Ten+ Years of MPLS: A Retrospective Deployment Survey

Arman Maghbouleh
Cariden Technologies

arman@cariden.com

www.mpls2010.com

1990s

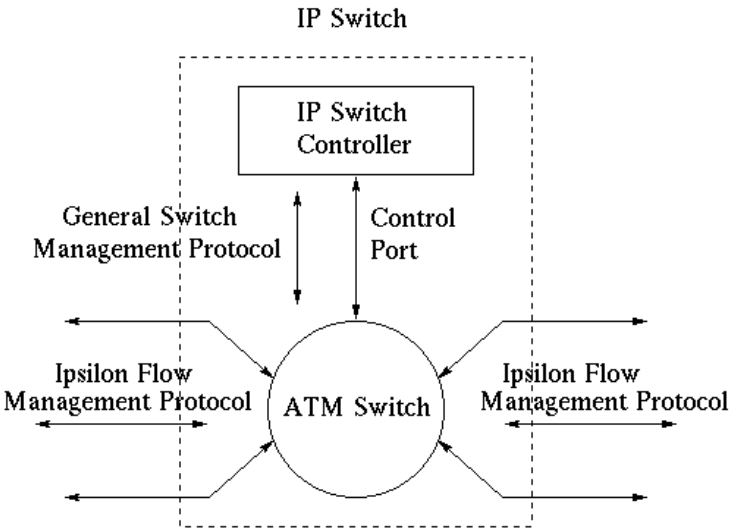


Figure 1: Strutcture of An IP Switch

August 1997

A Proposed Architecture for MPLS

draft-ietf-mpls-arch-00.txt

IPSILON the IP switch company Circa 1995

32 MONDAY, NOVEMBER 11, 1996 NETWORKING

Cisco to introduce tag switching technology

By Theang Kok Kui

ISCO Systems Inc plans to introduce a new

individually.

"Like the indexes in a book, each tag is unique and it indicates a predetermined path through which

routing takes up a massive amount of processing power." He added that another problem with the IP routing is that it only handles

MPLS 2010

cariden

Deployment Information is Scarce

- Questions of Interest
  - Who does/not deploy MPLS?
  - What do they deploy?
  - Why do they deploy it?
  - When did the deployment start?
- Challenges
  - Confidentiality issues
  - Only specialized, regional forums

A Survey

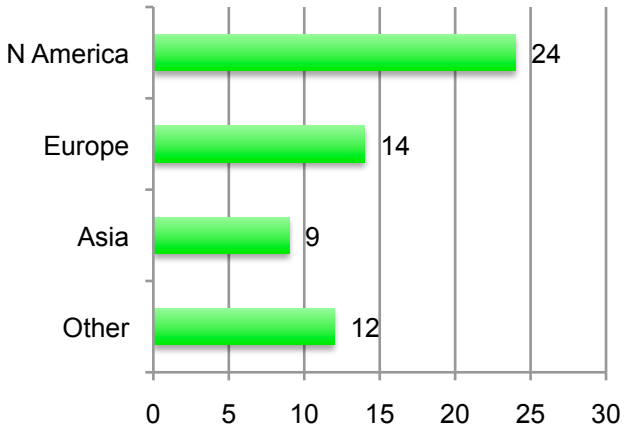
- 36 Questions (mostly multiple choice)
- Worldwide Participants
- Cariden Field Teams in Seven Countries
- Privacy Guarantees

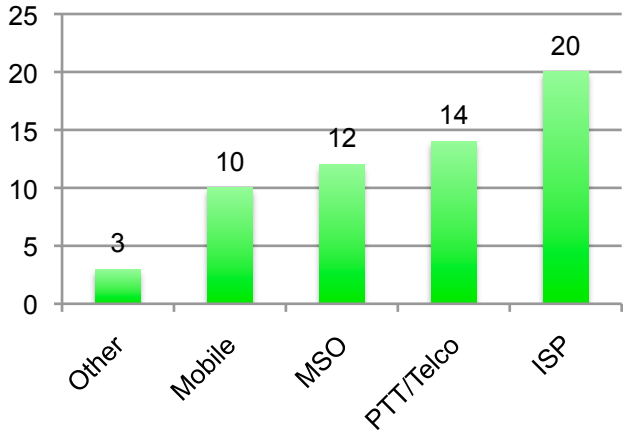
Questions

- Company/Network/Services Overview
  - Region, Category (PTT/ISP/…)
  - Extent (National/Regional/…), # Routers, Vendors
  - Internet (transit/Retail), L3 Services, L2 Services
- Technology Overview
  - IGP, QoS, LDP, RSVP-TE, FRR, Multicast
- LDP Detail
  - When, Why, Interarea
- RSVP Detail
  - When, Why, Where, How Many, Protection, BW, …

