Project: IEEE P802.15 Working Group for Wireless Specialty Networks (WSNs)

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Abstract: [IETF/IEEE802 Coordination Meeting Update]

Purpose: [IETF/IEEE802 Coordination Meeting Update]

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IEEE 802.15.12

(Upper Layer Interface)

Update

Paris, France

Friday, September 9, 2016

802-2014 Reference Model

The LLC sublayer contains a variety of entities, as illustrated in Figure 6.
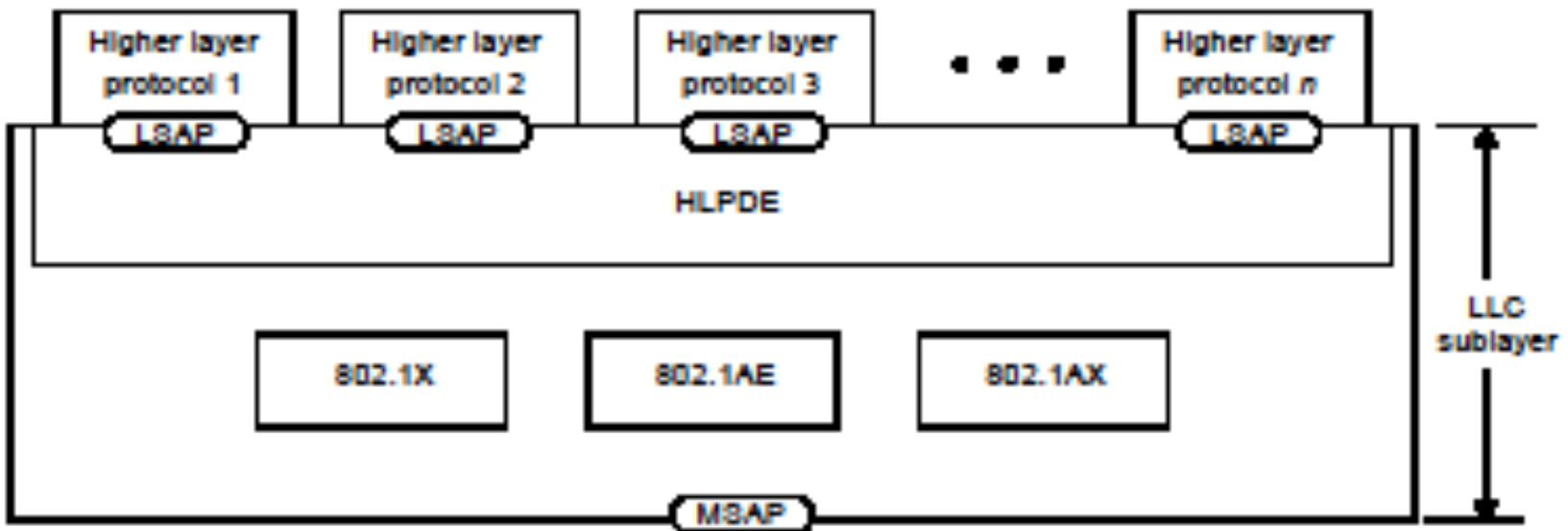

