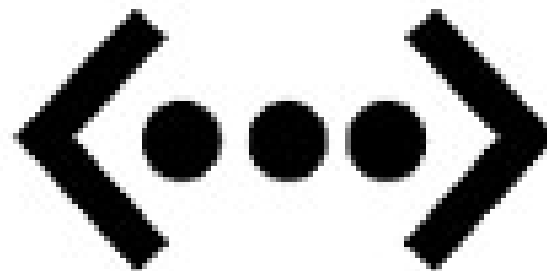# 100 GIGABIT AND BEYOND: INCREASING CAPACITY IN IP/MPLS NETWORKS TODAY

Greg Hankins <ghankins@brocade.com>

APRICOT 2010

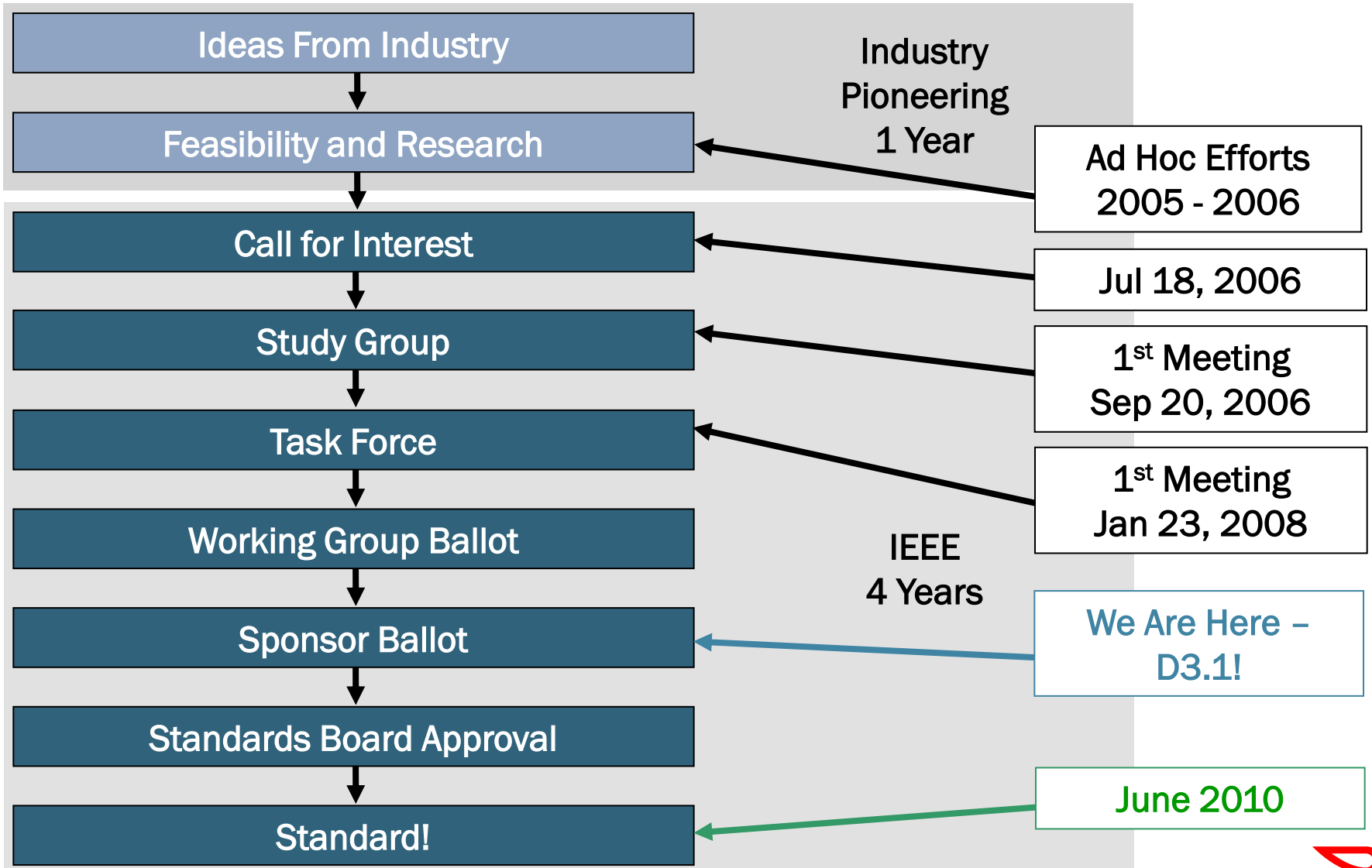# Per IEEE-SA Standards Board Operations Manual, January 2005

At lectures, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make it clear that his or her views should be considered the personal views of that individual rather than the formal position, explanation, or interpretation of the IEEE.

IEEE 802.3ba Developments Summary

- Many changes in 2006 – 2008 as objectives were first developed with lots of news and frequent changes

- After Draft 1.0, less news to report as the Task Force started comment resolution and began work towards the final standard

- Lots of activity to finalize the new standards specifications, working on Draft 3.1

