# 10GBASE-T: The Need to Support Cat 5e

## Mike Bennett

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# Contributors

- **Les Cotrell – Stanford Linear Accelerator Center (SLAC)**
- **Brent Draney – National Energy Research Supercomputing Center (NERSC)**
- **Roberto Morelli – Energy Sciences Network (ESnet)**
- **Scott Studham – Pacific Northwest National Laboratory**
- **Bill Wing – Oak Ridge National Laboratory**
- **Dave Wiltzius – Lawrence Livermore National Laboratory**

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# Supporters

- **Bruce Tolley – Cisco Systems**
- **Shimon Muller – Sun Microsystems**
- **Joel Georgen – Force10 Networks**
- **Mike Laudon – Force10 Networks**
- **Chris DiMinico – MC Communications**
- **Rick Rabinovich – Spirent Communications**
- **Wael Diab – Cisco Systems**
- **Joseph Babanezhad – Plato Systems**
- **Tetsu Koyama - NEC**
- **Les Cotrell – Stanford Linear Accelerator Center (SLAC)**
- **Eli Dart – National Energy Research Supercomputing Center (NERSC)**
- **William Johnston – Energy Sciences Network (ESnet)**
- **Scott Studham – Pacific Northwest National Laboratory**
- **Bill Wing – Oak Ridge National Laboratory**
- **Dave Wiltzius – Lawrence Livermore National Laboratory**
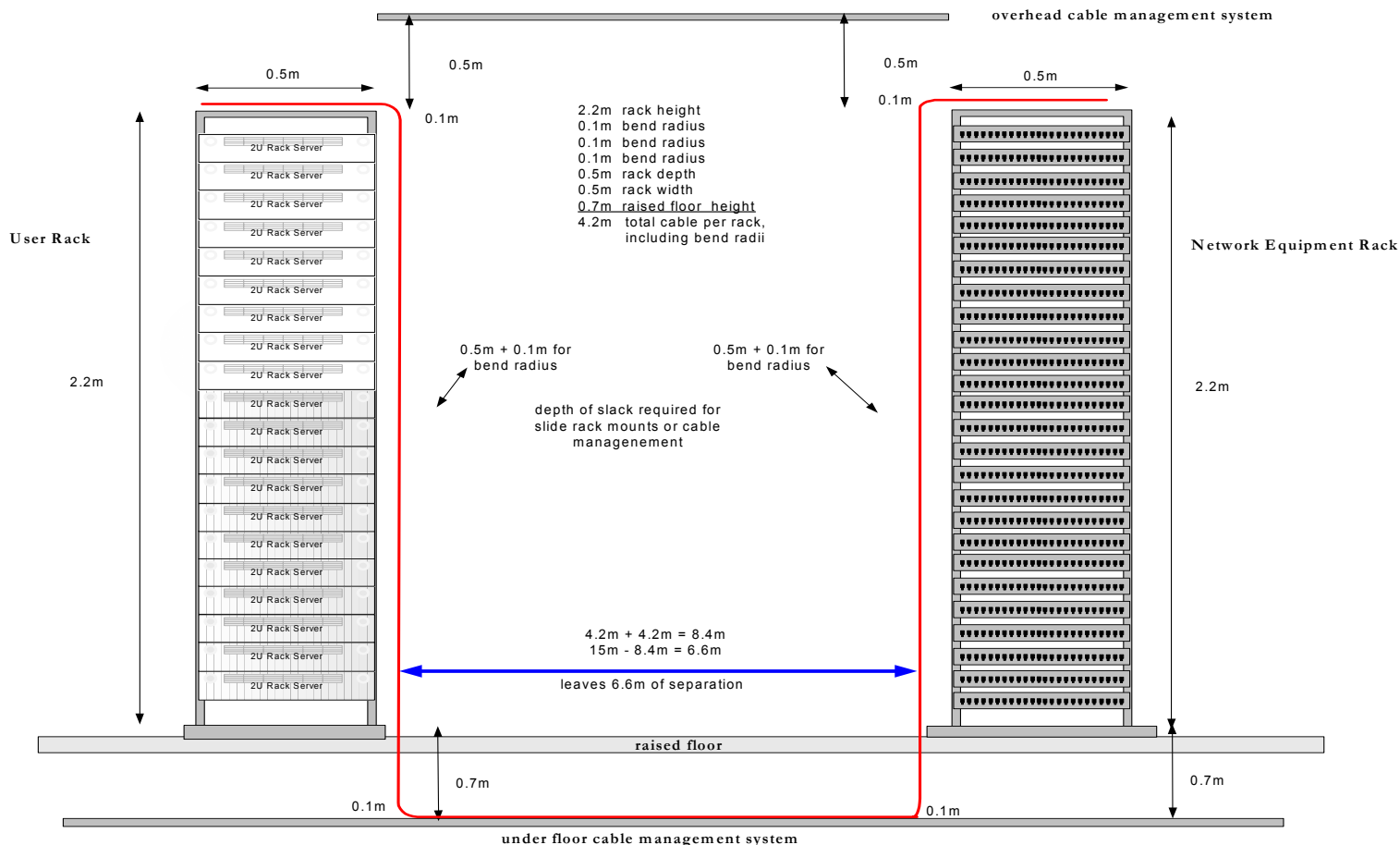- **Mike Bennett – Lawrence Berkeley National Laboratory**

