Cabling Cost-Centroid Lengths
for Simplified Total Cost Comparisons

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Purpose and Approach*

- To provide a cabling cost metric that:
  - Allows a simplified view of total channel cost (cabling + 2 PMDs)
  - Facilitates comparisons of SM PMD alternatives
  - Accommodates different cabling infrastructures (e.g. 2-f vs 8-lane)
  - Accommodates various complementary MM PMD scenarios
  - Avoids misapplication of cost-parity lengths for total cost comparisons

- Examine channel cost and length distributions of "Kolesar Kalculator" to determine new cost metric:
  - Cost-Centroid Length

* This approach is suitable for simple cases such as comparing two PMDs. The Kolesar Kalculator is recommended for more complex analysis such as total solution set cost analysis.
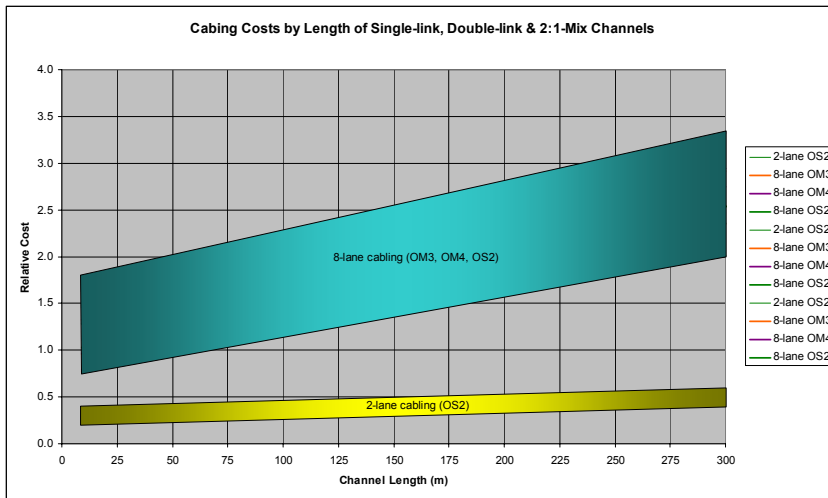
Definition

- Cost-Centroid Length (CCL)
  - The length of a cabling channel that has a cost which is equivalent to the length-distribution-weighted cost of all channels, or a range of channels, of a topology
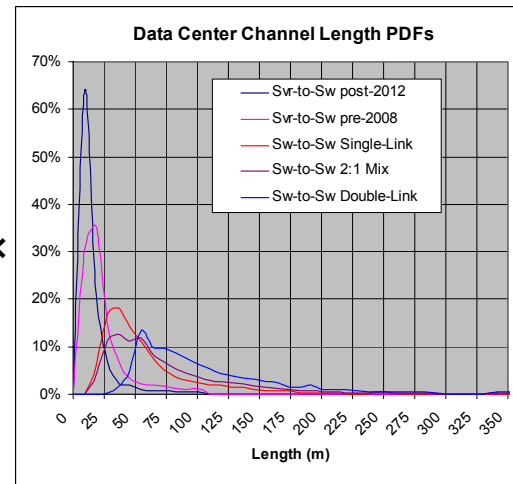
    Or stated more simply

  - The channel length that is representative in cost to the channels of a topology

Cost-Centroid Length Calculation

Cabing Costs by Length of Single-link, Double-link & 2:1-Mix Channels

8-lane cabling (OM3, OM4, OS2)

2-lane cabling (OS2)

Legend:
- 2-lane OS2
- 8-lane OM3
- 8-lane OM4
- 8-lane OS2
- 2-lane OS2
- 8-lane OM3
- 8-lane OM4
- 8-lane OS2
- 2-lane OS2
- 8-lane OM3
- 8-lane OM4
- 8-lane OS2

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Data Center Channel Length PDFs

Legend:
- Svr-to-Sw post-2012
- Svr-to-Sw pre-2008
- Sw-to-Sw Single-Link
- Sw-to-Sw 2:1 Mix
- Sw-to-Sw Double-Link

