# Lab3 Protocol

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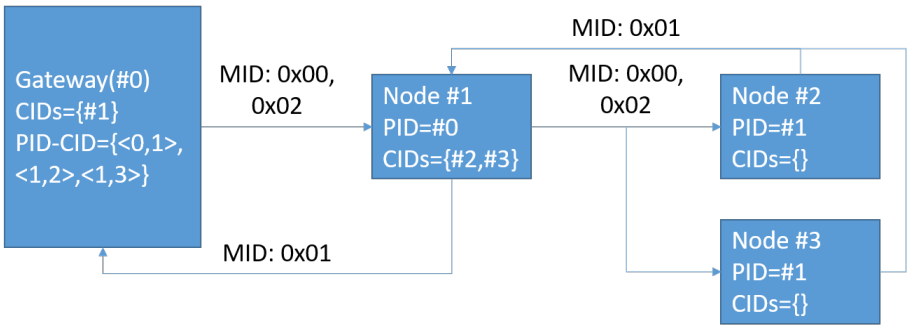
## Contents

# 1 Self-Organization




## 1.1 Gateway

### 1.1.1 TX (G-Thread-1): Message ID 0x00

1. Start (re-)organization at time $t$ (default reorganization interval: 5s configurable)
2. Clear parent-child list $\{< PID, CID >_i\}$
3. Increase round count $\rho \leftarrow (\rho + 1)\%256$
4. Broadcast an organization message with $\rho$, and node ID $NID$:
   | Message ID 0x00 [1B], $\rho$ [1B], $NID$ [1B]: e.g. 0x00 0x04 0x00 |
   |---|
5. goto 1

### 1.1.2 RX (G-Thread-2): Message ID 0x01

1. Get and parse the replied organization message (Message ID 0x01)
   - received round count $\rho_R$
   - received parent ID $PID_R$
   - received parent-child pair $< PID, CID >_R$
2. If $\rho_R \neq \rho$ or $PID_R \neq NID$, then goto 1
3. If $PID_R =< PID, CID >_R :: PID$, then reply an acknowledge message with $\rho$, $NID$:
   | Message ID 0x02 [1B], $\rho$ [1B], $NID$ [1B]: e.g. 0x02 0x04 0x00 |
   |---|
4. Add $< PID, CID >_R$ to $\{< PID, CID >_i\}$ and refresh the neighbor list of $< PID, CID >_R :: PID$ node.
5. goto 1

## 1.2 Communication Node

### 1.2.1 RX (N-Thread-1): Message ID 0x00

1. Get and parse the organization message (Message ID 0x00):
   - received round count $\rho_R$
   - received note ID $NID_R$
   - RSSI level $\Phi$
2. If $\Phi < \Phi^*$ ($\Phi^*$ is the minimum required RSSI to build a reliable wireless connection), then goto 1
3. If its own round count $\rho = \rho_R$, then goto 1
4. Set round count: $\rho = \rho_R$

5. Set parent ID: $PID = NID_R$
6. Reply an acknowledge message with $\rho$, $PID$, and $NID$:
   | Message ID 0x01 [1B], $\rho$ [1B], $PID$ [1B], $< PID, NID >$ [2B]: e.g. 0x01 0x04 0x01 0x01 0x02 |
   |---|
7. goto 1

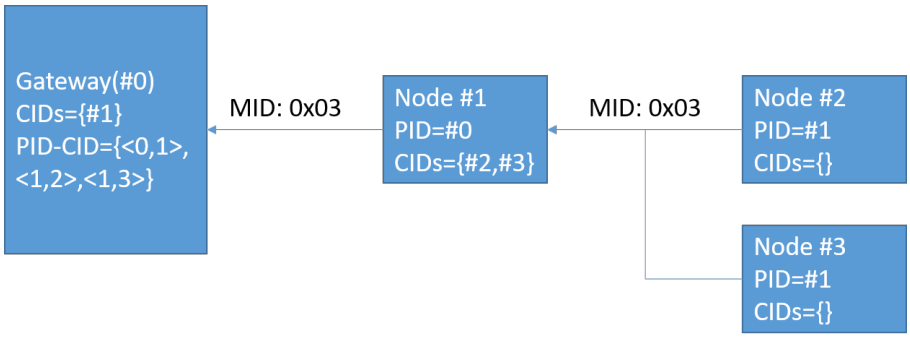
#### 1.2.2 RX (N-Thread-1): Message ID 0x01

