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Topologies in IoT Networking

Georgios Z. **PAPADOPOULOS**
e-mail: georgios.papadopoulos@imt-atlantique.fr
web: www.georgiospapadopoulos.com
twitter: @gzpapadopoulos
youtube: www.youtube.com/c/gzpapadopoulos

Context

Check the relevant video “*IoT Network Topologies*” on YouTube!

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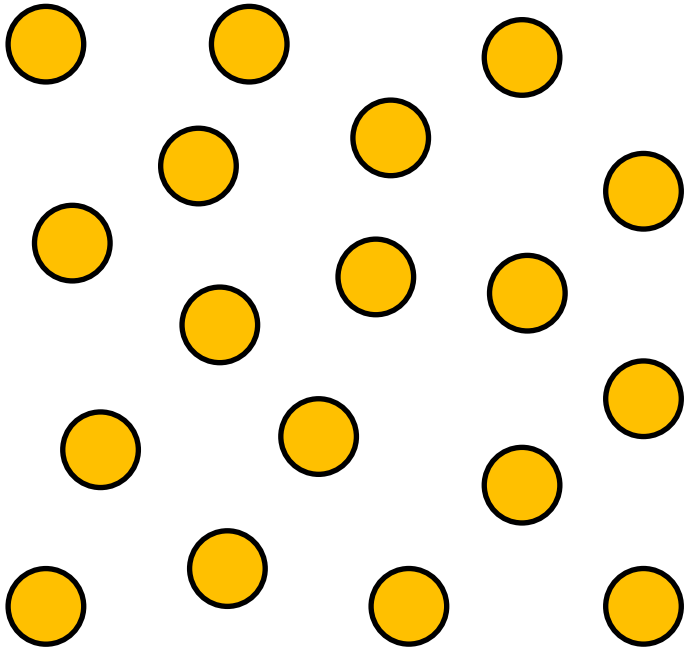
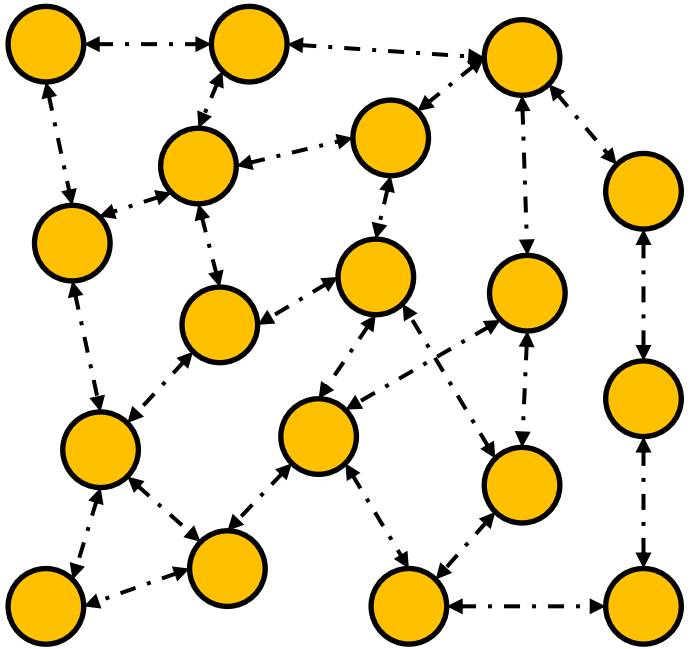
IoT Networks



- IoT networks are ***structured networks***.
- The nodes are organized in a given ***hierarchy***.

A low-power wireless (constrained) node.

IoT Networks

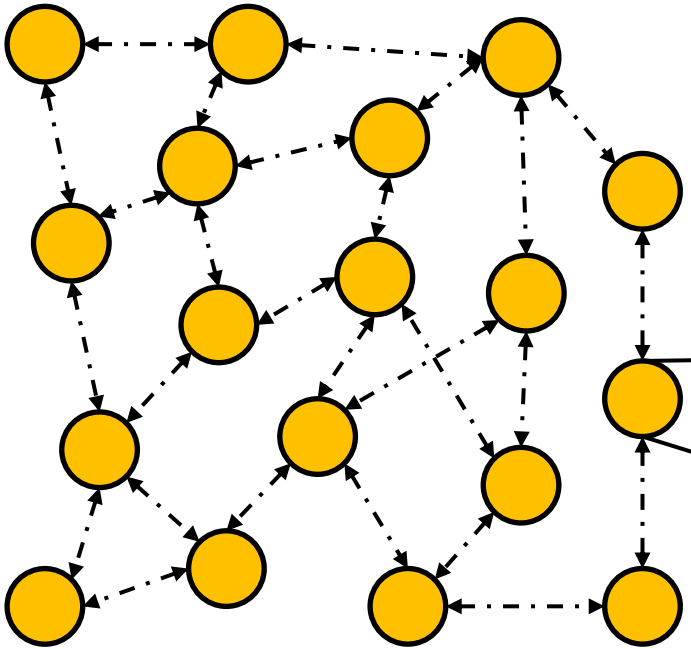


- This network arrangement is called a ***topology***.