Overall
= Cabling
  Cost (OCC)
for each topology
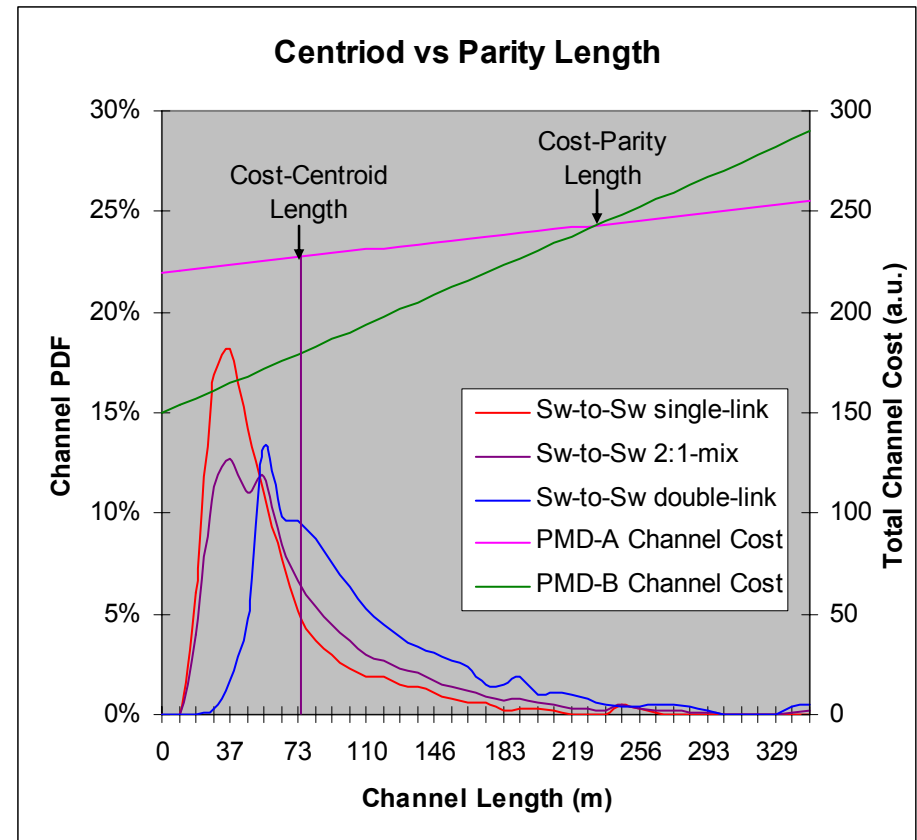and construction

$$\frac{\text{OCC} - \text{Fixed Costs (e.g. patch panels \& testing) [\$]}}{\text{Length-Dependent Cost Rate (e.g. cable \& cable installation) [\$/m]}} = \text{Cost-Centroid Length [m]}$$

Why Use Cost-Centroid Length?

- Use of other metrics,
  like Cost-Parity Length (CPL),
  is fundamentally flawed
  for total cost comparisons

  - CPL is the length where
    the cost advantage shifts
    between two PMDs
    for a single channel

  - But CPL does not account
    for channel PDF weighting
    on total deployment costs

  - CCL does account for
    channel PDF weighting and
    represents the correct length
    to use for total cost comparisons

  - CCL can be adjusted to account for
    different deployment assumptions
    (e.g. the effect of MM PMD usage)

Centriod vs Parity Length

Legend:
- Sw-to-Sw single-link
- Sw-to-Sw 2:1-mix
- Sw-to-Sw double-link
- PMD-A Channel Cost
- PMD-B Channel Cost

Note: PMD-A and PMD-B only for illustration

Cost-Centroid Lengths (CCLs) [m]

