Efficient Systematic CID Allocation and Relay Path Configuration Mechanism for IEEE 802.16j (Multi-hop Relay)

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Purpose:

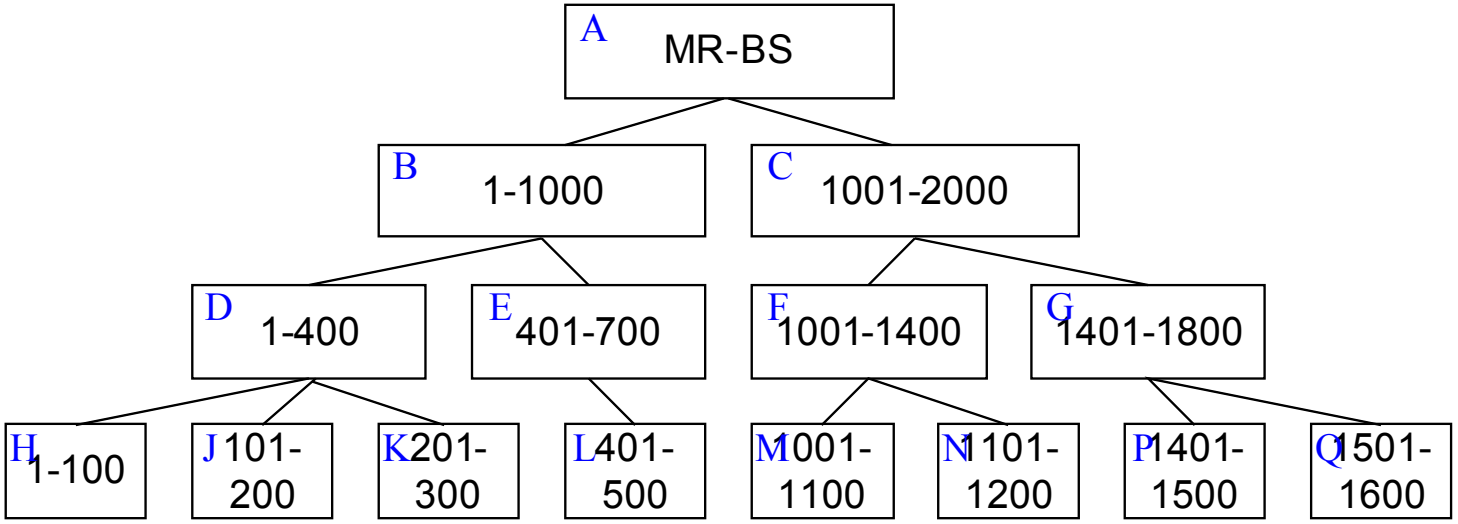
Discuss and adapt proposed text and message format.

Systematic CID Allocation

- Systematic CID allocation
  - Superordinate RS has a range as the superset of the union of CIDs of all its subordinate RSs
  - Advantages
    - Embed topology information into CIDs
    - Routing structure can be updated and maintained easily along with CIDs
    - The overall overheads for the routing can be reduced
      - Reduce storage overhead of storing CIDs in each RS
      - Reduce forwarding overhead of checking routing table
      - Reduce signal overhead of updating subordinate RS information

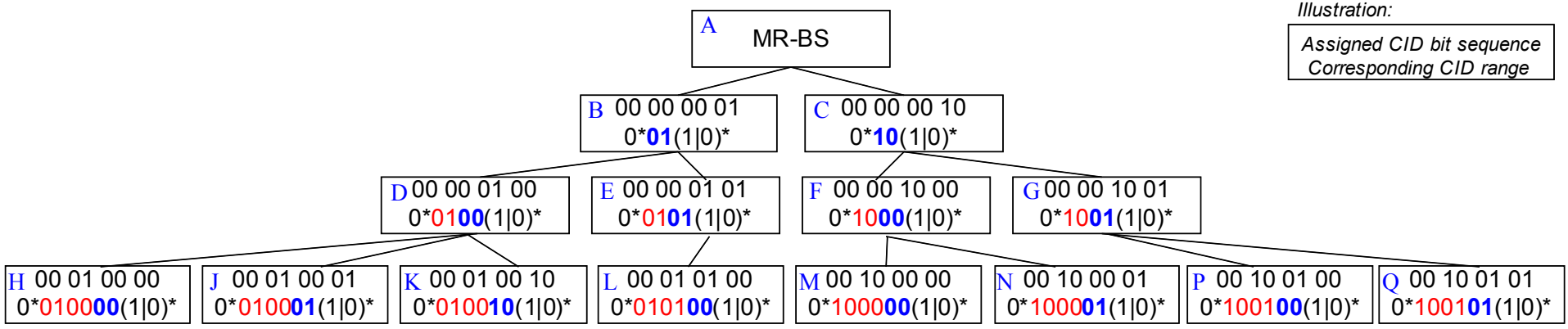
CID Allocation

- Two alternatives:
  - Contiguous integer blocks
  - Bit partition
- Contiguous integer blocks
  - For each subordinate RS, the assigned CID range has to be a subset of its connecting RS