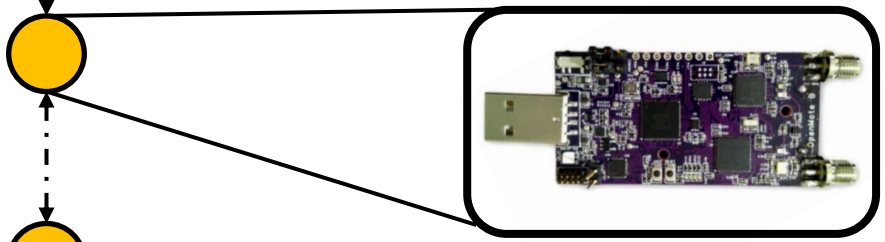
A low-power wireless (constrained) node.

A wireless link.

IoT Networks

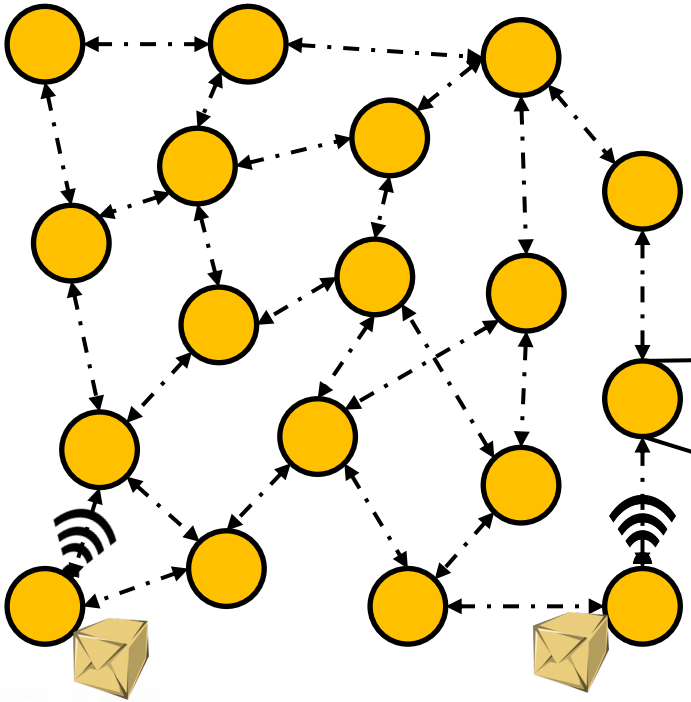


- IoT networks consist of ***sensors*** and ***actuators***.



The OpenMote B, a typical a low-power wireless node.

IoT Networks



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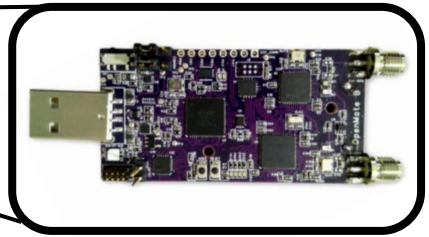

