A Unified Architecture for Flexible Radio Power Management in Wireless Sensor Networks

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Motivation

- **Need for system support for development of radio power management protocols**
  - Developers currently have to reimplement multiple layers and have intimate knowledge of all layers in a network protocol stack just to test out their power management protocols
  - No way of plugging in new power management protocols without modifying other functionality
  - No way of coordinating these protocols with those implemented at different layers
  - Result -> Tend to see lots of simulations, but few real life implementations
  - Solution: Develop a unified and flexible architecture that can incorporate and integrate different power management strategies

- **Need for coherent way of determining which power management strategy is most appropriate for a given application**
  - Different applications have different power management/latency requirements
  - How do these requirements map to the best possible networking and power management policies available for a given platform?
  - Solution: Develop configuration tools to produce the optimal strategy for a given application's requirements and platform characteristics

Link Layer Abstractions

*Set of interfaces defined to separate sleep scheduling protocols from MAC layer protocols*
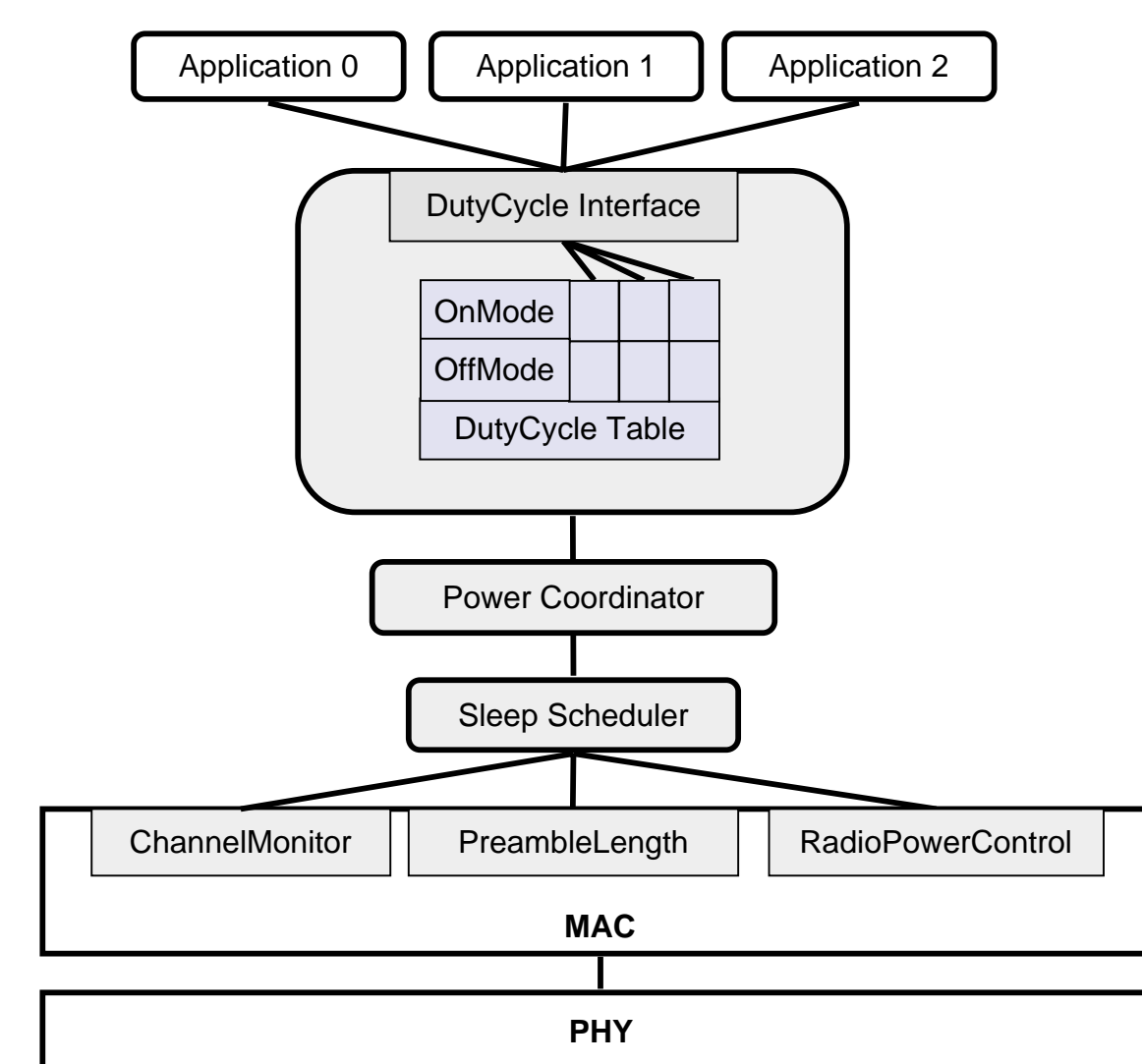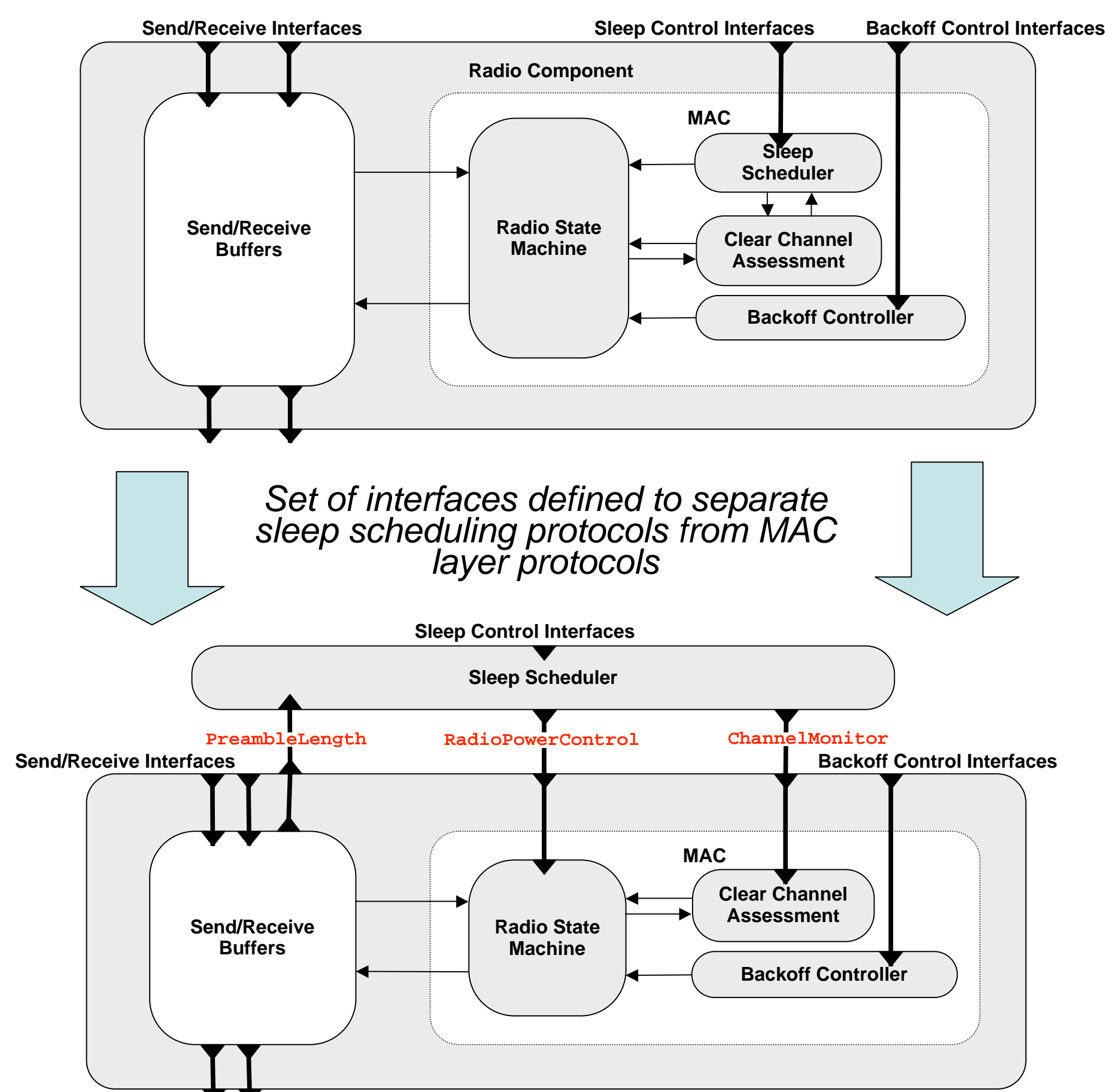