Participants

- 59 *Networks**, 49 *Companies*, 250+ IGPs

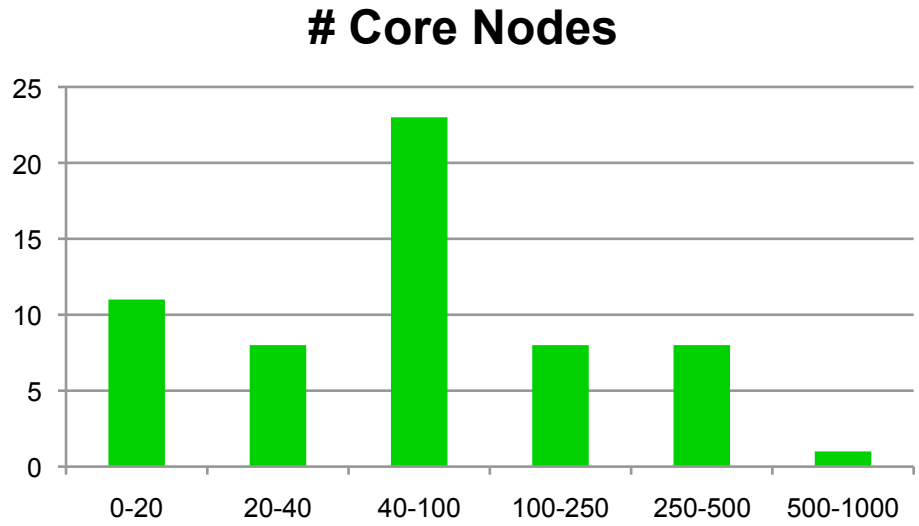




- Over-represents early MPLS adopters
- Undercounts traditional Telco/Mobile services

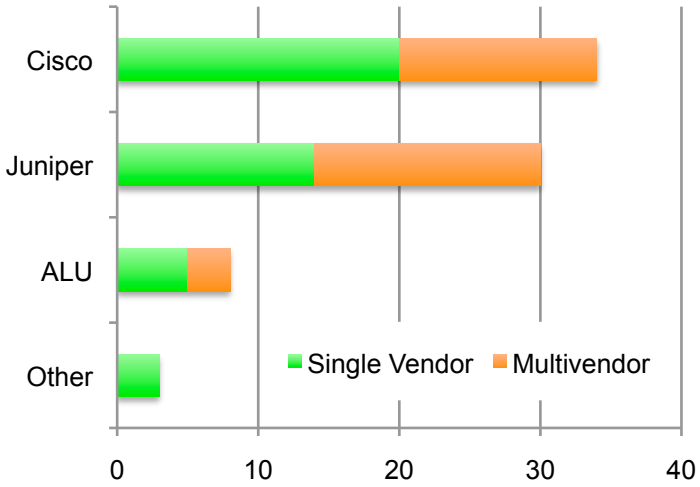
*See slide at end for details of definitions and counts.

Network Size Distribution



- Traffic too sensitive, # edge too variable
- Tier-1 ISPs with huge traffic volume tend to have relatively few but very high capacity nodes

