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SPIRAL DATA REPORTING MECHANISM IN LOW-POWER AND LOSSY NETWORKS

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ABSTRACT

The embodiments presented herein relate to low-power and lossy networks (LLNs), and more specifically, to dividing LLN nodes into groups. Groups may be determined by traversing a directed acyclic graph (DAG) topology in a spiral manner. In this manner, contention, collisions, and interference may be minimized, while bandwidth usage can be maximized.

DETAILED DESCRIPTION

Low-power and lossy networks (LLNs) may suffer from limited bandwidth regardless of whether a radio frequency or power-line communication link is used. In a typical deployment, a single Personal Area Network (PAN) may include thousands of nodes. Data collection from these nodes may be difficult, as pulling data from all nodes at the same time can cause severe traffic congestion within an LLN. The embodiments presented herein provide an algorithmic approach that can be used to divide LLN node into groups by following a set of rules. Nodes are grouped so that the traffic generated by the meters in a given group will have the least contention with each other.

Nodes in adjacent Reporting Groups (e.g., i-1, i, and i+1) should also be chosen to minimize contention, collision, and interference. Figure 1 depicts an example of an LLN topology having one connected grid router (CGR) and twelve nodes numbered as 11, 12, 13, 21, 22, 23, 31, 32, 33, 41, 42, and 43.

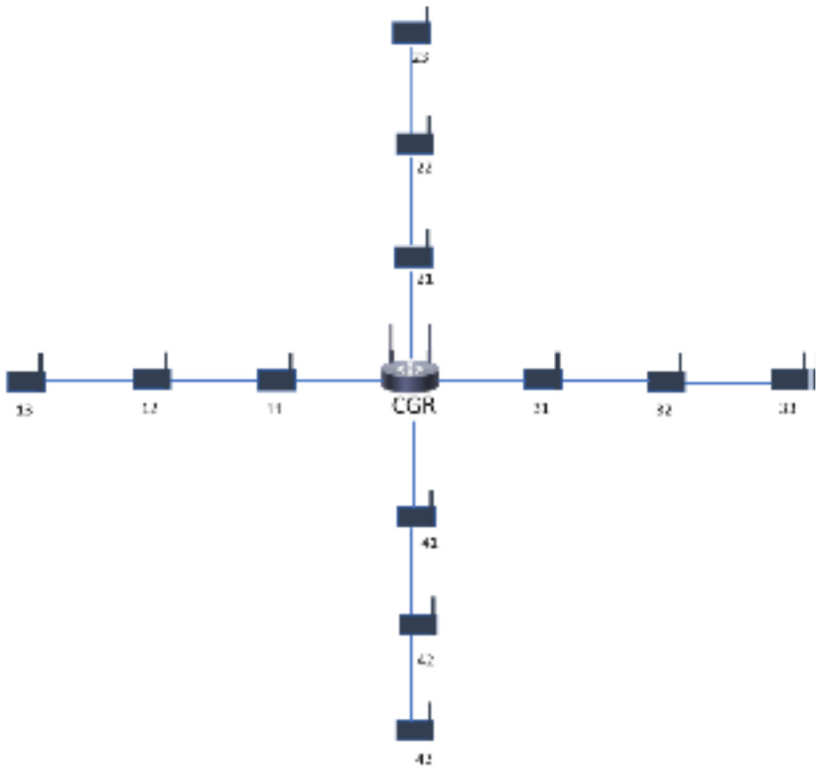

Figure 1

LLN nodes may be divided into groups by first retrieving the LLN topology from the CGR, and then analyzing the topology. As depicted, there are four branches in the tree, and each branch has three nodes in parent-child relationship: Branch 1 has nodes 11, 12, and 13, Branch 2 has nodes 21, 22, and 23, Branch 3 has nodes 31, 32, and 33, and Branch 4 has nodes 41, 42, and 43.

The LLN topology may then be traversed spirally. For example, the traversing may start from branch 1, node 11, go to the next hop on the next branch which is branch 2, node 22, and continue until node 33 is reached, as depicted in Figure 2.

