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MULTI-LAYER CAPACITY PLANNING, COST MODELING AND OPTIMIZATION

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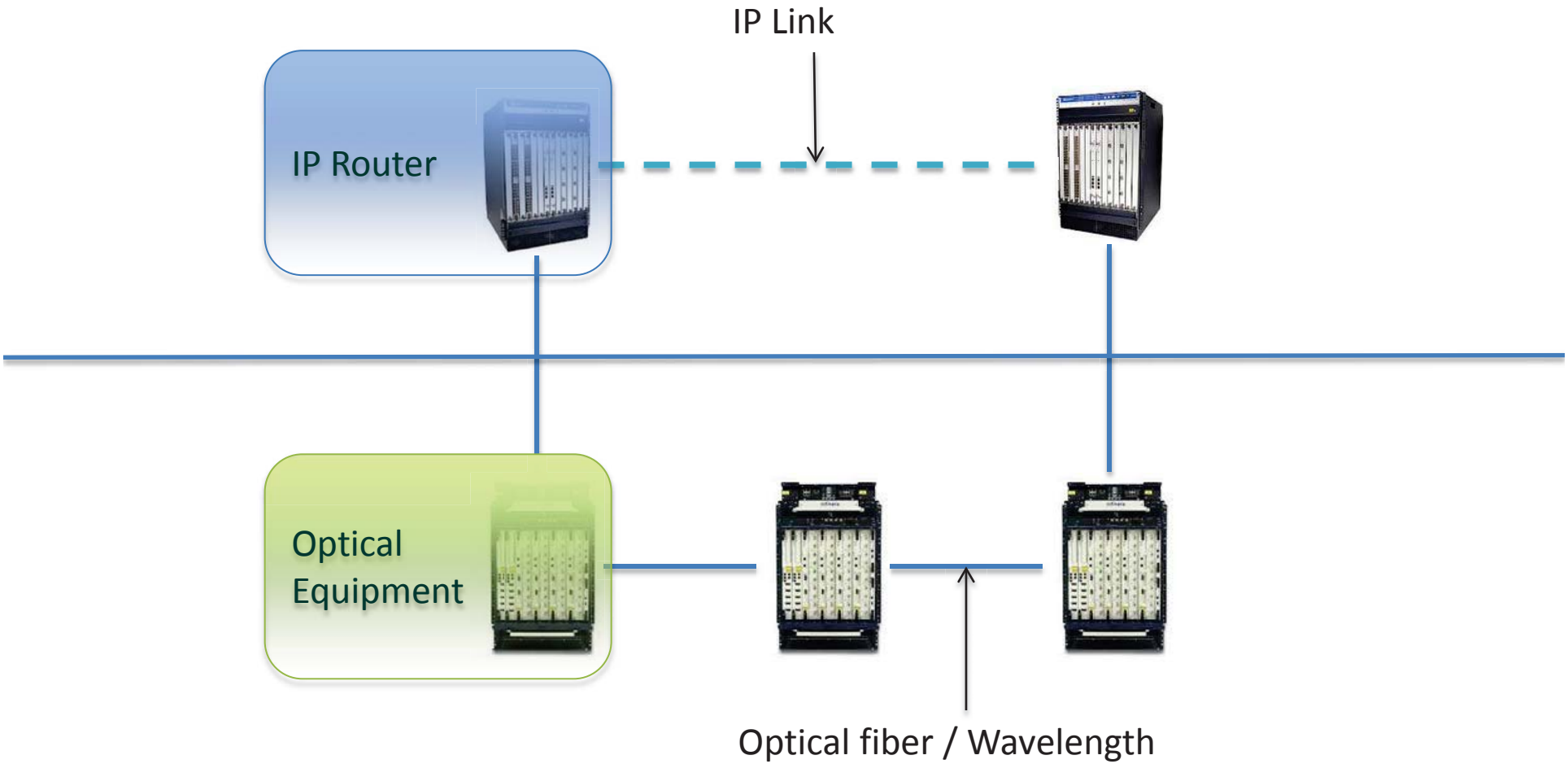
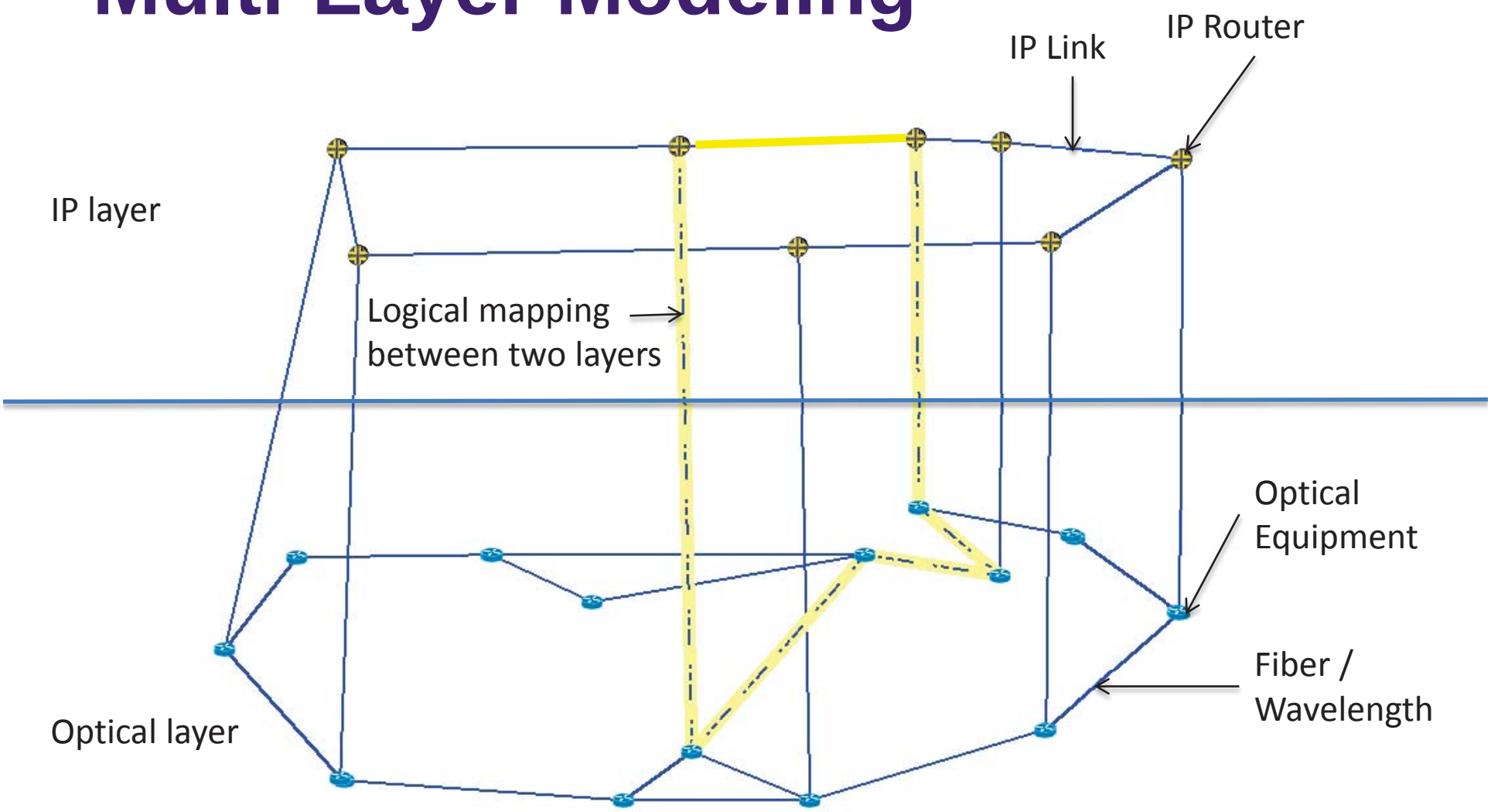
Introduction