- Abstraction table defined to collect duty cycle parameters supplied by multiple applications
- Power Coordinator determines optimal schedule for the sleep scheduler given the supplied parameters
- Sleep Scheduler uses MAC level interfaces to control the power state of the radio according to this schedule

Configuration Tools Support
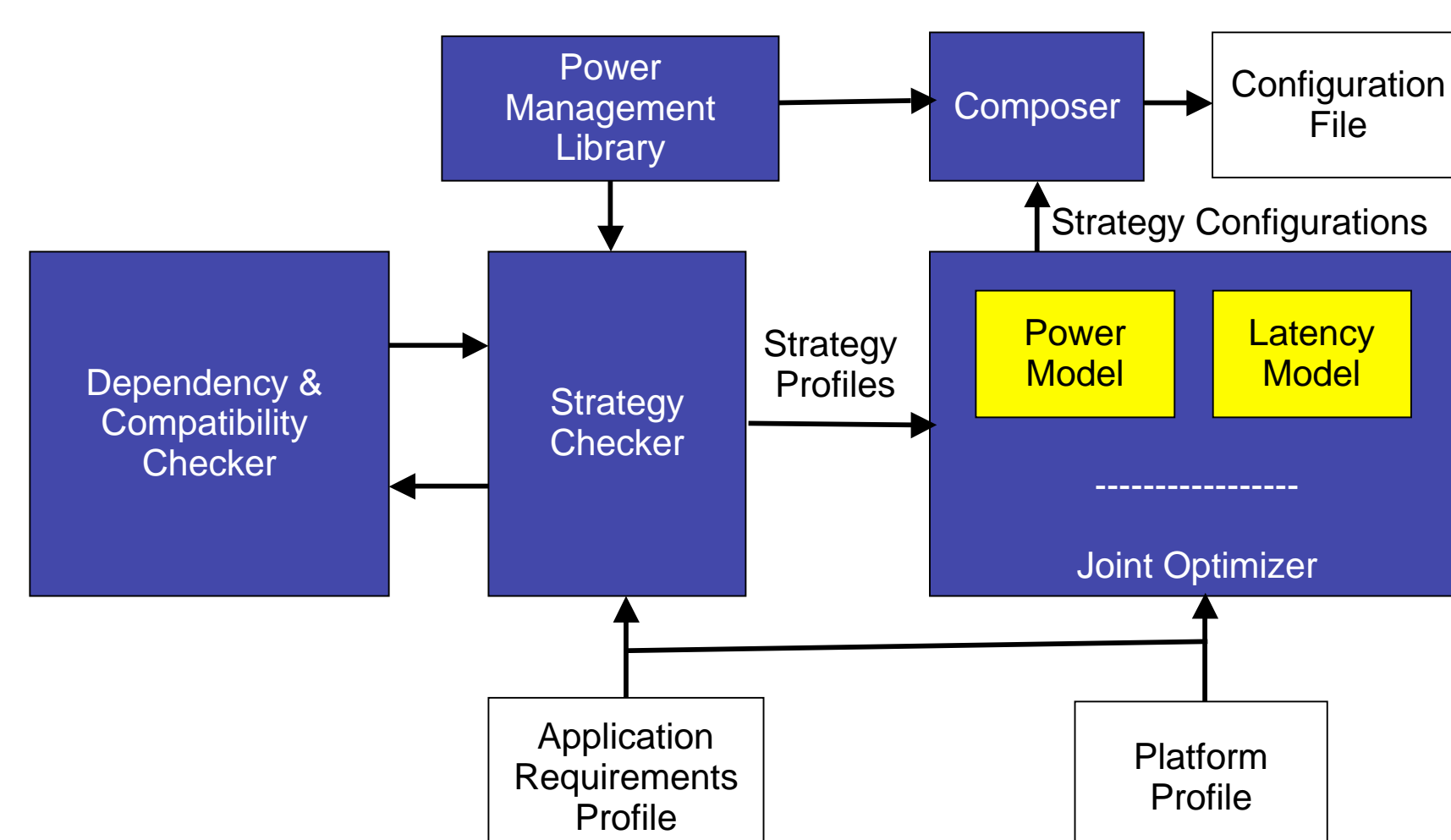
- **Given a set of network protocols and applications, choose the best power management strategy based on their requirements/limitations**
  - "Application requirements profile" and "platform profile" are jointly optimized with "power management profiles" selected from a power management library to compose a power management configuration file
