Self-Organizing Networks: Wireless Topologies for In-Plant Applications

KEY POINTS

- Built-in intelligence and flexibility allows for maximum efficiency and lower power consumption
- Lower installation and management costs from automatic self-adjusting network configuration
- Decrease communication disruption with “self-healing” capabilities

OVERVIEW

The topography of a wireless network is simply the way network components are arranged. It describes the physical layout of devices, routers, and gateways, as well as the data flow paths between them.

Three of the most common wireless topologies for in-plant applications are star, mesh, and cluster-tree. By understanding the strengths and weaknesses of each, you can determine which topology is best for your specific application.

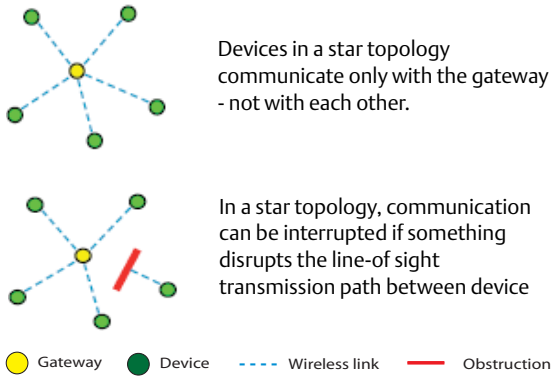
The topology of a wireless network is simply the way network components are arranged.

Star topology

Star topology is a point-to-point or line-of-sight architecture where individual wireless devices or nodes, communicate directly with a gateway or central “hub.” The gateway transmits the data to a central collection point, such as a control room, directly, or by connecting to another network. Star topology is also sometimes described as “point-to-point” or “line of sight” architecture because each device communicates directly with the gateway. Star topologies potentially use the least amount of power of the three architectures because of the simple, direct wireless connections. But the distance the data can be transmitted from the wireless device to the gateway is limited to a range of 30 –100 meters. Communication may be hindered or data lost if something disrupts the transmission path between a device and gateway. This disruption could be radio-frequency interference, physical structures, environmental factors, or temporary obstructions like trucks, construction equipment, or scaffolding.

A site survey is important in the planning of a wireless network to identify where devices can be placed to provide line-of-sight transmission, and appropriate range to the gateway. Site surveys are expensive and cannot predict future changes, including new construction or other environmental changes that may interrupt that line-of-sight transmission. Many of these limitations may be eliminated with a topology that allows for more than one transmission path between device and gateway.

Star Topology Modeling



ROSEMOUNT®

For more information:
www.rosemount.com

EMERSON™
Process Management

© 2007 Rosemount Inc. All rights reserved

Mesh topology

The devices in a mesh topology can also communicate with other nodes in the network (point-to-multipoint) using a capability called multi-hopping. A message can "hop" from node to node to node until it reaches the assigned gateway. The advantages of mesh over star topology includes a longer range distance and a decrease in loss of data or transmission.

Cluster-tree topology

A cluster-tree topology is a hybrid where wireless devices in a star topology are clustered around routers or repeaters that communicate with each other and the gateway in a mesh topology. This blends the advantages of both topologies: potentially low power consumption of the "star" portions of the cluster-tree, and extended range and fault tolerance of the "mesh" portions. However, a site survey is required to make sure the end devices in each star have a clear line-of-sight to their assigned router and there is no backup path for each device to communicate with its assigned router if there are changes or interference.

SOLUTIONS

Self-organizing networks

Process environments are dynamic and no single topology will always be best for any given application. However, self-organizing networks have built-in intelligence and flexibility to automatically chose a star, mesh, cluster-tree topology, or a combination of all three, to provide maximum efficiency at any given moment.

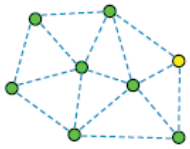
Self-organizing networks have the capability to let every wireless device act as a router for nearby devices. The devices and gateways work together to identify and use the most efficient communication path for each message, instead of having every device talk constantly with every other device.

- If a device is within range of a gateway, direct point-to-point transmissions allow low power consumption (especially when combined with technology that minimizes the need for communication "re-tries").
- Network expansion is easy. A new device can communicate with the nearest device or gateway, which recognizes the new device as an authorized node on the network, and knows when to receive and transmit messages.
- The network's "self-healing" capabilities automatically re-route messages along the next most-efficient route if a communication path is disrupted.

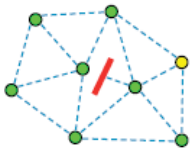
The capability to dynamically reconfigure itself to use the most efficient communication paths, without manual intervention, or interrupting the flow of data, is what sets a self-organizing network apart from other wireless solutions for process automation. Benefits include robust wireless network performance, high data reliability, lower overall power consumption and reduced message latency.

Self-organizing networks offer robust wireless network performance, high data reliability, lower overall power consumption and reduced message latency.

Mesh Topology Modeling



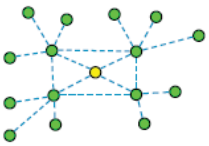
Devices in a mesh topology can communicate with any other network note within range.



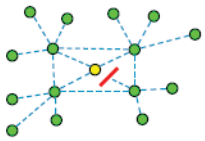
A mesh topology's multi-hop capability enables messages to "go around" blockages of failed nodes.

Gateway Device Wireless link Obstruction

Cluster-Tree Topology Modeling



A cluster-tree topology combines point-to-point communications from device to router with point-to-point multipoint communications between routes and gateways



If the direct, single-hop transmission path between a router and gateway is interrupted, messages can multi-hop through other routers to reach their destination.

Gateway Device Wireless link Obstruction

Standard Terms and Conditions of Sale can be found at www.rosemount.com/terms_of_sale

Rosemount and the Rosemount logotype are registered trademarks of Rosemount Inc.
All other marks are the property of their respective owners.

Emerson Process Management
Rosemount Division
8200 Market Boulevard
Chanhassen, MN 55317 USA
T (U.S.) 1-800-999-9307
T (International) (952) 906-8888
F (952) 949-7001

Emerson Process Management
Emerson Process Management GmbH & Co.
Argelsreider Feld 3
82234 Wessling
Germany
T 49 (8153) 9390
F 49 (8153) 939172

Emerson Process Management
Emerson Process Management Asia Pacific
Private Limited
1 Pandan Crescent

ROSEMOUNT®

For more information:
www.rosemount.com

EMERSON™
Process Management

00840-0200-4180, Rev AA