- On schedule: the 40 GbE and 100 GbE standards will be delivered together in June 2010
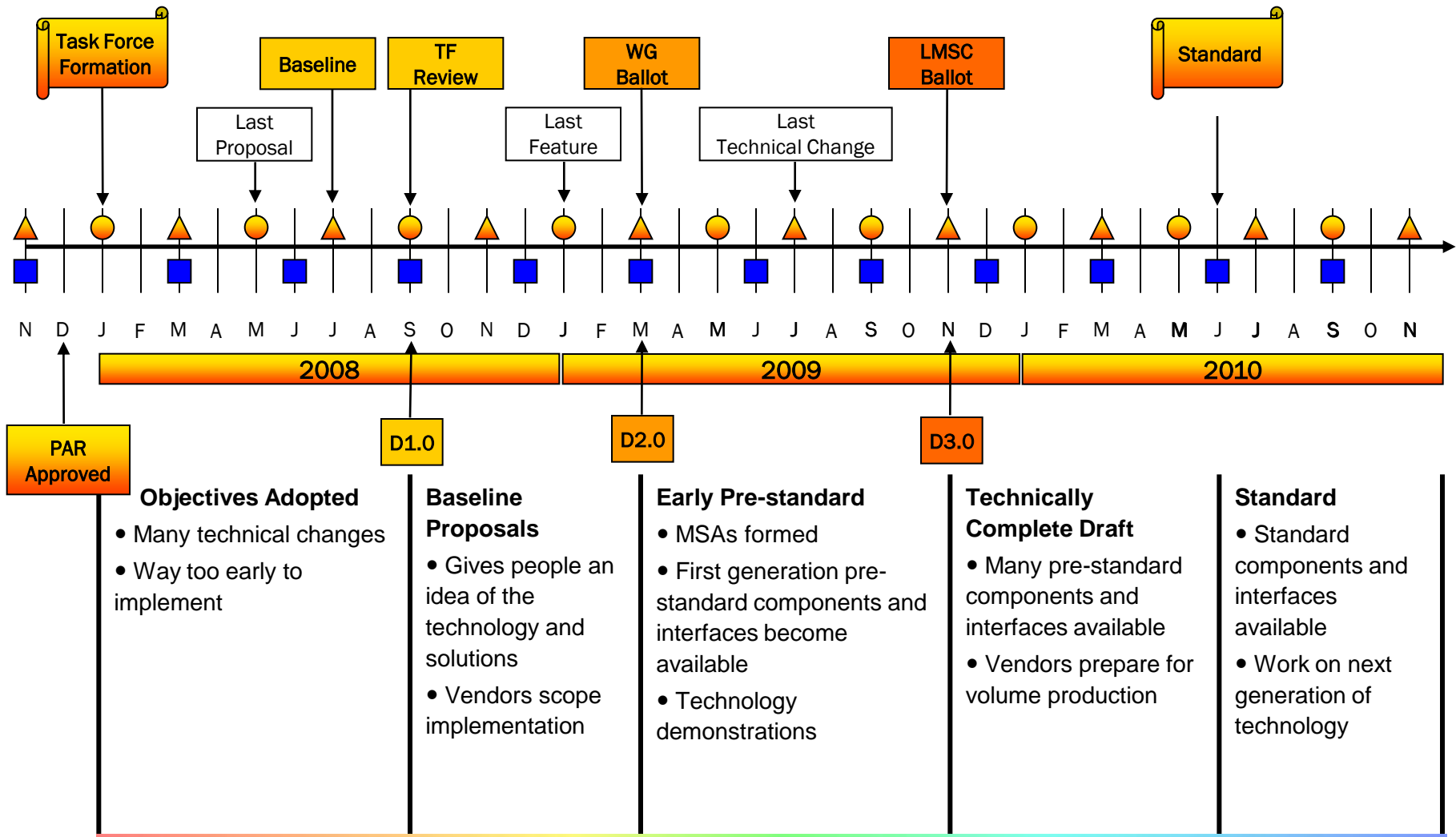
Where are we now after ~4 years?

Process Stage	Timeline	Milestone
Ideas From Industry	Industry Pioneering 1 Year	
Feasibility and Research		Ad Hoc Efforts 2005 - 2006
Call for Interest		Jul 18, 2006
Study Group		1st Meeting Sep 20, 2006
Task Force		1st Meeting Jan 23, 2008
Working Group Ballot	IEEE 4 Years	
Sponsor Ballot		We Are Here – D3.1!
Standards Board Approval		
Standard!		June 2010

IEEE P802.3ba Task Force Timeline – What it Means to You

Legend
- △ IEEE 802 Plenary
- ○ IEEE 802.3 Interim
- ■ IEEE-SA Standards Board

Task Force Formation

Baseline

TF Review

WG Ballot

LMSC Ballot

Standard

Last Proposal

Last Feature

Last Technical Change

N D | J F M A M J J A S O N D | J F M A M J J A S O N D | J F M A M J J A S O N

2008 | 2009 | 2010

PAR Approved

D1.0

D2.0

D3.0

Objectives Adopted
- Many technical changes
- Way too early to implement

Baseline Proposals
- Gives people an idea of the technology and solutions
- Vendors scope implementation

Early Pre-standard
- MSAs formed
- First generation pre-standard components and interfaces become available
- Technology demonstrations

Technically Complete Draft
- Many pre-standard components and interfaces available
- Vendors prepare for volume production

Standard
- Standard components and interfaces available
- Work on next generation of technology

Marketing Timing and Standards Process/Technical Compliance

Getting Closer to the Standard in 2010

- Draft 3.1 finished with second sponsor ballot in February 2010

- Technical specifications are finalized
  - Last technical change in November 2009

- First generation pre-standard components have hit the market
  - ASICs
  - Media modules (cables readily available already)
  - Test gear
  - Network gear

- Technology demonstrations and forums in 2009
  - Test equipment vendors had early demos in May 2009 at Interop
  - 40 GbE and 100 GbE CFP demos in September 2009 at ECOC
  - Ethernet Alliance white papers and education efforts