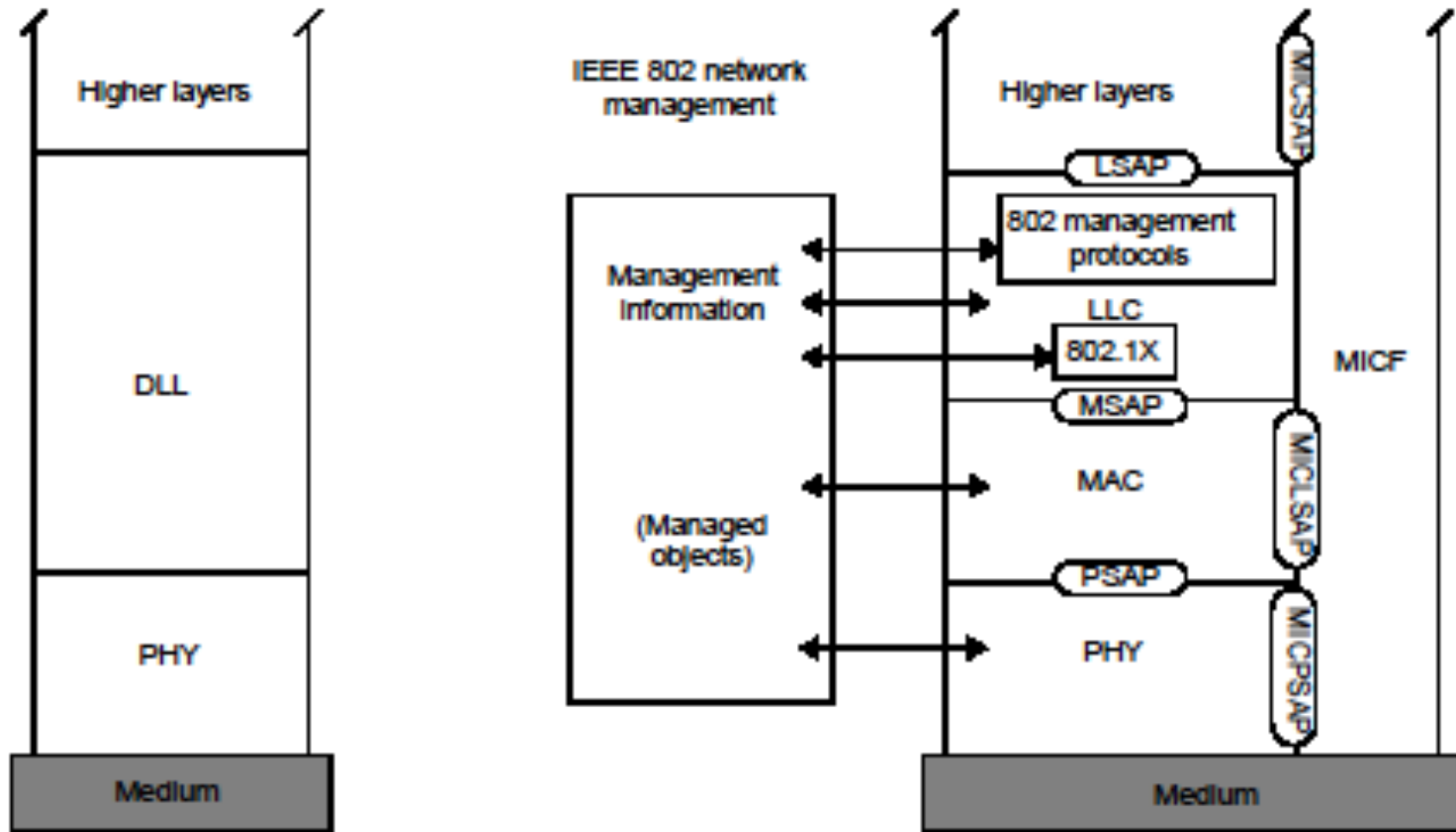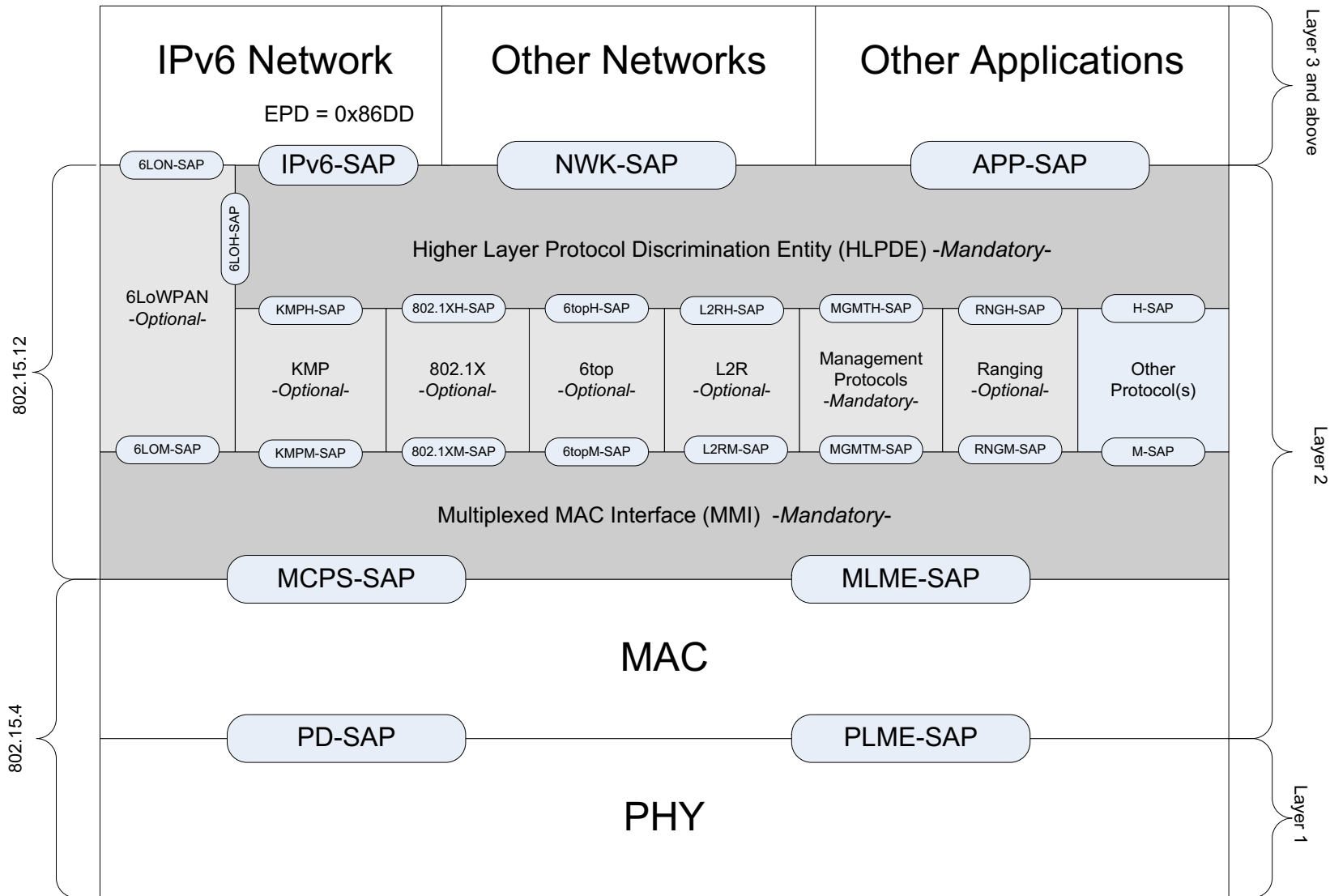Figure 6—LLC sublayer in 802 RM

