

Preamble structure for 11ax system

Date: 2015-01

Authors:

Name	Affiliation	Address	Phone	email
Jiayin Zhang	Huawei	5B-N8, No.2222 Xinjinqiao Road, Pudong, Shanghai	+86-18601656691	zhangjiayin@huawei.com
Le Liu		F1-17, Huawei Base, Bantian, Shenzhen		liule@huawei.com
Jun Luo				jun.l@huawei.com
Yi Luo			+86-18665891036	Roy.luoyi@huawei.com
Yingpei Lin				linyipingpei@huawei.com
Jiyong Pang				pangjiyong@huawei.com
Zhigang Rong		10180 Telesis Court, Suite 365, San Diego, CA 92121 NA		zhigang.rong@huawei.com
Rob Sun		303 Terry Fox, Suite 400 Kanata, Ottawa, Canada		Rob.Sun@huawei.com
David X. Yang		F1-17, Huawei Base, Bantian, Shenzhen		david.yangxun@huawei.com
Phillip Barber		The Lone Star State, TX		pbarber@broadbandmobiletech.com
Peter Loc				peterloc@iwirelesstech.com

Authors (continued)

Name	Affiliation	Address	Phone	email
Yunsong Yang	Huawei	10180 Telesis Court, Suite 365, San Diego, CA 92121 NA		yangyunsong@huawei.com
Zhou Lan		F1-17, Huawei Base, Bantian, SHenzhen	+86-18565826350	Lanzhou l@huawei.com
Junghoon Suh		303 Terry Fox, Suite 400 Kanata, Ottawa, Canada		Junghoon.Suh@huawei.com
Ron Porat	Broadcom			rporat@broadcom.com
Matthew Fischer				mfischer@broadcom.com
Sriram Venkateswaran				
Tu Nguyen				
Vinko Erceg				
Robert Stacey	Intel	2111 NE 25th Ave, Hillsboro OR 97124, USA	+1-503-724-893	robert.stacey@intel.com
Eldad Perahia				eldad.perahia@intel.com
Shahrnaz Azizi				shahrnaz.azizi@intel.com
Po-Kai Huang				po-kai.huang@intel.com
Qinghua Li				qinghua.li@intel.com
Xiaogang Chen				xiaogang.c.chen@intel.com
Chitto Ghosh				chittabrata.ghosh@intel.com
Rongzhen Yang				rongzhen.yang@intel.com

Authors (continued)

Name	Affiliation	Address	Phone	email
Fei Tong	Samsung	Innovation Park, Cambridge CB4 0DS (U.K.)	+44 1223 434633	f.tong@samsung.com
Hyunjeong Kang		Maetan 3-dong; Yongsong-Gu Suwon; South Korea	+82-31-279-9028	hyunjeong.kang@samsung.com
Kaushik Josiam		1301, E. Lookout Dr, Richardson TX 75070	(972) 761 7437	k.josiam@samsung.com
Mark Rison		Innovation Park, Cambridge CB4 0DS (U.K.)	+44 1223 434600	m.rison@samsung.com
Rakesh Taori		1301, E. Lookout Dr, Richardson TX 75070	(972) 761 7470	rakesh.taori@samsung.com
Sanghyun Chang		Maetan 3-dong; Yongsong-Gu Suwon; South Korea	+82-10-8864-1751	s29.chang@samsung.com
Lei Wang	Marvell	5488 Marvell Lane, Santa Clara, CA, 95054	858-205-7286	Leileiw@marvell.com
Hongyuan Zhang		5488 Marvell Lane, Santa Clara, CA, 95054		hongyuan@marvell.com
Yakun Sun		5488 Marvell Lane, Santa Clara, CA, 95054		yakunsun@marvell.com
Liwen Chu		5488 Marvell Lane, Santa Clara, CA, 95054		liwenchu@marvell.com
Mingguan Xu		5488 Marvell Lane, Santa Clara, CA, 95054		mxu@marvell.com
Jinjing Jiang		5488 Marvell Lane, Santa Clara, CA, 95054		jinjing@marvell.com
Yan Zhang		5488 Marvell Lane, Santa Clara, CA, 95054		yzhang@marvell.com

Authors (continued)