1. Get and parse the replied organization message (Message ID 0x01)
   - received round count $\rho_R$
   - received parent ID $PID_R$
   - received parent-child pair $< PID, CID >_R$
2. If $\rho_R \neq \rho$ or $PID_R \neq NID$, then goto 1
3. If $PID_R =< PID, CID >_R :: PID$, then reply an acknowledge message with $\rho$, $NID$:
   | Message ID 0x02 [1B], $\rho$ [1B], $NID$ [1B]: e.g. 0x02 0x04 0x01 |
   |---|
4. Relay an acknowledge message with $\rho$, $PID$, and $< PID, CID >_R$:
   | Message ID 0x01 [1B], $\rho$ [1B], $PID$ [1B], $< PID, CID >_R$ [2B]: e.g. 0x01 0x04 0x00 0x01 0x02 |
   |---|
5. goto 1

#### 1.2.3 RX (N-Thread-1): Message ID 0x02

1. Get and parse the replied organization acknowledge message (Message ID 0x02)
   - received round count $\rho_R$
   - received parent ID $PID_R$
2. If $\rho_R \neq \rho$ or $PID_R \neq PID$, then goto 1
3. Broadcast an organization message with $\rho$, and $NID$:
   | Message ID 0x00 [1B], $\rho$ [1B], $NID$ [1B]: e.g. 0x00 0x04 0x01 |
   |---|
4. goto 1

# 2 Upload Light Values




## 2.1 Gateway

### 2.1.1 RX (G-Thread-2): Message ID 0x03

1. Get and parse the light value message (Message ID 0x03)
   - received round count $\rho_R$
   - received parent ID $PID_R$
   - received node ID $NID_R$
   - received timestamp $Sec_R$, $NSec_R$
   - received light value $L_R$
2. If $\rho_R \neq \rho$ or $PID_R \neq NID$, then goto 1
3. Display light value "$Sec_R$ s + $NSec_R$ nsec : $NID_R$'s light value is $L_R$"
4. goto 1

## 2.2 Communication Node

### 2.2.1 RX (N-Thread-1): Message ID 0x03

1. Get and parse the light value message (Message ID 0x03)
   - received round count $\rho_R$
   - received parent ID $PID_R$
   - received node ID $NID_R$
   - received timestamp $Sec_R$, $NSec_R$
   - received light value $L_R$
2. If $\rho_R \neq \rho$ or $PID_R \neq NID$, then goto 1
3. Relay light value message with $\rho$, $PID$, $NID$, timestamp $Sec_R + NSec_R$, and $L_t$ to parent:

| Message ID 0x03 [1B], $\rho$[1B], $PID$ [1B], $NID_R$ [1B], $Sec_R$ [4B], $NSec_R$ [4B], $L_R$ [2B] |
|---|
| e.g. 0x03 0x04 0x00 0x02 0x19 0x90 0x11 0x23 0x19 0x88 0x10 0x25 0x11 0x23 |

4. goto 1

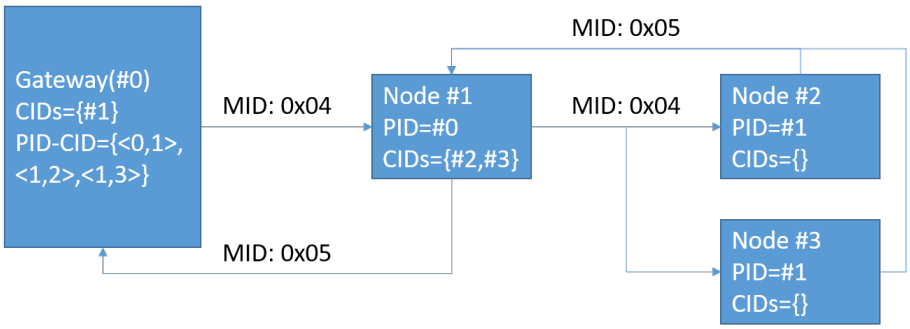
#### 2.2.2 TX (N-Thread-2): Message ID 0x03