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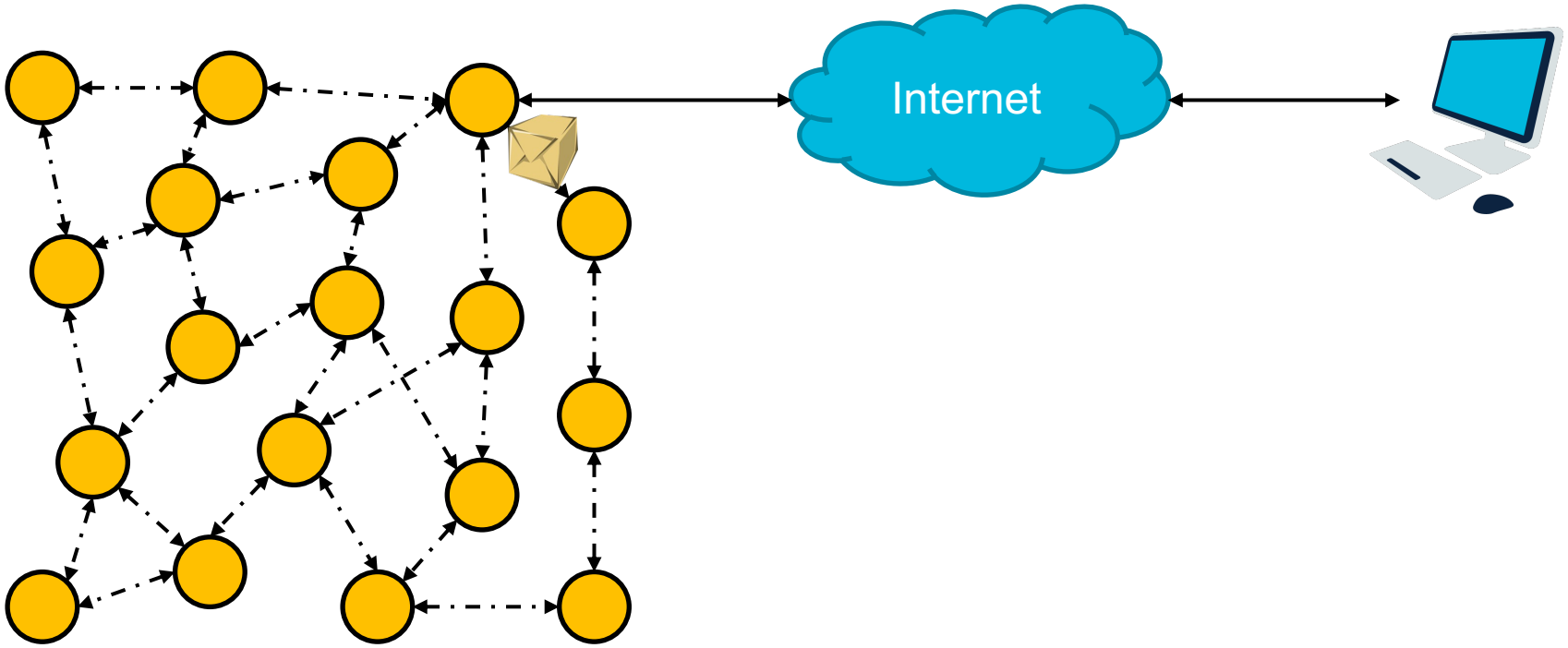
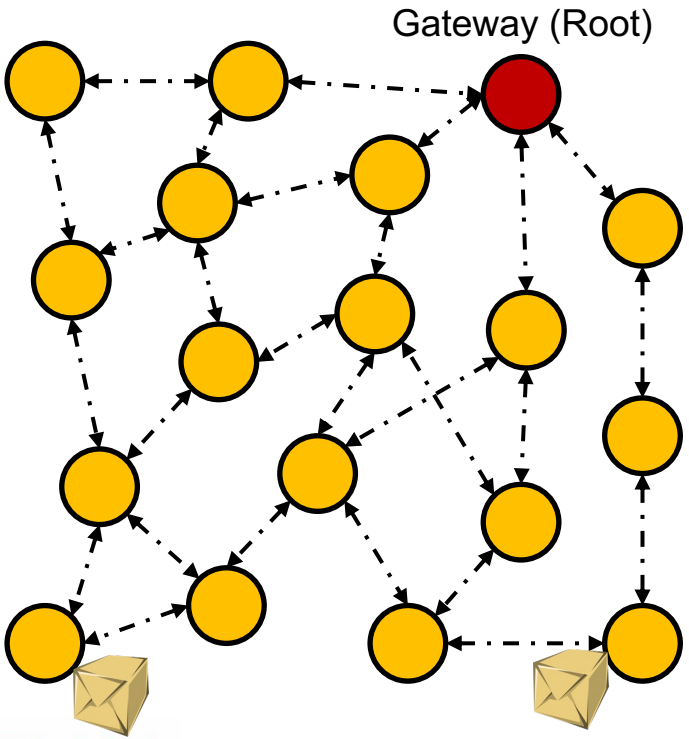
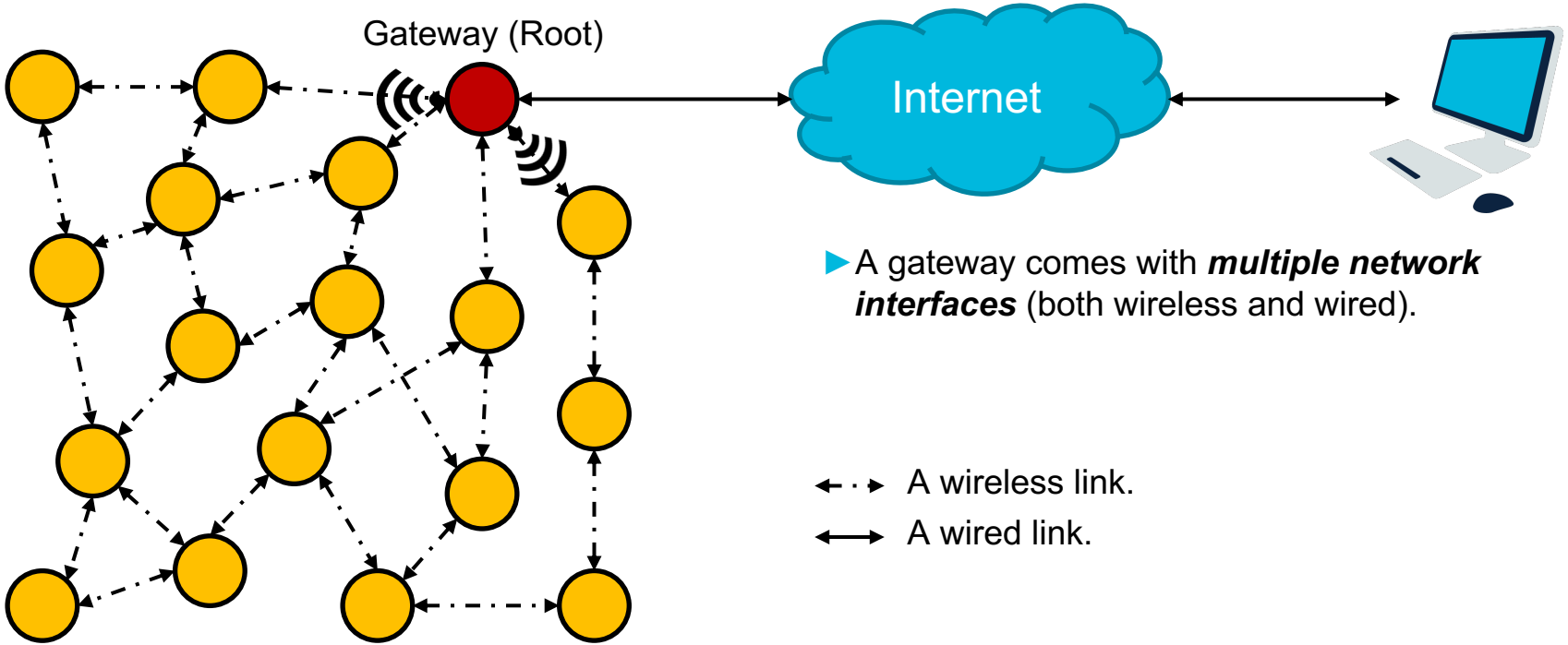