Name	Affiliation	Address	Phone	email
Rui Cao	Marvell	5488 Marvell Lane, Santa Clara, CA, 95054		ruicao@marvell.com
Sudhir Srinivasa		5488 Marvell Lane, Santa Clara, CA, 95054		sudhirs@marvell.com
Saga Tamhane		5488 Marvell Lane, Santa Clara, CA, 95054		sagar@marvell.com
Mao Yu		5488 Marvell Lane, Santa Clara, CA, 95054		my@marvel..com
Edward Au		5488 Marvell Lane, Santa Clara, CA, 95054		edwardau@marvell.com
Hui-Ling Lu		5488 Marvell Lane, Santa Clara, CA, 95054		hlou@marvell.com
Yasushi Takatori	NTT	1-1 Hikari-no-oka, Yokosuka, Kanagawa 239-0847 Japan		takatori.yasushi@lab.ntt.co.jp
Yasuhiko Inoue				inoue.yasuhiko@lab.ntt.co.jp
Yusuke Asai				asai.yusuke@lab.ntt.co.jp
Koichi Ishihara				ishihara.koichi@lab.ntt.co.jp
Akira Kishida				kishida.akira@lab.ntt.co.jp
Akira Yamada	NTT DOCOMO	3-6, Hikarinooka, Yokosuka- shi, Kanagawa, 239-8536, Japan		yamadaakira@nttdocomo.co m
Fujio Watanabe		3240 Hillview Ave, Palo Alto, CA 94304		watanabe@docomoinnovatio ns.com
Haralabos Papadopoulos				hpapadopoulos@docomoinno vations.com

Authors (continued)

Name	Affiliation	Address	Phone	email
Laurent cariou	Orange			Laurent.cariou@orange.com
Thomas Derham				thomas.derham@orange.com
Wookbong Lee	LG Electronics	19, Yangjae-daero 11gil, Seocho-gu, Seoul 137-130, Korea		wookbong.lee@lge.com
Kiseon Ryu				kiseon.ryu@lge.com
Jinyoung Chun				jiny.chun@lge.com
Jinsoo Choi				js.choi@lge.com
Jeongki Kim				jeongki.kim@lge.com
Giwon Park				giwon.park@lge.com
Dongguk Lim				dongguk.lim@lge.com
Suhwook Kim				suhwook.kim@lge.com
Eunsung Park				esung.park@lge.com
HanGyu Cho				hg.cho@lge.com
Albert Van Zelst	Qualcomm	Straatweg 66-S Breukelen, 3621 BR Netherlands		allert@qti.qualcomm.com
Alfred Asterjadhri		5775 Morehouse Dr. San Diego, CA, USA		aasterja@qti.qualcomm.com
Bin Tian		5775 Morehouse Dr. San Diego, CA, USA		btian@qti.qualcomm.com
Carlos Aldana		1700 Technology Drive San Jose, CA 95110, USA		caldana@qca.qualcomm.com
George Cherian		5775 Morehouse Dr. San Diego, CA, USA		gcherian@qti.qualcomm.com
Gwendolyn Barriac		5775 Morehouse Dr. San Diego, CA, USA		gbarriac@qti.qualcomm.com

Authors (continued)

Name	Affiliation	Address	Phone	email
Hemanth Sampath	Qualcomm	5775 Morehouse Dr. San Diego, CA, USA		hsampath@qti.qualcomm.com
Menzo Wentink		Straatweg 66-S Breukelen, 3621 BR Netherlands		mwentink@qti.qualcomm.com
Richard Van Nee		Straatweg 66-S Breukelen, 3621 BR Netherlands		rvanee@qti.qualcomm.com
Rolf De Vegt		1700 Technology Drive San Jose, CA 95110, USA		rolfv@qca.qualcomm.com
Sameer Vermani		5775 Morehouse Dr. San Diego, CA, USA		svverman@qti.qualcomm.com
Simone Merlin		5775 Morehouse Dr. San Diego, CA, USA		smerlin@qti.qualcomm.com
Tevfik Yucek		1700 Technology Drive San Jose, CA 95110, USA		tyucek@qca.qualcomm.com
VK Jones		1700 Technology Drive San Jose, CA 95110, USA		vkjones@qca.qualcomm.com
Youhan Kim		1700 Technology Drive San Jose, CA 95110, USA		youhank@qca.qualcomm.com

Authors (continued)