  - Tools take this configuration file and generate code necessary to support the proper power management strategy for a given operating system/hardware platform

Unified Power Management Architecture (UPMA)
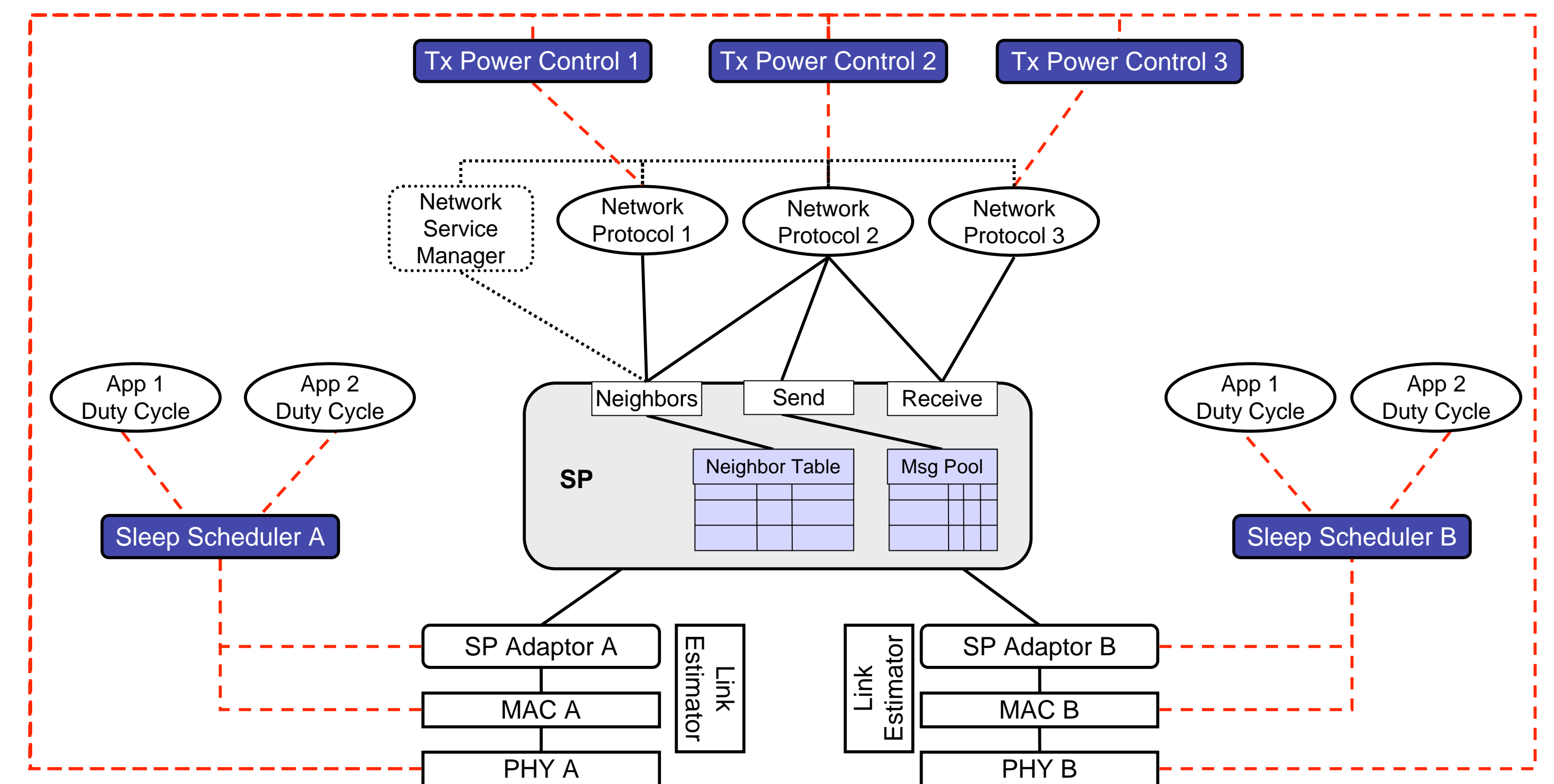
- **Extension of SP to include explicit support for radio power management across multiple networking protocol stack layers**
  - Separation of power management protocols from existing implementations at each layer
  - Allows power management protocols to develop independently from networking technologies
  - Allows different power management schemes to be easily changed based on application requirements
