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Simplicity in Network Design and Deployments

Experiences and views from a service provider

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Tribute

Heartfelt tribute to the people affected by loss & suffering in the April 2015 earthquake in Nepal and surrounding region.

Disclaimer Note

The contents in this session is based on experience , interactions and network practices in service provider networks. This is not authoritative principles , guidelines or recommendations for running your network.

Agenda

- Introduction
  - Notions for network simplicity
  - Target network architectures
- Network simplicity study models.
- Service provider networks – Problem space
  - Topology and connectivity
  - Platform Lifecycle and deployment outages
  - Redundancy
  - People and skills
- Summary & Closure

Introduction & Motivations for Network Simplicity

Notions for Network Simplicity in Operator Orgs

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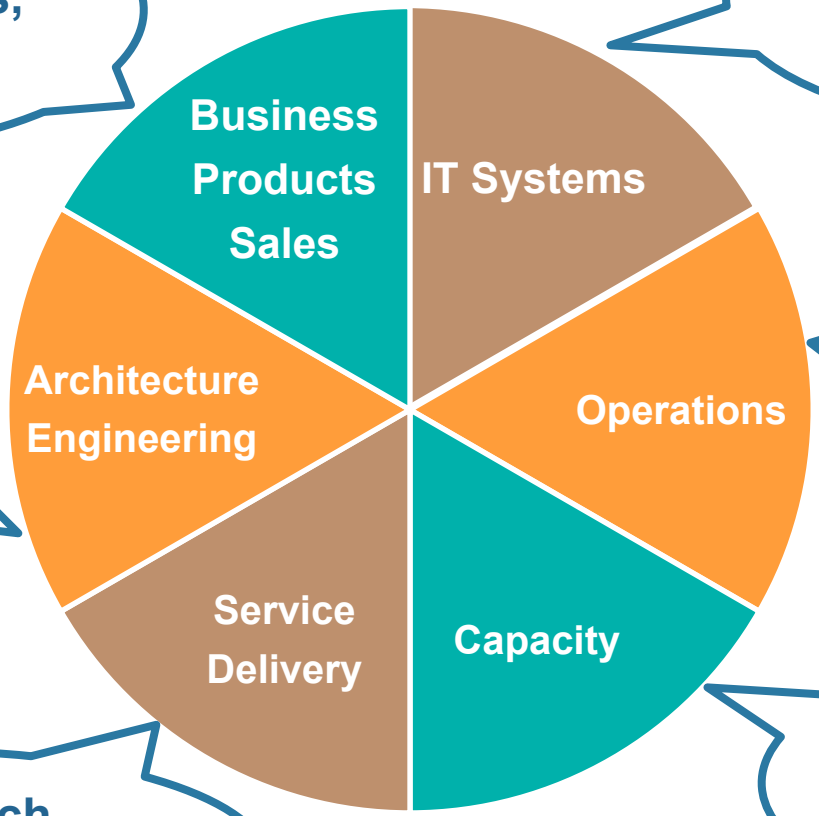
Good, Fast and Cheap : Pick any two !



