

Capacity Planning

A Service Provider Case Study

Tom Lundstrom

Qwest AS209 (now CenturyLink)

Nanog52

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Agenda

- Intro
- Our Team's Mission
- Some specifics on planning @ AS209
- Sample Studies
- Evolution

Qwest/CTL Network Overview

- Infrastructure includes Large Fiber Footprint
- Services including: IP, Hosting, VPN, Mpls, Metro-Ethernet, DWDM/ULH, Security, etc.
- 15M access lines
- 5M broadband customers
- IP Backbone
 - 60 cities
 - 120 Core routers
 - 150 Agg
 - 630 Edge
 - 40-120G link capacities

? Planning ?

	Tactical 1-2 year	Strategic 3-5 year
Finance/Budgeting	X	X
NOC / Ops Eng	X	X
Technical Modeling / Architecture	X	X

Agenda

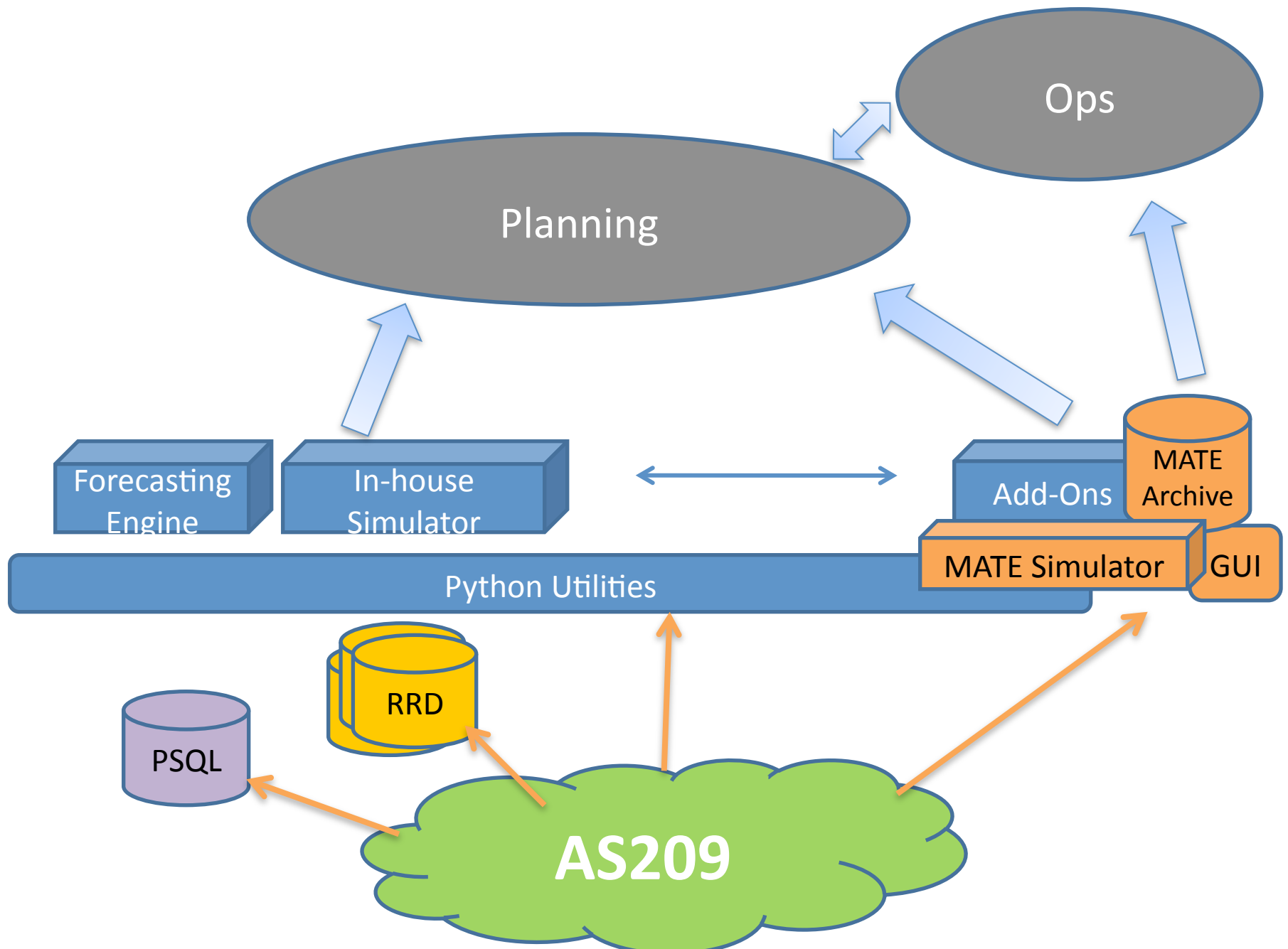
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Essential Goals

