Data Center Essentials
Cabling to Last

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Data Consumption is increasing...

50 billion devices connected to internet in 2020

400 zettabytes IoT data generation in 2018

1 zettabyte = 1 trillion gigabytes
People’s behavior is changing...

Source: GlobalWebIndex, Q4 2015. Based on a survey of internet users aged 16-64.
And the Data Center Market won’t stop growing...

Data Center market size in Southeast Asia (revenue from IT equipment, power management systems, cooling solutions, general construction, racks, security and DCIM).

US$ 359 million by 2020

20.17% CAGR

Projected growth during the period 2016-2020 for SEA DC Market.
We’ll need powerful networks
Data Centers

CABLING
What to expect from networks

- High Density
- Modularity
- Scalability
- Performance
What to expect from networks

Optical Systems

Copper Systems

Network Infrastructure
Data Center Solution – Copper Systems

- Categories 6, 6A and 8 (TIA-568-C.2-1, Jul.2016)
  2.0 GHz, 30m and 2-connector channel, with a maximum permanent link of 24m;

- **Shielded** and Unshielded options;

- Different flame rate options (LSZH).
Data Center Solution – Copper Systems

High Density  Modularity  Scalability  Performance
Data Center Solution – Copper Systems

ROADMAP 25/40GBASE –T

- 25 GBASE-T (IEEE 802.3by)
- 40 GBASE-T (IEEE 802.3bq)
  - Category 8
  - 30 m channel maximum length

- 100 GbE: without specification for Copper Channel
# Roadmap Ethernet

## Ethernet Interfaces and Nomenclature

<table>
<thead>
<tr>
<th>Electrical Interface</th>
<th>Backplane</th>
<th>Twisted Pairs</th>
<th>MMF</th>
<th>Parallel SMF</th>
<th>2km SMF</th>
<th>10km SMF</th>
<th>40km SMF</th>
</tr>
</thead>
<tbody>
<tr>
<td>10BASE-T</td>
<td></td>
<td>T</td>
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<tr>
<td>100BASE-T</td>
<td></td>
<td>TX</td>
<td>FX</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1000BASE-T</td>
<td>KX</td>
<td>SX</td>
<td>LX</td>
<td></td>
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<tr>
<td>2.5GBASE-T</td>
<td></td>
<td>T</td>
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<td></td>
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</tr>
<tr>
<td>5GBASE-T</td>
<td></td>
<td>T</td>
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</tr>
<tr>
<td>10GBASE-T</td>
<td>SFP, XFP</td>
<td>SX</td>
<td>LR</td>
<td>ER</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>25GBASE-T</td>
<td></td>
<td>T</td>
<td>SR</td>
<td>LR</td>
<td>ER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40GBASE-T</td>
<td>XLAUI</td>
<td>T</td>
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</tr>
<tr>
<td>50GBASE-T</td>
<td>50GAUI</td>
<td>T</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100GBASE-T</td>
<td>CAUI10</td>
<td>SR10</td>
<td>PSM4</td>
<td></td>
<td>10X10</td>
<td>LR4</td>
<td>ER4</td>
</tr>
<tr>
<td>200GBASE-T</td>
<td>200GAUI-4</td>
<td>SR4</td>
<td>DR4</td>
<td>FR4</td>
<td>LR4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>400GBASE-T</td>
<td>400GAUI-16</td>
<td>SR8</td>
<td>FR8</td>
<td>LR8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Gray Text** = IEEE Standard
- **Red Text** = In Standardization
- **Blue Text** = Non-IEEE standard but complies to IEEE electrical interfaces

**Note:**
- Duplex and Parallel Optical Fiber
- Twisted Pair Cat “x”
- 2W, 4W, 12W
- Twinax
- FCS
- Furukawa Cabling System
- Bicsi
Data Center Solution – Optical Systems

- Singlemode, OM3, OM4 and OM5
  (TIA 568.3-D, Oct.2016)

- LC and MPO connectors
  (TIA/EIA-604, FOCIS 10 and FOSIS 5)

- **Pre Terminated** Systems or Fusion Splice Systems;

- Different flame rate options (LSZH).
Data Center Solution – Optical Systems

STRAIGHT MODEL

REVERSE MODEL

IEC-61754-7
and
TIA-604-5

MPO Connector with guide pin (male)

MPO Connector without guide pin (female)

FURUKAWA CABLE SYSTEM

Bicsi
### Polarity for arrays

#### Near / Far End

<table>
<thead>
<tr>
<th>Near / Far End</th>
<th>Fiber sequence (viewing the array connector plug end face with key up)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near</td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
</tr>
<tr>
<td>Far</td>
<td>12 11 10 9 8 7 6 5 4 3 2 1</td>
</tr>
</tbody>
</table>