802-2014 Reference Model

Figure 5—IEEE 802 RM with end-station management, security, and MIH

802.15.12 Functional Decomposition

| | IPv6 Network | Other Networks | Other Applications | Layer 3 and above |

EPD = 0x86DD

6LON-SAP — IPv6-SAP — NWK-SAP — APP-SAP

6LOH-SAP

Higher Layer Protocol Discrimination Entity (HLPDE) *-Mandatory-*

| 6LoWPAN *-Optional-* | KMPH-SAP | 802.1XH-SAP | 6topH-SAP | L2RH-SAP | MGMTH-SAP | RNGH-SAP | H-SAP |

| | KMP *-Optional-* | 802.1X *-Optional-* | 6top *-Optional-* | L2R *-Optional-* | Management Protocols *-Mandatory-* | Ranging *-Optional-* | Other Protocol(s) |

| 6LOM-SAP | KMPM-SAP | 802.1XM-SAP | 6topM-SAP | L2RM-SAP | MGMTM-SAP | RNGM-SAP | M-SAP |

Multiplexed MAC Interface (MMI) *-Mandatory-*

MCPS-SAP — MLME-SAP

MAC

PD-SAP — PLME-SAP

PHY

802.15.12 (left margin label)
802.15.4 (left margin label)
Layer 2 (right margin label)
Layer 1 (right margin label)

Note: IEEE 802-2014 states: New IEEE 802 standards shall support protocol discrimination in the LLC sublayer using EtherType Protocol Discrimination (EPD).

