Software Defined Patch-Panels

Technology and Use Cases

ONS 2013 Research Track
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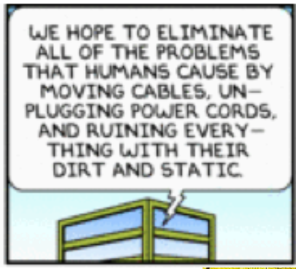
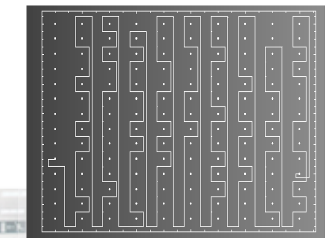
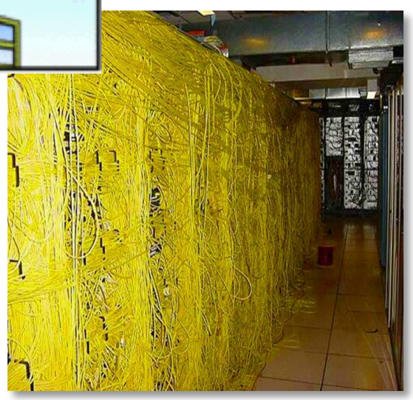
[1] Telescent Inc., [2] Caltech/CERN

Dilbert Comic Strip 2011



KBS Algorithm





The Old Way

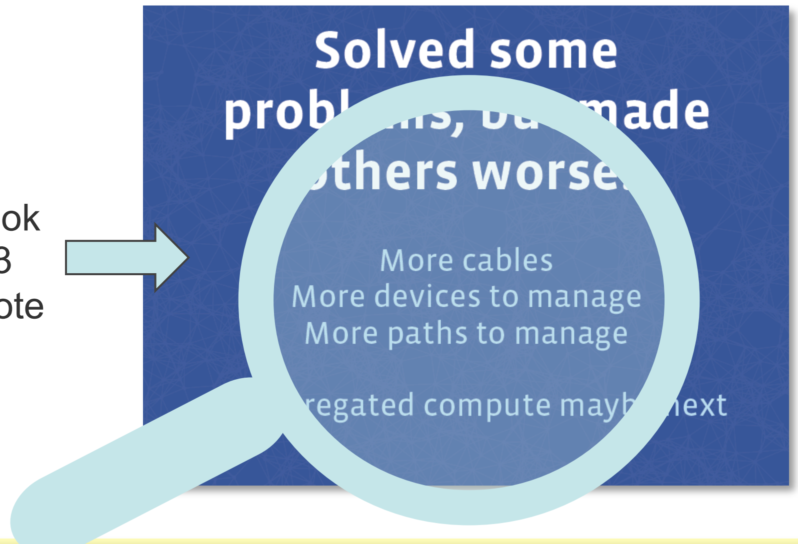
Today's Way

Automated Layer-0

Opportunity for SDN at Layer-0

East-West Traffic Creates Interconnect Management Challenges

Najam Ahmad, Facebook
Slide From OFC 2013
Executive Forum Keynote

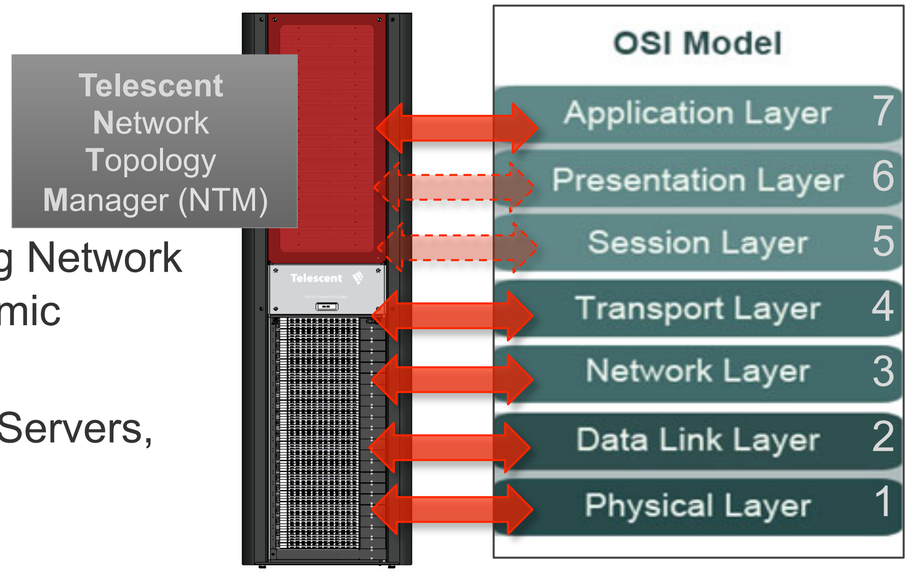