Project Comparison with 10 GbE

	802.3ae 10 GbE	802.3ak 10GBASE-CX4	802.3an 10GBASE-T	802.3aq 10GBASE-LRM	802.3ap 10GBASE-KR	802.3ba 40 GbE and 100 GbE
Date	Jun 2002	Feb 2004	Jun 2006	Sep 2006	Mar 2007	Jun 2010
MMF	✓			✓		✓ (40 / 100)
10 km SMF	✓					✓ (40 / 100)
40 km SMF	✓					✓ (100)
80 km SMF	✓ (not specified in 802.3ae)					
Copper Cable		✓	✓			✓ (40 / 100)
Backplane					✓	✓ (40)

Summary of Reach Objectives and Physical Layer Specifications – Updated July 2009

Physical Layer Reach	1 m Backplane	7 m Copper Cable	100 m OM3, 125 m OM4 MMF	10 km SMF	40 km SMF
40 Gigabit Ethernet					
Name	40GBASE-KR4	40GBASE-CR4	40GBASE-SR4	40GBASE- LR4	
Signaling	4 x 10 Gb/s	4 x 10 Gb/s	4 x 10 Gb/s	4 x 10 Gb/s	
Media	Copper Backplane	Twinax Cable	MPO MMF	Duplex SMF	
Module/Connector		QSFP Module, CX4 Interface	QSFP Module, CFP Module	CFP Module	
100 Gigabit Ethernet					
Name		100GBASE-CR10	100GBASE-SR10	100GBASE-LR4	100GBASE-ER4
Signaling		10 x 10 Gb/s	10 x 10 Gb/s	4 x 25 Gb/s	4 x 25 Gb/s
Media		Twinax Cable	MPO MMF	Duplex SMF	Duplex SMF
Module/Connector		CXP Module	CXP Module, CFP Module	CFP Module	CFP Module

QSFP Modules

- Created for high density short reach interfaces
  - Targeted for data center applications

- Used for a variety of Ethernet and InfiniBand applications including 40GBASE-CR4 and 40GBASE-SR4
  - 4 channels
  - Low power consumption

- Specifications defined to support 40GBASE-LR4 but QSFP not expected until 2011-2012
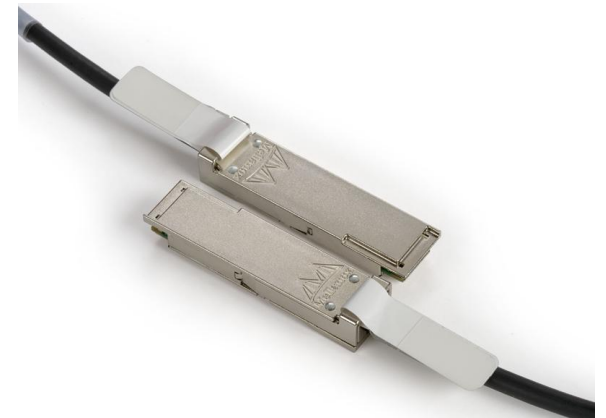
Mellanox QSFP Assemblies

CXP Modules

- Created for high density short reach interfaces
  - Targeted for data center applications
- Used for 100GBASE-CR10, 100GBASE-SR10 and InfiniBand 12X QDR
  - 12 channels
  - 100 GbE uses 10 of the 12 channels
- 45 mm long x 27 mm wide, slightly larger than an XFP
  - Small compact form factor enables high density but limits distance

Finisar C.wire CXP Assembly

CFP Modules

- New module optimized for longer reach applications

- Used for 40GBASE-SR4, 40GBASE-LR4, 100GBASE-SR10, 100GBASE-LR4 and 100GBASE-ER4
  - Dense electrical connector enables a variety of interfaces
  - Integrated heat sink allows efficient cooling

- 120 mm long x 86 mm wide, about twice as wide as a XENPAK

- 100GBASE-ER4 not expected until 2011-2012

Finisar CFP Assembly

CFP Module Examples
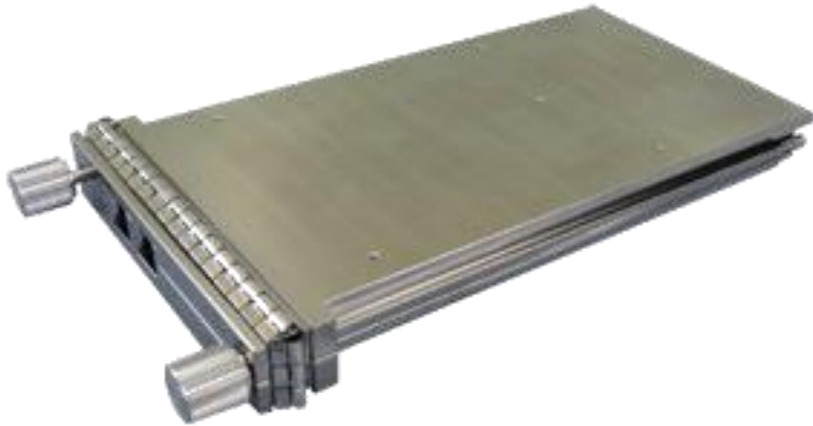

Opnext 100GBASE-LR4

Reflex Photonics Dual 40GBASE-SR4

Reflex Photonics 100GBASE-SR10
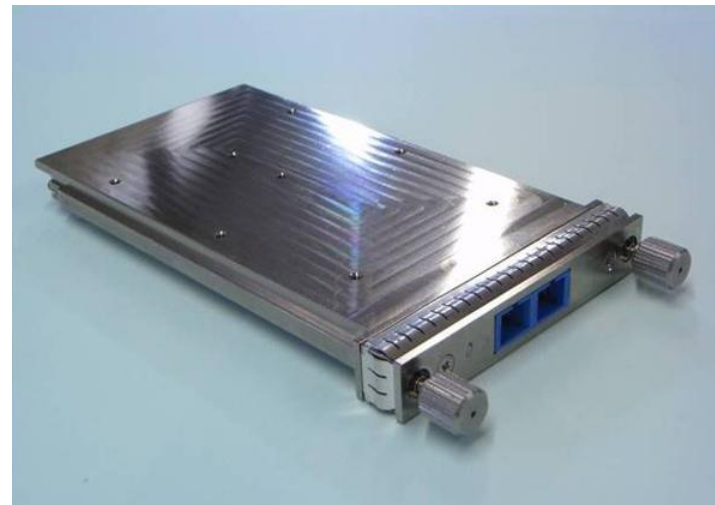
Sumitomo Electric Industries 40GBASE-LR4