- Multi-Layer Capacity Planning
  - Modeling and capacity planning for both Layer 3 and Layer 1 together
- Cost Modeling
  - Bridge capacity planning with the cost ($$$)
- Backbone Optimization
  - Search for the opportunity to increase CAPEX efficiency based on the multi-layer modeling and cost modeling

IP Backbone Demarcation



Multi-Layer Modeling



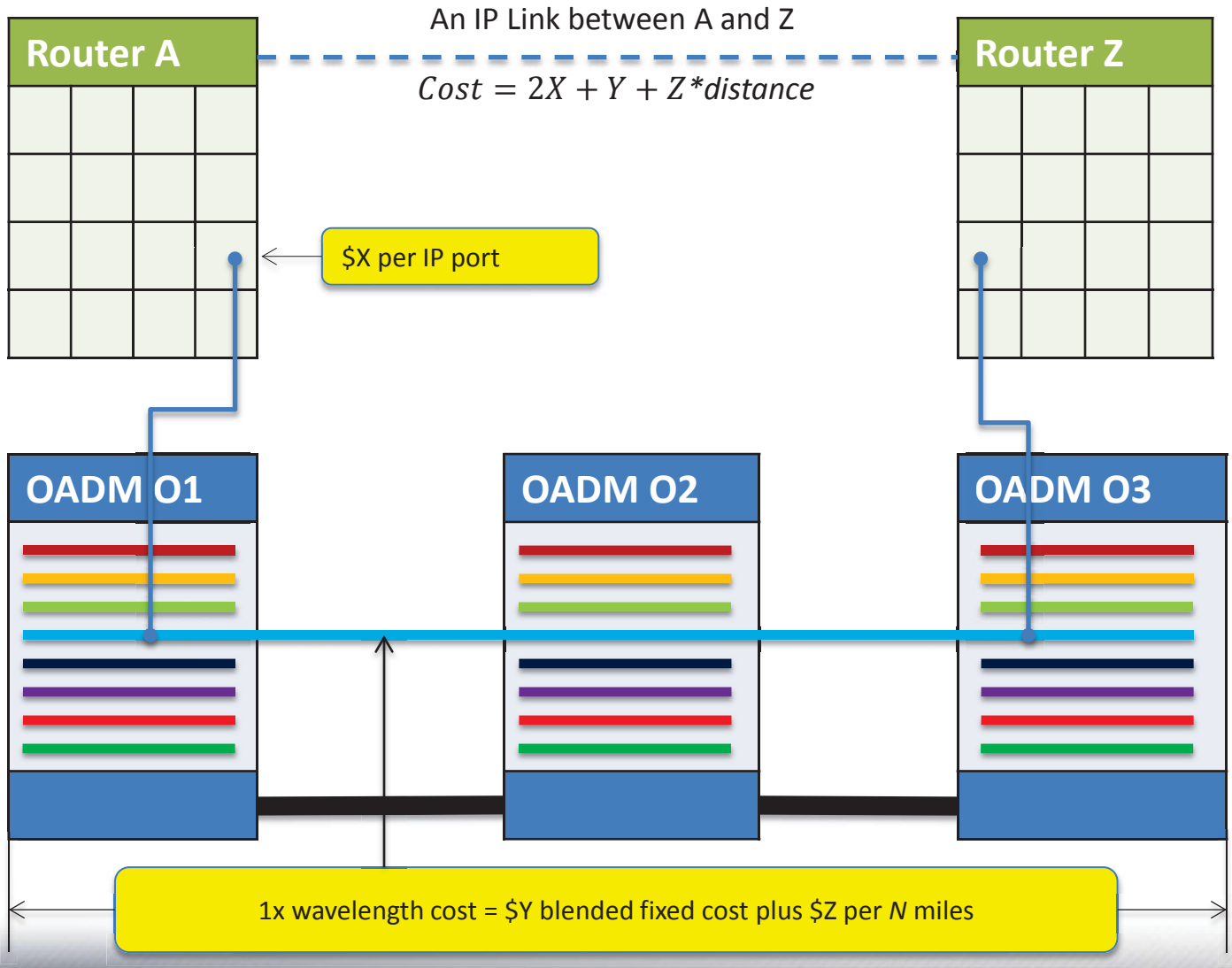
Multi-Layer Capacity Planning

- Directly translate layer 3 capacity requirements to layer 1
- Automatically generate Shared Risk Link Group (SRLG)
- Opportunities to optimize network from a holistic view