IoT Networks



*A very intuitive network arrangement is a set of nodes that collect environment measurements and send these measurements to a **Gateway**, often called a **Border Router**.*

The Gateway / Border Router / Root Node

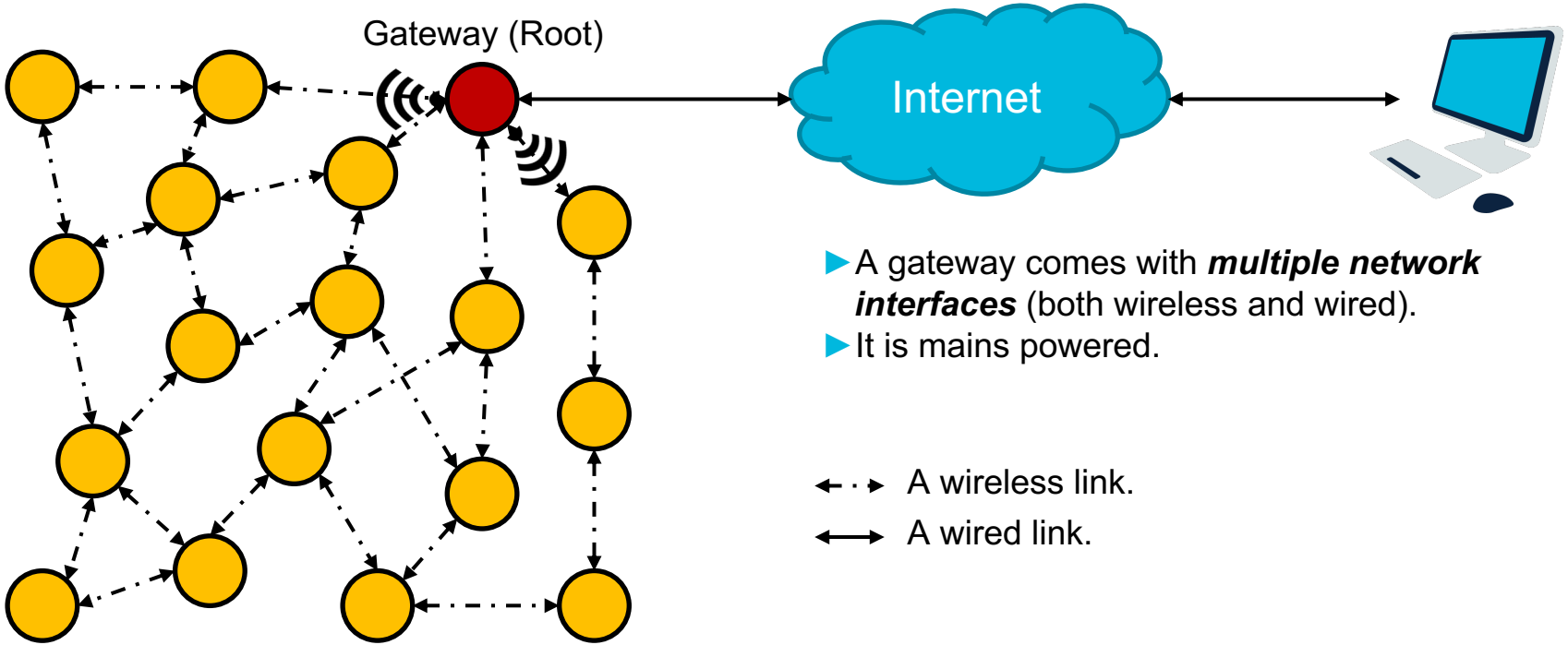


- A gateway comes with ***multiple network interfaces*** (both wireless and wired).

A wireless link.

A wired link.

The Gateway / Border Router / Root Node



- A gateway comes with ***multiple network interfaces*** (both wireless and wired).
- It is mains powered.

A wireless link.

A wired link.

Topologies

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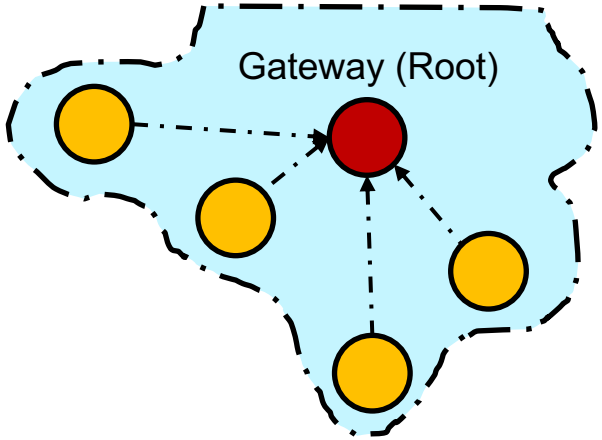
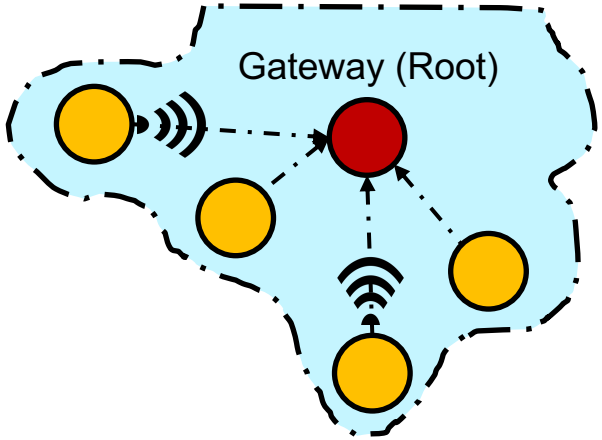
Star Topology



A star topology:

- The nodes are within the radio propagation of the **gateway**, and thus they can directly communicate with the **gateway**.