MPO/MTP Cable Assemblies

- MPO = "Multi-fiber Push On" assembly
  - Also called MTP by Corning

- Wide variety of high density cabling options
  - MPO to MPO
  - MPO cassette for patch panels
  - MPO breakout into SC, LC, etc

- 40GBASE-SR4
  - 12 fiber MPO cable, uses 8 fibers

- 100GBASE-SR10
  - 24 fiber MPO cable, uses 20 fibers

- May require new ribbon fiber infrastructure
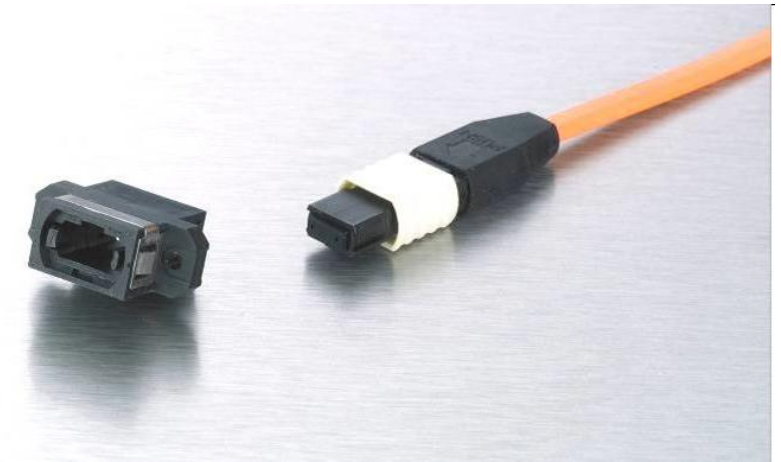
Fibernet MTP/MPO Assembly

What You Should Expect This Year

- The finished standard!

- First generation technology will be expensive and low density compared to *current* 10 GbE prices

  - Technology cost choices were chosen so 100 GbE will be cheaper than 10 x 10 GbE as the industry matures

  - Initially an application for early adopters

  - In the near term, n x 10 GbE LAG may be more cost effective for you

  - Higher speed interfaces will make 10 GbE denser and cheaper

- Density will improve as switch/router vendors develop higher capacity systems

  - Reasonable density requires several hundred Gbps/slot for multiple ports

- Cost will decrease as new technology becomes feasible and volume increases

  - Optics and component costs are higher initially

Future Meetings

- March 2010 Plenary
  - March 14 – 19, Orlando, FL, USA

- April 2010 Interim
  - April 19 or April 20, San Jose, Ca, USA

- May 2010 Interim
  - May 24 – 28, Geneva, Switzerland

- *June 2010 – Finished Standard!*

- July 2010 Plenary
  - July 11 – 16, San Diego, CA, USA

- Meeting information:
  http://ieee802.org/3/interims/index.html

More Information is Here

- IEEE P802.3ba 40 Gb/s and 100 Gb/s Ethernet Task Force

  http://grouper.ieee.org/groups/802/3/ba/index.html

What You Should Do

- Look at your network growth and needs in 3 – 5 years

- Ask for roadmaps
  - Optical gear and switch/router vendors
  - Server vendors
  - Transport and IP transit providers, IXs
  - Others?

- Figure out what is missing and ask for it
  - Will it work with your optical network?
  - What about your cabling infrastructure?
  - Do you need 40 km 40 GbE?
  - Ethernet OAM?
  - Jumbo frames?

What's Next

- There will be demand for other interfaces beyond the scope of 802.3ba
  - Standard defines a flexible architecture that enables many implementations as technology changes

- Expect more interfaces as technology develops, becomes cost effective and 2nd generation architectures are defined
  - Serial signaling specifications for 40 Gigabit Ethernet (1 x 40 Gb/s) and 100 Gigabit Ethernet (1 x 100 Gb/s)
  - Duplex MMF specifications
  - 25 Gb/s signaling for 100 Gigabit Ethernet backplane and copper cable applications

- The OIF is doing fundamental work on 25 Gb/s signaling which will make newer interfaces and optics modules possible
  - QSFP2, CFP2 and even CXP2

Second Generation Technology

- The second generation of 40 Gigabit Ethernet is being defined in a new IEEE project

  - 4 x 10 Gb/s electrical interface with a 1 x 40 Gb/s optical output over SMF

  - http://www.ieee802.org/3/40GSMF/index.html

- The second generation of 100 Gigabit Ethernet will use 4 x 25 Gb/s interfaces

  - The 4 x 25 Gb/s electrical interface is being defined in the OIF and should be finished in April 2011

  - The 4 x 25 Gb/s multimode interface will need to be defined in the IEEE and might complete in 2012/2013

Crystal Ball for the Future

- No one is asking for networks to be slower, traffic will continue to increase

- The need for Terabit Ethernet is already being discussed in the industry and by network operators
  - 400 Gb/s Ethernet is a likely choice by expanding 4 x 25Gb/s to 16 x 25Gb/s signaling

- Ethernet will continue to evolve as network and bandwidth requirements change

Questions?

