

Mindtree IEEE 802.15.4 MAC and PHY Semiconductor IP

*Designed for High performance, low footprint
Interoperable across all major solutions*

Semiconductor companies today, license Intellectual Property (IP) from third party suppliers and integrate it into their Chips, to hit the market faster. In such a scenario, building the right System-on-Chip (SoC) depends on appropriate selection and integration of the IP.

Mindtree, a leading provider of Short Range wireless IP for the last 19 years, has developed an IP based on IEEE 802.15.4-2011 specifications.

Mindtree's Wireless IP for IEEE 802.15.4 MAC and PHY is designed to suit the needs of semiconductor companies. By partnering with us, companies can accelerate their product development lifecycle, thereby achieving faster time-to-market for their products.

Mindtree, which is an associate member of Thread Group, is currently in the process of developing a Thread Stack which can be ported on top of the underlying hardware. With this, Mindtree will soon be able to provide a one-stop solution to the entire protocol stack of 802.15.4.

Why Mindtree 802.15.4 IP ?

Reduced development risk

- 19+ years of experience in building and licensing wireless IP
- Robust and interoperable across all major solutions
- Optimized implementation
- Enables product companies engineer low-footprint

Protocol supported: IEEE 802.15.4-2011

IP Maturity

- Meets all specification requirements
- Licensed to top semiconductor companies
- Successfully Taped out
- First Chip, based on our 802.15.4 IP to be in production shortly

Supported Software Stacks

- Zigbee
- RF4CE
- Thread

To view the video demo of our 802.15.4 IP [click here](#).

Faster time-to-market

- Well-defined platform abstraction layer for easy and risk-free porting and integration
- Highly customizable for product-specific optimization and differentiation
- Strong software credentials for building reference designs and sample applications

Reduced product costs

- One-stop-shop for 802.15.4 solution
- Optimized use of resources for low footprint, gate count
- Flexible support during product development life cycle.

Mindtree offering in 802.15.4

IEEE 802.15.4 has two IP components – IEEE 802.15.4 (MAC & PHY) and Software Stack. Currently, Mindtree offers IP for MAC and PHY layers.

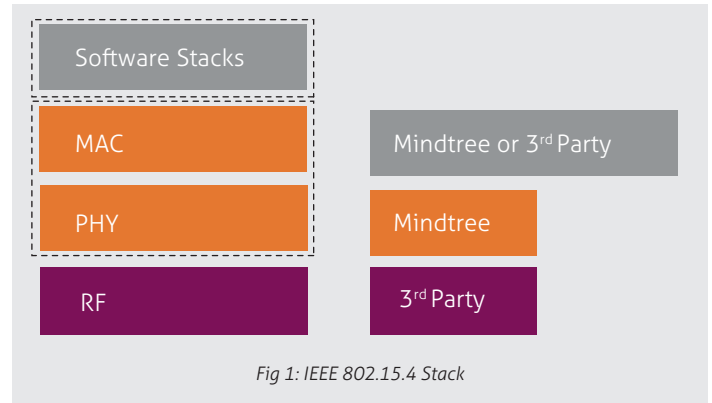


Fig 1: IEEE 802.15.4 Stack

Mindtree IEEE 802.15.4 MAC & PHY

Mindtree 802.15.4 IP is a hardware-firmware co-design. Time-critical functions are handled in the hardware, while protocol logics are implemented in firmware to offer greater flexibility.