Low Lead time
Port New services,
Margin model

Standard OSS & BSS
SDK/APIs
Modeling support

Cutting Edge ,
Innovative , Elastic,
Modular,
Futuristic

Less outages
Stable , Predictable
Less bugs
Low Maintenance

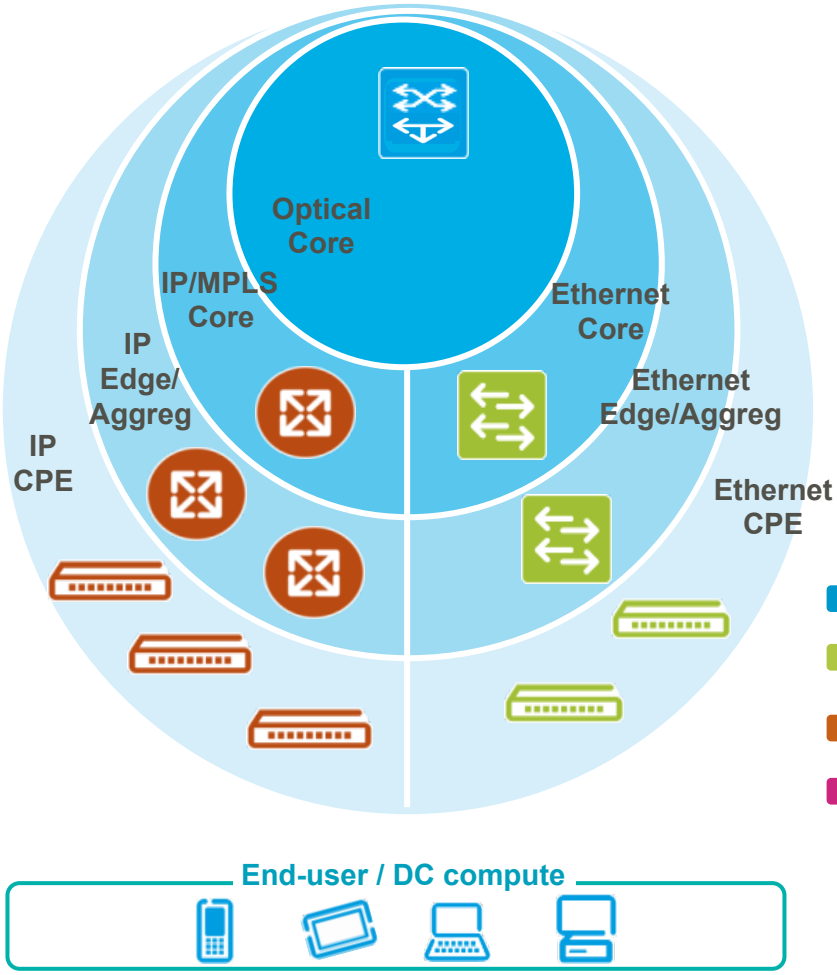
Zero touch
End-End Automation
Faster delivery

Scale
Easy Upgrade ,
Investment protection

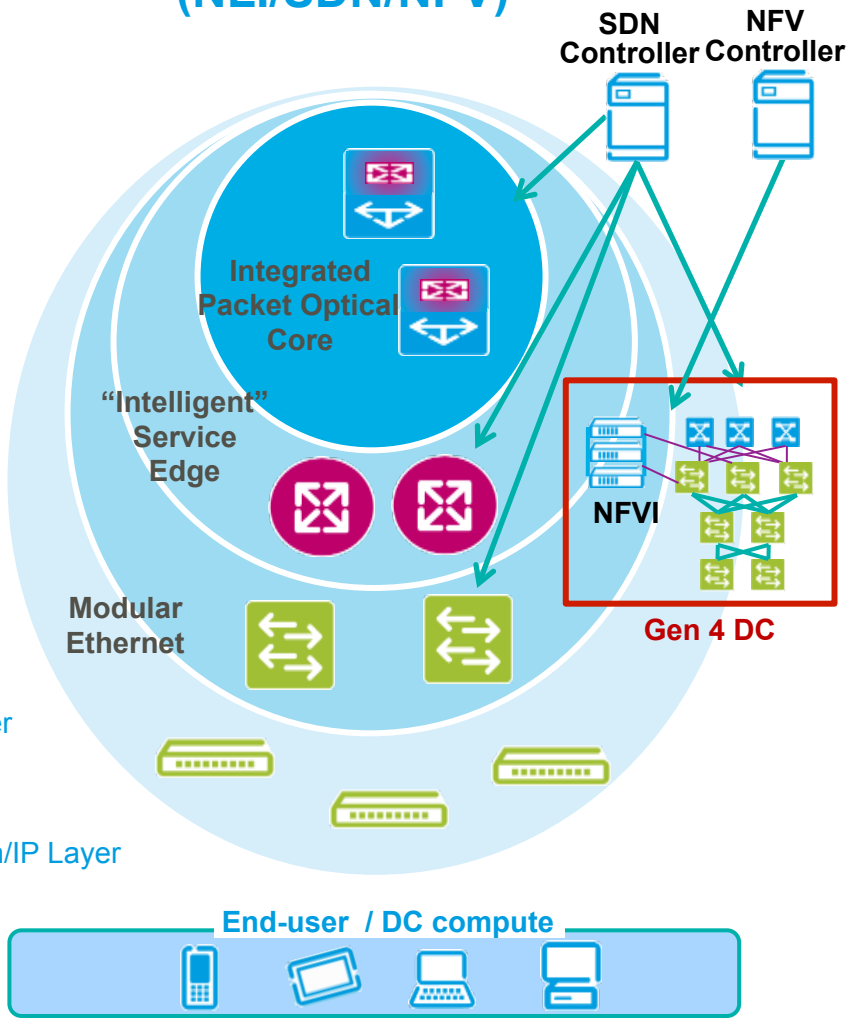
Source : RFC1925 - The Twelve Networking Truths – Ross Callon

