Categorization of 5 Criteria Responses

IEEE 802.3 Beyond 400 Gb/s Study Group

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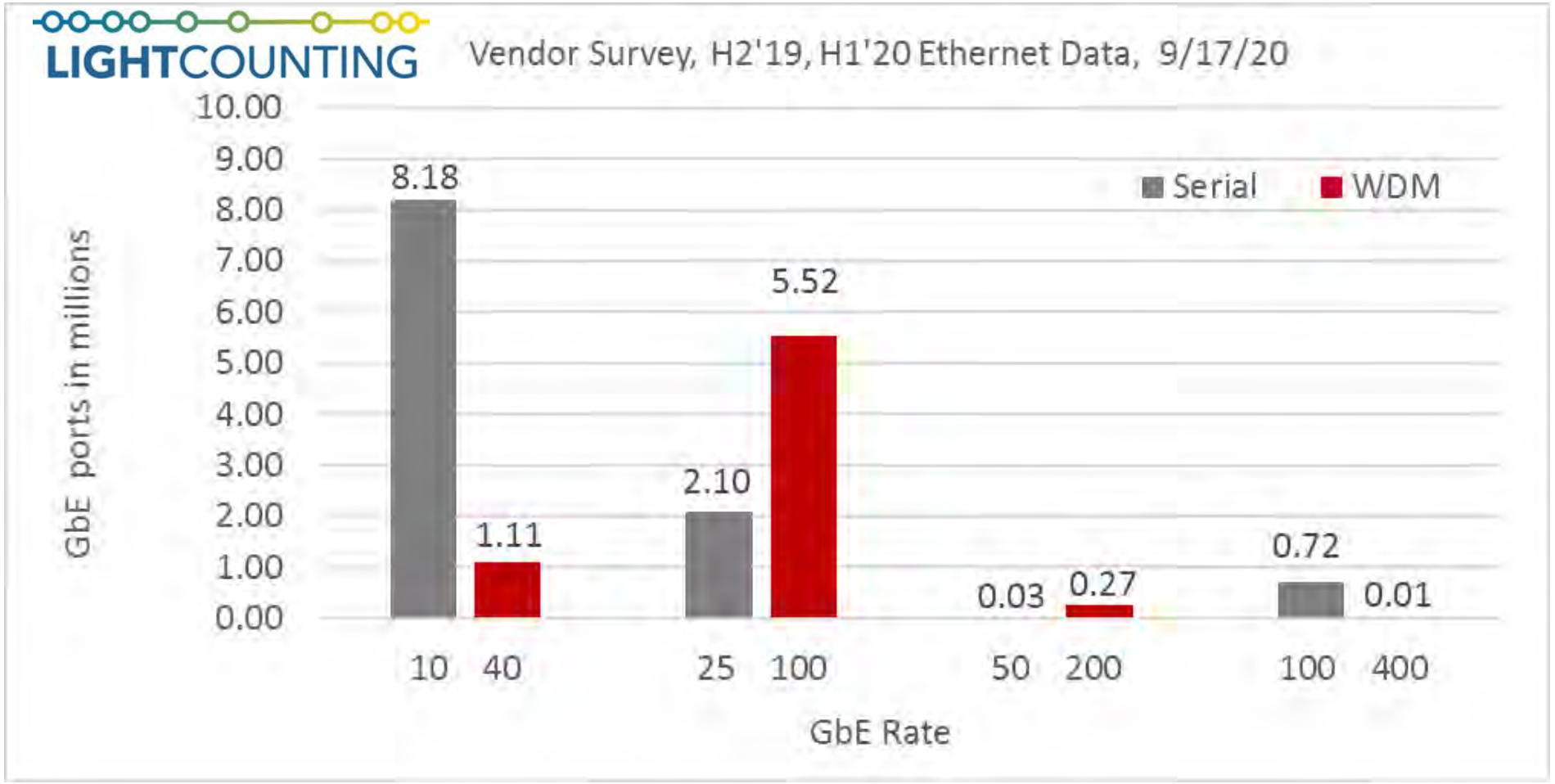
Introduction

- Great reference on 5 criteria responses by Howard Frazier: https://www.ieee802.org/3/100GCU/public/jan11/frazier_01_0111.pdf
- Past 802.3 projects 5 criteria responses fell into different time frame categories
- Blend of past GbE timelines is used to project the 800 & 1600GbE timeline
- >400GbE 5 criteria responses are placed into time frame categories
- Categorization will help industry optimize R&D and Deployment planning
- To maximize timeline projection accuracy:
  - astrology identifies the most favorable moment to predict the future: Vernal Equinox (3/20/21)
    https://www.astrology.com/article/spring-equinox-astrology-ritual/
    https://exploredeeply.com/live-your-purpose/tag/Ritual
  - crystal energy aligns internal Chakras for vision clarity

Ethernet Current Annual Port Shipments



Same data plotted as # of λs instead of GbE ports was sent out to the 802.3 NGECDC reflector last Sept.

