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Submission Title: [Frame aggregation recommendation for 15.3cMAC]

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Abstract: [Frame aggregation is essential to achieve the required MAC-SAP data rate based on 2Gbps PHY-SAP]

Purpose: [To be considered in 15.3c Usage Model Document]

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Frame aggregation recommendation for 15.3cMAC

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Summary

- Frame aggregation to expand data payload is essential to achieve high MAC-SAP data rate.
- Current assumption of 2K octet payload under the 2Gbps PHY-SAP data rate conditions can achieve the required MAC-SAP data rate in **neither** of UM1 nor 5, regardless of PHY overhead reduction.
- A 9K octet payload tolerates 2us and 4us PHY overhead length (preamble + PLCP header) in UM1 and 5, respectively.

Estimation parameters#1

- MAC-SAP data rate is estimated by using following parameters for mandatory UMs; UM1 and UM5.

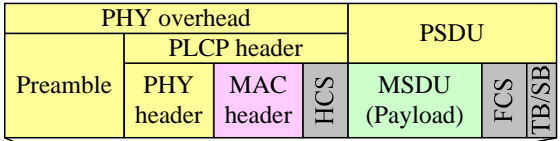
Common parameters for UM1 and 5	
PHY-SAP data rate	2Gbps (from the current assumption)
MIFS length	2us (from 15.3MAC specifications)
SIFS length	10us (from 15.3MAC specifications)
Guard time	3.3us (from 15.3MAC specifications)
Superframe length	65535us (from the maximum length in 15.3MAC specifications)
FCS	4octet (from 15.3MAC specifications)
TS/SB	1octet (from 15.3MAC specifications)
Beacon payload	Assumed as 100octet

Estimation parameters#2

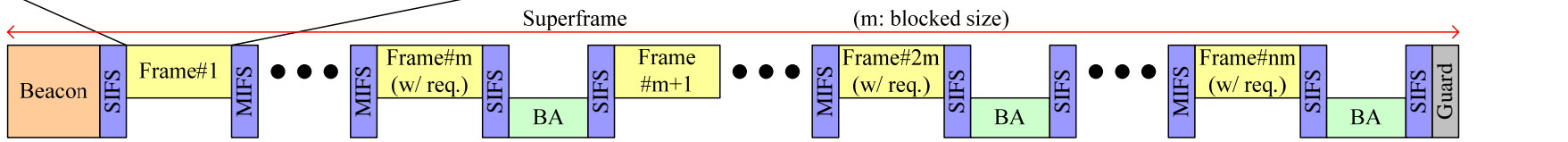
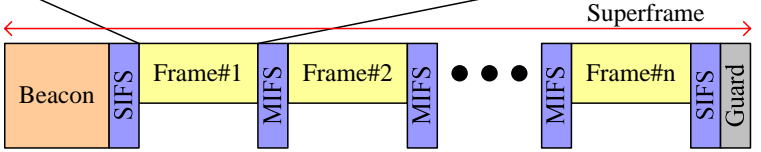
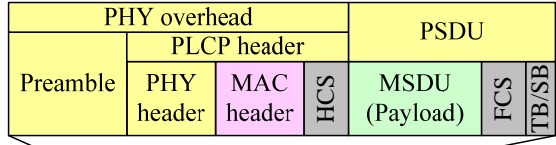
	Typical parameters for UM1	Typical parameters for UM5
BER	1e-10 (PiER=1e-9)	5.09e-6 (PER=8% for 2K octet payload), 1.16e-6 (PER=8% for 9K octet payload)
ACK/ARQ	No-ACK	Dly-ACK, BA size 16 is assumed, Selective repeat ARQ
MAC-SAP data rate	1.78Gbps(1080i, 24, 60) 1.49Gbps(1080i, 24, 60 w/o Blk.)	1.5Gbps

We should note that constant PER employed in UM5 case provides different BER according to payload length.