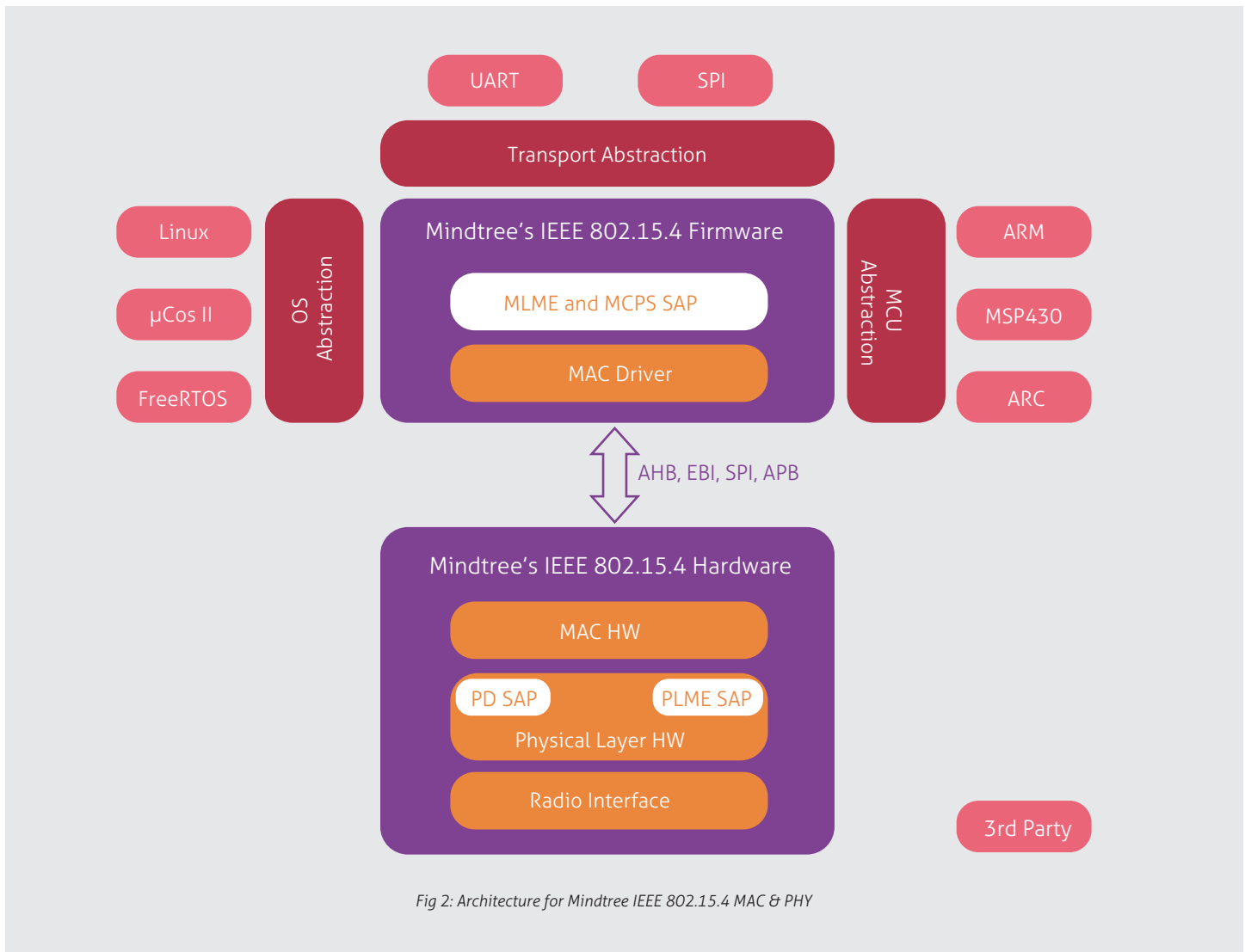


Fig 2: Architecture for Mindtree IEEE 802.15.4 MAC & PHY

Mindtree IEEE 802.15.4 MAC

Our MAC implementation is fully compliant with IEEE 802.15.4-2011 MAC specifications. We support all mandatory and optional features. Some of the features of our MAC implementation are:

- Association and disassociation
- Beacon management
- Channel access
- Frame validation and acknowledgement
- All defined security mechanisms.

MAC operates in two different modes based on the specification:

- Beacon enabled
- Non-beacon enabled.

Mindtree, currently, supports the non-beacon enabled mode.