Ethernet Milestones

1st 802.3 Project	designation	ae	ba		bs		>400GbE	
	GbE Rate	10	40	100	200	400	800	1600
	start	1999	2007	2006	2015	2013	2021	2021
	published	2002	2010	2010	2017	2017		

Ethernet >400GbE Milestone Prediction

1st 802.3 Project	designation	ae	ba		bs		>400GbE	
	GbE Rate	10	40	100	200	400	800	1600
	start	1999	2007	2006	2015	2013	2021	2021
	published	2002	2010	2010	2017	2017	2025*	2025*

*Turquoise-blue is used for predictions because on the crystal color energy wheel, Vernal Equinox is the transition from Blue (Trust) to Turquoise (Discovery)

10GbE Milestones

1st 802.3 Project	designation	**ae**
	GbE Rate	10
	start	1999
	published	2002
1st shipment	year	1998
	type	SONET LR
	wavelength	1x10
	I/O	16x0.622
	form factor	300-pin
1st million shipment	year	2008
	type	LR
	wavelength	10
	I/O	10
	form factor	SFP

40 & 100GbE Milestones

1st 802.3 Project	designation	**ae**	**ba**	
	GbE Rate	10	40	100
	start	1999	2007	2006
	published	2002	2010	2010
1st shipment	year	1998	2009	2011
	type	SONET LR	LR4*	OTN LR4
	wavelength	1x10	4x10	4x25
	I/O	16x0.622	4x10	10x10
	form factor	300-pin	CFP	CFP
1st million shipment	year	2008	2014	2016
	type	LR	LR4	CWDM4
	wavelength	10	4x10	4x25
	I/O	10	4x10	4x25
	form factor	SFP	QSFP	QSFP

*1st 40G shipped was VSR Serial λ in 16x2.5G I/O 300-pin form factor in 2003

200 & 400GbE Milestones

1st 802.3 Project	designation	**ae**	**ba**		**bs**			
	GbE Rate	10	40	100	200		400	
	start	1999	2007	2006	2015		2013	
	published	2002	2010	2010	2017		2017	
1st shipment	year	1998	2009	2011	2017	2018	2018	2019
	type	SONET LR	LR4	OTN LR4	Mobile LR4		LR8	
	wavelength	1x10	4x10	4x25	4x50		8x50	
	I/O	16x0.622	4x10	10x10	8x25	4x50	16x25	8x50
	form factor	300-pin	CFP	CFP	CFP	QSFP	CFP8	QSFP-DD
1st million shipment	year	2008	2014	2016				
	type	LR	LR4	CWDM4				
	wavelength	10	4x10	4x25				
	I/O	10	4x10	4x25				
	form factor	SFP	QSFP	QSFP				

200GbE 1st Million Shipment Milestone Prediction

1st 802.3 Project	designation	**ae**	**ba**		**bs**				
	GbE Rate	10	40	100	200		400		
	start	1999	2007	2006	2015		2013		
	published	2002	2010	2010	2017		2017		
1st shipment	year	1998	2009	2011	2017	2018	2018	2019	
	type	SONET LR	LR4	OTN LR4	Mobile LR4		LR8		
	wavelength	1x10	4x10	4x25	4x50		8x50		
	I/O	16x0.622	4x10	10x10	8x25	4x50	16x25	8x50	
	form factor	300-pin	CFP	CFP	CFP	QSFP	CFP8	QSFP-DD	
1st million shipment	year	2008	2014	2016	2021				
	type	LR	LR4	CWDM4	FR4				
	wavelength	10	4x10	4x25	4x50				
	I/O	10	4x10	4x25	2x4x50	4x50			
	form factor	SFP	QSFP	QSFP	OSFP	QSFP			