802.15.12 Functional Description

- ## Higher Layer Protocol Discrimination Entity (HLPDE)
  - Directs and optionally modifies information from Functional SAP to the appropriate higher layer protocol SAP or another Functional SAP

- ## Multiplexed MAC Interface (MMI)
  - Directs and optionally modifies information from Functional SAP to the appropriate MAC SAP or another Functional SAP

802.15.12 Higher Layer Protocol Discrimination Entity (HLPDE)

- HLPDE will be dependent upon configuration of device (via Mgmt Protocol entity).

- For frames going to the higher layer, the HLPDE removes the ULI header (if present), and directs the frame to the proper SAP identified by the ULI header information.

- For datagrams coming from a higher layer, the HLPDE prepends the datagram with a ULI header and forwards it to the appropriate SAP defined by the configuration setting.

  - Note: review how CoMI and CoAP send their management information to the correct device/SAP. Note: ask RAC for EtherType assignment for 802.15.12.

802.15.12 Multiplexed MAC interface

- ## Multiplexed MAC Interface (MMI)

  - Provides multiplex and fragmentation service to the packets sent by the ULI functions and send them to either the MCPS-SAP, the MLME-SAP, or to another function within the ULI.

  - The interface between the MMI and the ULI functions includes the Multiplex ID and the payload to be sent or the payload received.

  - The mechanism for the MMI, i.e. the ability to send the data to the proper SAP, will be an extension of the mechanism defined in IEEE 802.15.9 for the multiplexed data service

802.15.12 Functional Description

- **802.1X** provides authentication, authorization, and cryptographic key agreement mechanisms to support secure communication between end stations connected to 802 networks.

- **802.15.9 (KMP)** provides a methodology to enable key management by providing a transport for key management protocols outside the application layers. Additionally, provides a fragmentation and multiplexing layer for those packets so they can be delivered over smaller MAC layer frames and multiplexed on the recipient end to the right processing service.

- **6LoWPAN** provides the function of MAC frame modification into a frame format for transmission of IPv6 packets and the method of forming IPv6 link-local addresses and statelessly autoconfigured addresses on IEEE 802.15.4 networks. Additional functions include a header compression scheme using shared context and provisions for packet delivery in IEEE 802.15.4 meshes.

802.15.12 Functional Description

- **6tisch** functions as an abstraction of an IP link over the TSCH mode of the MAC sublayer by providing network formation and maintenance, multi-hop topology, assign time source neighbor, resource management, dataflow control, scheduling mechanisms, and security.

- **802.15.10 (L2R**) provides the following functions: topology construction, L2R mesh discovery/join/update/recovery, hop-by-hop retransmission, unicast/multicast/broadcast routing, data concatenation, short address assignment, and security

- **Management protocols** provides a Yang modeling interface via the   HLPDE-SAP to upper layer applications such as CoAP, CoMI. Additionally, it provides configuration parameters to the MAC and PHY via the MMI-SAP, and may provide configuration parameters to other protocol entities in the ULI.

Strategy for moving forward

Next Steps

1. Define the Higher Layer Protocol Discrimination Entity (HLPDE).
2. Define how the Multiplexed MAC interface (MMI) works using the Multiplexed data service as a baseline.
3. Define how the management protocols work
   - PHY configuration
   - MAC configuration
   - TG4s coordination efforts
4. Define how KMP should work within 15.12.
   - Define the KMP SAPs using 802.1X as an example

Strategy for moving forward

Next Steps (cont)

1. Define how 6LoWPAN should work within 15.12.
    - Define the 6LO SAPs using IPv6 as an example
2. Define how L2R should work within 15.12.
    - Define the L2R SAPs using both an endpoint and router as examples
3. Define how Ranging should work within 15.12
    - Define the RNG SAPs using RFID as example
4. Define ULI frame mechanism (ULI IE/Payload).
    - Unique identification of ULI presence
    - Compression of higher layer stack and EtherType
    - Other components?