CID Assignment

- Bit partition
  - 2^k: the maximum number of RSs that connect to another RS or MR-BS
  - First-level RS
    - MR-BS assigns CIDs by setting lowest *k* bits as $1\sim2^k$
    - Represent the range of 0*(assigned *k* bits)(1|0)*
  - N-level RS:
    - MR-BS assigns CIDs by left shifting k bits of its superordinate RS and set the lowest k bits from $0\sim2^k$
    - Represent the range of 0*(assigned *nk* bits)(1|0)*

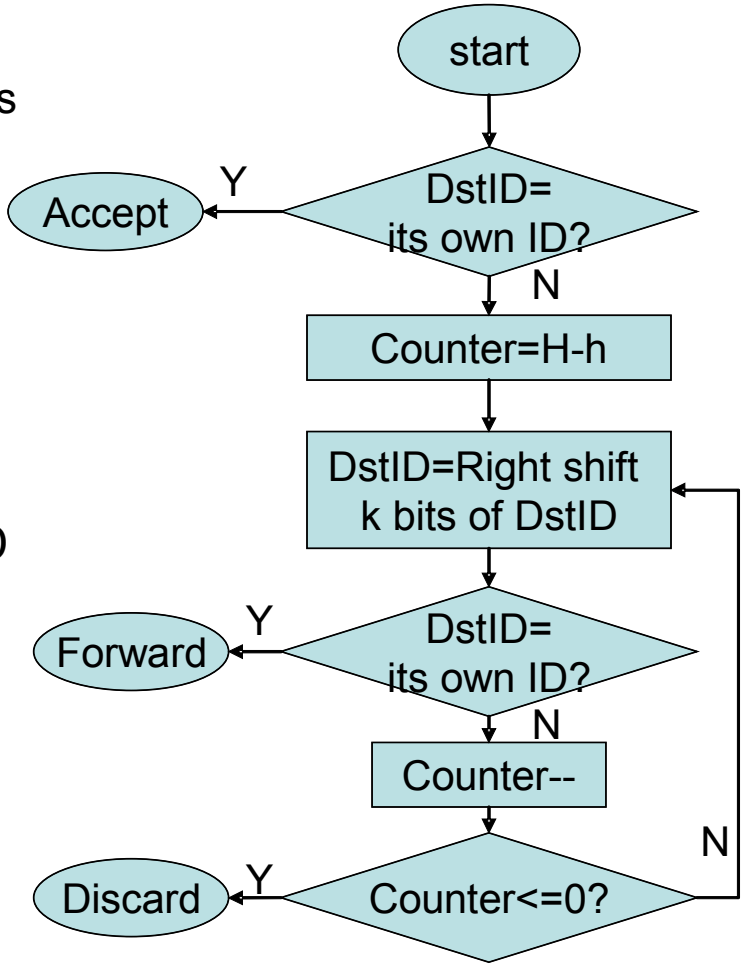


Routing with Systematic CIDs

- Upstream:
  - Destination: MR-BS
  - Method:
    - Send to the superordinate RS directly
- Downstream:
  - Destination: destination RS CID
  - Intermediate RS needs only to differentiate if the destination RS is its subordinate RS
    - By checking if destination RS CID belongs to its range

