Are You Leaving Money on the Table?
Making Strategic OSP Cable Choices

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Director of Applications Marketing, LAN and OSPC
Corning Incorporated
Black Cable is Black Cable

2018 BICSI WINTER CONFERENCE & EXHIBITION
Orlando, FL | February 4-8
Five Flavors of Black Cable

LOOSE TUBE  MICRO CABLES  RIBBON  DROP  INDOOR/OUTDOOR

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Focus on Three Cable Families That Overlap

LOOSE TUBE

MICRO CABLES

RIBBON

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NOT...

Armored Double Jacket

Temperature

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Strategic Choices That Matter

- Scalability
- Signal Latency
- Signal Loss
- Deployment Velocity
General Overprovisioning Guidance

**25% Rule**
If future network applications are defined and potential demand for unanticipated service is low

**50% Rule**
If future network applications are defined and potential demand for unanticipated service is high

**100% Rule**
If future network applications are uncertain and potential demand for unanticipated service is very high or subsequent installations are extremely difficult
Average Fiber Counts Are Growing Very Fast

Day 1: You need over 3000 fibers to connect two hyperscale data centers together
Quick Math Shows Staggering Splicing Labor

<table>
<thead>
<tr>
<th></th>
<th>Ribbon</th>
<th>Single Fiber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiber Count</td>
<td>1728F</td>
<td>1728F</td>
</tr>
<tr>
<td>Number of splices</td>
<td>144</td>
<td>1728</td>
</tr>
<tr>
<td>Time per splice</td>
<td>8 minutes ($40 per splice)</td>
<td>4 minutes ($25 per splice)</td>
</tr>
<tr>
<td>Total Splicing Time(hrs.)</td>
<td>19 hours</td>
<td>115 hours</td>
</tr>
</tbody>
</table>
Loose Tube, Ribbon and Micro Cables Can Support Low to Very High Fiber Counts

Fiber Counts

<12 12 24 36 48 60 72 84 96 108 120 144 156 192 216 228 240 288 360 432 576 720 864 1728

Loose Tube

Ribbon

Micro Cable
Loose Tube, Ribbon and Micro Cables Can Support Low to Very High Fiber Counts

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Fiber Counts

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Micro Cables Offer Scalability and Pay as You Go Model

Day One: $2 \times 288 = 576$F
Micro Cables Offer Scalability and Pay as You Go Model

Day One: 2 x 288 = 576F

Future: 7 x 288 = 2016F
Strategic Choices That Matter

- Scalability
- Signal Latency
- Signal Loss
- Deployment Velocity
When Latency Really Matters

In the world of high-frequency trading, a 1 ms advantage can be worth $100M/year to a financial institution*

*Source: Infinera, 2010

- NYSE measures latency in microseconds (μs), not ms
- With 22.4B messages and 15B trades daily, even a 100 μs latency advantage can help
Excess Fiber Length (EFL)

• In any cable design, the length of the fiber must be longer than the cable itself to protect the fiber against stress under cable tension.
• This is known as **Excess Fiber Length (EFL)**

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**Stranded Loose Tube (LT) Cable**

EFL = Typically 2-8 percent of cable length

**Ribbon Cable (Central Tube)**

EFL = Typically ~0.2 percent of cable length
Time of Flight Comparison

MIA MI, FL

Transmission length
550 km

JACKSONVILLE, FL

Loose Tube Cable, 144 F
Excess fiber length 5% (typical range 2-8%)
Time of flight 2826 μs

Ribbon Cable, 144 F
Excess fiber length 0.2%
Time of flight 2697 μs
Latency advantage 129 μs
Strategic Choices That Matter

- Scalability
- Signal Latency
- Signal Loss
- Deployment Velocity
When Loss Really Matters

1. Signal generation = # of lit fibers x # of wavelengths per fiber x transceiver cost

2. Regeneration = # of lit fibers x # of wavelengths per fiber x transponder cost

3. Amplification = number of lit fibers x amplifier cost
Generally, Loose Tube Cables Will Have Lower Attenuation Values Than Equivalent Ribbon Cables

<table>
<thead>
<tr>
<th>Wavelengths</th>
<th>Loose Tube</th>
<th>Micro Cable</th>
<th>Ribbon</th>
</tr>
</thead>
<tbody>
<tr>
<td>1310nm</td>
<td>0.34</td>
<td>0.34</td>
<td>0.40</td>
</tr>
<tr>
<td>1550nm</td>
<td>0.22</td>
<td>0.22</td>
<td>0.30</td>
</tr>
</tbody>
</table>
Low Loss Fiber Can Help Lower System Costs

<table>
<thead>
<tr>
<th>Wavelengths</th>
<th>Standard SMF (db/km)</th>
<th>Low Loss SMF (db/km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1310nm</td>
<td>0.34</td>
<td>0.33</td>
</tr>
<tr>
<td>1550nm</td>
<td>0.18</td>
<td>0.17</td>
</tr>
</tbody>
</table>

If system link is > 100km, it is worth the discussion
Strategic Choices That Matter

• Scalability
• Signal Latency
• Signal Loss
• Deployment Velocity
Cable Choices Can Impact Deployment Velocity

- Cable Construction
- Brownfield Capacity Adds
- Greenfield Capacity
Top Five Water Cooler Optical Cable Gel Myths
Top Five Water Cooler Optical Cable Gel Myths