Future Efforts

Functional Blocks

- **HLPDE**   P Kinney
- **MMI**   P Kinney
- **Management Protocol**   H Yokota
- **6LoWPAN**
- **KMP**
- **802.1X**
- **L2R**   C Perkins
- **6tisch**
- **Ranging**   B Verso

Functional Block Overview

- How do they work?
- What functions do they include?
- How do the SAPs work?
- What primitives are required?
- What parameters are required?

July Plenary Accomplishments

- ❑ **Discussion on the concepts necessary for 802.15.12**
  - ❑ **Use of an IE assigned to 15.12 for any ULI message**
  - ❑ **Use of an IE assigned to 15.12 for ULI 6LoWPAN message**
  - ❑ **Use of the frame payload for ULI message (note: requires the devices to have security and use a well-known key for discovery)**
- ❑ **Discussion on the architecture for 802.15.12**
  - ❑ **Agreement on extensible and scalable architecture**
- ❑ **Discussion with TG4s on common efforts**
  - ❑ **Agreement on common efforts and methods to work together**

Schedule

TASK	Start	Completed
TG12	**May, 2016**	**November, 2018**
Concept and Architecture	May, 2016	July, 2016
Baseline definition	July, 2016	Nov, 2016
Draft	Nov, 2016	March, 2017
TG Comment Collection	April, 2017	May, 2017
WG Letter Ballot	June, 2017	January, 2018
Sponsor Ballot	January, 2018	July, 2018
NesCom	July, 2018	September, 2018
IEEE-SA Publication	September, 2018	November, 2018