- Route along **lowest latency** path during healthy state.
- Survive failure scenarios (500+ SRLGs) **no congestion**.
- Always **Meet SLAs**: Packet Loss, Latency, Jitter, etc
- **Lowest cost**.

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Data Inputs for Simulation

Components of a 'plan' file

- Sites
- Routers
- Circuits (cap, metrics)
- LSPs
- Traffic Demand
- SRLGs
- etc.

SRLG Refresher...

- Shared Risk Link Group
- A set of Circuits
- With common physical vulnerability

ie, a shared fate

SRLGs in the Wild



SRLGs in the Wild

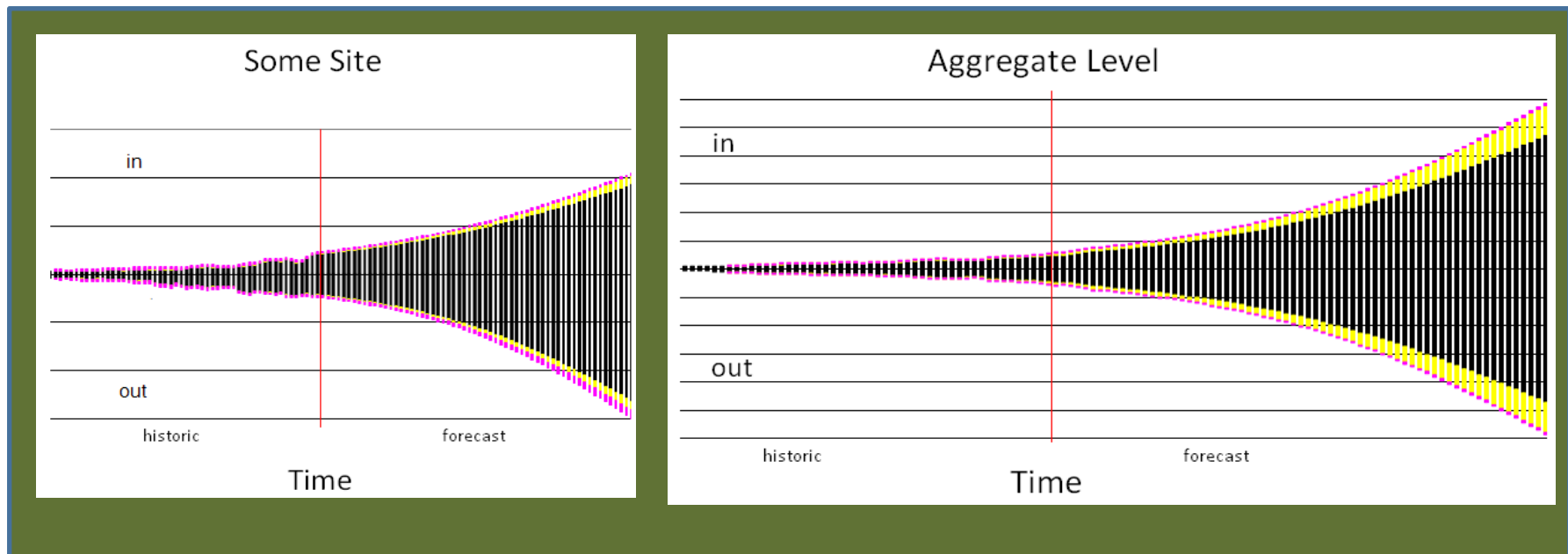


SRLGs in the Wild



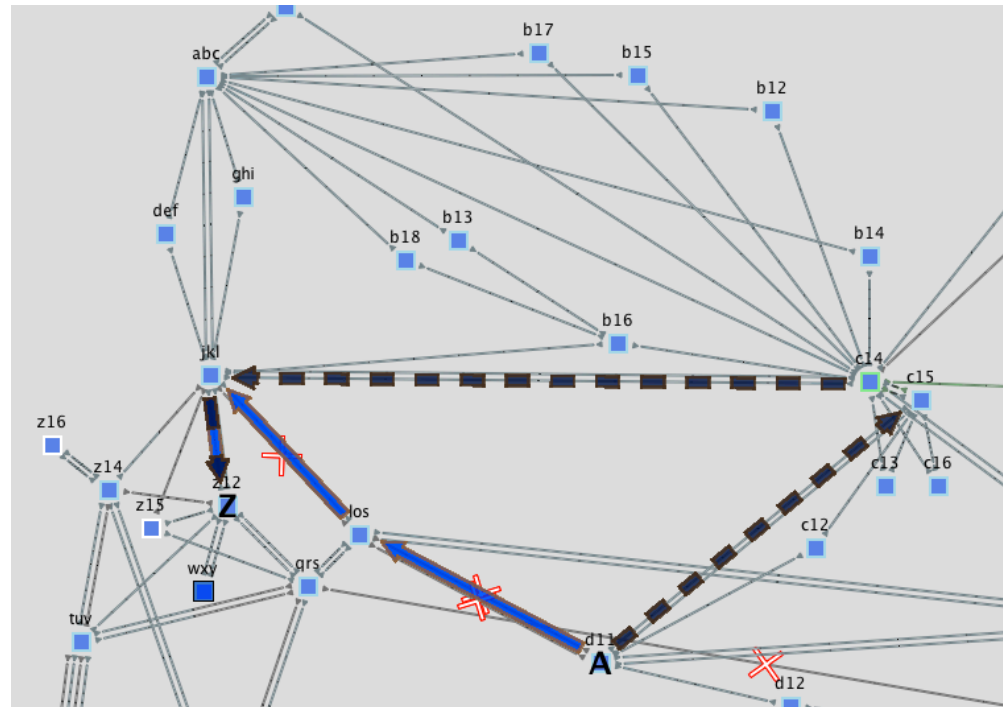
Demand Forecast and Tuning

- Primary input: measured LSP traffic
- 95% Peak, 5 minute intervals
- Tuning: Network, Site, Service, etc



The Modeling Begins

- Examine SRLGs
- Worst case analysis
- Evaluation
 - Circuit adds, timing
 - Platform assessment
 - Cost