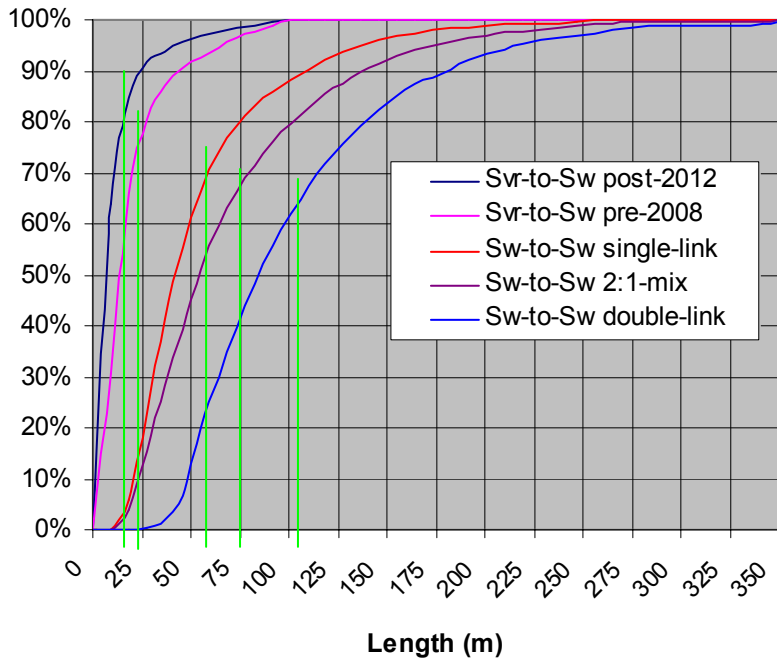| Length Selection	Server-to-Switch Channels		Switch-to-Switch Channels		
	Post-2012	Pre-2008	Single Link	2:1 Mix Link	Double Link
All Lengths	16	24	59	75	106
> 100m	n.a.	n.a.	148	157	163
			Propose to use 150 for all		
> 150m	n.a.	n.a.	192	202	206
			Propose to use 200 for all		

n.a. = not applicable. No length distribution within length selection.
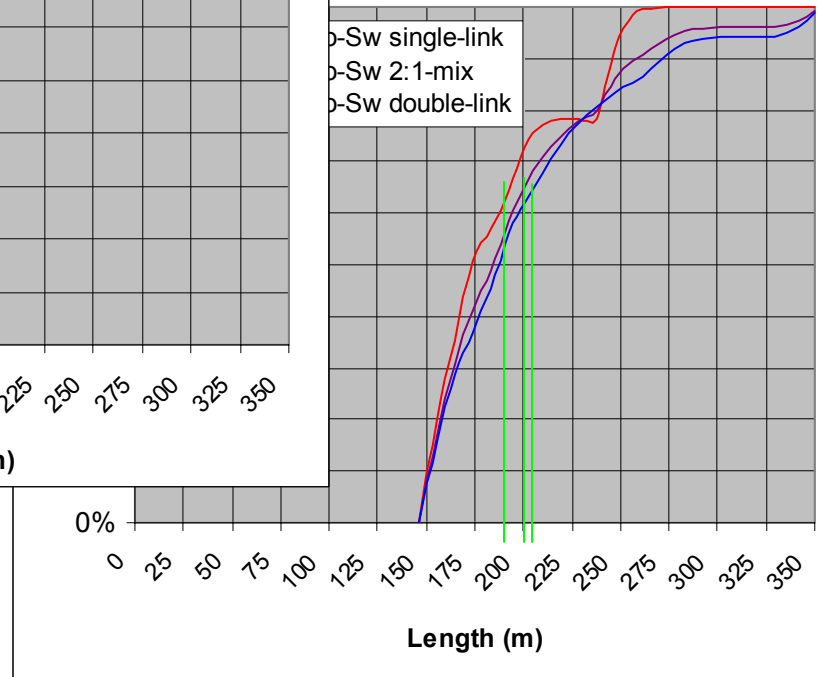
Graphically Depicted CCLs