Software Defined Layer-0 Configuration Solves This Problem

Software Define Network Topology

Potential Benefits:

- Reduce Errors
- Improve Performance by Making Network Resources Responsive to Dynamic Demands of Applications
- Increase Capacity Utilization of Servers, Switches, Routers, WAN, etc.



Program Configuration of Layers 1 – 4 Based on Application Layer 7
e.g. Web Services or Map Reduce

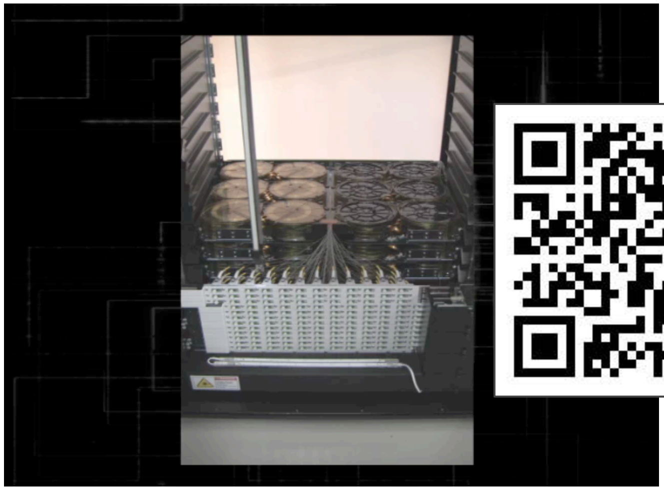
NTM Automates Layer-0

1008x1008 Port Network Topology Manager (NTM)

NTM

Automatic Network Topology Generation

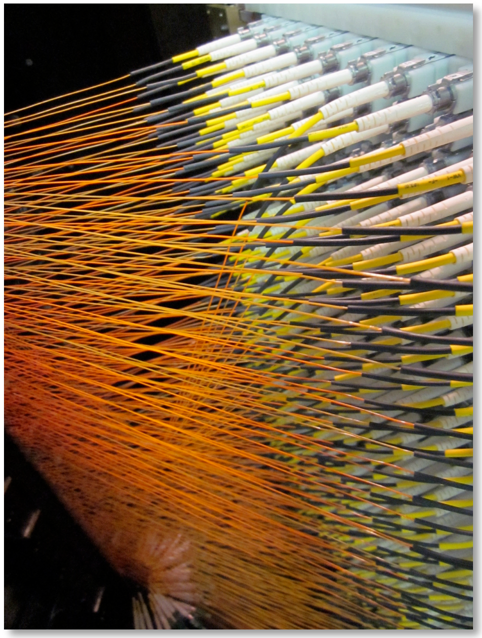
Algorithms and Internal Robot (a la tape drive library)