Core Vendor Distribution

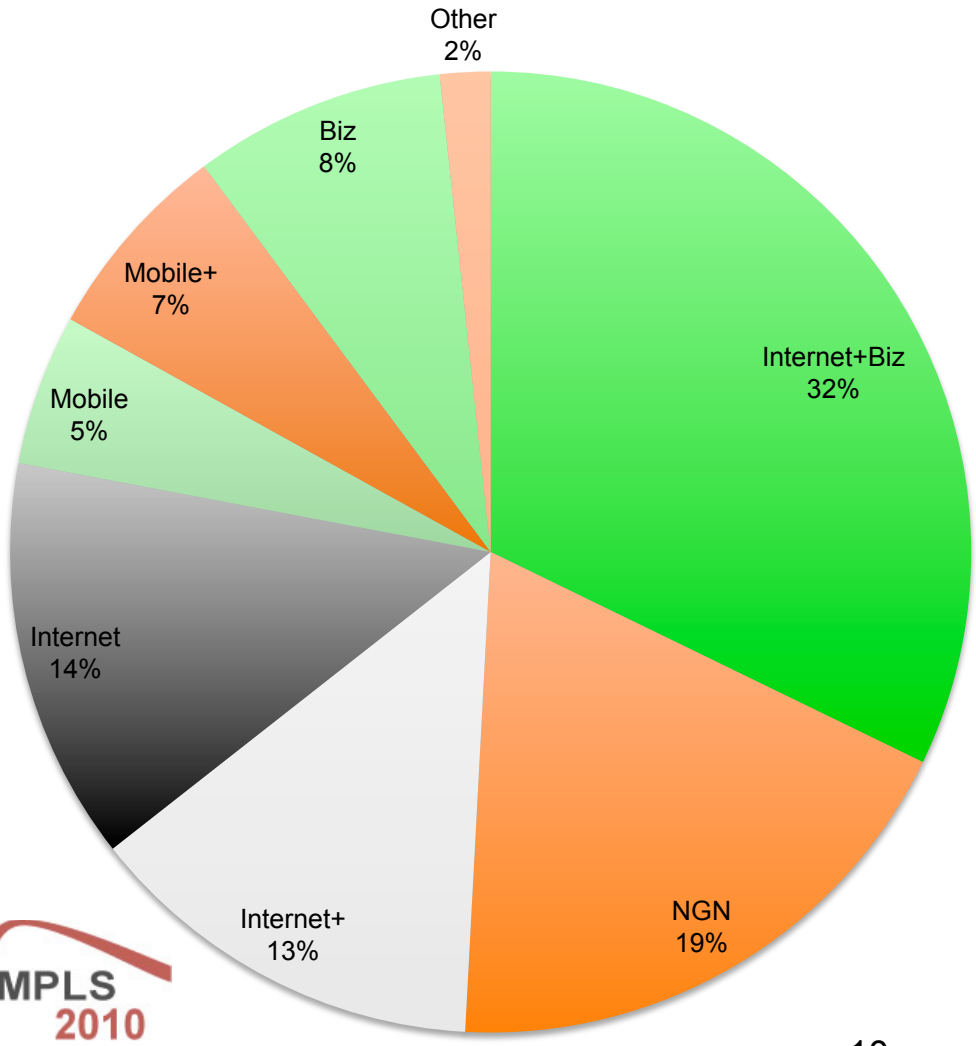


- Slight variations in geography (e.g. Juniper-NA)
- Some variations in services (e.g., Juniper-Internet Services, ALU-Layer 2)
- Edge picture is complicated

Results of Interest

- Coexistence of Single- and Multi- Service Networks
- Cisco vs. Juniper Protocol Clusters
- L3 vs. L2 Protocol Preference
- Just the Basics Please
- Long Adoption Cycle
- Qualitative Analysis
  - Follow up Questions
  - Cariden Experience