1. Sample start at time $t$ (sample rate is controlled by $dt$ ms and is configurable via gateway)
2. Get light value $L_t$
3. Send light value message with $\rho$, $PID$, $NID$, timestamp $Sec + NSec$, and $L_t$ to parent:

| Message ID 0x03 [1B], $\rho$[1B], $PID$ [1B], $NID$ [1B], $Sec$ [4B], $NSec$ [4B], $L_t$ [2B] |
|---|
| e.g. 0x03 0x04 0x01 0x02 0x19 0x90 0x11 0x23 0x19 0x88 0x10 0x25 0x11 0x23 |

4. goto 1

# 3 Configure Sample Rate [This can be done via broadcast]




## 3.1 Gateway

### 3.1.1 TX2 (G-Thread-3): Message ID 0x04

1. Give a new sample rate $dt$
2. Broadcast a sample rate message with $\rho$, $NID$, and $dt$ (ms):

| Message ID 0x04 [1B], $\rho$[1B], $NID$ [1B], $dt$ [4B]: e.g. 0x04 0x04 0x00 0x19 0x90 0x11 0x23 |
|---|

### 3.1.2 RX (G-Thread-2): Message ID 0x05

1. Get and parse the sample rate update message (Message ID 0x05)
   - received round count $\rho_R$
   - received parent ID $PID_R$
   - received node ID $NID_R$
   - received sample rate $dt_R$
2. If $\rho_R \neq \rho$ or $PID_R \neq NID$, then goto 1
3. Display sample rate update info "$NID_R$'s sample rate changes to $dt_R$"
4. goto 1

## 3.2 Communication Node

### 3.2.1 RX (N-Thread-1): Message ID 0x04

1. Get and parse the sample rate message (Message ID 0x04)
   - received round count $\rho_R$
   - received parent ID $PID_R$
   - received sample rate $dt_R$
2. If $\rho_R \neq \rho$ or $PID_R \neq PID$, then goto 1 [No need to check $PID_R$ with $PID$ if using broadcast]
3. Set $dt = dt_R$
4. Reply a sample rate update message with $\rho$, $PID$, $NID$, and $dt$ (ms):

| Message ID 0x05 [1B], $\rho$[1B], $PID$ [1B], $NID$ [1B], $dt$ [4B]: e.g. 0x05 0x04 0x01 0x02 0x19 0x90 0x11 0x23 |
|---|

5. Relay a sample rate message with $\rho$, $NID$, and $dt$ (ms):

| Message ID 0x04 [1B], $\rho$[1B], $NID$ [1B], $dt$ [4B]: e.g. 0x04 0x04 0x01 0x19 0x90 0x11 0x23 |
|---|

6. goto 1

#### 3.2.2 RX (N-Thread-1): Message ID 0x05

1. Get and parse the sample rate update message (Message ID 0x05)
   - received round count $\rho_R$
   - received parent ID $PID_R$
   - received node ID $NID_R$
   - received light value $dt_R$
2. If $\rho_R \neq \rho$ or $PID_R \neq NID$, then goto 1
3. Relay sample rate update message with $\rho$, $PID$, $NID_R$, and $dt_R$ to parent:
   Message ID 0x05 [1B], $\rho$[1B], $PID$ [1B], $NID_R$ [1B], $dt_R$ [4B]: e.g. 0x05 0x04 0x00 0x02 0x19 0x90 0x11 0x23
4. goto 1

# 4 Message Protocol

| ID | Code | Length | Note | Directions | Need Relay |
|---|---|---|---|---|---|
| 0x00 | 0x00 [1], $\rho$ [1], $NID$ [1] | 3 | Organization Message | Parent → Child | Y |
| 0x01 | 0x01 [1], $\rho$ [1], $PID$ [1], $CID$ [2] | 4 | Organization Message Reply | Child → Parent | Y |
| 0x02 | 0x02 [1], $\rho$ [1], $NID$ [1] | 3 | Organization Message Reply Ack | Parent → Child | N |
| 0x03 | 0x03 [1], $\rho$ [1], $PID$ [1], $PID_{(R)}$ [1], $NID_{(R)}$ [1], $Sec_{(R)}$ [4], $NSec_{(R)}$ [4], $L_{t/R}$ [2] | 15 | Light Value Message | Child → Parent | Y |
| 0x04 | 0x04 [1], $\rho$ [1], $NID$ [1], $dt$ [4] | 7 | Sample Rate Message | Parent → Child | Y |
| 0x05 | 0x05 [1], $\rho$ [1], $PID$ [1], $NID_{(R)}$ [1], $dt_{(R)}$ [4] | 8 | Sample Rate Updated Message | Child → Parent | Y |