Target Network Architectures - Colt

Network Architecture (2009)



Target Network Architecture (NLI/SDN/NFV)



Optical Layer

Ethernet Layer

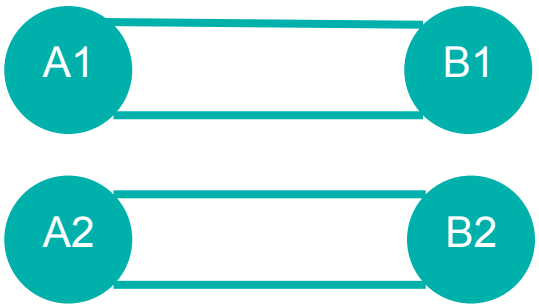
IP Layer

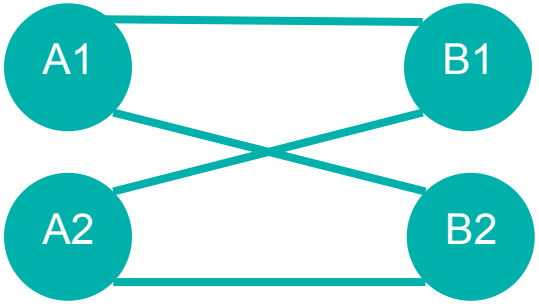
Integrated Eth/IP Layer

Network Simplicity Study Models

Network Simplicity – Study Models - Example 1

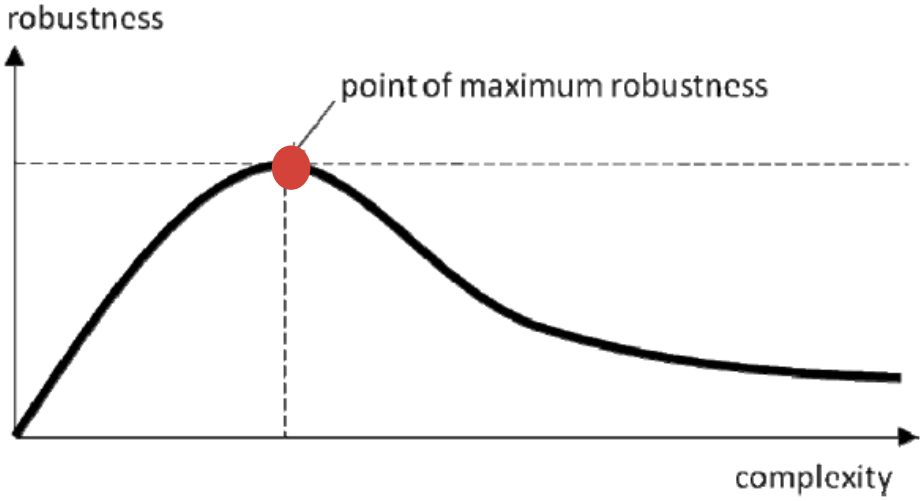
