Zigbee addressing scheme

Distributed address mechanism of zigbee

- A device is said **to join a network successfully** if it can **obtain a network address** from the coordinator or a router.
- Before forming a network, the coordinator determines the **maximum number of children of a router** (Cm), the **maximum number of child routers of a router** (Rm), **and the depth of the network** (Lm).
- Note that a child of a router can be a router or an end device, so Cm >= Rm.
- ZigBee specifies a **distributed address assignment using** parameters Cm, Rm, and Lm to calculate nodes' network addresses.

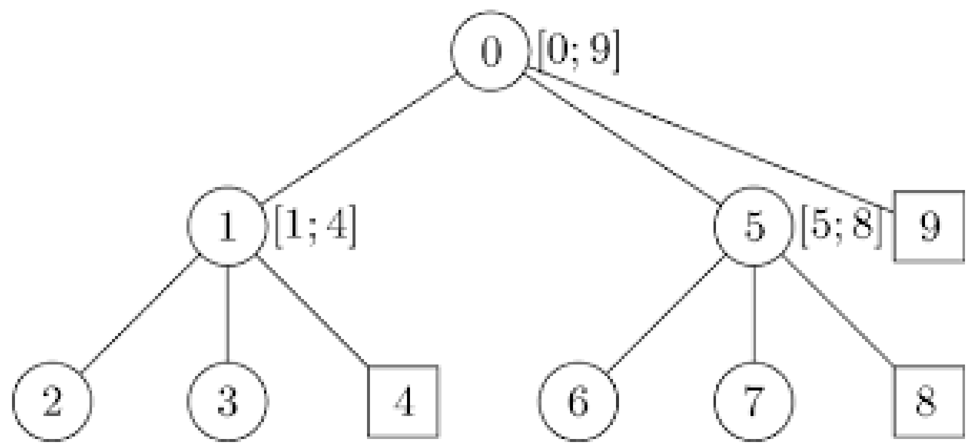
- The **allowed number of end devices** accepted by a router device is calculated as:
- MaxEndDevices = MaxChildren - MaxRouters = Cm - Rm
- In the sequence, when **a router device successfully joins** a network, its **parent device allocates a block of address** for its use, which means the joined router device becomes a potential parent device.
- Each joined router device can accept a certain number of children devices whose number cannot exceed Cm.
- The joining of the new router device is considered to extend the depth of the network, and the depth should not be greater than Lm
- If an end device successfully joins a network, it will be allocated a **network address by its parent devic**e.
- The joined **end devic**e does **not have** the capability to **accept new children devices**.

- Cskip is the method for calculating the total number of possible descendants that exist down any branch in the network. It is defined as follows:

$$Cskip(d) = \begin{cases} 1 + C_m(L_m - d - 1), & if \quad R_m = 1 \\ \frac{1+Cm-Rm-Cm*Rm^{Lm-d-1}}{1-Rm}, & otherwise \end{cases}$$

Then the distributed address assignment can be executed accordingly with $Cskip(d)$. For each parent device with address A_{parent} of depth d, the network addresses A_k for its kth router-capable child and A_n for its nth end device child are defined as follows.

$$
\begin{aligned}
A_k &= A_{parent} + 1 + Cskip(d) \cdot (k-1) \\
A_n &= A_{parent} + Cskip(d) \cdot Rm + n.
\end{aligned}
\tag{1}
$$



$$
C_{skip}(d) = \begin{cases} 1 + C_m \times (L_m - d - 1) & ; \; R_m = 1 \\ \dfrac{1 + C_m - R_m - C_m \times R_m^{L_m - d - 1}}{1 - R_m} & ; \; o/w. \end{cases}
$$

here in example,

$C_m = 3, \quad R_m = 2, \; L_m = 3.$

$$
C_{skip}(0) = \frac{1 + 3 - 2 - 3 \times 2^{(3-0-1)}}{1 - 2}
$$

$$= \frac{1+3-2-12}{-1} = 10$$

$$Cskip(1) = \frac{1+3-2-3\times 2^{(3-1-1)}}{1-2} = 4$$

$$Cskip(2) = \frac{1+3-2-3\times 2^{3-2-1}}{1-2} = 1$$

Address allocation :-

children level 0 :

$$R_1 = A_{parent} + 1 + Cskip(d).(k-1)$$
$$= 0+1+10.(1-1) = 1$$

$$R_2 = 0+1+10(2-1) = 11$$

~~R3 = 0+1+10(3-1) = 21~~

$$E_1 = A_{parent} + Cskip(d).R_m + n$$

$$= 0 + 10\times 2 + 1$$

$$= 21$$

children of R_1 (level 1).

