

# 500m Single Mode Objective for 400GbE

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# Supporters

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# Outline

- Proposed objective
- Five criteria:
  - Compatibility
  - Distinct Identity
  - Broad Market Potential
  - Technical Feasibility
  - Economic Feasibility

# Proposed Objective

- Define a 400Gb/s PHY for operation over SMF with reach up to at least 500m

# Compatibility

Compatible with 802.3 MAC

Compatible with proposed 400G PCS

Compatible with 100G PCS

Compatible with FEC

# Distinct Identity

- Proposed MMF objective is for 100m
- Long Reach solutions are not economically viable
  - Fiber plant restrictions and higher loss budget results in higher power, cost, size

# Broad Market Potential

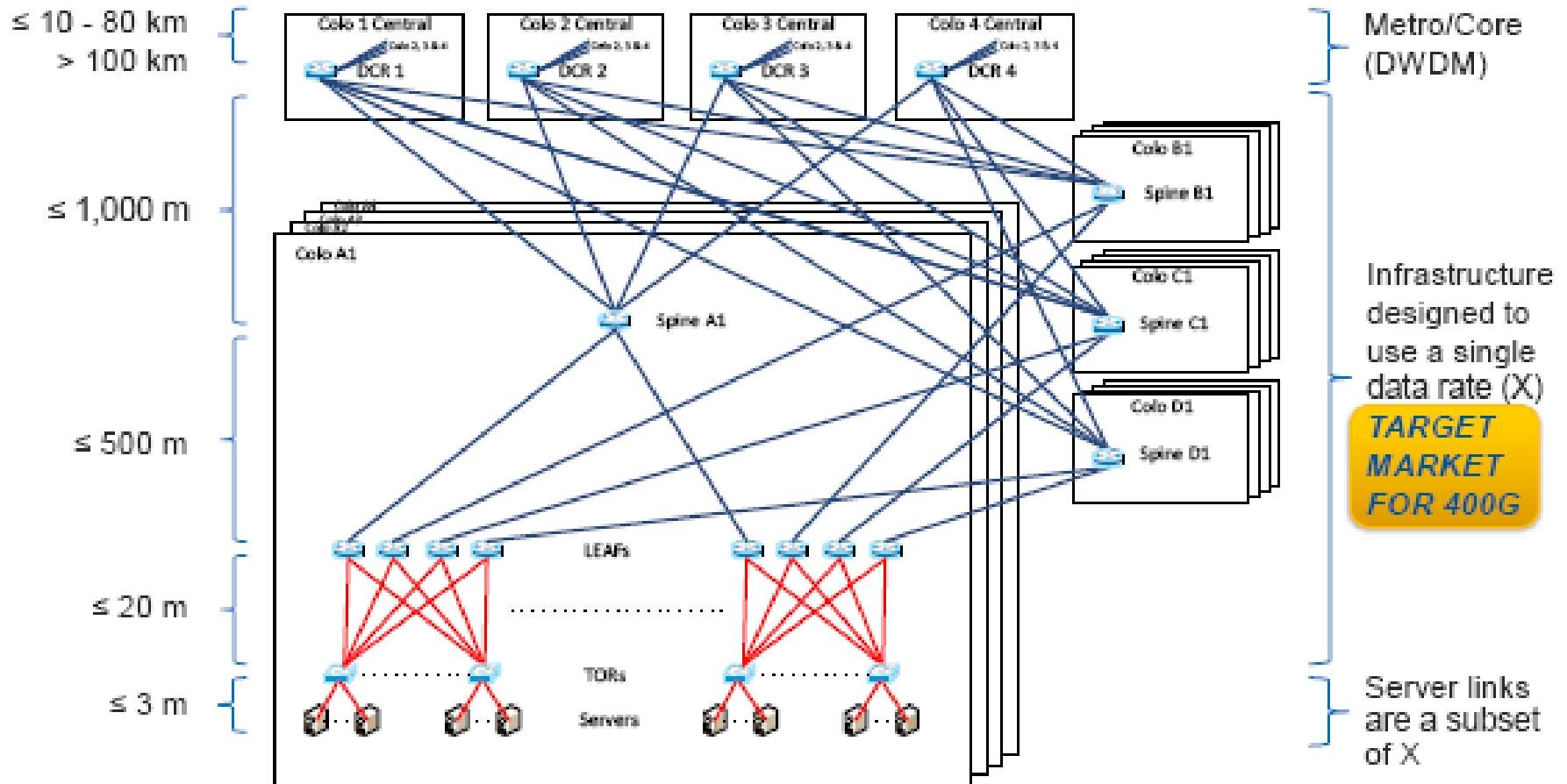
## Growth in Large data centers

- The Planning and Zoning Commission of Altoona, a suburb of Des Moines, has approved a 25 percent bump in the proposed size of the **three buildings** scheduled for construction on the site. The mysterious company has expanded its building plans by nearly 300,000 square feet, for a total of **1.4 million square feet**, [reported the \*Des Moines Register\*](#).
- To put this so-called “Project Catapult” in context, Facebook’s Prineville datacenter (as planned in 2010) totaled just over **300,000 square feet**—even after the social network announced plans to double the facility’s size. Apple’s own facility in Prineville, which will be powered exclusively by renewable energy sources, will total about **338,000 square feet**. And Apple’s Maiden, N.C. facility, one of the largest privately owned data facilities, covers **500,000 square feet** and cost about \$1 billion. Compare that to the original Altoona site plan, which called for one **350,000 square-foot** building and two buildings at **380,000 square feet**, and it’s clear something big is going on here.