Simple Connectivity





Robust Connectivity

Resilience features + Complexity



Source – Networks and Robustness - J Doyle

Network ~~Simplicity~~ Complexity Study Models – Example 2

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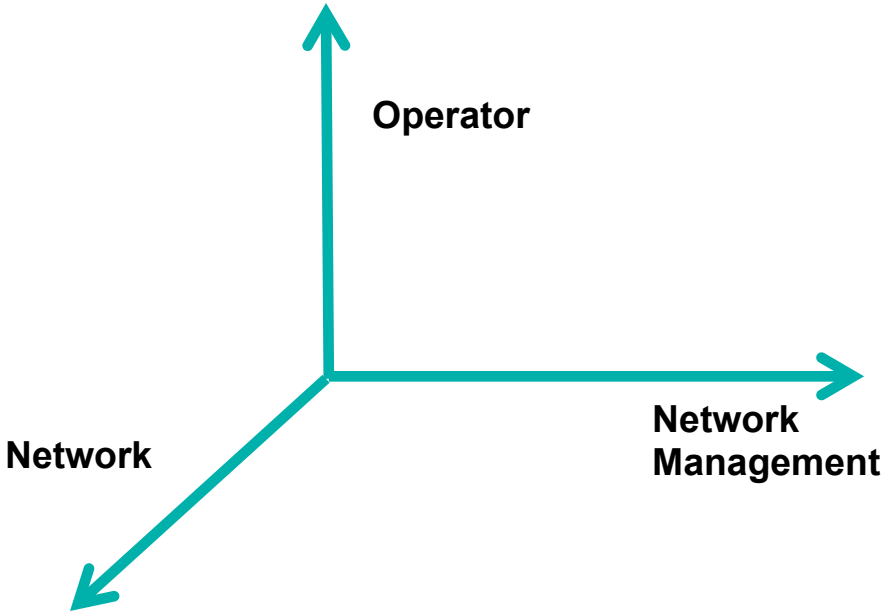
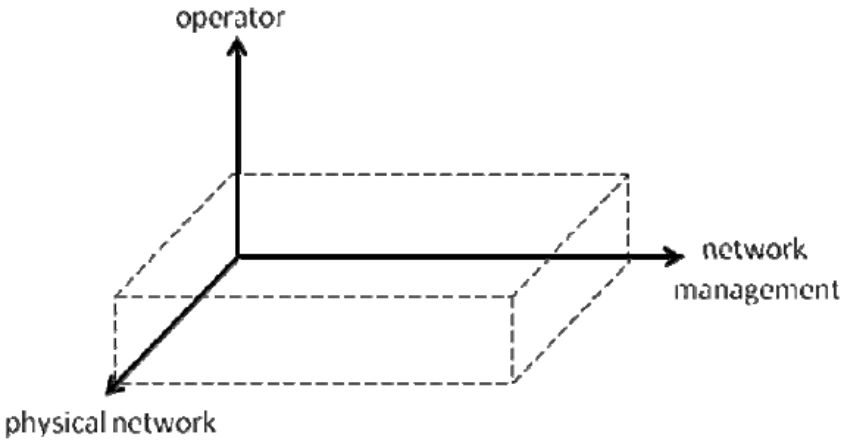
Source – Classifying Network Complexity – Michael Behringer , 2009



