Reduced Minimum Frame Size

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Purpose

- The purpose of this presentation is to consider whether a reduced minimum frame size (minFrameSize < 64 octets) would be of benefit for 10M single twisted pair Ethernet

- A minimum frame size is necessary for collision detection under certain conditions
  - The details are not discussed in this presentation

- Unless stated, clause references refer to:
  - IEEE 802.3-2012_SECTION1

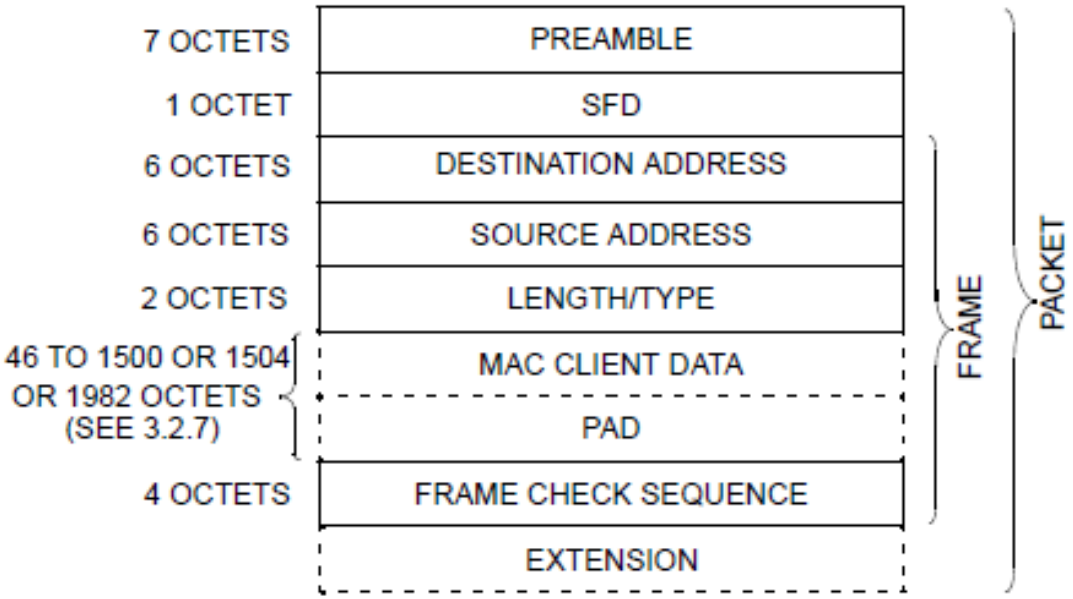
Small automation payloads

- Realtime control typically forms the bulk of the messages in an automation system
  - Periodic bi-directional message exchange

- Application data
  - 1 octet for a simple sensor/actuator
    - 1 bit + status
  - 8 octets for a small I/O “block”

MAC packet format

- MAC Packet
  - 72 octets
  - Contains MAC Frame
- MAC Frame
  - 64 octets
    - minFrameSize
  - MAC data
    - 46 octets (minimum)
  - Padding
- Extension is only for 1000 Mb/s half duplex



46 data octets
(in a minimum packet)

Total packet size with overhead

- MAC packet = 72 octets
- Table 4–2
  - interPacketGap = 96 bits (12 octets)

84 total octets (in a minimum packet)

- Assuming frames are:
  - Packed tightly
  - No collisions
  - No reduction of the MAC protocol overhead

Ethertype and VLAN header(s)

- 3.2.6 Length/Type field
  - If Type is substituted for Length, the MAC will still pad to minFrameSize
- 1.4.334 Q-tagged frame
  - IEEE Std 802.1Q

- Single tagging uses 4 octets from the MAC data
  - 46 octets reduced to **42 octets**