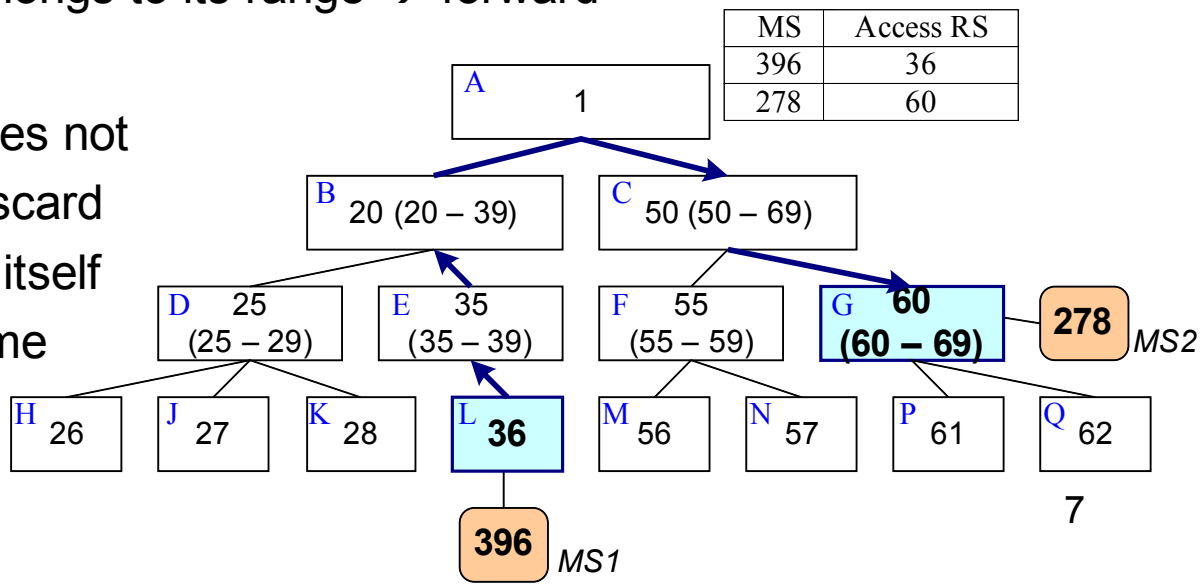
Subordinate RS Differentiation

- Contiguous integer block
  - Check if the destination CID is
    - Less than the maximum ID of its range
    - Greater than the minimum ID of its range
- Bit partition
  1. Compare its own CID with destination CID
     - Same: for this RS (receive the frame)
     - Different: go to next step
  2. Right shift k bits of destination CID and compare with its own CID
     - Same: for its subordinate RS (forward the frame)
     - Different: go to next step
  3. Keep doing step 2 for (maximum level – current level) times



Routing Example (tunnel for example)

- MS1→MS2 (access RS is RS G with CID 60)
  - Tunnel ID: destination RS CID 60
  - Upstream: to the parent RS until MR-BS
  - Downstream:
    - 1st hop:
      - RS B finds 60 does not in its range → discard
      - RS C finds 60 belongs to its range → forward
    - 2nd hop:
      - RS F finds 60 does not in its range → discard
      - RS G finds 60 is itself →accept the frame and send to MS



Proposed Text

- *[Add the following text into section 6.3.1.3]*
- ***6.3.1.3.1 Addressing Scheme for Relaying***
- In the procedure of network entry and initialization for a new RS, the MR-BS shall assign a range of CIDs for the new RS. The range could be contiguous integer blocks as in Figure 6.3.1.3.X (a) or bit partition as in Figure 6.3.1.3.X (b). In the bit partition assignment, the MR-BS sets the lowest *k* bits in ascending order to RSs for RSs associated to the MR-BS directly where the maximum number of RSs the MR-BS or a RS could serve is *2k*. For other level-n RSs, which need *n* hops to reach the MR-BS, the MR-BS left shifts *k* bits of its parent CID and sets the lowest *k* bits according to the arriving sequence of the RS.

Proposed Text

- Ranging response (RNG-RSP) message

Name	Type (1 byte)	Length	Value (variable-length)	PHY Scope
If(contiguous integer blocks){				
Start number of management CID for RS	xx	2		OFDMA
End number of management CID for RS	xx	2		OFDMA
}				
If(bit partition){				
CID bit sequence	xx	2		OFDMA
}				

Proposed Text

6.3.25 Relay path management and routing

Each relay station is assigned a range of CIDs for which the relay is responsible for decoding and forwarding. The CID range is assigned by the MR-BS, and are transmitted to RSs via CIDRNG-REQ and CIDRNG-RSP management messages. During operation, the RS is only responsible for listening to CIDs transmitted within this range.

The BS is responsible for managing the entire CID range. Each RS connected to a parent node (BS or RS) is assigned a subset of the CIDs assigned to the parent node. These subsets are non-overlapping.

By assigning a CID to each service flow, the MR-BS already specifies the relay routing path of the connection.

Summary

- Systematical CID assignment
  - Embed topology information into CIDs
  - Routing structure can be updated and maintained easily along with CIDs
- Systematical CID assisted routing
  - The overall overheads for the routing can be reduced
    - Reduce storage overhead of storing CIDs in each RS
    - Reduce forwarding overhead of checking routing table
    - Reduce signal overhead of updating subordinate RS information