

WirelessHART: Data Link Layer and MAC

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Overview

- Motivation
- Basic concept
- WirelessHART architecture
 - Data Link layer
 - MAC protocol
 - Time Division Multiple Access (TDMA)
- Conclusion

Motivation

- Technologies, such as ZigBee and Bluetooth could not meet requirements of industrial control
- stricter timing requirement and higher security concern
- environments are harsher for wireless applications in terms of interferences and obstacles
- WirelessHART (Wireless **H**ighway **A**dressable **R**emote **T**ransducer) in 2007
- designed for industrial automation

The logo for WirelessHART, featuring the word "Wireless" in a bold, black, sans-serif font, followed by "HART" in a bold, red, sans-serif font. A small registered trademark symbol (®) is located at the end of the word "HART".

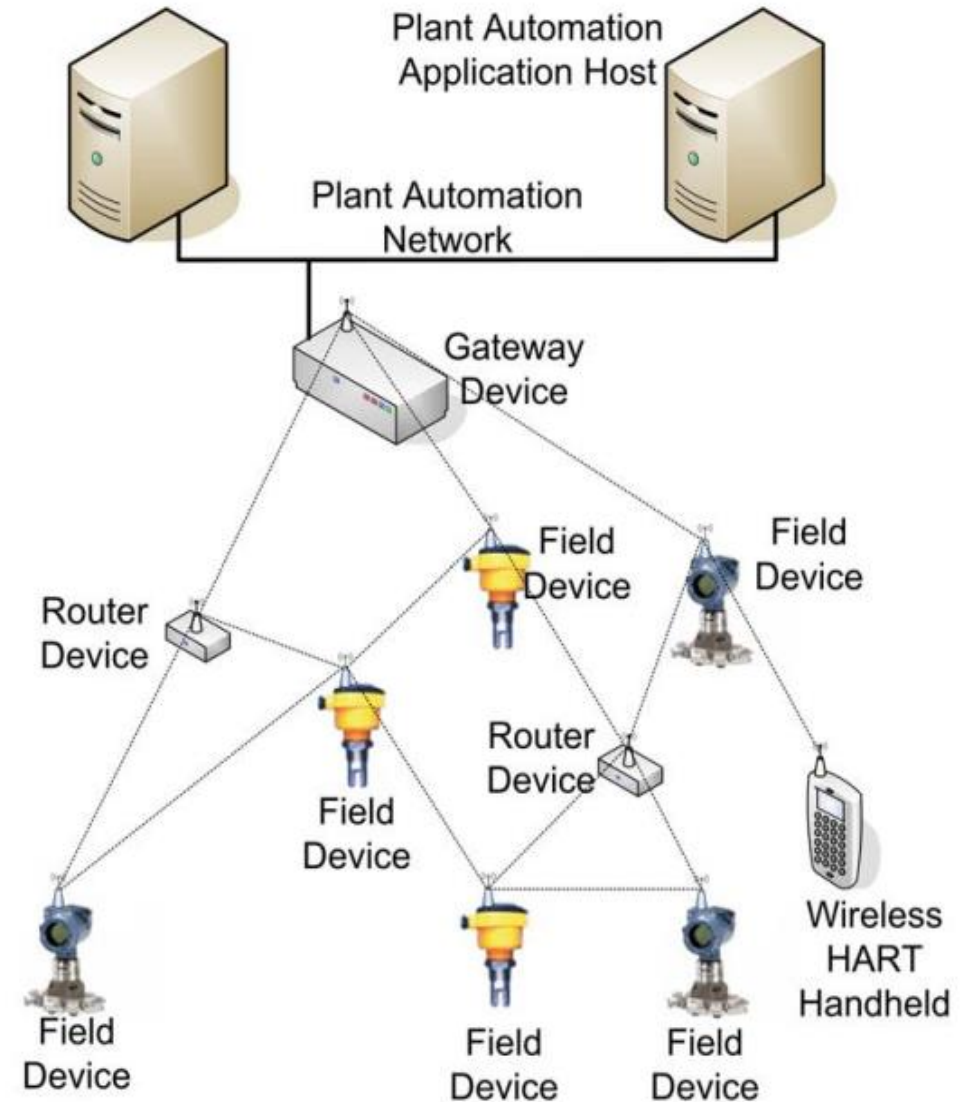
Basic concept

- 2.4GHz ISM radio band
- targeted for process control applications
- adopts IEEE 802.15.4 as the physical layer
- defines its own time-synchronized MAC layer
- channel hopping
- AES-128 cipher keys
- self-organizing and self-healing mesh networking techniques
- central network manager