Frame format for No-ACK



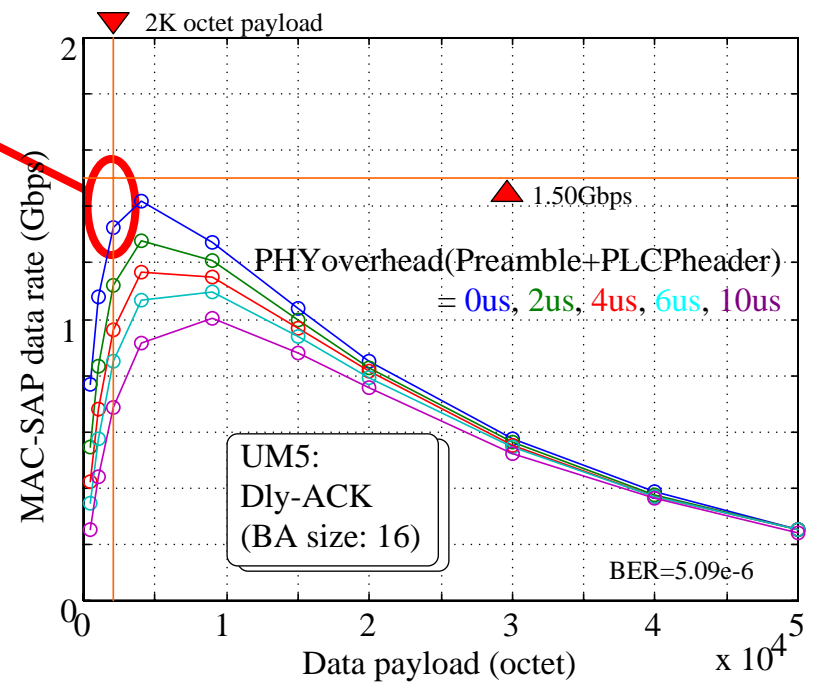
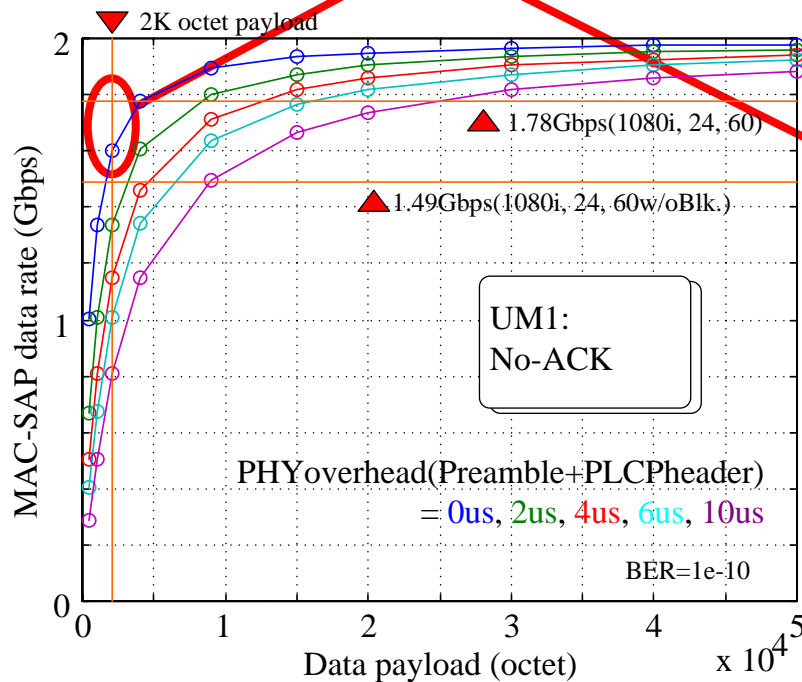
Frame format for Dly-ACK