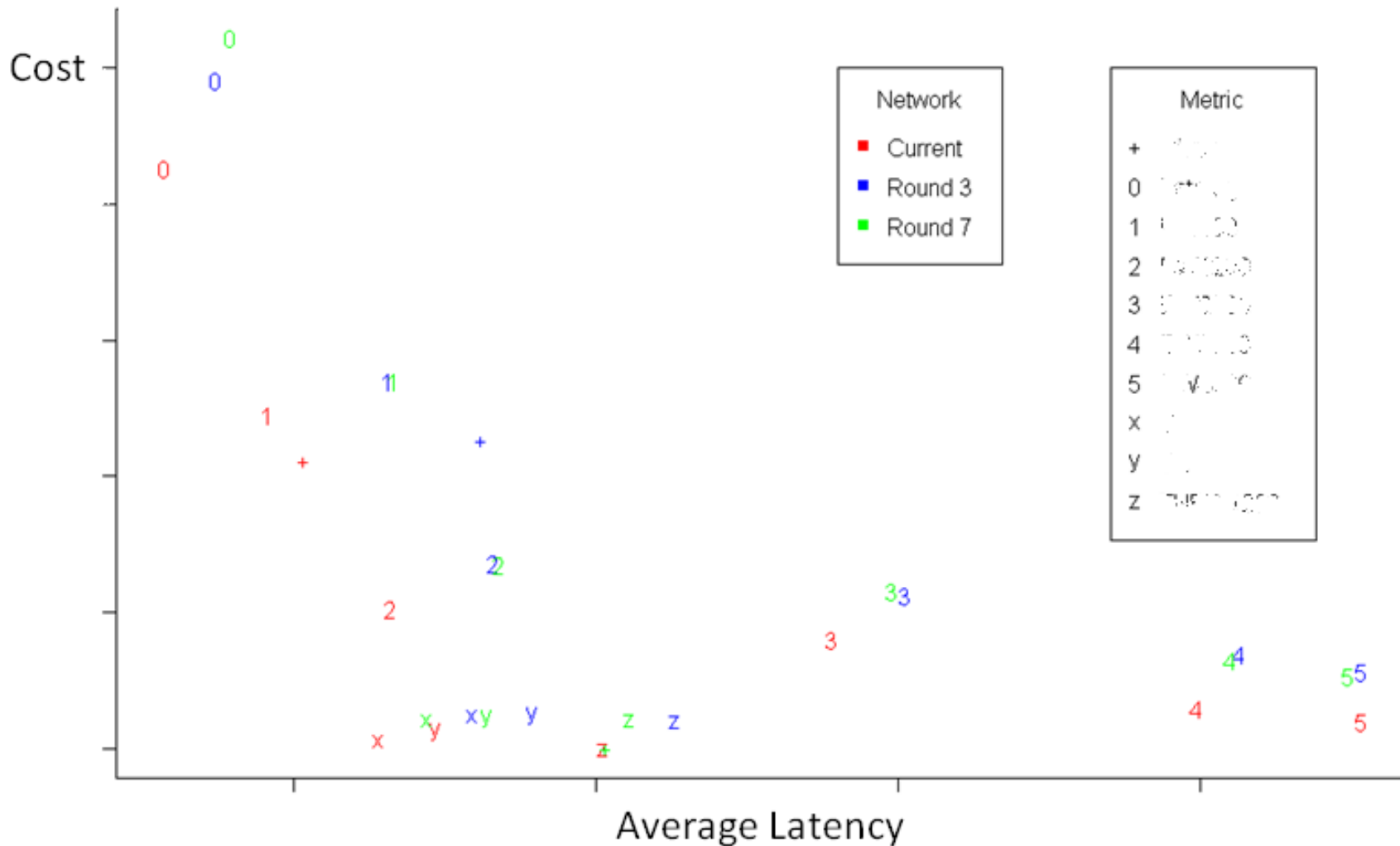
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