Thank you

Back-up Slides
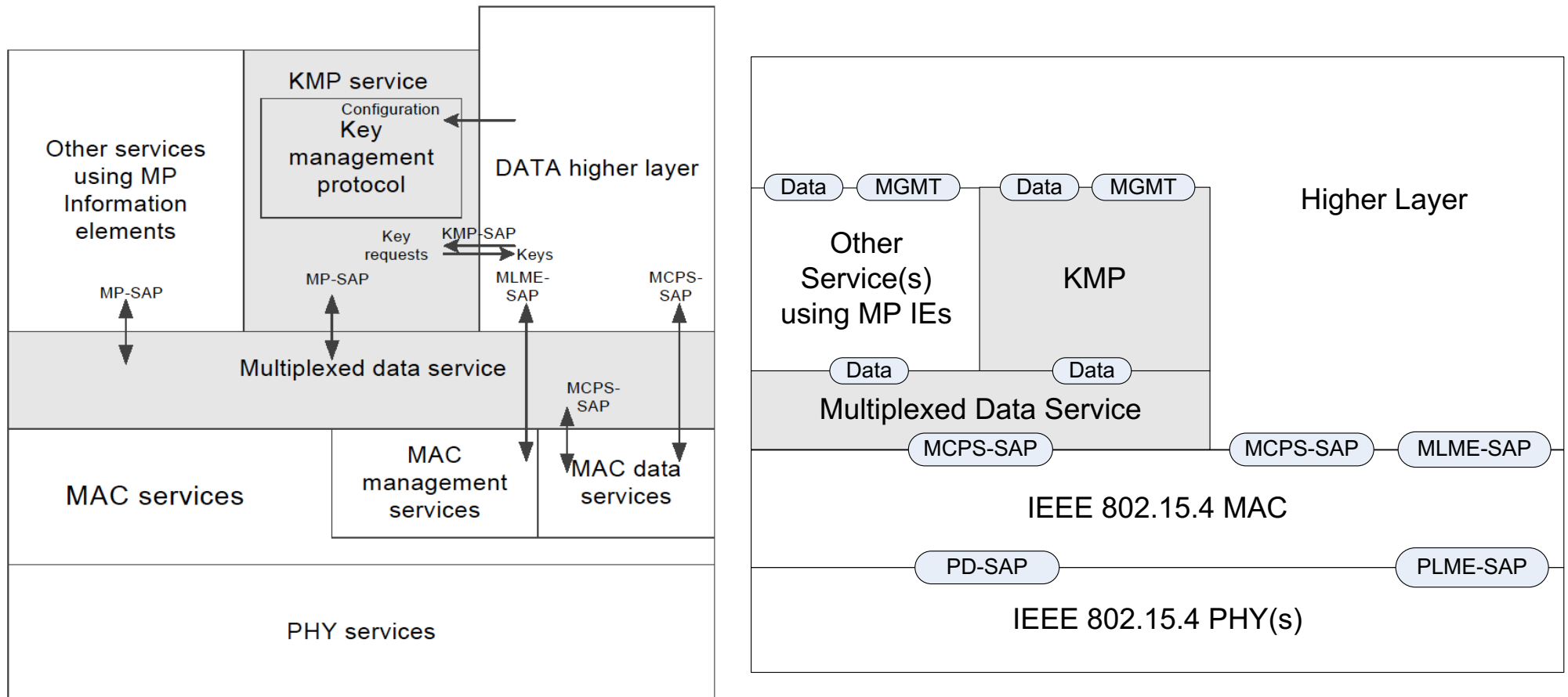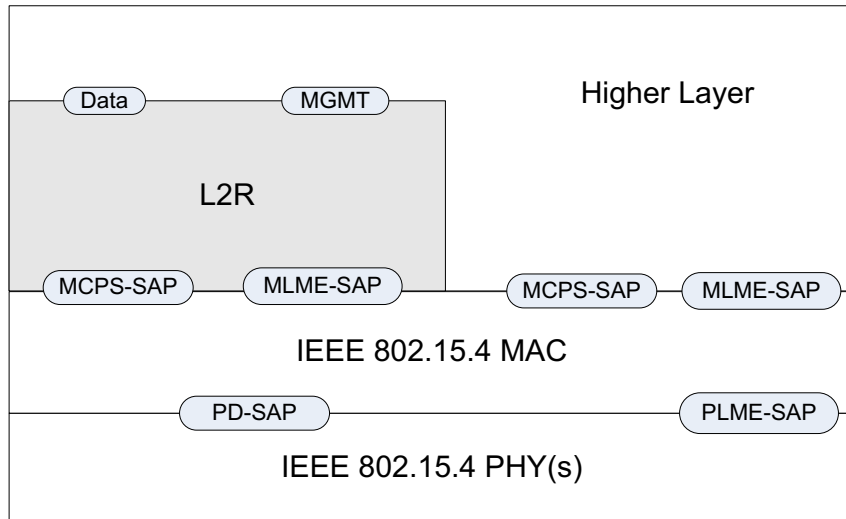
802.15.9 Functional Decomposition

Figure 1—System Overview

802.15.10 Functional Decomposition

The Data SAP and the MCPS-SAP are used for Multicast as indicated in Figure 19 and Figure 66