# Discussion

- **Overview**
- **Observations**
- **Conclusion**

# Overview

- **A good bit of this material is taken from `bennett_1_1103.pdf` from the Nov. plenary.**

- **There is a gap between current 10 GbE PHYs, 10GBASE-CX4, and what is needed in data centers and enterprise networks**
  - **Most notable is the gap between CX4 (15m) and LX4 (300m MMF)**
    - **No LX4 parts shipping**
    - **Optical 10GbE is still too expensive**
      - **Cost is still not down to the targeted 3x 1 GbE cost**

- **Initial broad market is data centers**

- **Recall that in the data center, 4.2 m of cable per rack is used inside the racks in order to provide enough cable to reach equipment and to access the cable management systems in the overhead trays or under the floor**
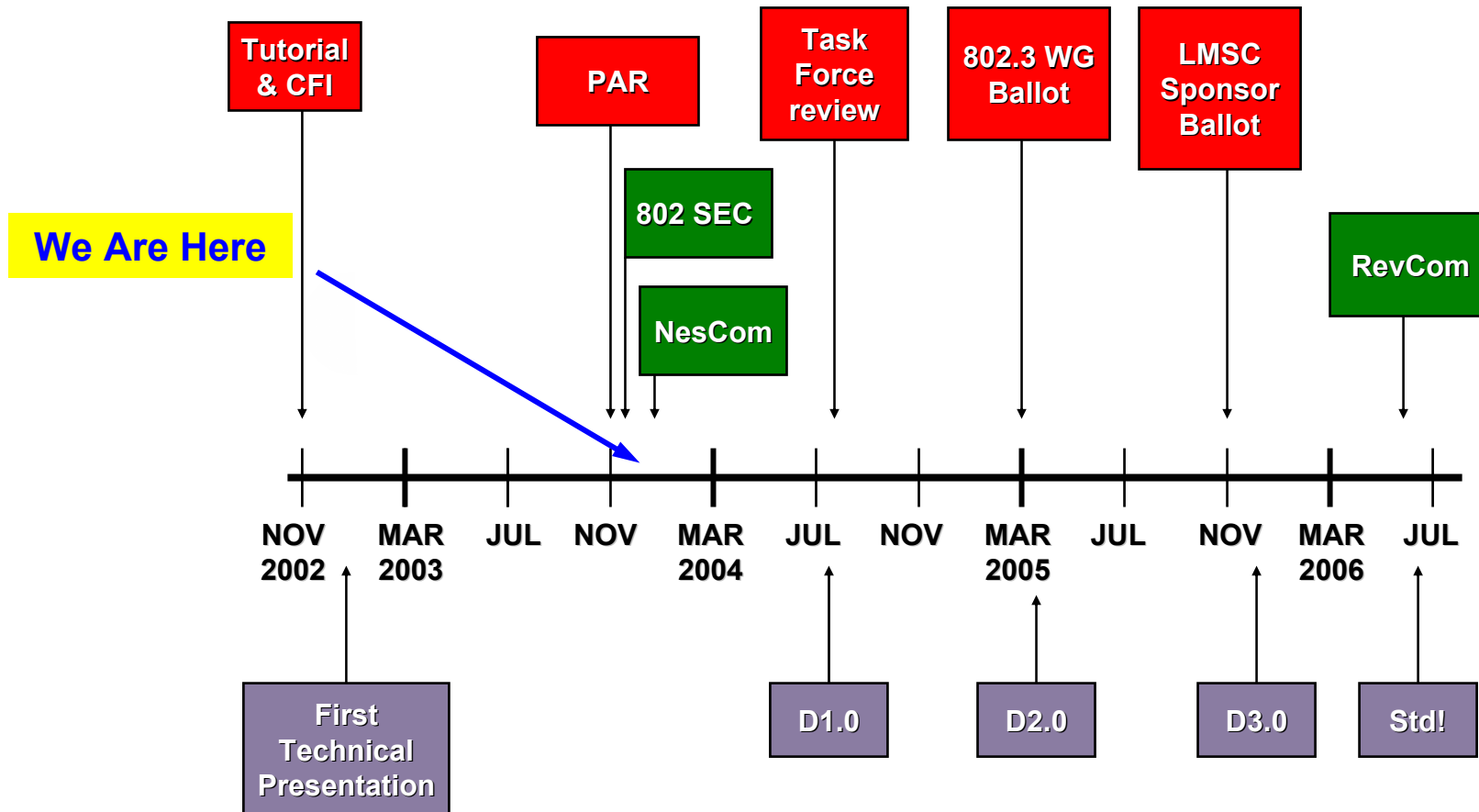
# Overview (cont.)