#### End

<table>
<thead>
<tr>
<th>2-row plug, top row</th>
<th>Fiber sequence (viewing the array connector plug end face with key up)</th>
</tr>
</thead>
<tbody>
<tr>
<td>End</td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
</tr>
<tr>
<td>2-row plug, bottom row</td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
</tr>
<tr>
<td>1-row plugs</td>
<td>12 11 10 9 8 7 6 5 4 3 2 1</td>
</tr>
</tbody>
</table>

#### Figures

- **Figure 11** – Type-B:1-1 array patch cord and array cable (key-up to key-up)
- **Figure 12** – Type-B:2-1 array patch cord (key-up to key-up)

(TIA 568.3-D, Oct.2016)
WBMMF (OM5)

- Standard published ANSI/TIA 492 AAAE
- 50/125 micron – Laser optimized fiber
- 4700MHz.km in 850nm and 2470 MHz.km in 953nm
- Supports up to 8 wavelengths
- Designed for applications in SWDM
- Totally compatible with OM4

<table>
<thead>
<tr>
<th>Optical fiber type (cabled fiber type)</th>
<th>Wavelength (nm)</th>
<th>Maximum attenuation (dB/km)</th>
<th>Minimum overfilled modal bandwidth-length product (MHz.km)²</th>
<th>Minimum effective modal bandwidth-length product (MHz.km)²</th>
</tr>
</thead>
<tbody>
<tr>
<td>850 nm Laser-Optimized 50/125 µm Multimode TIA 492AA/E (OM3)</td>
<td>850 1300</td>
<td>3.0 1.5</td>
<td>1500 500</td>
<td>2000 Not Required</td>
</tr>
<tr>
<td>850 nm Laser-Optimized 50/125 µm Multimode TIA 492AAAD (OM4)</td>
<td>850 1300</td>
<td>3.0 1.5</td>
<td>3500 500</td>
<td>4700 Not Required</td>
</tr>
<tr>
<td><strong>Wideband Laser-Optimized 50/125 µm Multimode TIA 492AAAE</strong></td>
<td>850 953 1300</td>
<td>3.0 2.3 1.5</td>
<td>3500 1650 500</td>
<td>4700 2470 Not Required</td>
</tr>
<tr>
<td>Single-mode Indoor-Outdoor TIA 492CAAB</td>
<td>1310 1338 1550</td>
<td>0.5 0.5 0.5</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Single-mode Inside Plant TIA 492CAAB</td>
<td>1310 1338 1550</td>
<td>1.0 1.0 1.0</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Single-mode Outside Plant TIA 492CAAB (OS2)²</td>
<td>1310 1338 1550</td>
<td>0.4 0.4 0.4</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

* FCS FURUKAWA CABLEING SYSTEM

* BICSI
WBMMF (OM5)

SWDM - Short Wavelength Division Multiplexing

1. Links 100G with LC duplex
2. Links 400G with 8 fibers.
3. Power dissipation – Low ~ 1.5 W

Multiple channels and a pair of MM-OM5 Optical Fibers:

40 Gbps = 4 x λ 10Gbps  
100 Gbps = 4 x λ 25Gbps
## Channel Attenuation

<table>
<thead>
<tr>
<th>Application</th>
<th>OM2</th>
<th>OM3</th>
<th>OM4 and OM5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethernet 10GBASE-LX4</td>
<td>2.0 dB / 300m</td>
<td>2.0 dB / 300m</td>
<td>2.0 dB / 300m</td>
</tr>
<tr>
<td>Ethernet 25GBASE-SR</td>
<td>-</td>
<td>1.8 dB / 70m</td>
<td>1.9 dB / 100m</td>
</tr>
<tr>
<td>Ethernet 40GBASE-SR4</td>
<td>-</td>
<td>1.9 dB / 100m</td>
<td>1.5* dB / 150m</td>
</tr>
<tr>
<td>Ethernet 100GBASE-SR4</td>
<td>-</td>
<td>1.8 dB / 70m</td>
<td>1.9 dB / 100m</td>
</tr>
<tr>
<td>Ethernet 100GBASE-SR10</td>
<td>-</td>
<td>1.9 dB / 100m</td>
<td>1.5* dB / 150m</td>
</tr>
</tbody>
</table>

*1.0 dB total connection and splice loss allowance per IEEE 802.3.
Channel Attenuation

TIA-569 Pathways & Spaces
Channel Attenuation
Channel Attenuation
Other helpful features

UNIBOOT Patch Cords

DUPLEX Patch Cords

Patch cords UNIBOOTs save 50% space on the cable manager tray

Ø 1.6 mm

e IL < 0.15 dB

PC DUPLEX UNIBOOT LOW LOSS

Fujikawa Cabling System

FCS

Bicsi
• Energy and Cooling systems compete for space with Cabling system.

• Integrated projects allow optimization of available space under technical floor and computer room.

• Optical cables that combine higher fiber count with smaller diameter reduce space and weight occupation.
Other helpful features
Importance of Cabling
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