Services

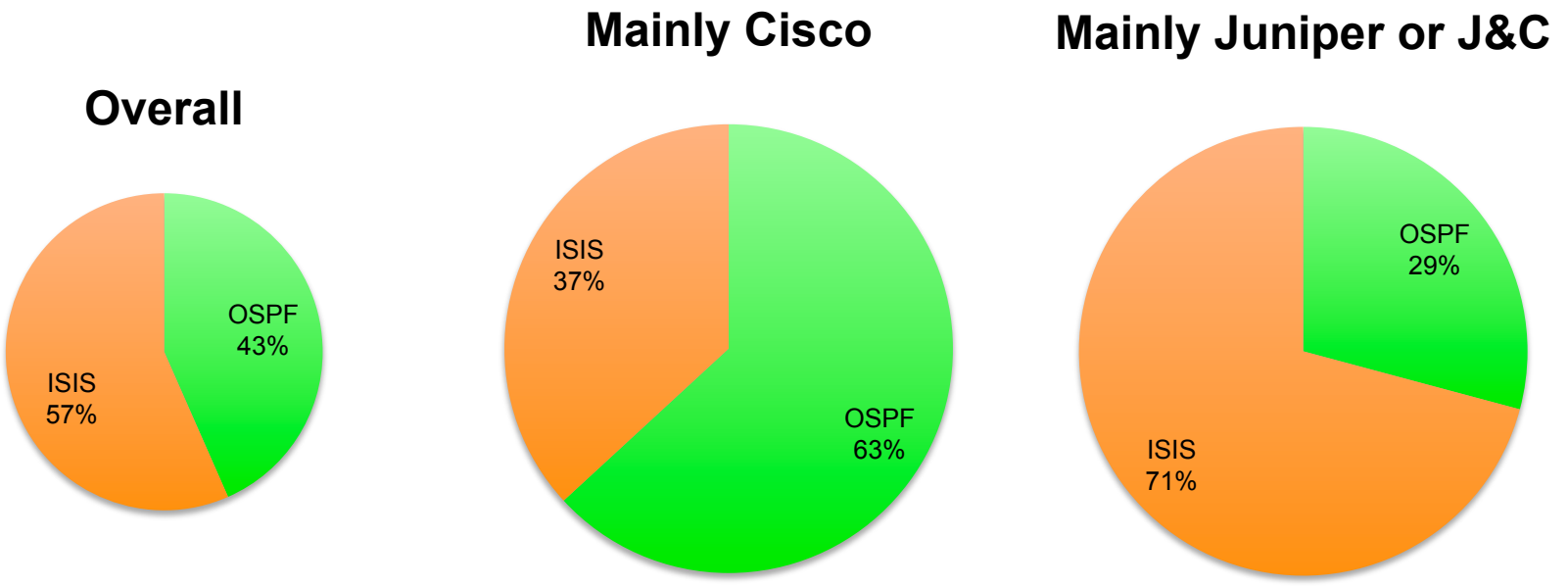


- Considered
  - Internet (wholesale, retail)
  - Business IP
  - Layer 2 (p2p, VPLS)
  - Video, Voice, Mobile
- Convergence is a reality: ≈70% multiservice
- Many single service networks (some new)

Single- and Multi- Service Networks

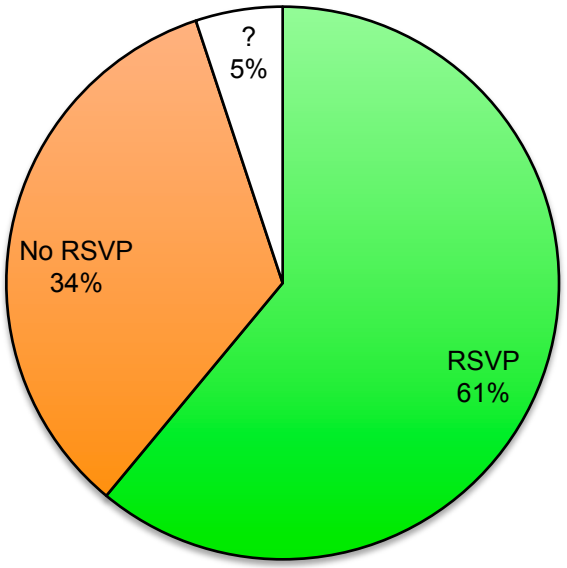
- Multiservice networks are popular but single service networks remain strong
- Two Clusters Observed
  - Pure ISP Play: prices are dropping, it is a fact, embrace it, buy the cheapest equipment possible focused on internet services
  - One-for-One Transition: minimize customer (revenue) disruption, customer is used to single-service high-guarantee network (and to paying for it), transition them to a new single-service high-guarantee network