$R_{11} = 1 + 1 + 4 \times 0 = 2$

$R_{12} = 1 + 1 + 4 \times 1 = 6$

$E_{11} = 1 + \cancel{6}\,4 \times 2 + 1 = 10$

chidren of R_2 (level 1).

$R_{21} = 11 + 1 + 0 = 12$

$R_{212} = 11 + 1 + 4 = \cancel{18}\ 16.$

$E_{211} = 11 + 8 + 1 = 20.$

children of R_{11}

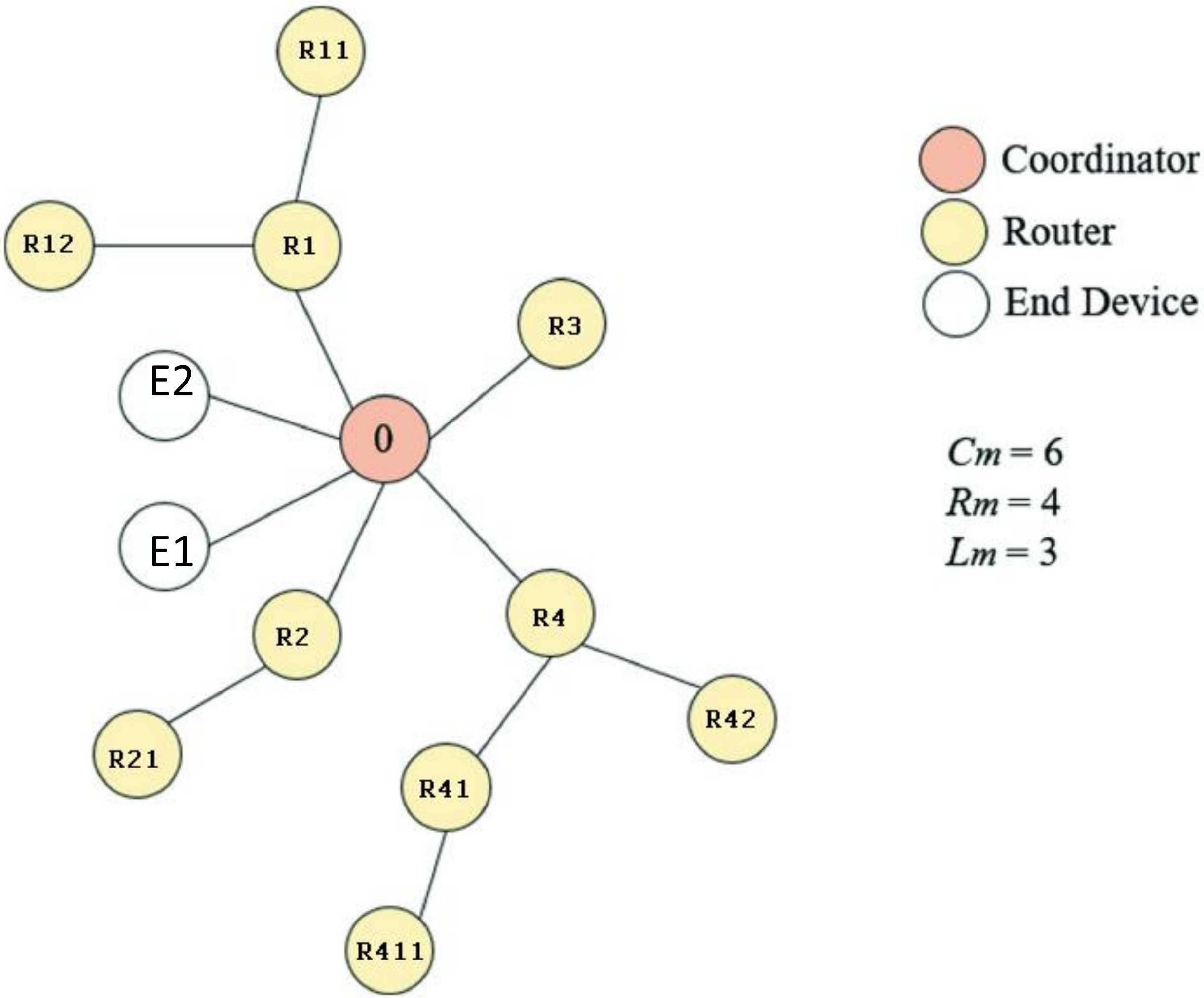
$R_{111} = 2 + 1 + 1(0) = 3$

$R_{112} = 2 + 1 + 1 = 4$

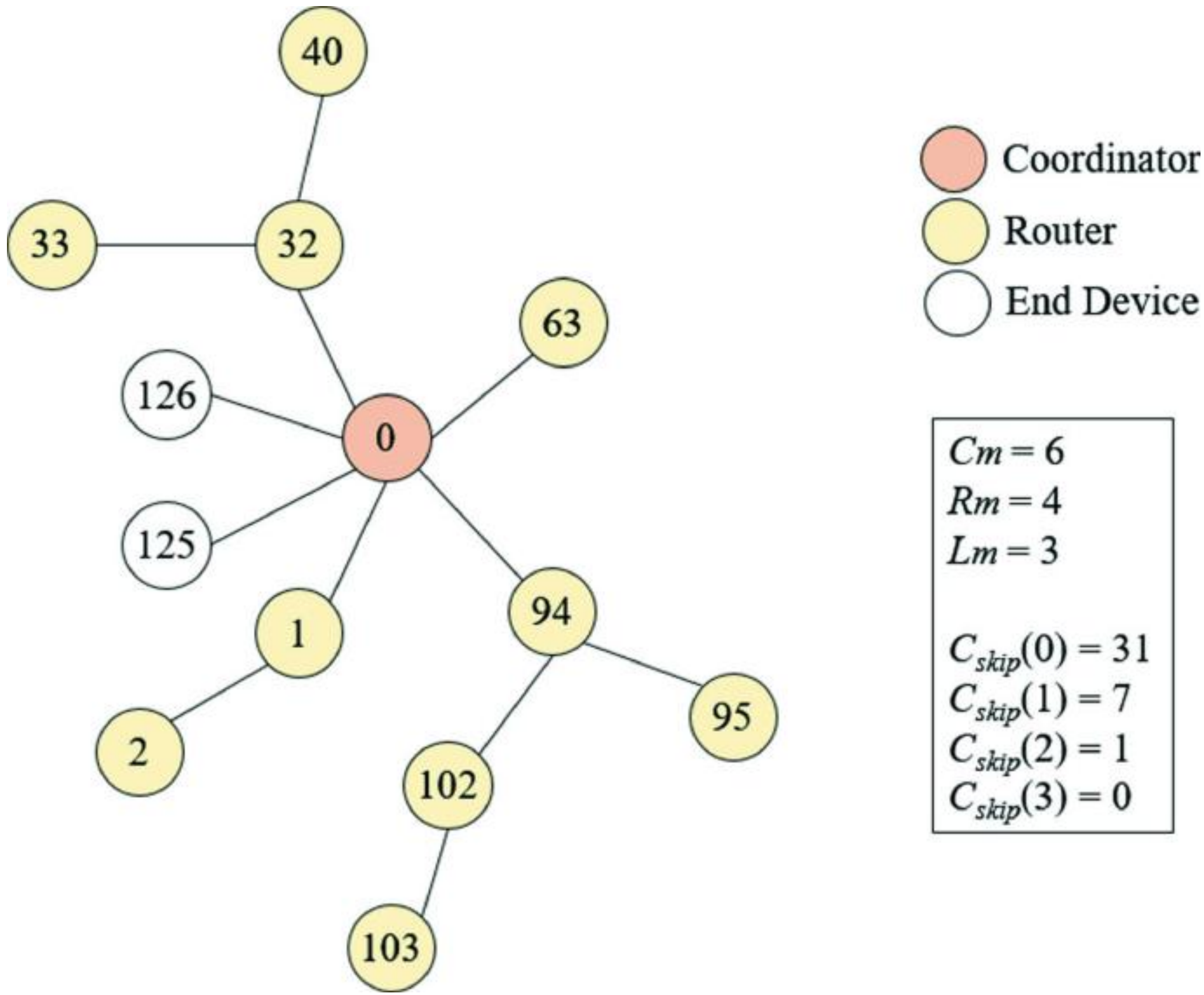
$R_{113} = 2 + 2 + 1 = 5$

Find the address of the following devices of the zigbee network. The sequence of the joining is