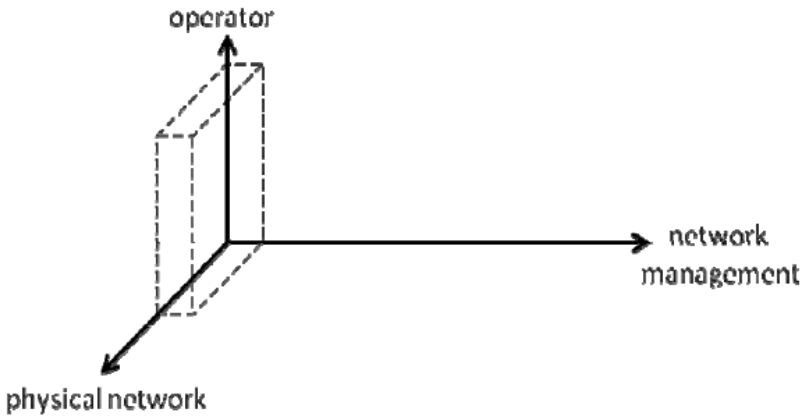
3 Axis to define complexity

* Network - Physical (and Logical)
* Network Management
* Operator & skills

Volume of cube is complexity measure



Complexity cube – Big ISP



Complexity cube – Small ISP

Service Provider's Complexity

Problem Space Examples

Behaviors, practices & principles

Topology, & Connectivity Complexity

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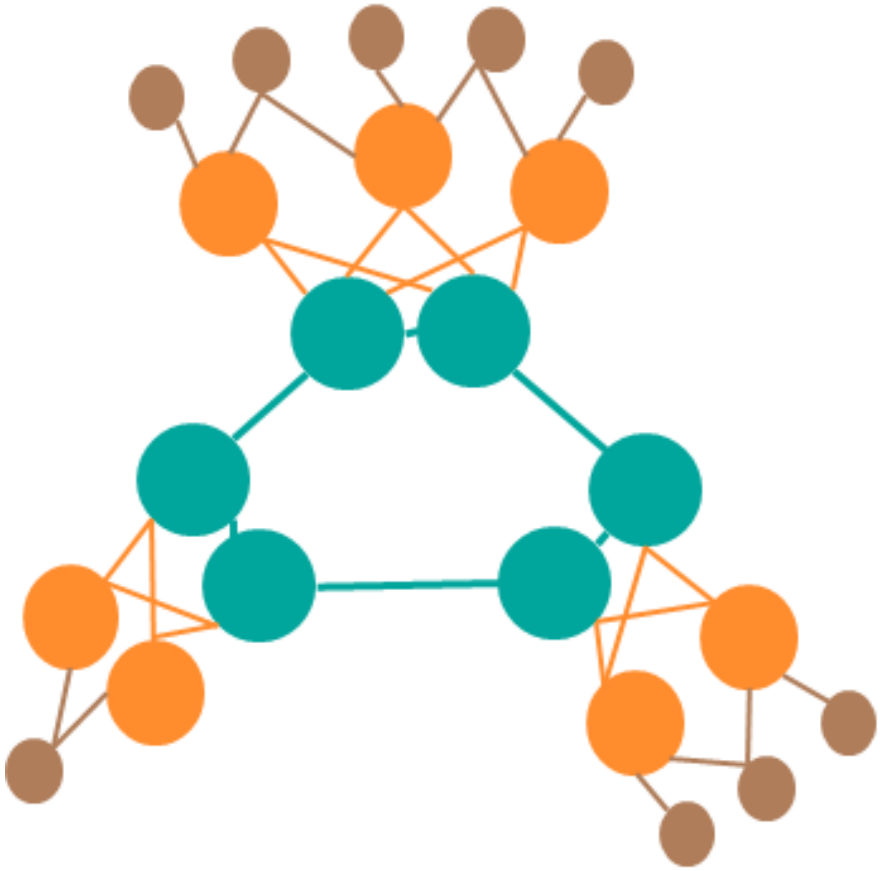

Core – Access – Aggregation

Tier 1 / 2 / 3 City PoP Models

- Graph theory & other studies solve specific computational goals.
- Operator's real connectivity has many more dimensions.
- Why fit well sold topology reference architectures ?
- Simplify & justify topologies as per business needs and scale.

Network Platform Complexity

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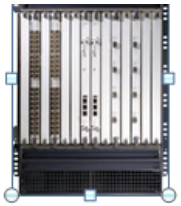
Life Cycle of a big and fat (expensive) router

