Data Center Design Considerations

Chris DiMinico
MC Communications
cdiminico@ieee.org
Contributors:

- Jonathan Jew, President, J&M Consultants (Telecommunication Engineering Firm)
  - Co-chair TR42.1.1, Data Center Standard
- Phil Isaak, Associate, Senior Communications Engineer, Mazzetti & Associates (Engineering Firm)
- William Baxter, Telecommunications Practice Leader, OWP/P (A&E Firm)
Telecommunication Infrastructure

- ISP
- Internet Data Center
- Home SOHO
- Local Loop service provided
- Service provider - Distribution Node - Central Office
- Service Provider Backbone • Customer lease
- Service provider - Distribution Node - Central Office
- Local Loop service provided
- Enterprise
- Customer Premise
- DATA/Voice Infrastructure
  - Data Center
  - EFM- Access Networks

10GBASE-T
Figure 4. The California State University System computing network.
Generic Cabling - ISO/IEC 11801 - TIA/EIA-568
TIA-942-Data Center Standard

- The standard is being developed by the TIA/TR42
- Engineering Committee - subcommittee-TR-42.1.1 Network Distribution Nodes - Project No. 3-0092
- Participants include:
  - Architecture & Engineering Firms
  - Consultants
  - End Users
  - Manufacturers
- The standard will become TIA-942
- To be submitted for approval by ANSI and CSA
- Draft 3.0 - expected to be issued by TIA end of November
- Anticipated ballot closure early January
Data Center - Relationship of Spaces

BUILDING SITE

BUILDING SHELL

GENERAL OFFICE SPACE

TELECOM ROOMS & EQUIPMENT ROOMS
for spaces outside data center

OFFICE BUILDING SUPPORT SPACE

DATA CENTER

SUPPORT STAFF OFFICES

ENTRANCE ROOM(S)

DATA CENTER ELECTRICAL & MECHANICAL ROOMS

OPERATIONS CENTER

TELECOM ROOM(S)
for data center support spaces

STORAGE ROOMS & LOADING DOCKS

COMPUTER ROOM

10GBASE-T
Data Center Topology

Entrance Facility

Offices, Operations Center, Support Rooms

Active Equip interconnect

Active Equip interconnect

Active Equip interconnect

Active Equip interconnect

Active Equip interconnect

Active Equip interconnect

Active Equip interconnect

Active Equip interconnect

Active Equip interconnect

Active Equip interconnect

Back bone Cabling

Horizontal Cabling

Zone Distribution

interconnect

interconnect

interconnect

Active Equip

Active Equip Storage Area Devices

Data Center

10GBASE-T
Data Center Horizontal cable distance

In a data center, horizontal cabling is the cabling from the horizontal cross-connect (in the main distribution area or horizontal distribution area) to the outlet in the equipment distribution area or zone distribution area.
Physical Layer Design Considerations:

- **Active Equipment** -
  - Network topology, including operating distances and numbers of connectors
  - PMD types
    + copper
    + optics, mode conditioning patch cords
  - Equipment densities per linear rack unit.

- **Cabling**
  - Cabling components: cable, connectors, patch cords
  - installation: conntecterization
  - cabling density
  - Field testing

- **Compatibility with existing (installed Network)**

- **Total Network Cost**
Data Center: Network Cabling Design Considerations

• Placement of active equipment and usage of interconnect versus cross-connects:
Data Center: Horizontal Cabling Length: J&M Consultants (Engineering Firm)

- Data centers recently built by (J&M) type and size
  - 93% of data center horizontal cables are <= 45m
  - 99% of data center horizontal cables are <= 55m

<table>
<thead>
<tr>
<th>Data Center Type</th>
<th>Data Center Size (sq ft)</th>
<th>0-30 m</th>
<th>31-45 m</th>
<th>46-55m</th>
<th>56-75m</th>
<th>76-100m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corporate</td>
<td>5000</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Corporate</td>
<td>8000</td>
<td>90%</td>
<td>10%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Govt</td>
<td>10000</td>
<td>70%</td>
<td>20%</td>
<td>10%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Corporate</td>
<td>20000</td>
<td>70%</td>
<td>25%</td>
<td>5%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Corporate</td>
<td>20000</td>
<td>90%</td>
<td>9%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Internet</td>
<td>40000</td>
<td>60%</td>
<td>35%</td>
<td>5%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Corporate</td>
<td>45000</td>
<td>65%</td>
<td>25%</td>
<td>8%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Internet</td>
<td>60000</td>
<td>35%</td>
<td>48%</td>
<td>15%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Internet</td>
<td>60000</td>
<td>55%</td>
<td>35%</td>
<td>8%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Internet</td>
<td>80000</td>
<td>55%</td>
<td>35%</td>
<td>8%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Internet</td>
<td>100000</td>
<td>55%</td>
<td>35%</td>
<td>8%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>67.7%</td>
<td>25.2%</td>
<td>6.2%</td>
<td>0.5%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