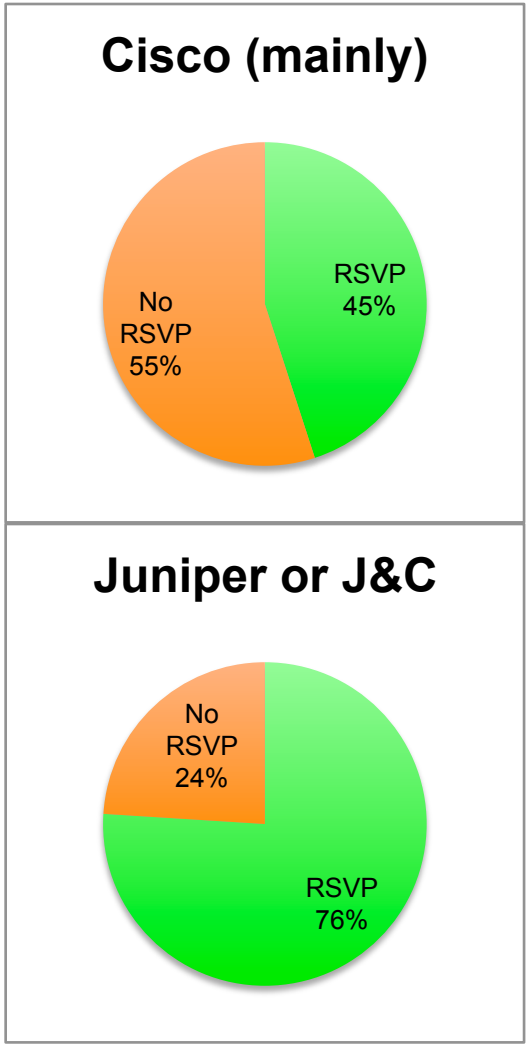
IGP



- Also correlations with RSVP
- ALU not broken out for confidentiality reasons

RSVP-TE



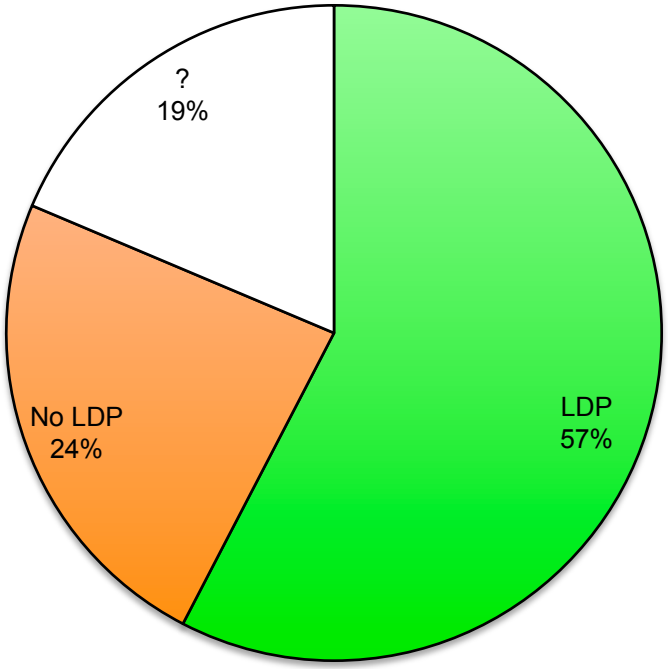


- 50% of RSVP deployments also deployed FRR (bypass)

Cisco vs. Juniper Protocol Clusters

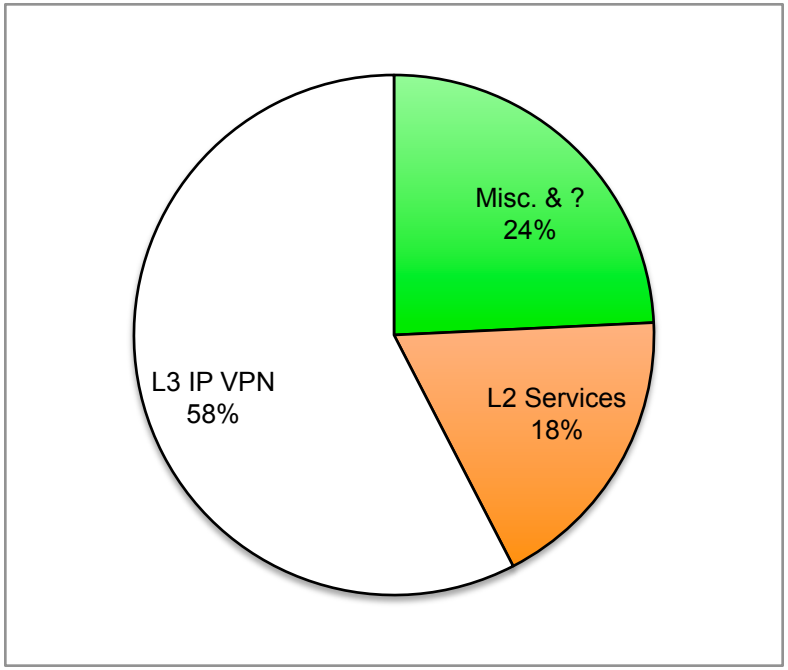
- Cisco: OSPF/LDP vs. Juniper: IS-IS/RSVP
- Artifact or Causal?
- Observations
  - Networks switching to IS-IS for RSVP (regardless of vendor)
  - One company has some regions with Cisco core and some with Juniper core (identical services). Dichotomy exists there too.
- Best Guess: RSVP adoption vendor-driven or vendor-dependent, IS-IS comes along for the ride.