Data Center Channel Length CDFs
and Cost Centroid Lengths
for Channels > 100 m
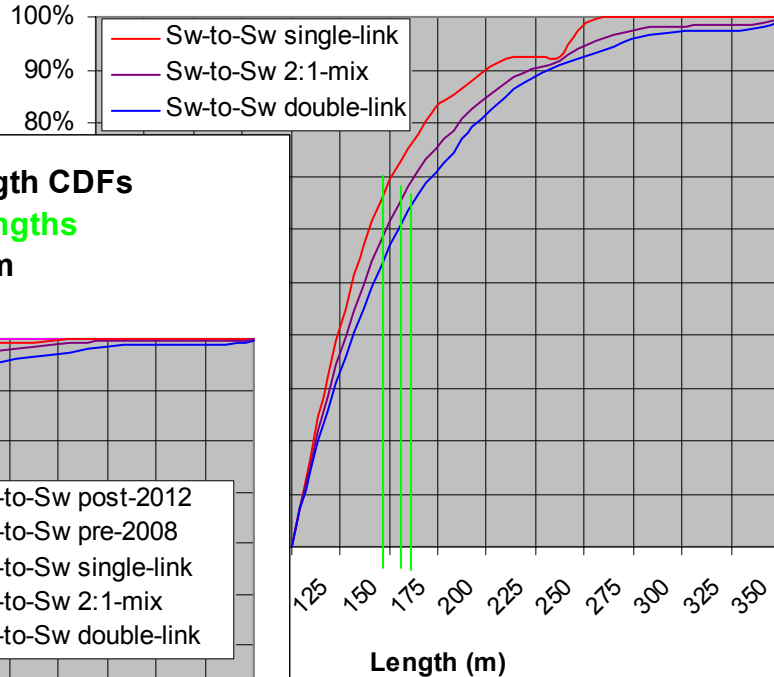
Legend:
- Sw-to-Sw single-link
- Sw-to-Sw 2:1-mix
- Sw-to-Sw double-link

Data Center Channel Length CDFs
and Cost Centroid Lengths
for Channels > 0 m

Legend:
- Svr-to-Sw post-2012
- Svr-to-Sw pre-2008
- Sw-to-Sw single-link
- Sw-to-Sw 2:1-mix
- Sw-to-Sw double-link

...er Channel Length CDFs
...ost Centroid Lengths
...Channels > 150 m

Legend:
- ...o-Sw single-link
- ...o-Sw 2:1-mix
- ...o-Sw double-link

Length (m)

Note: cost-centroid lengths are in the 65 – 70% range for Sw-to-Sw CDFs

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Utility of Length-Selected Centroids

Length Selection	Server-to-Switch Channels		Switch-to-Switch Channels		
	Post-2012	Pre-2008	Single Link	2:1 Mix Link	Double Link
All Lengths	16	24	59	75	106
> 100m	n.a.	n.a.	150	150	150
> 150m	n.a.	n.a.	200	200	200

- Use "All Lengths" values for cost models in which SM PMDs will be used for all channels
  - Customer deploys only SM solutions

- Use "> 100m" values for cost models in which SM PMDs will be used only for channels exceeding 100m
  - Customer deploys MM PMDs up to 100m capability

- Use "> 150m" values for cost models in which SM PMDs will be used only for channels exceeding 150m
  - Customer deploys MM PMDs up to 150m capability

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Example Usage

- Compare total channel cost (cabling + 2 PMDs) for two SM PMD types:
  - LR4 with relative cost = 2K × (100m 2-f OS2 single-link cabling end-user cost)
  - PSM4 with relative cost = K × (100m 2-f OS2 single-link cabling end-user cost)
  - K units: [PSM4 end-user cost / 100m 2-f OS2 single-link cabling end-user cost]
  - LR4 operates on 2-fiber cabling, PSM4 operates on 8-lane cabling
  - Assume MM PMD is used to 150m, so "> 150m" CCL values apply
    - CCL = 200m (proposed length suitable for any topology)
  - From Cole_01a_0512_optx.pdf the relative cabling costs at CCL:
    - `200m 2-f OS2 single-link channel =` 1.25
    - `200m 8-l OS2 single-link channel =` 5
    - `200m 2-f OS2 double-link channel =` 1.75
    - `200m 8-l OS2 double-link channel =` 7

- Total channel costs:
  - `LR4  single-link  =` 1.25 `+ 2×2K`
  - `PSM4 single-link =` 5 `+ 2×K`
  - `LR4  double-link  =` 1.75 `+ 2×2K`
  - `PSM4 double-link =` 7 `+ 2×K`

Plug in your K value to get relative costs

normalization cost factor = unity cabling cost from Cole_01a_0512_optx.pdf *

Single-link channel (SL CH)

Fiber Type	100m	300m	500m
8f OM4 MMF	5	9	13
8f OM3 MMF	4	7	10
8f OS2 SMF	4	6	8
2f OS2 SMF	1	1.5	2

* This is different normalization than used in Kolesar Kalculator

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Q & A