Operators justify SDN and NFV

Routine port upgrades

Business Case
RFx , Demo

Operator Lab Test



Mid life Upgrade

Processor
Memory
Fabric
Line cards

EoX Notice

EoSupport

End of usefulness

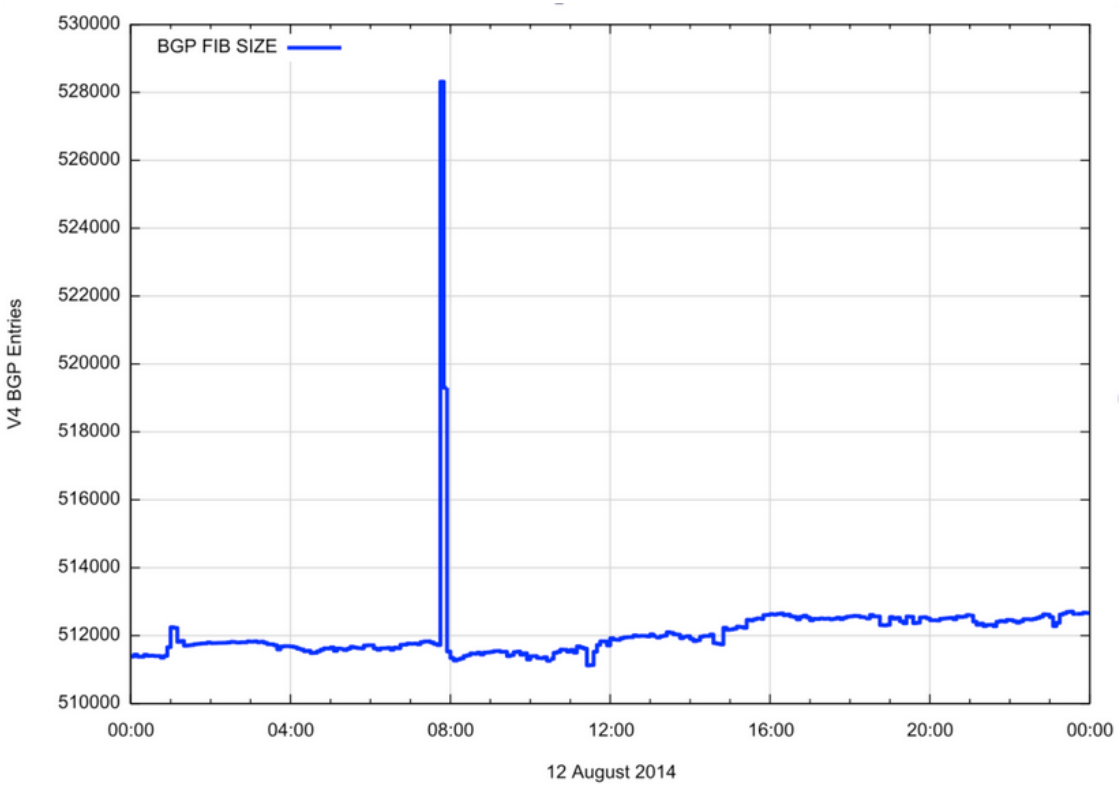
Hangs in Rack

Eats Opex

Software Release Deployment

Deployment Outages Complexity

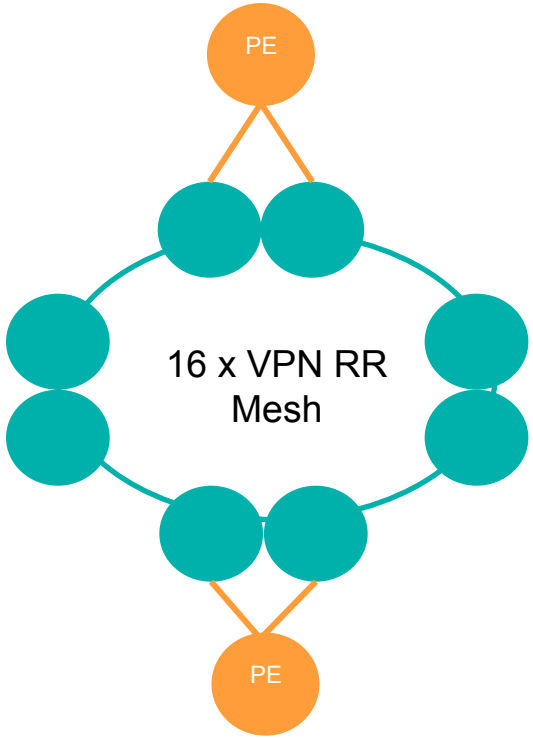
Global Routing Leak at 512K FIB Exhaust – August 12th 2014 Event