LDP



- Internet + Business IP very likely to use LDP
- Internet only likely not to use LDP

LDP Notes

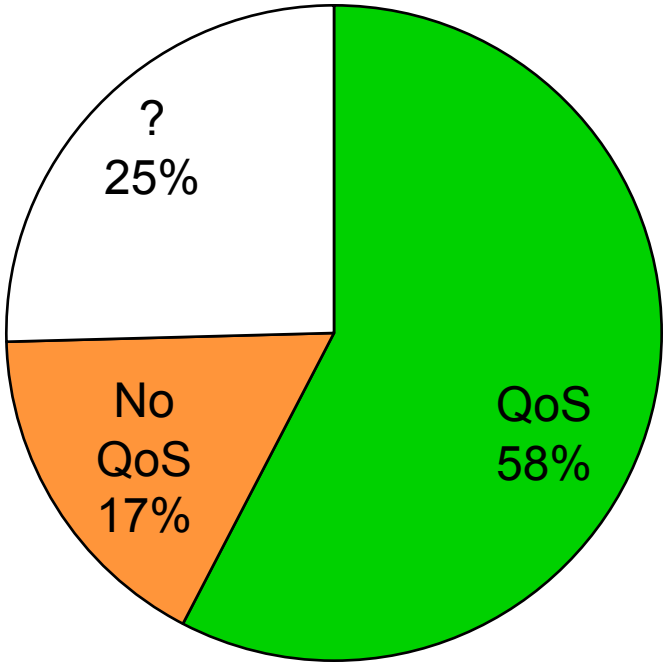


- 25% have inter-area LDP
  0 inter-provider.

L3 vs. L2 Protocol Preference

- L3 VPN services favor LDP
  L2 services do not favor LDP
- Observation: Networks transitioning from ATM to IP/ MPLS favor RSVP
- Guess: “Cultural” factors at work in protocol choice