MAC-SAP data rate estimation assuming 2Gbps PHY-SAP data rate #1

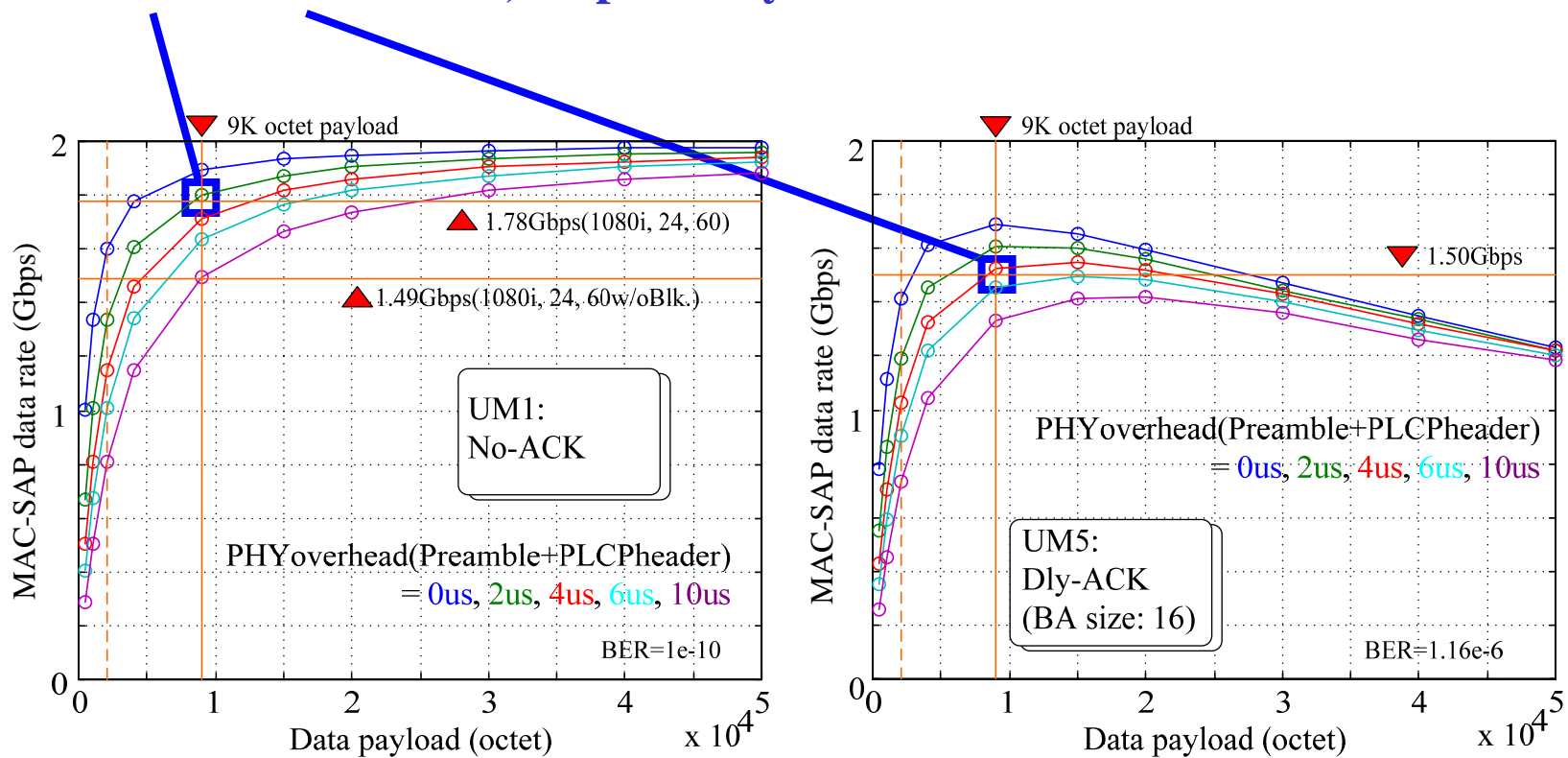
- With 2K octet payload, required MAC-SAP data rate could never be achieved **even if** 0 PHY overhead were employed.
- Payload expansion that could reduce relative redundancy of PHY overhead is expected to work effectively.