 **WirelessHART**[®]

Basic elements

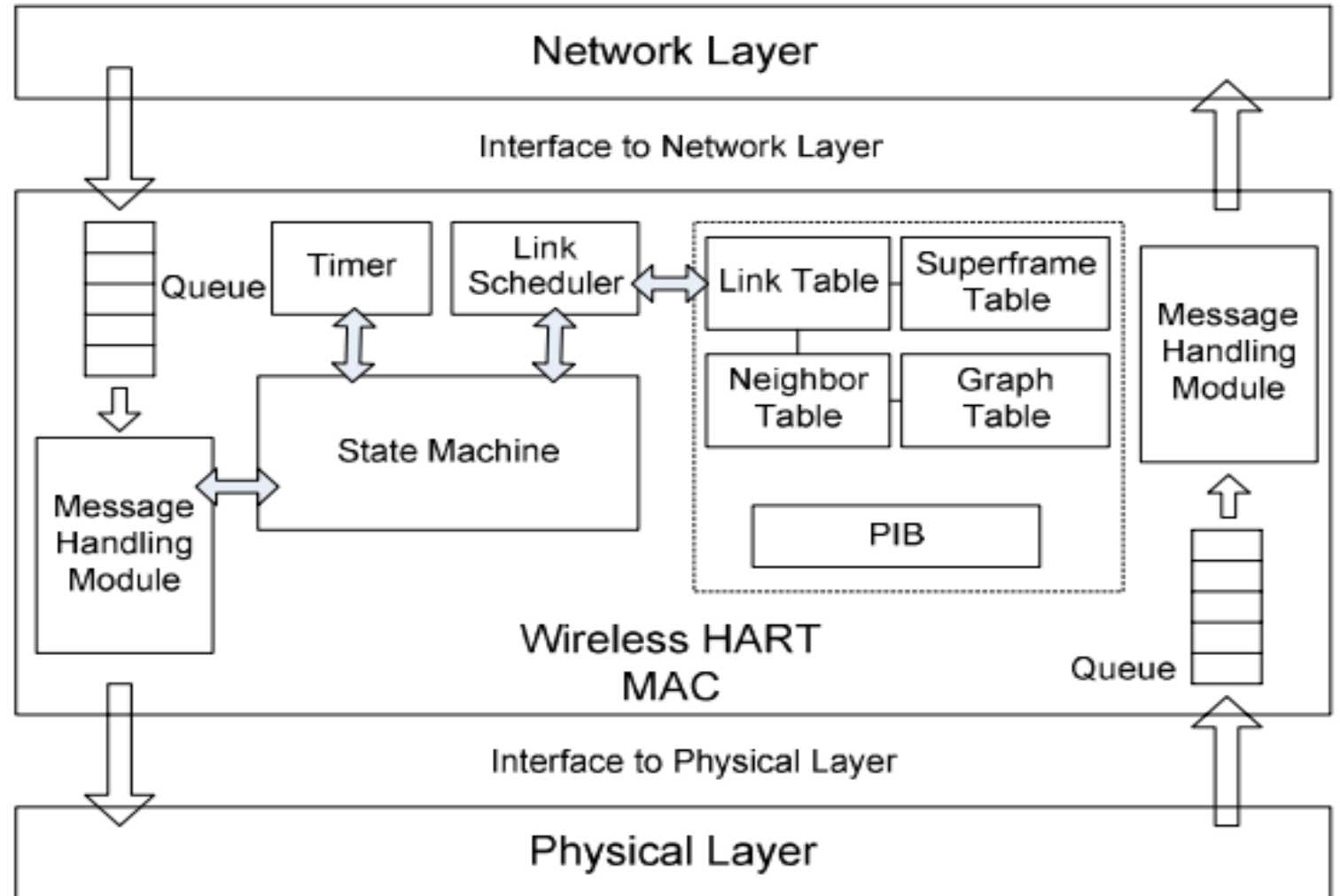
1. **Field Devices** that are attached to the plant process,
2. **Handheld** which is computer used to configure devices,
3. **A gateway** that connects host apps with field devices,
4. **A network manager** that is responsible for configuring the network.