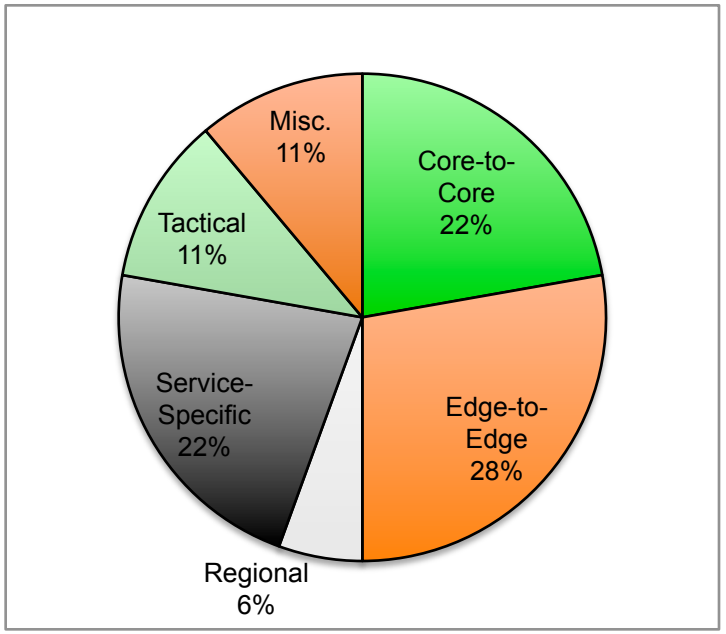
QoS

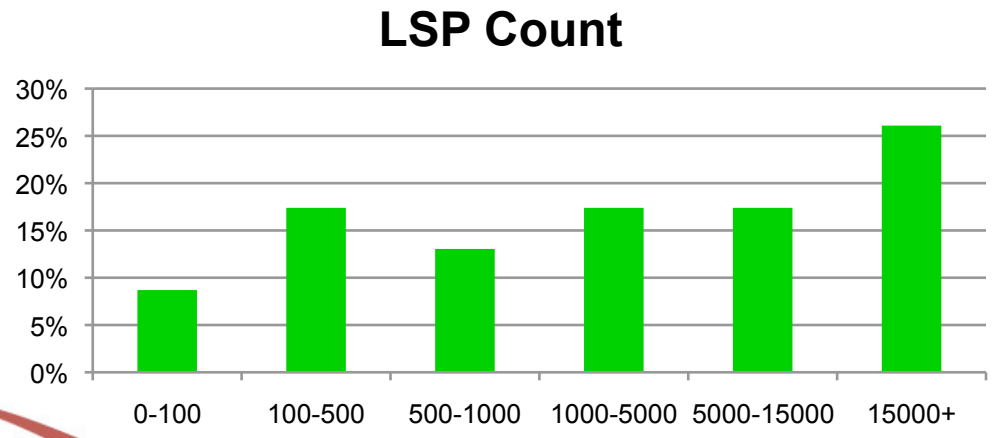


- No vendor, region differentiation noticed

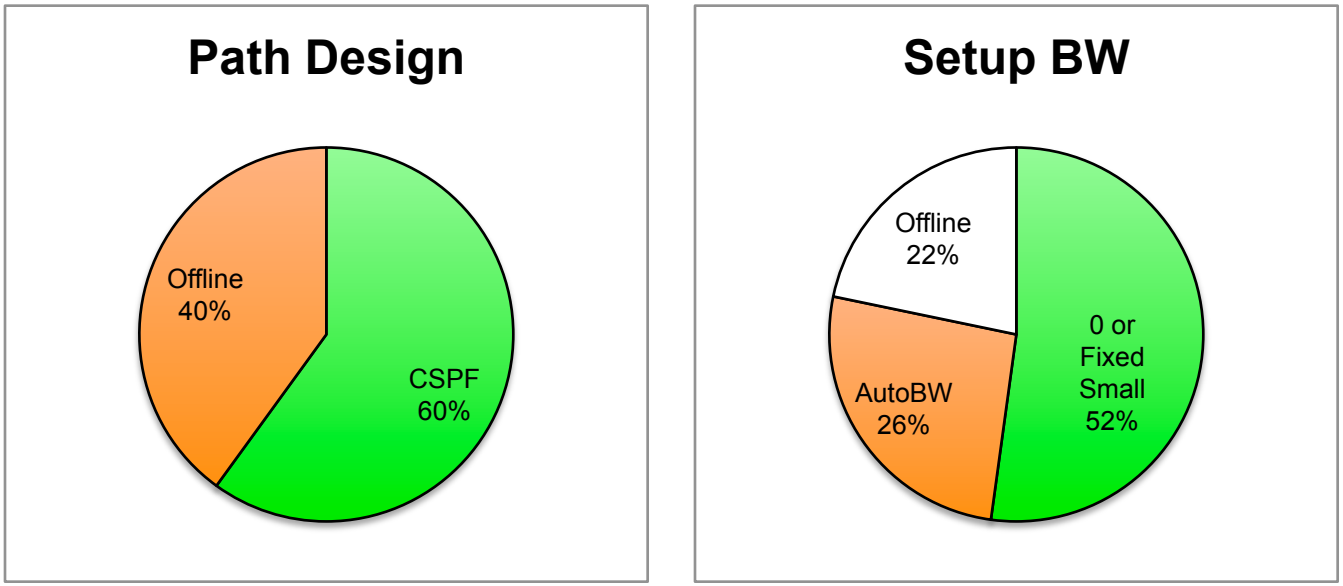
RSVP Motivation and Footprint

- TE is Main Motivation
  - Mismatched Capacities in Asia
  - Expensive Cross-Oceanic Links
  - N:1 Backup
  - Tactical TE





