Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: [DATA-ACK Based Ranging Sequence]
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Re: [802.15.4a.]

Abstract: [Proposal on PHY/MAC ranging extensions]

Purpose: [Promote discussion on 15.4a PHY/MAC ranging extensions]

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Required Features for Ranging

- Non-interruptible message sequences for round trip measurement
- Time stamps of message sequence to higher layer
- Preamble type control (preamble length)

Non-interruptible Message Sequence

- DATA-ACK Sequence is a non-interruptible message sequence per 15.4 MAC definitions
- There are several reasons, not to return the ranging information in the ranging response packet:
  - Avoiding new MAC services (e.g., DATA-DATA-like sequences)
  - Avoiding time critical processing of return information (especially in case of secure ranging mechanisms)

Time Stamps of Message Sequence (1)

- MCPS-DATA service primitive time stamp parameter is already available in the 15.4b MAC
- Additional time stamp parameter has to be added for the ACK packet
- Time stamps have to be extended for high resolution
  - minimum resolution t.b.d.

Time Stamps of Message Sequence (2)

MCPS-DATA Service Primitive

MCPS-DATA.confirm (
    msduHandle,
    ....
    Timestamp*, /* **high resolution** time stamp of transmitted DATA packet *\
    TimestampAck **/* high resolution time stamp of received ACK packet ***
)

MCPS-DATA.indication (
    SrcAddrMode,
    .....
    Timestamp*, /* **high resolution** time stamp of received DATA packet *\
    TimestampAck, **/* high resolution times tamp of transmitted ACK packet ***
    ....
)

Time Stamps of Message Sequence (3)

PD-DATA Service Primitive

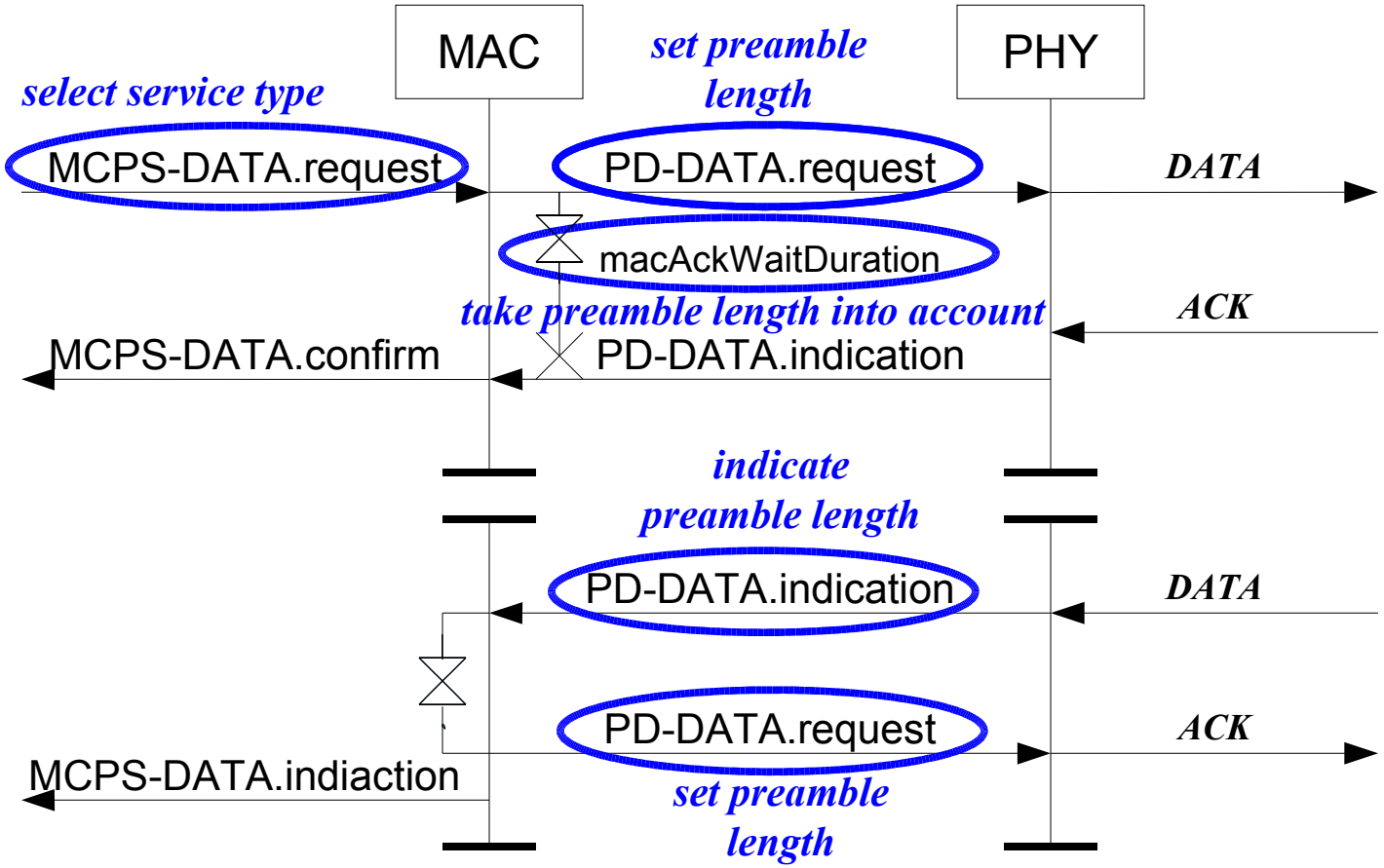
PD-DATA.indication (
    psduLenght,
    psdu,
    psduLinkQuality,
    Timestamp, **/* high resolution time stamp of received PSDU ***
)