- **4.2 m of cable in each rack (8.4m) allows only 6.6m between racks for 10GBASE-CX4 (15m)**



overhead cable management system

0.5m

0.5m

0.1m

0.5m

0.1m

0.5m

2.2m  rack height
0.1m  bend radius
0.1m  bend radius
0.1m  bend radius
0.5m  rack depth
0.5m  rack width
0.7m  raised floor  height
4.2m  total cable per rack,
        including bend radii

User Rack

2U Rack Server

2.2m

Network Equipment Rack

2.2m

0.5m + 0.1m for bend radius

0.5m + 0.1m for bend radius

depth of slack required for slide rack mounts or cable managenement

4.2m + 4.2m = 8.4m
15m - 8.4m = 6.6m

leaves 6.6m of separation

raised floor

0.7m

0.7m

0.1m

0.1m

under floor cable management system

# Overview (cont.)

- **Recall that 67% of the installed base of cables is less than or equal to 50m long**

- **50% of the installed base of cables is less than or equal to 40m long**

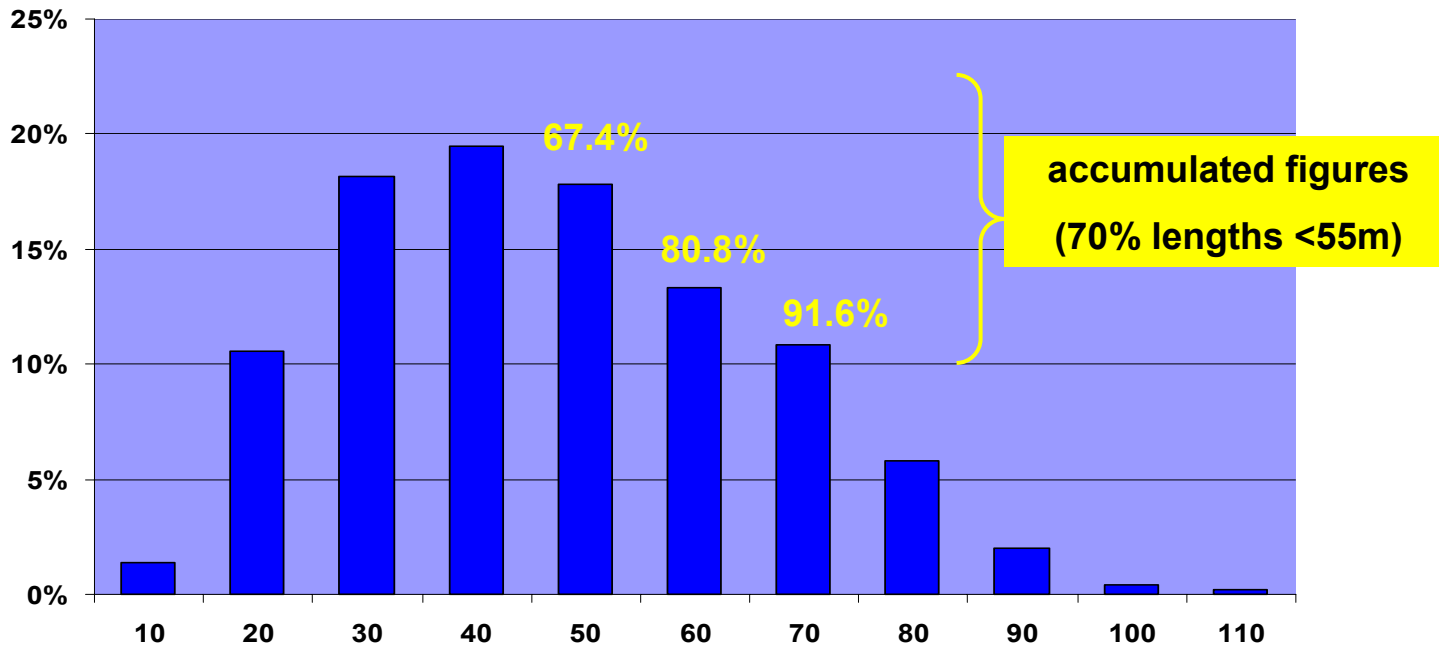- **What about when the standard is finished?**