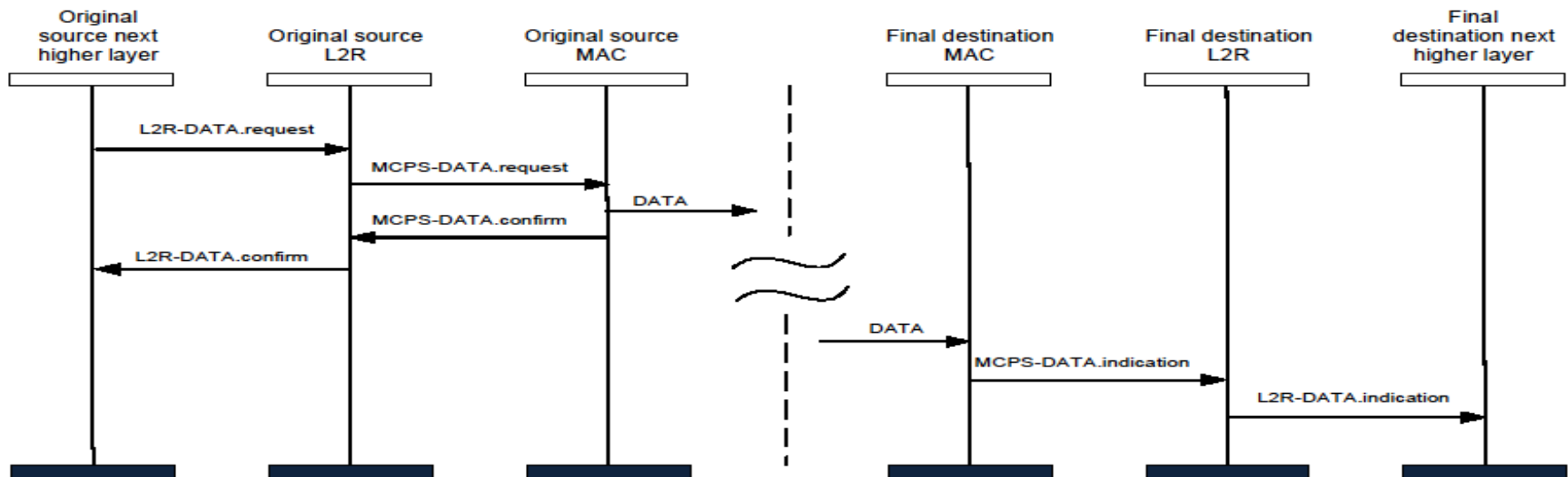The MGMT SAP and the MLME-SAP are used as indicated in Figures 3 through 13

Figure 66—Message sequence chart of a successful end-to-end data transmission
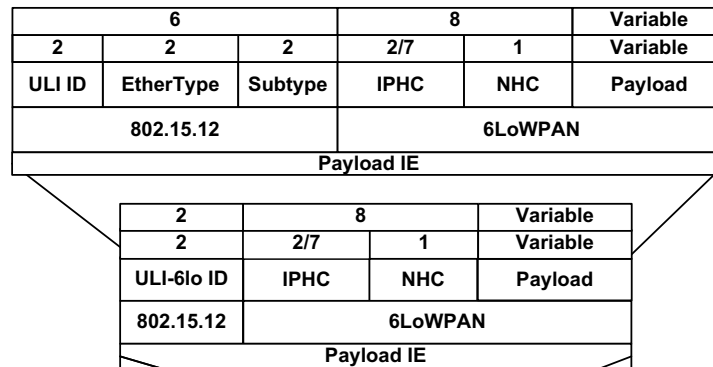
	Management Protocol Configuration Parameters via MGMT SAP		
ULI Protocol entity	**MAC Mode (incl. IEs)**	**PHY Parameters**	**PHY Parameters cont'd**
	TSCH	Channel	Number/Frequency/Band
	DSME	Bandwidth	
	RIT	Modulation	
	CSL	Preamble	Code/repetition
	SUN	FCS size	
	TVWS	Packet Length	
	RFID	Data Rate	
	RCC	Transmit power level	
	LECIM	CCA	Mode/duration
	PAN discovery	FEC	Rate/code/interleaving
	PAN set-up	SFD	Size/value
	Security	ED threshold	
	Association	Spreading factor	
	Promiscuous	DSSS code	
	Ranging	Data whitening	
	Spectrum Tracking	Common signaling mode	

Frame Composition

6			8		Variable
2	2	2	2/7	1	Variable
ULI header	EtherType	Subtype	IPHC	NHC	Payload
802.15.12			6LoWPAN		
Payload					