5. Gel filled cables provide more water block protection than dry
Top Five Water Cooler Optical Cable Gel Myths

4. Gel filled cables work best in harsh environments
5. Gel filled cables provide more water block protection than dry
Top Five Water Cooler Optical Cable Gel Myths

3. Gel works great for styling your hair

4. Gel filled cables work best in harsh environments

5. Gel filled cables provide more water block protection than dry
Top Five Water Cooler Optical Cable Gel Myths

2. Gel is necessary to prevent the fiber from delaminating over time
3. Gel works great for styling your hair
4. Gel filled cables work best in harsh environments
5. Gel filled cables provide more water block protection than dry
Top Five Water Cooler Optical Cable Gel Myths

1. Gel on fibers makes them splice better
2. Gel is necessary to prevent the fiber from delaminating over time
3. Gel works great for styling your hair
4. Gel filled cables work best in harsh environments
5. Gel filled cables provide more water block protection than dry
Reduction of Prep Time

Minutes

<table>
<thead>
<tr>
<th>Gel Filled Core and Buffer Tubes</th>
<th>Dry Core and Gel Filled Buffer Tubes</th>
<th>Gel Free</th>
<th>Gel Free without rip cords or binders</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>20</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>
Simple Cable Prep Can Add Up

<table>
<thead>
<tr>
<th></th>
<th>Gel filled</th>
<th>Gel free no ripcords/binders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable ends to prep</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Time to prep</td>
<td>23 minutes</td>
<td>3 minutes</td>
</tr>
<tr>
<td>Total Time to splice</td>
<td>37 hours</td>
<td>5 hours</td>
</tr>
<tr>
<td>Total labor cost at $20 an hour</td>
<td>$720</td>
<td>$100</td>
</tr>
</tbody>
</table>
Cost-Effective Capacity Upgrades in a Brownfield

**Standard Loose Tube Cable**

Day 1 capacity = 2 x 144 F = 288 F

Day one cost of 10 km installation: $1.34M

Duct OD/ID: 1.25 in
Cable OD: 15.8 mm
Same Upgrade Approach Cost a Fortune

**Standard Loose Tube Cable**

Day 1 capacity = 2 x 144 F = 288 F

Duct OD/ID: 1.25 in
Cable OD: 15.8 mm

Day one cost of 10 km installation: $1.34M

**Standard Loose Tube Cable Upgrade**

Duct OD/ID: 1.25 in
Cable OD: 15.8 mm

Capacity (fiber count) increase requires retrenching and installation of additional 10 km duct and new cable

Upgrade Cost = $1.27M
Upgrade Time = 7-10 months

**Assumptions**

- 10 km METRO route
- Civil Works $120k/km
- Cable Blowing $3k/km
- Duct and 144 F Loose Tube Cable $4k/km
- Microduct Bundle and 2 x 144 F Micro Cables $9.3k/km
Override With Microduct Can Reduce Future Upgrade Cost

Standard Loose Tube Cable
Day 1 capacity = 2 x 144 F = 288 F

Day one cost of 10 km installation: $1.34M

Duct OD/ID: 1.25 in
Cable OD: 15.8 mm

Microduct override

A microduct override can be a simple, faster and more cost-effective alternative to digging...

Assumptions

- 10 km METRO route
- Civil Works: $120k/km
- Cable Blowing: $3k/km
- Duct and 144 F Loose Tube Cable: $4k/km
- Microduct Bundle and 2 x 144 F Micro Cables: $9.3k/km
Better Greenfield Approach

**Standard Loose Tube Cable**
- Day 1 capacity = 2 x 144 F = 288 F
- Duct OD/ID: 1.25 in
- Cable OD: 15.8 mm

**Microducts and Micro Cables**
- Day 1 capacity = 2 x 144 F = 288 F
- Microducts: 7 x 12.7/10 mm
  - Bundle OD: 1.64 in
  - Micro cable OD: 8.1 mm

**Assumptions**
- 10 km METRO route
- Civil Works: $120k/km
- Cable Blowing: $3k/km
- Duct and 144 F Loose Tube Cable: $4k/km
- Microduct Bundle and 2 x 144 F Micro Cables: $9.3k/km

**Day one cost of 10 km installation:**
- Standard Loose Tube Cable: $1.34M
- Microducts and Micro Cables: $1.35M
Future Upgrade Costs Are Dramatically Reduced

**Standard Loose Tube Cable**
Day 1 capacity = 2 x 144 F = 288 F

- Duct OD/ID: 1.25 in
- Cable OD: 15.8 mm
- Day one cost of 10 km installation: $1.34M

**Microducts and Micro Cables**
Day 1 capacity = 2 x 144 F = 288 F

- Microducts: 7 x 12.7/10 mm
- Bundle OD: 1.64 in
- Micro cable OD: 8.1 mm
- Day one cost of 10 km installation: $1.35M

Capacity (fiber count) increase requires blowing of additional micro cable into vacant microduct only
- Upgrade Cost = $0.06M
- Upgrade Time = 1-2 days

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Assumptions

- 10 km METRO route
- Civil Works $120k/km
- Cable Blowing $3k/km
- Duct and 144 F Loose Tube Cable $4k/km
- Microduct Bundle and 2 x 144 F Micro Cables $9.3k/km

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Strategic Choices That Matter

- Strategy depends on which hat you wear
- Most choices will have trade-offs
- The right choice can provide a long-term advantage