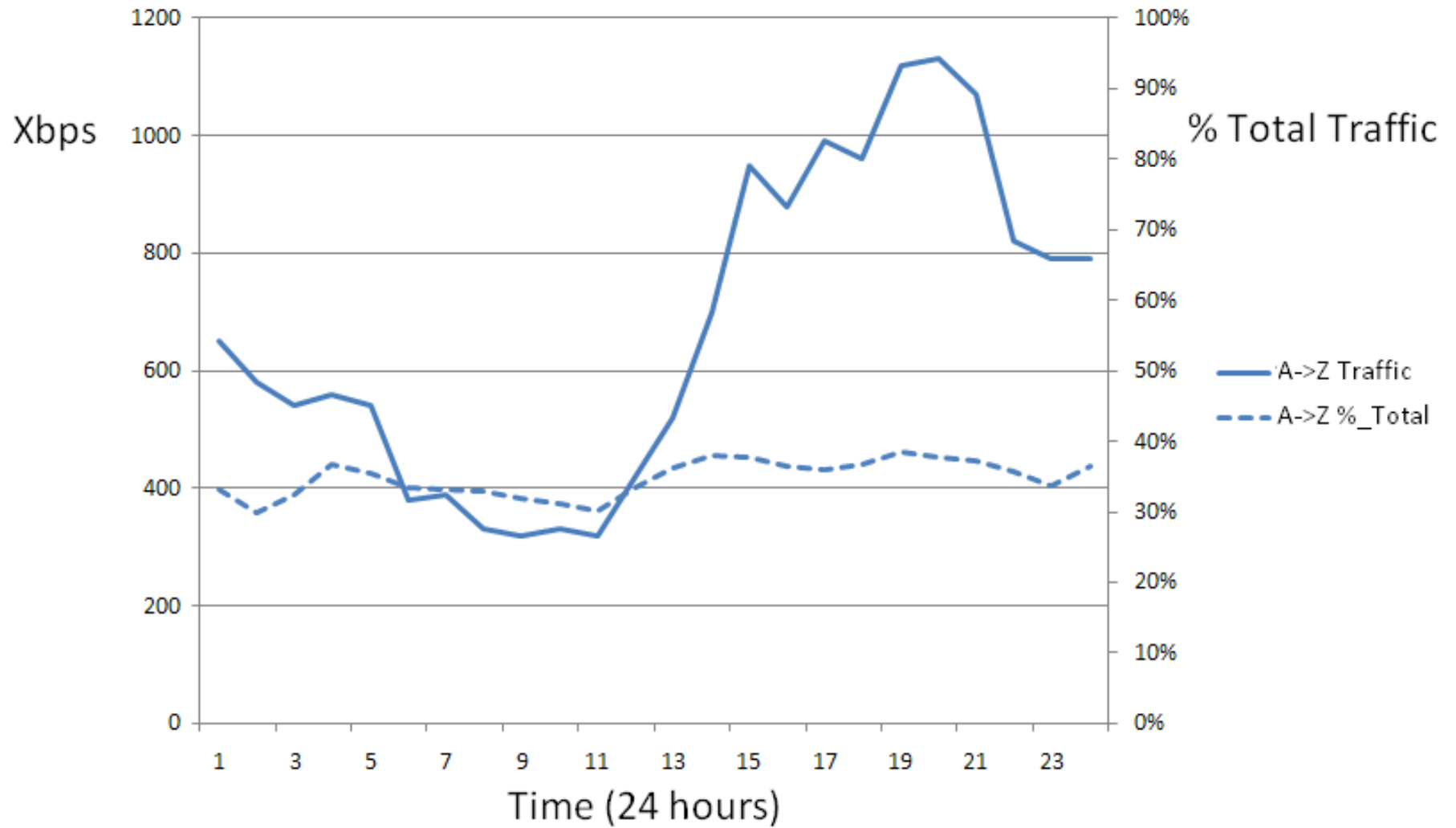
Sample Studies