Preamble Type Control (1)

- Regard data transfer and ranging as different types of services for higher layer
- Service type selection should be fast, because in most ranging applications service type can change after each message sequence
- PHY/MAC receiver should be able to detect service types (service type sequences are not predictable)
- Service type could be requested from higher layer per service primitive (MCPS-DATA)
- Preamble length is associated with service type

Preamble Type Control (2)

DATA-ACK Sequence Chart



Preamble Type Control (3)

MCPS-DATA Service Primitive

MCPS-DATA.request (

msduHandle,

...

ServiceType **/* type of service, preamble length associated ***

)

MCPS-DATA.indication (

SrcAddrMode,

.....

ServiceType **/* this is optional, but might improve support for application ***

....

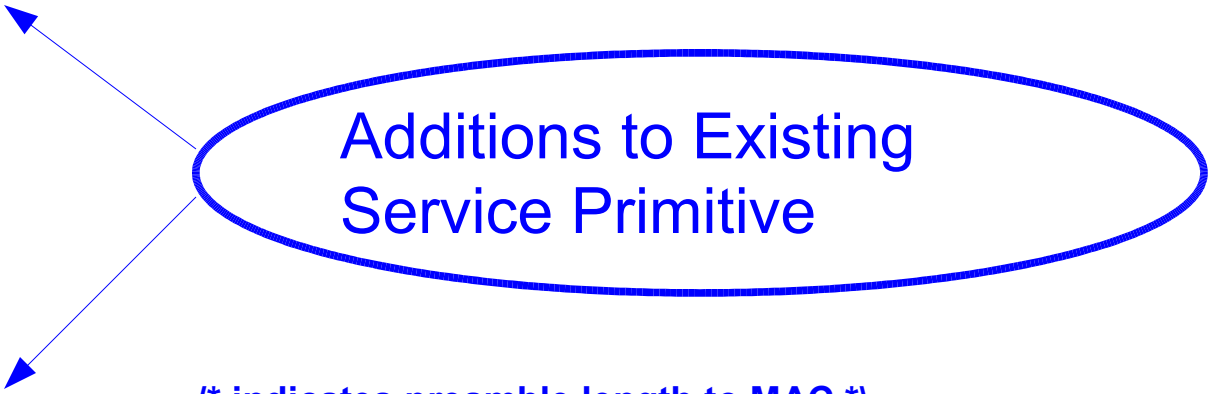
)

Preamble Type Control (4)

PD-DATA Service Primitive

PD-DATA.request (
psduLenght,
psdu,
PreambleType **/* sets preamble length ***
)

PD-DATA.indication (
psduLenght,
psdu,
psduLinkQuality,
PreambleType **/* indicates preamble length to MAC ***
)



Preamble Type Control (5)

- Receiver has to detect the preamble length reliably
- Preamble type identifier could be coded into the PHY frame
- PHY level coding avoids backward compatibility problems (4/4b MAC on 4a PHY)

Preamble Type Control (6)

- 1) Additional field in PHY packet identifies preamble type

PTI = Preamble Type Identifier

- 2) For improved robustness identifier should be coded and can be optionally combined with the SFD, similar to Access Code in 802.15.1

Summary

- DATA-ACK based ranging sequence
- Additions/extensions:
  - Additional parameters in PD-DATA service primitives
  - Additional parameters in MCPS-DATA service primitives
  - Additional code in PHY frame