RSVP Path Selection

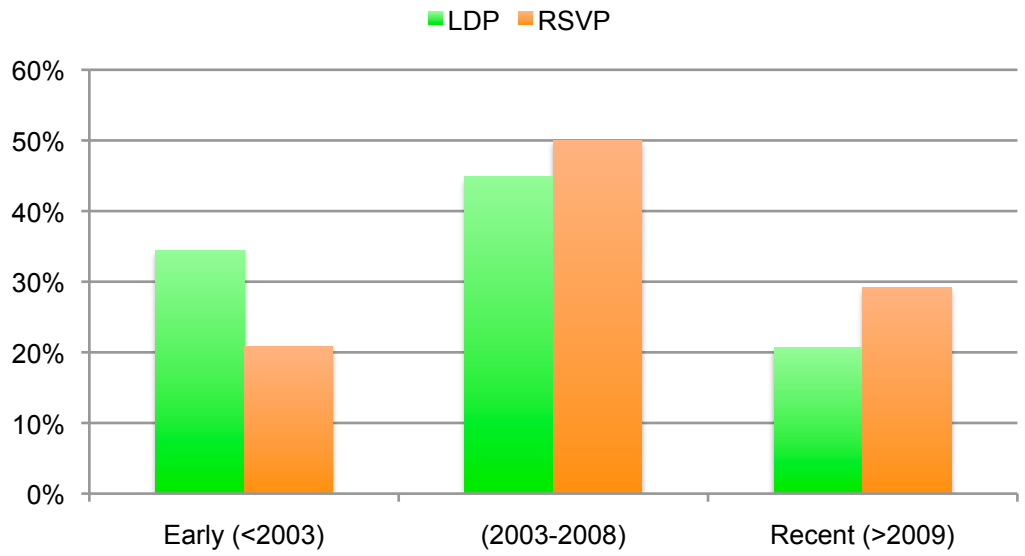


- Half of offline path design done manually
- Majority provisioning using in-house tools
- Half use standby secondaries
- Few use affinities, forwarding adjacencies

Just the Basics Please

- Keeping to Basics
  - Self-adjusting dynamic (CSPF + auto-bw) networks a small minority of all networks
  - Affinities, forwarding adjacencies, etc. used at a minimum
  - DS TE (subpools) not seen at all in this survey (RFC 3270 E-LSPs are present)
- Best Guesses:
  - Operational difficulties such as predictability and troubleshooting
  - General conservatism

Adoption Timelines



- Reading this chart, for example:
  - 20% of the RSVP networks in our sample deployed it 2003 or earlier.
  - ≈60% in sample adopted RSVP (previous slide)
  - So, ≈12% of sample adopted RSVP in 2003 or earlier.

Long Adoption Cycle

- Example: 4+ years for RSVP to reach 12% of networks in this survey (relatively tech savvy)
- Technology is alive and well, just slow
  - Adoption rate picking up after 10 years
  - Timing in line with other (e.g., QoS) adoption timing
- Operators deservedly wary of new technologies
  - Design flaws, bugs, …
- Protocols and systems are just the beginning. Successful deployments require whole system, e.g., planning, provisioning, visibility, troubleshooting, …

Summary

- 5-10 year adoption cycle not uncommon
- Many knobs available, few used at any given deployment
- Single-service and multi-service networks live side-by-side
- The vendor matters
- Culture matters

Details and Fine Points

- Definitions in this survey
  - Network: an operational entity with uniform personnel and policies e.g., all regional networks for a given PTT would be considered one network in this survey.
  - Company: usually a single corporation. Individual members of groups (e.g. Vodafone group) are considered separately.
- Missing and Questionable Data
  - Many attempts made to fill in blank responses, following up on second sources for data that respondent did not know answer to but >10% of the >2500 data points remained blank or with ?. Such data explicitly present in counts but usually left out in calculating percentages (e.g., in pie charts).
  - Do NOT trust the absolute counts or percentage values. It is the trends and differences that are meaningful.
- Confidentiality
  - Roll up data or use Misc/Other whenever a count or group might reveal source (rule of thumb named groups should have 4 or more members).