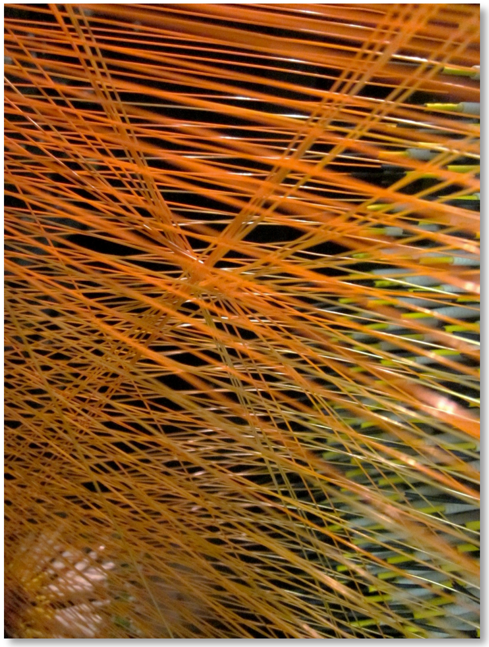


See video online at:
http://telescent.com/tswitch_video.php

Optical Fiber ⇔ Mathematical Strand

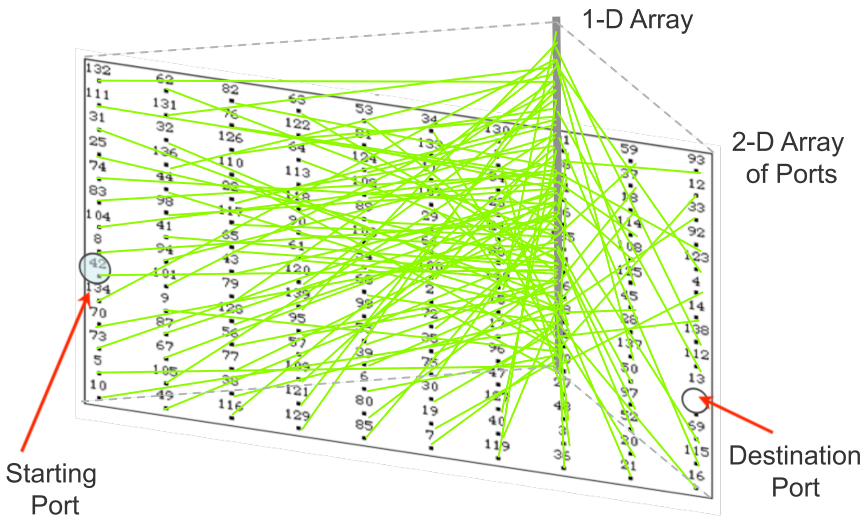
- New Mathematical Solution to Non-Blocking Cross-Connect Problem
- Optical Fibers are Represented as Mathematical Strands and Braids
- First Application of Theory of Knots and Braids to Switching

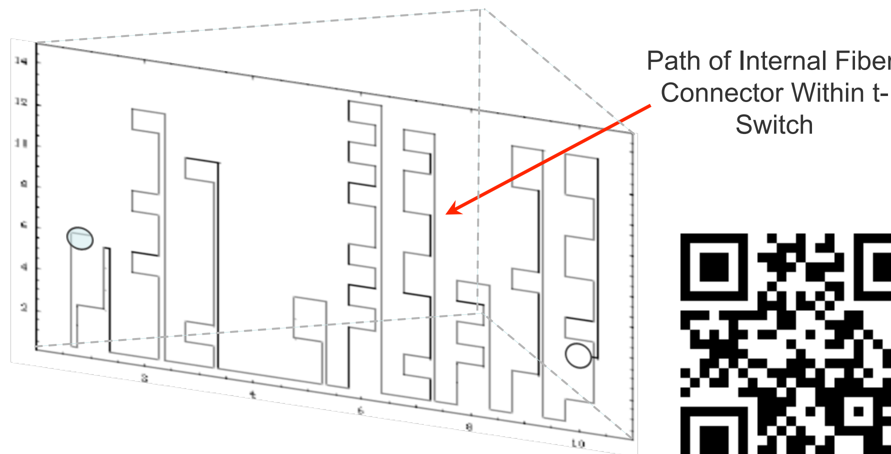




KBS Algorithm

Mathematics of Knots and Braids Applied to Fiber Routing





Advantages: Non-Blocking, Latching, No Entanglement, Infinitely Reconfigurable, Commodity Hardware