Source: Jonathan Jew, J&M Consultants, Co-chair TR42.1.1- Data Center Standard
Data Center: Horizontal Cabling Length: Mazzetti & Associates (Engineering Firm)

- Data centers recently built by (M&A) type and size
  - 83% of data center horizontal cables are <= 45m
  - 94% of data center horizontal cables are <= 55m

<table>
<thead>
<tr>
<th>Data Center Type</th>
<th>Data Center Size (sq ft)</th>
<th>0-30 m</th>
<th>31-45 m</th>
<th>46-55m</th>
<th>56-75m</th>
<th>76-100m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corporate</td>
<td>5000</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Corporate</td>
<td>10000</td>
<td>8%</td>
<td>23%</td>
<td>38%</td>
<td>31%</td>
<td>0%</td>
</tr>
<tr>
<td>Financial</td>
<td>25000</td>
<td>74%</td>
<td>19%</td>
<td>6%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Corporate</td>
<td>30000</td>
<td>99%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Internet</td>
<td>60000</td>
<td>47%</td>
<td>46%</td>
<td>5%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Internet</td>
<td>75000</td>
<td>44%</td>
<td>50%</td>
<td>4%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Internet</td>
<td>120000</td>
<td>35%</td>
<td>32%</td>
<td>27%</td>
<td>5%</td>
<td>1%</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>58.1%</td>
<td>24.4%</td>
<td>11.4%</td>
<td>5.6%</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

Source: Phil Isaak, Associate, Senior Communications Engineer, Mazzetti & Associates (Engineering Firm)
Data Center: size versus percentage built

<table>
<thead>
<tr>
<th>Data Center Size (sq ft)</th>
<th>Size Category</th>
<th>Percentage built</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;= 5000</td>
<td>small</td>
<td>50%</td>
</tr>
<tr>
<td>&lt;= 15000</td>
<td>midrange</td>
<td>30%</td>
</tr>
<tr>
<td>&gt; 15000</td>
<td>large</td>
<td>20%</td>
</tr>
</tbody>
</table>

• 80% of data centers recently built by (J&M) are ≤ 15000 sq ft
  Source: Jonathan Jew, J&M consultants, Engineering Firm

<table>
<thead>
<tr>
<th>Data Center Size (sq ft)</th>
<th>Size Category</th>
<th>Percentage built</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;= 5,000</td>
<td>small</td>
<td>30%</td>
</tr>
<tr>
<td>&lt;= 15,000</td>
<td>midrange</td>
<td>45%</td>
</tr>
<tr>
<td>&gt; 15,000</td>
<td>large</td>
<td>25%</td>
</tr>
</tbody>
</table>

• 75% of data centers recently built by (M&A) are ≤ 15000 sq ft
  Source: Phil Isaak, Associate, Senior Communications Engineer, Mazzetti & Associates (Engineering Firm)
### Data Center Cabling by Category: Percentage Usage (avg.)

<table>
<thead>
<tr>
<th>Category</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 5</td>
<td>10.00</td>
<td>1.67</td>
<td>0.33</td>
<td>0.33</td>
<td>0.33</td>
</tr>
<tr>
<td>Category 5e</td>
<td>66.67</td>
<td>60.00</td>
<td>55.00</td>
<td>46.67</td>
<td>35.00</td>
</tr>
<tr>
<td>Category 6</td>
<td>23.33</td>
<td>38.33</td>
<td>44.67</td>
<td>53.00</td>
<td>64.67</td>
</tr>
</tbody>
</table>

Source:

Jonathan Jew, J&M Consultants (Telecommunication Engineering Firm)
Phil Isaak, Associate, Senior Communications Engineer, Mazzetti & Associates (Engineering Firm)
William Baxter, Telecommunications Practice Leader, OWP/P (A&E Firm)
Data Center Cabling: Pathways and Spaces

Under Floor Space

Overhead Cable Tray

10GBASE-T
Example of Wire Basket Cable Trays For Cabling Under Raised Floor