Name	Affiliation	Address	Phone	email
James Yee	Mediatek	No. 1 Dusing 1 st Road, Hsinchu, Taiwan	+886-3-567-0766	james.yee@mediatek.com
Alan Jauh				alan.jauh@mediatek.com
Chingwa Hu				chingwa.yu@mediatek.com
Frank Hsu				frank.hsu@mediatek.com
Thomas Pare	Mediatek USA	2860 Junction Ave, San Jose, CA 95134, USA	+1-408-526-1899	thomas.pare@mediatek.com
ChaoChun Wang				chaochun.wang@mediatek.com
James Wang				james.wang@mediatek.com
Jianhan Liu				Jianhan.Liu@mediatek.com
Tianyu Wu				tianyu.wu@mediatek.com
Russell Huang				russell.huang@mediatek.com

Abstract

- In this presentation, we discuss the backward compatibility requirement for 11ax devices from the perspectives of frame structure.
- We propose to prepend legacy preamble duplicated on each 20 MHz for each 11ax PPDU.
- We also discuss the necessity of having HE-SIG-A in 11ax PPDU after legacy preamble.

Backward compatibility and Coexistence

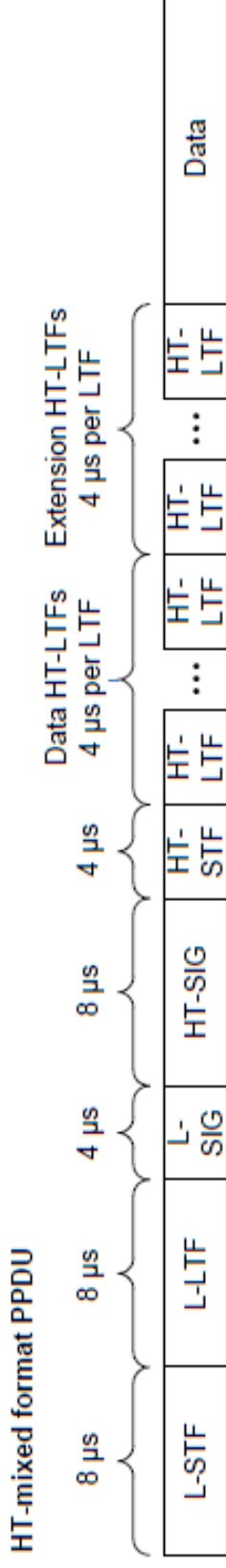
- In the PAR&CSD [1] of 11ax, the backward compatibility was defined as

*“This amendment defines operations in frequency bands between 1 GHz and 6 GHz. The new amendment shall enable **backward compatibility and coexistence with legacy IEEE 802.11 devices** operating in the same band.”*

- 11ax STA can decode legacy PPDU format operating in the same band.
- Legacy STAs can reliably detect 11ax preamble and defer its transmission within the packet duration

Preamble in 11n

- There is a mixed format for 11n PPDU



- 11n receivers acquire synchronization through legacy preamble and decide whether 11n PPDU format by checking the phase rotation of the first HT-SIG symbol.
- Legacy receivers (11a) will detect legacy preamble and decode/defer the rest of PPDU by the time duration indicated in the L-SIG

Preamble in 11ac

- 11ac keeps the mixed format PPDU

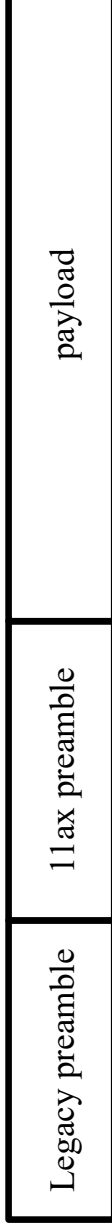


- 11ac receivers acquire synchronization and PPDU length in the legacy preamble and decide whether 11ac PPDU format by the phase rotation of 2 successive VHT-SIG-A symbols.
- Legacy receiver (11n/a) regard 11ac PPDU as 11a PPDU and decode/defer the rest of PPDU by the time duration indicated in the L-SIG

Preamble structure for 11ax PPDU

- legacy preamble

- In order to keep backward compatibility with legacy devices(11a/n/ac), it is straightforward to prepend a legacy preamble before each 11ax PPDU.
 - 11ax receiver can initially acquire synchronization through L-STF and L-LTF, and also channel estimation to decode 11ax preamble.