Star Topology



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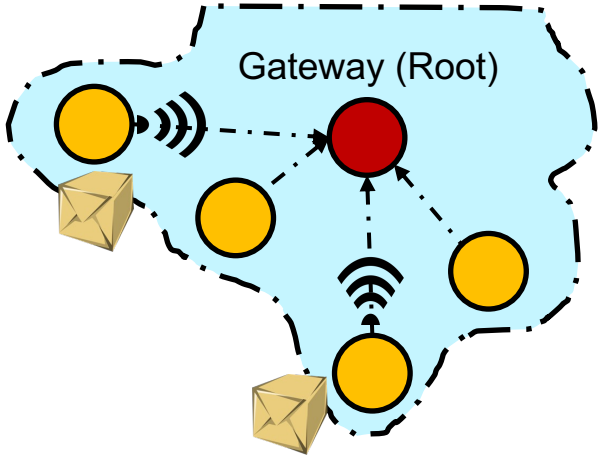

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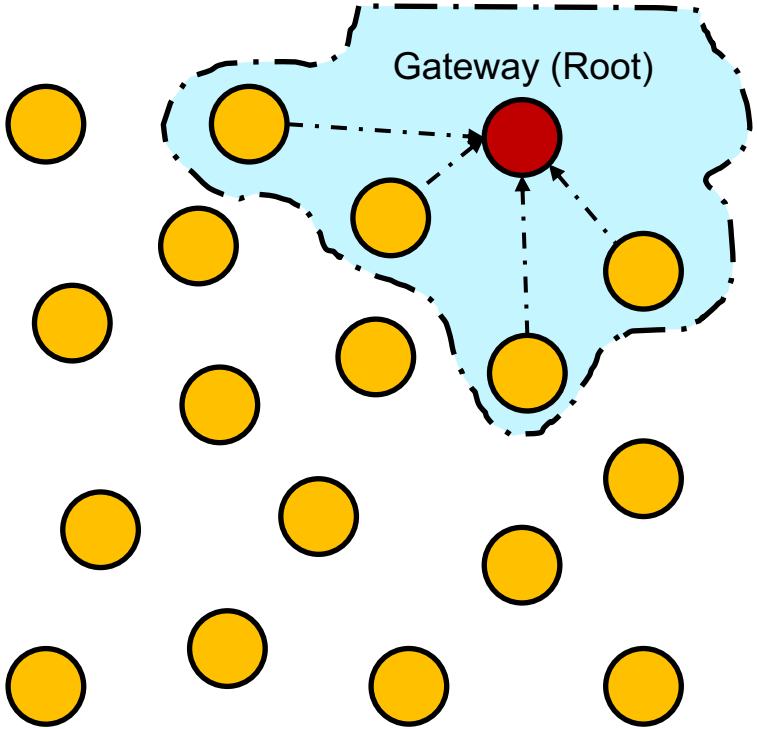
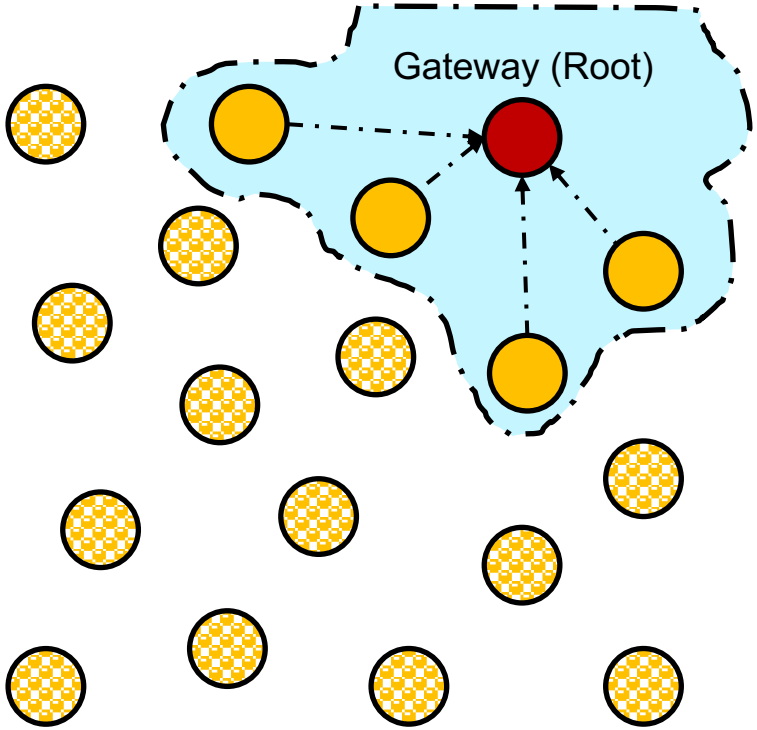


A star topology:

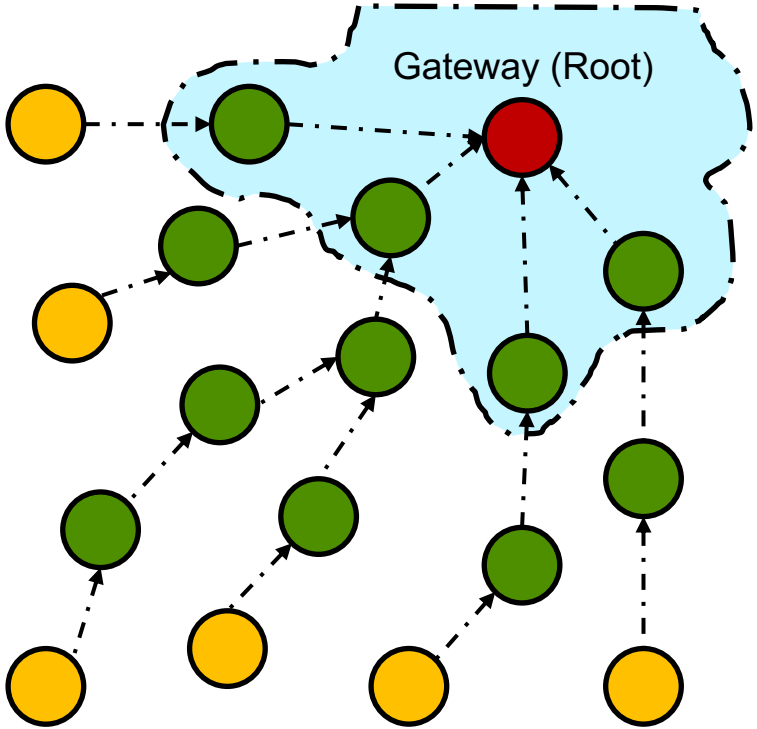
- The nodes are within the radio propagation of the **gateway**, and thus they can directly communicate with the **gateway**.
- However, if the nodes are out of the propagation range of the **gateway**, they cannot participate in the network.

Tree Topology



A tree topology:

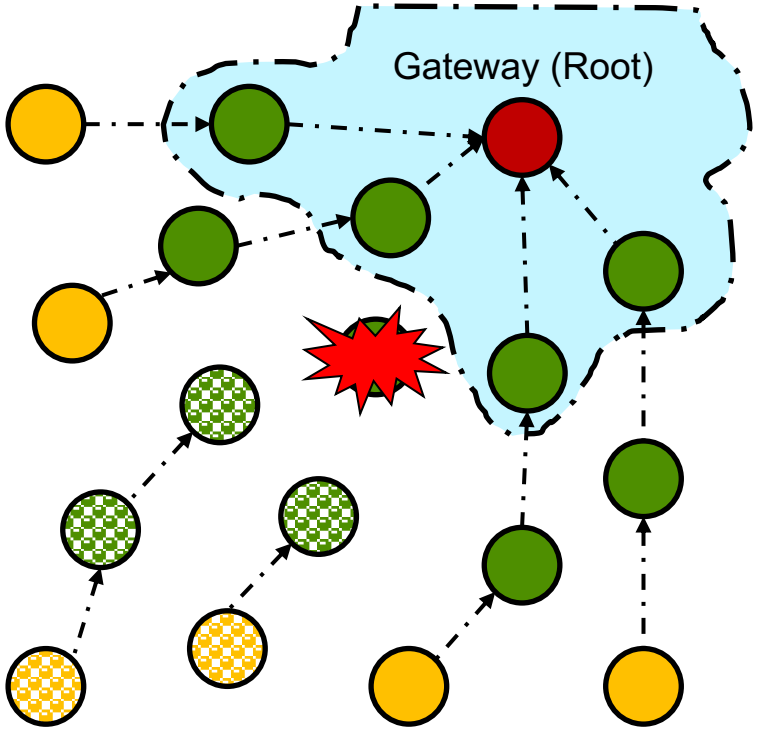
Tree Topology



A tree topology:

- In **tree** topology, some of the nodes operate as relays for others.

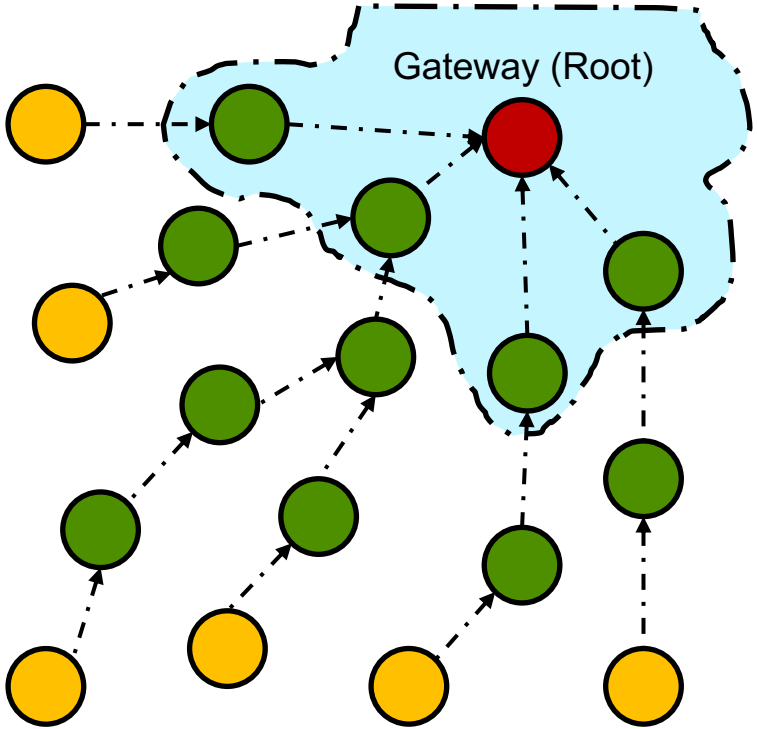
Tree Topology



A tree topology:

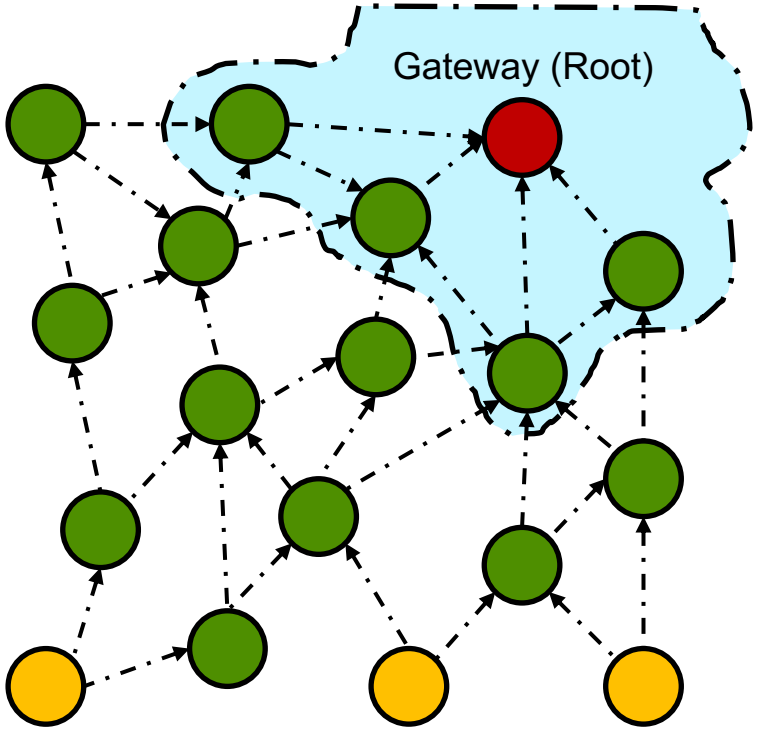
- In **tree** topology, some of the nodes operate as relays for others.
- However, if one of the relaying nodes crashes or the link quality drops, all its descendants in the network are disconnected.

Mesh Topology



A mesh topology:

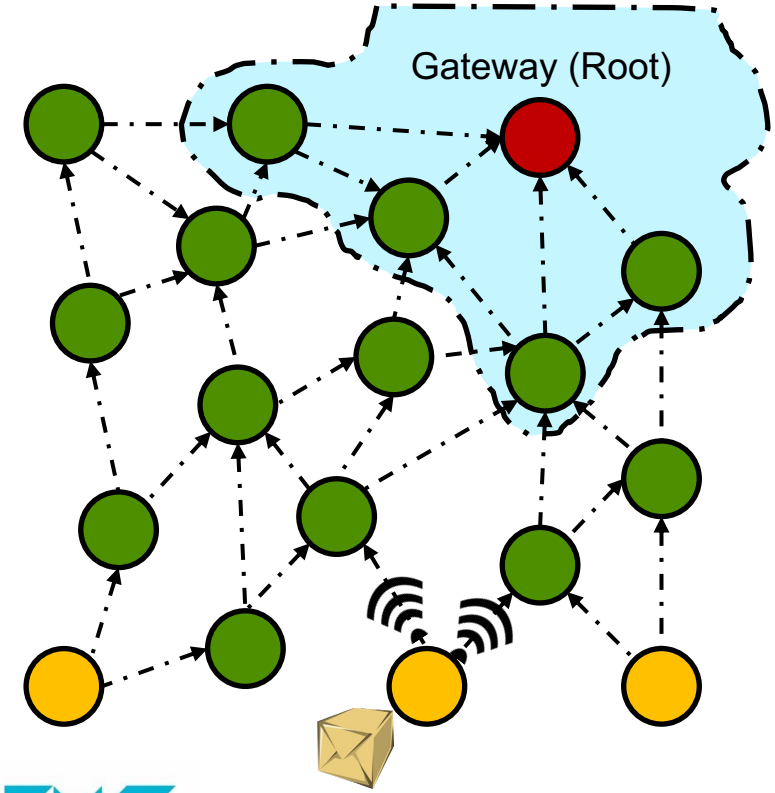
Mesh Topology



A mesh topology:

- It extends the **tree** topology by adding redundant paths.
- Each node has at least two neighbors to transmit the packet to.