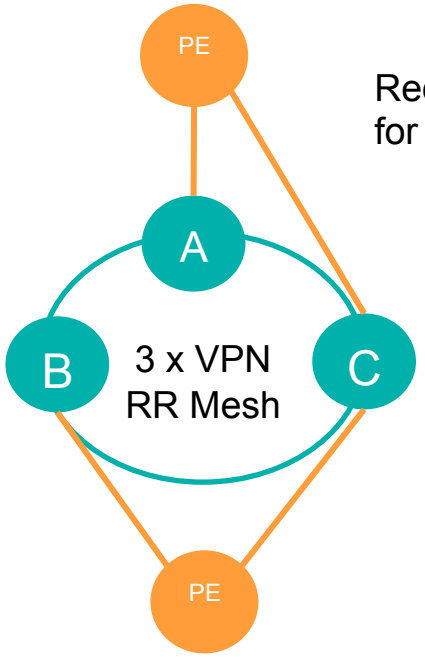


- Hardware, Software Limits and oversubscriptions
- Complexity of different beasts
- Routing table reports and Estimation

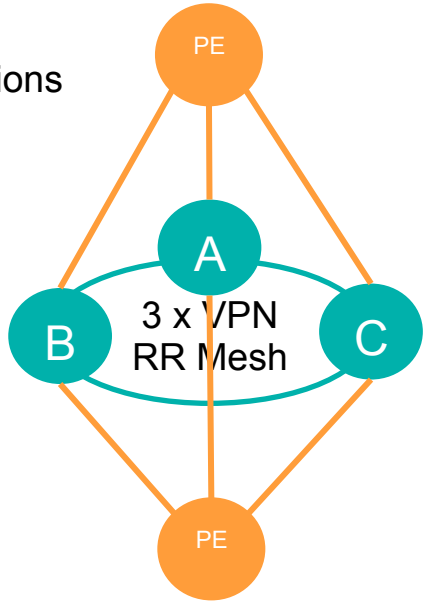
Source – What's So Special about 512? ISP Column - Geoff Huston
http://www.potaroo.net/ispcol/2014-09/512.html

Redundancy Complexity – Colt Route Reflector Example





Redundant Sessions for PE 2 or 3 ?



Old VPN RR Design

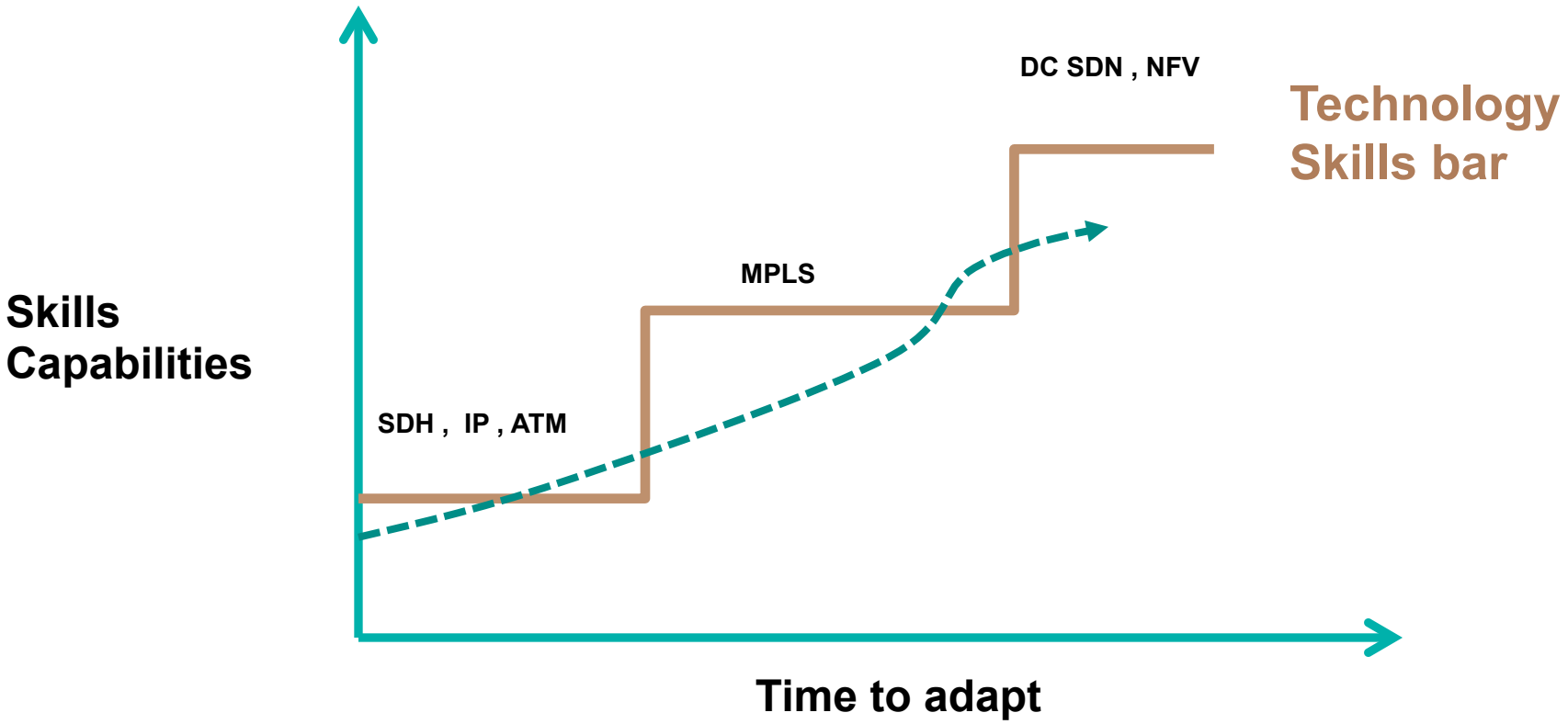
- 16 VPN RRs , 8 cities / region
- PE BGP to nearest RR region pair
- EoX , Scale and Features Limitations