Mark Hachman, Slashdot, April 2 2013

# Broad Market Potential

## Cloud Data Center Campus Interconnections





# Broad Market Potential

## Interconnection Volume

- Four sections per colo & multiple colos ( $\geq 4$ ) per data center
- Volumes below are per section (except DCR to Metro)

A End	Z End	Volume	Reach (max)	Medium	Cost Sensitivity	Market Space
Server ‡	TOR	10k – 100k	3 m	Copper	Extreme	LAN
TOR	LEAF	1k – 10k	20 m	Fiber (AOC)	High	
LEAF	SPINE	1k – 10k	400 m	SMF	High	
SPINE	DCR	100 – 1000	1,000 m	SMF	Medium	Campus
DCR	Metro	100 – 300	10 - 80 km	SMF	Low	WAN

‡ Server-TOR links may be served by breakout cables

# Broad Market Potential

- Break out cables to 100G
  - i.e. CDFP to 4xQSFP

# Technical Feasibility (Lowest risk first)

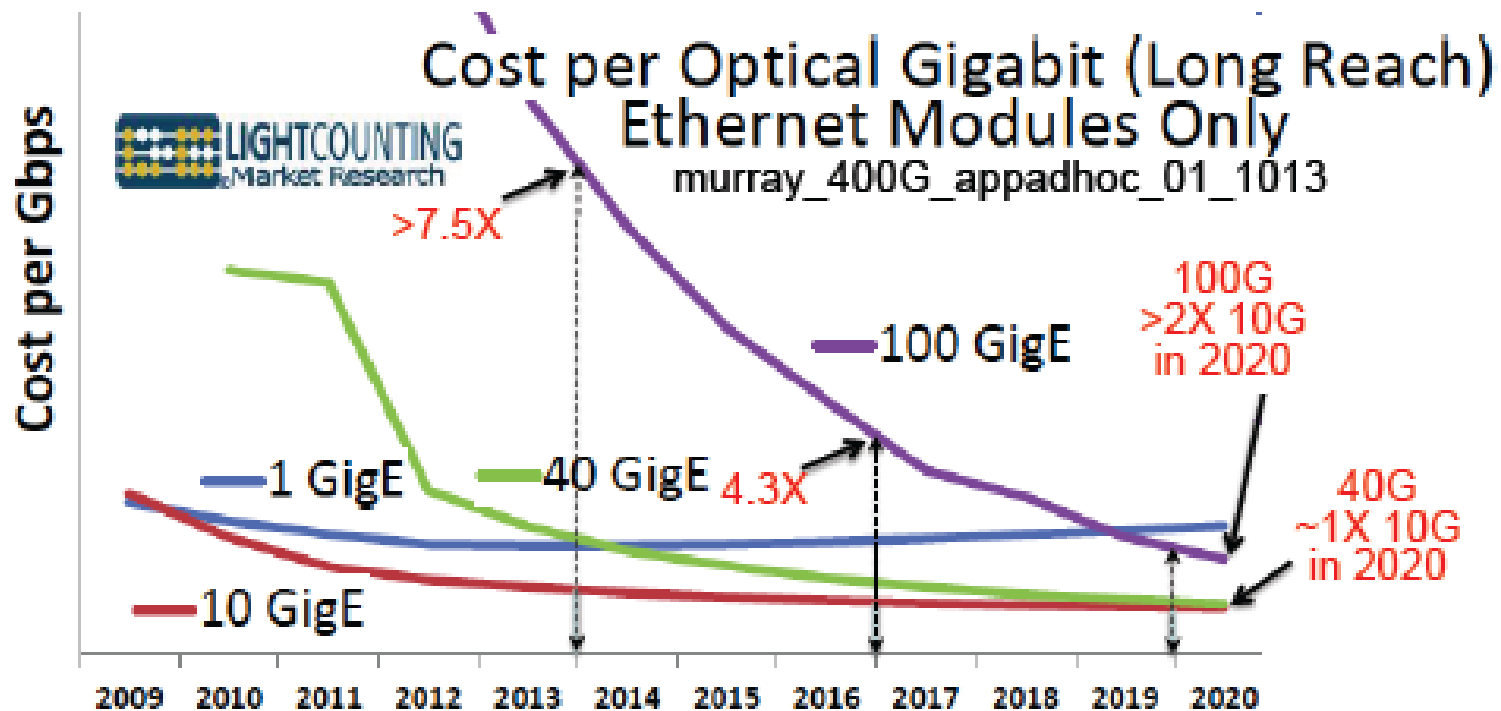
- 4xQSFP form factor
  - 4x CAUI4 electrical I/F
- CDFP MSA form factor
  - Supports 16x25G electrical interface
    - 4xCAUI4/CAUI16
- ‘New’ MSA form factor
  - Electrical I/F based on OIF 56G CEI project
    - 8x50G
- Other form factors (CFP)
  - Electrical I/F based on CAUI4 (16x25G) or 8x50G

# Economic Feasibility

- 100GBASE-LR4 is the only solution available today for distances >100m
  - Work in 802.3bm has shown cost reductions compared to 100GBASE-LR4 up to at least 500m
  - Cost reductions for 400G versions will only be larger

# Economic Feasibility

- A 500m objective would allow a 400G solution that would be lower cost/Gbit than 100G from day 1



# 5 Criteria Summary

- Compatibility
  - Compatible with 400G PCS proposals, 100G PCS, 100G FEC, 802.3 MAC etc
- Distinct Identity
  - MMF objective is 100m
  - Long reaches not economically viable
- Broad Market Potential
  - 500m distance required for data center applications

# 5 Criteria continued

- Technical Feasibility
  - Leverages work from 802.3bm
- Economic Feasibility
  - 100GBASE-LR4 comparisons show cost savings/Gbit from point of introduction

# Proposed Objective

- Define a 400Gb/s PHY for operation over SMF with reach up to at least 500m