Cost Modeling

- Network is a complex system
- Cost modeling can only be approximated
- Abstraction helps
  - Blended cost
  - Abstracted network and elements

A Cost Model


An IP Link between A and Z
$Cost = 2X + Y + Z*distance$
Router A
Router Z
$X per IP port
OADM O1
OADM O2
OADM O3
1x wavelength cost = $Y blended fixed cost plus $Z per N miles

Validation of Cost Model

- Compare the model with actual financial data
- *C/b*: network cost per Mbps customer traffic

$$C/b = \frac{Total\ network\ cost}{Total\ customer\ traffic}$$

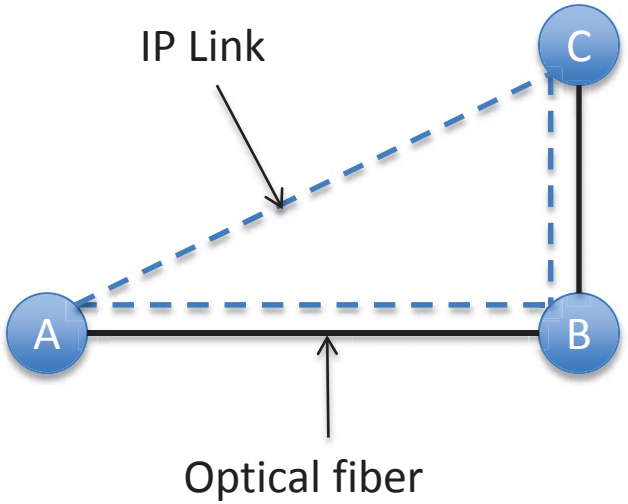
- Calculated *C/b* from model is compared to *C/b* from finance department
- Result is very close

Network Design Practice

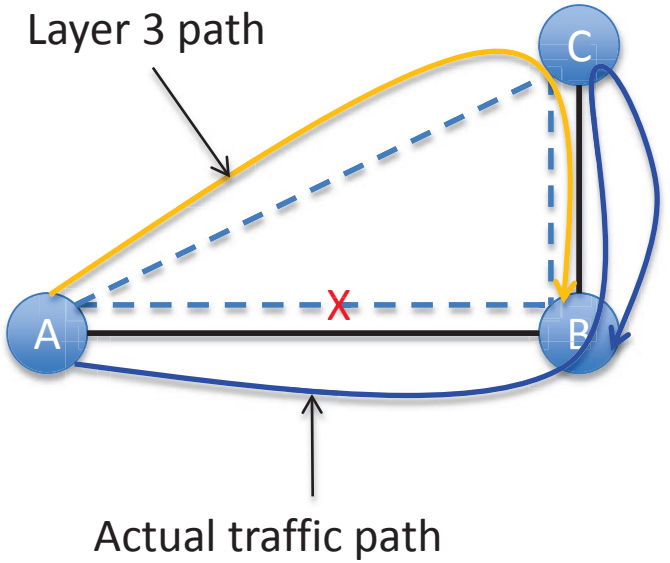
- Separated activity between layer 3 engineering and layer 1 engineering
- Without effective coordination, the final design may not be optimal
- Multi-Layer modeling and proper tools provide new opportunities for optimization