WirelessHART Architecture

Data Link Layer consists of

1. Interfaces
2. Timer
3. Communication Tables
4. Link Scheduler
5. Message Handling Module
6. State Machine



MAC Protocol

The main tasks of the MAC protocol are:

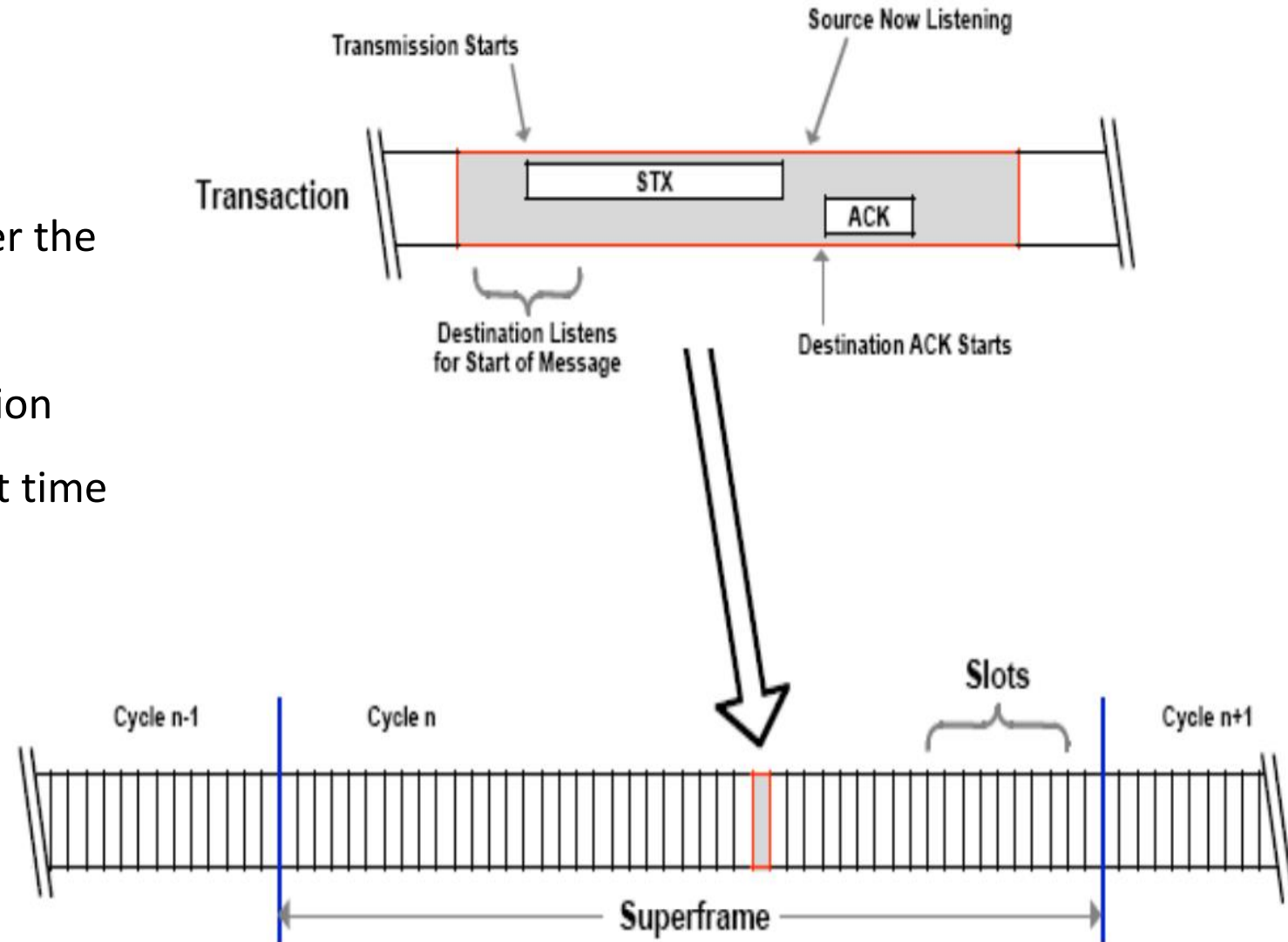
- slot synchronization,
- identification of devices,
- propagation of messages,
- to listen for packets being propagated

Devices must include:

- tables of neighbors, superframes, links, and communication graphs between devices,
- a link scheduler that evaluates the device tables,
- state machines that control the propagation of packets

Time Division Multiple Access (TDMA)

- collision free
- series of time slots form a superframe
- transmission starts at a specified time after the beginning of a slot
- receiver listens before the ideal transmission start time and continue listening after that time
- destination device sends an ACK
- shared slots, so collisions are possible
- random back-off delay
- channel hopping is combined with TDMA



Conclusion

- WirelessHART uses 2.4GHz license free frequency band
- designed and optimized for industrial wireless sensor communications
- TDMA synchronizes the devices and enables a highly reliable (collision free) network
- built on IEEE 802.4.15 standard, it can also co-exist with other wireless networks
- self-healing network, finds alternate paths around obstructions
- robust security mechanisms, such as AES-128 encryption, code management, and authentication

Thank you for your attention.

Questions?