Many interesting references follow this slide!

803.3ba Nomenclature Suffix Summary

| Speed	Medium		Coding Scheme	Lanes	
	Copper	Fiber		Copper	Optical
40G = 40 Gb/s 100G = 100 Gb/s	K = Backplane C = Copper	S = Short Reach (100 m) L = Long Reach (10 km) E = Extended Long Reach (40 km)	R = scRambled 64/66B Encoding	n = 4 or 10	n = Number of Lanes or Wavelengths
				N = 1 is not required as serial is implied.	

Example: 100GBASE-ER4
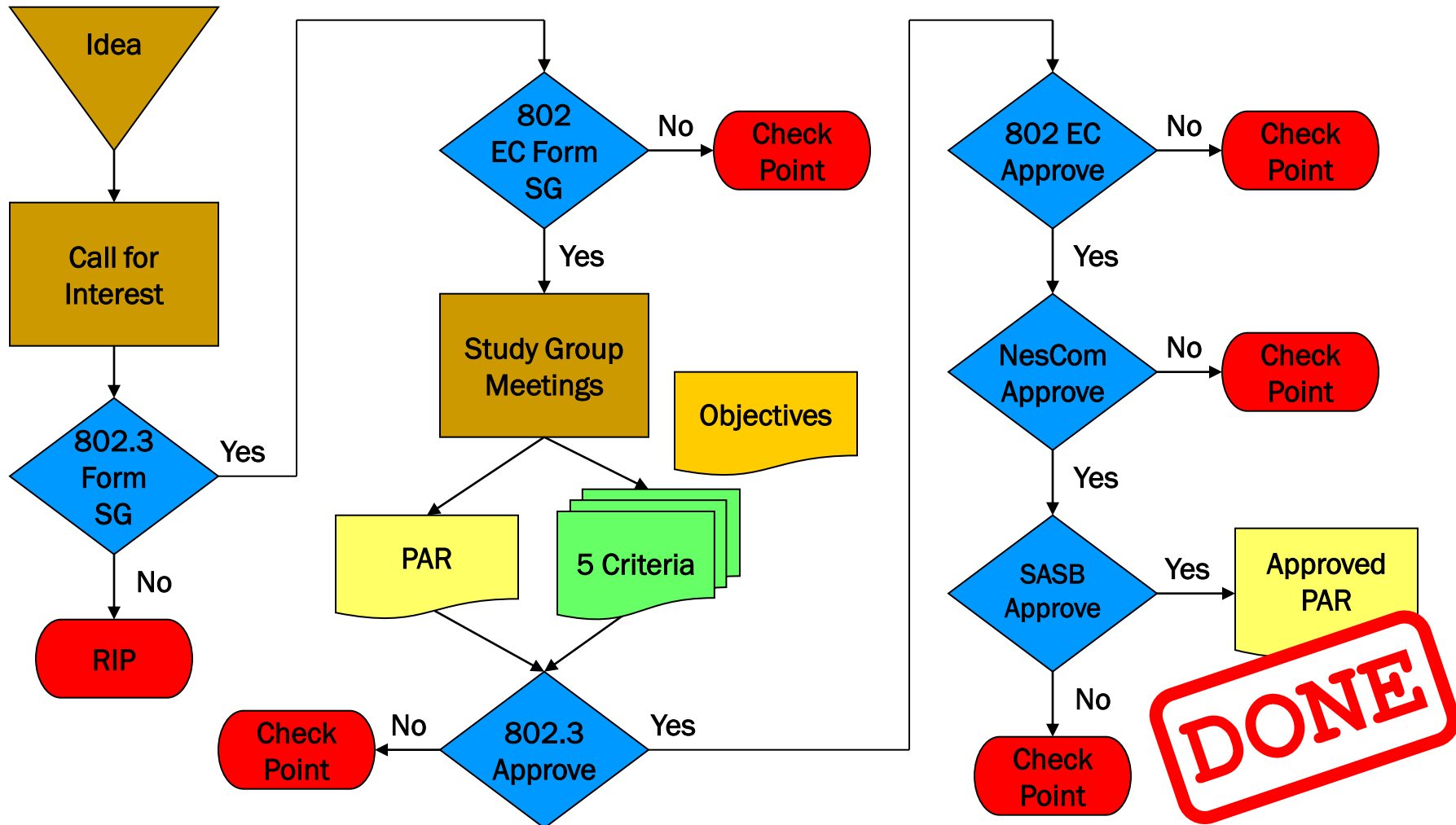
Notes: At "Check Point", either the activity is ended, or there may be various options that would allow reconsideration of the approval.
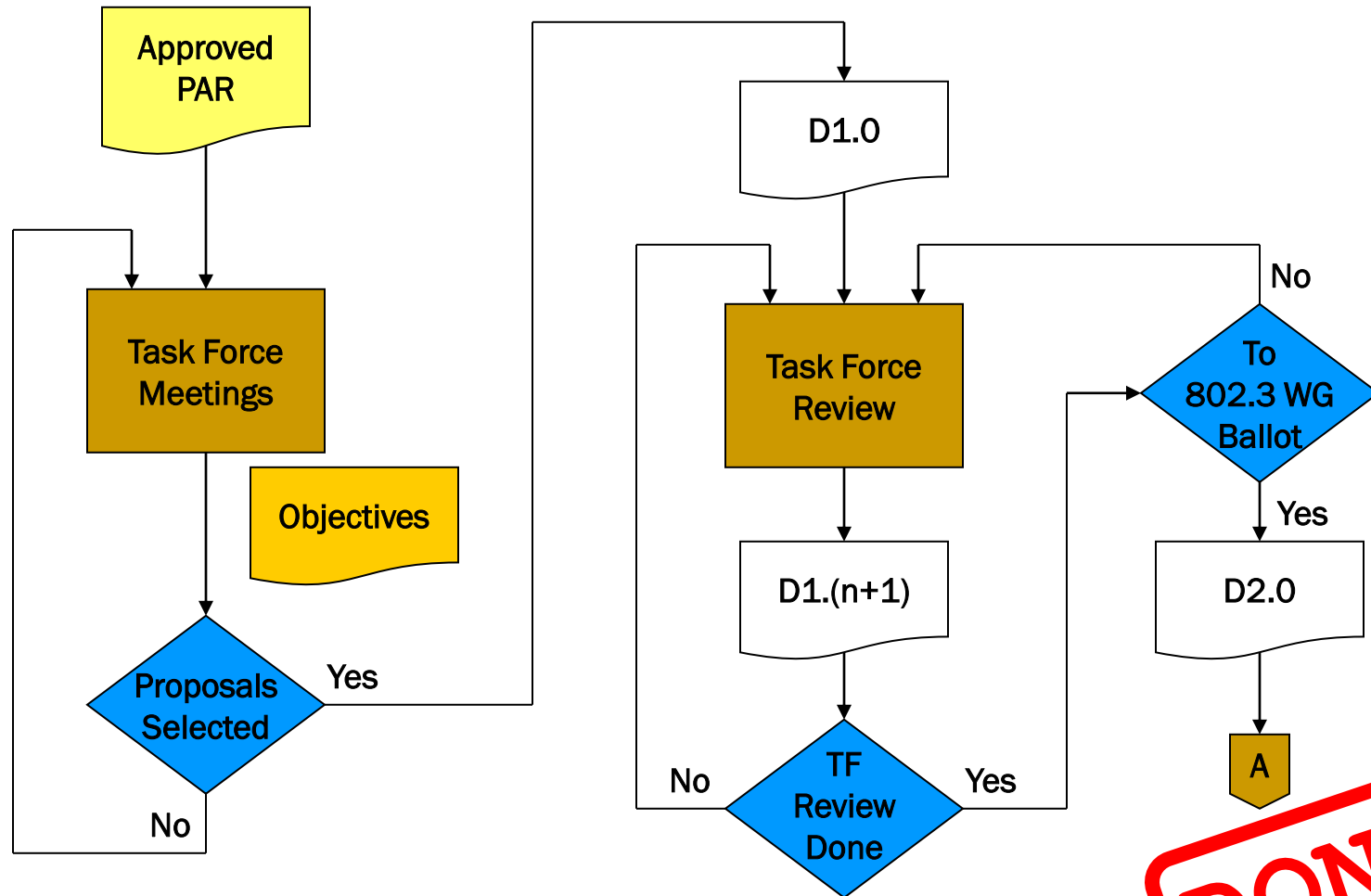
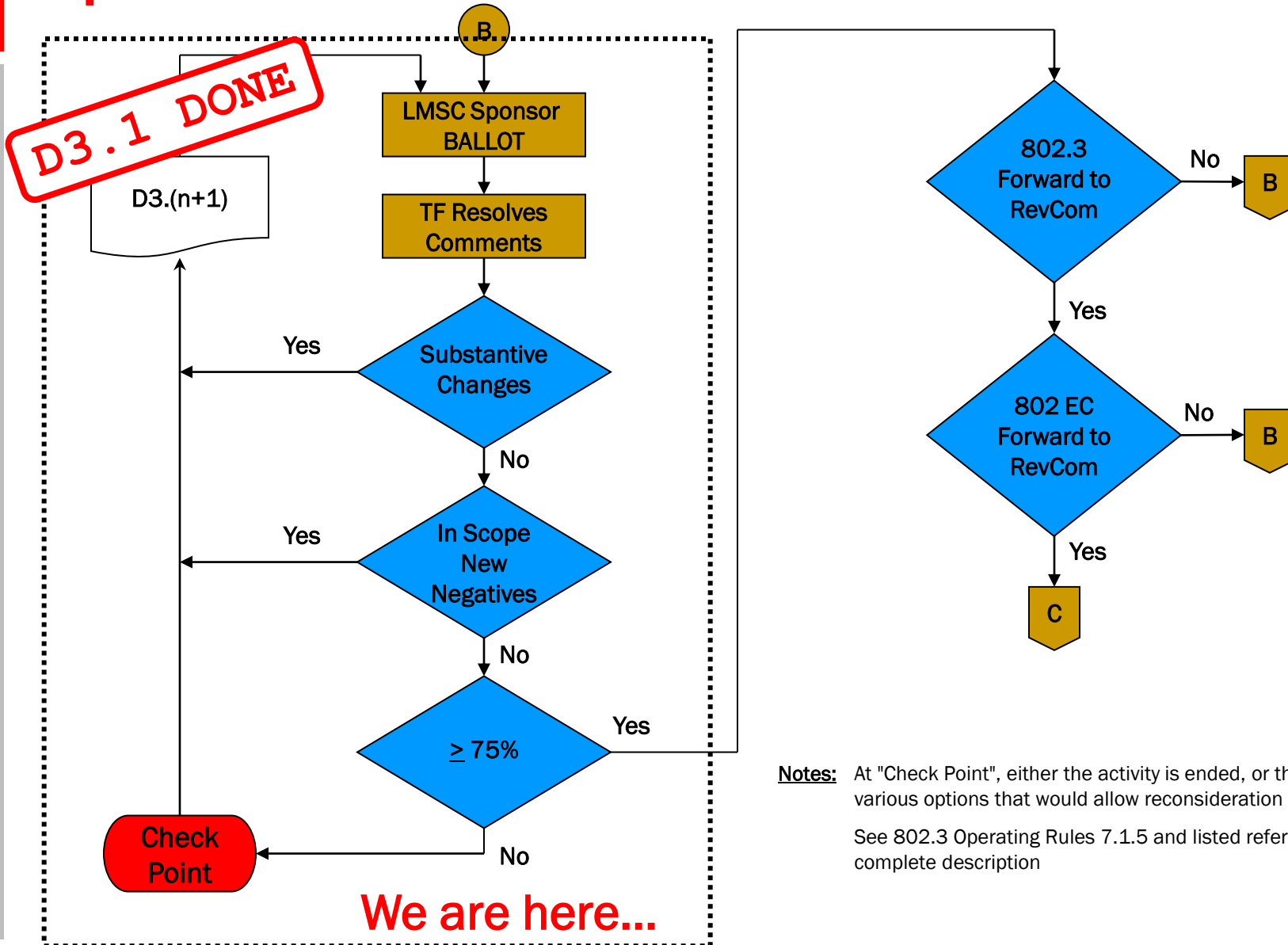# Overview of IEEE 802.3 Standards Process (3/5) - Working Group Ballot Phase
