant... Software Up... build smart_shopp... user@instant... bin Sensor Data ... Sensor Data ... Sensor Data ... radiolog-172...


Applications Places
9:44 PM
smart_shopping_cart - Cooja: The Contiki Network Simulator
File Simulation Motes Tools Settings Help
Network
View Zoom
Simulation control
Run Speed limit
Start Pause Step Reload
Time: 05:36.999
Speed: 69.05%
Notes
Enter notes here
Radio messages
No help available
Mote output
File Edit View
Time Mote Message
05:29.574 ID:21 Sending clothes data
05:29.607 ID:3 30 54538 38517 0 5397 5 1 0 22 42034 0 3826 48607 3 350 771 128 512 6 524 125 ...
05:30.435 ID:8 Sending grocery data
05:30.468 ID:1 30 54538 38531 0 2056 5 1 0 22 42251 0 2799 34712 49 256 257 128 512 6 524 125...
05:35.061 ID:13 Sending electronics data
05:35.094 ID:2 30 54538 38531 0 3341 5 1 0 22 42739 0 3093 39649 1 288 514 128 512 6 524 118 ...
05:35.649 ID:14 Sending electronics data
05:35.682 ID:2 30 54538 38532 0 3598 5 1 0 22 42870 0 3373 42202 3 305 514 128 512 6 524 104 ...
Filter:
Mobility: proj.dat
Mobility plugin started at (ms): 0
Parsing position file: /home/user/bonn-motion/bin/proj.dat
Loaded 18 positions
Radio messages: showing 57/91 packets
File Edit Analyzer View
No. Time From To Data
78+1 05:35.631 7 1,4 102: 15.4 D 00:12:74:07:00:...
80+4 05:35.639 7 1 102: 15.4 D 00:12:74:07:00:...
85 05:35.659 14 2 97: 15.4 D 00:12:74:0E:00:...
86 05:35.662 2 14 5: 15.4 A
87 05:35.661 7 1,6 102: 15.4 D 00:12:74:07:00:...
88 05:35.664 6 1,7 5: 15.4 A
89+2 05:37.036 17 3 102: 15.4 D 00:12:74:11:00:...
Software Updater
user@instant-c...
Software Updater
rpl-collect
smart_shoppin...
user@instant-c...
bin
Sensor Data Col...
Sensor Data Col...
Sensor Data Col...

Conclusion

This project has successfully demonstrated the feasibility and potential of a smart shopping environment through a comprehensive simulation using COOJA, the network simulator for Contiki OS. By modelling a retail space with distinct product clusters and implementing both fixed item nodes and mobile smart cart nodes, we have gained valuable insights into the challenges and opportunities presented by IoT technology in retail settings