400GbE 1st Million Shipment Milestone Prediction

1st 802.3 Project	designation	**ae**	**ba**		**bs**			
	GbE Rate	10	40	100	200		400	
	start	1999	2007	2006	2015		2013	
	published	2002	2010	2010	2017		2017	
1st shipment	year	1998	2009	2011	2017	2018	2018	2019
	type	SONET LR	LR4	OTN LR4	Mobile LR4		LR8	
	wavelength	1x10	4x10	4x25	4x50		8x50	
	I/O	16x0.622	4x10	10x10	8x25	4x50	16x25	8x50
	form factor	300-pin	CFP	CFP	CFP	QSFP	CFP8	QSFP-DD
1st million shipment	year	2008	2014	2016	2021		2023*	
	type	LR	LR4	CWDM4	FR4		FR4	
	wavelength	10	4x10	4x25	4x50		4x100	
	I/O	10	4x10	4x25	2x4x50	4x50	2x4x100	4x100
	form factor	SFP	QSFP	QSFP	OSFP	QSFP	OSFP	QSFP

*Requires annual volume to quadruple for the next 3 years, which is very aggressive

800GbE 1st Shipment Milestone Prediction

1st 802.3 Project	designation	**ae**	**ba**		**bs**				**>400GbE**			
	GbE Rate	10	40	100	200		400		800		1600	
	start	1999	2007	2006	2015		2013		2021		2021	
	published	2002	2010	2010	2017		2017		2025		2025	
1st shipment	year	1998	2009	2011	2017	2018	2018	2019	2023/24			
	type	SONET LR	LR4	OTN LR4	Mobile LR4		LR8		LR8			
	wavelength	1x10	4x10	4x25	4x50		8x50		8x100			
	I/O	16x0.622	4x10	10x10	8x25	4x50	16x25	8x50	8x100			
	form factor	300-pin	CFP	CFP	CFP	QSFP	CFP8	QSFP-DD	OSFP	QSFP-DD		
1st million shipment	year	2008	2014	2016	2021		2023					
	type	LR	LR4	CWDM4	FR4		FR4					
	wavelength	10	4x10	4x25	4x50		4x100					
	I/O	10	4x10	4x25	2x4x50	4x50	2x4x100	4x100				
	form factor	SFP	QSFP	QSFP	OSFP	QSFP	OSFP	QSFP				

800GbE 1st Million Shipment Milestone Prediction

1st 802.3 Project	designation	**ae**	**ba**		**bs**				**>400GbE**			
	GbE Rate	10	40	100	200		400		800		1600	
	start	1999	2007	2006	2015		2013		2021		2021	
	published	2002	2010	2010	2017		2017		2025		2025	
1st shipment	year	1998	2009	2011	2017	2018	2018	2019	2023/24			
	type	SONET LR	LR4	OTN LR4	Mobile LR4		LR8		LR8			
	wavelength	1x10	4x10	4x25	4x50		8x50		8x100			
	I/O	16x0.622	4x10	10x10	8x25	4x50	16x25	8x50	8x100			
	form factor	300-pin	CFP	CFP	CFP	QSFP	CFP8	QSFP-DD	OSFP	QSFP-DD		
1st million shipment	year	2008	2014	2016	2021		2023		2029			
	type	LR	LR4	CWDM4	FR4		FR4		FR4			
	wavelength	10	4x10	4x25	4x50		4x100		4x200			
	I/O	10	4x10	4x25	2x4x50	4x50	2x4x100	4x100	2x4x200	4x200		
	form factor	SFP	QSFP	QSFP	OSFP	QSFP	OSFP	QSFP	OSFP	QSFP		