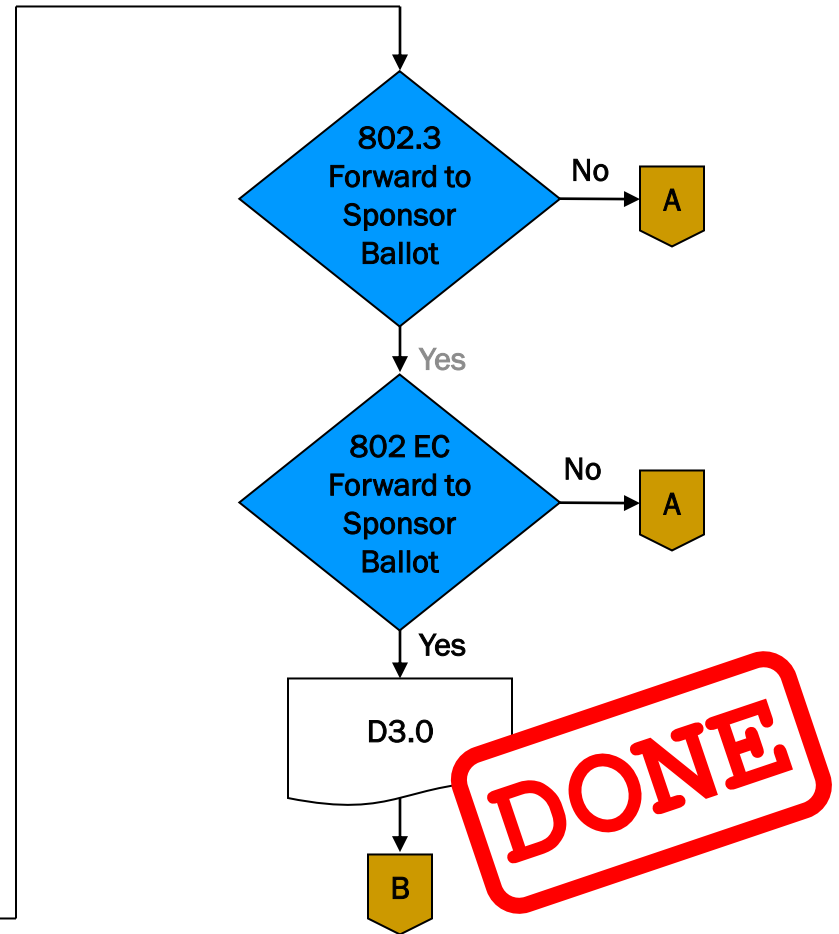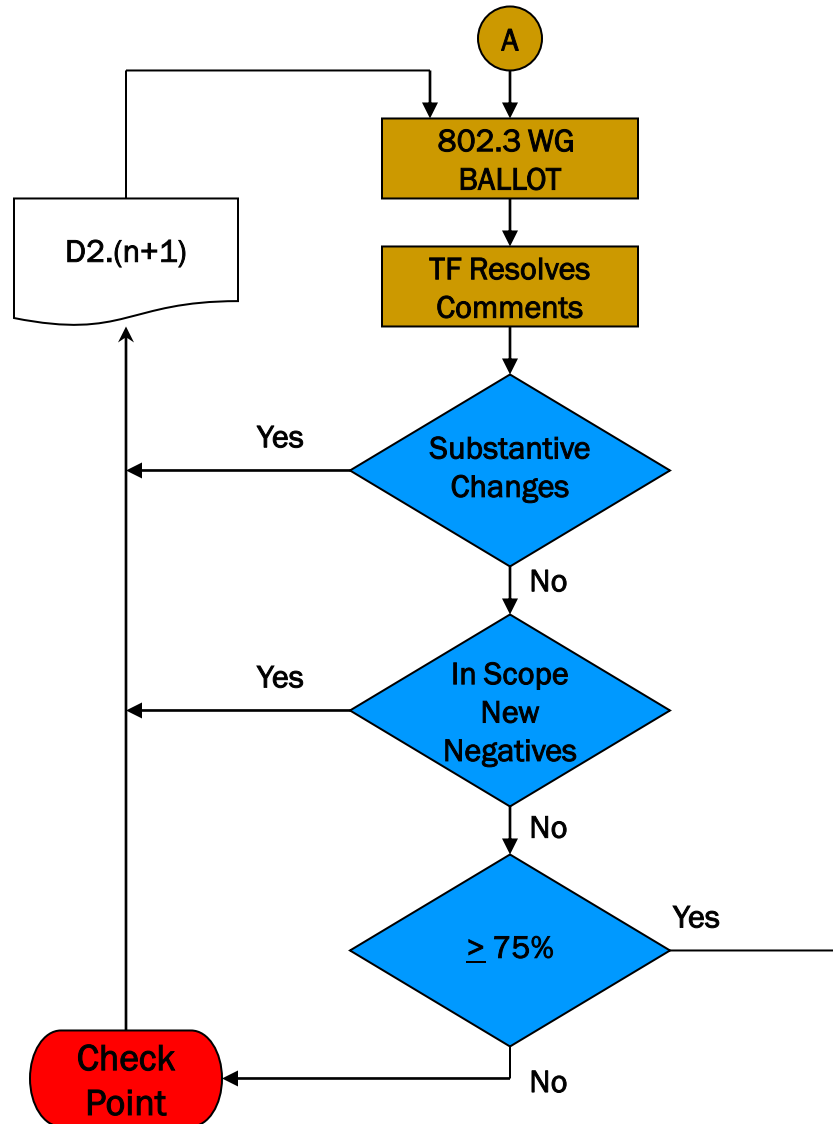
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See 802.3 Operating Rules 7.1.4 and listed references for complete description
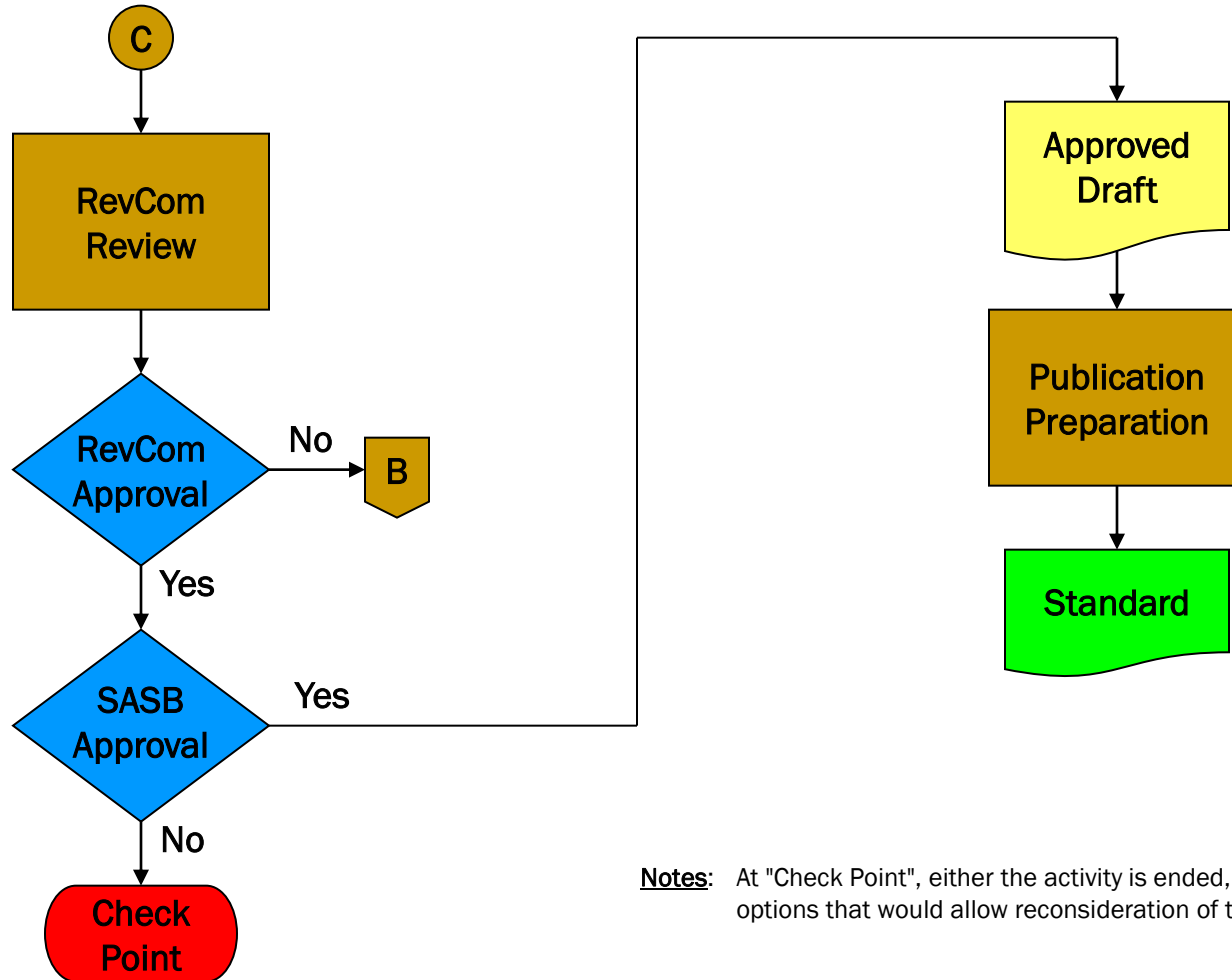
Overview of IEEE 802.3 Standards Process (4/5)- Sponsor Ballot Phase

D3.1 DONE

B.

LMSC Sponsor BALLOT

TF Resolves Comments

D3.(n+1)

Substantive Changes — Yes

In Scope New Negatives — Yes

≥ 75% — Yes / No

No

Check Point

We are here...

802.3 Forward to RevCom — No → B

Yes

802 EC Forward to RevCom — No → B

Yes

C

Notes: At "Check Point", either the activity is ended, or there may be various options that would allow reconsideration of the approval.

See 802.3 Operating Rules 7.1.5 and listed references for complete description

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