Mesh Topology



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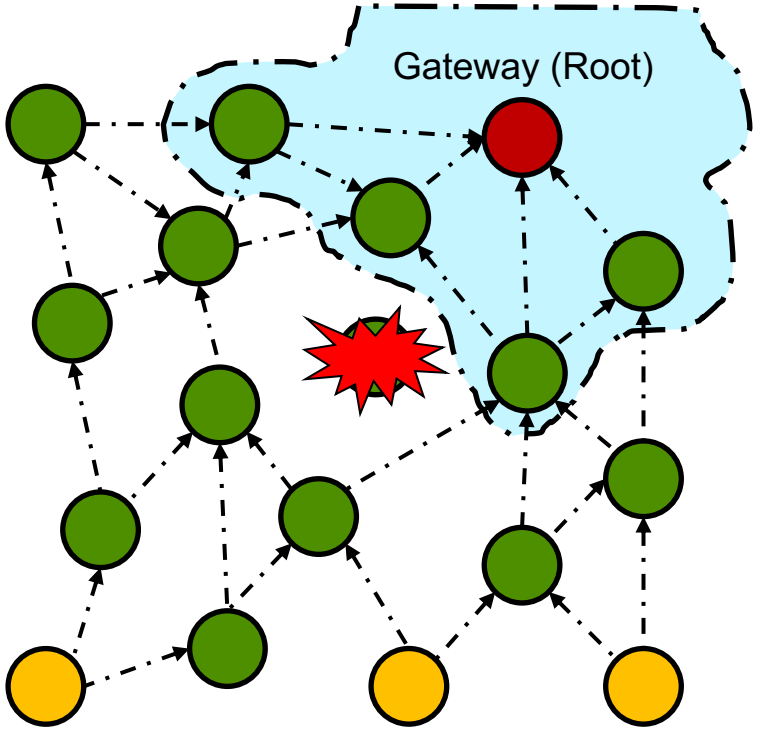
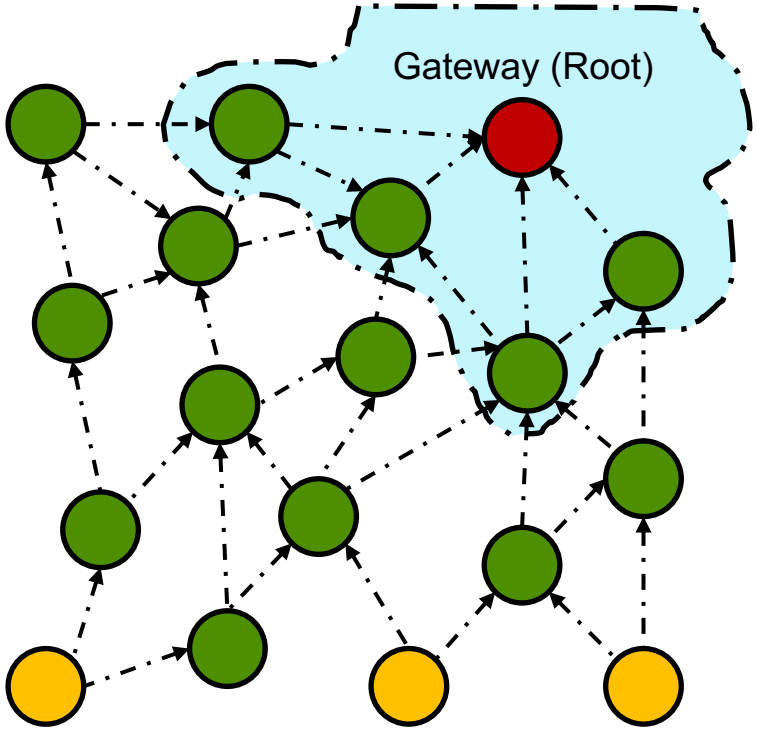


A mesh topology:

- It extends the **tree** topology by adding redundant paths.
- Each node has at least two neighbors to transmit the packet to.
- Thus, even if some of the nodes go OFF, neither the multi-hop network nor the traffic flow will be impacted.

Low-Power Wireless Mesh Networks

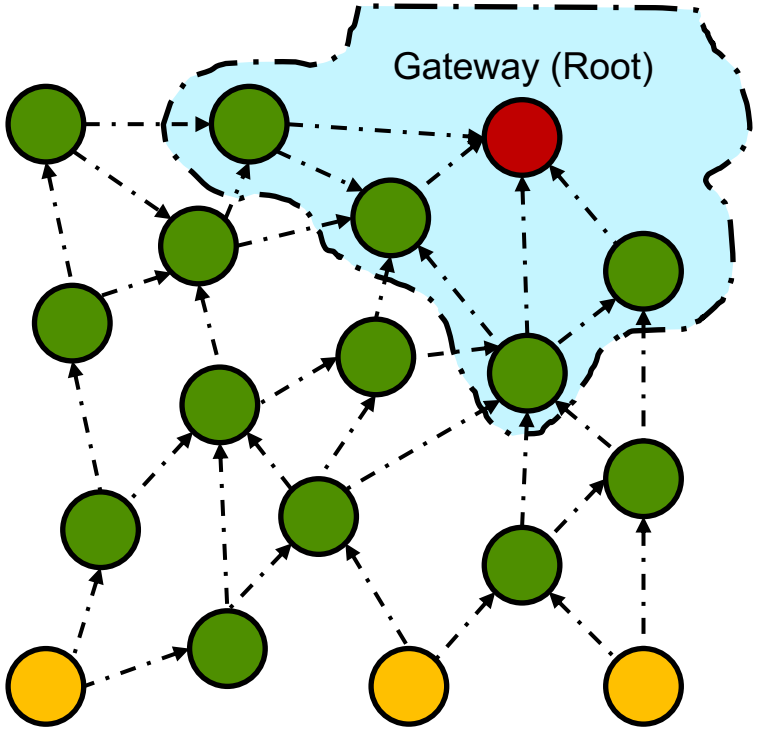
Low-Power Wireless Mesh Networks



Potential tunable trade-offs:

- The network capacity (the data traffic the nodes can generate).
- The end-to-end network latency.
- The end-to-end network reliability.
- The energy consumption.

Low-Power Wireless Mesh Networks



A typical industrial trade-off scenario:

- To target **network reliability** and **bounded latency** at the cost of **network capacity** and **energy**.

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