# Observations



Timeline of 10GBASE-T standardization process:

- **Tutorial & CFI** — NOV 2002 → First Technical Presentation
- **We Are Here** (pointing to NOV 2003/MAR 2004)
- **PAR** — NOV 2003
- **802 SEC** — NOV 2003
- **NesCom** — NOV 2003
- **Task Force review** — JUL 2004 → D1.0
- **802.3 WG Ballot** — MAR 2005 → D2.0
- **LMSC Sponsor Ballot** — NOV 2005 → D3.0
- **RevCom** — JUL 2006 → Std!

Timeline markers: NOV 2002 | MAR 2003 | JUL | NOV | MAR 2004 | JUL | NOV | MAR 2005 | JUL | NOV | MAR 2006 | JUL

# Observations (cont.)

- **When 10GBASE-T goes to sponsor ballot, a large percentage of the installed base will be cat 5e**



Cat 5e/ new Class D 50%

Cat 5/ old Class D 15%

FTTD 0.6%

Cat 6/Class E 34%

Cat 7/Class F 0.4%
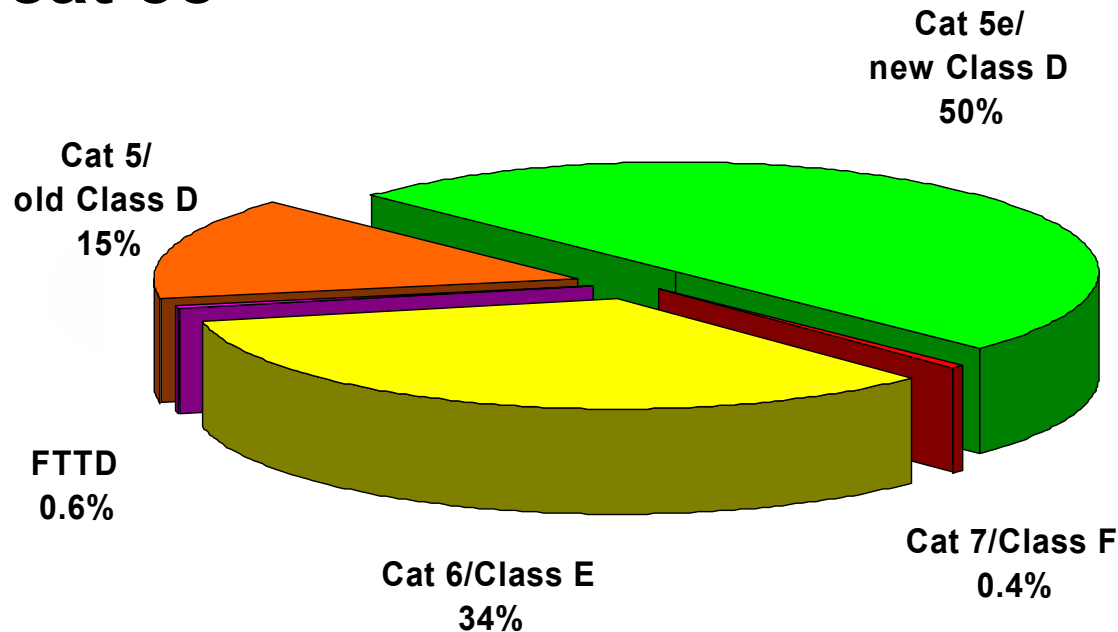
**Source: Flatman_1_0303.pdf**

# Observations (cont.)

- **More than half of the installed base of cables are less than or equal to 50m in length**

Source: Flatman, Fluke, Hubbell, Nordx/CDT, Siemon (total sample >108,000 cabling links)



accumulated figures

(70% lengths <55m)

67.4%

80.8%

91.6%

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# Observations (cont.)