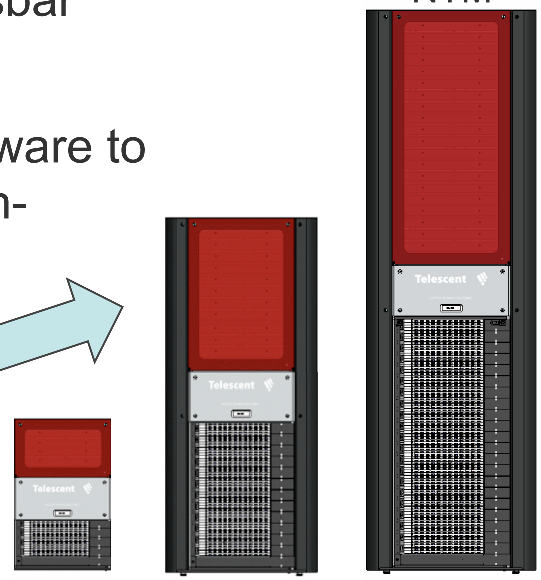
A. Kewitsch, J. Lightwave Tech. Vol. 27, pp. 3107- 3115, 2008

Advantage: Linear Scaling

- Complexity of Matrix or Crossbar Switches Scale as N^2
- KBS Algorithm Enables Hardware to Scale as N, like Manual Patch-Panels

N = # of ports

NTM



192x192 576x576 1008x1008

>10,000x10,000

Modular Aisle Solution
With Single Robot

Programmable Topology Use Cases

One Wilshire MTDC

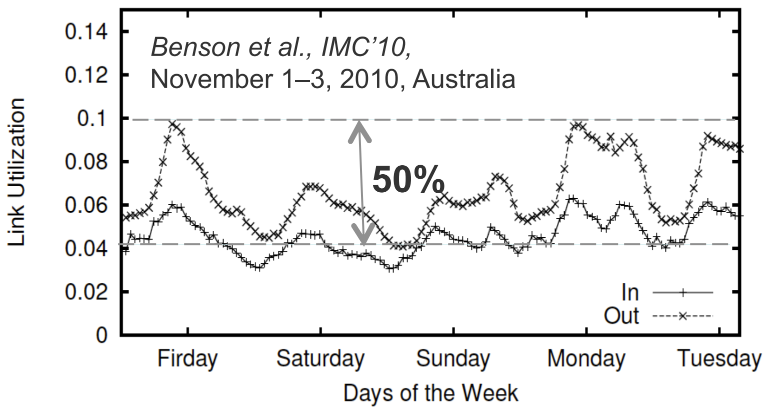
CERN MDC

- Mega Data Centers
- Multi-Tenant Data Centers

Theme: Application Awareness of Layer-0 Increases Utilization

Adapt to Diurnal Usage Patterns

With Large Predictable Swings in Link Utilization, How to Fill Troughs?



