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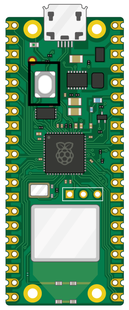

Standalone Wi-Fi Based IoT Systems Using the Raspberry Pi Pico-W

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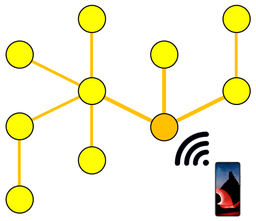
Wi-Fi based IoT systems are convenient

Wi-Fi is a **universal interface** shared by most modern mobile devices.

This makes Wi-Fi based IoT systems incredibly **easy to tap into** and extract information from.

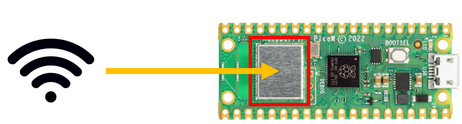


Wi-Fi doesn't exist everywhere

Many existing IoT systems depend on pre-existing Wi-Fi networks to host their capabilities. However, Wi-Fi networks don't always exist in the places where IoT systems could be useful.

Standalone IoT systems using the Pico-W

What if we could develop a Wi-Fi based IoT system that exists independently of an external network? The Raspberry Pi Pico-W makes this possible.



Using its onboard networking chip, the Pico-W can **host its own Wi-Fi** access point, as well as **connect to another Pico-W** as a client. Systematically toggling between the two modes gives us the capability to implement a mesh-like Wi-Fi based IoT system that hosts its own Wi-Fi network.

Learning the network and routing packets

Nodes self-identify the local topology

The network begins with no knowledge of its own topology. At startup, the nodes coordinate to perform a DFS-like operation where they assign themselves ID numbers and scan for neighbors.

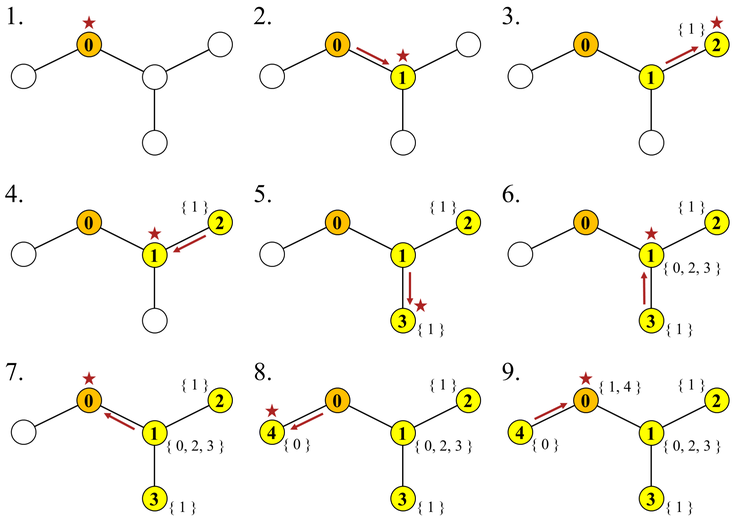


Figure 1: Neighbor finding algorithm.

The network optimizes its own routing patterns

Once the network topology is learned, the nodes use a modified distance-vector routing protocol to determine the shortest path between any two nodes.

Each node tracks its distance to every other node, as well as the next node on the path to that target. The nodes then exchange information until the shortest path to every node is known.

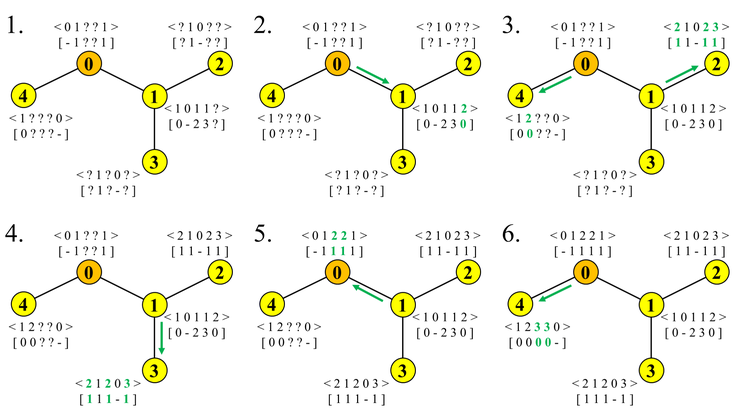


Figure 2: Distance-vector routing algorithm.

How did the network perform?

Results

I tested the design on multiple network topologies. In each case, every node was able to determine the optimal path to all other nodes in the network.

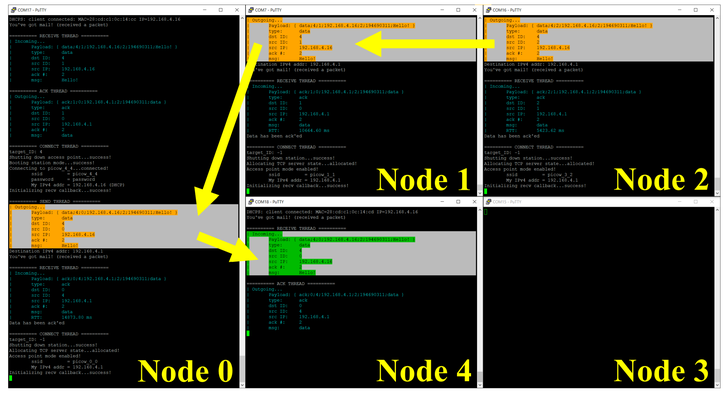


Figure 3: A successful transmission from node 2 to node 4.

Applicability

Pico-W networks are scalable. Increasing the size of the network is as easy as adding more nodes. If every node has a path to the root node, then the network will be able to find the optimal path from every node to every other node.

Pico-W networks do not depend on third-party Wi-fi. Since each Pico-W can host its own Wi-fi, it extends the versatility of these networks to places where there is no external Wi-fi.

Acknowledgements

I would like to thank my advisor Hunter Adams for his support throughout this project. Without his teaching I would have neither the skillset nor the passion for working with these incredible devices. I would also like to thank Bruce Land for his guidance. Discussions with him contributed heavily towards my understanding of the Raspberry Pi Pico-W and the Lightweight IP library.

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