New VPN RR Design

- 3 Central VPN RRs in 3 Tier 1cities.
- Future Scale & RR features optimized
- Each PE has BGP session to all 3 VRRs.

Additional redundancy is not complexity always.

People Skills & Complexities



- Operators orgs behind on skills – catch up
- Push your NOC to deal deployment intricacies early
- Lessen 1:00 AM troubleshooting and coffees !

Service Provider Network Complexity - Summary

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- **COMPLEXITY** – Ubiquitous in operator networks
- Key quantitative design factor.
- Dear NOG / Vendors / Academicians,

  Help us derive network **Complexity Index** ?

$$CI = f_n(???)$$

- Divide and Conquer – Breakdown , build metrics , contain & control numbers !

Closing Note

NGN Business case - Lets build Unicorns

Operators end up build this ….

Cessna 172 - Cockpit

Airbus A380 cockpit

Build the role of Auto pilots in Operator networks !

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For your time

Thank you

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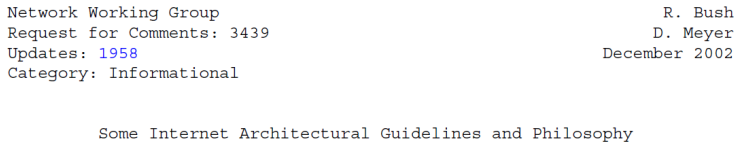
Study on Network Design principles & Complexity - References

Systematic study and efforts has gone in this space for many years

Architecture & Design Guidelines

RFC3439:“Some Internet Architectural Guidelines and Philosophy”
R. Bush , D. Meyer ,December 2002.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Request for Comments: 3439
Updates: 1958
Category: Informational

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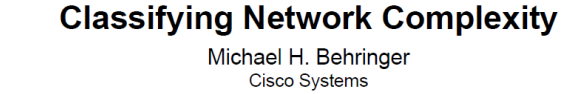
M Behringer ,December 2009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Cisco Systems

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John Doyle , October 2005.

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B Theophilius ,A Akella , David Maltz

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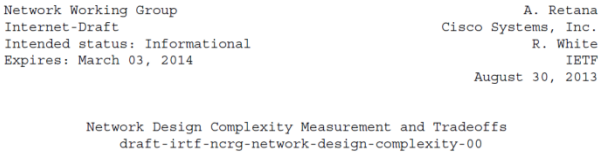
Retana, A. and R. White. August 2013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Internet-Draft
Intended status: Informational
Expires: March 03, 2014

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