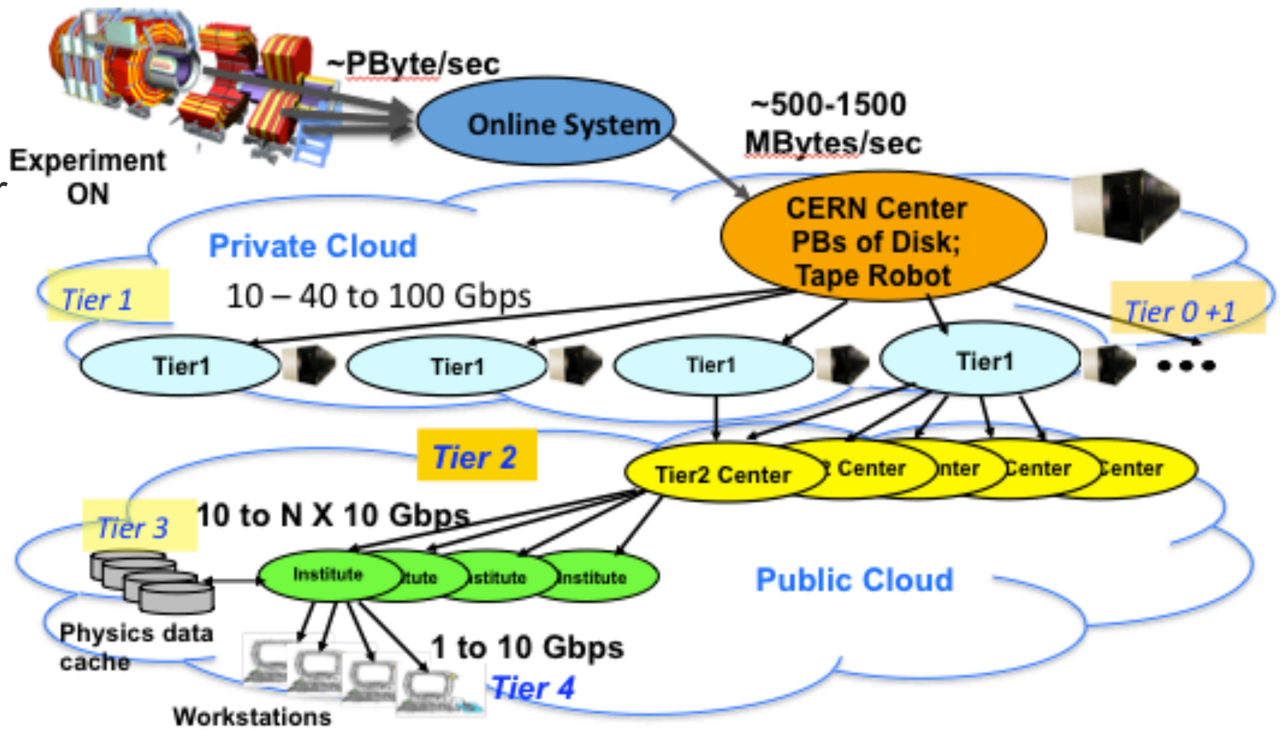
- Static Assets to Meet Average Load and
- Dynamic Pool of Resources Scheduled Based on Time of Day to Serve Different Geographies

Allocate lanes based on daily traffic patterns to improve asset utilization!

WAN is Costly and Must Be Used Efficiently

Adapt to Large Scale Workflow Changes

- CERN Operates a Global Network of Data Centers
- LHC = Large Hadron Collider (LHC) Generates PB of Data
- Online Server Farm w/100K Cores is Utilized Only During Experiments



