Networks Lab Assignment 7

Custom Lightweight Discovery Protocol (CLDP) Specification

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1 Overview

The Custom Lightweight Discovery Protocol (CLDP) is designed for closed network environments to allow nodes to announce their presence and exchange application-level metadata. This protocol operates directly over IP without using transport layer protocols (TCP/UDP).

2 Protocol Details

2.1 Protocol Number

- **Protocol Number**: 253 (Custom IP Protocol)

2.2 Message Types

- **0x01**: HELLO - Used to announce that a node is active
- **0x02**: QUERY - Request for specific metadata from nodes
- **0x03**: RESPONSE - Response containing requested metadata

2.3 Header Format

Each CLDP message contains an 8-byte header:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Message Type |  Query Type   |         Payload Length          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Transaction ID              |      Reserved         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

- **Message Type** (1 byte): 0x01 (HELLO), 0x02 (QUERY), or 0x03 (RESPONSE)
- **Query Type** (1 byte): Indicates the type of metadata being queried/responded
  - 0x01: Hostname

  - 0x02: System Time
  - 0x03: CPU Load
  - 0x00: No specific query (used for HELLO messages)
- **Payload Length** (2 bytes): Length of the payload following the header
- **Transaction ID** (2 bytes): Unique identifier for matching queries with responses
- **Reserved** (2 bytes): Reserved for future use, set to 0x0000

2.4 Query Types

The implementation supports the following query types:

1. **Hostname Query (0x01)**: Returns the hostname of the node
2. **System Time Query (0x02)**: Returns the current system time
3. **CPU Load Query (0x03)**: Returns the current CPU load average

3 Message Formats

3.1 HELLO Message (0x01)

- Header with Message Type = 0x01
- No payload required (Payload Length = 0)

3.2 QUERY Message (0x02)

- Header with Message Type = 0x02
- Query Type set to the type of metadata requested
- No additional payload required (Payload Length = 0)

3.3 RESPONSE Message (0x03)

- Header with Message Type = 0x03
- Query Type matching the original query
- Payload containing the requested metadata
  - For Hostname: ASCII string of the hostname
  - For System Time: ASCII string of the timestamp in ISO format
  - For CPU Load: ASCII string representing the load average

4 Protocol Behavior

4.1 Server Behavior

1. Server listens for incoming CLDP packets on the raw socket
2. Upon receiving a HELLO message, it logs the sender information
3. Upon receiving a QUERY message, it:
   - Extracts the query type
   - Collects the requested metadata
   - Constructs a RESPONSE message with the metadata
   - Sends the RESPONSE back to the querying node

4.2 Client Behavior

1. Client sends HELLO messages periodically (every 10 seconds)
2. Client can send QUERY messages to specific or broadcast addresses
3. Client processes RESPONSE messages by extracting and displaying the metadata

5 Packet Structure

Each CLDP packet consists of:

1. IP Header (crafted manually)
2. CLDP Header (8 bytes)
3. Optional Payload (for RESPONSE messages)

6 Implementation Notes

- IP_HDRINCL socket option is used to craft custom IP headers
- Checksum calculation is handled for the IP header
- The protocol filters incoming packets based on the protocol number (253)

7 Conclusion

The Custom Lightweight Discovery Protocol provides a simple and efficient mechanism for node discovery and metadata exchange in closed network environments. By operating directly over IP, it reduces overhead and simplifies implementation in specialized network scenarios.

8 References

1. RFC 791 - Internet Protocol
2. RFC 826 - Address Resolution Protocol
3. Linux Raw Socket Programming Documentation