1600GbE 1st Shipment Milestone Prediction

1st 802.3 Project	designation	**ae**	**ba**		**bs**				**>400GbE**			
	GbE Rate	10	40	100	200		400		800		1600	
	start	1999	2007	2006	2015		2013		2021		2021	
	published	2002	2010	2010	2017		2017		2025		2025	
1st shipment	year	1998	2009	2011	2017	2018	2018	2019	2023/24		2026/27	
	type	SONET LR	LR4	OTN LR4	Mobile LR4		LR8	LR8	LR8		LR8	
	wavelength	1x10	4x10	4x25	4x50		8x50	8x50	8x100		8x200	
	I/O	16x0.622	4x10	10x10	8x25	4x50	16x25	8x50	8x100		8x200	
	form factor	300-pin	CFP	CFP	CFP	QSFP	CFP8	QSFP-DD	OSFP	QSFP-DD	OSFP	QSFP-DD
1st million shipment	year	2008	2014	2016	2021		2023		2029			
	type	LR	LR4	CWDM4	FR4		FR4		FR4			
	wavelength	10	4x10	4x25	4x50		4x100		4x200			
	I/O	10	4x10	4x25	2x4x50	4x50	2x4x100	4x100	2x4x200	4x200		
	form factor	SFP	QSFP	QSFP	OSFP	QSFP	OSFP	QSFP	OSFP	QSFP		

1600GbE 1st Million Shipment Milestone Prediction

1st 802.3 Project	designation	ae	ba		bs				>400GbE			
	GbE Rate	10	40	100	200		400		800		1600	
	start	1999	2007	2006	2015		2013		2021		2021	
	published	2002	2010	2010	2017		2017		2025		2025	
1st shipment	year	1998	2009	2011	2017	2018	2018	2019	2023/24		2026/27	
	type	SONET LR	LR4	OTN LR4	Mobile LR4		LR8		LR8		LR8	
	wavelength	1x10	4x10	4x25	4x50		8x50		8x100		8x200	
	I/O	16x0.622	4x10	10x10	8x25	4x50	16x25	8x50	8x100		8x200	
	form factor	300-pin	CFP	CFP	CFP	QSFP	CFP8	QSFP-DD	OSFP	QSFP-DD	OSFP	
1st million shipment	year	2008	2014	2016	2021		2023		2029		2031	
	type	LR	LR4	CWDM4	FR4		FR4		FR4		FR8*	
	wavelength	10	4x10	4x25	4x50		4x100		4x200		8x200	
	I/O	10	4x10	4x25	2x4x50	4x50	2x4x100	4x100	2x4x200	4x200	8x200	
	form factor	SFP	QSFP	QSFP	OSFP	QSFP	OSFP	QSFP	OSFP	QSFP	OSFP	

*If 4x400G PAMn or Coherent, 1st M will be later than 2031 (for pros & cons see: https://www.ofcconference.org/en-us/home/program-speakers/rump-session/)

Ethernet Milestones

1st 802.3 Project	designation	**ae**	**ba**		**bs**				**>400GbE**			
	GbE Rate	10	40	100	200		400		800		1600	
	start	1999	2007	2006	2015		2013		2021		2021	
	published	2002	2010	2010	2017		2017		2025		2025	
1st shipment	year	1998	2009	2011	2017	2018	2018	2019	2023/24		2026/27	
	type	SONET LR	LR4	OTN LR4	Mobile LR4		LR8		LR8		LR8	
	wavelength	1x10	4x10	4x25	4x50		8x50		8x100		8x200	
	I/O	16x0.622	4x10	10x10	8x25	4x50	16x25	8x50	8x100		8x200	
	form factor	300-pin	CFP	CFP	CFP	QSFP	CFP8	QSFP-DD	OSFP	QSFP-DD	OSFP	QSFP-DD
1st million shipment	year	2008	2014	2016	2021		2023		2029		2031	
	type	LR	LR4	CWDM4	FR4		FR4		FR4		FR8	
	wavelength	10	4x10	4x25	4x50		4x100		4x200		8x200	
	I/O	10	4x10	4x25	2x4x50	4x50	2x4x100	4x100	2x4x200	4x200	8x200	
	form factor	SFP	QSFP	QSFP	OSFP	QSFP	OSFP	QSFP	OSFP	QSFP	OSFP	

Categorization of 5 Criteria Responses

1st 802.3 Project	designation	ae	ba		bs				>400GbE	
	GbE Rate	10	40	100	200		400		800	1600
	start	1999	2007	2006	2015		2013		2021	2021
	published	2002	2010	2010	2017		2017		2025	2025
Shipment	1st	1998	2009	2011	2017	2018	2018	2019	2023/24	2026/27
	1st million	2008	2014	2016	2021		2023		2029	2031
Broad Market Potential		ST → LT	MT	LT	MT		LT		MT	LT
Technical Feasibility		ST	ST	MT	ST		LT		MT	LT

ST: Short Term

MT: Medium Term

LT: Long Term

Categorization of 5 Criteria Responses

Thank you