Key advantages of Mindtree IEEE 802.15.4 MAC

- High degree of configurability based on target application
- Designed for portability across 8-bit/16-bit/32-bit processors
- Firmware architected for low foot-print
- Optimized memory architecture
- Built-in power management module for ultra-low power consumption
- Flexible interfaces for easy integration with third party modem/RF
- Run time configurability

Mindtree 802.15.4 - PHY

Our PHY implementation is fully compliant with IEEE 802.15.4-2011 PHY specification.

Mindtree has implemented 802.15.4 digital PHY for 2.4 GHz ISM band which easily integrates with customer's Radio front end.

It supports modulation/demodulation, Automatic Gain Control (AGC), Energy detection(ED), Link quality identification (LQI) and channel selection/assessment (CCA) algorithms.

Mindtree 802.15.4 – PHY supports:

- **Frequency Band:** 2.4 GHz (ISM/Worldwide)
- **Data rate:** 250 kbps (over the air)
- **Coding:** Direct Sequence Spread Spectrum
- **Modulation:** Offset-QPSK

For information related to Receiver Sensitivity, Channel Selection Filter attenuation requirement, Carrier offset, Carrier drift, clock drift and other related parameters, write to us at wireless.ip@mindtree.com.

Key advantages of Mindtree IEEE 802.15.4 PHY

- High performance modem
- Configurable architecture based on RF front end
- Optimized gate count
- Easily customizable for different RF Frontend

Mindtree IEEE 802.15.4 MAC and PHY Deliverables

MAC Layer Deliverables

1. Delivery of MAC hardware RTL
2. C-test cases for MAC hardware
3. MAC firmware
4. Hardware build and other shell scripts (Unix/Linux)
5. Firmware make file for Windows
6. Documentation
 - a. MAC Architecture document
 - b. MAC software programmer manual
 - c. MAC IP user guide
7. FPGA synthesis & PAR scripts for Mindtree FPGA platform.

PHY (Modem) Deliverables

1. RTL source code in Verilog for digital PHY (modem) for both transmitter and receiver.
2. ASIC Synthesis and STA scripts for EDA tool flow
3. RTL Simulation Environment
4. Test Suite for integrated MAC and PHY
5. Test scripts
6. Documentation

Software Deliverables





1. MAC firmware C source code targeted at Cortex M0 + RVDS compiler
2. Source code of sample application to illustrate the use of APIs
3. API Documentation

Note: Customers may opt for the CPU of their choice. Mindtree generally implements for Cortex M0.

Modes of Licensing Mindtree IEEE 802.15.4 IP

Modes of Licensing	Availability
Standalone 802.15.4 MAC and PHY	Available
802.15.4 + BlueLitE Bluetooth low energy combo solution	Available

Mindtree Wireless IP credentials

 500 + years of investment	 Bluetooth 4.x and 5.x Co-creator	 50 million+ products shipped with IP	 80+ Customers for IPs
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So, are you ready with your product design?

Write to us at wireless.ip@mindtree.com and we will schedule a meeting for you.

Appendix:

Abbreviations	Description
MLME	MAC sublayer management entity
MCPS	MAC common part sublayer service access point
PD SAP	PHY data service access point
PLME-SAP	Physical layer management entity service access point
RF	Radio Frequency
QPSK	Quadrature Phase Shift Keying

About Mindtree

Mindtree [NSE: MINDTREE] is a global IT consulting and services company which helps clients across 17 countries achieve business agility, competitive edge, and growth. We harness the power of Continuous Delivery, our digital expertise, industry knowledge, and research in emerging technologies to drive efficiencies and enable business innovation for over 340 clients. Mindtree is consistently regarded as one of the best places to work. This is a reflection of our entrepreneurial, collaborative and dedicated "Mindtree Minds" who embody the winning culture that defines our commitment to excellence, innovation, and co-creation. To learn more about us, visit www.mindtree.com or follow us [@Mindtree_Ltd](https://twitter.com/Mindtree_Ltd)