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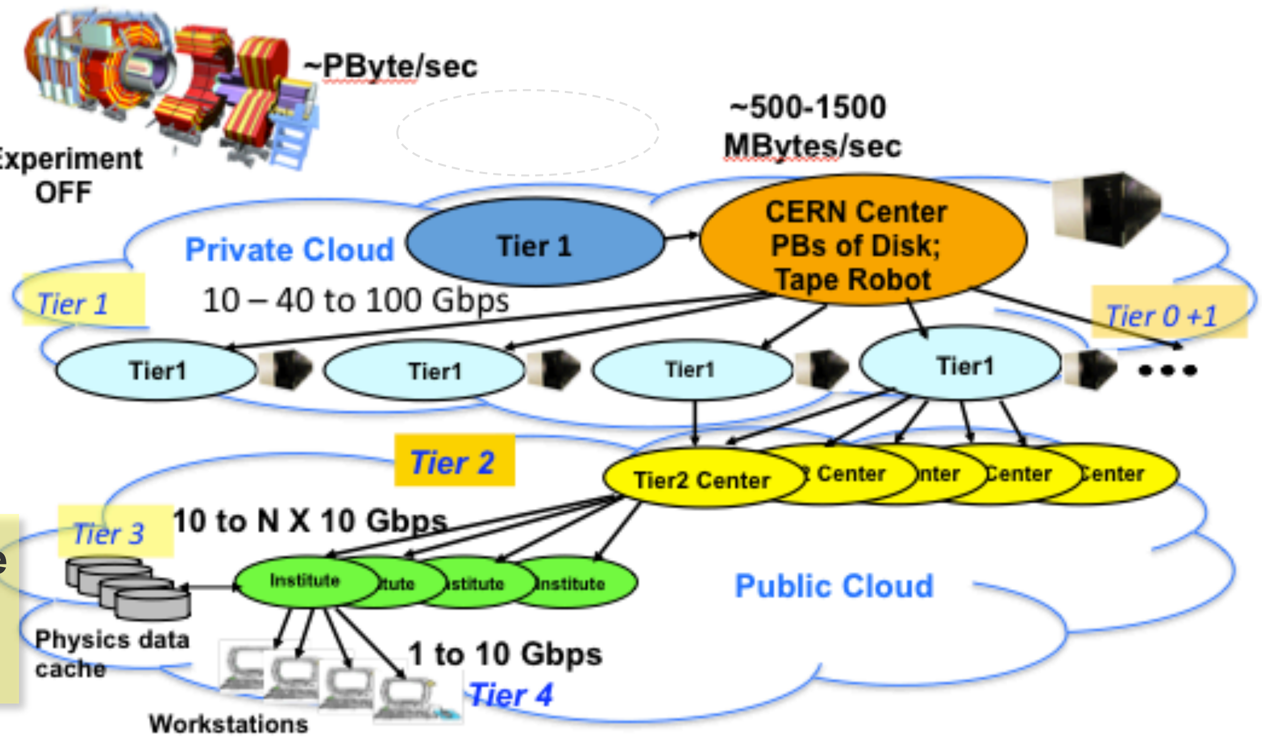
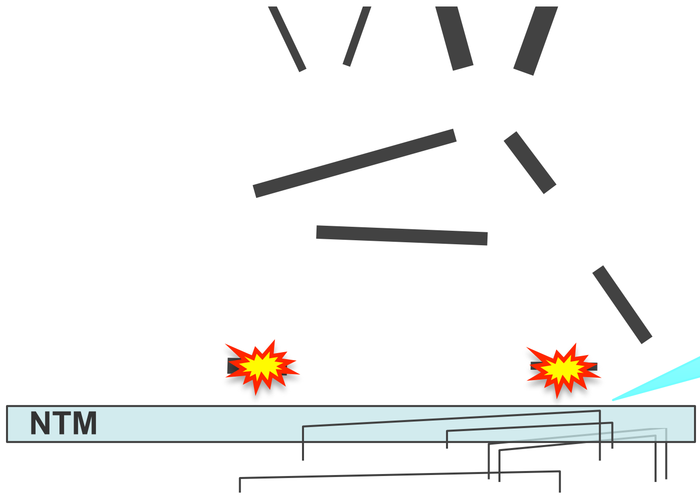
Reconfigure Topology of **Online System** to Transform it into a **Tier 1** Data Center



Adaptive Clustering Based on Apps

Manage East-West Traffic and Hot Spots



Reconfigure to Relieve Congested Trunks in L-2 Switch Fabric, Flatten Network

e.g. Dual Ethernet Servers w/ 1 NIC for Edge Switch, 1 NIC for Direct Optical Connect

Network Flattening Reduces Hops, Lowers Latency and Lowers Cost

Exciting Possibilities

- Increase Data Center Utilization by 25% or More by Programming Physical Network Topology?
- Eliminate Human Error by Fully Automatic Layer-0 Reconfiguration?
- Eliminate Manual Interconnect Record Keeping by Auto-Discovery of Physical Topology?

Thank You!

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