- **According to the presentation "10GBASE-T: How much capacity is enough?" the minimum channel capacity required to support 10GBASE-T is 18-20 Gb/s (roth_1_0503.pdf)**

- **According to the presentation "10GBASE-T Cabling Baseline Proposal" a 4 connector 50m category 5e channel has a capacity of 17.7 Gb/s with no alien crosstalk mitigation and 20.6 Gb/s with 5 dB alien crosstalk mitigation (diminico_2_0703.pdf)**

# Observations (cont.)

- **Based on that data, the channel capacity for a 4-connector 4 pair horizontal structured cable would be:**

  **No Alien Mitigation**               **5 dB Alien Mitigation**
  - **17.7 Gb/s at 50m**                    **20.6 Gb/s at 50m**
  - **19.5 Gb/s at 40m**                    **22.5 Gb/s at 40m**

- **It seems feasible to operate 10GBASE-T somewhere in this region**

- **Others have presented data that supports the feasibility of operating 10 Gb/s over cat 5e**

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# Observations (cont.)

- **The following link lengths capable of supporting 10 Gb/s on cat 5e were presented in Sept. '03:**

| Link Length (m) | Data Source |
|:---:|:---:|
| 20 | powell_1_0903.pdf |
| 20 | telang_1_0903.pdf |
| 30 | abughazaleh_1_0903.pdf |
| 45 | diminico_1_0903.pdf |
| 60 | nagahori_1_0903.pdf |

# Observations (cont.)

- **End users will test installed circuits before turning the service on**
  - **If the installed cable fails the test then we'll install new cable**
  - **A piece of test equipment and 30 minutes of technician time per 10GBASE-T installation will cost less initially than a major cable overhaul**
- **Our current objectives do not allow end users this option**
  - **It seems we would be doing the user community a disservice if we do not support the use of cat 5e for some link length**

# Conclusions

- **The data centers are where the majority of high end computers are going to be deployed**
  - This is where 10 GbE demand will most likely be
- **Its clear that 10GBASE-T fills the gap for 10 Gigabit Ethernet needs in data centers**
  - 10GBASE-CX4 will only support a 6.6m inter-rack distance when equipment is placed at the top of each rack
- **10GBASE-T has a much broader market potential with an objective to support the installed base of category 5e cable**
  - This would meet the needs of LBNL and other DOE national facilities
  - Category 5e will still be a large percentage of installed cable when the standard is completed in 2006

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# Extras

● **Link lengths and data center coverage**

| Link Length (m) | Data Canter Coverage ( sq. m) | Data Canter Coverage ( sq. f) |
|---:|---:|---:|
| | | |
| 20 | 135 | 1453 |
| 30 | 467 | 5039 |
| 40 | 999 | 10784 |
| 50 | 1731 | 18690 |

- ## **DoE Data Centers and link length needs**
  - ### **Link length = sqrt(size sq. m) + 8.4m**

| Data Center | Size (sq m) | Minimum Link Length Required (m) | Size (sq. ft) | Minimum Link Length Required (ft) |
|---|---|---|---|---|
| | | | | |
| ORNL | 1,852 | 51 | 20,000 | 159 |
| NERSC | 1,852 | 51 | 20,000 | 159 |
| SLAC | 1,204 | 43 | 13,000 | 134 |
| PNNL | 463 | 30 | 5,000 | 93 |
| Esnet | 463 | 30 | 5,000 | 93 |
| LBL ITSD | 463 | 30 | 5,000 | 93 |
| LBLnet | 324 | 26 | 3,500 | 82 |

# Straw Poll

- **Is there any interest in the study group to define a channel model based on category 5e UTP that can be included in the standard:**

**Yes:         26**

**Those willing to work on the channel model:**

**Yes: 11**

**Those willing to work on the channel model:**

**Companies: 4**