Case 1: Double Dipping

Normal State



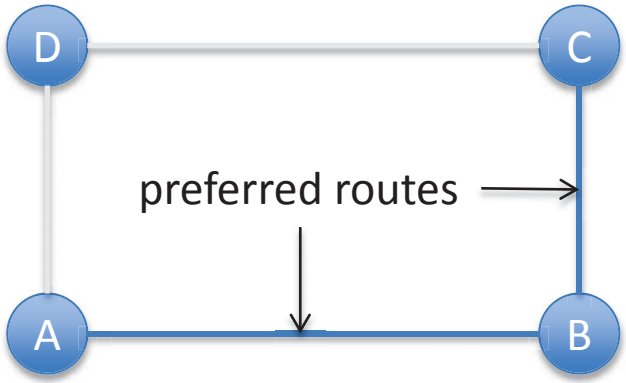
Failure State



Case 2: Hidden Cost

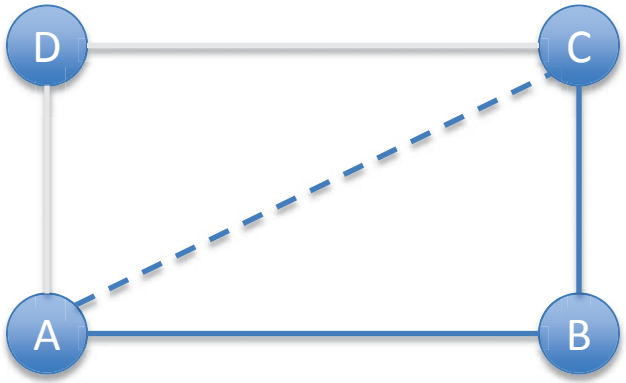
Traffic Matrix	
A→B	10G
B→C	10G
A→C	10G

Design I: Without Optical Bypass



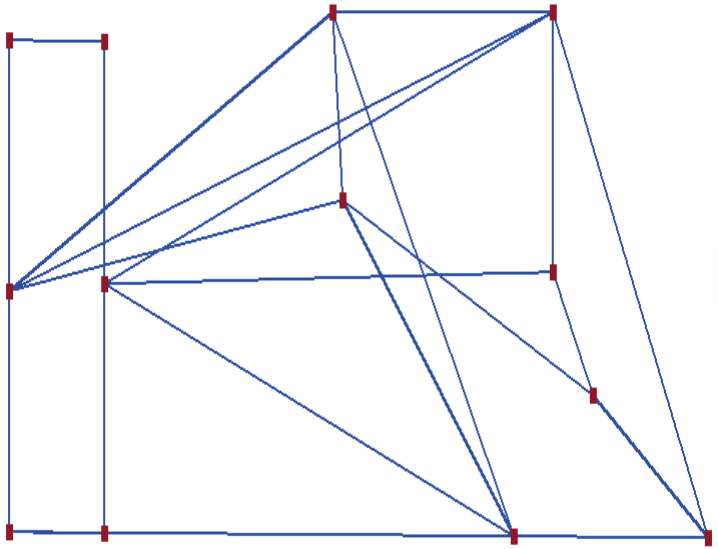
Link	Required Capacity
A-B	20G
B-C	20G
A-D	20G
D-C	20G

Design II: With Optical Bypass



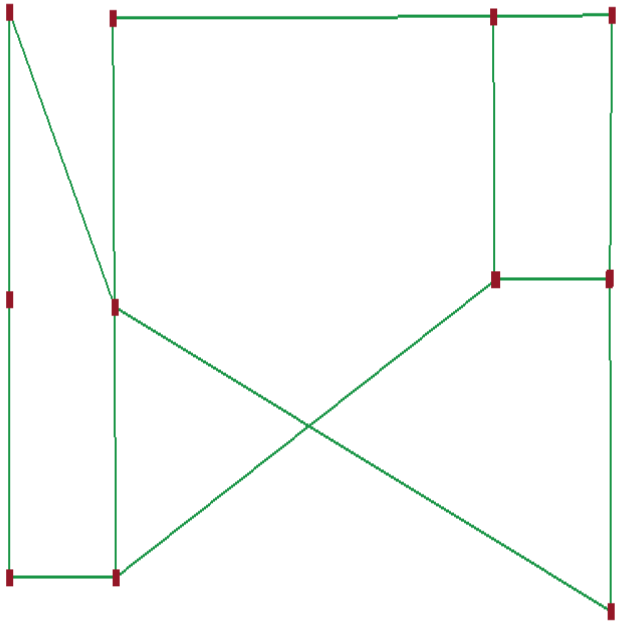
Link	Required Capacity
A-B	20G
B-C	20G
A-C	10G
A-D	20G
D-C	20G

Multi-Layer Network Optimization



Original network

10%+ CAPEX Savings



Optimized network

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