- Annual Planning Cycle
 - Quarterly updates and as needed.
- RFO
- Insight
 - Topology / Metric Optimization
 - Fan-out
 - TE Optimization
 - Forecasting: Sum of the Peaks -vs- Peak of the Sum

Topology / Metric Optimization



Fan-out

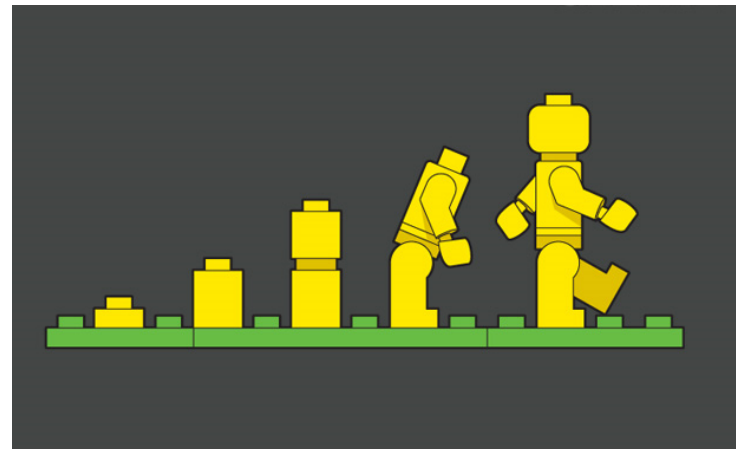


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Evolution

- In the beginning... useful info (but hidden in the data)
- Diverse skill-set
 - Data Storage/Mining, Ops
 - Mathematicians, Programmer
 - Modelers, Deployment Mgrs
- Vendor
 - Add-ons
 - Well-known data structures (extended)
 - Tools as basis for intra/inter-dept communication
- Repeated often: (Studies + Validation) =
Intelligent Designs



Evolution, part2

- More precise understanding of traffic flow/ behavior.
- Morphing into
 - Resource for business insights, not just capacity planning.
 - Inform decisions, strategy, policy.

Thank You

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