R2->R1->R3->R4->E1->R12->R21->R11->R42->R41->R411->E2



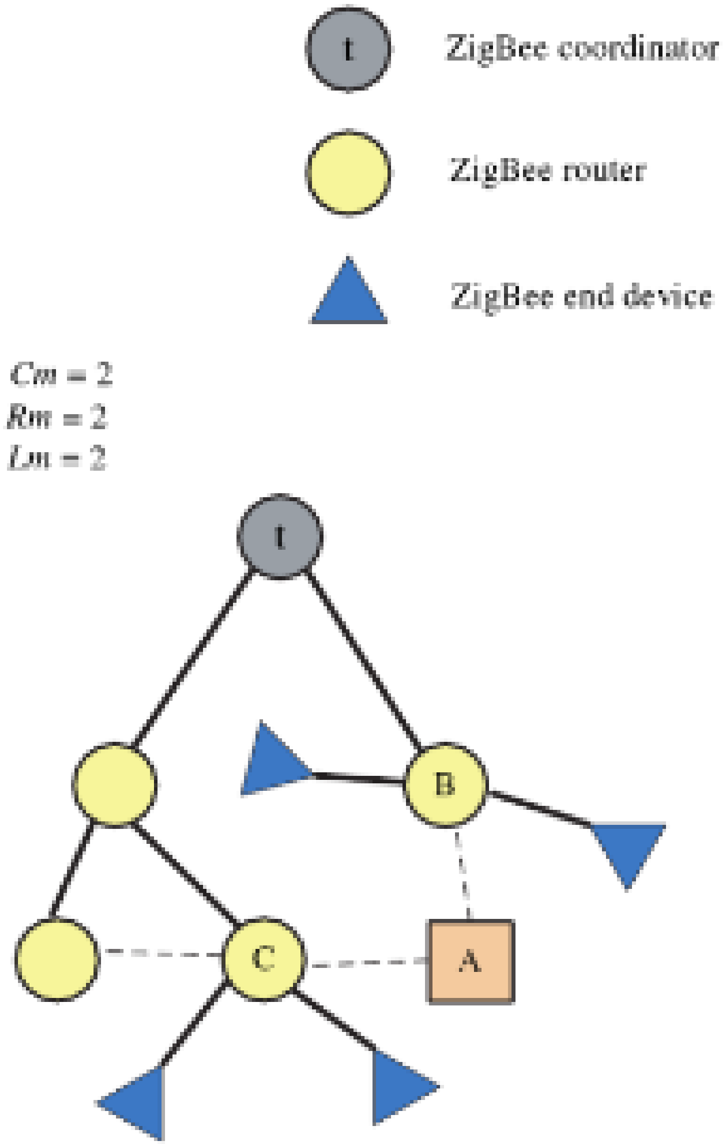
$Cm = 6$
$Rm = 4$
$Lm = 3$



40
33
32
63
126
0
125
1
94
2
95
102
103
Coordinator
Router
End Device
$Cm = 6$
$Rm = 4$
$Lm = 3$
$C_{skip}(0) = 31$
$C_{skip}(1) = 7$
$C_{skip}(2) = 1$
$C_{skip}(3) = 0$

- While these parameters facilitate address assignment, they may sometimes prohibit a node from joining a network.
- **A node is called an orphan node when it can not associate with the network but there are still unused address spaces remaining.**
- This situation is called the **orphan problem.**
- For example, in Fig., the router-capable device A has two potential parents B and C. But, router A cannot associate to router B or C because B and C have reached their maximum capacity of Cm = 2 children. So, A becomes an orphan node.

Orphan problem



REF:

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