- Legacy STA can detect the PPDU existence and defer their transmission by the LENGTH indicated in L-SIG.
 - It is more reliable(-82dBm) and energy efficient than ED to prevent the unexpected interference from legacy STA

Preamble structure for 11ax PPDU

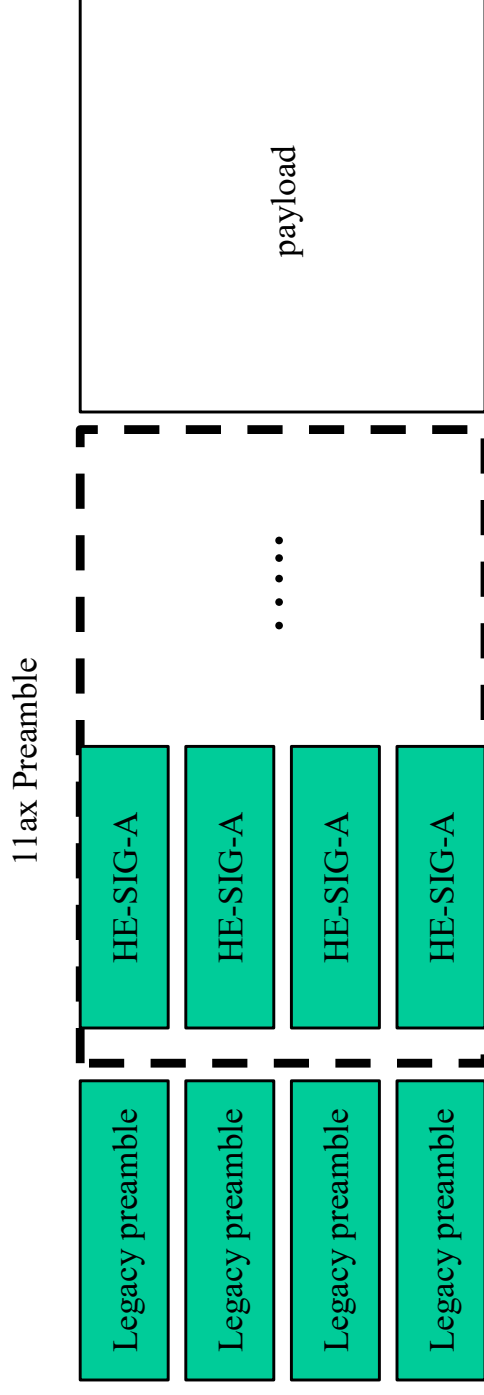
- HE-SIG-A

- **Background**
 - All intended 11n/ac receivers decode HT-SIG/VHT-SIG-A following legacy preamble to obtain common configuration information of the following PPDU.
- **11ax PPDU should also contain HE-SIG-A to carry some similar fields as in HT-SIG/VHT-SIG-A of 11n/ac, e.g. BW, GI.**
- **HE-SIG-A uses 64-FFT on each 20MHz channel**
 - Receiver can do coherent detection of HE-SIG-A based on the CSI estimation from L-LTF.
 - Legacy STA can be spoofed to receive a 11a/ac PPDU by specific design of modulation scheme.

Preamble structure for 11ax PPDU

- for more than 20MHz channel

- Similar to 11n/11ac, the legacy preamble and HE-SIG-A shall be duplicated on each 20MHz in order to maintain the reliability of carrier sensing and low PAPR at transmitter.



*For illustration only

summary

- In this presentation, we proposed to prepend legacy preamble for 11ax PPDU duplicated on each 20MHz for the backward compatibility with legacy devices.
- HE-SIG-A transmitted with 64-FFT duplicated on each 20MHz is used to indicate common control information.

Straw Poll 1

- Do you agree to add to TG Specification Framework
x.y.z An HE PPDU shall include the legacy preamble (L-STF, L-LTF and L-SIG), duplicated on each 20 MHz, for backward compatibility with legacy devices.
- **Y**
- **N**
- **ABS**

Straw Poll 2

- Do you agree to add to the TG Specification Framework:
x.y.z HE-SIG-A (using DFT period of 3.2 us and subcarrier spacing of 312.5 kHz) is duplicated on each 20MHz after the legacy preamble to indicate common control information.

- **Y**
- **N**
- **ABS**

Reference

**[1] IEEE 802.11-14/0165r1 “802.11 HEW SG Proposed
PAR”**