  - Requires coordination of power management protocols across multiple layers
  - Requires coordination of different power management protocols existing at the same layer
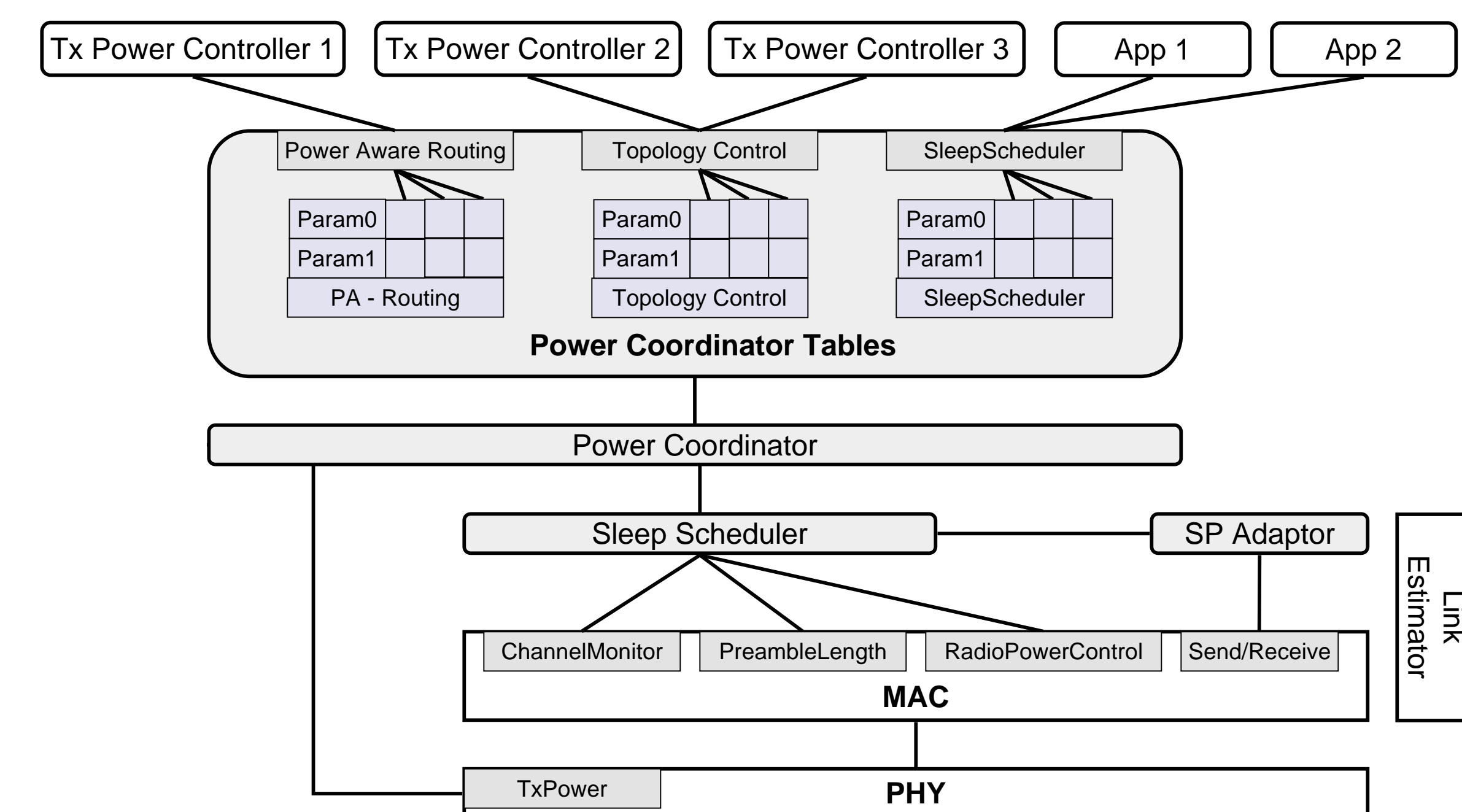
- **Architectural support for development of power management protocols**
  - Given a set of *TxPowerControl* Protocols and a *SleepScheduling* protocol, a *PowerCoordinator* must be defined that can optimize their interaction to produce an overall power management strategy
  - Different applications can specify different duty cycles/ other parameters to the sleep scheduler
  - Different *TxPowerControl* strategies can coexist
  - It is the job of the Power Coordinator to decide how to best configure the underlying layers.