2	1	2	2	0	2	1	4	1	0	0	6	8	Max Frame Size -∑all other fields	4	2
Octets: 2	0/1	0/2	0/2/8	0/2	0/2/8	1	0/4	0/1/5/9	Variable	Variable	6 / 3/8		Variable	0/4/8/16	2/4
Frame Control	Sequence Number	Dest PAN ID	Dest Addr	Source PAN ID	Source Addr	Security Control	Frame Counter	Key Identifier	Header IEs	Payload IEs	ULI Header	6LoWPAN Header	Data Payload	MIC	FCS
		Addressing Fields				Auxiliary Security Header (optional)									
MHR										MAC Payload					MFR

Using Data Payload to convey higher layer data

6			8		Variable
2	2	2	2/7	1	Variable
ULI ID	EtherType	Subtype	IPHC	NHC	Payload
802.15.12			6LoWPAN		
Payload IE					

2	8		Variable
2	2/7	1	Variable
ULI-6lo ID	IPHC	NHC	Payload
802.15.12	6LoWPAN		
Payload IE			

2	1	2	2	0	2	1	4	1	0	Variable	Max Frame Size -∑all other fields	4	2
Octets: 2	0/1	0/2	0/2/8	0/2	0/2/8	1	0/4	0/1/5/9	Variable	Variable	Variable	0/4/8/16	2/4
Frame Control	Sequence Number	Dest PAN ID	Dest Addr	Source PAN ID	Source Addr	Security Control	Frame Counter	Key Identifier	Header IEs	Payload IEs	Data Payload	MIC	FCS
		Addressing Fields				Auxiliary Security Header (optional)							
MHR											MAC Payload		MFR

Using IEs to convey higher layer data

Deliverables

Deliverables

- **Management SAP**
  - Configuration Management
    - Dynamic PHY management
      - B Rolfe to provide
  - Network
    - Set-Up
  - MAC
    - Set-Up
  - PHY
    - Set-Up
  - Security
    - Set-Up
  - TSCH set-up
    - P Kinney to provide
  - Channel Hopping
- Yang Modeling

- L2 Routing
  - C Perkins to provide
- **Data SAP**
  - Protocol Differentiation
    - EtherType
  - Security
    - KMP (802.15.9)
      - ETSI TS102887-2
      - 802.1x
      - Internet Key Exchange (IKE)
      - Dragonfly
      - PANA
      - Vendor specific
  - MAC Resource Management
    - Priority
    - GTS management
  - TSCH Operation

- P Kinney to provide
- Fragmentation
  - Adaptive
  - PHY (PSDU)
  - UpperLayer
    - 802.15.9
    - 6LoWPAN
- Location awareness
  - Ranging
  - B Verso to provide

Deliverables

- **Management SAP**
  - Configuration Management
    - PHY
      - Set-Up
        - Channel
          - Center frequency
          - Channel number
          - Regional band
        - Bandwidth
        - Modulation
          - Channel page
        - Preamble
          - Code
          - Repetition
        - FCS size
        - Packet Length
        - Data Rate
        - Transmit Power level
        - Data Whitening

- Common Signalling Mode
- ED Threshold
- Spreading Factor
- DSSS code
- CCA
  - Mode
  - duration
- FEC?
  - Rate
  - Coding
  - Interleaving
- SFD
  - Size
  - value

Deliverables

- **Management SAP**
  - Configuration Management
    - MAC
      - Set-Up
        - FFD?
        - Beacon-enabled?
          - DSME?
            - Seong-Soon Joo to provide
          - Superframe parameters
        - Low Energy?
          - Parameters
        - Channel Hopping?

- parameters
- Association?
  - Fast?
- Synchronization
  - Superframe
  - TSCH
- ACK required?
- Promiscuous mode?
  - Ask Packet Sniffer vendors or chipset vendors
- Device Announcement
- UL IEs?
  - parameters

Deliverables

- **Management SAP**
  - Configuration Management
    - Network
      - Set-Up
        - PAN Coordinator?
          - Beacon-enabled?
          - Low Energy?
          - Association?
            - Fast?
            - Permit to Join?
              - Criteria to accept
          - Short Address?
            - Assignment
      - Channel Scan