Insufficient MAC-SAP data rate

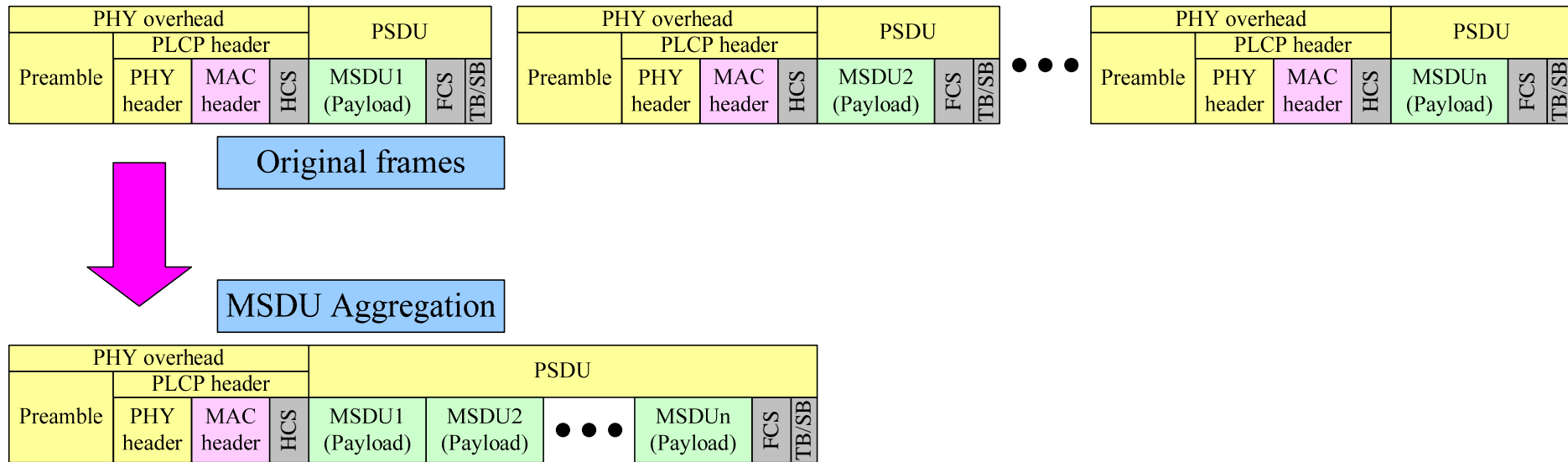


MAC-SAP data rate estimation assuming 2Gbps PHY-SAP data rate #2

- If we employ 9K octet payload length, **2us** and **4us** PHY overhead length could satisfy the required MAC-SAP data rate in UM1 and 5, respectively.



Frame aggregation technology to achieve expanded payload

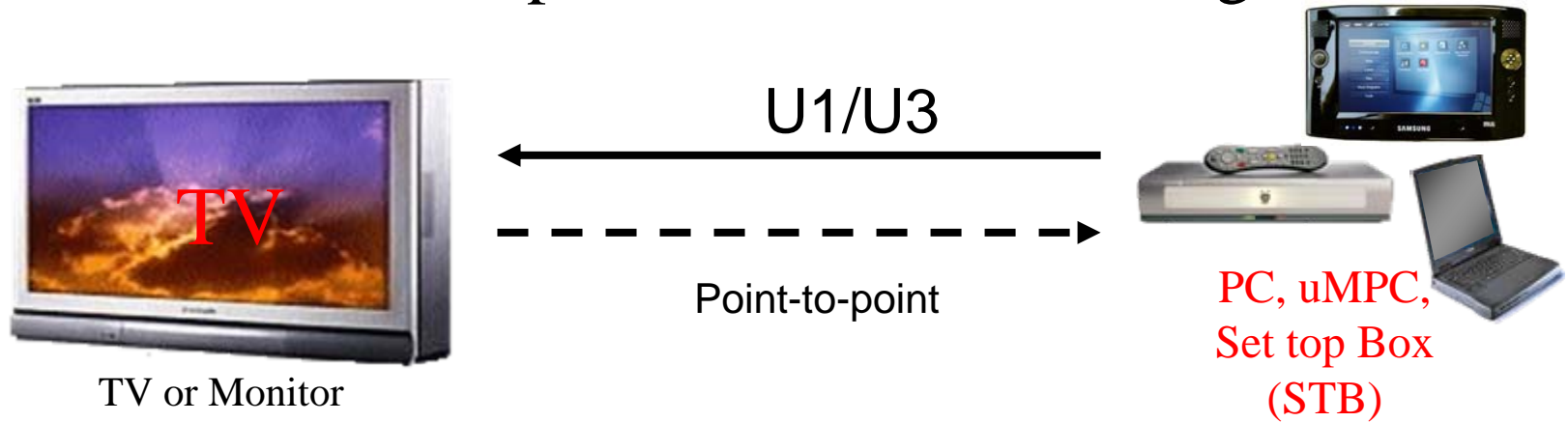


Conclusions

- Frame aggregation to expand data payload is essential to achieve high MAC-SAP data rate.
- Current assumption of 2K octet payload under the 2Gbps PHY-SAP data rate conditions can achieve the required MAC-SAP data rate in **neither** of UM1 nor 5, regardless of PHY overhead reduction.
- A 9K octet payload tolerates 2us and 4us PHY overhead length (preamble + PLCP header) in UM1 and 5, respectively.