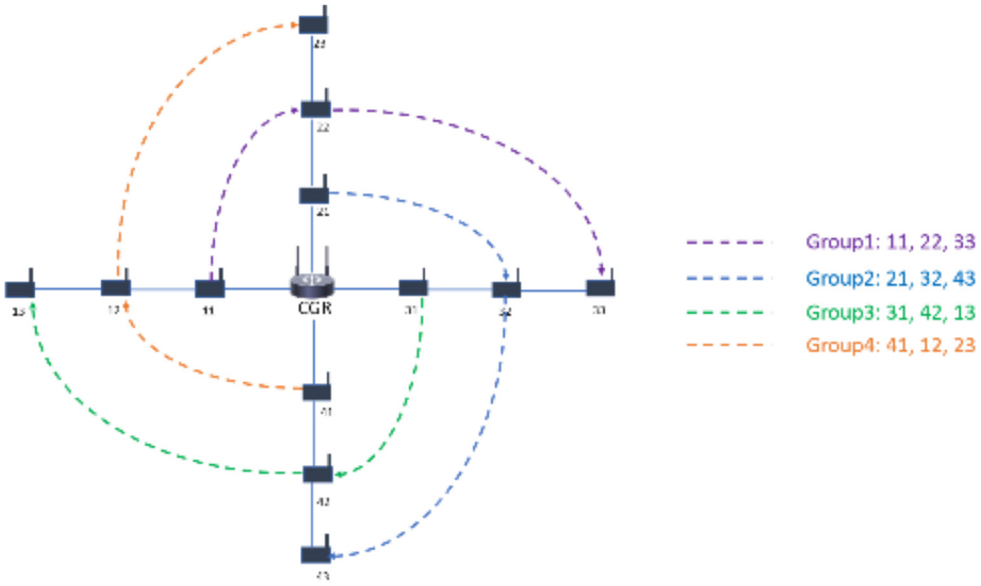

Figure 2

Group1 may then be defined as including nodes 11, 22, and 33. Likewise, Group2 may include nodes 21, 32, and 43, Group3 may include nodes 31, 42, and 13, and Group4 may include nodes 41, 12, 23. After all of the branches and all of the nodes have been traversed, the full mapping of groups is completed.

By grouping according to a spiral traversal of an LLN topology, contention, collision, and interference can be minimized within a DAG, and DAG bandwidth usage can be maximized. Figure 3 illustrates how these results can be achieved using Group1 as an example.

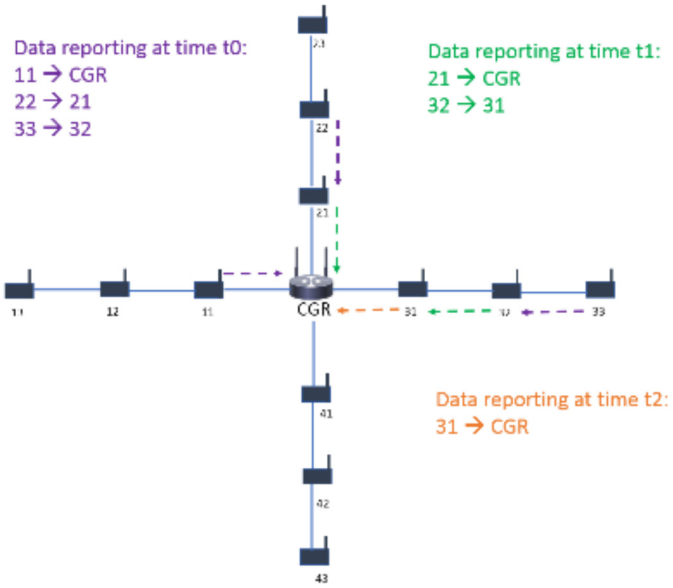

Figure 3

As depicted in Figure 3, data reporting can occur at different times for the different groups, thus avoiding contention, collisions, and interference. This approach can be extended to support more complex LLN topologies, and can be extended to various types of network other than LLNs.