MACsec and other security

- IEEE 802.1AE

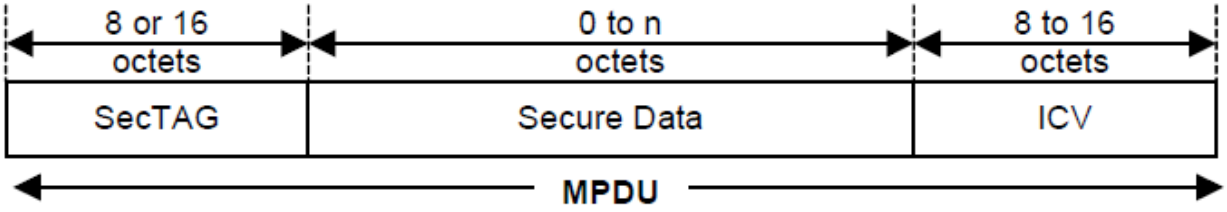


Figure 9-1—MPDU components

- MACsec adds 16-32 octets
  - 46 octets reduced to **14-30 octets**

- IPSec requires IP headers
- TLS/DTLS require IP and TCP/UDP headers

Combined MACsec and VLAN

- IEEE 802.1AE

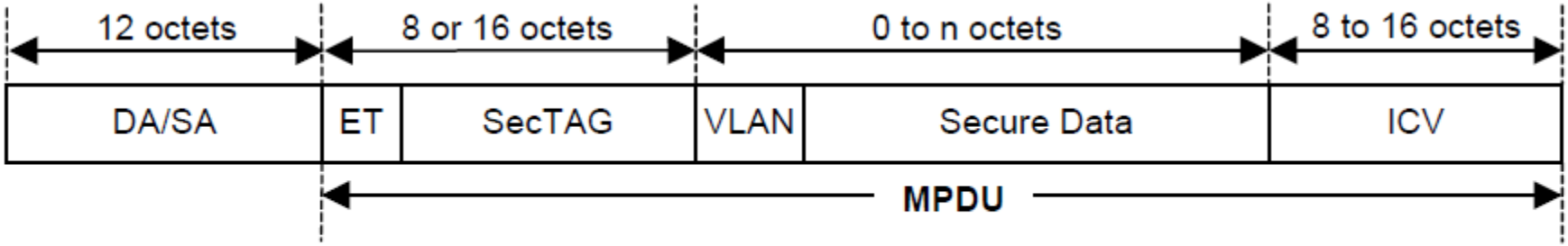


Figure 11-8—MACsec frame format showing VLAN Tag

- Single tagging
  - 46 octets is reduced to **10-26 octets**

IP application protocol overhead

- IP header = 20 octets
- UDP header = 8 octets
- Application headers >5 octets)
  - i.e., CoAP (RFC 7252)
- Total > **33 octets**

Use Cases

	minFrameSize = 64 octets					minFrameSize = 18 octets			
Protocol	No MAC data	IP, Security, VLAN	IP	Ethertype, Security, VLAN, implicit protocol	Ethertype, implicit protocol	IP, Security, VLAN	IP	Ethertype, Security, VLAN, implicit protocol	Ethertype, implicit protocol
Application Data		1	1	1	1	8	8	1	1
Application Header		5	5			5	5		
Transport Header		20	20			20	20		
Network Header		8	8			8	8		
MAC Security		16		16		16		16	
VLAN		4		4		4		4	
MAC Frame	18	18	18	18	18	18	18	18	18
MAC Padding	46	0	12	25	45	0	0	0	0
Total Frame	64	72	64	64	64	79	59	39	19
MAC Packet	8	8	8	8	8	8	8	8	8
InterFrameGap	12	12	12	12	12	12	12	12	12
Total Exchange	84	92	84	84	84	99	79	59	39

Values are in octets

Performance improvement

- Assuming:
  - Very small application data (<<46B)
  - Full duplex (no collision detection) or half-duplex and the smaller frames don't break collision detection
  - Transmissions are scheduled back to back with little or no interframe gap and avoiding collisions
  - Application data is sent as the Ethernet data payload using an Ethertype protocol
  - Data is implicitly understood (no protocol header with the data)
  - There is no security protocol (such as MACsec)
  - There is no use of VLANs
- Then:
  - We might get 2x packets/s

Link loading

- 84 octets = 672 bits
- At 10 Mb/s, each exchange is 67.2 us
  - 14880 packets/s
- For a full duplex connection:
  - 10 packet/s for 64 nodes (a trunk) represents 4.3% loading
    - Much less for a single node
  - Process Automation example
- For a half duplex connection:
  - 10 packet/s each direction for 64 nodes (a bus) represents 8.6% loading
  - Factory Automation low cost component example

Conclusions

- While there is a potential performance gain:
  - There is no clear benefit for Process Automation or cost-sensitive Factory Automation components - both with similar performance requirements
  - High performance requirements are server by other existing and emerging Ethernet solutions
- Future requirements integrate IT and OT and drive additional information between the Cloud and the edge
  - Large payload, VLANs, and security limit benefit
- MAC changes would complicate our project