40GBASE-T Advantages and Use Cases

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San Diego, California USA
July, 2014
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Introduction

• Historical advantage of BASE-T (relative cost, availability, flexibility)
• Comparison of relative cost of 10GBASE-T and predicted 40GBASE-T to other interconnect technology
• Effect of 40GBASE-T on architecture choices
BASE-T Advantages

• Least cost access layer alternative when compared to other interconnect technologies
  – Optical (e.g. SR, LR)
  – Direct-Attached

• Structured topology
  – Common physical interface (RJ45)
  – Flexibility and longevity
  – Optimized for small to medium-sized data centers (< 20K square feet)

• Supports auto-negotiation and Power-Over-Ethernet
  – Simple plug and play installation
  – Ubiquitous RJ45 interface simplifies 10GBASE-T to 40GBASE-T upgrade path
Centralized Switching Architecture: TIA-942 Direct Connect

- **Pro**
  - Lower cost than distributed architectures
  - Simple to design, implement and maintain
  - Minimized network bottleneck
  - Good port utilization
  - Easy device management

- **Con**
  - Large number of cables
  - Cable overlaps
  - Difficulties in cable pathway design
  - Lack of scalability

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End-of-Row or Middle-of-Row Switching Architecture

- **Pro**
  - Fewer number of cables than direct-connect architecture
  - Good scalability
  - Cost effective compared to top of rack (ToR)

- **Con**
  - More capital expenditure on end of rack (EoR) and middle of rack (MoR) switches
  - Increased management overhead
  - Network stability risks due to potential Layer 2 loops that cause broadcast storm

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Top-of-Rack Switching Architecture

- **Pro**
  - Most efficient cable use
  - Efficient use of floor space
  - Good scalability
  - Easy cable management
- **Con**
  - More switches to manage
  - Difficult to achieve full port utilization of ToR switch
  - Higher aggregation layer port count
  - Higher spanning tree logical ports in aggregation layer
  - More server-to-server traffic in aggregation layer
  - Potentially higher switch costs
  - Thermal management risks
  - Creation of hotspots

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EoR vs. ToR – Relative Costs

- Roughly a 26 percent increase in cost using ToR with Direct-Attached cabling

Source: Anixter Inc.
EoR vs. ToR – Relative Costs (Detailed)

- Reduced cabling costs with ToR
- Increased cost of ToR architecture driven by network electronics and server interfaces

Source: Anixter Inc.

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Category 8 Goals

• Reduce 40GBASE-T equipment power consumption
  – Reason for modifications in channel length and shielding
• Support End-of-Row and Top-of-Rack data center deployments
  – 30 meter reach with 2 connectors is sufficient
• Support auto-negotiation for backwards compatibility
  – Same 4-pair twisted-pair cable as prior categories
# Data Center Twisted-Pair Migration Roadmap

<table>
<thead>
<tr>
<th>Category</th>
<th>Maximum Bandwidth</th>
<th>Maximum Application Data Rate</th>
<th>Maximum Reach</th>
<th>Number of Connectors in Channel</th>
<th>Cable Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>250MHz</td>
<td>1000BASE-T</td>
<td>100m</td>
<td>4</td>
<td>Unshielded or shielded</td>
</tr>
<tr>
<td>6A</td>
<td>500MHz</td>
<td>10GBASE-T</td>
<td>100m</td>
<td>4</td>
<td>Unshielded or shielded</td>
</tr>
<tr>
<td>8</td>
<td>2000MHz</td>
<td>40GBASE-T</td>
<td>30m</td>
<td>2</td>
<td>Shielded only</td>
</tr>
</tbody>
</table>

**Upgrade Path**

- 1G to 10G
- 10G to 40G

**Category 6A Channel**

- 2m patch
- 85m horizontal
- 5m zone
- 5m patch

**Category 8 Channel**

- 3m patch
- 24m horizontal
- IEEE P802.3bq
- 3m patch
How to Future Proof Today

- Limit copper reach to 30 meters with only 2 connectors in the channel
- Ensure deployment can support shielded copper cabling
- New technologies like Application Centric Infrastructure (also called leaf-spine) can present new opportunities
Flexibility: Supporting mixed applications with BASE-T over structured cabling

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Where can 40GBASE-T be used?

• 40GBASE-T will work anywhere in a data center where 30 meter connections will reach. This includes:
  – Anywhere in the classic 3 level hierarchy
  – For the fat-tree / leaf-and-spine / interconnected fat-tree fabric architecture
  – For full-mesh, interconnected meshes, and centralized switch
  – For virtual switch

Source: Jonathan Jew, editor of TIA-9432-A, VC TIA TR42.1
Traditional Three-Tier Data Center Architecture

Core switches - typically in MDAs

Aggregation switches - may be in MDAs, IDAs, or HDAs

Access switches in HDAs for End/Middle of Row or EDAs for Top for Rack 40GBASE-T

Servers in EDAs (server cabinets)

Note – Access switch to server connections can use 40GBASE-T with Category 8 Cabling

Source: ANSI/TIA-942-A-1

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Data Center Fabric – Fat-Tree/Leaf and Spine

Interconnection switches (Spine switches) typically in MDAs, but may be in IDAs

Access switches (Leaf switches) in
- HDAs for End/Middle of Row/Zone
- EDAs for Top for Rack

Servers in EDAs (server cabinets)

Source: ANSI/TIA-942-A-1
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Data Center Fabric – Full Mesh

Fabric switches may be located in MDAs, IDAs, HDAs, or in small data centers in EDAs.

Servers in EDAs (server cabinets)

Source: ANSI/TIA-942-A-1
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Data Center Fabric – Interconnected Meshes

Interconnection switches - typically in MDAs, but may be in IDAs

Access switches in
- HDAs for End/Middle of Row/Zone
- EDAs for Top for Rack

Servers in EDAs (server cabinets)

Source: ANSI/TIA-942-A-1

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Data Center Fabric – Virtual Switch Architecture

Source: ANSI/TIA-942-A-1

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Summary

• Future proofing is possible today if you:
  – Design facilities to accommodate 30m of copper (24m link with 6m total of patch cords)
  – Design for only 2 connectors in a channel
  – Design so shielded can be accommodated

• BASE-T still retains traditional advantages
  – Low cost
  – Easy to deploy
  – Auto-negotiation for plug and play and backwards compatibility
THANK YOU!

QUESTIONS?