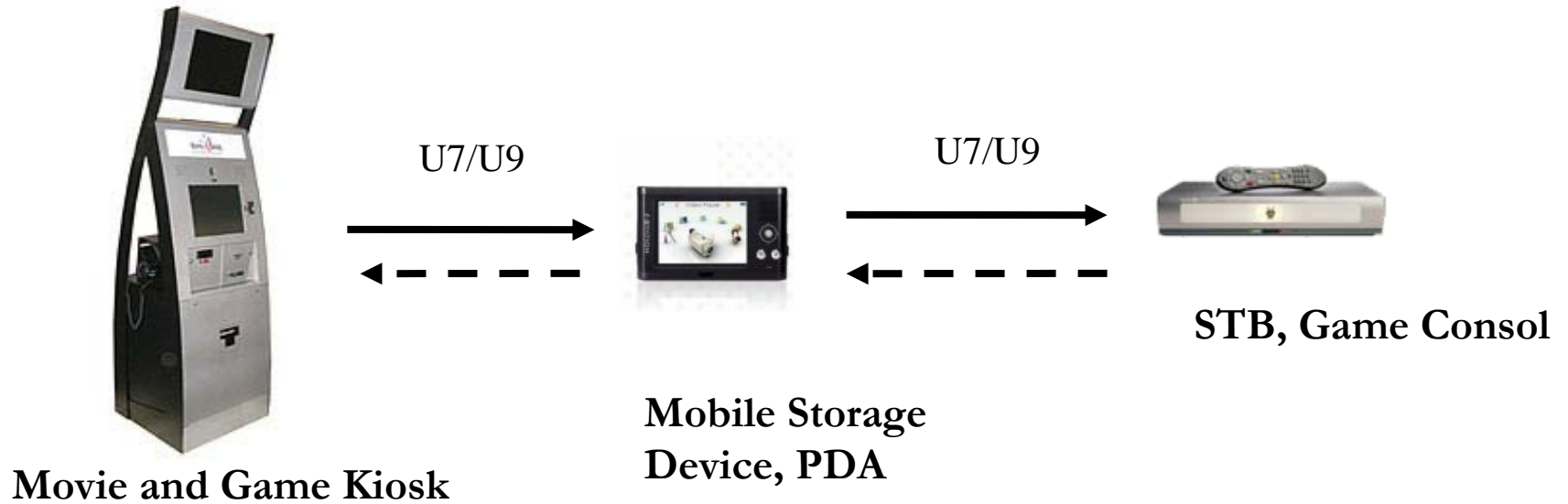
Appendix: Usage model 1 and 5

UM1 Uncompressed Video Streaming



Environment	Throughput MAC SAP	BER/PiER	Distance	Note
NLOS, LOS Residential (STB-TV)	1.78 Gbps 1.49, W/O Blk Stream, Up to 1080i, 24, 60	10 ⁻⁶ BER for PHY Simulations *Justification for this value is needed	5	<ul style="list-style-type: none"> ■ No data retransmission required ■ Unidirectional data transmission noted by Solid line ■ Low bitrate reverse link ■ Target of 10⁻⁹ PiER for HDMI ■ Pixel is RGB, 24 bits
LOS, NLOS Residential (STB-TV)	3.56 Gbps 2.98, W/O Blk Stream, Up to	10 ⁻⁶ BER for PHY Simulations *Justification for this value is needed	10	
Submission	1080p, 24, 60	Slide 11		Fumihide Kojima, NICT

UM5 Kiosk File-downloading



Environment	Throughput MAC SAP	BER/PER	Distance	Note
LOS-office (Server-PDA or PDA-STB)	1.50 Gbps burst (Server-PDA or PDA-STB)	8% PER before retransmission 2K Byte	1 m	<ul style="list-style-type: none"> ■ Asymmetric download/Upload ■ Low data rate reverse link ■ Degradation due to PDA jitter needs to be considered in the simulation ■ PDA jitter needs to be specified
LOS-office (Server-PDA or PDA STB)	2.25 Gbps burst (Server-PDA or PDA-STB)	8% PER before retransmission 2K Byte	1 m	